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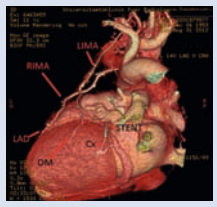

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The EACTS Techno College Innovation Award

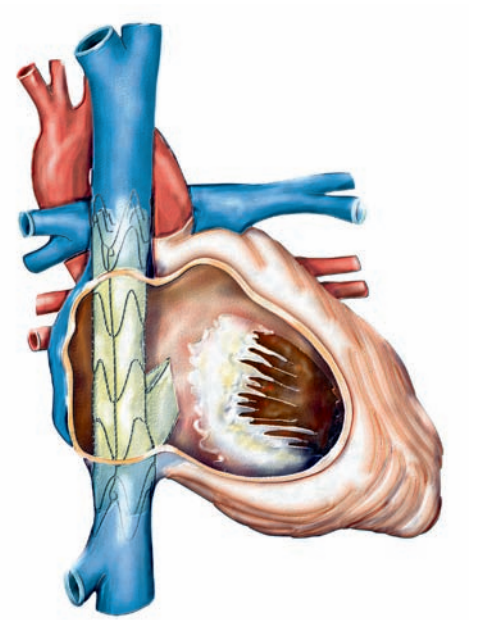
Congratulations to this year's recipients of the Techno College Innovation Award! The 2016 winner was Dr Maximilian Kütting (pictured centre), for his work with a novel transcatheter prosthesis for the treatment of severe and massive tricuspid valve insufficiency. He was joined by runners-up Dr Johannes Holfeld (right) and Dr Itai Schalit (left).

Read on to learn more about each recipient's award-winning work.

Cardiac | Techno College | Aorta, Ablation, and Assist devices

A novel transcatheter prosthesis for the treatment of severe and massive tricuspid valve insufficiency

Maximilian Kütting
NVT GmbH, Hechingen, Germany



Tricuspid valve regurgitation remains a disease with a poor prognosis for inoperable patients, but also for highly symptomatic patients undergoing isolated repair or replacement. Medical therapy provides short-term alleviation of symptoms in some cases, but the impact of the disease on quality of life is substantial, leaving a pressing need for effective minimally-invasive treatment options. Described by many as the "forgotten valve", the tricuspid valve's complexities, especially in patients with severe and massive tricuspid regurgitation, arguably pose more challenges to the development of treatment options than the other three valve positions.

NVT, a Swiss company with R&D and production facilities in Germany, is a specialist in developing innovative catheter-based solutions for heart valve disease, and has conceived a prosthesis to address tricuspid regurgitation. The concept involves implanting a stentgraft-like device spanning from the inferior to the superior caval vein with a lateral bicuspid valve. The idea of placing a fifth heart valve into the right atrium evolved after considering the anatomy and flow pattern of the right atrium. The decision to leave the tricuspid annulus untouched was also made considering previous unsuccessful attempts of other devices to anchor in this structure, and in order to avoid interference with the AV-node.

The prosthesis consists of nitinol stent springs and support structures covered by porcine pericardium. It is delivered using a 22F catheter which is advanced via the femoral vein to the right atrium. Radiopaque markers on the prosthesis help achieve precise orientation and positioning. Experience gained during the development of the NVT Allegra transcatheter aortic valve prosthesis, and also collaboration with JOTEC – experts in the field of stentgraft technology – helped ensure progress with the device.

The aim was to develop a technology which is effective in preventing backflow into the venous system to alleviate symptoms, such as venous congestion and ascites. It had to be fast, simple and safe to implant, preferably by a single operator.

The collaboration with Dr. Lausberg and Prof. Schlensak – two cardiothoracic surgeons from the University Clinic in Tübingen – Germany, was instrumental in refining the concept and developing it to its current stage. In extensive in-vitro and in-vivo tests, both the prosthesis and delivery system were improved along with the implantation technique. In an ovine model, massive tricuspid insufficiency was first induced using a specially-built device, and then treated via implantation of the prosthesis. Absence of backflow into the venous system could be confirmed under echocardiography. The proof-of-concept was achieved so that the project has now moved into the stage of preparations for first-in-man implantation.

The group of engineers and physicians from NVT and the University Clinic in Tübingen are grateful for the recognition of their work, and are thrilled to accept the EACTS Techno College Innovation Award, which is another reminder of the importance of taking this concept to clinical reality.

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First in-man shockwave application for spinal cord ischaemia after Type-A aortic dissection

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No causal treatment option has thus far existed for the devastating condition of paraplegia due to spinal cord ischaemia following aortic surgery or endovascular aortic repair. However, shockwave therapy has been shown to induce regeneration of ischaemic myocardium.[1] Therefore, in previous work we evaluated whether shockwave treatment of ischaemic spinal cord injury may be beneficial, and were able to prove that it does in fact cause regeneration of the spinal cord in an animal model.[2] Now, our current work shows deeper insights into the mechanism of spinal cord shockwave treatment, and for the first time reports on results in human tissue, specifically the first in-man application for paraplegia following acute Type-A aortic dissection surgery.

A 72-year old patient suffered from acute Type A aortic dissection with an early onset of lower limb malperfusion prior to hospital admission. Uncomplicated acute aortic surgery including arch replacement was performed, however it resulted in paraplegia due to ischaemic spinal cord injury. After obtaining permission from the local ethics board, as well as written informed consent by the patient, we performed the first in-man spinal shockwave treatment.

Numerous neurologic assessments were then performed over a six-month period, including motor- and sensory-evoked potentials, magnetic resonance imaging of the spine, and additional experimental mechanistic studies with spine slices from dead bodies.

Results

The patient suffered from complete paraplegia at day 0 after surgery, after which he received six shockwave treatments starting six weeks after the surgery. No somatosensory evoked potentials on both legs could be observed at day 0. However, the patient started to feel his right leg after three weeks. While he had been letting the nurse inject his daily heparin dose to the left leg, he then began to feel pain from the needle at this leg as well. Results were confirmed by neurological assessment by independent neurologists, and quality-of-life questionnaires showed a significantly-improved overall condition of the patient after six months.

Conclusion

Shockwave treatment of the spinal cord is safe, feasible, and is capable of improving symptoms of spinal cord ischaemia. In-vitro shockwaves even caused neuronal sprouting. Shockwave treatment immediately after spinal cord injury due to ischaemia from aortic dissection may therefore develop into the first ever causal treatment option for this devastating condition. It is known that spontaneous improvement of symptoms can occur. However, this is more likely to happen in patients with traumatic spinal injury. Six weeks after complete paraplegia due to an ischaemic injury to the myelon, no regenerative potential was estimated for our patient from an independent neurologist. Nevertheless, the experience from this single case plus the encouraging results from experimental studies need to be confirmed in a clinical trial. A randomised, controlled clinical multicentre trial therefore is on its way!

Please get in contact with us if you like to participate in the trial.

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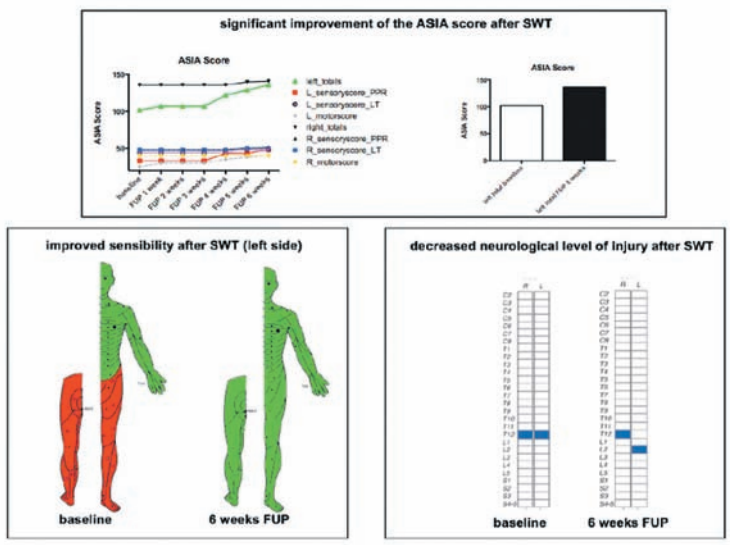

Figure 1 (above). Shockwave treatment was applied paravertebral at a 45-degree angle to the spine on both sides. Six treatments over a period of six weeks were performed at an energy flux density of 0.1mJ/mm^2. Shockwave application was not painful to the patient.

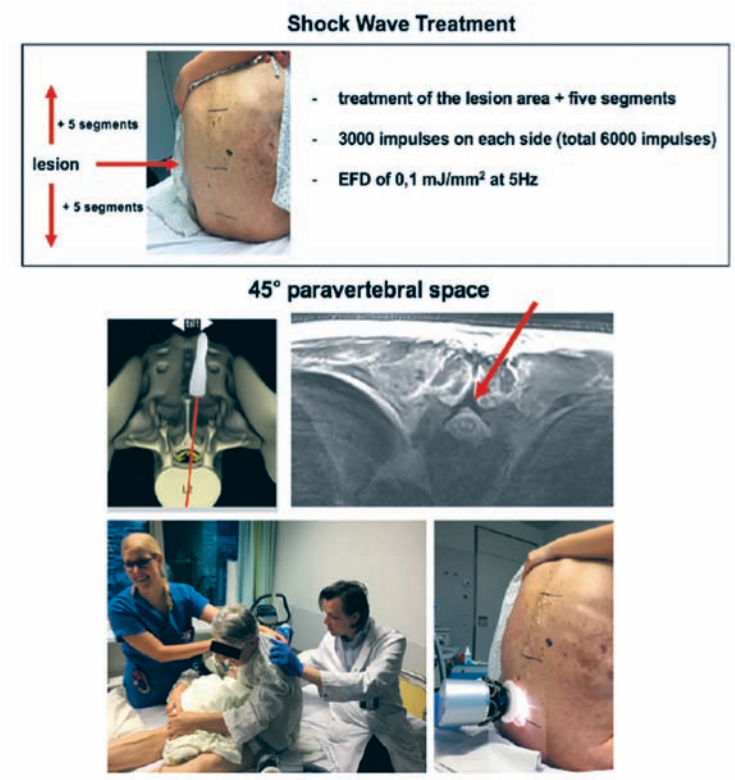

Figure 2 (right): The patient developed a significant improvement of the ASIA (American Spinal Injury Association) score, indicating spinal cord regeneration. His sensibility on both legs recovered completely and the level of injury on his left side decreased from T12 to L2.

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Accurate real-time detection of VAD thrombosis and thromboembolic events using an accelerometer

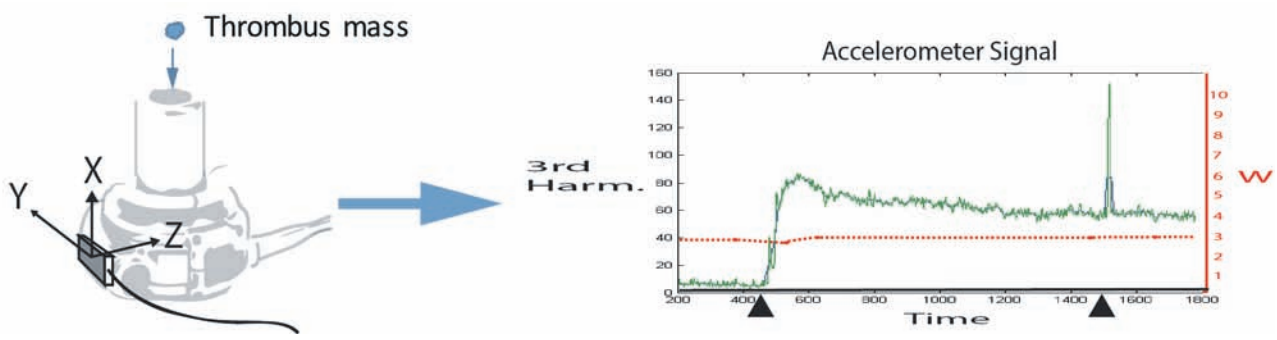

Figure 1. The concept: A 3-axis accelerometer attached to the pump detects thromboembolic events and pump thrombosis. Data from an in-vivo experiment. Green curve: accelerometer signal. Red curve: HVAD energy consumption. Black arrows indicate thrombus injection into the pump. The first injection leads to a permanent increase in the accelerometer signal, indicative of pump thrombosis; the second to a temporary amplitude increase, indicative for a thromboembolic event. Minor changes were seen in HVAD energy consumption. Thrombi 0.3ml

Itai Schalit and Per Steinar Halvorsen The Intervention Centre, Oslo university Hospital, Norway

Attaching an accelerometer to a ventricular assist device (VAD) allows the detection of pump thrombosis and thromboembolic events with much higher sensitivity and specificity than routine methods such as pump energy consumption (W).

Accelerometer technology offers new possibilities for early detection and prevention of complications in a growing population of patients treated for severe heart failure with VADs. The idea is an intuitive solution for detection of life-threatening complications such as pump thrombosis and thromboembolic events. Today, there is no method for monitoring thromboembolic events, and importantly, it is unknown how many subclinical thromboembolic events can precede a clinically-significant stroke. The accelerometer enables the detection of such events, and thus allows intervention before irreversible function loss.

In both in-vivo and in-vitro models using different HeartWare (USA) HVADs, we attached an accelerometer to the pump housing and measured its vibration pattern. The impeller in the HVAD generates a typical pump vibration pattern that will be temporarily disrupted if an embolus passes through the pump. A thrombus mass on the impeller changes its centre of gravity. This causes a permanent change in the pump vibration pattern (Figure 1). Flow obstruction also cause quantifiable vibration pattern changes.

In this work, submitted to the Techno College Innovation Award, we analysed the vibration pattern by the third harmonic frequency of the pump speed. The amplitude of this harmonic is extremely low in the absence of pump thrombosis, but increases dramatically when a thrombus residue is attached to the impeller. This robust parameter was previously described by Kaufmann and colleagues using intermittent pump sound recordings in HeartWare HVAD patients. This is easily detectable by the accelerometer, with its continuous high-quality signal that allows sensitive detection of acute events such as a thromboembolism passing through the pump, and build-up of pump thrombosis. We compared thromboembolic events using thrombi (sized 0.2-1ml) with control interventions including RPM-, preload- and afterload change (Figure 2). Sensitivity and specificity to detect thromboembolic events/pump thrombosis were 92% and 94%, respectively. In contrast, there were no significant changes in HLVAD energy consumption during the thromboembolic events (Figure 2). This demonstrated a superiority of the accelerometer to the LVAD energy consumption, which is the only continuous parameter that is currently used to detect pump thrombosis.

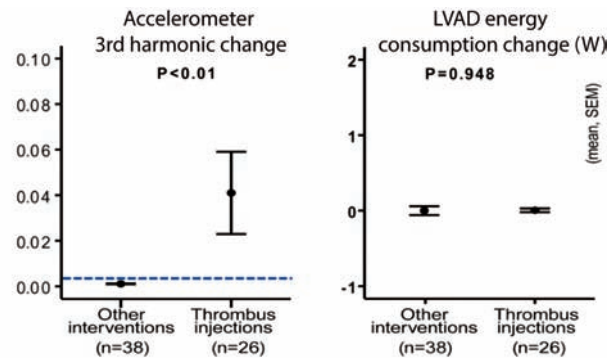

Figure 2. Changes in accelerometer signal (left panel) and HVAD energy consumption (W; right panel) during control interventions (alterations in load and pump speed) and during injections of thrombi (0.2-1ml). HVAD energy consumption was neither sensitive nor specific in the diagnosis of thromboembolic events and pump thrombosis, whereas the accelerometer demonstrated excellent sensitivity/specificity of 92%/94% (AUC 0.966 [CI 0.92-1], p<0.001). Blue line indicates the cut-off value

With an accelerometer on the pump housing, it is also possible to quantify changes in left ventricular load by analysis of frequencies of non-harmonic vibrations. This can be utilised for early detection of pump flow obstruction, and provides the possibility for an automated RAMP test and pump speed control. The blood barrier is not broken using the accelerometer, and therefore there is no added risk for the patient. Though tested only on HVAD, we have indications that the accelerometer will work in other pumps as well, simply by harnessing different signal analysis.

The high quality of the acceleration signal measured at a fixed position on the pump assures excellent reproducibility that will allow monitoring of pump performance and complications in addition to the effects of treatment. The chance to introduce the method to the medical community and promote its future use is a great privilege.

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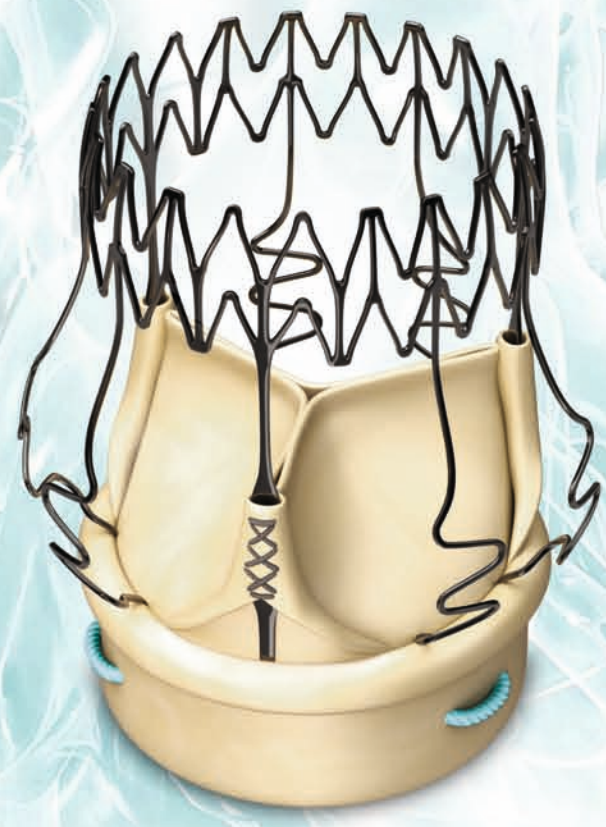

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How a robust research program can lead to innovation: the new RESILIA tissue

B. Meuris, MD, PhD
University Hospitals Leuven, Belgium

Although the use of tissue valves is growing fast world-wide, they will face two challenges in the future: life expectancy of elderly people is increasing and, many younger patients want to enjoy the benefits of a biological valve; these are strong drivers towards a constant improvement in long-term durability of valve tissue. Despite the optimal hemodynamic performance and good durability of bioprostheses, there is still room for improvement in younger and more active population with many years to go.

Within the quest to improve current pericardial tissue, research has led to more efficient detoxification and preservation of glutaraldehyde-fixed tissue. Through chemical modifications, it is now possible to produce an irreversible covalent binding of free-glutaraldehyde remnants (free-aldehydes). Stable capping these remnants leads to a significant reduction in binding sites for calcium. Also, by replacing water by glycerol, it's possible to store a tissue valve in dry condition, thereby avoiding the need for glutaraldehyde-based storage, further preventing additional free-aldehydes and the need for rinsing.

Recently, this new tissue, named RESILIA, was extensively tested in a large pre-clinical test involving 45 mitral valve implants in juvenile sheep, the current gold-standard in pre-clinical valve long-term performance testing[1]. The RESILIA tissue was used to build a tissue valve, using the well-known PERIMOUNT design, a frame that has proven its performance with more than 25y follow-up. The frame is important because, next to tissue treatment, valve design are critical for the long-term result. Using the PERIMOUNT valve (6900P) as a control, the calcification levels and the mean gradients in the RESILIA tissue were significantly lower. This result was obtained after 8 months in mitral position in juvenile sheep, which we believe equates to about a 10y period in an adult patient; Based on the pre-clinical evidence we expect an even longer durability.

Moreover three large studies (COMMENCE) encompassing aortic, mitral and pulmonic valve position have already enrolled over 800 patients to assess safety and efficacy of RESILIA tissue using the Magna Ease valve platform. The preliminary results of the aortic arm at 1 year were disclosed during the 2016 AATS meeting[2]. Follow up will continue up to 5 years.

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2) http://aats.org/annualmeeting

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Cardiac | Perfusion Programme | Perfusion - Session 2

CARL and CIRD: an update in emergency preservation and resuscitation for cardiac arrest

Today's extensive Perfusion Programme will feature a lecture detailing how new developments in the controlled automated reperfusion of the whole body (CARL), and CIRD (Controlled Integrated Resuscitation Device) systems can improve neurological survival after CPR.

Delivered by EJCTS Editor-in-Chief Friedhelm Beyersdorf (University Heart Center Freiburg, Germany), the lecture will have particular focus on new portable resuscitation systems for emergency care outside of the hospital. To that end, Professor Beyersdorf spoke to *EACTS Daily News* to offer a glimpse of some of the key talking points.

Outcomes following cardiac resuscitation are still quite poor, and although technology has improved with technology such as ECMO, there's obviously space for big improvement, would you agree?

Indeed – neurologic survival rates after CPR are still only 20% in-hospital, and 2% outside, despite the greater availability of defibrillators at airports and elsewhere. This was reported in the *New England Journal of Medicine* in 2012. Survival rates are still very bad. There was no significant change in overall survival from 1992 to 2005 with the use of standard resuscitation techniques.

The main reasons for poor prognoses in cardiac arrest patients include: ischaemia/reperfusion injury during cardiac arrest and CPR, lack of return of spontaneous circulation, re-arrest from haemodynamic instability after ROSC, multi organdysfunction and post-resuscitation syndrome.

What developments have there been over the past 10 years?

As cardiac specialists, we are perfusing everything right now. I mean, in complex cases, we have a brain perfusion – and in isolated brain perfusion we can lower the temperature, we can increase it, we can have pressure monitoring in each individual vessel etc. – whatever we want.

There have been tremendous developments in optimising perfusion technology over the last decade, such as the development of heart-lung machines (extracorporeal circulation), ECMO, ECLS, myocardial protection and antegrade and retrograde cerebral perfusion. The next evolutionary step in extracorporeal circulation was treatment during perfusion to maintain physiologic perfusion of normal tissues, and to provide treatment with extracorporeal perfusion for diseased treatment.

What has your research found?

I have worked for over 30 years in the field of organ protection, and myocardial protection. We decided to take the techniques that we had generated over many years for myocardial protection and organ protection, and apply them to the whole body.

We've done research on this in the last 10 years in Freiburg, in pigs, and – to summarise briefly – in our tests we had pigs who were dead (induced ventricular fibrillation), with no cardiac output, no intubation, nothing for 20 minutes, and then we treated them using the CARL principle. This involved controlling the conditions of reperfusion after cardiac arrest and the compositions of the initial reperfusate and automation of analysis of blood parameters to determine individual constituents of the reperfusate.

After treatment with CARL, the pigs were all running around after 5-7 days after the treatment again. Although when we scanned them with MRI there was some damage, they were clinically, neurologically, intact.

After those results, we managed to obtain permission from the ethics committee to apply this technology in 10 patients, the result being six neurologically-intact survivors. So obviously the results are an improvement. That's the story, and it's very promising, so now we are doing further research, and making further improvements.

Tell us about the new Controlled Integrated Resuscitation Device (CIRD) you have been involved in developing?

At the end of 2017, we will have a completely new perfusion apparatus, which is not comparable to the heart-lung machine, not to ECMO, or ECLS, also not comparable to the (TransMedics, USA) Organ Care System – another isolated perfusion organ system.

With this CIRD device, we change the initial conditions of perfusion. In terms of the conditions, it means high blood pressure, pulsatility, immediate hypothermia – that also fits in because nowadays everybody uses hypothermia, but only when they are in the hospital, and then it takes another three to four hours before the temperature goes down. But now we have a portable hypothermic device, which can lower the temperature from 36°C down to 33/32°C within 15 or 20 minutes.

We can also alter the blood which is returned back to the patient. When we take blood from the femoral vein, we can then change it in many ways – because we know there is oedema formation in the brain all the time after CPR. So it's a hyperosmolar solution. We also lower the calcium because we know there is a huge calcium influx into the cells.

We also, by the way, do not defibrillate the patients any more, rather we use so-called secondary cardioplegia, i.e. we give a bolus of potassium to stop the heart, and then the heart starts by itself, back to a regular rhythm again.

All this is in some way automated. We test the limits for all these parameters the way we want to, and then the machine provides us with a mixture of the crystalloid solution and blood. The PO2 also has to be low, not high– nowadays everybody is intubated and then regulated with 100% oxygen, which eventually results in a PO2 of 300 or 400 mmHg, thus creating free radical formation all the time. But we lower it to 100 mmHg.

So there are many, many aspects to it, and that's the reason why it took up to 10 years in the animal lab to figure out exactly what had to be done, which had to be changed, and in what way.

"Neurologic survival rates after CPR are still only 20% in-hospital, and 2% outside, despite the greater availability of defibrillators at airports and elsewhere."

Friedhelm Beyersdorf

"At the end of 2017, we will have a completely new perfusion apparatus, which is not comparable to the heart-lung machine, not to ECMO, or ECLS... CIRD 2.0 [is] really portable: you can put it in your hands and walk around."

Friedhelm Beyersdorf

You mentioned the portability of the CIRD device. What more can you tell us about this aspect in particular?

CIRD 1.0 was the one which we use only here in our hospital, because it's huge. You cannot transport it anywhere. We have one floor where we have the cardiac surgical ICU, the anaesthesiology ICU, and the internal medicine ICU, and the device can only really be moved between those areas. But this is only the first prototype.

The next device CIRD 2.0, is a really portable one: you can put it in your hands and walk around. Just this past month we have used it for the first time, in an animal, and it worked very well. Now we are now actually already in the process of evaluating how the CIRD 2.0 will work, and if there are any problems.

So there are still some things to work on, but in general we have another six to nine months, so we'll work on it then to iron out any last issues.

Cardiac | Focus Session | Training in cardio-thoracic surgery

Flipping the Classroom: Innovations in training

Simon Kendall South Tees Hospitals NHS Foundation Trust, Middlesbrough, UK

The 'Flipped Classroom' is an educational term to describe how education can be taken out of the classroom, harnessing technology to deliver the content – e.g. via videos or on-line information resources, rather than sitting in a classroom. Possibly first described in 1993 in 'From Sage on the Stage to Guide on the Side' by Alison King, and then further developed by Eric Mazur in 1997's 'Peer Instruction: A User's manual', the technique became more recognisable when Salman Khan founded the Khan Academy using videos of lectures that students could choose to view depending on their areas of need. In this way the classroom then becomes an arena where students consolidate their understanding of the knowledge with the help of a mentor.

Surgery, including cardiothoracic surgery, has probably adopted this style of education by accident rather than by design, although a structured study has shown benefit for junior surgeons.[1] But just how are we doing the flipped classroom? Possibly in two ways – one traditional and one more innovative.

The traditional route

Traditional surgical teaching adopts the three domains shown in Figure 1: before, during and after 'class' – where the classroom is the operating theatre. Before theatre there is the opportunity to gain knowledge from outpatients, assessment on admission and case-based discussion. During the case there is the opportunity to discuss the techniques and receive immediate feedback if the trainee is performing the case. Finally, after the case there is the opportunity for reflection and feedback as well as the time to further research the learning points that arose in the case.

Innovative approach

The innovative surgical learning environment has certainly adopted the flipped classroom. As a surgical community we are enjoying the medium of on-line learning such as YouTube to share techniques. Just type in 'cardiac surgery',

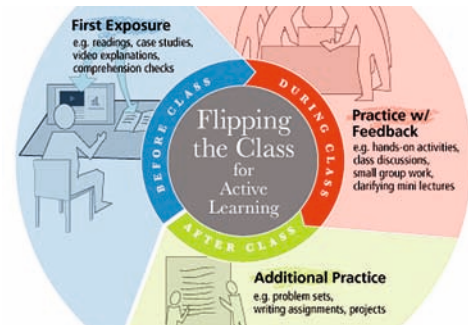

Figure 1. The 'flipped classroom' approach

'thoracic surgery' or 'mini mitral repair'; what a range of material is now available to the surgeon! However, this needs some filtering – and organisations such as CTSNET, EACTS and SCTS are able to create order from the chaos of the internet and give us structured access to this material. When we have a new problem do we go to a text book or do we Google the question? And then do we access the more reliable resources of peer reviewed literature and structured videos?

In the UK, the Society for Cardiothoracic Surgery, in partnership with Ethicon, deliver two courses in each year of training for every trainee – these courses are linked to the cardiothoracic curriculum and in effect they are a combination of the traditional classroom and the flipped classroom. The students will vary in their knowledge and their experience, so the lectures for some will present new material, and for others will consolidate their experience. As in the flipped classroom these courses are an opportunity for reflection and assimilation of knowledge with the aid of an experienced and motivated faculty. On these courses the trainees are brought together from different units to share their learning experiences and gauge how they are progressing against their peers.

The feedback from the delegates and faculty has been excellent so far and there is evidence of competency progression after these courses – for the majority these courses are a flipped classroom and are another example how this method of learning can be so effective.

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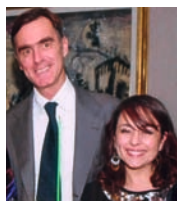
Cardiac | Abstract Session | Minimally invasive mitral surgery

Minimally-invasive heart valve surgery: Influence on coagulation and inflammatory response

Domenico Paparella and Micaela De Palo University of Bari Aldo Moro, Department of Emergency and Organ Transplant Santa Maria Hospital – Bari GVM Care & Research, Italy



Cardiac surgery has been continuously evolving since its birth, over time orienting more and more towards a 'minimally-invasive' approach, which aims at reducing the surgical trauma known to be a potent trigger of the inflammatory and coagulation systems. Another important trigger for a systemic inflammatory response syndrome, along with a massive activation of the coagulation cascade, is cardiopulmonary bypass (CPB), the effects of which increase with the prolongation of CPB time.

Considering these negative effects, as well as the possible benefit of minimised surgical exposure on the same pathways, we compared inflammatory and coagulation parameters in patients undergoing minimally-invasive or conventional cardiac valve surgery.

A prospective non-randomised study was performed enrolling 79 patients undergoing mitral (20 right mini-thoracotomy and 18 standard sternotomy) and aortic valve (20 mini-sternotomy and 21 standard sternotomy) procedures. Blood samples were collected before (T0), during (T1, T2) and after (T3, T4, T5) surgery to measure prothrombin fragment 1.2 (PF1.2, thrombin generation), plasmin antiplasmin complex (PAP, fibrinolysis) and interleukin-6 (IL-6, inflammation). Plasma free haemoglobin (f-Hb) was assessed to evaluate haemolysis.

Patients in the minimally-invasive group were younger and had fewer co-morbidities. CPB and cross-clamp times were comparable considering both aortic and mitral procedures, but longer in the mini-thoracotomy group (respectively 132 and 89 minutes in mini-thoracotomy vs. 105 and 77 minutes in standard sternotomy,

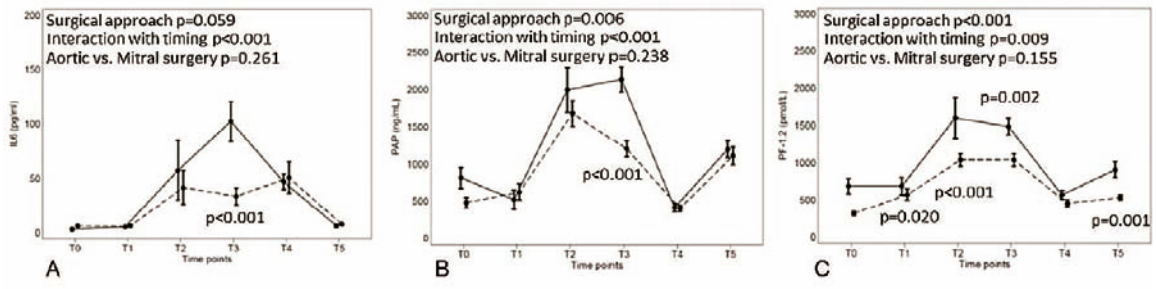


Figure 1. (A) Interleukin 6 (IL-6), (B) plasmin-antiplasmin complex (PAP), (C) prothrombin fragment 1.2 (PF1.2) in minimally-invasive (Mini Group; dashed lines) versus conventional (Standard Group; solid lines) surgery

p=0.038 and p=0.044). IL-6 and PAP were significantly reduced in the minimally invasive group, particularly 2 hours after CPB weaning. PF1.2 was also significantly reduced during and after the operation. Despite the use of vacuum-assisted active venous drainage (VAVD) f-Hb was significantly reduced in the minimally invasive group 24 hours after surgery. The other routine biomarkers such as CRP, Fibrinogen and cTnI were also significantly reduced in the minimally invasive group.

We demonstrated that a minimally-invasive approach is associated with a decreased activation of the inflammatory and coagulation systems as compared to standard sternotomy, even with some differences between mitral and aortic valve procedures.

Excessive activation of the inflammatory pathway is associated with worse post-operative outcomes, even if a direct association with mortality is yet to be demonstrated. In particular, IL-6 release has been recently associated with increased risk of post-operative acute kidney injury. We observed that IL-6 and CRP were significantly decreased in the minimally invasive group, even in the mini-thoracotomy group which had longer CPB times. This finding corroborates the fact that surgical trauma alone is a more powerful trigger for inflammation than CPB itself.

Minimally-invasive cardiac surgery is a challenging technique that requires a long learning curve, which is the reason why it is still performed in a minority of scheduled operations. The trend is increasing and depends on surgeons' training and motivation to change well-established techniques. Besides cosmetic and psychological advantages, clinical improvements have been described for patients receiving minimally-invasive procedures. Our data offer further evidence supporting the adoption of minimally-invasive approaches.

Cardiac | Focus Session | Evidence based decision making in aortic valve surgery

PERSIST-AVR tests "a new kind of prosthesis"

Earlier this year, LivaNova (UK) announced the first recruitments to the PERSIST-AVR trial, the prospective, randomised, multicentre, post-market non-inferiority study of the Perceval sutureless valve versus conventional aortic valve replacement. Principle investigator Theodor Fischlein (Department of Cardiac Surgery, Cardiovascular Center, Paracelsus Medical University (PMU), Nürnberg, Germany) will address the question: when and why use sutureless valves?

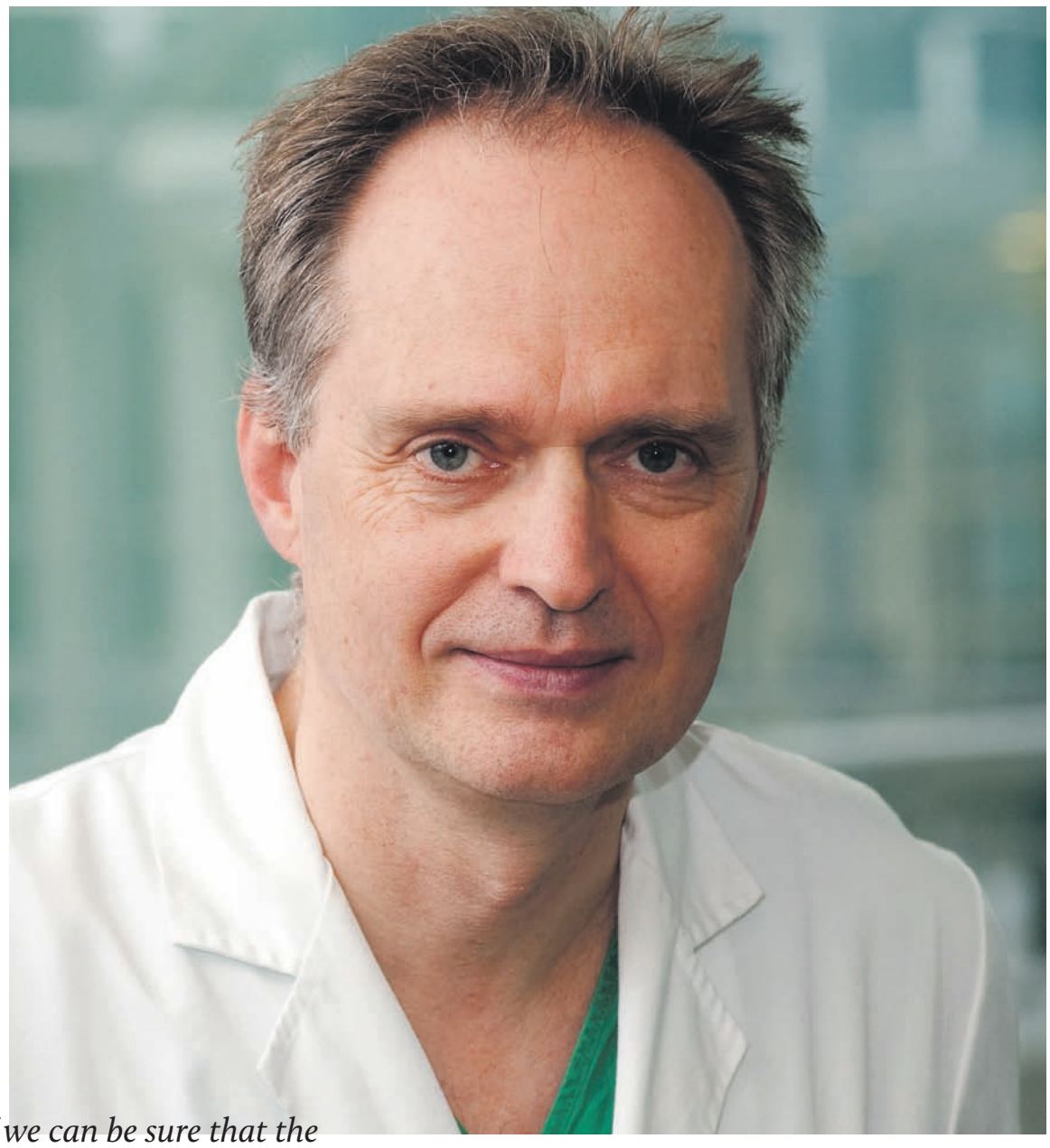
Speaking to *EACTS Daily News*, Professor Fischlein outlined the intentions of PERSIST-AVR, whose assiduous design seeks to demonstrate the non-inferiority of the Perceval with its sutured counterparts. "We wanted to cover the lack of prospective randomised data between sutureless valves and standard biological sutured valves, because this was not done up to now," he noted, adding: "What we have done up to now is the Cavalier study; this was also multicentre, and the biggest cohort we have to date – but it was not a randomised comparison.[2]"

What are the advantages of going sutureless? Valves like Perceval go hand in hand with the minimally-invasive approach due to their foldability, offered Professor Fischlein, and not having the suturing step translates into shorter operating times and procedural reproducibility: "What is very important is that you can reduce ischemic time – clamping time of the aorta – by one-third, and up to one-half. The mean clamping time is about 30-32 minutes, which is a much lower clamping time than with a conventional valve where we need about 45-50 minutes. Because of that, it is an excellent valve for older patients or higher risk patients."

Perceval comprises bovine pericardium fixed to a nitinol stent, which is delivered in folded form to its intended resting place, released at the aortic root and balloon-dilated.

Going on to highlight other patient groups who may benefit from sutureless procedures, Professor Fischlein noted those 'grey area' patients for whom the choice between interventional or surgical approaches is not clear-cut. For patients with calcified aortic root, where conventional valves fall short when it comes to suturing, the sutureless valve may fare better, reducing embolic risk.

"We even do a lot of re-do operations with this valve," he continued, "Because if you have, for example, an implanted stentless valve or a homograft valve, normally the root becomes very much calcified. With this sutureless valve, you can just excise the leaflets and then you implant. This is a big advantage because you don't need to implant those 12-15 sutures.



"If we can be sure that the valve degeneration and haemodynamic properties of this valve are the same as the conventional valve, then we can use it for every single patient."

Theodor Fischlein

"And because this valve does not have a suture ring, it also means that we can implant a bigger size than a conventional valve. For patients it is very important to have as big a size as possible of this prosthesis to achieve a good haemodynamic situation."

Experience plays a key role in ensuring the robustness of PERSIST-AVR's findings; institutions taking part must have at least two physicians experienced with Perceval. "In our institution we have now a big experience with this valve," said Professor Fischlein. "For us, it is a different procedure: sizing is very important, maybe more important than what we are used to normally; how to deploy the valve is different. This is the learning curve, and it takes, I would say, at least 20 cases until you feel familiar with the prosthesis. The prosthesis is very simple in use, but it is a new device.

"We all grew up with mechanical or biological valves that you had to suture in. In the interventional implantation of aortic valve prosthesis, you do not have any suturing; you just implant this valve into the old sclerotic valve, and that is it. Now, we actually explant the old calcified valve and then we implant the valve that does not need sutures.

"The [Perceval] prosthesis also looks different to what we are used to, because it does not have a suture ring. We have another one from Edwards Lifesciences [USA] – the Intuity – which is called a 'rapid deployment device'. It is more or less sutureless, but for this valve we still need three sutures. This is the big difference between the two: one is a stented valve with a suture ring needing three sutures (which is still faster than what we have in conventional valves), but the Percival valve can be folded to make the circumference smaller at introduction. It is not crimping, like in the TAVI valves, but it can be folded smaller to make it easier to put it down into the position of the annulus of the aortic valve. Then you deploy a nitinol stent, and within this stent is the biological pericardial valve."

PERSIST-AVR is recruiting all patients eligible for aortic valve replacement due to aortic valve stenosis. At least 1,234 subjects will be enrolled at investigational sites worldwide.These subjects are beir randomised to either conventiona sutured or Perceval valve. Re-valve procedures are being excluded – although perhaps posing an interesting question further down the line – but along with isolated procedures many will be combined with coronary artery bypass graft.

PERSIST-AVR's primary endpoint is non-inferiority of MACCE (major adverse cardiovascular and cerebral events) during follow-up. Interestingly, the investigators will also be looking into resource consumption and hospital discharges relating to patients treated with Perceval, compared to standard aortic valve replacement.

Returning to the question posed by the title of his talk – when and why? – Professor Fischlein described, from his surgical perspective, how devices like Perceval are carrying surgery along the current towards less invasive procedures that are becoming the new norm: "If a patient has a problem with his valve he goes to the cardiologist, many of whom now ask, 'do you want to have a puncture in your groin or an open chest?' Of course most patients say 'no' to an open chest!

"This is why I say that we have to work more and more with minimally invasive access for valve replacement. We do this for mitral valve surgery already since years ago, but for aortic valve surgery it is not so common. In Germany, according to one of our last statistics, we do only about 20-22% via mini-sternotomy. I think it is same in Britain and the rest of Europe. And, actually, I don't know why. But it would be much easier to do this procedure with sutureless valves for many surgeons.

"In the end, if our first results of our PERSIST-AVR study now show non-inferiority to conventional valves, I would say that the next question really becomes very big: what do we actually need conventional valves for?"

The Perceval valve was first used in 2007, meaning that next year it will be possible to analyse the first of its 10-year follow-up. "If we can be sure that the valve degeneration and haemodynamic properties of this valve are the same as the conventional valve, then we can use it for every single patient," concluded Professor Fischlein. "Maybe this is our new direction – a new kind of prosthesis."

Professor Fischlein presents 'Sutureless valves when and why?' during Monday's Focus session entitled 'Evidence based decision making in aortic valve surgery,' taking place in room 112 between 8:15 and 9:45.

Cardiac | Focus Session | Latest trials in cardiovascular medicine

STICHES: CABG reduces 10-year mortality for patients with ischaemic cardiomyopathy

Torsten Doenst
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The effect of coronary artery bypass grafting (CABG) in patients with relevant coronary artery disease and impaired systolic function has never been tested in a prospective randomised trial before the Surgical Treatment of IsChemic Heart failure (STICH) trial. Despite a favourable five-year outcome, a survival benefit of a strategy of coronary-artery bypass grafting (CABG) added to guideline-directed medical therapy, as compared with medical therapy alone, has been unclear in these patients. Professor Torsten Doenst now presents the 10-year outcome of the extension study (STICHES) on behalf of the STICH study group (see also Velazquez et al. NEJM 2016)

From July 2002 to May 2007, a total of 1,212 patients with an ejection fraction of 35% or less, and coronary artery disease amenable to CABG were randomly assigned to undergo CABG plus medical therapy (CABG group, 610 patients) or medical therapy alone (medical-therapy group, 602 patients). The primary outcome was death from any cause. Major secondary outcomes included death from cardiovascular causes and death from any cause or hospitalisation for cardiovascular causes. The median duration of follow-up, including the current extended-follow-up study, was 9.8 years.

A primary outcome event occurred in 359 patients (58.9%) in the CABG group and in 398 patients (66.1%) in the medical-therapy group (hazard ratio with CABG vs. medical therapy, 0.84; 95% confidence interval [CI], 0.73 to 0.97; p=0.02 by logrank test). A total of 247 patients (40.5%) in the CABG group and 297 patients (49.3%) in the medical-therapy group died from cardiovascular causes (hazard ratio, 0.79; 95% CI, 0.66 to 0.93; p=0.006 by log-rank test). Death from any cause or hospitalisation for cardiovascular causes occurred in 467 patients (76.6%) in the CABG group and in 524 patients (87.0%) in the medical-therapy group (hazard ratio, 0.72; 95% CI, 0.64 to 0.82; P<0.001 by log-rank test).

The authors conclude that in a cohort of patients with ischaemic cardiomyopathy, the rates of death from any cause, death from cardiovascular causes, and death from any cause or hospitalisation for cardiovascular causes were significantly lower over 10 years among patients who underwent CABG in addition to receiving medical therapy than among those who received medical therapy alone. (The study was funded by the National Institutes of Health; STICH [and STICHES] ClinicalTrials.gov number, NCT00023595.)

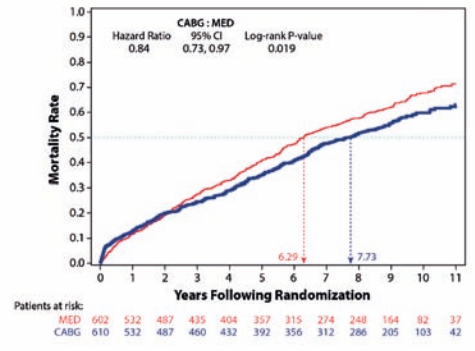

Figure 1. Kaplan–Meier estimates of the rates of death from any cause. Note that performing CABG in these patients extends life expectancy by almost 18 months over the 10-year follow-up

Cardiac | Focus Session | Latest trials in cardiovascular medicine

Aspirin and coronary artery bypass surgery

Julian A Smith Monash University and Monash Health, Melbourne, Australia

Many patients with coronary artery disease are taking aspirin for primary or secondary prevention of myocardial infarction, stroke and death. Aspirin taken at the time of coronary artery bypass surgery (CABG) creates a potential risk of excessive bleeding. To date, there has been a lack of evidence as to whether or not aspirin should be ceased prior to CABG. Traditionally most centres tended to withhold aspirin for 5 to 7 days in the lead up to CABG. A collaborative multi-centre international study (19 hospitals in 5 countries) was therefore conducted to investigate whether stopping or continuing aspirin before CABG posed more risks or benefits.

The study, as part of the Aspirin and Tranexamic Acid for Coronary Artery Surgery (ATACAS) trial, employed a 2-by-2 factorial design to randomly assign patients scheduled for CABG and at risk for post-operative complications to receive aspirin or placebo and tranexamic acid or placebo. The results of the aspirin arm of the trial have been reported and presented.

Preoperatively the patients were randomly assigned to receive 100 mg of aspirin or a matched placebo. The 100 mg dose was deemed to have the strongest evidence of preventative efficacy (at least in nonsurgical settings) balanced against a low risk of bleeding complications. The primary outcome measure was a composite of death and thrombotic complications (nonfatal myocardial infarction, stroke, pulmonary embolism, renal failure, or intestinal infarction) within 30 days following surgery.

A total of 2,100 patients were recruited, with 1,047 randomly receiving aspirin and 1,053 receiving placebo. For the aspirin group 202 patients (19.3%) and for the placebo group 215 patients (20.4%) experienced a primary outcome event – relative risk of 0.94 and 95% confidence interval of 0.80 to 1.12 with p=0.55. Excessive bleeding resulting in a return to the operating theatre occurred in 1.8% of patients in the aspirin group and 2.1% of patients in the placebo group (p=0.75) and cardiac tamponade was seen in 1.1% and 0.4% respectively (p=0.08).

It was concluded for patients undergoing CABG that the administration of aspirin preoperatively neither lowered the risk of death or thrombotic complications nor raised the risk of bleeding compared with placebo. From this study there appears to be no reason to cease aspirin prior to CABG. An important caveat to this recommendation would be for patients with a pre-existing bleeding disorder or possessing other major risk factors for bleeding. Overall this study provides a stronger level of recommendations surrounding the administration aspirin at the time of CABG.

Further reference

Myles PS, Smith JA, Forbes A, Silbert B, Jayarajah M, Painter T, Cooper DJ, Marasco S, McNeil JJ, Bussieres JS, Wallace S for the ATACAS Investigators and the ANZCA Trials Network. Stopping versus continuing aspirin before coronary artery surgery. N Engl J Med 2016;374:728-37.

Cardiac | Rapid Response | Trends in aortic valve replacement

The Ross procedure versus the Bentall operation in patients with ascending aorta dilatation: a propensity score analysis

Alexander Karaskov, Alexander Bogachev-Prokophiev, Ravil Sharifulin, Sergey Zheleznev, Igor Demin and Alexander Afanasyev
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Although the Ross procedure provides excellent long-term survival and a high quality of life, it is not widely used in patients with concomitant ascending aorta aneurysms. There are limited data on comparing the Ross procedure and the Bentall operation, thus in the present study we compared results of these two methods.

Between 2011 and 2015, 151 adult patients with aortic valve disease and concomitant aortic root dilatation (≥45 mm) were enrolled in this prospective study. Inclusion criteria were patient's age ≥18 years, indications for aortic valve surgery – when aortic valve repair is not possible, and aortic sinus diameter ≥45 mm. The patient exclusion criteria were presence of mitral and tricuspid valves pathologies requiring replacement, pulmonary valve anomalies, Marfan syndrome and other genetic diseases, severe left ventricle impairment (left ventricle ejection fraction ≤30%), aortic arch and descending aortic aneurysms, or aortic dissections DeBakey types I and III. The Bentall operation was performed in 63 patients and the Ross procedure in 88 patients. After a propensity score-matching we obtained two groups with 45 patients in each and compared them.

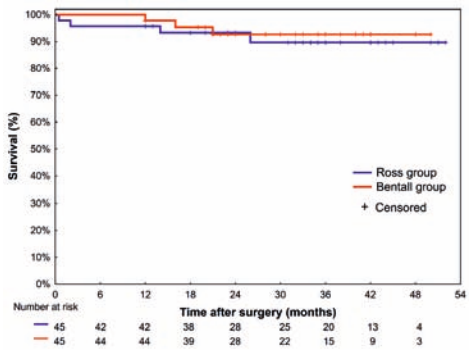

Figure 1. Survival comparison between the Bentall and the Ross groups

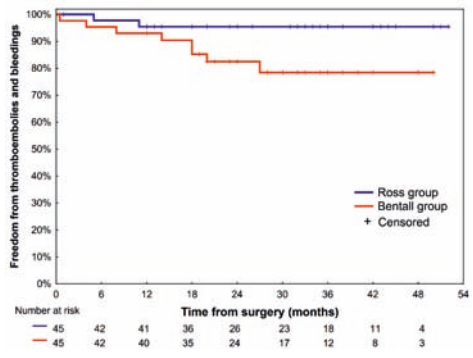

Figure 2. Freedom from thromboembolic and haemorrhagic events. Comparison between the Bentall and the Ross group

The early mortality was 2.2% in the Ross and 0 in the Bentall groups (p=1.0). The mean follow-up duration was 28.0±10 months for the Bentall and 29.6±13.6 months for the Ross groups, respectively (p=0.349). The survival rate did not differ between the groups (92.5% for the Bentall and 89.9% for the Ross, Figure 1, p=0.679). There were three autograft reoperations in the Ross group and no reoperations in the Bentall group. The freedom from reoperations was 100% and 92.7% in the Bentall and the Ross groups, respectively (p=0.080). The freedom from composite thromboembolic and haemorrhagic events were significant lower in the Bentall group: 78.0% after the Bentall and 95.5% after the Ross procedure (Figure 2, p=0.046). Patients in the Ross group had better quality of life at last follow-up. The difference was significant for physical functioning (80.9±15.1 vs 72.3±16.6, p=0.032) and mental health (75.9±12.4 vs 70.1±11.9, p=0.019).

Conclusions

Early and late mortality don't differ after the Ross procedure and the Bentall operation. The rate of valve-related complications is significantly higher after the Bentall operation. The Ross procedure provides a higher quality of live in comparison with the Bentall operation. Long-term results are needed.

Cardiac | Rapid Response | Trends in aortic valve replacement

Minimally invasive approach in aortic valve-resuspension procedure

Nadejda Monsefi
University Hospital Frankfurt, Germany

The role of minimally invasive valve surgery is becoming more fundamental, due to its benefits of reduced surgical trauma and pain. Cosmetics, wound healing and recovery time may also be favorable compared to conventional approaches.

A minimally invasive approach in aortic valve resuspension procedures like the David technique has also been reported. The David technique may provide an alternative to conduit implantation in patients with aneurysm of the ascending aorta and aortic valve insufficiency. Having accumulated substantial experience with minimally invasive isolated aortic valve replacement, in 2005 we began performing the David technique via a minimally invasive access through a ministernotomy up to the left fourth intercostal space.

From 2005 to 2015, the minimally invasive David technique was performed in 90 consecutive patients in our department. All operations were carried out through partial upper sternotomy (Figure 1). The mean patient age was 57±14 years; 23 (25%) were female. The mean follow up was 3±2 years.

Additional hemiarch was performed in nine patients, complete arch replacement in 10 patients, and elephant trunk procedure in five patients. There were no in-hospital or late deaths. One patient had perioperative neurologic event (stroke); only two occurred during follow up (1.2%/pt-yr). There were no sternal or wound infections postoperatively. One patient (0.6%/pt-yr) required aortic valve replacement after four years, because of relevant aortic valve insufficiency as a result of leaflet prolapse. There were no bleeding events.

At latest follow up, all patients had aortic valve insufficiency ≤1°. Mean New York Heart Association functional class was 1.3±0.5.

In general, minimally invasive surgical access provides many benefits for patients concerning morbidity and mortality. Minimally invasive operations are already performed routinely in abdominal and thoracic surgery, especially with laparoscopic techniques.

With an experienced team, the minimally invasive David procedure is technically feasible. Minimally invasive aortic valve sparing surgery for patients with ascending aortic aneurysm and aortic valve insufficiency is a durable procedure. Valve-related complications are rare and the rate of reoperations is not increased compared to conduit root replacement. Our mid-term results are encouraging, evidencing the safety and efficacy of this technique through limited incisions.

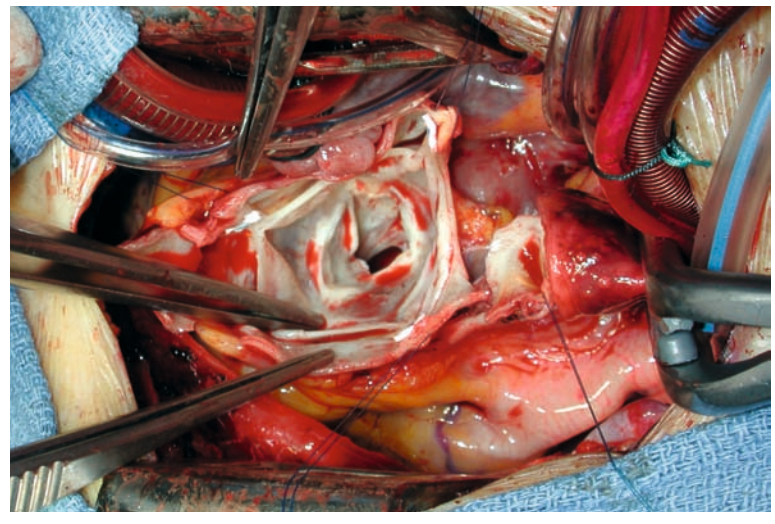

Figure 1: Approach through partial upper sternotomy showing the aortic valve.

The Heart Valve Society

HVS – the Heart Valve Society – leading the future of the Heart Team in Action

Many societies profess to embrace Heart Valve Surgery and Treatment, but only one provides a home for the entire Heart Team – the cardiac surgeons, the cardiologists, and the scientific researchers and practitioners who make up the team that treats patients suffering from heart valve disease.

Other societies have meetings which present science focused in their specialty area, and often the language suggests that one avenue of treatment is better than another. Sometimes there is even a sense of competition among the providers, implying that their way is the only way. Those groups don't encompass the team concept that is vital to the total well-being of heart valve patients. But the Heart Valve Society does just that. The Heart Valve Society is the first truly collaborative, multi-disciplinary society dedicated to the full range of treatment of heart valve disease internationally. Its membership is reflective of an inclusive international organization.

The Heart Valve Society held its second incredibly successful meeting in New York in March, a meeting that saw almost 600 total attendees. The meeting featured sessions of interest to all heart valve practitioners – from surgeons and cardiologists, to researchers, scientists, PA's and nurses. They came because they know of the importance of The Heart Team. And the Heart Valve Society is truly representative of its tagline – the Heart Team in Action.

The very first meeting of the Heart Valve Society was held in Monaco in May of 2015, and even in its first year, had 500 attendees. The interest in a medical society that emphasizes positive collaboration among the providers, and that embraces open discussion about the best routes of treatment for different types of heart valve patients, is boundless.

Next year the Society returns to the beautiful Grimaldi Forum in Monte Carlo, Monaco, with Dr. Gilles Dreyfus as President. Our Abstract submission site is open now and we urge you to send your best work for consideration for presentation – we will feature plenary sessions, multiple concurrent sessions, and poster sessions as well as display posters. Our dates are March 2 – 4, 2017, and early spring will be arriving in Monaco for this extraordinary meeting.

Whether you are a cardiologist, surgeon, researcher, scientist, or another member of the crucial valve disease treatment team, the HVS welcomes you to become a part of something very unique. HVS also offers all members of the heart valve community the opportunity to volunteer, participate, and become active in our committees and working groups. Work with the AVIATOR Registry, volunteer to serve in one of the many aspects of the ever-growing Scientific Research Committee, and inquire about our new Robotic Registry. If you are interested in helping shape the 2017 program – it's not too late to volunteer to be a part of our 2017 Scientific Program Committee and review our 2017 abstracts. Submit your work! Join the HVS! You can learn more about us and sign up for membership and submit abstracts via our website: www.heartvalvesociety.org.

The Heart Valve Society is proudly attending the EACTS Annual Meeting in Barcelona! Visit us while you are in the Exhibit Hall at Booth #18 and let us help you become the newest member of The Heart Team in Action!

Congenital | Rapid Response | Congenital Miscellaneous

Aortic dissection type A complicating a Glenn procedure

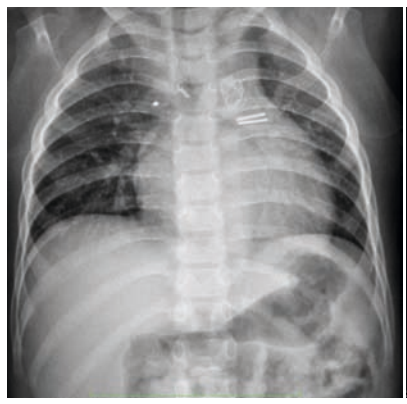

Figure 1. Chest X ray showing the position of the stent in the aortic arch 20 months after the surgery

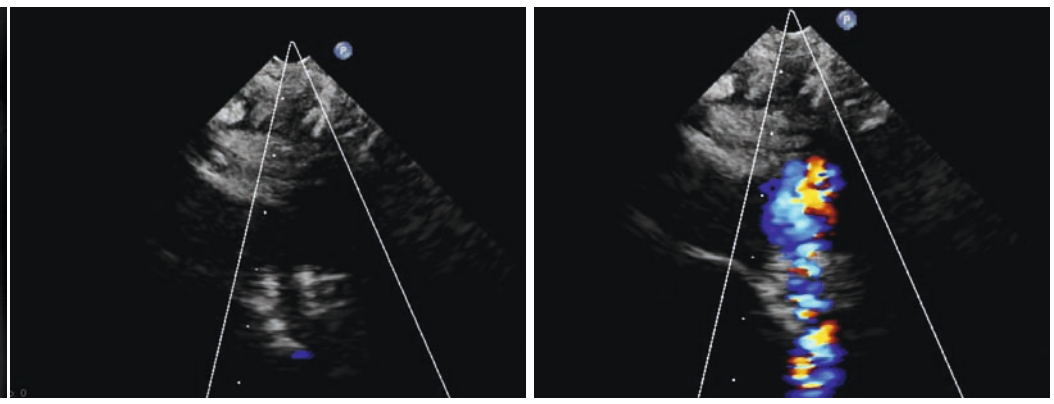

Figure 2A and B. Echocardiogram of the stent and the arch. Doppler flow in the stent does not show turbulence 20 months later

Sara E. Mendoza, Maria C Basto and Victor R. Castillo

Fundacion Cardiovascular de Colombia, Bucaramanga, Santander Colombia

We found this case interesting because it presented suddenly during surgery. In our efforts to not submit the patient to a more complex procedure, we made a life-saving decision that reduced our operating time considerably.

While type A aortic dissection has been reported as an iatrogenic complication during aortic cannulation in adult patients undergoing cardiac surgery, its presence in the paediatric population is almost non-existent.

Re-interventions are known to hold intraoperative risks. For patients with reconstruction of the ascending aorta, cannulation of the graft may be difficult due to structural changes generated in these tissues.

We present the case management of a paediatric patient who presented type A aortic dissection during a Glenn procedure.

A five-day-old female was admitted to our institution with a diagnosis of hypoplastic left heart syndrome. Echocardiography showed a mitral and aortic atresia with an ascending aorta diameter of 2.5 mm, moderate tricuspid regurgitation, patent foramen ovale of 3 mm and a ductus arteriosus. She was taken for a Norwood surgery. The reconstruction of the ascending aorta and the aortic arch was performed with bovine pericardium and a 6 mm Sano PTFE shunt. She presented right ventricular dysfunction, requiring extracorporeal membrane oxygenation (ECMO VA) for 4 days. She maintained satisfactory progress from the post-op period until discharge.

At five months of age (6.9 kg, 66 cm, surface area 0.34 m^2) she developed a progressive stenosis of the neoaorta in its distal portion with a gradient of 14 mmHg, requiring angioplasty. This was performed with a Tyshak Mini® 7* 20-3 at 3.5 and 4.5 atmospheres of balloon pressure and a Sterling 6* 20-5 at 6 and 8 atmospheres of pressure. The final gradient after the procedure was 5 mmHg.

At six days post angioplasty, the patient was taken for a Glenn procedure and plasty of the pulmonary branches. Anesthesia was induced without complications. The patient was monitored with a left femoral arterial line, a right femoral central venous catheter, and a monoluminal internal jugular vein catheter with bilateral near-infrared spectroscopy (NIRS). Lactate was 0.9 nmol/L at induction. Surgery began with cannulation of the aorta, superior vena cava (SVC) followed by the right atrium, and then a partial cardiopulmonary bypass, with no complications.

The SVC was closed and the reconstruction of the pulmonary artery was being performed when a sudden loss of pulsatility occurred. NIRS increased to 95% and the circuit pressures to 100 mmHg. Movement of the aortic cannula was initially suspected (selective perfusion) so we proceeded to re-position the aortic cannula, with no improvement. Pressure line in the aortic root showed adequate pulsatility. Aortic dissection was suspected. The temperature was lowered and a transoesophageal echocardiogram was performed, finding a flap at the level of the aortic arch with interruption of the flow, without the presence of a false light.

Cardioplegia was administered under direct vision and circulatory arrest at 18°C was initiated. Exploration of the aortic arch showed a membrane occluding the lumen of the vessel, which was resected. We decided to implant a Dynamic® 8* 20 fenestrated stent under direct vision, controlling the dissection at the left subclavian artery.

The aorta was sutured, and plasty of the pulmonary arteries and bidirectional Glenn was completed. The rest of the surgery was uneventful. The patient was weaned from CPB with adrenaline, milrinone and nitric oxide. Glenn pressure was 17 mmHg.

Twenty-four hours after surgery, the patient developed increased pressures in the Glenn circuit. The catheterisation study showed stenosis of the right lobar branch anastomosis and the distal portion of the left pulmonary artery. Balloon angioplasty was performed to decrease the system's pressure. The patient was discharged uneventfully.

Currently aged two years, the patient is in good condition: asymptomatic, and medicated with enalapril, spironolactone, acetyl salicylic acid and hydrochlorothiazide. Echocardiography shows adequate function of the single ventricle with no signs of stenosis or re-coarctation.

Vascular | Professional Challenge | EACTS/STS – Acute type A dissection

Aortic length and the risk of dissection. The Tübingen Aortic Pathoanatomy (TAIPAN) Project

Tobias Krüger, Alexandre Oikonomou, David Schibilsky, Mario Lescan, Katharina Bregel, Luise Vöhringer, Wilke Schneider, Henning Lausberg, Gunnar Blumenstock, Fabian Bamberg, Christian Schlensak
University Medical Center Tübingen, Germany

The ascending aorta diameter is the only established morphological risk factor for Stanford Type A aortic dissection (TAD). This parameter triggers prophylactic surgery. However, we hypothesise that aortic elongation may be another risk factor for TAD. Elongation, accompanied by changes in the longitudinal mechanical properties of the aorta may be an element of the pathogenesis of TAD.

We analysed aortic dimensions using contemporary three-dimensional imaging (curved multiplanar reformats) with the aim of refining the risk-morphology for TAD. Three groups were compared retrospectively: patients actually suffering from a TAD (n=153); patients who were about to experience a TAD (preTAD-group, n=19); and a healthy control group (n=235).

Changes in aortic morphology were correlated with patient age, but not with parameters of body size. Age-dependent circumferential dilatation predominantly affects the ascending aorta, whereas aortic elongation is pronounced in the distal arch.

Effective screening to identify those at-risk of TAD is certainly desirable, however a screening based solely on aortic diameter is bound to be ineffective: aneurysmatic aortas do have a high risk of dissection, but aneurysm prevalence in the population is low, and most dissections happen at diameters of <55 mm. In our study, although median diameters of preTAD and TAD aortas were significantly greater than those of the control group (43 mm vs. 50 mm vs. 34 mm respectively; p<0.001), 95% of preTAD and 68% of TAD aortas were <55 mm.

TAD and preTAD aortas were elongated compared to control aortas, particularly in the ascending aorta and arch. In the control aortas the central line distance from the aortic valve (AV) to the brachiocephalic trunk (BCT) was 97 mm. In preTAD aortas, it was 106 mm, and it was 117 mm in TAD aortas (p<0.001). Within 98% of the control patients, the central line distance between the aortic annulus and the brachiocephalic trunk was <120 mm, whereas 21% of the pre-TAD and 46% of TAD aortas exceeded this value. In our opinion, this provides the basis to consider central line distances from the aortic valve to the brachiocephalic trunk of ≥120 mm as pathological.

Table 1. Proposed two-dimensional prognostic score indicating prophylactic ascending aorta replacement.

Parameters		Points
Diameter of Ao ascendens	<45 mm	0
	45 mm-54 mm	1
	≥55 mm	2
Length of Ao ascendens	<120 mm	0
(3D-central line; AV to BCT)	≥120 mm	1
Prophylactic ascending aorta replacement at ≥2 points		

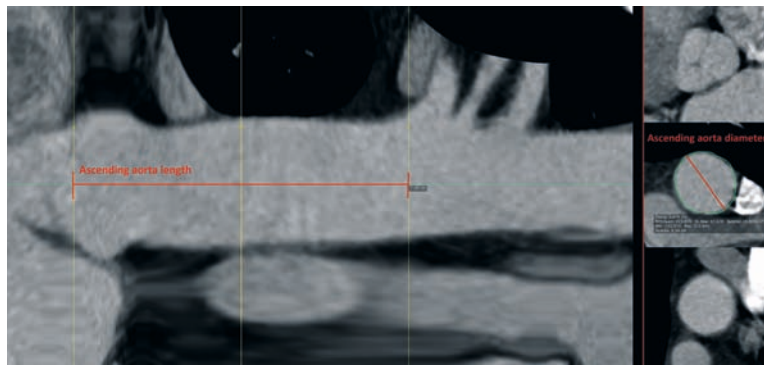

Figure 1. Measurement of ascending aorta diameter and length, the latter being the central line distance from the aortic valve to the beginning of the brachiocephalic trunk.

We propose a two-dimensional prognostic score composed of the ascending aorta diameter (<45 mm; 45 mm–54 mm or ≥55 mm) and the distance from the aortic valve to the brachiocephalic trunk (<120 mm or ≥120 mm). Patients that have at least 2 points in this score may be considered for prophylactic ascending aortic replacement. An ascending aorta diameter of 55 mm leads to 2 points and, consequently, to surgery, which matches the actual guidelines. A dilated aorta of ≥45 mm and a 3D central line distance between the AV and the beginning of the BCT of ≥120 mm are rated at one point each. In our data, this score had a specificity of 1.0 and a sensitivity of 0.21. The clinical value of this score has to be evaluated in future studies.

Thoracic | Focus Session | Oncology tumour board

Who gets induction therapy in non-small cell lung cancer?

Marcelo Jimenez and Mª Teresa Gomez Salamanca University Hospital, Spain

Surgery alone remains the treatment of choice for early stage non-small cell lung cancer (NSCLC). But advanced stages of NSCLC (especially stage IIIA for N2 disease) have a worse prognosis, and as such surgery has a role as part of multimodality treatment.

Induction therapy, usually chemotherapy or chemoradiation, is used to treat patients with resectable, locally advanced NSCLC with the following objectives:

- To eliminate systemic micrometastatic disease
- To achieve downstaging through the sterilisation of the affected lymph nodes and reduce the extent of tumour to enable a lesser resection,
- To ensure that during the treatment, metastatic disease does not appear.

All therapeutic decisions in NSCLC patients should be adopted after discussion within a multidisciplinary team including an oncologist,

radiotherapist, pulmonologist, and thoracic surgeons. Only surgeons actively involved in decision-making guarantee the accurate selection of cases to avoid exploratory operations and incomplete resections or to deny operation to surgical candidates.

Appropriate staging is essential because treatment recommendations and prognosis vary significantly by stage. Even in completely clinically staged patients, the rate of intraoperatively found or occult N2 disease is not negligible, representing more than 5% of the cases.

However, intraoperative staging is essential. There is a vast body of evidence showing that some patients with lymph node metastases detected at the time of surgery could have an overall survival benefit from adjuvant therapies.

There is unfortunately no consensus as to what studies should be included in re-staging, and what degree of residual disease should prompt the consideration of resection. In spite of the fact that patients achieving complete pathologic response of their nodes have the best overall prognosis, with an overall 5-year survival ranged from 40 to 70%, patients with residual N2 disease could benefit from adding surgical resection to an induction regimen leaving persistent residual disease.

The approach in many centres typically comes down to what is considered 'resectable' or 'unresectable' disease, with imaging and other diagnostic tests directed toward accurate determination of this status for an individual patient.

Recently the chemotherapy timing in resectable stage III (N2) NSCLC was evaluated using the National Cancer Database. Not surprisingly, patients with resected pN2 disease who underwent adjuvant chemotherapy had better 5-year survival than did those who underwent operation alone. However, even more interesting, no difference was observed between induction and adjuvant chemotherapy. Cerfolio and colleagues noted that the outcome for patients with residual N2 disease approaching that of complete responders.

A meta-analysis conducted by Elnay and colleagues showed that, in trials of NSCLC with N2 disease, patients who underwent operations as part of a trimodality treatment had improved overall survival compared with those who received chemoradiotherapy alone.

But the question remains: how much residual disease after neoadjuvant therapy is enough to obtain benefit from surgical resection? Should microscopic single-station only be considered, or macroscopic single-station, or microscopic multi-station? Precise studies will be crucial to determining which patient subsets with N2 disease really benefit from the addition of surgery to neoadjuvant treatment.

Cardiac | Focus Session | Improving outcome of left ventricle assist device therapy

Tailored implantation techniques and device selection

Jan D. Schmitto, Sebastian V. Rojas and Axel Haverich
Cardiac Transplantion and Mechanical Circulatory Support, Hannover Medical School, Germany

Left ventricular assist device (LVAD) therapy is currently one of the most powerful core areas in cardiac surgery. During the past 20 years, outcomes of LVAD therapy have improved dramatically: While in 2001 the REMATCH trial celebrated two-year survival rates of 23% applying the old HeartMate XV (Thoratec)[1], only 16 years after, mean survival rates have surpassed 80% in the same period following LVAD implantation[2]. Thus, it seems hard to find another therapy that has developed so fast, with such important improvements and in such a short period of time[3].

Consistently improved technology, and further research and clinical experience within the first decade of this century have established VADs as an important option for the treatment of congestive heart failure. However, important complications such as bleeding and thrombosis, postoperative right heart failure or infections limit wide-spread adoption of this therapy. An important development of the past five years is the emergence of novel devices[4,5] and less-invasive surgical procedures[6]. Both have revolutionised LVAD therapy: Miniaturisation of new generation LVADs has enabled less-invasive surgery, improving perioperative complication rates and postoperative outcomes. On the other hand, contemporary devices such as HVAD (HeartWare – Medtronic), HeartMate 3 (Thoratec – St. Jude Medical) and aVAD (ReliantHeart) are including innovative features addressing important disadvantages from previous generation LVADs.

From now on, heart failure specialists will have the choice among devices with different benefits for each patient group: tailored less-invasive implantation surgery for the LVAD candidate with impaired RV function, reduced blood trauma for destination therapy patients with higher gastro-intestinal bleeding risk or remote monitoring for the patient that lives far away from the treating heart failure centre. In our presentation we will review tailored surgical techniques, patient-centred device selection and provide a future outlook of VAD therapy.

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Vascular | Professional Challenge | EACTS/STS – Acute type A dissection

Fate of the dissected aortic arch after ascending replacement in type A aortic dismsection

Bartosz Rylski[1], Natalie Hahn[1], Friedhelm Beyersdorf[1], Philipp Blanke[2], Tomasz Plonek[3], Martin Czerny[1], Matthias Siepe[1]
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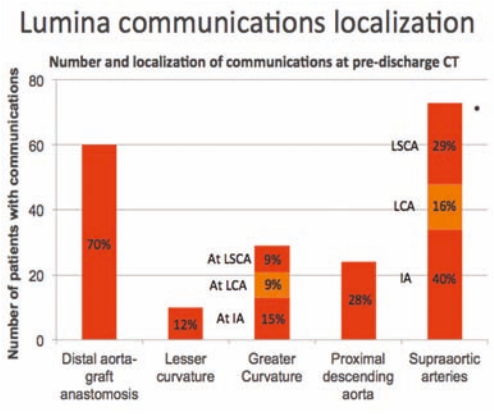

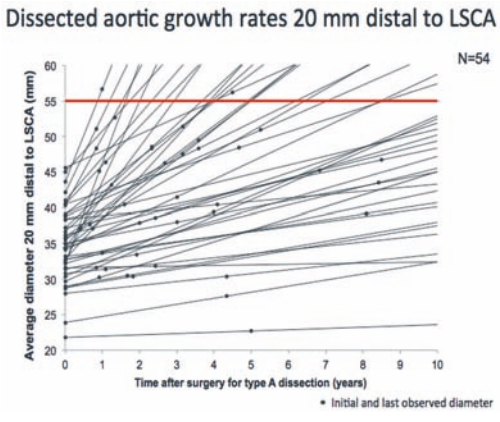

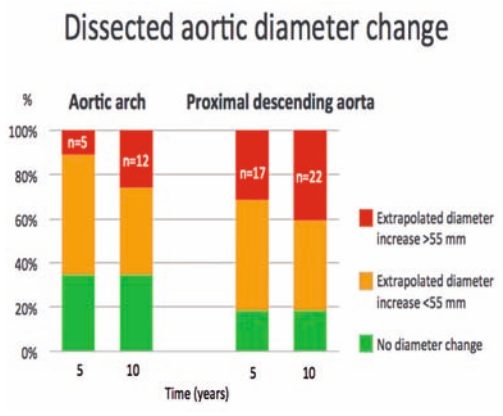

The primary aim of emergency surgery in acute type A aortic dissection is to save the patient's life by replacing the ascending aorta to prevent aortic rupture, correcting the aortic valve insufficiency, and directing the blood flow into the aortic true lumen to prevent malperfusion. In approximately 70% of patients, type A dissection extends beyond the ascending aorta and involves the aortic arch.

There is a paucity of data on anatomical changes of the aortic arch over time in patients with persisting dissection membrane within the arch after limited repair of acute dissection type A. Our aim, therefore, was to evaluate the consequence of not replacing the dissected aortic arch and the proximal descending aorta and to identify the anatomical risk factors for an accelerated growth of the dissected aortic arch.

In a group of 271 patients with acute type A dissection, we found 86 patients with residual dissection in the aortic arch after surgery. The findings of this study can be summarised as follows.

The vast majority of patients had at least one communication between lumina in the aortic arch or supraaortic arteries.

The true lumen diameter in the dissected aortic arch was larger in the proximal arch segment and smaller in the distal arch segment decreasing to 50% of the total aortic diameter.

The true lumen diameter increased proximally at the level of the IA. It did not increase in other, more distal segments.

The fastest increase in the total aortic diameter was observed 2 and 4 cm distal to the LSCA reaching an average of +1.5 mm/year.

Five and 10 years after type A dissection surgery, 39% and 50% of the patients, respectively, may develop a proximal descending aortic aneurysm (>55 mm) according to a linear model of aortic growth.

The number of communications between lumina in the aortic arch, their sizes and false lumen perfusion increased the risk of aneurysmal dilatation of the dissected arch.

We concluded that aortic arch residual dissection after surgical repair for type A dissection leads to aortic growth, which may result in arch aneurysm and the need for further surgery within several years. The number and size of communications in the aortic arch, as well as the false lumen perfusion, increase the aortic arch growth rate. The anatomy of the dissected aortic arch differs significantly from the anatomy of the non-dissected arch with respect to the existence of false and true lumina as well as multiple communications between them. The number of communications in the aortic arch identified at pre-discharge CTA was immense. Taking into consideration the fact that 36% of the patients had communications in the aortic arch at the greater or lesser curvature, there is a need for more careful intraoperative assessment of communications present in the aortic arch, which indicates the need for total aortic arch replacement according to the guidelines. Endovascular repair of the dissected aortic arch can be limited by the small true lumen of the arch and multiple communications between lumina.

Cardiac | Focus Session | Monitoring Quality in Your Unit: State of the Art

Governance and Risk management Structure – "Black Box Thinking"

Tessa Oelofse
Queen Elizabeth Hospital Birmingham, UK

On 29th March 2005 at 7.15, Martin and Elaine Bromiley, married for fifteen years, left home. Elaine – a 37-year-old mother of two young children – had been suffering with sinus problems for two years had been advised that it would be sensible to have a minor operation to deal with the problem once and for all. The risks are tiny, the doctor advised her. Elaine had a standard anaesthetic, however two minutes after induction her oxygen saturation had fallen to 75%. The anaesthetists could nor ventilate or intubate the airway. Another anaesthetist from an adjacent theatre was called to help. Ten minutes after induction and the oxygen saturation was now critical, with a very low heart rate. The two anaesthetists were joined by the ENT surgeon, who also tried to intubate the airway. An experienced theatre nurse anticipated that a tracheostomy would be the obvious next move and darted out to fetch the kit. She returned and informed the three doctors that the tracheostomy kit is ready for use. They briefly glanced at her, and proceeded with their attempts to intubate the airway. On April 11, Elaine died from a hypoxic brain injury after being on ITU for 13 days, following a routine, minor operation.

Governance and Risk Management is an essential part of providing high quality, safe, patient-centred care. In practice, what does this mean for clinicians at the forefront of patient care? How can we interpret and learn from risk management and governance to ensure patient safety and quality of care?

In 1912, 57% of US airline pilots died in crashes, and in 2013 there were 36.4 million commercial flights, carrying 3 billion passengers, with 210 fatalities. Yet preventable medical errors are the third leading cause of death worldwide, behind cancer and heart disease. Preventable harm is estimated to affect 400,000 patients per annum. The difference between health care and aviation lies in our approach to management of failure. The challenge is changing mindsets and it involves a whole new way of thinking and a change in our culture.

"The definition of insanity is to do the same thing over and over again, but expecting different results"
Albert Einstein

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Cardiac | Abstract Session | Minimally invasive mitral surgery

Minimally invasive or conventional edge-to-edge repair for severe mitral regurgitation due to bileaflet prolapse in Barlow's disease: does the surgical approach have an impact on the long-term results?

Michele De Bonis, Elisabetta Lapenna, Benedetto Del Forno, Stefania Di Sanzo, Andrea Giacomini Davide Schiavi, Luca Vicentini, Azeem Latib, Alberto Pozzoli, Federico Pappalardo, Giovanni La Canna and Ottavio Alfieri Department of Cardiac Surgery, IRCCS San Raffaele Hospital, Vita-Salute San Raffaele University, Milan, Italy

In Barlow's disease, mitral repair can be more technically demanding and not easily reproducible through a minimally-invasive approach. Nevertheless, several surgical techniques have been used through a right minithoracotomy access to treat these patients, and mid and long-term results have been described. We have previously reported excellent late durability (at 14 years) of double orifice edge-to-edge repair performed through a median sternotomy in bileaflet prolapse due to Barlow's disease, but no data have been published so far on the long-term results of this technique when adopted through a minimally-invasive approach.

Therefore we decided to assess whether the adoption of a right minithoracotomy did have an impact on the long-term results of edge-to-edge repair as compared to conventional sternotomy in this setting. We assessed the clinical and echocardiographic long-term results of 104 patients with Barlow's disease treated with a minimally-invasive edge-to-edge technique. Another 104 patients submitted to a conventional median sternotomy edge-to-edge repair for the same disease, thus were used as a control group. Inverse Probability of Treatment Weighting was used to create comparable distributions of the covariates which were significantly different at baseline in the two groups. After adjustment, the two groups were well balanced, and an adequate match was achieved. Although the edge-to-edge technique is a relatively straightforward approach that can be performed with short myocardial ischaemic time, both CPB and cross-clamp times were about 20 minutes longer in the minimally-invasive group. Those slightly longer procedural times did not have any impact on the immediate results and on the postoperative course because, overall, mean aortic cross-clamp time in the minithoracotomy group was only 64 minutes. This ischaemic time is significantly shorter than that reported with any other minimally-invasive surgical technique (chordal loop, resection, artificial chordae). Some of them can be particularly time-consuming in patients with multisegment disease and, as a matter of fact, when the EE was compared to loop technique in Barlow patients submitted to minimally invasive MV repair – a statistically significant 33% reduction in aortic cross-clamp time was observed.

Postoperative morbidity and late complications were low and not significantly different in the two groups. The minimally-invasive approach did not impair the quality of the repair. At 12 years, overall survival was similar and cumulative incidence functions (CIF) of cardiac death, reoperation and recurrence of MR ≥3+ and of MR ≥2+ were absolutely comparable (Figure 1,2). In addition, the minithoracotomy approach was not a predictor of cardiac death, reoperation or recurrence of MR. In particular, our echocardiographic data demonstrate, for the first time, the excellent durability of the minimally-invasive EE technique at long-term, with an IPW-adjusted CIF of recurrent MR ≥3+ at 12 years of 5.4%. Another issue which is commonly raised with the EE technique is the risk of inducing mitral stenosis. At the last follow-up, mean mitral valve area and gradient were 2.9±0.7 cm^2 and 3.3±1.0 mmHg, respectively, and no mitral stenosis was detected.

In conclusion, a minimally invasive approach does not have any negative impact on the effectiveness and long-term durability of the edge-to-edge repair for bileaflet prolapse in Barlow's disease. Survival, freedom from cardiac death, reoperation and recurrence of MR were similar in the minithoracotomy and sternotomy groups. Despite the challenge presented by patients with Barlow's disease, a minimally-invasive EE repair is associated with shorter myocardial ischaemic time when compared with other techniques, and excellent long-term outcomes. Valvular performance remains stable over time with no evidence of mitral stenosis.

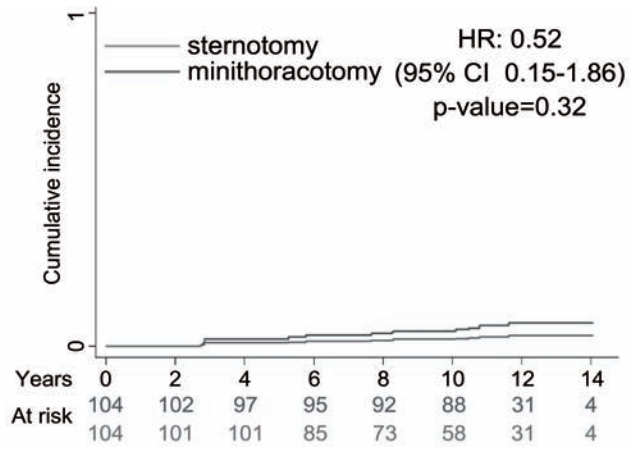

Figure 1. Adjusted cumulative incidence function of recurrent MR ≥3+, with death as competing risk

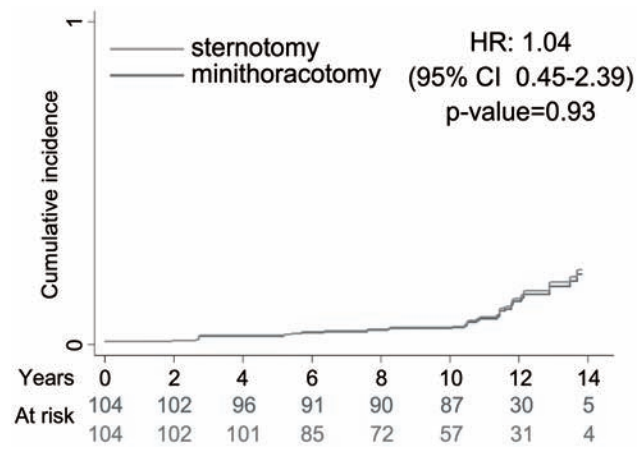

Figure 2. Adjusted cumulative incidence function of recurrent MR ≥2+, with death as competing risk

Thoracic | Abstract Session | Oncology I

External validation of a prognostic model of survival for resected typical bronchial carcinoid tumours

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Pulmonary typical carcinoids (TC) are rare, well-differentiated neuroendocrine tumours with an excellent survival after resection (90% five-year survival rate) and a low rate of lymph node and distant metastases at presentation (5-15% and 3%, respectively).[1] Due to their rarity and indolence, predicting survival after resection has been inconsistent. In 2008, Travis et al. proposed to apply the TNM staging system for lung cancer to stage such tumours, but it appeared to distinguish only between combined staging categories and not between stage subclasses.[2] Recently, the European Society of Thoracic Surgeons Neuroendocrine Tumors Working Group (ESTS NETs-WG) proposed a prognostic model to predict the five-year overall survival of patients undergoing curative lung resection for TC.[3] This model is based on an additional score system built on patients' demographic and clinico-pathological characteristics. It identifies four risk classes A, B, C and D with a decreasing five-year overall survival rate (Figure 1). The ESTS NETs-WG prognostic model was internally validated with the data from the ESTS NETs-WG retrospective database, but to be clinically relevant it requires an external validation. The objective of our study was to assess the reliability and the validity of this composite model of survival.

We performed a retrospective and multi-institutional study which included 240 patients [male/female: 164/76; median age: 58 years (IQR: 47-68)] who underwent curative lung resection for pulmonary TC in seven institutes between 2000 and 2015. For each patient we calculated the corresponding risk class (A, B, C, D) by summing the score-related metrics based on the following variables: male, age, previous malignancy, Eastern Cooperative Oncology Group performance status, peripheral tumour, TNM stage.

In our cohort, the overall survival curves for each risk class showed a significantly decreasing survival from Class A to Class D (p=0.004) with rates of 100%, 96.3%, 86.7% and 33.3% respectively for Class A, B, C, D (Figure 1-2). This difference persisted also when the clinical stage was substituted for the pathologic stage in the risk class calculation (p=0.006). However, when we assessed survival using the seventh edition TNM staging system, we could not separate the survival rates in between stages I, II and III with five-year overall survival rates of 94%, 91.7% and 100% respectively (p=0.94). This suggests that TNM staging alone may not completely represent the clinical situation and that an improved method of predicting the survival of patients after resection of typical pulmonary carcinoid tumours may need the integration of other variables as suggested by this new prognostic scoring system.

In conclusion, the ESTS NETs-WG prognostic model of survival is simple and easily applicable. Our independent cohort validates this model confirming that survival decreases significantly from Class A to Class D. Substitution of a clinical staging results in similar curves and suggests this model could be useful in counselling patients about their outcomes from surgical treatment and potentially in helping the surgeons tailor the treatment for high risk patients. The ESTS-NET WG is superior to the current TNM staging system in discriminating the different risk groups.

Class	Our cohort		ESTS NET-WG cohort[3]	
	Patients n(%)	5-year OS rate (95% CI)	Patients n(%)	5-year OS rate (95% CI)
A	67(28)	100(100-100)	378(34)	99.7
B	111(46)	96.3(88.6-98.8)	459(41)	96.3
C	53(22)	86.7(63.0-95.7)	234(21)	84.2
D	9(4)	33.3(0.9-77.4)	38(4)	53.9
All	240	94.2(90.2-98.2)	1109	93.7(91.7-95.3)

OS=overall survival; CI=confidence interval

Figure 1. Risk class five-year overall survival rate: current study and ESTS NETs-WG results.

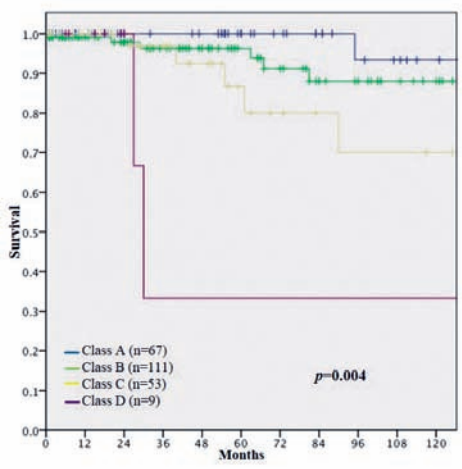

Figure 2. Kaplan-Meier overall survival curves at risk class

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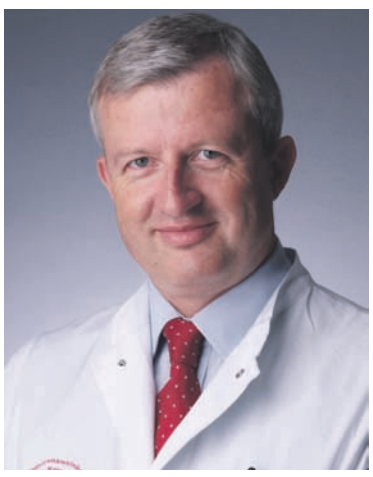
Congenital | Abstract Session | Tetralogy of Fallot / pulmonary atresia

A novel bioabsorbable pulmonary valved conduit in a chronic sheep model



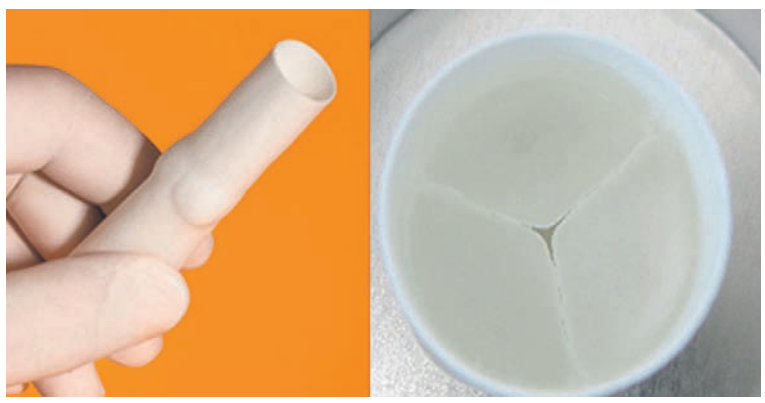


Figure 1. Xeltis' bioabsorbable pulmonary valved conduit: external and superior view

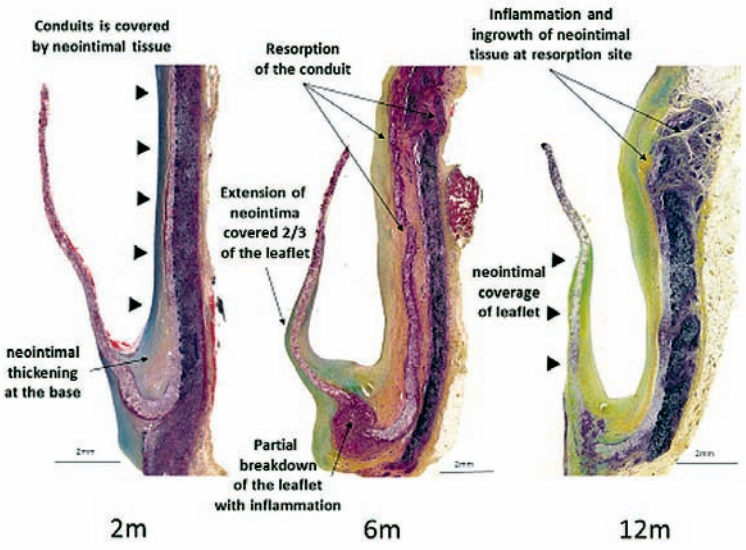


Figure 2. Histopathology showing the Xeltis PV conduit gradually being replaced over time with newly formed tissue due to ETR

Ger Bennink[1], Sho Torii[2], Marieke Brugmans[3], Martijn Cox[3], Oleg Svanidze[3], Elena Ladich[2], Renu Virmani[2] 1. Pediatric cardio-thoracic congenital surgery, Heart Center of the University of Cologne, Germany 2. CVPath Institute, Gaithersburg, USA 3. Xeltis BV, Eindhoven, The Netherlands

The worldwide incidence of newborns with life-threatening complex congenital heart defects requiring cardiac surgery is about 100,000 per year,[1] and congenital malformations of the right ventricular outflow tract (conotruncus) comprise 15-20% of all congenital heart defects.[2] The use of artificial grafts, homografts or xenografts is the standard of care in cardiac surgery for the repair of complex congenital malformations. However, this strategy is typically associated with complications including rejection, stenosis, thromboembolic events, calcification, degeneration and chronic infection.

To overcome these limitations, Xeltis developed a bioabsorbable pulmonary valved conduit. The device is designed to work as a heart valve directly when implanted. In addition, its porous structure is designed to harness the body's natural healing process to pervade it with new healthy tissue and enable Endogenous Tissue Restoration (ETR), the natural restoration of complex body parts. As the device is bio-absorbed over time, it is designed to leave the patient with a new healthy heart valve made of its own tissue. The ETR approach may help reduce the risk of complications and repeated surgeries associated with existing implants may be reduced. In the long term, this may consequently help reduce the disease burden for patients and costs to the healthcare system. In this study we present 2- to 12-month data from preclinical studies in sheep, evaluating the safety and performance of a bioabsorbable polymeric pulmonary valve conduit designed to allow ETR.

Xeltis' pulmonary valve conduits were surgically implanted in adult sheep in the pulmonary artery, and followed up for 2, 6 and 12 months. Of the 18 animals implanted, 15 survived until sacrifice. During the 12-month period, the valves showed acceptable regurgitation and mild gradient, with a 20-25% increase in diameter of the conduit beginning at six months – associated with increased compliance of the neotissue after mechanical absorption of the implant material. Histologic examination of the valve showed mild neointimal thickening and absorption beginning at two months, and continued to increase over the 12-month period with extension of the neointima from the base to the free margin of the leaflet. Only one of the 15 animals had noticeable calcification (at six months). The conduit absorbs faster than the valve, inducing inflammation that is rapidly replaced by neointimal tissue formed by fibroblasts and collagen without calcification and no significant narrowing of the conduit.

In summary, we believe the Xeltis pulmonary valved conduit has shown encouraging results in the sheep model up to 12 months, and could be an improvement over the current conduits available for children with complex congenital heart disease. We conclude that the safety and functionality of the pulmonary valve has now been demonstrated.

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Cardiac | Rapid Response | Minimizing sternal wound complication

Successful use of Platelet Rich Fibrin therapy (PRF) in post-operative cardiac surgical infected wounds: first reported case series

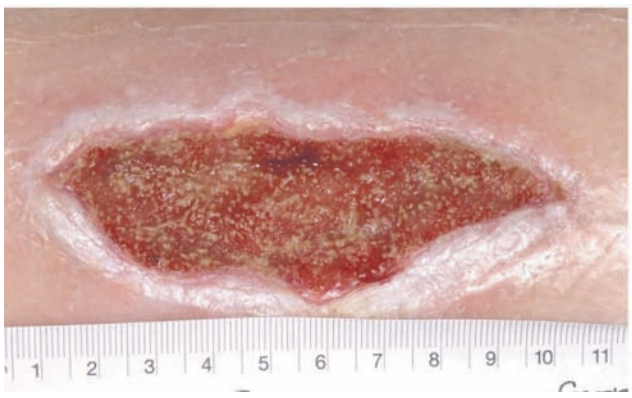

Figure 1. Platelet gel started

Subir Datta Manchester Royal Infirmary, UK

One of the most challenging problems facing cardiac surgery patients is treating difficult-to-heal post-operative infected wounds. Standard wound care management like VAC pumps can fail to heal wounds and this can be distressing to the patients for months.

Platelets produce secretory proteins important for wound healing. It has been shown that such proteins may be deficient in difficult-to-heal wounds. Platelet-rich fibrin (PRF) is a combination of platelets and fibrin, and is known to cause increased wound healing. The aim of this study was to analyse the efficacy of PRF application in infected cardiac surgical wound healing.

Patients with infected sternal and saphenous harvest site wounds treated with conventional methods (i.e. Vacuum therapy) for more than two months were selected for the study. PRF was prepared using the Vivostat® processing system by taking 100 ml of the patient's blood. This was then sprayed over the wound with an applicator. Wounds were reviewed after one week. All patients were treated on an out-patient basis in a dedicated wound clinic run by a single cardiac surgeon.

Twenty-eight patients received PRF therapy (age 62±12 years; 18 male: 10 female). There were 11 superficial and 17 deep wounds, 16 were sternal wounds and 12 were leg wounds. The total number of PRF applications were 64 (median 2) and median duration from start of PRP application to complete wound healing was six weeks.

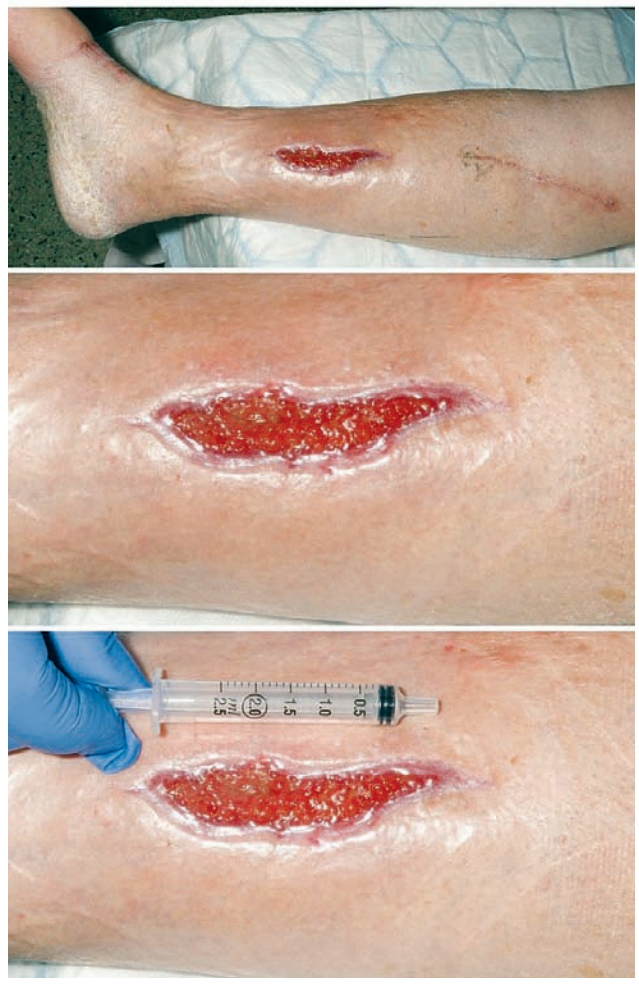

Figure 2. At one month

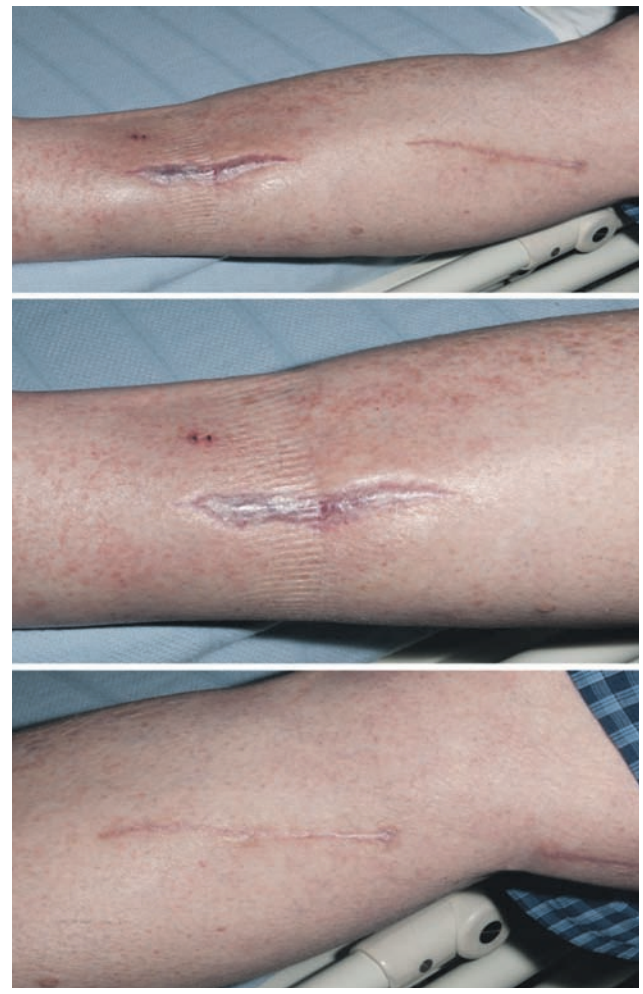

Figure 3. At three months

This is the first reported series to measure the efficacy of PRF on cardiac wounds. Our study suggests that application of PRF may have sufficient efficacy to stimulate healing in chronic wounds.

Cardiac | Focus Session | Bicuspid aortic valve and its challenges

Genetics of bicuspid aortic valve aortopathy

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About 500 years ago, Leonardo Da Vinci first described individuals with an aortic valve with only two aortic leaflets instead of the normal three, termed a bicuspid aortic valve (BAV). Although BAV often remains asymptomatic, it associates with severe cardiovascular complications in more than one third of cases[1]. Of these complications, thoracic aortic aneurysms (TAA), and particularly the resulting dissections, pose the most serious threat.

Historically, aberrant post-valvular blood flows were believed to be the sole trigger for TAA development in BAV patients. Over the last decade, however, increasing evidence for the existence of common genetic defects causing BAV and TAA has emerged[2]. Most likely, the aetiology of BAV/TAA is complex, with both genetic risk factors and abnormal flow patterns influencing disease development. While the majority of BAV patients do not report a positive family history for BAV or TAA, rare extended families segregating BAV in an autosomal dominant manner exist[3,4]. In these families, markedly-reduced penetrance and variable expressivity are typically present. Along with high genetic heterogeneity, the latter phenomena have significantly impeded disease gene identification. Over time, a couple of candidate genes or loci impinging on BAV or BAV/TAA risk have been suggested.

While some reports have related rare missense mutations in *GATA5*, *NKX2.5* and *SMAD6* as well as a translocation disrupting *MATR3* to the development of BAV(/TAA)[5-12], *NOTCH1* is considered the only firmly established BAV gene to date. Dominantly inherited loss of function *NOTCH1* mutations have been identified in up to 13% of familial and 4% of sporadic patients with BAV, aortic stenosis, or a combination of both manifestations[13]. Although TAA has been reported in a fraction of the mutation carriers, *NOTCH1* mutations are not considered as a major cause of non-calcified, non-stenotic BAV with highly penetrant TAA[14]. Already 10 years ago, family-based linkage studies pinpointed three other BAV candidate loci (chr 18q, 5q & 13q)[15]. Despite the recent advent of next-generation sequencing technologies, their underlying disease culprits still remain elusive.

As to TAA-predominant disorders, an increased BAV prevalence has been reported in patients with Loeys-Dietz syndrome (*TGFBR1/2, SMAD2/3, TGFB2/3*) and non-syndromic TAA attributed to *ACTA2* or *LOX* mutations[16-18]. In Marfan syndrome cases, BAV is observed at normal population frequencies. Rare *FBN1* mutations have been reported in BAV/TAA patients though[21]. As these mutations are rather mild, they might impinge on TAA risk by further perturbing integrity of a BAV patient's yet sensitised aortic wall.

Regarding syndromic presentations in general, BAV is patently frequent in Turner syndrome (45,X0)[19]. It is expected that the complex Turner syndrome phenotype results from loss-of-function of multiple X-linked genes, including at least one that associates with cardiovascular features. A higher prevalence of BAV has been observed in subjects only missing the short arm of the X-chromosome (Xp), suggesting Xp location of such yet to be identified gene(s)[20]. BAV has incidentally also been recognised in a variety of other syndromes, such as Andersen syndrome and Bosley-Salih-Alorainy[22]. Nevertheless, whether BAV truly belongs to the phenotypic spectrum of these disorders is still uncertain.

Functional characterisation of the yet known human and mouse BAV genes, with the latter being linked to partially penetrant BAV using knockout models, has revealed valuable pathomechanistic insights. Typically, malfunction of endothelial to mesenchymal transition or cardiac neural crest cell activity have been pinpointed as the key disease culprits of abnormal embryonic fusion of two aortic valve leaflets. The genetic and pathomechanistic picture of BAV/(TAA) is still far from complete though, hampering development of novel BAV/(TAA)-oriented therapies.

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Thoracic | Techno College | Beyond conventional video assisted thoracic surgery: Part 2

Transforming VATS Lobectomy with the 5 mm MicroCutter

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Current endostaplers are around 12 mm in shaft diameter, and articulate up to 50 degrees. The MicroCutter 5/80 from Dextera Surgical Inc. (USA), however, is 5.3 mm, and can articulate up to 80 degrees. This gives it two significant advantages. Firstly, intercostal spaces are often only 8-10 mm in size, and therefore a 5 mm stapler reduces the potential to cause damage to the sensitive intercostal nerves. Secondly the 80 degrees of articulation significantly increases the ability to get around small vessels from a range of directions.

It is an exciting time to be a thoracic surgeon. Although it is nearly 25 years since the first VATS lobectomy, innovation in minimally-invasive thoracic surgery has had a rebirth in the last five years. A major driver of this has been the advent of uniportal VATS lobectomy, which has been widely adopted in many parts of the world, particularly Asia and China. The uniportal movement has recently been taken even further with surgeons experimenting with subxiphoid and subcostal uniportal approaches. At the same time, robotic thoracic surgery is increasingly popular in the western economies, and in particular in the USA.

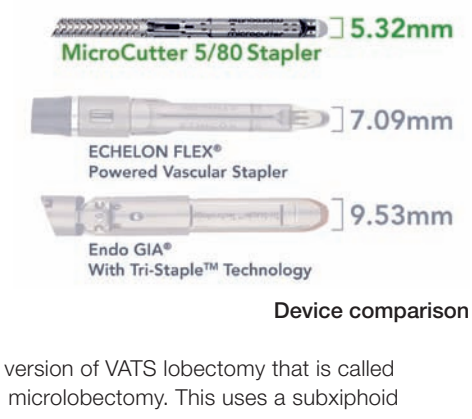
Here I present my experience with uniportal surgery with the MicroCutter, focussing on a few particular challenges in uniportal surgery that the MicroCutter is ideally placed to help with. Firstly, given that many instruments have to be passed through a single incision, it is extremely helpful to have a 5 mm stapler rather than a 12 mm shaft to perform your vascular firings as your vision of the vessel and ability to retract with additional instruments while firing is greatly enhanced. But more importantly, in uniportal surgery it is usually obligatory to fire the truncal branch of the pulmonary artery in a right upper lobectomy, and a segmental artery in a left upper lobectomy, before the superior pulmonary vein. With the 80-degree articulation of the MicroCutter, the vein can easily be fired first if preferred.

In robotic surgery the stapler is fired by the bedside assistant. I have found that the lighter weight of the MicroCutter and its increased ability to articulate has made the manoeuvrability of this stapler much easier, allowing it to be positioned by a less-experienced bedside assistant. In addition, for middle lobectomies it is much easier to perform all vascular firings from the anterior utility port, rather than removing a robotic arm and firing from a posterior port.

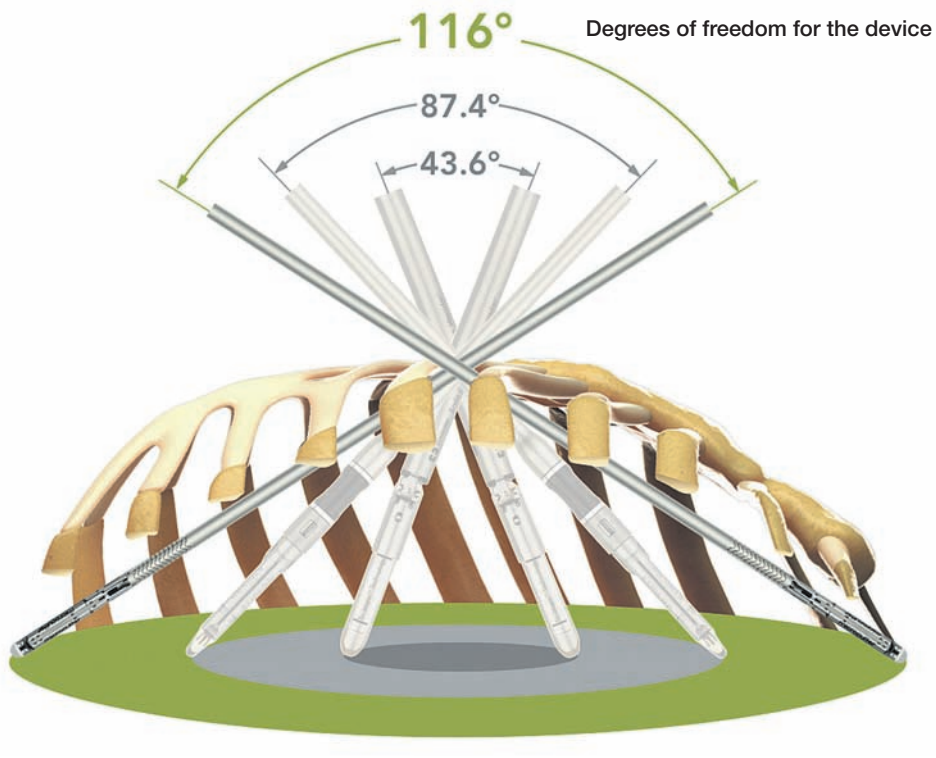
Finally, the MicroCutter has allowed myself and others to experiment with a hybrid version of VATS lobectomy that is called microlobectomy. This uses a subxiphoid port for all 12 mm staple firings, and this is extended to remove the lobe at the end of the case. Three 5 mm ports are then also used in the surgeon's normal intercostal port positions. The 5 mm vascular firings can be performed from any of these ports, and the advantage of this is that no incisions greater than 5 mm are ever made in the intercostal spaces, eliminating the potential for damage to intercostal nerves.

vl report on a series of 72 of these cases performed in six centres across Copenhagen (Denmark), the Mayo Clinic (USA), and Edinburgh (UK), as well as our own institution, where 22% of patients (16) went home on day one, postoperatively, and 42% of patients (30) went home day two. The group has performed anterior and posterior approach lobectomies, segmentectomies, a right pneumonectomy and a right upper lobe sleeve resection using this technique, thus demonstrating its versatility.

I look forward to sharing our experience with microlobectomy on Monday at 14:30 (Room 129/130).



Device comparison



Degrees of freedom for the device

Cardiac | Focus Session | Joint Session EACTS SBCCV PASCaTS – Cardiac surgery in underserved regions

Emergency surgical repair of an infected left ventricular pseudoaneurysm in a six-year-old child with purulent pericarditis

Lindiwe Sidali*, Darshan Reddy, Noel J Buckels, Himal Dama and Andiswa Nzimela

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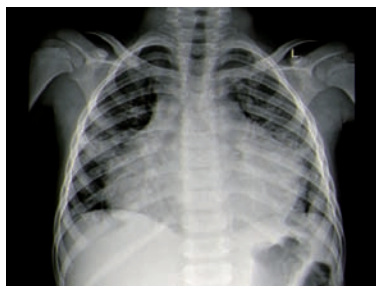

Figure 1. Plain chest radiography showed an enlarged cardiac silhouette and bilateral pulmonary patchy opacities.

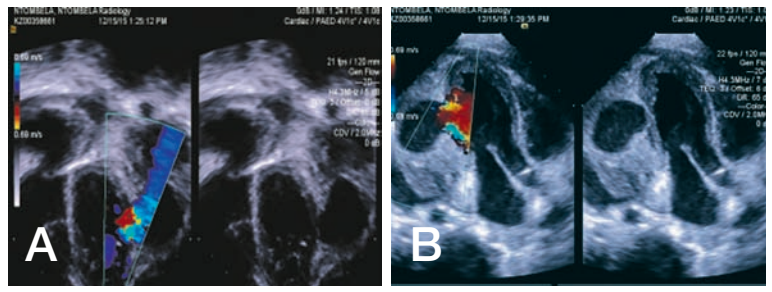

Figure 2. 2D echocardiography (A: apical 4-chamber view / B: parastenal long axis) demonstrated a large false aneurysm communicating with mid LV free wall measuring 34 by 30 mm and a large fibrinous effusion adjacent to this as well left ventricular wall. A colour flow doppler demonstrated bidirectional flow across the communication defect. Intracardiac anatomy was otherwise normal, there were no vegetations

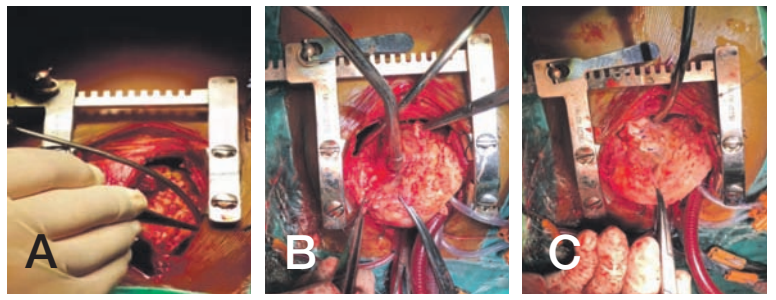

Figure 3. A) Mediansternotomy with a sternal retractor showing clots and signs of carditis; B) The defect on the posteroinferior LV wall; C) Defect closed with Teflon strips

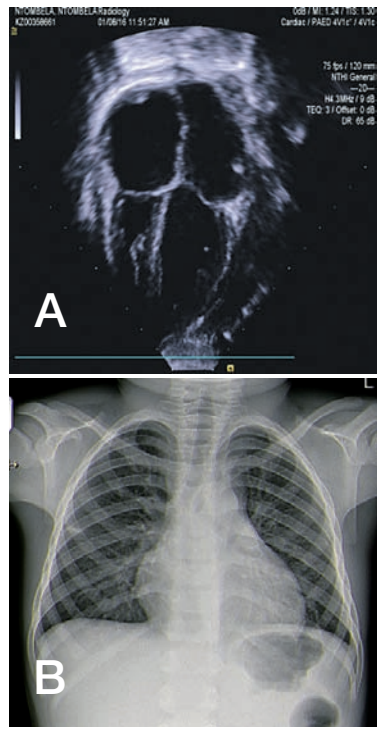

Figure 4. A (top) apical 4 chamber view post-operative echo showed no residual pseudoaneurysm; B (above) CXR on 3-month follow-up

Case report

A six-year-old was admitted in a regional hospital with a history of dyspnoea, fatigue and fever, and a diagnosis of acute pericarditis was made (suspected to be of tuberculosis or staphylococcal aetiology). Laboratory investigations showed mild, normochromic, normocytic anaemia, thrombocytosis and elevated erythrocyte sedimentation rate. Microbiology revealed no source of infection (sputum MCS, TB PCR, blood cultures all negative), and HIV test was also negative. He was treated with intravenous gentamycin, ampicillin and cloxacillin. Due to the prevalence of tuberculosis in our society, empiric anti-TB therapy was also started.

The patient showed no clinical improvement and was therefore transferred to our paediatric cardiology centre. An echocardiography was performed to evaluate the cause of heart failure and it revealed a large false aneurysm of the posteroinferior wall of the left ventricle (30 x 34 mm), fibrinous pericardial collection, no vegetations, no valve abnormalities and no signs of constrictive pericarditis.

Urgent surgery was planned for the next available theatre slot, but the patient had cardiac tamponade on day four of admission and therefore emergency surgery was performed. Surgery was performed via median sternotomy. On opening the pericardium there was pus (~ 200 ml), clots and signs of pancarditis, and the heart was adherent to the pericardium. After mobilisation of the heart , cardiopulmonary bypass was instituted with ascending aorta and bicaval cannulation. Cardiac arrest was achieved with crystalloid cardioplegia administered through the aortic root. The aneurismal sac was identified, the neck of the pseudoaneurysm was small and it showed multiple fenestrations. The sac was excised and the defect closed using a “sandwich technique” with Teflon strips, after which the child was weaned off cardiopulmonary bypass successfully.

His post-operative course was uneventful: extubation took place on day two, at which time he was transferred to a high care unit. The aneurysm wall that was sent for microbiology analysis showed no microorganisms and TB stains were also negative. Histology of the wall showed evidence of acute purulent pericarditis. The child was treated with six weeks of intravenous antibiotics, and anti-TB therapy for nine months. Follow up at three months showed that the child is well with no residual pseudoaneurysm.

Discussion

A pseudoaneurysm of the ventricle is formed when there is rupture of the myocardial wall with the discontinuity being roofed over by pericardium and mural thrombus or fibrous tissue without myocardial elements. Staphylococcus aureus is the most common organism causing infective pericarditis, and the primary site of infection is usually bone, joint or lung. Diagnosis is made based on the signs compatible with congestive heart failure, echocardiography and colour Doppler, which allows distinction between a true and false aneurysm. Pseudoaneurysms tend to expand which may lead to rupture causing cardiac tamponade and / or death. Median sternotomy is the preferred approach for full exposure. Techniques such as excision and closure of the defect with a patch (autologous pericardium/prosthetic material), and excision and direct closure with continuous sutures or pledgetted sutures have been described. Factors which influence the use of one technique over the other depends on the surgeon, the size of the defect, the state of the myocardium and the area or geometric relations of the aneurysm. We closed the defect with Teflon strips because, even though it was small, there were multiple fenestrations, and tissues were friable so we needed reinforcement tissue. We opted not to use autologous pericardium as this was also inflamed and infected.

Congenital | Abstract Session | Congenital miscellaneous 1

C1 esterase inhibitor in pediatric cardiac surgery with cardiopulmonary bypass plays a vital role in activation of the complement system

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Complement system protein may be activated through the classical, alternative and lectin pathways, leading to generation of biologically active products, such as C5a and the terminal membrane attack complex (MAC), and ultimately contributes to endothelial cell disruption during CPB. Significant differences in the complement factor levels indicate a higher grade of complement activation and simultaneous contact activation in patients during and after CPB. Complement factor C1 esterase inhibitor (C1-inh) levels decrease with CPB in infants. We thus consecutively investigated several complement compounds before and after pediatric cardiac surgery with CPB. Based on this hypothesis, we tested whether C1-inh supplementation after CPB would ameliorate C1-inh decrease in pulmonary and cardiac dysfunction after CPB. Our prospective study was therefore designed to determine which part of the systemic inflammatory response after cardiac operations resulted from CPB in neonates and infants.

After approval by the human ethical committee of the Gunma Children’s Medical Center (GCMC) and informed consent of the parents, 40 consecutive term congenital heat disease patients aged until 1 year who underwent long CPB time (> 3 hours) at surgery were included in the prospective study between January 2012 and December 2014. C1 esterase inhibitor (C1-inh) drug (@Berinert) was generously provided by CSL Behring (King of Prussia, PA). The C1-inh (20 IU/kg) was given intravenously 60 minutes after CPB. Blood samples for complement factors were obtained before and 48 hours after administration of C1-inh.

Six patients did not survive and their data were not included. Of 34 patients included, median age was 6.5 month, median body weight was 6050 g, and 16 (47%) were female. According to the Mann-Whitney U test, there were no differences between the two groups concerning demographic and intraoperative data, postoperative chemical data. C1q concentration was only significant lower in patients with C1-inh non-treated group than in patients with C1-inh treated group.

Table 1. Pre and Postoperative complement data

		C1-inhibitor non-treated group (n=26)	C1-inhibitor treated group (n=8)	P value
C1q (8.8-15.3 mg/dl)	pre	6.14±2.12	6.46±1.22	0.508
	post	4.77±0.92	5.86±1.13	0.045
P value		0.048	0.564	
C1 inh (70 -130 %)	pre	93.2±18.7	90.9±22.2	0.964
	post	71.3±13.7	80.4±18.0	0.115
P value		< 0.001	0.3706	
C3 (86-160 mg/dl)	pre	80.0±17.1	79.0±24.9	0.873
	post	56.3±11.5	61.8±11.6	0.121
P value		< 0.001	0.124	
C4 (17-45 mg/dl)	pre	16.2±6.6	15.8±3.2	0.964
	post	10.9±4.1	12.3±3.0	0.628
P value		0.002	0.072	
CH50 (25-50 /ml)	pre	43.0±14.0	37.6±21.8	0.873
	post	31.9±13.3	31.3±21.2	0.792
P value		0.042	0.482	

But, the consumption of C1q, C3, C4, CH_{50} and C1-inh in patients with C1-inhibitor non-treated group was observed early postoperatively in Table 1.

In the present study, after the prolonged use of CPB, there is a significant difference in the values before and after C1-INH treatment between the two groups. The lower value in the C1-INH-treated group is explained by the activation of the classical pathway through the replenishment of complements by C1-INH treatment. In the future, bradykinin and cytokine levels will be examined.

In summary, C1 INH is an important regulator of plasma protein cascade systems such as the classical pathway of complement, the intrinsic pathway of coagulation and inflammatory reactions. Thus, severely diminished C1 INH in pediatric cardiac surgery with cardiopulmonary bypass plays a vital role in activation of these systems. This study proposes the administration of C1 INH is an effective therapy to reduce the activation and improve the clinical capillary leak syndrome.

Cardiac | Rapid Response | Risk modelling and scoring systems in cardiac surgery

EUROSCORE II predicts mid-term morbidity and mortality in coronary artery bypass surgery

Ronald Ma[1], Jolane Eng[2], Bowen Li[2], Hai Dong Luo[2] and Oon Cheong Ooi[2]

1. Yong Loo Lin School of Medicine, National University of Singapore. 2. Department of Cardiac, Thoracic and Vascular Surgery, National University Health System

Cardiac risk models are used as decision making tools to predict risk of post-operative adverse events.

EuroSCORE II was released in 2012 as an improvement to the older logistic and additive EuroSCORE I. It has been validated in populations from European, American and some Asian countries, demonstrating very good discriminative power.

The utility of EuroSCORE II is not limited to patient selection for high-quality cardiac surgical service. It has a role in ensuring proper healthcare and economic resource. As such, the quality measure of cardiac surgery cannot be limited to the short term; it should encompass longitudinal outcomes, as key landmark trials and observational studies are beginning to demonstrate difference in long term survival between percutaneous coronary intervention and coronary artery bypass grafting (CABG). Hence a need to explore the expanded role of EuroSCORE II in mid to long term prediction arises.

Further, long term morbidity and cause-specific mortality are more specific outcome measures that have yet to be tested in cardiac risk models. This study aims to evaluate the ability of EuroSCORE II in risk stratification and prediction for mid to long term cause-specific mortality and morbidity following coronary artery bypass surgery.

A total of 1,769 consecutive patients underwent isolated CABG from January 2009 to December 2013 with a mean follow-up of 4.1±1.8 years. Exclusion criteria included patients undergoing CABG combined with heart valve repair/replacement or aortic surgeries.

The Kaplan-Meier (KP) estimates of overall survival at 1 and 5 years were 96.0% and 90.5% respectively. The KP estimates of cardiovascular mortality at 1 and 5 years were 96.5% and 93.4 % respectively and that of MACCE at 1 and 5 years were 86.8% and 73.1% respectively. Kaplan Meier survival curves (Figure 1) were constructed according to EuroSCORE II risk groups of high (>5%), medium (2-5%) and low risk (<2%). EuroSCORE II demonstrated good risk stratification for all 3 outcomes (log rank test p<0.0001).

Multivariate Cox regression analysis revealed that EuroSCORE II is an independent predictor of both overall mortality (HR1.03, 95%CI 1.01-1.06, p=0.002) and cardiovascular mortality (HR1.05, 95%CI 1.02-1.07, p<0.001), as well as MACCEs (HR1.03, 95%CI 1.01-1.05, p=0.005). EuroSCORE II has good discriminative power for mid-term overall mortality and cardiovascular mortality and fair discriminative power with an Area Under the Curve (AUC) of, respectively, 0.74 (0.70-0.78, p<0.0001), 0.76 (0.71-0.81, p<0.0001) and 0.69 (0.66-0.071, p<0.0001).

In conclusion, EuroSCORE II can be used as a risk stratification tool and is also an independent predictor with reasonable discriminative power for mid-term cause-specific mortality and morbidity.

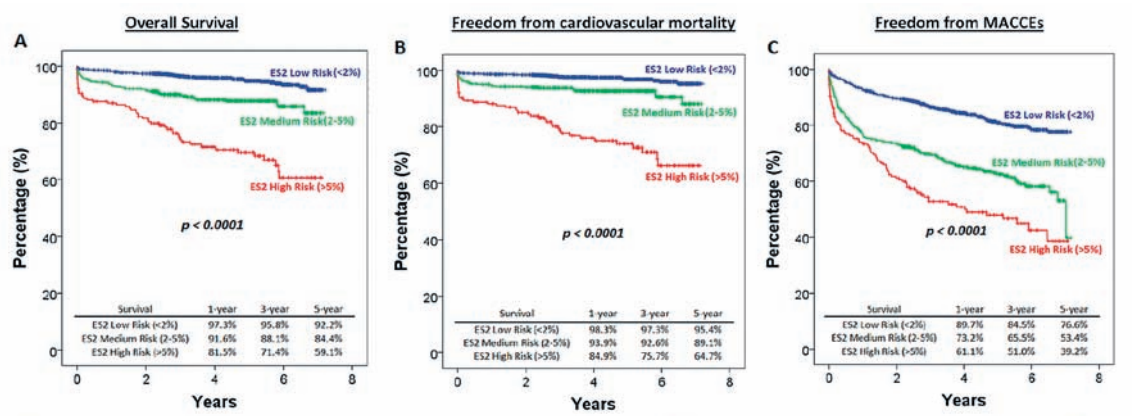

Figure 1: Kaplan- Meier analysis and log-rank test evaluating the **(A)** survival, **(B)** freedom from cardiovascular mortality and **(C)** freedom from Major Adverse Cardiac and Cerebrovascular Events (MACCEs) in patients undergoing isolated coronary bypass surgery. 1, 3 and 5-year survivals are displayed below the Kaplan-Meier curves.

Cardiac | Abstract Session | Regeneration - Preservation

Direct subendocardial implant of autologous stem cells during left ventricular restoration for ischaemic heart failure

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Among the different therapeutic options available to patients affected by heart failure due to ischaemic dilatation of the left ventricle, surgical ventricular restoration (SVR) represents a valid adjunct to conventional myocardial revascularisation. The concept to return the left ventricle to a more physiological shape and volume is the base of this surgical option (Figure 1). Tissue engineering and cell therapy are additional promising tools for improving cardiac function via myocardial tissue regeneration.

The authors present their experience with a group of 30 patients affected by ischaemic dilative myocardiopathy, who underwent SVR from 2007 to 2013. Indications for SVR were in-line with the STICH trial. The surgical technique has changed with time, moving from the concept of volume reduction surgery to the idea of reshaping the left ventricular cavity to be more elliptical, and therefore more physiological. As adjunct to surgical treatment, 16 patients were randomly assigned to receive intraoperative subendocardial, direct-vision implant of bone marrow-derived mononuclear cells, and were then compared with the 14 patients who represented the control group. The two groups were homogeneous with respect to age, gender, NYHA class, pre-operative mitral incompetence, and left ventricular size and volume. There was, however, a significant difference in EuroScore and Pre-operative Ejection Fraction ($p<0.05$), being significantly worse in the group of patients who received stem cell therapy. The mononuclear cells were obtained from 100 cc of bone marrow which was aspirated from the sternal midline before opening the chest. The cells were prepared in a sterile mini-lab next to the operating room, and were delivered to the myocardium into the infarcted area, by injection under direct vision, before the closure of ventriculotomy

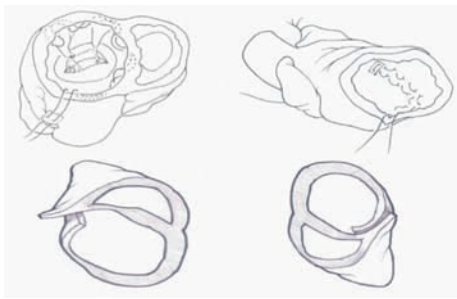
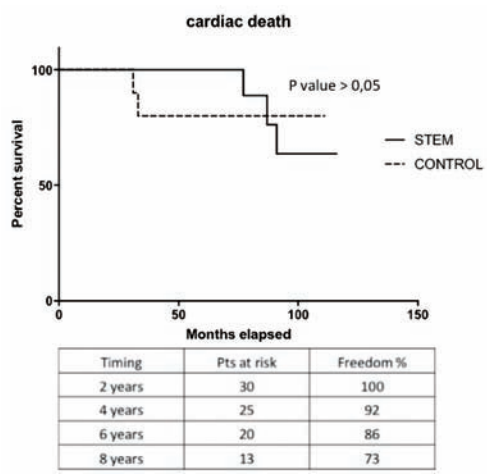


Figure 1. Left ventricular volume-reduction and reshaping surgical technique



Timing	Pts at risk	Freedom %
2 years	30	100
4 years	25	92
6 years	20	86
8 years	13	73

Figure 2. Long-term results showing cardiac mortality in the two groups of patients

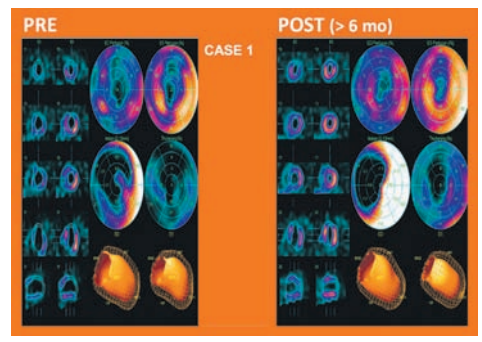


Figure 3. Pet-Scan at baseline (pre-op) and at six months after surgery. Note area of tissue regeneration

All-patient 30-day in-hospital mortality was 0. At last follow-up, ejection fraction increased from 25.3% before surgery to 36.3% in group A, and from 31.8% to 45.6% in group B ($p>0,05$). Reduction in LVEDD was 6% in group A, and 9% in group B (p: ns), LVESV decreased of 55% in group A and 35% in group B, without statistical significance. Late cardiac mortality at nine-year follow-up was similar in the two groups of patients (62.5% of the stem cell group, versus 30.8% in the control group; p=ns; Figure 2). No early or late adverse reactions, or cases of infection, were observed.

A Pet-Scan performed six-months after surgery (and compared to baseline) showed a limited area of myocardial tissue regeneration in six patients at the site of mononuclear cell implantation (Figure 3).

In conclusion, even though our study does not draw up any valuable clinical evidence concerning the benefit of associating myocardial regenerative therapy to surgical ventricular restoration, the observation of some degree of myocardial regeneration at the site of cell implantation, as detected by Pet-scan, might encourage further clinical application of this protocol: i.e. BMSc direct-vision myocardial delivery during SVR, as an adjunctive tool, in the treatment of patients affected by post-ischaemic dilative myocardiopathy.

Cardiac | Abstract Session | Young Investigator Awards

Does single clip implantation provide reliable durability after transcatheter edge-to-edge mitral repair?

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Currently, the biggest drawback of transcatheter mitral repair is its sub-optimal efficacy in terms of mitral regurgitation (MR) reduction and recurrence.

Approximately 60% of all patients treated with MitraClip (Abbott Vascular, USA) still receive only one single clip. To assess if the implantation of a single clip (SC) allows a similar durability in comparison to double-clip (DC), we retrospectively compared the outcomes of SC (n=71, 35.7%) vs DC (n=128, 64.3%) patients with an initially optimal result (MR ≤1+) at our institution. Patients treated with more than two clips were excluded, and all patients underwent a prospective in-hospital data collection and were enrolled in a dedicated echocardiographic outpatient clinic, with scheduled follow-up at 1-month, 6-months, 12-months and yearly thereafter.

Major pre-operative patient characteristics are summarised in Table 1. Mild acute residual post-procedural MR was observed in 40 (56.3%) vs 90 (70.3%) patients in the SC and DC groups respectively (p=0.047). Over 3.5 years, no difference was observed in survival, heart-failure recurrence nor NYHA class.

However, despite a more favourable valve anatomy, and less-pronounced heart remodelling, SC patients experienced a significantly worse MR≥3+ recurrence after 3.5 years compared to DC patients (74.4±7.0% vs 95.7±2.6% respectively, Log Rank < 0.001, Figure 1). This was confirmed both in functional (p=0.008, Figure 2) and degenerative MR (p=0.005, Figure 3). Only five (2.5%) partial clip detachments were observed – four in the SC group and one in the DC group. Following detachment, severe MR recurred in all four patients in the SC group, while remaining mild in the DC patient. Of note, the residual mitral valve area was significantly smaller in DC patients (p=0.016), but it was not associated with the impairment of any clinical outcome.

The disappointing MR recurrence in SC may be in part explained by increased partial clip detachment (a second clip not only stabilises the whole complex but also reduces the chances of severe MR recurrence in case of detachment), but also by residual or ongoing mitral pathology (leaflet prolapse, annular dilation, left ventricle remodelling), or by incorrect evaluation of acute residual MR.

More data from larger registries will be needed to ultimately confirm this finding, and the assessment of residual mitral valve area remains crucial to avoid the risk of mitral stenosis with multiple clips. Nevertheless, in the light of improving the durability of transcatheter mitral repair, together with careful patient selection, better technical performance should also be achieved. Therefore, the implantation of one single clip should be done with caution in patients who are eligible for a second clip, especially those younger and lower risk.

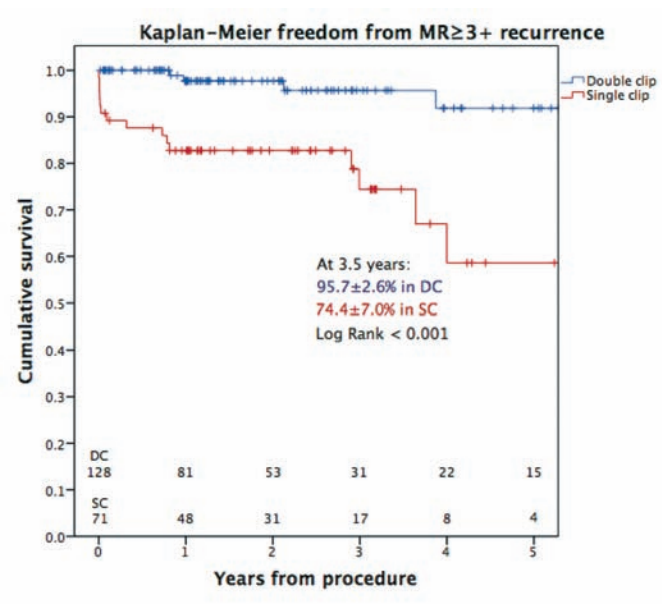

Figure 1. MR≥3+ recurrence in SC vs DC groups

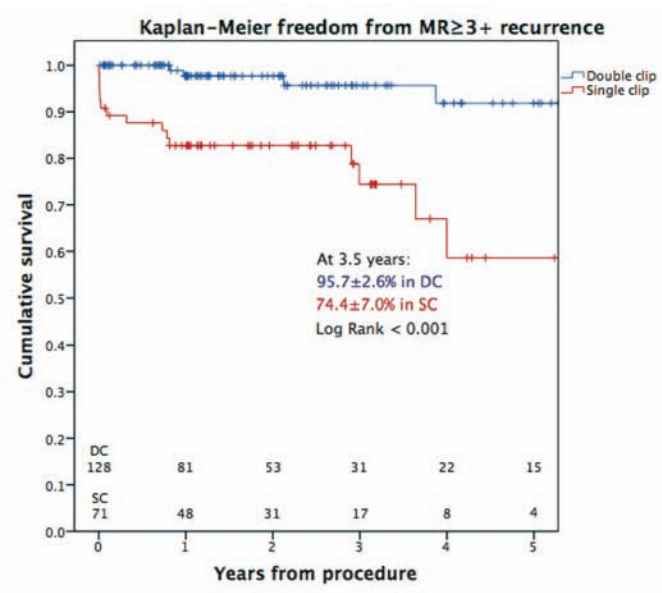

Figure 2. MR≥3+ recurrence in the FMR sub-group

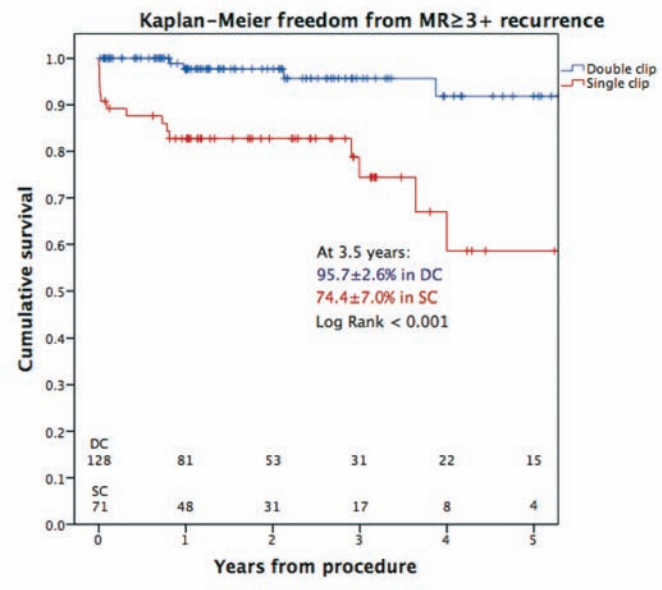

Figure 3. MR≥3+ recurrence in the DMR sub-group

Table 1. Major pre-operative patients characteristics.

	Single-Clip (n=71)	Two-Clip (n=128)	P value
Age, years Age>75, n(%)	70.5±10.5 28 (39.4)	71.4±10.2 56 (43.7)	0.52 0.55
Female gender, n(%)	21 (29.6)	38 (29.7)	0.99
BMI	25.9±4.8	24.6±4.1	0.041
CAD, n(%)	46 (64.8)	71 (55.5)	0.20
COPD, n(%)	16 (22.5)	26 (20.3)	0.71
CVD, n(%)	6 (8.4)	8 (6.2)	0.56
PVD, n(%)	12 (16.9)	16 (12.5)	0.39
eGRF, ml/min eGFR<60, n(%)	58.4 (37.9 - 80.6) 38 (53.5)	50.3 (37.7 - 64.8) 86 (67.2)	0.30 0.057
AFib, n(%)	15 (21.1)	47 (36.7)	0.023
Previous cardiac surgery, n(%)	19 (26.8)	28 (21.9)	0.43
NYHA class, n(%) II III IV	 21 (29.6) 39 (54.9) 11 (15.5)	 29 (22.7) 84 (65.6) 15 (11.7)	0.39
Preoperative inotropes, n(%)	3 (4.2)	6 (4.7)	0.88
STS-PROM, %	4.1 (1.9 - 11.5)	4.1 (2.1 - 8.7)	0.39
MR etiology FMR DMR Radiation SAM	 44 (62.0) 23 (32.4) 3 (4.2) 1 (1.4)	 97 (75.8) 28 (21.9) 2 (1.6) 1 (0.8)	 0.040 0.10 0.25 0.67
EDD, mm	60.6±10.1	65.8±9.6	<0.001
ESD, mm	46.2±12.2	49.7 ±12.2	0.09
EF, % EF<30, n(%)	38.6±16.8 30 (42.2)	34.2±16.1 74 (57.8)	0.07 0.035
CD, cm	1.1±0.3	1.3±0.3	0.005
TA, cm^2	2.2±0.8	2.7±0.9	0.022
Flail gap, mm	3.8±0.8	6.8±2.6	0.003
Flail width, mm	12.5±1.8	12.1±3.1	0.75
Jet extension, mm %	 10.9±2.0 30.3±6.9	 13.0±3.8 33.9±11.6	 0.033 0.26
Annulus size, mm IC SL	 39.7±7.0 37.0±5.2	 40.3±5.8 37.2±4.8	 0.72 0.90
MVA, cm^2	4.3±0.7	5.1±1.0	0.001
Multi-jet, n(%)	1 (1.4)	3 (2.3)	0.65
Cleft, n(%)	8 (11.3)	17 (13.3)	0.68
MAC, n(%)	4 (5.6)	6 (4.7)	0.77
EVEREST eligible, n(%)	35 (49.3)	44 (34.4)	0.039
LA volume, ml	86.5±28.9	120.2±62.7	<0.001
sPAP, mmHg	49.3±16.5	47.8±14.5	0.52
TR≥3+	20 (28.2)	30 (23.4)	0.46

Cardiac | Abstract Session | Young Investigator Awards

Robotic-assisted coronary bypass surgery: From exceptional event to routine practice

An 18-year, single-centre experience

Vincenzo Giambruno
London Health Sciences Centre, Western University, Cardiac Surgery Department, London Ontario, Canada

During the last decade, there has been a paradigm shift in the methods by which cardiac surgery is performed. The "invasiveness" of many procedures has been dramatically reduced, with excellent outcomes, as evidenced by fewer complications and quicker returns to functional health and productive life. The development of video-assisted techniques and robotic technology represented a critical step in our effort to provide a less traumatic coronary revascularisation procedure.

Minimally-invasive coronary artery bypass procedures have become an accepted method of surgical revascularisation. Currently, robotically assisted coronary artery bypass grafting surgery encompasses utilisation of robotic assistance in varying degrees, from robotically-assisted minimally-invasive direct coronary artery bypass (RADCAB) procedures to

Vincenzo Giambruno

totally endoscopic coronary artery bypass (TECAB). This robotic-assisted approach to myocardial revascularisation attempts to overcome the main limitations affecting standard approaches, such as the need for sternotomy and cardiopulmonary bypass (CPB), offering, at the same time, other potential benefits such as reduced tissue trauma, lower transfusion rate, reduced systemic inflammatory response, reduction in pain, reduced post-operative complications, shorter hospital stay, faster return to normal activities with a positive impact on the quality of life.

By capitalising on the excellent, proven long-term results of the LITA-LAD grafting, these less-invasive approaches to myocardial revascularisation can be applied to patients with isolated LAD disease or even multivessel disease. Since 1997, the London Health Sciences Centre group has embraced robotic assistance. We have performed over 600 robotic-assisted coronary artery bypasses so far, and the world first chest-closed robotic assisted CABG was performed in our Institution. Our results are more than encouraging. In fact, in our series, the mortality rate was 0.3%, and the rate of reintervention was 2.6%. With improvement in patient selection, the rate of conversion to sternotomy for any cause was reduced from 16.0% for the first 200 cases, to 6.9% of the last 405 patients. A routine post-operative angiography showed a patency rate of the LITA-to-LAD anastomosis of 97.4%. The rate of surgical re-exploration for bleeding was 1.8%, and only 9.2% of the patients required a blood transfusion.

The rate of peri-operative myocardial infarction was 1.3%, and the rate of cerebral vascular accident was 1%. Only one patient (0.2%) developed renal failure requiring dialysis, and only 0.8% of the patients required a prolonged mechanical ventilation. Average ICU stay was 1.2±1.4 days and average hospital stay was 4.8±2.9 days.

In conclusion, Robotic-assisted coronary artery bypass grafting seems to be safe and feasible. Although this technique requires specialised equipment and advanced training, it offers, in selected patients, the potential for less traumatic myocardial revascularisation with reduced postoperative morbidity. However, randomised prospective trials comparing RADCAB with conventional CABG procedures or PCI will be necessary to further evaluate the effectiveness of this alternative coronary revascularisation technique. Nevertheless, it is evident that a new era in cardiac surgery is evolving, and it is clear that rapid acquisition of video- and telemanipulation-dexterity is critical to those surgeons planning to be part of this revolution.

Pick up your copy of
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AVAILABLE EVERY DAY

EACTS Daily News
The official newspaper of the 30th EACTS Annual Meeting 2016
Issue 1 Saturday 1 October

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9 Conventional VATS or single-incision approach?
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22 Cerebral autoregulation during bypass
24 Optimising mechanical support

Welcome to Barcelona

The 30th Annual Meeting of the European Association for Cardio-Thoracic Surgery

It is with great pleasure to welcome you to the 30th EACTS Annual Meeting in Barcelona, and we are honoured and delighted with your presence at this conference. The purpose of this event is to facilitate the exchange of knowledge and information for clinicians and researchers. As you will see, this year's programme covers the many different aspects of cardio-thoracic surgery, emphasising areas that are important in our daily clinical work. As ever, we are hoping to create an interactive meeting with the exchange of knowledge and ideas, facilitating discussions and debates between delegates.

Techno College
Saturday will host the Techno College, where the Acquired Cardiac Disease Programme will focus on Aortic Valve, Atrioventricular valve, Aorta, Ablation and Assist Devices, the Thoracic Programme will look 'Beyond conventional video assisted thoracic surgery', and the Congenital Disease Programme will cover 'Valve-sparing aortic root replacement'.

Postgraduate Course and Scientific Programme
Sunday's sessions cover a wide variety of topics. In the plenary session, Rebecca Stephens, the first British woman to climb Mount Everest, will talk about the relevance of teamwork in climbing the highest mountain in the world in her lecture 'Summit teams in Everest's Death Zone'. Join us and listen to what we can learn from Summit teams. I am convinced that performing cardio-thoracic surgery is also a team effort, and therefore I dare to say that in cardio-thoracic surgery, a similar principle applies. Indeed, the whole is greater than the sum of its parts, and the stronger the team, the better the outcome.

Sunday will also feature a focus session in which David Gall will meet 'Goliath' – TAVR versus SAVR – moderated by EACTS President Fred Mohr and myself. Surgeons and cardiologists will debate on the data published in the last year, but what will be the outcome? Will the giant be taken down again?

Rapid Response sessions will be held on Monday and Tuesday, where lively discussions on a diversity of topics provide a fantastic forum for knowledge-sharing and discussion. On Monday afternoon, nightmares and complicated cases that relate to difficult decision-making issues will be discussed by a panel in a 'Meet the experts' session. These case reports were sent by delegates and will be presented in five-minute bursts to the panel.

The Abstract, Professional Challenge and Focus 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 cardio-thoracic specialist and allied health professional to learn, discuss and take home.

Jeopardy
Special attention should also be reserved for the 'Jeopardy' sessions. During two competition rounds on Sunday and Monday, national teams – composed of one cardiac and one general thoracic resident, or two cardio-thoracic residents – will test their cognitive skills and compete for a ticket to the next STS Annual Meeting in Houston in January 2017. The winning team will represent Europe and will compete against the American winners for the 'world champion' title. Come to cheer on the teams and try to test your own knowledge!

30th Anniversary Party: Do you remember the '80s?
This year we celebrate the 30th Anniversary of the EACTS. Established by our Founding Fathers in 1986, the EACTS has grown to the largest Cardio-Thoracic Surgery meeting in the world. Come and join in the fun at our celebration party on Tuesday 4 October. A full evening of entertainment is planned, culminating in dancing to our EACTS 'House' Band. Fancy dress is encouraged with a prize awarded for the best outfit!

EACTS and Portfolio Management System
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. Also, the EACTS has developed a digital portfolio management system to keep track of your residency training programme. The system will be launched during the Monday morning session 'Your educational pathway in surgery: how can EACTS help you', and is simple to use and free for members. 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 2017 and information on the EACTS Acquired Cardiac Database.

Of course, 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*.

We hope the information and techniques presented at this year's Annual Meeting will be of great interest. In addition to an outstanding scientific programme the opportunity to explore Barcelona's rich cultural heritage, including the famous Sagrada Familia by Gaudi, to stroll 'La Rambla' as well as enjoying tapas and Sangria with (new) friends will make your stay in Barcelona unforgettable.

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

Pieter Kappetein
EACTS Secretary General

Pieter Kappetein

All Domains | Focus session | Balancing a surgical career with a family

Balancing a surgical career with a family

Malakh Shrestha
Hannover Medical School,

The objective of this session is to discuss this problem and try to find objective solutions, which could

about a career in cardio-thoracic surgery.
And times are changing – and for

EACTS 2016 **Agenda**

Saturday 1 October

Techno College

08:00	Aortic valve	Forum	Cardiac
10:30	Atrioventricular valve 1	Forum	Cardiac
13:15	Aorta, Ablation, and Assist devices	Forum	Cardiac
15:10	Atrioventricular valve 2	Forum	Cardiac
09:00	Beyond conventional video assisted thoracic surgery: Part 1	113	Thoracic
13:30	Beyond conventional video assisted thoracic surgery: Part 2	113	Thoracic

Wetlab

14:00	Valve sparing aortic root replacement	114	Congenital

Sunday 2 October

Professional Challenge

08:15	EACTS/STS – Acute type A dissection	113	Vascular
10:00	EACTS/STS – Type B aortic dissection	113	Vascular

Focus Session

08:15	Latest trials in cardiovascular medicine	116 & 117	Cardiac
08:15	Perfusion – Session 1	115	Cardiac
09:45	TAVR versus SAVR: David and Goliath	116 & 117	Cardiac
08:15	State of the art in airway and esophageal endoluminal therapy	131 & 132	Thoracic
08:15	Basic science: Thoracic	120 & 121	Thoracic
08:15	Failing Fontan	111	Congenital
09:00	Allied Health Professionals Programme – Pain	133 & 134	All Domains
10:00	Perfusion – Session 2	115	Cardiac
10:00	When strategy fails – Case based	112	Cardiac
10:00	Training in cardiothoracic surgery	118 & 119	Cardiac
10:00	Meet the experts – nightmare/complicated cases	111	Congenital
10:00	Neuroendocrine lung tumours: where do we stand?	131 & 132	Thoracic
10:00	Allied Health Professionals Programme – Innovation	133 & 134	All Domains
10:30	QUIP Adult Database: Present and Future	120 & 121	All Domains
10:45	Allied Health Professionals Programme – Nursing	133 & 134	All Domains
13:30	Perfusion – Session 3	115	Cardiac
13:30	Latest news and research on treatment of aortic valve stenosis	112	Cardiac
13:30	Treatment of patients with bicuspid aortic valves	118 & 119	Cardiac
13:30	Basic Science – Cardiac	120 & 121	Cardiac
13:30	Oncology tumour board	131 & 132	Thoracic
13:30	Allied Health Professionals Programme – Abstracts	133 & 134	All Domains
15:15	Expanding indications for transcatheter heart valves	116 & 117	Cardiac
15:15	Monitoring Quality in Your Unit: State of the Art	112	Cardiac
15:15	Surgery for advanced infectious disease	131 & 132	Thoracic
15:15	Allied Health Professionals Programme – Closing the day	133 & 134	All Domains
15:15	Balancing a surgical career with a family	114	All Domains

Abstract Session

08:15	Young Investigator Awards	212	Cardiac
13:30	Surgical videos	111	Congenital
13:30	Defining good outcomes after aortic root surgery	113	Vascular
15:15	Arch and descending aortic pathology	113	Vascular

Abstract Rapid Response

15:15	Congenital Rapid Response – Miscellaneous	211	Congenital
15:15	Trends in Aortic valve replacement	212	Cardiac

Training in Research Session

08:15	Preparing your scientific breakthrough: from abstract to paper	122 & 123	All Domains
13:30	Statistics from scratch: finding your way through the forest of options…	122 & 123	All Domains

Plenary

11:45	The whole is greater than the sum of its parts: a strong team for a better outcome	116 & 117	Plenary

Competition

13:30	Jeopardy Competition Round 1	212	Competition

Monday 3 October

Professional Challenge

08:15	Wire skills transcatheter aortic valve implantation	116 & 117	Cardiac
14:15	Rhythm Surgery in the upcoming decade	112	Cardiac

Focus Session

08:15	Personalized revascularization strategies	115	Cardiac
08:15	Aortic valve repair – When and how	114	Cardiac
08:15	Evidence based decision making in aortic valve surgery	112	Cardiac
08:15	Joint Session EACTS SBCCV PASCaTS – Cardiac surgery in underserved regions	120 & 121	Cardiac
08:15	Update on thymic surgery	129 & 130	Thoracic
08:15	The aorta and the bicuspid valve	113	Vascular
10:15	Robotics revisited	122 & 123	Cardiac
10:15	The future of early stage non-small cell lung cancer	129 & 130	Thoracic
10:15	Repairing a bicuspid valve	113	Vascular
10:15	Nightmares in cardiothoracic surgery	115	All Domains
10:15	Your educational pathway in surgery: how can EACTS help you?	118 & 119	All Domains
10:15	How can we work together? Latin America, Africa and Asia Perspective	120 & 121	All Domains
14:15	Mitral valve repair beyond P2	116 & 117	Cardiac
14:15	Hypertrophic obstructive cardiomyopathy revisited	115	Cardiac
14:15	How to – video session 1	113	Vascular
16:00	Minimally invasive aortic valve replacement – How to do it right in all patients	118 & 119	Cardiac
16:00	Diaphramatic disease	129 & 130	Thoracic
16:00	Thoracic and thoraco-abdominal aneurysms treatment: Surgery after thoracic endovascular aortic repair and thoracic endovascular aortic repair after surgery	113	Vascular
16:00	Meet the experts	122 & 123	All Domains

Abstract Session

08:15	Extra corporeal circulation/Left ventricular assist device/ Transplantation 1	133 & 134	Cardiac
08:15	Univentricular heart – Fontan	111	Congenital
08:15	Oncology I	131 & 132	Thoracic
08:15	Work in progress	122 & 123	All Domains
10:15	Coronary artery bypass graft and percutaneous coronary intervention	114	Cardiac
10:15	Endocarditis	112	Cardiac
10:15	Extra corporeal circulation/Left ventricular assist device/ Transplantation 2	133 & 134	Cardiac
10:15	Basic science and lung transplantation	131 & 132	Thoracic
10:15	Hypoplastic left heart syndrome	111	Congenital
14:15	Transcatheter aortic valve implantation	114	Cardiac

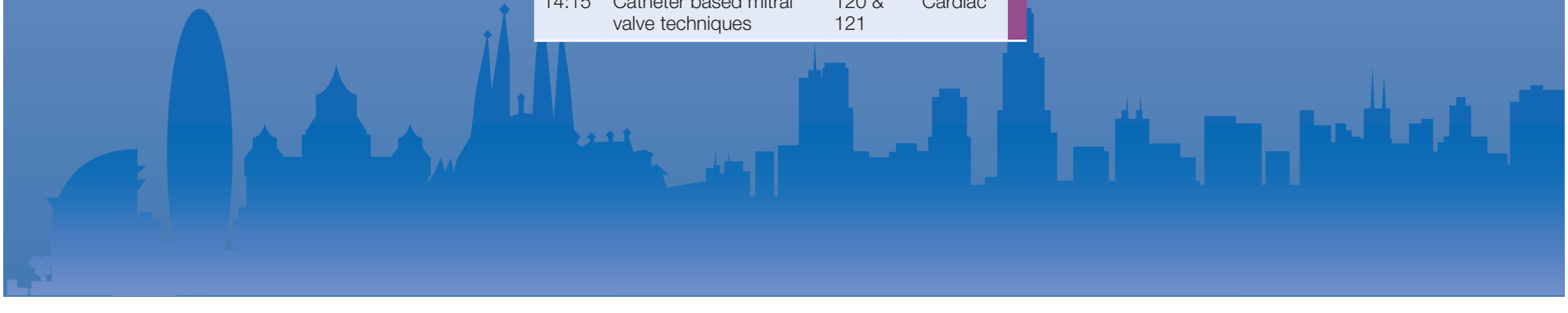
14:15	Blood management	133 & 134	Cardiac
14:15	Oesophagus	131 & 132	Thoracic
14:15	VATS lobectomy	129 & 130	Thoracic
14:15	Congenital miscellaneous 1	111	Congenital
16:00	Improving outcomes in hypertrophic obstructive cardiomyopathy (HOCM)	115	Cardiac
16:00	Translational vascular biology	133 & 134	Cardiac
16:00	Regeneration – Preservation	120 & 121	Cardiac
16:00	Congenital miscellaneous 2	111	Congenital
	Abstract Rapid Response		
08:15	Minimising sternal wound complication	211	Cardiac
08:15	Type A Aortic dissection from research to clinical application	212	Vascular
10:15	Cardiac General	211	Cardiac
10:15	An update on mitral valve interventions	212	Cardiac
14:15	Developments in assist devices and transplantation	211	Cardiac
16:00	Adult Cardiac	211	Cardiac
16:00	Thoracic	212	Thoracic
	Training in Research Session		
08:15	How to perform more advanced statistics: basics and pitfalls	118 & 119	All Domains
14:15	Meta-analysis from start to finish	118 & 119	All Domains
	Plenary		
11:50	Presidential Address	116 & 117	Plenary
	Competition		
14:15	Jeopardy Final	212	Competition

Tuesday 4 October

	Professional Challenge		
08:15	Fighting infection in cardiac surgery	116 & 117	Cardiac
08:15	Management of coarctation in newborn and infants	111	Congenital
10:15	Management of aortic arch obstruction beyond infancy	111	Congenital
	Focus Session		
08:15	Bioprosthetic valve durability: also for younger patients?	115	Cardiac
08:15	Atrial fibrillation and management of the left atrial appendage	114	Cardiac
08:15	Experimental models for basic research in thoracic surgery	129 & 130	Thoracic
08:15	Translational regenerative medicine for cardio-thoracic surgeons	118 & 119	Cardiac
08:15	Bicuspid aortic valve and its challenges	122 & 123	Cardiac
08:15	Connective tissue disorders and aortic disease: New frontiers in diagnosis and management	113	Vascular
10:15	Late tricuspid regurgitation after previous mitral valve surgery	115	Cardiac
10:15	Improving outcome of left ventricle assist device therapy	120 & 121	Cardiac
10:15	Interdisciplinary maximally invasive thoracic surgery	131 & 132	Thoracic
10:15	Arch surgery: Towards a low mortality and low complications rate	113	Vascular
10:15	Simulation based training	122 & 123	All Domains
14:15	People skills for surgeons	116 & 117	Cardiac
14:15	Designing a valve centre of excellence; not just numbers!	113	Cardiac
14:15	Electrophysiology and the surgeon	112	Cardiac
14:15	Pro and Cons debates	122 & 123	All Domains
16:00	From cardiac surgery guidelines to aircrew licensing regulations	133 & 134	Cardiac
16:00	Future surgical approach for routine anatomical lung resections	131 & 132	Thoracic
16:00	Endovascular competence for the cardiac surgeon. Keeping in track.	113	Vascular
16:00	EACTS publications: Best papers	211	All Domains
	Abstract Session		
08:15	Tricuspid valve – repair and replacement	112	Cardiac
08:15	Mesothelioma	131 & 132	Thoracic
10:15	Transcatheter aortic valve implantation 2	118 & 119	Cardiac
10:15	Stand-alone and concomitant MAZE is an evidence based procedure	114	Cardiac
10:15	Coronary artery bypass graft: From start to finish	112	Cardiac
10:15	Functional mitral insufficiency	133 & 134	Cardiac
10:15	Non-oncology	129 & 130	Thoracic
14:15	Coronary artery bypass graft: Minimally invasive and hybrid revascularisation	115	Cardiac
14:15	Who will do well after aortic valve replacement?	114	Cardiac
14:15	Catheter based mitral valve techniques	120 & 121	Cardiac
14:15	Chest wall and mediastinum	131 & 132	Thoracic
14:15	Valves	111	Congenital
16:00	Complications in mitral valve surgery	116 & 117	Cardiac
16:00	Tissue repair and myocardial homestasis	114	Cardiac
16:00	Aortic valve replacement – rapid deployment valves	112	Cardiac
16:00	Oncology 2	129 & 130	Thoracic
16:00	Tetralogy of Fallot / pulmonary atresia	111	Congenital
	Abstract Rapid Response		
08:15	Coronary artery bypass graft: Decreasing complications & improving graft potency	211	Cardiac
10:15	Risk modelling and scoring systems in cardiac surgery	212	Cardiac
14:15	Thoracic	212	Thoracic
14:15	The old, the new, the evident in aortic surgery	211	Vascular
16:00	Beyond lines and clips	212	Cardiac
	Training in Research Session		
08:15	Starting a trial: what you must know	120 & 121	All Domains
14:15	Interpreting randomized trial data	118 & 119	All Domains
	Plenary		
11:50	Honoured Guest Lecture	116 & 117	Plenary
	Resident's luncheon		
12:30	Resident's luncheon – The force awakens: training of the new Jedi	Banquet Hall 1	All Domains

Wednesday 5 October

	Advanced Techniques		
09:00	Controversies and catastrophes in Adult Cardiac Surgery	122 & 123	Cardiac
09:00	Multiple arterial grafting: vhow I do it	133 & 134	Cardiac
09:00	A future without suture: where we stand?	112	Cardiac
09:00	How to do it, with live in box?	127 & 128	All Domains
	Abstract Session		
09:00	Video & Case Study 1	129 & 130	Thoracic
11:00	Video & Case Study 2	129 & 130	Thoracic
	Wetlab		
09:00	Mitral Valve Repair	111	Cardiac
09:00	Thoracic	131 & 132	Thoracic
09:00	Aortic Valve Repair	118 & 119	Vascular
11:00	Thoracic	131 & 132	Thoracic

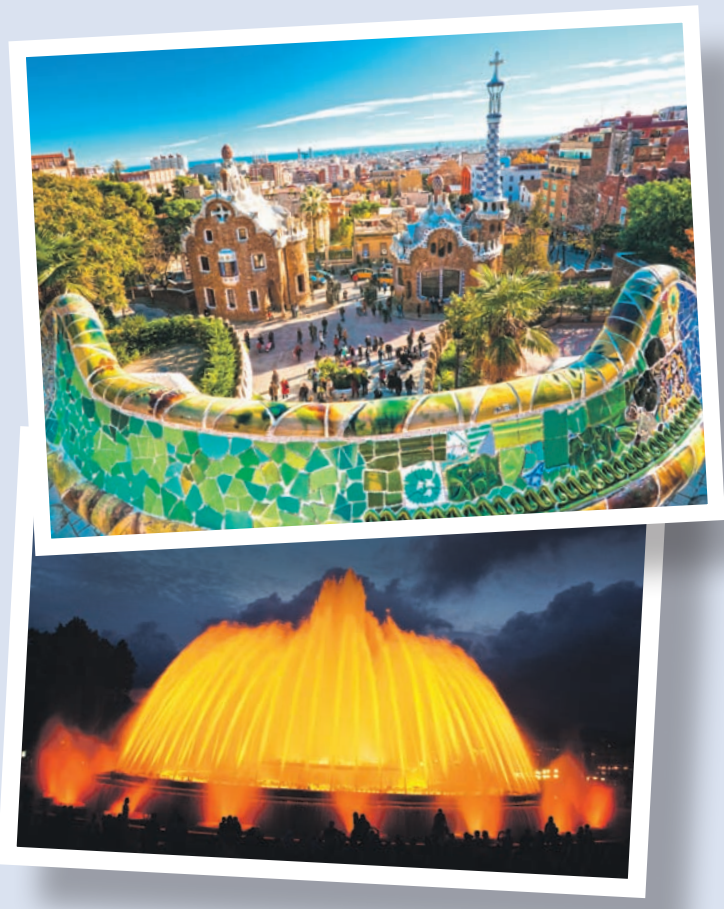


INSIDE BARCELONA
Where to go? What to do?

CULTURE

PARK GÜELL
Gaudí's weird and wonderful public park is a UNESCO World Heritage Site with over 100 years of history within its borders. Take a stroll through nature, architecture and vibrant mosaics that include a multi-coloured salamander called "El drac".

MAGIC FOUNTAIN
The Font màgica de Montjuïc is an eye-popping display of colour, light and aqua-aerobics. If you are sticking around until Friday night, it is a truly majestic showcase.



EATING

JAI-CA
Listen carefully and you'll hear "true Spain" and "locals' favourite" when people discuss this quiet, affordable tapa joint, renowned for its excellent seafood.
TRY: Calamari or grilled sardines

QUIMET & QUIMET
A small but bustling joint that proves less really is more. You may find yourself loitering on the pavement outside, but the food – the choice of which will depend on the night you go – is definitely worth it. Wash it down with one of their excellent wines.

TRY: Montaditos (small breads with toppings) or tinned seafood (for a surprise treat)!

BARS
If cocktails are your thing, Barcelona has is covered. And while there are many a mixologist waiting to fill up your glass, here are a couple of suggestions to get you started.

SOLANGE
Vintage sofas and touches of gold offer a warm welcome at this swanky venue – a perfect match for the icy-cool cocktails that await you at the bar.

AIGUA DEL CARMEN
If you're tired from your visit to the Sagrada Família, this nearby hotspot may be just the tonic you need. Although the bar is named after an old remedy that was thought to treat all ailments, the staff will be all-too-happy to mix you up a more modern, and perhaps stronger, potion.

ALTERNATIVELY...

BLACKLAB BREWHOUSE & KITCHEN
Turn left at the bottom of La Rambla and you can pop in for a "brew" or two at this dedicated beer bar. Try local and international beers in a range of styles, and legend has it the staff will even offer you a tour of their brewing process, if you ask nicely...

Thoracic | Abstract Session | Non-oncology

Twenty cricotracheal resections for benign post-intubational laryngotracheal stenosis: three years' single centre experience

Ahmed Mostafa
Consultant of Thoracic Surgery, Ain Shams University, Cairo, Egypt

Single staged laryngotracheal resection with primary end-to-end anastomosis is currently one of the standard operative techniques in the curative treatment of benign post-intubational laryngotracheal stenosis. This retrospective study aims to review our practice, and analyses the outcome of cricotracheal resection done in our institute (Thoracic surgery department, Ain Shams University) from September 2012 till September 2015.

In this study we included 20 patients, 14 male (70%) and 6 female (30%). The median age was 26 years (range 3-75 years), while the median intubation time was 16 days (range 5-35 days). Nineteen patients (95%) had bronchoscopic dilatation at some point, six patients (30%) had tracheostomies, while four (20%) had tracheal stents prior to surgery. We included patients with subglottic stenosis presenting as de novo, redo, or having had previous interventions, and excluded patients with long segment stenosis (more than half of the tracheal length), and isolated glottic stenosis.

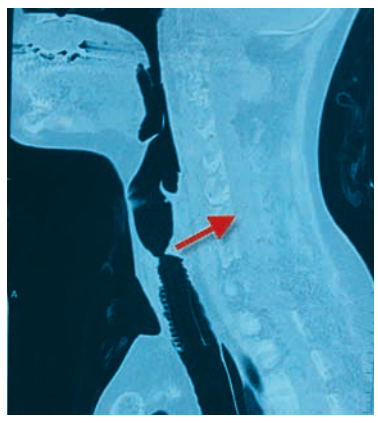


Figure 1. Preoperative CT demonstrating subglottic stenosis

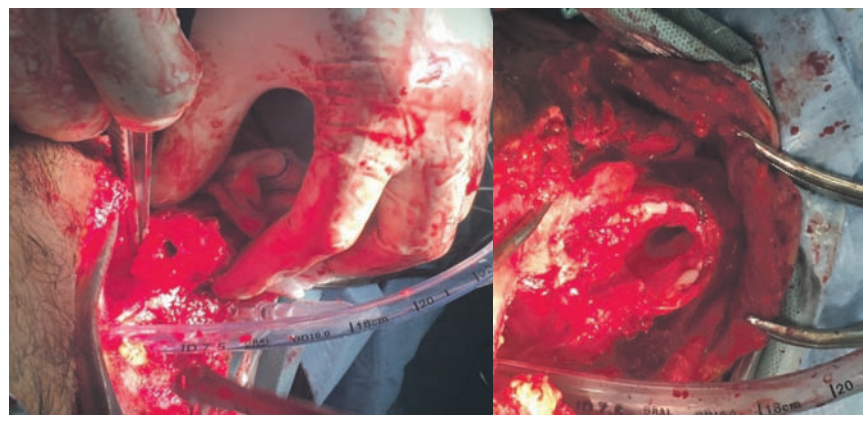


Figure 2. Cricotracheal resection and reconstruction following the methodology of Grillo et al.

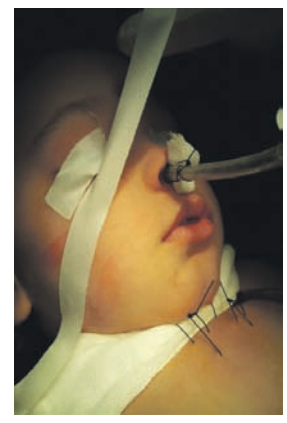


Figure 3. Immediately post-operation

Preoperatively, all patients were subjected to the following: full medical history, CT scan with volume rendering of the airway (neck and chest), direct laryngoscopy, and bronchoscopy (before or at the same operative setting in case of acute airway obstruction). Our operative technique reference was that utilised by Grillo et al.[1]

Twelve patients (60%) needed resection of the anterior cricoid arch sparing the mucosa covering the posterior segment of the cricoid, while eight patients (40%) needed resection of the posterior mucosa. All patients had a chance for immediate postoperative decannulation.

Fifteen patients (75%) had successful decannulation, one patient (5%) had bilateral vocal cord paralysis after resection of the posterior cricoid segment due to an extensive cricoid abscess, while four patients (20%) had delayed decannulation. Eighteen patients (90%) were completely cured, one patient (5%) developed restenosis on the suture line which was sufficiently treated by bronchoscopic dilatation. The patient who had severe inflammation at the cricoid with abscess formation needed permanent tracheostomy.

We conclude that cricotracheal resection is a safe option for the treatment of benign post-intubational laryngotracheal stenosis. The need for repeated preoperative dilatation is nearly abandoned. Finally, the rush for tracheostomies or stent placements is certainly not advised.

Reference

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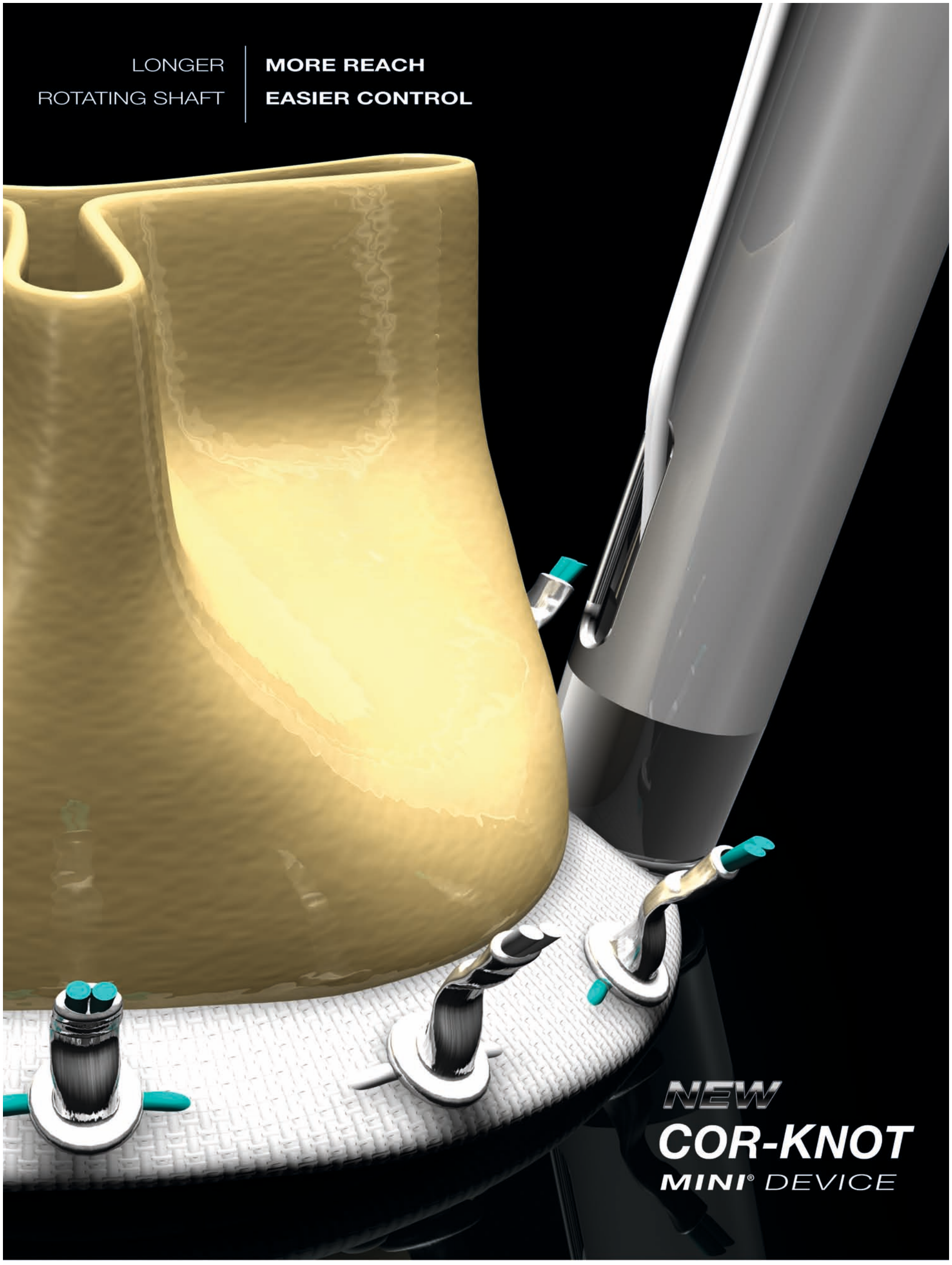

SOLUTIONS® **BOOTH 30**

Cardiac | Focus Session | How can we work together? Latin America, Africa and Asia Perspective

Training and education: Approaching programmes in the 21st century?

Fabio B. Jatene University of Sao Paulo, Sao Paulo, Brazil and President of the Brazilian Society of Cardiovascular Surgery

Training in cardio-thoracic (CT) surgery has undergone important changes in recent years, penned by some authors as the 'decade of change'. Analysis of the training programmes has demonstrated that, in the last years, they have a tendency to become fully integrated, where more general topics such as operative technique, diagnostic methods and imaging, and catheter manipulation skills – amongst others – are incorporated into the program of CT surgery.

The method of training has also undergone significant changes, especially in terms of the rapid development of new technology and techniques in CT surgery, which – over the past decades – has impacted on the model of learning. Indeed, we have observed changes in training methods such as the incorporation of simulators and virtual reality, minimally-invasive techniques, robotics and catheter-based therapies which demand integration between different specialties, with repercussions for training.

Surgical education is becoming a progressively more complex endeavour. The residents must acquire skills in technical operations with increasing complexity, thus, intensive and repetitive opportunities for learning are mandatory. On the other hand, the specialist medical societies must also be in charge of the task of training and retraining the graduated surgeons in order to maintain excellence in their daily practice. Therefore, new and creative educational techniques must be used to ensure that surgeons in training achieve proficiency in more complex problems during shorter training periods, and that practicing surgeons can be rapidly trained in new technologies.

In the last years, the Brazilian Society of Cardiovascular Surgery (BSCVS) has discussed the learning of new complex surgical techniques as well as the incorporation of new technologies, and how to disseminate and to extend their use in daily practice. Considering these goals, BSCVS introduced hands-on sessions at their annual national meeting, by way of a teaching and learning strategy that fosters interaction between the expert and surgeon (Figure). Over the course of five editions, more than 3,000 participants have passed through simulation surgeries, and have been trained in new technologies. Wetlabs and hands-on initiatives have also been introduced in some medical schools, and we are observing the proliferation of regional centres for simulation in different places and countries.

Finally, one aspect that must be considered is the tendency of how we approach training in CT surgery, regardless of country or region – particularly aspects such as the uniformity of training, enhancement of the use of successful experiences, and standardisation of training as a whole. We should not be limited only to the teaching and use of the most modern technology, but use it mainly in relation to the development of training patterns, employment of more efficient teaching methods, appropriate workloads and programmatic content. This would facilitate a lot of interchange and cooperation, which would favour the flourishment of CT surgeons who are better trained and better prepared, with the ultimate goal of excellence in training, service quality and patient safety.

Figure1. Hands-on session during Annual Meeting of the Brazilian Society of Cardiovascular Surgery.

Vascular | Rapid Response | The old, the new, the evident in aortic surgery

Safeness of unilateral or bilateral cerebral perfusion according to preoperative evaluation of Willis' Circle completeness in aortic arch surgery

Giuliano Jafrancesco Cardiochirurgia Di Bartolomeo, Ospedale Sant' Orsola-Bologna, Italy

Background

Antegrade, selective cerebral perfusion (ASCP) with moderate hypothermia has become the preferred technique for brain protection during aortic arch surgery. A recent European survey showed that roughly two-thirds of centres prefer bilateral ASCP (bi-ASCP), while one-third of them deliver the cerebral perfusate in a unilateral manner.

Unilateral ASCP (u-ASCP) is usually performed by a right subclavian-axillary approach or by cannulation of the brachiocephalic trunk or of the right common carotid artery. u-ASCP relies on adequate collaterals from right to left, for adequate brain protection that is mainly dependent on the Circle of Willis (CoW). The CoW, however, is known to be incomplete in more than half of the population, risking suboptimal brain protection during u-ASCP, albeit its reduced metabolism due to concomitant moderate hypothermia.

Materials and methods

In a total of 391 patients, from January 2005 to June 2015, complete functional evaluation of CoW was possible. This group consisted of 237 males (60.7%) and the mean age was 61.7±12 years (range, 17-82 years). As shown in figure 1, we divided our population in three groups of no-risk, moderate-risk, and high-risk, according to anatomic variation of CoW and perceived level of malperfusion during u-ASCP and bi-ASCP.

Results

According to risk rate, we classified vessel variations into three groups. For u-ASCP, the three identified groups are: no-risk (nRK) in 70.1% of cases, moderate-risk (mRK) in 19.7%, and high-risk (hRK) in 10.2% of overall (Figure 1).

The total percentage of the variations of CoW significant for risk of brain injury during unilateral uSCP was 29.9%.

Conversely, in case of bi-SCP, the brain receives blood from both carotid artery and rVA with ischemia risk only in 1 patient (0.3%).

Discussion

Nowadays, more and more centres have changed their strategies. In fact, various authors illustrated aortic arch replacement at warmer temperature (28-30 °C), to limit unfavourable events of hypothermia and to accomplish arch vessel anastomosis after aortic declamping to reduce cardiac ischaemia time and thus limiting the risk of spinal cord injury. In the present work, we report some variations of the CoW that could vitiate the protective effect of unilateral SCP and could even lead to stroke, especially in cases of moderate hypothermia and prolonged ACP time (>30 minutes). Furthermore, the clinical manifestation of watershed infarction is quite variable – from dense plegia to lack of any symptoms.

The presence of such variations could explain the unfavourable postoperative events after unilateral SCP (uSCP), which occurs in some patients. Because of the high percentage of these variations (30% of the population) we retain that preoperative transcranial colour Doppler (TCCP) and Eco-colour Doppler of the aortic arch vessel should be routinely performed if uSCP has been planned; in contrast, thanks to its high capacity of brain protection and lower percentage of population at risk (only 0.3%), bi-SCP doesn't need routine preoperative TCCD because it permits a satisfying cerebral perfusion in almost all patients eligible for aortic arch surgery; and, optimising cerebral perfusion, it might confirm the idea to safely perform aortic arch replacement in mild hypothermia.

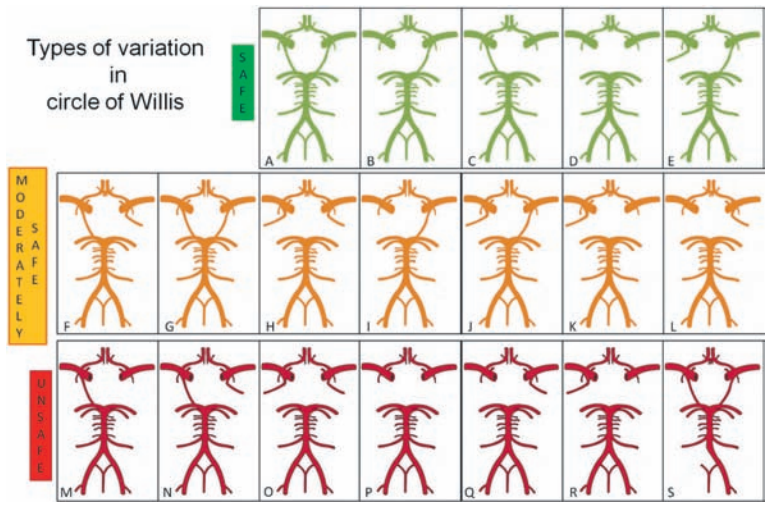

Figure 1

Cardiac | Abstract Session | Robotics revisited

Robotic mitral valve repair: A European single-centre experience

Emiliano Navarra Division of Cardiovascular and Thoracic Surgery, Cliniques Universitaires Saint-Luc, Université Catholique de Louvain - Brussels, Belgium

Minimally-invasive mitral valve (MV) repair techniques have emerged in the last 25 years as alternative approaches to conventional sternotomy for degenerative mitral regurgitation, and several authors have shown that minimally-invasive MV repair is safe and durable.[1-3] Robotic technology represents the latest development, and there have already been a number of reports praising the technical advantages of robotic technology (high-resolution 3D visualisation, up to 10x magnification of the operating field, fine dexterity of robotic forceps allowing the access to the entire sub-valvular apparatus). But despite the very good results reported in the literature,[4,5] only a few centres in Europe have launched a robotic programme, because of the concern about its technical complexity, longer operative time and costs.

We now report on the outcomes of robotic mitral valve repair for degenerative regurgitation in our institution. The aim of the study was to analyse our experience with robotic MV repair for degenerative mitral regurgitation, with special emphasis on early and mid-term valve-related morbidity and mortality. Between February 2012 and July 2016, 134 patients underwent robotic mitral valve repair with the da Vinci Si (Intuitive Surgical, USA) system. All the operations were performed through a mini-thoracotomy in the fourth intercostal space, with cardiopulmonary bypass and mild hypothermia. The clinical and echocardiographic follow-up was 100% complete. There was no hospital death. Pre-dismissal echocardiograms showed no to mild residual mitral regurgitation in all patients.

Median follow-up was 24.1 months: one early and four late reoperations occurred for an overall freedom from reoperation of 98.2% and 94.1% at 12 and 36 months, respectively. Furthermore, echocardiographic follow-up revealed freedom from recurrence of mitral regurgitation >1+ of 92.5% and 80.7% at 12 and 36 months, respectively. Nevertheless, freedom from recurrence of mitral regurgitation >2+ was 97.2% at 12 and 36 months.

We conclude that robotic mitral valve repair is a feasible and safe option for the treatment of degenerative mitral regurgitation in selected patients, with excellent perioperative outcomes. Early and mid-term results are remarkable, and are associated with a low risk of late recurrence of MR and reoperation. Long-term follow-up is needed to confirm the durability of valve repair.

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Cardiac | Rapid Response | Risk modelling and scoring systems in cardiac surgery

Which patient characteristics would predict Renal Replacement Therapy (RRT) after cardiac surgery?

G.E. Drossos, A. Boutou, L. Karagounis and F. Ampatzidou
Papanikolaou Hospital, Thessaloniki, Greece

Renal dysfunction after cardiac surgery, referred to as Cardiac Surgery-Acute Kidney Injury (AKI-CS), occurs in over 30% of patients. Its worst form, requiring dialysis, is estimated in recent reports to occur in <2%. Patient characteristics have changed over time and now include patients who are elderly, sicker, and with multiple comorbidities, all of whom are at a higher risk of revealing post-op complications.

Acute renal failure after cardiac surgery is very common, since there are many factors that could induce renal damage, such as the alteration of renal perfusion during ECC, the increase of renal and systemic inflammation, along with exogenous blood products transfusion, and vasopressors infusion, all of which are involved in the development of AKI-CS. The slight improvement in our ability to understand the pathophysiology and to treat renal injury has not impacted the consistent mortality rate, which is estimated to be at least 50% among CS patients who undergo postoperative RRT. This devastating death rate triggered the interest of several authors to investigate the impact of possible preoperative, intraoperative or immediate postoperative risk factors on renal function or even to create risk models predicting the occurrence of CS-AKI requiring RRT. However, data on this field is still rather controversial.

Reviewing the literature and observing our patients, a question was raised regarding the predominant factor for RRT: is it the pre-op patient's condition, or is it a complicated procedure?

Against this background we conducted a nested case-control study examining 12 factors which could potentially be related to CS-AKI-D, based on clinical evidence and published data. These factors were divided into 4 categories. The first comprised 5 pre-op characteristics which are objective parameters of an existing or vulnerable atherosclerotic condition of the patient: age, smoking, diabetes mellitus, history of stroke, and dyslipidaemia. The second category included the glomerular filtration rate (GFR) as being the most reliable pre-op marker of renal function. The third comprised both the clinical condition of the heart expressed in accordance with the NYHA classification, and the EURO-SCORE II classification model, as a prognostic indicator for the severity of the procedure. The fourth and final category included cardiopulmonary and aortic cross clamp time as well as the units of transfused red blood cells (RBCs). These factors are related to the intra- and early post-op period.

Univariate analysis indicated that patients who underwent postoperative RRT presented with higher EUROSCORE II index, lower eGFR and higher NYHA class, compared to controls. Moreover, cardiopulmonary bypass (CPB) duration and cross clamp time were higher, while blood units transfused were greater among patients who received RRT than among those who did not.

All variables which were univariately associated with postoperative RRT were then entered in a multivariate logistic regression analysis model. CPB duration (OR=1.004; 95% CI=1.004-1.014), number of blood units transfused overall (both intraoperatively and postoperatively) (OR=1.549; 95%CI=1.339-1.792) and the presence of higher NYHA class (OR=4.880; 95%CI=1.856-12.835) were the only independent predictors of postoperative RRT.

Other Observations:

1. Age, diabetes mellitus, dyslipidaemia, smoking history and history of stroke were not univariately different between those who received and those who did not receive RRT.
2. NYHA functional class, but not ejection fraction, entered the multivariate analysis.
3. The lower pre-op GFR was a univariate but not an independent predictor of RRT need after cardiac surgery, among patients who were not on chronic dialysis.
4. The CPB duration and the number of transfused RBC units, which are associated to the duration and the complications of the surgical procedure and are, to some extent, modifiable, proved to be independent predictors of postoperative RRT requirement.

Cardiac | Abstract Session | Minimally invasive mitral surgery

Three-port endoscopic mitral valve surgery without robotic assistance

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Totally endoscopic minimally-invasive mitral valve surgery (MIMVS) with standard endoscopic systems originated in the late 1990s, yet the technique is still lacking in popularity, irrespective of its convenience and reduced cost when compared with the robotic da Vinci System (Intuitive Surgical, USA). Typically, endoscopic MIMVS has been done by simply reducing the size of incision of direct vision MIMVS – i.e. via a single slit-like incision. This setting resembles recent 'single port endoscopic surgery' as a more challenging style of endoscopic surgery.

However, multiple-port surgery is not yet standard for complicated endoscopic surgeries. In thoracic surgery, three-port video assisted thoracic surgery (VATS) is a basic procedure, consisting of one small thoracotomy, one camera port, and one additional working port.

We hypothesised that adoption of the three-port VATS technique would then facilitate MIMVS, which we then evaluated for feasibility and safety. Thus, between October 2010 and June 2016, 249 patients underwent first-time MIMVS (122 were male, and average age was 62.4 years). The most common mitral lesions were myxomatous degenerations (n=175), followed by 23 rheumatic, and 15 infectious endocarditis patients.

Surgical technique

The surgical setting is based on usual MIMVS through right mini-thoracotomy with peripheral cannulation. Chest wounds consists of one small (3-5cm) fourth intercostal thoracotomy opened with only a soft tissue retractor, and two additional trocar ports. One trocar port is for the endoscope, the other is for left-handed instruments (Figure 1). An aortic clamp with flex shaft, a left atrial vent, a CO2 line and a left atrial retractor are all inserted through the small thoracotomy. Right-handed instruments are then inserted through remnant space of the thoracotomy. High-definition endoscopy (recently 3D) is hand-held, and controlled by an assistant.

Results

A total of 233 patients underwent mitral valve repair (MVP), and 26 mitral valve replacements (MVR). Of these 26, 24 were scheduled and 2 were conversions from attempted repair. Forty-nine patients underwent concomitant tricuspid annuloplasty, and 45 a Maze procedure. Average aortic clamp and bypass time were 126, and 175 minutes respectively.

One patient died in-hospital, two patients had a stroke, three required re-exploration for bleeding, two needed conversion to sternotomy, two had minor wound infection, and seven needed prolonged ventilation. Thirty-three percent of patients needed blood transfusion, while 82% of patients needed only an overnight ICU stay. During 30 months of mean follow-up, seven (3%) patients needed re-operation for recurrent MR. Of them, six underwent a second MIMVS, and five needed re-repair.

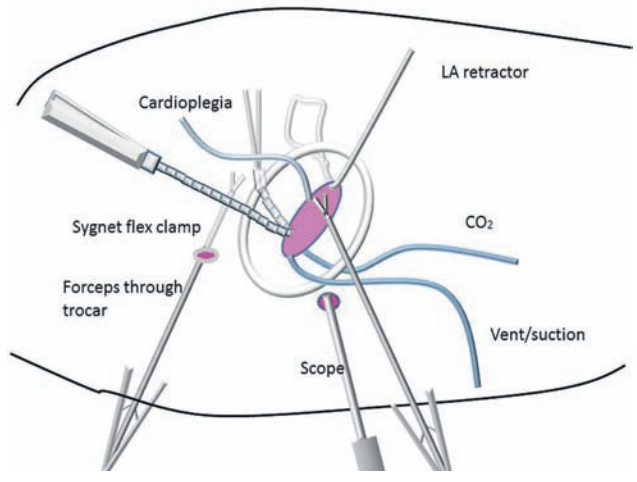

Figure 1

Conclusion

The addition of an independent trocar port for left-handed instruments facilitated totally endoscopic mitral surgery. This three-port VATS technique could be a practical option instead of robotic assistance.

Further reference

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Congenital | Rapid Response | Congenital Miscellaneous

Factors influencing pulmonary artery growth from Bidirectional Cavopulmoanry Anastomosis (BCPA) to Total Cavopulmonary Connection (TCPC)

Lucio Careddu and Gaetano Gargiulo Department of Pediatric Cardiac Surgery and GUCH Unit, University of Bologna, Sant'Orsola-Malpighi Hospital, Bologna, Italy

The staged Fontan approach has proven to be a valid option in patients with univentricular physiology.[1] Bidirectional cavo-pulmonary anastomosis (BCPA) on course for total cavo-pulmonary connection (TCPC) has confirmed to be a successful strategy for staged palliation of univentricular hearts (UVH). The growth of pulmonary arteries during palliation is considered to be a crucial factor for better outcomes in patients whit UVH.

Many factors that could influence the growth of pulmonary arteries (PAs) have been postulated during the last decades, but it still remains unclear which factor could truly influence the development of pulmonary arteries. According to the Groningen experience[2], patients with a BCPA, and additional pulmonary blood flow (APBF), will have a longer interval before the TCPC, without evident untoward effects, and postponement of the final Fontan completion.

In addition, the presence of a persistent left superior venae cave (LPSVC) has, in the past, been associated with a risk for TCPC completion. But the role of LPSVC has been evaluated in a recent analysis[3], and no difference on the growth of central pulmonary arteries, rate of reintervention and rate of Fontan completion have been demonstrated.

Because there are still controversies on this topic, we decided to evaluate the growth of the pulmonary arteries from BCPA to TCPC. To do this, we selected different risk factors that could influence the growth of PAs, highlighting especially the role of APBF, the influence of persistent left superior vena cava at BCPA completion, presence of azygos or emiazygos continuation and morphology of UVH.

The study population included only patients operated for UVH at S.Orsola-Malpighi Hospital in Bologna who underwent a pulmonary artery angiography before BCPA and TCPC. All angiographies were reviewed and Nakata values and PA diameters on BSA were recorded. A normalisation of Nakata index was also calculated and was defined Delta-Nakata (Δ-Nakata) calculated as: (PreTCPC-Nakata – PreBPCA-Nakata)/PreBCPA-Nakata.

The results showed that the ventricular morphology, presence of LPSVC at time of BCPA or azygos or emiazygos continuation do not influence the growth of PAs. Meanwhile, ABPF results are related with an increased Nakata index at time of TCPC as well as diameter of left PA on BSA (p=0.02 and 0.03 respectively). Also at the long-term follow-up, tpatients with AFBF didn't develop protein-losing enteropathy after TCPC completion ($\chi 2$ p=0.03).

Nowadays, factors influencing pulmonary artery growth in patients with univentricular physiology still remains unclear. The ventricular morphology does not appear to be a relevant prognostic factor for development of PAs, especially there were no differences between HLHS patients and other groups.

Bilateral BCPA and Kawashima operation does not demonstrate, in our series, to provide additional flow to the PAs resulting in an influence on development of PAs too. Only APBF demonstrated an increase in Nakata index as well as a reduction of PLE at follow-up. Future investigations are needed to confirm the role of APBF, especially in the growth of left PA that could be hypothetically attributed to a competitive flow between the superior vena cava and the antegrade flow from the UVH.

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Cardiac | Rapid Response | An update on mitral valve interventions

Single Center Experience with Transapical Transcatheter Mitralvalve Implantation

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TAVI is an established treatment for aortic stenosis, but still there is an unmet need for transcatheter mitral valve treatment (TMVT). There are failed repairs with annuloplasty rings, detoriation of bioprostheses as well as mitral annular calcifications (MAC) all of which can serve as "docking" for TAVI valves in mitral position. Specially designed catheter valves are at present in studies for native mitral valve regurgitation.

We present a single center experience with all these TAMVI (transapical, transcatheter mitral valve implantation) treatment options in eleven patients.

CT reconstruction, echocardiography, 3D print as well as bench tests (Figure 1) were done in the preoperative evaluation and for planning of the procedures. All were done in a hybrid operation room under general anesthesia, fluoroscopy and TEE guidance. Transapical access via mini left thoracotomy was performed. The Edwards Sapien XT (Edwards Lifesciences Corp, Irvine, CA) was implanted in eight patients with either failed repair or bioprosthesis. The Lotus valve (Boston Scientific, Marlborough, MA) in MAC with concomitant Edwards S3 in aortic position was done in one patient (Figure 2). Tendyne transcatheter mitral valve (Abbott, Abbott Park, IL) with apical tether was used in two patients with native valve regurgitation (Figure 3).

Procedural success was 100% with no LVOT obstruction. Good haemodynamics and improved NYHA class was achieved in all patients. One patient died before 30 days (sepsis). One patient had valve thrombosis after changing from Coumadine to NOAC (new oral anticoagulant) and had a second catheter valve implanted into the first one, "a valve-in-valve" procedure.

Transapical approach is excellent to access the mitral valve. "TAVI" prostheses may be used in redo surgery with an already sufficient "docking station". For regurgitation the specially designed prostheses for the mitral valve are promising. Anticoagulation is mandatory.

Figure 1. Different annuloplasty rings with the Edwards Sapien XT deployed. 1) CE classic rigid ring size 34 with Edwards Sapien XT 29 inside. Increased opening of the ring and gap between ring and valve. 2) CG future band size 32 with Edwards Sapien XT 26 inside. 3) CG future ring size 32 with Edwards Sapien XT 26 inside. 4) Medtronic Profil 3D size 34 and Edwards Sapien XT 29 expanded inside. 5) Edwards Physioring size 34 with Edwards Sapien XT 29 inside on the balloon fits perfect and the ring is made circular. 6) Edwards Physioring size 36 with Edwards Sapien XT 29 turns out circular, but there are gap between the valve and the ring. 7) Liva Nova, Memo-3D semi rigide ring size 34 tightly fitting around a CM valve sizer

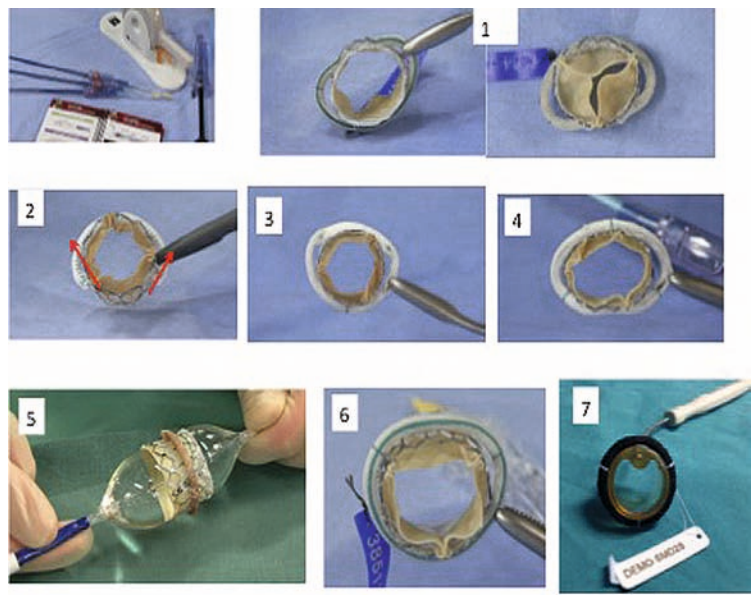


Figure 2 (left). Valve-in-MAC. A, B, C) CT reconstruction of the calcified mitral annulus. D) 3-D print of the heart. Planning double valve implantation, TAVI with Sapien 3 in aorta, Lotus (Boston Scientific) in the mitral annulus. Evaluation of the AMA-angle and eventually any LVOT obstruction preoperatively. E) Transapical implantation of both valves, Sapien 3 deployed, the Lotus valve before releasing

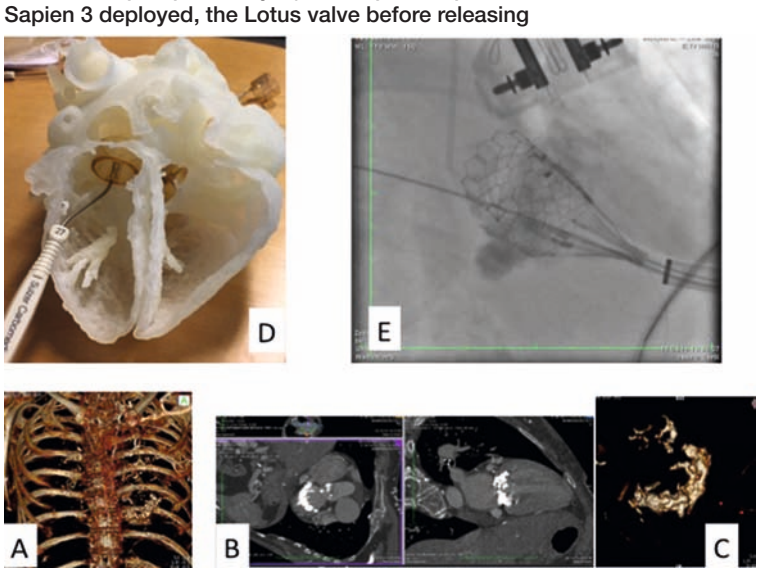
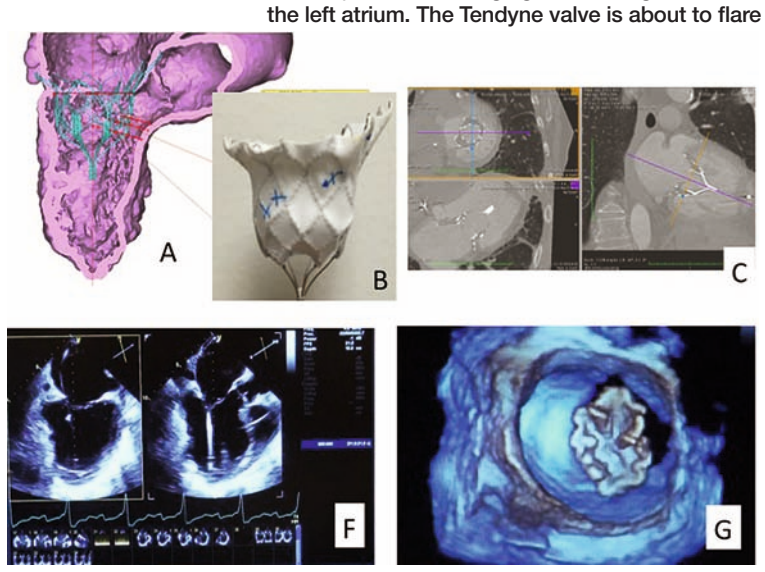


Figure 3 (right). Tendyne valve in a native mitral regurgitation. A) CT reconstruction of the mitral annulus and LVOT simulating the Tendyne valve in place. B) The Tendyne valve. C) CT reconstruction after deployment of the Tendyne valve F) Echo imaging during procedure. The tip of the introducer at the border of the mitral leaflets. G) 3-D Echo imaging from a surgical view in the left atrium. The Tendyne valve is about to flare



Cardiac | Abstract Session | Endocarditis

Reversed aortic-valved conduit in the mitral position for treatment of mitral endocarditis requiring reconstruction of the intervalvular fibrous body

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Surgery for active infective endocarditis continues to be challenging, and is associated with high operative mortality and morbidity. Operative mortality for paravalvular abscess is higher than that for native valve endocarditis primarily due to the complexity of the operation. Resection of aortic root abscess is indeed a complex operation, but resection of mitral annulus abscess can be even worse (Figure 1). Although aortic valve homografts are believed to be the best valve for aortic root abscess, they are not a substitute for radical debridement and implantation of the new valve on healthy and strong tissue. Although there is considerable information on surgery for aortic root abscess, there is little on mitral annulus abscess or on patients with combined mitral and aortic valve abscesses (Figure 2). Resection of abscess in the posterior mitral annulus, in the intervalvular fibrous body, or in both, is a formidable operative procedure associated with high operative mortality, but we believe that it is the only way to eradicate the infection and provide satisfactory long-term results. We present a modified technique for the reconstruction of the intervalvular fibrous body in double-valve replacement through an aorto-annulo-atriotomy. This technique allows the surgeon to enlarge and reconstruct both annuli by using a tailored aortic-valved conduit in a mitral position.

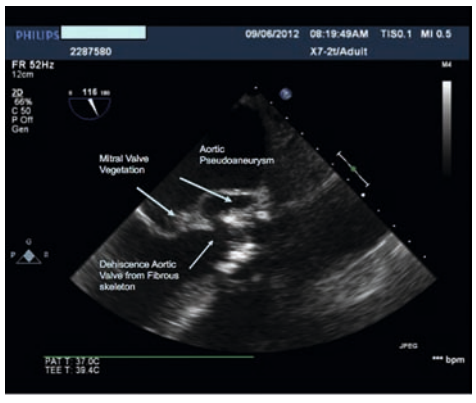

Figure 1. Resection of aortic root abscess is indeed a complex operation, but resection of mitral annulus abscess (pictured) can be even worse

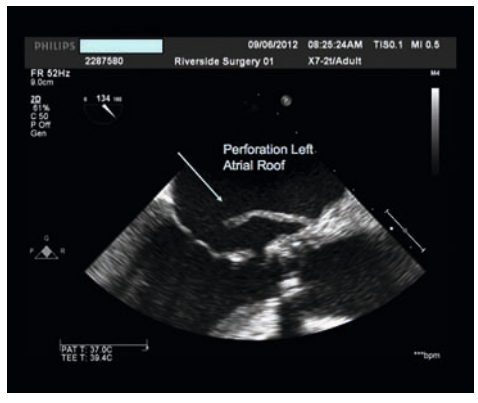

Figure 2. Combined mitral and aortic valve abscesses

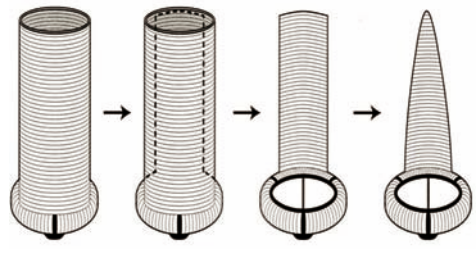

Figure 3. An aortic-valved conduit (SJM Masters Series; St. Jude Medical, St. Paul, MN) from which 270 degrees of the graft's circumference was trimmed, anchored in the mitral position

From 2009-2015, 16 patients who needed aortic and mitral valve surgery were found to have a diseased intervalvular fibrous body. The indication for reconstruction of the intervalvular fibrous body was abscess or left atrial fistula in all patients. Repair was achieved via oblique aortotomy carried down to the mid portion of the non-coronary sinus. A second incision starting on the left atrium dome at the level of the superior vena cava was directed toward the aortic incision up to the level of the annulus. Both native valves or prostheses were excised and diseased tissues were debrided. An aortic-valved conduit (SJM Masters Series; St. Jude Medical, St. Paul, MN) from which we trimmed 270 degrees of the graft's circumference was anchored in the mitral position (Figure 3). The residual prosthetic graft served to anchor the non-coronary sinus sutures of the aortic valve and enlarge the aortotomy closure. The graft also served to anchor a gortex patch utilised to close the left atrium dome. This technique creates a secure attachment for the valve in the aortic position on a prosthetic aortic curtain. It also eliminates the need for a separate patch to close the aortotomy, thereby creating a more timely, haemostatic reconstruction.

We have used this technique in 16 patients over a 60-month period. There were no operative deaths. Thirty-day survival was 94%. Postoperative complications included re-exploration for bleeding in two patients, insertion of a permanent pacemaker for heart block in two patients, and renal failure requiring dialysis in one patient. Although used infrequently, this technique has proved useful in the surgical treatment of complex valvular disorders.

Cardiac | Focus Session | Personalized revascularisation strategies

Hybrid coronary revascularisation

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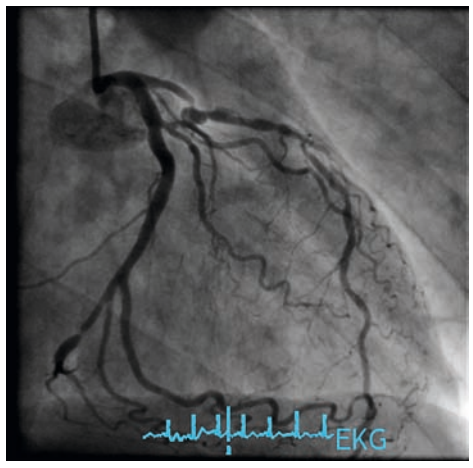


Figure 1

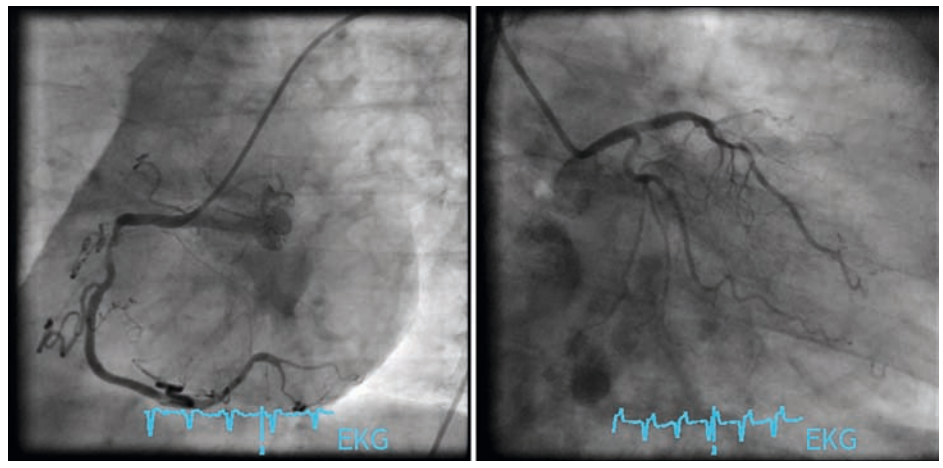


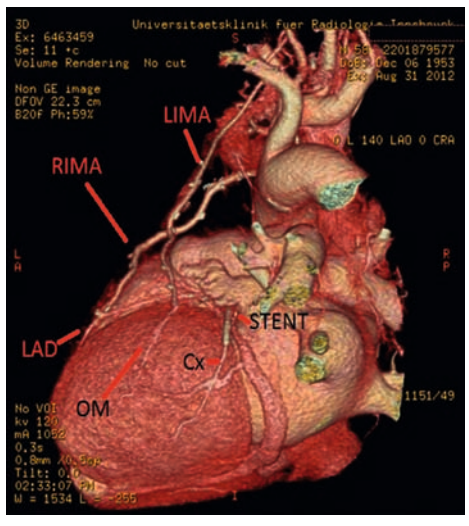
Figure 2

The compelling results of several prospective randomised trials, as well as large registries on coronary revascularisation, put contemporary revascularisation strategies in a new frame. According to this, a successful therapeutic strategy is characterised by the completeness of revascularisation and by minimising the risk of repeat procedures. One of the major merits of the SYNTAX trial is the identification of a new major factor for predicting the outcome after coronary revascularisation, namely the complexity of every single stenosis. Based on the anatomical characteristics of the stenosis, the calculation of the SYNTAX score has enriched the armamentarium of coronary specialists, as a major parameter for identifying patients, who would benefit from percutaneous intervention or coronary surgery. Although concomitant clinical characteristics, such as age, sex and other comorbidities still play an important role on decision making, we now know that intermediate and high SYNTAX-score patients will most probably benefit from surgical revascularisation.

A closer look at the SYNTAX score distribution leads us to the following conclusion: the most significant part of the SYNTAX score is contributed by left-sided coronary vessels and especially the left main and the LAD. Moreover, the right coronary system is mainly affected by proximal lesions, less prone to severe tortuosity or bifurcation areas, which can be well treated by a percutaneous intervention (PCI). It is worth mentioning that any evidence showing a benefit of bypass grafting (CABG) as compared to PCI, as well as that of arterial as compared to vein grafts for the right coronary system is completely missing.

Having that in mind, the concept of hybrid coronary revascularisation (HCR) in patients with two vessel disease, involving the LAD and the RCA and in patients with three vessel disease with complex LAD lesions and less complex RCA and CX stenoses can be theoretically supported by all major contemporary trials. Even at the practical level, and according to the short-term results of the Hybrid Observational Trial – which was the first prospective multicentre study on HCR, funded by the NIH – equivalence of HCR to multivessel PCI was found, and in general very good early procedural safety has been shown. The latter and other smaller observational trials are important hypothesis-generating studies to compare HCR with both established treatment modalities, PCI and CABG. Indeed, the single prospective randomised trial on HCR, POLMIDES, showed equivalent mid-term results between HCR and CABG in selected patients. An interesting finding of this study was the higher incidence of treatment failure (combined endpoint graft occlusion of stent thrombosis/restenosis) in CABG- as compared to HCR-treated patients.

Figure 3



The current guidelines for myocardial revascularisation propose HCR as an acceptable method to achieve complete revascularisation in patients with limited graft options or specific anatomical conditions (e.g. porcelain aorta) requiring surgical revascularisation. Beyond that, the use of HCR is gaining acceptance in three additional patient categories:

- Those with tight LAD lesions and additional stenoses of non-dominant non-LAD vessels not amenable for grafting (Figure 1)
- Patients with tight LAD lesions and moderate stenoses of non-LAD vessels (Figure 2)
- Patients requiring revascularisation and non-sternotomy valve intervention (e.g. minimally-invasive aortic or mitral valve surgery)

Taking advantage of robotic and non-robotic techniques for thoracoscopic harvesting of both internal mammary arteries (IMA), specialised centres are able to use bilateral IMA grafting for the left coronary system and PCI for the right coronary artery. This type of advanced HCR (Figure 3), though highly complex, can provide the advantages of bilateral IMA grafting and respect of the bone integrity of the thoracic cavity.

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Cardiac | Rapid Response | Coronary artery bypass graft: Decreasing complications and improving graft potency

Clinical impact of ascending aortic manipulation during off-pump coronary artery bypass grafting in 21,031 patients with three vessel disease

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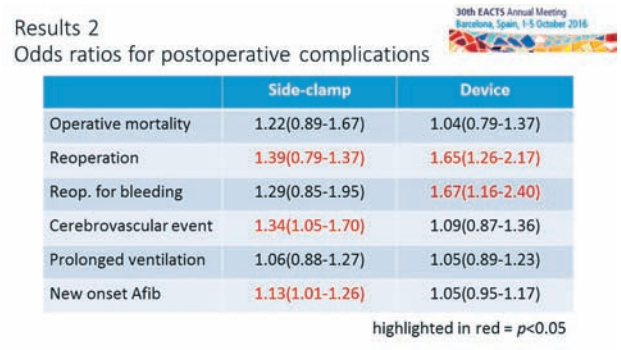
Ascending aortic manipulation during coronary artery bypass grafting (CABG) may be considered as a risk factor of postoperative adverse events, and the impact of varying extents of manipulation of the aorta (side-clamp use, anastomosis assist device use and aorta no-touch technique) on postoperative complications has been also evaluated in previous publications, especially focusing on the incidence of cerebrovascular events. The efficacy of using anastomosis assist devices in comparison to application of side-clamps or no manipulation of the ascending aorta have not been fully evaluated to date.

This study sought to analyse the impact of ascending aortic manipulation on short-term outcomes after off-pump CABG (OPCAB). 21,032 patients with 3VD who received isolated OPCAB were retrospectively reviewed using the Japan Adult Cardiovascular Surgery Database (JACVSD) from 2008 to 2012. Patients were divided into 3 groups: 'Ao no-touch', without any manipulation of the ascending aorta (n=5,447); 'Side-clamp', with side-biting clamp use (n=6,015), and 'Device', with anastomosis assist device use for proximal anastomosis (n=9,570). Preoperative profiles, incidence of postoperative mortality/ morbidity and predictors of operative mortality and morbidities were analysed.



	Side-clamp	Device
Operative mortality	1.22(0.89-1.67)	1.04(0.79-1.37)
Reoperation	1.39(0.79-1.37)	1.65(1.26-2.17)
Reop. for bleeding	1.29(0.85-1.95)	1.67(1.16-2.40)
Cerebrovascular event	1.34(1.05-1.70)	1.09(0.87-1.36)
Prolonged ventilation	1.06(0.88-1.27)	1.05(0.89-1.23)
New onset Afib	1.13(1.01-1.26)	1.05(0.95-1.17)

Figure 1. The impact of ascending aortic manipulation on short-term outcomes after off-pump CABG (OPCAB), where 'Side-clamp' involved side-biting clamp use (n=6,015), and 'Device', involved anastomosis assist device use for proximal anastomosis (n=9,570)

As a result, baseline variables showed less history of cerebrovascular disease, extracardiac arteriopathy, and symptoms in 'Side-clamp' which implied some tendency of patients' selection. Operative data showed most frequent use of blood products in 'Device'. Procedure time did not differ among the 3 groups. Short-term results showed significantly higher reoperation rate in 'Device', higher incidence of renal failure, lower incidence of atrial fibrillation (Af) and wound infection in the leg in 'Ao no-touch'. Since preoperative risk stratification defined by JapanSCORE for operative mortality and mortality and morbidity was significantly different among the three groups, multivariate logistic regression analysis (simultaneous method) was added to best neutralise the preoperative background of the three groups for comparison; thus the impact of each risk factor as predictor of short-term outcome was examined by setting the odds ratios for 'Ao no-touch' as 1 for reference. Results revealed that these 2 factors ('Side-Clamp', 'Device') were significant predictors of postoperative reoperation (odds ratio 1.39/1.65, p<0.05); in particular, 'Device' was a predictor of reoperation for bleeding (odds ratio 1.67, p<0.01). Furthermore, 'Side-clamp' was a significant predictor of postoperative cerebrovascular events (odds 1.34, p<0.05) and Af (odds 1.13, p<0.05).

As far as the present authors are concerned, this is the first study to accomplish the comparison regarding the clinical results among varying types of ascending aortic manipulations with a reasonably significantly large population using a Japanese national database. Anastomosis assist device use may provide lower the risks of postoperative cerebrovascular events and new onset Af than side-clamp to some extent, but may result in more frequent postoperative reoperation. Further research on long-term outcome and also cost-effectiveness would be awaited.

Congenital | Abstract Session | Tetralogy of Fallot / pulmonary atresia

Long-term outcome of staged-repair with complete unifocalisation for pulmonary atresia with ventricular septal defect and major aorto-pulmonary collateral arteries

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Objectives

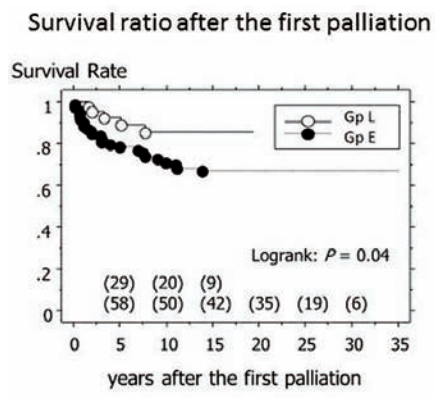
We previously reported that hypoplastic central pulmonary artery is associated with worse outcome of definitive repair for pulmonary atresia (PA) with ventricular septal defect (VSD) and major aorto-pulmonary collateral arteries (MAPCAs), and that unifocalisation (UF) should be performed using autologous tissue in the early infancy for excellent mid-term outcome. The objective of this study is to evaluate the long-term outcome of this strategy.

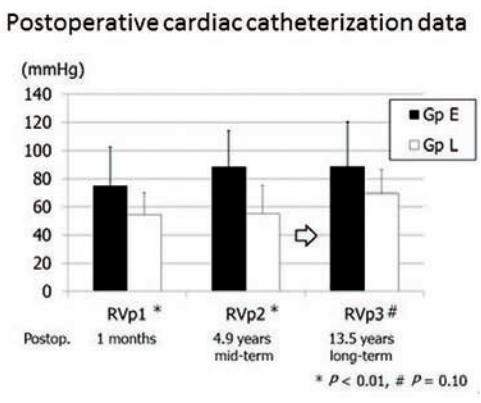
Patients and methods

Between 1982 and 2014, staged repair was performed in 124 patients (62 of them male) with PA with VSD and MAPCAs. Absent, vestigial (diameter <2 mm) and moderate CPA (>3 mm) were seen in 18, 15 and 91 patients, respectively. The number of MAPCA was 3.4±1.3 per patient. Palliative surgery was performed a total of 226 times (right UF: 95, left UF: 91, bilateral UF: 2, right Blalock-Taussig (BT) shunt: 8, left BT shunt: 15, palliative RV outflow tract reconstruction (RVOTR): 7, others: 8). Patients were divided into 2 groups (Gp E, 79 cases who underwent the first palliation before 1995; and Gp L, 45 cases mainly with autologous tissue after 1996).

Results

The follow-up period after the first palliation was 13.1±9.8 years. Kaplan-Meier survival rate after the first palliation was 71.1% at 10 years, 66.7% at 20 years in Gp E, and 85.3% at 10 years, 85.3% at 20 years in Gp L (Logrank: p=0.04). Definitive repair was performed in 64 patients in Gp E, and 35 in Gp L. HD was recognized in 9 in Gp E (infection: 5, heart failure: 3, brain injury: 1), and in 2 in Gp L (infection). LD was recognized in 7 in Gp E (infection: 1, heart failure: 4, sudden death: 2), and in 2 in Gp L (heart failure). Three patients in Gp E died at the timing of reoperation. Kaplan-Meier survival rate after the definitive repair was 71.3% at 10 years, 69.5% at 15 years in Gp E, and 87.6% at 10 years, 87.6% at 15 years in Gp L (Logrank: p=0.10). Palliative Rastelli procedure with VSD fenestration was performed in 11 patients (Gp E: 10, Gp L: 1) with worse outcome (HD: 4, LD: 5). Freedom from reoperation after the definitive repair was 78.9% at 10 years, 69.1% at 15 years and 80.4% at 10 years, 58.6% at 15 years in Gp L (Logrank: p=0.89).





Postoperative cardiac catheterisation data revealed significant differences in RVp in the mid-term period (Gp E: 88.7±25.4 mmHg, Gp L: 55.0±20.3 mmHg, p<0.01), but no difference in the long-term period (88.8±31.5 mmHg in Gp E, 69.5±17.0 mmHg, Gp L, p=0.10). Number of patients who revealed high RVp (RVp >70 mmHg or RVp/LVp >0.7) were 13 in Gp E (16.4%), and 7 in Gp L (15.6%). The risk factors of high RVp in the long-term survivors were use of Xenopericardium in CPA creation as well as RV-PA continuity.

Conclusions

Long-term outcomes of staged repair with complete UF using autologous tissue in early infancy for PA with VSD, MAPCAs was excellent. Further careful observation and appropriate medical treatment are mandatory because some patients reveal high RVp in the long-term period.

Thoracic | Focus Session | Surgery for advanced infectious disease

Surgery for destroyed lung

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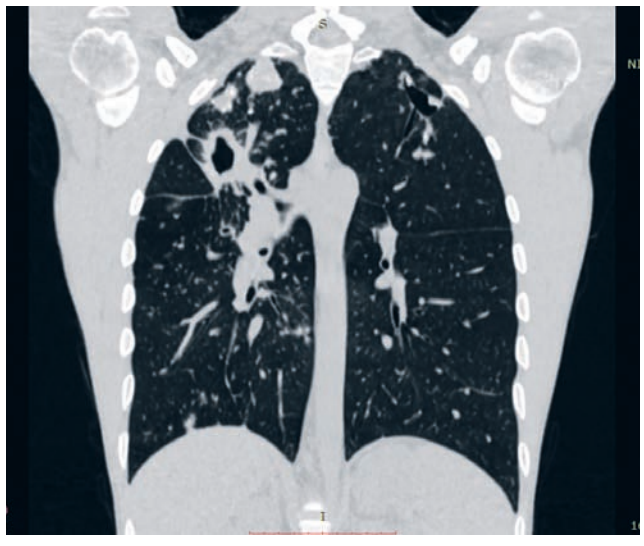

Figure1. CT scan of patient with local destructions in both lungs

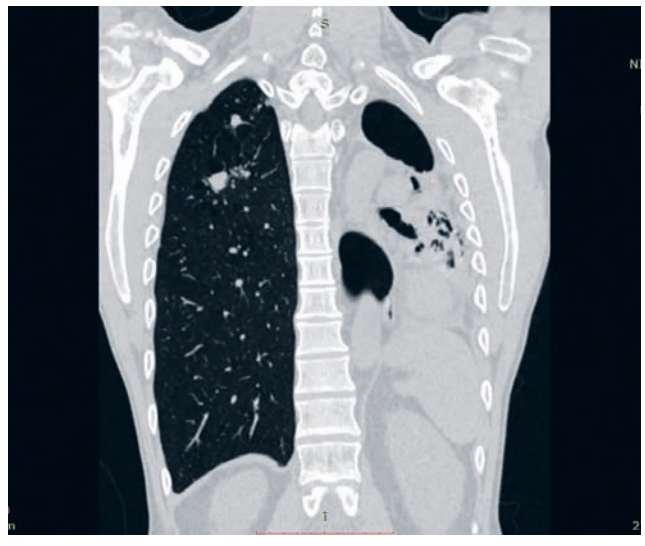

Figure 2. CT scan of patient with total destructions in one lung and local in other

Recently, Gaetano Rocco said, "Surgery for thoracic infections is the mother of all surgeries" (Thoracic Surgery Clinics, 2012-08-01, Volume 22, Issue 3). This kind of surgery went into oblivion for many years. But nowadays, due to the huge expansion of conditions of immunodeficiency, AIDs and tuberculosis, surgery of pulmonary destructions has become a hot topic at scientific events, proved by a lot of related discussion.

Historically, the first problem in the area of lung destruction that surgeons tried to resolve was cavitary tuberculosis. Today we can see an improvement in this type of indication for surgery, especially in patients with conditions of immunodeficiency. Moreover, the widespread epidemic of MDR and XDR tuberculosis made surgery of pulmonary destruction due to tuberculosis the most reliable option for such conditions. In our presentation today, "Surgery for destroyed lung" we will show the tactic and results of the treatment of patients with pulmonary destructions due to specific and nonspecific infections.

Cases with pulmonary destruction caused by nonspecific infections are divided into three groups: lung abscess, lung gangrene and necrotising pneumonia. Surgery is indicated in patients with failure of medical therapy or unavailable therapy, development of complications or inability to rule out malignancy in a mass lesion. Lobectomy is the most widely used type of procedure in Russia in such patients. A VATS approach can be used with acceptable complication rate and mortality.

Surgery of patients with pulmonary destruction caused by Mycobacterium tuberculosis is a big challenge of the modern time. In this group, the tactic of surgical treatment depends on the localisation of destructions in the lungs and the presence of a pleural empyema. Patients with destructions in both lungs form the most complicated group. All such patients can be divided into three groups: local destructions in both lungs, total destructions in one lung and local in other and massive destructions in both lungs with massive foci.

Anatomical pulmonary resections are remarkable treatment procedures. The main point of surgery is to prevent the damage of the cavity. Sometimes it is reasonable to perform the procedure in the extrapleural layer. In some cases of localised destruction, the minimally invasive procedure can be done. We had successful experience of RATS lobectomy in cases of localised destructive forms of tuberculosis. In general surgery, the case of pulmonary destruction is a very dramatic procedure.

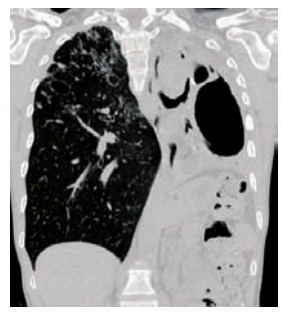

Figure 3. CT scan of patient with massive destructions in both lungs with massive foci

Therefore the complication rate in cases of pulmonary resections is higher than in the other cases according to statistical data. The surgeon performing surgery for patients with such conditions should be familiar with all kind of types of bronchial stump coverage.

To summarise, we can conclude that surgery in cases of pulmonary destruction could be the most effective option for treatment. Minimally invasive access can be used selectively in some cases with good results. Surgery can be successful even in cases of two-sided localisation of destruction.

Cardiac | Abstract Session | Young Investigator Awards

Deteriorated mitral bioprostheses or failed mitral valve repair: transcatheter mitral valve implantation versus re-operative surgery

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Transcatheter mitral valve-in-valve (ViV) and valve-in-ring (ViR) procedures are an attractive alternative treatment option for failing bioprostheses or failed mitral valve (MV) repair using annuloplasty rings.[1] Experience with these procedures is limited, while redo MV replacement (redo-MVR) is the gold standard treatment.[2]

We compare outcomes of both treatment options in high-risk patients according to the recently established MVARC criteria.[3] All ViV/ViR patients treated for failing mitral BP or repairs from 2008 to 2016 were included as treatment cohort (n=41). For controls, we explored the in-hospital databases of both centres for patients treated with redo-MVR between 2000 and 2016; isolated procedures in patients with failing BP aged >60 years were included, yielding 52 patients. ViV/ViR and redo-MVR patients were similar in age but ViV/ViR patients were more often female (p<0.01) and had a higher logistic EuroSCORE I (p<0.01), which was mainly due to a more frequent history of previous coronary artery bypass grafting (19.5% vs. 2.4%, p<0.01). Technical success rate was similar between the groups with 92.7% vs. 92.3% (p=1.00). Obstruction of the left ventricular outflow tract (LVOT) occurred in two patients in ViV/VIR, which led to death in one patient and abortion of the procedure with retrieval of the valve in another. At 30 days, mortality was not significantly different between the cohorts as it was 9.8% vs 5.8% (p=0.69). Post-operative rate of stroke tended to be lower after ViV/ViR procedures (p=0.06), as well as rate of life-threatening bleeding (p=0.08). Length of post-operative ICU- and hospital-stay was not significantly different. During one-year follow-up, late valve migration occurred in one ViV/ViR patient (3.6%), which was treated with redo surgery four months after the initial procedure. Furthermore, valve thrombosis occurred in two patients after ViV and resolved under coumarin medication. Survival rate at one-year was not significantly different

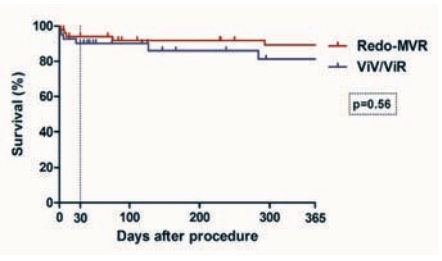

Figure 1. Survival after both procedures.

between the cohorts (see Figure 1), 83.3% (ViV) and 89.7% (redo-MVR) of patients were in NYHA class I/II at one year.

In summary, ViV/ViR patients had a higher pre-operative risk profile, but they presented with less perioperative strokes and 30-day mortality was not different compared to redo-MVR. However, ViV/ViR was associated with specific complications, such as valve migration, LVOT obstruction and valve thrombosis, which need to be addressed in future ViV/ViR experience.

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Table 1. Baseline data and periprocedural results

Baseline characteristics	ViV/ViR (n=41)	Redo-MVR (n=52)	p value
Age, y ±SD	70.1±13.0	69.3±6.2	0.71
Logistic EuroSCORE I, % ±SD	27.9±18.5	16.8±13.6	<0.01
Failed bioprostheses, n Failed ring annuloplasty, n	28 (68.3%) 13 (31.7%)	29 (55.8%) 23 (44.2%)	0.28
Previous CABG, n	8 (19.5%)	1 (2.4%)	<0.01
Time since last mitral valve surgery, y±SD Time since repair, y±SD Time since replacement, y±SD	9.7±18.6 6.2±6.6 10.9±21.2	10.6±17.1 4.9±4.7 15.1±21.6	0.82 0.56 0.50
Periprocedural results			
30-day mortality	4 (9.8%)	3 (5.8%)	0.69
Technical success, n Procedural success at 30 days (Device success + Absence of major device + procedure related adverse events), n	38 (92.7%) 22 (53.7%)	48 (92.3%) 23 (44.2%)	1.00 0.41
Device success at 30 days, n Device failure reason**, n Elevated gradient Valve migration Paravalvular leackage (>1) Access site related intervention/ death/ stroke LVOT Obstruction Procedural mortality or stroke	28 (68.3%) 7 (17.1%) 1 (2.4%) 1 (2.4%) 1 (2.4%) 2 (4.9%) 1 (2.4%)	29 (55.8%) 11 (21.2%) 0 0 8 (15.4%) 0 4 (7.7%)	0.28 0.79 0.44 0.44 0.07 0.19 0.38
Neurological Events TIA, n Stroke, n	 1 (2.4%) 0	 1 (1.9%) 5 (9.6%)	 1.00 0.06
Regurgitation II/III at discharge, n	1 (2.4%)	0	0.44

Cardiac | Abstract Session | Endocarditis

Complicated infective aortic endocarditis: comparison of different surgical strategies

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Despite advances in medical and surgical treatment of acute infective endocarditis (IE), management remains challenging and is associated with high morbidity and mortality[1,2]. For uncomplicated IE, replacement with a mechanical (MP) or stented biological prosthesis (SP) is the treatment of choice. However, complicated aortic valve IE, defined by the presence of a prosthetic valve or aortic root involvement, is associated with even higher rates of morbidity and mortality[1-4]. In this setting, homografts have been the gold standard treatment in the past as they allow radical excision of infected tissue and can be used to repair the entire aortic root if needed[5,6] However, their use is hampered by their limited availability[7] and a high re-operation rate for recurrent aortic regurgitation.

Stentless bioprostheses (SBP) are believed to provide similar advantages compared to conventional prostheses, but evidence of their superiority is scarce. We retrospectively studied outcomes of patients with complicated aortic valve (AV) IE (n=77) treated using SBP (n=25), MP (n=16) and SP (n=36) at our institution from 2000-2015. The primary endpoint was long-term survival. In addition, a time-related, combined endpoint was created, defined as time to one of the following events: death, stroke, re-operation for re-infection or structural valve deterioration or any diagnosed re-infection of the operated valve requiring antibiotic treatment.

Survival data was obtained via the National Health Service central register and was 100% complete. Mean age was significantly different between the cohorts, as MP patients were younger (p<0.01). SBP and MP presented less frequently with concomitant infections of additional heart valves than SP and SBP patients were less frequently in NYHA class III/IV (p=0.03). Other risk factors, such as intravenous drug abuse, septic shock, pre-operative ventilation and pulmonary oedema, were not significantly different. The acute in-hospital outcome was not different between the cohorts. Thirty-day mortality was 12.0% (SBP), 6.3% (MP) and 11.1% (SP, p=0.83). Median follow-up was 5.2 years. Early re-infection (<90 days) did not occur in any SBP patient, compared to 4.4% (MP) and 7.1% (SP) (p=0.29). Kaplan-Meier Survival rates were 86.9% for 1-, 5- and 10 years in SBP, versus 81.3% in MP and 68.8% (1-year), 57.2% (5- and 10 years) in SP patients (p=0.07, see figure). Although event-free survival was not statistically different between the cohorts, in absolute numbers it was best in SBP patients (Figure 1).

Based on these results, we conclude that SBP should be the preferred substitute for patients over 60 years with complicated AV IE and should be considered for younger patients at high risk for reinfection. Further studies with larger patient numbers and comparison to other root replacement techniques are needed to identify the best surgical strategy for patients with AV IE.

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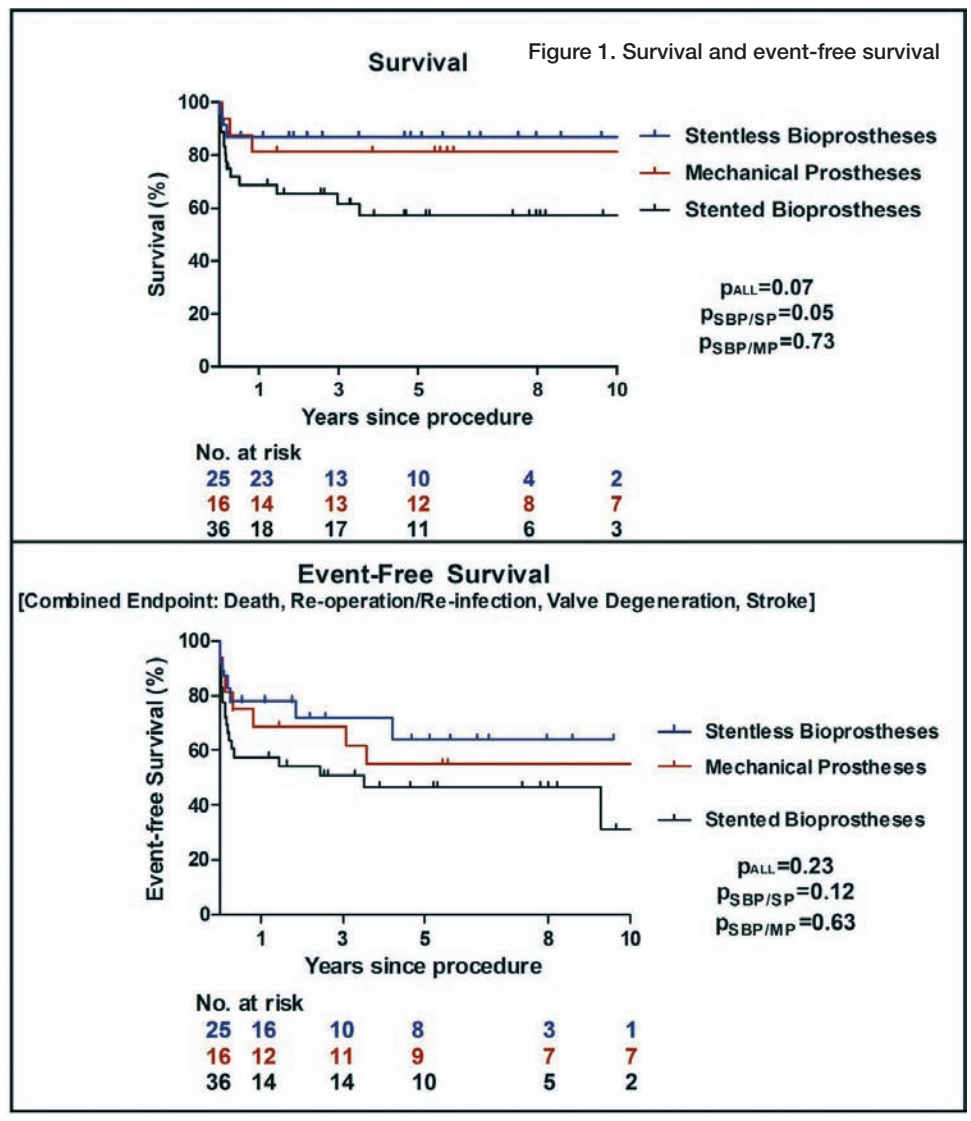
Figure 1. Survival and event-free survival



Cardiac | Abstract Session | Tissue repair and myocardial homeostasis

Proteomics highlights decrease of matricellular proteins in left ventricular assist device therapy

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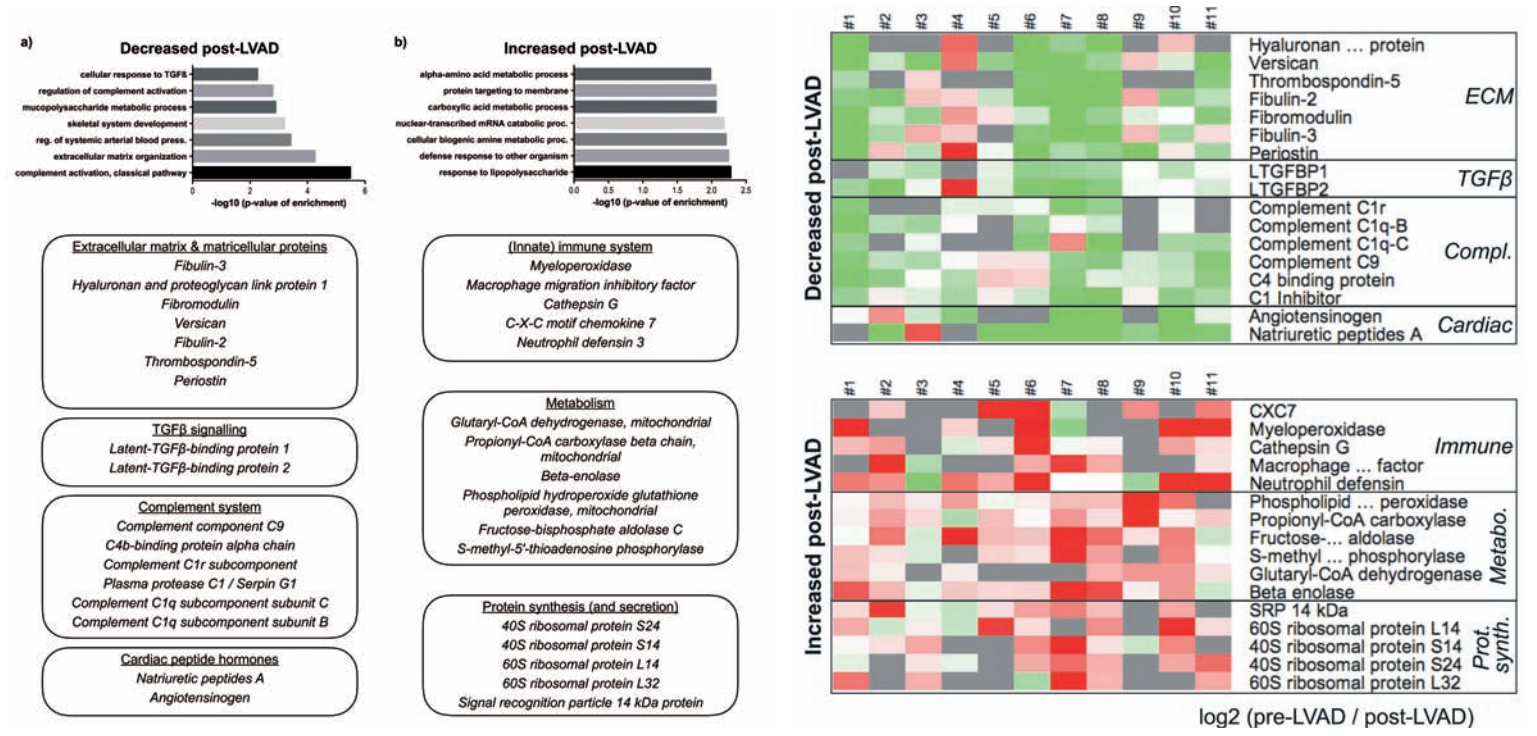

The current therapy for heart failure includes non-pharmacological options such as implantation of left-ventricular assist device (LVAD) and/or heart transplantation. Within this context the term 'reverse remodelling' has found its importance as a surrogate parameter for successful therapy. While cardiac remodelling implicates the disease-associated maladaptive alteration of cardiac morphology on tissue, cellular and molecular levels, the term 'reverse remodelling' describes the multifaceted process of therapy-associated changes of cardiac tissue structure and function. Our study focuses on LVAD-induced alterations of the myocardial proteome from the time-point of LVAD implantation and the time-point of heart transplantation. We performed a differential proteomic analysis of patient-matched samples with 11 cases of non-diabetic, dilated cardiomyopathy (DCM) at an average age of 59 years and a median LVAD therapy timespan of 191 days. Over 1,700 proteins were robustly identified and quantified. Statistical analysis highlighted 56 down-regulated proteins post-LVAD and 43 up-regulated proteins post-LVAD. To classify the observed proteome alterations, we performed an enrichment analysis using functional protein annotation. The clusters of down-regulated proteins comprise, among others, proteins belonging to extracellular matrix and matricellular proteins, transforming growth factor (TGF)β signalling, and cardiac neurohormones (Figure 1).

Matricellular proteins such as periostin or versican constitute the non-collagenous part of extracellular matrix (ECM). While collagens have predominantly a structural functionality, matricellular proteins are associated with these key ECM proteins and often have crucial roles in ECM functionality, e.g. by supporting cell-cell communication; although the exact role(s) of the various matricellular proteins in cardiac biology remain a controversial topic. Generally, our finding of a strong impact of LVAD therapy on matricellular proteins highlights LVAD-induced, partial ECM remodelling and suggests that the non-collagenous cardiac matrisome warrants further investigation.

TGFβ signalling is a key component of cardiac remodelling, regulating the expression of matricellular proteins such as periostin. In line with the impact of LVAD therapy on matricellular proteins, our study also found decreased post-LVAD levels of proteins that play accessory roles in TGFβ signalling.

Lastly, we note decreased, tissue resident levels of cardiac peptide hormones such as atrial natriuretic peptide (ANP) and angiotensinogen. However, in both cases, proteomics identified the long precursor proteins. Numerous independent studies corroborate a post-LVAD decrease of cardiac peptide hormones. This collective finding strengthens robustness and reliability of our proteomic approach. At the same time we note pronounced inter-patient heterogeneity with regard to the actual proteome alterations (Figure 2). The individual factors that mediate the extent of cardiac proteome remodelling upon LVAD therapy remain an area that requires further research.

In conclusion, our findings testify to a strong and likely beneficial impact of LVAD therapy on the myocardial proteome. These results encourage continuing to explore the process of cardiac remodelling in order to move a step further towards the search for the ideal biomarker for evaluation of LVAD therapy and related clinical decisions.

Cardiac | Abstract Session | Aortic valve replacement - rapid deployment valves

Minimally access versus conventional aortic valve replacement: A meta-analysis comparison of outcomes based on propensity matched studies

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Aortic valve replacement through full sternotomy is the standard conventional (CAVR) therapy of aortic valve diseases. Over the past two decades, minimally invasive cardiac surgery techniques have been increasingly adopted with the goal of reducing the invasiveness of the surgical procedure, while at the same time aiming to offer the same quality, safety and results of standard conventional surgery.

Minimal access aortic valve replacement (MAAVR) is performed in many institutions in different accesses, most commonly via upper partial sternotomy and lateral minithoracotomy. Since many studies showed controversial results of both procedures, we hereby aimed to assess the efficacy of both approaches and to test if MAAVR offers any superiority over CAVR procedure by performing advanced meta-analysis on studies that already performed a propensity-matched analysis of these procedures.

Relevant articles were searched in Medline, Cochrane and Scopus database based on pre-defined criteria and endpoints. All studies underwent a special screening of inclusion and exclusion criteria. Only studies using perform propensity score matching were included in this meta-analysis. The selected studies' data were evaluated; their operative as well as postoperative outcomes and complications were compared.

Nine studies performed propensity matching between MAAVR and CAVR groups, combining a total of 4,558 patients. 2,279 (50%) of these patients underwent CAVR, and the other 2,279 (50%) underwent MAAVR either through minithoracotomy or partial sternotomy. Because all of the included studies had performed a propensity-matched analysis, unsurprisingly our meta-analysis showed no significant difference with regards to baseline characteristics. Patient ages ranged from 58.4±15 to 70.5±10 years in the MAAVR group, versus 59.6±13 to 70.6±12 years in the CAVR group. Body mass index ranged from 26.6±4.3 to 28±5 % in the MAAVR group versus 26.3±4.5 to 28.2±4.8 % in the CAVR group. Our meta-analysis indicated a significant lower rate of postoperative low cardiac output syndrome (LCOS) (1.4 vs. 2.3%, p=0.05) (Figure 1), and incidence of atrial fibrillation (AF) (11.7 vs. 15.9%, p=0.01) (Figure 2), in the MAAVR group compared to the CAVR group, respectively. In contrast, aortic cross-clamp and cardiopulmonary bypass times were significantly longer in the MAAVR group (p<0.05).

Finally, the incidence of early mortality (1.5 vs. 2.2%, p=0.14), stroke (1.4 vs. 2%, p=0.20), postoperative myocardial infarction (0.4 vs. 0.5%, p=0.65), postoperative renal injury (4.5 vs. 6%, p=0.71), postoperative respiratory complications (9.0 vs. 10.1%, p=0.45), re-exploration for bleeding (4.9 vs. 4.1%, p=0.27), and need for permanent pacemaker implantation (3.3 vs. 4.1%, p=0.31) were similar in MAAVR and CAVR.

To conclude, our meta-analysis is of a high merit due to its highly selectivity, including as it did only those studies whose patients were propensity-matched. Although MAAVR surgery is slight longer in duration, it was not associated with greater CPB-related adverse effects. Interestingly, MAAVR shows lower incidence of LCOS and AF. MAAVR, either performed via partial sternotomy or right minithoracotomy, yields better cosmetics and patients' satisfaction. On this basis, MAAVR could be considered as the routine procedure for patients presented with primary isolated aortic valve diseases.

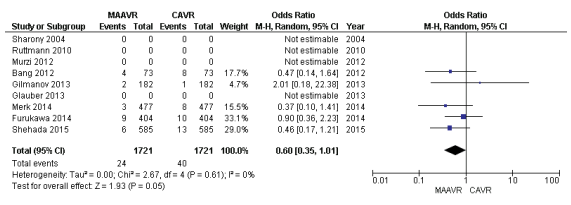

Figure 1. Meta-analytic comparison showing the incidence rate of LCOS between MAAVR and CAVR.

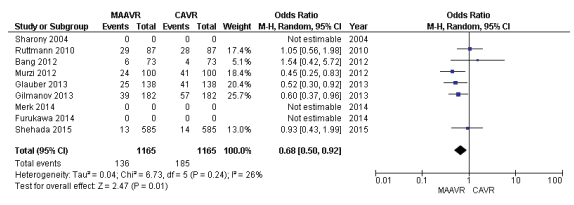

Figure 2. Meta-analytic comparison showing the incidence rate of AF between MAAVR and CAVR.

Thoracic | Focus session | Video & Case Study 1

VATS continuous lymphnode dissection from right middle lobe to superior and inferior mediastinum

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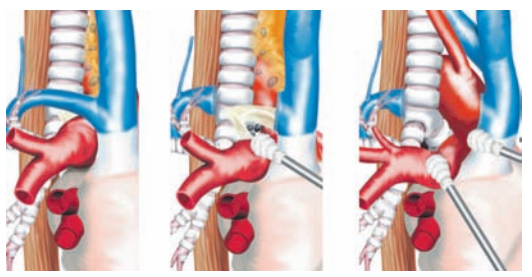

Figure 1. The resection of broncho-pericardial membrane enables the continuous lymph node dissection from inferior to superior mediastinum

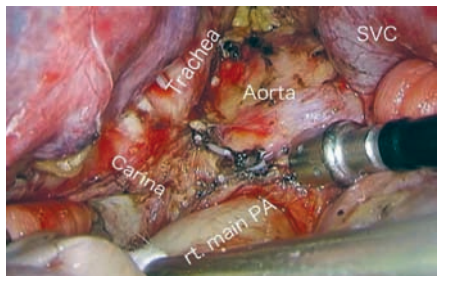

Figure 2. Findings after lymph node dissection. Inferior mediastinal zone continues to superior mediastinal zone.

Figure 3. The overall survival of surgically treated lung cancer of each lobe in University of Tsukuba Hospital.

The prognosis of primary lung cancer arising from right middle lobe (RML) is reported to remain inferior to those of other lobes. The smallest volume of RML is considered to be associated with a high rate of invasion into other lobes and locoregional recurrence. Furthermore, RML has numerous lymphatic drainage sites extending to both the superior and inferior mediastinal zones, which is associated with a high rate of lymph node metastasis, especially multiple-station metastasis. Therefore, precise lymph node dissection, including the routes to the superior and inferior mediastinal zones, should be performed for RML cancer.

However, systematic lymph node dissection that maintains continuity from RML to the superior and inferior mediastinal zones is difficult, due to the anatomical location of RML and numerous incidences of lymphatic drainage to both mediastinal zones. In other words, the route from RML to the superior and inferior mediastinal zones tends to be left undissected, which declines the quality of overall lymph node dissection.

To accomplish lymph node dissection from RML to the superior and inferior mediastinal zones, the route from superior #11, 12u to 10R, through the right upper lobe, has to be dissected to keep continuity to the superior mediastinum.

The route from inferior #11 to 7, through the dorsal wall of right upper pulmonary vein and pericardium, has to be dissected to keep continuity to inferior mediastinum.

The broncho-pericardial membrane also has to be dissected, for the continuous dissection between superior and inferior mediastinum (Figure 1).

The broncho-pericardial membrane is a membranous connective tissue that extends from the anterior surface of the tracheal bifurcation via the dorsal wall of the pericardium to the diaphragm and between both main bronchi. We have performed the above procedures with VATS for RML cancer since 2009, and the procedures are shown with video. We apply one access port, then three ports so that not only the operator but also the assistant can use two devices for the visual development of the surgical site. The finding after lymph node dissection is displayed in Figure 2, showing continuity from the inferior to superior mediastinum with the resection of broncho-pericardial membrane.

The prognosis of surgically-treated RML cancer in our facility is not inferior to those of other lobes' cancers (Figure 3). Although there is no control group of uncontinuous lymph node dissection, it is speculated that the fine prognosis of RML is partly due to the radical lymph node dissection that maintains continuity from RML to the superior and inferior mediastinum. Therefore, we consider that radical and continuous lymph node dissection not only provides accurate pathological staging, but could also improve the prognosis of lung cancer of RML.

Thoracic | Abstract Session | Non-oncology

Role of pulmonary endarterectomy in chronic thromboembolic disease

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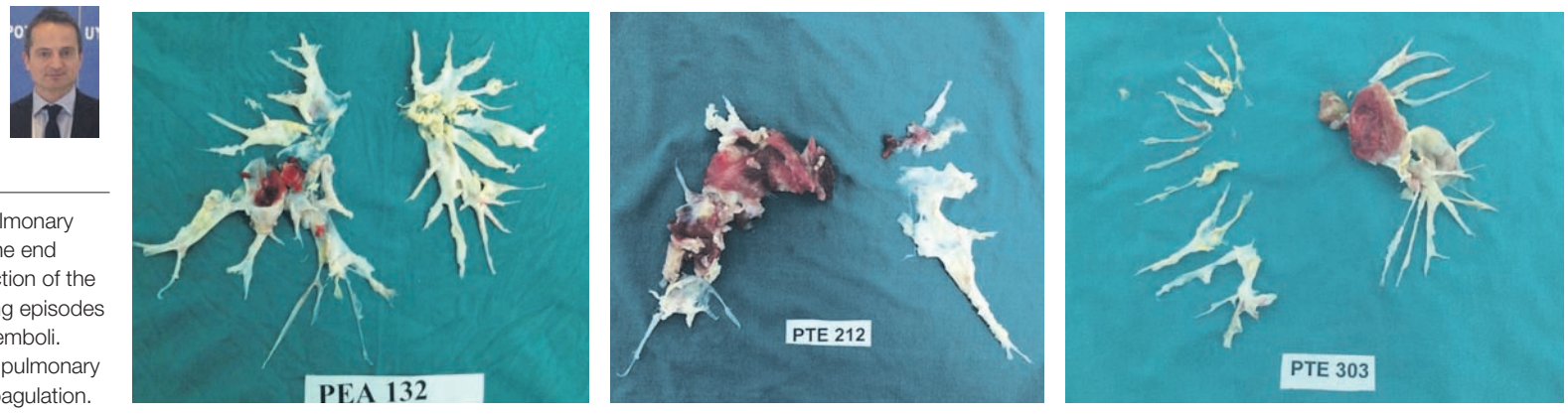

Figure 1. Samples of the pulmonary endarterectomy specimens taken from the patients included in the study.

Chronic thromboembolic pulmonary hypertension (CTEPH) is the end result of persistent obstruction of the pulmonary arteries following episodes of acute and/or recurrent pulmonary emboli. Consequently many patients develop pulmonary hypertension despite adequate anticoagulation. Once pulmonary hypertension occurs, the prognosis is poor due to right heart failure. Pulmonary endarterectomy is the treatment of choice for CTEPH. The surgery leads to major clinical improvement due to improved haemodynamic parameters and oxygenation, and a reduction in dead space ventilation.

In the era of successful surgical therapy, CTEPH, which was considered to be a rare entity, is being diagnosed more and more frequently. Several recent prospective studies have shown that the prevalence of CTEPH can be as high as 5% after acute pulmonary embolism. In addition, following an episode of acute pulmonary emboli, a growing number of patients are being identified with persistent dyspnoea in the absence of pulmonary hypertension (mean pulmonary arterial pressure <25 mmHg at rest), affecting their exercise capacity and quality of life. The symptoms of breathlessness in these patients can be related to excessive dead space ventilation, pulmonary hypertension on exercise and/or maladaptation of the right ventricle to the decreased pulmonary artery compliance. The prognosis and risk of progression to a more severe form of pulmonary hypertension, however, remains unclear.

Over the past few years, an increasing number of patients with symptomatic chronic thromboembolic disease (CTED) in the absence of pulmonary hypertension have undergone pulmonary endarterectomy in expert centres to improve their symptoms and quality of life.

We systematically analysed the results of pulmonary endarterectomy in these patients. We demonstrated the benefit of pulmonary endarterectomy and the significant impact on quality of life. Among 322 patients undergoing pulmonary endarterectomy in our centre between 2011 and 2015, 23 underwent pulmonary endarterectomy for CTED in the absence of pulmonary hypertension at the time of their evaluation. Ours is the only expert centre in Turkey. Although no mortality was observed, the rate of perioperative complications was still high (39%) demonstrating the complexity of the surgical treatment concept. All patients were discharged from hospital alive and two died during follow-up. A total of 21 patients underwent a review at 6 months after pulmonary endarterectomy. Their assessment showed a significant improvement in the New York Heart Association functional class and 6-minute walking distance at 6 months of follow-up.

Our study does support the role of pulmonary endarterectomy in selected patients with CTED without pulmonary hypertension and highlights that, nowadays, the outcome of pulmonary endarterectomy should not only be looked at from a survival standpoint, but should also take into account quality of life and duration of benefit. Not offering pulmonary endarterectomy to patients with CTED due to the lack of pulmonary hypertension would potentially deprive many symptomatic patients of the chance to improve their quality of life. The individual expectation of pulmonary endarterectomy in patients with CTED is, however, different than in patients with CTEPH and careful selection of patients for surgery is important.

The selection of patients for pulmonary endarterectomy in the absence of pulmonary hypertension should be made after a thorough evaluation and individual discussion with the patients. The indication for surgery must be made based on patients' expectations and acceptance of risk. Pulmonary endarterectomy is a complex procedure that can be safely performed only in expert centres based on a high level of experience of an interdisciplinary team. This is even more important for the cohort of patients with CTED without pulmonary hypertension as their prognosis without surgical treatment is probably favourable.

Cardiac | Abstract Session | Tricuspid valve – repair and replacement

Long-term results (up to 14 years) of the clover technique for the treatment of complex tricuspid valve regurgitation

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In most patients requiring tricuspid valve repair during left-sided valve surgery, tricuspid regurgitation (TR) is secondary to annular dilatation, and isolated ring annuloplasty represents the treatment of choice. Besides enlargement of the tricuspid annulus, when TR is caused by prolapse of the leaflets, annuloplasty alone is not enough to restore valve competence and other procedures are necessary to achieve this goal including artificial chordae implantation, leaflet resection, chordal transposition and papillary muscle re-implantation. Similarly, in the presence of tethering of the tricuspid leaflets, isolated annuloplasty is not durable, and concomitant enlargement of the anterior leaflet has been proposed to avoid valve replacement.

In these circumstances, the so called "clover technique" has been used to treat tricuspid regurgitation. This approach consists of stitching together the central part of the free edges of the tricuspid leaflets producing a "clover" shaped valve. This method of repair replicates, on the right side, the principle of the "edge-to-edge" technique used for mitral regurgitation and it has initially been adopted to treat few cases of complex forms of post-traumatic TR. The encouraging preliminary results obtained in this setting justified its application in patients with degenerative mitral and tricuspid valve disease, and in a limited number of patients with dilated cardiomyopathy or advanced RV dilatation, in whom tethering had developed besides annular dilatation.

In this study we assessed the long-term results of the clover technique which have not been reported so far. Ninety-six consecutive patients (mean age 60±16.4, LVEF 58±8.8%) with severe or moderately-severe TR due to important leaflets prolapse/flail (81 patients), tethering (13 patients) or mixed (2 patients) lesions underwent clover repair combined with annuloplasty. The aetiology of TR was degenerative in 74 cases (77.1%), post-traumatic in 9 (9.4%) and secondary to dilated cardiomyopathy in 13 (13.5%). Concomitant procedures (mainly mitral surgery) were performed in 82 patients (85.4%). The mechanism of TR was one or more leaflets prolapse/flail in 81cases (84.3%) due to chordal elongation/rupture (77 pts) or tear of the anterior papillary muscle (4 pts).

In particular, the prolapse/flail involved one leaflet in 29.6% of the patients, two leaflets in 38 (38/81, 46.9%) and all three leaflets in 19 (19/81, 23.4%). Leaflet tethering was responsible for TR in 13 patients (13.5%), as a result of advanced right ventricular dilatation. Finally, mixed lesions were present in 2 (2%) post-traumatic cases. All patients but 3 (96.8%) underwent ring (59 pts, 61.5%) or suture (34 pts, 35.4%) annuloplasty associated with the clover repair.

At hospital discharge, 92 (95.8%) patients had no or mild TR. Follow-up was 98% complete (median 9 years, IQR 5.1;10.9). During follow-up only one patient required a new cardiac operation

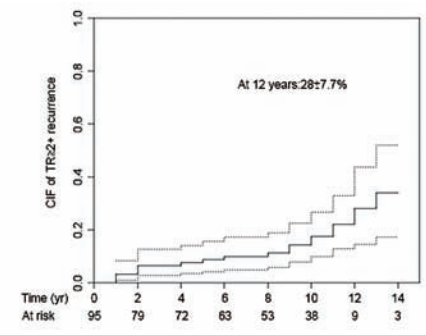


Figure 1. Cumulative incidence function of tricuspid regurgitation ≥2+ with death as competing risk

due to severe late TR. At 12 years the cumulative incidence function of TR ≥3+ with death as competing risk was 1.2±1.2 %. When TR ≥2+ was considered, the CIF of this event with death as competing risk was 28 ±7.7% at 12 years (Figure 1). Univariate predictors of recurrent TR ≥2+ were preoperative LVEF (HR 0.9, CI 0.9-1, p=0.05) and previous cardiac surgery (HR 2.7, CI 1-7.1, p=0.03). However, both of them did not reach a statistical significance at mutivariate analysis. Although a mild progression of TR occurred in about 16% of the hospital survivors over the years, the grade of regurgitation documented in those patients at the last echocardiogram was no more than moderate (2+/4+). At the last echocardiogram, 77.5% of hospital survivors (69/89 pts) had no or mild TR, and 20.2% (18/89 pts) showed moderate (2+/4+) tricuspid insufficiency. Only 2 pts (2.2%) had recurrent TR ≥3+. Mean tricuspid valve area and gradient were 4.3±0.6 cm^2 and 2.8±1.4 mmHg.

In conclusion, long-term clinical and echocardiographic data confirm that the clover repair is an effective and durable technique for the surgical treatment of TR due to lesions which are unlikely to be fixed by annuloplasty alone. In those difficult settings, this approach represents a useful adjunct to the current surgical armamentarium and it might significantly increase the rate of repair and reduce the incidence of suboptimal early and late results.

Table 1. Preoperative characteristics of the patients

Age (mean±SD, range)	60±16.4
Male sex (n,%)	46 (47.9)
Preoperative atrial fibrillation (n,%)	31 (32.3)
Previous cardiac operation (n,%)	18 (18.8)
NYHA Class (n,%)	
I	17 (17.7)
II	34 (35.4)
III	42 (43.8)
IV	3 (3.1)
Associated MV disease (n,%)	75 (78.1)
TR etiology (n,%)	
- post-traumatic	9 (9.4)
- degenerative	74 (77.1)
- secondary to DCM	13 (13.5)
LVEF, % (mean±SD)	58±8.8
LVEDD, mm (mean±SD)	55±8.4
SPAP, mmHg (mean±SD)	50±12.8
RV dysfunction (n, %)	27 (28.1%)

D: standard deviation; NYHA: New York Heart Association; MV: mitral valve; TR: tricuspid regurgitation; DCM: dilated cardiomyopathy; LVEF: left ventricular ejection fraction; LVEDD: left ventricular end-diastolic diameter; SPAP: systolic pulmonary artery pressure.

Cardiac | Rapid Response | Risk modelling and scoring systems in cardiac surgery

The Modified Model for end-stage liver disease predicts death within one year in ambulatory patients with severe heart failure awaiting a heart transplant

Bozena Szyguła-Jurkiewicz et al. Medical University of Silesia, Katowice, Poland

Background

In the modMELD (modified Model of End-Stage Liver Disease) scoring system, international normalised ratio (INR) is replaced with albumin level. This scale is also independent from oral anticoagulants, in contrary to the other MELD systems.

Purpose

The aim of the study was to determine the prognostic value of modMELD score and other death risk factors during a one-year follow-up in heart transplant candidates.

Method

We retrospectively analysed the data of 221 adult patients who were accepted for heart transplant over a two-year period between 2013 and 2014.

Results

The average age of patients was 54.7±9.62 years and 90.1% of them were male. Mortality rate during the observation period was 43.3%. The modMELD scores (OR 1.70; p<0.001) as well as serum hs-CRP (OR 1.10; p<0.01), serum sodium (OR 0.74; p<0.001) and uric acid (OR 1.03; p<0.05) levels were independent death risk factors. ROC analysis indicated that a modMELD cut-off of 10 [AUC 0.868, p<0.001], hs-CRP cut-off of 5.6 mg/l [AUC 0.674, p<0.001], serum sodium cut-off of 135 mEq/l [AUC 0.778, p<0.001] and serum uric acid cut-off of 488 [AUC 0.634, p<0.001] were the most accurate death predictors.

Discussion

Based on a single-centre study, we found that the modMELD (Modified Model for End-Stage Liver Disease) score – an objective numerical score obtained by inserting the values of serum total bilirubin, albumin, and serum creatinine into a logarithmic formula – may be used to estimate the risk of one-year mortality in ambulatory end-stage heart failure (HF) patients, put on a transplant waiting list. Using a cut-off value of 10 for the modMELD score, we found a highly positive predictive value for one-year death in the analysed group of patients. Among other independent risk factors of one year mortality were serum hsCRP, uric acid, and sodium concentrations.

The modified MELD score system is better than the standard MELD score in the patients with end-stage HF due to the lack of an interaction with oral anticoagulants.

The main advantage of this model is its low cost and the common availability of the analysed parameters, as well as its high specificity and

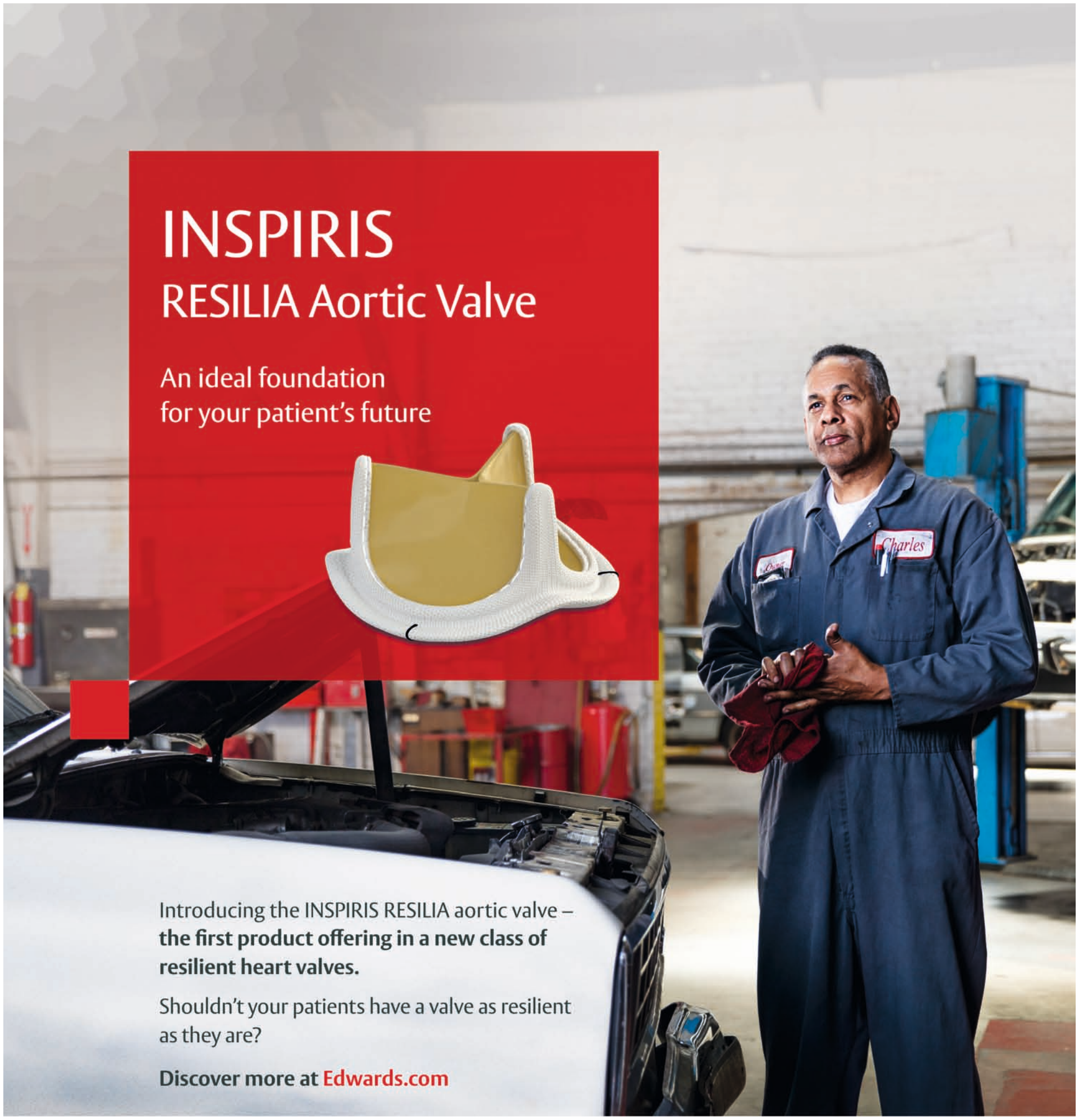
sensitivity as shown in our study. In our opinion, a routine determination of the modMELD score in each patient put on a transplant waiting list should be an important element of risk stratification.

It is a well-known fact that end-stage HF affects adversely other organs, especially the kidneys and the liver. Hypervolemia and the transmission of venous congestion to the renal veins impair the glomerular filtration rate by reducing the glomerular net filtration pressure. Hepatopathy secondary to chronic HF is attributed to three main processes: an increased hepatic venous pressure, a decreased hepatic blood flow, and a decreased arterial oxygen saturation. It may result in hypoalbuminemia and, frequently, an elevated level of serum bilirubin. The above parameters are elements of the modMELD score system.

We have found only two publications discussing the prognostic value of the modMELD score in the group of patients with advanced HF. Kato et al., in studying a group of ambulatory patients who underwent a heart transplant evaluation, created a risk stratification model, which consisted of peak VO2, modMELD, RVSWI (right ventricular stroke work index), and PCWP (pulmonary capillary wedge pressure), and successfully discriminated between patients with a high risk of one-year death, ventricular assist device (VAD) implantation, or a heart transplant.

In a single-centre retrospective study, Chokshi et al. demonstrated that a modMELD score of >20 predicts a significantly higher mortality rate than a modMELD score below this value. The results of our study, together with analysis carried out by Chokshi et al., suggest that patients on a transplant waiting list with a modMELD score fluctuating between the value of 10 and 20 are at an increased risk of death during the 12-month follow-up; such patients should undergo a heart transplant as soon as possible. However, in the group of patients with a higher modMELD score (>20), it is necessary to conduct a careful selection, because these patients have a high risk of death both while awaiting a heart transplant and after the operation.

It should be emphasised that the single-centre nature of our study and the limited sample size may result in the power of risk stratification obtained by the use of modMELD, serum sodium, serum uric acid, and serum hs-CRP level when applied to different populations. Due to the small number of enrolled patients, the number of variables included in the univariate analysis had to be limited. Moreover, our patients underwent a symptom-limited cardiopulmonary exercise testing, with the goal of respiratory gas-exchange ratio (RER) >1. Some patients could not reach RER >1, but we used their data as their best effort.



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Cardiac | Rapid Response | Trends in aortic valve replacement

Three-year follow-up results of a new generation of aortic bioprosthesis

Agata Bilewska Department of Cardiac Surgery and Transplantology, Institute of Cardiology, Warsaw, Poland

On behalf of the Institute of Cardiology in Warsaw and the JP II Hospital in Crakow, I am reporting the mid-term results of a new aortic bioprosthesis with a novel tissue platform (RESILIA™) by Edwards Lifesciences (USA).

Between July 2011 and February 2013, we enrolled 133 patients into this non-randomised, prospective, single-arm observational study with the objective to assess the safety and performance of a new aortic valve, with added durability via the addition of the RESILIA tissue. RESILIA is treated bovine pericardial tissue that has been transformed by a unique integrity preservation technology, which virtually eliminates free-aldehydes, a major source of tissue calcification.

The study allowed us to operate on patients who were scheduled to undergo elective AVR with or without concomitant CABG. A unique aspect of this study was that we enrolled a fairly high proportion of patients of younger age, and of smaller annulus – characteristics which denote a high risk of structural valve deterioration. The mean age of the patients was 63.5 years, with 26% of them being younger than 60 years, and half even younger than 50. 58% of the study subjects did receive a small (≤21 mm) aortic valve, which mimics the routine patient population in our institutions.

Figure 1. The RESILIA platform

Procedural outcomes were very good. The mean cross clamp time was 61.7 min and the mean stay in the intensive care unit was 2.2 days. The total length of stay was 9.7 days. All-cause mortality at 30 days was 2.3%. Late mortality reached the level of 3%. At 30 days, thromboembolic events such as stroke, TIA and 'other' occurred in 2.3% of patients.

At three years, there was one case of valve thrombosis and one case of endocarditis, at which time the valve had to be explanted. No single case of SVD was reported during this time period

We were extremely satisfied with the excellent procedural results and the sustained safety profile as well as the haemodynamic performance of this new tissue valve. Indeed, it may have the promise to represent a new class of bovine pericardial valves if results continue to be favourable. Additional follow-up is required to confirm the long-term durability of RESILIA tissue, and we are planning to report our extended experience in the near future.

Cardiac | Abstract Session | Young Investigator Awards

Apical closure device for fully-percutaneous transapical valve procedures: Stress-tests in an animal model

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Transcatheter aortic and mitral valve replacements (TAVR, TMVR) can be performed transapically through a left antero-lateral mini-thoracotomy. Despite the advent of low-profile introducer sheaths and new delivery catheters, the apical access remains a challenge in old patients, with a risk of infection, myocardial damage, ventricular tear and life-threatening bleeding. Moreover, standard apical access represents a limit for the development of video-assisted thoracoscopic TAVR/TMVR or fully-percutaneous transapical valve procedures.

Recently, closure devices for transapical TAVR/TMVR have been developed with encouraging results, but only few prototypes fulfil selective requirements for less-invasive or fully-percutaneous transapical procedures. We developed and tested a new self-expandable apical occluder, the SAFEXTM (Comed, Bolsward, the Netherlands), designed for full-percutaneous transapical valve procedures with large-size introducer sheaths.

SAFEX apical occluder

The SAFEX has reached its final design (Figure 1). It is made of woven nitinol wires designed in two self-expandable round retention disks with a connecting extendable waist. The surfaces of the discs are slightly curved to adapt with the ventricular anatomy. Inside the two disks are two membranes of ePTFE that guarantee haemostasis. The device is expected to occlude apical access sites ranging from 20-Fr to 35-Fr with four different sizes. The design allows a 'user-friendly' two-step manoeuvre for the deployment through large-size sheaths (Figure 2): 1) under fluoroscopic control and guidance, the inner disk is deployed into the left ventricle and pulled back (together with the delivery catheter) towards the apex in order to guarantee apical sealing from inside (Figure 3 A, B, C, D). Tactile feedback and fluoroscopic imaging confirms the positioning; 2) The introducer sheath and the delivery catheter are pulled back while the occluder is left in place: the outer disk opens outside the apex (Figure 3E). Then, the wire is unscrewed and disconnected (Figure 3F).

Acute animal study

Under general anaesthesia, five young pigs (weight: 67±6 kg) received full heparinization. The right carotid artery and the jugular vein were prepared and used to monitor the pressure, the central venous pressure (CVP), as well as for blood sampling and fluid or drug infusion. Through mini-sternotomies, 21-Fr introducer sheaths for TAVR (outer diameter: 25-Fr) were placed over-the-wire in the apex. Delivery-catheters carrying SAFEX occluders were inserted in the sheaths and plugs were deployed under fluoroscopic guidance using the two-step manoeuvre. Then, the animal experience was split in two phases. Electrocardiography, blood pressure, CVP, heart rate and oxygen saturation were continuously monitored and recorded every 10 minutes during Phase 1, and every five minutes during Phase 2. Activated clotting time (ACT) measurements and gasometry were performed at baseline and two minutes after heparin and protamine administration.

Figure 1(above left): The self-expandable SAFEX apical occluder with the extendable and flexible waist (Comed, Bolsward, the Netherlands).

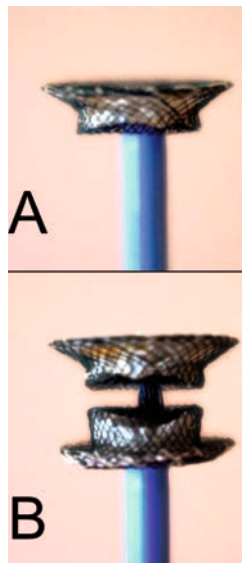


Figure 2 (above centre): The two-step manoeuvre for the deployment of the apical occluder. A) The inner disk opens when the sheath is partially retrieved. B) The outer disk opens when the sheath is fully retrieved.

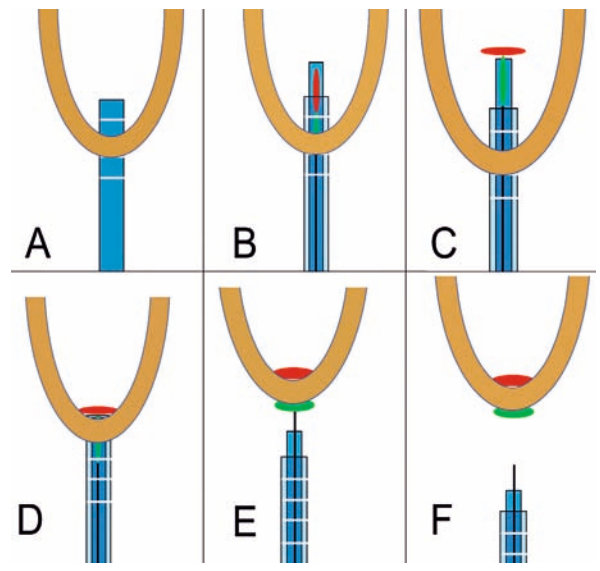
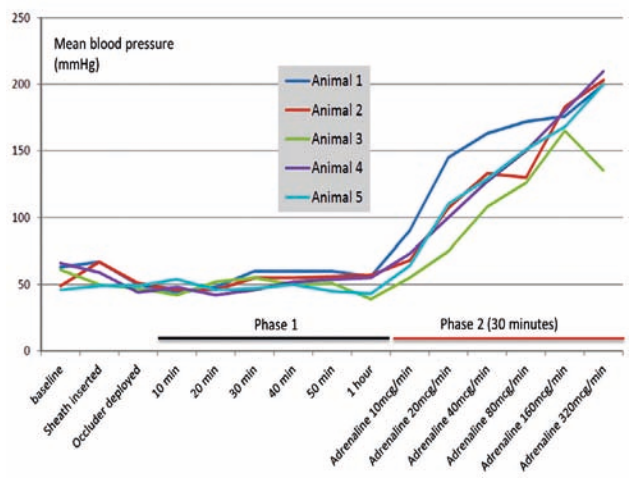


Figure 3 (above right): Schematic view of the two-step manoeuvre. A) The introducer sheath is placed in the cardiac apex. B) The delivery system with the constrained occluder is inserted in the left ventricle through the introducer sheath. C) The inner disk (in red) is deployed in the left ventricle. D) The inner disk is pulled back towards the sheath and all systems are pulled back until the inner disk is in contact with the apex. E) Step two: the introducer sheath and the delivery system are pulled back while the wire connected to the occluder remains in place. The outer disk opens and occludes the apical access site. F) The wire is unscrewed and the device is released.

In the first phase, after protamine infusion, apical bleeding was monitored for one hour with standard haemodynamic conditions. In phase two, we induced systemic blood hypertension with adrenaline infusion to test the occluder sealing properties under stress. Every five minutes, and for six occasions (i.e. 30-minutes in total) the adrenaline dose was doubled (10 mcg/min; 20 mcg/min; 40 mcg/min; 80 mcg/min; 160 mcg/min; 320 mcg/min) (Figure 4).

The results of our tests are encouraging. Procedural success rate was 100% with immediate good apical sealing. Haemodynamic parameters were stable during Phase 1 with a mean heart rate of 87±14 bpm and mean pressure of 52±9 mmHg. During Phase 1 we collected 4±5 ml of blood lost per animal. Mean haemoglobin levels at baseline, after occluder deployment and at the end of the one-hour observational period were 8.4±0.8 gr/dL, 8.2±0.6 gr/dL and 8.7±0.8 gr/dL. During Phase 2, mean systolic and diastolic pressure levels peaked at 268±24 mmHg and 175±17 mmHg respectively, without plug dislodgment or bleeding. Animals were sacrificed and hearts analysed: post-mortem examination confirmed the good deployment without macroscopic myocardial injuries.

Figure 4: The graphic shows the mean blood pressure of each pig during Phase 1 and Phase 2.



Conclusions

Full-percutaneous or video-assisted transapical transcatheter valve procedures with large-size introducer sheaths cannot be performed with existing technology. Only the development of apical occluders that can be delivered and deployed without opening the chest or through a very small mini-thoracotomy will allow minimal invasive or full-percutaneous TAVR/TMVR. The SAFEX device fulfils criteria for full-percutaneous transapical procedures and it has been tested in stressful haemodynamic conditions with very good results in terms of safety (no dislodgement) and efficacy to seal big-sheaths apical access sites in an animal model. The apical plug guarantees apical access site sealing without myocardial injuries and bleeding, and it's an easy device to use with a user-friendly two-step manoeuvre for deployment. Chronic animal tests in a minimally-invasive setting are already scheduled and will focus on SAFEX thrombogenicity. Full-percutaneous tests in animals to standardise the technical platform for further clinical use in humans are ongoing.

Congenital | Abstract Session | Valves

Contemporary results of aortic valve repair for congenital disease: lessons for management and staged strategy

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The surgical capacity to restore a competent and non-restrictive geometry to the diseased aortic valve has consistently developed over the last decade with improving imaging technologies and repair techniques. This field is now dominated by the question of durability, which can only be solved through experience and follow-up. In this regard, our experience with congenital aortic valve disease has highlighted the prominent roles of choice of technique and growing geometry.

In the past, the development of aortic valve repair (AVr) in children has been considerably veiled by the preeminence of competitive techniques. Aortic balloon valvuloplasty (BVP) rapidly developed in the 1980s and onward, today being the primary treatment modality in most centres worldwide. During the 1990s, following the adult experience, the Ross procedure was popularised in the paediatric field and became the procedure of choice in children with aortic valve disease. Such strategies resulted in little room for development of aortic valve repair techniques, which were limited to open valvulotomy in rare centres with surgically-oriented policy. The vast remaining children were first managed with balloon valvuloplasty then with the Ross procedure, which was preferred to the uncertainty of complex repair of a torn aortic valve.

Two events of the last decade promoted a renewed interest for aortic valve repair in children: first, the favourable results of aortic valve repair in adults (pioneered by El Khoury[1] and Schäffers[2]), sustained by the demonstration of reliability and superiority of repair in mitral domain; second, the emergence of Ross paediatric patients in their second postoperative decade showing alarming results of up to 40% autograft failure at 15 years[3].

On these bases, few centres since 2000 have pioneered a repair-oriented policy for aortic valve disease in children. Among them, the Melbourne centre has developed world-renowned expertise[4].

However, long term data are scarce, because of the young age of the technique, and the paucity of paediatric cohorts. Furthermore, prognostic factors are dramatically lacking to refine strategy in such moving targets as children. Thus, the place of repair in the armamentarium of techniques to manage aortic valve disease in children is still debated[5,6].

During the past decade in Sankt Augustin, triggered by the large amount of patients referred for surgery after BVP and the local good results of AVr in infancy[7], our centre has adopted a deliberate repair-oriented policy in patients with congenital aortic valve disease. We sought to investigate the long-term outcomes (survival and freedom from reoperation and replacement) of this policy in our non-neonatal group of patients and to determine risk factor associated with such outcomes, specifically looking across age groups.

The limitation of preceding literature was due to the selective nature of their studied cohorts (e.g. only AI[8], only complex repair[9], or only extension[10]). In our report, we sought to encompass primary congenital aortic disease across all ages and including various treatment techniques.

Since 2003, 354 consecutive patients underwent AVr in Sankt Augustin. Of those, 205 met the inclusion criteria (being older than 30 days, with 'primary' disease of the aortic valve or endocarditis, undergoing 'primary' repair).

The principal result demonstrates that AVr is safe with regard to survival and maintenance of ventricular function. As such, 10-year survival is 98.7%, and 97.3% had undisturbed left ventricular function. Indeed, delaying more definitive procedure by AVr can only be proposed if this does not impair chances for subsequent procedure (Ross, prosthesis, or more durable repair). AVr can reliably be used as a temporary solution, which is primarily aimed to accommodate growth of the patient to an age at which more definitive solutions are available.

A further result shows that surgical strategy should be adapted to the underlying morphology of the aortic valve and to the growth potential of the aortic root. In younger patients (<10 years), creation of a new commissure is promising; other techniques (commissurotomy-shaving and leaflet replacement) are equally effective or ineffective. In older patients (>10 years) all techniques except leaflet extension offer 80% freedom from reintervention at 8 years of follow-up.

Finally, though mostly unidentified in previous paediatric cohorts because of small numbers, our results highlighted few prognostic factors that influence outcome. A tricuspid post-repair arrangement (in older children) is associated with improved outcome. Balloon valvuloplasty before 6 months clearly mitigates the chances for long-lasting results free of replacement.

The integration of these new findings in an age-individualised technical strategy for AVr in children will refine our future approach. This report also highlights that repair durability is not only related to material, but to a combination of material properties and growing geometry. Therefore, further improvement will come not only from better materials, but also from more appropriate age-adapted geometry.

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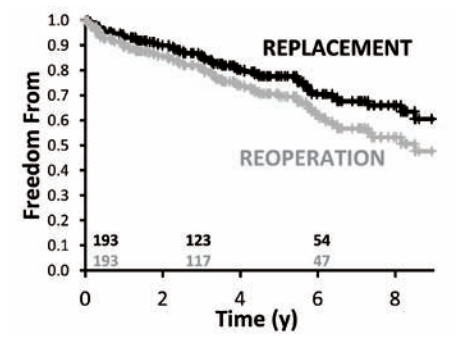


Figure 1. Kaplan-Meier curve shows freedom from reoperation and replacement after aortic valve repair. Numbers of patients at risk are above the x-axis

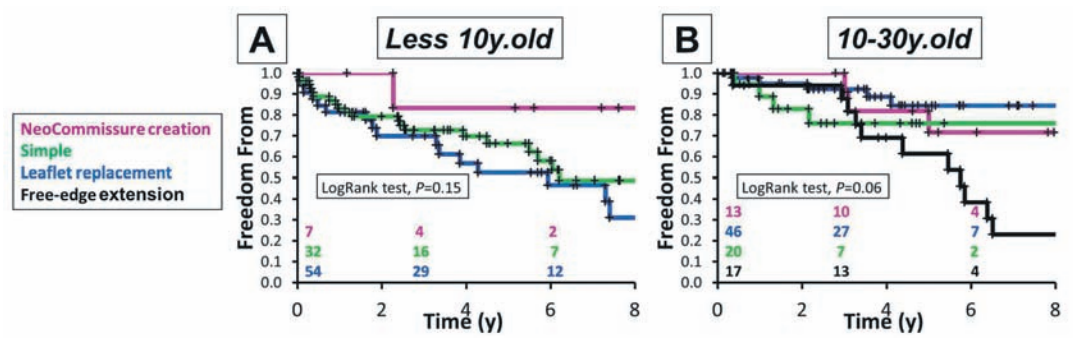
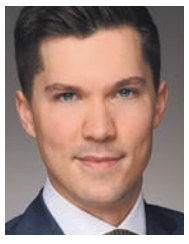


Figure 2. Kaplan-Meier curve shows freedom from reoperation after aortic valve repair, according to repair techniques. Numbers of patients at risk are above the x-axis. A. 1month to 10 years of age patient group. B. 10 to 30 years of age patient group

Congenital | Rapid Response | Congenital Miscellaneous

Right vertical axillary mini-thoracotomy for correction of ventricular septal defects and complete atrioventricular canal defects in infants and children

Paul Philipp Heinisch, Thierry Carrel and Alexander Kadner Department of Cardiovascular Surgery, Inselspital Bern, University Hospital, Switzerland



The treatment of congenital heart defects has evolved over the last decades with further reduction of morbidity and mortality. The surgical repair of ventricular septal defects (VSD) and atrial septal defects (ASD), with a less-aggressive approach to the patient, is the goal of minimally-invasive surgery. Right axillary vertical mini-thoracotomy (VRAMT) is the standard approach for correction of ASD, sinus venosus defects and partial AV-canal defects at our institution and provides excellent clinical and cosmetic results. We report our experience with this approach for the repair of ventricular septal defects (VSD) and complete atrioventricular canal defects (CAVC) in infants and children. This study compares the early outcome after right axillary vertical mini-thoracotomy and conventional median sternotomy (CMS) for correction of VSD and CAVC.

Patients undergoing correction of VSD and CAVC through a vertical right mini-axillary thoracotomy or a conventional median sternotomy were reviewed retrospectively. Perioperative and postoperative clinical data of all patients undergoing correction of VSD and CAVC were analysed. The surgical technique for the VRAMT involved a 3-5 cm vertical incision parallel to the right anterior axillary fold, with central arterial and bi-caval cannulation for administration of mild hypothermic cardio-pulmonary-bypass. A total of 34 patients underwent correction through a vertical right axillary mini-thoracotomy (VRAMT): VSD closure (n=24; mean: 17.8 (2 – 138) months; mean weight: 8.6 (3.8 – 39) kg) and correction of CAVC (n=10; mean age: 6.9 (2 – 25) months; mean weight: 5.8 (4.2 – 9) kg). There was no need for conversion to another approach in any of these patients. The mean ICU stay for VSD patients was 3.8 days, and 6.9 days for CAVC patients.

Follow-up was complete with a median of 20.1±12.8 months. One patient with severe pneumopathy died at five months after surgery due to sepsis and MOF. No wound infections and no thoracic deformities were observed until present. In the control group, a total of 55 patients received a conventional median sternotomy (CMS): VSD closure (n=31; mean: 6.7± 6.1 (Range: 1.5 – 28.9) months; mean weight: 5.6±1.6 (3.3 – 9.9) kg) and correction of CAVC (n=24; mean age: 22.4±36.7 (1.3 – 172.7) months; mean weight: 9.4±11.1 (3.4 – 34) kg). Follow-up is complete with a mean of 42.6±22.4 months. In the CAVC group (CMS), one patient died due to cardiac arrest, and one patient had a stroke. Pre-sternal wound infection was observed in one patient (VSD group). Indication for permanent pacemaker implantation was seen in two patients (VSD and CAVC group).

Using standard techniques and equipment, and avoiding peripheral vessel cannulation, the right vertical mini axillary thoracotomy (VRAMT) presents an attractive cosmetic access for safe and complete correction of VSD and CAVC-defects. This access allows the correction of a limited spectrum of malformations of congenital heart defects with comparable results achieved by the standard sternotomy.

Cardiac | Techno College | Aorta, Ablation and Assist Devices

Live-in-a-box: Minimally invasive off-pump implantation of a novel implantable centrifugal left ventricular assist device through a bilateral thoracotomy approach

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A growing adoption of left ventricular assist device (LVAD) implantation without sternotomy reflects its many advantages that include the preservation of right ventricular function, less bleeding, and faster recovery.

At Deutsches Herzzentrum Berlin, we practise implantation through bilateral thoracotomy without the use of extra-corporeal life support. During our live-in-the-box presentation, we illustrated our method of implantation with the recently-introduced HeartMate 3 LVAD device (Thoratec, USA).

This implantation method demands the presence of two surgeons: one to attach the fixation ring to the left ventricular apex through the fifth or sixth intercostal space, and the other to access the ascending aorta via the third right intercostal space in order to clamp and anastomose the outflow graft. Once this is achieved, the partial clamp remains closed, keeping the graft freed of blood. Then the pump is connected to the fixation ring along with a reinforcing kink protector.

After 5,000 IU heparin had been administered and rapid pacing commenced, a core of cardiac apex is resected. The partial aortic clamp is released, achieving continuous retrograde de-airing, and the inflow cannula inserted.

Full contact with the fixation ring is necessary to release the fixation mechanism of the HeartMate 3 pump. Furthermore, incision and subsequent fixation can be complicated by the ejection of blood after core resection and, moreover, the pump tends to obstruct the view into the operating field. The appropriate positioning of the heart is essential in order to close the fixation mechanism, and is made easier by a clamp we developed especially to grasp the fixation ring (Fittkau Metallbau GmbH Germany). Once this is achieved, the pump is immediately started. Protamine is administered and the chest is closed.

This technique offers a number of benefits. The avoidance of sternotomy circumvents its associated complications such as later adhesions behind the sternum. Bleeding risk is reduced by way of lower heparin doses facilitated by off-pump implantation and by keeping the partial aortic clamp closed until de-airing and pump start. Furthermore this procedure takes around one hour of operating time, which may speed postoperative recovery. Conversely, the limited exposure of the ventricular apex is a disadvantage in instances of bleeding and unexpected adhesions; in such cases, conversion to standard sternotomy approach would be undertaken.

We find this particular technique feasible in patients with good right ventricular function who are not undergoing concomitant procedures. For redo procedures, we recommend a left lateral approach with connection of the outflow graft to the descending aorta.

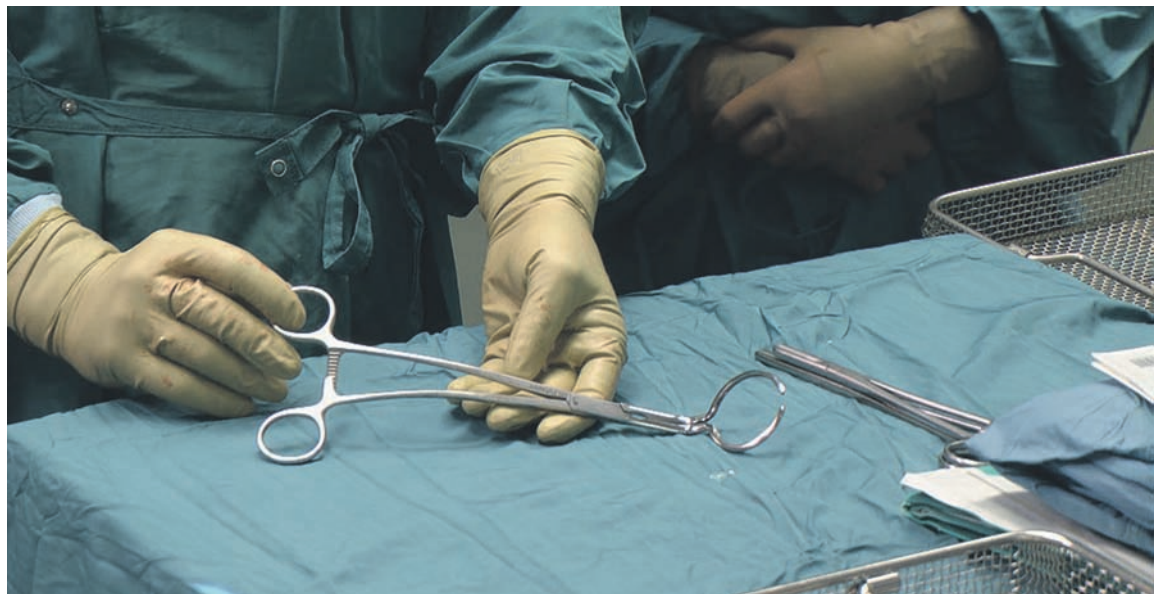


Figure 1. The clamp developed at Deutsches Herzzentrum Berlin (Fittkau Metallbau GmbH, Berlin, Germany), designed to grasp the fixation ring

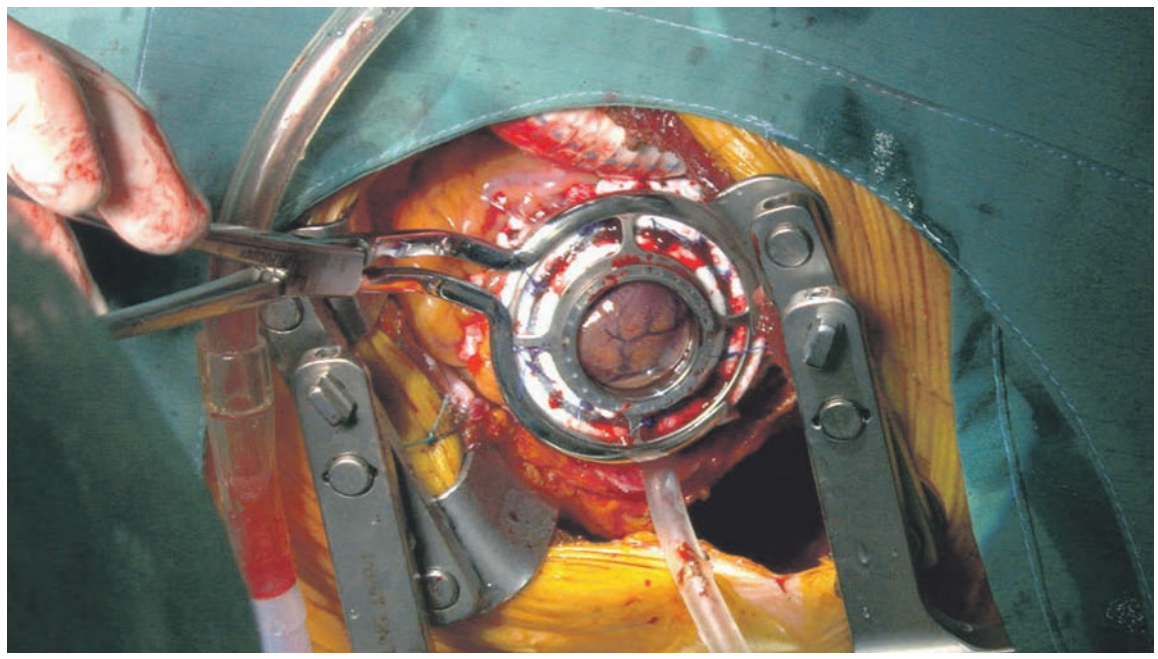


Figure 2. The clamp securely grasping the fixation ring.

Cardiac | Abstract Session | Young Investigator Awards

Is the need for cusp repair associated with higher risk for recurrent aortic insufficiency after aortic valve-sparing surgery?

Eilon Ram, Alexander Kogan, Ami Shinfeld, Alexander Lipey, Sagit Benzekry, Ronny Ben-Avi, Shany Levin and Ehud Raanani Sheba Medical Center, Tel Hashomer, Ramat Gan, Israel

Aortic valve sparing surgeries (AVSS) provide alternative treatment for prosthetic aortic valve replacement (AVR) in carefully selected patients with aortic insufficiency (AI) in order to reduce prosthesis-related complications in bio- and mechanical prostheses. AVSS include root replacement by re-implantation or remodelling techniques, replacement of the ascending aorta at the height of the sinotubular junction (STJ) with an appropriate Dacron graft diameter, or aortic cusp repair (subcommissural annuloplasty / circular annuloplasty / partial resection of the aortic cusps / cusp plication / cusp pericardial patch augmentation).

The purpose of our study was to investigate predictors for failure and early and late outcomes in patients who underwent AVSS in our department from 2004 to 2016.

Of the 227 patients who underwent AVSS, 81 (36%) underwent aortic root replacement with or without cusp repair, 97 (42%) ascending aorta replacement with or without cusp repair, and 49 (22%) isolated aortic cusp repair. A total of 110 patients had cusp repair and 117 patients underwent AVSS without cusp repair. All patients were followed for clinical and echocardiographic follow-up.

There was one case of in-hospital mortality, with an overall 30-day mortality rate of 0.4%. Mean clinical and echocardiographic follow-up was 75±37 and 56±39 months respectively, and was completed for 100% and 97% of patients respectively. There were 15 (6.6%) cases of late death. Survival rate was 94.4% during five years of follow-up. Recurrent aortic insufficiency (≥3+) was found in 38 patients (16.7%) and reoperation occurred in 16 patients (7%). Predictors for failure were: greater preoperative AI (RR 3.64, p=0.007) and the need for cusp repair (RR 4.32, p=0.014). In patients who underwent cusp repair, the use of pericardial patch augmentation was found to be a risk factor for failure (RR 7.57, p=0.009).

The conclusions from the results of the study are that AVSS are alternatives for AVR, and can be performed with good early and late clinical outcomes. However, in our experience there was a significant rate of recurrent AI, especially in patients who underwent cusp intervention using glutaraldehyde-treated autologous pericardial patch for cusp augmentation. When deciding which procedure (AVR or AVSS) is best for a patient, several factors should be taken into account: the patient's age, compliance for medication and for medical follow-up, as well as the surgeon's experience with regard to the various procedures. Furthermore, the subject of possible aortic valve cusp intervention, especially the need for pericardial cusp augmentation, should be carefully discussed with the patient.

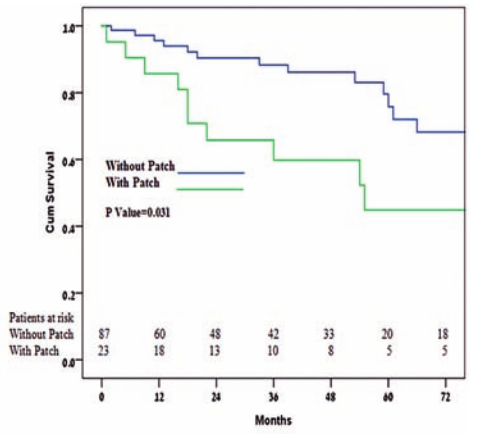


Figure 1. Freedom from recurrent AI (≥3+) or reoperation in patients who underwent cusp repair by pericardial patch use

Cardiac | Abstract Session | Young Investigator Awards

Coronary artery bypass surgery is superior to second generation drug-eluting stents in three-vessel coronary artery disease: A propensity score matched analysis

Hiroshi Tsuneyoshi Kurashiki Central Hospital, Kurashiki, Japan

Coronary artery bypass grafting (CABG) has remained the first-choice revascularisation strategy in patients with multivessel coronary artery disease for several decades. In contrast, percutaneous coronary intervention (PCI) has rapidly been progressing, along with newly-developed devices such as drug-eluting stents (DES).

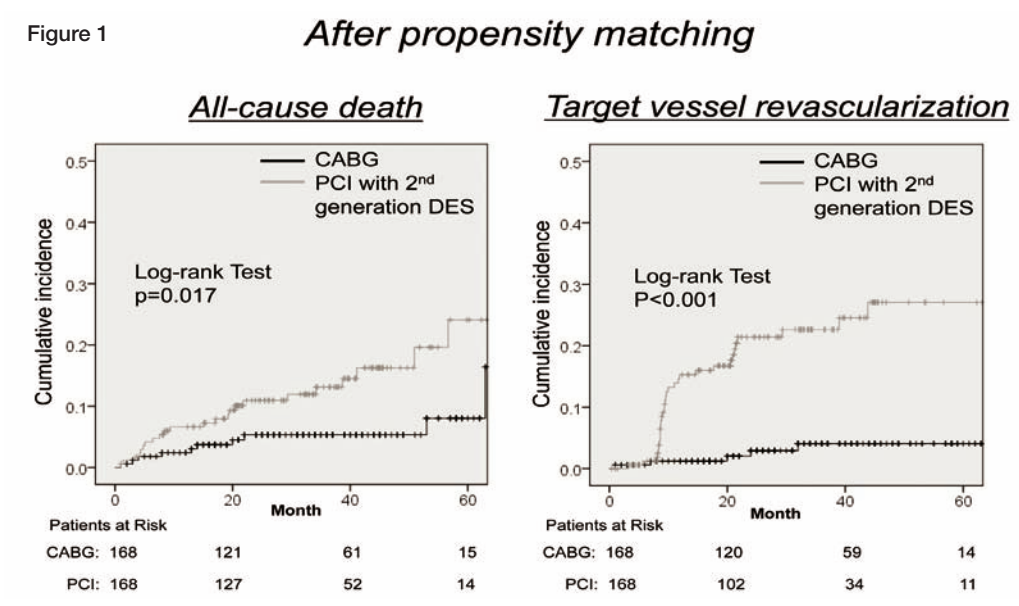
Several contemporary trials reported that PCI using DES reached similar mortality rates compared with CABG. However, in previous trials comparing these treatments, second generation drug-eluting stents (DES) have not yet been used. Thus, we conducted a retrospective evaluation to compare the outcomes between CABG and PCI using second generation DES in patients with three-vessel and/or left main disease. This single-centre clinical result was evaluated using propensity score-matched analysis.

From January 2010 to December 2014, a total of 537 patients with three-vessel and/or left main trunk coronary artery disease underwent either isolated CABG (n=239) or primary PCI using second-generation DES (n=298). For both treatments, we used Kaplan-Meier analysis to compare all-cause mortality, MI, repeat revascularisation, and stroke rates. A propensity score-matched analysis was performed, resulting in 168 matched pairs.

Looking at patient backgrounds, the CABG group included sicker patients (renal dysfunction, peripheral vascular disease, low ejection fractions and current smoking habits) when compared to those in the PCI group. The SYNTAX scores and EuroScore were similar between the 2 groups (SYNTAX: 28.7±8.3 vs. 28.3±9.4 for CABG vs. PCI, p=0.571, EuroScore: 5.5±7.2 vs. 5.5±3.1 for CABG vs. PCI, p=0.976). After propensity matching, however, both groups were well matched in all parameters. In the CABG group, 84% of patients were performed off-pump, with an average of two arterial grafts per patient. In the PCI group, an average of five second generation DES in each case were used. The mean follow-up period was 32 months in CABG, and 35 months in PCI. In the unmatched patient population, there was no difference in the incidence of all-cause death, cardiac death, MI, and stroke but the incidence of target vessel revascularisation (TVR) was significantly higher in the PCI group (p<0.001 by log-rank test). After propensity matching, the incidence of all-cause death and TVR was significantly higher in the PCI group than in the CABG group (Figure 1).

In conclusion, when the backgrounds of patients undergoing CABG or PCI using second generation DES are adjusted by propensity matching, CABG remains the first choice of revascularisation strategy for 3-vessel and/or left main disease to prevent future cardiac and revascularisation events.

Figure 1



Cardiac | Focus Session | Latest trials in cardiovascular medicine

CABG: Still better than BEST

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Since its clinical introduction almost three decades ago, the use of percutaneous coronary intervention has seen a dramatic evolution in the stent technology, from initial balloon angioplasty to bare metal stents, then to first and second generation drug-eluting stents (DES), and now to fully bio-absorbable stents.[1] Although each successive iteration of stents has shown a reduction in in-stent restenosis there has been no significant improvement in clinical outcome in comparison to CABG, which has consistently demonstrated improved survival, reduced myocardial infarction and a dramatic reduction in the need for repeat revascularisation. The most recent meta analysis addressing this subject in patients with multi-vessel disease has shown that CABG, in comparison to first generation DES, still reduces mortality, myocardial infarction and repeat revascularisation at the cost of a 0.9% increase in the incidence of stroke over five years.[2]

More recently, two large studies have compared everolimus DES versus CABG. The BEST trial randomised 880 patients, but the trial was terminated early due to slow recruitment.[3] At a median follow up of 4.6 years the primary endpoint (a composite of death, MI or target vessel revascularisation) had occurred in 15.3% of PCI patients and 10.6% of CABG patients (HR 1.47; p=0.04). These results were largely driven by an increased incidence of repeat revascularisation and myocardial infarction in the PCI group. Of particular note was that the mean SYNTAX score in BEST was 24, suggesting less complex coronary artery disease, and the results were therefore comparable to those observed in the lower tertile group of the SYNTAX trial.

In a propensity-matched registry study, over 9,000 patients with everolimus DES were compared to over 9,000 CABG patients (from a total population of 117,000)[4]. At mean follow-up of 2.9 years, PCI and CABG had a similar incidence of death (3.1% and 2.9%) but with a higher risk of MI (1.9% versus 1.1% per year: p<0.001), repeat revascularisation rate (7.2% versus 3.1% per year: p<0.001) and a lower risk of stroke (0.7% versus 1.0% per year: p<0.001) with PCI. The two major limitations of this study were that without SYNTAX scores, the severity of coronary artery disease was unknown in both populations, and there was a limited duration of follow-up (less than three years). SYNTAX showed that the major differences between PCI and CABG were only apparent by five years.

Consequently, both these studies still show inferiority of PCI to CABG, even using second generation DES in what was a predominantly low-risk population. And this is not surprising given the differing physiological effects of CABG and PCI. The benefits of CABG are due to (i) placement of bypass grafts to the mid-coronary vessel, which offers prophylaxis against development of new disease, (ii) evolution of nitric oxide from the internal mammary artery into the coronary circulation thereby reducing disease progression in the coronary circulation, and (iii) avoiding inappropriate incomplete revascularisation observed in many patients undergoing PCI. These are the key reasons that while progressive generations of stents have reduced in-stent restenosis they have not reduced the overall incidence of mortality, myocardial infarction and repeat revascularisation seen with CABG. Consequently even with the newer generation of bio-absorbable stents it is likely that CABG will remain best treatment for most patients with multi-vessel disease and those with left main with additional proximal coronary artery disease.

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Exhibition opening times:

Sunday 2 October	**15.00 – 19.00**
Monday 3 October	**09.00 – 17.00**
Tuesday 4 October	**09.00 – 17.00**

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074-075	Admedus
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098	Andocor NV
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073	CORONEO Inc
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092	Dendrite Clinical Systems Ltd
009	EACTS-Euromacs and QUIP Programme
113	EACTS-The European Association For Cardio-Thoracic Surgery
114 & Training Village Unit 8	Edwards Lifesciences
120	Eurosets SRL
016-017	Fehling Instruments GmbH & Co. KG
028	Genesee BioMedical Inc
110	Getinge Group
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cryoFORM™ Probe	Thorsten Hanke, MD	Monday, October 3	15:30-17:00
EPi-Sense® Coagulation Device	Chris Blauth, MD	Monday, October 3	15:30-17:00

SPOTLIGHT ON SURGICAL ABLATION & APPENDAGE MANAGEMENT SERIES

Freezing Equals Freezing? Efficacious and Efficient Cryoablation Techniques	Nicolas Doll, MD	Monday, October 3	10:00-10:30
Staged Hybrid Approach: A New Opportunity	Sir Malcom Dimple-Hay, MD; Guy Haywood, MD	Monday, October 3	15:45-16:15
The Endoscopic Approach: How to Ablate Efficaciously AND Safely	Mark LaMeir, MD	Tuesday, October 4	10:00-10:30
Isolation of the Posterior Atrial Wall: A Concomitant Treatment Strategy	Mohamed Bentala, MD	Tuesday, October 4	15:45-16:15
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