Daily News

Saturday 3 October

The official newspaper of the 29th EACTS Annual Meeting 2015

EACTS European Association For Cardio-Thoracic Surgery

Welcome to Amsterdam

Pieter Kappetein

Embracing the challenge

Welcome to the 29th European Association for Cardio-Thoracic Surgery (EACTS) Annual Meeting in Amsterdam! As ever the conference brings together a world-class faculty to present, debate and discuss the latest developments in cardiothoracic surgery. Through this year's programme, the EACTS promises to deliver the highest quality of advanced education in the field of cardiovascular and thoracic surgery, as well as promote the benefits of research in thoracic physiology, pathology and therapy. We are ready to embrace the challenges of the rapid development of interventional techniques and the aging population.

Techno College

Saturday will host the Techno College and the Acquired Cardiac Disease Programme will focus on four topics:

1. Transcatheter aortic valve implantation and aortic valve replacement
2. Tricuspid valve surgery
3. Heart failure
4. Mitral valve interventions.

The Congenital Disease Programme covers 3D imaging modalities in congenital heart surgery and the management of the mechanical support of circulation. The Thoracic Disease Programme will look at malignant pleural mesothelioma. From biomolecular aspects to maximal invasive surgery: what thoracic surgeons should know.

Postgraduate Course

Sunday's Postgraduate Course of the Acquired Cardiac Disease Domain covers a wide variety of topics related to surgical safety and quality improvement. The Thoracic Disease Programme covers an interactive session with a penal of experts. This year's topics are: pneumonectomy controversies, oesophageal perforations management and acquired tracheal disorders management. Personal illustrative clinical cases will be shown by the panel to stimulate and encourage interactive discussion. The Congenital Disease Programme will provide sessions on the management of hypoplastic left heart syndrome, all aspects of Tetralogy of Fallot with pulmonary atresia (TOF-PA) and major aortopulmonary collateral arteries (MAPCAs). There will also be a meet the expert session where complex cases will be presented and discussed, and a surgical film session will illustrate complex repairs.

The postgraduate programme of the Domain of Vascular Disease will already feature some of the best-selected abstracts that will logically fit with the invited presentations. A basic approach to the surgery of the ascending aorta will cover the indication and timing for a tailored surgical approach, as well as the optimal technique in different pathological situations. The programme will continue with the type of follow-up procedures that are required after major thoracic surgeries and with the last unsolved issues of the thoraco-abdominal pathologies.

The Postgraduate Course has a plenary session at noon: **'CanBetter: optimising training programmes in cardiothoracic surgery'**

Monday and Tuesday's programme has numerous Abstract, Professional Challenge and Focus Sessions, encompassing the whole spectrum of cardiothoracic surgery. These sessions will provide you with all the latest information on understanding preventive measures, intraoperative techniques, prediction and perioperative interventions to reduce complications, dealing with complications when they occur, and how to improve outcomes. We are sure there is something for every cardiothoracic specialist and allied healthcare professional 0to learn, discuss and take home from the meeting.

Keynote lectures

This year's Presidential Address by Martin Grabenwöger entitled '**The Power of Surgery**' will be presented on Monday afternoon. We are also delighted to welcome André Kuipers, MD, Astronaut and Ambassador of Earth (the Netherlands) to Amsterdam who will address one of the most important characteristics of cardiothoracic surgeons – the belief in future technologies and the impulse to explore new galaxies during his Honoured Guest Lecture '**Medical aspects in Space Industry**' on Tuesday afternoon.

EACTS

If you appreciate what the EACTS presents during this event and you would like to support the work of the Association, I encourage you to visit the EACTS booth and become a member. The membership fee is low and you will receive the *European Journal of Cardio-Thoracic Surgery* and the *Interactive CardioVascular and Thoracic Surgery Journal*, as well as a reduced rate for the Annual Meeting. You can complete your application online through the EACTS website (www.eacts.org) or by visiting the EACTS booth in the exhibition area. At the booth you will also find information on our new courses planned for 2016.

We thank our industry partners for their continued support of the Annual Meeting, and all the presenters who have taken the time to contribute to this year's EACTS Daily News newspaper.

It is a great pleasure to welcome you in Amsterdam, and we are honoured and delighted by your presence at this year's conference. We hope the information and techniques presented here will be of great interest.

In addition to an outstanding scientific programme, the opportunity to stroll through the narrow streets, explore the city by boat, and sample the rich cultural history the city has to offer visiting museums like the Stedelijk Museum, the Van Gogh Museum, and the Rijksmuseum with Rembrandt's famous 'Nachtwacht' painting, will make your stay in Amsterdam unforgettable.

I hope you enjoy the meeting and all Amsterdam has to offer.

Pieter Kappetein

EACTS Secretary General

In this issue...

Techno College – Programme overview

Thomas Walther
Kerckhoff Heartcenter,
Department Cardiac Surgery, Bad Nauheim, Germany

Dear Colleagues

I would like to bring to your attention our exciting programme for this year's Techno College (TC)! Over the past 10 years under the leadership of Hugo Vanermen and Volkmar Falk the TC has evolved to become one of the most interesting days at medical conferences worldwide. My task, together with the EACTS New Technology Committee is to maintain and build on this level of expectation for attendees in future years. We want to ensure the that TC stays at its best and would therefore be very happy to receive your feedback on this year's programme, as well as gather potential suggestions for future content.
This year's 1-day programme combines excellent cardiac surgical and cardiological skills with new techniques and future scientific developments. Over the past months, during multiple discussions, we have put together a very exciting programme. Although confronted with clinical realities, individual expectations, and restrictions with the initiation of clinical studies, we have adapted our programme while maintaining the scope of the sessions which include general presentations, live-in-a-box and videos illustrating technical details and live cases. We are very thankful to Fred Mohr and the whole team from Leipzig for their kind hospitality in hosting the live cases at the Leipzig Heart Centre – once again over the weekend! In addition we would like to thank MediLive for their excellent audiovisual support.
Today you will see three very exciting sessions which focus on many aspects of modern cardiac and cardiac surgical therapies. In the morning session we will cover topics of conventional aortic valve diseases, valve repairs and (of course) transcatheter therapies. After the first break we will present the New Technology Award, for which there are several excellent applicants with brilliant ideas. The second session will focus on the aorta, heart failure and new techniques for ablation therapy. One of today's absolute highlights will be the keynote lecture immediately prior to the lunch break, presented by Mike Mack from Dallas, USA. Within the third session we will focus on the atrioventricular valves, including the tricuspid and mitral valves. Besides many live-in-a-box presentations there will be two interesting live cases in this session.
Although we have worked hard to bring you an exciting programme, it is you, the audience, who can turn a good meeting into a great one. I would therefore like to thank all of you very much for coming to this year's Techno College, and I look forward to seeing you in Amsterdam or at future meetings.

On behalf of the New Technology Committee, EACTS

Thomas Walther

somahlution
Advancing Human Health

VGS

MEDISTIM

Somahlution, Medistim and Vascular Graft Solutions (VGS) will host a joint satellite lunch symposium **"Optimizing Vein Graft Outcomes for CABG: New Solutions"** on Monday, October 5th. The luncheon will be moderated by Professor David Taggart of the University of Oxford and will cover new intraoperative techniques that better warrant successful patient outcomes and may lessen rates of vein graft failure.
Somahlution is dedicated to providing medical products focused on relieving Ischemia Reperfusion Injury (IRI) to improve healthcare delivery to patients around the world. Somahlution's flagship product, DuraGraft® – an Endothelial Damage Inhibitor™, is first-in-class and the only commercially available product intended for the preservation, storage, and flushing of vascular grafts, a pivotal step in coronary artery and peripheral bypass surgeries. In addition to being buffered, DuraGraft is synergistically designed with components that preserve the overall structure and functionality of grafts whose performance is critical to successful patient outcomes. Professor John Pepper of the Royal Brompton Hospital will discuss the significant clinical outcomes when DuraGraft is used.
Medistim is an innovator and market leader within intraoperative Transit Time Flow Measurement (TTFM) and ultrasound imaging for surgical guidance and quality assessment. Medistim is serving the global market with the devices VeriQ™, VeriQ C™ and the latest generation, MiraQ™. These systems enable medical professionals to reduce risk and enhance quality of cardiac, vascular and transplant surgery.
Dr. Daniel Wendt of West German Heart Center Essen will present their experience with the combined use of TTFM and High-frequency Ultrasound Imaging to ensure successful clinical outcomes.
VGS develops external scaffolds for saphenous vein grafts (SVG) improving their longevity and the clinical outcome of peripheral and coronary bypass surgery. VEST, the company's leading product, is the only available technology that has demonstrated clinical effectiveness in mitigating SVG intimal hyperplasia and improving lumen uniformity and hemodynamics. In use in more than 40 leading heart centres across Europe, VEST offers the cardiac surgeon a hybrid conduit which combines the benefits of venous and arterial grafts. This simple tool, aims to drive a significant change in the clinical outcome of CABG. Prof. David Taggart (Oxford, UK) will present his clinical experience and discuss latest clinical results.
The luncheon will take place Monday October 5th, from 12:45–14:00 in Room E104/105 onsite at the RAI Amsterdam.

Techno College

Nicolas Doll
Nicolas Doll, Sana Herzchirurgie, Stuttgart, Germany

Not only the demand for minimally invasive techniques but also excellent exposure of the valve and good results in terms of perioperative complication rate have made the video assisted anterolateral mini-thoracotomy our standard approach in mitral valve surgery.
Atrial fibrillation (AF) is associated with mitral valve disease and can effects up to 50% of patients who do not receive a surgical treatment in time. Besides significant hemodynamic compromises in some cases, stroke remains the most feared complication of AF with a 5-fold increase in risk. Despite those significant compromises many patients with AF still remain untreated during their mitral valve surgery. This is remarkable considering the fact that the left atrium is exposed anyway and that the addition of an ablation does not increase the perioperative mortality, even in high-risk patients, while the long term outcome will significantly improve.
In the case presented during Techno College, new generation devices were used which allow for a minimally invasive and effective application of ablation lines as well as a safe, quick and effective closure of the left atrial appendage during a mitral valve reconstruction. The patient suffered from severe mitral valve regurgitation due to a flailing leaflet in the P2 region, which was corrected applying the loop technique and implanting an annuloplasty ring, and persistent AF with a slightly enlarged left atrium.
The enhanced flexibility of the cryoFORM probe (AtriCure, West Chester (OH), USA) makes it a convenient device in minimal access surgery because the probe can be easily formed within the thorax by robotic or MIS instruments. The ablation device uses N_2O as coolant gas to remove heat from the tissue. Since the heat removal capacity of N_2O is higher than that of other coolants such as CO_2 or Argon, we see rapid cell necrosis which is necessary for the creation of reliable transmural lesions. This effect is even pronounced by a defrost mechanism for a quick removal of the device from the tissue after ablation while allowing the tissue to remain frozen and thaw slowly for maximal necrosis. The cooling performance is monitored by thermocouples which are placed right at the probe-tissue interface. As a result, I believe our excellent long term success rates of about 85% in terms of sinus rhythm restoration using cryo energy can be reproduced with this device while giving me the choice of a more flexible probe now.
The effective closure of the left atrial appendage in minimal invasive mitral valve surgery using an endocardial suture line is challenging because recanalisation is unfortunately not infrequent. We presented a safe and efficacious way to close the left atrium epicardially in minimally invasive mitral valve surgery using a clip device (AtriClip®, AtriCure, West Chester (OH), USA). The AtriClip® uses a nitinol spring to apply enough force to exclude the left atrial appendage effectively without the risk of recanalisation or of leaving a residual pouch which would cause a remaining thromboembolic risk. Additionally, it isolates the left atrial appendage electrically from the atrium and thus also eliminates an AF trigger source. The application is completely atraumatic and can be applied via the transverse sinus trough a right-sided minithoracotomy.
I believe that these recent developments allow for an efficacious treatment of AF during minimally invasive mitral valve surgery and should be adopted for most of our concomitant procedures in patients with AF to not only warrant a perfect functioning valve but also to reduce any remaining stroke risk exposure in these patients.

Techno College – Bronchoscopic indocyanine green fluorescence imaging for visualisation of the perfusion of airway anastomosis

The indocyanine green fluorescent bronchoscope

Konrad Hoetzenecker and Thomas Schweiger
Medical University of Vienna, Austria

Background and current situation

Anastomotic complications are a rare but serious problem in surgery of the central airways. They occur in about 4–9% of patients after tracheal resection, and 3–7% of lung transplant recipients. The most critical factor for anastomotic healing is a sufficient perfusion at the site of the airway anastomosis. Malperfusion of the anastomosis leads to infection, leakage, dehiscence with a partial or complete separation of the airway. Even if a secondary healing occurs, sequelae of such perfusion defects like malacia or extensive cicatrisation limit the functional long-term outcome after surgery.
Currently, a judgement on the perfusion of an airway anastomosis is limited to white light bronchoscopy. However, only the consequences of an insufficient airway perfusion can be assessed (e.g. mucosal necrosis, oedema, ulcerations and dehiscence), resulting in delayed treatment.
Indocyanine green (ICG) is a fluorescent dye with various applications and is widely used in medicine. It is routinely used for non-invasive angiography in ophthalmology and can visualise tissue perfusion. ICG was approved by the Food and Drug Administration (FDA) as a diagnostic substance in the late 1950s. It is plasma-protein bound after intravenous injection and is rapidly biliary excreted. The half-life is about 150–180 sec. The absorbance of ICG is 600–900 nm, whereas the emission is 750–950 nm with a maximum at 800 nm, which allows a very specific measurement of the emitted near-infrared light with special optical devices. Due to the highly plasma-bound state of ICG after injection and its strong fluorescence, perfused tissue can be visualised and clearly distinguished from tissue with no blood flow (Figure 1).

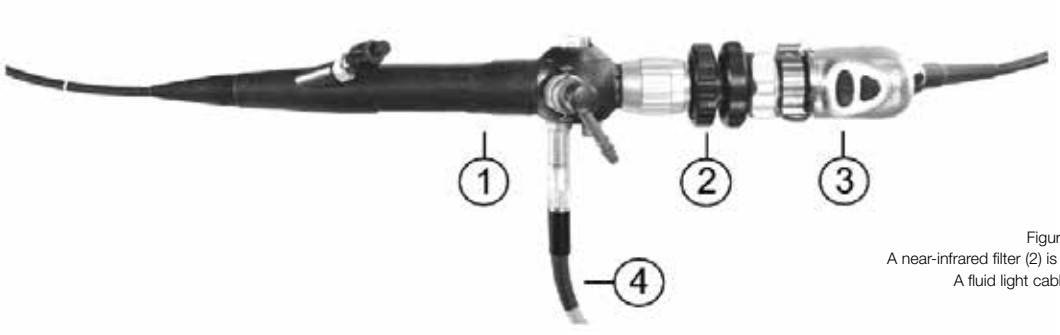


Figure 2. The components of the ICG bronchoscope.
A near-infrared filter (2) is connected to a standard broncho-fibrescope (1)
A fluid light cable and a near-infrared light source are needed (4)
Images are recorded by an HD camera-head (3)

The ICG-bronchoscope

We assembled an ICG bronchoscopy unit consisting of a near-infrared light source, fluid light cable, full HD camera-head, near-infrared filter, broncho-fibrescope (all by Karl Storz Endoscopy, Tuttlingen, Germany) (Figure 2). For video documentation, a media hub was connected to the bronchoscopy unit (Karl Storz Endoscopy, Tuttlingen, Germany).
This new device was tested in a feasibility study (EUDRACT #2013-001725-10; EUDAMED #CIV-AT-15-06-013636) in 12 patients undergoing a laryngotracheal resection. The perfusion at the site of the anastomosis could be visualised precisely. Image resolution was sufficient to demonstrate perfusion of the transverse intercartilaginous arteries branching in to the submucous capillary plexus.

Clinical impact

To the best of our knowledge, this is the first technical tool that can measure the perfusion at the anastomotic site of airway anastomosis. This could have significant implications in everyday clinical life for cardiothoracic surgeons. Using ICG bronchoscopy, the quality/healing of airway anastomosis can be monitored easily. Failure of the anastomosis could be detected at an earlier stage and could therefore be treated more effectively by drugs improving the microcirculation (rheologicals) or by hyperbaric oxygen therapy. Our innovation has the potential to become routine in airway surgery, bronchoplastic operations and lung transplantation.

Figure 1. A typical postoperative endoscopy after tracheal resection. White light endoscopy shows an inconspicuous anastomosis; however, ICG bronchoscopy reveals perfusion defects at the anterior parts of the anastomosis.

Thoracic surgery: Part II,

Date/duration: 8–11 December 2015. Location: Windsor

Course Director: P Rajesh, Birmingham, UK

Course overview

The course will include didactic presentations with interactive discussions and seminar sessions with faculty to promote discussion with delegates.
The course material will be such that, at the conclusion of the 4 days, the delegates will have an understanding of the principles of airway management, mediastinal and oesophageal disorders, indications and contraindications and techniques and access for surgery.

Target Audience

This course is designed for Senior Trainees in Cardio-thoracic Surgery and newly appointed Consultants in Europe. The faculty are experts in the various subspecialities of General Thoracic Surgery. Senior Trainees in Cardio-thoracic Surgery and newly appointed Consultants.

Techno College – Novel aortic clamp with equal pressure distribution along the clamp jaws

Novel aortic clamp with equal pressure distribution along the clamp jaws

Bartosz Rylski Heart Center Freiburg University, Freiburg, 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 postoperative 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 (Figure 1). In our study, which will be presented on Tuesday 6 October 2015 at 08:15–09:45, entitled '*Innovation and new strategies in thoracic aortic surgery*', we set up an *in-vitro* model for aortic cross-clamping and evaluated the pressure distribution of the following clamps: DeBakey, Satinsky, femoral, iliac, Chitwood, angled handle Fogarty and straight handle Fogarty. The pressure over the clamp was not found to be distributed equally for any of the vascular clamps analysed. The ratio between the highest and lowest maximal pressure measured along the jaws ranged between 1.5 and 3.6 (Figure 2). All clamps seem to carry a risk of the 'scissor' effect. According to the law of the lever, cross-clamping, especially a large aorta, triggers a large difference in the stress placed on different parts of the aorta; the aortic area near the hinge is under more stress than the aortic area distal to the hinge. Even the least trauma-causing, currently available aortic clamp can lead to serious, potentially lethal aortic injuries in such patients.

Cross-clamping with the aortic clamps currently available may injure the aorta, especially large ones, or those of patients with connective tissue disorders. We propose a new aortic clamp design that causes less trauma by distributing the pressure equally. 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 (Figure 3). 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. We have analysed the clamp prototype performance in the same *in-vitro* model and measured the pressure distribution along the jaws (Figure 2). Our experiments showed that the Kowalski–Rylski clamp distributes the pressure equally along the jaws and the ratio between the highest and lowest maximal pressure measured along the jaws was 1.0. The pressure measured near the Kowalski–Rylski clamp hinge and at the top of the clamp jaw was the same and was similar to the lowest pressures measured in other clamps (Figure 2). We believe that our less invasive solution to aortic clamping is a positive contribution to today's surgical armamentarium. It may decrease the incidence of aortic injury associated with cross-clamping and enable surgeons to clamp aortas that are vulnerable to injury in patients with connective tissue disorders or those with aortic aneurysm, safely and with greater confidence.

Currently available clamps

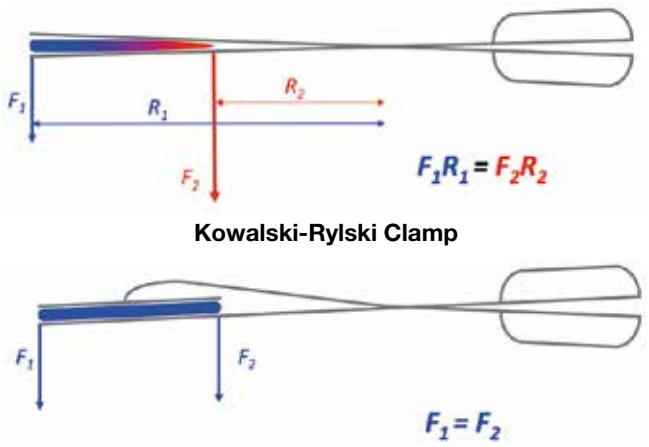


Figure 1. Stress distribution along the clamp jaws. In currently available clamps according to the law of the lever, the aortic area near the hinge is under more stress (F2) than the aortic area distal to the hinge (F1). In the novel Kowalski–Rylski clamp an additional hinge allows the upper jaw to adjust its position according to the pressure resulting in equal pressure distribution along the jaws.

Maximal pressure generated along the clamp jaws

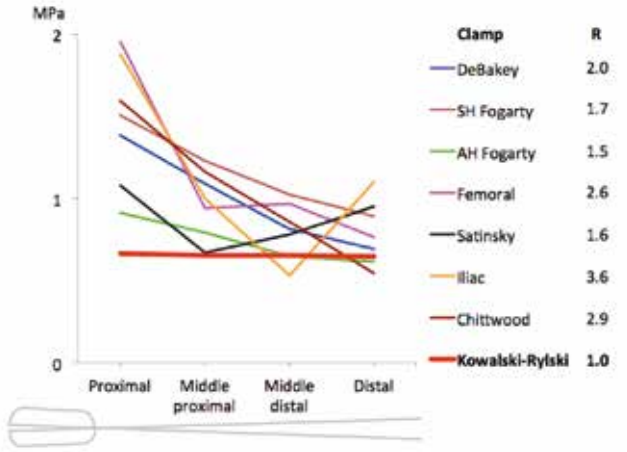


Figure 2. Maximal clamping pressure generated at proximal, middle proximal, middle distal and distal areas to the clamp hinge quartiles. The proximal quartile is near, the distal quartile far from the clamp hinge. R – ratio between the highest and lowest pressure measured along the clamp jaws; SH – straight handle; AH – angled handle.

Kowalski-Rylski Clamp

Figure 3. The Kowalski–Rylski 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.

Techno College – Sternal stapler: sternal closure and ribs approximator device

Sternal stapler: sternal closure and ribs approximator device

Ajay K Patil and Deeva A Patil Sterling Hospital, Rajkot, India

Median sternotomy has been the main surgical access to the heart and mediastinum since the 1950s. Following completion of surgery, the median sternotomy is re-approximated using fixation methods. Although the complications of sternal closure are low (3–5%), they are associated with high morbidity and mortality (14–47%).

Related complications include sternal instability, wound infections, osteomyelitis, sternal displacement, mediastinitis and sternal dehiscence. The most important factor in the prevention of dehiscence and mediastinitis is a (rigid) stable approximation. There has been a constant quest to find the ideal method for sternal closure.

Disadvantages of currently used methods

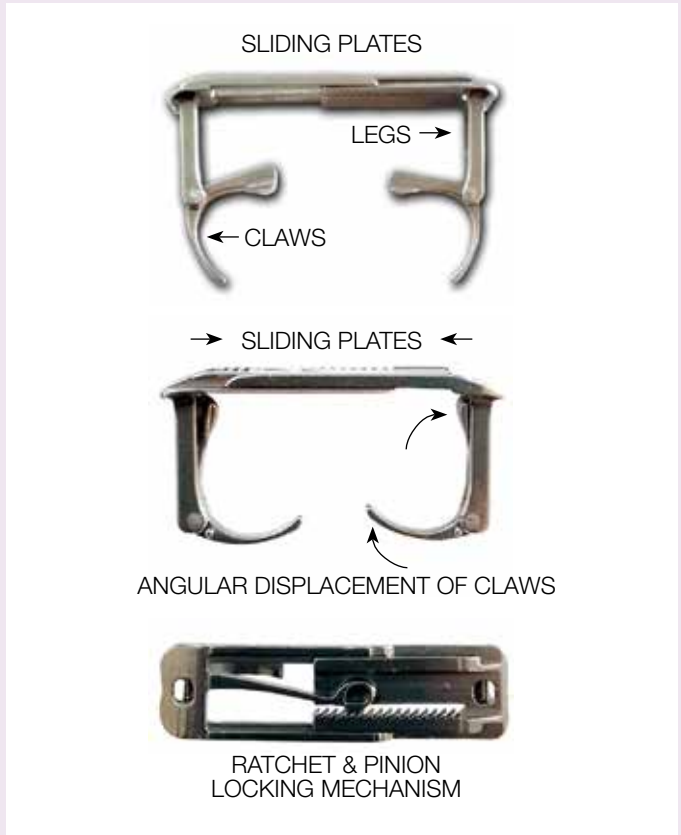
1. Thin SS wires easily cut through the sternum especially osteoporotic sternums and in elderly, obese, COPD or diabetic patients, resulting in sternal instability. An unstable sternum increases the risk of infection, mediastinitis and sternal dehiscence.
2. Sternal bands are time consuming to apply, complex to lock and are difficult to remove during later removal for band infections, as its rigidity may cause injury to underlying organs.
3. Talons have complex insertion techniques as they are two-piece devices requiring alignment in all 3-dimensions before closure is possible. Their fixed angle arms both increase the chances of play between the sternum and the device; and also increase operating theatre inventory. A stock of up to 30 sizes, of these expensive items, is required, with each patient requiring a minimum of three talons.

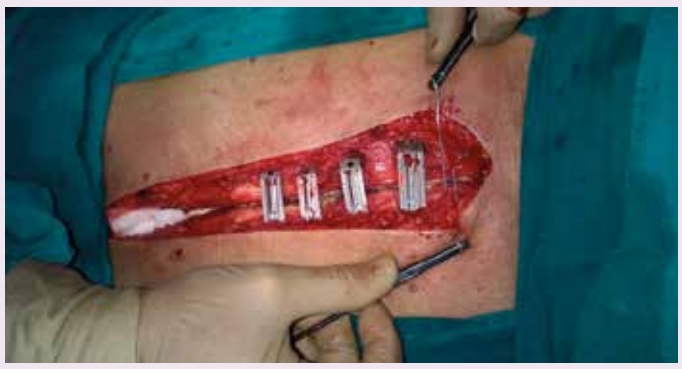
To avoid these complications, at our institution, we advocate the use of a novel sternal stapler device. The sternal stapler is made of implant grade stainless steel (316L). It comprises of two angular collapsible members (sliding into each other) forming a C-shaped unit, with a locking mechanism attached and a pair of claw-shaped clamping elements pivoted to the C-shaped arm in such a way to allow angular movement of the claw.

During closure of sternotomy, small spaces are created parasternally in each intercostal space on both sides allowing the 5 mm claw part of the device to be lowered through it. The sternum is approximated using a temporary approximator. As the device is lowered, the medial end of the claw comes in contact with the upper outer edge of the sternum, initiating its angular movement. When lowered completely, the device is collapsed to the required length so that it firmly approximates sternum. This action further enhances the angular movement of the claws. which now tightly grip the under surface of the sternum, not allowing any movement between the device and the sternum. The temporary approximator is then removed and the final device is placed. About 4–6 devices are required depending on the anatomy of the sternum. If required additional SS wires may be used to achieve firm approximation.

Advantages

1. As a rigid fixation device with a broad base, it does not permit sternal instability, hence reducing the risk of instability related complications.
2. The broad base stops it cutting through weak and osteoporotic sternums.
3. Unlike other devices this single piece device is loaded onto an applicator making its handling very easy, simple and quick.
4. Within minutes the sternum is closed reducing the sternal closure and operating time considerably.
5. The designed angular movement of the claws, holds the device firmly over the sternum nullifying the play between claws, and also reducing the range sizes required to an inventory of 5–6 sizes only, covering the entire range of lengths and breadths of sternum.
6. Simple design and minimal inventory makes it cost effective allowing its use in all patients requiring sternotomy closure.
7. Removal of the device in case of emergency re-explorations/ late redo surgeries is very easy. The device is simply unlocked and lifted up from the sternum.





In conclusion, the sternal stapler, sternal closure and ribs approximator device, is the simplest, fastest and the most effective method for closure of the sternum following sternotomy.

Techno College – From intraoperative empirical mitral valve inspection towards quantitative analysis using optical tracking technology

From intraoperative empirical mitral valve inspection towards quantitative analysis using optical tracking technology


Raffaele De Simone[1], Sandy Engelhardt[3], Sameer Al-Maisary[1], Jörg Rodrian[2], Hans-Peter Meinzer[3], Matthias Karck[1], Ivo Wolf[3,4]
[1]Department of Cardiac Surgery and [2]Media Center, University of Heidelberg, Heidelberg, Germany; [3]Division of Medical and Biological Informatics, German Cancer Research Center, Heidelberg, Germany; [4]Department of Computer Science, Mannheim University of Applied Science, Mannheim, Germany

Figure 1. Intraoperative mitral valve analysis by optical tracking.

Today intraoperative mitral valve analysis is based on visual assessment and 'eyeball guesstimates'. This conventional approach aims to obtain measurements using simple surgical tools, such as a ring sizer, calipers or clamps, although the application of these tools are highly subjective and cumbersome, especially during critical phases of cardiac arrest. Furthermore, current measurement procedures only provide a rough estimate of just a small number of desired measures of the surgical target. We have developed a new method for mitral valve analysis based on optical tracking technology that allows quantitative assessment of complex three-dimensional (3D) valve anatomy. The tips of specially developed surgical instruments are located by an infrared stereoscopic camera system (NDI Polaris Spectra™) that identifies spherical markers mounted on the tools (Figure 1). The titanium instruments (pointers and hooks) enable the localisation of predefined anatomical landmarks on the mitral apparatus (Figure 2). The measured landmark data is then processed by our own plug-in in the open-source software MITK to create a 3D geometric model showing the spatial relationships between annulus, leaflets, chordae and papillary muscle.

From this model, new quantitative indices are provided by the surgical assistant system, such as longitudinal and anterolateral diameters and shape of the annulus (Figure 2), the coaptation line, leaflet segment areas (A1-3,P1-3), chordae length indices (Figure 3), segmental prolapse height (Figure 4) etc.

The surgeon's understanding of the complex valve anatomy and the spatial relationship between the different valve components is substantially enhanced by the 3D visualisation of the geometrical parameters, always visible to the surgeon on a big screen ('viewstation') next to the operating table (Figure 1). This is very useful when the degree of chordal shortening needs to be determined (Figure 4) or the appropriate size for an annuloplasty ring needs to be selected (Figure 2). Concerning the latter procedure, our system computes automatically a suitable ring prosthesis for the patient and provides a virtual representation of the ring (green curve in Figure 2) matched onto the measured annulus, potentially overcoming ambiguous sizing procedures.

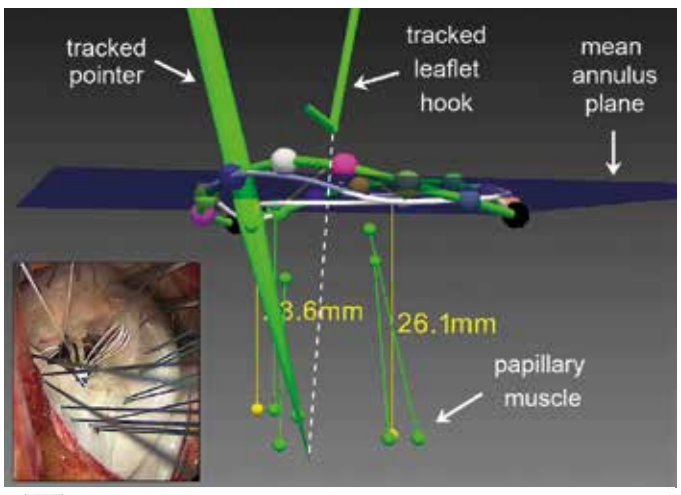
This innovative computer-based surgical assistance system for analysing the complex patient-specific mitral valve geometry was evaluated several times during reconstructive mitral valve surgery. It was developed as part of larger collaborative research, which includes several interdisciplinary projects aiming to create a technical cognitive system to support the surgeon during different surgical procedures (http://www.cognitionguidedsurgery.de/). Our surgical assistant system integrates customised hardware- and software-based components which are specially tailored for minimally invasive mitral valve repair (Figure 5) and therefore also fully suitable for conventional sternotomy approaches in those patients who need associated surgical procedures such as coronary revascularisation or aortic valve surgery.

Our surgical assistant overcomes the limitations of current subjective analysis, shows a unique ability to get precise, quantitative and highly reproducible measurements of mitral valve anatomy with manifold advantages. First, it can help the surgeon and his team choose the most suitable reconstruction procedure for reshaping valve geometry. Second, patient-specific valve morphology can be easily visualised and compared between different patients. Third, it can provide a tool for training surgeons, since all geometric anatomical details and the degree of surgical correction are recorded by the system. Fourth, it can improve the outcome of mitral valve repair by providing standardised and straightforward quantitative assessment procedures.

This new quantitative approach may provide a greater impact in future development of mitral valve repair surgery and promote a substantial philosophical change from an empirical procedure towards quantitative predictable modern reconstructive surgery.

A video showing application of the assistance system in a patient undergoing mitral valve repair and coronary revascularisation can be viewed here: http://tinyurl.com/otls74x

This work was carried out with the support of the German Research Foundation (DFG) as part of project B01, SFB/TRR 125 Cognition-Guided Surgery.



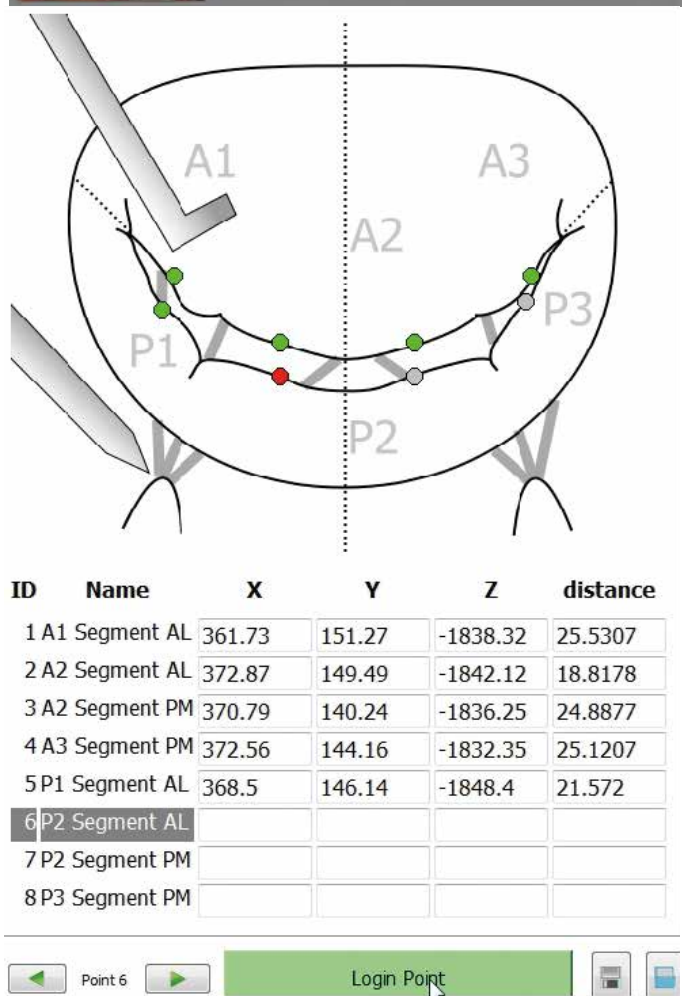
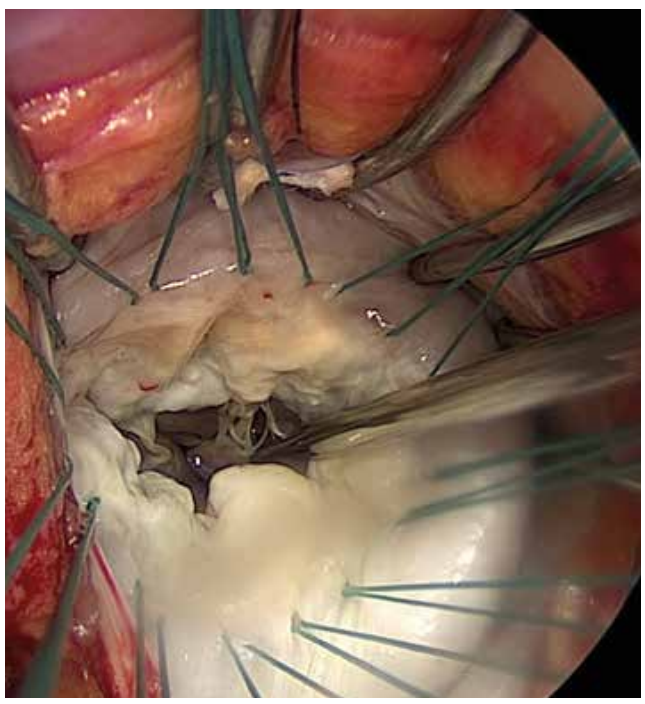


Figure 4. Height of prolapse.



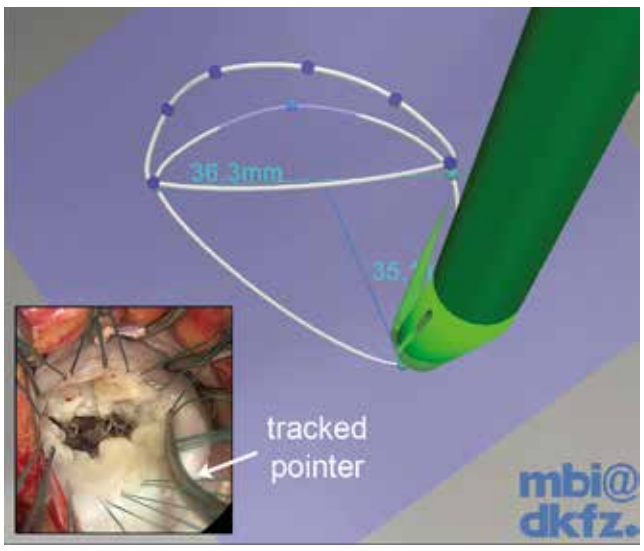


Figure 2. Annulus measurement.

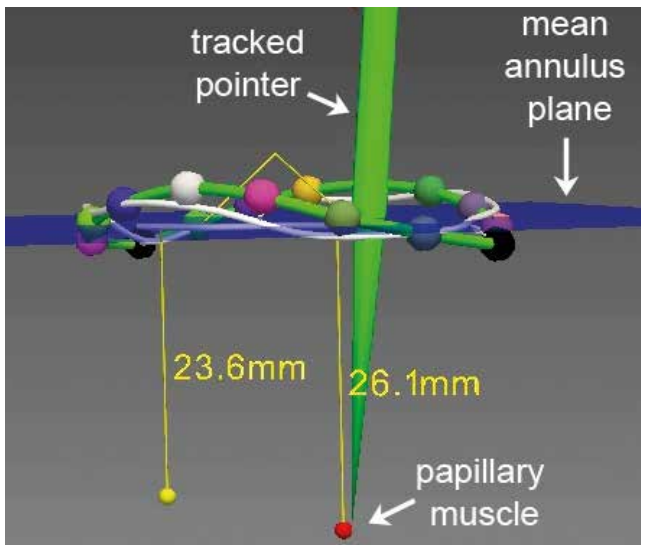


Figure 3. Chordae measurement.

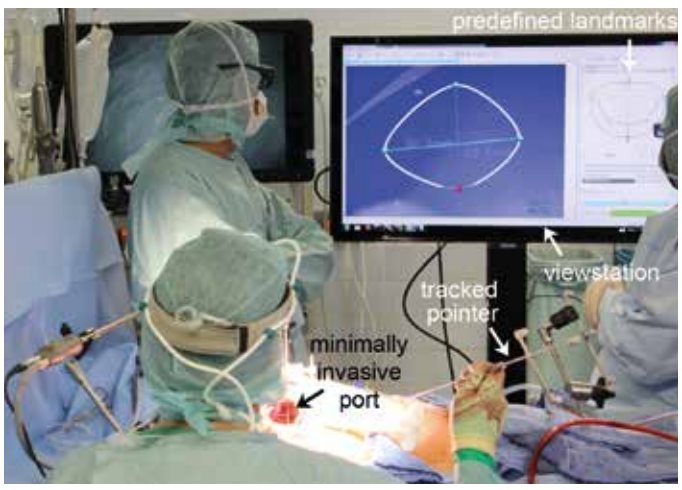


Figure 5. Optical tracking analysis during minimally invasive procedure.

Inside Amsterdam

WHERE TO GO AND WHAT TO DO?

Stuart Head

Every day, this section will give you a few things to do in Amsterdam and suggests a restaurant for you to go to.

BREAKFAST

Bakers and Roasters

We all know a good breakfast will get you through the day. This place has everything you want with eggs.
Located at Eerste Jacob van Campenstraat 54.

MUSEUM

The Anne Frank House

Nothing much needs to be said about this place as the world already knows the story of Anne Frank. You can easily fit this in between the meeting and dinner, as the museum is open daily until 9:00 pm. If you choose to visit, make sure to buy a ticket in advance to avoid standing in the line for hours.
www.annefrank.org/en/Museum/Practical-information/Opening-hours-prices-and-location1/

SWEET SNACK

Stroopwafel

If you ever visited the Netherlands before, this is what you have probably already tried. You can eat warm stroopwafel at the side of the street or in a candy shop, but you can also buy them in the supermarket to take home.

SNACK

Bitterballen

You will be able to get this tasty snack at every bar in Amsterdam, the 'bitterbal'. Just give it a try and you will want to eat it for the rest of your stay in Amsterdam. Enjoy it with a nice beer or glass of wine.

RESTAURANTS

Mossel and Gin

Dutch residents love it: mussels. Everyone loves it: gin and tonics. Go to this restaurant for the best of both. Located in Westerpark, one of Amsterdam's hip areas with many bars and concert venues.
Located at Gosschalklaan 12.

Fyra

A great taste of everything from fish to meat to vegetarian.
Located at Noorderstraat 19-21-23.

ACTIVITY

Dutch National Opera and Ballet

A real must-go when in Amsterdam. The Dutch National Opera and Ballet has multiple shows a week, largely sold-out throughout the entire year. During EACTS, you can visit 'Narnia: the Lion, the Witch and the Wardrobe' ballet on October 1st-4th or the 'Hans van Manen Live' ballet from legendary choreographer Hans van Manen on the 3rd or 4th 'Gala' ballet. Or are you looking for a short lunch intermezzo? Enjoy a free concert on Tuesday at 12:30 (doors open 12:15), which lasts about 30 minutes; just enough time for you to get back to the meeting!
Check www.operaballet.nl/en/program for tickets or just visit the location at Amstel 3.

Techno College – Internal thoracic artery to SVG composite grafting: potent alternatives to enhance technical capabilities of conventional coronary artery bypass grafting

Internal thoracic artery to saphenous vein graft composite grafting: potent alternatives to enhance technical capabilities of conventional coronary artery bypass grafting

Mathias Hossain Aazami Cardiac Surgery Department, Imam Reza Hospital/Mashhad University of Medical Sciences, Mashhad, Iran

Complete revascularisation of both the right- and left-coronary artery branches in line with avoiding manipulating ascending aorta (proximal-less) have proven to be salient factors to enhance overall patient outcomes. At the same time, this reduces the perioperative occurrence of adverse cerebrovascular events by the time of coronary artery bypass graft (CABG). To meet the latter recommendations, encouraging the use of bilateral internal thoracic arteries (ITAs), and overcoming technical shortcomings in the frame of conventional CABG, two new patterns of ITA to saphenous vein composite grafting (CG) are described.

The 'Reverse-T' CG is used for both the right and left coronary branches (Figure 1, A–D), while 'Tripod' CG is used for the left coronary artery system (Figure 1, E–H). These techniques can be adopted by both on- or off-pump approaches. An inter-coronary-bridge (SIB) is constructed between the coronary artery targets using a segment of saphenous vein graft (SVG) (Figure 1). Orientations of each distal SIB-anastomosis is tailored in an attempt to avoid angulations or kinking of SIB-segments by varying the placement of grafts heels' from 5 to 90 degrees in respect to the arteriotomy axis. Care is taken to choose an adequate SIB-segment with respect to the topography of SVG semi-lunar-valves and to determine a suitable site for the composite ITA-SIB anastomosis, to avoid tactical errors in target perfusion by the feeding-ITA. The composite anastomosis is then performed as end-to-side for Reverse-T and side-to-side for Tripod CG.

These two new patterns of CG were conducted on 31 patients (mean age: 64.5±10.3 years; female: 44%; preoperative left ventricular ejection fraction [LVEF]: 43.4±11%; LM disease: 44%; EuroSCORE II: 5±5.8%) during 2013 and 2014. All patients were considered not suitable for all CABG. Bilateral ITAs were used in 31% of patients. The mean total number of distal anastomosis per patient was 3.94±0.89. A left- or right-sided left internal thoracic artery (LITA)–SVG CG was constructed in 90.7% and 15.6% of patients, respectively. Of all patients, 9.4% had bilateral left- and right-sided ITA–SVG CG. The mean number of distal anastomoses achieved by ITA–SVG CG was 3±0.86 per patient, of which 2.7±0.8 were performed using SVG. 81% of distal anastomoses performed by SVG were assigned to ITA–SVG grafting. Resorting ITA–SVG CG resulted in 53% of patients benefiting from a proximal-less CABG approach. All patients survived the operation, there was no occurrence of major adverse cardiac and cerebrovascular events (MACCE), none of the patients required inotropic or intra-aortic balloon pump (IABP) support. The mean time of ICU stay was 2.25 days and the mean postoperative LVEF was 45±10%. The mean follow-up time was 12.5 months; all patients remain free from angina recurrence.

The current series sustains operational safety and excellent operative outcomes of these two new patterns of ITA–SVG CG.

The latter enables moving towards reducing ascending aorta manipulations, reaching more complete revascularisation in high Syntax scoring patients, while encouraging the use of bilateral ITA in the frame of conventional CABG. The conduit-sparing feature offered by SIB reduces the extent of cicatrices to harvest SVG. Anastomosing ITA on SIB is an effective measure to deal with short ITA length that may otherwise not reach the expected coronary artery targets. Reducing the number of side-to-side distal anastomosis make these two new CG patterns technically more attractive and attainable. ITAs are known to protect the assigned coronary territory by releasing endothelin-protecting factors that may favourably impact the longevity of SVG used as SIB and deserved by ITA. The shorter segment of SVG used as SIB and a real in-series pattern do provide haemodynamic benefits by lowering CG-system resistances.

Considering the aforementioned technical and physiological benefits, these two new CG patterns can actually enhance tactical-technical potency, as well as perioperative outcomes of conventional CABG.

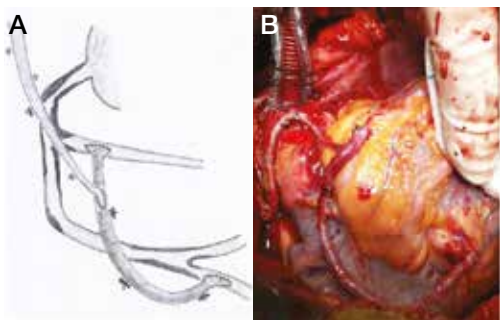


Figure 1.
A, B: a Reversed-T composite grafting resulting in complete right-sided revascularisation. The short-length ITA was remedied using this approach.

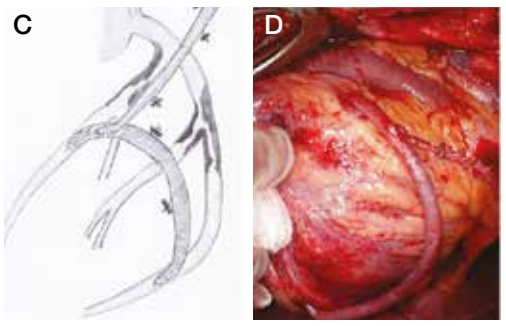


Figure 2.
C, D: a Reversed-T composite grafting enabling complete left-sided revascularisation in the face of a small-diameter and short-length ITA.

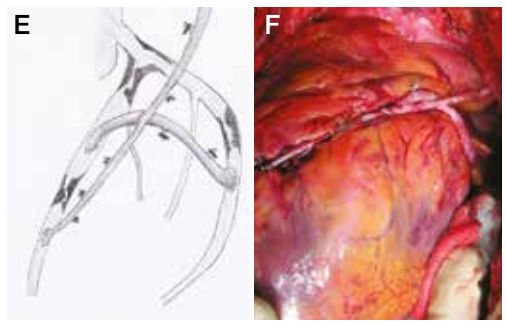


Figure 3.
E, F: complete left-sided revascularisation using a Tripod pattern as an alternative technique to classical 'Jumping' grafting to LAD.

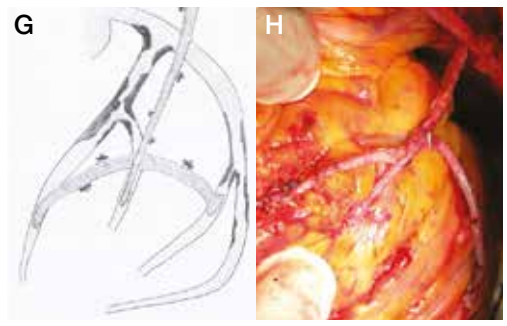


Figure 4.
G, H: a Tripod composite grafting of the left-sided in the face of a short-length ITA that has been distally anastomosed to a diagonal branch.

Techno College – Acquired Cardiac: Heart failure/aortic disease

Redo-aortic arch surgery after limited repair of acute type A aortic dissection using the Evita-open antegrade stent graft

Martin Grabenwöger Department of Cardiovascular Surgery, Hospital Hietzing, Vienna, Austria

There is an ongoing debate, whether the primary operation for acute type A aortic dissection should be kept as simple as possible and mainly aim to save the patient's life, or should initial surgery be more extensive and complex in order to reduce the need for reoperations and consequently improve long-term results.

Reviewing the literature one can find numerous studies indicating in approximately 30% of patients after successful operation of an acute type A aortic dissection complications of the downstream aorta in a follow-up period of 7 years. This means that patients who survived the first operation still face a high risk from late distal aortic events. This fact stimulated aortic surgeons around the world to work on the concept of a more extended initial aortic arch procedure to reduce late aortic complications.

The 'frozen elephant trunk' operation offers the possibility to treat the ascending aorta, the aortic arch and the proximal descending aorta in a one-stage procedure. Open antegrade stent grafting of the true lumen of the downstream aorta promotes thrombosis of the false lumen of the proximal descending aorta resulting in an improved perfusion of the true lumen and shrinkage of the false lumen. This hybrid technique not only has its value in the first operation, but in particular in redo-arch operations after failed initial repair.

The video presents the case of a 58-year-old male patient, who developed a pseudoaneurysm at the distal anastomotic site and a chronic dissection of the aortic arch with a diameter of 7 cm, 1-year after limited operation of an acute type A aortic dissection. The operative technique includes axillary artery cannulation, moderate hypothermia (260C), bilateral antegrade cerebral perfusion with balloon-occlusion of the left subclavian artery and open antegrade stent grafting of the true lumen of the proximal descending aorta. The 'collar' of the Evita-open hybrid prosthesis (Jotec, Hechingen, Germany) was anastomosed to the proximal descending aorta, thereby occluding the large false lumen.

Supra-aortic vessels were re-implanted into the prostheses using the island technique. The proximal anastomosis was performed just above the sinotubular junction. Due to this very complex redo operation, antegrade cerebral perfusion time was 90 minutes. Despite that fact, postoperative recovery was uneventful and the patient could be discharged from hospital 12 days after the operation.

In conclusion, the frozen elephant trunk procedure is extremely helpful to overcome complex anatomical situations in redo aortic arch surgery after limited operation for acute type A aortic dissection.

Techno College – Development of a simple reusable stabiliser for OPCAB

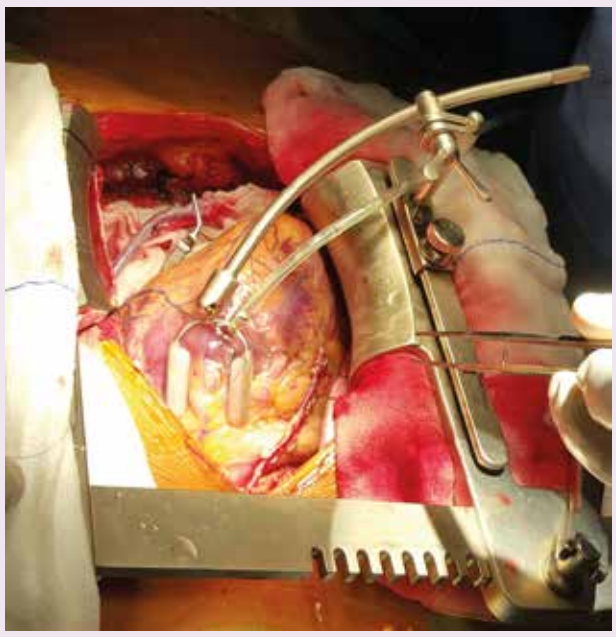
Development of a simple indigenous stabiliser for beating heart surgery

Murali Vettath Malabar Institute of Medical Sciences, Kerala, India

Over the past two decades, beating heart surgery (off-pump coronary artery bypass [OPCAB]) has evolved to become a definitive surgical technique with which to perform coronary artery bypass grafting (CABG) for patients with coronary artery disease (CAD). At present, <5% of centres worldwide perform 100% of their CABGs without the pump. Another 10% of centres are able to perform nearly 98% of their CABGs off pump.

With the aim of performing all our CABG without the heart–lung machine, we have so far invented, fabricated, modified and developed several novel devices, equipment and techniques to help us achieve this. These include: Vettath's anastamotic obturator (patented in 2008); Vettath's blower and blower/mister; a modified aortocoronary shunt; Vettath's technique of long mammary patch; modified use of the intra-aortic balloon pump (IABP) in OPCAB; and a re-engineered technique of OPCAB.

Despite all these advances, it was still necessary to use either the Octopus® (Medtronic Inc., MN, USA) or the Acrobat system (Maquet, Rastatt, Germany) for performing OPCAB. Previously, we had attempted to develop a similar stabiliser, which though successful, was still not cost effective because it was disposable; it was made of plastic and had to be replaced after a few uses.



For this reason, the challenge was set to develop our own indigenous reusable metallic stabiliser, to enable us to reduce, reuse and recycle the stabilisers used for OPCAB, thereby reducing our carbon footprint. The design we came up with is a simple metallic stabiliser with a similar suction pod to the type commercially available that can be changed if needed.

This stabiliser is made of a curved, metallic hollow tube, with another rod inside it. The inner rod can be pushed from behind by a screw, which tightens a small metal piece (locking rod) in front of it. This small metal piece with a scooped end in front, in turn tightens the ball end of the U-shaped suction pod. The pod, when placed parallel to the coronary artery to be grafted, stabilises the part of the heart on which surgery is to take place. The stabiliser rod is in turn tightened on a vertical metal stand (2 inches in length) with a screw, which is fixed to the sternal spreader with another screw. The sternal spreader is also modified in such a way that the vertical metal stand can slide on to it and be tightened at any point along the spreader rail.

We have used this stabiliser on more than two hundred patients consecutively over the past six months, and have been able to perform OPCAB on all types of patients without any problems.

In conclusion, this stabiliser was found to be stable, steady and reusable, like any metallic instrument. It will therefore definitely reduce the carbon footprint and the escalating cost of surgery that would result from using hundreds of disposable stabilisers.

Techno College – Personalised external aortic root support

A new alternative to root replacement for aortic dilation: the ExoVasc® Personalised External Aortic Root Support (PEARS)

Tal Golesworthy Member of the Energy Institute and Member of the Royal Society of Chemistry

The perspective from the sharp end of a scalpel – that is from the patient perspective – is necessarily different from that of the surgeon. When Tal Golesworthy discovered that his Marfan syndrome involved aortic dilation and that he was facing root replacement surgery, after the initial shock, the subsequent denial and the slow acceptance of this reality, he set about finding a better solution. As a research and development engineer, putting together an appropriate team and project wasn't too much of a problem but he needed help from the medical profession and was fortunate in meeting Professor Tom Treasure. With his introduction to the medical world, and after 4 years of development, Professor John Pepper implanted the first ExoVasc® around Tal's dilated aorta at the Brompton Hospital (London, UK) in 2004.

That was just the beginning. Since then the ExoVasc® Personalised External Aortic Root Support (PEARS) support has been implanted in 56 patients, all sharing aortic dilation, although diagnosed with various different disease types, including Marfan syndrome, Loeys-Dietz syndrome, Bicuspid Aortic Valve disease, and patients with other congenital conditions, totalling over 200 postoperative patient years of experience.

So what is different about the PEARS approach? The principal problem with congenital connective tissue disorders, such as Marfan syndrome, is the reduced strength of fibrillin-deficient tissues. In vascular tissues, particularly the ascending aorta, this renders them liable to dilating permanently with the repetitive internal pressure loading. When aortic dilation reaches limits dictated by size, rate of change of size and family history, surgery is indicated. Conventionally, the aortic root is replaced either by a composite graft (Total Root Replacement, TRR) or a valve sparing graft (Valve Sparing Root Replacement, VSRR). However, aside from the need for cardiopulmonary bypass, both of these approaches have drawbacks. TRR requires a lifetime of anticoagulant therapy and VSRR is associated with a high incidence of subsequent valve failure and a need for reoperation. It was these drawbacks that led Tal Golesworthy to suggest a better approach – that of providing an external support, tailored to fit the exact shape of the patient's aortic root. In developing and producing the ExoVasc® PEARS device, the following steps were done:

- Imaging the aorta (to acquire dimensional data)
- CAD modelling the aorta (to generate a 3D computer model)
- Converting the CAD model into a physical model of the aorta (using 3D printing to produce a manufacturing former)
- Specifying and producing a biocompatible material that takes its shape from the manufacturing former to produce the finished implant.

As the principal engineer and first patient, Tal Golesworthy is proud to point out that, 11 years after his ground-breaking surgery, he and those who have followed him have a dimensionally stable aortic root, a fully functional aortic valve, and a quality of life that is the envy of many of who have had root replacement surgery.

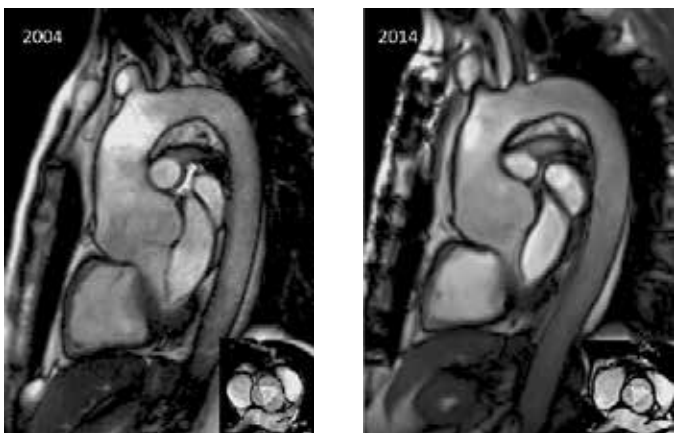


Figure 1. Sagittal image of the Marfanoid aorta in April 2004 (3 weeks pre-op) and November 2014 (10.5 years post-PEARS surgery).

Techno College – Innovation Award

A novel external stent for saphenous vein grafts

David P Taggart[1] and Eyal Orion[2] [1]Oxford University Hospitals NHS Trust, Oxford, England, UK; [2]Vascular Graft Solutions Limited, Israel

Despite the proposed benefits of multiple arterial grafts, autologous saphenous vein grafts (SVGs) are still the most frequently used bypass conduits in coronary artery bypass grafts (CABGs). However, progressive SVG disease and failure significantly increases the risk for re-intervention and remains a key limitation to the long-term success of CABG. SVG disease is typically dominated by intimal hyperplasia which predisposes the SVG to accelerated atherosclerosis. Arterial pressure coupled with abnormal flow patterns generated mainly by luminal irregularities are the main contributors to both focal and diffuse intimal hyperplasia that develops in the SVG over time.

In contemporary studies, SVG failure rate has been reported as 20% over the first year while at 10 years only 50% of vein grafts are patent of which half has significant disease.

Attempts to mitigate intimal hyperplasia and SVG failure have been the focus of intense clinical research. To date, only persistent use of statin therapy and ß-blockers have been shown to reduce intimal hyperplasia in SVGs. Mechanical external stents for SVGs have shown considerable promise in pre-clinical testing with reduction of proliferative intimal hyperplasia by reducing wall tension, improving lumen uniformity and creating a protective 'neo-adventitia' layer rich with microvasculature.

VEST is a novel external stent for saphenous vein grafts (SVG). By restricting vein graft dilatation and improving its lumen uniformity, the VEST targets the underlying mechanism of SVG intimal hyperplasia and atherosclerosis: disturbed flow which is mainly a result of lumen irregularities and increased venous wall tension due to the exposure to the arterial circulation conditions. The kink resistant device is a combination of different types of cobalt-chrome wires which provide it with radial elasticity and axial plasticity. This design makes VEST fully adjustable *in situ* enabling the surgeon to optimise the dimensional match with the SVG. No sutures and/or glue are required to fix the device and the implantation procedure takes minutes to complete without changing current grafting technique or requiring excessive vein graft manipulation. While mildly constricting the SVG, the unique VEST design creates a functional gap between the SVG and the stent to enable to formation of a 'neo-adventitia', which generates potent angiogenic factors (VEGF, NO) and prevents migration of vascular smooth muscle cells to the intima.

Two analyses from the Venous External Support Trial have recently been published.[1,2] This first in human randomised-controlled study has demonstrated that external stenting of saphenous vein grafts has the potential to increase SVG lumen uniformity, improve flow haemodynamics and significantly mitigate intimal hyperplasia 1 year after CABG. The authors noted higher occlusion rates of stented SVGs when the stent was fixated to the distal and/or proximal anastomoses and/or when metallic clips were used to secure the side branches.

The VEST is CE marked in Europe and to date more than 180 cases have been performed by leading heart centres in Europe. In 2015, extensive clinical programme which includes several pan-European studies has started with an objective to establish the role of SVG external stenting.

If long-term clinical studies will demonstrated effective mitigation of SVG atherosclerosis, SVG external stenting may create a new type of conduit for cardiac surgeons which combines the benefits of both arterial and venous conduits: (1) high flow conduit (2) availability and versatility (3) no sensitivity to competitive flow (4) resistance to thrombosis and atherosclerosis.

References

1. Taggart et al ATS, 2015.
2. Meirson T, Orion E, et al. Flow patterns in externally stented saphenous vein grafts and development of intimal hyperplasia, *JTCVS*, 2015.

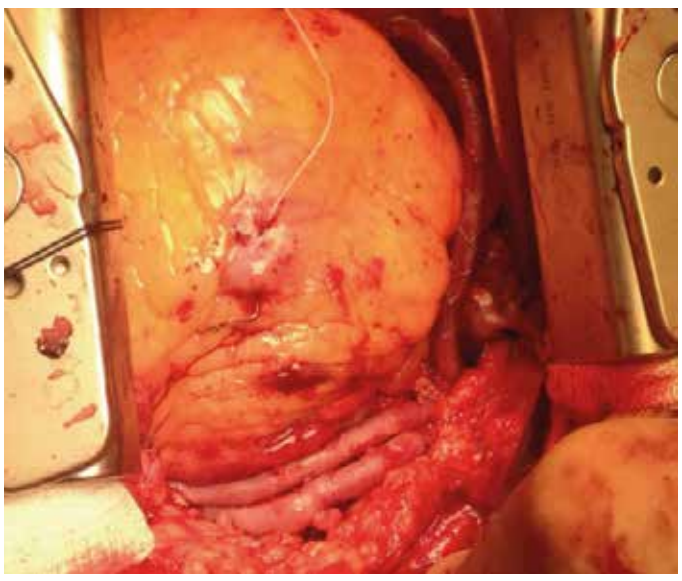


Figure 1. Two non-stented vein grafts to OM1 and OM2 and externally stented graft to PDA.

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Reference: [1]Internal testing.
CE Mark Pending

TERUMO

OZAKI's Autologous Pericardium Aortic Valve Neo-Cuspidization and OZAKI VRec Sizer

Shigeyuki Ozaki
Toho University Ohashi Medical Center, Tokyo, Japan

While transcatheter aortic valve replacement (TAVR/I) has been dramatically taking the market of the conventional aortic valve replacement (AVR) with prosthesis in Europe and other countries, there is a novel aortic valve surgical procedure that has been quietly spreading. The Aortic Valve Neo-Cuspidization (AVneo) with autologous pericardium is a novel and innovative surgical procedure for any aortic valve diseases, regardless of age of patients or size of annulus.

By suturing three meticulously designed pericardium cusps on annulus, this surgery can treat both adult and paediatric patients with aortic stenosis, aortic regurgitation with or without infective endocarditis. What makes AVneo different from previous other repairs are three points: 1) measuring the distances between commissures (not the annular diameter to design cusps), 2) suturing those cusps directly on annulus, and 3) raising the contact point of the cusps to the commissural level (Figure 1). First, by designing new cusps from intercommissural distances, it is possible to design cusps uniquely, regardless of the heights of the commissures from the base of annulus. Second, suturing those cusps directly on the annulus enables the annulus to move naturally, preserving the natural haemodynamics. Reduced mechanical stress to the cusps contributes to avoiding calcifications and postoperative pressure gradient. Finally, by raising the contact point, cusps make the new coaptation zone longer than the native valve. The elongated coaptation zone warrants the minimised postoperative aortic insufficiency. Of course, anti-coagulation is not necessary because there is no stent or any prosthesis left in the circulation system.

We have performed the AVneo in almost 900 patients over the past 8 years, and teams in other countries have already done approximately 500 cases. The overall outcome of this procedure is remarkable, as shown in Figure 2. The rate of freedom from re-operation reached 98.3% for the 765 cases whose longest follow-up is close to 100 months; this rate is 99.0% for patients below 60 years of age. Quite recently, a few hospitals in the US have started the Ozaki procedure and the short-term outcomes are equally excellent in all cases, proving the reproducibility of this operation.

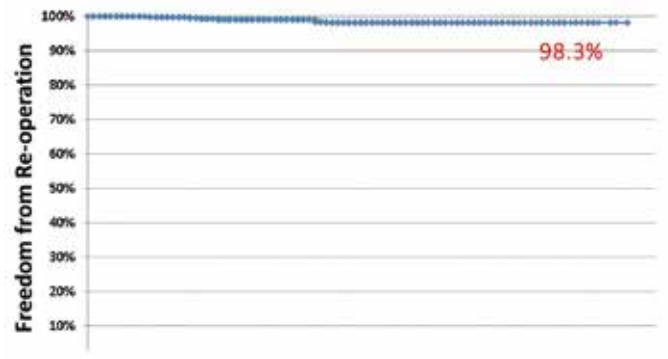
This surgery is also very promising in the paediatric and congenital fields. While most of the 900 cases in our hospital are elderly patients, we have confirmed the good mid-term outcomes for patients who are in their teens to 30s or 40s. At the Boston Children's Hospital (Boston, MA, USA), a 23-month-old child with an annular diameter of less than 13 mm was treated successfully with the procedure. Although mid- to long-term outcomes in paediatrics is not yet clear, AVneo may be a good substitute for the Ross procedure or other aortic valve repairs, whose long-term outcomes are not always satisfactory.

Cost-efficiency is another appealing feature of the Ozaki procedure. A cost-effective analysis conducted in Japan revealed that the in-hospital cost of AVneo is reduced by approximately US$8000 (per case) compared with that of conventional AVR. Savings are much more when the unnecessity of anti-coagulation is taken into account.

Reproducibility is particularly important in any surgical technique; therefore, we developed a set of proprietary sizing and moulding devices, OZAKI VRec Sizer™ (Figure 3). This device is now registered and marketed as a medical device in the US, Japan, Europe, China and South Korea by the JOMDD, Inc. (Tokyo, Japan). Appropriate training for the Ozaki procedure is also necessary. High definition video clips, and other procedural instructions are available at http://ozaki-proc.com/en/, and a drylab training model is on sale. All of these materials will contribute to better reproducibility for many surgeons.

Dr Pettersson from the Cleveland Clinic (Ohio, USA), said "Up to 75% of the conventional surgical AVR could be replaced by this procedure if these excellent outcomes are maintained for a couple of more years." The AVneo, the Ozaki procedure, may shift the paradigm of treatment for aortic valve diseases in the near future.

Freedom from re-operation



Overall survival

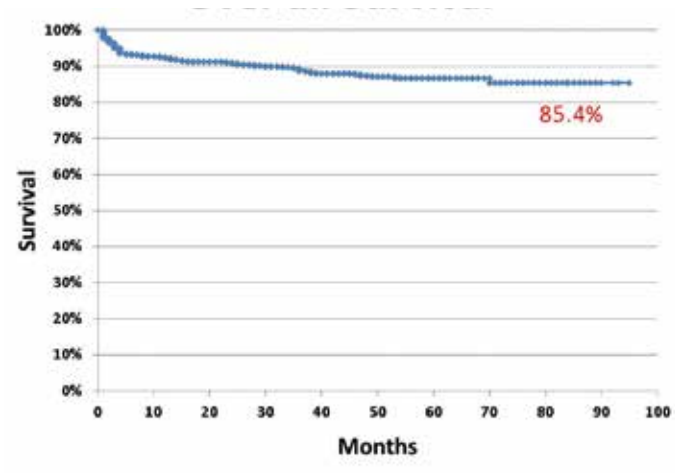
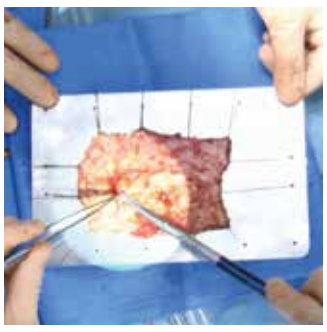
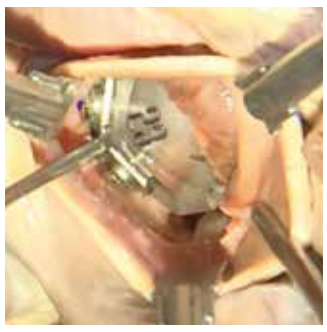
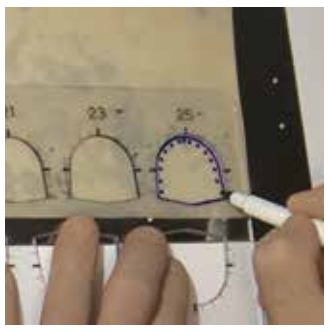
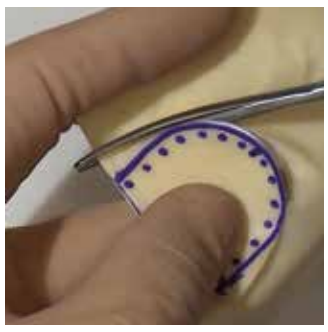


Figure 2. Freedom from re-operation and overall survival using the Aortic Valve Neo-Cuspidization (AVneo) with autologous pericardium procedure.


Pericardium treatment.

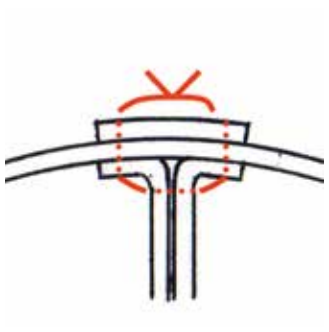

Sizing three cusps.


Drawing three cusps.


Cutting out cusps.


Suturing on annulus.


Making commissures.



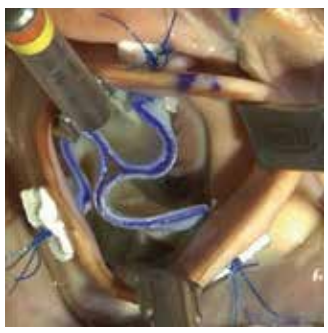

New aortic valve.

Figure 1. The surgical procedures involved in the Aortic Valve Neo-Cuspidization (AVneo) with autologous pericardium.

Brand name	Set component	QTY
OZAKI VrecS™		
	Sizer 19, 21,23, 25, 27, 29, 31, 33, 35 (size)	1 each
	Outer box	1
	Template	1
	Plate for pericardium	1
	Separated container for trimmed leaflet	1
	Container for glutaraldehyde solution	1

Figure 3. The OZAKI VRec Sizer™

Coffee Reception for Residents

The Surgical Training and Manpower Committee (STMP) will host a coffee reception for all residents on **Monday 5th October at 12:45–14:00 in room F002**.

The aim of the meeting is to inform you about the activities of the STMP, both at the Annual Meeting and throughout the year.

We will also be looking for new members to join us and we will announce new vacancies for which residents can apply.

Furthermore, we will inform you about resident's associations across Europe and their needs and explore how we can collaborate.

Peyman Sardari Nia

Techno College – A catheter-based technology for minimally invasive atraumatic repair of intracardiac defects with light

Cardiac defects

Assunta Fabozzo University of Bologna, Bologna, Italy

Cardiac defects, either congenital, aquired or iatrogenic, warrant effective and often rapid closure. Currently, open surgery remains the standard approach, but minimally invasive (catheter-based) strategies offer a potentially alternative with less surgical time and faster recovery periods. Intracardiac septal defects are the most common congenital defects in the young. The gold standard treatment is suture-based surgical closure, requiring cardiopulmonary bypass, which can increase exposure to pump-related complications. Multiple transcatheter metallic occluder devices exist, but have inherent limitations of cardiac erosion, conduction system block and thrombus formation owing to their bulky and permanent nature. Biodegradable, hydrophobic light-activated adhesives represent an attractive alternative to sutures, but lack a specifically designed minimally invasive delivery tool, which limits their clinical translation.

We developed a catheter-based device that enables closure of congenital, and acquired, cardiac wall defects by deploying a biodegradable elastic patch, activating a photo-curable adhesive and thereby attaching the patch to achieve closure of the defect site in a minimally invasive manner. The device uses a fibre optic system and reflective metallic coating to uniformly disperse UV light for activation of the adhesive. The concept is that UV light is delivered via an internal optical fibre to a reflective balloon where it is reflected onto a patch, precoated with photocurable adhesive, to affix the patch to the tissue prior to removal of the device. The functional components of the device include a reflective distal balloon fixed on an inner shaft and a proximal stabilising balloon on an intermediate shaft. All components can be loaded into an outer shaft. An optical fibre, connected to a UV source at one end, and a specifically designed conical tip for optimal light dispersion at the other, is housed in the inner shaft, and can be advanced into the inner lumen until the tip is located in the distal balloon. The reflective distal balloon has an outer layer that allows temporary suture-based attachment of a patch/adhesive system to the balloon, ensuring the patch unfolds with the balloon and can be released from the system in situ. All components are soft and can be deflated and loaded into the outer catheter shaft for delivery.

The procedural steps are as follows: i) the catheter is delivered through the defect, ii) the patch is released by pulling back the open suture loop connecting the patch to an outer membrane on the reflective balloon, iii) the distal and proximal balloons are sequentially deployed, iv) a UV source is turned on to activate the photocurable adhesive coated on the proximal side of the patch, and v) both balloons are fully deflated and removed from the body. In the last step, the distal reflective balloon is retrieved through a four-leaflet valve in the patch, leaving the patch adhered to the tissue. Each shaft can be connected to an ergonomic handle, which allows coupling and uncoupling of shafts, and enables volume-controlled inflation and deflation of the balloons via a syringe.

In a small animal (rat) model with a miniaturised device we showed that inflammation was mild, and equivalent to suture-based patch attachment. In an *in vivo* porcine model, a 6 mm ventricular septal defect in a beating heart was reduced to <2 mm. With this device we have also demonstrated *ex vivo* and *in vivo* closure of tissue defects in the abdomen and stomach. This new therapeutic platform has broad utility in a vast range of clinical scenarios that warrant minimally invasive and non-traumatic repair of hard-to-reach defects, and could represent a paradigm shift to biodegradable, elastic materials from suture-based or metallic device-based closure of intracardiac defects.

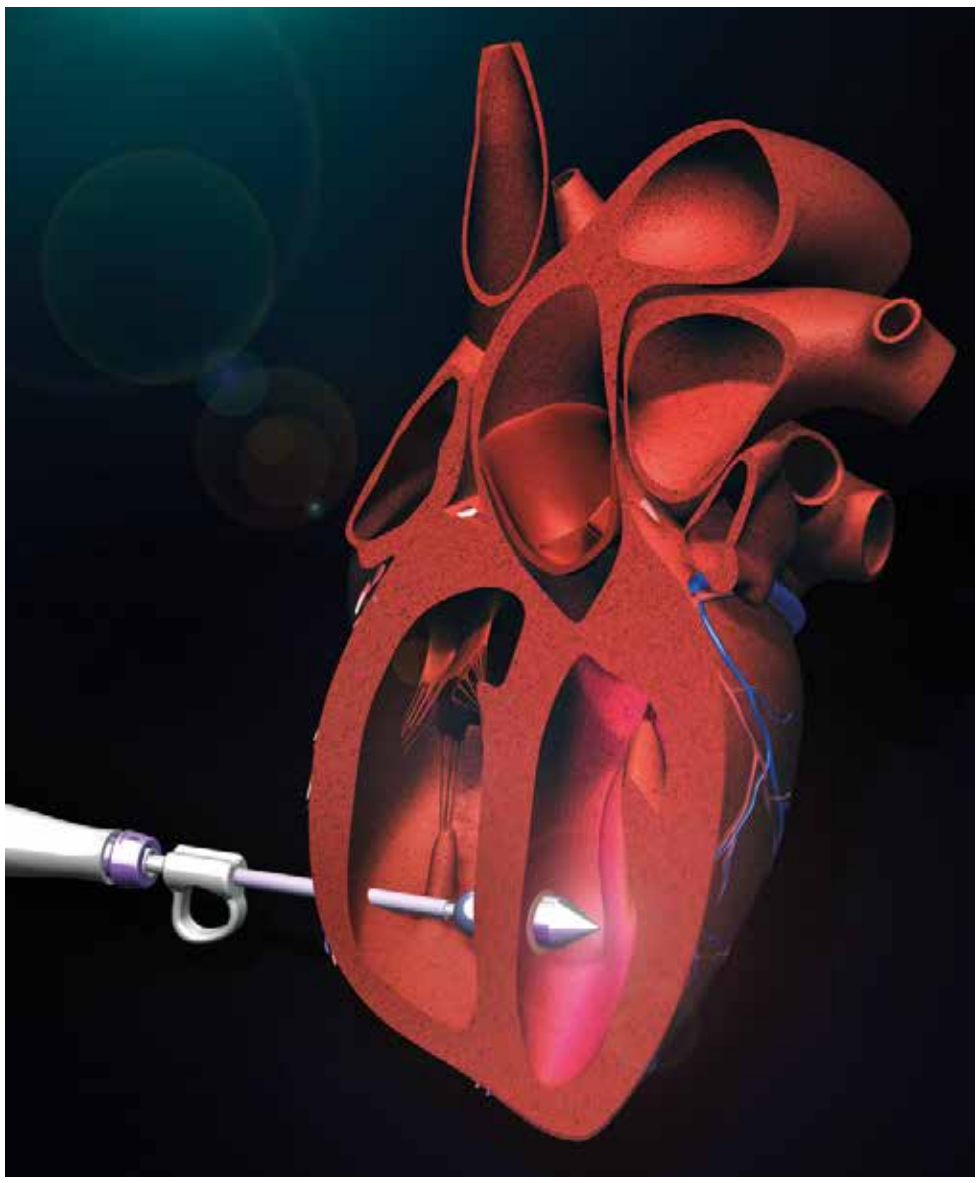


Figure 1.

Techno College – The right internal thoracic artery stump as a systematic graft inflow source for the aorta no-touch technique

A technique for better brain preservation in myocardial revascularisation: the right internal thoracic artery stump as a systematic vein graft inflow source for the aorta no-touch technique

Walter J Gomes São Paulo Hospital of the Federal University of São Paulo, São Paulo, Brazil

Despite the superior outcomes provided by coronary artery bypass surgery (CABG), results have been negatively affected by the higher incidence of perioperative neurological complications and stroke, the main cause of which is aorta manipulation.

The aorta no-touch technique in off-pump coronary surgery (OPCAB) has been developed to avert this potential risk and virtually eliminate embolism of aortic wall debris into the brain circulation. Nonetheless, the use of saphenous vein grafts (SVG) still plays a important role and is widely used for accomplishing complete revascularisation, but their proximal anastomoses still remain an issue.

To optimise the aorta no-touch technique, a strategy involving systematic use of the proximal stump of the right internal thoracic artery (RITA) has been developed as an alternative vein graft inflow source, thus eliminating aortic handling.

As a preliminary report, 27 consecutive patients underwent aortic no-touch OPCAB using preferentially both internal thoracic arteries (ITA) dissected in a skeletonised fashion and SVG. The RITA is proximally divided leaving a 2–3 cm stump. Then, the left ITA is anastomosed to the left anterior descending coronary artery; next the SVG is attached to the posterior descending artery and the top end connected end-to-end in a running suture to the proximal stump of the RITA. Subsequently, the free RITA graft is anastomosed to the obtuse marginal artery or ramus intermedius and proximally sutured end-to-side with LITA in a Y configuration. With increasing experience, complete opening of the upper part of the pericardium was not required and the aorta was not even seen during the operation. The follow-up was completed in all patients by reviewing their hospital charts. Mean age of the patients was 64.2±6.9 years, and no hospital mortality, stroke or re-exploration occurred. The median number of grafts was 3, and no new interventions were required in this cohort.

Figures currently available for brain derangement after heart surgery are fairly inaccurate. A recent study performing postoperative magnetic resonance imaging has revealed that new brain infarcts after CABG are markedly more frequent than clinically evident stroke, reaching 27.6% of the operated patients, and most of the lesions were clinically silent. The long-term aftermath of the induced cerebral damage is unknown as yet, and the introduction of strategies to reduce this high incidence is needed without delay.

The top end of vein grafts attached to the ascending aorta have poor long-term patency rate, likely due to the exposure of the SV to direct pressure and circulatory stress from the ascending aorta. Conversely, recent evidence demonstrates that the SVG used as a composite graft based on the *in situ* LITA shows a patency rate comparable with that of ITA grafts, where exposure to the nitric oxide released from the *in situ* ITA plays a vital role.

The current fierce debate on whether on- or off-pump surgery is superior is extemporary and not constructive. Both techniques bear proper indications and therefore should be seen as complementary rather than antagonistic. Therefore, an additional benefit to patients is attained if the surgeon and staff master the two techniques, and henceforth they must be trained in both.

In conclusion, the proximal RITA stump is a logical and straightforward vein graft inflow source, avoiding handling of the aorta, theoretically granting further protection against neurological complications and stroke. Widening the experience of this and including more patients should bring additional information. Thus, a multicentre trial is warranted for making possible this goal.

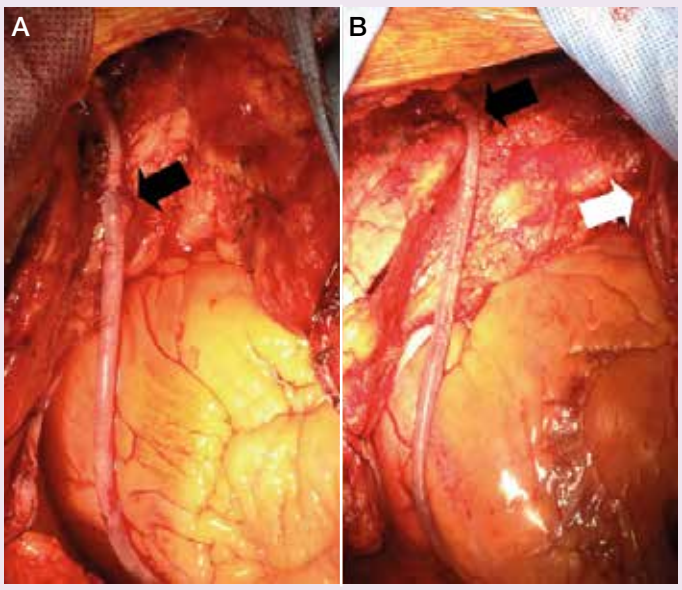


Figure 1. Black arrows point to the proximal anastomosis between the vein graft and the right internal thoracic artery (RITA) stump. The white arrow indicates the free RITA sutured end-to-side with left ITA in a Y configuration.

RAPID DEPLOYMENT WITH THE EDWARDS INTUITY ELITE BIOPROSTHESIS: MIAVR REOPERATIONS MADE SIMPLER?

Tommaso Danesi Hinna, Loris Salvador, San Bortolo Hospital, Vincenza, Italy

Optimal application of new devices typically evolves naturally with time and experience. Yet despite the advantages of rapid deployment (or sutureless) valves, including ease of implantation, fast learning curves and the associated reduction of procedural times, clear-cut indications remain broadly undefined.

As Minimally Invasive Aortic Valve Replacement (MIAVR) requires easily implantable devices, rapid deployment devices are especially suitable for UHS and RAT videothoracoscopy; in our view, potentially one of the more interesting applications is for redo-MIAVR patients.

Indeed patients undergoing redo-MIAVR due to a failed conventional stented, stentless or full root prosthesis, often require lengthy procedures, with a high risk of injury during debridment especially in small calcified annuli or during the removal of degenerated aortic root stentless bioprostheses. In these challenging cases RDAVR could prove the difference.

We report herein our first two implants of an EDWARDS INTUITY Elite valve in complex redo-MIAVR.

The first patient was a 55-year-old male with systemic and pulmonary hypertension, HCV chronic infection and persistent AFib. The patient underwent AVR in 2006 for severe AR and a 29 mm Toronto SPV (St. Jude Medical, Minneapolis, MN) bioprosthesis was implanted. In 2015, the patient underwent a minimally invasive upper J-resternotomy due to the recurrence of severe AR due to post-endocarditis with perforation of the non-coronary leaflet and a peak pressure gradient (PPG) of 37 mmHg.

Externally the aortic root was heavily calcified with massive mediastinal adhesions; the valve had a fully calcified root, and severe fibrosis with a perforation of the non-coronary cusp. After leaflet excision, a 23 mm EDWARDS INTUITY Elite valve was easily implanted. Aortic cross clamp and CPB time were 57 and 117 minutes respectively. The patient was weaned from CPB with a minimal inotropic support. Postoperative TEE showed no PVLs and low gradients. The patient was extubated after 5 hours of AMV. Inotropic agents were suspended after 6 hours. ICU stay and hospital stay were 2 and 9 days respectively. No transfusions were needed.

The second patient was a 57-year-old male affected by systemic hypertension. In 2009 the patient underwent AVR for severe AR due to aortic root enlargement; at that time a 25 mm homograft was implanted. In 2015, the patient presented with a severe calcific degeneration of the homograft and underwent a minimally invasive upper J-resternotomy with a 21 mm EDWARDS INTUITY Elite. Aortic cross clamp and CPB time were 62 and 113 minutes respectively. No inortopic agents were needed. AMV time, ICU stay and hospital stay were 3 hours, 1 and 6 days respectively.

These two cases demonstrate how the prosthetic choice at the time of the first and second operation is crucial. The classical surgical approach would have required a redo-Bentall procedure with a higher grade of surgical complexity and risk.

Rapid deployment bioprostheses demonstrated to be safe and suitable for redo-MIAVR patients, allowing performing fast and efficient reoperation in a safe minimally invasive fashion.

In our experience redo-MIAVR has finally become “minimal” for patients and “simpler” for surgeons.

Rapid prototyping

Adam Hill McLaren Applied Technologies, UK

Once the province of science fiction, rapid prototyping – or additive manufacturing – is now so accessible that even domestic consumers can buy 3D printers ‘off the shelf’. And although we are very much in the early stages of the journey, the technology has many potential applications in medicine, from orthotics and prosthetics to the bioprinting of complete organ systems and beyond.

Two key waypoints in the past decade have provided the catalyst for the rapid growth of additive manufacturing in medicine: fused deposition modelling coming off patent in 2009, followed by selective laser sintering in 2014. These are just two of many additive manufacturing processes, but ones that can use medical-grade materials as feedstock and have had an early impact upon the field.

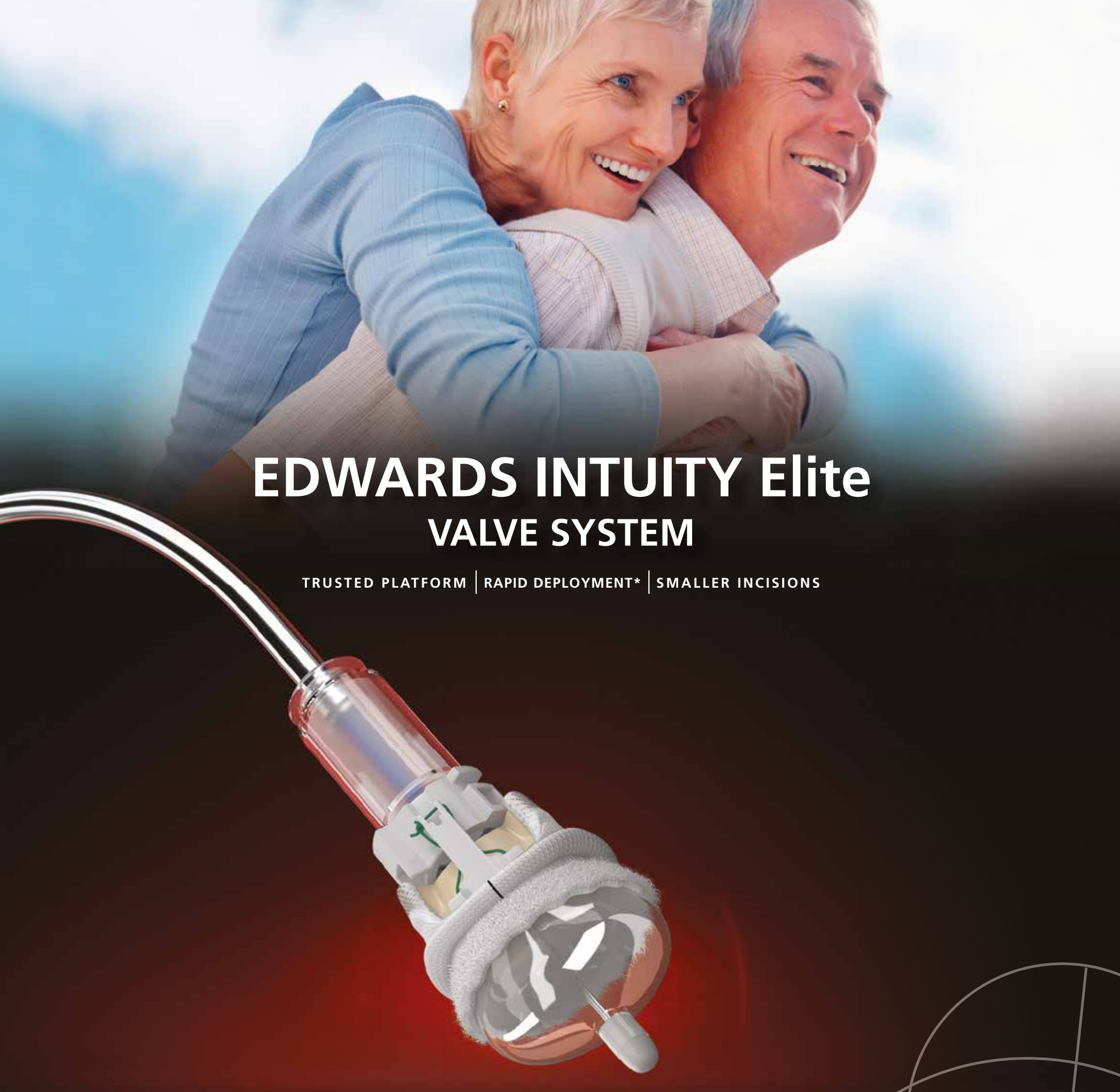
Cost, flexibility and speed are three of the chief advantages of additive manufacturing. In the traditional subtractive manufacturing method, a process that removes unnecessary excess from a block of material until only the desired shape remains, designing and tooling the moulds represents a significant up-front cost that has to be amortised over a long production run. Additive manufacturing – where no mould is involved and each item is formed individually, layer by layer, from a computerised design – enables the creation of limited-run or bespoke, individualised products without that fixed up-front cost.

At McLaren we capitalise on this agility in the design, manufacture and ongoing development of our racing cars. Not only is each of our cars a bespoke design, over 70% of its components will change over the course of a racing season through an iterative design process. We continuously observe, measure and simulate; and our real-time data-processing capability is such that we can design and manufacture new, optimised components based on that data before the car returns from an on-track test session.

Already the medical industry constitutes 25% of the market for rapid prototyping, and that share will grow. At the far end of the spectrum at the moment, but with exciting possibilities in the cardiothoracic field, is bioprinting – the manufacturing of complete organ systems, which are then implanted at a later date. As you can imagine, this will demand a very sophisticated and exacting design process, but the future is closer than you think.

In 2010, the first human blood vessels were printed in the USA by Organovo without the use of scaffolds, and in 2013, the same company bioprinted liver tissue for the first time. ETH Zurich bioprinted cartilage earlier this year, and we have also seen the world’s first beating artificial heart cells bioprinted by researchers at Wake Forest University. In the near future we may be able to create components from a patient’s own tissue, being both biocompatible and able to match the performance of the original, offering longer life than an equivalent mechanical part.

We are rapidly moving towards a position where many of the challenges in this market are being overcome, although some – such as the cost and toxicity of some of the feedstock materials – remain. Once the technology has become cost-effective, and we have increased the sophistication of the design software, the only limit might be your imagination…



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Techno College – Acquired Cardiac: Atrioventricular valves (mitral plus tricuspid)

Transcatheter aided surgery to face the challenge of mitral annular calcification in mitral surgery – a brave new world

Christoph Huber, Bettina Langhammer, Thierry Carrel
Bern University Hospital, Swiss Cardiovascular Center Bern, Bern, Switzerland

Large circumferential mitral annular calcifications (MAC) remain a major surgical obstacle in mitral valve surgery. Even for very experienced surgical hands, applying various skilful techniques like pericardial patch annulus reconstruction, atrial sliding and plication to bridge the calcified annulus, or direct annular reconstructions – in MAC surgery reaches its limits.
Expanded indications and off-label use of transcatheter techniques have given rise to changed treatment modalities. Valve-in-valve implantation in degenerated aortic and mitral tissue valves or valve-in-ring implantations in the mitral and tricuspid position became easy to learn transcatheter techniques, increasing the armamentarium of treatment modalities (Figure 1).
A translational approach was used when, in 2012, an 81 year-old lady presented with combined mitral disease and severe circumferential MAC. Only during surgery could the massive extent of MAC really be appreciated and operating surgeon, Thierry Carrel, decided to implant a SAPIEN XT transcatheter aortic valve implantation (TAVI) device. Via the left atrium and under full cardiopulmonary support, mitral valve balloon annuloplasty was performed, initially using a 20 mm balloon, followed by a 24 mm Osypka balloon, which enabled implantation of a 26 mm XT valve. Extreme care was taken to crimp the valve in the appropriate (transapical) direction onto the Ascendra+ delivery system (Figure 2) and the tip of the delivery catheter was cut to ease the intra-annular device positioning. Finally, the 26 mm XT valve was deployed under direct visual control (Figure 3). Although digital evaluation confirmed the correct implantation and stable anchoring within the annulus, additional anchoring sutures of the prosthesis to the atrial tissue were placed at the level of the commissures and at the mid-P2 portion of the annulus using non-calcified right atrial tissue. Due to pre-existing atrial fibrillation, left atrial appendage exclusion and pulmonary vein ablation was performed concomitantly.[1]
Encouraged by the excellent immediate and medium-term clinical outcome this procedure was performed in three further patients. In the follow-up, no adverse events were reported and echocardiographic evaluation confirmed a good valve function in all four patients (all NYHA class II).
At this European Association for Cardio-Thoracic Surgery (EACTS) meeting our group will present the mid- to long-term outcomes of the worldwide first open TAVI device implantations in MAC. We will focus on technical considerations, as well as how to avoid pitfalls, drawing on our experience of this transcatheter-aided surgery to master challenging mitral valve operations in MAC.

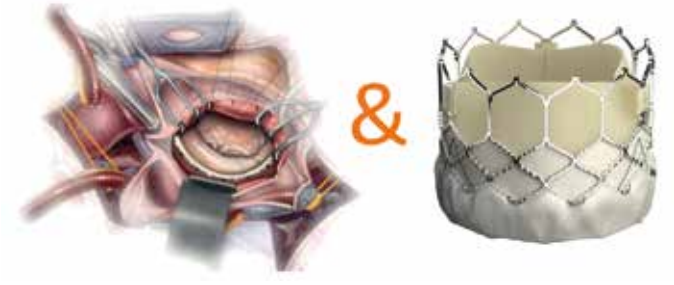


Figure 1. Fusion of surgical and transcatheter techniques to allow transcatheter aided surgery in challenging settings like mitral annular calcifications.

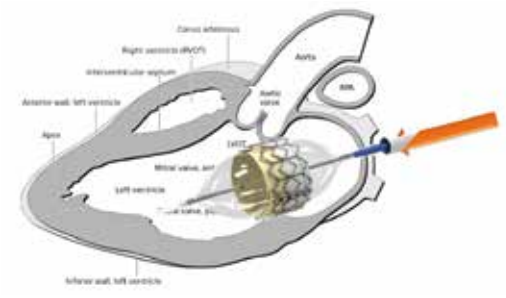


Figure 2. Surgical transcatheter access via the left atrium. In off-label use of non-dedicated devices technical considerations and planning are key for success. The SAPIEN XT device needs to be crimped in the same direction as for aortic transapical implantation when performing surgical TAVI in mitral position via the left atrium.

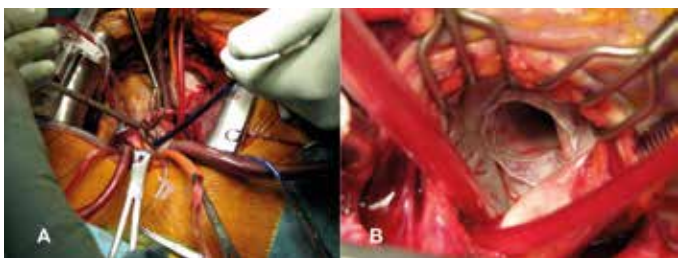


Figure 3. A) Transcatheter implantation using the Ascendra+ delivery system for SAPIEN XT implantation in MAC. B) Detailed illustration of the correctly deployed device.

Reference
1. Carrel T, Wenaweser P, Reineke S, et al. Worldwide first surgical implantation of a transcatheter valved stent in mitral position. *Cardiovasc Med* 2012;15:202–4.

Techno College – Acquired Cardiac: Transcatheter aortic valve implantation/aortic valve

Direct aortic TAVI using the CoreVista system: another step in the direction of day case TAVI

Otto Dapunt LKH University, Hospital, Graz

The direct aortic (DA) approach to transcatheter aortic valve implantation (TAVI) has emerged as a valid alternative in patients not eligible for transfemoral (TF) TAVI. This approach has found favour among surgeons for its familiarity and its relative freedom from complications and contraindications. However, despite providing convenient access to the aortic valve, the surgical nature of this approach, requiring either partial sternotomy or right anterior thoracotomy, impedes the achievement of rapid recovery from the procedure in comparison with TF-TAVI which is now capable of being performed as a same day / next day discharge procedure. Similarly to the transapical (TA) approach, DA-TAVI implies chest disruption, which inevitably increases hospital length of stay and possible complications, jeopardising the potential advantages of this approach.
If TAVI was originally reserved for the very elderly, or for patients with multiple co-morbidities, where same day/next day discharge seemed unfeasible or inappropriate, its progressive expansion into lower risk patient groups has made day case TAVI more realistic and even necessary to justify the cost of transcatheter valve prostheses.
This study reports an alternative approach to DA-TAVI based on the use of a novel device system designed to provide access to the aorta from a short transverse incision in the neck. The CoreVista system (CardioPrecision Ltd, Glasgow, UK) comprises a lifting frame that affixes to the surgical or catheter lab table, a retractor equipped with a set of lights to sequentially illuminate different zones of the surgical field in step with the surgical procedure and a high definition monitor that is positioned above the incision in the line of sight of the surgeon for HD visualisation of the field throughout, permitting careful substernal dissection of mediastinal structures and safe exposure of the aorta.
The CoreVista system, so named because it provides a remarkably clear view of the heart for TAVI to be performed, finds its inspiration in the thoracic surgical experience with transcervical thymectomy, a procedure that allows complete thymus gland resection within a regimen of day-surgery or next-day discharge and exceptional reduction in postoperative recovery time and risk/severity of complications in comparison to the traditional median sternotomy approach.
Two patients were successfully treated using the CoreVista system for severe aortic stenosis with self-expanding transcatheter aortic valve prostheses. Procedure success was determined by a set of pre-determined criteria internationally agreed by the Valve Academic Research Consortium (VARC). Both patients made a swift recovery and were discharged on the second postoperative day in sinus rhythm with only minor discomfort from the wound.
This was a feasibility study and despite the encouraging results, more confirmatory data are needed to assess the effectiveness of this approach in clinical practice. However, the ability to convert DA-TAVI into a sternotomy/thoracotomy-free procedure reproducing the benefit and the clinical course characteristics of TF-TAVI would represent a crucial achievement in this field. Indeed, Direct Aortic TAVI using the CoreVista system might become a valid ally of TF-TAVI in securing same day/next day discharge for the majority of patients, their combination allowing a dramatic reduction in length of stay and perioperative costs, rendering the TAVI procedure financially competitive to surgical AVR and therefore viable also in lower risk patients.

Figure 1. The CoreVista system in place.

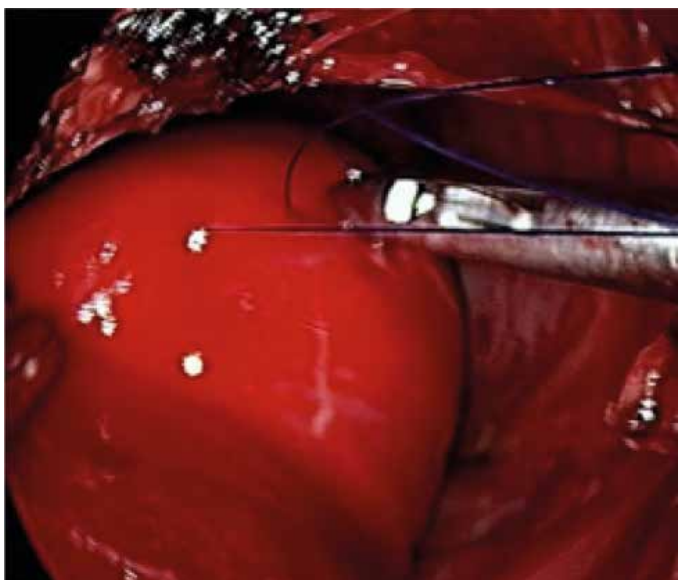


Figure 2. Placement of pursestring-suture at the ascending aorta.

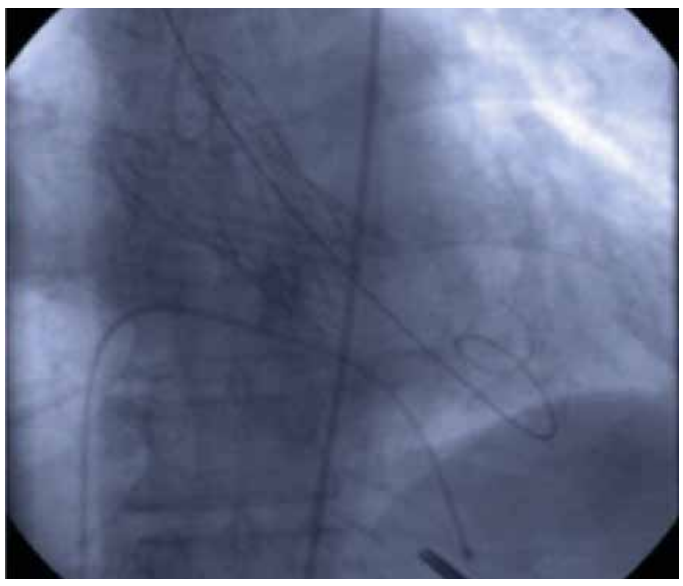


Figure 3. Angiography of deployment of Corevalve.

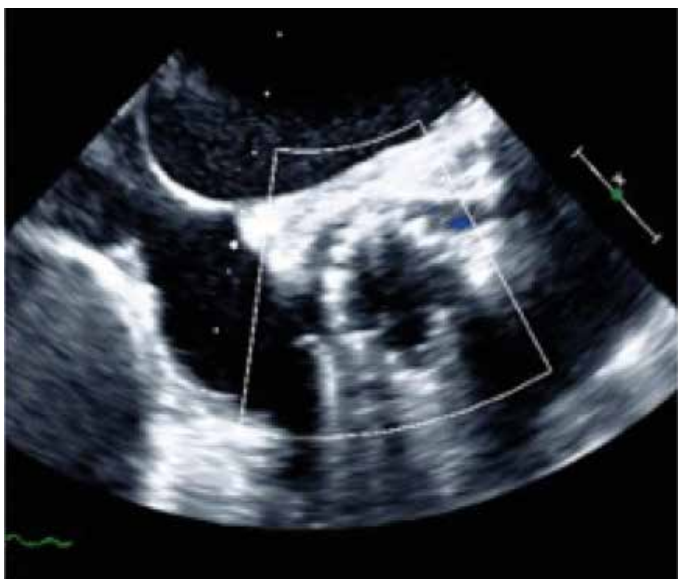


Figure 4. Echo result after valve implantation.

Techno College – Acquired Cardiac: Transcatheter aortic valve implantation/aortic valve

Video guided sutureless aortic valve replacement

L Salvador, T Hinna Danesi, GD Cresce, A Favaro
San Bortolo Hospital, Vicenza, Italy

In the past 10–15 years minimally invasive cardiac surgery has rapidly developed.

In the treatment of mitral valve disease, the right anterior mini-thoracotomy has progressively been reduced to key-hole access. Consequently the surgical approach in experienced centres has become completely video-guided. With aortic valve disease, minimally invasive approach started with partial sternotomy and then moved to right anterior thoracotomy. Video-thoracoscopic minimally invasive aortic valve surgery is an excellent choice for patients requiring minimally invasive approaches, or patients with comorbid conditions such as COPD, obesity, osteoporosis or in fragile patients not reaching the inclusion criteria for transcatheter aortic valve implantation. Using sternal sparing to reduce surgical trauma results in faster recovery after surgery, a lower need for transfusions, and fewer perioperative complications. In the Western world most mitral surgery consists of in valve repair whereas aortic valve surgery in the elderly is usually valve replacement. Aortic valve replacement by standard stented prosthesis in a minimally invasive fashion is typically associated with longer cross clamp and CPB time. These elements reduce the advantages of the minimally invasive approach.

In our centre we've applied our experience of minimally invasive mitral valve surgery to the aortic valve position. Independently of the underlying pathology, standardizing the sequence of the operative manoeuvres has become key for successful results. We do not perform any additional preoperative assessment, including CT scans, for the majority of patients undergoing minimally invasive surgery. The completely video guided approach allows us to operate on aortic valve even if it is in left sided position.

The patient lays supine with a 30° elevation of the right shoulder in order to facilitate the insertion of ports, and to extend the intercostal spaces. A single lumen oro-tracheal intubation is achieved. CPB in our minimally invasive surgery strategy is performed through a peripheral cannulation with surgical exposure of the femoral artery through a small skin incision and counter-lateral percutaneous femoral venous drainage.

A mini, right-sided, thoracotomy (about 4 cm) in the 2nd or 3rd intercostal space is performed with soft-tissue retractor placement; two 5 mm ports are made to place the 30° thoracoscope with CO_2 insufflation and the left atrial/ventricle venting line, and a 3rd port is made for a Chitwood clamp.

After aortic cross clamp, under video-thoracoscopic vision, anterograde Custudiol® cardioplegic solution is given directly into the aortic root or selectively in the coronary ostia after incision of the ascending aorta. Accurate excision of native aortic leaflets and annular decalcification is made to achieve a smooth and regular annular surface to reduce the risk of paravalvular leaks. An accurate bioprosthetic sizing is mandatory. In normal, non-dilated ascending aorta, or preferably when the aortic diameter is small, we implant a sutureless bioprosthesis, while in mildly dilated aorta our choice is to implant a rapid deployment bioprosthesis. The two bioprostheses are implanted following the usual techniques recommended by the manufacturers.

When the aorta and the aortic annulus are anatomically

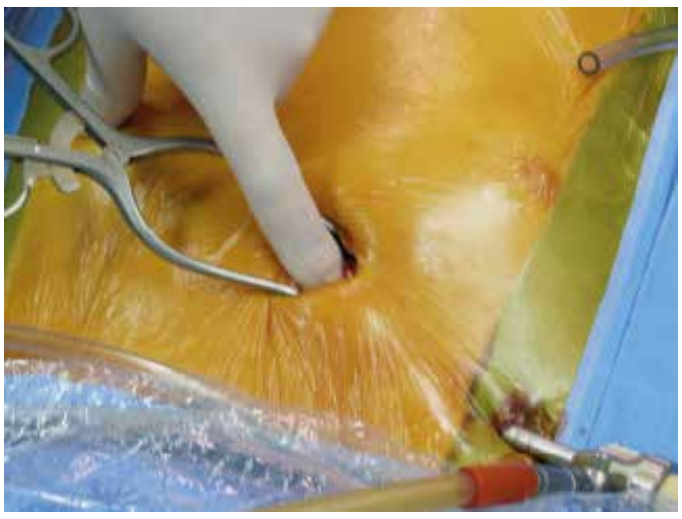


Figure 1.

favourable, the use of a sutureless bioprosthesis over a rapid deployment bioprosthesis, is a matter of personal choice for the surgeon. Reduced aortic cross-clamp time and CPB time are the main advantages that have become evident for the patient, while the minor need for sutures have made the bioprosthetic implant less difficult for the surgeon.

Video-thoracoscopic minimally invasive surgery is a technique that provides real benefits to the patients in centres with specific experience. The development of sutureless and rapid deployment bioprostheses has made minimally invasive aortic surgery even easier and safer. Good results are now more apparent in particular groups of patients.

Techno College – Septulus a novel device for minimally invasive treating hypertrophic cardiomyopathy

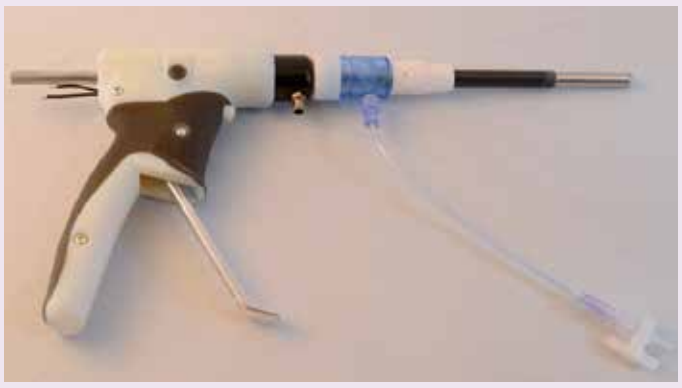
Hypertrophic obstructive cardiomyopathy

H Bjursten Skane University Hospital, Lund, Sweden

Hypertrophic obstructive cardiomyopathy (HOCM) and other forms of septal hypertrophy is an underserved condition in cardiac patients. It has been estimated that 1 in 500 suffers from HOCM globally, which translates to 1.5 million people in Europe and the United States. At the same time only 5–10,000 patients undergo surgery for this condition annually due to the lack of a simple and effective treatment.

Patients with HOCM have septal hypertrophy, which is defined as a thickening of the septum from a normal 6–10 mm to up to 25–30 mm. This thickening leads to an outflow obstruction of the left ventricle, requiring the heart to work harder to maintain blood pressure and cardiac output. When severe, the condition decreases a patient's cardiac output and physical strength and increases the likelihood that a patient will die prematurely from heart failure. Physicians currently have two modalities for treating septal hypertrophy: surgical myectomy and Alcohol Septal Ablation (ASA). While both procedures reduce symptoms and increase the heart's work capacity, surgical myectomy shows far better results in terms of survival, pacemaker implantation rate, and repeat procedures. The main disadvantage of surgical myectomy compared with ASA is the invasiveness of the procedure and the subsequent risk of complications.

The Septulus technology was developed to accomplish septal myectomy less invasively and in a more controlled manner. It is performed through a transapical or transaortic approach, allowing the surgeon to resect the septum of a beating heart. The technology permits a controlled sequential resection of hypertrophic tissue, with continuous monitoring of resected volume by transeosophageal echocardiography and continuous measurement of pressure gradient. The device has undergone testing in live animals with good results. Based on these animal tests, the Septulus technology appears to offer the effectiveness of surgical myectomy, but with the less invasiveness, rapid recovery, and lower cost of ASA. The technology should result in fewer complications and better control of the amount of tissue removed from the heart than either surgical myectomy or ASA. With a new and less invasive technology, large groups of patients that previously were not treated according to guidelines can now be offered a procedure.



Techno College – Acquired Cardiac: Atrioventricular valves (mitral plus tricuspid)

A novel transcatheter repair device for treatment of tricuspid regurgitation

Azeem Latib San Raffaele Scientific Institute &
EMO-GCM Centro Cuore Columbus, Milan, Italy

Functional Tricuspid Regurgitation (TR) is the most common aetiology of severe TR in the western world.[1] The prevalence of functional TR with mitral valve disease is >30%,[1,2] with some studies suggesting over 1.6 million patients in the US may currently be suffering from this disease.[1] Only 8000 undergo tricuspid surgery annually and consequently a large number of patients remain untreated, while a growing number of studies suggest that severe TR is associated with a poor prognosis[1–4] Compared with patients with no, or mild, TR the one year survival changes significantly in patients with moderate and severe TR with a 65% one year mortality in patients with severe TR.

Interest in treatments for the tricuspid valve has increased in recent years with the recognition of the impact of FTR on outcomes and the benefits of tricuspid repair. Conservative management of FTR includes optimisation of right ventricle preload and afterload with diuretics and angiotension-converting enzyme inhibitors. Severe FTR is usually corrected at the same time as left-heart surgery.

Mitralign Inc has designed a system to perform percutaneous suture annuloplasty of the tricuspid annulus to treat functional tricuspid regurgitation. The procedure replicates a surgical procedure first described by Kay which involved suture plications of the posterior annulus to stabilise and to reduce the annulus area in order to restore the tricuspid valve function.

The procedure utilises catheters and wires to deliver a pair of surgical pledgeted sutures across the tricuspid annulus at the septal/posterior and the posterior/anterior commissure. The implants are then plicated together to perform an annuloplasty of the posterior tricuspid annulus. To date, 9 procedures have been performed in non-surgical candidates, with excellent safety results. The goal for the company is to commence a European CE Mark trial in 2015 with strict inclusion and exclusion criteria, in order to demonstrate the safety and efficacy of the device.

Figure 1. Pledget implant pair.

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Techno College – Congenital Session 2: Mechanical support

Update on haemodynamic monitoring in paediatric cardiac patients

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Cardio-circulatory dysfunction is frequent in paediatric patients after cardiac surgery. This challenging situation is multifactorial but typically of cardiogenic aetiology, due to pump dysfunction: ischaemia-reperfusion, surgical trauma, inflammation, residual lesions, atrio-ventricular valve regurgitation, left obstruction, arrhythmia, but most frequently, low cardiac output syndrome (LCOS).[1,2] Postoperative outcomes of paediatric cardiac patients have much improved over the last 20 years due to multiple factors, including the implementation of a consistent interdisciplinary management, modern surgical techniques and myocardial protection processes, efficient drugs and technology, and quality improvement, safety and clinical effectiveness bundles and algorithms. Cardio-circulatory monitoring has been of critical importance in achieving these improvements. The need to develop such tools has been all the more imperative as clinicians are unable to anticipate haemodynamic instability early enough.[3] Nevertheless, it is still unclear whether currently used tools are good enough. These tools ought to be inexpensive, sensitive and specific, and able to provide early warnings, as well as an assessment of therapeutic responses. Such tools are probably more effective when used in combination, which certainly impacts the financial burden in highly specialised programmes. Haemodynamic monitoring has various clinical objectives, namely anticipating and preventing LCOS as specifically and sensitively as possible, anticipating and preventing shock of any nature, multi-organ failure and cardiac arrest. Nonetheless, aims and goals are not limited to these facets. It is essential to understand whether interventions are effective and whether they will reduce LCOS duration, and it is also imperative to determine whether these tools are causing any harm. Moreover, effective monitoring tools should define and anticipate outcomes beyond LCOS, shock, multi-organ failure or cardiac arrest. Foreseeing if we are doing the right thing for the patient, rather than to the patient, and if we are impacting long-term outcomes is as important as achieving good immediate results.[4–7] The concept behind the utilisation of tools is even more important than their selection. Blood pressure, pulse, temperature gradient, central venous pressure, measures of cardiac output or any combination of these variables do not seem to predict adverse outcomes in paediatric cardiac patients.[8] In fact, rather than aiming to achieve 'normal' systemic or pulmonary pressures, caregivers should focus on effective circulation as a final goal, which depends upon complex interactions between the heart, central and peripheral circulations and the neuro-hormonal axis: end-organ perfusion and tissue oxygenation. Avoiding the anaerobic threshold[9] that is triggered by an imbalance between oxygen delivery (DO2) and oxygen consumption (VO2) is vital.[10–12] Currently, these parameters are evaluated using a combination of serial blood lactates,[13–15] and technologies to assess regional (NIRS)[8,16] and global (mixed venous)[8,17–19] perfusion. Modern arterial pressure waveform analysis may be useful in selected scenarios, but they have significant restrictions and lack reliability in certain patient populations.[20] Current developing technologies aim to provide more advanced, sensitive, specific and consistently reliable, early information about tissue oxygenation, micro-circulation[21–24] and the development of scores through the use of big data. As take-home messages, it may be meaningful to recognise that more tests or tools do not necessarily mean better diagnosis, that the less invasive the tools the better, and that trends matter more than absolute values.

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Techno College – Acquired Cardiac: Atrioventricular valves (mitral plus tricuspid)

Minimally invasive mitral valve repair for complex bileaflet disease using a new 3D ring

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

Minimally invasive mitral valve surgery (MIMVS) has shown excellent postoperative outcomes in terms of mortality and morbidities as well as patient satisfaction, providing faster recovery, fewer blood transfusions, less wound infection and shorter hospital stays. Despite these results, traditionalists have claimed that MIMVS is technically more demanding, has a longer learning curve and reduces the chances of mitral valve repair in favour of mitral valve replacement, especially in the presence of complex mitral valve disease. In the setting of degenerative mitral regurgitation, several studies and my own group have demonstrated the high success rate of mitral valve repair and a high freedom from reoperation at 10 years, even for those patients with mitral valve Barlow disease. Whatever the type of approach, the rules for mitral valve repair for degenerative mitral valve regurgitation are:

1. Preservation or restoration of normal motions for both leaflets;
2. Stabilisation of the mitral apparatus using a prosthetic ring;
3. Creation of a large surface of coaptation.

Despite the 'French correction' still being widely performed among surgeons, in recent years the concept of 'respect rather than resect' has become very popular based on the use of artificial PTFE neo-chordae. This technique may correct the prolapsed portion of the mitral valve and restore the surface of coaptation. However, the key to success for this procedure is the correct length of the neo-chorda in order to avoid a residual prolapse or a tethered leaflet in case of longer or shorter chorda, respectively. The Memo 3D ReChord is a new semi-rigid complete ring associated with a temporary chordal guide system, which allows correct positioning of the neo-chordae without the need to measure them. This technique uses the posterior annulus as a reference point for the height of the neo-chorda, relying on the principle that the length of a marginal chorda is always equal to that of the corresponding basal chorda. Technically, once the PTFE is passed through the prolapsing leaflet and then into the loop system, the free margin of the leaflet is brought to the posterior annulus and the PTFE is tied. Finally, after that the loop system is removed, the length of the neo-chordae will match the plane of the mitral annulus, restoring a normal coaptation.

This technique is applicable for both anterior and posterior correction, but also in the presence of bileaflet correction, and it can be associated with a segment leaflet resection. Conventionally, the bileaflet correction has been considered a complex procedure, and therefore more prone to failure. Conversely, this new semi-rigid ring with the temporary chordal system guidance has shown excellent repair even in mitral valve Barlow disease, reducing operative times. In conclusion, this technique is a reproducible procedure, which allows anterior, posterior or bileaflet correction. It restores the leaflet motion and ensures a large surface of coaptation. This technique will definitively standardise the 'respect rather than resect' technique, further facilitating the minimally invasive mitral valve approach.

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Figure 1.

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Techno College – Acquired Cardiac: Atrioventricular valves (mitral plus tricuspid)

Mitral bridge implantation in a patient with functional mitral regurgitation

VA Subramanian and S Cerny HRT-Heart Repair Technologies Inc. Morgan Hill, CA, USA and Na Homolce Hospital, Prague, Czech Republic

The gold standard surgical restrictive ring annuloplasty for the treatment of functional mitral regurgitation (FMR) has become a subject of controversy and criticism because of reports of high early mitral regurgitation (MR) recurrence and functional mitral stenosis. Restrictive ring annuloplasty achieves an indirect reduction of the septolateral diameter of the mitral annulus by circumferential cinching, resulting in increased stress in the commissural segments of the annulus, a negative impact on the coaptation geometry and stress distribution in the leaflets. These unsatisfactory clinical results and the high invasiveness of traditional surgical mitral repair has led to increasing interest in transcatheter technologies for treatment of FMR.

A novel transvalvular mitral bridge with infra-annular curvature for the treatment of both FMR and degenerative MR (mitral valve prolapse) has been developed by Heart Repair Technologies Inc., Morgan Hill, CA, USA. On Saturday 3 October 2015, at the Techno College, Acquired Cardiac Disease session, we will be presenting a mitral bridge implantation in a patient with Type I FMR.

The mitral bridge has two annular anchoring retention pads with an intervening curved nitinol-silicon bridge. The device is a single piece with no moving parts. The pads are sutured into the annulus across the mitral valve in the septolateral dimension with standard surgical sutures (2–3 tangential or horizontal mattress sutures) at the midpoint of the bases of the anterior and posterior leaflets. The bridge is available in sizes of 22, 24, 26, 28 and 30 mm. The bridge sizing and selection is based on the anterior leaflet height (preoperative echo and intraoperative visual inspection). The infra-annular curvature of the bridge preserves the normal curvature of the leaflets and achieves a non-planar direct reduction of the septolateral diameter and restoration of the saddle shape of the annulus. The remainder of the large part of the annulus is free to move normally with preserved function. The curvature of the bridge reduces the leaflet tenting height and creates a large coaptation zone, assuring long-term repair durability. These features of the mitral bridge creates a favourable sub-valvular geometry promoting early positive LV remodelling. Preclinical bench testing beyond 1 billion cycles and a 1-year chronic sheep study have confirmed the durability and safety of the bridge, showing stability, no migration of the device and no thromboembolism as well as preserved function and architecture of the native leaflets. In animal studies with flail leaflet prolapse, mitral bridge implantation with no concomitant leaflet repair was effective in eliminating MR and the leaflet prolapse. The mitral bridge is currently being tested in a prospective observational and safety CE Mark trial in 30 surgically eligible patients with FMR. Primary endpoints are MR grade 1± at 6 months F/U and MACE. Clinical results of this trial will be presented by Dr Stepan Cerny at the Rapid Response Session: *New technology in mitral surgery* on Tuesday 6 October. In summary, the results show near complete elimination of MR at 6 months and 1 year with a large coaptation zone over 7.5 mm and low mitral gradients with freedom from death, MI, stroke and device failure.

In conclusion, mitral bridge implantation in FMR patients is simple, safe and effective in the elimination of MR, showing durable clinical results over a period of 12 months. The current device is easily folded and deliverable via a 16 Fr. catheter and suture anchored with no bridge and anchor design changes for transcatheter implantation, both by transapical and transseptal accesses. This project is in a preclinical phase.

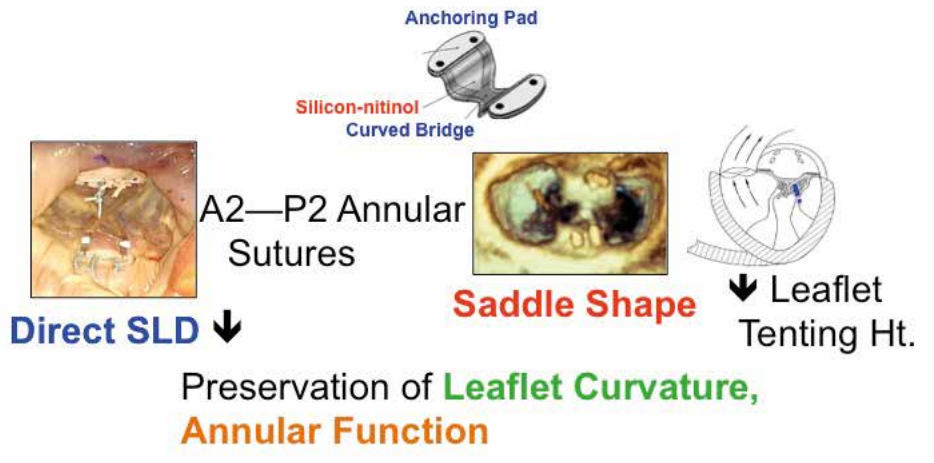

Figure 1. Mitral bridge

EACTS
European Association For Cardio-Thoracic Surgery

Chest Wall Diseases

Date/duration: 2–4 December 2015

Location: Windsor

Course Director: M Yüksel, Istanbul, Turkey

2013 Chest Wall Disease in Windsor.

Course overview

This course aims to teach the indications, techniques and follow-up of minimally invasive and open surgery in pectus deformities, alternative treatments for pectus deformities, chest wall resection and reconstruction techniques in chest wall diseases, the surgical techniques in thoracic outlet syndrome. As well as learning the treatment options in sternal dehiscence.

The programme will include a combination of both high level interactive discussion and lectures delivering theoretical knowledge.

Course Director

SORIN SOLO SMART MIMICS ANATOMY OF NATIVE AORTIC VALVE

David A. Heimansohn, M.D. St. Vincent's Heart Hospital, Indianapolis, IN-USA

Stentless bioprosthetic valves, first introduced in the late 1990s, represented a major change in valve design and performance, with reported superior hemodynamic properties compared to stented valves due to lower pressure gradients and reduced turbulence in the aortic sinuses.[i,ii]

The Sorin Group Solo Smart™, launched in Europe in 2013 and now available to U.S. surgeons, represents the first and only valve with a removable stent to be approved in the U.S. market. Surgeons will appreciate the removable nickel-titanium alloy stent that sets this valve apart from all others. Following implantation, the Solo Smart becomes an entirely stentless valve.

Made from bovine pericardium, this unique valve has no synthetic material added, allowing it to mimic the healthy native aortic valve. By aligning to the patient's annulus with a 100 percent orifice-to-annulus ratio, Solo Smart maximises blood flow and delivers excellent hemodynamic performance while providing the ease of implantability of a stented valve.

Having conducted the first U.S. implant of the Solo Smart at St. Vincent's Heart Hospital in Indianapolis in 2014, I was able to directly experience the ease of implantation, with only a single suture line required. Most striking about this device is that it so closely resembles a native aortic valve in appearance and performance, offering optimal hemodynamics and the opportunity to dramatically improve patients' lives.

Clinical evidence supporting individual surgeon experiences includes: a prospective North American trial by Heimansohn et al.,[iii] the results of which were used to obtain Solo Smart Food and Drug Administration approval; March 2015 published results from a prospective multicenter study of 804 patients by Grubitzsch et al.[iv] that showed beneficial survival, morbidity and functional status outcomes with Solo Smart up to three years following surgery; and research from Thalmann, et al.[v] that followed 277 patients out to five years with 100 percent freedom from structural valve deterioration. Individual surgeon experience coupled with the early clinical evidence and outcomes data represents an important and significant step forward in the treatment of aortic valve disease.

Find out more at Sorin Group Booth # 3.15

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Techno College – Acquired Cardiac: Heart failure/aortic disease

Totally thoracoscopic left atrial appendage exclusion – standalone and concominant to hybrid ablation

Piotr Suwalski
Central Clinical Hospital of the Ministry of Interior, Warsaw, Poland

Atrial fibrillation (AF) is the most common clinically relevant arrhythmia and it is strongly associated with stroke, the most devastating complication. The most frequent source of thrombotic material leading to cerebrovascular events is from the left atrial appendage (LAA). Oral anticoagulation remains the standard of care for patients with AF. According to current guidelines such therapy is recommended when CHA_2DS_2-VASc exceeds 1. However, as patients with AF often have many comorbidities, oral anticoagulation may be contraindicated. Recent publications indicate that LAA closure may not be inferior to oral anticoagulation in patients in who the latter is not recommended. This was reflected in the European Society of Cardiology (ESC) guidelines, which indicate that LAA closure in this group of patients (those with elevated CHA_2DS_2-VASc and/or HAS-BLED with contraindications for oral anticoagulation) may be recommended.[1]

In recent decades a number of surgical, percutaneous and hybrid approaches for LAA occlusion have been described showing better or worse efficacy, but also confirming the 'old' difficulties, mainly associated with auricle's fragility (tear), variable anatomy, incomplete closure or left remnant (stump) of LAA, and finally late recanalisation. The game has been risky since it has been proven that incomplete LAA closure or residual stump >1 cm increases the risk of stroke to a higher level than open LAA.[2]

The latest system for LAA occlusion, the AtriClip® (Atricure, Dayton, OH, USA), has proven its efficacy in complete closure of LAA, in both short- and long-term observation studies, revealing 100% of closures with no complications over 3 years. No stroke or bleeding were observed during this period, although the mean CHA_2DS_2-VASc score was 4 (about 10% of yearly stroke risk) and half of the patient group were not receiving oral anticoagulation therapy.[3] The simplicity of the AtriClip®PRO, which is a thoracoscopic version of the system, offers an interesting option for both standalone LAA closure and as a part of the totally thoracoscopic or hybrid ablation for AF, which can potentially add value in terms of stroke prevention, especially in patients with arrhythmia recurrence.

The procedure requires general anaesthesia with a double lumen intubation and single right lung ventilation, and uses the three-port technique. The very short 'skin-to-skin' procedural time of approximately 30 minutes and totally thoracoscopic approach enabling quick extubation 'on table' make the procedure highly minimally invasive. It is important that during the procedure the clip can be repeatedly reopened and repositioned under the simultaneous transoesophageal echocardiographic control, until the optimal result is achieved. From a practical point of view, the implantation setup neither requires an X-ray arm nor hybrid operating room, however, close cooperation with an experienced echocardiographer is recommended.

Undoubtly, the new surgical systems enabling closure of the LAA significantly enrich the surgical ablation, but also have a fuller potential to open a new niche for the cardiac surgeon – standalone LAA exclusion in preventing stroke. Cardiac surgeons, in cooperation with cardiologists, should embrace these new technologies and participate in their further progress, since the potential exists to combine simplicity, efficacy and safety, with a high-level of minimally invasiveness. Further studies in this cohort of patients are necessary.

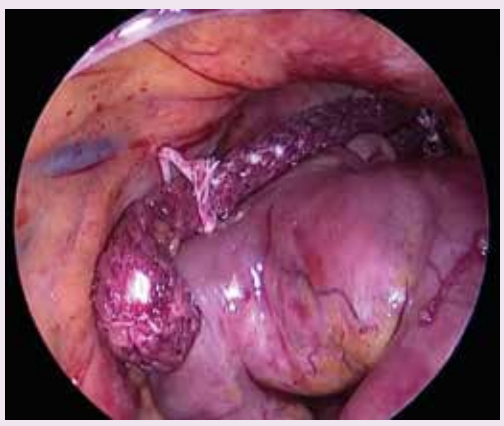

Figure 1.

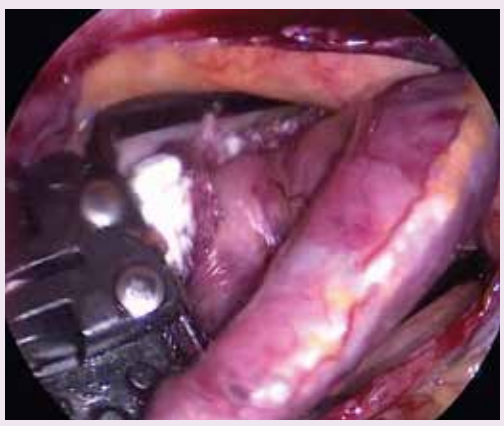

Figure 2.

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Techno College – Acquired Cardiac: Transcatheter aortic valve implantation/aortic valve

Redefining the risk of reoperation with valve-in-valve procedures

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Transcatheter heart valve (THV) therapy has now established itself as one of the treatment options for patients with aortic stenosis. Confidence in this technology has led to its use in novel indications, such as in the treatment of a degenerated bioprosthetic surgical heart valve (SHV). During the past 5 years, multiple reports of valve-in-valve (VIV) procedures have appeared in the literature, with substantial experience acquired in treating degenerated SHV in aortic position and increasing experience in mitral, tricuspid and pulmonary positions.

Initial experience was limited to two devices – the Sapien/Sapien XT (Edwards Lifesciences Ltd, Irvine, CA, USA) and CoreValve/Evolute (Medtronic Inc., Minneapolis, MN, USA). During early clinical experience, the focus was on implanting the THV device in the correct position but it became obvious that there are unique problems associated with VIV therapy, such as increased gradients (especially in small size SHVs), risk of coronary artery obstruction and malposition including embolisation. Availability of newer devices, which can be repositioned and retrieved, and the ability to assess the possibility of complication before release of the device, has become a reality and will reduce the incidence of complications.

Clinical and bench research has provided excellent guidance for VIV because the success of a VIV procedure is based on the correct identification of the surgical valve, choosing the correct size of the transcatheter aortic valve implantation (TAVI) valve and its subsequent accurate placement. VIV aortic and VIV Apps are now available to address the majority of clinical situations.

Experience with VIV procedures has now been widened to newer indications, such as failed stentless valves, failed mitral repairs, failed tricuspid repairs and mitral annular calcification (MAC). Owing to the nature of device size and delivery system, only the Sapien THV platform has been used for these indications. Mitral VIV and VIR can be associated with left ventricular outflow tract obstruction and delayed embolisation. This can also be an issue with Sapien in MAC. Sapien THV is balloon expandable and once deployed cannot be retrieved and repositioned. However, recently Lotus THV (Boston Scientific, MA, USA) has been used to treat failed SHV and rings in Mitral position. Lotus THV can be deployed fully and results assessed before release. The valve can be repositioned for optimal position and can even be retrieved fully if the result is unsatisfactory. Similar experience with another THV platform (Direct Flow, CA, USA) has now been reported. Although these new indications, and the use of new devices, are promising, we have to be cautious and understand the strengths and limitations of this expanding therapy area.

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

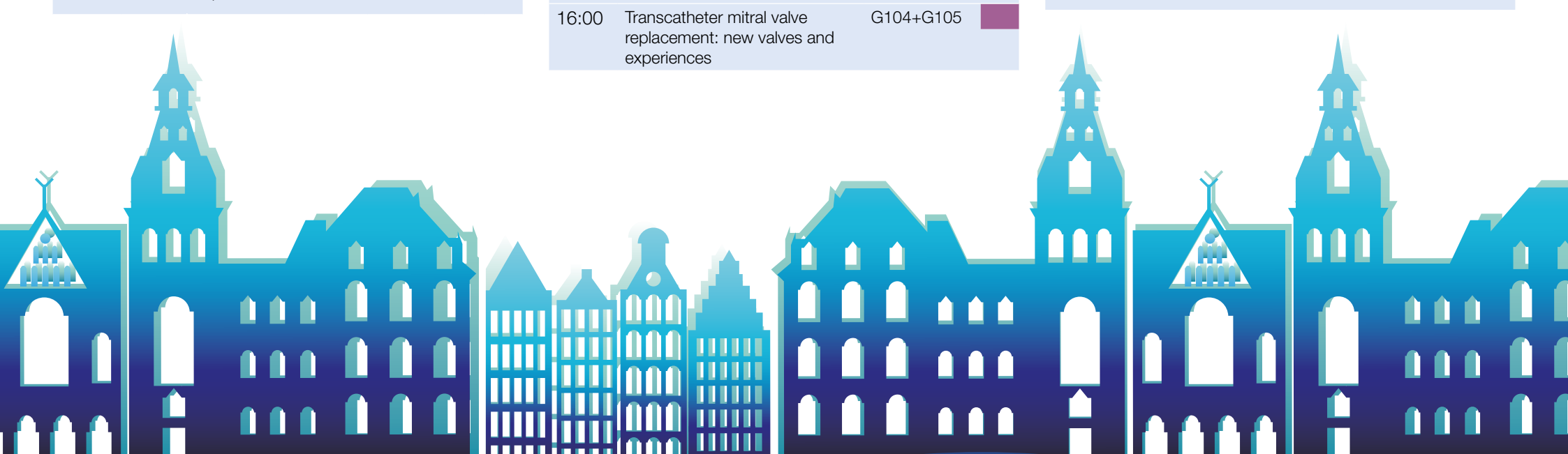
10:15	Avoiding disasters in cardiac surgery	E106+E107
10:15	Meet the experts	Emerald Room
14:15	Coronary artery bypass graft is on the rise, don't give it up	Auditorium
14:15	Infectious problems	E106+E107
14:15	Transcatheter aortic valve implantation: current and future perspectives	E104+E105
14:15	Pro 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

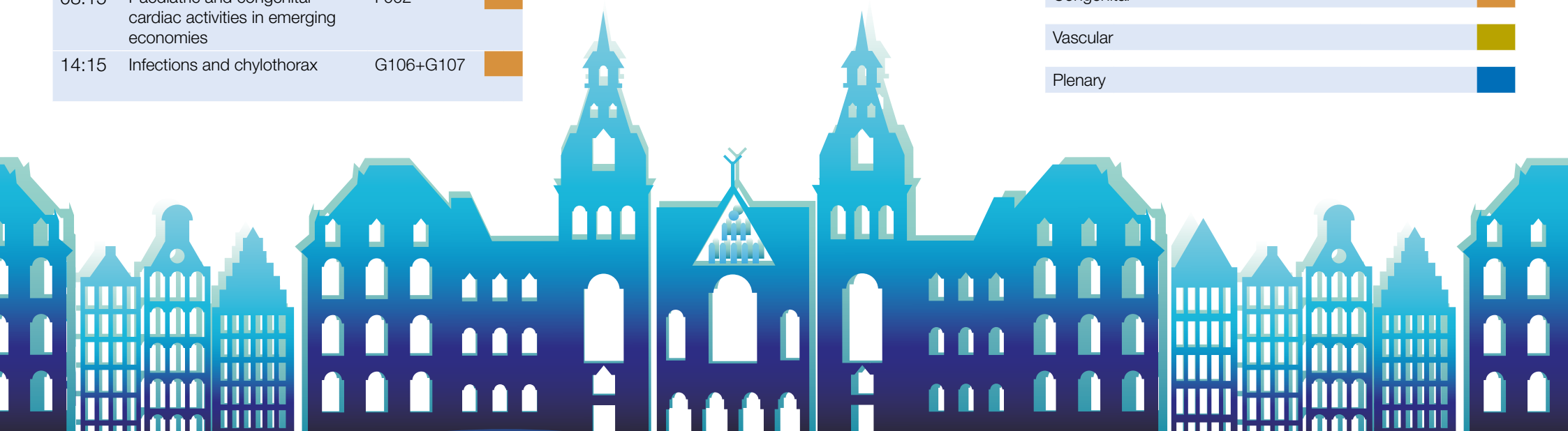
	Focus Session	
09:00	How to do it? With live in a box	Emerald Room

	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



Techno College – Acquired Cardiac: Atrioventricular valves (mitral plus tricuspid)

Transcatheter mitral valve implantation with the Tendyne TMVI device. An apically tethered device for the treatment of mitral regurgitation

Neil Moat Royal Brompton Hospital, London, UK

Mitral regurgitation (MR) is a leading cause of valvular heart disease. Although conventional mitral valve surgery is the gold standard, as many as 49% of patients with severe MR may not undergo conventional surgery.[1] Following on from the successful roll-out of transcatheter aortic valve replacement (TAVR), there have been some recent reports of transcatheter mitral valve implantation (TMVI).[2–4] This communication introduces the Tendyne (Roseville, Minnesota) TMVI system.

The Tendyne TMVI device is a trileaflet porcine pericardial valve sewn onto an apically tethered, self-expanding nitinol frame (Figure 3). The valve is designed to fit the anatomically complex mitral annulus and can accommodate a wide range of sizes. The outer stent is D-shaped, which helps seat the valve in relation to the aortic-mitral continuity. The tether stabilises the device, passing through the ventricular myocardium where it is fixed to an epicardial pad. The device can be retrieved and/or repositioned intraoperatively, even after full deployment.

Three-dimensional transoesophageal echocardiography (3D TEE) and multidetector computed tomography (MDCT) imaging are used for detailed measurements of mitral annular dimensions and geometry, as well as for defining the optimal left ventricular apical access location (Figures 2 and 3). The valve size is chosen based on pre-procedural MDCT imaging and confirmed by intraoperative quantitative 3D TEE.

The device is implanted with the patient under general anesthesia via a transapical approach through a small left minithoracotomy using a 34-French sheath, advanced over the wire into the left atrium. The implant is advanced through the sheath until the correct anatomic position of the D-shaped outer stent can be visualised and confirmed within the left atrium. The device is then positioned within the mitral annulus and fully deployed. The apical pad is then inserted into position over the tether and the tension on the tether adjusted to optimise the position of the device. All of the above was effected predominantly using 2- and 3D TEE imaging.

A total of 15 patients with either degenerative/primary or functional/secondary MR have been treated with the Tendyne system. All patients were deemed to be at high or extreme risk for conventional mitral valve surgery and had symptomatic severe MR. There were no procedural complications (Valve Academic Research Consortium-2). All patients had no or trivial paravalvular MR, no transvalvular MR, and no significant transmitral gradient. There has been no early mortality (30 days).

Figure 1.

The complex pathoanatomy of the mitral valve will present a much more difficult challenge for TMVI compared with TAVI. All the devices with early clinical experience have their advantages and disadvantages, and much work remains to be done before TMVI becomes a viable therapeutic alternative to surgical valve repair/replacement. However, the FIH experience with this system is a very promising beginning. Stabilisation by means of an apical tether is a novel way to attempt to minimise the risk of device migration, left ventricular outflow tract obstruction and paravalvular leakage. The unique design features of this device also offer the potential for it to be useful across a wide range of mitral valve pathologies.

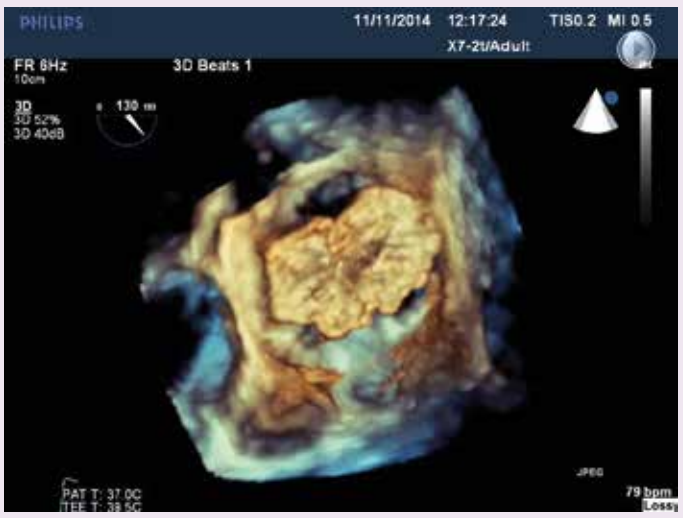


Figure 2.

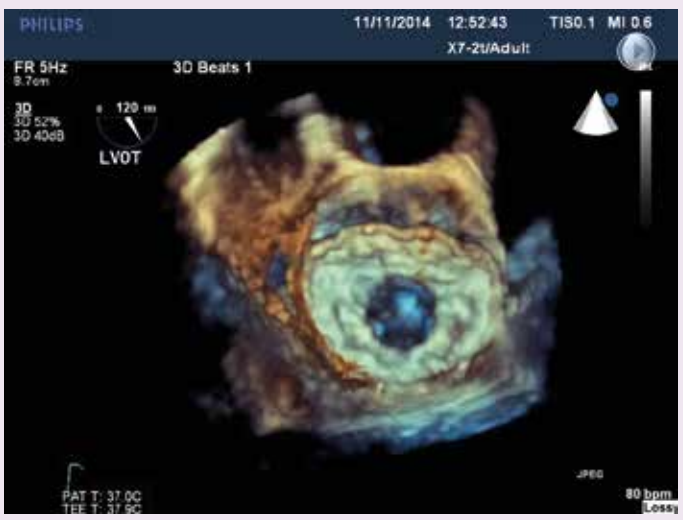


Figure 3.

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5. in-hospital outcomes of an apically tethered device. Moat N, Duncan A, Lindsay A, et al. *J Am Coll Cardiol* 2015;65(21):2352–3.

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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.

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Techno College – Acquired Cardiac: Transcatheter aortic valve implantation/aortic valve

Transcarotid transcatheter aortic valve implantation

Thierry Folliguet Vandoeuvre les Nancy Cedex, France

Transcarotid transcatheter aortic valve implantation represents another access for transaortic valve implantation (TAVI). Since the first publication in 2012 by T. Modine the number performed are slowly increasing. In the French TAVI Registry the carotid approach represented 7% of all TAVI implants in France in 2014, thus being equal to direct aortic and transapical access (80% femoral, 20% others).

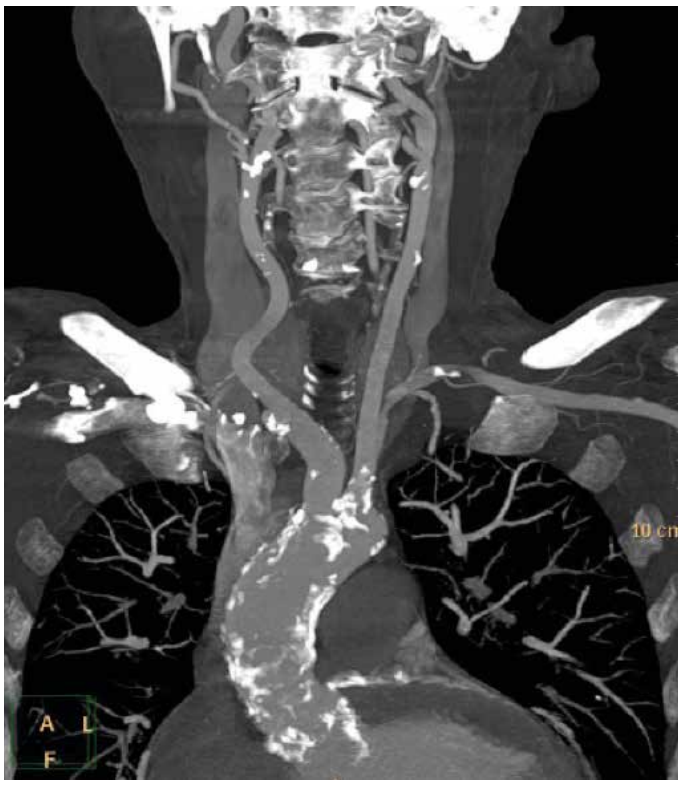

Figure 1. Preoperative CT scan shows direct access to the aortic valve via the left carotid artery.

In actual fact, it is reserved mainly for patients with contraindications to femoral access and/or for whom a transapical or a direct aortic route is not preferred (chest radiation, previous mastectomy, respiratory insufficiency, poor ejection fraction). Another indication is for patients who are morbidly obese, since the neck is usually exempt from fat and femoral access can be a source of haematomas and lymphoceles in these patients.

Transcarotid transcatheter aortic valve implantation can be performed either under local or general anesthesia, which represents an added value compared with other invasive routes requiring general anaesthesia.

Preoperative work-up includes an echo Doppler of the cervical vessels as well as a CT of the cervical vessels and a cranial CT. An adequate diameter of the common carotid vessel is required (6–7 mm according to the valve model chosen), as well as minimal vessel tortuosity and the absence of calcifications. Either left or right carotid can be chosen, but the left carotid artery usually offers a more direct approach. Cranial CT should search for previous ischaemic lesions. Finally echo Doppler or MRI can be performed to assess the patency of the circle of Willis.

After making a small incision two fingers above the sternal notch in the right or left side, the common carotid artery is easily exposed and controlled with vessels loops. The artery is punctured under direct vision and a small introducer is placed to allow for valve valvuloplasty. Only then a valve introducer sheath is placed in the common carotid and slowly advanced in the first centimeters of the ascending aorta. A small depth stop is made on the introducer with a 26 pleural tube at the 4 cm or 5 cm mark. The rest of the procedure is performed routinely.

Advantages of this route are its shorter distance to the aortic valve, the small incision and easy access. Disadvantages are

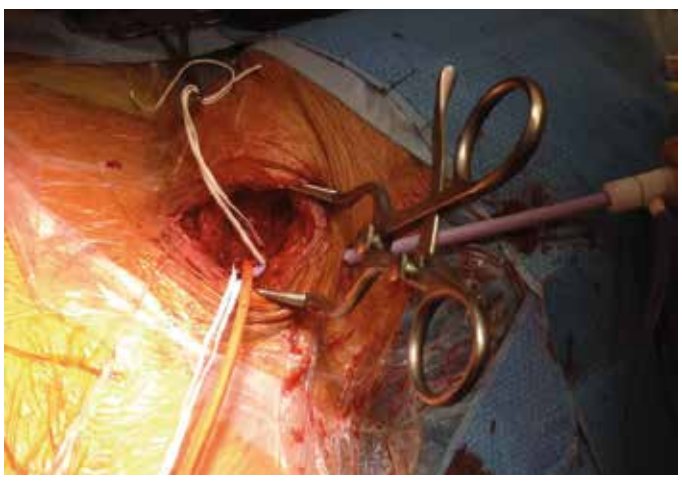

Figure 2. Left carotid approach with placement of the valve sheath through a counter incision.

linked to the surgical incision, there is a risk of stroke if patient selection is poor.

Results of published series are extremely encouraging with minimal complications (local asymptomatic carotid dissection, cervical haematomas, and minimal stroke rates). These results are mainly due to the selection of patients. Further published studies with a large number of patients are needed to establish the carotid artery as an alternative route.

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Vascular – Abstract: A broad view on acute dissection

Surgical outcomes for acute type a aortic dissection with aggressive primary entry resection

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Acute type A aortic dissection (AAAD) remains a challenging and fatal emergent disease with extremely poor prognosis without surgical therapy. There is still no consensus about the 'ideal surgical therapy' for AAAD. Although primary entry resection is an important principle, the operation itself could be too invasive due to aggressive primary entry resection. Since the implementation of the frozen elephant trunk (FET) technique, FET has been widely used to achieve the primary entry closure or the downstream false lumen thrombosis. The FET is applied not only to total arch replacement, but also to hemiarch replacement. However, concerns still remain regarding the FET such as long-term outcomes without primary entry resection or postoperative paraplegia.

Since 2000, we have routinely performed the aggressive primary resection for 334 AAAD repairs without FET. We retrospectively reviewed the outcomes of these patients. The mean age was 67±13 years (range, 20–95). Ninety-five patients (28%) presented with shock vital status and 84 patients manifested malperfusion of branched arteries. The proportion of the DeBakey classification were type I 69%; type II 21%; retrograde dissection 8.7%; and unknown 1.3%. The hospital mortality rate was 8.4% (28/334) for all cases, 5.2 % (16/309) in cases without preoperative cardiopulmonary arrest (CPA) status and 44% (12/25) in cases with preoperative CPA status. Ninety-five percent of patients underwent primary entry resection, 173 patients underwent hemiarch replacement and 161 underwent total arch replacement. Concomitant procedures were root repair in 38 (11%) and CABG in 22 (6.6%). Prolonged ventilation time (>72 h) was required for 106 patients (32%), tracheotomy in 28 (8%), and newly permanent haemodialysis in 7 (2%). No spinal cord injury was found. Postoperative contrast CT angiography was done in 91% (304/334) of patients and revealed 57% (173/304) of patients had thrombosed false lumen. The mean follow-up time was 46±44 months with a follow-up ratio of 97% (323/334). The survival rate was 81% at 3 years, 74% at 5 years, and 65% at 10 years after surgery in all patients. Freedom from dissection-related downstream aortic reoperation rate was 89% at 3 years, 86% at 5 years, and 80% at 10 years. The frequency of downstream aortic reoperation in patients with patent false lumen was significantly higher than in patients with thrombosed false lumen.

Surgical outcomes for acute type A aortic dissection with the aggressive primary entry resection were satisfactory. Even though FET was not used in this series, thrombosed false lumen was achieved in a relatively high proportion (57%) of patients, who significantly avoided downstream aortic reoperation other than those with a patent false lumen. Ideally, a randomised study would be helpful to answer the question whether a more aggressive approach, like our strategy, should be adopted or not. However, we should be aware that use of FET to effect the primary entry closure and downstream false lumen thrombosis without entry resection might pose both operative and endovascular potential risks.

Cardiac – Rapid Response: Reducing invasiveness

Early and mid-term results of no-touch aorta multi-vessel small thoracotomy versus conventional off-pump coronary artery bypass grafting: a propensity score matched study

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[1]Vitebsk Regional Clinical Hospital, Vitebsk State Medical University, Vitebsk, Belarus; [2]Scientific and Practical Center of Cardiology, Minsk, Belarus

Left to right: K. Vykhrystsenka, A. Ziankou, Y. Ostrovsky, M. Laiko.

The invasiveness of coronary artery bypass grafting (CABG) remains considerable and has not been reduced in over 40 years. Various minimally invasive methods for myocardial revascularisation have been developed, including minimally invasive multi-vessel small thoracotomy (MVST) CABG, totally endoscopic CABG and hybrid myocardial revascularisation; however, as these methods are in the process of becoming established, basic comparative studies of immediate and long-term results are a matter for future research. The present study is a comparative analysis of early and mid-term results of no-touch aorta MVST-CABG and conventional off-pump CABG (OPCABG). From 2007 to 2014, a total of 396 patients underwent CABG: MVST-CABG – 219 patients, and OPCABG – 177 patients. Patients in the MVST-CABG group had lower body mass index, greater left ventricular ejection fraction, smaller average number of diseased coronary territories and less complexity of coronary disease (SYNTAX score). Propensity score computer (nearest-neighbour) matching using caliper widths equal to at least 0.2 of the standard deviation of the logit of the propensity score was performed to correct for and minimise selection bias. Covariates that affected treatment assignment and/or the outcome were included in the propensity score model: age, body mass index, left ventricular ejection fraction, left ventricular mass, left ventricular end diastolic volume, number of diseased coronary territories, EuroSCORE, SYNTAX score, preoperative haemoglobin level and preoperative creatinine level. A total of 304 patients were successfully matched in two groups of 152 patients.

In group 1 the minimally invasive CABG strategy was directed to perform multi-vessel arterial revascularisation via the left small thoracotomy on the beating heart with the aortic no-touch technique. In group 2 conventional OPCABG was performed via median sternotomy (aortic no-touch technique or aortocoronary bypass). Criteria for inclusion were multi-vessel coronary artery disease, II–IV Canadian Cardiovascular Society functional class of angina and patients at 1 month after acute myocardial infarction. Exclusion criteria were previous CABG, single vessel disease and need for emergency revascularisation.

Significant differences were found between the MVST-CABG and OPCABG groups, respectively, in intraoperative blood loss – 220 (180, 300) mL versus 400 (300; 550) mL (p=0.039); first 24-hour postoperative blood loss – 220 (150; 350) mL versus 370 (200; 570) mL (p=0.034); operation time – 352.4+74.4 min versus 289.3+55.0 min (p<0.001); median time to return to full physical activity – 14 (7; 21) days and 56 (42; 77) days (p<0.001); rate of wound infection – 2.6% and 7.9% (p=0.040); and physical health component of the SF-36 health status survey – 51.5 (45.2; 52.6) versus 47.2 (45.1; 50.0) (p=0.012). The mean follow-up duration in the MVST-CABG and OPCABG groups was 39.7+15.5 months and 47.6+21.3 months, respectively. At the 3-year postoperative follow-up (Figure 1) no significant differences were observed in rates of cumulative mid-term survival (log-rank test, p=0.876; HR: 1.12, 95% CI: 0.35 to 3.56, p=0.847) and freedom from major adverse cardiac and cerebrovascular events (log-rank test, p=0.996; HR: 1.12, 95% CI: 0.48 to 2.62, p=0.796).

In conclusion, MVST-CABG is as safe as OPCABG and is associated with less wound infection, perioperative blood loss and time to return to full physical activity and greater improvement in physical-health-related quality of life.

MVST-CABG can be applied to the majority of multi-vessel patients, saving the effectiveness during mid-term follow-up.

The present study has several limitations. Firstly, it was retrospective. Secondly, in the MVST-CABG group total arterial revascularisation was performed in 94.0% of patients and the aortic no-touch technique was used in all patients versus the OPCABG group, which could have an influence on postoperative results. Finally, long-term follow-up is ongoing and comparative long-term results concerning survival rate, quality of life, frequency of major cardiovascular events and bypass patency are needed.

Table. Operative characteristics and early postoperative results

Characteristic	MVST-CABG (n=152)	OPCABG (n=152)	p-value
Average number of distal anastomoses	29±0.5	3.0±0.6	0.662
Operation time, min	352.4±74.4	289.3±55.0	<0.001
Intraoperative blood loss, mL	220 (180; 300)	400 (300; 550)	0.039
First twenty-four hours postoperative blood loss, mL	220 (150; 300)	370 (300; 570)	0.034
Transfusion of blood and/or derivatives	17 (11.2)	28 (18.4)	0.076
Postoperative ventilation time, hours	4.0 (3.0; 11.5)	5.5 (3.0; 15.0)	0.536
Intensive care unit stay, hours	18 (16.5; 21)	22 (16.5; 28)	0.457
New onset atrial fibrilation	18 (11.8)	27 (17.8)	0.146
Wound infection	4 (2.6)	12 (7.9)	0.040
Superficial wound infection	4 (2.6)	9 (5.9)	0.156
Deep wound infection	–	3 (2.0)	0.082
Postoperative pneumonia	10 (6.6)	8 (5.3)	0.627
Stroke	–	1 (0.7)	0.317
Myocardial infarction	1 (0.7)	2 (1.3)	0.562

TISSUE SCAFFOLD TECHNOLOGIES MAY BE THE ANSWER TO REPAIRING DAMAGED HEARTS

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Tissue scaffold technology started with the father of modern mitral valve repair, Alain Frederic Carpentier when he used a glutaraldehyde-fixed bovine pericardium to repair a heart valve in the 1960s.

However, in recent years, stem cells have come to the fore in many clinical studies as a promising treatment for repair. Many animal studies have demonstrated the ability of stem cells to affect repair of damaged tissues, including heart muscle after infarction. Results from such models have showed some efficacy, but the technology has some way to go before it is considered an established solution.

Meanwhile, tissue scaffold technologies have been improving for several decades now, providing highly biocompatible tissue products, with low toxicity, limited calcification, good durability and the ability to remodel when implanted in the body. New products such as CardioCel® have shown postoperative remodelling. Data suggests that this remodelling occurs through the action of native stem cells and vascularisation, with scaffolds being repopulated with these cells followed by remodelling over time. Animal studies have shown how next-generation tissues can offer advantages over current industry standards. For example, CardioCel® used to repair sheep mitral and pulmonary valves shows, seven months after implant, highly functional and normal valves. Total aortic valve reconstructions with Cardiocel® in a sheep model demonstrated complete surface endothelialisation, new collagen formation, and infiltration of native cells without any calcification of the scaffold after 6 months. These next generation tissue products provide a better repair path forward, at least until stem cell treatments come of age. Given the initial evidence for products like CardioCel® and autologous regeneration around these tissues, it may be that cellular therapies like stem cells will not be needed after all and better patient outcomes could be achieved with these new types of tissue scaffolds which allows normal repair and tissue regeneration.

CARDIO CEL

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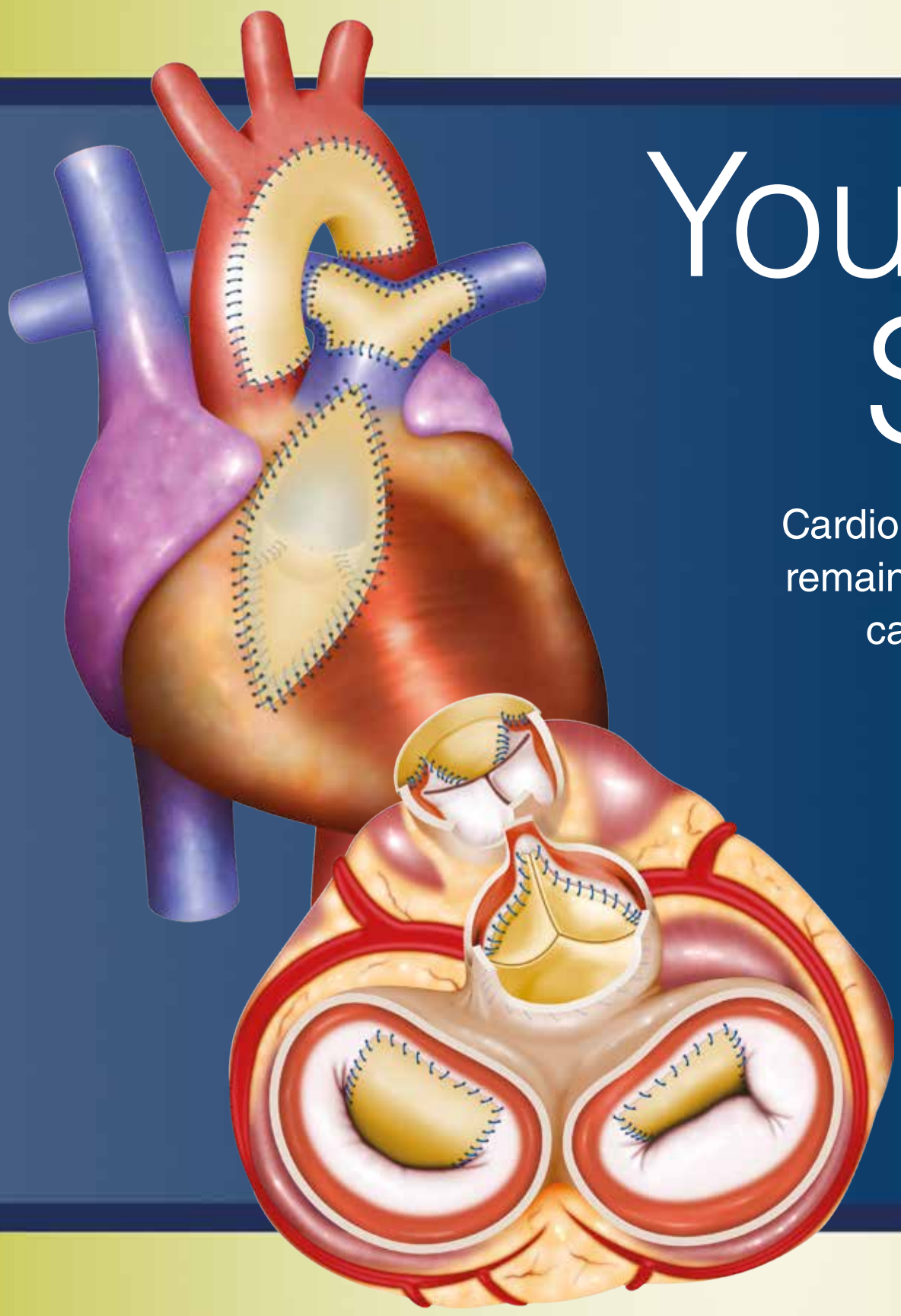

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Cardiac – Abstract: Risk models in coronary surgery

EuroSCORE II and SYNTAX score to evaluate coronary artery bypass grafting outcomes

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Risk stratification models have recently been developed to assess post-procedural mortality and morbidity in patients undergoing coronary artery revascularisation. The European System for Cardiac Operative Risk Evaluation (EuroSCORE) risk model is one of the tools used to evaluate the risk of postoperative mortality in patients undergoing cardiac surgery by integrating several clinical and procedural factors. It has been suggested that EuroSCORE often overestimates postoperative mortality; therefore, the EuroSCORE II was developed to achieve better calibration than the original risk model.

Since the use of the SYNergy between percutaneous intervention with TAXus drug-eluting stents and cardiac surgery (SYNTAX) score in the SYNTAX trial, the SYNTAX score has been used mainly for pre-procedural evaluation in patients undergoing percutaneous coronary intervention (PCI). The score is used to evaluate coronary artery complexity and is well correlated with early and long-term outcomes after PCI. However, the relationship between the SYNTAX score and outcomes after coronary artery bypass graft (CABG) is still debated.

EuroSCORE II and SYNTAX scores have been investigated separately in previous studies. The aim of our study is to evaluate the usefulness of the combination of EuroSCORE II score and SYNTAX score in predicting risks associated with in-hospital outcomes after CABG.

Between October 2011 and February 2014, 400 patients underwent isolated CABG at the National Heart Institute. EuroSCORE II and SYNTAX scores were calculated retrospectively and their ability to predict early outcomes was evaluated. Patients were divided into four groups (Table 1), according to median EuroSCORE II and SYNTAX scores: Group 1, low EuroSCORE II, low SYNTAX score (n=93); Group 2, low EuroSCORE II, high SYNTAX score (n=79); Group 3, high EuroSCORE II, low SYNTAX score (n=103); and Group 4, high EuroSCORE II, high SYNTAX score (n=125).

Results show that there was no difference in the rate of operative deaths among the four groups. However, postoperative mortality was higher in Group 4. In addition, Group 4 had the highest major complications rate of the four groups. Multivariate analyses revealed that both high EuroSCORE II (odds ratio [OR] 2.26; $p<0.001$) and high SYNTAX score (OR 1.088; $p<0.001$) were independent predictors of both in-hospital mortality and early postoperative major complication.

Table 1: Four groups stratified by EuroSCORE II and SYNTAX score

	SYNTAX <21	SYNTAX >21
EuroSCORE II <1.45	Group 1, n=93	Group 2, n=79
EuroSCORE II >1.45	Group 3, n=103	Group 4, n=125

EuroSCORE: European System for Cardiac Operative Risk Evaluation; SYNTAX: SYNergy between percutaneous intervention with TAXus drug-eluting stents and cardiac surgery.

In conclusion, our results show that combined EuroSCORE II and SYNTAX scores can predict postoperative mortality with greater accuracy than each score alone. This suggests that a combined scoring algorithm might be useful in the decision-making process by heart teams for a revascularisation strategy for each patient.

Cardiac – Rapid Response: Reducing invasiveness

Minimally invasive coronary surgery in third world countries

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The public health system in third world countries is completely different from that of developed countries, most don't include Cardiac Surgery, and therefore most patients die without any assistance. Cardiac surgeons are under huge pressure not only to produce good results but also to find a way to reduce costs, in order to increase the number of operations, sometimes creating foundations to collect funds for this purpose.

After the 1992 economic and political crisis in Venezuela, we established Fundacardio, a charity institution to help patients with limited economic resources, and, at the same time, to improve the techniques and technologies of the surgical team. We organised seven workshops with life surgeries inviting prominent surgeons to learn new techniques and many of our team members were also trained abroad with the same intention.

In order to decrease costs, we started a 'Fast Track Protocol' in 1993, extubating patients in the operating room and reducing the length of hospital stay. Afterwards we were trained in 'Off-Pump' coronary artery by-pass surgery to further reduce the surgical budget. In this way we significantly increased the number of patients, doubling the number of operations.

By 1998 we averaged 100% off-pump coronary artery by-pass surgery and improved our fast track protocol. With the same motivation we then started a 'Midcab' programme for single vessel disease extending progressively toward multivessels disease via left thoracotomy using conventional instruments, establishing this procedure as a routine by the year 2002. Associated with this, the fast track protocol evolved into an 'Ultra-Fast Track Protocol' all patients are admitted the same day of the surgery, extubated at the end of the procedure, and 80% discharged from hospital to home within 3 postoperative days. The minimally invasive coronary surgery, not only has reduced our costs, but also improved our results and patient's quality of life, encouraging cardiologists and government institutions to refer more patients to Fundacardio.

Until July 2015, the patient population that underwent complete revascularization using the ALT-CAB approach (75.7% male, median age 57.9±10.1 years) 32.2% had low ejection fraction, 56.9% previous myocardial infarct, and 84.3% multivessel disease. The mean EuroSCORE (Eu-ropean System for Cardiac Operative Risk Evaluation) was 3.8 and the Parsonnet score was 7.8. Complete revascularisation was achieved in all patients (mean number of grafts 3.3±1.0); 0.4% were converted to on pump; 4.4% experienced postoperative atrial fibrillation; the mortality rate was 1.1%.

Figure 1.

Access to new technology, equipment and special instruments for third world countries is more difficult than in developed countries. Therefore, minimally invasive coronary artery by-pass grafting when performed with conventional instruments, in a very simple way, associated with ultra-fast track protocol can help more patients resolve their condition, especially those with limited economical resources.

In conclusion, we suggest this technique is suitable for third world countries, always following some recommendations:

1. Must be implemented gradually.
2. Appropriate training for the surgical team.
3. Initiate with proctor assistance.
4. Backup from experienced centres.

However, the use of this new technique must never put under more risks the patient's life, the primary endpoint is not the price of the surgery, but the results. Our experience in more than 2000 patients has demonstrated the feasibility of this procedure associated with a lower cost program, at a low risk.

Vascular – Abstract: A broad view on acute dissection

Acute type a dissection in octogenarians: does emergency surgery impact long-term survival?

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Open surgery for acute type A dissection is still the gold standard procedure. In cases of type B dissection, the INSTEAD XL trial advocated the efficacy of thoracic endovascular aortic repair (TEVAR) for sub-acute phase; however, optimal medical treatment for uncomplicated acute type B dissection is still considered the method of choice. In the chronic phase of either type A or type B, the best surgical option remains controversial. TEVAR for chronic dissection of descending thoracic aorta has a high re-intervention rate, and hybrid repair for chronic dissections of thoraco-abdominal aorta has anatomical limitations. Open surgery for chronic dissection has less anatomical limitation and a lower re-intervention rate. The high mortality and morbidity for descending thoracic and thoracoabdominal aortic open repair have been mentioned in many previous reports. However, results are improving. We evaluated contemporary outcomes of open repair of chronic aortic dissections (ChAD).

From January 2008 to December 2014, 371 patients had elective open repair of ChAD. Mean age was 60.2 years and 79.0% were male. In total, 100 (27.0%) patients were chronic type A dissection; 64 patients had undergone hemi-arch replacement, and 23 total arch replacement emergently. Thirteen patients had received other treatment. A total of 271 (73.0%) patients were chronic type B dissection, and the majority received optimal medical treatment initially.

Descending thoracic aortic repair (DTAR) was performed in 220 cases (59.3%) and thoraco-abdominal aortic aneurysm repair (TAAAR) in 151 cases (40.7%). Of TAAAR, Crawford extent II repair were 25.6%. During the same period, no patient underwent TEVAR as primary treatment for descending aorta, and no patient underwent hybrid procedure for thoraco-abdominal aorta. We used left heart bypass in 196 cases of DTAR, and 147 cases of TAAAR, and deep hypothermia and circulatory arrest (DHCA) in 23 cases of DTAR. In TAAAR, DHCA was none. A cerebrospinal fluid drain was placed for 155 (41.8%) patients preoperatively (in 10 cases of DTAR and 145 cases of TAAAR).

Overall, major adverse outcomes (including in-hospital death, tracheostomy, paraplegia, newly dialysis at discharge) occurred in 13.2%. Operative mortality was 3.5%. In-hospital mortality was 6.5%. Spinal cord deficits (paraplegia and parapalesis) occurred in 5.1% patients.

Comparing the latter half (2012–2014) with the first half (2008–2010) of the study population by year, these rates have generally decreased in for both DTAR and TAAAR (Figure 1).

The operative mortality has improved from 2.0% in DTAR and 9.6% in TAAAR during the first half of the term (2008–2011) to 1.7% and 1.5%, respectively in the second half (2012–2014).

Mean follow-up was 16.6 months. During the follow-up period, 12-, 36-, 60-months survival was 90.4%, 88.5%, and 88.5%, respectively. Re-intervention for pseudo-aneurysm formation was necessary in 2.2%. During the follow-up period, contrast agent use is not mandatory.

Our open surgery of ChAD had acceptable early outcomes and improvements are apparent over time. Our surgery had low intervention rates. These results should be compared with those of evolving approaches including endovascular and hybrid repairs.

Cardiac – Rapid Response: Reducing invasiveness

Off-pump versus on-pump coronary artery bypass: a propensity score matched analysis using the Japan adult cardiovascular surgery database

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In Japan over 60% of isolated coronary artery bypass grafting (CABG) is performed without using cardiopulmonary bypass, however the validity of this approach is unproven. We evaluated the early surgical outcomes using off-pump (OPCAB) and on-pump CABG (CABG) methods by propensity score matching utilising the Japan Adult Cardiovascular Surgical Database (JACVSD).

Between 2008 and 2010, a total of 24,287 patients who underwent isolated coronary artery bypass were reported in JACVSD. Emergency and redo sternotomy cases were excluded. A total 10,227 cases were selected including 3191 (31.2%) CABG and 7036 (68.8%) OPCAB cases for this study. Propensity score matching was performed using 18 parameters for preoperative risk adjustment. Consequently, 2955 cases in each group were selected.

After propensity score matching the patient background data were as shown in Table 1 with no significant differences between the two groups. The operation time was significantly shorter in the OPCAB group (CABG: 317±92 min, OPCAB: 300±84 min, $p<0.001$), but the number of bypassed arteries was similar in the two groups (CABG: 3.4±1.0, OPCAB: 3.4±1.1, non-significant). Thirty-day and hospital mortality were lower in the OPCAB group, although there were no significant statistical differences. In the OPCAB group the rate of composite, re-exploration, dialysis, prolonged ICU stay, prolonged ventilation, and gastrointestinal bleeding were all significantly lower after matching (Table 2).

In conclusion, the use of off-pump CABG produced better early surgical outcomes compared with the use of on-pump CABG based on data from the JACVSD.

Table 1. Characteristics of matched groups

	CABG (n=2955)		OPCAB (n=2955)		*p* value
Age (years)	67.5		67.8		0.142
	n	%	n	%	
Male	2273	76.9	2282	77.2	0.781
Diabetes	1282	43.4	1278	43.2	0.916
Renal dysfunction	310	10.5	334	11.3	0.361
History of cerebrovascular disease	414	14.0	413	14.0	0.97
History of myocardial infarction	1149	38.9	1115	37.7	0.363
Triple vessel disease	2232	75.5	2217	75.0	0.651
Unstable angina	812	27.5	769	26.0	0.206

Table 2. Surgical outcomes before and after matching

	Before matching					After matching				
	CABG (n=3191)		OPCAB (n=7036)			CABG (n=2955)		OPCAB (n=2955)		
	n	%	n	%	*p* value	n	%	n	%	*p* value
30-day mortality	27	0.8	28	0.4	0.003	26	0.9	14	0.5	0.051
Hospital mortality	43	1.3	58	0.8	0.009	40	1.4	25	0.8	0.053
Composite	353	11.1	453	6.4	<0.001	324	11.0	211	7.1	<0.001
Reexploration	53	1.7	70	1.0	0.004	47	1.6	23	0.8	0.004
Stroke	52	1.6	76	1.1	0.021	50	1.7	34	1.2	0.079
Dialysis	63	2.0	69	1.0	<0.001	60	2.0	33	1.1	0.005
Infection	53	1.7	75	1.1	0.012	49	1.7	31	1.0	0.043
Prolonged ventilation	232	7.3	232	3.3	<0.001	211	7.1	128	4.3	<0.001
Perioperative MI	17	0.5	34	0.5	0.742	16	0.5	16	0.5	1
TIA	50	1.6	64	0.9	0.003	47	1.6	39	1.3	0.385
Renal failure	145	4.5	222	3.2	<0.001	134	4.5	144	4.9	0.539
GI bleeding	54	1.7	59	0.8	<0.001	52	1.8	27	0.9	0.005
ICU stay ≥8 days	186	5.8	211	3.0	<0.001	174	5.9	96	3.2	<0.001

Cardiac – Rapid Response: Reducing invasiveness

Ten-year follow-up after minimally invasive left anterior descending revascularisation

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Well-established therapeutic options for proximal stenosis of the left anterior descending coronary artery (LAD) are conventional sternotomic bypass grafting on-pump or off-pump (OPCAB), minimally invasive direct coronary artery bypass (MIDCAB), and percutaneous coronary intervention (PCI) either with bare-metal stents (BMS) or drug eluting stents (DES).

The most recent guidelines[1–2] indicate a level of evidence I for both surgical revascularisation and PCI in the case of proximal LAD lesions, even if PCI is the preferred choice of patients and cardiologists, mainly because of its lower invasiveness.

MIDCAB, proposed by Kolessov in 1967[3] and reintroduced in clinical practice in 1995 by Benetti and Ballester[4], has gained wide acceptance, but it is still seldom considered the method of choice for LAD surgical revascularisation in isolated lesions or as a part of a hybrid strategy. Nevertheless, MIDCAB eliminates the need for sternal incision, aortic manipulation and cardiopulmonary bypass (CPB) while achieving the same results in terms of patency of conventional surgery,[5] and thus it should be considered the perfect operation for LAD revascularisation.

To further evaluate the advantages and disadvantages of this technique, we present the results of 660 MIDCAB procedures performed in 1997–2005 with 10 years of follow-up. Mean age of patients was 76±14.6 years, SYNTAX score was 27.5±3.5 and Euroscore I was 7.8±5.4%.

Patients were classified into different clinical/therapeutic groups:

- MIDCAB group (404): true single vessel disease (LAD) or functional single vessel disease;
- MIDCAB+OMT group (136): multivessel disease with functional incomplete revascularisation and optimal medical treatment;
- HCR (120): multivessel disease with functional complete revascularisation (hybrid coronary revascularisation treatment).

Candidates were patients with isolated LAD disease (MIDCAB group) in whom a PCI was not advisable (type B and C lesions) or not possible (occluded LAD); patients with LAD disease and multivessel disease with lesions that should not be treated anyway for small diameter, diffuse disease, irreversible ischaemic damage or distal hypoplasia, or patients with multivessel disease in whom CPB had a presumed high morbidity (cancer, severe renal failure, diffuse cerebrovascular disease) and MIDCAB was performed as a palliative procedure (MIDCAB and optimal medical therapy (OMT)); and patients with LAD disease and a second vessel disease that could be treated by PCI before or after surgical treatment and evaluation of residual ischaemia (Hybrid group, HCR).

The total surgical procedure time was 91±12 min.

No conversion to CBP was necessary due to haemodynamic reasons. No ventricular fibrillation occurred. The perioperative (30 days) mortality rate was 0.7%.

A 10-year follow-up was completed for 97.6% of patients. Actuarial overall survival at the 5-year follow-up was 82.6% (95% CI: 79.1%–86.1%) and at 10 years was 70.6% (95% CI: 67.5%–73.7%). Kaplan–Meier analysis for cardiac-related mortality at 5-years was 88.4% (95% CI: 84.7%–92.1%) and at 10-years was 75.5% (95% CI: 69.9%–81.1%); freedom from MACCE at 5-years was 84.2% (95% CI: 79.1%–89.7%) and at 10-years was 71.7% (95% CI: 68.1%–75.3%).

Moreover a comparison between the two propensity-matched groups of multivessel disease patients (HCR versus MIDCAB+OMT) surprisingly showed no significant differences in both survival and MACCE, with an obviously higher target vessel revascularisation rate in the HCR group.

MIDCAB is a safe revascularisation option with excellent short- and long-term results. MIDCAB should be considered as a valuable strategy both for LAD complex lesions alone and also in MVD patients, having lower invasiveness than conventional surgery. Moreover in the HCR group, patients with LAD complex coronary lesions should take advantage of LIMA-LAD revascularisation, ensuring a long-term duration in terms of graft patency, reducing the SYNTAX score when due to LAD lesions, and lowering target vessel revascularisation rate and cardiac adverse events when compared with PCI.

As a surgeon involved in minimally invasive techniques, I think we must make MIDCAB more accessible to all cardiac surgery centres as a major determinant for wider diffusion of the hybrid revascularisation strategy.

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Cardiac – Rapid Response: Reducing invasiveness

A novel technique of harvesting bilateral internal thoracic arteries under direct vision via left small thoracotomy in MICS CABG

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In this article we introduce novel techniques of bilateral internal thoracic artery (BITA) harvesting under direct vision in minimally invasive coronary artery bypass grafting (MICS CABG).
Preoperatively, we routinely examine the length and diameter of the BITA with enhanced computed tomography (CT). Patients are positioned in an approximately 30-degree right lateral decubitus position. An 8–10 cm left thoracotomy is made on the fifth intercostal space (ICS) below the left nipple. A Thoratrak Retractor (Medtronic Inc., MN, USA) is used to retract the ribs and is pulled in a cephalad and rightward direction with an additional Kent Retractor. The mediastinal space is dissected beneath the sternum with an electrocautery until the right lung is visible. The right internal thoracic artery (RITA) is identified above the right lung, which is depressed using an Octopus NUVO Stabilizer (Medtronic Inc.) that is inserted via a 1 cm subxiphoid incision. We avoid entering the right pleura to prevent the protrusion of the right lung that interferes with RITA harvesting. A 5 mm surgical port is inserted into the fifth ICS 5 cm away from the incision. A 32 cm hock-type harmonic scalpel (Ethicon Endo-Surgery Inc., NJ, USA) is inserted through the surgical port to harvest the RITA (Figure 1). The surgical port assists the precise use of the long harmonic scalpel by providing an axis of movement. The RITA is carefully skeletonised under direct vision with the Harmonic scalpel to remove fat tissues and the internal thoracic vein. In cases where bleeding from the internal thoracic artery (ITA) is observed, we stitch the point of bleeding with 7–0 monofilament suture and tie using a knot pusher. After harvesting the distal and mid-portion of the RITA, we reposition the Octopus NUVO Stabilizer next to the superior vena cava to harvest the proximity of the first intercostal branch of the RITA. After harvesting the RITA, mediastinal fat tissue and pericardium are removed with electrocautery to minimise the distance to the left anterior descending artery (LAD). The left internal thoracic artery (LITA) is harvested in a similar fashion (Figure 2). Distal anastomoses are completed as done in an off-pump coronary artery bypass graft (CABG) through the thoracotomy. Our preferred method is to use RITA as an *in-situ* graft to the LAD.
A total of 11 cases of MICS CABG using BITA were completed between February 2014 and November 2014. All ITAs were harvested without any difficulties. In five cases, the in-situ RITA was grafted to the LAD, and one in-situ RITA was grafted to the first diagonal branch. In three cases, a Y-composited graft was constructed using the BITA. The mean number of distal anastomoses was 2.5±0.8. The mean operative time was 343.2±62.1 minutes. There was no mortality or conversion to sternotomy. The patency of all ITA grafts was confirmed with a coronary CT scan 1 week after operation.
Our outcomes demonstrated the safety and reproducibility of this technique. All steps of the operation are carried out under direct vision, ensuring additional safety. Important and novel steps in the procedure are perceived to be the following: firstly, the use of the Octopus NUVO Stabilizer (Medtronic Inc.) to depress the right lung, which provides a wide operative view under the sternum; and secondly, the use of a surgical port for the long harmonic scalpel (Ethicon Endo-Surgery Inc.), which provides sufficient length to dissect the proximal RITA under an excellent surgical view through a small incision. By using the port, the surgeon's right arm holding the harmonic scalpel does not obscure the view through the small thoracotomy.
In conclusion, BITAs can be safely harvested under direct vision via a small left thoracotomy. MICS CABG using BITA may offer excellent long-term results, while providing the advantages of minimally invasive coronary surgery. We believe the procedure has a potential to become an alternative standard for routine CABG.

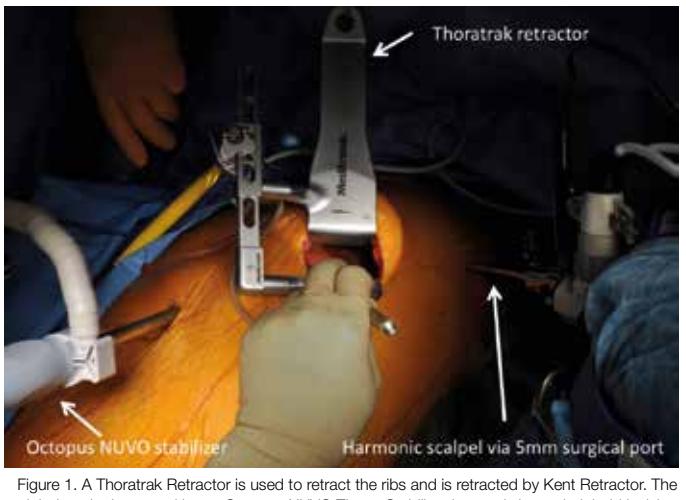

Figure 1. A Thoratrak Retractor is used to retract the ribs and is retracted by Kent Retractor. The right lung is depressed by an Octopus NUVO Tissue Stabilizer inserted via a subxiphoid incision (Bow 1). A harmonic scalpel is used through the port to harvest the RITA (Bow 2).

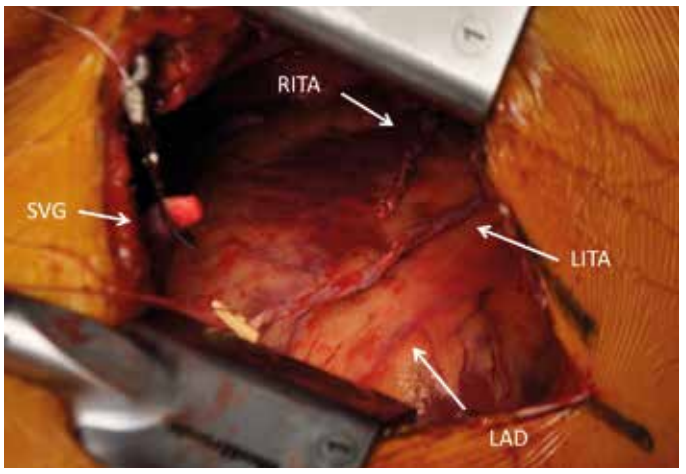

Figure 2. The view after harvesting skeletonised BITA via small thoracotomy
RITA: right thoracic artery; LITA: left thoracic artery; SVG: saphenous vein graft; LAD: left anterior descending artery.

Thoracic – Abstract: Mediastinum

Evaluation of the perfusion of the gastric sleeve after oesophagectomy by laser-induced fluorescence tissue angiography

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Progress in the perioperative treatment, intensive care and complications management have reduced the operative risk in patients undergoing an oesophagectomy. However, this operation is still associated with severe postoperative morbidity.
Anastomotic leakage occurs in 8%–30% of the patients after oesophagectomy and is associated with increased morbidity and mortality. A poor perfusion of the conduit (gastric tube or colon interposition) is one of the main reasons leading to an anastomotic leakage. Approaches such as ischaemic preconditioning of the stomach by ligation of the left gastric artery prior to oesophageal resection and reconstruction, have been attempted previously. Until recently, surgical experience was the only tool to assess the sufficiency of the blood perfusion of the conduit and the anastomotic region. Indocyanin-green (ICG) tissue fluorescence angiography methods have been developed and assessed during the past decade.
In our series of 76 patients, 20 patients were assessed by a lately developed laser-induced fluorescence angiography system, PinPoint® (Novadaq™, Canada). This technological innovation allows the surgeon to assess the tissue while preparation and operation either thoraco-/laparoscopically or in open surgery. After creation of the gastric sleeve ICG was administered intravenously and florescence angiography became visible several seconds after the injection. The gastric conduit was shortened to the point a diminished perfusion was detected by the system (Figure 1). For better interpretation of the results, we formed a control group using the internal prospectively-conducted oesophageal database. A total of 56 patients, who underwent surgery in our department between 2010 and 2014 using a thoracoscopic or an abdomino-thoracic approach, were identified. To investigate the patient-specific factors influencing the rates of anastomotic leakage, we performed a pair-matched analysis according to age, gender, surgical approach, ASA, physical status, and history of neoadjuvant treatment.
Within the fluorescence group, 15 patients received an abdomino-thoracic oesophagectomy with gastric tube reconstruction with an intrathoracic stapler anastomosis; the remaining five patients underwent a thoracoscopic oesophagectomy with gastric tube reconstruction and hand-sewn cervical anastomosis. In nine cases we performed a further resection of the gastric tube according to the findings of the PINPOINT system. The anastomosis was always performed in an area of good perfusion indicated by fluorescence.
One patient developed an anastomotic leakage postoperatively (5%). This patient had experienced cardiopulmonary instability during the operation and received high levels of catecholamine support during the early postoperative period.
For the better interpretation of the results we compared our findings with the oesophageal database of the past 4 years: 40 patients had undergone an abdomino-thoracic oesophagectomy with an intrathoracic stapler anastomosis and the remaining 16 patients a thoracoscopic approach with a cervical anastomosis. Mean age and other personal characteristics did not differ significantly. Nine cases of anastomotic leakage were identified (16.07%).
ICG tissue angiography represents a feasible and reliable technical support for the evaluation of the perfusion of the gastric tube after oesophagectomy. The system is however lacking as a tool for proper quantification of blood flow, because fluorescence is dependent on multiple factors. A prospective multicentre trial is needed to assess the interpretation of the grey zones of perfusion using the ICG tissue angiography. In our department, however, the technique has already led to a relevant decrease in anastomotic leakage rates.

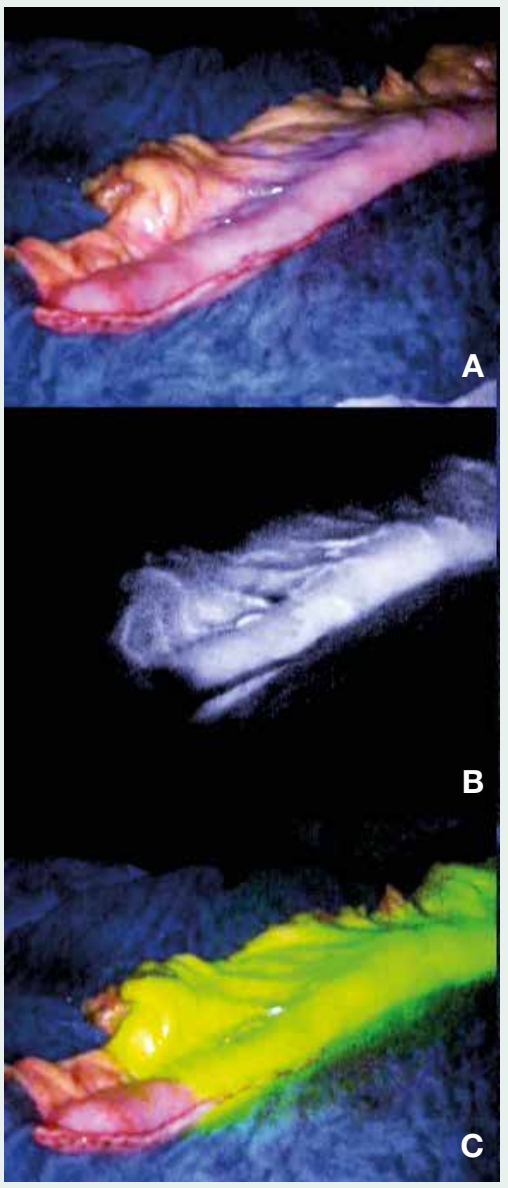

Figure 1. All pictures A–C are displayed simultaneously in fluorescence mode. Picture A shows a white light image of a gastric tube. For the surgeon a malperfusion of the tip was not seen by sight. However, in pictures B (black and white mode of fluorescence) and C (PinPoint mode), a clearly defined sharp line of diminished perfusion was seen and the gastric sleeve was shortened accordingly.

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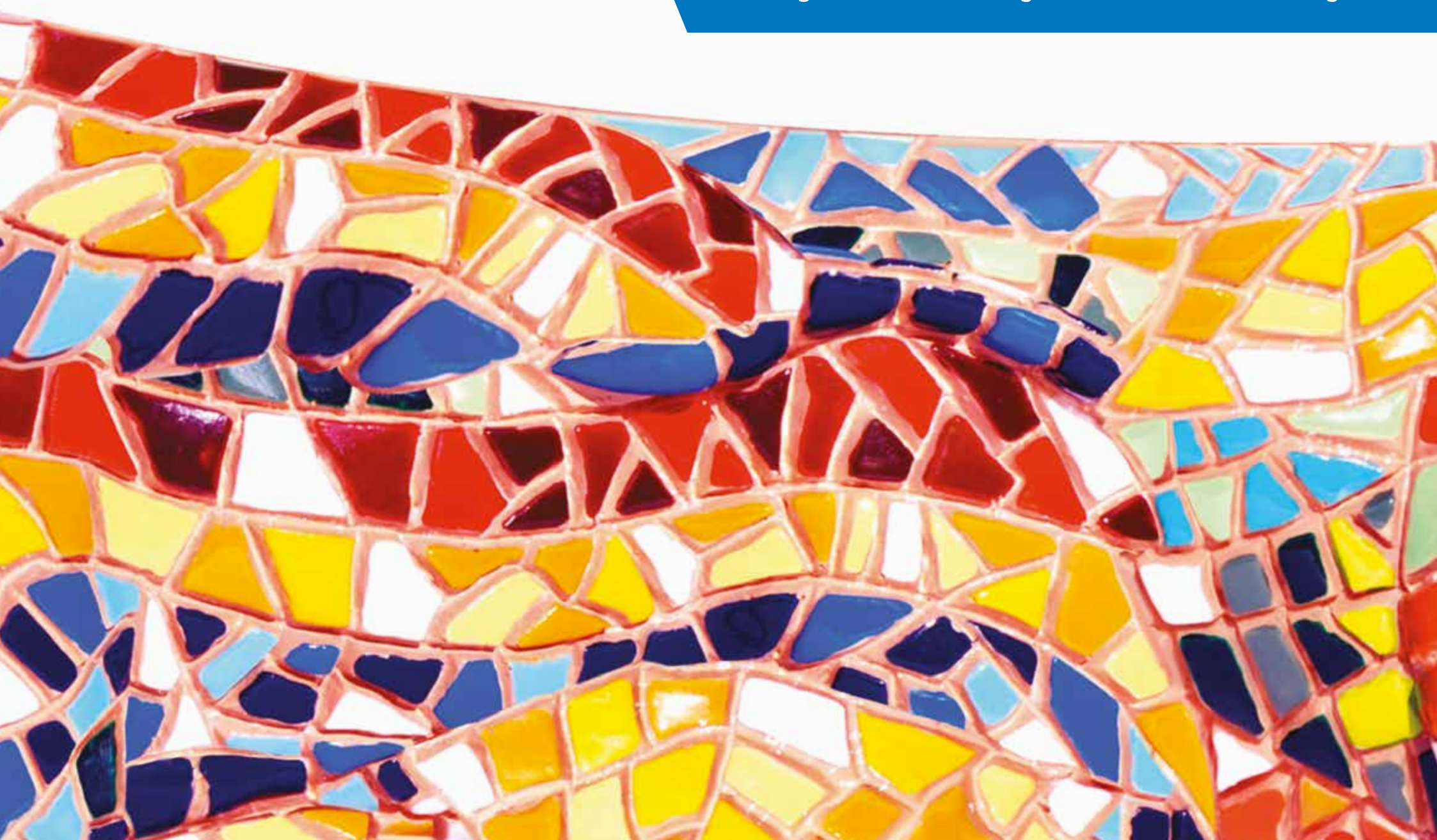

Cardiac – Abstract: Aortic valve replacement: what is new?

Root repair procedure guided by electrocardiogram-triggered preoperative CT scan interleaflet triangles analysis

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Today, aortic valve repair is commonly recognised as a good option for the treatment of aortic valve repair insufficiency. Aortic regurgitation can be determined by different mechanisms; among these, one of the most frequent is the dilation involving aortic root functional unit. Subcommissural triangles are key elements of this unit and play a fundamental role in the absorption of the diastolic load.

In our surgical experience we can identify three classes of triangles: the acute-angle that can be considered normal, the equilater ones that are moderately dilated, and the obtuse ones that are severely dilated. Our reparative approach differs according to the degree of dilation: in the first case we would perform an interleaflet triangles reshaping procedure to increase the coaptation, or a remodelling procedure in the case of aortic root dilation; in the second case, a stabilisation of the ventriculo-aortic junction is mandatory and this can be achieved with an external ring, a circular annuloplasty or a re-implantation procedure. Finally, in the latter case, stabilisation alone would not be enough to achieve a successful repair, since the anatomy of the triangles has been lost, preventing them from performing their function of stress absorption. In cases like this where the triangles are severe dilated, we would perform a re-implantation technique with a different positioning of the proximal suture line in order to simultaneously reshape the ventriculo-aortic junction. Interleaflet triangles cannot be well visualised on echocardiogram; however, the electrocardiogram-triggered CT scan, thanks to the possibility of performing post-processing multiplanar reconstructions, allows a complete evaluation of all the root elements. For this reason, we chose to focus our attention on the subcommissural triangles apical angles with the aim to better plan the surgical reparative strategy. To validate this method of measurement, data obtained from CT scan reconstructions were compared with those collected in a previous post-mortem study, coupling each triangle. No statistically significant difference was highlighted by this comparison, thus demonstrating that electrocardiogram-triggered preoperative CT scan is a useful tool for the measurement of the interleaflet triangles.

This approach enables the surgical team to fully analyse the aortic root preoperatively, with the final goal of better tailoring the surgical reparative procedure to each individual patient's anatomical characteristics.

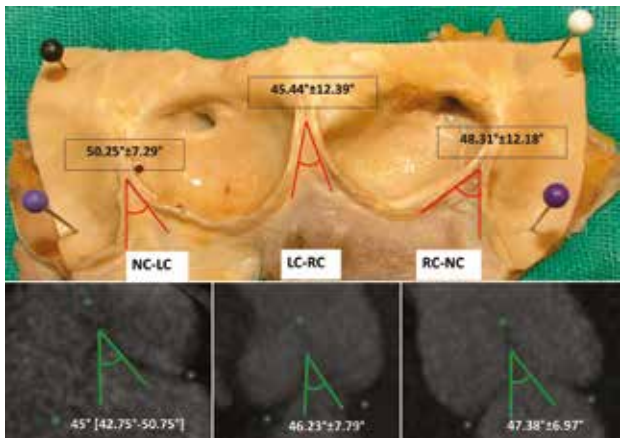

Figure 1. Above an aortic root post-mortem specimen completely spread apart; below CT scan reconstructions of interleaflet triangles.NC-LC: non coronary-left coronary triangle; LC-RC: left coronary-right coronary triangle; RC-NC: right-non coronary triangle.

Cardiac – Rapid Response: Supporting the heart and lung

Implanting permanent left ventricular assist devices in patients on veno-arterial extracorporeal membrane oxygenation support. Do we really need a cardiopulmonary bypass machine?

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A tremendous increase in the number of veno-arterial extracorporeal membrane oxygenation (VA-ECMO) implantations has been observed worldwide. While the primary goal for every patient on VA-ECMO is to wean them off mechanical support, selected patients who fail to be weaned from VA-ECMO may be considered for long-term left ventricular assist devices (LVADs). These high-risk patients are usually converted to a cardiopulmonary bypass (CPB) machine at the time of VAD implantation surgery. Activation of the systemic inflammatory response due to CPB and associated deleterious effects on the coagulation system have been well documented in the literature. Since June 2012 we have routinely avoided using a CPB machine for patients on VA-ECMO who require long-term VAD support at our institution, unless a simultaneous aortic valve procedure is necessary. The aim of this study was to compare the outcome of patients receiving VAD after VA-ECMO with or without CPB.

Data from patients undergoing VAD support after VA-ECMO implantation between January 2010 and April 2015 were retrospectively reviewed. Perioperative characteristics of and postoperative outcome for patients who received VAD after VA-ECMO with or without CPB were compared. A total of 37 patients received permanent VAD after VA-ECMO. CPB was used in 23 patients with a mean age of 51±12 years. A total of 14 patients with a mean age of 52±11 years received VAD on VA-ECMO without using CPB. A HeartWare HVAD was used as a long-term mechanical support in all patients except for three patients in the CPB group. None of the patients required simultaneous valve procedures. The average ECMO support duration prior to LVAD implantation was 5±4 days and 7±7 days in patients with or without CPB respectively (p=0.356). A median sternotomy approach was used in all patients.

No technical issues were encountered at the time of VAD implantation surgery. One patient was converted to a CPB machine on an emergency basis after rupture of the left ventricle at the time of LVAD surgery. This patient was operated on a few days after a massive myocardial infarction. On the day of surgery, a significantly lower number of blood products were necessary in patients who underwent LVAD implantation without using CPB compared with patients who underwent implantation with CPB. Blood product utilisation in both groups was as follows: PRBC 15±15 Units (CPB) versus 8±4 Units (no CPB) (p=0.02); FFP 8±13 Units (CPB) versus 1±2 Units (no CPB) (p=0.04) and platelets 6±4 Units (CPB) versus 4±4 Units (no CPB) (p=0.08). A postoperative temporary RVAD was necessary in 61% versus 49% of the patients with or without CPB respectively (p=0.286). Resternotomy for bleeding was necessary in 35% versus 14% of patients with or without CPB respectively (p=0.260).

However, no significant difference in postoperative survival between these two groups was observed (p=0.629) (Figure 1). In summary, this study showed the feasibility of implanting a long-term VAD on VA-ECMO support without using CPB. A significantly lower number of blood products were necessary in these patients compared with in patients in whom a CPB machine was used. A trend towards lower rates of postoperative bleeding and right ventricular failure was seen. However, no significant difference in the survival rate between these two groups was observed.

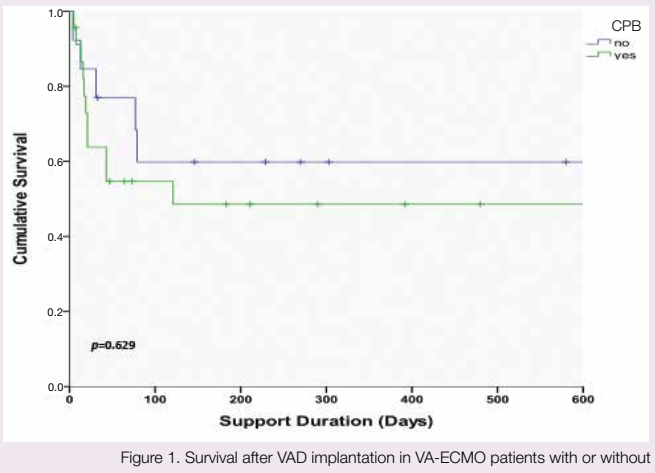

Figure 1. Survival after VAD implantation in VA-ECMO patients with or without using a CPB machine.

Cardiac – Rapid Response: Supporting the heart and lung

Primary biventricular assist device implantation (BVAD): rebirth of a lost procedure?

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INTERMACS registry data indicate reduced 1- and 2-year-survival of BVAD compared with left ventricular assist device (LVAD) patients (55 versus 80%, 53 versus 69%).[1] Nowadays the BVAD strategy is mostly used only when the right ventricle (RV) fails to adapt after LVAD implantation. However, INTERMACS registry data demonstrate RV failure after LVAD implantation to be a risk factor for early mortality.[2] The aim of our study was to evaluate whether primary BVAD implantation can reduce RV-failure, duration and intensity of inotropic and vasopressor support, mechanical ventilator time, ICU- and hospital stay, and improve secondary organ function in selected patients.

We retrospectively analysed short-term outcome parameters in terminal heart failure patients (n=44, 6 female) undergoing primary continuous flow (CF) BVAD implantation (n=9) and compared these to CF LVAD procedures (n=35). Surgically we used median sternotomy in all BVAD procedures and LVAD implantation was performed using median sternotomy and partial sternotomy, anterolateral thoracotomy (83 versus 17%). In 17% of LVAD and 56% of BVAD patients an extracorporeal life support (ECLS) was present prior to procedure. The implantations took place between November 2011 and March 2015. The mean follow-up was 338 days (range 1–1256 days). Preoperative patient data, clinical status and risk scores were comparable between the groups. BVAD patients exhibited deteriorated RV function, as indicated by reduced RV ejection fraction (30±4% versus 46±2%), elevated central venous pressure (CVP) (15±2 versus 7±3 mmHg, p=0.001), and elevated glutamic oxaloacetic transaminase levels (370±887 versus 53±49 IU/l, p=0.035). Bypass time in BVAD patients lasted longer (134±25 versus 98±38 min, p=0.015), operative procedure lasted equally in BVAD and LVAD procedures (293±78 versus 275±93 min). Postoperative mechanical ventilator time was shorter in BVAD than in LVAD patients (5.8 versus 14.9 days). Postoperative inotropic and vasopressor support with epinephrine, milrinone and vasopressin were significantly shorter in BVAD patients (1±1 versus 12±13 days, 1±1 versus 12±9 days, and 1±1 versus 9±8 days). Maximum epinephrine doses were significantly lower in BVAD patients (0.6±0.29 versus 1.12±0.51 mg/h, p=0.016). Postoperative renal failure was significantly less frequent (BVAD 33% versus LVAD 53%) and severe (BVAD 4±5 versus LVAD 22±14 days, p=0.015) in BVAD patients. ICU and total hospital stays were comparable between the groups (21±25 versus 25±26 days, 31±23 versus 32±24 days). The 60-day survival was also comparable between BVAD and LVAD patients (67% versus 76%).

In conclusion, primary CF-BVAD implantation appears to be a valuable treatment option for end-stage heart failure patients with failing RV, resulting in superior haemodynamic patient status early after surgery when compared to LVAD patients. Our data indicate less secondary organ failure after primary CF-BVAD procedures, presumably due to assisted RV function. The short-term outcome after primary CF-BVAD implantation is comparable to CF-LVAD procedures.

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Congenital – Rapid Response

Cylinder reconstruction of tricuspid valve in children


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The research team at the Ukrainian Children's Cardiac Centre, lead by Professor Illya Yemets is focusing its efforts on developing and implementing new surgical methods and strategies in neonatal cardiac surgery. The main goal is to make surgery as physiological as possible for the newborn. Examples are: successfully established programmes of arterial switch operation in the first hours of patients' life and use of autologous umbilical cord blood for perioperative transfusion instead of homologous blood components. We strongly believe that such strategies will improve not only surgical results, but also the ongoing quality of life for patients.

It is well known that replacement of atrioventricular (AV) valves has very limited use in young children and is almost impossible in neonates, because of small annulus sizes, subsequent growth of the heart and reoperation burden. That often leaves patients and surgeons with valve repair as the only option, even in cases where it is impossible to construct a competent valve.

We sought to overcome those limitations in a small series of patients with severe tricuspid dysfunction, where quality repair was not feasible. All cases were emergent because of critical haemodynamic condition. Our main goal was to find the most physiological solution to provide a patient with durable valve repair or replacement with potential to grow independently of native annulus size.

Based on the experience of Dr Cox and colleagues in adults with infective endocarditis, we used sewn out cylinder valve of decellularised equine pericardium. Between October 2014 and July 2015, five children with complex coronary heart disease (CHD) accompanied by severe tricuspid regurgitation, unsuitable for conventional repair, underwent tricuspid valve replacement during complex surgery. *Patient 1*: 4 hours old, 3.2 kg in weight with PA I type, IVS, PDA, Ebstein-like TV dysplasia. *Patient 2*: 9 months old, 5.8 kg in weight with Ebstein's anomaly type C, VSD, SP. *Patient 3*: 7 years old, 13 kg in weight with VSD and endocarditis. *Patients 4 and 5*: 9- and 15-year-old boys with severe tricuspid insufficiency after previously undergoing Ebstein's anomaly repair. In all patients the tricuspid valves were replaced with a cylindrical construct sewn out of decellularised equine pericardium (Matrix Patch™, Auto Tissue Berlin GmbH, Germany). Cylinders were sized accordingly to normal annulus diameter. The base of the cylinders was attached to the tricuspid annulus by running suture and the apex attached to the papillary muscles by two diametral single sutures.

All patients underwent successful complete repair of CHD. Patient 1 had delayed sternal closure on day 6 after surgery. There were no to mild regurgitation and no evidence of tricuspid stenosis by echocardiography immediately and 3 months after repair. MRI assessment of right ventricular function 3 months post-repair showed good performance of the cylindrical valve and improvement in right ventricular function. Cylinder reconstruction may be suitable for replacing the tricuspid valve in children, even neonates, when conventional repair techniques are inapplicable and may give these babies a chance to survive.

Cardiac – Abstract: Challenges in surgical aortic valve replacement

Aortic prosthesis – patient mismatch halters regression of secondary mitral regurgitation after isolated aortic valve replacement: 6-year follow-up analysis

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Mitral regurgitation is present in about two-thirds of patients with aortic stenoses, but secondary mitral regurgitation (SMR) is generally reduced after isolated aortic valve replacement (AVR). Notwithstanding the latter, there is important inter-individual variability in the magnitude of the reduction, and phenomena as prosthesis – patient mismatch (PPM) may hinder normalisation of left ventricular geometry and pressure overload following AVR. We investigated the relationship between PPM and regression of SMR following AVR for aortic valve stenosis, previously reported a short-term analysis, whilst now present data from of a 7-year propensity-matched follow-up study.

A total of 578 patients with aortic stenosis who underwent isolated AVR at two institutions and presenting moderate SMR (mitral regurgitant volume (MRV) 30–45 mL/beat) not considered for surgical correction were included in this study. Aortic PPM was defined as an indexed effective orifice area (EOAi) ≤0.85cm^2/m^2. A total of 219/578 patients (37.9%) showed PPM, and there were no significant differences in baseline and operative characteristics between patients with or without PPM. Patients with PPM had less regression of SMR following AVR compared with those with no PPM (change in MRV: -12±5 versus -19±4 mL/beat, respectively; p<0.0001). Variables significantly associated with postoperative change in MRV on univariable analysis were entered in a multivariable linear regression model, which showed EOAi (p<0.0001) and LA diameter (p=0.006) to be independently associated with MRV improvement. Patients with PPM also had less postoperative improvement in 6 minute walking test distance (+43±39 versus +82±74 m, p<0.0001).

In conclusion, PPM is associated with lesser regression of SMR following AVR, and this unfavorable effect was associated with worse functional capacity. The mechanism probably responsible for the lack of SMR improvement after isolated AVR may be the following. The fall in LV cavity pressure achieved by AVR usually translates into an immediate decrease in the trans-mitral systolic pressure gradient and thereby into a reduction of SMR. Of note, this is also corroborated by the drop in pulmonary artery systolic pressures found among patients without PPM. Moreover, the regression of LV hypertrophy and positive remodelling of LV cavity and mitral annulus that occurs after AVR further contribute to the reduction of SMR.

However, owing to various preoperative and operative factors including PPM, the reduction of trans-aortic gradient and thus of LV pressure overload as well as the regression of LV hypertrophy and dilatation varies extensively from one patient to the other and is often incomplete, thereby explaining the persistence of SMR in a substantial proportion of the patients.

These findings emphasise the importance of operative strategies aiming to prevent PPM in patients with aortic stenosis and concomitant SMR.

Cardiac – Abstract: Basic Science 1

The extracellular isoform of superoxide dismutase has a significant impact on cardiovascular ischaemia and reperfusion injury during cardiopulmonary bypass and hypoxia

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Cardiac surgery employing extracorporeal circulation using cardiopulmonary bypass (CPB) is a powerful therapeutic option in the treatment of most forms of cardiovascular disease. Unfortunately, extracorporeal circulation using a heart–lung machine may cause ischaemia and reperfusion injury. Therefore, extracorporeal circulation carries a 2%–10% risk of systemic inflammatory response syndrome, which may induce lethal multiple organ dysfunction syndrome.[1] Accumulation of toxic superoxide (O_2-) and its metabolite peroxynitrite (ONOO-) during ischaemia and reperfusion is suggested as one of the main mediators of detrimental effects of cardiopulmonary bypass.[2] Superoxide dismutases, where extracellular superoxide dismutase (SOD3) is the prevailing isoform in the cardiovascular system, detoxify superoxide and protect the physiological diffusion of vasodilatative nitric oxide (NO) in vascular smooth muscle cells.[3]

By applying a delicate small animal model of extracorporeal circulation to a novel transgenic rat strain we demonstrated the multiple role of systemic SOD3 activity on the nature and extent of ischaemia/reperfusion injury during major surgery using CPB and circulatory arrest. Rats with decreased SOD3 function resulting from an amino acid shift in the active site of the enzyme (SOD3-E124D) and SOD3 competent controls (Dahl/SS) were acquired and bred in-house under license agreements from Transposagen Biopharmaceuticals Inc. (Lexington, KY, USA). Animals were subjected to CPB including 45 minutes of deep hypothermic circulatory arrest followed by 60 minutes reperfusion in order to induce systemic ischaemia/reperfusion injury.[4] During the operative procedure, vital signs were monitored and blood gas analyses performed. After euthanasia, the heart and aorta were harvested and their protein levels analysed by western blots. In addition, *in vitro* studies on isolated cardiac myocytes were performed to further investigate mechanistic pathways involved in direct myocardial effects of SOD3.

At euthanasia, mean heart rate and arterial blood pressure were decreased in rats with decreased SOD3 activity. Moreover, increased serum potassium and lactate levels were observed when compared with SOD3 competent controls. On the gene expression level, SOD3 expression was increased. However, a reduced SOD3 function was evident using activity assays, and decreased activation of cardioprotective anti-apoptotic and pro-proliferative p44/42 MAPK and STAT3 signalling in cultured cardiac myocytes, as well as in heart and aortic tissue, were observed after CPB. Further, cardiac myocytes with impaired SOD3 activity also showed decreased expression of the other superoxide dismutase isoforms and increased levels of the nitrosative stress marker 3-nitrotyrosine as compared to SOD3 competent controls.

Our results suggest an impaired handling of oxidative stress and a misregulation of superoxide dismutases as a consequence of decreased SOD3 function. SOD3 impacts protective signalling pathways and directly affects the myocardium. Reduced SOD3 activity strengthens tissue injury after extracorporeal circulation, thereby increasing the risk of systemic inflammatory response syndrome with lethal multiple organ dysfunction syndrome. SOD3 has a significant protective effect against systemic ischaemia and reperfusion injury. Novel interventional strategies targeting SOD3 and dependent pathways may provide therapeutic options against major cardiac events.

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Cardiac – Rapid Response: Reducing invasiveness

Early results of minimally invasive coronary artery bypass grafting using *in situ* bilateral internal thoracic arteries and extension technique with the radial artery

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The development of new minimally invasive methods in coronary surgery is a response to the aspiration to optimise the outcomes of surgical treatment of patients with coronary heart disease, especially those with an increased risk of complications associated with extracorporeal circulation, sternotomy and aortic manipulations. Another gap in practice is the probability of hypoperfusion and competitive blood flow at composite no-touch aorta multi-vessel grafting.

The aim of the present study was to develop a method for beating heart full arterial revascularisation via the left small thoracotomy using the aortic no-touch technique and two sources of the myocardium blood supply. Multi-vessel small thoracotomy coronary artery bypass grafting (MVST-CABG) using *in situ* left internal thoracic artery (LITA) and composite *in situ* right internal thoracic artery to radial artery (RITA-RA) has never been done or described before. We evaluated early results of this minimally invasive technique within the scope of the prospective randomised controlled trial MICSREVS (http://www.clinicaltrials.gov/show/NCT02047266).

Between January and October 2014, a total of 23 patients underwent composite MVST-CABG using *in situ* bilateral internal thoracic arteries and radial artery (BITA-RA). The indications were as follows: 1) multivessel disease with the presence of both critical (≥90%) and severe (>70%) stenoses, when composite or sequential single ITA Y grafting could cause competitive or retrograde flow, especially if the most distal target had ≤90% stenosis; and 2) bypass of more than three coronary arteries was required.

Each patient was intubated with a double-lumen endotracheal tube that is right-lung ventilation. The lateral fifth or sixth intercostal small thoracotomy approach was performed with the use of the minimally invasive retractor system. The LITA and RITA were harvested in a semi-skeletonised fashion as *in situ* grafts under direct vision without robotic or thoracoscopic assistance. The RA was harvested by the assistant. Then LITA was used to graft the left anterior descending artery (LAD) territory; end-to-end anastomosis between RITA and RA was performed using a graft extension technique. The composite RITA-RA extension terminated in a single distal anastomosis to the right coronary artery (RCA) branches or as a sequential graft with a side-to-side anastomosis to the posterior descending artery and an end-to-side anastomosis with the circumflex artery (CX) (Figures 1 and 2). The mean patient age was 60.3±5.2 years, and all patients were men. Eight (34.8%) patients had diabetes mellitus, 14 (60.9%) were obese, nine (39.1%) had chronic obstructive pulmonary disease and five (21.7%) had calcification of the ascending aorta. The median preoperative Canadian Cardiovascular Society angina class was 3.

The average number of distal anastomoses was 2.91±0.42, operation time was 375.6±81.4 min, intraoperative blood loss was 275 (200; 387) mL, first 24-hour postoperative blood loss was 270 (215; 310) mL, postoperative ventilation time was 2.3 (1.2; 4.7) hours and intensive care unit stay was 18 (16.5; 21) hours. There were no cases of hypoperfusion, competitive or reversed blood flow at the intraoperative transit-time flow measurement. The mean volumetric blood flow was 67.1±22.7, 40.0±18.3 and 32.0±12.1 mL/min in LAD, RCA and CX territory, respectively, while the pulsatility index in LAD, RCA and CX territory was 1.86±0.72, and 1.9±0.6 and 2.2±0.5, respectively. There were no cases of incomplete revascularisation, wound infection, conversion to cardiopulmonary bypass and sternotomy, deaths and major adverse cardiac and cerebrovascular events during the hospitalisation period. Twelve patients underwent contrast-enhanced CT coronary angiography to examine midterm (mean 16.7+5.5 months) graft patency. All grafts were patent without evidence of disease or suboptimal anastomoses. It is expected that use of composite *in situ* BITA-RA MVST-CABG will lead to the reduction of the perioperative complications rate, especially in high-risk patients.

Two sources of the myocardium blood supply from both ITAs allow the prevention of incomplete revascularisation and reduce the probability of hypoperfusion and competitive blood flow in composite multi-vessel grafting.

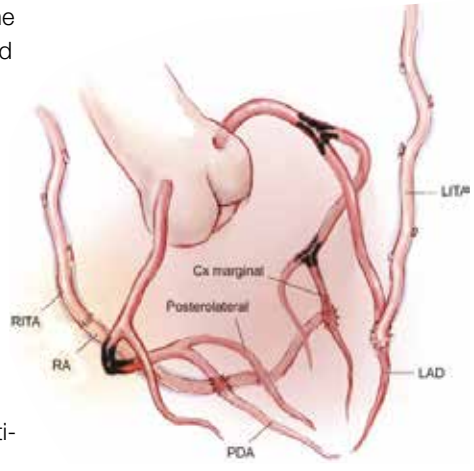

Figure 1. Scheme of MVST-CABG using in-situ bilateral internal thoracic arteries and extension technique with the radial artery.

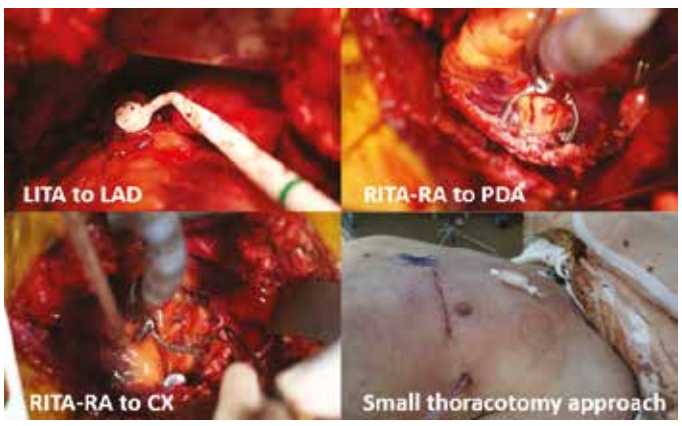

Figure 2. Operation technique.

Thoracic – Abstract: Mediastinum

Long-term results of laryngo-tracheal resection for benign stenosis from a series of 108 consecutive patients

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Benign stenosis, most commonly caused by post-intubation injury, represents the main indication for surgical treatment of the upper airway. Involvement of the subglottic region presents increased technical problems, principally due to the need for extending the resection to the cricoid cartilage without damaging the recurrent laryngeal nerves.

Endoscopic treatment modalities, including laser and stenting, whose application in tracheal surgery has greatly increased in the past few years, have a limited role in subglottic stenosis due to anatomic and technical reasons. These techniques are therefore mainly employed to stabilise the stenosis before surgical resection or to achieve an acceptable palliation in patients not suitable for surgery; the benefit is however temporary, and endoscopic controls and repeated procedures are often necessary.

Since Gerwat and Brice in 1974, and Pearson in 1975, described the technical principles for a safe laryngotracheal resection and reconstruction, high success rates have been reported in this setting, with low morbidity and mortality, thus affirming the role of surgery as the treatment of choice. However, only few centres have achieved large experience in this type of surgery and published series of laryngotracheal resections for benign stenosis with long-term results remain limited.

Between 1991 and February 2015, 108 consecutive patients with benign subglottic stenosis underwent laryngotracheal resection using the Pearson technique at the Sapienza University Hospital of Rome, Italy. The cause of stenosis was post-intubation injury in 93 patients and idiopathic in 15 patients. Distance of the upper limit of the stenosis from the vocal cords ranged between 0.5 and 1.5 cm. Stenosis grade was from 60% to 100% of the airway lumen. At the time of surgery 35 patients presented with tracheostomy, which had been performed in other centres in 33 of them. The operation was performed after single or multiple laser procedures in 17 patients and after laser ablation associated with Dumon silicone stent in 18 patients. Airway resection length ranged from 1.5 to 6 cm (mean 3.4±0.8 cm) and it was over 4.5 cm in 14 patients. Twenty-eight patients presented with post-coma neuropsychiatric disorders at the time of surgery.

There was no perioperative mortality. Ninety-eight patients (90.7%) had excellent or good early results. Ten patients (9.3%) experienced major complications including restenosis in eight patients, dehiscence in one patient, and glottic oedema requiring tracheostomy in one patient. Restenosis was treated in all eight patients with endoscopic procedures. They included laser treatment in five patients, laser ablation plus stenting in two patients and mechanical dilation in one patient. Patient with anastomotic dehiscence required temporary tracheostomy closed after 1 year with no sequelae. The patient presenting with postoperative glottic oedema underwent permanent tracheostomy. Minor complications occurred in four patients (three wound infections, one atrial fibrillation). Definitive excellent or good results were achieved in 94.5% (102) of patients. Twenty-eight post-coma patients with neuro-psychiatric disorders showed no increased complication and failure rate.

In conclusion, laryngotracheal resection is the definitive curative treatment for subglottic stenosis allowing very high success rate at long-term. Early complications can be managed by endoscopic procedures achieving excellent and stable results over time.

Thoracic – Abstract: Non-oncology I

Robotic surgery in patients with pulmonary tuberculosis: new technology against the old problem

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Today, pulmonary resection is not a well-established operation in the treatment of patients with TB. For many years, this problem was ignored by international surgical forums. However, three factors have led to increased interest in this problem today:

1. The growth of drug resistance, mediated by MDR and XDR-TB, and the low efficiency of conservative treatment of such diseases.
2. The adoption of the consensus WHO document 'The role of surgery in the treatment of pulmonary TB and multidrug- and extensively drug-resistant TB' in 2014.
3. Publications demonstrating the high efficiency of the surgery in the treatment of such patients.

Minimally invasive surgery is a not well-known problem of modern cardiothoracic surgery. Most thoracic surgeons are unfamiliar with TB surgery due to the complexity of the surgical procedures required.

That is why the use of minimally invasive surgery in cases of TB is not widespread. Reports on the use of robotic surgical systems have been informal.

That is why our message on the effectiveness and safety of robotic surgery for cavitary pulmonary TB is very interesting. Our study demonstrates a short learning curve for robotic operations, which offer low postoperative morbidity and mortality.

The basic rules of robotic operations are the same as for video-assisted thoracoscopic surgery (VATS): no rib spreading, monitor-based procedure, anatomical hilar dissection. In addition features of robotic techniques have been published in multiple papers: 3D visualisation, precision divided of hilar structures, scaling movements, smooth movements, tremor filtration, high range of motion, simulation of operation angle without loss of movement speed, short learning curve.

Features of robotic-assisted thoracoscopic surgery (RATS) pulmonary resection for TB are a high rate of pleural adhesions and the presence of perivascular and peribronchial fibrosis. Division of adhesions in the apical area of the pleural cavity is conveniently carried out using robotic surgical systems, whereas its use in the lower portion is difficult and sometimes requires the use of the VATS technique.

The rate of post-operative complication after robotic operations is significantly lower than after open or VATS operations for pulmonary TB (OTM & M classification).

I believe that the future of minimally invasive surgery for pulmonary tuberculosis is robotic surgery. In our presentation, I will try to convince you of that.

Cardiac – Abstract: Heart transplantation in the modern era

Moderate-to-severe early graft failure after cardiac transplantation: treatment strategies and predictive risk factors analysis


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Examination of early mortality after heart transplant documented in the International Society for Heart and Lung Transplantation (ISHLT) Registry reveals that 66% of the deaths that occur in the first 30 days after transplant are due to 'graft failure' and multi-organ dysfunction.[1]

Most of these events are the result of a fatal graft dysfunction (GD). Fortunately, at the 33rd Annual ISHLT Meeting, a consensus conference was organised to better define, diagnose, and manage this syndrome. There were 71 participants (transplant cardiologists, surgeons, immunologists and pathologists) representing 42 heart transplant centres worldwide. According to the new consensus statement,[1] early graft failure (EGF) is classified as primary GD (PGD) in the case of an unknown triggering factor, and secondary GD (SGD) where the cause is discernible, e.g. hyper-acute rejection, pulmonary hypertension or known surgical complications. The risk of PGD occurence is considered to be multifactorial and usually includes either donor, recipient or surgical variables. Severity scale for GD was divided into mild, moderate or severe depending on the level of cardiac function, and the extent of inotrope and mechanical circulatory support (MCS) required.

In our study, GD was defined according to the new ISHLT consensus conference criteria. The primary aim was to evaluate the results of MCS treatment for EGF, with regards to intra-aortic balloon pump (IABP) support for moderate GD and extracorporeal membrane oxygenation (ECMO) for severe GD. It was also hoped to identify eventual predictive markers of GD occurrence. Among the 412 patients included, 46 (11%) experienced moderate-to-severe EGF. Twenty-nine (63%) patients required peripheral or central ECMO support to treat severe EGF, and 17 (37%) required IABP for moderate EGF. Results revealed that absence of GD correlated strongly with better survival: 94% at 1 year and 81% at 5 years without EGF versus 76% and 36% at 1 year, and 70% and 28% at 5 years with EGF requiring IABP or ECMO support, respectively. However, weaned and/or survived patients after IABP and/or ECMO treatment appeared to have a similar 5-year conditional survival rate as those transplant patients not having suffered EGF: 88% without EGF versus 84% with EGF treated with MCS devices (p=0.08). The analysis also underlined some predictive risk factors for moderate-to-severe EGF occurrence. Recipient factors included preoperative transpulmonary gradient >12 mmHg (OR 5.2; p=0.023), inotropic score >10 (OR 8.5; p=0.0001), and ECMO support before transplant (OR 4.2; p=0.012); while for the donor, a Eurotransplant donor score[2] ≥17 (OR 8.3; p=0.006).

In summary, while confirming that EGF, either primary or secondary, is a major risk factor for in-hospital graft loss, our results showed that MCS appears to be a reliable strategy for treating both moderate and severe forms. It also confirmed that the occurrence of this syndrome is often multifactorial, and dependent on both donor and recipient profiles. Since such parameters and characteristics are not readily modifiable, optimisation of donor/recipient matching is crucial to reduce the risk of EGF. Additionally, changes in strategies of myocardial protection for marginal donors should be evaluated to better protect allograft function, and the adoption of *ex-vivo* perfusion for donor hearts may become a routine option in the near future.[3]

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Vascular – Professional Challenge: Arch involvement in acute aortic dissection: a surgical challenge

Systolic flow displacement using 3D cardiac magnetic resonance imaging in an experimental model of ascending aortic aneurysm: are we underestimating rheology?

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Bicuspid aortic valve (BAV) is the most common congenital heart disorder, with a prevalence of 1–2%. Up to 80% of patients with BAV will develop ascending aortic aneurysm. There is considerable debate on the pathogenesis of the aortic dilatation in BAV. The two main theories explaining the aortopathy in BAV disease are: 1) the genetic theory, whereby the presence of aortic wall fragility is a consequence of a common developmental defect, involving the aortic valve and the aortic wall; 2) the haemodynamic theory, in which the abnormal haemodynamic stress on the aortic wall, induced by eccentric turbulent flow through the BAV, leads to subsequent aortopathy.[1] The presence and type of BAV is associated with changes in regional wall shear stress distribution and systolic flow eccentricity, assessed with 4D cardiac magnetic resonance (CMR). Haemodynamic markers suggest a physiological mechanism, by which valve morphology phenotype can influence phenotypes of BAV aortopathy.[2] Moreover, systolic flow displacement has been shown to be a good predictor of ascending aortic growth.[3–4] However, experimental studies in this regard are lacking; therefore, the pure influence that rheological stimulus has in aortopathy development is unknown.

The objectives of this study are: first, to demonstrate that rheological stimulus *per se* induces aortic aneurysm; second, to assess the predictive value of systolic flow displacement, measured by 3D phase contrast CMR for aortopathy in an experimental ascending aortic aneurysm animal model, where BAV phenotype is absent but flow eccentricity is present. Animals were randomly allocated to either restrictive ascending aortic banding (n=14) or sham operation (n=6). 3D phase contrast CMR was performed at 6 weeks and 18 weeks after the banding procedure, and systolic flow displacement and aortic diameter were assessed.

At 6 weeks, aortic diameter growth was evident. Dilatation was mainly distal to the aortic banding (Figure 1). Mean aortic diameter was greater in banded animals at 6 weeks: 34.3±4.8 mm versus 21.4±2.7 mm in sham-operated controls (p=≤0.001). At 18 weeks, banded animals developed a larger aortic aneurysm: 50±8.4 mm versus 38±8.3 mm (p=0.0015) (Figure 2). In banded animals (n=14), no significant differences between peak gradient at 6 weeks and 18 weeks (p=0.84) were found. Peak gradients were 14.1 mmHg (±4.7) at 6 weeks, and 19.6 mmHg (±5.9) at 18 weeks. In banded animals, normalised systolic flow displacement at 6 weeks was 0.22 mm (±0.02), and correlated to aortic diameter at 18 weeks (R=0.59; p=0.02; Figure 3).

In the past 5 years, there has been emerging evidence that altered patterns of flow, flow displacement, wall shear stress and flow angle, measured by 4D phase contrast MRI, have an impact in the follow-up of the ascending aorta growth; or at least, an altered characteristic of some types of BAV. These markers will probably identify a new pathologic phenotype, regardless of the type of fusion cusp. Imaging biomarkers could be used to risk-stratify patients in whom clinically significant aortic disease is likely to develop. This is of major clinical relevance, because it will have an influence on the different surgical techniques of the valve and the ascending aorta.

In our study, we have shown that a high gradient and, in particular, an eccentric flow, was per se sufficient to induce an ascending aortic aneurysm. Moreover, the higher the flow displacement was, the greater the aneurysm became. This suggests that haemodynamic theory plays a very important role in the pathogenesis of aortic dilatation. 3D phase contrast CMR might be useful to predict aortopathy in subjects with aortic valve disease.

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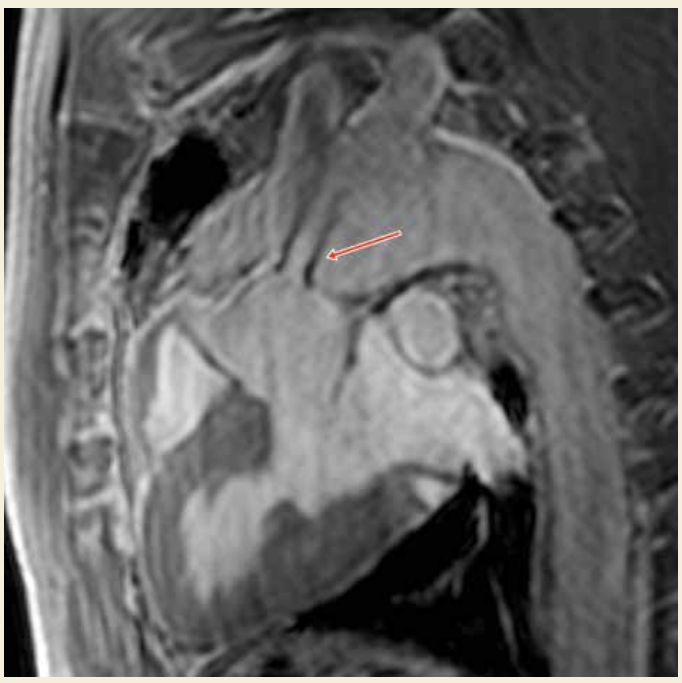

Figure 1. Sagittal view of 3D cardiac magnetic resonance. The arrow shows the jet of the aortic stenosis.

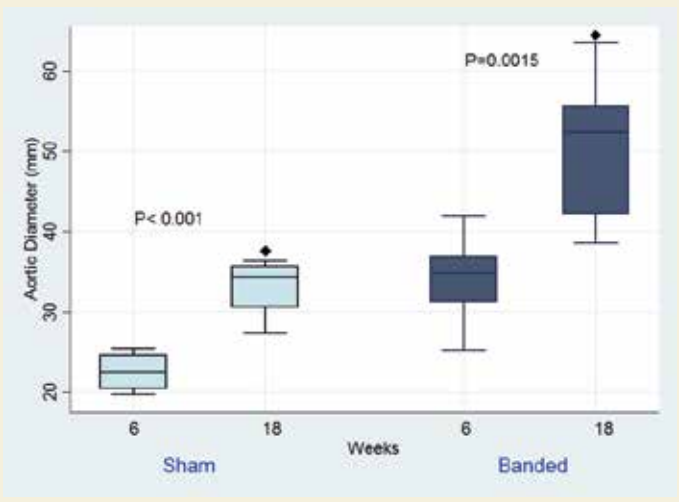

Figure 2. Comparison of aortic diameter (mm) at 6 weeks and 18 weeks between sham and banded animals. There are significant statistical differences at 6 weeks and 18 weeks.

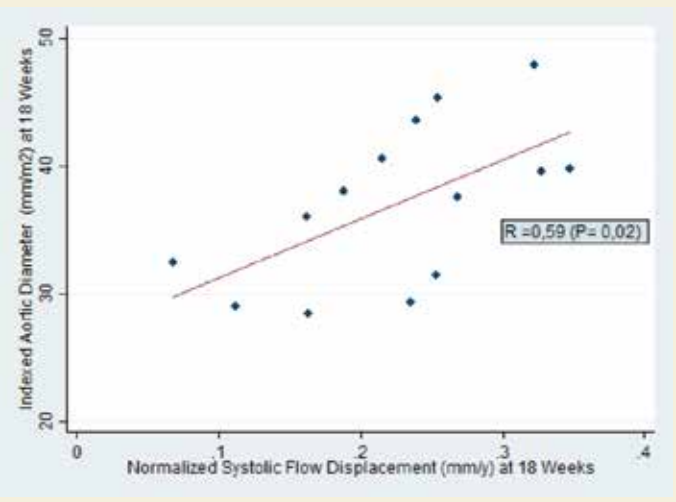

Figure 3. Scatter plot showing a linear regression between normalised systolic flow displacement at 6 weeks, and aortic diameter index (mm/m²) at 18 weeks. In banded animals, normalised systolic flow displacement at 6 weeks showed a positive correlate with aortic diameter index at 18 weeks (R=0.59; p=0.02).

Cardiac – Abstract: Basic science 1

Shock wave therapy causes increased macrophage recruitment and enhances M2 polarisation in ischaemic muscle

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Ischaemic heart disease still represents a major socio-economic health burden in Western countries, with significant impairment of quality of life for affected patients. Ischaemia leads to a loss of viable myocytes, resulting in remodelling of the myocardium and the formation of scar tissue. Experimental regenerative approaches of recent years mainly include (stem) cell-based therapies. Although favourable results have been reported, none of these therapies has reached broad clinical use due to distinct limitations.[1]

Low energy shock wave therapy (SWT) developed for tissue regeneration was based on the incidental finding of iliac bone thickening in patients undergoing shock wave lithotripsy.[2] Since then, low energy SWT has developed as a standard of care or alternative therapy for a variety of orthopaedic and soft tissue diseases, including ischaemic heart disease.[3] Percutaneous cardiac SWT was reported to induce angiogenesis and vasculogenesis, reduction of infarction size and improvement of ventricular function in animal models of ischaemic heart failure. Additionally, patients suffering from coronary heart disease were shown to experience relief of symptoms after treatment.[4-7] Although the results are encouraging, the working mechanism remains largely unknown.

Macrophages have a crucial role in post-infarction remodelling. In the first hours after the infarction, macrophages are responsible for the phagocytosis of necrotic tissue and loosening of the collagen network by metalloproteinases to enable cell migration. At the same time, macrophages enhance angiogenesis by the secretion of pivotal growth factors, like vascular endothelial growth factor (VEGF) and fibroblast growth factor (FGF) (Figure 1A).[8] In our current work, we aimed to investigate whether the regenerative effect of SWT is at least partly a result of enhanced macrophage recruitment.

Therefore, mice were subjected to unilateral hind limb ischaemia with subsequent SWT sham treatment. Tissue was analysed for macrophage markers via RT-PCR and immunofluorescence staining. To evaluate the functional outcome, animals were subjected to Laser Doppler perfusion imaging of the ischaemic leg. In addition, the number of vessels was evaluated via immunofluorescence staining.

Treated muscles showed increased expression of the pivotal macrophage recruiting factor monocyte chemotactic protein 1 (MCP-1). Indeed, we found increased numbers of macrophages in treated muscles confirmed by increased expression of the macrophage marker CD14, as well as by immunostaining. Analysis of the scavenger receptor CD163 revealed that mainly the number of the regenerative M2 macrophages was increased in SWT animals.

In line with these findings, treated mice showed improved limb perfusion when analysed by Laser Doppler perfusion imaging. In addition, analysis of tissue sections revealed a higher number of capillaries (CD31) as well as arterioles (CD31 and aSMA), clearly indicating induction of angiogenesis. Interestingly, macrophages were found in close proximity to newly formed vessels.

With this work, we could show for the first time that the recruitment of macrophages has a major role in the angiogenic effect of SWT. We believe that SWT will become a promising tool for the regeneration of ischaemic myocardium and will be used as an adjunct to coronary artery bypass graft (CABG).

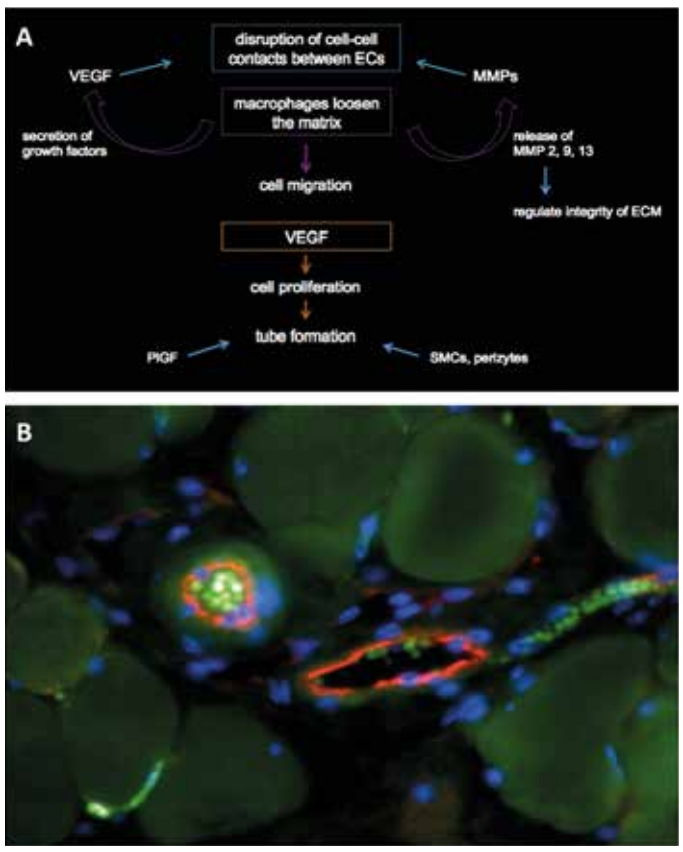

Figure 1. A. Schematic drawing of the concept of how macrophages contribute to angiogenesis. B. Newly formed, functional arterioles after SWT in ischaemic muscle.

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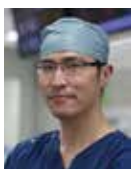
Vascular – Professional Challenge: Uncertainties in the treatment of chronic dissection

Open surgery of chronic aortic dissection: examination of 371 elective cases



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Open surgery for acute type A dissection is still the gold standard procedure. In cases of type B dissection, the INSTEAD XL trial advocated the efficacy of thoracic endovascular aortic repair (TEVAR) for sub-acute phase; however, optimal medical treatment for uncomplicated acute type B dissection is still considered the method of choice. In the chronic phase of either type A or type B, the best surgical option remains controversial. TEVAR for chronic dissection of descending thoracic aorta has a high re-intervention rate, and hybrid repair for chronic dissections of thoraco-abdominal aorta has anatomical limitations. Open surgery for chronic dissection has less anatomical limitation and a lower re-intervention rate. The high mortality and morbidity for descending thoracic and thoracoabdominal aortic open repair have been mentioned in many previous reports. However, results are improving.

We evaluated contemporary outcomes of open repair of chronic aortic dissections (ChAD).

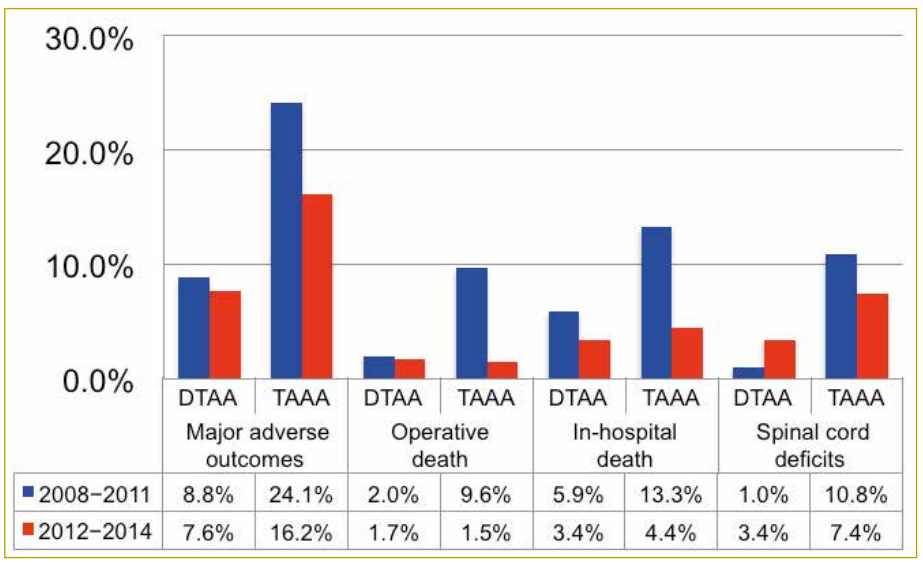
From January 2008 to December 2014, 371 patients had elective open repair of ChAD. Mean age was 60.2 years and 79.0% were male. In total, 100 (27.0%) patients were chronic type A dissection; 64 patients had undergone hemi-arch replacement, and 23 total arch replacement emergently. Thirteen patients had received other treatment. A total of 271 (73.0%) patients were chronic type B dissection, and the majority received optimal medical treatment initially.

Descending thoracic aortic repair (DTAR) was performed in 220 cases (59.3%) and thoraco-abdominal aortic aneurysm repair (TAAAR) in 151 cases (40.7%). Of TAAAR, Crawford extent II repair were 25.6%. During the same period, no patient underwent TEVAR as primary treatment for descending aorta, and no patient underwent hybrid procedure for thoraco-abdominal aorta. We used left heart bypass in 196 cases of DTAR, and 147 cases of TAAAR, and deep hypothermia and circulatory arrest (DHCA) in 23 cases of DTAR. In TAAAR, DHCA was none. A cerebrospinal fluid drain was placed for 155 (41.8%) patients preoperatively (in 10 cases of DTAR and 145 cases of TAAAR).

Overall, major adverse outcomes (including in-hospital death, tracheostomy, paraplegia, newly dialysis at discharge) occurred in 13.2%. Operative mortality was 3.5%. In-hospital mortality was 6.5%. Spinal cord deficits (paraplegia and parapalesis) occurred in 5.1% patients.

Comparing the latter half (2012–2014) with the first half (2008–2010) of the study population by year, these rates have generally decreased in for both DTAR and TAAAR (Figure 1). The operative mortality has improved from 2.0% in DTAR and 9.6% in TAAAR during the first half of the term (2008–2011) to 1.7% and 1.5%, respectively in the second half (2012–2014). Mean follow-up was 16.6 months. During the follow-up period, 12-, 36-, 60-months survival was 90.4%, 88.5%, and 88.5%, respectively. Re-intervention for pseudo-aneurysm formation was necessary in 2.2%. During the follow-up period, contrast agent use is not mandatory.

Our open surgery of ChAD had acceptable early outcomes and improvements are apparent over time. Our surgery had low intervention rates. These results should be compared with those of evolving approaches including endovascular and hybrid repairs.



	DTAA	TAAA	DTAA	TAAA	DTAA	TAAA	DTAA	TAAA
	Major adverse outcomes		Operative death		In-hospital death		Spinal cord deficits	
2008–2011	8.8%	24.1%	2.0%	9.6%	5.9%	13.3%	1.0%	10.8%
2012–2014	7.6%	16.2%	1.7%	1.5%	3.4%	4.4%	3.4%	7.4%

Figure 1. Comparison of the results by the duration.

MEMO 3D RECHORD DRIVES ADVANCES IN MITRAL VALVE ANNULOPLASTY

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Mitral valve repair (MVR) represents the gold standard therapy for patients with mitral regurgitation, enabling preservation of the entire native valvular structure and allowing patients to enjoy good quality of life. Over the past decade, the substantial positive impact of annuloplasty on long-term durability of MVR has been gradually recognized. However, to date the choice of the "most appropriate" annuloplastic ring still largely relies on individual surgeon's personal preference. In particular, recent experimental and clinical researches highlighted the potential advantage of a saddle-shaped annuloplasty in diminishing mitral annular and leaflet strain, as well as improving leaflet coaptation geometry[1]. Nonetheless, it remains controversial whether we should apply saddle-shaped annuloplastic ring in every patient.

In our own practice, we have adopted a tailored selection principle following the guidance of preoperative 3-dimensional transesophageal echocardiography (3D TEE).[2] We routinely measure the annular height to commissural width ratio (AHCWR) prior to every mitral valve repair operation for an individualized selection of the proper annuloplastic ring type. By using this approach we have found that a semi-rigid ring rather than a saddle-shaped ring may provide more reliable repair results in patients whose AHCWR remains within the normal range (i.e., AHCWR ≥ 15%). Whenever such condition is confirmed we would select the MEMO 3D ring (Sorin SpA, Milan, Italy) as the ring of choice, due to its unique structural characteristics that help to achieve satisfactory repair results. Postoperative 3D TEE showed that mitral annular saddle shape could be well preserved in these patients. In fact, the MEMO 3D ring's innovative design and laser-cut alloy cell structure provide a progressive degree of flexibility from anterior to posterior, mimicking the heart's complex yet natural anatomy and therefore preserving truly physiologic annular dynamics.[3,4,5,6] In addition, the bio- and hemo-compatible properties of the unique Carbo¬film coating allows complete ring endothelialization while preventing inflammatory reaction and scar tissue formation,[7] leading to physiological dynamics preservation in the long term.[6]

Latest advances in annuloplasty technology have provided additional opportunity to address the challenges in MVR presented by the dynamic physiology of the heart. One particularly interesting breakthrough is the MEMO 3D ReChord™ mitral annuloplasty ring which, in addition to the unique Memo 3D design, provides an innovative chordal guiding system that allows a correct implantation of PTFE neochordae without the need for chordal measurement, thus improving the accuracy of artificial chordae replacement technique while streamlining the procedure. The temporary chordal guiding system, placed at the level of the posterior annulus, acts as a reference point for the height of the neochordae, relying on the principle of basal marginal chordae equivalence, where the height of a marginal (primary) chorda is always equal to that of the corresponding basal (tertiary) chorda.[8,9] Once the PTFE chordae are passed through the loops of the guiding system, the free margin of the anterior or posterior leaflet is brought to the posterior annulus, the PTFE are tied and the temporary loops system is removed. The length of the neochordae obtained with this system exactly matches the plane of the native annulus at the coaptation point. Artificial chordae implantation guided by the MEMO 3D ReChord results in a simple and reproducible technique suitable for both anterior and posterior leaflet prolapse. In particular, it restores leaflet motion and ensures a large surface of coaptation while shortening the procedure duration effectively.[9]

Over the past 8 months, we have implanted the MEMO 3D ReChord ring in 12 patients (male/female= 9/3, age range: 37-82 years), including 2 semi-urgent cases with preoperative IABP and/or mechanical ventilatory support. Concomitant aortic valve replacement (n=1), tricuspid repair (n=3), or coronary artery bypass grafting (n=2) were carried out. Mitral valve lesions involved anterior leaflet (n=9), bi-leaflet (n=2), and posterior leaflet (n=1). Within the same period of time we have also implanted the MEMO 3D rings in another group of 12 patients with posterior leaflet lesions (n=11) or ischemic mitral regurgitation (n=1). There was no 30-day mortality in all 24 patients. Pre- and post-operative 3D TEE was completed in all patients, with subsequent 6-month (and yearly thereafter) transthoracic echocardiography follow-up. So far, in the MEMO 3D ReChord ring group, none of the patients had greater-than-trivial postoperative mitral regurgitation upon follow-up. This series represents the first Asian clinical experience using the MEMO 3D ReChord ring. Whereas the long-term durability of mitral valve repair with the MEMO 3D ReChord ring warrants further validation, our current clinical observation and short-term echocardiography data following this type of mitral annuloplasty appeared extremely encouraging.

Find out more at Sorin Group Booth # 3.15

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Vascular – Abstract: A 4D view of the aortic root

Dilatation of the proximal aorta does not progress after isolated aortic valve replacement for bicuspid aortic valve stenosis: magnetic resonance imaging follow-up study

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The clinical course of bicuspid aortopathy is still insufficiently defined after isolated aortic valve replacement (AVR) surgery in patients with bicuspid aortic valve (BAV) disease. As a consequence of this ongoing controversy, there are no generally accepted recommendations to guide the surgical treatment of mild-to-moderate proximal aortic dilatation in BAV patients at the time of AVR surgery. Our previous data[1] and those from other studies[2,3] suggest that the progression rate of post-AVR aortopathy is not uniform and may differ depending on the clinical phenotype of BAV disease. In our current study we therefore aimed to quantify the progression of proximal aortic disease in patients who underwent isolated AVR surgery for BAV stenosis and concomitant mild-to-moderate ascending aortic dilatation.

We identified a total of 96 consecutive BAV patients (57±10 years; 78% male) who underwent an isolated AVR surgery for BAV stenosis and concomitant mild-to-moderate ascending aortic dilatation from 1995 through 2006 from our institutional BAV database. Preoperative proximal aortic diameter (i.e. ≥40 mm in all patients) was quantified by means of MRI/CT measurements in all 96 patients. Consequently, all BAV patients w/o preoperative MRI/CT were excluded. Clinical follow-up data (922 patient-years) were obtained for all patients and aortic MRI/CT follow-up (855 patient-years) was performed in 83 (87%) of them. Study endpoints were MRI/CT-defined progression rate of bicuspid aortopathy (mm/patient-year) and prevalence of adverse aortic events (sudden death, aortic dissection, and aortic surgery). MRI/CT follow-up demonstrated comparable post-AVR aortic diameters vs preoperative values at 10.3±3.8 years post-AVR (i.e. 46.4±4.4 mm pre-AVR vs 46.9±4.6 mm post-AVR; p=0.1). Moreover, aortic diameters remained completely unchanged (i.e. pre-AVR vs post-AVR) in 64 (77%) study patients. Progression rate of bicuspid aortopathy was 0.09 mm/patient-year for the whole study population, whereas clinically relevant progression of 5 mm was revealed in only one (1%) patient. No documented aortic dissection occurred during follow-up. A total of five (5%) patients with post-AVR aortic diameter of 53±3 mm (50–56 mm) underwent redo aortic surgery, while three of them demonstrated unchanged aortic diameters as compared to their pre-AVR values. The current study demonstrates that post-AVR aortic diameters remain stable in patients with BAV stenosis and concomitant mild-to-moderate ascending aortic dilatation at least 10 years after an isolated AVR.

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Thoracic – Abstract: Non-oncology I

Decortication of empyema thoracis in children: a large single-centre perspective

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The Freeman Hospital's Cardiothoracic Centre was established with two surgeons in a purpose built facility in 1977 and has since expanded to a team of 14 surgeons. The Freeman Hospital is the only hospital in the country to provide the full range of cardiothoracic surgery for adults and children, including heart and lung transplantation under one roof. Mr Asif Hasan, Senior Consultant Congenital Cardiothoracic Surgeon, alongside his colleagues Mr Massimo Grisselli and Mr Bari Murtuza, as a team, have extensive experience of operating on paediatric patients with empyema thoracis.

Empyema thoracis can cause significant morbidity and mortality in children. Various treatment modalities have been employed including tube thoracostomy, video-assisted thoracoscopic surgery (VATS) and decortication. However, the evidence base is limited and practice varies widely within the UK. We reviewed the outcomes from primary surgical management in our unit for later comparison with a national audit – the UK-ESPE study.

Our team studied a total of 194 children who were selected between 2007 and the present day for this prospectively-recruited observational study. All patients underwent muscle sparing thoracotomy and decortication of empyema. The outcomes reviewed included: chest drain duration, total hospital and paediatric intensive care unit (PICU) length of stay (LOS), need for ventilation and readmission rates, complications (including recurrence and repeat procedures) and mortality. Within the study population, there were 84 females and 110 males. Median age was 3 years (1–16 years). Our results compared favourably with published series with a median duration of chest drainage of 2 days (0–10 days). Post-procedure complications occurred in 21 patients (10.8%) (pneumothorax 7, recurrence 6, lung abscess/necrosis 4, infection 2, renal failure 1, veno-venous extracorporeal membrane oxygenation (ECMO) 1). Reoperations were performed in eight patients (4.1%) (redo decortication 6, wound debridement 2). Forty-two patients (21.6%) were admitted to PICU. 31/194 patients (15.9%) required ventilation postoperatively (nine patients were ventilated >24 hours; one patient required veno-venous ECMO). Median PICU LOS was 2 days (1–40 days). Median hospital LOS was 6 days (3–64 days). Nine patients (4.6%) were readmitted post discharge; four required a repeat surgical procedure. Mortality was 2/194 patients (1%) (non-surgical: co-morbidity related). In conclusion, we present our results of a large cohort of paediatric empyema patients managed with thoracotomy and decortication. A median LOS of 6 days, 4.1% reoperation rate and 1% mortality compare very favourably with other published series.

Cardiac – Abstract: Cardiac general

Comparison of septal myectomy with and without mitral subvalvular apparatus intervention in patients with obstructive hypertrophic cardiomyopathy: a prospective randomised study

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Hypertrophic obstructive cardiomyopathy (HOCM) is the most common monogenic cardiac disease and is characterised by left ventricular outflow tract (LVOT) obstruction, mitral valve systolic anterior motion (SAM), and can produce symptoms of heart failure and sudden cardiac death. Mitral regurgitation (MR) in HOCM patients is induced by SAM and subvalvular apparatus abnormality.

Myoectomy of LVOT described by Morrow is considered the gold standard of surgical correction in symptomatic patients with HOCM who are both refractory to medical therapy and suitable for surgery at experienced centres. Mitral valve repair in the setting of HOCM can be challenging, and there are various different approaches, such as: anterior mitral leaflet plication,[1] the Resection-Plication-Release (RPR) method,[2] papillary muscle repositioning,[3] Alfieri stitch,[4] anterior mitral leaflet extension[5] and anterior leaflet retention plasty.[6] However, the role of mitral subvalvular apparatus intervention (MSA) for elimination of MR and SAM is still unclear.

The aim of this prospective randomised study was to compare the results of extended myoectomy with or without MSA intervention.

Between 2010 and 2014, we performed 182 extended septal myectomy procedures. Seventy patients met the inclusion criteria and were randomly assigned to receive MSA intervention, in addition to septal myectomy (MSI group; n=36) or undergo septal myectomy only (no-MSI group; n=34).

SAM syndrome was observed in all patients, with moderate MR in 42 cases (60%) and severe MR in 28 cases (40%). MSA intervention included: mobilisation of papillary muscle (Figure 1A), secondary and abnormal cord resection (Figure 1B) and longitudinal papillary muscle resection (Figure 1C).

Table 1. Complex MSA intervention

Excision of abnormal papillary muscles	9 patients (25.0%)
Mobilisation of papillary muscle	36 patients (100%)
Longitudinal resection of papillary muscles	32 patients (88.9%)
Secondary cord resection	36 patients (100%)

There were no early deaths in either group. Immediately following the procedure, the residual MR ≥2+ was 14.7% (5 patients) in the no-MSA group and none in the MSA group (p=0.023); residual SAM was shown in eight patients (23.5%) and one patient (2.7%), respectively (p=0.001). Peak LVOT gradient was 12.2±6.3 mmHg (no-MSA group) and 8.7±4.5 mmHg (MSA group) (p=0.009). Two patients (5.6% and 5.9%) in both groups required pacemaker implantation before discharge, owing to complete atrioventricular block, and one patient (2.8%) had septal defect in the MSA group (p=0.514).

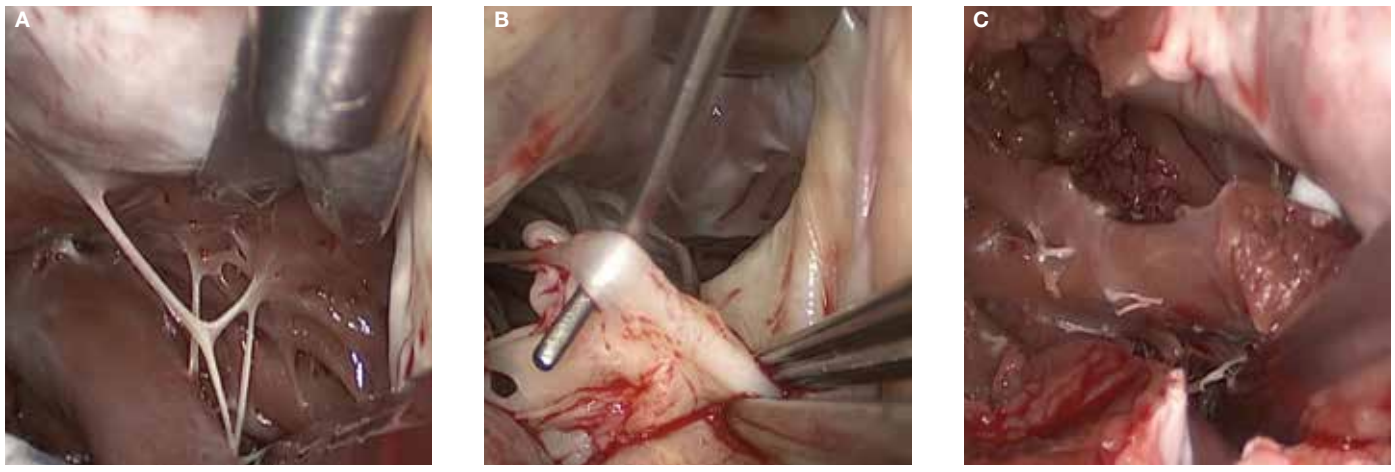

Figure 1. Mitral subvalvular apparatus intervention. A. Mobilisation of papillary muscle. B. Secondary and abnormal cord resection. C. Longitudinal papillary muscle resection.

MSA intervention during septal myectomy in patients with HOMC has been shown to be a safe and effective procedure. Complex MSA intervention in addition to septal myectomy allows more effective elimination of SAM-syndrome and MR.

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