Daily News

Tuesday 6 October

The official newspaper of the 29th EACTS Annual Meeting 2015

EACTS European Association For Cardio-Thoracic Surgery

Presidential Address

The power of surgery

Prof. Dr Martin Grabenwöger, Amsterdam, the Netherlands, 5 October 2015

Prof. Dr Martin Grabenwöger

From conversations with colleagues I know that some of you are concerned. You're concerned about the future development of our profession.

Minimally invasive and interventional techniques, it appears, are being developed continuously. These techniques entered the realm of cardiovascular and thoracic surgery a long time ago. At lectures delivered by cardiologists nowadays, we hear grandiose announcements like:

"Currently we treat almost all coronary patients. In the future we will also take over the cardiac valve business."

I understand your distress and concern regarding your own – or our own – profession. Such feelings are quite natural. Whenever something new develops, it is accompanied by a certain degree of anxiety and restlessness. Once the changes start to be implemented, the existing system is pressurised and fear arises. All said and done, Man is a creature of habit. And occasionally finds it difficult to cope with our current fast-moving times, in which nothing will be the same tomorrow as it is today.

Many dynamic developments are based on technical innovations and do not only concern us but several other branches. I'd like to mention three examples:

Take a look at the world of banking – a growing number of branch offices are closing because banking operations are being done online to an increasing extent.

Even traditional media companies and newspaper publishers are having a hard time in an era of Internet, Google and Co. News is no longer purchased at the tobacconist's, but is read on the iPad. Authors publish their books on their own.

In the US, radiologists are feeling the pressure of globalisation and technical innovations. At some hospitals the evaluation of CT scans is delegated to doctors in India and Australia.

Despite all the radical changes and reorganisation measures, I am not concerned.

But I'm also not a dreamer or an idealist. I am a realist and deeply convinced of the fact that the fully trained thoracic and cardiovascular surgeon will always be able to meet the requirements of our constantly changing times.

In fact…

The fully trained thoracic and cardiovascular surgeon will lead our specialty into a flourishing and prosperous future.

Under one condition, ladies and gentlemen…

We must be willing to experience change. We must be open to new information and skills. We must remain flexible.

Aristoteles said: "I can't change the direction of the wind, but I can adjust my sails to always reach my destination."

In actual fact, surgeons have always done this. They have re-invented themselves time and again. A glance at the history books reveals the enormous changes and developments that are already behind us.

Let's take a look at our workplace and compare an operating room today with one in the early days. Illumination, hygiene, clothing, devices – these two pictures look like they are worlds apart. And we haven't spoken about the actual work of a surgeon yet.

The history of surgery and especially cardiac surgery is very young. In medicine the heart was regarded as a taboo zone for a long time. While brain operations were being performed, the heart was still avoided. Interventions on the motor of life were considered presumptuous.

At the beginning of the 19th Century, the surgeon's principal task was to amputate arms and legs. At the time, of course, without anaesthesia. Every effort was made to complete the procedure as soon as possible so that the patient would be exposed to the intolerable pain for a minimum period of time.

We have an almost incredible story handed down from those times:

A surgeon who was known for working fast inadvertently cut off the finger of one of his assistants while performing an amputation. The patient and the assistant subsequently died of sepsis. One of the observers was overwhelmed by the drama of the operation. He experienced a heart attack and also died. This is the only operation I know of with a mortality rate of 300%.

However, the surgeons of earlier generations are known today not only for their (currently) unimaginable working conditions, unconditional swiftness and peculiar events. They are also known for their innovative drive, courage, and joy of discovery.

One of the most well known persons among these medical adventurers was the German surgeon Werner Forßmann.

As a 25-year old assistant in 1929, he proved – on his own body – that one can insert a long, flexible catheter from the crook of the arm into the heart. Forßmann had to perform the procedure in secret because his seniors had forbidden the experiment. With this discovery Forßmann laid the foundations of modern cardiac medicine. Cardiac defects and many heart diseases could only be diagnosed with the catheter. This achievement was not appreciated at all at the time. His contemporaries reacted, at best, with disinterest. Some reacted with mockery or disapproval. It was 10 years later that two

continued overleaf

An operating room in the year 1847.

A modern hybrid operating room.

In this issue...

Presidential Address – The power of surgery (continued)

American scientists transformed his pioneering achievement into a breakthrough. A further 17 years later, Werner Forßmann received the Nobel Prize for medicine.

Success, sometimes, is a matter of patience.

The history of surgery is clearly one of persistent change. Surgeons of the past were pioneers with a willingness to broach new pathways. Time and again, they demonstrated their courage and willingness to take risks. If this had not been the case, we would not have the drastically different basic conditions, techniques and options we have today to help our patients. We would have had no anaesthesia, transplantations and no artificial heart.

We must now continue to walk this path and consistently look for new options to improve the treatment of our patients and reduce their trauma. Let us feel free to have visions – like the chemical engineer Paul Thomas from the University of Manchester. For several years now, he has been working on the development of a special respiratory mask that will identify pathological changes in the patient's respiratory air and show tumours in the lung, with no blood test whatsoever, simply by having the patient breathe into the mask. The underlying technology, by the way, is derived from detectors used to trace weapons.

Obviously, the history of surgery is not just one of advancements and positive changes. There have also been complications, errors and failures. Success, it appears, is inevitably accompanied by failure. But not at a personal level, if we learn from our own errors, so that we evolve further and become better. And not at a scientific level, if a new achievement arises from errors and failed attempts.

We are constantly confronted with complications in our work. With failures and losses. With death. What makes death so terrifying for one and all is the fact that it signifies loss of control. Control is of enormous significance in our lives, because our Western mind tries to arrange the world in a logical way, and we are always looking for explanations that will help us to predict life and control it. However, control – like many other things in life – is a fragile illusion. Coping with death is one of the most difficult tasks imposed on us by life. A task that we all have to handle alone, in essence. The only support we get in facing death is derived from ourselves.

In the way to overcome a defeat we can learn a lot from other professional groups. I would like you to watch a brief video. It shows the downhill run of the Austrian skiing champion Hermann Meier at the Winter Olympics in Nagano in Japan, in 1998.

Hermann Meier stood on his feet after this terrible fall. He skied again. In fact, he again took part in the next ski races. Not the following year or the following season, but during the following 3 days he competed in the giant slalom in Nagano and the Super-G. In both competitions he won a gold medal and became a two-fold Olympic champion. An absolutely incredible achievement, both in terms of sport and also mentally. This achievement and performance catapulted Hermann Meier to incredible heights in the world of skiing. His ability to fall and stand up again, try again, and be successful in the attempt, were a source of inspiration for people all over the world. Like the Phoenix he rose from the ashes.

Meier's story is reminiscent of Arnold Schwarzenegger's legendary statement "I'll be back". Arnie returned to the movie theatres last summer, in his famed role as the Terminator. Although I have to admit that one can have a conflicting perception about Arnold Schwarzenegger, he said something true in an interview about this film:

"I can stand up after I've fallen. Losers remain lying on the ground. Winners stand up. They brush off the dust and walk on. They don't try to make excuses for themselves. They are the first to admit their mistake. And learn from it."

When we thoracic and cardiovascular surgeons return to the operating room after a failure we don't have television cameras and millions of viewers around us. We have no mental coach at our side and we have no Olympic gold medal or international film prize waiting for us. But we still bring forth the mental strength demanded of us. That's what makes our profession very special. That's what makes us different from other human beings, and even different from other medical specialists. Coping with defeat, and especially preventing defeat, requires two things: training of outstanding quality and intensive further training.

In his bestseller 'The Outliers', the Canadian author Malcolm Gladwell addresses the following question: What makes a person achieve exceptional heights? In a variety of sectors, he investigates the factor or factors that make people achieve exceptional success. The core of his answer is: 10,000 hours. Ten thousand hours of training. Only with 10,000 hours of practice, practice and more practice – says Gladwell – is exceptional success achieved.

Now you may say, "Yes, but what about Mozart? He was exceptional even as a child. No matter how much or how little he practised. So the theory must have a flaw". But then – although Mozart is known to have been a child prodigy and a boy wonder, he actually wrote his first masterpiece at the age of 21 years. It was the piano concert no. 9, number 271 in Köchel's catalogue.

Ten thousand hours of practice to bring forth a peak performance. That's 5 hours per day over a period of 5 and a half years. If our young colleagues work for no more than 48 hours a week, which is a much discussed issue in current times, then I ask myself: How are they supposed to achieve their training? How can they bring forth their peak performance? Most of all: when? When they've grown old? Or maybe just before their retirement? I believe that working-time restrictions – an avidly discussed topic in current times – is a highly obstructive notion. Working-time restrictions obstruct the achievements, the success, and the work quality of thoracic and cardiovascular surgeons.

However, a surgeon's strength is not based on training alone. Rather, it is based on very specific qualities. We have spoken about mental strength. I've also spoken about flexibility and innovative strength, which became evident very early in the history of surgery. Furthermore, surgeons must be persistent and tough. Think for a moment about the replacement of the thoraco-abdominal aorta. Surgeons need to have three-dimensional imaginative power if they wish to reconstruct an aortic root. Minimally invasive interventions are impossible without dexterity and precise craftsmanship.

I think we have good reason to be proud of these qualities and the performance we bring forth, based on these qualities. We may be confident about our strength and need not worry about alleged threats or impending hardships.

I want to tell you about a term from Japanese culture known as 'Kaizen'. *Kai* means 'change' and *zen* means 'for the better'. Kaizen is not a specific method or a project. Rather, it is a mental attitude and a way of thinking. One that I'm very fond of. Let us view the evolution of our profession as kaizen, a change for the better, for the benefit of our patients. Change always signifies a zest for action. It signifies strength and determination. The animal that most vividly symbolises these characteristics – not only for Asians – is the horse.

If we steer our profession in the correct direction and are determined, we shall walk towards a successful future, which we – in my view – shall conquer as a 'heart team' together with our cardiological partners.

Thank you for joining us at the 29th Annual Meeting of the EACTS

Honoured Guest Lecture – Astronaut and Ambassador of Earth

Honoured Guest Lecture: André Kuipers, MD, Astronaut & Ambassador of Earth

André Kuipers is a physician and astronaut who will share insights from his experience of two trips to the International Space Station. He has spent a total of 204 days in space, during which time he filled multiple roles in addition to being the doctor.

André Kuipers qualified as a doctor in 1987 and joined the European Astronaut Corps in 1998. After years of astronaut training he first travelled into space on the DELTA mission in 2004. During this trip he carried 15 scientific experiments with him designed to be performed in space. These encompassed multiple disciplines including physiology, biology, microbiology and medicine.

In December 2011 André became the first Dutchman to make two trips into space, leaving Kazakhstan on a Soyuz spacecraft and spending 193 days on the International Space Station, the longest European space mission, before returning to the Kazakh steppes on 1 July 2012. He was the first astronaut selected for ISS Expeditions 30 and 31. On board the International Space Station he was a medical doctor, scientist, flight engineer and handyman also serving as an ambassador for several charities. These included acting as a world ambassador for the World Wildlife Fund (WWF). He contributed to the latter by writing the foreword for its Living Planet Report, providing images from the Space Station and launching the Report from high above the Earth.

In his presentation André Kuipers will describe the astronaut selection process and the impact of the extensive training undergone by astronauts, drawing from his years of experience in Houston, Moscow, Cologne, Montreal and Tokyo. The problems of working and living in a zero gravity environment, the constraints it imposes on the design and performing of scientific experiments, and the impact of a prolonged period in space on human physiology are all some of the experiences that he can share with you.

The benefits offered by visiting space and, in particular, the advantages of studying the Earth from space, using both satellites and space stations, will be discussed by André. In addition to facilitating the monitoring of the planet using a range of sensitive instrumentation, the presence of man in the space station provides opportunities to produce high quality images of the planet and to study the impact of man as highlighted by e.g., light pollution. His presentation will be illustrated by some of these stunning images that highlight how humanity's footprint is challenging the Earth's ecosystems. He will share his thoughts on humanity's need to develop better strategies for managing natural resources, as discussed in the WWF's Living Planet Report. Since his return from space he has sought to inspire people about space and science, as well as continuing to promote awareness of the WWF.

Satellite sessions at the 29th EACTS Annual Meeting

Tuesday 6th October 2015

Company	Time	Room	Session
AtriCure Europe BV	12.45–14.00	E106/E107	Integrated management of persistent atrial fibrillation – how, when and why?
Auto Tissue Berlin GmbH	12.45–14.00	E108	The use of decellularised tissue in cardiac surgery
JOTEC GmbH	12.45–14.00	G109	10 years E-vita OPEN PLUS – a track record
Medtronic International Trading Sàrl	12.45–14.00	G104/105	Mitral valve disease management: positioning yourself for success today and tomorrow
PneuX Life Systems	12.45–14.00	E103	Improving cardiac surgery outcomes by reducing VAP rates
Symetis	12.45–14.00	E102	ACURATE TAVI: easy, stable TAVI for all access and anatomies
Thoratec Corporation	12.45–14.00	Forum Room	Heartmate 3™: early experiences and outcomes

Cardiac – Abstract Session: Current challenges for extracorporeal life support

The future of extracorporeal perfusion systems

Friedhelm Beyersdorf University Heart Center Freiburg, Germany

Temporary replacement of the heart and lung function was a dream for many centuries. It turned into a realistic option when John Gibbon used the first heart–lung machine in 1953 and Walton Lillehei began using his method of 'cross-circulation' in 1954. After many decades of research, the heart–lung machine is a very safe and efficient tool in the armamentarium of every cardiac surgeon today.

Miniaturised perfusion systems were already developed in the 1960s, but at that time had many shortcomings (bleeding, thrombosis, insufficient cannula and tubing system, inadequate flow etc.). Due to further improvements in extracorporeal perfusion technology, we are now equipped with very reliable short-term (up to 1 week) extracorporeal membrane oxygenation (ECMO) devices for patients with respiratory failure and extracorporeal life support (ECLS) devices for cardiac and lung support.

The indications for ECLS include all patients with insufficient cardiac function for various reasons, e.g. patients who are unable to be weaned from cardiopulmonary bypass (post-cardiotomy patients), or patients in cardiogenic shock secondary to severe myocardial failure (acute myocardial infarction, terminal heart failure etc.). The results of these extracorporeal perfusion systems have improved tremendously over the past years.

The first 60 years' of development of extracorporeal perfusion systems were directed towards 'maintain' (to perform surgical cardiac repair) or to 'restore' physiologic cardiorespiratory function (in patients with terminal heart and lung failure).

During the past 10 years, research has been directed towards expanding the scope of extracorporeal perfusion systems to not only maintain or restore cardiorespiratory function, but to 'treat' damaged organs and now even the whole body, e.g. after witnessed cardiac arrest (CA).

For this purpose a new and innovative strategy has been developed experimentally, which is based on three columns: 1) control of the conditions of immediate reperfusion; 2) control of the composition of the reperfusate; and 3) automatisation of the controlled composition of the arterial in-flow during the initial reperfusion period. This concept of '**C**ontrolled, **A**utomated **R**eperfusion of the who**L**e body' (CARL) was developed by our group in order to improve the currently very dismal results after in-hospital and out-of-hospital cardiopulmonary resuscitation (CPR). The concept of CARL was evolved from over 200 experiments over a period of more than 10 years in the experimental laboratory. We have used a pig model and the most recent conduct of CARL has resulted in a neurologically intact survival of >85% after complete normothermic CA for 20 minutes, which has never previously been reported. These very successful experiments have led to approval from the Ethics Committee in Freiburg, Germany, allowing us to implement this strategy clinically (Figure 1). In order to apply the principles of CARL clinically, we created a new extracorporeal perfusion system called CIRD (**C**ontrolled **I**ntegrated **R**esuscitation **D**evice), which is able to integrate all CARL principles after femoral cannulation.

Other options for clinical treatments using extracorporeal perfusion technology will follow. Recent studies using heterochronic parabiosis will give new insights in systemic pro-aging factors, and their role in cognitive function and neurogenesis.[1,2] In addition, the role of extracorporeal perfusion in tumour patients will be further evaluated.

References

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Figure 1. Clinical set-up of CARL during the early clinical application using a CIRD prototype (CIRD 1.0).

Thoracic – Focus Session: Guidelines

EACTS: Statement on pleural empyema

Marco Scarci
Consultant Thoracic Surgeon, Papworth Hospital, Cambridge, UK

Infection of the pleural space is a common clinical condition, but in spite of its frequency, its management is still mostly based on surgeon's preferences and local practice. Recent large case series demonstrate that prompt treatment can reduce hospital costs, as well as lower morbidity and mortality, however, recent advances in treatment have been very variably implemented in clinical practice.

In order to address this gap in knowledge, the European Association for Cardio-Thoracic Surgery (EACTS) Thoracic Domain and the EACTS Pleural Diseases Working Group established a team of thoracic surgeons to produce a comprehensive review of the available scientific evidence on pleural empyema. The review aimed to cover all aspects of surgical practice related to its treatment, with particular focus on surgical treatment of empyema in adults, surgical treatment of empyema in children, and surgical treatment of post-pneumonectomy empyema (PPE). The EACTS statement reviews the latest developments and concepts to improve clinical management and stimulate further research.

In the management of Stage 1 empyema, prompt pleural space chest tube drainage is required. In patients with Stage 2 or 3 empyema who are fit enough to undergo an operative procedure, there is a demonstrated benefit of surgical debridement or decortication, possibly by video-assisted thoracic surgery (VATS) over tube thoracostomy alone, in terms of treatment success and reduction in hospital stay. In children, a primary operative approach is an effective management strategy, associated with a lower mortality rate and a reduction of tube thoracostomy duration, length of antibiotic therapy, reintervention rate and hospital stay. Intrapleural fibrinolytic therapy is a reasonable alternative to primary operative management. Uncomplicated PPE (without bronchopleural fistula [BPF]) can be effectively managed with minimally invasive techniques, including fenestration, pleural space irrigation and VATS debridement.

PPE associated with BPF can be effectively managed with individualised open surgical techniques, including direct repair, myoplastic and thoracoplastic techniques. Intrathoracic vacuum-assisted closure may be considered as an adjunct to the standard treatment. The current literature cements the role of VATS in the management of pleural empyema, even if the choice of surgical approach relies on the individual surgeon's preference. My personal approach is to study the CT carefully and determine the chances of successfully re-expanding the lung by VATS. Longstanding effusion, thick pleural peel and/or fibrothorax would suggest a direct open approach. If this is the case, I opt to remove a short segment of the sixth rib to avoid excessive spreading of the ribs. There is a debate on whether to remove the parietal pleura or not. I personally prefer to do so, in order to restore the normal 'bucket handle' movement of the chest. I have never experienced issues with the lung failing to fill the pleural space, provided the lobes are decorticated along the fissures to allow 3D inflation.

Cardiac – Focus Session: Aortic valve disease and heart failure: how do they connect?

Impact of aortic valve replacement on heart failure management

Marc Ruel University of Ottawa Heart Institute, Canada

Aortic valve replacement (AVR) is one of the most successful cardiac operations, indisputably prolonging and improving the life of our patients. The main therapeutic goal of AVR is to prevent cardiac death and to ensure freedom from heart failure. Over the years, various concepts have emerged regarding AVR prosthesis selection and sizing, the optimisation of haemodynamics and durability, and postoperative left ventricular remodeling.

The University of Ottawa Heart Institute's valve surgery follow-up clinic comprises over 11,000 patients followed over four decades, allowing for new inferences regarding the outcomes of AVR. In longitudinal analyses, we defined heart failure after AVR as persistence, or recurrence, of NYHA class III symptoms for at least 4 weeks, or death with heart failure as a contributory cause.[1] We developed a logistic model that accurately predicts heart failure and which has been externally validated in large multicentre cohorts.[2] Notably, prosthesis-patient mismatch (PPM) at an effective orifice area/body surface area ratio of less than 0.80 cm^2/m^2 is associated with persistence or recurrence of clinical heart failure, but not increased death, in all comers.[2] However, patients with depressed left ventricular (LV) function or low-gradient aortic stenosis (AS) are most susceptible to PPM, where it is associated not only with heart failure but also death.[3,4] Conversely, PPM does not affect patients with aortic insufficiency (AI) or over 70 years of age nearly to the same degree, unless they have other unfavourable factors.[5,6]

Recently, we examined the clinical impact of changes in postoperative LV function in over 3000 AVR patients.[7] In patients with LV dysfunction before AVR, a preoperative trans-aortic valve mean pressure gradient <40 mmHg and postoperative PPM correlate with the composite outcome of death or congestive heart failure after AVR. Not surprisingly, recovery of LV dysfunction predicts better survival and freedom from heart failure. However, maximum LV mass regression requires on average 24 months in AS patients and nearly 5 years in AI patients. In the presentation we will also examine salient aspects of postoperative secondary prevention and treatment that may help optimise heart failure outcomes after AVR.

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Cardiac – Focus Session: Acute extracorporeal support and mechanical circulatory assist

EUROMACS participation grown by 50%

Theo MMH de By, Managing Director, Euromacs Registry

Within 1 year, the number of participating centres that register implantations of mechanical circulatory support (MCS) devices has increased by 50%, and within the same period the number of registered cases has also increased by almost 1700, submitted by 36 international hospitals.

The EUROMACS registry can be accessed online and connected to existing local and national databases, enabling quick and easy upload of local and national data, which means a lot of work is saved and errors are prevented. While there have been several plans to create new national databases, using the EUROMACS registry saves time, energy and money because data from any country can be easily filtered for use on a national level. By sharing data, clinicians and researchers both nationally and internationally are able to analyse outcomes with higher accuracy and probability.

Quality assurance

The hospitals that contribute data commit themselves to provide these data accurately and timely, as a rule within 6 weeks after implantation or after an event. While quality checks on data are carried out on a continuous basis, the EUROMACS team ask participants to confirm that patient data are complete twice a year (on 30 June and 31 December annually). In this way, the register can consolidate the data set for completeness. In individual cases where there is no recent follow-up, the centres are asked to confirm, by entering this information as 'routine follow-up', that these patients are still alive per the consolidation dates.

Outcomes

Outcomes of the EUROMACS analyses are published in the *European Journal of Cardiothoracic Surgery (EJCTS)*. One observation is, given the fact that the number of organ donors is lower than needed to cover the demand, there is a growing importance for destination therapy. Figure 1 shows the expected trend in which the relative growth of the cohort of patients with destination therapy is expected to increase over time. Meanwhile, patients under evaluation to become a transplant candidate, as well as those on the active waiting list are included in the two largest groups submitted to the registry (Figure 2). Infection, mainly caused by the drive line creating a porte d'entrée for microorganisms, is the most common serious adverse event reported in the EUROMACS registry (Figure 3).

Benchmarking of centre outcomes

One of the advantages of having a multicentre database is that surgeons and cardiologists can compare data from their own centre with statistics generated from the entire EUROMACS database. Thus, they can see the relative values of the local centre. The EUROMACS committee strives to offer hospitals, which contribute data to the EUROMACS database, even more possibilities to benchmark their own data. The planned comparison will include patient distribution according to therapy strategy: '(possible) bridge to transplant', 'rescue' or 'destination' and others. When finalised, the development will enable comparisons of adverse events, Intermacs profiles and actuarial survival graphics in different age and therapy categories. Furthermore, any clinician or scientist can contact EUROMACS and ask for (downloads of) anonymous data for scientific research to be used in a study proposal.

IMACS cooperation

In 2014, a cooperation between EUROMACS and IMACS (International Society for Heart and Lung Transplantation Registry for Mechanically Assisted Circulatory Support), a subsidiary of the ISHLT, was established. IMACS strives to collect data from regions such as the US and Canada, Europe, Japan, UK, South East Asia, Australia and others. These data will, comparable to the International Heart and Lung Transplant Registry, track morbidity and mortality data of post-implant MCS cases. EUROMACS will contribute data to the first annual report, in which data from 5851 patients will be broken down into a number of analyses on a global level.

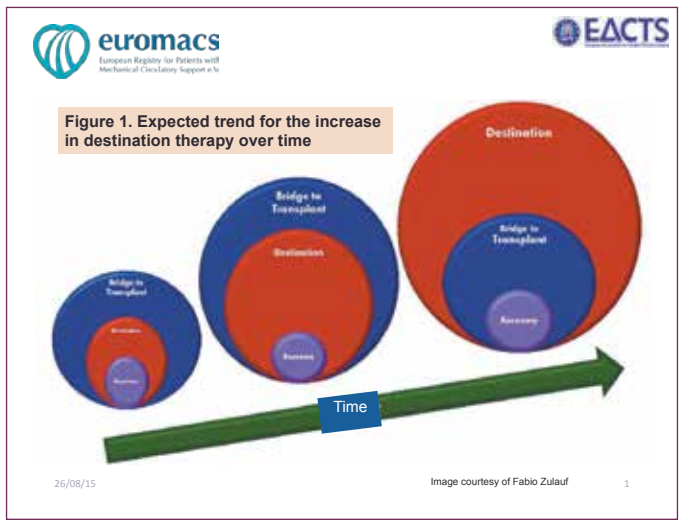
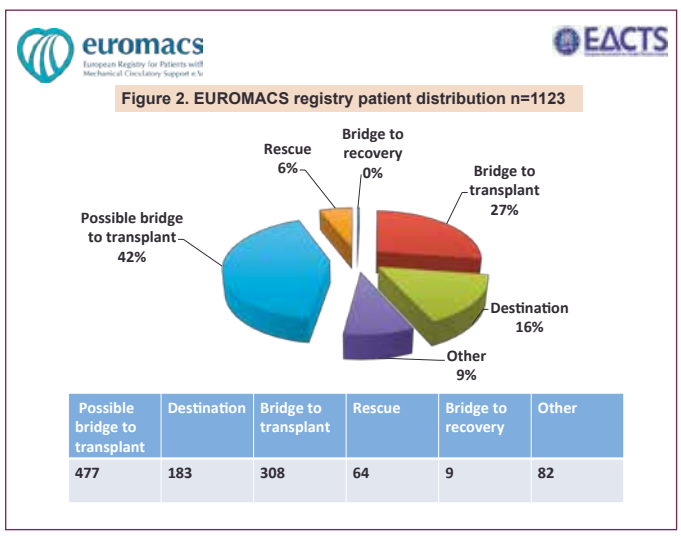
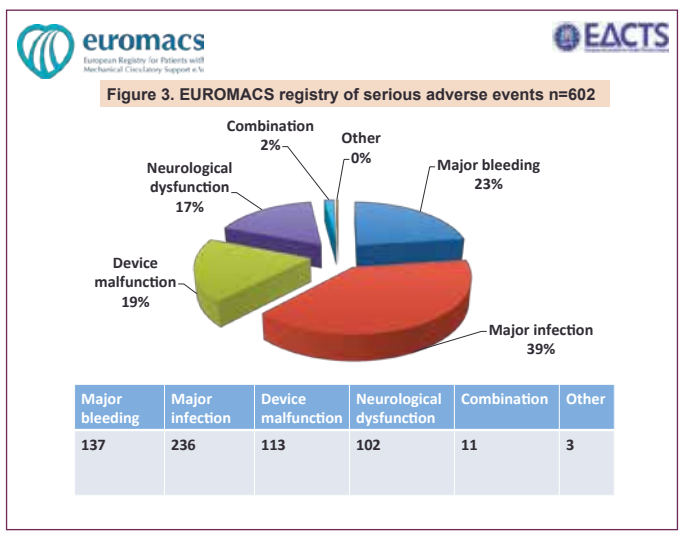


Figure 1.



Possible bridge to transplant	Destination	Bridge to transplant	Rescue	Bridge to recovery	Other
477	183	308	64	9	82

Figure 2.



Major bleeding	Major infection	Device malfunction	Neurological dysfunction	Combination	Other
137	236	113	102	11	3

Figure 3.

Surgical treatment of lung failure, 16–18 November 2015, Windsor, UK

Course Directors: J Pepper and A Simon, London, UK

Recent developments in extra corporeal organ support and the use of pre-operative extra corporeal membrane oxygenation have radically improved the prospects for patients waiting for new lungs. This course will bring you up to date with these developments, describe in detail how these technologies are applied and enable you to manage the complications for the benefit of your patients.

Please refer to the EACTS Academy website for further information and registration http://www.eacts.org/academy/courses/lung-failure

The surgical treatment of lung and heart failure courses will run consecutively in Windsor, UK. A specially discounted fee is available for delegates wishing to attend both.

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TERUMO

Inside Amsterdam

WHERE TO GO AND WHAT TO DO?

Stuart Head

GO TO

Oude Kerk

Located at Ouderkerksplein 23, in the heart of Amsterdam, in the middle of the Red Light district. It is the oldest building in the city. The stone church was built around 1300. This church would eventually grow to become the impressive monument we know today. Don't forget to climb on top of the building for a nice view. Drink a cup of coffee in '**De Koffieschenkerij'** just next door (number 27)!

SWEET SNACK

Pepernoten

Go into the supermarket and ask for 'Pepernoten', if you're able to pronounce it though… Otherwise look for the 'Sinterklaas' candy, which should be in every Albert Heijn or other supermarket. Buy regular or chocolate-coated ones.

SNACK/RESTAURANT

De Foodhallen

In the West of Amsterdam there is a new place that offers you a choice of several fantastic dinner establishments. If your colleagues or friends are craving different types of dinners, go here and order whatever you like at the different stands.

Located at Bellamyplein 51

MUSEUM

Rijksmuseum

At the same square as the Van Gogh Museum, the Rijksmuseum is one of the three large museums in Amsterdam, and definitely worth your while. Rembrandt's famous 'Nachtwacht' is here, as well as many paintings from the Dutch Golden Age paiting period in the 17th century. It closes at 5pm daily.

RESTAURANT

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Cardiac – Focus Session: Perioperative complications in cardiac surgery

When is timing of intervention for mitral regurgitation too late?

Ottavio Alfieri San Raffaele University Hospital, Milan, Italy

Repair of mitral regurgitation (MR) should be carried out early enough to achieve a life expectancy similar to that of the matched population. When survival and quality of life after a good and durable surgical repair are inferior to those of the normal population, the operation has to be considered too late in the course of the disease.

The appropriate timing of intervention and a perfect surgical repair are both crucial for an ideal outcome, which is therefore the result of an optimal cooperation between the referring cardiologist and the operating surgeon.

Factors affecting early and late postoperative outcome of patients with degenerative MR (the most common type of MR in the western world) have been clearly identified in the recent European and American guidelines for the management of patients with valvular heart disease. When MR is severe, repair should be carried out even in asymptomatic patients.

It has been repeatedly documented in the literature that the presence of symptoms at the time of surgery is associated with suboptimal results in terms of survival and quality of life. Even in asymptomatic patients, surgery can be too late if left ventricular (LV) dysfunction is present (LV ejection fraction <60%, LV end systolic diameter >45 mm). It has been recognised that an ejection fraction below 60% results in a remarkably increased late mortality.

Mitral repair is definitely carried out too late if atrial fibrillation is present. The unfavourable impact of such arrhythmias on the natural history of patients with MR has been clearly demonstrated in many studies. The enlargement of the left atrium *per se* is also associated with an increased occurrence of cardiac events in the postoperative follow-up. The size of the left atrium should therefore be taken into account in the decision-making process regarding surgical indication.

Pulmonary hypertension is a consequence of severe MR and is a reflection of advanced disease. Mitral repair should be carried out before the presence of pulmonary hypertension. The degree of pulmonary hypertension is a factor that significantly affects hospital mortality, and also has an influence on late survival as well as the occurrence of heart failure.

In summary, if a good and durable repair can be performed before the occurrence of symptoms, LV dysfunction, atrial enlargenment, atrial fibrillation and pulmonary hypertension, a normal life expectancy and quality of life can be achieved. In other words, the disease can be completely neutralised. This is possible when the current surgical indications are respected and the timing of intervention is not too late. It has to be emphasised, however, that early surgery as recommended above, is only justified when a good and durable repair (a repair for life) can be offered to patients with MR. For patients with degenerative MR, a near 100% successful repair rate can be achieved in reference centres. On the contrary, repair of rheumatic MR is more demanding and a durable repair is generally less likely. The same is true for mitral valves affected by acute disruptive endocarditis. With regard to functional MR, the dysfunction of the mitral valve is secondary to ventricular disease and therefore such considerations are not pertinent.

Cardiac – Abstract rapid response: General cardiac

The Chaos Theory: preoperative anaemia, blood transfusion or both?

A Luiz Augusto F Lisboa[1,2] and the REPLICCAR Study Group[2]

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[2]São Paulo State Cardiac Surgery Registry, Brazil

Perioperative anaemia is common after cardiac surgery, and blood transfusion is the preferred treatment for better outcomes. This logical approach (based on cause and effect) is currently responsible for over usage of blood transfusions. This thinking is based on Deterministic Theory, which is supported by Euclidean geometry. Deterministic Theory produced most human knowledge until the early twentieth century.

However, preoperative anaemia could be associated with other comorbidities such as advanced age and renal failure and, in some cases blood transfusion cannot be the solution. A new non-linear way of thinking began in the 1960s and was called the Chaos Theory. The central idea of this theory is that small changes in initial conditions can expand dramatically and bring enormous consequences, absolutely unknown, in the future. Therefore, such events would be virtually unpredictable, i.e., chaotic. Chaos theory was summarised by Lorenz as the 'butterfly effect' and it is based on non-Euclidean or fractal geometry.

From this perspective, lower haemoglobin thresholds can be as safe and effective as higher ones. In contrast, blood transfusions have uncertain benefits, and can be associated with organ injury, infections, immunologic complications and future problems. Currently Chaos theory is one of the most important laws, present in the essence of almost everything around us. A practical example of this theory in medicine is the correlation between anaemia and blood transfusion.

Our study investigated the impact of three different strategies considering preoperative anaemia, blood transfusion and the combination of both to the morbidity and mortality of patients undergoing cardiac surgery.

Our final study cohort comprised 1490 patients (average patient age=64±10 years, 37% female) who are part of the São Paulo State Cardiac Surgery Registry (REPLICCAR), a compulsory multicentre registry. They underwent cardiac surgery (CABG and/or valvular surgery) from November 2013 to August 2014. In this population, 855 (57.4%) underwent isolated CABG and 458 (30.7%) of whom had anaemia (HCT ≤37.5). This threshold is three times the haemoglobin levels considered normal by the WHO. Moreover, 439 (29.4%) patients received blood transfusions during, or up to 6 hours after, surgery.

For comparison, the study cohort was divided into 4 groups: (i) control group, no anaemia and no transfusion, (ii) preoperative anaemia without blood transfusion, (iii) no preoperative anaemia with blood transfusion; and (iv) both preoperative anaemia and blood transfusion.

Postoperative morbidities were observed in 655 (43.9%) patients including infection (11.2%), renal failure (8.8%), sepsis (3.2%), AMI (1.7%), stroke (1.5%), mediastinitis (0.8%) and 30 day isolated CABG mortality (3.4%). Unadjusted analysis showed that patients who received blood transfusion, regardless of anaemia, had the highest postoperative complications. After risk-adjustment, blood transfusion (not anaemia) demonstrated stronger associations with postoperative morbidities (Figure 1). Furthermore, decreasing preoperative HCT was associated with an increased probability of blood transfusion and patients who received ≥3 red blood cell units had significantly worse outcomes.

Our data suggest that, among patients undergoing cardiac surgery, a double exposure to preoperative anaemia and blood transfusion carries the highest morbidity risk. However, just exposure to blood transfusions increased the morbidity risk as well. As preoperative anaemia increases the probability of blood transfusion, it should be considered a risk factor and be included in the risk scores. Efforts to optimise preoperative HCT and measures to avoid operative anaemia should be strongly encouraged as a potentially modifiable risk factor and to improve cardiac surgery patient outcomes.

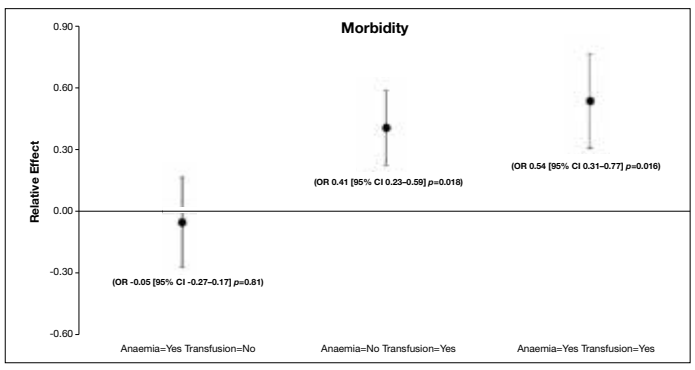

Figure 1.

Cardiac – Focus Session: Acute extracorporeal support and mechanical circulatory assist

Total artificial heart: what's new?

P Leprince Université Pierre et Marie Curie, Paris VI Groupe Hospitalier Pitié Salpétrière, Paris, France

Although total artificial hearts (TAHs) were pioneered in the early 80s with the Jarvik 7 devices, its use was almost secret during the past 20 years in comparison to the dramatic development of left ventricular assist devices (LVADs). It was not FDA approved until 2004 and thus its use was confined to a few centres mainly in Europe. Moreover, the experience with the fully implantable electrically powered TAH Abiocor in the early 2000s was not convincing enough and was finally stopped.

In 2004, particularly due to the tenacity of Dr Jack Copeland who addressed the safety and efficiency of the TAH Jarvik-7 (actually named Syncardia) with a clinical trial, it was finally approved by the FDA. Thereafter, the number of implanting centres as well as number of implants increased. As shown in Table 1, in the last 5 years, the number of implants (i.e., 559) was greater than the total reported for the preceding 10 years (i.e., 516).

One of the main problems with the Syncardia TAH was the lack of a portable console. Indeed, the initial console called 'the big blue' weighted 250 kg and was not compatible with hospital discharge but only with in-hospital ambulation. The Syncardia Company made a tremendous effort to improve the ergonomics of the hospital console and to develop a portable one named 'Freedom' (Figure 1). This made the Syncardia TAH compatible with a long-term bridge to transplantation or even with destination therapy. Thus, up to now, close to 100 patients

Figure 1. Patient on Freedom portable console.

were supported on a TAH for 1 to 2 years and close to 30 for more than 2 years (up to more than 3.5 years).

The other issue with the TAH is the fitting of the artificial ventricles. We published that the 70 cm^3 ventricles of TAH Syncardia were compatible with smaller patients between 1.5 to 1.7 m, as long as patients had dilated hearts. However, Syncardia has recently developed 50 cm^3 ventricles which will increase the number of patients with compatible anatomy.

Of course, TAH is specifically indicated in biventricular failure patients. Moreover, it is well indicated in specific pathologies like congenital heart diseases, post-heart transplant issues as well as LVAD issues, intractable rhythm disturbances, amyloidosis or cardiac tumours.

Table 1: TAH Syncardia implants

Years	N
1982–1990	181
1991–2000	203
2001–2010	516
2011–2015 (June)	559

The most recent TAH available for clinical use is the Carmat TAH which is currently in clinical trials. The Carmat comprises 2 electrically powered ventricles manufactured in 1 piece. The Carmat prosthesis was developed in order to make it more biocompatible and physiological. Biocompatibility was addressed by covering the inner surface with a pericardium and using biological valves for inflow and outflow. Physiological flow adaptation is generated through pressure and flow captor distributed all over the prosthesis allowing automatic control. Currently the clinical experience remains limited to 3 patients. It is obvious that LVAD will not address all cases of heart failure. Thus, the more TAH will become safe, efficient and compatible with a good quality of life, the more it will be used. New concepts of TAH based on continuous flow are in development. They will become an interesting challenger to actual pulsatile TAH.

Cardiac – Rapid Response: General cardiac

Thrombus resolution and right ventricular functional recovery using ultrasound-accelerated thrombolysis in acute massive and submassive pulmonary embolism

Nur Dikmen Yaman, Cahit Saricaoglu, Ahmet Ruchan Akar, Mustafa Bahadir Inan, Serkan Durdu, Mehmet Cakici, Evren Ozcinar, Mustafa Sirlak Ankova, Turkey

Objective

To evaluate the efficacy and safety of ultrasound-accelerated catheter-directed thrombolysis (UACDT) in the treatment of massive and submassive pulmonary embolism.

Methods

A prospective single-centre study was performed between May 2014 and April 2015. A total of 38 patients (21 females and 17 males; age range, 24 to 89 years; mean age, 63.7 years) with a diagnosis of massive or submassive pulmonary embolism were treated for UACDT with the EKOS EkoSonic® system. Computed tomography showed evidence of large thrombus burden and right ventricular dysfunction and/or failure. Ultrasound-accelerated thrombolytic infusion catheters were placed into the affected pulmonary arteries. Clinical outcomes and complications, echocardiographic results and thrombus status were evaluated.

Results

Treatment of 38 patients resulted in complete thrombus clearance in 55.2% of the patients, and near-complete clearance in 22%. The median tissue plasminogen activator (tPA) dose for all patients in our study was 21.0 mg (range, 16 to 35 mg) and the infusion time was 15 hours. Measurements before and after treatment showed a decrease in pulmonary artery pressure (from 61.4±3.53 to 55.5±7.07 mmHg [systolic]). The right ventricular (RV) diameter decreased from 4.16 ±0.14 mmHg to 3.94±0.21 mmHg at follow-up. There were 37 patients who survived to discharge. Complications were only two minor puncture site bleeding complications, one gastrointestinal bleeding and one intracranial haemorrhage. At the 30-day follow-up, 37 patients (97.3%) were alive.

Conclusion

This prospective study demonstrates effectiveness and safety of ultrasound-accelerated thrombolysis in patients with pulmonary emboli with a large thrombus burden. This application provides a treatment option and a valuable addition to the treatment algorithm for the management of both submassive and massive pulmonary embolism.

Cardiac – Abstract: Native and prosthetic valve endocarditis: an update

Surgery for prosthetic valve endocarditis: interrelations between morbidity, mortality and costs

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Prosthetic valve endocarditis (PVE) is the most severe form of infective endocarditis. Accounting for 10–30% of all cases of endocarditis, it frequently requires surgical treatment. These procedures are not only often extremely challenging, but also associated with significant morbidity and mortality. Furthermore, surgery for native and prosthetic valve endocarditis requires substantial healthcare resources with significant economic impact. For reduction of risks and costs, understanding of contributing factors and interrelations is essential. Therefore, this study assessed morbidity, mortality, and costs after surgery for PVE, primarily to identify patterns of interrelations.

We reviewed the clinical course of patients who underwent re-operation for PVE at our institution between January 2010 and December 2012, and for whom complete economic data were available (n=30). Cost matrix for each individual patient was obtained from the Institute for the Hospital Remuneration System (InEK GmbH, Siegburg, Germany). The mean age of patients studied was 64±11.9 years, and 73% were men. Based on EuroSCORE II higher than 20%, preoperative status was critical in 43% of patients. Staphylococci were the most common infecting microorganisms (27%). Early mortality, defined as death occurring within 30 days after surgery, was 16.7%. Early morbidity was 70%, since 21 patients presented with at least one disease or surgery-related complication. More than one complication occurred in 12 patients (40%). Follow-up was 2.6 years at median and it was 100% complete. At 1 year, overall survival was 71±8.8%. During follow-up, endocarditis did not recur and re-operation was not required. Mean total hospital costs were 42,600±37,374 € (median 25,718 €). In 10% of cases, total costs exceeded 100,000 €. Intensive care medicine, comprising intensive care unit (ICU) and intermediate care (IMC) unit stay, accounted for 40±18.6% of costs. The operation per se accounted for 26±12.1% of costs. There was a significant correlation between total costs and duration of hospital stay (r=0.83; $p<0.001$) and between ICU/IMC costs and duration of ICU/IMC stay (r=0.97; $p<0.001$). Median daily hospital costs were 1796 €/d, but exceeded 2389 €/d in 25% of patients.

The following pattern of significant interrelations was identified (Figure 1). Early mortality was related to preoperative morbidity and postoperative renal failure. Early morbidity was associated with preoperative morbidity and urgency. Total costs were mainly defined by preoperative morbidity, postoperative morbidity, and urgency. High EuroSCORE, complex surgery, need for mechanical circulatory support, as well as postoperative mortality and morbidity, increased daily costs.

In conclusion, surgery for PVE is not only associated with relevant morbidity and mortality, but also with significant costs. For reduction of mortality, morbidity and costs, it is primarily preoperative morbidity that has to be addressed by timely diagnostic assessment and immediate treatment. In the presence of recommended indications, such as heart failure, uncontrolled infection and prevention of systemic embolism, early surgery should be preferred.

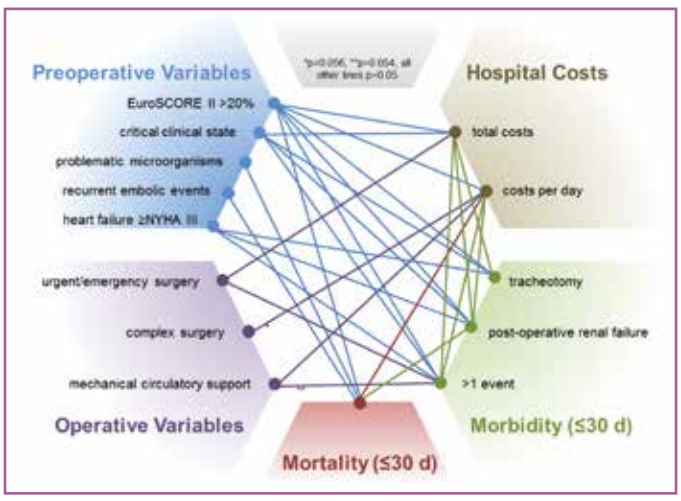

Figure 1. Pattern of significant interrelations.

Cardiac – Focus Session: A contemporary approach to the aortic valve and aortic root?

Valve-preserving root replacement, the role of valve geometry and the need for cusp repair

Hans-Joachim Schäfers
Saarland University Medical Center, Homburg/Saar, Germany

In the past 20 years it has become clearer that aortic root and cusps form a functional unit in which any changes of root configuration may have relevant consequences on aortic valve form. Normal cusp dimensions (tissue height and width) are also required in order to have normal valve function.

Valve-preserving surgery was conceived for patients with aortic aneurysm and aortic regurgitation assuming that regurgitation was solely due to aortic dilatation. Both root remodelling and aortic valve reimplantation normalise root dimensions, and it was hypothesised that, consequently, valve geometry and function would be normalised likewise. This assumption, however, ignored the observation that cusp dimensions are not constant but seem to correlate with root diameter. In addition, the presence of regurgitation in aortic aneurysm may also be caused by concomitant cusp pathology, with prolapse being the most frequent. This prolapse is often not apparent on echocardiographic examination since it may be masked by cusp stretching due to root dilatation.

Previously inspection was the only means of detecting prolapse. It may, however, evade surgical inspection, especially if it involves more than one cusp. Based on the analysis of failed valve-preserving aortic replacement procedures, it was recognised that normalisation of root dimensions may induce prolapse through reduction of intercommissural distance. Further studies led to the detection of a new configuration parameter in the judgement of aortic valve form: cusp effective height. This effective height is the discrepancy in height between the annular plane and the free margins in diastole. It can be determined by echocardiography, and also intra-operatively using a specially designed caliper. It was also found that cusp tissue height (geometric height) is not constant but seems to be normally distributed with a mean of 20 mm for tricuspid and 23 mm to 24 mm for bicuspid valves. Measurement of geometric height has thus become a tool that can be used to exclude retracted cusps from valve preservation because of their known limitations in valve function and repair stability.

Employing the parameters of geometric and effective height has facilitated the practice of valve-preserving surgery. As the initial step of the procedure, geometric height is measured to eliminate retracted cusps (<18 mm) from repair. Root replacement is then performed followed by careful inspection of aortic valve configuration and determination of effective height. If effective height is 9 mm or 10 mm (and the free cusp margins are at identical height) postoperative aortic valve function will be close to normal in most instances. If prolapse is encountered, it is most easily corrected by reducing the length of the free margin using plicating sutures in its central portion. This type of cusp correction has been stable over more than 15 years.

With better understanding of valve geometry, valve-preserving surgery has thus become an aortic repair procedure and can be applied reproducibly. The correction of cusp prolapse in most instances does not increase the complexity of the procedure, but it improves results and allows valve-preserving surgery in the large majority of patients with aortic regurgitation and aortic aneurysm.

Cardiac – Focus Session: Better outcomes through optimising INR management and anticoagulation in aortic valve replacement

What is the place of new anticoagulant therapy for patients after aortic valve replacement?

Freek WA Verheugt
Onze Lieve Vrouwe Gasthuis, Amsterdam, the Netherlands

Heart valve surgery has been one of the great leaps forward in the management of heart disease in the last 60 years. Thanks to advances in technology, artificial heart valves have been developed, which have proven to be both competent and durable. Besides the risk of infective endocarditis, thromboembolism from the foreign body structures of the prosthesis remains a major problem, which can be effectively reduced, but not annihilated by the use of oral anticoagulants. For nearly all patients taking oral anticoagulants, bleeding is the most common problem. The only available and proven effective oral anticoagulants for carriers of mechanical heart valve prosthesis are the vitamin K antagonists (VKA). These patients require intensive monitoring of their anticoagulation status, through the dense network of thrombosis clinics across the Netherlands.

Recently, non-VKA direct-acting novel oral anticoagulants (NOACs) have been introduced, which are proven to be safer and more effective than VKA in stroke prevention in atrial fibrillation (AF).[1] They have also been tested in patients undergoing mechanical heart valve replacement and in those with recent implantation, but here they failed in efficacy and safety compared with VKA.[2] Thus, VKA remains the standard of anticoagulation care for patients carrying artificial heart valves.

For patients carrying a bioprosthesis suffering from AF the NOACs may be excellent alternatives to VKA. This has been tested in one of the largest clinical trials comparing NOACs with VKA for stroke prevention in AF to date, in which many patients with significant valvular disease were included.[3] However, it is important to note that these were post-hoc analyses where patients with severe valvular disease or surgical procedures were excluded. The only exception was the ENGAGE trial, in which the oral Xa blocker edoxaban was compared with warfarin for stroke prevention in AF.[4] In this study, patients with a prior valvuloplasty or a bioprosthesis were allowed to participate; however, specific data on their outcomes are not yet available.

Thus, for most patients carrying a heart valve prosthesis, VKA remains the standard of care. The NOACs may only be used in patients with a bioprosthesis and AF, and further scientific studies are required to support their use in this and other indications.

Conflict of interest: The author is advisor to the manufacturers of the agents mentioned within this article.

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Cardiac – Abstract: Case reports and videos

Pericardio-oesophageal fistula: an unusual complication of ablation for atrial fibrillation

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A 35-year-old female patient had atrial fibrillation for 6 years and had undergone several electrical cardioversion procedures in the past. She had been non-compliant with her antiarrhythmic medications and reverted back into persistent symptomatic atrial fibrillation. She was electrically cardioverted and underwent transcatheter radiofrequency ablation. The patient underwent successful endovascular pulmonary vein isolation and was discharged in a stable condition. Two weeks after her ablation procedure, she presented to another facility with low-grade fevers, general malaise and substernal chest pain. A CT scan demonstrated intrapericardial air and fluid (Figure 1, arrow marks intrapericardial air). Given her history, we suspected a pericardio-oesophageal fistula and emergently transferred her to our centre. She was intubated in the critical care unit and expeditiously transferred to the operating room. She was maintained in Trendelenburg position during this entire process to avoid air embolus should there be a connection between the oesophagus and left atrium. After induction of general anaesthesia, a full sternotomy was performed. Purulent material and food particles were noted as soon as the pericardium was entered. Ascending aortic and bi-caval cannulation was performed and cardiopulmonary bypass was initiated. Aorta was cross-clamped and antegrade cardioplegia was administered to obtain cardiac arrest. The heart was lifted up to expose the posterior pericardium, and a fistula from the oesophagus to the pericardium was identified (Figure 2, arrow marks the fistula in posterior pericardium). The left atrium was carefully separated from the oesophageal defect and was noted to be leathery and scarred; however, the left atrium had completely healed and there were no areas of bleeding. Oesophagoscopy was performed to carefully evaluate the oesophageal defect. This was debrided to healthy tissue and closed primarily with several interrupted 3-0 vicryl sutures and buttressed with pericardium. The oesophagus was insufflated endoscopically and no leak was identified. Next, an upper midline laparotomy was performed. The omentum was mobilised off the stomach and the colon, while preserving the gastroepiploic artery. The short gastric vessels were divided and long pedicled flap of omentum based on the right gastroepiploic artery was developed. The omentum was brought to the chest through an opening in the central tendon of the diaphragm and placed posterior to the heart to separate the left atrium from the oesophagus. A feeding jejunostomy tube was inserted, and a nasogastric tube was placed under endoscopic guidance for gastric drainage. The patient was separated from bypass; entire chest and abdominal cavities were copiously irrigated and closed in the usual fashion, with wide drainage of both cavities. A follow-up oesophagogram showed complete healing without a remnant oesophageal fistula. Pericadio-oesophageal fistula is a rare complication after atrial fibrillation ablation. A high index of suspicion must be maintained to make the diagnosis. In cases where there is a connection between the left atrium and the oesophagus, the patient can present not only with bleeding, but also with sequelae of air or food embolism. Endoscopy and oesophageal insufflation is avoided till after the aorta is cross-clamped to minimise risk of air embolism. It is safest to approach this condition through a sternotomy, and with cardiopulmonary bypass support to deal with any fistulous connection between the oesophagus and the atria that may exist. In cases where the left atrium defect cannot be closed primarily, reconstruction with bovine pericardium may be necessary.

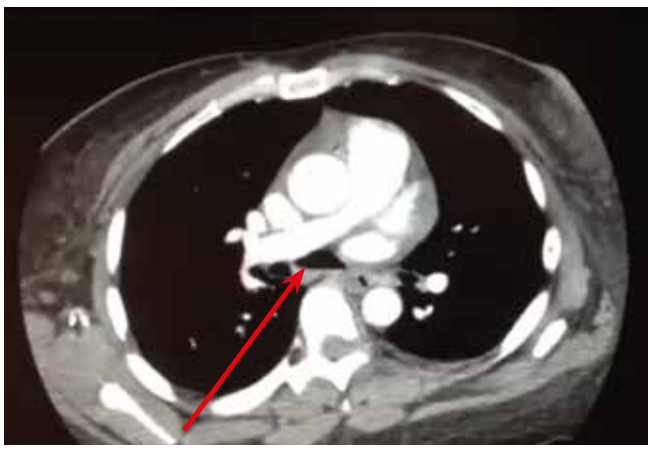

Figure 1.

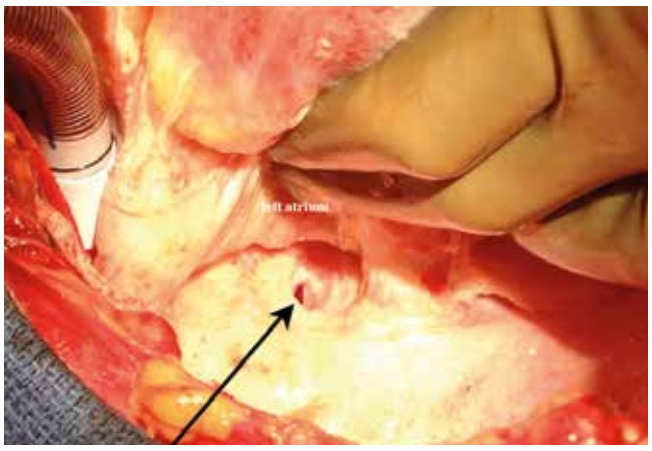

Figure 2.

Thoracic – Focus Session: Sublobar resections: controversies

Functional aspects: is it a real advantage?

Francesco Puma
Perugia University School of Medicine, Perugia, Italy

In 1995 the Lung Cancer Study Group (LCSG) presented the first randomised trial comparing lobectomies (LBCT) versus sublobar resections (SLR) for patients with stage I non-small-cell lung cancer (NSCLC). Following this trial, LBCT has been considered the standard operation for these patients. Since then, considerable progress has been made in staging, technique, postoperative care and pathological classification, suggesting a possible role for anatomical segmentectomies (AS) in the treatment of small, peripherally located, mostly non-solid cN0 NSCLC.

The task of analysing the cons regarding the functional advantage of SLR over LBCT was made through an overview and appraisal of literature from the past 20 years. We focused on AS rather than wedge resection, because the latter seems to be confined to a limited role, primarily as a diagnostic or compromise procedure. Many case series reported the superiority of AS over LBCT in preserving postoperative pulmonary function and no paper claiming the opposite was found. Few studies showed equivalent functional results after the two resection modalities. The conclusion is that a functional advantage for AS exists, but that the evidence for this is weak due to the nature of published data so far.

Discussion of the following four issues outlined below can help to weigh up the importance of the functional aspects for possible indication of AS in patients with stage IA NSCLC.

1. How much preservation of lung function can be achieved by AS compared with LBCT?

Many studies analysed the different postoperative decline of respiratory parameters and data is quite homogeneous in favour of the superiority of AS in preserving lung function. How substantial the entity of preserved function is in real terms is less clear, and the advantages seem to only be related to spirometric function, with no differences in exercise capacity or blood gases. In actual fact, LBCT is a well tolerated procedure, even by patients with significant preoperative lung impairment, and those patients who cannot tolerate a LBCT are generally also at high risk for an AS (video-assisted thoracic surgery [VATS] wedge resections are strongly recommended in such circumstances).

2. When do these functional advantages occur?

According to some authors, the functional advantage of AS over LBCT cannot be appreciated early after surgery but needs some months to be established. Other studies reported that the functional difference disappears over time. VATS will most likely affect both the entity and the timing of postoperative functional recovery, and therefore the comparison between AS and LBCT must also consider the influence of the different surgical approach. Indeed, some studies comparing VATS and open lung resections showed conflicting results.

3. What type of patients will experience the best preservation of lung function after AS?

Patients with upper lobe tumour and apical emphysema may have a lower functional loss after LBCT compared with patients with normal lungs. This phenomenon, called 'lung volume reduction effect', may be responsible for the improvement of spirometric function after LBCT. Furthermore, AS could increase the risk of postoperative complications in patients with severe emphysema. Other reports showed that the postoperative decrease in lung function, changes according to the lobe or the segment/s resected, resulting in available data being inconsistent.

4. Are there other factors potentially influential on functional outcome?

There is evidence that VATS provides functional advantages compared with open surgery. The VATS LBCT technique is currently well documented and these procedures are performed widely, especially for stage I patients. AS are also feasible in VATS, but such techniques are less widely practiced and could be more challenging.

In conclusion, AS offers a postoperative functional advantage compared with LBCT, but the currently available scientific evidence to support this is weak. The functional difference between the two resection modalities is not sufficient alone to modify the current recommendations, at least not until the oncologic equivalence between the two procedures is conclusively proven.

Congenital – Focus Session: Paediatric and congenital cardiac activities in emerging economies

Paediatric cardiology and cardiac surgery in emerging economies

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[1]Leicester, UK, [2]Oldenburg, Germany

It is generally accepted that the incidence of congenital heart defects is about 8/1000 living births everywhere in the world, without major differences among the various geographical areas. Attempts have been made to identify the true incidence, with studies reporting that in emerging economies the incidence of congenital heart defects is higher than the average because of several factors, including genetics, poor nutrition, poor sanitation, etc.

Since the care of patients with congenital heart defects is complex and requires very intensive resources, the main global issues related to the congenital heart defects remain:

- the inadequacies with the access to diagnostic screening
- the absence of uniformity of diagnostic modalities
- the fact that the access to care is not equal for all, depending on the countries of origin and the geographical location

As a result, every year about 90% of the 1,000,000 of children born with a congenital heart defect around the world do not have access to care or only receive suboptimal care. Not to mention the huge number of patients of paediatric age requiring heart care for non-congenital cardiac lesions, such as rheumatic and endocarditic disease.

This situation has stimulated the creation of many non-profit humanitarian organisations, trying to reduce the imbalance in health care existing across the globe. All these organisations rely on volunteer teams donating their time and expertise to provide diagnostic and surgical treatment for congenital heart defects. Considering that the children in need outnumber by far the people able to provide care, in this humanitarian medicine there should be plenty of room for cooperation rather than competition. The main goal should be to provide teaching to local staff and implementing methods and techniques to support the improvement of the care of the patients in the long run. The motto should be: "Providing care is good, teaching is better".

Our special session focuses on the organisation of paediatric cardiac activities in the emerging economies, but 'the less privileged parts of the world' can be anywhere, not necessarily limited to economic constraints. Lack of diversity because of social, intellectual, educational and professional growth, the latter consisting in cultural stagnation, are responsible for the lack of scientific progress and development.

The purpose of our session is to attract the interest of all the people potentially involved with humanitarian activities in the emerging economies, providing the audience with suggestions and solutions coming from the personal experience of the speakers.

In particular, attention will be given to the basic requirements of organisation of paediatric cardiology and cardiac surgery activities, the requirements for a successful partnership with the local existing organisations, and the basic elements of a patient-centered multi-disciplinary integrated approach.

Cardiac – Abstract: Left ventricular assist device: latest advances

A new technique to exclude the left ventricle with an assist device

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Left ventricular assist device (LVAD) implantation has become an effective treatment for end-stage heart failure patients. However, LVAD support disrupts the natural blood flow path through the heart, introducing flow patterns associapted with thrombosis. The standard implantation technique with the inflow cannula in the left ventricular (LV) apex especially, might bear an eminent risk of thrombus formation in the commonly dilated and poorly contracting LV cavity (Figure 1A).

The aim of this study was to quantitatively evaluate the flow patterns in the left ventricle during LVAD-support, with a focus on alterations in vortex development and stasis. In addition, we propose a novel implantation technique sparing the LV cavity.

We hypothesise that by using this technique it might be possible to reduce flow disturbances and stagnation around the inflow cannula of the assist device. For this study we developed an *ex-vivo* dilated porcine heart failure model and a magnetic resonance imaging (MRI)-compatible inflow cannula made out of perspex based on the original HeartWare HVAD® (HeartWare, Framingham, MA, USA) geometry. The inflow cannula was implanted in the LV apex with a Dacron suture ring and connected to the outflow of a conventional rotary flow pump with a pump flow rate of 4.5 L/min. The inflow to the heart was connected to both isolated pulmonary veins.

For the new technique we developed a novel cone-shaped prosthetic tube attached from the mitral valve annulus to the LVAD cannula, completely excluding the LV cavity and transforming the original LVAD into a LV replacement device (Figure 1B). The cone-shaped prosthetic tube was made out of ring-reinforced ePTFE and sewed with a 4-0 prolene running suture (Ethicon Inc., Somerville, NJ, USA) at the mitral valve annulus. The distal end of this prosthesis was sized to fit in the LVAD inflow cannula. Sequential experiments were performed within a closed MRI-compatible continuous flow circuit with a water-Glycerol mixture and a contrast medium to maximise the signal ratio. State-of-the-art magnetic resonance velocity mapping at 3T (Philips Achieva, v3.2.1, the Netherlands) and blood flow analysis with colour-coded visualisation (GTFlow v2.16, GyroTools, Zurich, Switzerland) were used for the experiments and subsequent analysis.

With this standard LVAD implant technique in the LV apex, the average flow in the LV cavity was between 11.2 and 14.3 m/sec, with a large flow vortex and severe disturbances with flow stasis at the inflow cannula (Figure 1C). The MRI 4D-flow measurements with this new technique demonstrate remarkably improved average flow of between 31.2 and 41.4 m/sec in the novel prosthesis (Figure 1D). In addition, the flow became more streamlined, rotating into the LVAD inflow cannula. The unique design of this LVAD inflow cannula developed using MRI-compatible material, meant that for the first time it was possible to picture LVAD flow with an MRI 4D-flow measurement. The standard implant technique shows a severely disturbed flow pattern in the LV cavity, especially around the inflow conduit.

By using the novel technique of implanting a LVAD as an LV replacement device, we could show a streamlined flow without flow disturbances within our new prosthesis. This may have the potential to reduce shear stress, and thus blood damage, by preserving helical flow in the prosthesis directed to the inflow cannula. We hypothesise that in turn, this may have a beneficial effect on haemostasis. With this direct flow into the inflow cannula, the need for anticoagulant and antiplatelet therapy may also be reduced.

One further outstanding feature of this technique is that it has the potential to implant a usual LVAD system as a single left heart replacement, while preserving right heart function.

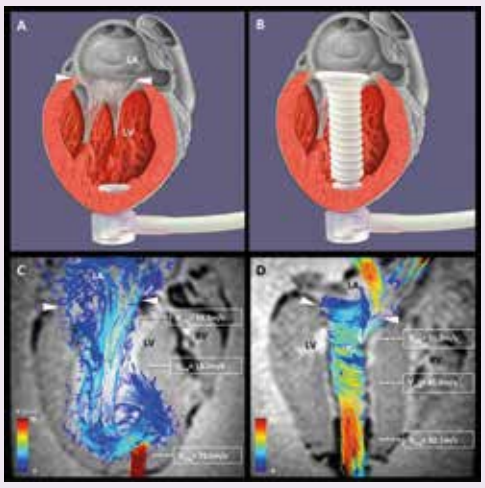

Figure 1.

VALVE CHOICE FOR PATIENTS UNDER 65: THE SURGEON'S ROLE WHEN MOVING TOWARDS SHARED DECISION-MAKING


Ben Bridgewater

The paper published by Bourguignon et al. in *The Annals of Thoracic Surgery* documents the 20 year outcomes of 2659 Edwards PERIMOUNT valves implanted in the aortic position. The highlights include an expected valve durability of 19.7 years for all age groups and freedom from reoperation due to structural valve deterioration (SVD) of 98.1±0.8% at 15 years in patients older than 70 years at the time of implantation.[1] A follow-up paper focusing on patients younger than 60 years at time of implant demonstrated that expected valve durability remained above 17 years.[2]

Given such a low incidence of SVD and solid hemodynamics it is hard to see past these valves as a good choice for elderly patients. Younger patients have to make a trade-off between anticoagulation risks and potential redo surgery when choosing between a mechanical and tissue valve. Bourguignon et al. suggest that their results support using bioprosthetic valves at least from the age of 60.[1] The UK trend is of increasing use of tissue valves in under 65 year olds because of [3]:

(1) Better proven longevity of tissue valves

(2) Lower risk of planned reoperation

(3) TAVI valve-in-valve solutions for degenerated tissue valves

The risk of redo surgery is indeed low with the publication reporting a 2.3% reoperation mortality amongst patients younger than 60 at the time of first implant.[2] These results are supported by an overall mortality in the UK for isolated first time AVR of 1.7% and 5.5% for redo surgery. Given the UK risk for redo surgery in patients without significant comorbidities is 2.3%, it is reasonable to implant tissue valves in younger people who are otherwise well.[4] Patients with other risk factors do however have a higher risk profile (e.g. low LVEF) for redo surgery.

Additionally valve-in-valve TAVI is an alternative for treating degenerated tissue valves, but again there must be caution. At present the best results are obtained in valves greater than 23 mm.[5] Long-term outcomes for patients that have undergone a valve-in-valve procedure are not yet available, but a patient aged 55 having a pericardial valve today will be unlikely to need further intervention. Bourguignon et al. report a probability of 10% for patients that are 55 years at first implant to undergo a redo procedure after 13.1 years.[1] There are of course still opportunities for continued improvements to catheter based treatment options, but this is a voyage into un-navigated waters.

As delivery of healthcare is moving towards shared decision-making with patients it is the surgeon's role to support them in making the best choice. What AVR option would I prefer being under the age of 55? With a good LVEF, without other comorbidities and assuming a valve reasonable orifice size, I would choose a tissue valve that should see me through my life comfortably with the knowledge that treatment options of low risk would be available if needed.

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Research Training/General – Focus Session: Clinical studies

Statistical power – what does it mean?

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'Statistical Power' lives at the heart of hypothesis testing and has a close relationship with the more commonly discussed 'P-value'. In statistical hypothesis testing the study sample is examined to evaluate two, opposing hypotheses and will suggest either no difference between groups (fail to reject null hypothesis) or the presence of a distinct difference (reject null hypothesis). At the same time there is the actual truth in the population from which the sample was obtained. A 2x2 table helps demonstrate the relationship between the statistical test result and the truth in the population with regards to whether a difference exists or not. The statistical test result can correctly reject the null hypothesis (p11) or not reject it (p00) (Figure 1a). On the other hand, the test result can falsely suggest a difference (p10), although there is actually none (type I error; α); or the test finds no difference (p01) – the null hypothesis is not rejected – although there truly exists a difference in the underlying population (type II error or β). The probability of avoiding a type II error, i.e. correctly rejecting the null hypothesis, is the power of a statistical test (probability p11; calculated as $p=1\beta$) (Figure 1b).

The analogy of a court trial can be used to understand the concepts of *statistical hypothesis* testing and statistical power. In a murder trial, the judge assumes innocence of the defendant (null hypothesis), until innocence has been ruled out beyond a reasonable doubt. Once innocence has been ruled out beyond reasonable doubt (null hypothesis rejected), guilt (alternative hypothesis) has not been proven, but is assumed to be the more likely case. Unfortunately, judges do make errors and occasionally let someone get away with murder because they lack sufficient evidence to reject innocence beyond reasonable doubt (type II error).

Statistical hypothesis testing works in similar ways and the aforementioned lack of forensic evidence would correspond to insufficient statistical power in a study. Statistical power is determined by data quantity and quality, the statistical test and significance level used as well as the magnitude of the effect of interest. Power increases with a larger sample size, decreases in measurement error, and a less stringent significance level or larger effect size. It is therefore an important concept during study design, data collection, analysis and interpretation whenever statistical hypothesis testing is applied. For example, when a study finds a *statistically not significant* difference in outcome X while the study had insufficient power to demonstrate the observed difference in X, we cannot know whether there is truly no difference between groups in the population or whether the study simply was *underpowered* to reach statistical significance. The only way of resolving this conundrum would be to conduct another study with sufficient power to detect the difference of interest.

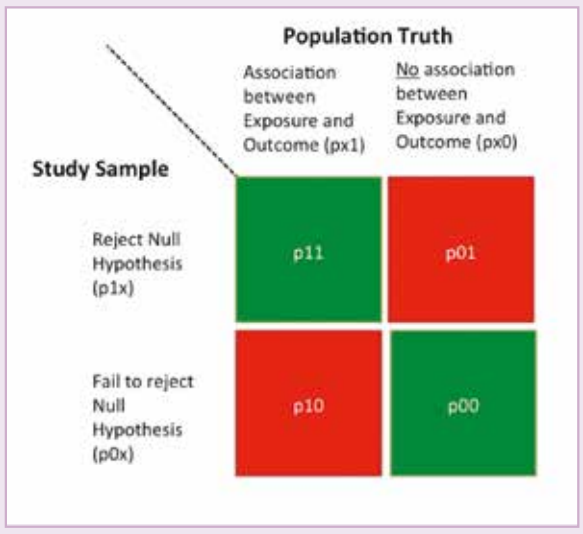


Figure 1a.

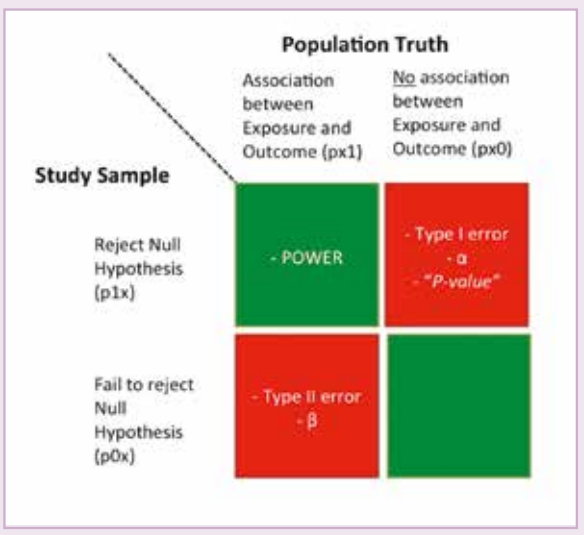
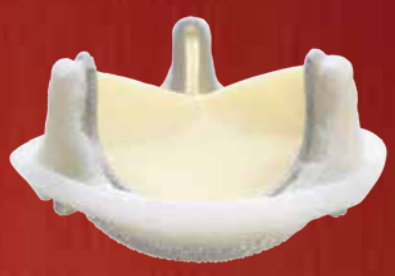


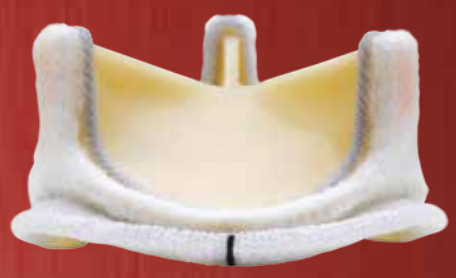
Figure 1b.

Edwards Pericardial Valves

Built on a proven trusted valve platform



CARPENTIER-EDWARDS
PERIMOUNT
PERICARDIAL AORTIC BIOPROSTHESIS



CARPENTIER-EDWARDS PERIMOUNT
MAGNA EASE
PERICARDIAL AORTIC BIOPROSTHESIS

EDWARDS INTUITY Elite
VALVE SYSTEM

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Congenital – Focus Session: Infections and chylothorax

Mediastinitis: cause or consequence of a frail organism?

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Mediastinitis after open-heart surgery in children is extremely rare, yet it is characterised by a dim prognosis (mortality rate is around 30%). A sternal wound infection is an unusual event that can be classified as a superficial (the subcutaneous tissues down to the fascia), deep (the fascia and bone) or space/organ infection. Mediastinitis belongs to the latter class.

Infections flourish on traumatised tissues in a weakened organism. Surgical technique directly impacts the amount of trauma (Table 1), but it can also influence the inevitable weakening (through surgery itself) of an organism. Still, sometimes – even when surgical attention has been scrupulous – mediastinitis, or refractory sepsis, can develop. In this case, the heavy infection primarily reflects a failure of the organism to cope with an excessive burden. Mediastinitis, therefore, appears more as a consequence of the collapse of an exhausted body than as a primary cause of its decline.

The most favourable setting for a mediastinitis (or any intractable infection) is encountered in children supported postoperatively by a central ECMO. The non-pulsatile reduced blood flow (which affects perfusion of the parietal walls of the body), the stunning of all organs and immune defences, the multitude of indwelling lines/catheters/tubes, and the selection of resistant organisms creates an overwhelming challenge to a weakened organism. The second most perilous situation is found in children with a delayed sternal closure, especially in neonates with their immature immune system. Surprisingly, provided that surgery has been performed 'atraumatically', the incidence of mediastinitis remains extremely low in this setting (no more than 0.5%), emphasising the preventive role of a meticulous handling of the tissues.

A mediastinitis in the immediate postoperative period has a better prognosis than one occurring after a latent period of a few weeks. Probably, the former is more a consequence of sub-optimal surgical technique than of the weakness of a frail organism.

The treatment of a mediastinitis varies according to its severity and the residual strength of the organism. For a surgically-induced mediastinitis, intravenous antibiotics and a thorough debridement of the devitalised tissues with direct closure of the sternum (with or without antibiotics irrigation) are often sufficient to solve the problem. If a thorough debridement cannot be immediately achieved, or if exogenous patch material cannot be covered by native living tissue, or if the sternal bone itself looks amorphous (with no bleed on curettage), delayed closure of the sternum is warranted to progressively obtain an infection-free space before proceeding to a secondary closure. A vacuum-assisted closure system can be used in some of these situations or in those where the debridement has resulted in significant tissue loss. The time required to obtain a tension-free closure can be long and would profit from this closed, easy to manage, system. A pectoralis muscle flap should be considered as an exceptional measure in children because of the sternal instability and the poor subsequent musculoskeletal (and breast) development it creates.

Table 1: Surgical measures that reduce the incidence of sternal wound infections

Minimal stress on tissues
Midline (and not paramedian) sternotomy
Appropriate stretch on sternal edges
Accurate anatomic dissection
Exact approximation of tissue in wound closure
Minimal tissue destruction
Appropriate use of cautery
Avoidance of bone wax
Strict control of bleeding
Reduction of the time of sub-optimal tissue perfusion
Short times of CPB
Reinforcement of the organism defences
Antibiotic prophylaxis
Strict control of blood sugar levels
Adequate red blood cell levels
Closure on gentamycin sponges in high-risk sternum

Thoracic – Abstract: Thoracic oncology III: postoperative follow-up

Long-term results of percutaneous radio-frequency ablation of pulmonary metastases

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The lung is one of the most frequent sites for tumours to spread to. Surgical resection of pulmonary metastases is now considered a standard therapeutic procedure in properly selected patients. However, many patients are unable to tolerate surgical intervention due to coexisting comorbidities and/or poor pulmonary reserve, often related to repeated parenchymal resections.

In this scenario, we decided to investigate the experience at our centre, analysing all patients that underwent radiofrequency ablation (RFA) to treat lung metastases, in the period 2003–2013. The primary endpoints of our study were overall survival (OS) and the local progression-free survival (LPFS). The secondary endpoint was analysis of the possible risk factors affecting OS and LPFS. Inclusion criteria were: the complete control of the primary tumour and the absence of extra-thoracic disease or the presence of controlled extra-thoracic disease. All patients were evaluated by an experienced thoracic surgeon as unsuitable for surgical resection based on cardiopulmonary reserve and/or medical comorbidities, or refused surgery. Additional criteria were lesion diameter <5 cm, distance from large vessels and airways >1 cm, and adequate platelet count.

A total of 99 RFAs were performed on 61 patients (38 men, 23 women; median age 74 years). The total number of treated lesions was 86. Seven patients were treated for two lesions, five patients for three lesions, one patient for four lesions, and one patient for six lesions. In 12 cases, lesions were treated up to three times. The median lesion diameter was 2 cm. The majority of patients were affected by lung metastases from colorectal cancer (48%). All procedures were successfully performed under conscious sedation with local anaesthesia. One death occurred due to progressive respiratory failure, while the morbidity rate was 11% (8% pneumothorax requiring chest drainage).

At a median follow-up of 28 months (range, 2–126 months), the 1, 3 and 5-year OS rates were 86%, 70% and 68%, respectively. The 1, 3 and 5-year LPFS was 95%, 49% and 45%, respectively. No correlation was observed, by univariate and multivariate analysis, between OS and age, gender, ACE-27 score, type of approach (CT vs ultrasound), histology of primary cancer (colon vs others), type of approach (CT vs ultrasound guidance), number of treated lesions (one versus more than one), disease-free interval (from primary tumour to first lung metastases) (1–35 months vs >35 months), or previous thoracic resection (yes vs no).

A tendency towards better OS was observed, by univariate analysis, for lesions smaller than 3 cm and for the presence of local disease 1 month after treatment (yes vs no), despite there being no evident statistically significant difference (p=0.051 and p=0.056, respectively). With regard to LPFS analysis, none of the above-mentioned parameters proved to be a significant risk factor, except for the presence of local disease 1 month after treatment (p<0.001) and lesion dimension <3 cm (p=0.005), by both univariate and multivariate analysis.

Based on our data, RFA can be evaluated as a feasible and safe procedure, with an acceptable morbidity, offering the possibility to repeat treatment on the same lesion safely. RFA can be considered a valid option for local control of lung metastases, in patients not eligible for surgery, especially for those with lesions smaller than 3 cm.

Cardiac – Abstract: Optimising outcomes in coronary surgery

Dual antiplatelet treatment related bleeding complications in coronary artery bypass grafting

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Following acute coronary syndromes or recent PCI with stent implantation, dual antiplatelet treatment (DAPT) is indicated. The new antiplatelet drug ticagrelor has been demonstrated to improve clinical outcomes when compared to clopidogrel. However, due to the potential for increased platelet inhibition, concerns have been raised regarding the safety of ticagrelor exposure prior to cardiac surgery. Currently, international guidelines recommend discontinuation ≥5 days prior to surgery for both drugs. However, pharmacodynamic studies have shown that residual platelet inhibition declines faster after ticagrelor discontinuation in comparison to clopidogrel. In the current study, we assessed whether it is safe to accept a shorter discontinuation period for ticagrelor prior to CABG.

626 patients undergoing isolated on-pump CABG were included in this study. All patients continued acetylsalicylic acid up to the day of surgery. Based on the pharmacodynamic characteristics and current guidelines, we hypothesised that the rate of bleeding complications would not be increased in patients in whom ticagrelor was discontinued >72 h and clopidogrel >120 h prior to surgery. Patients were stratified into the following groups: Control group (only acetylsalicylic acid up to the day of surgery, n=404), Group T ≤72 (exposure to ticagrelor ≤72 h prior to surgery, n=61), Group T 72–120 (exposure to ticagrelor 72–120 h prior to surgery, n=23), Group C ≤120 (exposure to clopidogrel ≤120 h prior to surgery, n=125), and Group C 120–68 (exposure to clopidogrel 72–120 h prior to surgery, n=13).

The primary outcome was a composite end-point including chest tube drainage ≥1000 ml in the first 12 h after surgery, transfusion of ≥10 units of blood products, surgical re-exploration, or death due to bleeding. Secondary end-points included chest tube drainage ≥1000 ml or ≥1500 ml in the first 12 h after surgery, transfusion requirement, transfusion of ≥10 units of blood products, surgical re-exploration, postoperative MI, in-hospital mortality, and death due to bleeding.

When compared to controls, the transfusion requirements were higher in the Group T ≤72 (72.1% versus 41.3%, p<0.001) and Group C ≤120 (71.2% versus 41.3%, p<0.001). Patients in the Group C ≤120 showed increased incidence of ≥1000 ml chest tube drainage in the first 12 h after surgery (26.4% versus 12.6%, p<0.001). Furthermore, an increased incidence of composite end-point was seen in Group T ≤72 (27.9% versus 17.3%, p=0.049) and Group C ≤120 (36.8% versus 17.3%, p<0.001) when compared to controls. No increased incidence of bleeding complications was seen in patients in whom ticagrelor was discontinued >72 h and clopidogrel >120 h prior to surgery.

Multivariate logistic regression analysis failed to reveal exposure to ticagrelor ≤72 h prior to surgery as an independent risk factor for bleeding complications. However, exposure to clopidogrel ≤120 h prior to surgery was shown as an independent risk factor for chest tube drainage ≥1000 ml in the first 12 h after surgery (HR 2.31, 95% CI: 1.33 –4.01, p=0.003), transfusion of ≥10 units of blood products (HR 3.26, 95% CI 1.47 –7.22, p=0.004), and composite end-point (HR 2.45, 95% CI 1.49 –4.03, p<0.001).

Discontinuation of ticagrelor >72 h or clopidogrel >120 h prior to surgery were not risk factors for bleeding complications.

Our results demonstrated that ticagrelor discontinuation >72 h prior to undergoing CABG did not increase the incidence of bleeding complications.

Cardiac – Focus Session: Pilots and passengers after cardiac surgery: so you want to fly again?

To fly after cardiac surgery: so you want to fly again?

Thomas Syburra Luzerner Kantonsspital, Luzern, Switzerland

Be ready for takeoff: win one hour of Airbus A320 full-flight-full-motion simulator!

Surgeons operating on patients who are going to board a flight postoperatively, as passengers and especially as pilots, have to both understand and be aware of the guidance from regulatory bodies such as the European Aviation Safety Agency, the International Air Transport Association, the International Civil Aviation Organization and the World Health Organization (EASA, IATA, ICAO, WHO). Furthermore, each passenger has to comply with their individual airline's policy for the 'so-called' carriage by air of 'Special Categories of Passengers', ergo our postoperative patients.

The Aviation Medicine and Cardiac Surgery Committee (AMCS) was constituted during the 27th EACTS 2013 in Vienna to guide the cardiac surgical community through the mandatory regulations, and to provide assistance to EASA when updating EACTS/ECS guidance material for both cardiac surgeons and the aviation authorities.

In an aircraft, the pilot's status is not the only health concern. The passenger's health status may also impact on the safety of flight operations and is two-fold. Firstly, can the passenger be safely evacuated in the case of an emergency, or is the passenger likely to become an emergency during flight, inducing a costly and hazardous re-routing of the aircraft? This is a major importance both from a health and safety standpoint, but also from a commercial and financial standpoint. For pilots, there is obviously no need to demonstrate how important sensible regulations are for flight safety and the AMCS' inputs have already positively supported the updating process of EASA's Flight Crew Licensing regulations. However, much remains to be done and thanks to the support of EACTS, it's becoming a more manageable and likely successful endeavour.

AMCS has, since its inception, involved a broad group of airline industry specialists, together with cardiac surgeons and flight surgeons. AMCS facilitates the co-ordination of the work of all partners and is committed to serve the best interests of passengers and of pilots undergoing cardiac surgery, in accordance with current guidelines and regulations.

This year in Amsterdam, AMCS benefits from the privilege of a Focus Session. We will talk about both postoperative passengers and pilots. As a little reward to our audience today, we can proudly announce a raffle among all the delegates present at our Focus Session to win one full flight, full motion, Airbus A320 simulator session at the SWISS Aviation Training Centre. The lucky winner will start with a 90 minute briefing, delivered by a qualified Airbus A320 instructor, then fly the A320 as pilot-in-command for full 60 minutes under the instructor's supervision, and then be awarded a diploma of successful simulator flight. Welcome to the future of flying after cardiac surgery. Be prepared!

Thomas Syburra, chairman; John Pepper, co-chairman.

Congenital – Focus Session: Infections and chylothorax

Pre- and postoperative infection screening in paediatric cardiac patients: do we know what we are doing?

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Infectious screening of paediatric cardiac patients remains a challenge as practitioners strive to become proactive rather than reactive. There is significant paucity of data related to the impact of sepsis in paediatric cardiac patients and most studies are limited to critically ill congenital heart disease patients with hospital-acquired infections.

Nevertheless, it has been reported that approximately 2.8% of paediatric patients have major infectious complications including sepsis and septic shock,[1] and sepsis has been identified as an independent risk factor for increased duration of mechanical ventilation, intensive care length of stay, healthcare costs and mortality.[2–5] Challenges in identifying sepsis in this population start with the fact that it is often almost impossible to distinguish infection from inflammation. Indeed, it is a well-known fact that inflammation occurs after cardiac surgery (due to cardiopulmonary bypass, ischaemia-reperfusion injuries, hypothermia or surgical trauma, among other reasons), which may induce an overt systemic inflammatory response syndrome (SIRS) and may also cause a transient immunosuppression (immunoparalysis), which increases the odds of infection or sepsis in these patients. This inflammatory process also impacts biomarkers usually utilised to rule out or follow therapeutic responses in sepsis, hence limiting their value after cardiac surgery.[2,3,6–9] Many other confounding factors add to this equation: SIRS may mimic sepsis; the utility of biomarkers has not been well defined in children, particularly in younger surgical patients; the use of steroids may alter the inflammatory response or even predispose to sepsis; and there is the possibility of sepsis-induced myocardial and haemodynamic dysfunction.

At this point, it remains illusory to think that biomarkers systematically differentiate non-infectious SIRS from sepsis in paediatric cardiac patients. Ideal biomarkers should be promptly available, inexpensive, specific and sensitive, age-specific, consistently reliable and reproducible, which unfortunately is not quite within the realm of reality.

In preoperative patients, various meticulous aspects may help identify patients with higher odds of infection or at risk. These patients require a comprehensive evaluation, including the identification of alerting risk factors (extremes of age, male gender, malnutrition or obesity, chronic illness, trisomy 21 or 22q11 deletion, cyanotic heart disease or chronic hypoxia, need for invasive supportive devices, extended hospital stays and multiple interventions) and epidemiological data (i.e. respiratory season, viral activity data). Caregivers ought to keep a high level of suspicion related to the presence of 'undercover respiratory infections'. Realistically speaking, it is not pragmatic to screen all patients with biomarkers, cultures or viral studies, owing to a significant financial impact with no proven benefits, but high suspicion should prompt to consider cancelling or delaying interventions.[10–17] Postoperative patients are even more challenging to screen and as a result are often treated empirically with antibiotics based on clinical alerts, unspecific symptoms and signs, upon observing disproportionate haemodynamic instability or due to caregivers' anxiety levels, owing to the lack of biomarker (i.e. whole blood cell count and differential, C-reactive protein [CRP], procalcitonin) reliability. While recent studies suggest that procalcitonin values and trends may be more accurate than CRP, there is lack of evidence-based data to steer practices in this regard.[18]

From a practical standpoint, clinical and therapeutic decisions should be multifactorial and should not be made solely upon biomarker levels. Notwithstanding this fact, and although not sensitive or specific enough to guarantee early detection, biomarkers remain undoubtedly important in the follow-up of confirmed sepsis in paediatric cardiac patients. The identification and validation of better biomarkers for risk stratification and therapeutic monitoring are undeniably a necessary future development. Until further conclusions are drawn, antibiotic use in this population will probably remain necessary.

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Cardiac – Abstract: Revisiting the tricuspid valve

New technique of tricuspid valve repair due to infective endocarditis and midterm results

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New technique of tricuspid valve repair due to infective endocarditis and midterm results.

Tricuspid valve endocarditis is a rare clinical condition accounting for about 14% of patients with infective endocarditis. The most common causative factors are intravenous drug abuse, propagation of percutaneous interventions, pacemakers and prolonged usage of intravenous catheters. In approximately 20% of cases, conservative treatment is not effective and surgical treatment is required, sometimes emergency surgery. In cases of extensive lesion, valve replacement with a bioprosthesis or a mechanical valve remains the solution, but leads to valve-related complications, and there might be a risk of recurrent endocarditis, especially in drug-addicted patients. Tricuspid valve reconstruction demonstrates better late results with respect to reoperations, low incidence of reinfection and long-term survival.

Fresh autopericardium, with or without short immersion in glutaraldehyde (GA), is a first-line tissue for reconstruction of heart valves. Our experiments have shown that treatment with 0.3% GA for 10 min ensures low cytotoxicity and preserved strength of autopericardium. Since 2008 we have used a novel approach for valve replacement that uses rags of auto- or xenopericardium (20 and six cases respectively), with formation of neochordae loops (Gore-Tex) for 26 patients. Based on the surgical anatomy of the heart, we have identified the desired dimensions of the gussets of pericardium for total replacement of leaflets. According to the diameter of the annulus, which is equal to the length of the base of the septal cusp, we added 5 mm to create commissures and convexity of the leaflets. Radius equals (r) – d/2+5, chord length (L) – (r+5)/3. Multiple loops of Gore-Tex sutures (4-0) were prepared according to a technique offered by F Mohr and two bases were secured to the corresponding papillary muscle or the septo-marginal trabecula. The other side of the loop was fixed to the free margin of the new leaflet or to the native cusp. The procedure was ended by annuloplasty. We prefer to use a length of 5 cm PTFE band.

Generally, in 18 patients the anterior leaflet was replaced, in three – posterior and septal leaflets, in one – septal, in two – anterior and septal, and in two – posterior. At discharge there was no leak in 16 patients, while seven patients had regurgitation I+ and only two patients had grade 2. Rates of 5-year survival and freedom from recurrent infection were 94.5% and 88% respectively. We had to redo the procedure three times, in up to 5, 8 and 16 months, associated with drug-addiction (two with bovine pericardium and one with autopericardium). In two patients valvulectomy was performed, and in other one valve replacement. Late follow-up data showed 14 patients had no leakage, while nine presented with trivial and one presented with mild regurgitation. Xenopericardium was used in the first six cases. The remaining procedures were performed using autopericardium. Of course, to date we can't assert the advantages of the proposed approach compared with replacement with any artificial valve. But our small experience has shown reproducibility of the technique and stability in the midterm. We believe that this approach may be expanded to various congenital and acquired tricuspid valve pathologies of non-infectious aetiology.

Cardiac – Focus Session: Is minimally invasive cardiac surgery the present and the future of mitral valve repair?

Teaching minimally-invasive cardiac surgery should be mandatory in current cardiovascular surgery training

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Surgical interventions for valvular heart disease are some of the most common procedures in cardiac surgery, particularly for calcific aortic stenosis and degenerative mitral regurgitation. Minimally-invasive cardiac surgery (MICS) approaches are becoming increasingly popular, with an increasing number of minimally-invasive operations for valvular disease performed worldwide every year. MICS has steadily gained popularity among cardiac surgeons, cardiologists and patients due to excellent clinical results, a faster recovery time and a more appealing cosmetic result.

In expert hands, most patients with valvular disease can be offered minimally-invasive procedures with excellent results. However, it is not clear how training programs should adapt to this new reality and how young surgeons should be taught and mentored in these new techniques, while maintaining the expected excellent clinical outcomes and high levels of safety, particularly in the field of mitral repair.

It is clear that most teaching programs currently face difficulties in training young surgeons to perform conventional mitral valve repair surgery during residency for a number of reasons (e.g., intrinsic technical difficulty, insufficient case volume and a suboptimal vision of the valve to allow trainees to gain enough experience while assisting their seniors but also to guarantee good supervision when performed by trainees). Under such circumstances, implementing a training program in MICS may seem impossible to many.

Despite these difficulties, MICS offers some clear advantages for training and I prefer viewing MICS as an opportunity for, rather than a barrier to, training. Firstly, the use of video images puts the mitral valve where it never was before: at the centre of attention of all operating room staff (including trainees), who now have an unrestricted, perfectly clear, high definition view of its anatomy, and of the procedures performed to reestablish its functionality. Just by doing this, learning mitral valve repair becomes much easier and faster. Trainees now can evaluate the anatomy of the valve and discuss its findings with the surgeon, as well as with the repair strategy and all the surgical steps to make it competent again (including the assessment of the repair).

The use of videothoracoscopic assistance also gives the surgeon the confidence of being able to track every move of the trainee while learning how to repair a valve and, in case of difficulties, being able to easily help them through a difficult step of the operation without having to take over, and without compromising safety or outcomes.

There are many unresolved questions regarding training in MICS. To be able to effectively train our young surgeons on MICS, it has to be established:

- When should it be initiated? From the beginning of their training or later, after conventional operations are mastered?
- Where should it be done? Should all teaching hospitals train their residents and fellows to a lesser or greater extent in MICS or is it preferable that it is only undertaken in high-volume centres where trainees get more exposure in less time?
- What is the best way to overcome the learning curve associated with MICS? Is very rigid case selection needed?
- What is the optimal stepwise strategy? Start with cannulation and move sequentially to the next steps like thoracotomy, placing of ports, open/closing the atriotomy, annuloplasty and finally leaflet resections and neochordae.

There is much to learn when starting MICS, and in the particular case of mitral valve repair, there can be overlap of two steep learning curves (minimally invasive techniques and mitral valve repair). It is clear that we have to able to find the best way to transfer this knowledge to the young surgeons, and it is important to minimise the trauma for everyone: trainees, teaching surgeons and patients.

Vascular – Rapid Response: Innovation and new strategies in thoracic aortic surgery

A computational fluid dynamics based study to identify haemodynamic risk factors for retrograde aortic type A dissections

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Aortic type A dissection constitutes a rare disease (2.6–3.5 per 100,000 persons a year) with high mortality (30-day mortality is 20% with surgical treatment and 50% with medical treatment).[1] Well-known risk factors include arterial hypertension, hereditary connective tissue disorders and prior cardiac surgery. Identifying patients at risk for developing a type A dissection remains challenging. In addition to the risk factors mentioned above, certain haemodynamic conditions in the ascending aorta might favour its development. In particular of retrograde type A dissections, which originate from existing dissections of the descending aorta (type B dissection). The purpose of this clinical study was to identify haemodynamic risk factors for retrograde type A dissections by means of computational fluid dynamics (CFD) simulations. Aortic dissections often appear as clinical emergencies of sudden onset. Therefore prior computed tomographic angiography (CTA) images, which are necessary for performing these simulations, are often unavailable. For type B dissections CTA images are routinely acquired and if in these patients a retrospective type A dissection develops, CFD simulations are possible. In our institution, 8 patients with aortic type B dissections subsequently developed retrograde type A dissection; 4 of these dissections were managed by medical treatment and 4 treated surgically (TEVAR). Haemodynamic conditions during systole (cardiac outflow velocity 0.8 m/s) were calculated from steady CFD simulations (Star-CCM+, CD-adapco, blood approximated by a Newtonian fluid, density of 1050 kg/m^3, viscosity of 0.004 Pa*s.) using polyhedral meshes. Pressures, velocities and wall shear stresses (WSS) were quantified at the future entry point of the retrograde dissection (immediately distal to the origin of the left subclavian artery) and the surrounding area in the aortic arch (Paraview, Kitware Inc.) (Figure 1). The WSS magnitude was of particular interest since it is directly proportional to the shear force of flowing blood onto the arterial wall. We therefore hypothesised that WSS may be used as a parameter for predicting the entry point of the future type A dissection. Statistical analysis of the mean WSS with a Mann-Whitney U Test showed a significant increase at the future entry point (mean 16.4 Pa, range 9.6–30.3 Pa) relative to the surrounding area in the aortic arch (mean 5.3 Pa, range 2.9–9.6 Pa, $p<0.002$). Average pressure and velocity magnitude were also elevated at this point (33.4 mmHg, 0.66 m/s, respectively) compared to the aortic arch (31.1 mmHg, 0.52 m/s).

These results from our retrospective study imply that elevated WSS, pressure and velocity magnitudes immediately distal to the origin of the subclavian artery are indicative of increased risk for retrograde type A dissections. CFD simulations show predictive value in the risk stratification of retrograde type A aortic dissections in patients with type B dissections.

Reference

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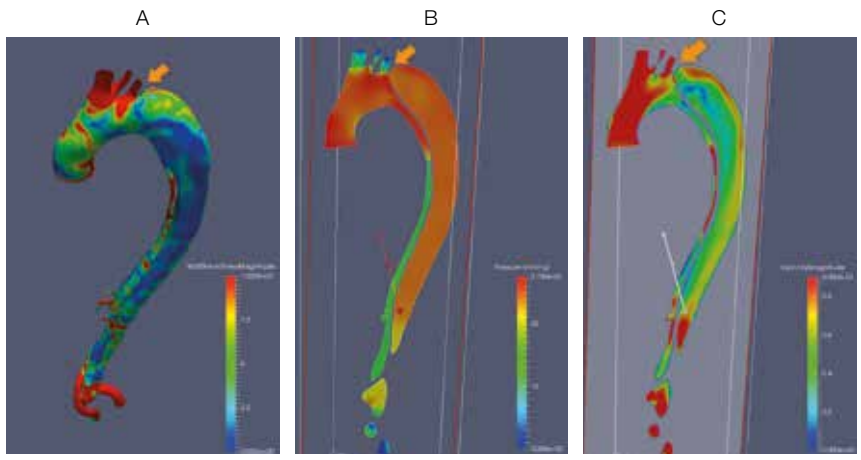

Figure 1. Elevated WSS (A), pressure (B) and velocity magnitude (C) at the future entry point of the retrograde type A dissection.

Cardiac – Rapid Response: How to perform an effective surgical atrial fibrillation ablation

Long-term results of concomitant surgical ablation for atrial fibrillation

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Background

Concomitant surgical AF ablation is an established procedure, recommended in guidelines for patients with atrial fibrillation (AF) undergoing cardiac surgery. According to guidelines, ablation success should be indicated by 24 h Holter ECG results. However, information on long-term success, especially obtained by 24 h Holter-ECG, is rare. Therefore we analysed the rhythm course and long-term outcomes of our patients undergoing concomitant surgical AF ablation.

Methods

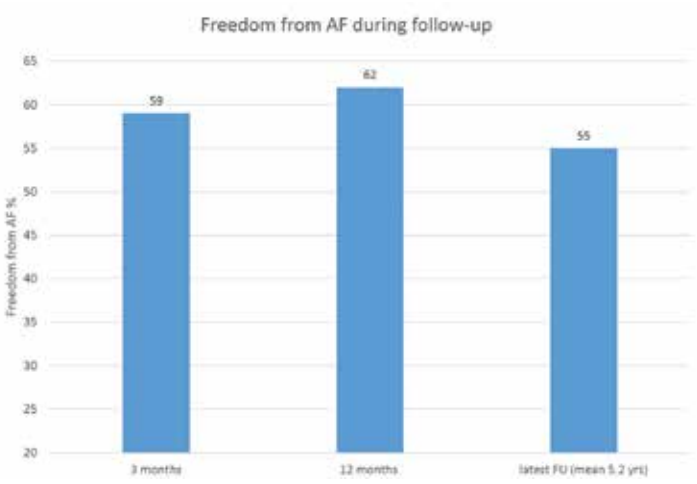
Between January 2003 and April 2011, 486 patients underwent concomitant surgical AF ablation in our institution. Patients with 24 h Holter ECG rhythm status available between 4 and 11 years post-surgery, were included in this retrospective data analysis (n=135). Ablation lesions were either limited to a pulmonary vein isolation (n=35, 15.1%), a more complex left atrial lesion set 201 (70.2%), or biatrial lesions (n=83, 14.7%). All follow-up rhythm evaluations were based on 24 h Holter ECG, successful ablation defined by the absence of AF episodes longer than 30 s. The endpoint of the study was freedom from AF during long term follow-up. Uni-and multivariate logistic regression analyses were used to identify predictors for rhythm outcome.

Results

The mean age of the patients was 68.1 years, 57.4% were male. Mean follow-up time was 5.2 years (4–11 years). Surgical AF ablation provided freedom from AF rate of 55.3% during long-term follow-up, with significantly better results in patients with paroxysmal-AF compared to those with persistent AF (66.9% versus 51.1% $p=0.32$). A stable rhythm course was observed during follow-up, without statistically significant differences between 12 months and latest follow-up (mean 5.2 years; 62.1% versus 55.3%; $p=0.26$). Irrespective of ablation success, 53% of patients, who were in sinus rhythm at latest follow-up, were still on oral anticoagulation drugs. Uni- and multivariate logistic regression analysis identified preoperative paroxysmal AF and left-atrial diameter as predictors for long-term ablation success.

Conclusion

Surgical AF ablation provided freedom from AF rate of 55.3% during long-term follow-up. Statistically significant predictors for ablation success at latest follow-up were preoperative paroxysmal AF and a preoperative smaller left atrial diameter.



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Thoracic – Focus Session: Guidelines

The surgeon's view on the ERS statement on primary spontaneous pneumothorax

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The European Respiratory Society (ERS) task force statement on primary spontaneous pneumothorax has recently been published in the *European Respiratory Journal (ERJ)*.[1] It represents an innovative way to address a disease that is often treated in different ways by different specialists throughout Europe.

The ERS task force was established following recommendations by the ERS Scientific Committee for the need for a comprehensive scientific review by a group of experts that reaches pan-European agreement on the use of thoracic surgery and pulmonary medicine. The task force is comprised of seven pulmonologists, five thoracic surgeons and one ERS methodologist from a total of nine European countries. The ERS statement is based on a body of scientific evidence, which was identified by systematic searches and documented by references to support the conclusions. The literature search was limited to reference material, related to adult patients, published between 1993 and September 2014. The statement does not make recommendations for clinical practice, but has been endorsed by the ERS Scientific Committee and, after peer review, published in the *ERJ*.

In recent years there has been a move towards a more conservative approach to the management of primary spontaneous pneumothorax, based on the principles that intrapleural air does not necessarily require therapeutic intervention, and that management depends on the clinical symptoms and not on the size of the pneumothorax. In the first instance, a conservative approach is preferred (bed rest, thoracentesis, small-bore pleural drainage); surgery is recommended only in limited cases. In recurrent or complicated pneumothorax, video-assisted thoracoscopic surgery (VATS) represents the 'gold standard' approach and includes resection of the bullae or apex of the lung, plus pleurodesis. Presently, the pleurodesis techniques – pleurectomy, pleural abrasion and talc poudrage – offer similar results in terms of safety and recurrence rate.

In conclusion, we recommend a CT scan (with low-dose protocol) before surgery, followed by VATS with bullae or lung resection, plus pleurodesis (talc poudrage being our preference) in all cases. However, there is also a need for randomised clinical trials to better assess the treatment of primary spontaneous pneumothorax in the future.

Reference

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Thoracic – Abstract: Thoracic non-oncology II

Do we need a new evidence of video-assisted thoracoscopic surgery safety and feasibility in benign pathologies?

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During the first half of the 20th Century, thoracoscopy was used almost exclusively for the management of pleural effusions and pulmonary tuberculosis. The tremendous success of laparoscopic procedures in the 1980s gave impetus to surgeons to apply this technology to the thoracic cavity. With this dramatic revolution in thoracoscopic technology, there have been several newly published studies on the feasibility and safety of using video-assisted thoracoscopic surgery (VATS) in malignant diseases and advanced resections, however, there are far fewer recent studies investigating VATS for benign intrathoracic lesions, where most of the data available dates from the early 1990s.

The existing body of literature on therapeutic VATS is more concerned with malignant diseases than benign ones, except for a very few studies, and no single study to date has demonstrated a collective data of VATS for benign diseases or for a group of diseases other than parenchymal resection. Although some articles recommend learning curves for VATS lobectomy, in which performing more than 100 cases of minor VATS procedure is suggested, they do not provide definitions or specify the particular types of operation included under this 'minor VATS operation' term.

In light of this limited body of evidence, and because VATS has become the standard procedure for the majority of benign intrathoracic diseases we commonly encounter as surgeons, we decided to evaluate VATS in terms of safety, feasibility and rate of conversion to open thoracotomy, using the early publications on the procedure as a reference for our recent practice.

We carried out a retrospective study of patients admitted with a clinical diagnosis of benign disease in whom VATS therapeutic procedures had been performed. In total, 223 patients were admitted to the service between March 2009 and May 2013. Of these, 62.8% (140) were male and 37.2% (83) were female. Within this group there were ten different categories of benign intrathoracic disease. The most commonly operated was hyperhydrosis (35.9%), followed by pneumothorax (20.6%) and pleural effusion (19.3%). Clotted haemothorax was operated on in 8.9% of cases, 5.4% for pectus excavatum, and 4.9% for mediastinal mass or cyst. Combined benign diseases were only found in one patient (pneumothorax and pectus excavatum).

In the majority of cases two ports were used (49.8%), 31.8% were carried out using three ports, and 17.9% used only one port (for repair of pectus excavatum and sympathectomy in the past 2 years in most cases, exploration, drainage of pleural effusion and evacuation of haemothorax in one case). Only one case of bullous lung disease required the use of four ports. Mean drainage was 2.9 days. No chest tube drainage applied in 17% of cases for Nuss operation and cases of sympathectomy from late 2011. Complications occured in one case of haemothorax, where the patient had a cardiac arrest during procedure, which necessitated internal massage and the procedure was continued via open thoracotomy. Conversion to open thoracotomy was necessary in two other cases, one case of diaphragmatic hernia due to difficulty to reduce contents via VATS and one case of haemothorax due to uncontrolled bleeding. There were no cases of intra-operative mortality. Mean duration of operation was 120.76 minutes.

Although VATS practice and the number of publications about the procedure have become more widespread in the past decade, there remains no standard definition of the common terms used to describe minor VATS procedures, the operative process, duration of operation and sympathectomy, which need to be addressed in future studies.

Thoracic – Abstract : Thoracic oncology III: postoperative follow-up

Adjuvant chemotherapy for stage IB non-small cell lung cancer (NSCLC) based on blood vessel invasion

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Background: Within the stage I designation, blood vessel invasion (BVI) is reported to be associated with poor long-term survival of NSCLC patients. To improve the postoperative survival, the development of effective postoperative therapy is essential. In general, the use of adjuvant chemotherapy remains controversial for patients with stage I NSCLC. However, for stage IB NSCLC patients, oral uracil-tegafur (UFT) adjuvant chemotherapy is recommended as the standard treatment in Japan. The objective of the present study was to evaluate the impact of adjuvant chemotherapy for stage IB NSCLC patients with or without BVI on survival.

Methods: We reviewed the medical record of a set of patients with NSCLC, in an attempt to reevaluate the role of adjuvant chemotherapy. Between 2000 and 2007, a total of 260 consecutive patients with pathological stage IB NSCLC underwent complete resection with systematic lymph node dissection at Tokyo Medical University Hospital. Of the 260 patients, 189 patients (72.7%) received adjuvant chemotherapy and 71 patients did not. We statistically analysed the effect of adjuvant chemotherapy on survival for the patients stratified by BVI.

Results: BVI was detected in 125 patients with stage IB NSCLC (48.1%). The 5-year overall survival (OS) rates of the patients without and with BVI were 90.8% and 61.0%, respectively (p<0.001) (Figures 1 and 2). The 5-year OS rates of the patients with and without adjuvant chemotherapy were 80.0% and 67.2%, respectively (p=0.050). BVI and adjuvant chemotherapy were found to be significant independent prognostic factors by multivariate survival analysis (HR 2.69, p<0.001; HR 0.55, p=0.016, respectively). Furthermore, we analysed the OS and recurrent-free survival (RFS) of the patients stratified by BVI. The 5-year OS rates of the BVI patients with and without adjuvant chemotherapy were 67.0% and 43.3%, respectively (p=0.003). Similar relationships of recurrent-free survival (RFS) were observed among these groups (p=0.048). In contrast, there was no significant difference between 5-year OS rates of the patients without BVI with and without adjuvant chemotherapy were 92.4% and 85.9%, respectively. Similar non-significant differences in RFS were observed.

Conclusion: Adjuvant chemotherapy could be effective for those patients with BVI. Additional prospective studies to evaluate the effect of adjuvant chemotherapy for stage IB NSCLC patients with BVI are warranted.

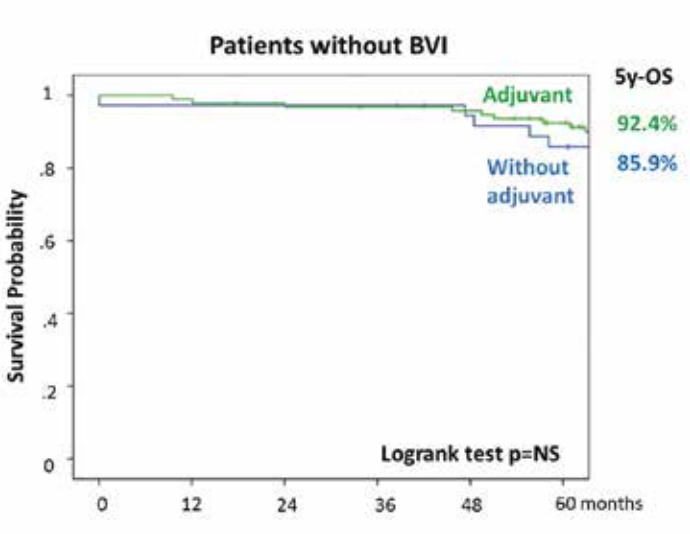

Figure 1. 5 year OS rate of patients without BVI.

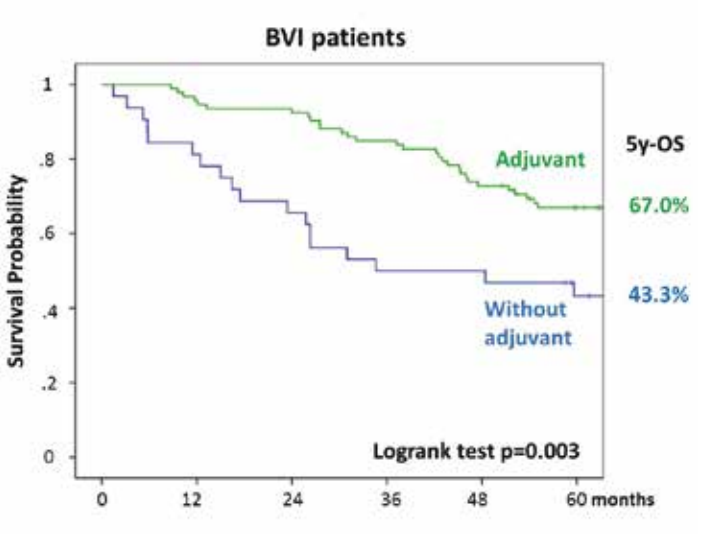

Figure 2. 5 year OS rate of patients with BVI.

Vascular – Focus Session: Arch repair

Aortic diameter remodelling after frozen elephant trunk in aortic dissection: results from an international multi-centre registry

Mauro Iafrancesco and Nora Goebel
on behalf of the IEOR (International E-vita Open Registry)

The frozen elephant trunk (FET) allows one-stage hybrid repair of aortic dissection (AoD), providing an opportunity to treat the descending aorta at the same time as the aortic arch through a median sternotomy without the need for a lateral thoracotomy. The supposed benefit of this approach would be the higher aortic remodelling rate in the distal aorta resulting in a reduced incidence of late aneurysm and need for intervention in the descending thoracic or thoraco-abdominal aorta.
However, the fate of the distal aorta after FET, in particular regarding the diametric changes of the entire aortic lumen (AL) and true lumen (TL), is not completely understood yet. Moreover, even if the effect of the FET technique on promoting false lumen (FL) thrombosis has been proven in the past, the relative importance of FL thrombosis on aortic remodelling at different levels of the distal aorta and the magnitude of this effect are not very well known.
The International E-vita Open Registry (IEOR) is a multi-centre prospective registry collecting preoperative, operative and follow-up data on all patients undergoing FET with the E-vita Open hybrid prosthesis at participating institutions. Based on the IEOR database, we designed the present study to investigate the prevalence of aortic remodelling following FET in AoD with special attention to the effect of FL thrombosis on AL and TL diameter changes at various levels of the distal aorta. Following a standardised protocol, preoperative and follow-up CT scans were reviewed, the diameters of AL and TL were measured at five different levels and the status of FL was recorded at every level. We selected 137 patients (65 with acute dissections and 72 with chronic dissections) operated on for an aortic dissection at seven centres between January 2005 and March 2014 with at least one-year follow-up data available and good quality preoperative and follow-up CT scan images.
Analysis of collected data showed that, for the entire cohort, the TL presented a significant increase of diameter at all levels while the AL showed positive remodelling at the level of the stent graft but continued to increase its diameter during FU in the abdominal aorta. Analysis of data according to the FL status showed that in patients with FL thrombosis, the TL increased its diameter at the level of the stent graft but remained stable distally during follow-up, while the AL decreased its diameter at the level of the stent graft and remained stable distally. Also, in patients with FL patency, the AL remained stable proximally but continued to grow distally.
Our data provide further evidence that FET represents an effective treatment for AoD, promoting FL thrombosis and remodelling in the DTA. However, this benefit appears to be dependent on the false lumen thrombosis and it is mainly seen in the stented segment of the DTA, but it is not maintained at the level of the abdominal aorta. Strict follow-up remains mandatory even in these patients to detect early changes in the aortic dimensions, which may warrant further intervention.

Cardiac – Abstract: What is new in transcatheter aortic valve implantation

Impact of changes in left ventricular ejection fraction on survival after transapical TAVI

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What happens to the left ventricle after transapical transcatheter aortic valve implantation (TA-TAVI)? According to our study in almost 70% of patients undergoing this procedure, left ventricular ejection fraction (LVEF) remains similar to the preoperative period, while it is improved or worsened in 13% and 17% of patients, respectively, with no impact on late survival. Many physicians performing TAVI are concerned that the purse-string sutures required for the ventricular apical access might affect left ventricular function, especially in patients with low preoperative LVEF. Previous reports highlighted that the transapical approach was associated with greater injury of the myocardium when compared with other accesses. This single-centre retrospective study was set up to evaluate the impact of TA-TAVI on LVEF and its implications on patient survival. We analysed data from 122 consecutive high-risk or inoperable patients who underwent TA-TAVI with the Edwards Sapien, Sapien XT and Sapien 3 valves. Mean age was 80±6 years and preoperative Logistic Euroscore I, Euroscore II and STS score were 20.2±11.9%, 7.2±5.6% and 6.7±6%, respectively. In order to evaluate the changes in LVEF after TA-TAVI, the differences between preoperative and discharge (ΔEF = LVEF postop – LVEF preop) were evaluated, with 5% arbitrarily considered as the cut-off value. Echocardiographic examinations were performed at hospital admission, immediately before discharge, at 1–3 months after TA-TAVI, and on a yearly basis thereafter. Finally, patients were divided into three groups according to changes in left ventricular function: LVEF improved (ΔEF>+5%); LVEF unchanged (ΔEF between +5% and –5%); LVEF worsened (ΔEF<-5%). We also performed a sub-analysis according to the different sheath diameter of the three Sapien generations in order to assess whether the dimension of the sheath, and consequently the dimension of the apical purse strings, might have an impact on LVEF. No differences were observed between overall preoperative and postoperative LVEF (54.7±11.9% versus 54.5±12%; *p*=ns). LVEF was improved, unchanged and worsened in 16 (13.1%), 85 (69.7%) and 21 (17.2%) patients, respectively. No differences were observed in late survival between the three groups at a mean follow-up of 2±1.3 years. Furthermore, comparing the ΔEF of the smallest sheath available (Sapien 3, 18 French) with that of larger sheaths belonging to previous generation TAVI devices, no significant differences were observed. Therefore, according to our data, after TA-TAVI, 17% of patients have LVEF reduction of more than 5%. However, LVEF reduction is not associated with worse late survival and its real clinical impact should be further evaluated. Sheath diameter has no impact on LVEF changes after TAVI.

Thoracic – Abstract: Lung transplantation

Utilisation of the organ care system for bilateral lung transplantation: preliminary results of a comparative study

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For several decades lung transplantation (LTx) has been the gold standard treatment for patients with end-stage lung disease. However, organ scarcity leads to a significant mortality rate on the transplant waiting list, 21% per year in the UK, representing one of the limitations of this treatment. And, due to worsening organ quality in the UK only 15% of donated lungs are used. Therefore, there is a need for different strategies to expand the lung donor pool. Innovative preservation and lung assessment techniques could increase the pool of donor organs and improve the function of poorer quality lungs. A combined and portable Organ Care System (OCS) Lung (Figure 1) is a commercial, transportable, *ex vivo* lung perfusion system designed to assess and improve routine donor lungs and, potentially, improve marginal lungs as well. OCS allows for normothermic, continuous, *ex vivo* perfusion, recruitment and bronchoscopy during transport.
We sought to assess long-term outcomes after lung transplantation using OCS and to compare outcomes including overall survival and freedom from bronchiolitis obliterans syndrome (BOS) to those after conventional preservation.
We included 322 consecutive patients who underwent LTx performed at Harefield Hospital between January 2007 and December 2014. Recipients were divided into two groups depending on the organ storage strategy: the majority of patients (n=308) were transplanted using lungs after cold storage, whereas 14 organs were preserved using OCS. The primary endpoints were overall survival after LTx and freedom from BOS. Secondary endpoints were perioperative clinical characteristics as well as adverse events that occurred during follow-up. There were no statistically significant differences between the two groups in terms of donor and recipient age, gender, proportion of non-beating heart donor organs, organs with abnormal chest X-ray, abnormal bronchoscopy, duration of donor mechanical ventilation and proportion of recipients requiring long-term oxygen therapy. However, there was a trend towards higher rate of redo transplantation in the OCS group (*p*=0.084). The percentage of heavy smokers among donors (*p*<0.001) and the median number of pack-years smoked by donors (*p*=0.026) were statistically higher in the OCS group.
Post-operatively, there was a trend towards higher post-operative PaO2/FiO2-ratio at 0 h (*p*=0.081) and 72 h (*p*=0.072) in the OCS group. Interestingly our results showed that patients from the OCS group had significantly better postoperative FEV1 at 3 and 6 months (*p*<0.001, *p*=0.006) after LTx. Furthermore, the incidence of grade 3 rejection over the follow-up was significantly lower in the OCS group (*p*=0.014). There were no statistically significant differences in terms of cumulative survival and freedom from BOS between the two groups. Therefore, results after LTx using OCS are acceptable with excellent survival, and significantly superior early outcome in terms of post-operative lung function. The results of our work in progress study should be enhanced by further studies on lung transplantation using OCS. OCS could be a useful routine tool for the assessment of donor lungs as it allows bronchoscopy and recruitment in addition to continuous *ex vivo* perfusion and treatment during transport under near physiological conditions. OCS could become the standard of care in the evaluation and transport of lungs extending the time from donation to LTx and expanding the donor pool.

Figure 1. OCS Lung machine (Transmedics®, Andover, MA, USA).

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A NEW TISSUE ENGINEERING APPROACH TO CREATE A VERSATILE COLLAGEN SCAFFOLD FOR APPLICATION IN CARDIOVASCULAR SURGERY.

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School of Surgery (Cardiothoracic Surgery)
University of Western Australia
Perth WA 6009 Australia

Numerous biological substitutes are used for congenital and adult cardiovascular repair procedures. Most of these substitutes have a limited life span due to degeneration and calcification. Alternative approaches with autologous tissue substitutes and synthetics have shown some improvement but fail due to retraction, surface thickening and calcification. The primary objective of this innovation was to create a versatile collagen scaffold with outstanding biocompatibility, durability, optimal physical properties and maximum calcification resistance for congenital and adult cardiovascular applications.

Biological substitutes are chemically treated to improve durability and reduce antigenicity. The cytotoxic nature of these chemicals have a negative effect on biocompatibility and also on the physical properties of these substitutes. The reduced biocompatibility induces a cascade of inflammatory responses after implantation which result in calcification and graft failure. This problem was addressed by a multi-step treatment approach. Bovine pericardium from BSE-free cattle were used for all studies and clinical trials. All tissue-related factors responsible for the cascade of inflammatory responses were eliminated. The pericardium was exposed to a multi-step tissue engineered treatment regime which is called the ADAPT® process. Tissue engineering principles such as delipidation, decellularisation and nuclease treatment form part of the ADAPT® process. The collagen scaffold was cross-linked in a novel way using monomeric glutaraldehyde at a significantly lower concentration compared to what is currently being used in the industry (12 times less than the conventional glutaraldehyde concentration which is done with the polymeric form of glutaraldehyde). The cross-linked scaffold was exposed to a detoxification treatment after crosslinking which addressed unbound and residual glutaraldehyde moieties. The detoxified, crosslinked scaffold was sterilized and stored in a non-glutaraldehyde solution which allows for direct application without any rinsing procedures.

Assessment included in vitro assessments (tensile testing, stem cell interactions, enzymatic degradation studies, residual glutaraldehyde levels, burst testing) and in vivo assessments (small and large animal models as well as a Human Phase II Clinical Trial).

Results demonstrated a unique collagen scaffold with outstanding physical properties and a significantly high resistance to calcification in both pediatric and adult patients.

The CardioCel® bioprosthetic patch obtained CE mark and FDA 510k clearance for use in Europe and the USA respectively during 2013-2014.

For the first time all aspects to produce an ideal universal bioprosthetic substitute for cardiovascular application in both pediatric and adult patients were effectively addressed. Pre-clinical as well as clinical evaluations have demonstrated ultimate biocompatibility, durability, outstanding calcification resistance and unique physical properties in simple and complex cardiovascular repair procedures.

October 2015 **Four-day academy course on congenital heart disease**

EACTS
European Association For Cardio-Thoracic Surgery

Date/duration: 27–30 October 2015 (4 day course)

Location: Windsor, UK

Course Director: **V Hraska**, Sankt Augustin

Programme Committee:

V Hraska, Sankt Augustin, Germany
M Kostolny, London, UK
M Danton, Glasgow, UK
J Photiadis, Berlin, Germany
R Cesnjevar, Erlangen, Germany
M Helvind, Copenhagen, Denmark
O Ghez, London, UK

Course overview

A course on surgical anatomy, physiology and principles of surgical and non-surgical treatment of congenital heart diseases for advanced residents and junior congenital heart surgeons.

Course topics

1. Fallots tetralogy
2. Double outlet right ventricle
3. Truncus arterious
4. Total anomalous pulmonary venous return and anomalous venous drainage
5. Atrioventricular septal defect both partial, and complete and complex
6. Mitral and tricuspid valve disease
7. Left ventricular outflow tract and aortic valve disease
8. Vascular rings, coarctation of the aorta and interruption of the aortic arch
9. Transposition of the great arteries
10. Complex transposition and congenitally corrected transposition
11. Univentricular heart – neonatal palliation, including hybrid approach
12. Univentricular heart – staged palliations, bidirectional Glenn, Fontan

A wetlab will be held on the final day.

This 4-day course aims to provide an update on surgical and medical management of children with congenital heart diseases. The main objective is to provide interactive teaching on the specific forms of congenital heart disease by renowned experts in the field. The course is divided into 12 modules, each covering one of the major types of congenital heart disease. Each module consists of a key note presentation on the management of the specific form of congenital heart disease being focused on, followed by a clinical discussion about individual cases and live-in-a box surgery. The key note presentation will elaborate on the anatomy, nomenclature, principles of perfusions, diagnostic tools, and principles of surgical and non-surgical treatment of the specific congenital heart disease. Clinical discussion will mimic our joint conferences with cardiologists, where the patient is comprehensively presented, different treatment pathways are outlined, and finally a treatment decision is made. More than 30 live-in-a box high-quality surgical videos will cover all practical aspects of surgical management. In a wetlab, hands on training of different techniques of aortic valve reconstruction and right ventricular outflow tract reconstruction will be provided.

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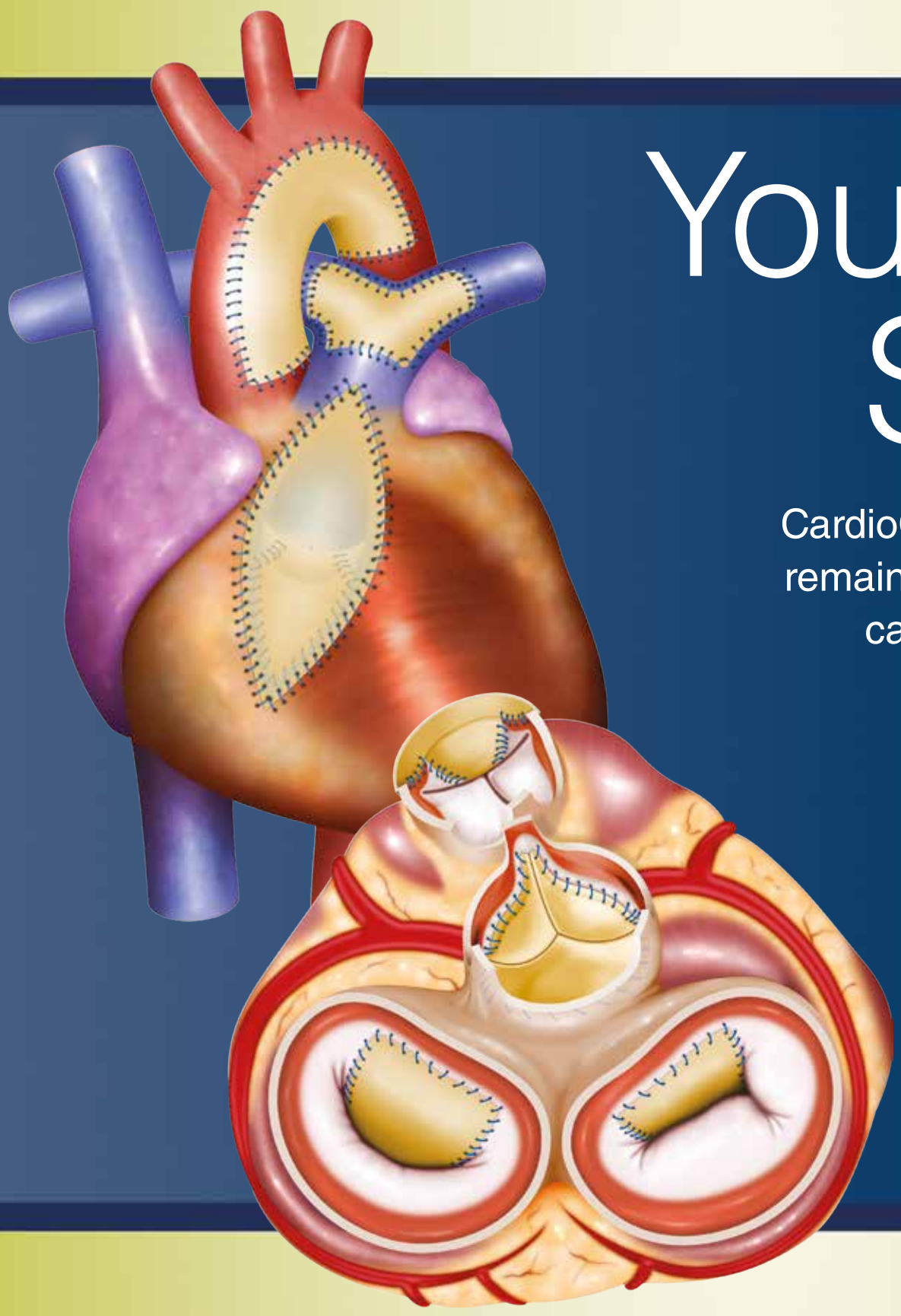

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Thoracic – Abstract: Case report

Video-assisted thoracoscopic lobectomy for huge pulmonary abscess due to intralobar sequestration

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Introduction

Pulmonary sequestration (PS) is a rare congenital abnormality,[1] consisting of a portion of lung parenchyma supplied by an abnormal artery from the aorta or one of its side branches.[1,2]
The arterial supply is derived from the thoracic aorta (75%), the abdominal aorta (20%) and two other different origins (5%). Venous drainage is mainly via pulmonary veins, and in rare cases via systemic veins.[1] There are two types of sequestration: intralobar, the more frequent, and extralobar, lacking connection with the bronchial tree and which has its own visceral pleura.[1,2]
The sequestered lung is not functional, commonly causing chronic cough, chest pain and recurrent pneumonia.[2] Some patients have severe complications: haemoptysis, massive haemothorax, superimposed infections, such as fungal infections and tuberculosis, benign and malignant tumours.[3] Standard treatment is lobar or sub-lobar resection via traditional thoracotomy, after isolation and ligation of the aberrant artery.[4]
This report shows a complicated case where a VATS lobectomy was successfully performed to treat intralobar PS.

Case presentation

A 26 year old man, a light smoker, with a history of asthma, was admitted at the Emergency Department complaining of fever and shortness of breath for 2 days. Chest X-ray showed a large opacity in the left hemithorax, and a CT scan revealed a giant abscess, about 10 cm diameter, in the left lower lobe (Figure 1). This history, the recent onset of symptoms and a negative HIV test suggested a pulmonary malformation. CT angiography showed a left lower intralobar sequestration fed by an aberrant artery from the abdominal aorta (Figure 2). After 3 days of intravenous broad-spectrum antibiotics, percutaneous drainage of the giant abscess via the fifth lateral intercostal space under ultrasound assistance, under general anaesthesia with single lung ventilation, and obtained about 400 ml purulent fluid (Figure 3). At the end of the procedure, the patient was extubated.

Microbiological examination showed the presence of S aureus, Asp fumigatus, and C parapsilosis in the purulent fluid, and of S aureus in the blood. Daily lavage of the abscess cavity, via the chest drainage, was performed using 0.5% sodium hypochlorite in saline to obtain clear fluid. The patient's general condition improved, and after 15 days of abscess drainage, we performed a left lower VATS lobectomy using 5 cm utility incision and two 1 cm camera ports. After intervention, both blood microbiological tests and serum chemistry parameters normalised in a few days. Follow up by CT angiography at 3 months showed an excellent surgical result (Figure 3).

Discussion

Potential complications of the rare congenital malformation PS may include recurrent pulmonary infections, haemoptysis and tumorigenesis.[1-3] Thus treatment has always been surgical excision even for asymptomatic patients with PS. VATS offers an alternative approach to PS, with minimum surgical trauma morbidity, postoperative pain and shorter postoperative care.[4] Our patient was discharged 20 days post-surgery when septic complications were completely resolved. Preoperative awareness of aberrant arteries using radiologic imaging remains crucial to reduce the risk of perioperative accidents.[4,5] Our experience suggests that PS, although rare, should be suspected in young patients with lung abscesses and rapidly evolving respiratory symptoms.

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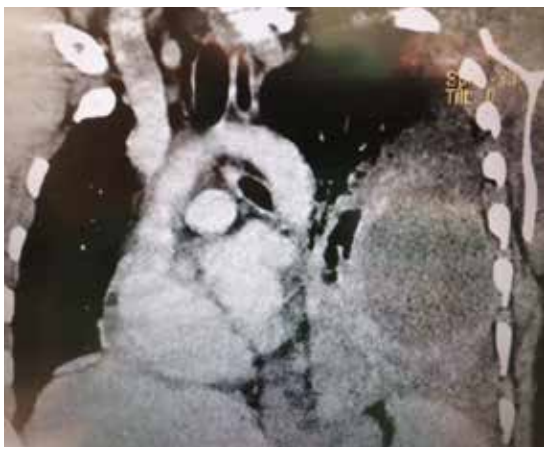

Figure 1. Oblique coronal CT-scan with contrast showing a 10 cm giant pulmonary abscess in the left lower lobe.

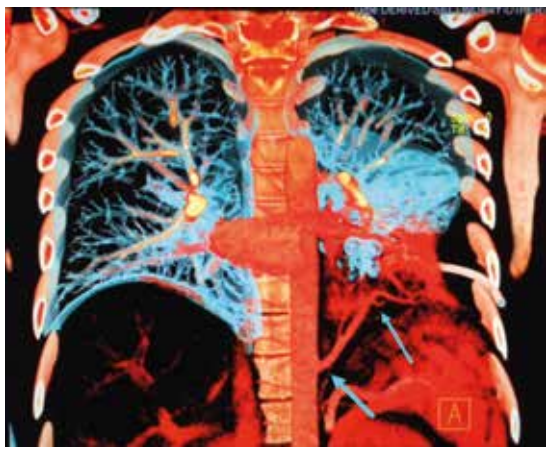

Figure 2. Coronal CT-angiography reconstruction showing the aberrant artery arising from abdominal aorta that supplied lower intralobar sequestration.

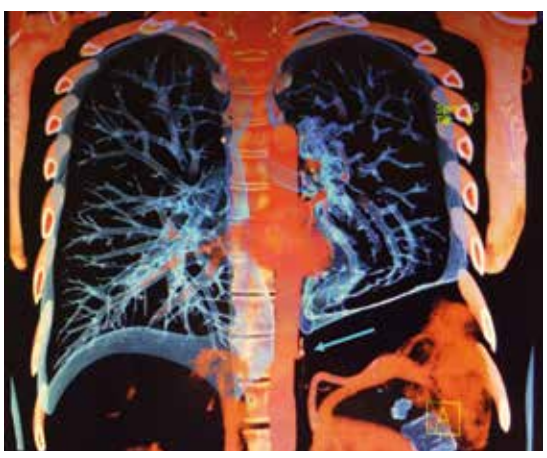

Figure 3. Coronal CT-angiography reconstruction showing the aberrant artery stump and the residual left lung.

Cardiac – Focus Session: Challenging the options for younger patients (50-60)? Minimising long-term risks with biological valves along the patient journey

Defining the long-term risks for younger patients (50–60 years)

Thierry Bourguignon Tours University Hospital, Tours, France

Classic teaching recommends use of the mechanical valve for younger patients because of its durability at the expense of lifetime anticoagulation. In contrast, bioprostheses will free patients from anticoagulation but expose them to the risk of structural valve deterioration (SVD). As the trend grows towards increased use of bioprostheses, age limit for bioprosthesis use versus mechanical valve is intensely debated. The joint European Society for Cardiology (ESC) and European Association for Cardio-Thoracic Surgery (EACTS) guidelines recommend bioprosthesis in patients >65 years of age for prosthesis in aortic position and >70 years of age for mitral position (Class IIa).[1] These age cut-offs are set at the point where the benefit of bioprostheses (no anticoagulation) outweighs the risk of reoperation for SVD, pointing out the crucial need for defining the longer-term risks.

Survival

Aortic or mitral valve replacement reduces life expectancy in a middle-aged patient population compared with age- and gender-matched populations. Hypotheses include poor timing of intervention, establishment of left ventricular dysfunction before intervention, or suboptimal haemodynamic performance of prostheses. Combining the outcome from randomised controlled trials and large retrospective studies, long-term survival and mortality are similar between bioprosthetic and mechanical valves in patients >50 years of age.[2]

Bleeding and anticoagulation

Lifetime anticoagulation remains the Achilles' heel of mechanical valves because it is associated with an accumulative risk of bleeding, especially if the valve is implanted at a young age. In microsimulation, simulated lifetime risk of bleeding after aortic valve replacement (AVR) is 12% in bioprostheses versus 41% in mechanical valve for a 60-year-old man.[3] Difficulty controlling the therapeutic level with warfarin is common and exposes patients to bleeding risk if international normalised ratio (INR) is higher or to thromboembolism if INR is lower. Other issues associated with warfarin include frequent blood draw, drug interaction, activity, diet regulation for young active patients, cost of medication and monitoring, and the need to discontinue warfarin before a surgical or dental procedure. Even in patients with atrial fibrillation, choosing a bioprosthesis that maintains a lower INR compared with a mechanical prostheses (especially for mitral valve), may offer the opportunity to use new oral anticoagulants that are easier to manage.

Structural valve deterioration and reoperation

The major flaw of bioprostheses is the occurrence of SVD, which must be defined from strict echocardiographic criteria and not solely based on surgical reports that may underestimate its prevalence. In retrospective studies, actuarial freedom from SVD in younger patients (<60 years) are reported from 67% at 15 years to 37% at 20 years in AVR,[4] and 40% at 15 years to 19% at 20 years in mitral valve replacement (MVR),[5] using current pericardial valves. Younger patients are obviously more likely to undergo reoperation, but considering competing risk ('actual') analysis, probability for a 60-year-old man of being reoperated on for SVD at 15 years after bioprosthetic valve replacement is 15% in aortic position and 25% in mitral position.[4,5] Even if reoperation is required, reoperative valve replacement can be performed safely by optimising timing of surgery. High-volume valve centres now report reduced mortality of 2% in redo AVR to 5% in redo MVR. In addition, transcatheter valve-in-valve implantation is an attractive less-invasive alternative to conventional reoperation for elderly high-risk surgical patients with bioprosthetic degeneration, although evidence to support this new technique is still being documented.

In summary, there is growing evidence to support the view that either prosthesis type is a reasonable choice in patients 50–60 years of age undergoing AVR or MVR. In this age-group, combined risk of subsequent reoperation and bleeding with bioprostheses is equal to that of mechanical valves, suggesting that valve choice should be guided more by the presence of comorbidities or shorter life expectancy than the age of the patient alone. Patient selection and attention to timing of reintervention may be determinants of long-term outcomes.

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Cardiac – Abstract: Functional mitral regurgitation

Latest trials in FMR: What do they teach us?

Jerry Braun Leids Universitair Medisch Centrum, Leiden, The Netherlands

There are some things we know for certain about functional (ischaemic) mitral regurgitation (FMR): it is the consequence of left ventricular wall motion abnormalities, has a high prevalence in patients after myocardial infarction, and, being an independent risk factor for death, portends a poor prognosis. However, the optimal surgical treatment of FMR has been a matter of debate for years. The key questions being which patients to treat and what techniques to use? Published reports convey ambiguous messages and are essentially difficult to compare because of different patient populations, different definitions (of severity) of FMR, different surgical techniques and different follow-up. This controversy is reflected in the guidelines as well. In order to try and answer these questions, several multi-centre randomised controlled trials were designed and performed, the results of which have been published in recent years.

Two studies focused on whether to add implantation of an undersized mitral ring annuloplasty to coronary revascularisation in patients with moderate FMR. The European RIME trial (73 patients) was terminated after interim analysis of results had shown that CABG with MVP after 1 year was superior to CABG alone with regard to the primary endpoint (functional capacity measured by peak oxygen consumption upon exercise) and to the secondary endpoints (decrease of LV end-systolic volume index (LVESVI)), mitral regurgitation severity.[1] In contrast, the North American CST Network trial (301 patients) found that addition of MV repair was not associated with greater improvement of LVESVI as compared to CABG alone at 1 year.[2] This study also did not find differences in the occurrence of cardiac or cerebrovascular events, readmissions or quality of life. There was significantly less residual MR (moderate or more) in the MV repair group. Both studies show that there is no difference in perioperative mortality comparing CABG only to CABG with MV repair. So how can two clinical trials on the same subject produce contrasting results? Presumably there were differences in patient characteristics (inherently caused by selection criteria) and possibly in surgical procedures.

Another CST Network Trial (251 patients) focused on MV repair versus replacement in patients with severe ischemic MR.[3] The authors concluded that there is no significant difference in LV reverse remodelling at 1 year between groups, and observed a more durable correction of MR after replacement. However, a critical appraisal casts doubts on the validity of the claim regarding reverse remodelling. It should be noted that the percentage of residual or recurrent MR in the repair group is unprecedentedly high (33% at 1 year), which can only reflect some flaws in the surgical approach since disease progression cannot account for such high recurrence rates. In addition, the decrease of LVESVI in patients who underwent successful repair (MR less than moderate after repair) is much greater than that in patients who underwent replacement, indicating that successful MV repair leads to more extensive LV reverse remodelling than MV replacement.

So, what can we learn from these trials? The key lesson should be that 'the patient with ischaemic MR' simply does not exist. Instead, we should continue to focus on the individual aspects of each patient (clinical presentation, integrative estimation of severity of MR, specific echocardiographic aspects of mitral valve anatomy, assessment of severity of LV dysfunction, and potential chances of reverse remodelling) and provide them a tailored medico-surgical approach that treats both ischaemia and MR. These trials also show that perioperative mortality is not increased when mitral valve surgery is added to coronary revascularisation, and that MV repair leads to less residual MR than CABG alone. Finally, the third trial[3] shows us that in FMR, a good mitral valve replacement is only as good as a bad repair. The development and initiation of surgical RCTs should be commended. But, especially in surgical specialities there are many pitfalls that can make the final results debatable, not justifying the effort expended.

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Thoracic – Abstract: Case report

Acute pulmonary artery obstruction as the primary manifestation of a rapidly growing intimal sarcoma in a 54-year-old patient

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The pulmonary intimal sarcoma is a rare malignant neoplasm with an incidence of approximately 0.001% and has only been reported in a few hundred cases. We would like to report on a 54-year old male patient with no prior medical history, who presented with acute onset of non-exercise related chest pain, suspicious of a pulmonary artery embolism (PE).

A chest X-ray revealed suspicious solitary pulmonary nodules in a racemose cluster in the left upper pulmonary lobe. The following CT scan verified solitary soft tissue lesions extending from the left hilum to the lateral left upper lobe pleura with in-growth into adjacent blood vessels. In addition, an abdominal scan showed hepatic lesions consistent with cysts or cystic metastases. In a transbronchial biopsy no malignant cells were detected. The patient was then discharged and developed recurrent episodes of fever with the early signs of systemic septic reaction. Systemic antibiotic therapy did not show an improvement in the clinical situation. Blood test results showed a procalcitonine level of over 20µg/L. CT scans were then repeatedly performed and revealed a rapid progress of the tumour mass. A complete occlusion of the left main pulmonary artery with tumour protruding into the pulmonary trunk became apparent. Based on the progressive character of the disease, the decision for a left-sided pneumonectomy with extracorporal circulatory support for pulmonary trunk repair was made. The operation was planned and realised by an interdisciplinary team of cardiothoracic and lung specialists.

The procedure was performed via a left antero-axillary thoracotomy. Intraoperatively, the lung was found strongly attached to the chest wall. An extended pneumonectomy with partial pleurectomy and pericardiectomy due to tumour infiltration and lymph node dissection was performed. Palpable tumour nodes were soft, the pulmonary artery was filled with a mucinous, amber-coloured mass. In an intraoperatively performed frozen-section, the dignity of the explanted tumour could not be specified. Histological analysis and tumour typing later revealed the diagnosis of a myxoid, spindle-cell intimal sarcoma FNCLCC Grade III with intravasal dissemination into the parenchyma of left upper and lower lobe. The patient recovered quickly. Adjuvant chemotherapy with ifosfamide and etorubicin was initiated due to positive resection margin (R1). After 1 year of follow-up the patient is in a good clinical condition and tumour free without signs of relapse. Under regular CT-monitoring he now receives a maintenance treatment with trofosfamide.

Median survival time of the pulmonary intimal sarcoma without therapy ranges at about 1.5 months and surgical resection is the treatment of choice. The value of adjuvant chemotherapy or radiotherapy is still unclear. Initial symptoms can be misleading and PE is an important differential diagnoses. Diagnostic workup however, should not postpone surgery since this type of tumour is aggressive and fast growing.

The diagnosis of PE can in most cases not definitely be excluded preoperatively and should be critically questioned in patients with progressive dypnoea despite adequate anticoagulation. An operative and adjuvant treatment and follow-up at an experienced centre is very important.

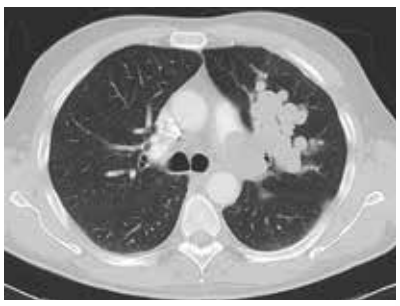

Figure 1. Preoperative CT scan showing rapid progression of the tumour mass.

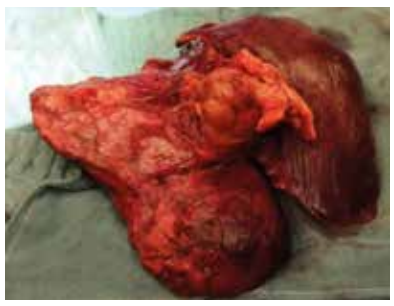

Figure 2. Resected specimen.

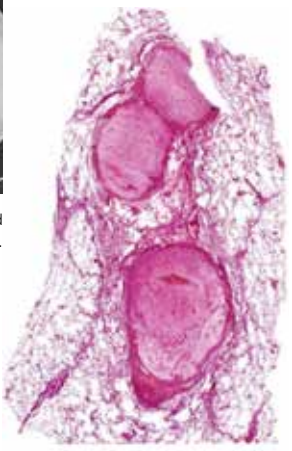

Figure 3. Histological section of the tumour mass.

Cardiac – Focus Session: Aortic valve replacement – ever had any problems?

Aortic valve replacement – ever had any problems? Annular enlargement or root replacement

Gonçalo F Coutinho University Hospital of Coimbra, Portugal

The main goal of aortic valve replacement (AVR) is to alleviate the pressure and volume overload on the left ventricle, allowing remodelling and regression of the ventricular mass. The incidence of degenerative aortic valve disease continues to grow because the population is ageing, and the issue of dealing with a small aortic root becomes frequent.

Although many cardiac surgeons were trained to choose an aortic prosthesis based solely on the size of the debrided annulus, there is increasing evidence that the size of the patient (body surface area) is an important factor in the decision as to which valve size should be implanted, in order to prevent prosthesis–patient mismatch (PPM). PPM has been implicated as a deleterious factor on the regression of the left ventricle mass, postoperative functional class/ exercise tolerance and long term survival after aortic valve replacement. This is even more relevant for young, physically active patients or for those with a poorly functioning ventricle, who may be less tolerant of the increased haemodynamic burden associated with PPM.

Since all prostheses are to some degree obstructive due to sewing rings, struts and stents, it is not always possible to avoid PPM using standard implantation procedures, particularly in small patients or those with a large body surface area. Surgeons have several options available when confronted with this problem, including: use of a small prosthesis (admitting some degree of PPM) or a stent-less valve; replace the aortic root; or perform an aortic root enlargement (ARE). In our experience root replacement is seldom appropriate in this context, since it is time-consuming and associated with an almost three-fold higher operative risk, and should therefore be limited to cases of unexpected heavily calcified aorta.

Our procedure of choice to deal with such cases is ARE. Surgical methods of ARE have long been described but surgeons are still reluctant to perform it, probably influenced by reports of higher mortality and by the small number of patients included in the studies published. In our unit, we have used patch enlargement of the aortic annulus routinely over the past 15 years in about 350 patients, and found this technique to be particularly attractive and straightforward, allowing implantation of a one or two-size larger prosthetic valve.

We typically use the Nicks (or modified Nicks) procedure, in which the aortic incision is extended into the middle of the non-coronary sinus, through the aortic annulus and into the anterior margin of the fibrous mitro-aortic curtain, 5–10 mm below the aortic annulus. Where there is a need to create a larger surface for the prosthesis implantation we extend the incision into the anterior leaflet of the mitral valve, but without opening the left atrial roof (Figures 1–4). We have used this procedure in a wide range of patients (8–87 years of age), with an overall mortality of 0.8% (including associated procedures, mainly coronary artery bypass graft [CABG]) and with an acceptable morbidity rate, which does not differ greatly from that of standard AVR.

The current trend to use a bioprosthesis in younger patients has raised the importance of implanting larger valves, not only for the better haemodynamic performance and longer prosthesis durability, but also to facilitate a valve-in-valve procedure in the future. In this respect, ARE can potentially play a crucial role during the first procedure to enable implantation of larger prosthesis. Hence, every cardiac surgeon performing AVR should have this technique in his armamentarium.

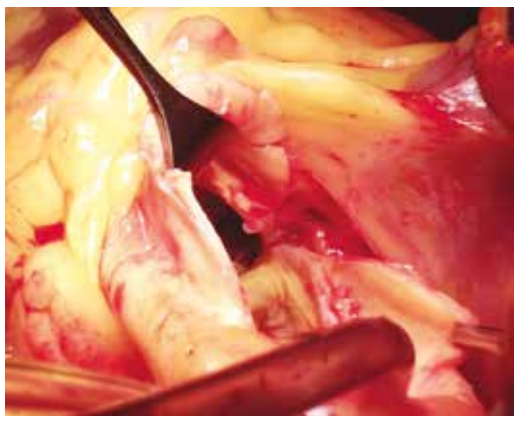

Figure 1.

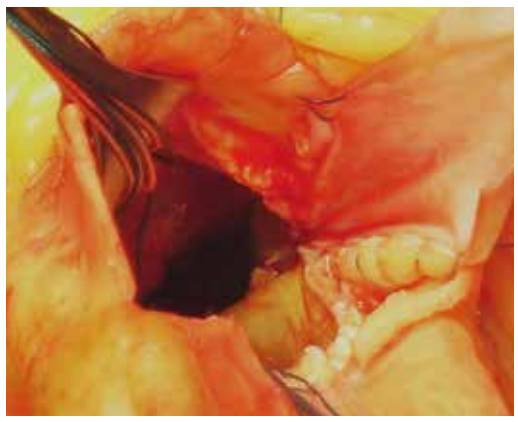

Figure 2.

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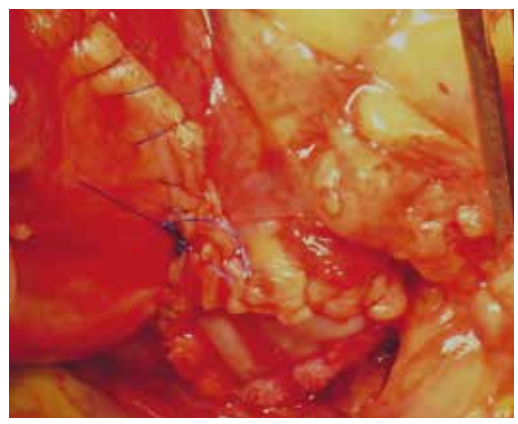

Figures 4.

Cardiac – Focus Session: Challenging the options for younger patients (50-60)? Minimising long-term risks with biological valves along the patient journey

Tissue testing best practices to improve predictability in the absence of long-term *in vivo* data

Bart Meuris University Hospitals, Leuven, Belgium

In the entire pre-clinical safety evaluation of new tissue valves, animal models are an important component. When reviewing literature on tissue testing in animal models, a wide variety of different models can be found, ranging from very simple procedures in small animals (e.g., rat, rabbit) to actual valve implantations in large animals (e.g., sheep, calves). Both the valve industry and academic research laboratories still use various small and large animal models with very diverse study protocols. No model has really been accepted as the gold standard for testing tissue durability and anti-calcification properties. Experience has shown that certain specific elements play a crucial role tissue degeneration and calcification which should be used for a reliable predictive model.

Exposing implanted tissue to circulating blood from a large animal is essential to assess the complex biological reaction of the host's body to the implanted material.[1] Subcutaneous or intramuscular implants performed in small animal models can be used as a rapid screening tool when many different materials or treatments have to be compared but these experiments have to be completed with models involving blood contact in larger animals.[2] The physiological reaction of the body towards a foreign material in the subcutaneous position is very different in small animals versus larger ones and in subcutaneous position versus the circulation.[3]

The tissue or valve should be studied in the haemodynamic position for which it is intended.[4] Although tissue valve degeneration is determined by multiple factors, and we still do not understand the complete mechanism behind it, we do know that mechanical stress on leaflets and commissures is an extremely important element. Valves designed for aortic or mitral valve replacement should therefore be tested with a left-sided implant model, where closing pressures on the tissue are similar to the clinical condition. Valves or conduits for right ventricular outflow tract reconstruction can easily be studied using right-sided implants, where other factors such as neo-intima formation and tissue overgrowth can be assessed.

We know from clinical experience that host age is a crucial factor in tissue degeneration. Therefore, models for pre-clinical testing will produce the most reliable prediction when juvenile animals are used. The animals need to be observed over several months. In guidelines concerning pre-clinical testing, a 20 week period is frequently mentioned as a minimum, but in order to demonstrate improvements over the current valves, with already advanced tissue treatments, even longer implant periods up to 8 months may be required.[5] Valve degeneration and calcification are phenomena that occur with great inter-individual variability, necessitating the use of large numbers of animals in order to reach a reliable and stable result. Animals that suffer from any interfering disease (e.g., infections) during the study period will have to be excluded since this can have important consequences for the implant. A properly sized control group, where equally sized control valves are implanted with similar surgical techniques and handling, is important. Evaluation of the implanted valve or tissue should be performed using *in vivo* analyses during the implant period (echography, CT-scanning, haemodynamic measurements) and full assessment of the tissue after explantation (macroscopy, radiography, histology, calcium content). Obviously, last but not least, animal welfare has to be addressed in accordance with ISO-standards. It is highly recommended to have these tests performed in appropriately experienced and equipped test laboratories.

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T. Seyfried *et al.* Fat Removal during Cell Salvage: Comparison of Devices and Programmes, 16th Annual NATA Symposium, April 16-17, 2015, Prague

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NEW PROTOCOL IMPROVES FAT REMOVAL IN DISCONTINUOUS AUTOTRANSFUSION

SORIN GROUP
AT THE HEART OF MEDICAL TECHNOLOGY

Prof. Ernil Hansen, Dr.med. Dr.rer.nat., Universitätsklinikum Regensburg, Regensburg- Germany

Neuropsychological disorders, brain and lung injury are potentially serious problems for patients undergoing cardiac and other surgery surgical. A significant contributor to these complications is lipid embolism.[i,ii]

In a report by Carrier et al., washing of pericardial shed blood with a cell saver led to lower S-100B serum levels for elderly patients during cardiac surgery.[iii] The positive effect of cell savers in removing fat and reducing cerebral microembolization in cardiac surgery has been shown in previous studies. However, Latham bowl-based (discontinuous) systems have been reported with considerably lower fat removal rates compared to the continuous autotransfusion system C.A.T.S. (Fresenius).

In a study published in the Transfusion Journal,[iv] we found evidence for variation of the performance of discontinuous autotransfusion systems (DATS), depending on the protocol in use. The separation of blood into its essential components occurs during centrifugation. Partial retention of fat in the separation chamber, where lipids should be removed with the cell-free supernatant, is the reason for the limited removal rate with Latham bowls. Our research demonstrated the dependency of fat removal on process parameter, and thus the option of improvement.

In a subsequent study[v] presented at the 2015 NATA Symposium in Prague and soon to be published in the Transfusion Journal, we evaluated a special software protocol called Pfat, developed for the XTRA discontinuous ATS system from Sorin Group. Using Pfat modulation of process parameters, our team was able to overcome the limitations of fat removal in discontinuous autotransfusion. The study demonstrates the influence of different phases and parameters of the washing procedure on fat removal. The Pfat program combines changes in the wash volume, the wash flow, and a final concentration step. The high fat elimination experienced with Pfat is independent of bowl size or blood haematocrit (HCT), and therefore covers different clinical situations, including pediatric, cardiac and orthopedic surgery.

With 98.5% the effective fat removal capacity using the new software protocol was not significantly different from the known high fat elimination rate of Fresenius CATS. Furthermore, we confirmed that the Pfat protocol modification maintains the high values for RBC recovery rate and plasma elimination rate. This study demonstrates that new and specific clinical challenges can be met by modifications in process parameters and program software. With the XTRA ATS system, a simple software update containing the new Pfat protocol now allows improved fat removal when required.

Find out more at Sorin Group Booth # 3.15

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Vascular – Focus Session: Inflammatory and infectious aortic disease: a difficult environment

Treatment of infected aortic grafts

Thierry Carrel and Jürg Schmidli
University Hospital Berne, Switzerland

Infection of a vascular prosthesis or an endovascular stent graft is a rare but serious complication that can dramatically affect a patient's outcome. Clinical presentation may be subtle with patients complaining from unspecific symptom and vascular imaging is mandatory to confirm the diagnosis of infection.
The presence of fluid and air surrounding the aorta or an aortic graft is a normal finding in the early postoperative period and should resolve with time. However, any air in the peri-aortic or peri-prosthetic tissues on a CT-scan should be judged as abnormal beyond 6–8 weeks after original surgery. MRI is useful to distinguish between perigraft fluid and perigraft fibrosis, thanks to signal intensity differences between T1 and T2 weighted images.
The most appropriate antibiotic treatment is applied as soon as the germ has been identified. Anti-fungal treatment is started routinely in every patient with suspicion of an aorto-bronchial or aorto-oesphageal fistula and discontinued when cultures are negative. In the case of favourable postoperative clinical evolution (absence of fever and weight loss), normalisation of infectious parameters and normalised imaging, antibiotics are discontinued after 3–6 months.
Surgical treatment is always required, it is usually challenging and even after a technically successful procedure, morbidity can be significant. Complete excision of the foreign material associated to debridement of the surrounding tissue gives the best results. Anatomic reconstruction is the best option for thoracic and thoraco-abdominal pathologies. The use of homografts and silver- or antibiotic-coated vascular grafts has been described as the most commonly used implants for such situations.
In the past 10 years, we have developed the concept of self-made vascular tubes from xenopericardial tissue.[1–3]
The customised construction of a biological tube graft is simple. A 14x8 cm bovine pericardial patch (Synovis Surgical Innovations, St Paul, MN, USA) is sewn over a sizer to form a tubular neo-aorta with a diameter of 25 mm and a length of 14 cm (Figure 1). The continuing suture is performed with 4.0 polypropylene material and interrupted at 7 cm to allow the use of a shorter segment if necessary. If needed, two or more segments can be used depending on the individual situation.

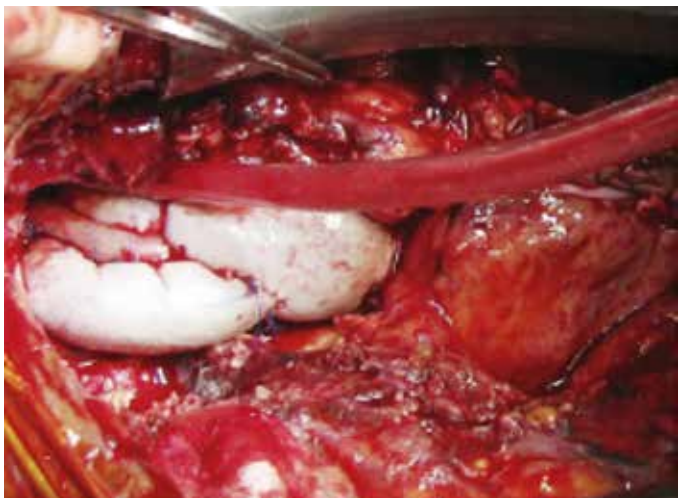

Figure 2. Xenopericardial tube graft implanted in a case of recurrent infected ascending aortic aneurysm with replacement of the innominate aetery and the left carotid artery using biological tube grafts (reproduced with permission from Carell et al).

Figure 2 shows a self-made xenopericardial aortic tube implanted in a case of recurrent ascending and aortic arch graft infection, with reconstruction of the supra-aortic vessels also using biological tubes.
Looking at the severe, sometimes disastrous, clinical condition of the patients, the perioperative mortality rate is acceptable at approximately 12%. Deaths are generally due to multiorgan failure as sequelae of the underlying infective process. We now have some long-term observations on the use of biological aortic tube grafts in thoracic and abdominal position with definitive healing of the infective process and absence of long-term complications. There is no dilation of the biological tube graft so far and no re-interventions at all on the same segment in 50 patients.
There are very few contraindications to surgery, e.g. irreversible neurological damage because of embolisation, uncontrollable septic condition with severe haemodynamic compromise and advanced age with significant frailty. In some exceptional situations, endovascular stent graft implantation can be performed as a bridging procedure until the general condition of the patient has been stabilised and a more radical treatment is possible. This may be helpful to control severe bleeding in patients suffering from aorto-bronchial or aorto-oesophageal fistulas. However, major concern still exists regarding the risk associated with endograft placement in an infected vascular bed, and a definitive surgical treatment is recommended.

Figure 1. Self-made biological aortic tubes from xenopericardial tissue using a 8x14 cm pericardial patch from Synovis gives a diameter of the new tube graft of 26–28 mm. The suture is interrupted one or two times to allow proper length accomodation (reproduced with permission from Czerny et al).

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Cardiac – Abstract: Degenerative mitral regurgitation

Minimally invasive mitral valve repair for degenerative disease: a multicentric propensity score matching analysis

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[1]GVM Care and Research, Maria Eleonora Hospital, in Palermo, Italy, [2]GVM Care and Research, Anthea Hospital, Bari, Italy.

In the mid-1990s, minimally invasive 'keyhole' approaches for mitral valve operations were pioneered with the intent of reducing morbidity, postoperative pain and blood loss, improving cosmesis, shortening hospital stay and reducing cost, compared with the conventional median sternotomy approach. Although clinical studies suggest that some of these benefits have been realised, there has been no confirmatory large scale study or randomised controlled trial. Concern still exists with regard to safety and feasibility of minimally invasive mitral valve surgery (MIMVS) for degenerative mitral valve disease. In this study, we sought to assess the performance of MIMVS and specifically right thoracotomy (RT), in terms of early mortality (30 days/in-hospital mortality) and intraoperative and major postoperative outcomes compared with standard sternotomy (ST). A propensity-matched analysis was performed in a cohort of patients who underwent isolated mitral valve repair in the context of degenerative disease.
Prospectively collected data were extracted from a central database that incorporated the datasets of six cardiac centres with surgeons equally skilled in minimally invasive and standard sternotomy technique (GVM care and research, IT). From January 2009 to December 2014, 2970 patients underwent mitral valve repair. Propensity score matching generated 624 pairs of patients who underwent RT and ST mitral valve repair. Demographics and preoperative clinical characteristics were similar in both groups except for NYHA class and BMI. The standard sternotomy group had higher NYHA class (p=0.02), while BMI was higher in RT group (p=0.0001).
There were no differences in terms of early mortality between the two groups (0.9% and 1.9%, RT and ST, respectively; p=0.15). Cardiopulmonary bypass (CPB) time was longer in the RT group (p=0.0001), while no difference was observed with regard to cross clamp time (XCT) (p=0.16). MIMVS repair led to a reduced number of patients transfused (p=0.03) and a lower rate of permanent pacemaker insertion (p=0.03). No differences were observed with regard to neurological events in either group. Data are illustrated in Table 1.
In conclusion, in this large multicentric propensity match score series, RT was as safe as ST, with no differences in terms of early mortality; CPB was longer with no differences with regard to XCT; RT led to improved certain postoperative outcomes.

Intraoperative and postoperative outcomes (N=1548)	RT (n=624)	ST (n=624)	*p*
CPB time (min)	98.3± 36.8	89.2±34.1	**.001**
XCT (min)	73.3±29.9	69.9±27.8	.16
Patients transfused (n)	151	198	**.03**
Reopening for bleeding (n)	11	12	.83
IV inotrops	2	4	.41
Postoperative AF (n)	170	182	.18
Stroke	2	3	.65
TIA	1	0	.31
Delirium	7	12	.24
Postoperative MI	1	0	.60
Wound dehiscence	7	10	.46
Wound re-intervention	8	15	.13
Permanent pacing	2	9	.03
Renal failure (dialysis)	3	10	.051
Moderate renal failure	16	20	.49
Respiratory failure	5	11	.13
ARDS	1	4	.17
Other respiratory complications	12	13	.84
Mechanical ventilation (hours)	7	6	.19
LOS ICU (days)	1.6	1.7	.24
LOS total (days)	10.5	10.5	.09
Early mortality	6	12	.15

AF: atrial fibrillation; ARDS: acute respiratory distress syndrome. IV: intravenous; CPB: cardiopulmonary bypass; ICU: intensive care unit; LOS: length of stay; MI: myocardial infarction; XCT: cross clamp time.

Table 1.

Cardiac – Focus Session: Challenging the options for younger patients (50-60)? Minimising long-term risks with biological valves along the patient journey

Transcatheter aortic valve implantation in valve procedures: are sutureless and rapid deployment valves suitable?

Vinayak (Vinnie) Nilkanth Bapat Cardiothoracic Department, Guys and St. Thomas's hospital, London, UK

Multiple reports of valve-in-valve (VIV) procedures have appeared in the literature during the past 5 years, with substantial experience acquired in treating degenerated surgical heart valve (SHV) in aortic position and increasing experience in mitral, tricuspid and pulmonary positions. Two transcatheter heart valves (THV), Sapien/Sapien XT (Edwards Lifesciences Ltd, Irvine, CA, USA) and CoreValve®/ Evolut™ (Medtronic Inc., Minneapolis, MN, USA) have been used predominantly for this indication with increasing experience, with newer devices such as Lotus© (Boston Scientific, MA, USA), ACURATE TA™ (Symetis, Switzerland) and Direct Flow® (Direct Flow Medical Inc., CA, USA).

Compatibility between SHV and THV is important for the success of the VIV procedure. Guidance is now available for the majority of stented and stentless valves, with respect to correct identification of the surgical valve, choosing the correct size of the TAVI valve and its subsequent accurate placement.

Sutureless or rapid deployment valves have recently emerged as an alternative to the sutured SHV. Three valves – Perceval™ (Sorin, Milan, Italy), Intuity (Edwards Lifesciences) and Enable (Medtronic Inc.) – have been implanted in the past few years, with numbers increasing rapidly. Similar to any other bioprosthetic valve, they are predisposed to degeneration. Similar to the sutured SHV, the sutureless valves differ in design and are available in multiple sizes; therefore, it will be important to understand the interaction between these valves and the current THVs. Bench testing to understand sizing and ideal positioning, and functional testing such as accelerated wear testing (AWT), has provided important insights into this field and will be helpful when considering this option.

Cardiac – Focus Session: A contemporary approach to the aortic valve and aortic root

The role of annuloplasty for aortic valve repair. How to choose among the different proposed options?

Ruggero De Paulis European Hospital, Rome, Italy

In the past few years there has been a marked increase in the number of techniques for sparing and repairing the aortic valve. Avoidance of a valve replacement is particularly appealing in the young patient population, where the use of anticoagulant and its associated morbidity is definitely undesirable.

In this respect, experience in remodelling and reimplantation valve sparing techniques has played an important role in advancing our understanding of the geometry, physiology and dynamics of the root. Particularly, the importance of re-establishing a normal geometry and dimension of the aortic annulus has come to light as the single most important step for a long-lasting optimal result. The reimplantation procedure is generally preferred, due to its intrinsic ability to reduce and stabilise the annulus diameter, while the addition of some form of annuloplasty is becoming more frequent for those who prefer the remodelling approach.

The importance of annuloplasty in all cases of aortic valve repair, even in the absence of a dilated root, is now clear. Annuloplasty enables the surgeon to reconstruct geometry, restore the coaptation height and increase the coaptation length. In this regard, the sub-commissural annuloplasty (or Cabrol stitch) used to decrease the annulus diameter by virtually abolishing the inter-leaflet triangle has failed the test of time for its inability to prevent annular re-dilatation. Furthermore, it eliminates the physiological role of the inter-leaflet triangles (i.e. the ability to transmit the ventricular pressure up to the top of the commissures).

Presently, there are two different approaches to aortic valve annuloplasty that are increasingly being used. The first is the internal approach, where aortic annuloplasty is achieved by a circumferentially-placed GORE-TEX® suture or by an internal rigid ring. While proponents of the internal rigid ring claim a consistent and predictable re-shaping of the annulus to facilitate leaflet plasty and to create a more durable repair, there are still concerns regarding the potential inflammatory reaction, the risk of leaflet restriction, contact and abrasion, haemolysis or thromboembolism. Alternatively, proponents of the simple suture technique claim that it is simple, fast and reproducible, does not require foreign material and does not alter the valve geometry. However, the potential risks of suture dehiscence, along with a less than accurate annular remodelling, are common arguments for mitigation of its wider applicability.

The second approach commonly used for aortic valve annuloplasty, is the external approach where a flexible ring is positioned externally around the annulus and fixed by a series of sutures positioned below the leaflet, inside out of the aortic annulus, in a manner similar to that used for the reimplantation technique. However, for this procedure a deep external dissection is an important pre-requisite. Often the surrounding structures, such as the left and right atrium or the ventricular septum, can be attached to the aortic wall at a level higher than the aortic annulus and need to be carefully dissected out. Nonetheless, recent anatomical studies have pointed out how, in the region comprised from the left/right commissure to the right/non-coronary commissure, it may be virtually impossible to reach the annulus from outside without incorporating a significant proportion of these heart structures. This variability could influence the choice of ring size and may prevent correct positioning of the ring, which should ideally be positioned for a plane passing through the nadir of the three cusps. Currently, we lack sufficient scientific data to establish the superiority of one technique over the other. An internal approach might guarantee the placement of the annuloplasty at a proper level and offer a more accurate reconstruction of annular geometry when a rigid ring is utilised; however, internal devices or internally-placed sutures work against the centrifugal forces that tend to re-dilate the annulus. Alternatively, an external approach may not provide an optimal annular re-shaping, but might guarantee a better annular stabilisation.

Because of our experience with the reimplantation technique, our surgical preference has been for the external placement of a 26–30 mm Dacron ring (5 mm large), with the aim to obtain an internal annular diameter of approximately 23 mm. Once all sutures are passed through, the Dacron ring is parachuted down (Figure 1). After being cut at the level of the two coronary take-off, in order to reach the proper annular level, its continuity is immediately re-established and the suture tied over a Hegar dilator.

In conclusion, a modern approach to aortic valve repair relies on the use of some form of annuloplasty. As more data are collected, we will gain a better understanding of how to achieve long-term durability of a repaired aortic valve in a safe, reproducible and standardised fashion.

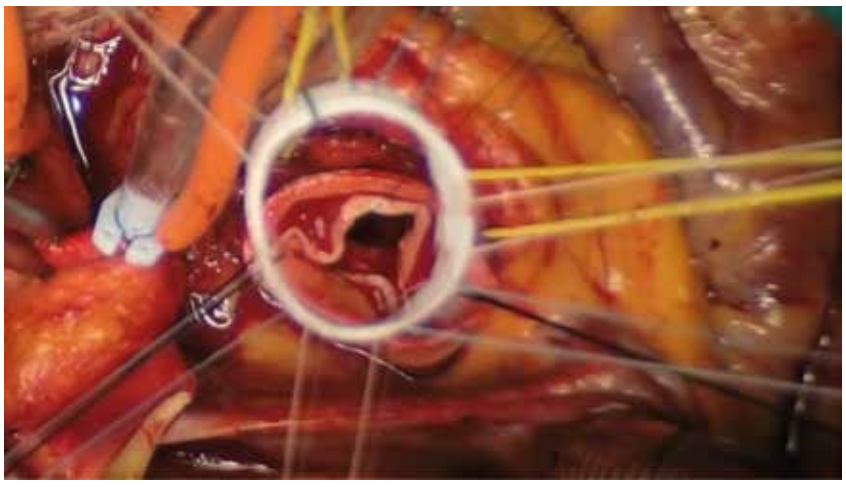

Figure 1.

Vascular – Rapid Response: Innovation and new strategies in thoracic aortic surgery

Unequal pressure distribution along the jaws of currently available vascular clamps: do we need a new aortic clamp?

Bartosz Rylski Department of Cardiovascular Surgery, Heart Center Freiburg University, Germany

Aortic clamping carries the risk of intimal damage, local dissection potentially leading to aortic dissection type A, the dislodgement of atheromatous material, and aortic plaque rupture. These complications, although infrequent in published series, lead to intra- and post-operative morbidity and mortality.

The pressure along aortic clamp jaws is unequally distributed and is larger near the clamp hinge than at its top. Unequal pressure distribution requires a greater total clamp force to close the aorta than would be necessary were the pressure distributed equally across the clamp. Cross-clamping with the aortic clamps currently available may injure the aorta, especially large ones or those of patients with connective tissue disorders. We evaluated pressure distribution along the various currently available clamp jaws and propose a new aortic clamp design that causes less trauma by distributing the pressure equally.

We set up an *in vitro* model for aortic cross-clamping using thoracic aortas from pigs that were filled up with water (diameter 2.0–3.0 cm). The pressure inside the aorta was raised to 100 mmHg and the aorta clamped so tightly that no water escaped from the distal aortic end. Each aorta was clamped seven times at different sites with the following clamps: DeBakey, Satinsky, femoral, iliac, Chitwood, angled-handle Fogarty and straight-handle Fogarty. The pressure along the clamp jaws was measured with a pressure-detecting film placed between the clamp jaws and the aorta. The collagen-fibre disorganisation was examined in Haemotoxylin-Eosin- and Elastica-van-Gieson-stained tissue samples.

The lowest maximum pressure along the clamp jaws after complete aortic occlusion was measured in the DeBakey clamp (1.43±0.49 MPa); this was lower than the pressure measured in the Satinsky (p=0.069), iliac (p=0.007) and Chitwood (p=0.003) clamps. The highest maximum pressure was observed after clamping with the Chitwood clamp (3.26±1.93 MPa). The pressure along the clamp jaws was unequally distributed in all the clamps. The most homogeneous distribution was observed in the angled-handle Fogarty clamp, as it revealed the lowest difference (33%) between the highest and lowest maximum pressures measured at the four quartiles. We observed the greatest difference between maximum pressures across the clamp in the iliac (72%) and Chitwood (66%) clamps (Figure 1). The architectural disorganisation of collagen fibres after 2 hours' aortic cross-clamping with each clamp. The highest average collagen-fibre damage score was observed in the proximal to the clamp hinge quartile after clamping with the angled-handle Fogarty (2.8±0.4), straight-handle Fogarty (2.3±0.8) and Chitwood (2.3±0.5) clamps. The angled-handle Fogarty clamp revealed the most even pressure distribution observed. However, the difference between the highest and lowest maximum pressures measured at four quartiles was >30% even in this clamp.

To address the unequal pressure distribution along the clamp jaws, we designed a novel Kowalski–Rylski aortic clamp (named after its designers) with an additional hinge. It is constructed to provide a homogeneous distribution of the clamping force, since the second hinge allows the upper jaw to adapt its position to the pressure and thus provide the same pressure at the proximal and distal quartiles (Figure 2). We believe that our less invasive solution to aortic clamping is a positive contribution to today's surgical armamentarium.

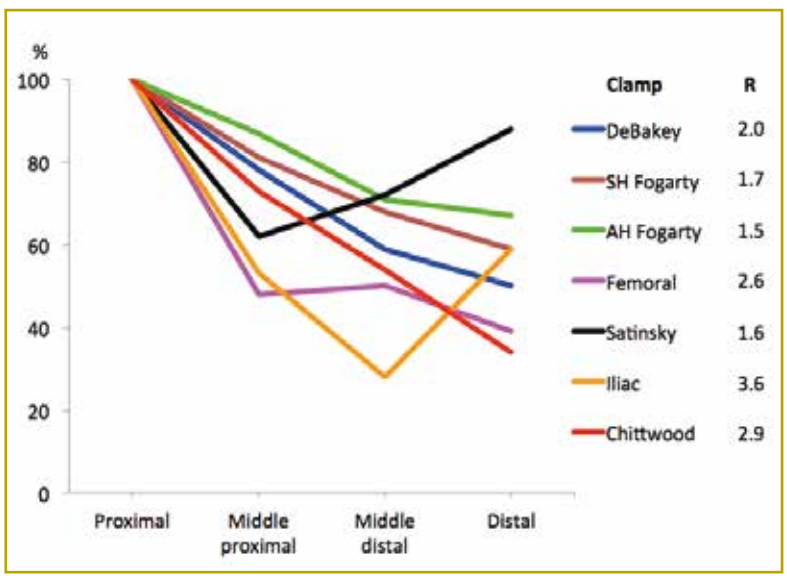

Figure 1. Maximum clamping pressure generated at proximal, middle proximal, middle distal and distal areas to the clamp hinge quartiles. Pressure in the proximal quartile is 100% for each clamp. The proximal quartile is near, the distal quartile far from the clamp hinge. R – ratio between the highest and lowest pressure measured along the clamp jaws; SH – straight handle; AH – angled handle.

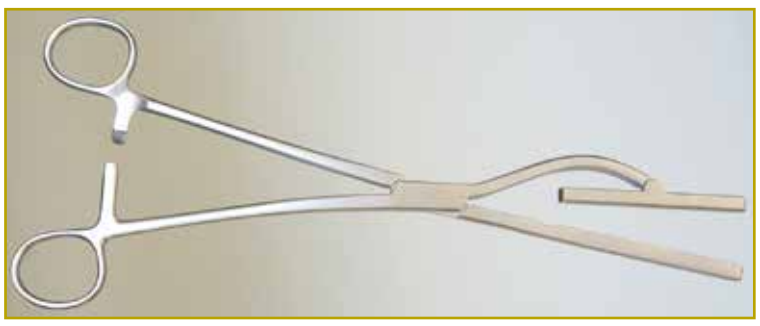

Figure 2. The Kowalski–w clamp design with an additional hinge allowing the upper jaw to adjust its position according to the pressure, thus providing equal pressure distribution along the clamp jaws.

Cardiac – Abstract: Revisiting the tricuspid valve

Long-term echocardiographic follow-up of untreated mild or moderate tricuspid regurgitation in patients undergoing mitral valve surgery

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National Cerebral and Cardiovascular Center, Japan

Functional tricuspid regurgitation (FTR) is a common finding in cases of mitral valve disease. Concomitant tricuspid valve surgery (TVS) with mitral valve surgery (MVS) is recommended for severe FTR patients. However, in cases of mild or moderate FTR, TVS is not without risk. Therefore, in this article we evaluate the long-term results of untreated mild or moderate FTR undergoing MVS.
We retrospectively reviewed the records of 113 patients with mild or moderate FTR that underwent MVS during the period 2003–2010. We assessed survival rate, freedom from heart failure and postoperative tricuspid regurgitation (TR) progression over the long-term. Median follow-up was 7.1±2.7 years.
We found that untreated TR improved significantly, albeit temporarily, in the postoperative 1-year period (paired t test, $p<0.001$), but that it progressed again in the mid- to long-term. The freedom rate from moderate to severe TR at 10 years was 42% in patients with preoperative mild TR and 47% in patients with preoperative moderate TR. Multivariate logistic regression revealed that independent risk factors for TR progression were age (HR 1.1, $p=0.02$) and preoperative tricuspid annulus diameter (HR 1.2, $p=0.03$). The long-term survival rate was significantly higher in the mild TR group than in the moderate TR group (at 10 years: 90% vs 58%; log-rank test, $p<0.001$). Multivariate logistic regression also revealed that preoperative TR grade (HR 8.5, $p=0.006$), age (HR 1.1, $p=0.006$) and preoperative NYHA class (HR 2.8, $p=0.02$) were independent risk factors for survival. Freedom rate from heart failure was also significantly higher in the mild TR group (at 10 year 97% vs 80%, $p=0.02$).
In conclusion, the severity of untreated TR affected the chance of long-term survival. Although untreated TR significantly improved temporarily after MVS, it deteriorated again in the mid- to long-term. Therefore, concomitant tricuspid valve repair should be considered in patients with mild or greater TR, especially in patients with dilated tricuspid annulus or preoperative heart failure, or in those who are elderly.

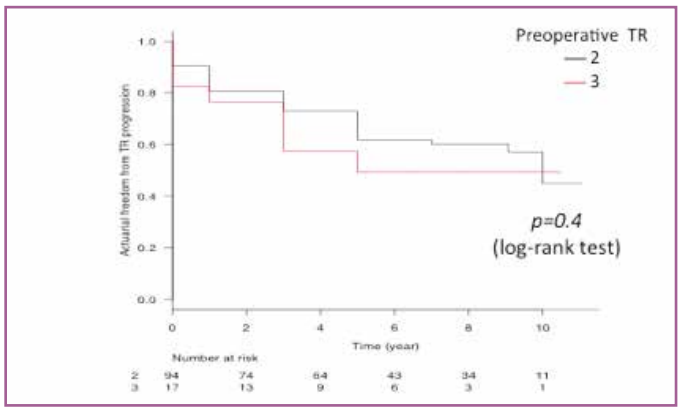

Figure 1. Acturial freedom from TR progression.

Thoracic – Abstract: Chest wall

Growth development of patients with pectus excavatum

Jae-Jun Kim, Hyung Joo Park Uijeongbu St. Mary's Hospital, The Catholic University of Korea College of Medicine, Korea

Pectus excavatum is the most common chest wall anomaly. It is characterised by a depression of the anterior chest wall at variable degree level. It has been postulated that pectus excavatum is a congenital but progressive disease and is empirically assumed that the growth development in patients with pectus excavatum is retarded. However, few studies have been carried out to support this and the mechanisms involved are not yet truly understood. In addition, little is known about the effects resulting from the correction of deformity on growth development. The purpose of this study is to clarify the growth development of patients with pectus excavatum. Data from 1371 patients with pectus excavatum (733 patients for the Nuss procedure, 638 patients for the pectus bar removal) performed in thoracic and cardiovascular surgery departments in single tertiary Korean hospitals during March 2011 to December 2014, were assessed with respect to body measurements (height, weight, body mass index [BMI]). Anthropometric measurements and developmental data of a reference population and deviations were analysed by The Fifth Korea National Health and Nutrition Examination Survey (KNHANES V-3), 2011–2013, Korea Centres for Disease Control and Prevention. In order to analyse the growth development in patients with pectus excavatum, we performed: 1) comparisons between the pectus excavatum and the normal population; 2) analyses of the postoperative changes of the body measurements; and 3) analyses of the body measurements in the pectus group with respect to age at surgery, morphology and severity.

The body measurements of the preoperative group (PreG, patients for the Nuss procedure) were significantly smaller than those of the normal control group (NCG) (height, weight and BMI, all $p<0.001$). Weight and BMI of the postoperative group (PostG, patients for the pectus bar removal) were also significantly smaller than the NCG (weight and BMI, both $p<0.001$). However, height of PostG patients was not significantly different from those in the NCG. In addition, the body measurements of PreG patients were not significantly different from those of PostG patients. Weight and BMI of the high pectus index group (HG) were significantly smaller than those of the low pectus index group (LG) preoperatively (weight $p=0.029$, BMI $p=0.008$). However, height of HG was not significantly different from that of LG preoperatively. Body measurements of HG were not significantly different from LG postoperatively. Severity of pectus excavatum was not related to age. Body measurements of the symmetric group (SG) were not different from those of the asymmetric subgroup (AS) preoperatively. However, AS is more common in the older-age group ($p<0.001$). In addition, body measurements of SG were also not different from those of AS postoperatively. Body growth after the surgery was more prominent in the early (age <10 years) operation group (height $p=0.0059$, weight $p=0.0859$, BMI $p=0.0789$) than the late operation group (age ≥10 years).
In conclusion, growth development in patients with pectus excavatum is retarded and the severity of pectus excavatum is thought to be related to growth development in patients with this condition. The growth development could however be recovered by early correction of the deformity.

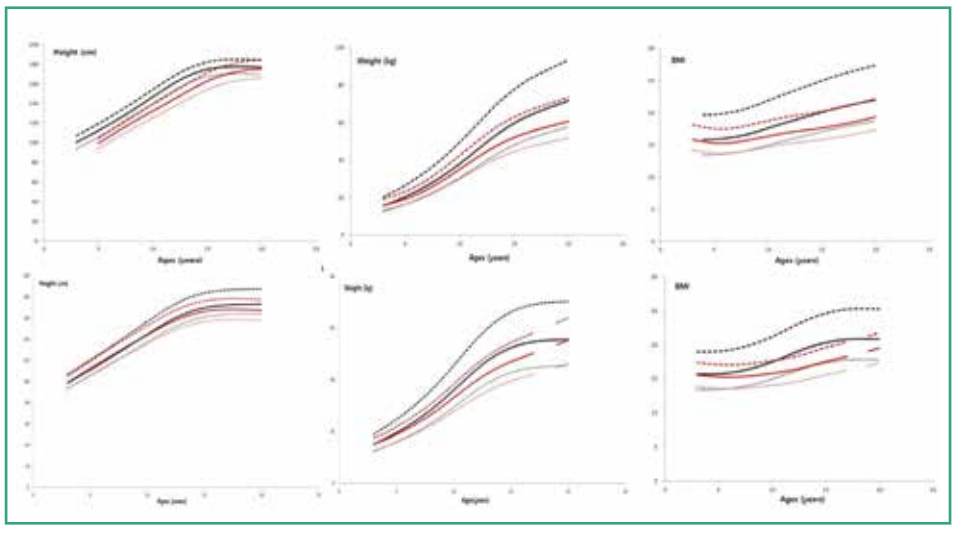

Figure 1. The body development curves of the normal control group (black lines) and preoperative group (red lines) are described. The lines represent 10th, 50th and 90th BMI, height and weight percentiles. The overall growth development of patients with pectus excavatum was retarded compared with the normal population preoperatively.

Cardiac – Rapid Response: General cardiac

Pregnancy outcome after thrombosis of a mechanical heart valve prosthesis

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Pregnancy poses a challenge to women with mechanical valve prosthesis (MVP), because it can disturb the effective thromboprophylaxis offered by oral anticoagulants (OA), which is associated with considerable foetal loss and carries the threat of teratogenesis caused by warfarin between 6–13 weeks of gestation. Substituting OA with either unfractionated heparin (UFH) or low molecular weight heparin (LMWH), which are not able to cross the placenta, was one approach for improving foetal outcomes and this definitely reduced the incidence of warfarin-induced embryopathy; however, the decrease in foetal mortality observed initially, rapidly inclined when UFH/LMWH were continued throughout pregnancy. Another adverse effect was failure to maintain adequate thromboprophylaxis with fixed dosing: the rates of prosthetic valve thrombosis (PVT) and subsequent maternal mortality were 5.3% and 1.7%; both increasing to 10.2% and 4.7% when UFH/LMWH were continued throughout pregnancy.[1] Adjusting UFH by a mid-dose activated partial thromoboplastin time (aPTT) >2 the control or LMWH given twice-daily according to the weight to give an anti-factor Xa activity of 0.8–1.2 U/mL, 4–6 hours after administration, was recommended to improve these outcomes.[2]
Conversely, a low dose of warfarin (LDW) not exceeding 5 mg/day was proposed to be relatively safe, provided weekly INR monitor.[2] A recent systematic review of 494 pregnancies showed a significant drop in foetal embryopathy (to 0.9%), adequate thromboprophylaxis (0.6% PVT; 1.8% total thromboembolic events) and no maternal mortality.[3] LDW is our regimen of choice and favoured by the European societies,[2] because it is associated with better patient compliance and does not have the high costs associated with LMWH and the necessary tests of adjustment.
Between January 2003 and May 2014, 28 pregnant patients presented with thrombosed bileaflet mitral MVP: 22 patients (78.6%) were shifted to fixed-dose LMWH by their gynaecologists (1 mg/kg twice daily) and six patients were on warfarin (4–6 mg/day), with the INR being <1.4 in four cases (66.6%). All prostheses were emergently replaced with same-sized bileaflet mechanical valve, under normothermic bypass. Among 18 patients presenting >28 weeks of gestation, 13 babies were successfully delivered by Cesarean section before bypass. Only one baby survived bypass at 31 weeks (20%) and continued until full term. Among 10 patients presenting before 28 weeks, only two babies (10 and 22 weeks of gestation) survived bypass (20%). We had two maternal mortalities (7.1%); both recorded among this group (20%). PVT was mainly noted in patients with unmonitored and/or unadjusted anticoagulation, especially those receiving fixed therapeutic dose LMWH. When feasible, immediate delivery by Caesarean section before bypass for patients presenting >28 weeks is associated with acceptable foetal and maternal outcomes. Otherwise foetal survival after bypass is limited and thrombolytic therapy should be attempted, especially in light of recent literature suggesting the efficacy and safety of low-dose thrombolysis under transoesophageal echocardiography guidance.[4]

References

1. Hassouna A, Allam H. Anticoagulation of pregnant women with mechanical heart valve prosthesis: a systematic review of the literature (2000–2009). *J Coagul Disord* 2010;2:81–88.
2. Regitz-Zagrosek V, Blomstrom Lundqvist C, Borghi C, et al. ESC Guidelines on the management of cardiovascular diseases during pregnancy: the task force on the management of cardiovascular diseases during pregnancy of the European Society of Cardiology (ESC). *Eur Heart J* 2011;32:3147–197.
3. Hassouna A and Allam H. Limited dose warfarin throughout pregnancy in patients with mechanical heart valve prosthesis: a meta-analysis. *Interact Cardiovasc Thorac Surg* 2014;18:797–806.
4. Ozkan M, Cakal B, Karakoyun S, et al. Thrombolytic therapy for the treatment of prosthetic heart valve thrombosis in pregnancy with low-dose, slow infusion of tissue-type plasminogen activator. *Circulation* 2013;128:532–540.

Agenda

Saturday 3 October

Techno College

08:00	Transcatheter aortic valve implantation/aortic valve	Auditorium
11:00	Heart failure/aortic disease	Auditorium
14:30	Atrioventricular valves	Auditorium
09:00	Diagnosis and surgery	G102+G103
13:30	Outcome	G102+G103
13:00	3D Technology	G104+G105
16:20	Mechanical support	G104+G105

Sunday 4 October

Professional Challenge

08:15	Challenges in mitral valve repair	Auditorium

Focus Session

08:15	Safer surgery for who?	G104+G105
10:15	Quality improvement	E106+E107
10:15	Safer surgery for who?	G104+G105
13:45	Women in cardiac surgery	F003
13:45	Quality improvement programme update	F002
13:45	Basic science – heart	G109
10:15	Basic science – lung	G109

Abstract Rapid Response

10:15	Transcatheter aortic valve implantation versus surgical aortic valve replacement	E102
13:45	Aortic valve substitutes: the long-term view	E102

Plenary

12:00	CanBetter: optimising training programmes in cardiothoracic surgery	Auditorium

Postgraduate Education

08:15	Perfusion	Forum
08:15	Nurse and nurse physician postgraduate programme	E108
13:15	Update on the results and rationale and design of ongoing clinical trials	Auditorium
13:45	Extracorporeal life support devices and strategies for management of acute cardiorespiratory failure	G104+G105
08:15	Pneumonectomy controversies: what is the problem?	E104+E105
10:15	Management of oesophageal perforations	E104+E105
13:45	Management of acquired tracheal disorders: from stenosis to laceration	E104+E105
08:15	Update on hypoplastic left heart syndrome management	G106+G107
10:15	Update on Tetralogy of Fallot with pulmonary valve atresia and major aortopulmonary collateral arteries	G106+G107
13:45	Meet the experts	G106+G107
14:45	Surgical film session	G106+G107
08:15	Basics in proximal thoracic aortic surgery: session 1	G102+G103
10:15	Basics in proximal thoracic aortic surgery: session 2	G102+G103
13:45	Outcome and follow-up after major thoracic aortic surgery: session 3	G102+G103
14:45	Thoraco-abdominal aneurysms revisited: session 4	G102+G103

Monday 5 October

Professional Challenge

08:15	A lifetime living with transposition of the great arteries – part I	G106+G107
10:15	A lifetime living with transposition of the great arteries and left ventricular outflow tract obstruction – part II	G106+G107
08:15	Arch involvement in acute aortic dissection: a surgical challenge EACTS/STS	G102+G103
10:15	Uncertainties in the treatment of chronic dissection EACTS/STS	G102+G103
08:15	Wire skills for the surgeon	Auditorium
10:15	Wire skills for the surgeon	Auditorium

Focus Session

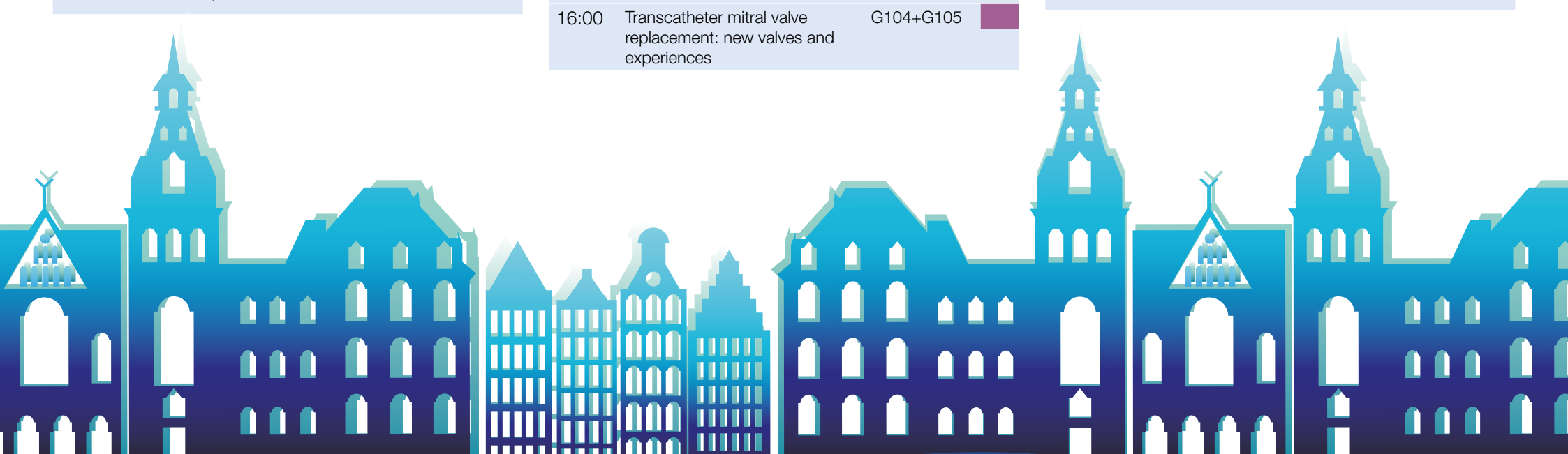
10:15	Avoiding disasters in cardiac surgery	E106+E107
10:15	Meet the experts	Emerald Room
14:15	Coronary artery bypass graft is on the rise, don't give it up	Auditorium
14:15	Infectious problems	E106+E107
14:15	Transcatheter aortic valve implantation: current and future perspectives	E104+E105
14:15	Pro and con debates	Emerald Room
14:15	Joint session EACTS SBCCV PASCaTS – Cardiothoracic surgery	G109
16:00	Fast-track management	E104+E105
16:00	Live-heart team of complex pathologies	Emerald Room
16:00	Transcatheter mitral valve replacement: new valves and experiences	G104+G105
16:00	Joint Session EACTS SBCCV PASCaTS – Cardiac surgery in the emerging economies: the evolving management strategies	G109
10:15	Minimally invasive surgery for lung cancer: up-to-date debates	E108
14:15	Meet the experts in robotic cardiothoracic surgery	E103
16:00	TNM classification: 8th edition	E103

Abstract

08:15	Heart transplantation in the modern era	Forum
08:15	Endocarditis: a continuous dilemma	G104+G105
08:15	Risk models in coronary surgery	E104+E105
08:15	Work in progress	Emerald Room
10:15	Left ventricle – strategies in left ventricular moderations	Forum
10:15	Aortic valve replacement: what is new?	G104+G105
10:15	Cardiac general	E104+E105
10:15	Basic science 1	G109
14:15	Future of sutureless valves	Forum
14:15	Challenges in surgical aortic valve replacement	G104+G105
14:15	Basic science 2	F002
16:00	The two faces of arterial revascularisation	Auditorium
16:00	Results of Ross procedures and homografts in aortic surgery	E106+E107
08:15	Thoracic oncology I: staging	E103
08:15	Non-oncology I	E108
10:15	Thoracic oncology II: perioperative management	E103
14:15	Mediastinum	E108
16:00	Fontan circulation	G106+G107
14:15	A broad view on acute dissection	G102+G103
16:00	A 4D view of the aortic root	G102+G103

Abstract Rapid Response

08:15	Reducing invasiveness	E102
10:15	Supporting the heart and lung	E102
16:00	Thoracic quick fire session	E102
14:15	Congenital	E102



	Plenary	
11:50	Presidential Address	Auditorium

	Residents Session	
10:15	EACTS Cardiothoracic Masters Jeopardy	F002
12:45	Cardiac surgery residents – where do we come from and where are we heading	F002
16:00	Endoscopic port access mitral valve repair	F004

	Training in Research	
10:15	All you need to know for your next research project – part I	F003
14:15	All you need to know for your next research project – part II	F003
16:00	How to statistically analyse your next research project	F003

Tuesday 6 October

	Professional Challenge	
08:15	Less invasive procedures for complex patients	Auditorium
10:15	Less invasive procedures for complex patients	Auditorium

	Focus Session	
08:15	Aortic valve disease and heart failure: how do they connect?	E104+E105
10:15	Acute extracorporeal support and mechanical circulatory assist	Forum
10:15	Is minimally invasive cardiac surgery the present and the future of mitral valve repair?	G104+G105
10:15	Perioperative complications in cardiac surgery	E104+E105
10:15	Nightmares in cardiothoracic surgery	Emerald Room
14:15	Pilots and passengers after cardiac surgery: so you want to fly again?	F002
14:15	Challenging the options for younger patients – minimising long-term risks with biological valves along the patient journey	Forum
14:15	Pre-operative planning, simulation, 3D printing and intra-operative navigation in cardiothoracic surgery	Emerald Room
16:00	Aortic valve replacement: ever had any problems?	Forum
16:00	Better outcomes through optimising international normalised ratio management and anticoagulation in aortic valve replacement	E104+E105
16:00	A contemporary approach to the aortic valve and aortic root	E106+E107
14:15	Guidelines	E103
16:00	Sublobar resections: controversies	E103
08:15	Paediatric and congenital cardiac activities in emerging economies	F002
14:15	Infections and chylothorax	G106+G107
08:15	Inflammatory and infectious aortic disease: a difficult environment	G102+G103
14:15	Arch repair	G102+G103
16:00	A contemporary approach to the aortic valve and aortic root	E106+E107

	Abstract	
08:15	Current challenges for extracorporeal life support	Forum
08:15	Native and prosthetic valve endocarditis: an update	G104+G105
08:15	Revisiting the tricuspid valve	E106+E107
10:15	Functional mitral regurgitation	E106+E107
14:15	Optimising outcomes in coronary surgery	G104+G105
14:15	Left ventricular assist device: Latest advances	E104+E105
14:15	Degenerative mitral regurgitation	E106+E107
16:00	What is new in transcatheter aortic valve implantation	Auditorium
16:00	Case reports and videos	G104+G105
08:15	Thoracic oncology III: Postoperative follow-up	E103
08:15	Thoracic non oncology II	E108
10:15	Session case report	E103
10:15	Lung transplantation	E103
14:15	Basic science and education	E108
16:00	Chest wall	E108
08:15	Tetralogy of Fallot	G106+G107
10:15	Valve surgery	G106+G107
16:00	Congenital miscellaneous	G106+G107

	Abstract Rapid Response	
08:15	How to perform an effective surgical atrial fibrillation ablation	E102
14:15	General cardiac	E102
16:00	New technology in mitral surgery	E102
10:15	Innovation and new strategies in thoracic aortic surgery	E102

	Plenary	
11:50	Honoured Guest Lecture	Auditorium
12:25	EACTS Award Presentations	Auditorium
12:35	Presidential Inauguration	Auditorium

	Residents Session	
12:45	Residents Luncheon	Amsterdam Cafe

	Simulator Session	
08:15	Endoscopic port access mitral valve repair	F004
10:15	Endoscopic port access mitral valve repair	F004
14:15	Endoscopic port access mitral valve repair	F004
16:00	Endoscopic port access mitral valve repair	F004

	Training in Research	
08:15	A summary of essentials for your next research project	F003
10:15	Clinical studies	F003

Wednesday 7 October

	Advanced Techniques	
09:00	Controversies and catastrophes in adult cardiac surgery	G102+G103
09:00	A future without suture	G104+G105
09:00	Advance technique session on multiple arterial grafting	G106+G107

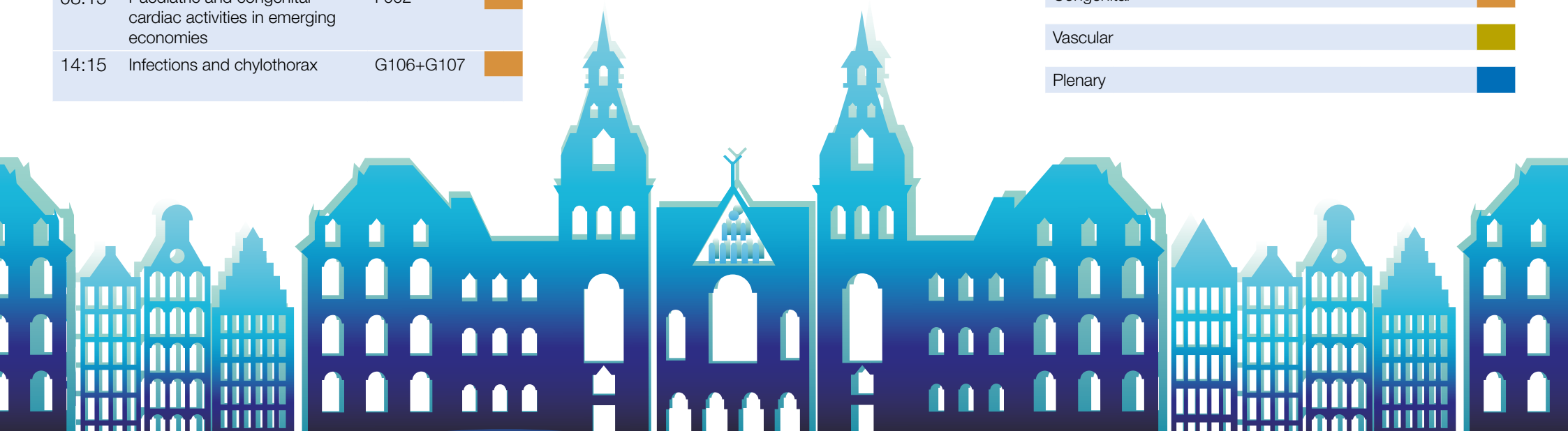
	Focus Session	
09:00	How to do it? With live in a box	Emerald Room

	Wetlab	
09:00	Learn from the experts how to do a remodelling or a re-implantation procedure	E106+E107
09:00	Mitral valve repair	E104+E105
10:30	Learn from the experts how to do a remodelling or a re-implantation procedure	E106+E107
09:00	VATS lobectomy	E103
09:00	AoV reconstruction and Senning	E102

	Abstract	
09:00	Video session	G109

Key

- Cardiac
- Thoracic
- Congenital
- Vascular
- Plenary



Cardiac – Abstract: Revisiting the tricuspid valve

Should less than severe tricuspid regurgitation be treated during mitral valve repair?

Michele De Bonis
IRCCS San Raffaele University Hospital, Milan, Italy

For many years, less than severe functional tricuspid regurgitation (TR) has been managed conservatively according to the widely accepted concept that, in most cases, it decreases or disappears after mitral valve (MV) surgery alone. More recently, compelling data have shown that surgically untreated functional TR can persist or even worsen despite correction of the associated rheumatic, functional or degenerative MV disease. In addition, there is some evidence to suggest that even moderate degrees of functional TR may have a negative impact on survival and functional outcome. Therefore, a more aggressive approach towards this pathology has been advocated. In most of the studies supporting prophylactic tricuspid annuloplasty, this concomitant procedure restored valve competence, prevented TR progression, and did not increase postoperative morbidity, leading to enhanced right ventricular reverse remodelling.

Since secondary TR is an extremely dynamic entity, tricuspid annular dilatation has been proposed as an indication for prophylactic tricuspid annuloplasty in patients with less than severe functional tricuspid insufficiency. The dilatation of the tricuspid annulus is a more objective measurement than the degree of TR and seems to be a risk factor for the development of more severe late functional TR. In the current guidelines, a tricuspid annulus diameter ≥40 mm or >21 mm/m^2 has been proposed as a criterion for concomitant tricuspid valve (TV) annuloplasty regardless of the degree of TR. Despite this recommendation, several issues still need to be addressed and clarified.

Firstly, the echocardiographic cut-off values for concomitant annuloplasty are based on 2D measurement of the septo-lateral dimension of the tricuspid annulus using the transthoracic 4-chamber view. However, 3D echocardiographic analysis showed that the tricuspid annulus is a complex saddle-shaped structure, with a highest antero-posterior point and lowest septo-lateral point. Consequently, 2D echocardiography may underestimate its true size. In addition, 3D echocardiographic studies have shown that the septo-lateral dimension is an insensitive parameter to detect the antero-posterior enlargement of the tricuspid annulus (from the antero-septal to the antero-posterior commissure). Consequently, 3D echocardiography is necessary to avoid underestimation of asymmetrical annular remodelling.

Secondly, the majority of studies evaluating the impact of left-sided valve surgery on TR evolution have focused on secondary mitral regurgitation (MR) or rheumatic valve disease. In the context of degenerative MR, TR progression may be less significant, possibly because patients with degenerative MR are more likely to undergo early MV repair, thus avoiding pulmonary hypertension and long-standing right ventricular (RV) pressure overload. The only randomised trial published to date on prophylactic tricuspid valve (TV) annuloplasty, enrolled patients with MV disease of different aetiologies and showed no advantages of concomitant TV annuloplasty in the setting of degenerative MR (but the number of patients included in this subgroup was extremely low). A recent study from the Mayo Clinic, USA, reported that clinically silent, not-severe TR, is unlikely to progress after isolated MV repair for degenerative MR. However, this statement does not appear to be justified by the data presented, considering that 29.4% of the patients had TR ≥3+/4+ at 5-year follow-up (compared with 16% preoperatively) and patients with the highest risk of TR progression were not included (patients with pulmonary disease, significant RV dysfunction, or right-sided heart failure). Moreover, it is not clear how many of the patients did have a dilated tricuspid annulus before MV surgery.

Therefore, the usefulness of concomitant prophylactic TV repair in degenerative MR remains to be definitely proven and further randomised data are needed. For this reason, we are running the NOSTRUM trial at our institution – a prospective, randomised study designed to test the hypothesis that concomitant TV annuloplasty in patients with tricuspid annulus dilatation and TR ≤2+ prevents the progression of TR after isolated MV repair for degenerative MR and leads to a meaningful clinical benefit for the patients.

Thoracic – Abstract: Chest wall

Massive chest wall resection and reconstruction for malignant disease (Abstract ID: 6666)

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Aristotle University of Thessaloniki, AHEPA University Hospital, Greece

Malignant chest wall tumours are rare neoplasms. The majority of primary tumours of this nature are mesenchymal neoplasms and, as such, radical tumour resection with wide free margins is considered to be the optimal treatment. However, in the case of larger tumours this can result in the need for massive chest wall resection, and reconstruction of the resulting chest wall defect using synthetic materials is often necessary.

In this retrospective study, a recent case series of 20 consecutive patients who underwent curative massive chest wall resection and reconstruction for malignant chest wall tumours between 2006 and 2014, is reported. Our aim was to find any possible correlation between tumour histology, extent of resection, type of reconstruction and adjuvant treatment for both short- and long-term outcomes. Patients who underwent chest wall reconstruction for primary lung cancer involving the chest wall were excluded from the study.

Overall 20 patients (10 female), 15–80 years of age (mean age: 59±4 years) were included in the study. These 20 patients account for the 2.68% of a total of 745 curative procedures performed during the study period for thoracic malignancies. Subtotal sternal resection was applied in nine cases, while resection of multiple (≥4) ribs was applied in the remaining 11 cases.

Tumour diameter varied from 5.4 cm to 32 cm, with a median diameter of 10 cm (Figure 1). The resulting area of the bony chest wall defect following tumour resection varied from 60 cm^2 to 340 cm^2 (median: 108 cm^2). Reconstruction of the chest wall defect was performed using the sandwich technique (polypropylene mesh – methyl-methyl-acrylate – polypropylene mesh) in nine cases of large anterior defects, especially those including part of the sternum (Figure 2). In the 11 cases of large lateral or posterior defects, reconstruction of the chest wall defect was made with a 2 mm e-PTFE mesh (Figure 3). Support from a plastic surgeon to cover full-thickness defects was mandatory in seven cases. Adjuvant oncologic treatment was offered in 13 patients according to the decision of the multidisciplinary oncology team.

The majority (80%) of the resected tumours were primary chest wall soft-tissue sarcomas, and of these, most were found to be chondrosarcomas.

Mortality resulting from the procedures was nil; while major morbidity occurred in four patients (20%), including ischaemia of musculocutaneous flap in one patient, atelectasis requiring bronchoscopy for resolution in two patients, and skin necrosis in one patient. Microscopic incomplete resection was observed in one patient who underwent further surgery to complete chest wall resection 3 weeks after the initial operation. Local recurrence was observed in five cases and surgical re-intervention was applied in two of these. Recurrences were observed in two cases of giant tumours with maximum tumour diameters of 20 cm and 32 cm, respectively, and in three additional cases where the radical resection followed an initial incomplete resection performed by non-thoracic surgeons.

Five patients died during the study period due to recurrent disease or complications arising from chemotherapy applied to treat recurrent disease.

The median survival of these five patients was 18 months. Adjuvant treatment did not prevent tumour recurrences in the case of initial incomplete resections. The remaining 15 patients are still alive without local recurrence or metastases, with a median survival of 62.5 months.

Poor survival after massive chest wall resection for chest wall tumours is related to the large size of tumours, the tumour's histology (since malignant fibrous histiocytomas tend to reach large dimensions and to recur) and to inappropriate initial management by non-thoracic surgeons, especially initial macroscopic incomplete resections. Extensive chest wall resection and reconstruction is technically demanding surgery, however, it is associated with favourable prognosis for most of the tumours if complete resection with wide tumour-free margins can be achieved. The sandwich technique is a classic, inexpensive and well-documented method of reconstruction for large anterior chest wall defects involving the sternum.

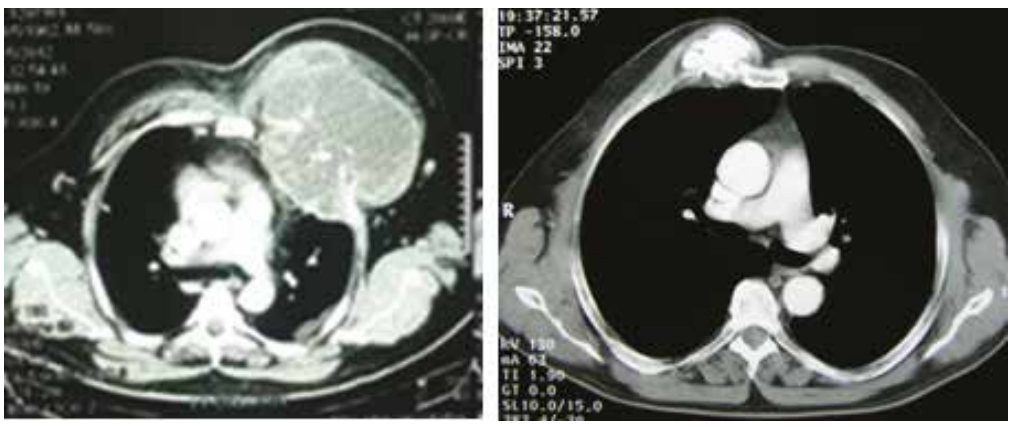


Figure 1.

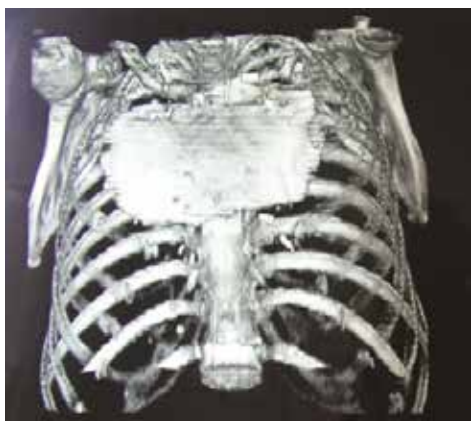


Figure 2.

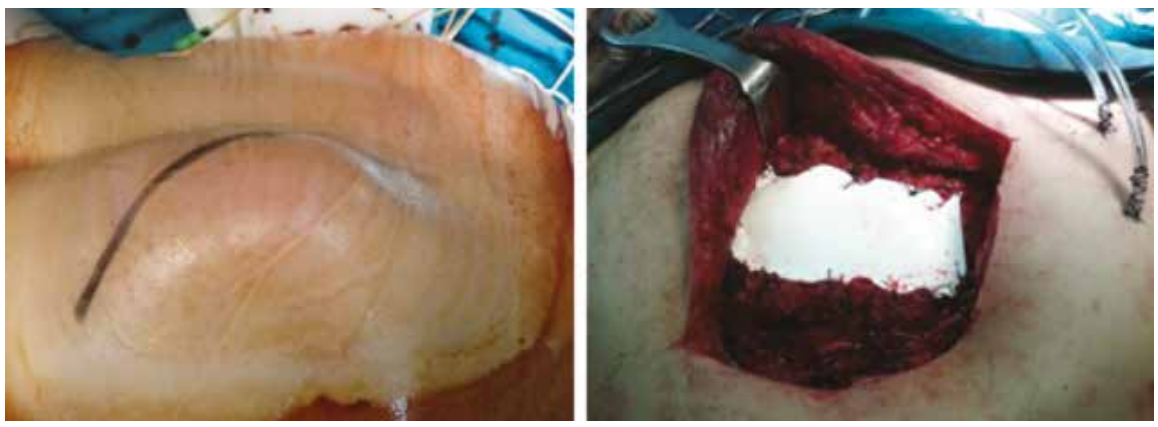


Figure 3.

Cardiac – Rapid Response: New technology in mitral surgery

Transvalvular mitral bridge for functional mitral regurgitation: midterm clinical results

Štepan Černy[1] and VA Subramanian[2] [1]Na Homolce Hospital, Prague, Czech Republic, [2]HRT-Heart Repair Technologies Inc., Morgan Hill, USA

Undersized ring annuloplasty is the conventional wisdom and the 'gold' standard for the treatment of functional mitral regurgitation (FMR). It achieves an indirect reduction of septo-lateral diameter (SLD) of the mitral annulus for leaflet coaptation by circumferential cinching of the dynamic mitral annulus. It increases the stress in the commissural segments of the mitral annulus, resulting in a malalignment of the leaflet-chordae-papillary muscle unit, and negatively impacts on the coaptation geometry and stress distribution in the leaflets. Unsatisfactory clinical results (high early recurrence rates and functional mitral stenosis) and high invasivity of traditional surgical treatment with ring annuloplasty have led to a greater interest in transcatheter technology and other innovative surgical concepts and techniques.

A novel nitinol-silicon transvalvular mitral bridge with infra-annular curvature which achieves a direct nonplanar reduction of SLD while preserving leaflet curvature, annular function and restoration of saddle shape of the mitral annulus has been developed by cardiac surgeon VA Subramanian MD (Heart Repair Technologies Inc, Morgan Hill CA, U.S.). Currently this device is implanted surgically and fixed with standard sutures to the mitral annulus at the midpoints of the base of anterior and posterior leaflets (Figure 1). It is under CE mark trial (single-centre, prospective, observational feasibility and safety FMR study). Primary endpoints are mitral regurgitation (MR) grade 1 ± at 6 months follow-up (F/U) and major adverse cardiac events (MACE).

Mitral bridge was implanted in 30 patients with symptomatic FMR, both type I and type IIIb (MR grade ≥3+, male/female ratio 16/14, age of 70.1±5.99 years). Mean EF was 55.9±10.1%, ERO 0.32±0.13 cm^2 and RV 51.8±16.8 ml. Mean SLD was 40.2±3.3 mm. Surgical access was midline sternotomy in 27 patients and right small thoracotomy in 3 patients.

Mitral bridge was successfully implanted in all patients, without any early or late mortality, or MACE (MI, device-related adverse events, device explant and stroke). All 30 patients completed the 6 months F/U and 10 patients the 12 months F/U with the longest follow-up of 19 months. Echocardiographic F/U showed a significant reduction of the mean grade of MR from 3.3±0.5 to 0.2±0.6 (p<0,001), SLD from 40.2±3.3 mm to 30.3±2.2 mm (p<0,001) and increase in coaptation height from 3.6±1.5 to 7.9±1.4 mm (p<0,001) at 1 month F/U. These changes remained stable in all patients over periods of 6 and 12 months. The transmitral gradients remained low (Figures 2 and 3). One patient required reoperation due to perimitral bridge leak for leaflet hole, with no central MR and a functioning MB.

We conclude that transvalvular mitral bridge implantation in FMR is simple, safe and effective in eliminating the mitral regurgitation by nonplanar reduction of SLD and preservation of leaflet curvature with restoration of the mitral annulus saddle shape (Figure 4). These results remain stable over periods of 6 and 12 months. The simplicity of the concept and the implantation with an excellent performance and durability of this device are very promising for an off-pump and transcatheter implantation. The transcatheter mitral bridge delivery system (16 F catheter) is in a preclinical phase. One- and two-year F/U of the 30 patients in this trial is ongoing, and a multi-centre, post-market study is in the planning phase.

VA Subramanian (left) and Štepán Černý.

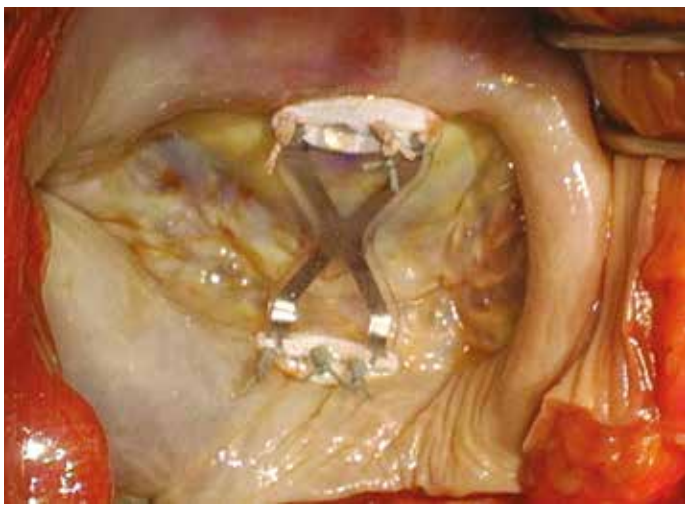


Figure 1. The mitral bridge implanted *in situ*.

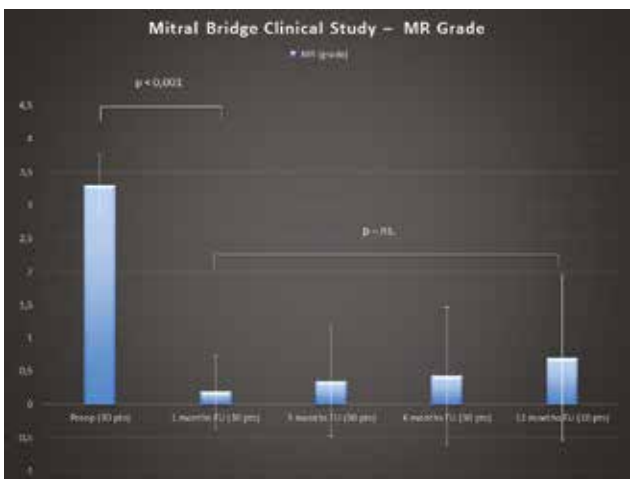


Figure 2. Significant reduction of mitral regurgitation: results remained stable over periods of 6 and 12 months.

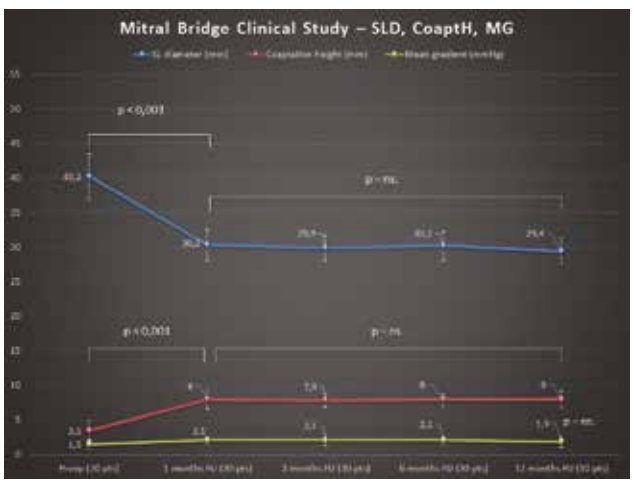


Figure 3. Significant reduction in septo-lateral diameter and increase in coaptation height: Effect of the repair was preserved over periods of 6 and 12 months. The mitral gradients remained low.

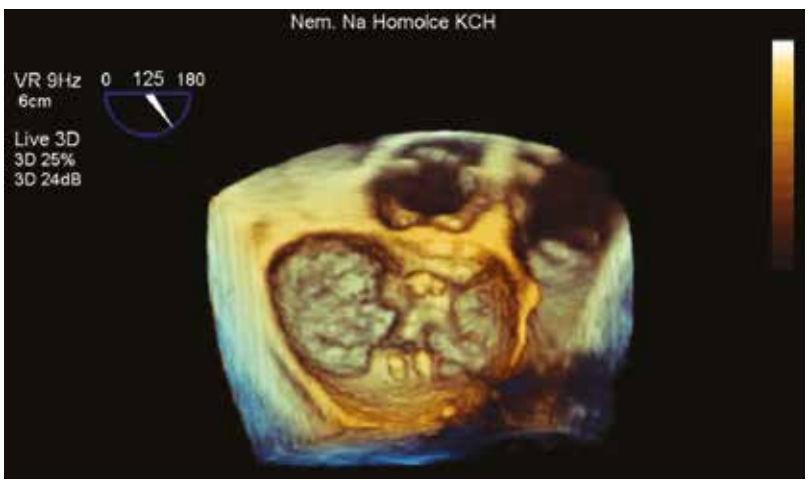


Figure 4. Postimplantation 3D TEE of the mitral bridge: restoration of the mitral annulus saddle shape.

Cardiac – Abstract: Functional mitral regurgitation

Concomitant mitral valve repair for moderate ischaemic mitral regurgitation: a meta-analysis of randomised trials

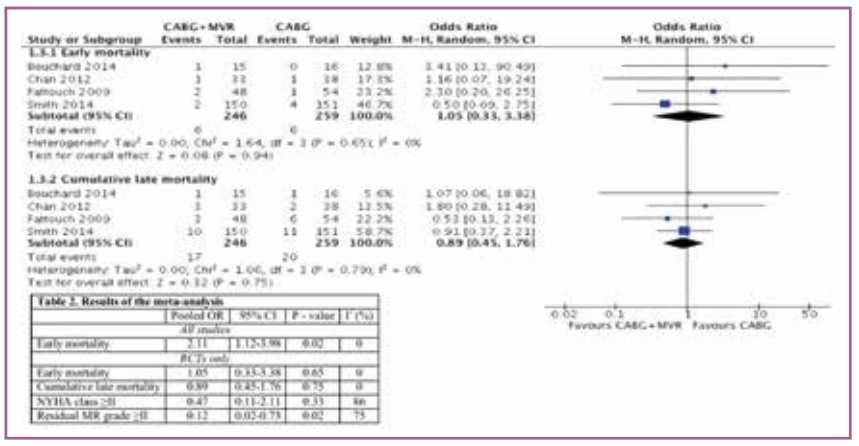
Tomislav Kopjar*[1], Hrvoje Gasparovic*[1], Carlos Mestres[2], Davor Milicic[1], Bojan Biocina[1] [1]University of Zagreb School of Medicine and University Hospital Center Zagreb, Zagreb, Croatia, [2]Cleveland Clinic Abu Dhabi, Abu Dhabi, United Arab Emirates
*Drs Kopjar and Gasparovic contributed equally to the research.

Ischaemic mitral regurgitation (IMR) is a complication of coronary artery disease with normal chordal and leaflet morphology. It is associated with increased mortality and morbidity as well as the development of heart failure. Almost 20% of patients following a myocardial infarction develop moderate or severe IMR. Currently there is no consensus whether to surgically treat moderate IMR in patients with an indication for coronary artery bypass surgery. Proponents advocating combined mitral valve repair (MVR) and coronary artery bypass grafting (CABG) emphasise that 40% of patients continue to have moderate or severe mitral regurgitation (MR) after isolated CABG, and that persistent or progressive MR may lead to worse outcomes. Considering the lack of consensus on the optimal treatment method for moderate IMR, we conducted the present systematic review with meta-analysis. It aims to determine whether a concomitant MVR during CABG improves clinical outcome in moderate IMR patients.

A systematic literature search for studies reporting on clinical outcome of CABG versus concomitant CABG and MVR in patients with moderate (2+ and/or 3+) IMR was performed. Randomised controlled trials (RCTs) and observational studies were included in the meta-analysis. As per recommendations in the Centre for Evidence-Based Medicine guidelines, to provide the highest level of clinical evidence a sub-analysis was performed, which included only the RCTs. The primary outcome of interest was operative (30-day) and cumulative late mortality. Secondary outcomes were NYHA class ≥II and residual MR grade ≥II at follow-up.

The literature search yielded 718 articles. Following title and abstract analysis, 28 full-text articles were assessed for eligibility. Finally, after exclusion criteria were applied, nine articles (five observational and four RCTs) were selected for the meta-analysis, with an overall number of 1161 patients, of which 505 patients were from RCTs. Mean follow-up across these studies ranged from 1 to 5.1 years. Pooled data for all included studies (both observational and RCTs) showed a significant difference in operative mortality favouring isolated CABG (OR 2.11; 95% CI 1.12–3.98; p=0.01), while data including RCT studies only did not (OR 1.05; 95% CI 0.33–3.38; p=0.65). Cumulative late mortality and NYHA functional class ≥II at follow-up did not show a significant difference in either analysis. In contrast, the reduced prevalence of residual MR grade ≥II was shown in the combined MVR patient population in both analyses.

A significant number of studies have been published on the subject of optimal treatment for moderate IMR patients. Some studies suggested a functional benefit from concomitant mitral valve surgery, while others found neither symptomatic nor a survival benefit from the addition of mitral valve surgery to CABG. It remains unclear whether the lower prevalence of MR following the combined procedure has any clinical benefit. Increased operative mortality previously suggested for concomitant MVR and CABG in moderate IMR patients was refuted with pooled RCT data from our meta-analysis. Although, no significant difference in cumulative late mortality was found, a concomitant MVR and CABG strategy for moderate IMR may be prudent considering the comparable incidence of adverse events, while providing a decreased mitral regurgitant volume.



Cardiac – Abstract: Current challenges for extracorporeal life support

Preserved brain morphology after controlled automated reperfusion of the whole body after normothermic circulatory arrest time of up to 20 minutes

Itumeleng Taunyane, Christoph Benk, Georg Trummer, Friedhelm Beyersdorf University of Freiburg, Germany

In order to improve the results after in-hospital cardiac arrest (IHCA) as well as after out-of-hospital cardiac arrest (OHCA), the Freiburg research group of Professor Beyersdorf has developed a method of Controlled Automated Reperfusion of the Whole Body (CARL) in a pig model over the past 10 years. This new approach to cardiac arrest combines the effects of controlling composition of the for whole body reperfusate, control of reperfusion conditions as well as an online assessment of the femoral venous effluent and an automated modification of this effluent for arterial return. In addition, mobile oxygen delivery and immediate systemic cooling were part of the CARL treatment.

Over the past 10 years, the CARL technique has been optimised in many different experimental groups. Eventually, complete myocardial and neurologic recovery has been achieved after 15 min of normothermic cardiac arrest. Even after 20 min of normothermic cardiac arrest complete myocardial and greater than 85% of neurological recovery occurred in the most recent experimental groups.

In addition to other parameters, neurologic recovery was assessed by using a neurologic deficit assessment score (0–500) and we investigated brain morphology preservation by both Magnetic Resonance Imaging (MRI) and histologic evaluation.

Twenty-eight pigs were included in our analysis, and were allocated to 4 different treatment strategies. In the first group (n=6), we induced circulatory arrest by fibrillation, and immediately performed open chest CPR for 10 min (group 1 – no circulatory arrest period). In the second group (n=6), we induced cardiac arrest for 15 min followed by open chest CPR for 10 min (group 2). In the third (n=6) and fourth groups (n=10), we induced circulatory arrest times of 15 and 20 min respectively without subsequent CPR. In all groups, CARL of 60 min was subsequently applied. In addition, six healthy pigs served as histology controls and seven others as MRI controls. Full clinical and neurological deficit assessments (NDS) were performed on all pigs up to the seventh day after the intervention, except in cases where early euthanasia was warranted for ethical considerations. MRI (Figure 1) and histology of the brains were then performed.

Except for one pig in group 4, all pigs in groups 1, 3 and 4 survived to the end of the experimental period, with completely normal neurological function. In group 2, only one pig survived to the end of the experimental period with intact neurological function. In this group, three pigs died within 24 hours of the post-intervention period, with a further two succumbing on days 4 and 5 respectively. In this group, the inability to reliably control the initial conditions of reperfusion by standard CPR techniques has proved futile.

We welcome this opportunity provided by the 29th EACTS Annual Meeting to be presenting some of our preliminary results today (Figure 1).

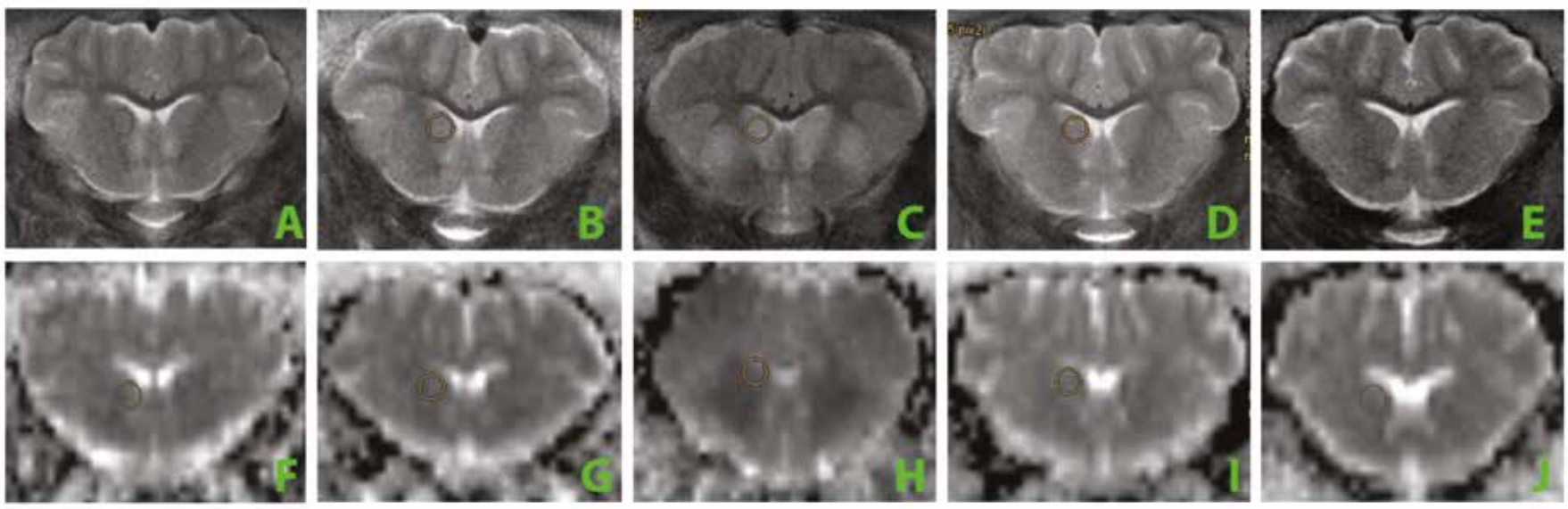


Figure 1. T2-Weighted Images (A-E) and Apparent Coefficient Diffusion (F-J)
Images: Coronal MRI images at the level of the Parietal Lobe representing the Caudo-Putamen and the Diencephalon of representative pigs from different groups.
(Control Subject – A and F; Group 1 – B and G; Group 2 – C and H; Group 3 – D and I; Group 4 – E and J). Circles represent Regions of Interest (ROI) for signal intensity (SI) measurements.

Cardiac – Rapid Response: How to perform an effective surgical atrial fibrillation ablation

Hybrid ablation for persistent atrial fibrillation bridges the surgery-electrophysiology divide: insights from the Polish AF registry

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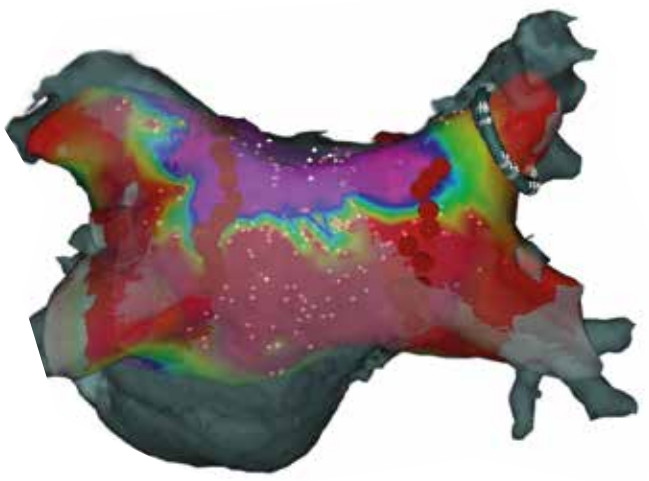
Silesian Center for Heart Diseases, Poland

Atrial fibrillation (AF) is the most common cardiac arrhythmia, affecting nearly 2% of the worldwide population. It is associated with an increased risk of stroke and constitutes an independent risk factor for sudden death. A sharp increase in AF prevalence is attributed to both diagnostics and the aging population. Novel technologies allow catheter-based endocardial procedures to achieve exceptionally high efficacy in the termination of arrhythmia, generating foci in the pulmonary veins (PVs). This, combined with predictable safety outcomes, made endocardial ablation a treatment strategy with a class IA recommendation in patients suffering from symptomatic paroxysmal AF who fail optimal medical therapy. The recurrent nature of chronic AF diminishes the initial optimism of endocardial ablation and indicates a difficult route through medical, cardioversion, and invasive treatments that are often ineffective. Successful treatment of persistent and long-standing persistent atrial fibrillation remains a therapeutic challenge further blurred by ill-defined guidelines that equate percutaneous, low efficacy, repeat procedures with endoscopic, high efficacy, hybrid approaches.

Our group's results, based on a Polish Registry of Totally Endoscopic Ablation of Atrial Fibrillation, document an exceptional success rate of 81% freedom from AF after 1 year. The Registry combines independent results of thoracoscopic bilateral, bipolar ablation (37% of patients) and convergent, hybrid procedure with transabdominal, closed chest ablation (63%) demonstrating that success comes from the collaboration and convergence of surgical and electrophysiological specialties. Surgical and hybrid techniques are not competitive, but provide complementary, patient-tailored approaches: bilateral thoracotomy allows for circular electrical isolation of both pairs of PVs. It requires chest incisions and sequential lung deflation, which can be difficult to obtain in patients suffering from chronic obstructive pulmonary disease (COPD), or after lung/lobe resection or inflammation and pleural adhesions may severely limit endoscopic access. Transabdominal access is independent of lung function and anatomy allowing for unrestricted posterior ablation and PV isolation in patients with severe COPD or other pulmonary diseases. Our experience shows that successful AF ablation is possible even in patients with a history of total lung resection due to massive chest trauma. Importantly, both strategies permit direct visualisation of PVs irrespective of anatomy. When combined with endocardial applications (either RF or cryogenic) they offer exceptional long-term results. Left atrial appendage ligation or exclusion represents a valuable thoracoscopic approach, which can also be combined safely with transabdominal access in a selected population.

While this material contributes to growing evidence on safety and efficacy of both surgical and hybrid ablation of AF, there is a need for prospective, randomised, multicentre clinical trials (RCTs) to independently assess its role in AF treatment. With thousands of patients successfully treated worldwide, surgical standalone or hybrid ablation is still considered a Class IIb indication in both European and US AF treatment guidelines, limiting its use to either 'highly symptomatic' patients or patients in whom percutaneous procedures have failed. Assessing our material it is apparent that 'symptomatic', with a mean European Heart Rhythm Association score of 2.6 rather than 'highly symptomatic' patients are treated. While patients who have failed percutaneous treatment, 20% of the cohort, benefit from hybrid procedures, the ability to create a defined anatomic lesion pattern, preventing pro-arrhythmic gaps, highlights the importance of making hybrid procedures first line treatment for patients who require more than simple pulmonary vein isolation.



CARTO mapping of the left atrium post Convergent Procedure.

Currently hybrid procedures tend to be utilised as a last resort in patients who have failed multiple treatment modalities, including percutaneous catheter ablation or those deemed not to benefit from catheter ablation. Although hybrid procedures show high efficacy and excellent safety, solid data from RCTs is required to switch hybrid procedures to first line treatment.

Cardiac – Focus Session: Better outcomes through optimising INR management and anticoagulation in aortic valve replacement

Effectiveness of rivaroxaban, a direct Factor Xa inhibitor, for the thromboprophylaxis of mechanical prosthetic heart valves in a porcine heterotopic model

Lawrence E Greiten and Hartzell V Schaff Mayo Clinic, Rochester, MN, USA

Despite substantial evolution in the construction and design of mechanical valves,[1] they remain thrombogenic in nature, arising from both prosthesis- and patient-related factors. Without anticoagulation, patients with a bileaflet valve in the orthotopic aortic position have a 12% per year risk of embolism or valve thrombosis; 22% per year if placed in the mitral position.[2] Conversely, the risk of thromboembolism or thrombosis in a patient receiving anticoagulation is as low as 1% per year for valves in the aortic and 2% per year for mitral[3] positions. To date, warfarin is the only oral medication approved for anticoagulation in this patient population. Several new oral anticoagulation medications have been developed and marketed as alternatives to warfarin for long-term anticoagulation[4] and their use are increasing in the United States, Europe and Canada.

Each of these newer medications have the advantage of a predictable pharmacokinetic and pharmacodynamic profile[5] with a rapid onset of action. They are administered in standard fixed dosages and do not require frequent monitoring to assess therapeutic efficacy. In clinical trials, rivaroxaban, a direct factor Xa inhibitor, has shown to be safe and effective in preventing arterial and venous thrombosis,[6,7] preventing stroke associated with atrial fibrillation[8,9] and treating pulmonary embolism.[10] Age and gender[11,12] do not appear to affect pharmacokinetics, and there is emerging data demonstrating rivaroxaban's safety profile in subjects with decreased renal[13] and hepatic function.[14]

Goal weight-based dose trough levels of 45 ng/mL and peak levels of 200 ng/mL (equivalent to 20 mg of plasma levels in human) were used for the comparative phase of the investigation. Thirty animals were randomised into one of three experimental groups: rivaroxaban (weight-based), enoxaparin (2.0 units/kg SQ), or no anticoagulation. Clotting times, anti-FXa activity and coagulation activity biomarkers such as PT, APTT, fibrinogen, prothrombin, thrombin antithrombin complex, D dimer, F1 + F2, anti-Xa activity, and plasma concentrations were measured serially (baseline, day 10, 20 and 30). Serial haematologic profiles and faecal blood quantification were used to assess for occult bleeding. At sacrifice, valve thrombus burden was assessed by radiolabelled platelet quantification and gross thrombus weight measured. Additionally, one kidney was inspected grossly and histologically for thromboembolism. Valve thrombus and number of radiolabelled platelets deposited on the valve prosthesis were reported as mean and treated as continuous variables, compared through the Mann–Whitney U-test.

Elevated anti-factor Xa levels were observed in swine receiving enoxaparin and rivaroxaban relative to the control group. When comparing the two treatment groups, significantly less thrombus burden was seen in the rivaroxaban group. The mean number of platelets deposited on the mechanical valve prosthesis was significantly less in the rivaroxaban group 6.13 x 109 than in the enoxaparin group 3.03 x 1010 (p=0.03). No thrombotic, haemorrhagic, or microembolic complications were observed in any of the groups.

Inadequate anticoagulation has been shown to increase the incidence of thromboembolism by 2–6 times[15,16] in patients with mechanical heart valves. Perhaps more pressing is that as many as 50% of postoperative patients have INR levels outside of the recommended therapeutic range.[15] Warfarin has a slow onset of action and has the potential for numerous interactions with foods, medications, and changes in the patients' health status. Its use is also complicated by the need for frequent invasive testing to monitor and maintain therapeutic levels. Because oral factor Xa inhibitors do not require monitoring and can be administered once daily, they would be intriguing alternatives in anticoagulating prosthetic heart valve patients.

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Cardiac – Abstract: Left ventricular assist device: latest advances

Conservative approaches for HeartWare HVAD pump thrombosis may improve the outcome compared with immediate surgical approach

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Left ventricular assist device (LVAD) thrombosis is among the most devastating complications related to mechanical circulatory support systems. Surgical pump exchange is the traditional management strategy used in the majority of institutions. Needless to say, surgical pump exchange is a known high-risk surgery with a 1-year survival of merely 50%. Other less invasive management strategies in the form of local and/or systemic thrombolysis haven been also described but limited to anecdotal case reports. In this study, we aimed to summarise our experience with several alternative management approaches in patients with HeartWare HVAD (HeartWare, Framingham, MA, USA) pump thrombosis.

A retrospective analysis of prospectively collected data was performed. Pump thrombosis was defined as follows: high pump power and flow alarm, high LDH and free Hb values, and presence of haematuria. The outcome of HeartWare HVAD implantations performed at a single institution between January 2010 and April 2015 was studied. A total of 85 HeartWare HVAD pumps were implanted. A total of 13 patients (15%) had confirmed pump thrombosis. Mean age of the patients was 55±14 years. Six patients (46%) were on short-term mechanical circulatory support systems prior to LVAD implantation. Median pump support duration was 467 days (11–784 days).

Table 1 shows a summary of events and treatment strategies for every patient. Eight patients had a single event, one patient had two events, one patient had three events and three patients had four events. Intravenous heparin was used in all patients. Surgical pump exchange as initial treatment strategy was performed early in our experience in only one patient. A conservative approach with systemic thrombolysis (rtPA) plus heparin was used in the majority of the patients (16 events = 65%). Several patients required more than one approach (Table 1). Four patients were successfully treated with systemic thrombolysis and upgraded to high-urgency status for heart transplantation and underwent subsequent heart transplantation. Device explantation was performed in two patients and pump deactivation and closure of the outflow graft was performed in another three patients. Device explantation or deactivation was only performed after observing recovery of left ventricular function.

No major complications related to thrombolysis therapy were observed. However, one patient with heparin-induced thrombocytopenia, who developed pump thrombosis a few days after VAD implantation surgery, required resternotomy for bleeding after thrombolysis. Another two patients developed minor intracranial bleeding after thrombolysis, with no negative effect on the outcome. 1-year survival in this cohort of patients with pump thrombosis after the latest intervention was 77%.

In summary, this report shows the feasibility of several alternative conservative approaches combining medications, minimally invasive and interventional methods for patients with confirmed HeartWare pump thrombosis. A conservative approach with systemic thrombolysis (rtPA) plus heparin was successful in the majority of the patients. It is suggested that the outcome may be better than that with immediate surgical pump exchange.

Table 1: Patients, interventions and outcome

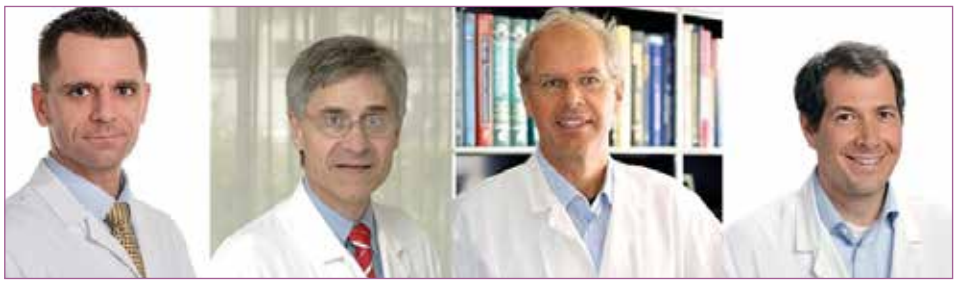
Patient number	No. of pump thrombosis events	Treatment options	Outcome after latest intervention	1-year survival after latest event
1	1	i.v. tirofiban, later HTX	Survived	Yes
2	1	i.v. tirofiban, later HTX	Survived	Yes
3	1	Pump exchange	Survived	Yes
4	1	i.v. tirofiban, later surgical pump explantation	Survived	Yes
5	1	i.v. heparin, later pump explantation	Survived	Yes
6	1	Pump deactivation and interventional outflow graft closure	Survived	Yes
7	2	i.v. thrombolysis (rtPA)+heparin, later pump deactivation and surgical outflow graft ligation	Survived	Yes
8	1	i.v. thrombolysis (rtPA)+heparin	Survived	Yes
9	3	2 x i.v. thrombolysis (rtPA)+heparin. Pump exchange several months later	Expired	No
10	4	4 x i.v. thrombolysis (rtPA)+heparin. Later HTX	Survived	Yes
11	4	4 x i.v. thrombolysis (rtPA)+heparin. Awaiting HTX	Survived	Yes
12	4	3 x i.v. thrombolysis (rtPA)+heparin. later interventional outflow graft closure	Expired	No
13	1	i.v. thrombolysis (rtPA)+heparin	Expired	No

HTX=heart transplant; i.v.=intravenous

Cardiac – Abstract: Case reports and videos

Hybrid transcatheter postoperative paravalvular leak closure

Winkler Bernhard, Meier Bernhard, Carrel Thierry, Huber Christoph



From left to right: Winkler Bernhard, Meier Bernhard, Carrel Thierry, PD Huber Christoph

Percutaneous transcatheter closure for aortic puncture and paravalvular leak closure with the Amplatzer III device

Paravalvular leak (PVL) is an infrequent but known complication of valve replacement surgery with most PVLs being very small or asymptomatic, only approximately 2% are reported to be clinically relevant and associated with major complications such as arrhythmias, heart failure, haemolysis or endocarditis.[1] With increasing age and risk profile of patients with postsurgical PVL, reoperation can present a major challenge. In those patients percutaneous PVL closure can be a very attractive and effective technique. In the present two cases the percutaneous strategy was clinically and echocardiographically successful with good mid-term results.

Two selected but consecutive patients will be extensively discussed during this year's EACTS meeting. In one case (patient 1) an Amplatzer Vascular Plug III device (AVP III; St. Jude Medical, Plymouth, MN, USA) was used to effectively seal the PVL, while in the other a 10 mm Amplatzer septal occluder was used. Nevertheless, the typical half-moon shape of most PVLs are demanding in terms of choosing the optimal device and device size. Furthermore, the technical aspects of percutaneous PVL closures should not be underestimated, but should be considered in detail before performing the procedure, and include ideal access, potential interference with the prosthetic valve leaflets and bail-out strategies.

In our experience the AVP III appeared to be well suited for paravalvular leak closures. The AVP III is an oval nitinol device with a height of 6.5 mm, and sizes that vary from 4 mm to 14 mm along the long axis and 2 mm to 5 mm along the short axis (Figure 1). The delivery sheaths vary from 4 French (F) to 7 F, depending on the device size.

The discussion focuses on the value of the heart team to efficiently conduct patient selection and procedure planning and to successfully master those challenging complications.

In the first case a patient with a long-standing history of rheumatic heart disease with serial operations of the aortic and mitral valves over the last 20 years will be presented in detail. After endocarditis of the mitral valve prosthesis a relevant PVL was diagnosed. The patient was admitted in a severely reduced clinical state. Because of the increased peri-operative risk a percutaneous transcatheter approach was selected by the interdisciplinary heart team through a transseptal approach.

The procedure was performed from the right femoral vein, under general anaesthesia and guidance by transoesophageal echocardiography. An accidental perforation of the aortic root was immediately treated by insertion of a first AVP III. An 8x4 mm AVP III was then successfully implanted into the PVL in the mitral annulus (Figure 2). Transoesophageal echocardiography showed no residual paravalvular regurgitation and a mean transvalvular gradient of 4 mmHg at follow-up, and the patient remained in excellent condition without further symptoms and without haemolysis 3 months after the intervention.

The second case underwent double mechanical valve replacement and pericard patch aortic root repair for double valve endocarditis after previous mechanical aortic valve replacement. In the early postoperative setting a PVL was identified with pulsatile flow within a pericardium-covered abscess cavity of increasing size. We successfully closed the PVL via a transcutaneous transapical transcatheter approach (Figure 3) with good clinical outcome.

It is concluded that percutaneous PVL closure with the AVP III in selected patients can be a safe and effective treatment tool but requires interdisciplinary planning, lively and active teamwork, and a mix of skills with catheters and surgery.

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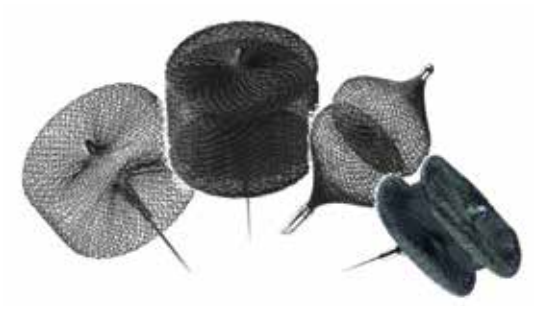

Figure 1. Selection of Amplatzer Vascular Plugs. The AVP III is at the far right.

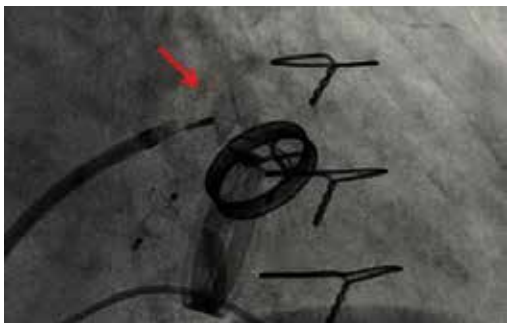

Figure 2. AVPIII 8x4 mm (arrow) before release from the delivery cable in the paravalvular mitral leak of patient 1. Left of the mechanical valves, the Amplatzer device sealing the accidental aortic perforation is seen.

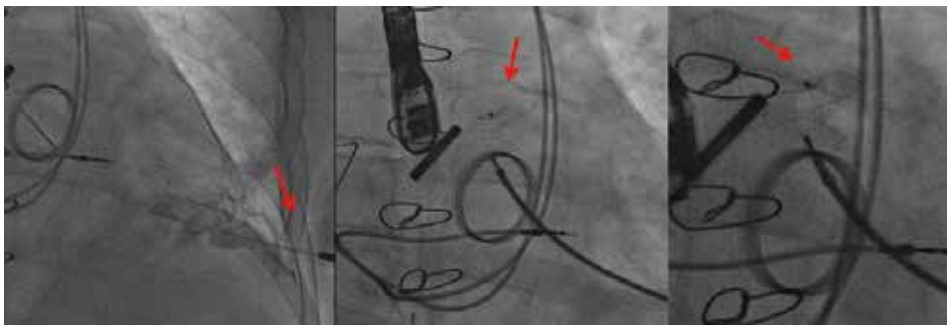

Figure 3. Left panel: transapical needle puncture (arrow); middle and right panels: Apmplatzer device in paravalvular abscess cavity closing the entry (arrow) and the exit of the leak.

Thoracic – Abstract: Thoracic oncology III: postoperative follow-up

Postoperative follow-up strategy based on recurrence dynamics for non-small cell lung cancer

Katsuya Watanabe Kanto Rosai Hospital, Kanagawa, Japan

Lung cancer is the leading cause of cancer-related death in Japan and many countries around the world, non-small cell lung cancer (NSCLC) accounting for 75% to 85% of all cases. Surgery is the mainstay of treatment for early-stage NSCLC. Unfortunately, local or distant recurrence (or both) often develops, even in patients with early disease who undergo complete resection.

At present, evidence-based methods for postoperative follow-up remain to be established, and guidelines recommended by major organisations in Western countries differ considerably.

Our study was designed to visually represent recurrent patterns after surgery for lung cancer with the use of event dynamics and to clarify postoperative follow-up methods based on the times of recurrence. A total of 829 patients (538 men, 291 women) with NSCLC who underwent complete pulmonary resection from January 2005 through December 2007 were studied.

In the present study, we examined recurrence dynamics using Kernel-like smoothing procedure and a piecewise exponential regression model.

The event of interest was the development of local recurrence and distant metastasis.The influences of sex, histology and age were studied.

The resulting curve displayed an initial surge in the hazard rate that peaked about 6 to 8 months after surgery. Another distinct peak was noted at the end of the second year of follow-up (Figure 1). In men, the first peak in recurrence appeared 6 to 8 months after surgery, and the hazard rate then showed a downward sloping tendency. In women, however, there was only a small peak in the first year after surgery. The hazard ratio then gradually increased to a peak 22 to 24 months after surgery (Figure 2). Neither age (≤70 or ≥70), nor histological type (squamous cell carcinoma versus adenocarcinoma) showed distinct differences in the timing of the first peak of recurrence.

On the basis of the current situation and our results, hospital visitation programs should be designed to focus on 6 to 8 months and 22 to 24 months after surgery, the times of peak hazard rates of recurrence, and appropriate CT-based imaging studies should be performed at these times. In addition, because the peak times of recurrence differed between men and women, imaging studies should be planned according to sex to most intensively cover the period from 6 to 8 months during the first year after surgery in men and 22 to 24 months during the second year after surgery in women.

The timing of recurrence after surgery for lung cancer was characterised by a bimodal pattern, and the times with the highest risk of recurrence were suggested to differ between men and women.

Postoperative follow-up strategies should be based on currently recommended follow-up programs, take into account the recurrence patterns of lung cancer, and be modified as required to meet the needs of individual patients.

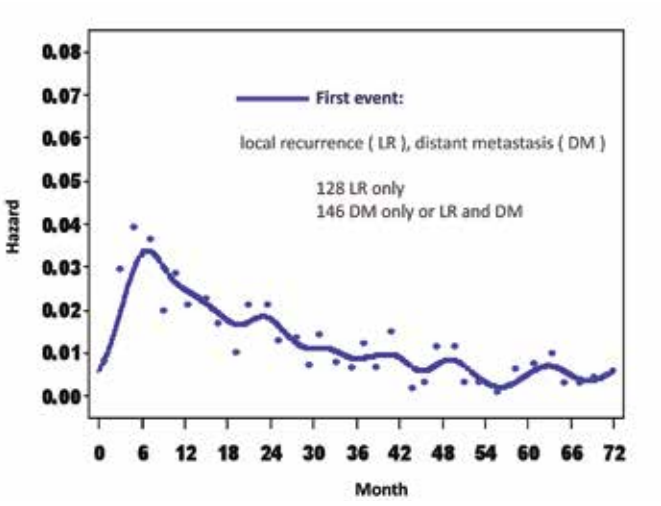

Figure 1. Smoothed hazard ratio estimates for first event.

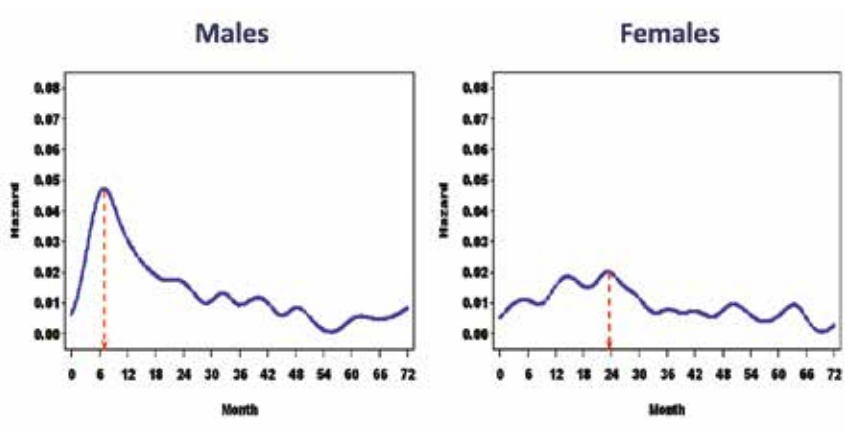

Figure 2. Smoothed hazard ratio estimates for first event in 538 men and 291 women.

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SOLUTIONS FOR VASCULAR DISEASE

Cardiac – Abstract: Current challenges for extracorporeal life support

The outcome of patients requiring multiple extracorporeal membrane oxygenations

Heng-Wen Chou, Te-I Chang, Yih-Sharng Chen
National Taiwan University Hospital, Taipei, Taiwan

Extracorporeal membrane oxygenation (ECMO) has been proven effective in life support for patients with refractory cardiopulmonary failure. For those under cardiopulmonary resuscitation, emergent ECMO set-up also improves survival rate. However, there are some patients who experienced recurrent cardiopulmonary dysfunction after first weaning off ECMO and required further courses of ECMO support. Technical difficulties in cannulation for the second course of ECMO, especially for paediatric patients, a higher rate of ECMO-related complications, as well as deteriorating diseases, mean the survival rate for patients who needed multiple courses of ECMO support is far lower than for those who successfully weaned off the first ECMO course. The outcomes of patients with repeat ECMO courses have rarely been discussed in the literature. We retrospectively reviewed our database and reported the indications, complications and survival for patients who required multiple ECMO during single admission and have sought to identify the factors that have a significant effect on patient survival.

From October 1994 – December 2013, there were 86 patients in our hospital who received at least two courses of ECMO support in a single hospitalisation. The mean age was 34.8 years old, 42 (48.8%) were paediatric patients (below the age of 18 years) and 60 (69.8%) were male. A total of 71 (82.6%) had received veno-arterial ECMO and 15 (17.4%) veno-venous ECMO.

The indication for the first use of ECMO was pulmonary support in 26 (30.2%) patients (acute respiratory distress syndrome [ARDS] n=11, and lung transplantation n=15), cardiac support in 59 (68.7%) patients (acute myocardial infarction n=17, congenital heart disease n=7, cardiomyopathy n=16, acute myocarditis n=3, and post-cardiotomy n=16) and septic shock in one patient (1.2%). The mean ECMO support duration was 333 hours (45–5013 hours) and the mean hospital stay was 78 days (10–378 days). Of the 86 patients reviewed, 75 (87.3%) received two runs of ECMO implantation; nine (10.4%) received three runs and two (2.3%) received four runs of ECMO. The percentage of major complications experienced by patients was 14% (12 out of 86) cannula-related haemorrhage, 57% (49 out of 86) total haemorrhagic events, 32.6% (28 out of 86) neurological defect, 14% (12 out of 86) ischaemic limbs, 55.8% (48 out of 86) post-ECMO infection and 53.5% (46 out of 86) acute renal failure (ARF) under haemodialysis.

The total survival rate to hospital discharge was 30.2% (26 out of 86). The survival rate for patients with two runs of ECMO was 33.3% (25 out of 75), 11.1% for those with those with three runs (1 out of 9), and 0% (0 out of 2) for those with four runs of ECMO. The univariate analysis demonstrated that age, length of hospital stay, diabetes mellitus, hypertension, coronary artery disease, smoking, acute myocardial infarction, intra-aortic balloon bump (IABP) support, CPR before ECMO implant, lactate level 16 hours after ECMO implant and ARF with haemodialysis all differed significantly between the survival (26 out of 86) and non-survival (60 out of 86) groups ($p \leq 0.1$). The multivariate analysis (logistic regression) revealed that ARF with haemodialysis seemed to be the only independent risk factor for survival (OR: 14.8).

Selection and decision of repeated ECMO set-up is a complex and difficult process. Despite the arguments relating to resources consumption and increased complications, one out of four patients will survive to discharge. However, the installation of ECMO three or four times offers grave prognosis. ARF with haemodialysis proved to be the only independent risk factor of survival.

Variable (categoric)	Survivor (n=26)	Non-survivor (n=60)	*p* value
Gender (male)	15 (57.7%)	45 (75%)	0.177
ECMO indications			
ARDS	4 (15.4%)	7 (11.7%)	0.640
Lung transplant	5 (19.2%)	10 (16.7%)	0.777
Acute myocardial infarction	2 (7.7%)	15 (25%)	0.065
Congenital heart disease	3 (11.5%)	4 (6.7%)	0.454
Cardiomyopathy	7 (26.9%)	9 (15%)	0.196
Acute myocarditis	0 (0%)	3 (5%)	0.251
Post-cardiotomy	5 (19.2%)	11 (18.3%)	0.923
Septic shock	0 (0%)	1 (1.7%)	0.514
ECMO complications			
ARF with haemodialysis	7 (26.9%)	39 (65%)	0.003
Re-open	5 (19.2%)	10 (16.7%)	0.765
Gastrointestinal haemorrhage	0 (0%)	5 (8.3%)	0.132
Cannula-related haemorrhage	3 (11.5%)	9 (15%)	0.675
Total haemorrhage	15 (57.7%)	34 (56.7%)	0.931
Neurological complications	5 (19.2%)	23 (38.3%)	0.173
Infection after ECMO	13 (50%)	35 (58.3%)	0.481
Limbs ischaemia	3 (11.5%)	9 (34.6%)	0.675

Cardiac – Abstract: Optimising outcomes in coronary surgery

Transit-time flow measurement in composite arterial grafts and single target anastomoses in coronary bypass surgery

Hatem Beshir, Moustafa Elhamami, Ahmed Saleh, Bassem Ramadan University of Alexandria, Egypt

Surgical myocardial revascularisation still remains as one of the most effective and long-lasting modalities in the treatment of coronary artery disease (CAD). The results of recent landmark trials and registries provide solid evidence in support of coronary artery bypass graft (CABG), especially in more complex anatomies, patients with diabetes, and the wider use of arterial conduits.

Complete revascularisation and arterial grafting are recognised with improved long-term outcomes. Therefore, there has been an upsurge in the use of arterial conduits, especially bilateral internal mammary artery (BIMA) grafts and their composite configurations, due to their excellent patency rates compared with saphenous vein grafts (SVG). This was emphasised in the recent European Association for Cardio-Thoracic Surgery (EACTS) guidelines in 2014 that indicate Class I for the use of arterial conduits on the left coronary artery (LCA) and Class IIa for their use in patients <70 years of age.

It is increasingly important to focus on the optimisation of the outcomes of CABG, and on early detection and the reduction of associated technical errors, morbidity and mortality.

Graft patency verification is a highly valued procedure. The incidence of intraoperative graft failure has been estimated to be approximately 5% for IMA grafts, and 11% for vein grafts. Therefore, the EACTS gives a Class IIa indication for the routine intraoperative assessment of graft patency.

Several modalities are described: imaging technologies including coronary angiography, thermal angiography (TCA) and intraoperative fluorescence imaging (IFI); ultrasound technologies including transit-time flow measurement (TTFM), epicardial-colour Doppler, dual-beam Doppler flowmeter, combined high resolution epicardial ultrasonography (HR-ECUS) with TTFM; and finally transoesophageal echocardiography (TEE).

As experience with TTFM grew, a number of pitfalls in CABG became clear. Thus, it is the most widely-used, easy, instant and reproducible technique for intraoperative graft patency assessment. Our study set out to address the TTFM readings in composite BIMA Y grafts compared with the conventional single mammary graft group, and their correlation with postoperative major adverse cardiac events (MACEs). This prospective study included 230 consecutive patients. They were treated with a total of 677 (45% arterial) coronary grafts via isolated on-pump CABG through median sternotomy over a 1 year period. Patients were assigned into two groups according to the surgical technique. Group A comprised 165 patients (474 grafts; 35% arterial), who underwent conventional CABG. Group B consisted of 65 patients treated with the BIMA composite Y grafts (203 grafts; 66% arterial). Medistim's TTFM equipment was used to measure mean flow (MGF), diastolic fraction (DF%) and pulsatility index (PI) in all of the single, sequential and composite grafts.

Grafts targeted to the LCA system demonstrated diastolic dominant pattern in all grafts, more marked diastolic component, higher MGF, lower PI, and more back flow compared with grafts on the right coronary artery (RCA). Flow in composite grafts was found to be equivalent to the sum of the MGF of the targeted branches, while the DF% in the inflow source was equivalent to the mean of both limbs. The left internal mammary artery (LIMA) in-flow source of the Y graft had significantly higher MGF and less PI, compared with LIMA to left anterior descending (LAD) artery in group A. The LIMA–LAD targeted branch of the Y graft had significantly less MGF and higher PI, compared with corresponding measurements in group A. Flow-in sequential grafts was found to be satisfactory. No statistical significance between skeletonised and pedicled IMA based anastomoses could be found.

Suboptimal readings were found in (28/677, 4.1%) grafts. Competitive flow was diagnosed in four grafts (0.59%) and only one was revised. In group A, seven out of 17 (1.5%) total grafts were revised. While in group B, three out of 11 (1.4%) grafts were revised. Findings of graft revision revealed competitive flow, graft tension, conduit spasm and dissection. Seven patients required intra-aortic balloon pump support. Five patients had myocardial infarction (all in group A). Mortality following non-emergent surgery (7/230, 3.04%) was significantly higher in patients with LIMA–LAD graft where was PI >5, while flow and DF% were not predictive of outcomes after multivariate analysis.

We interpreted our findings as being yet another piece of compelling evidence supporting satisfactory use of multiple arterial conduits in CABG, mainly on the left coronary system. They suggested that grafts with these readings should be re-assessed and that revision may be appropriate.

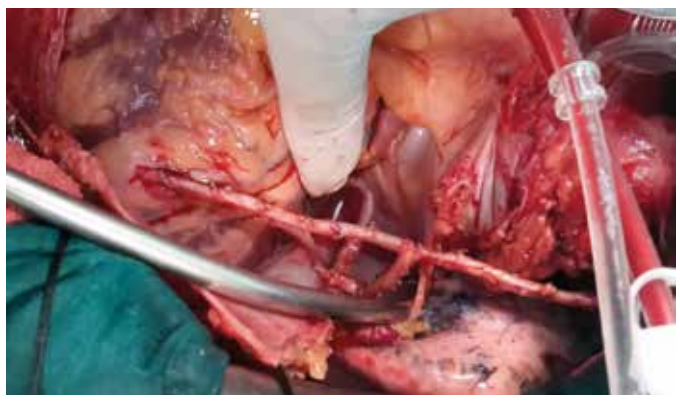

Figure 1. Intraoperative image of a composite TY graft for triple vessel disease
The *in-situ* LIMA (right) was anastomosed side to end with free RIMA as a Y graft, at the level of the pulmonary valve. The LIMA was anastomosed end to side with the LAD (left). The RIMA was anastomosed to the OM, and another segment of RIMA was anastomosed end to side to the RIMA making a T graft, and distally anastomosed to the Ramus Intermedius branch.

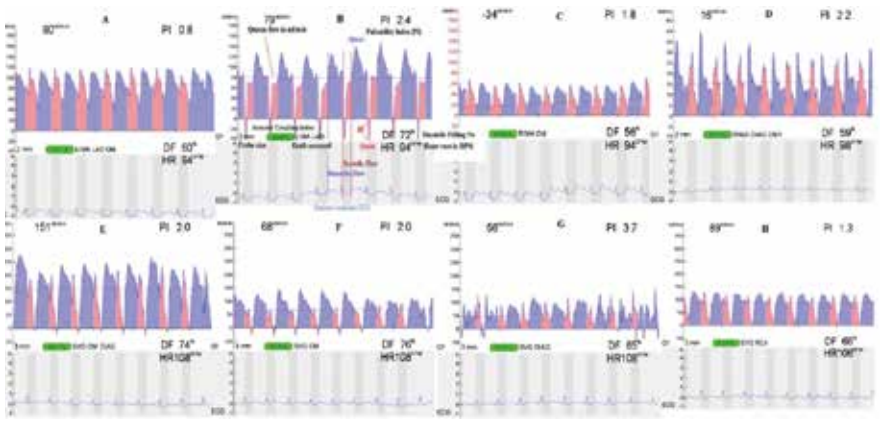

Figure 2. Tracing of optimal TTF patterns in different coronary grafts.
(A) LIMA–LAD/RIMA–OM Y graft inflow source; (B) labelled LIMA–LAD branch tracing of the same Y graft; (C) RIMA–OM branch of the same Y graft; (D) sequential arterial graft; (E) sequential SVG to the LCA system; (F) SVG–OM; (G) SVG–diagonal; (H) SVG–RCA.

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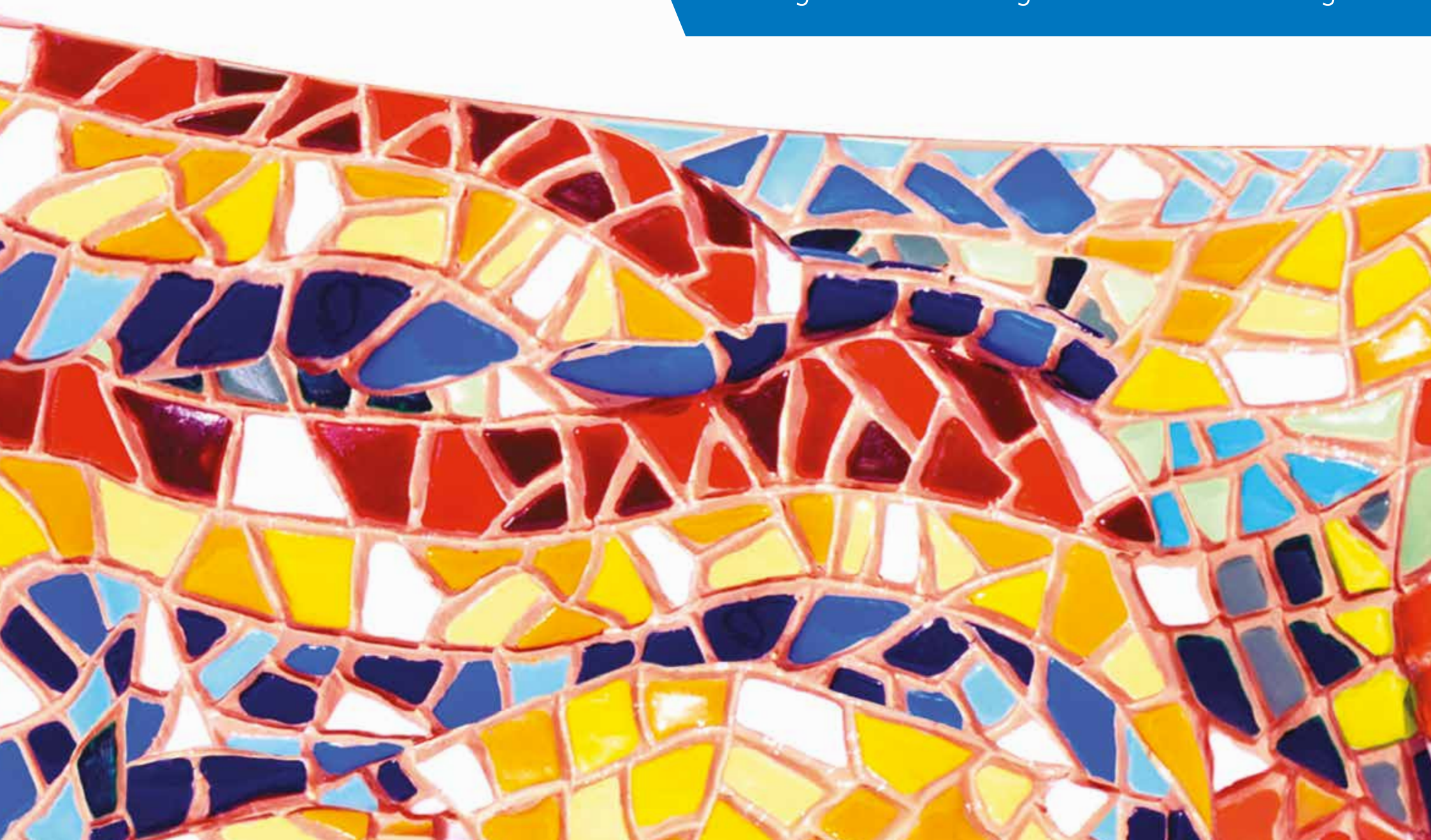


Cardiac – Rapid Response: General cardiac

Ganglion plexi-pulmonary artery ablation in mitral valve surgery patients with pulmonary artery hypertension

Alexander Bogachev-Prokophiev, Sergey Zheleznev, Alexander Afanasyev, Michail Fomenko, Denis Demidov, Ravil Sharifulin, Alexey Pivkin, Sergey Ivanov, Alexander Karaskov State Research Institute of Circulation Pathology, Novosibirsk, Russian Federation

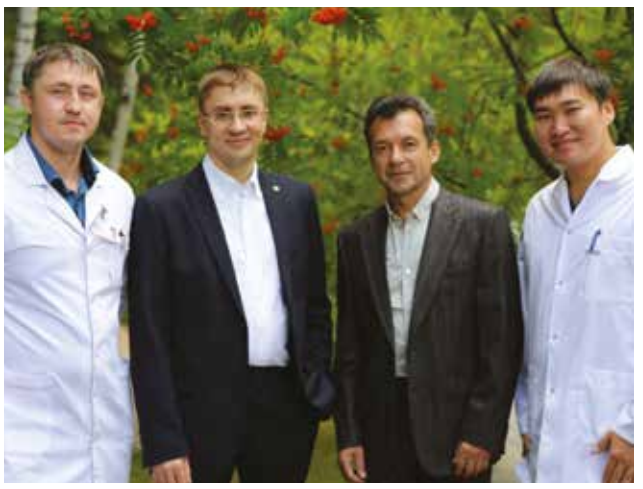
Pulmonary hypertension (PH) has been defined as an increase in mean pulmonary arterial pressure (PAP) ≥25 mmHg at rest, as assessed by right heart catheterisation. PH associated with left heart disease results in more severe symptoms and worse exercise tolerance, and exerts a negative effect on patient outcomes. Previous studies have shown that distension of the main pulmonary artery (PA) stimulates pulmonary stretch receptors located in or near the bifurcation area of the PA.

We initiated a study to evaluate the safety and efficacy of concomitant PA ganglion plexi (GP) ablation in patients with mitral valve disease and high PH. From January 2014 to December 2014, 14 patients with mitral valve disease and severe PH were enrolled in the study. Recruitment was based on right heart catheterisation, although pre-screening by echocardiography was also considered.

Eligibility criteria for concomitant PA-GP ablation were mean PAP ≥40 mmHg at rest and a positive-reactive test with nitric oxide inhalation. Chronic obstructive pulmonary disease (COPG) and pulmonary thromboembolic anamnesis were exclusion criteria in the study enrolment protocol. Six male and eight female patients (mean age 53.4±7.8 years) underwent concomitant GP ablation of the PA at the time of elective cardiac surgery. The ablation procedure was performed epicardially at the bifurcation of the main PA, and 10 mm distal to the right and left PAs (Figure 1) using a dry multifunctional radiofrequency pen (AtriCure® Inc., West Chester, OH, USA) in all patients. Tissue ablation was performed by applying constant firm pressure to the target tissue without movement. Ablation was terminated after a period of 60 seconds at each point (Figure 2). PA GP ablation time was 9.5±3.1 minutes.

There were no early deaths. We observed sPAP, dPAP, and mPAP significantly decreasing immediately after the operation and on the first and third ICU days, compared with baseline data (Table 1). The incidence of early atrial fibrillation paroxysms was 4/14 (28%), which required electrical cardioversion in one (7.1%) case. Pacemaker implantation owing to sinus node dysfunction was required in one patient. All the other patients were discharged with stable sinus rhythm. Pleural effusion was observed in two patients (14.3%). PA-GP ablation–related complications (e.g. PA perforation, PA dissection and PA thrombosis by MDCT assessment) were not observed. There were no incidents of transient ischaemic attack or stroke, or deep sternal infection.

We conclude concomitant pulmonary artery ganglion plexi ablation mitral valve surgery in patients with high pulmonary hypertension is safe and effective. Further study with longer-term follow-up may determine whether lower levels of mean pulmonary artery pressure translate into clinical benefits.



Right to left: M Fomenko, A Bogachev-Prokophiev, S Zheleznev, and A Afanasyev.

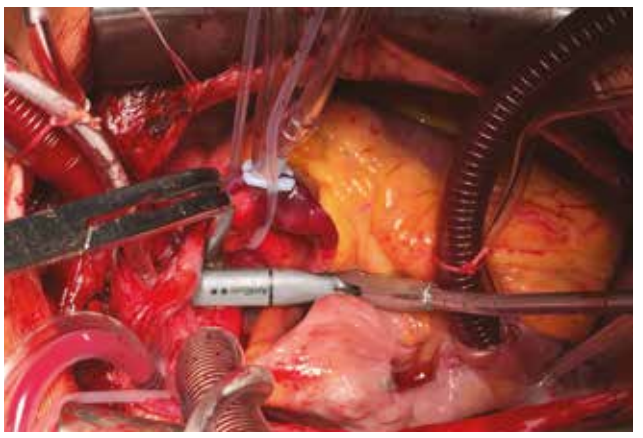


Figure 1. Epicardial pulmonary artery GP ablation around the ostial right PAs.

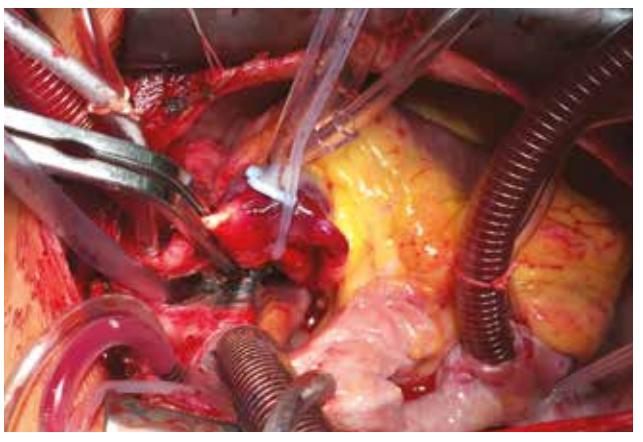


Figure 2. Adventitial tissue damage after ostial right PAs ablation.

Table 1. Right heart catheterisation data

	sPAP, mmHg	dPAP, mmHg	mPAP, mmHg	PAOP, mmHg	CO, l/min × m^2	PVR, Wood units	TPG, mmHg	DPD, mmHg
Baseline	92.6±18.4	44.1±14.9	59.5±9.8	33.6±9.7	2.4±0.9	10.8±3.6	25.9±7.8	10.3±0.8
Immediately after surgery	54.2±17.2*	25.4±7.8*	32.0±7.3*	15.9±5.2*	2.4±1.2	6.9±2.3*	15.8±8.8*	7.8±2.1*
ICU stay: 1 day	47.3±12.1*	21.6±8.3*	28.4±5.2*	15.2±4.9*	2.4±1.1	5.4±1.7*	13.4±6.6*	6.1±0.5*
3 days	46.4±13.3*	22.4±6.7*	29.7±4,4*	14.6±5.2*	2.4±1.0	6.1±2.2*	14.6±7.4*	7.2±0.7*

*Significantly decreased from baseline (p<0.05).

Cardiac – Abstract: Left ventricular assist device: latest advances

High survival, low adverse event profile observed in early HeartMate 3™ CE mark trial data. *A 30-day analysis of 50 patients*

Daniel Zimpfer Medical University Vienna, Austria

The Thoratec® HeartMate 3™ left ventricular assist system (LVAS) is an investigational, chronic mechanical circulatory support (MCS) device intended for a broad range of advanced heart failure patients.

The HeartMate 3™ CE mark clinical trial is a single-arm, prospective, multi-centre, non-blinded and non-randomised study. The device is being evaluated for use as a long-term support option (years) for patients who are not candidates for cardiac transplantation (also known as destination therapy), for shorter-term support options, for patients awaiting transplantation (bridge to transplantation) and for myocardial recovery. The primary study objective is to evaluate the performance and safety of the HeartMate™ 3 LVAS at six months of support in subjects with advanced heart failure.

The HeartMate™ 3 CE mark clinical trial enrolled 50 patients at 10 sites in six countries, including Austria, Germany, Czech Republic, Kazakhstan, Australia and Canada. Enrollment of the 50 patients began June 25, 2014 and was completed November 27, 2014.

Subjects are currently being followed to the primary endpoint of six months or outcome (transplant, explant or death), whichever occurs first. Subjects who remain ongoing after six months will continue to be followed to 24 months post-implant or outcome, whichever occurs first. After a systematic review of 30-day data relative to the 50 patients treated with the device as part of the HeartMate™ 3 CE mark trial, a survival rate of 98% was noted in a mixed bridge to transplantation (BTT) and destination therapy (DT) cohort. An acceptable adverse event profile was observed. Most notably, there was no haemolysis, pump malfunction or pump thrombosis. Follow-up continues on these patients.

It was concluded that – in addition to appropriate patient selection – the new design of the HeartMate™ 3 is a strong contributing factor to the exceptional results we have observed thus far.

A few key features of the HeartMate™ 3 include:

- Blood compatibility. The design of the HeartMate™ 3 includes large blood flow gaps (passages) designed to reduce blood trauma.
  - Textured blood-contacting surfaces. This encourages a tissue-to-blood interface that potentially reduces complications. Like inside the heart, blood is in contact with tissue and not an artificial material.
  - Fully Mag Lev™ (magnetically-levitated) technology allows the device's rotor to be 'suspended' by magnetic forces. Since the parts 'float', there is no friction and therefore less wear and tear on the rotor. This contact-free environment is designed to help minimise complications.
  - Artificial pulse technology may impact a reduction in clinical adverse events. The artificial pulse may also assist with pump washing, with the goal of reducing the possibility of blood clotting, which can lead to thrombus formation.
- Advanced design for surgical ease. HeartMate™ 3 incorporates advanced technology to enhance the surgical experience including an engineered apical cuff, designed to allow for ease of implantation.
- Designed for an active lifestyle. The HeartMate™ 3 controller provides a small, safe, smart patient interface for the HeartMate™ 3 LVAS. It features single-sided cables, so it discreetly slips into a front pocket for easier cable management.

Dr Daniel Zimpfer will present 30-day results relative to a 50-patient cohort treated with the device as part of the HeartMate™ 3 CE mark trial on Tuesday, October 6, 14:15–15:45 during the session 'Left Ventricular Assist Device: Latest Advances'.

Cardiac – Abstract: What is new in transcatheter aortic valve implantation

Insights from a multicentre, prospective study

Elias Bonaros Long Island Jewish Medical Center and NorthShore University Hospital, New York, USA

Transcatheter aortic valve implantation (TAVI) has become an accepted alternative to surgical aortic valve replacement in inoperable and high-risk patients with severe aortic stenosis. Although the availability of low profile catheters allows a transfemoral (TF) approach in the majority of cases, there is still a need for alternative routes in more than a third of TAVI candidates. The transapical (TA) access is considered to be the first-line alternative, however, it is associated with a left-sided thoracotomy and myocardial injury. Contraindications such as severe lung disease, previous left-sided thoracotomy, and severely impaired left ventricular function or presence of left ventricular aneurysm, are not uncommon.

The use of a transaortic approach (TAo) as an access route is considered a logical alternative: firstly because it represents a widely used access in cardiac surgery, and secondly because it requires only a limited incision for exposure of the distal part of the ascending aorta. There is an increasing body of evidence to suggest that TAo-TAVI has a number of advantages over transfemoral and transapical procedures. Device success and access-related complications are reported to be equivalent for both direct approaches (TA and TAo).[1,2] These results encouraged many centres to use TAo-TAVI as a default approach for TAVI.

The **R**egistry **O**f the **U**tilisation of the **T**Ao-TAVI approach using the **E**dwards SAPIEN Valve (ROUTE) is a multicentre, multinational prospective database aiming to evaluate the 30-day and 12-month outcomes after TAo-TAVI using a balloon expandable valve. The present study uses data from the ROUTE-Registry to compare the perioperative outcome between patients who underwent TAo-TAVI as a first-line procedure (TAo-first) versus those who had TAo-TAVI as last resort, due to contraindications to other routes (TAo-last).

Out of the 271 patients enrolled in ROUTE, 137 had contraindications to TF- and TA-TAVI and were therefore included in the TAo-last group. For the remaining 134 patients, the use of transaortic access was the default procedure at the site and was therefore considered first-line treatment (TAo-first). Demographic data revealed no significant differences between the groups, except for the incidence of peripheral vascular disease, which was found to be higher in the TAo-last group (51% vs 36%; p=0.01). Out of the 134 TAo-first patients, 98.5% and 21.6% would have been suitable for a TA or TF approach, respectively.

The ascending aorta was accessed through upper ministernotomy or right anterior thoracotomy in 95.6% and 3.7% of the patients, respectively. The mean duration of the procedure, the amount of contrast used and fluoroscopy time were lower in TAo-first compared with TAo-last patients. Conversion to surgical aortic valve replacement, access complications and the incidence of paravalvular regurgitation >mild was similar in both groups. It is noteworthy that need for pre- and post-balloon dilatation did not differ between the groups. Overall mortality was found to be low in both groups (8.5% vs 6.3% in the TAo-last and TAo-first groups, respectively; p=0.840). Outcome at 30 days according to the VARC II criteria are summarised in Table 1 and revealed a tendency to higher device success rates in the TAo-first group compared with the TAo-last group (p=0.08). The incidence of complications at 30 days was low and roughly equivalent between the two groups, and did not differ from data previously reported.

These data indicate that the efficacy and safety of TAo-TAVI are independent of the presence of contraindications for TF- or TA-TAVI. Although mortality was comparable to that reported for TA procedures and slightly higher than observed for TF procedures, rates of adverse events were similar. Our results demonstrate that the TAo access has the same safety and efficacy profile as TA access and can be used as a first-line approach in TAVI candidates. Further studies are needed to determine the value of the TAo route in patients with specific comorbidities, such as severe pulmonary disease, impaired left ventricular function or porcelain aorta.

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Cardiac – Abstract: Functional mitral regurgitation

Long-term results of mitral repair in patients with severe left ventricular dysfunction and secondary mitral regurgitation: does the technique matter?

Michele De Bonis
IRCCS San Raffaele University Hospital, Milan, Italy

The choice of treatment in secondary mitral repair (MR) remains controversial. Surgical correction can improve symptoms and quality of life, and reverse left ventricular (LV) remodelling in selected patients. However, a clear prognostic benefit compared with optimal medical therapy has not been demonstrated.

MR performed with an undersized rigid complete ring has been considered the reference standard for many years. The main disadvantage is the risk of recurrent MR, which may underlie the lack of observed survival benefit. Several predictors of recurrent MR have been identified over the years and should be considered during patient selection. In particular, more advanced leaflet tethering is an important predictor of repair failure, and recurrent MR and concomitant techniques to improve durability have been described. These include resection of secondary chordae, suturing of the posteromedial papillary muscle to the aorto-mitral continuity, infarct plication, papillary muscle imbrication or sling, posterior LV restoration and the edge-to-edge (EE) technique.

In our early experience of surgeries of this nature, one of the few predictors of repair failure that had been identified was a coaptation depth of the mitral valve leaflets ≥1 cm. At that time, therefore, the policy followed in our institution was to treat secondary MR using an isolated undersized annuloplasty if the coaptation depth was <1 cm. By contrast, in the presence of significant tethering of the mitral leaflets (coaptation depth ≥1 cm), the EE technique was routinely combined with the annuloplasty procedure, with the aim of improving the durability of the repair. Since the long-term results of this approach are unknown, we decided to look at the late clinical and echocardiographic outcome of the first 105 consecutive patients treated with this strategy.

The surgical patients enrolled in this analysis were treated at a time when the MitraClip was not yet available and, therefore, surgery was the only treatment option, even for cases at high surgical risk due to severe LV remodelling and dysfunction. Not surprisingly, most of the patients were in NYHA Class III or IV, the mean ejection fraction (EF) was 29±6.6%, mean LV end diastolic diameter (LVEDD) was 68±7.1 mm, and mean LV end diastolic volume (LVEDV) approached 200 mL. The majority of patients had pulmonary hypertension and approximately one third were in atrial fibrillation. Depending on the severity of tethering, 40 patients received an isolated undersized annuloplasty (annuloplasty group) and 65 patients were treated with the EE technique combined with annuloplasty (EE group). Baseline LV dimensions and function were slightly worse in the EE group, but only the severity of tethering was significantly more pronounced compared with the annuloplasty group. Clinical and echocardiographic follow-up (median duration 7.2 years) was performed in a dedicated outpatient clinic. Hospital mortality was similar in the EE and isolated annuloplasty groups (3% vs 2.5%; p=1.0). Freedom from recurrence of MR ≥3+ at 10 years was higher in the EE patients (86±5.6% vs 63±9.3%; p=0.02). At multivariate analysis, independent predictors of recurrence of MR ≥3 were residual MR >1+ at hospital discharge (HR 9.6; 95% CI 3.5–26.2; p=0.0001) and isolated annuloplasty (HR 2.6; 95% CI 0.9–7.1; p=0.05). Interestingly, the 10-year overall survival (42±6.7% vs 55±8.5%; p=0.2) and freedom from cardiac death (62±6.7% vs 64±8.8%; p=0.3) were not significantly different in the EE and annuloplasty groups, respectively.

Failure of repair was associated with recurrence of NYHA III or IV and most of the cardiac deaths were due to congestive heart failure. Therefore, in this series, the association of the EE technique to the undersized annuloplasty significantly decreased the rate of recurrent MR at long-term follow-up. However, a surprising and apparently contradictory finding was that this higher repair durability did not translate into a better long-term survival. One possible reason might be found in the small number of patients compared. Another explanation could be represented by the advanced stage of the disease affecting our study population, whose negative prognostic implications have possibly nullified the survival benefit expected from the greater effectiveness of the EE repair.

Cardiac – Abstract: Degenerative mitral regurgitation

Early outcomes after mitral valve repair versus replacement in the elderly: a propensity-matched analysis

Shakil Farid, Hannah Povey, Andrew Ladwiniec, Edward Caruana, Ayyaz Ali, Narain Moorjani , Yasir Abu-Omar
Papworth Hospital, Papworth Everard, Cambridge, UK

Objective: To compare early outcomes of mitral valve repair versus replacement in elderly patients with degenerative mitral valve disease.

Methods: A retrospective review of prospectively collected clinical data of patients over 75 years of age, who underwent mitral valve surgery for degenerative disease between 2010 and 2013, was carried out. Propensity matching was conducted and the co-variants included in the logistic regression model to calculate the propensity score were: logistic EuroSCORE, age, gender, left ventricular ejection fraction, urgency, renal function, history of cerebrovascular disease and diabetes mellitus.

Results: A total 260 patients were identified – 145 underwent mitral valve repair and 115 mitral valve replacement. After propensity matching, 78 patients were included in each group. In the unmatched group, the in-hospital mortality was significantly higher in the replacement group compared with the repair group (9.6% vs 1.4%; p=0.003). In-hospital death occurred in six cases (7.7%) in the propensity matched replacement group, and none in the repair group (p=0.012). Among the propensity matched groups, mortality at 12 months was 4/78 (5.1%) in the repair group and 12/78 (15.4%) in the replacement group (HR 3.25; 95% CI 1.06–9.97; p=0.039) (Figure 1).

Conclusions: Within the limitations imposed by retrospective analyses, our study demonstrates a significant short-term survival advantage of mitral valve repair over replacement for degenerative disease in the elderly.

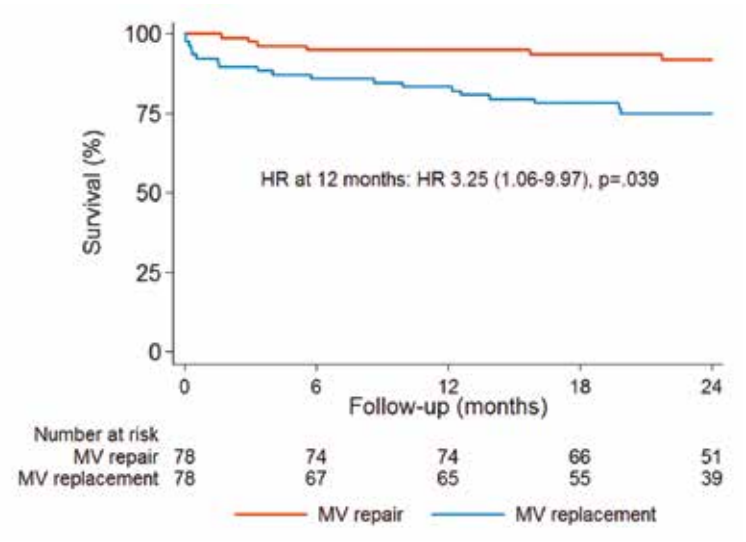


Figure 1. Kaplan–Meier curves showing survival rates for propensity-matched patients with mitral valve repair or replacement.

Vascular – Rapid Response: Innovation and new strategies in thoracic aortic surgery

Unilateral antegrade cerebral perfusion and moderate hypothermia: safety at the molecular level

Ertekin Utku Unal
Yuksek Ihtisas Training and Research Hospital, Ankara, Turkey

Cerebral protection has been maintained using several techniques in the last 50 years. With advanced surgical techniques and cerebral protection methods, antegrade cerebral perfusion (ACP) is the preferred technique with a high quality of evidence. However there are two compelling points about ACP; the degree of hypothermia and the unilateral or bilateral perfusion of the brain. Some surgeons may feel comfortable using lower temperatures, but there is high quality evidence for the non-inferiority of moderate hypothermia for cerebral protection. We have been performing thoracic aortic procedures at moderate hypothermia (28°C) for more than a decade. Unilateral ACP has some advantages such as its easiness and avoiding manipulation of supraaortic vessels. But there are some concerns about the perfusion of the contralateral side because of incompleteness of the Willis polygon. This study investigated the safety of unilateral ACP at molecular level with novel biomarkers of oxidative stress and inflammation.

Thirty consecutive ascending aortic aneurysm patients were prospectively enrolled in the study. Cerebral protection was maintained unilaterally through right proximal brachial artery cannulation at moderate hypothermia (28°C) according to our previously described protocol.[1] A left internal jugular vein catheter was routinely inserted for each patient after induction. In addition another catheter was placed to the right internal jugular vein through the superior vena cava at the operative field. Blood samples from these catheters were taken at four time periods (before, during and after cardiopulmonary bypass and during ACP). Right and left jugular venous oxygen saturations, lactate and glucose levels and novel biomarkers of oxidative stress (advanced oxidative protein products, ischaemia-modified albumin, sialic acid and total thiol levels) were measured from collected samples. Additionally regional oxygen saturation values of both hemispheres were recorded using near-infrared spectroscopy. All distal anastomoses were performed under low flow at ACP as open distal anastomosis. The mean ACP period was 16.4±6.0 min. There was no difference between right and left hemispheric samples with regard to aforementioned parameters.

Comparison of the values from two hemispheres indicated that the perfusion of the contralateral side was adequate and the oxidative stress and inflammation level did not differ from the primarily perfused hemisphere. This may mean that there is no threat for the other side. However, these results must be confirmed for longer periods of ACP, and the surgeon must be converted to using bilateral ACP for long periods.

Thanks to the wider usage of ACP and evidence of its safety, more extensive replacement of the aortic tissue is possible.

A secondary interpretation of the study findings may provide insights about open distal anastomosis which we perform extensively. Open distal anastomosis during low flow of ACP provides some advantages such as inspection of the aortic arch from inside, avoidance of cross-clamp injury and performing anastomosis with greater care, leading to avoidance of bleeding and elimination of distortion. We strongly suggest extensive aortic replacement (i.e., hemiarch replacement usually lasting at 15 min) with open distal anastomosis even in isolated ascending aortic pathology.

The molecular level of oxidative stress and inflammation show that there is no difference between right and left cerebral hemispheres during unilateral ACP. We therefore conclude that unilateral ACP can be used safely for aortic procedures at least for the given time period.

Reference

1. Tasdemir O, Saritas A, Kucuker S, et al. Aortic arch repair with right brachial artery perfusion. *Ann Thorac Surg* 2002;73:1837–1842.

Meeting EACTS – National Societies

Date: Tuesday 6 October 2015

Time: 16:15–17:15

Venue: Room G108
Auditorium Building (1st floor)

RAI Congress Centre
Amsterdam (The Netherlands)

Agenda

1. **Welcome and introduction** (M Grabenwöger)
2. **EACTS QUIP** (D Pagano)
   - 2.1. Database
   - 2.2. Benchmarking tool
3. **Training and education** (A Kappetein)
   - 3.1. Courses
   - 3.2. Skills programme
   - 3.3. Portfolio
4. **Clinical guidelines** (M Sousa Uva)
5. **Adjournment**

EACTS
European Association For Cardio-Thoracic Surgery

Thoracic – Abstract: Lung transplantation

Zonal organ allocation system and its impact on long-term outcomes after lung transplantation: a propensity score matched analysis

Mohamed Zeriouh Royal Brompton & Harefield NHS Foundation Trust, Harefield, Middlesex, United Kingdom

Donor organ procurement for cardiothoracic transplantation represents a specific and systematised operative procedure necessitating special training and skills. Until the early 1990s, surgical teams at transplant centres in the UK were also responsible for retrieving organs in donor hospitals. This strategy is still practised in most European countries and is the standard for thoracic organs.

The UK's NHS Blood and Transplant modified the national standard organ retrieval protocol, and introduced geographical organ zones enabling a more rational allocation system for donated organs. Each transplant centre became responsible for retrieving organs from an identified area of the country for all transplant centres. Furthermore, donated organs within the geographical zone of each transplant centre were offered first to those centres before being offered to other UK centres. The idea behind the implementation of these regional arrangements was to avoid long travel times, reduce costs and to optimise co-ordination of organ and tissue retrieval. This strategy, however, might be associated with several drawbacks e.g., miscommunication among teams. In many cases organs are procured by 'foreign' teams and then sent for transplantation to the implanting centre.

The aim of this study was to assess the impact of the regional organ allocation system on early and long-term outcomes after lung transplantation (LTx), including overall survival and freedom from bronchiolitis obliterans syndrome (BOS). We included 331 consecutive patients who underwent LTx at our institution between January 2007 and January 2015. Recipients were divided into two groups depending on the organ retrieval team: 204 (61.6%) patients were transplanted using lungs procured by our institutional group whereas 127 (38.4%) organs were retrieved by other external groups from experienced UK transplant centres. To exclude selection bias and other confounders, 1:1 propensity score-based matching was used yielding 238 donors and recipients who were well matched for baseline characteristics. The primary endpoints were overall survival after LTx and freedom from BOS. Secondary endpoints were perioperative clinical characteristics as well as adverse events documented over the follow-up. After propensity score matching all donor characteristics and all baseline recipient characteristics were statistically similar between the two groups. Other potential confounders, such as total ischaemic time, redo procedures, percentage of donation after cardiac death, operative strategy (on-pump, off-pump or the need for intraoperative conversion from off-pump to on-pump), and the use of *ex vivo* lung perfusion or organ care system showed no statistical difference between groups.

In terms of early postoperative results, both groups were statistically comparable. However, there was a trend towards higher incidence of primary graft dysfunction (PGD) in the external group (p=0.054). Regarding long-term results with up to 7 years of follow-up, overall survival also appeared to be poorer in the external group, however this difference did not reach statistical significance (Figure 1), whereas freedom from BOS was significantly poorer in the external group (Figure 2).

The regional allocation system might be associated with several problems in terms of poor communication between 'foreign' retrieval teams and implanting surgeons. Despite excellent early outcomes this allocation system might be associated with significantly poorer long-term outcomes in terms of freedom from BOS and potentially overall survival after LTx. Further research is definitely needed to confirm our preliminary results.

Figure 1.

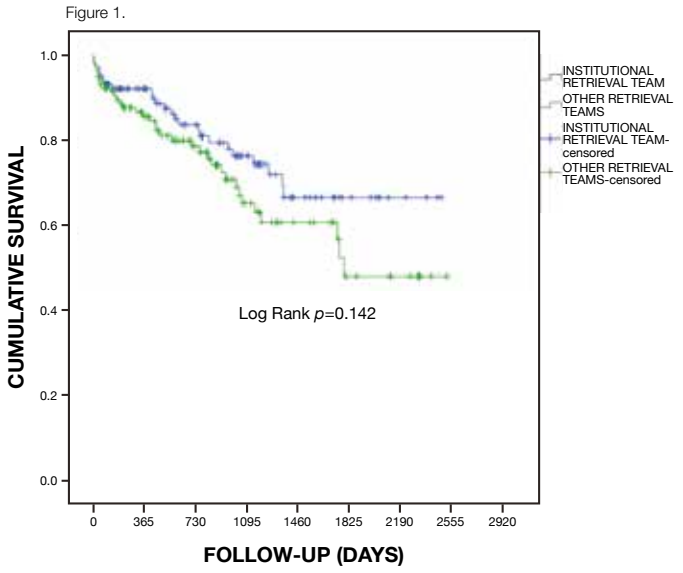
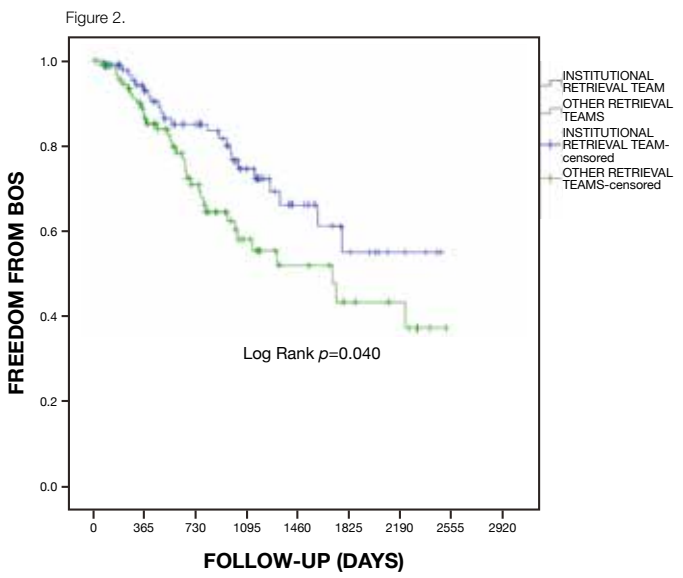


Figure 2.



Cardiac – Abstract: Degenerative mitral regurgitation

Long-term results of mitral valve surgery for degenerative anterior leaflet or bileaflet prolapse: negative factors for repair; early and late failures of repair; and survival analysis

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University Hospital of Coimbra, Portugal

Mitral valve (MV) repair is the procedure of choice to treat severe mitral regurgitation (MR) of degenerative aetiology, due to its known advantages regarding: the preservation of left ventricular function; greater freedom from valve-related complications (endocarditis, thromboembolism and anticoagulant-related bleeding); and, most importantly, improved chances of long-term survival. Successful repair of the posterior leaflet has been well reported, and in centres of excellence can reach nearly 100%. MR due to anterior leaflet prolapse (ALP) or bileaflet prolapse (BLP) is recognised as more demanding to repair and the literature is scarce regarding the causes of both the inability to repair and failure of the repair. We have evaluated the feasibility of MV repair (MVRep) in patients with ALP or BLP and the long-term outcomes after surgery regarding survival and freedom from mitral reoperation, in comparison with patients that underwent MV replacement (MVR).

From January 1992 – December 2012, 768 patients with ALP or BLP underwent MV surgery. The study population comprised the 501 of those patients that had degenerative involvement (of which 336 [67.1%] had myxomatous and 165 [32.9%] fibroelastic deficiency). Isolated ALP was present in 274 patients (54.7%) and BLP in 227 (45.3%) (Table 1). All other associated procedures, apart from MV surgery, were omitted. Barlow's disease, defined as severe myxomatous involvement, with multiple prolapsing segments, elongated chordae and severe annular enlargement, was present in 114 patients (33.9%). Patients with fibroelastic deficiency were significantly older, more symptomatic and with higher incidence of atrial fibrillation. The central scallops of each leaflet (A2 and P2) were the most frequently involved. Isolated ALP was commonly encountered in cases of fibroelastic deficiency and BLP in myxomatous disease. MVRep was achieved in 94.8% of patients with an overall 30-day mortality rate of 1.8% (worse in MVR patients, $p<0.001$) and no differences regarding the mitral etiology. However, in the last decade only one patient died following MVRep (0.3%). Age, moderate-to-severe LV dysfunction, previous cardiac surgery, multiple segment prolapses and mitral calcification were identified as independent negative factors to the successful repair of the MV. MVRep patients had a greater adjusted 20-year survival rate compared with MVR patients ($p<0.001$; Figure 1) and an expected survival rate similar to the general population (age- and sex-adjusted, $p=0.1$; Figure 2). MVR, NYHA III–IV, pulmonary hypertension and LV dysfunction emerged as independent predictors of late mortality. Two patients had early failure (<1 year) of repair due to technical failures and in both cases the MV was re-repaired. Late failure was observed in 31 patients, the reasons being disease progression, technical failure, material failure and endocarditis (Table 2). Freedom from reoperation (5-, 10- and 20-years) was 98.6±0.6%, 92.7±1.7% and 88±2.7%, respectively, and significantly worse in ALP patients ($p=0.03$).

In conclusion, this study showed that ALP and BLP can be repaired in the majority of patients with durable long-term results. Patients that underwent MVRep had similar survival rates to those expected of the general population. On the contrary, MVR was identified as an independent predictor of late mortality and the survival rate for patients that underwent MVR decreased significantly compared with those in the MVRep group. Early failures of repair are often due to technical failure and can usually be re-repaired, whereas late failures are often a consequence of disease progression and therefore more likely to be replaced in the reoperation.

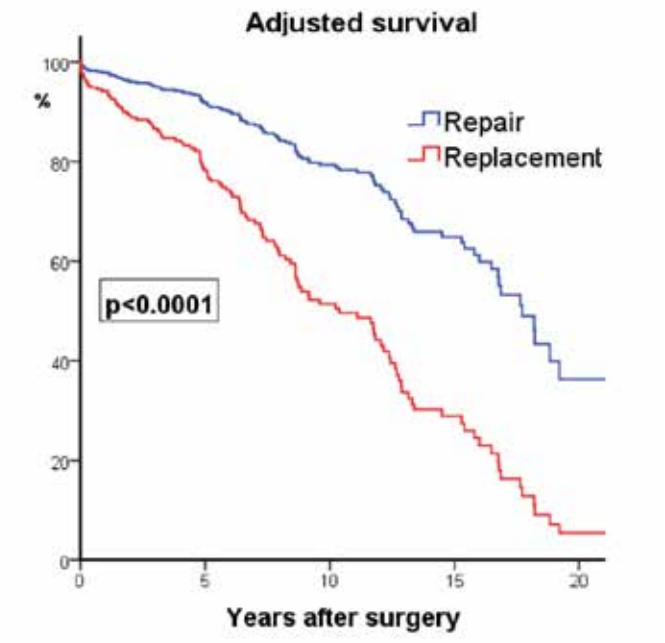

Figure 1.

Table 1. Study population

Variables	Myxomatous D. n=336	Fibroelastic D. n=165	*p* value
Demographic			
Age (years)	**54.8±15.5**	**64.4±12.1**	**<0.0001**
Male gender	242 (72.2%)	111 (66.9%)	0.215
NYHA III–IV	149 (44.5%)	104 (62.7%)	<0.0001
Previous cardiac surgery	12 (1.6%)	16 (3.9%)	0.018
Tricuspid pathology (Reg ≥2+)	45 (13.4%)	49 (29.5%)	<0.0001
Aortic valve disease	28 (8.4%)	29 (17.5%)	0.003
Coronary artery disease	27 (8.1%)	29 (17.5%)	<0.0001
Hypertension	79 (23.6%)	63 (38.0%)	0.001
Atrial fibrillation	88 (28.1%)	72 (45.9%)	<0.0001
Echocardiographic			
Ejection fraction (%)	64.3±10.9	61.0±13.0	<0.0001
LV dysfunction (EF <45%)	19 (5.7%)	20 (12.0%)	0.012
Left atrium (mm)	53.1±10.5	54.8±11.1	0.158
LV (systolic) (mm)	39.9±6.9	41.7±7.9	0.029
LV (diastolic) (mm)	63.9±8.1	64.0±8.3	0.927
PASP (mmHg)	47.8±18.0	53.0±17.8	0.007

Table 2. Causes of late failure of MVR

Causes of reoperation	n (%)
Technical failure	**7 (30.4%)**
Ring dehiscence	5 (21.7%)
Suture dehiscence	2 (8.7%)
Material failure (Gore-Tex neo-chordae rupture)	**6 (26.1%)**
Disease progression	**16 (69.6%)**
Fibrosis/leaflet retraction	7 (30.5%)
New prolapses (native chordae rupture)	9 (39.1%)
Endocarditis	**2 (8.7%)**

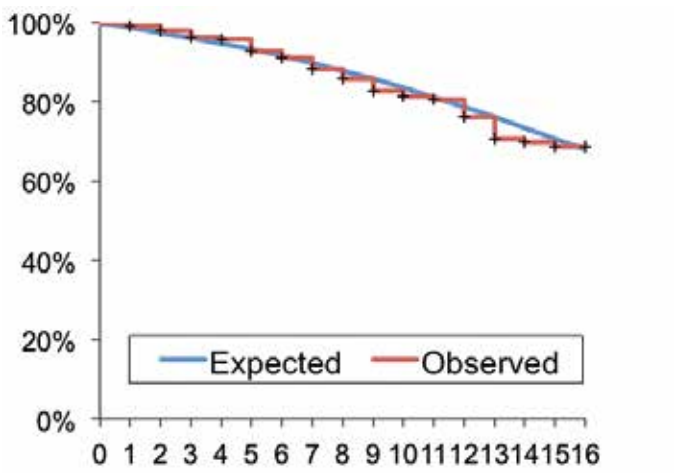

Figure 2.

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Cardiac – Rapid Response: General cardiac

Pulmonary endarterectomy is effective and safe in patients with haemoglobinopathies and abnormal red blood cells: the Papworth experience?

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Department of Cardiothoracic Surgery,[1] Anaesthesiology,[2] Haematology[3] and Pulmonary Vascular Diseases Unit,[4] Papworth Hospital, Cambridge, United Kingdom

Pulmonary endarterectomy (PEA) is well established as the best treatment for patients with chronic thromboembolic pulmonary hypertension (CTEPH). However, patients with haemoglobinopathies constitute a unique population, being more predisposed to developing chronic thromboembolic pulmonary hypertension whilst having other reasons for PH. In addition, as these patients are more likely to have absent or dysfunctional spleens, they have more distal thrombo-embolic disease, which makes surgery more technically demanding. Procedures involving deep hypothermic circulatory arrest (DHCA) are more challenging in these patients due to the effects of cooling on their physiology. Patients with abnormal red cell diseases have additional unique problems when exposed to hypothermia and prolonged cardiopulmonary bypass (CPB).

Apart from a few isolated case reports, the results of PEA in these patient populations have not been previously reported, and it has been argued that the risk of PEA may be higher and the potential benefit reduced. We are sharing our knowledge through our experience in managing these complex patients.

Between the start of our PEA programme in 1997 and April 2015, we have performed PEA in 18 patients (1.4% of our total experience) with haemoglobinopathies or congenital haemolytic anaemia. Mean age was 52±16 years. Eleven patients (61%) were male. There were seven patients with sickle cell trait, two patients with combined sickle trait-alpha thalassemia, one patient with HbSC disease, two patients with betathalassemia major, three patients with hereditary spherocytosis, two patients with hereditary stomatocytosis (one of whom had cryohydrocytosis) and one patient with HbC trait. PEA was performed at 20°C, using DHCA in all patients.

Median ICU stay was 4.5±4.75 days and median hospital stay was 22±11 days. The surgical clearance was good in all but one patient, who required postoperative extra-corporeal membrane oxygenation support; this patient weaned from ECMO, but eventually died of complications 81 days later. The remaining 17 patients are alive at 3.4±3 years, which represents a 94.4% survival rate.

Immediately following surgery, the patients showed a 75% drop in pulmonary vascular resistance [972±449 to 273±162 dyne·sec·cm^{-5}; p<0.001]. Six months following surgery, the patients showed a significant improvement in NYHA status, and almost doubled their six-minute walk distance. Correspondingly, there was a significant improvement in the pulmonary haemodynamic parameters: mean right atrial and pulmonary arterial pressures dropped by half, whilst the pulmonary vascular resistance dropped by two thirds compared with preoperative levels.

Patients with sickle cell diseases are at risk of sickling crisis during DHCA due to predisposition of the abnormal haemoglobin-S laden erythrocytes to undergo sickling in hypothermic conditions, sludging in the microcirculation, and leading to micro-infarcts. The mean HbS fraction was 33.3±7% prior to surgery. Exchange transfusions to reduce HbS <10% remain the mainstay of our protocol for PEA in sickle cell patients, along with correction of anaemia to raise the level of HbA to 100 grams/litre. Over time, our experience included different techniques to achieve this, initially with five patients receiving a partial exchange transfusion of a mean of 10.4±3 blood units per week before PEA, and more recently, with five patients receiving a partial exchange transfusion of a mean of 3.7±1.2 blood units immediately prior to CPB. The variation in approach was caused by evolution of practice over time, as we accumulated institutional experience with this population.

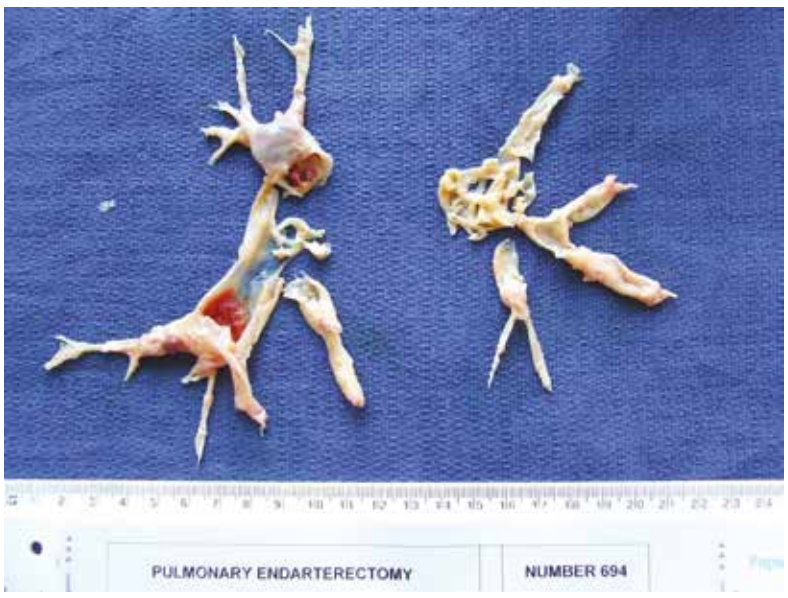

Figure 1.

In conclusion, as we have demonstrated, the results of PEA in these complex patients are excellent, with outcomes equivalent to patients with normal adult haemoglobin and red cells. Our DHCA management strategy for these patients has been proven effective and safe.

December 2015: Two-day advanced course on anatomic correction of ccTGA

http://www.eacts.org/academy/courses/advanced-course-on-anatomic-correction-of-cctga/

Date/duration: 3–4 December 2015

Location: German Pediatric Heart Center, Sankt Augustin, Germany

Course Director: V Hraska, Sankt Augustin

Programme Committee:

B Asfour, Sankt Augustin, Germany	**GJ Krings, Utrecht, Holland**	**M Schneider, Sankt Augustin, Germany**
A Bogers, Rotterdam, Holland	**M Kostolny, London, UK**	**O Stumper, Birmingham, UK**
C Hart, Sankt Augustin, Germany	**JE Mayer, Boston, USA**	**P Suchoverskyj, Sankt Augustin, Germany**
M Hazekamp, Leiden, Holland	**R Prêtre, Lausanne, Switzerland**	**N Vansen, Koblenz, Germany**
V Hraska, Sankt Augustin, Germany	**S Quarshi, London, UK**	**P Vouhe, Paris, France**
J Janousek, Prague, Czech Republic	**E Schindler, Sankt Augustin, Germany**	**P Zartner, Sankt Augustin, Germany**

Course overview

Two-day onsite course in a hospital with a large amount of experience of anatomic correction of corrected transposition of the great arteries. This module will offer interactive discussions with experts in the field and live surgery demonstrations on how the technique can be applied.

This interactive course represents a great opportunity for paediatric cardiac surgeons and cardiologists to discuss all aspects of medical and surgical management of corrected transposition of the great arteries. The first day will provide an update on diagnosis of the condition, focusing on assessment of suitability for anatomical correction using different diagnostic tools. The indication criteria for physiological repair and single ventricle pathway will be elaborated on in detail and typical problems related to the double switch operation, including the left ventricle training and issues related to atrial and arterial switch will be covered. Technical details of the double switch operation will be further demonstrated in live cases from the operating theatre. Anaesthesiological, cardiopulmonary and post-operative management will also be discussed.

The second day will focus on issues related to the Senning–Rastelli operation and the long-term problems associated with the treatment of corrected transposition of the great arteries. Burning questions, such as how to deal with arrhythmias, severe tricuspid regurgitation, progressive dilatation of the aortic root associated with aortic regurgitation after double switch operation etc., will be answered, and there will be live-case demonstrations from the operating theatre and cath lab focusing on the technical aspects of surgery and necessary long-term interventions, respectively. The quality of life and long-term outcomes of patients after anatomical correction will also be discussed. By the end of the course, through teaching, discussion and demonstrations from the experts, the aim is that participants will have a greater understanding about when to operate, what kind of procedure should be used and when the operation should be avoided.

This course is dedicated to William Brawn from Birmingham, UK for his extraordinary contribution to current management strategies of corrected transposition of the great arteries.

EACTS
European Association For Cardio-Thoracic Surgery

2015 COURSES

Congenital heart disease	27–30 October
Mitral valve surgery	9–11 November (Barcelona, Spain)
Surgical treatment of lung failure	16–18 November
Surgical treatment of heart failure	18–20 November
Endoscopic port-access mitral valve repair drylab training using high-fidelity simulators	19–20 November (Maastricht, The Netherlands)
Hospital leadership: the human factor	23–24 November
Chest wall diseases	2–4 December
Advanced course on anatomic correction of ccTGA	3–4 December (Sankt Augustin, Germany)
Thoracic surgery part II	8–11 December
Endoscopic port-access mitral valve repair drylab training using high-fidelity simulators	17–18 December (Maastricht, The Netherlands)

All courses to take place at EACTS House in Windsor, UK, unless stated otherwise.

Raising Standards Through Education and Training

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Congenital – Abstract: Tetralogy of Fallot

Systemic-to-pulmonary shunts in congenital heart surgery – results from the UK national database

Dan M Dorobantu, Serban C Stoica Bristol Royal Hospital for Children, United Kingdom

Systemic-to-pulmonary shunts (SPS) are among the first choices for palliation in congenital patients with insufficient pulmonary blood flow, when primary repair is not considered possible. Originally this procedure was used to allow neonates and infants with Tetralogy of Fallot (ToF) to grow to a suitable age for anatomical correction. Since then the SPS variants became a staple of treatment for a diverse array of malformations, from the simple to the very complex.

Improvements in neonatal intensive care and also in the management of post-operative complications have translated to more boldness in surgery. As a consequence smaller, more critically ill children who at some other point in history would have entered palliative care, are now treated by the single ventricle route. And the age of correction of biventricular amenable defects has decreased to the point where it is argued palliation by shunt is no longer necessary.

At this point we decided to analyse national UK audit data, provided by the National Institute for Cardiovascular Outcomes Research (NICOR). This had previously shown that SPS was the only procedure with increasing early mortality every year, in contrast to much more complex operations, which have seen a marked decrease in mortality.

Our data shows that while the early mortality is in fact increasing (Figure 1), important changes are taking place in terms of case selection: fewer and fewer patients with ToF are receiving a shunt, while more and more single ventricle patients and patients with pulmonary atresia (PA) patient do (Figure 2). These categories are also risk factors for mortality as shown by our data. We concluded that the nationally observed trend is due to a combination of different case-mix by diagnosis, but also the selection of more critically ill patients for this route of treatment. The full procedural and life-status follow-up of the NICOR dataset has allowed us to look, for the first time with a national dataset, at the full spectrum of patients with isolated SPS and their trajectory to correction. The conclusions are both encouraging and worrying at the same time. Firstly, mortality 1 year after the SPS procedure is quite high, at 15%, but with large variations by diagnosis group (ToF for example has a much lower figure, of 7%, while PA-IVS is at 33%).

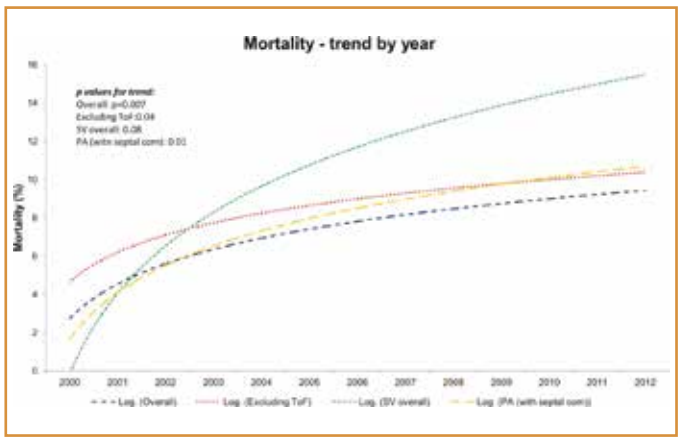

Figure 1.

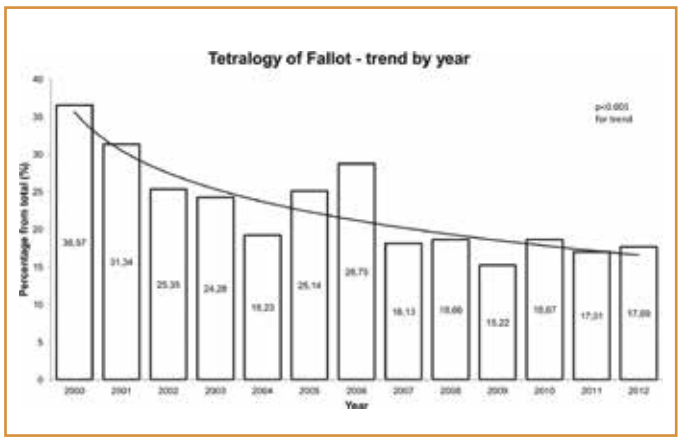

Figure 2.

Shunt reintervention rate at 1 year is 15%, with the presence of PA being risk factor in most of these groups (Figure 3 shows the hazard ratio of PA-VSD compared to ToF). In fact, this anatomical form has proven to be the main predictor of shunt reintervention, raising the question: how can outcomes be improved in duct dependent patients? An encouraging ouctome was that repeated shunt reoperations do not increase the risk of death, but having one soon after placing the shunt does. This translates into the fact that shunt-related complications, which occur early, incur a survival penalty, while later revisions (even repeated ones) can be performed safely, allowing the child to grow.

The fact that SPS are being used in more and more complex, and critical, scenarios, but with unsatisfying overall results begs the following questions: is this high mortality seen today a sign that we are salvaging more patients who were previously untreatable, or a sign we are selecting the wrong ones for palliation? Is shunting the only alternative for critically ill patients with complex anatomy, or should we look at newer methods, less prone to complications? All these questions will be better answered in targeted studies, with more patient level data.

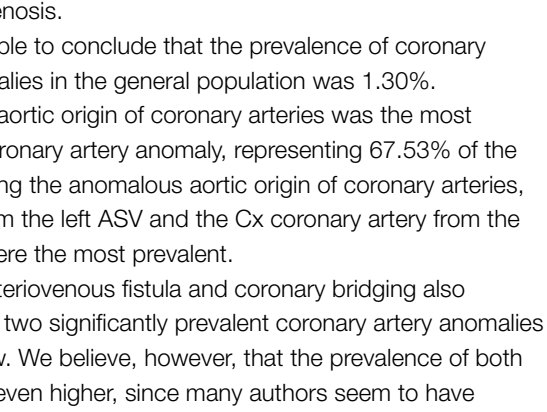

Figure 3.

Congenital – Abstract: Congenital miscellaneous

Coronary artery anomalies in the general population: a systematic review of 450,116 patients

Leila Barros, Gabriel Liguori, Vera Aiello, Juliano Penha, Leonardo Miana, Luiz Fernando Caneo, Carla Tanamati, Marcelo Jatene
University of São Paulo (Incor), São Paulo, Brazil

The anatomical patterns and frequency of occurrence of congenital coronary anomalies in the general population have been widely investigated, but no study to date has sought to collate the data from these studies in a systematic review to achieve greater reliability and representativeness. Thus, our aim was to systematically review the literature and assess the prevalence of coronary artery anomalies in the general population undergoing cardiac diagnostic imaging testing.

We conducted a systematic review of the literature, using the following search strategy: '(coronary vessel anomalies) AND (diagnostic imaging OR cardiac imaging techniques) AND (cross-sectional studies OR prevalence)'. The review was conducted using the MEDLINE database through PubMed. Articles that did not perform a study on the prevalence of coronary artery anomalies in the general population undergoing cardiac diagnostic imaging testing, which included articles that addressed populations with specific diseases or that assessed only particular coronary anomalies, were excluded. The coronary artery anomalies classification criteria used was the Congenital Heart Surgery Nomenclature and Database Project, an initiative in partnership between the Society of Thoracic Surgeons (STS) Congenital Heart Surgery Database Committee and the European Association for Cardio-Thoracic Surgery (EACTS).

The search strategy returned 332 articles of which, after screening and eligibility selection, 37 were summarised in the present systematic review, totalling 450,116 patients. The mean age was 56.2±11.3 (range 6–95) years and 69% of patients were male. Coronary artery anomalies were found in 5840 (1.30%) patients, 65% of them male.

Of the 5840 patients, 38 (0.65%) had anomalous pulmonary origin of coronary arteries (33 anomalous left coronary artery from the pulmonary artery [PA], four anomalous right coronary artery [RCA] from the PA, and one anomalous circumflex [Cx] coronary artery from PA); 3944 (67.53%) had anomalous aortic origin of coronary arteries (67 left main coronary artery [LMCA] from right aortic sinus of Valsalva [ASV], 551 RCA from left ASV, 60 left anterior descending [LAD] from right ASV, 60 LAD from RCA, 763 Cx from right ASV, 110 Cx from RCA, 134 single coronary artery, eight inverted coronary arteries, 2239 other anomalies, and six non-specified); one patient (0.02%) had congenital atresia of the LMCA, 505 (8.65%) had coronary arteriovenous fistula, 1256 (21.51%) had coronary bridging, 88 (1.51%) had coronary aneurysm and eight (0.14%) had coronary stenosis.

It was possible to conclude that the prevalence of coronary artery anomalies in the general population was 1.30%. Anomalous aortic origin of coronary arteries was the most common coronary artery anomaly, representing 67.53% of the cases. Among the anomalous aortic origin of coronary arteries, the RCA from the left ASV and the Cx coronary artery from the right ASV were the most prevalent.

Coronary arteriovenous fistula and coronary bridging also represented two significantly prevalent coronary artery anomalies in this review. We believe, however, that the prevalence of both diseases is even higher, since many authors seem to have omitted them from their case series.

Daily News
EACTS European Association For Cardio-Thoracic Surgery

Publisher: Purple Agency
Editor in Chief: Pieter Kappetein
Managing Editor: Claire Hempson
Project Management: Sandra Tyrrell and Florence Brann
Design and Layout: Chris Laakvand

Head Office: Purple Agency
Lilly House, Priestley Road,
Basingstoke, Hampshire
RG24 9LZ
Website: http://www.purple-agency.com

Cardiac – Rapid Response: New technology in mitral surgery

A new approach for minimally invasive cardiac surgery: the periareolar access

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Hospital Israelita Albert Einstein, São Paulo, Brazil

With the constant evolution of heart surgery, new techniques and technologies have been applied in order to make surgical procedures safer and less invasive. In the mid-1990s, several reports about less invasive heart surgery techniques appeared in medical literature. The objectives were better patient recovery with less pain and fewer postoperative complications, resulting in fewer hospital stays and cost reductions. Another issue was the aesthetic appearance and patient satisfaction due to reduced surgical trauma (scarring). With the advent of videothoracoscopy came the possibility of making even smaller incisions or none at all.

In this study we describe an unprecedented route for video-assisted minimally invasive cardiac surgery, combining the effectiveness of this method with a technique optimising the manipulation of cardiac structures: the periareolar access. Between February 2006 and November 2014, 214 patients underwent video-assisted minimally invasive cardiac surgery using the periareolar access. The cardiac pathologies approached were: mitral valvopathy (n=132), atrial septal defect (n=74), 24 patients presented associated tricuspid insufficiency, 35 presented associated atrial fibrillation. Eight patients, whose ages ranged from 18 to 72 years, and of whom 146 patients were female, had pacemaker lead endocarditis. The surgical approach consisted of femoral arterial and venous cannulation or right jugular vein cannulation, minithoracotomy on the right periareolar region through the right breast and thoracoscopy (Figure 1).

From this cohort it was possible to perform mitral valve repair in 95 patients, and mitral valve replacement in 37 patients. Correction of atrial septal defect was conducted in 74 patients. In eight patients, this technique was used to perform pacemaker lead extraction. As concomitant procedures, tricuspid valve repair was performed in 24 patients, and correction of atrial fibrillation in 35 patients. There were no complications during the procedures, and no conversion to thoracotomy in any of the cases. No complications were observed relating to the surgical healing of the periareolar access or the peripheral cannulation. This study demonstrates the range of possible cardiac diseases that can be approached using the periareolar acess. We can conclude that the periareolar access is safe and effective, and that it can be used for video-assisted minimally invasive cardiac surgery. It demonstrates both excellent aesthetic and functional results. Currently, it is our approach of choice, especially in female patients who present with mitral or tricuspid valve disease, atrial-septal defect and atrial fibrillation.

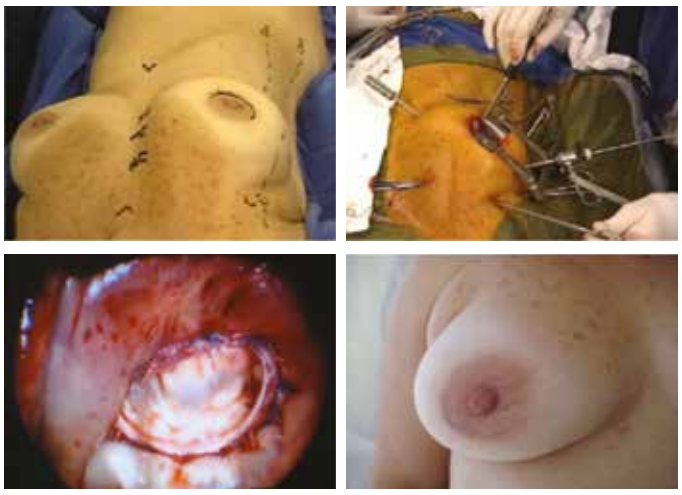

Figure 1.

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Cardiac – Abstract: Left ventricular assist device: latest advances

An examination of the HVAD Lavare Cycle in clinical practice

Daniel Zimpfer Medical University Vienna, Austria

The HeartWare® ventricular assist device system (HVAD) is approved for bridge to transplant in the U.S. and for treatment of advanced heart failure in other countries. The Lavare Cycle is a feature approved in selected countries, which provides a periodic speed modulation to the HVAD pump altering flow pattern within the left ventricle and therefore possibly reducing areas of potential blood stasis. The impeller rotational speed is first decreased below the set speed by 200 rpm for two seconds. The speed then increases by 400 rpm (200 rpm above set speed) for one second and returns to the set point.

The Lavare Cycle is enabled via a switch-on clinical monitor, therefore its use is up to the discretion of the implanting surgeon or the patient care team. Pre-clinical data has revealed that the decrease in speed results in an immediate decrease in flow, and a consequent change in the intra-ventricular flow patterns. The increase in speed results in a change in the flow vortices and an increase in the vertical velocity of blood flow into the inflow cannula. This 'washing' effect of the flow changes has been theorised to possibly reduce areas of potential stasis in the ventricle; however, the clinical implications of the Lavare Cycle in a patient supported with the HVAD Pump are not well described.

The ReVOLVE study was an investigator-initiated, prospective review of the HVAD in commercial use following initial CE Mark approval in 2009. ReVOLVE included 254 patients implanted with the HVAD Pump on-label as a left ventricular assist device following CE Mark in 9 centres in Europe and Australia between February of 2009 and November 2012. The results of the ReVOLVE study were published in the June 2014 issue of JHLT (Strueber, et al.), and a follow-up analysis of long-term outcomes was presented by Jan Schmitto earlier this year at the ISHLT meeting in Nice. Since we noted that there were some patients in the ReVOLVE database in whom the Lavare Cycle was not used (n=33), we decided to examine whether any differences in outcomes could be observed between those with and those without Lavare. Despite the small number of patients in the cohort in whom Lavare was not used, we did note some differences among the two cohorts. Although there was no difference in survival among the two groups, those with Lavare enabled had significantly fewer strokes (0.06 versus 0.20 events per patient year [EPPY]), sepsis (0.03 versus 0.15 EPPY) and right heart failure (0.03 versus 0.18 EPPY) compared with those in whom Lavare was not used.

In summary, despite the small number of patients in this retrospective analysis, these preliminary results appear to imply that there may be some positive impact on several adverse events when the Lavare Cycle is employed in patients with HVAD System support. Larger studies are warranted to further examine the clinical implications of the Lavare Cycle.

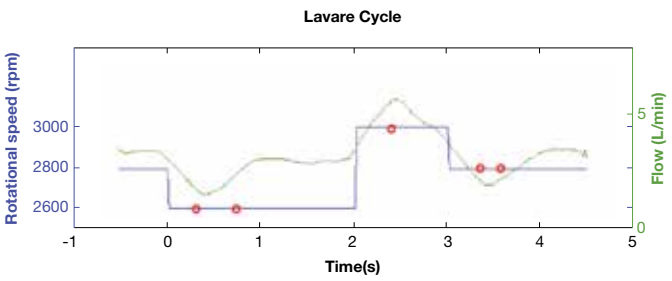

Figure 1. Timeline of Lavare Cycle and the flow (at time points marked with red dots).

Cardiac/General – Focus Session: How to do it?

How to repair a thoraco-abdominal aortic aneurysm

Michael Jacobs European Vascular Center Aachen – Maastricht, Maastricht, The Netherlands

Treatment modalities for thoracic aortic aneurysms (TAA) and thoraco-abdominal aortic aneurysms (TAAA) have changed significantly during the last decade. Following the evolution of open repair without adjunctive measures, the era of protective strategies was introduced, including extracorporeal circulation, spinal fluid drainage and techniques to assess spinal cord integrity. However, despite these supportive techniques, overall mortality and morbidity following open repair remained considerably high, especially in low volume hospitals.

Rapidly developing endovascular techniques have made TAA and TAAA treatment less invasive and short term outcomes seem to be promising. Especially in TAA, endovascular treatment has become the treatment of choice. Open repair remains the treatment of choice in complex post-dissection thoracic aneurysms and in patients with connective tissue diseases.

The surgical approach in TAA(A) consists of a left-sided thoracotomy or thoraco-laparotomy. Depending on the proximal and distal extend of the aneurysm, the intercostal space is chosen: if the distal aortic arch is involved, the fifth intercostal space is preferred in order to achieve adequate exposure of the arch. Generally it is necessary to cross-clamp between the left carotid and subclavian arteries, requiring transection of Botalli's duct. The clamp and sew technique is obsolete. In order to provide distal aortic perfusion, either left-sided partial bypass or total extra corporeal circulation is installed. In principle, all patients have a spinal fluid drainage system in place, which in our centre is kept for 72 h. During the operation, neuromonitoring by means of motor evoked potentials (MEP) is routinely used. Based on MEP information, blood pressure management is adjusted and intercostal arteries revascularised.

One of the main differences between degenerative and post-dissection aneurysms is the fact that intercostal and lumbar arteries are patent in post-dissection aneurysms and almost totally occluded in degenerative disease. Therefore, in order to limit excessive blood loss, multiple cross clamp positions are prepared in post-dissection aneurysms. In patients with connective tissue disease, all major side branches are reconstructed with individual grafts. Button or island reimplantation of these vessels often lead to late aneurysms requiring repeat surgery.

Is there still a role for open TAA and TAAA repair? There are several indications for which endovascular repair is now the first choice of treatment: traumatic aortic rupture, localised penetrating aortic ulcer, post-operative false aneurysms, localised descending thoracic aneurysms and probably aorto-brochial fistula.

There is debate on the indication for endovascular treatment in extensive TAAA, especially in young(er) patients who are fit for open surgery. Even more debatable is endovascular treatment in patients with connective tissue disease. Also, patients with aortoesophageal fistula appear not to be good candidates for the endovascular approach.

In our centre the indications for endovascular repair are as mentioned above.

Patients suffering from TAAA who are not good candidates for open repair will have total endovascular treatment with fenestration or side branch technology. This also accounts for repeat surgery patients. Open repair is offered to young patients and patients who suffer from connective tissue disease. Adequate short and long term outcome is warranted. In addition, failed endovascular repair, for example type I endoleak in chronic dissection, is also a reason for open repair if additional endovascular solutions are not possible anymore. This is the situation in 2015, however, in less than 10 years this approach will have changed completely.

Cardiac – Advanced Techniques: A future without suture

When sutureless and rapid deployment valve can cover the gap between transcatheter aortic valve implantation and conventional aortic valve replacement

Antonio Miceli Istituto Clinico Sant'Ambrogio, Gruppo Ospedaliero Sandonato, Milan, Italy

Aortic valve replacement using sutured stented valve is the treatment of choice in patients with severe aortic valve stenosis. This surgical approach has shown excellent mortality, morbidities and long-term survival. Nevertheless, this procedure has often been denied to high-risk patients with severe aortic stenosis due to the advanced age, numerous comorbidities and poor predicted outcomes. In this setting, transcatheter aortic valve implantation (TAVI) has been considered a valid option in the treatment of high-risk patients, as it has shown to be superior to medical therapy and not inferior to conventional surgery in terms of mortality and early survival. These enthusiastic results have brought the cardiac community to increase the number of TAVI procedures, with the aim of decreasing the invasiveness of surgical operations even in lower risk patients. However, it has been reported that TAVI was associated with higher incidence of neurological events, vascular complications and paravalvular leakages when compared with the conventional surgery.

From the dualism between the surgical and transcatheter approaches, a new valve technology has been developed as an additional treatment option to the high-risk patient undergoing aortic valve replacement to simplify and standardise the surgical procedure and facilitate the minimally invasive approach.

The sutureless and rapid deployment aortic valves have been designed to avoid or minimise passing stiches through the annulus and suture knotting to decrease the surgical trauma to the aortic annulus and consequently reduce operative times. Many studies have reported excellent clinical results in terms of postoperative outcomes, haemodynamic performances, structural valve deterioration and freedom from reoperation up to 5 years. These results have been confirmed even in the setting of minimally invasive surgery. As a consequence, these valves have been recommended for those patients belonging to the 'grey zone' between TAVI and conventional surgery.

The potential benefits of sutureless and rapid deployment valves when compared with TAVI are the decreased paravalvular leak rate and decreased need for postoperative pacemakers. Furthermore, the surgical approach has the advantage of removing the calcified stenotic valve, a possible cause of neurological events. A recent study from two European centres (Massa and Nurnberg), reported the largest experience of minimally invasive aortic valve replacement with the sutureless valve through a right mini-thoracotomy approach or mini-sternotomy. We showed that this approach is a safe and reproducible procedure associated with excellent postoperative outcomes, haemodynamic results and 1 year-survival. These outstanding results have raised the hypothesis that the combination of minimally invasive surgery with the sutureless technology might be considered the 'real alternative' to the TAVI technology in high-risk operable patients. To date, two small retrospective propensity-matched studies have demonstrated that this approach is associated with a trend of better outcomes and mid-term survival compared with TAVI. Most importantly, the rate of paravalvular leakages was extremely low with an average of 1.3% in the sutureless group and 39.2% in the TAVI group. Paravalvular leakage is now considered a negative outcome, because it has been demonstrated that even mild regurgitation is associated with lower survival at 2 and 5 years. More studies and a proper randomised trial are required to confirm these data.

In conclusion, based on the current literature data, TAVI is recommended for inoperable and very high-risk patients, whereas sutureless and rapid deployment valve in combination with any minimally invasive approach are advised for medium or high-risk operable patients. Low-risk patients may benefit from a minimally invasive approach but still with a conventional sutured valve. In this setting, the role of the 'heart team' is essential for the correct indication, minimising the potential risks. While we await some robust data and recommendations from the American and European Societies, we expect that the future be without suture!

Cardiac – Advanced Techniques: A future without suture

Sutureless prosthesis in true bicuspid aortic valves

Mattia Glauber Centro Cardiotoracico Sant'Ambrogio – Gruppo San Donato IRRCS, Milano, Italy

Bicuspid aortic valve (BAV) is the most common congenital heart disease (1% to 2% of live births), and often evolves into aortic stenosis (AS); it has been estimated that more than 50% of all aortic valve replacements for AS can be attributed to BAV disease. The use of a sutureless prosthesis has been recently developed as an alternative to a conventional stented valve for its potential advantages in intermediate- to high-risk patients, such as shorter cross-clamp times and easier implantation, especially in minimally invasive procedures. However, the presence of a BAV has always been considered a contraindication for the implantation of a sutureless bioprosthesis due to the potential risk of paravalvular leakage. This risk has been linked to different anatomic aspects (elliptic annulus, sinus asymmetry, and different leaflet commissures heights) that carry a higher probability of prosthesis dislocation.

Recently, Vola et al. described their experience with the 3f Enable valve (Medtronic, Minneapolis, Minnesota, U.S.) in five Sievers type 0 BAVs, showing an inadequate performance of the prosthesis and a high rate of paravalvular leakages.

Conversely, Nguyen and colleagues, evaluating a cohort of 25 patients with BAVs and AS treated with Perceval S prosthesis (Sorin, Milan, Italy) implantation, have shown that this sutureless valve could be deployed in this subgroup of patients, without increasing the risk of paravalvular leakage. Specifically, neither migration nor structural damage occurred at follow-up, and only three patients had signs of paravalvular leakage.

Normally, a well-positioned Perceval S valve covers the aortic annulus, including the intercommissural triangles, with its inflow ring. For this reason, in our opinion, three elements are mandatory for a successful implantation of the Perceval S in BAV patients: the elasticity and the circularity of the aortic annulus, and the equal heights of the leaflet commissures. In this setting, a complete decalcification of the aortic annulus is recommended to restore its elasticity, which is a key element to gain a good adaptability to a self-expanding prosthetic valve.

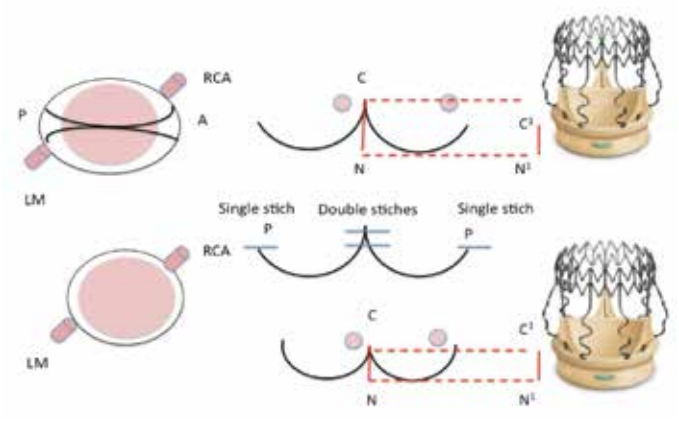

Figure 1.

To better manage the asymmetry of aortic cusps, Nguyen and colleagues suggest recreating 3 natural nadir points positioned at approximately 120 degrees. However, this technique is valid only for BAV with three sinuses of Valsalva (type I).

Conversely, in presence of other types of BAV, our experience suggest that a commissural plication is often required to restore the circularity of the aortic annulus, especially when the commissures are placed at different heights (Figure 1). If the height of one of the intercommissural triangles is higher than the inflow ring, the incomplete coverage of the annulus carries a higher risk of paravalvular leakage. However, this case could be managed with the plication of all intercommissural triangles at their basis, bringing the commissure to the same height and achieving the result of a more circular aortic annulus that could be fully covered by the inflow ring of the prosthesis.

Finally, once the prosthesis is released into the aortic annulus, its correct position must always be checked to ensure perfect symmetry and coaptation of the neoleaflets ('Mercedes-Benz' sign).

In conclusion, although this is still an off-label procedure, BAV is no longer an absolute contraindication for aortic valve replacement with a sutureless prosthesis. Recent studies have shown that, once the aortic annulus becomes circular, if necessary with commissural or sinus plasty, it is feasible and associated with promising results. Further data are required to confirm these results.

Cardiac – Advanced Techniques: A future without suture

Reimbursement and health economic evidence for the sutureless valve and rapid deployment valves

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Sutureless and rapid deployment aortic bioprosthetic valves have been recently introduced into clinical practice and have the advantage of a short and simple implantation, thus reducing surgical times. Nevertheless, the costs associated with, and the potential savings resulting from, these technologies are still reason for debate.

To help clarify this scenario, we carried out a retrospective observational study comparing a sutureless valve model (Perceval Sutureless Aortic Valve, Sorin Group, Italy) with traditional aortic valve replacement (AVR) in propensity matched groups. We demonstrated faster operation time, cardiopulmonary bypass time and cross-clamp time associated with the sutureless valve model, and relevant better outcomes in terms of hospital and ICU stay, and clinical outcomes (atrial fibrillation, pleural effusion, respiratory insufficiency, and the need for blood transfusion). These benefits translated into reduced hospital costs per patient (savings* of 25% when compared with traditional valves) at the ICU, complication-related costs and operating room costs. Similar cost reduction associated with the use of the Perceval valve was reported by the Leuven group, which found favourable effects on the postoperative recovery and use of resources in a population of elderly intermediate-risk patients. Savings* of 27% with the use of Perceval were reported by the authors when compared with traditional biological AVR.

These findings triggered the next step of our study, comparing the sutureless AVR (Perceval) with the transcatheter aortic valve implantation (TAVI) technology in aortic stenosis patients in an observational study. In a propensity score matching analysis, Perceval was demonstrated as a cost-saving treatment compared with TAVI, with a net saving of 34%. Regarding the different cost components, sutureless AVR reported savings in device cost and diagnostics tests, while TAVI reported savings in hospital stay. In agreement with other published studies, we showed higher rates of occurrence of paravalvular leakage (at least 1–4+) in patients undergoing TAVI treatment (34.3%) versus sutureless (6.9%), with impact on follow-up survival.

As a consequence of this positive economic profile and the relevant increased use of sutureless technology, some healthcare systems have granted additional and more favourable reimbursement levels to sutureless prostheses compared with traditional valves and, to date, Belgium (Perceval only), Germany (in two stages: isolated procedures since January 2014, concomitant procedures since January 2015), Czech Republic, Turkey and Australia (Perceval only, in private hospitals) are within those countries adopting such reimbursement policy.

*Excluding device cost.

Cardiac – Advanced Techniques: A future without suture

Perceval valve: a step forward for minimally invasive surgical approaches

Borut Gersak University Medical Center, Ljubljana, Slovenia

Concurrent advances in aortic valve design and minimally invasive aortic valve replacement (MIAVR) surgery are leading to improved techniques and outcomes in the treatment of aortic valve disease.

Sutureless aortic valve replacement (SU-AVR) techniques – which obviate suturing after annular decalcification – aim to reduce cross-clamp and cardiopulmonary bypass (CPB) duration, and thereby improve surgical outcomes and facilitate a minimally invasive approach.[1] Additionally, MIAVR has shown excellent results in terms of mortality, morbidity and patient satisfaction, providing less pain, faster recovery and a shorter hospital stay.[2–6] The largest single-centre report on MIAVR confirms that, compared with sutured prostheses, sutureless AVR significantly reduces assisted ventilation times and is associated with low mortality and morbidity, leading to excellent surgical and haemodynamic results.[7]

Surgical benefits of sutureless valve technology have enabled more centres to adopt minimally invasive approaches. Phan et al., report that not only is sutureless valve technology likely to be embraced by surgeons with more extensive minimally invasive cardiac surgery (MICS) experience, but sutureless valve technology itself facilitates MICS adoption. The significant correlation between the increased use of minimally invasive incisions in sutureless AVR and midpoint of study periods strongly support this notion (Figure 1).[1]

Considering the benefits of sutureless AVR, the Sorin Perceval is a truly sutureless valve with a collapsible design that is easier to implant than sutured valves, particularly in minimally invasive approaches.[8] The Perceval valve is particularly suited for minimally invasive approaches due to its collapsibility and increased visibility, precise positioning, less trauma and short learning curve. A recent European multicentre experience, demonstrated excellent clinical and haemodynamic results that remain stable even up to the 5-year follow-up. Both early and late mortality rates were very low with no valve migrations, structural valve degeneration or valve thrombosis in the follow-up.[9]

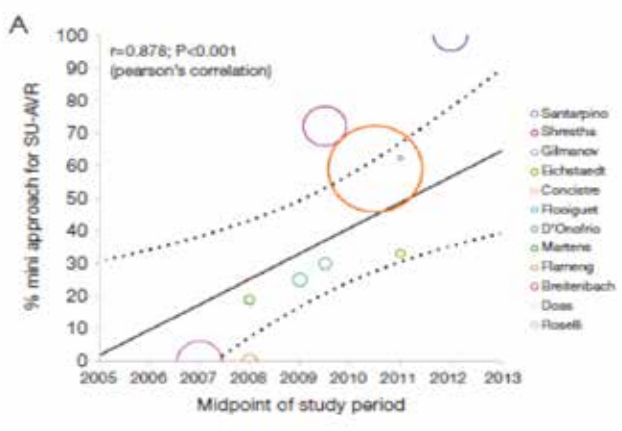

Figure 1. Correlation between the increased use of minimally invasive incisions in sutureless AVR and midpoint of study periods.[1]

The continued refining of MICS techniques driven by improved aortic valve design makes Perceval a promising alternative to standard biological valve procedures and the potential new gold standard in AVR surgery.

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Cardiac – Advanced Techniques: A future without suture

Perceval valve: the weight of clinical and health economic evidence

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Sutureless valves are emerging as an innovative alternative to traditional stented valves, offering several potential advantages in all surgical approaches, including minimally invasive aortic valve surgery. These advantages include: collapsible design for more rapid implantation without affecting cusp integrity,[1] reduced cross-clamp and cardiopulmonary bypass (CPB) duration, minimal manipulation in the aortic root during placement, and maintenance of satisfactory haemodynamic outcomes with low paravalvular leak rates.[2]

Among the commercially available sutureless and fast deployment aortic valves, the Sorin Perceval valve has the broadest clinical experience, and the highest number of publications with the longest published durability to date.

Perceval is a truly sutureless valve with a self-expanding prosthesis made of bovine pericardium mounted in a nitinol stent. Of the approximately 18,000 sutureless and fast deployment units implanted to date, almost 12,000 are Perceval. Since 2008, Perceval has supporting clinical data from 98 papers and so far in 2015 there have been 30 publications. The most recent published clinical data is promising in terms of durability.[2,3] In a summary of three consecutive European multicentre trials investigating the safety and performance of the Perceval, researchers reported excellent clinical and haemodynamic results up to 5 years in an elderly cohort (more than 700 patients, the largest patient cohort ever implanted with sutureless valves), including low and stable transvalvular gradients up to 5 years, low stroke rate (0.8%) and low cardiac mortality rate (1.9%). No valve migration, structural valve degeneration or valve thrombosis was observed in the follow-up.[2]

In addition, in the first and longest human experience evaluating Perceval valve implant feasibility and safety,3 5-year follow-up results confirmed the performance and safety of Perceval in a medium- to high-risk patient population with a small aortic annulus. Results included 100% procedural success, 71.3% 5-year survival despite the high age of the patients at implant (mean age, 80.4 years) and no structural valve degeneration. Compared with stented valves in a similar patient profile, Perceval has also demonstrated improved clinical outcomes, with faster patient recovery and discharge, all translating into a favourable effect regarding hospital costs.[4]

Although more data and longer follow-up are required, the cardiac surgery community should be encouraged by these results, which highlight sutureless valves as a promising alternative to standard biological valves.

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Cardiac – Advanced Techniques: A future without suture

Sutureless valve in hybrid procedures

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Patients with degenerative aortic valve disease may present with associated coronary artery disease (CAD), the most common comorbidity importantly influencing outcomesafter aortic valve replacement (AVR). CAD affects a third of patients, half of those ≥70 years while >65% of patients over 80 years have concomitant CAD. Current guidelines recommend bypass of all significant stenoses at the time of AVR, with evidence level C. However, addition of coronary artery bypass grafting to AVR is associated with elevated short- and long-term mortality.

While minimally invasive AVR has been linked to improved surgical outcomes compared with full sternotomy approach, CAD requiring concomitant coronary artery bypass grafting through the full sternotomy increases the operative mortality.

We analysed the outcomes of hybrid approach, minimally invasive AVR and percutaneous coronary intervention, in patients with aortic valve stenosis and CAD.

Between 2011 and 2013, 310 patients were treated for degenerative aortic valve disease with Perceval S sutureless AVR, 90 patients presented with coexistent CAD and 220 were excluded. In 23 patients who presented with two- or three-vessel CAD, not suitable for PCI, CABG was associated with AVR in full sternotomy.

In the remaining 67 patients a tailored approach was undertaken. Direct PCI with coronary stent implant was performed before minimally invasive AVR in 3 patients with acute coronary syndrome. In 22 patients with stable coronary plaques and asymptomatic for angina, deferred PCI treatment was programmed (the study group). For the remaining 42 CAD patients, due to sub-critical or too distal coronary lesions, only medical treatment was proposed. So, results are from those in whom deferred PCI treatment was programmed after minimally invasive AVR.

The 22 patients with stable asymptomatic coronary artery disease had a mean age of 79 years and included 13 females. All patients presented with a cardiovascular risk profile typical of aortic valve stenosis, mean NYHA functional class 2.5. The mean left ventricular (LV) ejection fraction was 57%, and 3 patients presented with impaired LV systolic function. Mean values: trans-aortic gradient 44 mmHg, EuroSCORE 8, and logistic EuroSCORE 11.5.

All patients in the study group received sutureless AVR through right anterior mini-thoracotomy. Mean cardiopulmonary bypass time was 86.5 min with aortic cross clamping time of 56.1 min. Mean duration of mechanical ventilation was 6.1 h and mean ICU stay was about 1 day. One case of perioperative acute coronary syndrome occurred in a patient with severe LV dysfunction, ischemic cardiomyopathy and venous coronary grafts occlusion with previous CABG. No major surgical complications, no mortality occurred in the study group. One patient with advanced atrioventricular block was treated with pacemaker implantation. Mean hospital stay was 7 days. The patient is usually discharged one week after surgery. All the 22 patients successfully underwent PCI/stenting following AVR after a mean period of 42 days. From 1 to 3 vessels presented with haemodynamically significant lesions and LAD mostly involved. Mainly, 1 vessel per patient was treated, and 1 or 2 coronary stents implanted.

To conclude, staged hybrid treatment may be an option in patients with severe aortic stenosis associated with clinically stable 1, 2 or 3 vessel CAD, suitable for percutaneous treatment. Deferred PCI with coronary stenting can be safely performed allowing minimally invasive AVR for patients who would otherwise undergo full sternotomy. Tailored hybrid approach in selected patients represents a valuable strategy to minimise procedural risk. Closer collaboration between surgical and interventional operators is crucial to obtain better clinical outcomes.

Cardiac/General – Focus Session: How to do it? With live-in-a-box

Robotics in advanced stage thymomas?

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When a conversion to thoracotomy or sternotomy is needed in a robot assisted minimal invasive procedure, it is generally considered as a failure of the robotic approach. However, a conversion to an open procedure can also be part of a carefully and deliberately planned surgical strategy in which the benefits of the robotic approach are only needed in a specific part of the case.

The best prognosis for thymoma patients is obtained with complete surgical resection. For advanced stage and very large thymomas this can be challenging, or even considered impossible, because of anticipated technical difficulties. Full sternotomy or clam shell and hemi-clam shell approaches may seem the only way to obtain a complete resection. However, here minimally invasive techniques may also help to increase the chances for success of the operation.

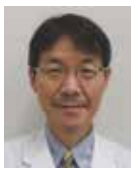
In our institution, in recent years 17 patients with giant and invasive thymomas underwent surgical resection with, in some form or other, robotic assistance. As an example, a 66 years old male presented 1 year ago with myasthenia gravis and a mediastinal mass that was supposed to invade the brachiocephalic vein and the ascending aorta. An attempt to resect the tumour through a sternotomy in a referral hospital

was aborted because of the presumption of tumour invasion of the sternum. The tumour did not respond to subsequent chemotherapy and the patient was referred to our hospital. In a multidisciplinary setting we decided to do a robotic assisted, bilateral resection up to the vessels and then to continue repeating the sternotomy to take care of the vessels and to remove the tumour. Bilateral resection was started from the right. It appeared to be possible to free the tumour from the sternum and there was no suspicion of invasion beyond the soft tissues. As it was possible to cross the midline with the minimal invasive instruments it could be observed that the tumour neither invaded the left phrenic nerve nor invaded parts of the left lung. Thus, the additional left sided approach became unnecessary. The thymoma had invaded the pericardium and was therefore almost completely dissected anteriorly. Careful inspection revealed macroscopic invasion of the brachiocephalic vein, but not from the caval vein and not from the aorta. As planned beforehand, because of the enormous size of the tumour, the sternum wound was reopened again and the tumour was taken out including part of the brachiocephalic vein. The patient was free of recurrent disease at 12 months follow up.

A case like this shows how, minimally invasive techniques also in combination with conventional surgery, may help to reduce the surgical trauma. Typical advantages of robotics in the thoracic cavity are the fact that one can reach almost any spot with full control and manoeuvrability of the instruments, and at high magnification of the surgical field for optimum dissection. Such advantages are not only helpful in simple cases but may appear to be quite powerful especially in surgery for the most complex abnormalities.

Thoracic – Abstract: Video session

Thoracoscopic repair of pulmonary artery injury



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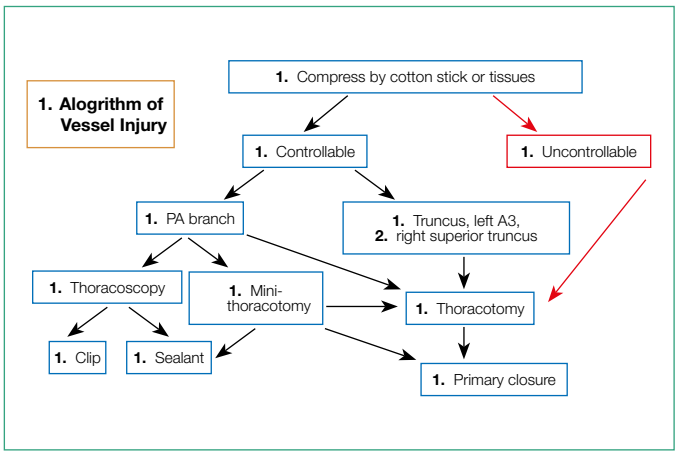
Background: Video-assisted thoracic surgery (VATS) anatomical resection has been in widespread use since the early 1990s; however, few studies have reported on intraoperative complications with VATS, such as vessel injury. We have reported on troubleshooting of thoracoscopic vessel injury for non-small lung cancer operation. The purpose of this case video is to introduce our technique of thoracoscopic repair of pulmonary artery injury by sealant application in swine and human lung operations.

Methods: Mild bleeding from the pulmonary artery was first treated by compression with rotated lung tissues or a cotton stick, and then controlled using thrombostatic sealant. First, we cut the sealant to 5 mm^2 and introduced its tip, holding with endoscopic forceps, through one large port (12 mm). Sealant was then attached to the bleeding point for a couple of minutes. A second amount of sealant of 1 mm^2 or larger was then applied using the same procedure. If the sealant did not work well, much larger sizes of sealant were applied.

Results: The first case was training of thoracoscopic surgery in swine. After left apical lobectomy of swine, the main pulmonary artery was accidentally injured by ultrasonic coagulation shears. The thoracoscopic repair was deemed to be successful after confirming the adequate application of sealant at the bleeding point. (Video)

The second case was a 75-year-old male with invasive adenocarcinoma of the left upper lobe. Pulmonary artery branch of lingular segment was accidentally injured during stapling. Thoracoscopic sealant was applied after immediate compression using a cotton stick and careful exploration. Finally, the injury point was sutured after re-bleeding under minithoracotomy. (Video)

Conclusion: Thoracoscopic anatomical resection is feasible and safe, regardless of the intraoperative pulmonary artery injury. Although surgeons should pay attention to avoid unexpected bleeding, thoracoscopic sealant application is effective, and training in thoracoscopic surgery using swine is useful for intraoperative troubleshooting.



Cardiac – Advanced Techniques: A future without suture

Current guidelines on aortic valve replacement from evidence-based medicine to payment-based medicine

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Acute cardiogenic shock (CS) in patients with severe aortic stenosis and left ventricular (LV) systolic dysfunction is associated with a poor prognosis. Recent guidelines suggest that percutaneous aortic balloon valvuloplasty can provide a temporary 'bridge' to aortic valve replacement or transcatheter aortic valve implantation (TAVI), or be used as palliative treatment (level of evidence IIb C). However, aortic balloon valvuloplasty is associated with a high rate of procedural complications. In patients with CS in particular, readmission rates for heart failure are high, and in-hospital and 2-year mortality rates of 56.5% and 80.4%, respectively, have been reported. Moreover, although encouraging results have been reported in patients presenting in CS who undergo TAVI, in our experience, TAVI requires accurate imaging to ensure successful implantation and avoidance of paravalvular leaks. This is not always achievable in an emergency setting. On the basis of a recent study, we used the Edwards INTUITY rapid-deployment valve (Edwards Lifesciences LLC, Irvine, CA, USA) in three patients with aortic stenosis in CS. The valve is implanted by means of a delivery system and three guiding sutures that ensure correct positioning and sealing. The system is intended to reduce operative duration, enable minimally invasive surgical techniques, and ultimately improve patient outcomes.

We decided to treat three patients with severe aortic stenosis and CS with the Edwards INTUITY rapid-deployment valve for four reasons. Firstly, this procedure has been shown to shorten myocardial ischaemic time compared with standard aortic valve replacement, which we consider to be a key therapeutic aim in these patients. Secondly, we wanted to ensure optimal haemodynamics following aortic valve replacement in these patients, who already have severe LV dysfunction. A previous study, reported very low transvalvular gradients and large effective orifice areas 1 year after implantation of the Edwards INTUITY valve. This was confirmed in all three of our patients in CS, and although data are not available, we speculate stent expansion in the LV outflow tract plays a role in enabling a smooth blood flow compared with traditional prostheses. Thirdly, avoidance of device-related post-operative complications is particularly important in CS patients. In our patients, successful implantation was achieved with a good safety profile, in line with low rates of post-operative and short-term adverse events reported previously. Finally, no additional diagnostic studies were required before the intervention, which allows treatment decisions to be made and initiated quickly in accordance with current guideline recommendations.

Aortic valve replacement with the Edwards INTUITY rapid-deployment valve in patients with aortic stenosis in CS can be achieved with a favourable safety profile. Although further studies are needed to confirm our observations, rapid-deployment valves have the potential to become the first-line treatment in these critical patients. New implant technologies, such as TAVI and rapid deployment valves, represent additional treatment options for aortic stenosis patients presenting under emergency CS.

Cardiac – Advanced Techniques: A future without suture

Sutureless valve in failed freestyle root

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Stentless valves offer a large effective orifice area and low trans-valvular gradient. The root implantation technique allows operations to provide near physiological reconstruction of the LVOT-aortic root complex. *Freestyle* (Medtronic, Minneapolis, USA) and *PrimaPlus* (Edwards LifeSciences, Irvine, USA) porcine roots are versatile stentless valves and provide an alternative to homografts and pulmonary autografts. Failures of this kind of biological conduit range from regurgitation (leaflet rupture) to stenosis (calcification). Re-operation is a demanding procedure that has traditionally been tackled in one of two ways: either the conservative option implanting a stented valve within the root if technically feasible, or the more radical Bentall repetition. Trans-catheter aortic valve implantation (TAVI), established to treat degenerated native valves, is also an option for failing bioprostheses, but limited experience and some technical details, e.g., risk of coronary obstruction, absence of radio-opaque markers and stents as landing support, make TAVI difficult. However, advances in traditional surgery have been made thanks to sutureless valve technology. Here, we present a neat rescue surgical strategy performed in 4 cases for small and/or calcified biological roots.

1) A 63-year-old woman, BSA 1.5 m^2, was operated on for severe regurgitation of a *Freestyle* valve. The patient had previously undergone mitral valve repair and mechanical AVR (size 19) at the age of 40. At 51 she had mechanical mitral valve replacement (size 25) and a *Freestyle* (size 21) implantation as full root. She came to our attention for stentless valve dysfunction. The xenograft root was found to be calcified and narrowed, whereas the leaflets were thin and pliable with some tears. Root take-down was not feasible due to the porcelain walls of the *Freestyle* and calcification of the coronary ostia. The rigid superior edge of the *Freestyle* valve did not allow the passage of an 18 sizer. Off-label use of a sutureless prosthesis was considered as a rescue option and a *Perceval* (size S) (Sorin Group, Milan, Italy) was chosen for a valve-in-valve procedure. Weaning from the cardiopulmonary bypass and haemostasis were easy. She is progressing well after 31 months.

2) A 56-year-old woman received at age 43 a Dacron tube (size 18) for aortic coartaction, via left thoracotomy, and a *Freestyle* (size 21), prolonged with a Dacron tube (size 24), for aortic root aneurysm with bicuspid valve, via median sternotomy (one stage). She presented with heart failure, aortic regurgitation and complete calcification of the porcine aortic root (Figure 1). A *Perceval* (size S) was chosen for a valve-in-valve procedure. Postoperative course was smooth.

3) A 71-year-old man had previously undergone, 11 years earlier, aortic root and ascending aorta replacement (*PrimaPlus* 25 and *Intervascular* 32) for type A aortic dissection. He returned to our attention for heart failure and aortic regurgitation with LV dysfunction. A moderate neurological impairment coexisted. After cusp excision, a *Perceval* (size M) was easily implanted in the porcine root (Figure 2). At 1 year follow-up, he has NYHA I status.

4) A *Freestyle* (size 27) failed after 1 year due to infective endocarditis. The patient underwent *Perceval* implantation (size L) 6 months after sepsis resolution of Considering the high EuroSCORE II (14.6%), a rapid sutureless device was chosen instead of a reBentall. Early outcome is favourable.

In conclusion, the risk of reoperative AVR is usually low, but some situations, e.g. surgery for stentless root dysfunction, can be challenging for the surgeon. In particular small root diameters, not allowing for secure suture placements and conventional valve siting, and 'porcelain' neo-aorta involving coronary ostia can preclude safe repeat Bentall procedures. The availability of sutureless prostheses may help us manage such situations and may transform a challenging scenario into an intelligent procedure preserving both root architecture and coronary buttons.

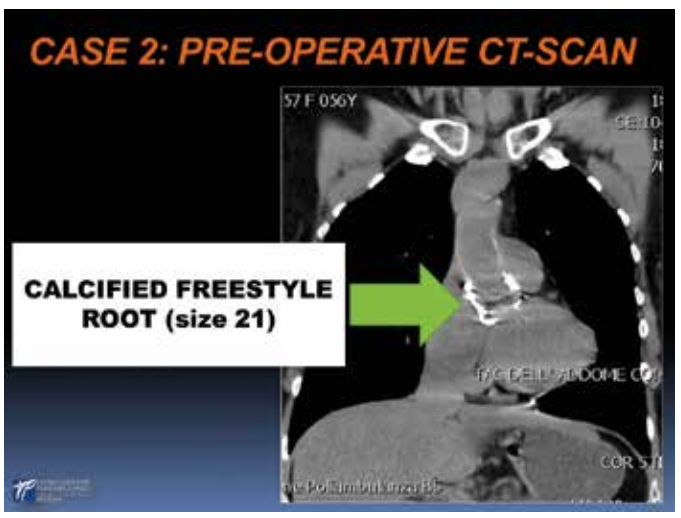

Figure 1. Pre-operative CT scan.

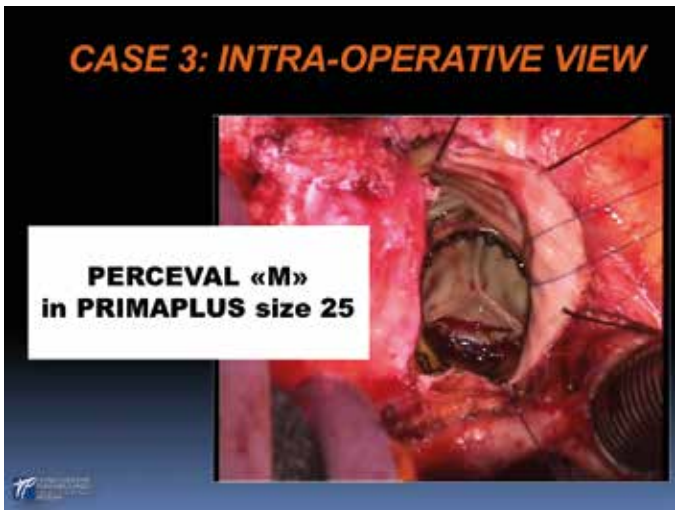

Figure 2. Intra-operative view.

Cardiac – Advanced Techniques: Controversies and catastrophes in adult cardiac surgery

Current guidelines on aortic valve replacement from evidence-based medicine to payment-based medicine

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Transaortic valve implantation (TAVI) is evolving rapidly since the first implant by Alain Cribier in 2002. Initially performed only in very high risk patients, the procedure is now being carried out more and more in those of high or intermediate risk.

The enthusiasm for TAVI is being driven by a number of factors, including the novelty of the procedure, results from multiple clinical studies (including randomised controlled trials), and emerging reimbursement.

If we examine the first studies, this technique was proposed as a salvage procedure for extremely high risks patients. The mortality rate was initially high, but lower than the natural course of the disease of aortic stenosis itself. The Placement of Aortic Transcatheter Valve (PARTNER) Cohort B Study demonstrated a reduced mortality of 23% at 2 years in the TAVI group compared with medical treatment. The PARTNER Cohort A Study, which compared surgical aortic valve replacement (SAVR) with TAVI, showed similar rates of survival at 3 and 5 years, with an increased rate of hospitalisation and aortic paravalvular insufficiency in the TAVI group, despite a high rate of redo in the SAVR group, which may have artificially increased the mortality in this group. A recent registry of more than 12,000 patients with a Society of Thoracic Surgeons (STS) Predicted Risk of Mortality (PROM) score of 7.1%, reported a 30-day mortality rate of 7% and a 1-year mortality rate of 23.7%, with a readmission rate at 1 year of 53.2% and a stroke rate at 1 year of 26%.

Recommendations established in both Europe and the US, advise the use of TAVI in high risk patients for SAVR. However, surgical scores provide good discrimination but limited calibration for high risk patients and should therefore only be used as an aid for decision making. What is best for an individual patient should be decided collectively by all members of the heart team, including cardiologists, surgeons and anesthesiologists, because despite all the recommendations, there remains subjectivity in the decision-making process; for example, in the PARTNER Study, among patients who were initially assessed to be inoperable and randomised to medical therapy, 10% went on to undergo SAVR in the following year.

Reimbursement for the TAVI procedure has slowly been emerging, with variation in the levels of reimbursement available across Europe, from countries with limited funds, for example Belgium, Poland, the UK, and some regions of Italy, to countries such as Germany, Switzerland, France and Austria where reimbursement is unlimited. If we draw a parallel between those countries with the highest reimbursement, a similar progression may be observed in order of highest to lowest implantation rates per population for Germany, Switzerland, Austria, France, and the Netherlands, respectively. Other European countries with more limited rates of reimbursement implant far less than the countries where reimbursement is unlimited. In Germany, for example, the rate of reimbursement for a hospital is three times higher for TAVI than SAVR.

Few studies have been published analyzing cost per procedure, when comparing TAVI with medical treatment or SAVR. However, among those which have, most have concluded that TAVI does offer a cost benefit versus medical treatment in high risk patients due to the decreased rate of rehospitalisation in the TAVI group. This was not found to be the case compared with SAVR, except in very high risk groups.

Finally, some recent studies have compared SAVR with sutureless and with standard bioprosthesis, and have found a reduced cost in the sutureless group. Some limitations apply to these comparisons, however, because they are retrospective and the data being studied are variable, between centres, public or private sector hospitals, and countries.

We can conclude at this stage that TAVI is cost effective in high risk patients compared with medical treatment, but further studies need to be carried out in order to validate this technique in intermediate risk groups, both in terms of medical and financial outcome.

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Cardiac – Advanced Techniques: Controversies and catastrophes in adult cardiac surgery

Preventing expansion in the aortic root

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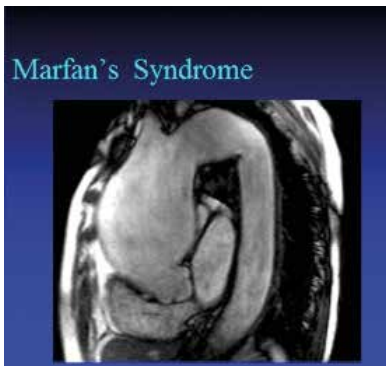
Elective root replacement in Marfan syndrome (MFS) has greatly improved life expectancy in affected patients. Detection, diagnosis, monitoring and prophylactic surgery are believed to have dramatically reduced deaths from dissection and to have resulted in increased longevity in these patients. As a result the threshold for intervention has reduced progressively over 30 years. Three forms of surgery are now available: total root replacement (TRR) with a valved conduit, valve sparing root replacement (VSRR), and personalised external aortic root support (PEARS) with a macroporous mesh sleeve, manufactured and tailored to the patient's own aortic dimensions. The latter is quite different in concept from the established procedures above and is designed to be a prophylactic procedure at an earlier stage in the natural history of MFS for an aortic root measuring between 40 and 50 mm in an adult without aortic regurgitation. It is not suitable for patients with more than trivial aortic regurgitation. The patient's own images are used to create a faithful copy of the aorta using computer-aided design, which is then made into a physical copy by '3-D printing'. Next, a macroporous fabric sleeve is made, which is placed around



the aorta, including the segment proximal to the coronary arteries, down the aorto-ventricular junction.

TRR can be performed irrespective of aortic dimensions and a mechanical replacement valve is a secure and near certain means of correcting aortic valve regurgitation, but has thromboembolic and bleeding risks. VSRR offers freedom from anticoagulation and attendant risks of bleeding, but re-operation for aortic regurgitation is 1.3% per annum. A prospective, multi-institutional study found this to be a substantial underestimate of the true rate of valve-related adverse events. PEARS conserves the aortic root anatomy and optimises the chance of maintaining valve function. PEARS includes the advantages of VSRR while avoiding myocardial ischaemia and usually cardiopulmonary bypass. The first operation was in 2004 and average follow-up is just over 5 years, so the long-term rate of acute root dissection is yet to be determined.

The size threshold for prophylactic interventions has been reduced to 4.5 cms so an increasing number of patients not destined to dissect will now undergo root replacement. Patients are on average in their 30s, so consequently the cumulative lifetime risks of thromboemolism and further surgery are high. This is an important consideration when advising young adults about a prophylactic operation.

Over the past 3 years the PEARS principle has been applied to a group of patients who were born with a cono-truncal abnormality that may be severe (e.g. transposition of the great vessels) or mild (e.g. bicuspid aortic valve). Some patients who have undergone an arterial switch operation in infancy re-present in early adult life with a dilated aortic root and ascending aorta. In circumstances where the aortic valve is functioning normally but the aortic root or ascending aorta is enlarging, the deployment of a personalised sleeve around these structures may help to constrain the aorta and prevent further dilatation. The aortic valve and the native aortic endothelium are preserved. Should aortic valve replacement or repair be deemed necessary, the presence of an external sleeve is unlikely to be a significant hazard. Our experience of 56 such patients over the past 10 years suggests this may be a helpful approach.

Cardiac – Advanced Techniques: A future without suture

Can sutureless valves compete with transcatheter aortic valves?

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Severe symptomatic aortic stenosis is a common disease among the elderly, and aortic valve replacement (AVR) is still the gold standard treatment. However, the increasing age and prevalence of severe comorbidities in the elderly has led to the introduction of alternatives to conventional surgery such as transcatheter aortic valve implantation (TAVI). Despite the enthusiasm for this treatment method, TAVI has resulted in increased costs, and high incidences of pacemaker implantation and of paravalvular leaks, secondary to the inability of remove the calcium in the aortic annulus. Accordingly, one of the major advantages of surgery is to achieve a complete decalcification of the aortic annulus to avoid potential peripheral embolisms as well as to create a smooth and circular seat for the aortic prostheses. However, the implantation of conventional aortic valve prostheses requires prolonged cross-clamping and cardiopulmonary bypass time. Recently, sutureless aortic bioprostheses have been developed in order to simplify surgical implantation and reduce the duration of myocardial ischaemia and cardiopulmonary bypass.

Perceval (Sorin Group, Saluggia, Italy) is a sutureless bioprosthesis with a particular design, being made of pericardium folded over a nithinol stent. Uniquely, this valve offers the ability to implant a stentless prosthesis using sutureless technology. Accordingly, this makes Perceval the ideal valve in the case of small aortic annuli, with the potential of minimising the maximal effective orifice area.

Furthermore, no stitches are required for implantation, and the aortotomy is typically performed 1.5 cm above the sinotubular junction, that is, far from the usual site. The advantage of this technical requirement is a concrete reduction of manipulations on the aortic root. Therefore, Perceval is considered the ideal valve for calcified aortic root. Finally, its exclusive holder and collapsing system allow for full visualisation of the aortic annulus down to the left ventricular outflow tract, which helps for a precise seating of the valve, especially during minimally invasive approaches.

In conclusion, Perceval is the most versatile tool available for the surgical treatment of aortic stenosis.

Cardiac – Advanced Techniques: Controversies and catastrophes in adult cardiac surgery

Near miss or direct hit?

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The concept of the near miss is common to both aviation and medicine, and demonstrates beautifully why surgeons are nothing like pilots. All it takes to constitute a near miss in aviation is for two planes to come reasonably close to each other so that an accident may have been possible. In aviation, therefore, a near miss is just that: an accident that could have happened but absolutely did not.

In medicine, however, there are three types of near miss, which I classified 12 years ago in *The Lancet*. In type 1, a mistake is made, the systems designed to detect it work as planned, and nothing happens. In type 2, the error is made and the safety systems fail, but no harm is done by sheer luck alone. In type 3, harm is done, but it falls short of a direct hit – death or disability. Near misses in aviation are overwhelmingly type 1, more benign in nature than many in medicine, and yet the aviation industry approaches them with earnestness. They are reported, collected, and scrupulously analysed. Lessons are learned from them, and changes in practice and protocol are introduced as a result. After all, it is so much safer (and more intelligent) to learn from a near miss than from a direct hit. Owing to near-miss observations and other technological improvements, the current rate of fatal accidents in air travel has dropped by about 65%, to 1 fatal accident in about 4.5 million aeroplane departures, from 1 in nearly 2 million in 1997. In medicine, the systems are, by comparison, primitive. With exceptions in the fields of drug prescription and blood transfusion, near-miss reporting is still in its infancy. There is some near-miss reporting in some surgical specialties, but in others it is almost non-existent, and in medical specialties it is totally non-existent. In clinical practice, on the whole, we are sadly still in the rudimentary stages of learning from a direct hit.

I was working on the 'Near Miss' chapter in *The Naked Surgeon*, in which I described the medical profession's lamentable inability to learn from a near miss, when a catastrophic event in my own practice poignantly and viciously threw the issue into unforgivingly sharp focus. One afternoon, I was operating on a 73 year-old woman with aortic stenosis. The patient had a few risk factors, but nothing prohibitive, and we expected the operation to be smooth, quick, and relatively easy.

We attached the patient to the heart–lung machine in the usual way, and in the old-fashioned way, inserted a left ventricular vent, which malfunctioned. The result was disaster. Even more tragically, it was an avoidable disaster and a direct hit. The hospital immediately swung into action to study the root cause of the problem and see what could be learned from it. On a human level, this was a tragedy for the patient and her loving family. On a professional level, it was a direct hit from which lessons could be learned, but I could not stop thinking how easily the accident had happened, and being somewhat surprised that it hadn't happened before. In 20 years of working at the same hospital, I had not seen such a calamity until now, and this begged the question: if this event was the direct hit, was it preceded by any near misses? I asked the perfusionists and surgeons if they had ever witnessed such an accident before. To my horror, most said 'Yes'. All of them had seen it or, at the very least, were aware of it happening to colleagues, but, by sheer luck, on these past occasions the patients escaped injury: the archetypal type 2 near miss.

We may think that we are as careful as pilots, but we have a long way to go.

Hospital leadership: the human factor

John Pepper, London, UK

'Vive l' empereur', cried the half-dead French soldiers as they trod the long road from Moscow back to Paris.

What were the qualities of leadership that Napoleon possessed as a young man that inspired such loyalty?

Leadership by threat and fear works for a short time but leadership that inspires loyalty lasts much longer.

In this two-day course we shall discuss more prosaic forms of leadership from different viewpoints. We will examine personal qualities, working with others, managing and improving services and the challenge of setting direction for your unit. While the details may be different across varying healthcare systems, the principles remain the same. On the second day we will have an interactive session where you will be able to role-play in three different settings: the surgeon, the manager and the appraiser. We aim to make this both instructive and entertaining. Basic principles can be made to work in different environments across the nations of Europe.

Vive la difference!

Total aortic arch replacement: conventional or hybrid?

Jean Bachet Emeritus Senior Consultant Surgeon, Paris, France

Since the first aortic arch replacements performed during the sixties, this procedure has been steadily improving. Considered for a long time as a surgical challenge with major risks and uncertain results, within 50 years it has become an essential element of cardiovascular surgery, performed in many centres worldwide with reproducible and reliable techniques and achievements.

In the mid-nineties, considering the success and development of endoluminal therapies in coronary or peripheral vascular diseases, some surgeons had the idea to treat aortic lesions using endoluminal methods. Several reasons explain the sudden popularity of this type of endovascular treatment, but it was primarily led by the supposed impossibilities and failures associated with conventional surgery. However, as far as the aortic arch was concerned, endovascular methods were almost totally excluded. They required precise anatomical features and could not be placed on this aortic segment, from which important tributaries originate, without any other form of procedure. So the idea of performing 'hybrid' procedures associating some sort of vascular 'de-branching' and bypasses before implanting a stented graft was born and rapidly implemented.

Today, procedures like this are not only becoming more popular, but also considered by some as a better alternative to the traditional 'anatomical' replacement of the arch. It is noteworthy that the same statements in favour of these methods are regularly put forward by promoters and upholders of the techniques, and are repeated throughout their articles or presentations:

- 'Hybrid procedures are a must in risky patients'
- 'They are generally minimally invasive'
- 'Hybrid de-branching procedures are surgically easier'
- 'The technical success at 24 hours or 30 days is excellent' etc.

Yet, the questions of how the patient's risk is assessed and what is considered a 'risky patient' are very seldom addressed. It is also intriguing that patients who are supposed to be in too poor a condition to undergo conventional surgery, often undergo a median sternotomy, side-bite cross clamping (or similar) of the ascending aorta, the implantation of a vascular prosthesis before the sequential interruption and re-implantation of the brachiocephalic vessels, and ultimately, the placement of an endoprosthesis with all its possible associated complications. Is such a procedure really less invasive and more appropriate than a straightforward conventional replacement of the aortic arch? The notion of immediate 'technical' success is also a strange one. What does this mean in the first 24-postoperative hours? And what is meant by the term 'clinical success' at 30 days postoperatively? Other issues pertain to a simple but irreducible principle: to gain recognition, a new technique must either do what was not previously possible or do it better than it was done before. Indeed, what about the immediate and long-term results and outcomes of these techniques? Several recently published meta-analyses comparing open surgery and hybrid methods to benchmark this innovative approach were conducted in order to assess technical success, stroke, spinal cord ischaemia (SCI), renal failure, and cardiac and pulmonary complication rates, as well as in-hospital mortality. In these meta-analyses, rates of mortality and neurological complications were higher, and the overall outcomes were no better than in conventional arch replacement. Indeed, if we compare these results with those from recently published large-scale case series of conventional methods of total arch replacement, we observe in the latter reports, that the number of patients was far more important and that the mortality and morbidity rates were significantly lower, despite the fact that the proportion of emergencies was much higher. Furthermore, in the majority of publications reporting the results of hybrid procedures, the mean follow-up is very short and no data are provided to give an indication of what the long-term outcomes might be.

Therefore, in summary, conventional arch replacement can be carried out in a large majority of patients. Hybrid procedures are often as invasive and technically difficult as conventional ones. Moreover, their immediate results are, in many reported instances, not better, and their long-term results are much less favourable than those observed with conventional methods. Things may of course evolve in an undetermined future, yet for the moment, it is impossible to state that 'hybrid' techniques of aortic arch repair result in better outcomes than the conventional but modern open techniques of replacement, which in our opinion can be performed in most patients and still remain the 'gold standard'.

EACTS – New membership applications approved by the General Assembly 2015

New Active Members List 2015

Surname First name	Country
Aass Terje	*Norway*
Abid-Allah Mouhcine	*Morocco*
Abubakar Umar	*Nigeria*
Abusamra Rafik	*United Arab Emirates*
Al Zuhbi Amer	*Germany*
Al-Abbar Atif	*Saudi Arabia*
Albaradai Abdulaziz	*Saudi Arabia*
Almat Baisalov	*Kazakhstan*
Amanullah Muneer	*Pakistan*
Ampatzidou Fotini	*Greece*
Ananiadou Olga	*United Kingdom*
Andin Alexei	*Russian Federation*
Arcieri Luigi	*Italy*
Arnoni Renato	*Brazil*
Asmat Atasha	*Singapore*
Atoui Rony	*Canada*
Azama Masato	*Japan*
Bedjirgi Chidanand	*United Arab Emirates*
Belal Hatem	*Germany*
Bhabra Moninder	*United Kingdom*
Bianchi Giacomo	*Italy*
Birtan Hasan	*Cyprus*
Bjursten Henrik	*Sweden*
Bollys Ramunas	*Lithuania*
Bonatelli Lourival, Filho	*Brazil*
Bruno Vito Domenico	*United Kingdom*
Cañas Alfonso	*Spain*
Cannoletta Maria	*United Kingdom*
Cánovas López Sergio	*Spain*
Caradonna Eugenio	*Italy*
Casiraghi Monica	*Italy*
Caushi Fatmir	*Albania*
Chaiseri Praditchai	*Thailand*
Chan Justin	*Australia*
Chanda Prasanta	*Bangladesh*
Chandra Abha	*India*
Charoenpatcharaporn Pisanuwach	*Thailand*
Chen Yi	*Australia*
Chernov Igor	*Russian Federation*
Choudhary Jivesh	*Australia*
Chung Jae Ho	*Korea, Republic of*
Ciccone Anna Maria	*Italy*
Cini Roberto	*Kuwait*
Congedo Maria Teresa	*Italy*
Correa Jaime	*Brazil*
Costa Marcos	*Brazil*
Czapla Jens	*Belgium*
D'Andrilli Antonio	*Italy*
Danigond Ashvini	*India*
Dausch Andreas	*Germany*
De Almeida Sergio	*Brazil*
De Waele Michele	*Belgium*
Deglurkar Indu	*United Kingdom*
Demuth Markus	*Germany*
Denti Paolo	*Italy*
Desai Himanshu	*Australia*
Diab Sammer	*Israel*
Ding Jianyong	*China*
Diodato Luis	*Argentina*
Doi Atsuo	*Australia*
Dragne George Iulian	*South Africa*
Dronamraju Anil	*India*
Duangpakdee Pongsanae	*Thailand*
Durand Marion	*France*
Durham Iii Lucian	*United States of America*
Echenique Javier	*United States of America*
Eichstaedt Harald	*Germany*
El-Basheir Hatim	*United Kingdom*
Elkhayat Hussein	*Egypt*
Elshafey Mohamed	*Egypt*
Elsiddig Abdal Mahmoud	*No country assigned*
Elwatidy Ahmed	*Egypt*
Ensminger Stephan	*Germany*
Ezzat Mohamed	*Egypt*
Falase Bode	*Nigeria*
Feder Stefan	*Germany*
Fedevych Oleh	*Ukraine*
Fernandes Marcio	*Brazil*
Fontana Gregory	*United States of America*
Freitas Rodrigo	*Brazil*
Fujita Tomoyuki	*Japan*
Furukawa Nobuyuki	*Germany*
Gasanov Elnur	*Azerbaijan*
Gavrilov Roman	*Russian Federation*
Gebauer Roman	*Czech Republic*
Gebitekin Cengiz	*Turkey*
Geldenhuys Agneta	*South Africa*
Gewily Noureldin	*Egypt*
Giffhorn Hélcio	*Brazil*
Ginko Vladiimir	*Russian Federation*
Glonek Ivan	*Slovakia*
Gontijo Bayard	*Brazil*
Gonzalez Rocafort Alvaro	*Spain*
Gopichand Sharavan	*South Africa*
Granato Felice	*United Kingdom*
Guden Mustafa	*Turkey*
Guenther Sabina	*Germany*
Gupta Vishal	*India*
Habib Robert	*Lebanon*
Halezeroglu Semih	*Turkey*
Hanafy Dudy	*Indonesia*
Handa Takemi	*Japan*
Heredia Tomás	*Spain*
Hillebrand Julia	*Germany*
Hirata Yuichiro	*Japan*
Hoel Tom	*Norway*
Hoksch Beatrix	*Switzerland*
Hsieh Wan Chin	*Czech Republic*
Hsu Kang Hung	*Taiwan*
Huffman Lynn	*United States of America*
Hussein Ahmed	*Egypt*
Hwang Jinwook	*Korea, Republic of*
Hysi Ilir	*France*
Ibrahim Islam	*Egypt*
Iliev Rumen	*Bulgaria*
Imai Kenta	*Japan*
Inoue Yosuke	*Japan*
Intanoo Worawit	*Thailand*
Iqbal Muhammad	*Pakistan*
Jaber Osama	*United Kingdom*
Jacoski Mary	*United States of America*
Jagtap Ranjit	*India*
Jain Anil	*India*
Jansen Evert	*Netherlands*
Jeamanukoolkit Paiboon	*Thailand*
Johari Raghav	*India*
Jong Yuan Hsun	*Malaysia*
Juarez Cheng Giovanni	*Guatemala*
Jung Jae Jun	*Korea, Republic of*
Juvonen Tatu	*Finland*
Kacar Sasa	*Serbia, Republic of*
Kaliyev Rymbai	*Kazakhstan*
Kamarulzaman Mohd	*Malaysia*
Kamath M. Vinayak	*United States of America*
Kamiloğlu Ramadan	*Cyprus*
Kanno Kazuyoshi	*Japan*
Kantamneni Srinivas	*India*
Karamichalis John	*United States of America*
Karazanishvili Levan	*Italy*
Karnnaowakul Santichai	*Thailand*
Karunakaran Jayakumar	*India*
Kawamoto Shunsuke	*Japan*
Kazlou Siarhei	*Belarus*
Khalil Ayman	*Egypt*
Khattab Mohammad Amen	*Germany*
Kilo Juliane	*Austria*
Kim Jae Hyun	*Korea, Republic of*
Kim Seok	*Korea, Republic of*
Kimura Fumiaki	*Japan*
Kimura Naoyuki	*Japan*
Kiser Andy	*United States of America*
Kittayarak Chanapong	*Thailand*
Klinkenberg Theo	*Netherlands*
Klotz Stefan	*Germany*
Kofler Markus	*Austria*
Koksal Cengiz	*Turkey*
Kolvekar Shyam	*United Kingdom*
Kono Takanori	*Japan*
Kotani Yasuhiro	*Japan*
Kotob Mostafa	*Egypt*
Krabatsch Thomas	*Germany*
Kristjánsson Tómas	*Iceland*
Kulik Anatoliy	*Belarus*
Kumar Akshay	*United States of America*
Kundrotas Gedeminas	*Lithuania*
Kuplay Huseyin	*Turkey*
Kutay Veysel	*Turkey*
La Forgia Serrano Giambattista	*Venezuela*
Lacroix Valerie	*Belgium*
Lajos Paul	*United States of America*
Lalezari Shirin	*Netherlands*
Lavrsen Michael	*United Kingdom*
Lebreton Guillaume	*France*
Lee Seung Hyun	*Korea, Republic of*
Lee Sang-Kwon	*Korea, Republic of*
Lee Sung Ho	*Korea, Republic of*
Lewis Steven	*United States of America*
Leyh Rainer	*Germany*
Liman Serife	*Turkey*
Lin Suping	*Germany*
Lio Antonio	*Italy*
Loberman Dan	*United States of America*
Longo Massimo	*Italy*
Lysenko Andrey	*Russian Federation*
Macys Antanas	*United Kingdom*
Mahdy Mohamed	*Saudi Arabia*
Mallya Basrur	*India*
Marques Marta	*Portugal*
Martinez Colombres Moises	*Argentina*
Martínez Comendador Jose Manuel	*Spain*
Matarrita Bosco	*Costa Rica*
Mathew Thomas	*India*
Matsumoto Keitaro	*Japan*
Matsuura Kaoru	*Japan*
Melina Giovanni	*Italy*
Mellert Fritz	*Germany*
Merlanti Bruno	*Italy*
Messerschmidt Antje	*Germany*
Middleton Ben	*United Kingdom*
Mikulyak Artur	*Russian Federation*
Mirza Aghayan Mohammad Reza	*Iran*
Mishra Yugal K	*India*
Mitiek Mohi	*United States of America*
Miyahara Shunsuke	*Japan*
Modi Rajan	*India*
Montinaro Flavio	*Italy*
Moser Bernhard	*Austria*
Mounla Ali Rakan	*Saudi Arabia*
Mozulle Biruta	*Latvia*
Muraoka Genya	*Japan*
Nadirbekova Gulnur	*Kazakhstan*
Nagaoka Eiki	*Japan*
Nagayasu Takeshi	*Japan*
Nair Kannan	*India*
Najafi Nader	*United States of America*
Najafi Mahdi	*Iran*
Nandi Jayanta	*United Kingdom*
Nifong L Wiley	*United States of America*
Nina Virreira Clahsius	*Bolivia*
Nitta Takashi	*Japan*
Nouraei Seyed Mahmoud	*United Kingdom*
Ogawa Shinji	*Japan*
Okada Satoshi	*Japan*
Okamura Homare	*Japan*
Omerbasic Edin	*Bosnia and Herzegovina*
Ono Minoru	*Japan*
Opfermann Ulrich	*Germany*
Oprea Alexandru	*Romania*
Oz Kursad	*Turkey*
Paleru Cristian	*Romania*
Paraforos Alexandros	*Germany*
Park Steven	*United States of America*
Patel Ramesh	*United Kingdom*
Pavlov Alegzander	*Russian Federation*
Pedrosa Sobrinho Antonio Cavalcanti	*Brazil*
Pena Diego	*Colombia*
Pereda Daniel	*Spain*
Pinaud Frédéric	*France*
Pitiguagool Vithoon	*Thailand*
Piwkowski Cezary	*Poland*

We are pleased to confirm that we have received 471 complete EACTS membership applications for 2015. Please find below the list of the new members elected at the General Assembly.

From now on, we are happy to receive new EACTS Membership Applications for the year 2016. Please, spread the work amongst your colleagues.

www.eacts.org/membership

EACTS
European Association For Cardio-Thoracic Surgery

Surname First name	*Country*
Pizzuti Manuela	*United Kingdom*
Pope Renato	*Brazil*
Prabhu Prashant	*India*
Prasongsukarn Kriengchai	*Thailand*
Purino Pio Jr.	*Philippines*
Quadri Arshad	*United States of America*
Rahman Haley Shelley	*United Kingdom*
Ramil Aliyev	*Azerbaijan*
Ramlawi Basel	*United States of America*
Rampinelli Amandio	*Brazil*
Reddy Darshan	*South Africa*
Rey Alejandro	*Mexico*
Rooney Stephen	*United Kingdom*
Roque João	*Portugal*
Rosendahl Ulrich	*United Kingdom*
Salem Abdelmegid Mohamed Abdelmegid	*Egypt*
Salem Alsayed	*Egypt*
Samalavichus Robertas	*Lithuania*
Samankatiwat Piya	*Thailand*
Santos Heron	*Brazil*
Scardini Gabriel	*Brazil*
Scoti Peppino	*Italy*
Semensky Vladimir	*Russian Federation*
Sethuratnam Rajan	*India*
Shaheen Yousry	*Egypt*
Shahinian Jasmin	*Switzerland*
She Helen	*Hong Kong*
Shibata Miyuki	*Japan*
Shin Jae-Seung	*Korea, Republic of*
Shiraishi Shuichi	*Japan*
Shirakawa Takashi	*Japan*
Shumovets Vadim	*Belarus*
Silaev Andrei	*Russian Federation*
Singab Hamdy	*Egypt*
Singh Amrendra	*India*
Stefanof Sergey	*Russian Federation*
Stephen Thomas	*India*
Steuer Johnny	*Sweden*
Strike Eva	*Latvia*
Stroeh Katja	*Germany*
Sugama Moriichi	*Japan*
Sugano Mikio	*Japan*
Takagi Yasushi	*Japan*
Takahai Akihiro	*Japan*
Takeshita Masashi	*Japan*
Tarasov Dmitrii	*Russian Federation*
Tauron Manel	*Spain*
Tayeb Marwan	*Saudi Arabia*
Temyord Chatchai	*Thailand*
Thalmann Markus	*Austria*
Thapmongkol Siraphop	*Thailand*
Thomas Martins	*Nigeria*
Thourani Vinod	*United States of America*
Toloza Eric	*United States of America*
Tsukui Hiroyuki	*Japan*
Tsunezuka Hiroaki	*Japan*
Ttofi Iakovos	*Greece*
Tunçer Eylem	*Turkey*
Ueki Chikara	*Japan*
Ustunel Onur	*Turkey*
Valencia Alex	*Colombia*
Vladlen Bazylev	*Russian Federation*
Wei Jeng	*Taiwan*
Williams Richard	*United Kingdom*
Wortel Pieter	*Netherlands*
Wu Yiliang	*Taiwan*
Yamada Toshiyuki	*Japan*
Yamamoto Taketsugu	*Japan*
Yanushka Andrei	*Belarus*
Yanushka Viachaslav	*Belarus*
Yoshitake Shuichi	*Japan*
Yoshizumi Ko	*Japan*
Yukami Shintaro	*Japan*
Zimpfer Daniel	*Austria*
Zotov Alexander	*Russian Federation*

Surname First name	*Country*
NEW TRAINEE MEMBERS LIST 2015	
Agrafiotis Apostolos	*France*
Ahmad Khalil	*Denmark*
Akansel Serdar	*Turkey*
Alexopoulos Panos	*Greece*
Ali Ihab	*Egypt*
Alqumber Hassan	*Saudi Arabia*
Andrade Daniel	*Brazil*
Anjum Muhammad	*Ireland*
Anwer Lucman	*Saudi Arabia*
Arias Dachary Francisco Javier	*Spain*
Arora Niket	*India*
Arsalan Mani	*Germany*
Ayaon Albarran Ali	*Spain*
Baban Zana	*Iraq*
Balasubramanian Sendhil Kumaran	*United Kingdom*
Balta Cenk	*Turkey*
Bartnik Aleksandra	*United Kingdom*
Bartos Oana	*Romania*
Barua Anupama	*United Kingdom*
Bavarskis Egidijus	*Denmark*
Bestoff Gustasvo	*Mexico*
Bilewska Agata	*Poland*
Boeddu Serena	*Italy*
Borowka Magdalena	*Poland*
Büchner Sumy Alexandra	*Germany*
Buderi Silviu	*United Kingdom*
Caruana Edward	*United Kingdom*
Cekmecelioglu Davut	*Turkey*
Ciamberlano Bernardo	*Italy*
Ciobanu Celia	*Romania*
Combellack Tom	*United Kingdom*
Dalén Magnus	*Sweden*
De Siena Paolo Maria	*United Kingdom*
Di Lorenzo Nicola	*Italy*
Dikhoff Marie-Jose	*Netherlands*
Dimberg Axel	*Sweden*
Dohle Daniel	*Germany*
Domashych Roman	*Ukraine*
Elsaegh Mohamed	*United Kingdom*
Elsaify Mohammad	*Egypt*
Ferreira Debora	*Brazil*
Fujiyoshi Toshiki	*Japan*
Gandet Thomas Anthony	*France*
Garzesi André	*Brazil*
Glizevskaja Julia	*United Kingdom*
Gomez Hernandez M Teresa	*Spain*
Gordon Amit	*Israel*
Grant Stuart	*United Kingdom*
Gulmaliyev Rufat	*Germany*
Hancer Hakan	*Turkey*
Haqzad Yama	*United Kingdom*
Hashish Menna Allah	*Egypt*
Heim Christian	*Germany*
Holst Hans Torulv	*Germany*
Hosoba Soh	*United States of America*
Ibrahim Alnameir	*Egypt*
Ildani Beka	*Georgia*
Ishigami Shuta	*Japan*
Ismail Nur	*United Kingdom*
Jadoon Mehmood	*United Kingdom*
Jafrancesco Giuliano	*Italy*
Jankulovski Atanas	*Germany*
Joshi Devang	*United States of America*
Kalandadze Giorgi	*Georgia*
Kalezic Ana	*Montenegro*
Kandler Kristian	*Denmark*
Khamooshian Arash	*Netherlands*
Khan Adil	*Norway*
Khan Muhammad	*United Kingdom*
Korasidis Stylianos	*Italy*
Koutsogiannidis Charilaos-Panagiotis	*Greece*
Kowalówka Adam	*Poland*
Krapf Christoph	*Austria*
Kreibich Maximilian	*Germany*
Kulmane Edite	*Latvia*
Kusurin Marko	*Croatia*

Surname First name	*Country*
Laili Almutairi Noha	*Kuwait*
Lee Geun Dong	*Korea, Republic of*
Lutz Jon	*Switzerland*
Lyskawa Kathrin	*Germany*
Maeyashiki Tatsuo	*Japan*
Mani Aleksander	*United Kingdom*
Mazur Piotr	*Poland*
Mercedes Raquel	*France*
Merk Denis R.	*Germany*
Metreveli Mikheil	*Georgia*
Michaelsen Jens	*Germany*
Migliano Francesco	*Italy*
Mohamed Ahmed	*United Kingdom*
Mohiyaddin Syed	*United Kingdom*
Morjan Mohammed	*Germany*
Munteanu Iulian	*Romania*
Mutema Chileshe	*Russian Federation*
Nagarajan Kumaresan	*United Kingdom*
Nemeth Attila	*Germany*
Nemeti Mihai	*Switzerland*
Nicusor Dima	*Romania*
Nowacka Anna	*Switzerland*
Okubo Yu	*Japan*
Olesen Winnie	*Denmark*
Omoregbee Benjamin	*Nigeria*
Ondrusek Matej	*Slovakia*
Ong Lay Ping	*United Kingdom*
Osman Salem	*Croatia*
Parasca Catalina	*Netherlands*
Pelliciari Giovanni	*Italy*
Perrier Stephanie	*France*
Petrosyan Andranik	*France*
Pieleanu Silvia	*Romania*
Piscitelli Mariantonietta	*Italy*
Pontailler Margaux	*France*
Popescu Florentina	*United Kingdom*
Popescu Alexandru	*Romania*
Potoczny Mateusz	*Poland*
Ram Duvuru	*India*
Reinersman J Matthew	*United States of America*
Reis Andreia	*Switzerland*
Riebandt Julia	*Austria*
Rodrigues Jaqueline	*Brazil*
Rodriguez Maria	*Spain*
Rosati Fabrizio	*Italy*
Ruka Emmeline	*Canada*
Salomie Silviu	*Romania*
Salsano Antonio	*Italy*
Sayan Bihter	*Turkey*
Sef Davorin	*Croatia*
Shokri Hoda	*Egypt*
Sjatskig Jelena	*Netherlands*
Smith Tim	*Netherlands*
Solari Silvia	*Belgium*
Sotiropoulos Georgios	*Greece*
Souza Maraisa Fernanda	*Brazil*
Stelzmueller Marie-Elisabeth	*Austria*
Sukhodolya Tetyana	*Germany*
Tahir Zaheer	*United Kingdom*
Taverne Yannick	*Netherlands*
Thorén Emma	*Sweden*
Umminger Julia	*Germany*
Vardas Panos	*United States of America*
Varzaly Jason	*Australia*
Verbrugghe Peter	*Belgium*
Vidrih Kolar Tadeja	*Slovenia*
Viviano Alessandro	*United Kingdom*
Vizziello Anna	*Italy*
Vogel Beatrice	*Germany*
Vondran Maximilian	*Germany*
Westhofen Fiona Sumi	*Germany*
Witkowska Anna	*Poland*
Wyler Von Ballmoos Moritz	*United States of America*
Yamamoto Tsunehisa	*Japan*
Yannopoulos Fredrik	*Finland*
Yasin Mohammed	*United Kingdom*
Yazicioglu Volkan	*Turkey*
Yudo Mikalay	*Belarus*
Zuber Zibung Jacqueline	*Switzerland*
Zucchetta Fabio	*Italy*

Floor plan – Exhibition opening times: *Sunday 4 October 15.00–19.00 Monday 5 October 09.00–17.00 Tuesday 6 October 09.00– 17.00*

2.65	3-D Matrix Ltd
2.73	A&E Medical Corporation
3.08	AATS-American Association for Thoracic Surgery
2.51	Admedus
2.72	Advancis Surgical
2.68	Andocor NV
2.54B	AngioDynamics
2.55	Argentum Medical LLC – Curasurgical LLC
3.26	Asanus Medizintechnik GmbH
2.47	ATMOS MedizinTechnik GmbH & Co. KG
2.50	AtriCure Europe BV
2.19	B Braun Surgical S.A.
2.22	Bard Davol
3.12	Berlin Heart GmbH
2.52	BioCer Entwicklungs-GmbH
2.11	Biointegral Surgical, Inc.
2.56	Biometrix BV
2.46	Cardia Innovation AB
2.25	CardiaMed BV
2.06	Cardica GmbH
2.53A	Cardio Medical GmbH
3.29	Carmat
2.76	ClearFlow Inc.
2.41	Cook Medical
2.52A	CorMatrix Cardiovascular Inc.
2.79	CORONEO Inc.
2.32	Cryolife Europa Ltd.
3.10	CTSNet
2.42	CytoSorbents Europe GmbH
3.01	De Soutter Medical Limited
2.59	Delacroix-Chevalier
2.13	Dendrite Clinical Systems Ltd
2.23	Direct Flow Medical GmbH
3.09	EACTS-Euromacs and QUIP Programme
3.17	EACTS-The European Association For Cardio-Thoracic Surgery
3.16	Edwards Lifesciences
Training Village Unit 2	Edwards Lifesciences
2.78	ESCVS 2016-European Society for Cardiovascular and Endovascular Surgery
3.14	Eurosets SRL
3.32	Fehling Instruments GmbH & Co KG
2.66	Gebemed medical systems GmbH
2.18	Geister Medizintechnik GmbH
2.36	Genesee BioMedical Inc.
2.67	GUNZE Int'l Europe GmbH
2.16	Hamamatsu Photonics Deutschland GmbH
2.74	Heart and Health Foundation of Turkey
3.24	Heart Hugger / General Cardiac Technology
2.33	HeartWare Inc.
2.61	Hemotec Medical GmbH
2.70	HMT Medizintechnik GmbH
2.23A	Inter Medical Services Ltd
3.07	ISMICS-International Society for Minimally Invasive Cardiothoracic Surgery
2.53	Jena Valve Technology GmbH
3.04	Johnson & Johnson Medical S.p.A.
Training Village Unit 6	Johnson & Johnson Medical S.p.A.
3.28	JOMDD INC – Japanese Organisation for Medical Device Development, Inc
3.20B	JOTEC GmbH
2.07	KLS Martin Group – Gebrueder Martin GmbH & Co KG

2.44	Labcor Laboratorios Ltd.
3.20	LSI Solutions
2.04	Mani, Inc.
2.31	MAQUET
Training Village Unit 5	MAQUET
2.37	Master Surgery Systems AS
2.14	MDD Medical Device Development GmbH
2.63	Medela AG
2.77	Medex Research Ltd
3.20C	Medical Concepts Europe BV (co-exhibitor with Wexler Surgical Inc.)
2.20	Medistim ASA
2.21	Medos Medizintechnik AG
2.28	Medtronic International Trading SARL
Training Village Unit 1	Medtronic International Trading SARL
2.10	Meril Life Sciences Pvt. Ltd
2.22A	Moeller Medical GmbH
3.03	NeoChord Inc.
3.19	On-X Life Technologies INC™
2.58	OpInstruments GmbH
2.05	Oxford University Press
3.02	PEMCO Medical
3.22	Peters Surgical
2.22C	PneuX Life Systems
2.54	Posthorax Ltd
2.09	Qualiteam SRL
2.40	Redax S.p.A.
2.26	ReliantHeart
2.39	RTI Surgical Inc.
2.52B	Rumex International Co.
2.12	Sage Products
2.01	Scanlan International Inc.
2.49	Siemens Healthcare
3.31	Smartcanula LLC
2.54A	Somahlution
3.15	Sorin Group Italia Srl
Training Village Unit 3	Sorin Group Italia Srl
2.48	Spectrum Medical
Training Village Unit 4	St Jude Medical
2.30	St Jude Medical
3.25	stroke2prevent
3.11	STS-The Society Of Thoracic Surgeons
3.18	Symetis SA
2.17	SynCardia Systems Inc.
3.20C	TeDan (co-exhibitor with Wexler Surgical Inc.)
3.21	Terumo & Vascutek
2.53C	The Heart Valve Society
2.38	The Medicines Company
3.13	Thoratec Corporation
2.24	Tianjin Plastics Research Institute Co. Ltd (TPRI)
2.34C	Tianjin Welcome Medical Equipment Co Ltd
2.34A	Transonic Europe BV
2.34	VGS-Vascular Graft Solutions Ltd
2.15	Weigao Group
3.20C	Wexler Surgical Inc.
2.80	Wisepress Online Bookshop
2.45	WL Gore & Associates GmbH
2.75	WSPCHS-World Society for Pediatric and Congenital Heart Surgery
2.37	Xenosys (co-exhibitor with Master Surgery Systems)
2.71	Zimmer Biomet

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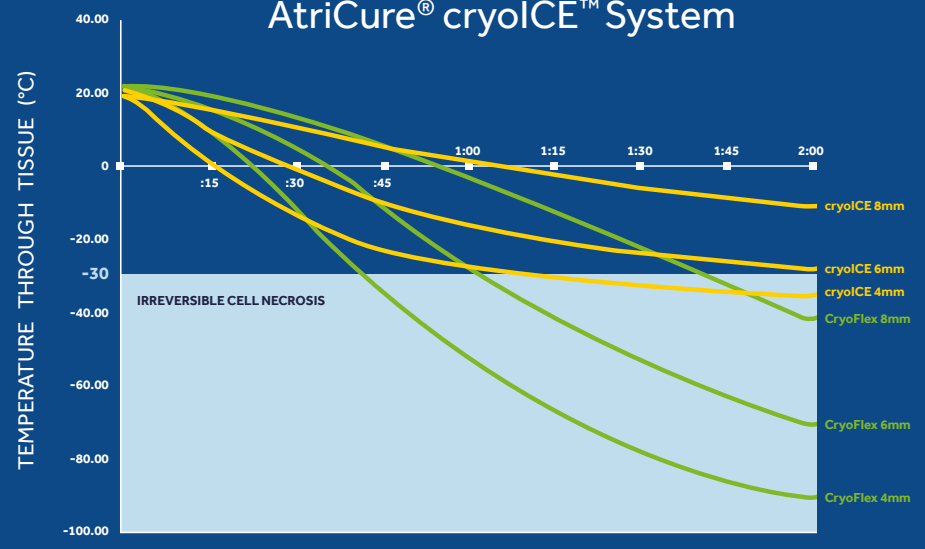
Medtronic CryoFlex™ System
Vs.
AtriCure® cryoICE™ System



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1.Medtronic in vitro test data on file. Comparison of the performance of the Cardioblate CryoFlex argon gas powered system (60SF3 probe) to the AtriCure cryoICE nitrous oxide powered system (CRYO2 probe) on porcine tissue. Results may not be indicative of clinical performance.

Medtronic
Further, Together

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