



EACTS
European Association For Cardio-Thoracic Surgery

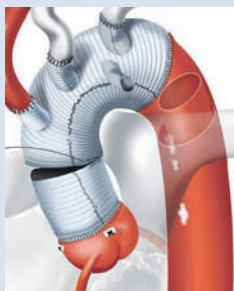
Daily News

The official newspaper of the 30th EACTS Annual Meeting 2016

Issue 1 Saturday 1 October

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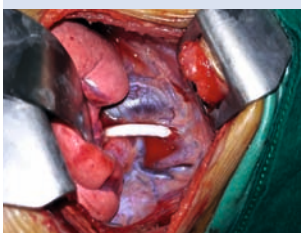


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Welcome to Barcelona

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' 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



Pieter Kappetein

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 Família 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

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

Balancing a surgical career with a family

Malakh Shrestha

Hannover Medical School, Germany



The field of cardio-thoracic surgery is not only fascinating but also very demanding, both in terms of the working hours involved and the impact this has on family life. A surgical career involves long working hours – including at odd and unpredictable hours of the day. It also involves up to 10 years of training, along with a huge workload that used to involve 80+ hours per week. Perhaps it is for this reason that, traditionally, cardio-thoracic surgery has been so heavily male dominated.

Of course there have been great women surgeons in our field. But till

now they have only been the 'exception'. And even the experiences of male and female residents regarding their family life have been very different. More male surgeons have families and children than women. Directly or indirectly, women surgeons have felt the overwhelming peer pressure to hold off having children until they have completed training.

Nowadays, medical schools are more heavily dominated by female students, but only a small number choose to go on to a surgical career, let alone a cardio-thoracic surgical one. Moreover, the younger generation of male doctors are also looking for work-life balance and are therefore choosing not to join our field.

The objective of this session is to discuss this problem and try to find objective solutions, which could include creating a more flexible working environment. This year, we want to discuss how to make our field more family friendly – not only for our female colleagues, but for all of us.

We should also work harder to attract younger doctors to our field. We want to change the present image of being a family-unfriendly profession, and we want to convince medical students to at least think

about a career in cardio-thoracic surgery.

And times are changing – and for the better: EACTS organised the first ever 'Women in cardio-thoracic surgery' session during the annual meeting in Amsterdam. The European guidelines on working hours have tried to address this too, partly by reducing the maximum hours one is allowed to work. And for the first time in its over-200 year history, the Royal College of Surgeons of England elected a female President, Clare Marx.

Don't miss!

Balancing a surgical career with a family

Sunday, 15:15–16:45 in room 114

Cardiac | Abstract Session | Stand-alone and concomitant MAZE is an evidence based procedure

One-Year Mortality and Costs after Surgical Ablation for Atrial Fibrillation Concomitant to Coronary Artery Bypass Grafting

J. Scott Rankin¹, Mary Jo Braid-Forbes², Daniel J. Lerner³, Michael A. Ferguson⁴, Kevin F. Forbes⁵, Vinay Badhwar¹ 1. West Virginia University, Morgantown, WV, USA. 2. Braid-Forbes Health Research, Silver Spring, MD, USA. 3. Health Sciences West, Scarsdale, NY, USA. 4. Director of Research, Atricle USA. 5. Catholic University, Washington, DC, USA

Dislosures: Research was funded by Atricle USA. Authors Rankin, Lerner, Braid-Forbes, and Forbes were consultants for – and Dr. Ferguson was an employee of Atricle.

Surgical ablation (SA) for persistent atrial fibrillation (AF) is accepted to reduce AF rates and improve quality of life. Effects on long-term patient survival and health care costs are controversial, however. This study compared clinical outcomes and resource utilisation of patients with persistent AF who did and did not have concomitant SA at the time of coronary artery bypass grafting (CABG).

The Medicare Standard Analytic File (SAF) for hospital inpatient care was utilised, and outpatient services and denominator files (deaths) also were queried. Included were all Medicare beneficiaries of: age >65, end-stage renal disease, and disability. The population consisted of all patients having CABG surgery in the US between January 1 and December 31, 2013 (total n=88,101). Exclusions comprised: valvular AF, other cardiovascular procedures, reoperative CABG, prior ablation or left atrial appendage manipulation, and prior heart replacement. The final study included 3,745 patients with persistent AF who underwent CABG. A piecewise Cox proportional hazard (PH) model for mortality was performed.

The study design was a retrospective dual cohort: group SA included CABG patients with AF receiving ablation (n=626, 17%). Group No-SA included CABG patients with AF, not receiving ablation (n=3,119, 83%). The first postoperative year was divided into two

intervals: 0-90 days, representing early operation-related events, and 91-364 days representing late events. A logistic regression model also was used to assess clinical outcomes. Risk adjustments included: all clinically relevant variables plus CHA2DS2-VASc/stroke & HAS-BLED/bleeding score. A negative binomial model calculated risk-adjusted costs and lengths of stay.

Concomitant SA was performed in 17% (626/3,745) of CABG patients with AF. Unadjusted preoperative characteristics were better in SA than in No-SA patients: age (73±6 vs. 74±7 years [mean±SD]); elective presentation (66% vs. 50%); heart failure prior 2 weeks (31% vs. 36%); chronic lung disease (27% vs. 33%); and renal failure (4% vs. 7%) (all p<0.05). No difference was observed in number of grafts per patient (p>0.22). Unadjusted 90-day (early) mortality was: 7.0% for SA versus 8.2% for No-SA (p=0.36). After risk adjustment by the PH model, early operative outcomes (mortality, renal failure, or stroke) were no different for SA versus No-SA (HR=1.03; p=0.86). In the 91-364 day (late) period, however, mortality (SA vs. No-SA) was significantly lower after SA, whether considering unadjusted (2.7% vs. 5.7%; p=0.007) or adjusted (HR=0.58, p=0.03) comparisons (Figure 1). Adjusted index hospital costs were 11% higher (95% CI [6-15%]; p<0.0001), and adjusted total inpatient costs at 1 year, including the index and readmission

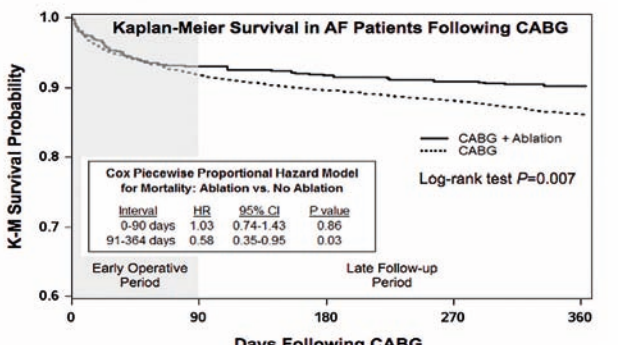


Figure 1. Survival probability from zero to 364 days post-CABG. In the post-90 day (late) period, mortality in patients undergoing surgical ablation in addition to CABG versus CABG alone was significantly lower

costs, were 6% higher in the SA group (95% CI [1%-11%]; p=0.02).

During CABG procedures in the US Medicare population, SA was performed in 17% of persistent AF patients in 2013. Patients were selected for SA primarily on the basis of severity of illness, rather than procedural complexity. With the addition of SA, early operative mortality, renal failure, and stroke did not increase. However, SA was associated with a 42% decline in late mortality rate, and significant improvement in risk-adjusted survival. Half of adjusted index hospital costs were recovered in the first postoperative year. These data suggest significant long-term survival benefits of SA for AF during CABG, and also illustrate a potential for cost-efficacy over the long-term.

Cardiac | Techno College | Atrioventricular valve 2

How to guide transcatheter mitral interventions

Alison Duncan, Simon Stephens and Neil Moat
Royal Brompton & Harefield NHS Foundation Trust, London, UK

Transcatheter mitral valve (MV) intervention is the new 'event horizon', emerging as an alternative therapy for patients with severe mitral regurgitation (MR) who are deemed high-risk for conventional mitral valve surgery. The most common of these is the MitraClip (Abbott, USA) device, with over 30,000 procedures performed world-wide. In more recent years, transcatheter mitral valve implantation using TAVI devices into calcified mitral annulus, mitral valve-in-valve and valve-in-ring for patients with failed prior mitral surgery have developed. Insertion

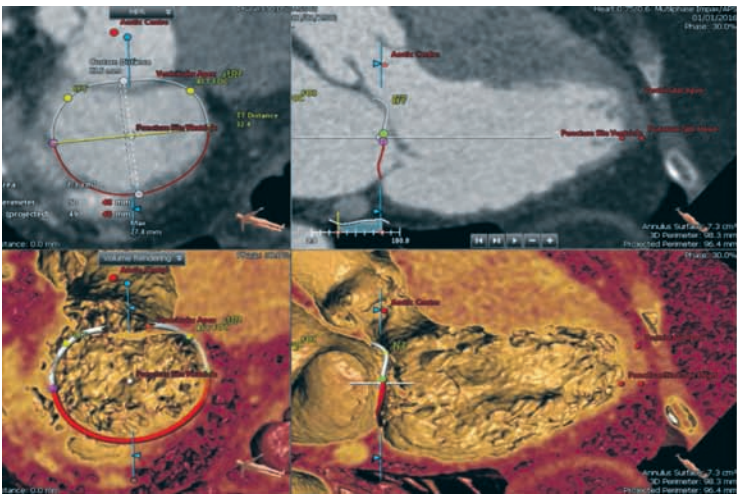


Figure 1. MSCT analysis of mitral annular dimensions

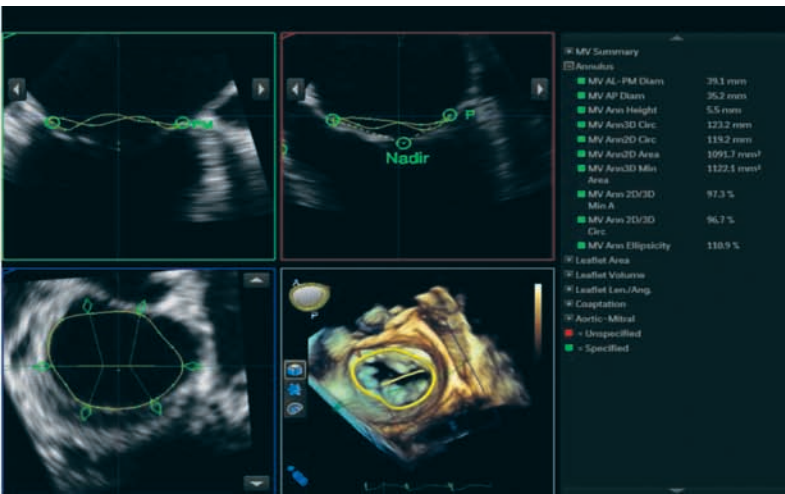


Figure 2. 3D TOE analysis of mitral annular dimensions

of transventricular mitral chords, placement of transcatheter mitral annuloplasty rings, and novel dedicated mitral devices for transcatheter mitral valve implantation into native mitral annulus have added to the armamentarium of transcatheter mitral valve intervention therapies available to cardiac surgeons and cardiologists. Key to procedural success is high-specification imaging; while fluoroscopy and cardiac MRI play a role, cardiac CT and echocardiography are the work-horses of pre-procedural planning, peri-procedural guidance, and post-procedural assessment and monitoring.

Pre-procedural planning

Multi-slice computed tomography (MSCT) provides anatomical MV characterisation using a mitral valve 3D data set with high spatial resolution along defined planes. Mitral annular shape (dimensions, area, circumference), angiographic coordinates, presence and extent of annular calcification, coronary sinus spatial relationship, leaflet tethering angles compared to annulus plane, and papillary muscle structure can be assessed using MSCT in pre-procedural planning. Post-processing analysis permits 3D reconstruction of

the aorto-mitral angle and LVOT size and shape, and facilitates construction of 3D print models that can be used to plan implant technique prior to the procedure. Moreover, reconstructed mitral planes can be described relative to the body axes, and specifically in angiographic coordinates (LAO/RAO-cranial/caudal). Four-dimensional MSCT permits real-time imaging, and assessment of mitral valve leaflet and chordae tendineae motion is a growing area of research. However, MSCT does not assess flow and therefore cannot directly detect or grade MR.

2D transthoracic echocardiography remains the standard method for identification of mitral valve disease and grading of MR severity. It can be used to assess mitral annular geometry and dimensions, annular calcification, valve leaflet morphology leaflet motion, anatomy of the subvalvular apparatus including chordae tendineae and papillary muscles, as well as evaluate left and right ventricular function and provide an estimation of pulmonary arterial pressure. 3D transoesophageal echocardiography (TOE), performed according to European Association of Cardiovascular Imaging recommendations, provides detailed,

structured assessment of leaflet anatomy and motion, and intricately assesses the pathophysiology of MR, which should be classified according to Carpentier criteria. Using post-processed 3D-TOE datasets of the MV and sophisticated in-built echo software, detailed 3D mitral valve quantification can be performed to assess mitral annular dimensions, area, and circumference, as well as mitral leaflet lengths, areas, and volumes. Coaptation length at the central level (A2-P2) and tenting volume between the leaflets and the annular surface area can be measured, and coaptation area calculated. Like MSCT, an assessment of aorto-mitral angle and LV outflow tract diameter can be made that may be important in predicting the likelihood of developing LV outflow tract obstruction after mitral valve-in-valve or valve-in-ring procedures.

Peri-procedural guidance

Peri-procedural guidance for percutaneous MV interventions represents the real challenge for imaging. Manoeuvring steerable catheters, delivering clips, artificial valves or anchors in the narrow 3D space of the left heart chambers

is extremely challenging, and in the context of a wide spectrum of transcatheter mitral therapies, the requirement for high-level periprocedural real-time continuous 2D and 3D-TOE, as well as X-plane imaging (simultaneous visualisation of two perpendicular 2D planes) is critical to provide effective and individualised transcatheter valve treatments. Crucially, peri-procedural TOE guides the entire transcatheter device implantation procedure, including intra-atrial puncture for MitraClip, directing intra-cardiac wires and sheaths, ensuring leaflet grasping with MitraClip, Harpoon, or NeoChord devices, accurate placement of annuloplasty rings, and confirming correct position and function of transcatheter valve-in-valve, valve-in-ring, and mitral valve implantation devices, while excluding significant left ventricular outflow tract obstruction or residual MR.

The use of ever-increasingly sophisticated hybrid or fusion imaging systems, consisting of an overlay of 3D-MSCT data onto real-time procedural fluoroscopy or TOE greatly assists procedural guidance for complex structural cardiac intervention.

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EACTS President
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A. Pieter Kappetein

Editor-in-Chief
Peter Stevenson

Managing Editor
Rysia Burmicz

Editor
Joanne Waters

Design
Peter Williams

Industry Liaison Manager
Amanda D'rojas

Head Office
51 Fox Hill
London SE19 2XE
United Kingdom
Telephone: +44 (0) 7506 345 283
mary.kennedy@medifore.co.uk

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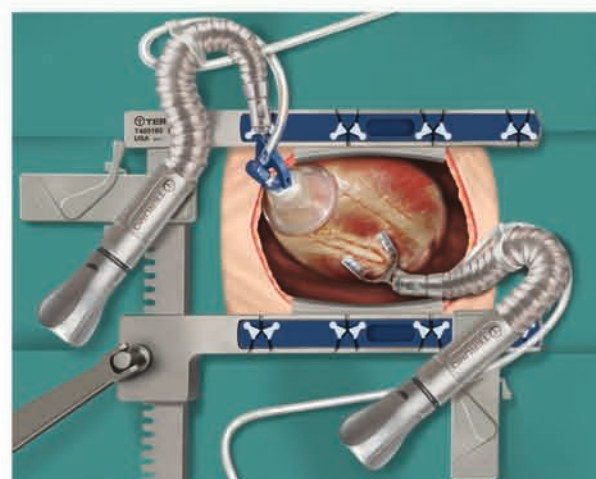
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Live-in-a-box: **Aortic valve repair using heterologous pericardium,
Ozaki technique**

C. Quarto (London), O. Ghez (London), S. Ozaki (Tokyo)

Date: Saturday, Oct. 1st 2016

Time: 08:00 – 10:10 am

Location: Forum Room, CCIB Barcelona

Prof. S. Ozaki,
Toho University, Tokyo Japan



Vascular | Abstract Session | Arch and descending aortic pathology

Hybrid repair of complex aortic arch pathologies with a novel sutureless anastomosis for revascularisation of the supra-aortic vessels

Nimesh D. Desai, Ashley Hoedt, T. Wallen, Wilson Y. Szeto, Taylor Dibble, Danielle Savino, Danielle Spragan and Joseph E. Bavariam

Hospital of the University of Pennsylvania, Philadelphia, US

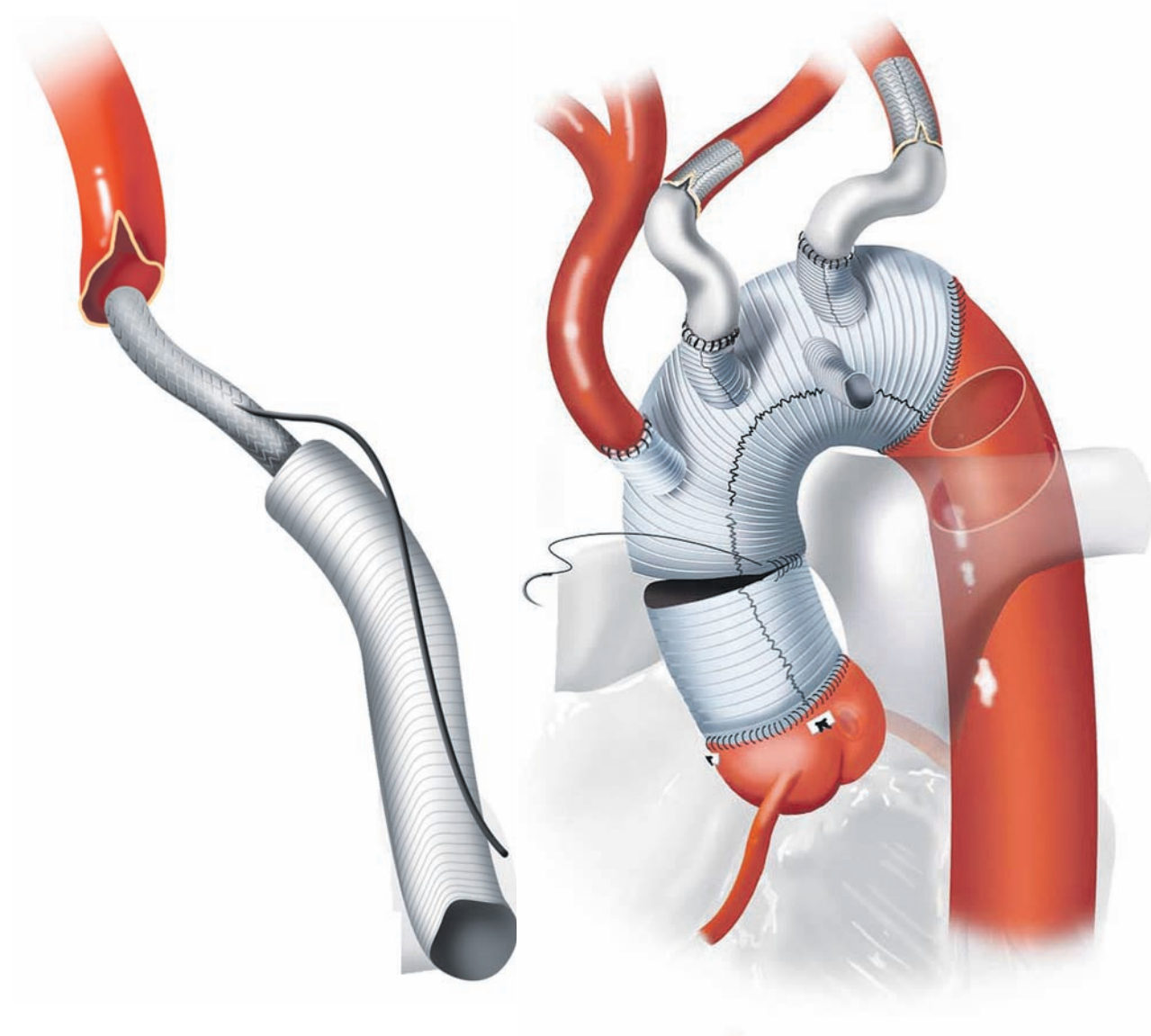
Conventional open surgical repair of complex aortic arch pathologies requires use of cardiopulmonary bypass and deep hypothermic circulatory arrest, and – despite advancements in operative techniques and perioperative management – remains associated with significant morbidity and mortality. Hybrid repair by supra-aortic arch vessel revascularisation in combination with thoracic endovascular aortic repair (TEVAR) has become increasingly accepted as an alternative to traditional open repair.

Complex aortic arch pathologies or anatomic variation may render revascularisation challenging and time-consuming, leading to increased cardiopulmonary bypass (CPB) time and circulatory arrest time. In an attempt to minimise these surgical complications, we used a novel sutureless anastomosis revascularisation technique for debranching of supra-aortic vessels during hybrid repair. Use of this technique may allow for reduced cerebral ischaemia time, minimisation of arch vessel manipulation and decreased neurological injuries.

This study analysed a cohort of 23 patients with complex aortic arch pathologies who were treated using our sutureless anastomosis revascularisation technique. Indications for surgical treatment included acute Type A dissections, chronic aortic dissections, aortic arch aneurysms and ruptured aortas. Patients underwent classic hybrid arch (no circulatory arrest) debranching, or Zone 2 or Zone 3 arch replacement with antegrade cerebral perfusion and subsequent thoracic endovascular repair. Supra-aortic bypasses to vessels less than 10 mm in diameter were performed with a Gore HYBRID® stent graft (W.L. Gore and Associates, USA).

The HYBRID vascular graft was used for sutureless debranching of the supra-aortic left common carotid and subclavian vessels during the hybrid repair. The graft is an expanded polytetrafluoroethylene (ePTFE) vascular prosthesis with a self-expanding nitinol-reinforced segment that deploys as a sutureless endoluminal anastomosis. It has a continuous lumen bonded with the CARMEDA® BioActive Surface (CBAS; Medtronic, USA) consisting of a stable, covalently-bonded, reduced molecular weight heparin. The attachment of this graft to a standard Dacron allows for replacement of the aortic arch and all its vessels with circulatory arrest times similar to those of a simple hemiarch replacement and mitigates the need for complex cerebral circulation strategies.

The average age of patients included in this series was 60 years old (range: 27-84 years). Patients were predominantly



male (87%) and the majority of patients had history of hypertension. Other common morbidities were history of smoking, diabetes and coronary artery disease. Using our sutureless technique, 25 grafts were implanted in either the left common carotid artery or the left subclavian artery. Technical success was achieved in 100% of cases. At 30 days post-

operatively, all patients were alive and 100% graft patency was observed by contrast CTA.

Hybrid repair using a novel sutureless anastomosis revascularisation technique is thus a reasonable and effective option for treatment of complex aortic arch pathologies which simplifies technique and minimises cerebral ischaemic time.

Vascular | Abstract | Defining good outcomes after aortic root surgery

Elective aortic arch repair: factors influencing neurologic outcome in 791 patients

Mariano Cefarelli^{1,2}, Giacomo Murana^{1,2}, Wim J. Morshuis³, Robin H. Heijmen^{1,4}

1. Department of Cardiothoracic Surgery, St Antonius Hospital, Nieuwegein, the Netherlands. 2. Department of Cardiac Surgery, University of Bologna, Sant'Orsola-Malpighi Hospital, Bologna, Italy. 3. Department of Cardiac Surgery, Radboud university medical center, Nijmegen, the Netherlands. 4. Department of Cardiothoracic Surgery, Academic Medical Center, Amsterdam, the Netherlands

Despite the improvement in surgical techniques over the last decade, aortic arch surgery still represents a major challenge for both patient and surgeon. Indeed, various cerebral perfusion strategies have been proposed in order to protect the brain against ischaemia during aortic arch repair. The most frequently used strategies in this setting have been deep hypothermic circulatory arrest (DHCA) and selective cerebral perfusion, performed either retrograde (RCP) or antegrade (ASCP)¹⁻³. The choice between each technique is often guided by the experience of the team and policy of the heart centre.

The aim of our study was to evaluate factors influencing neurologic outcome in a large, single-centre cohort of consecutive patients undergoing elective aortic arch repair. From January 2005 to June 2015, 791 consecutive elective patients received an open aortic arch procedure with differing cerebral protection strategies: ASCP was used in 636 patients (80.4%) and DHCA in 155 patients (19.6%).

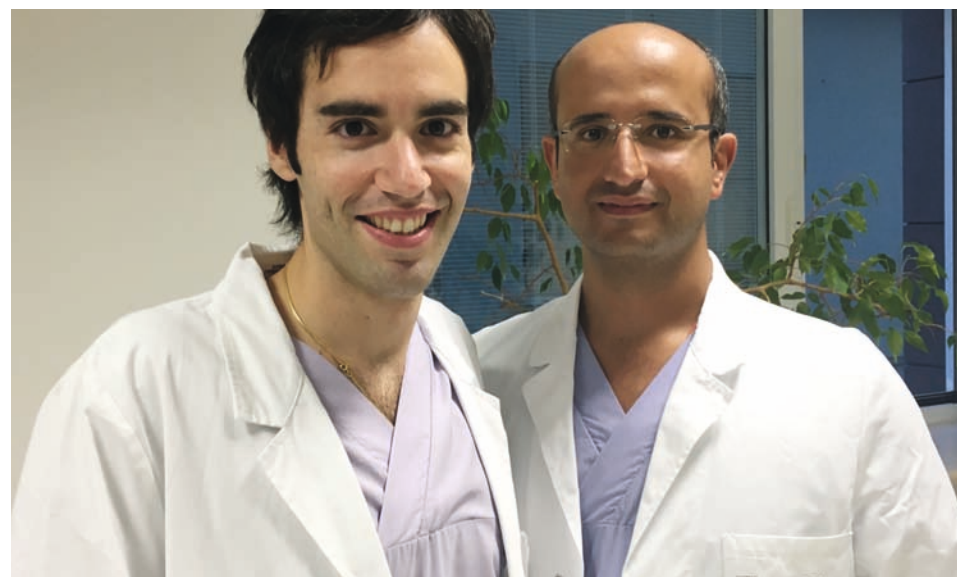
Excluding emergent and urgent cases from this study allowed us to evaluate the risk factors

that affect the neurologic outcome of patients receiving well-prepared, elective aortic arch surgery.

Analysis of the results were encouraging, with permanent neurological dysfunction (PND) appearing in 42 (5.3%) patients, and temporary neurological dysfunction (TND) in 49 (6.2%).

As expected, the duration of cardiopulmonary bypass, circulatory arrest and ASCP time emerged to be independently related to post-operative neurological deficits. On the other hand, the use of an ASCP confirmed to be a strong protective factor for PND. This well-known technique, initially introduced by Kazui in 1986, has undergone a remarkable expansion over time³. It has considerably prolonged the safe duration of circulatory arrest, in particular when used with moderate hypothermia. However, a statement paper from the EJCTS⁴ reported that, despite the widespread acceptance of ASCP, a substantial heterogeneity of technical details in aortic arch surgery is still an issue.

The results of our single centre experience clearly confirm that it is possible to safely perform



Giacomo Murana (left) Mariano Cefarelli

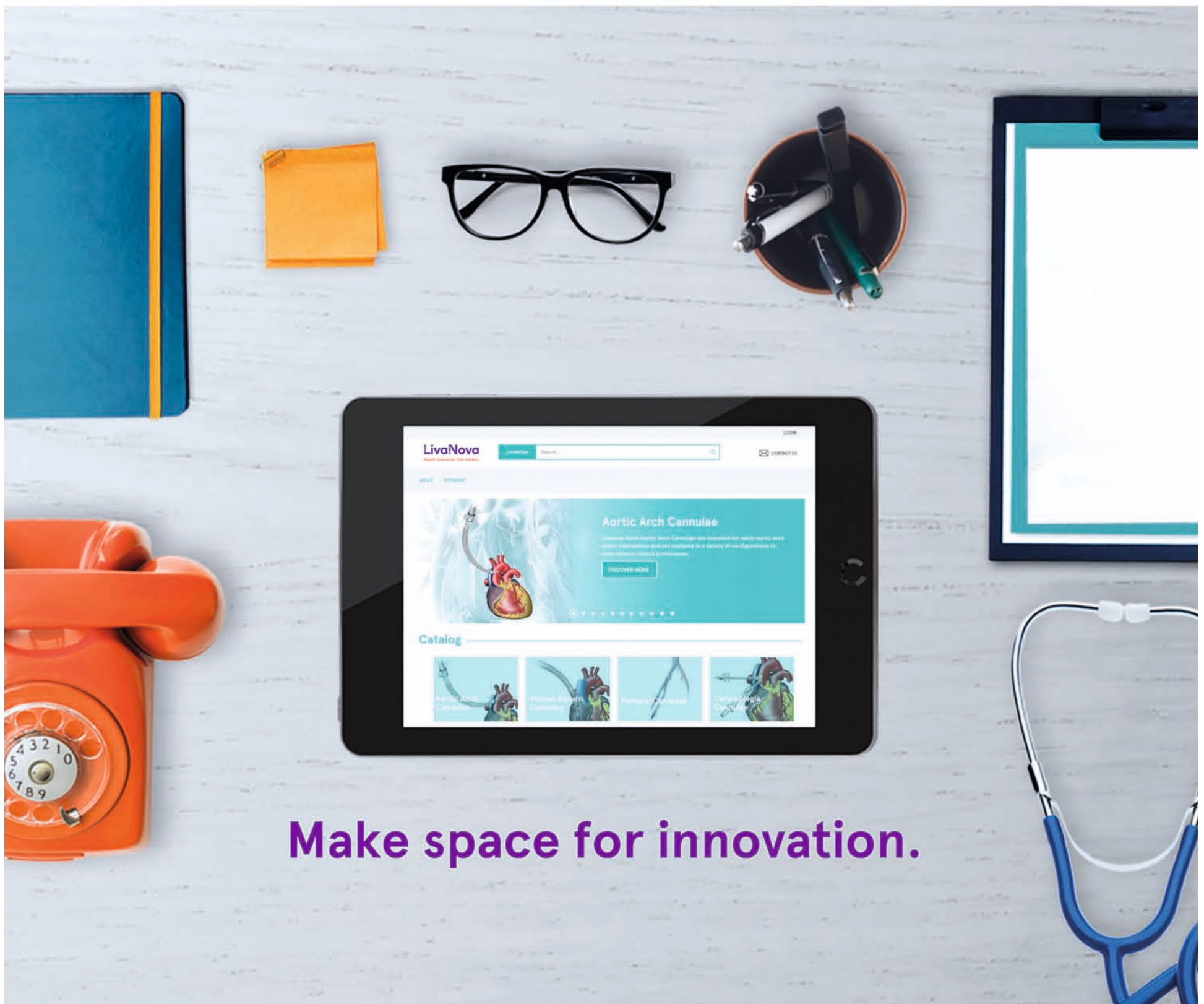
an open aortic arch repair when appropriate neurological adjuncts are applied. It seems also that the use of antegrade cerebral perfusion is protective, irrespective to the type of aortic aetiology and extent of repair. Larger multicentre studies are surely necessary to increase the power of this evidence, with the final objective being to homogeneously uniform the cerebral protection strategies during open arch surgery across different European centres.

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INSIDE BARCELONA

Where to go? What to do?

CULTURE

SAGRADA FAMÍLIA

You'd be hard pressed to name a more famous Barcelona landmark. Gaudi's awe-inspiring gothic Basilica is truly unmissable up-close. The view from the top is equally impressive. **Open 09:00–19:00.** **Tours available**



LA BOQUERIA

Barcelona's bold, bountiful and downright beautiful market – just off the bustling 'La Rambla' stretch – may be busy, but there's a reason. Get lost in a seemingly infinite display of tempting fresh produce from land and sea.



EATING

Catalan cuisine is almost as important as fresh air! It would be impossible to leave the city without relishing in the exceptional delights that are on offer throughout. Whether you opt for small tapas dishes, a handful of treats from the market, or settle down to one of the

many fine-dining restaurants, you will not be disappointed.

PINOTXO

While you're in La Boqueria, head to this much ballyhooed slice of tapas heaven, and don't forget to try some of their sweet treats as well. **TRY: Rabo de toro (oxtail stew) or a delicious Xuixo pastry (filled with burnt cream, and deep fried!)**

7 PORTES

If you want to get away from the hustle and bustle of the market, wander down towards the port for paella and seafood at this iconic, 180-year-old Barcelona institution. **TRY: Zarzuela (lobster casserole)**

BARS

Looking for a local treat? Why not try a little vermut de la casa (house vermouth) as an aperitif? This traditional Barcelona tippie may be discussed just about as much drank (should you have red or black? With or without spritz?) but however you take it, be sure to accompany it with a snack to really fit in with the locals.



Recommended vermut bars...

CARMELITAS

Situated a stone's throw from the Boqueria, take a seat in this converted nun's convent as you sip on strong and sweet offerings

GRAN BODEGA SALTÓ

Vibrant décor and rumba music will accompany your vermut in this very popular bar in the super-trendy Poble-sec district



LA CONFITERÍA

Fine cocktails are also on the menu in this well-dressed, early 1900s hot spot

ALTERNATIVELY...

BAR MINGUS

If you want something a bit different, this little gem in the Gothic quarter might be just the place. A relaxed ambience is flanked with a wall covered in skateboards, but don't be tempted to try any skateboarding after you've sampled some of the excellent beers – both local and beyond!

Edwards Lifesciences

MIAVR Patients Benefit From Enhanced After-Surgery Recovery in Bordeaux

Minimally invasive surgery for aortic valve replacement (MIAVR) is becoming more and more common. Less bleeding, better respiratory recovery and ultimately less pain are just some of the numerous benefits of this surgical technique. However, the fields of anesthesia and perioperative medicine have not evolved at the same speed as MIAVR.

In fact, the scientific literature offers few examples of "enhanced after-surgery recovery" (ERAS) for MIS patients. It is therefore crucial to establish ERAS

recommendations for MIAVR to maximize its benefits. A surgeon and an anesthesiologist, Dr Osés P. and Dr Zaouter C. teamed up to set up the Bordeaux ERAS program for MIAVR and a dedicated ERAS MIAVR team. From June 2015 until June 2016, 56 patients were included in the ERAS MIAVR program.

Bordeaux's ERAS MIAVR pathway

Pre-operative period: The ERAS MIAVR program developed a pathway that starts prior to surgery, when patients meet with a trained

nurse, a physiotherapist and a nutritionist; on top of the standard patient assessment, patients watch a dedicated institutional video which explains their pathway within the hospital and informs them about what is going to happen after their surgery. This establishes a trusted relationship between the patient and the hospital and brings "anxiolytic" benefits. Patients also receive a booklet with preoperative instructions and details about their surgery and the postoperative course. The premedication is not based on anxiolytic agents but

together with pregabalin serves solely as analgesia. Any benzodiazepine will be avoided. **Perioperative period and surgical technique:** A mini-sternotomy is performed in a J-shaped fashion, up to the fourth intercostal space. Both, the arterial and the venous cannulation are carried out centrally through the main surgical site. For all minimally invasive procedures, rapid deployment valves (Edwards INTUITY Elite) were used to make the MIAVR easier and simpler to reproduce. An additional benefit was that it also reduced the duration of the procedure.

Local infiltration of lidocaine is performed to limit pain in the next 6-8 hours; 2 small drainage tubes are passed from upper part of the incision to limit discomfort and facilitate mobility. Finally we protect the incision using skin Glue (Dermabond ©Ethicon) to avoid using adhesive bandage. The risk of nosocomial infection with multiple bandage redo



Dr Pierre Osés

is reduced. Furthermore, skin glue allows a better psychological acceptance for both the patient and his family by allowing faster demedicalization. The psychological impact of the scare is often an underestimated point. Our target is to extubate all patients within 1 hour after surgery. **Postoperative period:** We have an aggressive early mobilization strategy with patient in a chair 4 hours after surgery with physiotherapist in intensive care unit, compare to 36 hours. Feeding is started from the 6th hour. Ambulation

walking test and incentive spirometer exercises during the 1st day after surgery. Urinary catheter and central venous line are removed also on the 1st day. TTE was performed at the 5th day for a median length of hospital stay of 5.5 days (instead of 8.8 days). In conclusion, ERAS pathway benefits from an optimised MIAVR with rapid deployment valves as they contribute mitigate some of the risk factors responsible the failure of ERAS strategy in cardiac surgery (bleeding, procedural times, and respiratory function). Our preliminary experience with ERAS MIAVR with Edwards INTUITY Elite was associated with improved clinical and post discharge outcomes, which resulted in lower overall costs (about 2200 euros) than classical AVR, but also with MIAVR alone without dedicated pathway. Finally our next step will be to avoid ICU stay for our ERAS MIAVR patients, thus reducing further our hospital resources utilization.

	ERAS Pathway (N=56)
Logistic Euroscore (%)	13.5±2.2
Cross clamp time (min.)	47±6.2
Rapid deployment valve implantation n (%)	55(98.2)
Postoperative morphine consumption	3±1
Mobilization on a chair on the day of the surgery; n (%)	47(83.9)
Transurethral catheter removal on the morning after surgery n (%)	50(91)
Overall infections during the hospitalization; n (%)	5(8.9)
Readmission for cardiac reasons; n (%)	0(0)
Extubation in operative room n (%)	42(75)
Pace-maker implantation	4(7.1)

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Cardiac | Focus Session | Perfusion Programme

Recent trials of steroids for cardiopulmonary bypass: is it really 'end of story'?

Stefan Dieleman

Dept of Anesthesiology and Intensive Care, University Medical Center, Utrecht, the Netherlands
Dept of Anaesthesia and Perioperative Medicine, Monash University, Melbourne, VIC, Australia



The postoperative systemic inflammatory response syndrome that is associated with cardiac surgery and the use of cardiopulmonary bypass may contribute to postoperative organ dysfunction and complications. With that, the use of high-dose corticosteroid drugs ('steroids') for prophylaxis of perioperative systemic inflammation in cardiac surgery is a topic of

increasing controversy. With severe SIRS gradually becoming less of an issue for the every-day cardiac surgical patient, it is now increasingly recognised that the scientific evidence necessary to justify the routine use of perioperative high-dose steroids – especially regarding the effects on clinical outcomes and safety – is largely lacking.

With this evidence gap, local experience and subjective 'belief' have essentially been the driving forces to determine practice of corticosteroid prophylaxis in most places, resulting in large global variation. This practice variability formed the ideal basis for two pragmatic clinical trials – the DEXamethasone for Cardiac Surgery (DECS) study, and the Steroids In caRdiac Surgery (SIRS) trial. These two studies mark the first very large comparative trials of high-dose intraoperative steroids versus placebo, in which a total of 12,001 cardiac surgery patients were randomised, with a focus

on important clinical endpoints.

Both studies were negative on their primary composite endpoints of mortality and major complications, although the DECS study demonstrated a trend towards benefit. Nonetheless, when looking into the study data in more detail, an interesting blend of benefit and harm on multiple endpoints was observed. Substantial benefits in terms of costs, pulmonary complications, renal outcomes, and length of ICU and hospital stay was observed. There also appeared to be an age-dependent effect of corticosteroids with younger patients (<65 years) having a lower risk of mortality (a trend also observed in the SIRS trial), while older patients (>80 years) had an increased risk of mortality when receiving steroids. The differential effects of the steroids on patient outcomes (between the different age groups) may be based on a decreasing intensity of the systemic

inflammatory response with advancing age.

On the other hand, unexplained negative effects on risks of early reoperation (DECS) and myocardial injury (SIRS) counterbalanced these beneficial signals.

Therefore, despite the large number of patients included, we must conclude that both the DECS study and the SIRS trial have not been able to provide the much-needed 'definitive' evidence to either support or advise against routine corticosteroid administration in all patients undergoing cardiac surgery. Lacking a clear answer, perioperative corticosteroid prophylaxis therefore continues, unfortunately, to be a topic of great controversy. Future studies should be designed to identify those individual patients who are more susceptible to developing an excessive inflammatory response, and who may receive most benefit from anti-inflammatory treatment.

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

Surgical correction of supracardiac total anomalous pulmonary venous connection in a 28-year-old man from rural South Africa

Kaylesh Dullabh and Darshan Reddy

Department of Cardiothoracic Surgery, Nelson R Mandela School of Medicine, Inkosi Albert Luthuli Central Hospital, Durban, South Africa

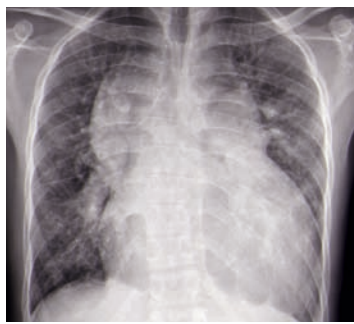


Figure 1. A typical 'snowman' appearance on chest radiograph

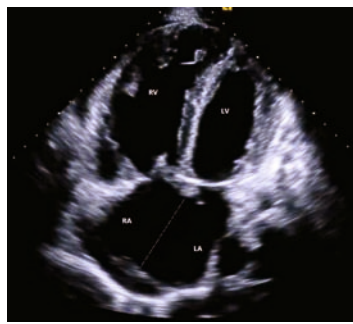


Figure 2. Echocardiography: apical long axis view showed a 51 mm atrial septal defect (dotted line)

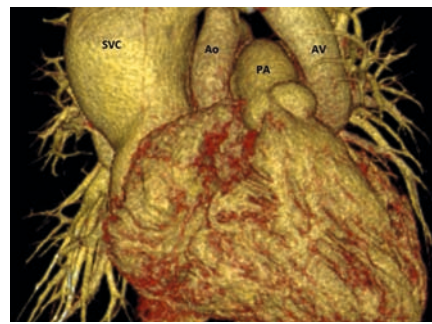


Figure 3. 3D reconstruction of the CT scan shows the ascending vein (AV) draining into the left brachiocephalic vein (LBV) as well as a large superior vena cava (SVC) measuring 60 mm at its largest diameter



Figure 4. Post-operative chest radiograph showing a reduction in the size of the superior mediastinum

Total Anomalous Pulmonary Venous Connection (TAPVC) is an uncommon congenital cardiac lesion often diagnosed and treated surgically in the first year of life. The presenting features and urgency of repair are dictated by the degree of obstruction in the pulmonary venous pathway, and late presentation may result in irreversible pulmonary vascular obstructive disease.

We report a case of a 28-year-old man from rural South Africa who presented with dyspnea (NYHA III) and cyanosis (saturation 86% on room air) with a suspected atrial septal defect. On clinical examination

he had clubbing and an elevated jugular venous pressure. Auscultation revealed a 3/6 ejection systolic murmur on the left sternal border and 2/4 early diastolic murmur. Laboratory investigations revealed a haemoglobin of 20.8 g/dl. The chest radiograph demonstrated cardiomegaly and a widened mediastinum producing the classic 'snowman' appearance, due to the dilated superior vena cava and left brachiocephalic vein.

Echocardiography demonstrated a supracardiac TAPVC with a dilated right atrium and right ventricle, with

a right to left shunt across the atrial septal defect (Figure 2). Computer tomography angiography (CTA) confirmed the pulmonary venous confluence draining into the left brachiocephalic vein via a vertical vein. The pulmonary confluence was located posterior to the left ventricle. The superior vena cava (SVC) measured 60 mm at its widest diameter (Figure 3).

A haemodynamic cardiac catheter study measured pulmonary vascular resistance of 6.4 Wood Units, which subsequently improved to 3.8 Wood

Units after the administration of oxygen. In addition, the pulmonary to systemic flow ratio (Qp/Qs) of 3.09 made him a suitable candidate for surgical intervention.

At surgery on moderate hypothermic cardiopulmonary bypass, the ascending vein was ligated with a silk suture. Via the right atrium, the interatrial septum was opened and the pulmonary confluence anastomosed to the left atrium using continuous polypropylene suture. The atrial septal defect was closed with a bovine pericardial patch. The patient's

post-operative convalescence was uneventful, and he made a satisfactory recovery. His discharge medication included a diuretic and oral anticoagulation (due to concern of thromboembolism emanating from the large SVC).

At 3- and 12-month follow-up, the patient reported a marked improvement in dyspnoea (NYHA I). Chest radiographs at 12 months showed a marked decrease in the mediastinum, and clear lung fields (Figure 4). Echocardiography showed mild dilation of the right ventricle.

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

Uniportal VATS sleeve resections

Diego Gonzalez Rivas

Director Uniportal VATS training program, Shanghai Pulmonary Hospital, Tongji University, Shanghai, China



The most common approach for complex procedures such as bronchial, vascular and carinal resections is still open surgery. The technical difficulties, the steep learning curve and the concerns about performing an oncologic and safe reconstruction in advanced cases are the main reasons for the low adoption of VATS for sleeve resections.

While the sleeve procedures offer benefits of parenchymal preservation and oncologic

safety even for patients who can tolerate more extensive resections, they are technically more demanding than pneumonectomy and are more prone to particular complications. For instance, sleeve procedures are contraindicated when local extension of the tumor requires pneumonectomy as it occurs with involvement of interlobar fissure. The surgeon must identify and avoid reconstructive techniques with risk to develop a severe complication. If the bronchial reconstruction is likely to fail because of the excessive tension or poor anastomotic technique, the result should be carefully evaluated at the end of the procedure, leading to an extensive resection in case of doubt.

Thanks to the recent improvements in thoracoscopy, sleeve resections can be performed without performing thoracotomies. During the last years, experience gained through

VATS techniques, design improvements of the surgical instruments and improvements of high definition cameras have greatly contributed to advances in VATS. Most of the authors use 3-4 incisions for thoracoscopic sleeve procedures. However these surgical techniques can be performed through a single 4 cm incision by skilled uniportal VATS surgeons. Because it is less invasive, the uniportal approach for VATS has emerged as a novel technique, applicable to a large spectrum of pulmonary resections including complex cases and broncho-vascular reconstructive procedures.

We consider proper placement of the incision to be very important, especially when it is performed by uniportal VATS. Performing the incision at the fourth or fifth intercostal space, more anterior (anterior axillary line), helps to use the needle holder parallel to the hilum, making

suturing similar to an open anterior thoracotomy. Using a wound protector is helpful because fatty tissue could interfere with the suture threads.

Our preferred method for the anastomosis is to use a running absorbable suture for membranous and cartilaginous portions (Polydioxanone, PDS 3/0) or by using only one prolene 3/0 suture with two needles. The running suture makes the thread movement easier, as well as the tying, especially when we use only one suture with two needles.

We always test the anastomosis under saline water and we only place one chest tube at the end of the operation. For tracheal or carinal resections and reconstructions, the high frequency ventilation jet is our preferred method for ventilation to avoid interference with the anastomosis of the lateral portion of trachea and bronchus.

Vascular | Abstract Session | Arch and descending aortic pathology

What would be the optimal imaging interval for surveillance of moderately-dilated ascending aorta?

Kay-Hyun Park, Suryeun Chung, Dong Jung Kim, Jun Sung Kim and Cheong Lim

Department of Thoracic and Cardiovascular Surgery, Seoul National University Bundang Hospital, Seongnam, Korea

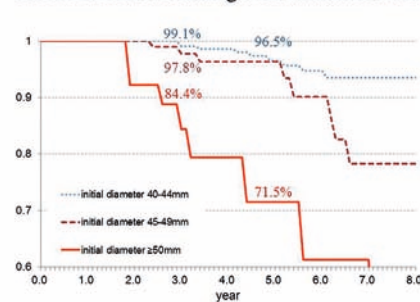


Despite increasing literature and debates regarding ascending aortic aneurysms, limited information has been established concerning the optimal medical management and surveillance protocol for a moderately-dilated ascending aorta. Among the guidelines that have been published during the past decade regarding the thoracic aortic aneurysm, only two have remarked on the follow-up surveillance of a thoracic aortic aneurysm which is smaller than the recommended criteria for intervention. In

the US (2010) and Japanese (2011) guidelines, they recommend continuous annual or semi-annual examinations with computed tomography or magnetic resonance imaging for a moderately dilated ascending aorta (diameter 35–54 mm). Applying the guidelines to patients in their 50s would force them to undergo at least 20 CT or MR examinations during their subsequent lifetime. However, few data have shown the yield and benefit of such a rather aggressive protocol.

In our institutional database, we identified adult patients who had an ascending aortic diameter ≥ 40 mm shown in contrast-enhanced computed tomography and underwent follow-up imaging after ≥ 1 year. In the 509 patients (mean age 67.2 ± 10.4 years) enrolled, the mean growth rate of a 40–49 mm ascending aorta was 0.3 ± 0.5 mm/year. Only 3.4% (40–44 mm) and 5.6% (45–49 mm) of the patients showed a significant progression (diameter increased by ≥ 5 mm) during the mean interval of 4.3 ± 2.4 years. The 3-/5-year rates of freedom from

Freedom from ascending aorta dilatation ≥ 5 mm



significant progression were 99.1%/96.5% (40–44 mm) and 97.8%/96.4% (45–49 mm). Acute type A aortic dissection occurred in 5 patients (1%), before the maximal diameter of the ascending aorta reached 55 mm or significant progression was observed.

We conclude that the growth of a moderately dilated ascending aorta is too slow to justify annual or semi-annual imaging follow-up – as

recommended in the current guidelines. A 3- to 4-year interval would be reasonable for subsequent CT or MR examinations for a moderately-dilated ascending aorta not initially exceeding 50 mm, and remaining stable in the first annual follow-up imaging. Although the incidence of acute dissection seems to be higher in these patients than in those who had normal ascending aortic diameter, frequent surveillance for interval growth is not considered helpful to predict or prevent an aortic dissection.

One of the limitations of this study is that the majority of patients were older than 60 years, and many of them had major illness including malignancy. So, considering that the growth rate of a dilated aorta may differ according to age and younger patients may be prone to faster growth, it may be doubted whether the same extension of imaging interval can be recommended for otherwise healthy patients in their 40s or 50s. The same argument applies to the patients with an aortic root aneurysm. Future studies on a larger cohort would resolve this query.

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

Does preoperative sarcopenia impact on the long-term survival in elderly patients undergoing heart valve surgery?

Homare Okamura
Saitama Medical Center,
Jichi Medical University,
Saitama, Japan



In an aging society, decision-making of operability on elderly and morbid patients has increasingly been an issue. Heterogeneity of comorbidity and activity in this population renders the decision-making process more challenging. It is crucial to perform accurate risk scoring in the context of risk/benefit balance. Furthermore, technological advances in cardiac surgery have led to various treatment options for each condition and also made risk assessment more important to provide optimal treatment to each patient.

Several risk models, such as EuroSCORE II and Society of Thoracic Surgeons score, are currently available for predicting perioperative risk in cardiac surgery. However, these risk-scoring systems do not incorporate frailty, an age-related systemic vulnerability. It is also unclear whether these conventional risk stratification systems can predict long-term survival after cardiac surgery.

Long-term survival after matching

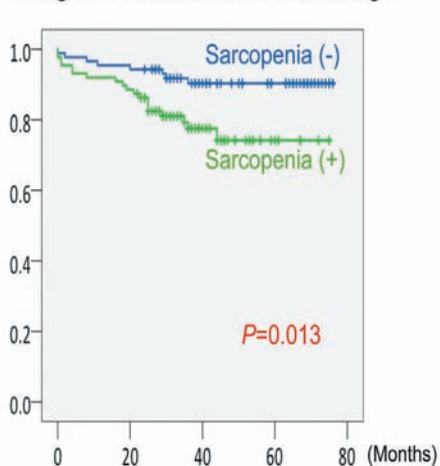


Figure. Long-term survival in patients with or without sarcopenia. Study population comprises 87 propensity score-matched patient pairs

Frailty is a geriatric syndrome reflecting impaired physiologic reserve and a decreased resistance to stressors across multiple physiologic systems. Both the aging process

and some chronic diseases interact with each other and lead to frailty. With the aging population, frailty becomes increasingly prevalent and is associated with a considerable social and economic burden. Measures of frailty are based on a matrix of several physical function and mental tests, which makes frailty hard to define.

In connection with frailty, sarcopenia is the age-related loss of muscle mass and function, which is closely related to poor physical performance. Not surprisingly, many of the adverse results of frailty stem from loss of skeletal muscle mass. Sarcopenia has been reported to be associated with higher long-term mortality after gastrointestinal surgery. However, the impact of sarcopenia on clinical outcomes after cardiac surgery is still unclear.

In this study, we aimed to assess whether sarcopenia provides prognostic information after heart valve surgery in elderly patients. From 2009 to 2013, 1,119 patients underwent valve surgery via median sternotomy at Saitama Medical Center, Japan. Patients younger than 70 years old and urgent or emergent cases were excluded. 428 elective patients with preoperative abdominal computed tomography

(CT) were included in this study. Psoas muscle area, a validated measure of sarcopenia, was measured at the level of the top of the iliac crest at preoperative CT. Sarcopenia was defined as the lowest sex-specific quartile in average of both psoas muscle area. The cut-off values for sarcopenia were 770 mm² in male and 495 mm² in female. Propensity score matching was performed in patients with or without sarcopenia and 87 pairs were matched. There was no difference between the groups in preoperative characteristics and operative procedures. After matching, patients with sarcopenia had significantly worse long-term survival (Figure) and the tendency to have worse freedom from major adverse cerebrovascular or cardiovascular events.

Frailty and sarcopenia can impact dramatically upon the health outcomes of elderly patients. Sarcopenia, defined from CT scan-derived psoas muscle area, was associated with long-term survival after valve surgery. Preoperative measurement of psoas muscle area can be an objective, reproducible, and simple risk assessment tool to provide important prognostic information, which helps identify patients who will derive optimal benefit from surgery.

Thoracic | Presentations | Beyond conventional video assisted thoracic surgery: Part 2

Conventional VATS or single-incision approach – also for pneumonectomy?

Gregor J. Kocher
University Hospital Bern, Switzerland

While open surgery was the gold standard approach for pneumonectomy for many years, video-assisted thoracoscopic (VATS) techniques have of late gained popularity in major lung resection. Thoracoscopic lobectomy has become the new standard of care for early stage lung cancer. Furthermore, the feasibility and usefulness of a uniportal approach has been reported even for advanced stages of non-small cell lung cancer.

So far only a few case reports,

as well as one series of 10 patients, have been published on the topic of single-incision thoracoscopic pneumonectomy in the international literature. We illustrate and discuss our preferred approach for single incision thoracoscopic pneumonectomy, including indications. Unlike other authors, we prefer to divide the pulmonary artery as one of the first steps of the procedure, in order to obtain a clear field of vision on one hand and to have optimal control of bleeding and total blood loss on the other.

From an oncological point of view, thoracoscopic pneumonectomy has been shown to be comparable to open surgery, with equivalent

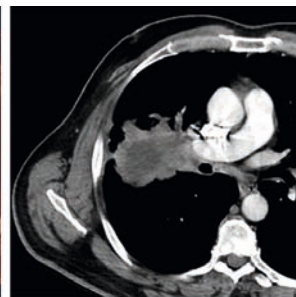
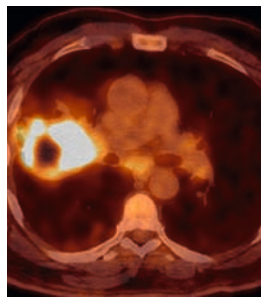


Figure 1. (Above) PET-CT (left) and contrast-enhanced CT-scan (right) show a central tumor with invasion of the right pulmonary artery (PA).

survival rates. Furthermore, the uniportal approach seems to result in less pain and a faster recovery compared to VATS with multiple access ports. It also allows easy

coverage of the bronchial stump if deemed necessary.

In our experience, division of the main pulmonary artery as a first step might be an important detail which



Post-operative view of the surgical skin incision (left) and chest X-ray (right).

may not only ease the course of the whole procedure, but also potentially improve patient recovery after surgery due to a minimisation of total blood loss.

Cardiac | Techno College | Aorta, Ablation and Assist Devices

Cooling catheter for spinal cord protection (animal trial only)

John ElefteriadesAortic Institute at
Yale-New Haven,
New Haven, CT,
USA

There are few moments in cardiac surgery so desperately saddening as when, after surgery on the thoracic or thoracoabdominal aorta, the surgeon asks the patient to move his toes, and the patient cannot. Incredulity (i.e. "this cannot be") gives way to despair (i.e. "how can I live like this?") for the patient, the surgeon, and the team. Little by little, the profound adverse impact of paraplegia overwhelms the patient, the family, the nurses, the surgeon, and the team.

Paraplegia in thoracic aortic surgery is the direct result of spinal cord ischemia of multiple mechanisms, including aortic clamping, interruption of key spinal arteries, and embolism of air or particles to the intercostal arteries.

Medical science has made great strides towards the prevention of paraplegia in thoracic and thoracoabdominal aortic surgery. Left atrial-femoral artery bypass, spinal



- Simple design
- User friendly
- Quick placement, <15 min
- Localized spinal hypothermia
- No more effort than conventional spinal drain

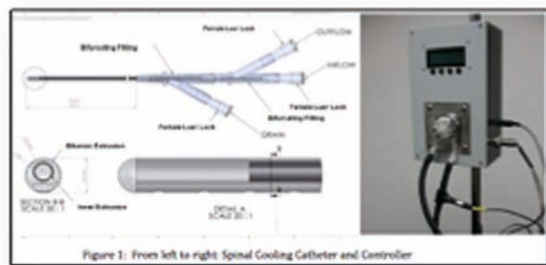


Figure 1. The Cooling Catheter system. Note: The cross-sectional profile of the catheter at the upper right of the figure; the construction details and controller at the lower left; and the location of the catheter running vertically up the spinal canal, shown at the lower right of the figure.

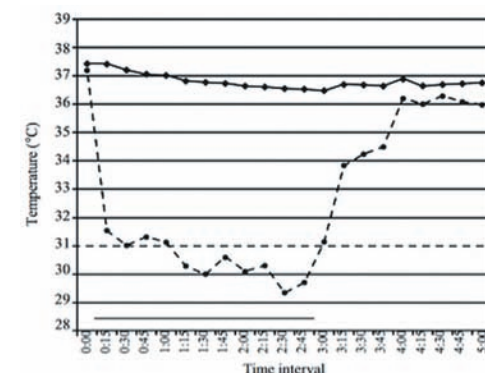
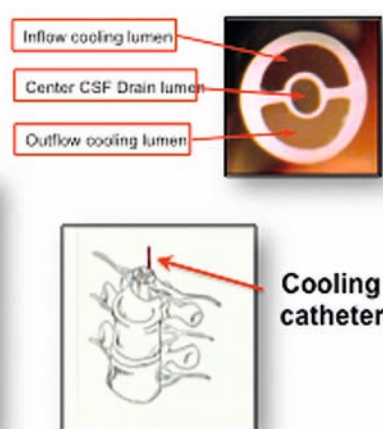


Figure 2. Note that deep hypothermia is achieved (dotted curve), all at systemic normothermia (solid curve). The line above the horizontal axis shows the duration that cooling is activated; cooling is rapidly achieved. Rewarming proceeds passively when the cooling system is turned off.

fluid drainage, intercostal artery reimplantation, and deliberate hypertension have all worked to decrease the likelihood of paraplegia. However, this devastating complication still occurs—in about 10% of open and 5% of endovascular procedures on extensive (Crawford types II and III) aneurysms. And, as the number of thoracic aortic procedures increases, with the dissemination of open and endovascular surgical expertise, the total number of post-operative paraplegia cases is increasing dramatically.

My team and I at Yale spin-off CoolSpine have developed and tested a novel spinal cord cooling device that takes direct aim at post-operative paraplegia.

Cooling is the best-known protectant for neurons, whether they are found in the brain or in the spinal cord. Even 0.5 to 1°C is substantially protective. However, prolonged systemic cooling has adverse effects, including shivering, sepsis, and bleeding. Topical cooling avoids these drawbacks of systemic hypothermia.

The Cooling Catheter

from CoolSpine takes a novel, yet simple approach to hypothermic protection of the spinal cord. Essentially all patients undergoing open (and most undergoing endovascular) procedures on the thoracic aorta have a spinal drain placed, to keep the spinal fluid pressure low and thus encourage blood flow to the spinal cord itself. The Cooling Catheter simply makes this obligatory spinal drain a cooling device as well. A closed system recirculates a cold refrigerant into and out of the spinal drain, which is passed far up toward the top of the thoracic spinal

canal. In essence, one achieves spinal cooling for "free", with no extra effort or invasiveness than a conventional spinal drain placement.

Animal experiments by the Yale team have confirmed that substantial cooling of the spinal cord is achieved—more than 4°C—all at systemic normothermia.

What's more, experiments done at other institutions have confirmed a dramatic beneficial impact on experimental paraplegia in animal models. Preparations are being made for human safety and efficacy trials.

It is anticipated that this novel, simple technology will "take another bite" out of the devastating problem of post-operative paraplegia, decreasing the frequency or severity with which paraplegia occurs.

Another iteration of the Cooling Catheter takes direct aim at protecting brain tissue from traumatic brain injury and stroke. The catheter is introduced percutaneously into the lateral ventricles of the brain—protecting injured brain tissue via local hypothermia—like having two durable ice cubes right in the centre of the brain.

Cardiac | Techno College | Aorta, Ablation and Assist Devices

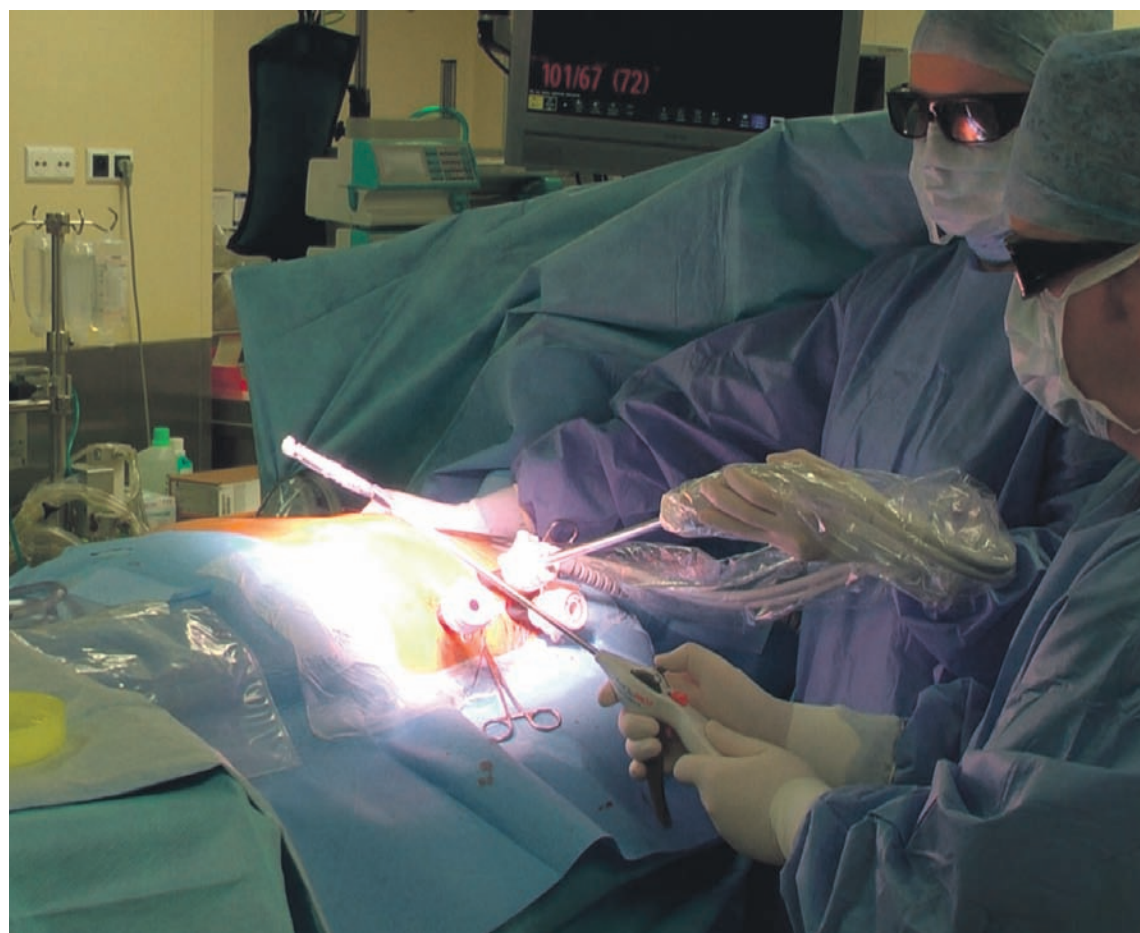
Totally thoracoscopic left atrial appendage exclusion concomitant to endoscopic atraumatic coronary bypass grafting (EACAB)

Piotr SuwalskiDepartment of Cardiac Surgery,
Central Clinical Hospital of the
Ministry of Interior, Warsaw, Poland

Atrial fibrillation (AF) is the most common clinically-relevant arrhythmia, and it is strongly associated with stroke – the most devastating complication. The most typical source of thrombotic material is the left atrial appendage (LAA). While oral anticoagulation remains the standard of care of the patients with AF, recent publications – and also ESC/EACTS Guidelines – indicate that, in patients who are contraindicated to oral anticoagulation, that LAA closure might be a non-inferior alternative.¹

As the frequency of both illnesses rises with the age, cardiology and cardiac surgery is facing the raising number of patients with coronary artery disease concomitant to AF, especially those who are elderly and fragile. They are often after or ahead of drug-eluting stent (DES) implantation, as hybrid therapy in this cohort seems to be a good approach. A significant hurdle, however, is the necessity of complex (especially so-called "triple") antithrombotic therapy, which is a huge, widely-discussed challenge leading patients to significant occurrences of major, often fatal, bleeding complications.¹

The system for LAA occlusion, AtriClip® (AtriCure, USA) has proven its efficacy with total closure of the LAA both in short- and long-term



observations, with zero complications over three years, followed by very low stroke occurrence even in high risk patients off oral anticoagulation.²

The AtriClip PRO2 is the latest thoracoscopic version of the system, one which is having its European premiere at this year's EACTS

Techno College. The device offers an interesting option for both stand-alone LAA closure, and as part of other minimally-invasive or thoracoscopic procedures. Compared to the previous model, a number of improvements – focusing mainly on the delivery system – have been introduced, such

as simplified release and withdrawal after implantation, an ambidextrous handle, and an articulation system which enables maneuvering with the end effector inside the chest using two levers built-in to the handle. It can also be inserted through a 12 mm chest port.

The procedure of totally

thoracoscopic LAA exclusion concomitant to endoscopic atraumatic coronary bypass grafting (EACAB) is performed on single right lung ventilation through three ports placed on the left chest wall. As the first step, using 3D augmented endoscopy, the left internal mammary artery (LIMA) is harvested thoracoscopically with the harmonic knife. Subsequently, using exactly the same ports, pericardiectomy is performed parallel to the phrenic nerve to visualise the LAA, and the occlusion is performed using the AtriClip PRO2 system. To optimise its sitting, the clip can be reopened and repositioned, and the final closure is confirmed with transoesophageal echocardiography. The last stage of the operation includes a 4 cm minithoracotomy and LIMA to LAD anastomosis, after which the patient can be extubated on the table.

Undoubtedly, new surgical systems enabling closure of the LAA significantly enrich the surgical armamentarium, offering high efficacy, relative simplicity, minimal invasiveness and – in combination with different procedures – can positively influence the final short- and long-term results.

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Thoracic | Focus Session | Lasers and cryotherapy in the airways

Lasers and cryotherapy in the airways

Franz Stanzel
Lung Clinic Hemer, Germany

The bronchoscopist is confronted today with an increasing number of patients suffering from centrally-located obstructions in lung cancer or metastatic disease, often in patients with life threatening symptoms. Immediate intervention is required, and in most cases there can be only palliative treatment. Rarely there is underlying benign disease or very early malignant disease. Then, bronchoscopic treatment can be curative too.

In the last 30 years the bronchoscopic techniques for tissue ablation have improved and changed. In interventional bronchoscopy, various tools for tissue ablation are used depending on the possibilities, the characteristics of the lesion (intraluminal, extraluminal, combination) and the preferences of the bronchoscopist. The standard procedure includes the coagulation of the intraluminal component, debulking with different tools, and additional stenting if needed.

For tumour desoblation, mechanical removal and different coagulation methods are available. The laser was the standard technique for many years, but is losing popularity. The laser is a very precise instrument. Advantageous is the combination of coagulation for haemostasis and vaporisation for tissue removal at the same time. In the 80s, the NDYAG laser was widespread, but nowadays diode lasers dominate, which are smaller, more comfortable, and less expensive. But safety issues for the risk of fire must be handled in every case of laser use, and it is comparatively time consuming if used alone. The procedure time can be reduced, if it is combined with mechanical debulking.

Electrocoagulation and argon plasma beamer are alternatives, leading to comparable results, but have different characteristics. Especially in polypoid lesions electrocautery with a snare can be much faster, to achieve airway patency. Recently cryorecanalisation as a form of cryotherapy became widely used, and

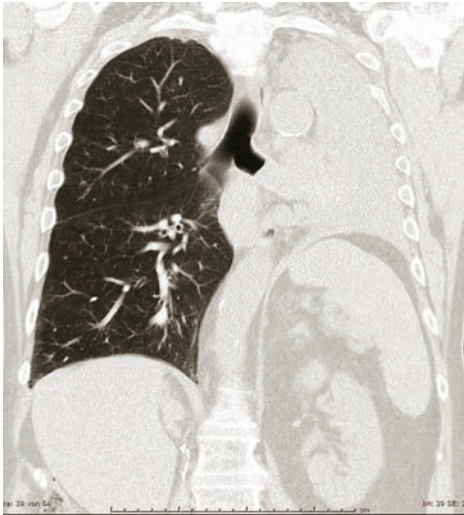


Figure 1. 77-year-old patient suffering from renal cancer with dyspnea. Obstructing mass in the left main stem

is very fast too. The probe is advanced to the intraluminal mass and frozen to it; the tip sticks to the mass and can be removed together with the bronchoscope. There is no fire risk, but the result is unpredictable, and bleeding can occur. Regardless of the tool used for removal of the intraluminal component and/or dilatation, a stent

Figure 2. Complete obstruction by an intraluminal mass in the left main stem bronchus. Histology shows metastasis from renal cell cancer

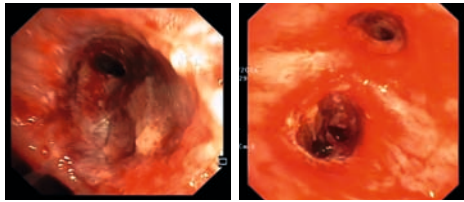


Figure 3. A & B: Different steps of laser ablation with partial and complete recanalisation of the left main stem, the upper lobe bronchus and the lower lobe bronchus

can be used for securing airway patency, if there is still compression.

The repertoire also includes brachytherapy, and photodynamic therapy if other characteristics are in the foreground. Brachytherapy is still an option if there is a more extrabronchial and diffuse component. Photodynamic therapy plays a role in therapy of early cancer. The principal includes the use of a sensitizer, given before therapeutical bronchoscopy, and the use of a red light diode laser. The laser induces a chemical reaction, leading to apoptosis and cancer cell death. But the disadvantage of week-long hypersensitivity of the skin can be overcome by new sensitizers such as Photolon, emerging in the early future.

We conclude that there are different methods available for interventional bronchoscopy. The laser plays still a role, but there are others that are popular too. Most important are the

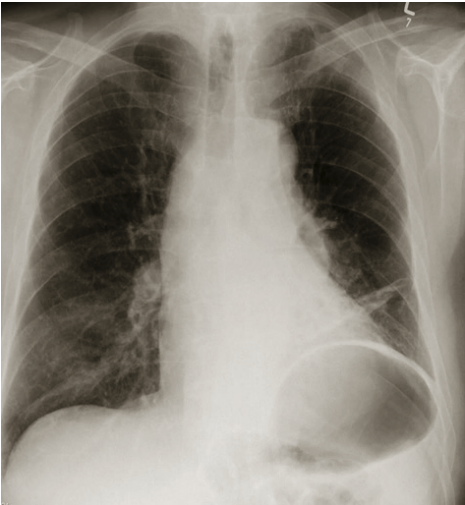
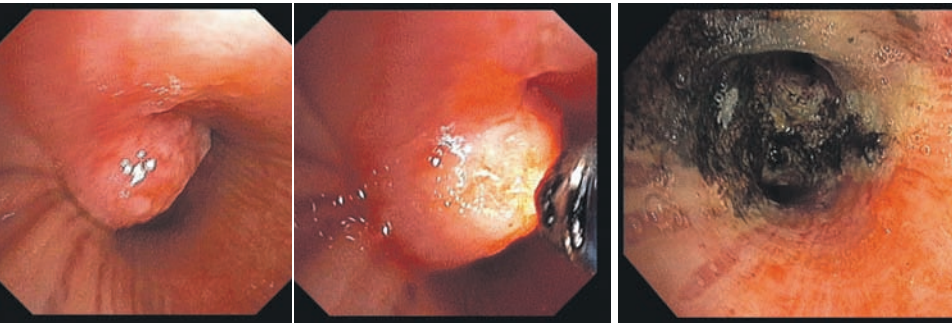


Figure 4. Documentation of elimination of atelectasis of the left lung. Patient's symptoms reduced to cough only

characteristics of the obstructing or intraluminal lesion to specify the ablation method. In addition, all the methods should be carried out in centres with a great experience, and can be performed alongside each other when required. Overall, with suitable lesions the success rate is high and the complication rate is very low.

Figure 5. Different steps of laser ablation. A) Obstructing mass in the left main stem bronchus. B) Laser coagulation as the first step. C) Carbonised wall of the distal left main stem with left upper lobe carina, open left upper and lower lobe bronchus. Complete recanalisation achieved



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

Tuberculous constrictive pericarditis mimicking an endomyocardial fibrosis (EMF) in an 18-year-old boy from rural Sierra Leone



Emily A. Farkas ThedaCare Appleton Heart Institute, Appleton, Wisconsin, USA

Access to advanced cardiovascular care is very limited in sub-Saharan Africa due to a paucity of established programs, prioritisation toward resource-intensive communicable disease management, and chronic equipment / technological / personnel shortages. Specifically in West Africa, there is one cardiac surgeon per

26.5 million people. By comparison, in China there is one cardiac surgeon per 0.208 million (208,333) and in Germany there is one cardiac surgeon per 0.087 million (87,723) people.¹

The consequences can be particularly devastating in areas such as rural Sierra Leone, where a 16-year-old boy originally presented to a local physician with several weeks of dyspnoea, tachycardia, and signs of congestive failure. Echocardiogram revealed a pericardial effusion with haemodynamic compromise, and although pericardiocentesis initially offered some relief, symptoms progressed over two years to the point where he could no longer attend school or participate in any normal activities.

Because no cardiac surgery is available anywhere in the country, various diplomatic communications successfully resulted in transfer by Sierra Leone's Ministry of Health, with the assistance of the Pan-African Society for Cardiothoracic Surgery, to Komfe-Anokye Teaching Hospital in Kumasi, Ghana. In this University setting, the charitable organisation CardioStart International was already conducting a humanitarian mission to develop the region's cardiovascular program. Evaluation and treatment involved distinguishing EMF from tuberculous pericarditis with only limited investigative tools, uncertain outcome, and the potential for high expense to the host centre.

In the context of current preoccupation with



16-year-old boy from Sierra Leone six months prior to cardiac surgery in Ghana (left) and six months after surgery (right), returning to school for the first time in 2 years with aspirations to become a doctor from his own personal experience.

Ebola and Human Immunodeficiency Virus in many parts of Sub-Saharan Africa, this medical collaborative effort, taken at some risk, illustrates the value of persistence in overcoming logistical obstacles across borders. A favourable outcome was achieved against unlikely odds, connecting two regions with acute and chronic specialist

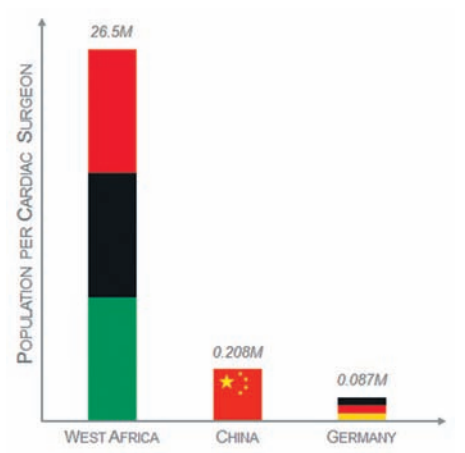


Figure 1: Population in million per cardiac surgeon. West Africa = 1 cardiac surgeon per 26.5 million people; China = 1 cardiac surgeon per 0.208 million (208,333 people); Germany = 1 cardiac surgeon per 0.087 million (87,723 people).

Adapted with permission from: Yankah et al. Cardiac surgery capacity in sub-saharan Africa: quo vadis? Thorac Cardiovasc Surg. 2014 Aug;62(5):393-401

healthcare deprivation, and providing a template to assist future improvements in medical standards assurance for resource-limited areas.

Vascular | Abstract Session | Defining good outcomes after aortic root surgery

Understanding brain protection during aortic arch surgery – the International Aortic Arch Surgery Study Group

David Tian Macquarie Park, NSW, Australia
On behalf of the International Aortic Arch Surgery Study Group (IAASSG)

Surgical management of aortic arch pathologies have evolved significantly over the past four decades. In more recent years, databases such as the International Registry for Aortic Dissection (IRAD), the IRAD Interventional Cohort (IRAD-IVC), and the German Registry for Acute Aortic Dissections (GERAADA), have evolved our understanding of aortic disease's pathological progression and prognostic outcomes.

However, these studies are either limited by their size (e.g. single-centre studies), or their inclusion criteria (e.g. only dissections). The current consensus on operative strategies, particularly for brain protection, rests on a collection of institutional series which are difficult to pool in meta-analyses due to heterogeneities in the underlying patient populations.

The International Aortic Arch Surgery Study Group (IAASSG) was founded in 2013 by a collaboration of 37 hospitals in 12 countries. Recognising the lack of surgically-orientated database on aortic arch pathologies at the time, the IAASSG created the ARCH Multi-

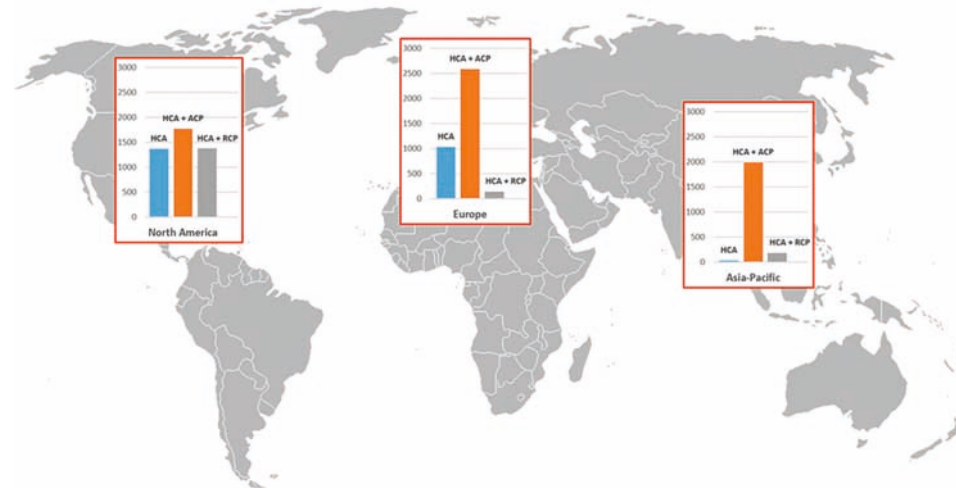


Figure 1. Brain protection strategies for aortic arch surgery in the ARCH Multi-Institutional Database. HCA, hypothermic circulatory arrest; ACP, antegrade cerebral perfusion; RCP, retrograde cerebral perfusion

Institutional Database, which to date consists of over 13,000 aortic arch cases conducted over the past 15 years. Each hospital submitted its own patient series during this time, which was carefully matched and amalgamated together. The Database aims to focus on surgical parameters and outcomes for aortic arch surgery, with derived results directing the next

phase of research in this domain.

Several trends have been evident in the Database, and are reflective of the evolving nature of aortic arch surgery. Recognising the fact that results are only reflective of the participating centres, we are seeing improved patient outcomes, in terms of both mortality and neurological morbidities. Neuroprotection

strategies continue to evolve as well; the vast majority of patients undergoing arch surgery with hypothermic circulatory arrest (HCA) with antegrade cerebral perfusion (ACP), while retrograde cerebral perfusion (RCP) is only used in a handful of centres (Figure 1). A trend towards warmer circulatory arrest temperatures also exist, particularly for HCA+ACP cohorts.

Numerous projects are currently underway to investigate the Database, with some surprising findings which will be presented and published at upcoming conferences and journal issues. These projects include assessing the benefit of deep versus moderate hypothermia during circulatory arrest, hemiarch versus total arch replacement for acute aortic dissection, unilateral versus bilateral ACP in elective surgeries, with more proposals under consideration.

Further collaborative projects between the IAASSG centres are also under discussion. We foresee several key areas of collaboration, including standardisation of key clinical variables (similar to VARC endpoints), uniform prospective data collection to enable robust and rigorous statistical analysis, and fostering development of novel avenues of research. Such research will help evolve management strategies and improve outcomes for all patients.

Vascular | Rapid Response | Type A Aortic dissection from research to clinical application

Aortic valve pathology as a predictive factor for acute aortic dissection: Numerical analysis of ascending aorta and aortic arch haemodynamics



Denis Berdajs Department of Cardiac Surgery, University Hospital Basel, Switzerland / Department of Surgery and Anesthesiology, Cardiovascular Research, University Hospital Lausanne, Switzerland

Acute aortic syndrome is a broad clinical picture, including acute type A and/or B aortic dissection, development of aortic wall haematoma and rupture of the atherosclerotic plaque. In acute dissection, intimal integrity disruption provides a path for blood flow between the aortic wall layers. The aortic haematoma may be a consequence of plaque or vasa vasorum rupture. Although numerous clinical factors were brought in for association of the mentioned events, the exact mechanism responsible for the interruption of the aortic wall integrity was not known until now. In the past it was postulated that local haemodynamic conditions such as shear stress profile, flow characteristics and pressure were associated with onset of type A and/or B aortic dissection. The low shear stress, combined with turbulent flow (or flow oscillation) is associated with vascular wall inflammation

and generation of arteriosclerotic plaques. Low shear stress, per se, promotes core necrosis and rupture of the stable plaque and as such may be considered as one of the most important haemodynamic elements responsible for plaque rupture and consequent acute aortic dissection.

In an experimental setup we examined the impact of the aortic valve pathology on local haemodynamic conditions that may be identified as trigger elements for acute aortic events. For this purpose, time pressure and a geometry-related, 4-D computed fluid dynamics model of the aorta was established. Under experimental conditions, in aortic valve stenosis and insufficiency, a

4-D cardiac cycle related high fidelity aortic root geometry, and pressure and flow were obtained. The *in vivo* measured parameters were used to obtain 4-D pressure and flow-related computed fluid dynamic simulations in the thoracic aorta under aortic valve stenosis and insufficiency, in order to simulate pressure, velocity and shear stress profiles from the aortic root up to the descending thoracic aorta.

In 4-D computed fluid dynamic simulations of aortic valve stenosis and insufficiency, objective relations between the local haemodynamic conditions and of the onset of acute aortic dissection were established. In aortic valve insufficiency, at the regions corresponding to those

traditionally identified as rupture entries of the arteriosclerotic plaques in type A and/or B dissection following haemodynamic alterations, we found: low shear stresses accompanied with large blood flow velocity oscillations, such as the high flow values at peak ejection and flow stagnation, or even reverse flow at diastole, were localised at the ascending aorta, at the lesser curvature of the aortic arch and in front of cervical vessel bifurcation (Figure 1). Additionally, looking at the low shear stress and rapid velocity alterations, the lateral wall of the ascending aorta was exposed to the elevated wall pressure. In this constellation, the elevated pressure may be considered as a key trigger element for acute

plaque wall disruption and consequent acute aortic dissection at the ascending aorta.

In simulating the conditions of aortic valve stenosis, there was a net presence of high shear stress with elevated pressure at the sinotubular junction, at the ascending aorta and at the ostium of both cervical arteries. The elevated shear stress in combination with high pressure may be considered as trigger element for vessel dilatation, aneurysm formation and direct intimal tear typically for type A aortic dissection.

This recent simulation could strongly contribute to better understanding of the development of acute aortic events.

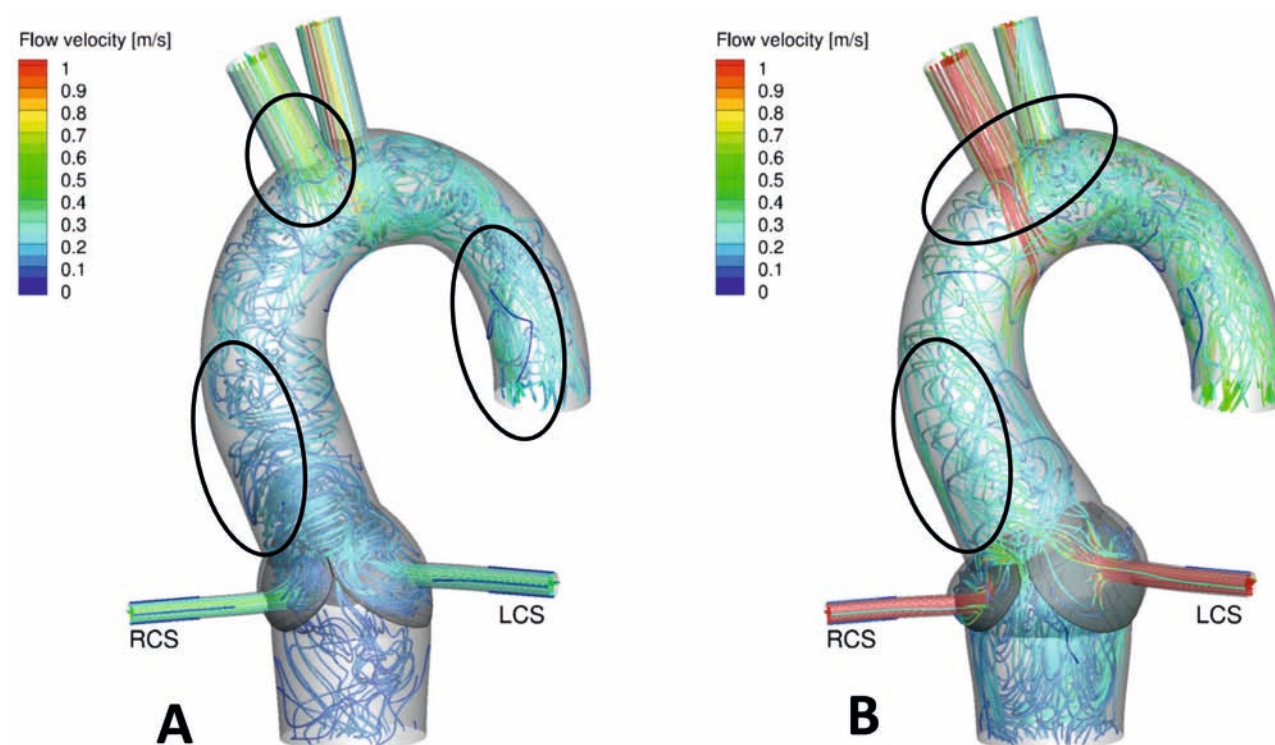


Figure 1. Schematic with indication of presumed levels of entry tears for acute aortic dissection in aortic valve insufficiency (A) and in aortic valve stenosis (B). The high-risk areas are identified as follows: in aortic valve insufficiency at the ascending aorta, at the aortic arch curvature and at the aortic isthmus. In aortic valve stenosis they are at the ascending aorta and at bifurcation of cervical arteries

Vascular | Abstract Session | Defining good outcomes after aortic root surgery

Biological versus mechanical Bentall procedure for aortic root replacement: a propensity-score analysis of 1,112 patients

Davide Pacini, Giacomo Murana, Luca Di Marco, Leone Alessandro, Roberto Di Bartolomeo University of Bologna, Sant'Orsola-Malpighi Hospital, Bologna, Italy

The Bentall procedure is the treatment of choice for many patients with proximal ascending aorta disease requiring surgery.¹⁻³ Sometimes it can be difficult to choose between a biological (BB) or mechanical (MB) valve conduit because of clinical conditions and root anatomy.⁴ Starting from the idea that both types of prosthesis are inclined to have known limitations (life-long anticoagulation for the MB and structural valve deterioration for the BB), we tried to compare the two composite valve graft options in terms of early and late postoperative mortality and morbidities. From our single centre experience (beginning in 1978), the study population was divided into two groups: Bio-Bentall (n=356), and Mechanical-Bentall (n=756). With the aid of the propensity score analysis, we obtained two homogeneous groups for comparison (138 BB vs 177 MB). After adjusting the preoperative variables, a similar mean age of 65 and 66 years old for the MB and the BB patients was respectively observed. Early outcomes showed similar rates of in-hospital mortality and no differences in terms of acute myocardial infarction, neurologic damage (TIA, stroke, and paraplegia) and postoperative renal failure. However, the most interesting findings between the biological and mechanical grafts were observed at follow-up because they continued to show similar results. Cumulative survival at five years was 76.5±3.9 % in the MB group and 82.1±3.7 % in the



From left to right: Giacomo Murana, Alessandro Leone, Davide Pacini and Luca Di Marco

BB group (log-rank p=0.7). Freedom from haemorrhagic, thromboembolic, and cerebral embolism events, as well as endocarditis, were also statistically comparable between groups. Finally, freedom from proximal aortic reoperation at 10-years was also very similar (95.3±3.4 % for MB, versus 93±3.2 % for BB group; Figure 1). Multivariate Cox-regression analysis indicated that among all risk factors, including the use of bio-prosthesis conduit, infective endocarditis was the only independent predictor for proximal aortic redo (OR: 30.9; p=0.006)

As a result of this study, we can conclude that there is no specific advantage of either graft choice. However, we have identified some interesting features. Firstly, no matter which kind of prosthesis is used, the Bentall procedure provides a standardised method to safely replace the aortic root in different aortic pathologies. Secondly, it is reasonable to offer patients of 65 years either a MB or a BB procedure, inasmuch as valve-related complications and need for reoperation are relatively low and comparable. Thirdly, mechanical valve root replacement could

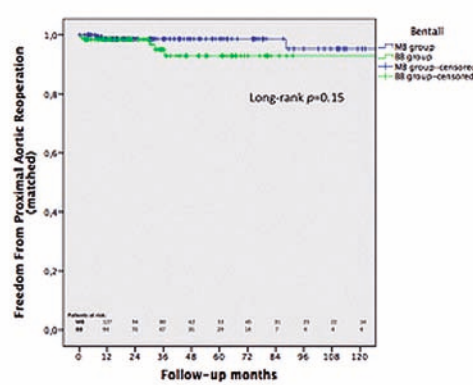


Figure 1. Freedom from aortic root redo in the matched population

guarantee a long-life treatment with a low incidence of thromboembolic complications after hospital discharge. In conclusion, despite our comparable mid-term results a longer follow-up is warranted to further validate structural valve deterioration and valve-related events, in order to optimize the graft selection for each patient.

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



Surgical Procedures

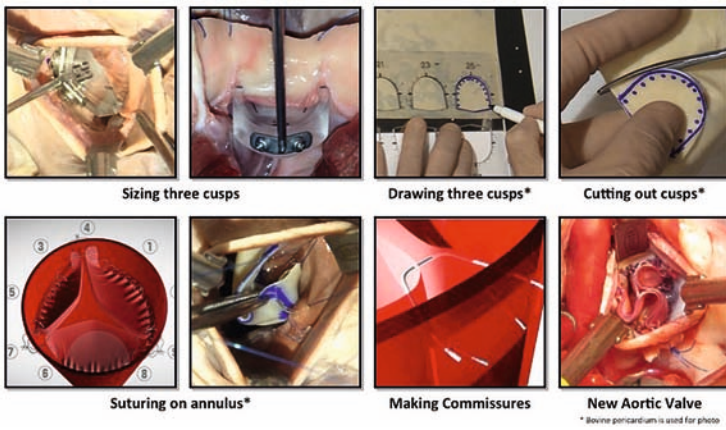
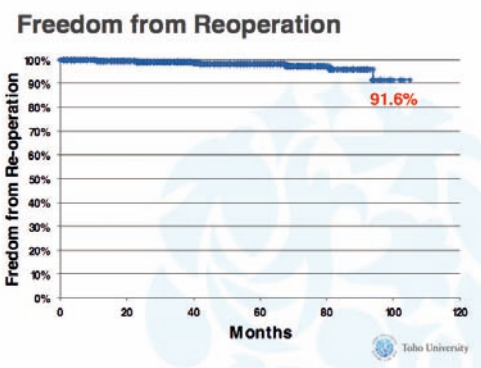


Figure 1: Surgical procedures



Overall Survival

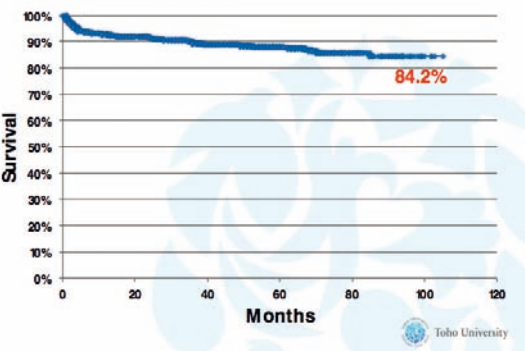


Figure 2: Freedom from Reoperation & Overall Survival

By Prof. Shigeyuki Ozaki
September 2016

The Ozaki Aortic Valve Neo-Cuspidization (AVNeo) procedure using autologous pericardium is a novel and innovative surgical procedure for any aortic valve disease, regardless of the age of the patient or the size of annulus. By suturing three meticulously designed pericardium cusps onto the annulus, this surgery can treat both adult and pediatric patients with aortic stenosis, with or without endocarditis. What makes the Ozaki AVNeo procedure different from others are the following:

1. Measurement of the distances between commissures, not the annular diameter
2. Suturing the cusps directly onto the annulus
3. Raising the contact point of the cusps to the commissural level (Figure 1)

By designing new cusps from intercommissural distances, it is possible to design cusps uniquely, regardless of the height

of the commissures from the base of the annulus. Suturing these cusps directly onto the annulus enables the annulus to move naturally, preserving natural hemodynamics. Reduced mechanical stress to the cusps facilitates the reduction of calcification and postoperative pressure gradients. By raising the contact point, the new cusps make the new coaptation zone longer than the native valve. The elongated coaptation zone warrants the minimised postoperative aortic insufficiency. Anticoagulation is not necessary, as there is no stent or prosthesis left in the circulation system. We have performed the Ozaki AVNeo procedure in more than 900 patients over the past 9 years. Other surgical teams in Japan and overseas have already performed as many as 1000 cases. The overall outcome of this procedure is remarkable, as shown in Figure 2. The rate of freedom from reoperation reached 91.6% for the 850 cases, where the longest follow up was 105 months. In addition, there are several reports that demonstrate better hemodynamics after AVNeo, as compared to conventional prosthetic valves. The Ozaki AVNeo procedure is very promising, not only for

adults, but also for pediatric and congenital patients. Major pediatric centers have incorporated the Ozaki AVNeo procedure into their programs, with the youngest patient at 23 months old. Although mid to long term outcomes in pediatric surgery are not yet clear, the Ozaki AVNeo procedure may be a good substitute for the Ross procedure or other aortic valve repairs, where long term outcomes are not always satisfactory. Cost efficiency is another appealing feature of this procedure. The in-hospital cost of the Ozaki procedure reduced conventional AVR costs per case. Costs are further reduced when unnecessary anticoagulation therapy is taken into account. Reproducibility is particularly important in any surgical technique, therefore we have developed a set of proprietary sizing devices; The Ozaki VRec Sizer™. This device is now registered and marketed as a medical device in the US, Japan, Europe, China and South Korea by JOMDD, Inc. (Tokyo, Japan). Appropriate training for the Ozaki procedure is necessary and available. The Ozaki AVNeo procedure may shift the paradigm of treatment for aortic valve diseases in the near future.

Thoracic | Focus Session | Surgery for advanced infectious disease

Is there a role for thoracostoma fenestrations and thoracoplasty?

Rajan SantoshamSantosham Chest Hospital,
Chennai, India**Introduction**

Open thoracostomy is the creation of an open window for the drainage of complicated chronic empyema. It is suited to patients with post-pneumectomy empyema and bronchopleural fistula who are unfit for major surgical intervention. A portion of the chest wall with ribs is removed and the skin is stitched to the underlying pleura, resulting in control of sepsis. This may be the singular option for patients who will not withstand other procedures, and closure of fistula may be possible if it is small. This method has saved lives in difficult situations. Occasionally this is a permanent procedure, or a staged procedure for further intervention. With daily dressing, without necessary

hospitalization, control of sepsis and improved ventilation are achieved.

In contrast, thoracoplasty is the resection of short segments of ribs in order to enable adequate collapse of the chest wall and closure of the infected pleural space or collapsed cavities. In such a scenario, the main indications of thoracoplasty are: (1) the treatment of cavitary MDR and XDR tuberculosis, unsuitable for resection because of endobronchial disease and patients not fit for major resection; and (2) post-resection empyema to collapse the residual space.

Objectives

A comprehensively trained thoracic surgeon should be familiar with the technique of thoracostomy and thoracoplasty, the latter possibly being the preferred option in very difficult situation. We reviewed the results and complications of thoracoplasty, as well as some cases of thoracostomy,

carried out in our institute.

Results

1,542 patients who underwent thoracoplasty over a period of 52 years between the years 1964 and 2016 were reviewed. At its beginnings thoracoplasty was performed under local anesthesia, as there was no double lumen tube; as such, cough reflex had to be preserved and spillover avoided. 356 of our cases were performed under local anesthesia during the early period till 1976.

Where there is an underlying functional lung, thoracoplasty should be performed in two stages, since removing more than five ribs at each stage can lead to paradoxical respiration. Because most of the TB cavities were located in the apicoposterior segment of the upper lobe and the superior segment of the lower lobe, costotransversectomy and apicolysis gave the best collapse.



Figure 5. Open window thoracostomy, with bronchoscopic light through the fistula



Figure 1. Thoracoplasty and collapse of the chest wall with apicolysis

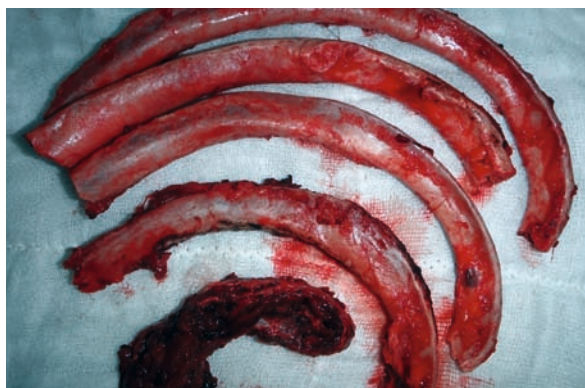


Figure 2. Resected ribs

Seven hundred and five cases were performed in two stages, the main indication being cavitary tuberculosis. 837 cases were performed in a single stage, for empyema and bronchopleural fistula. The immediate post-operative survival rate was 95%. There were 16 deaths (1%). Thoracoplasty procedures failed in 32 patients (2.0%). Second surgeries were necessary in six patients (0.4%); completion pneumonectomy was carried out in six patients (0.3%). 15 patients (0.9%) developed pulmonary hypertension during follow-up. Few cases of thoracostomy were done, but outcomes were favorable.

Conclusion

Thoracostomy and thoracoplasty are salvage procedures that have stood the test of time, still proving useful in indications such as those detailed here. Careful case selection is absolutely necessary in determining which patients would benefit from open window thoracostomy, and which directly require thoracoplasty. However, timing, appropriate staging, and anatomical understanding of thoracoplasty are important in achieving the goal of adequate obliteration of space and resolution of empyema, and healing of tubercular cavity.



Figure 3. Post-pneumectomy empyema

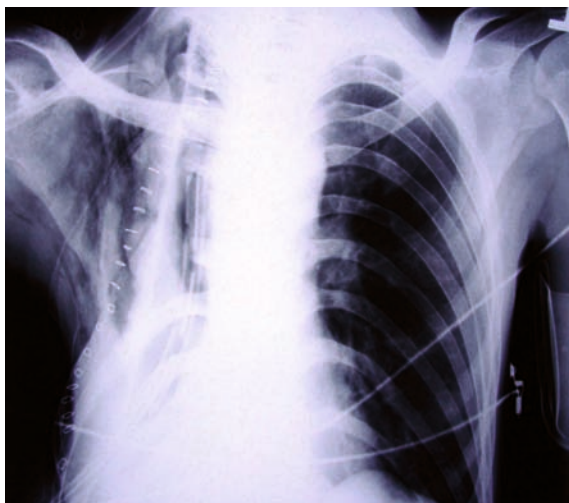


Figure 4. Post-thoracoplasty (immediately post-op)

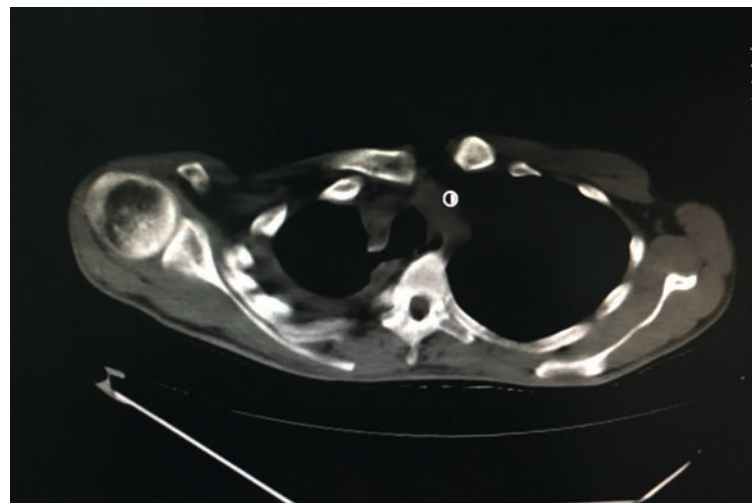


Figure 6. CT scan demonstrating the bronchopleural fistula

E Edwards Lifesciences

MIAVR Patients Benefit From Enhanced After-Surgery Recovery!

Dr Pierre OSES Hôpital
du Haut-Lévêque, Pessac,
Bordeaux, France

MIAVR is becoming more and more common. Less bleeding, better respiratory recovery and less pain are just some of MIAVR's benefits, however perioperative medicine has not evolved at the same pace. The literature offers few examples of "Enhanced After-Surgery recovery" (ERAS) for MIS patients and we believe it is crucial to establish ERAS recommendations to



maximize its benefits.
A dedicated ERAS MIAVR
team (Dr Oses P. and Dr

Zaouter C.) included 56 patients in an ERAS program from 06/2015 to 06/2016.

This program starts prior to surgery when patients meet with a trained nurse, a physiotherapist and a nutritionist; on top of a dedicated clinical assessment, patients watch a video which informs them about their pathway during and after surgery. This establishes trust and brings "anxiolytic" benefits for the patients. Our premedication is based on analgesics, and any benzodiazepine is avoided.

We perform a J-shaped UHS

at the 4th intercostal space; both the arterial and venous cannulation are carried out centrally. For all MIAVRs, rapid deployment valves (Edwards INTUITY Elite) are used to make MIAVR easier and reproducible while reducing procedural times.

At the end of the procedure, local infiltration of lidocaine mitigates pain for 6-8 hours; 2 small drainage tubes are passed from the upper part of the incision to limit discomfort. Finally, we protect the incision using skin glue (Dermabond® Ethicon) instead of adhesive bandage as it brings better

psychological acceptance and thus allows earlier mobilization, and reduced risk of nosocomial infections. Our target is to extubate all patients within 1 hour after surgery.

We have an aggressive early mobilization strategy: patients have to be in a chair after 4 hours (instead of 36 hours). Feeding starts from the 6th hour. An ambulation walking test and incentive spirometer exercises are introduced on the first day. The urinary catheter and central venous line are removed, as well. Our median LOS is 5.5 days

(instead of 8.8 days).

The ERAS pathway benefits from MIAVR with rapid deployment valves as they mitigate some of the risk factors responsible for ERAS failure. Our experience with ERAS MIAVR with Edwards INTUITY Elite was associated with improved clinical and post-discharge outcomes, which resulted in lower overall costs (-2200 euros) than FS AVR or MIAVR alone. As a next step, we are aiming to avoid ICU stays for ERAS MIAVR patients, thus reducing our hospital resources utilization further.



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Cardiac | Abstract Session | Extra corporeal circulation/Left ventricular assist device/ Transplantation 2

Mobile extracorporeal life support: on the verge of playing a fundamental role in emergency care medicine?

Hug Aubin*, Alexander Albert and Artur Lichtenberg

Department of Cardiovascular Surgery, Heinrich-Heine University, Düsseldorf, Germany

*hug.aubin@med.uni-duesseldorf.de



Miniaturisation of extracorporeal membrane oxygenation (ECMO) systems and integration into mobile devices has ushered mobile ECMO therapy into the realm emergency care medicine. Today, veno-arterial ECMO (vaECMO) – also referred to as extracorporeal life support (ECLS) – is no longer restricted to selected tertiary care centres. Remote initiation of vaECMO offers the possibility to provide mobile advanced mechanical circulatory support to out-of-centre

patients presenting with refractory circulatory failure due to shock or cardiac arrest which is non-manageable on-site. This enables us to temporarily restore and secure vital haemodynamics in order to transport the patient to a core facility, where mechanical circulatory assistance can be maintained until completion of diagnostics, implementation of specialised therapy or full recovery from underlying pathology.

Due to recent approaches trying to provide systematic mobile ECLS support and comprehensive follow-up therapy on a regional scale, mobile ECLS networks are now increasingly in the spotlight. In our study “Outcome of mobile extracorporeal life support for out-of-centre circulatory failure in 160 consecutive patients”, we provide an update on patient outcome of the previously introduced Düsseldorf ECLS Network (Aubin, JACC: Heart Failure 2016) – a supra-institutional ECLS network

(20 currently participating centres covering an area of about 800,000 inhabitants), reporting on 160 patients consecutively treated with mobile vaECMO rescue therapy for out-of-centre refractory circulatory failure. Our study, as well as outcome data from similar programs, illustrates that systematic mobile ECLS rescue therapy for refractory circulatory failure can be provided on regional scale with an encouraging outcome for a patient population otherwise doomed with a fatal prognosis (Figure 1). Therefore, with further propagation and improved outcomes, mobile ECMO therapy may soon play a fundamental role in emergency care medicine.

Nonetheless, a lot of unanswered questions still remain unsolved. Institutional standards required to provide out-of-centre ECLS emergency support on a regional scale are still poorly defined. Management of ECMO therapy

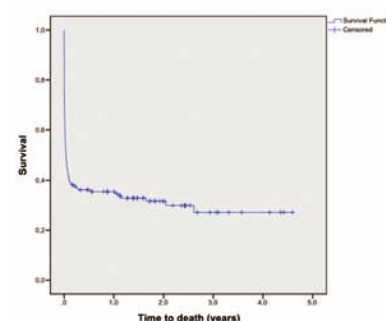


Figure 1. Kaplan-Meier-Survival curves of patients treated with vaECMO for refractory circulatory failure within the Düsseldorf ECLS Network. Kaplan-Meier-Survival with patient number at risk after follow-up of complete study cohort.

is challenging, with procedural complications severely decreasing survival if not handled properly. Also, there is still a lack of adequate patient selection criteria correlating to long-term survival as well as

early outcome parameters reflecting on therapy success or futility after initiation of vaECMO rescue therapy. Another important aspect that we all should bear in mind are the implied costs of ECMO support. The estimated cost of ECMO therapy in the United States exceeds 300,000 USD per case, the median costs within the setting of the Düsseldorf ECLS Network averages to 50,000-60,000 EUR per patient, when considering solely the reimbursement from the health care providers through the German Diagnosis Related Groups. However, total costs, e.g. including constant availability of specialised personnel and equipment, will presumably amount to much more. Hence, socioeconomic implications with regards to detailed cost-benefit-analyses need to be discussed between all stakeholders, while it lies in our hands to contribute to existing emergency care concepts.

Congenital | Abstract Session | Congenital miscellaneous 2

Midterm outcomes in unbalanced atrio ventricular septal defect

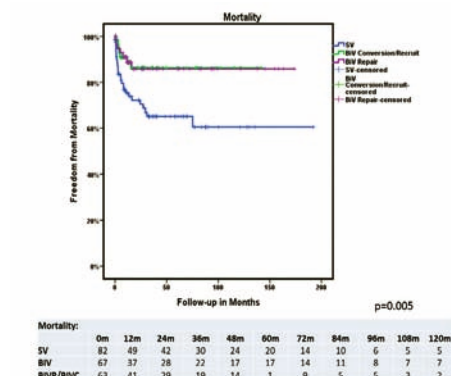
Successful biventricular conversion from single ventricle palliation

Meena Nathan^{1*}, Sitaram Emani¹, Rinske Ijsselhof¹, Hua Liu¹, Kimberlee Gauvreau² and Pedro del Nido¹ Department of (1) Cardiac Surgery and (2) Cardiology, Boston Children's Hospital, Harvard Medical School, Boston, MA, USA

*meena.nathan@cardio.chboston.org

Unbalanced common atrioventricular defects (UCAVSD) represent between 10-25% of all atrio ventricular septal defects. Management strategy for UCAVSD includes single ventricle (SV) palliation and primary or staged biventricular (BiV) repair. More recently, biventricular conversion (BiVC) from single ventricle palliation, and staged BiV recruitment (BiVR), have also been advocated.

We sought to assess midterm outcomes in UCAVSD grouped according to management



strategy. Consecutive UCAVSD patients undergoing surgery at our centre between January 2000 and February 2016 were included in this study. Index surgery was defined as first palliation procedure in the SV group, biventricular repair in the BiV group, and conversion or first surgery for recruitment in the BiVC/R group. Mortality was defined as death any time after

index surgery. Reinterventions (RI) included any unplanned reintervention (surgical or catheter based) that occurred after index surgery. Planned staged procedures were not included as reinterventions. Demographic, clinical, imaging and follow-up data were collected, with all follow-up being from date of index surgery. While all index surgery occurred at our centre, initial palliation for the BiVC/R group may have occurred at an outside institution. Kaplan Meier and Cox Regression was used for time-to-event analysis of mortality and unplanned reinterventions (RI) that occurred after index surgery.

There were 212 subjects: 82 (38.7%) SV; 67 (31.6%) BiV; 63 (29.7%) BiVC/R; and 50 subjects had undergone successful BiVC. There were 93 (43.9%) males, 51 (24%) with Down syndrome, 101 (48%) with heterotaxy, 51 (24%) with pulmonary vein disease, 57 (26.9%) with additional complex cardiac anomalies, and 148 (69.8%) with R dominance. For the entire cohort there were 40 (18.9%) deaths, 110 (51.9%) reinterventions, 82

(38.7%) surgical RI, 70 (33%) catheter RI, with some subjects having more than one RI. Median length of follow up was 35 months (range 1-192). The BiVC/R group had a similar survival benefit as the primary BiV repair group when compared to the SV group. The BiV repair group had a lower need for catheter based reinterventions compared to the SV and BiVC/R group.

Biventricular conversion or recruitment from a single ventricle pathway can be achieved with acceptable mortality and morbidity. This strategy may be particularly important in high-risk groups, such as patients with trisomy 21 and heterotaxy who tolerate single ventricle palliation poorly. Early establishment of adequate inflow and outflow may be key in allowing ventricular growth and normalisation of the compliance of the hypoplastic ventricular chamber with the resulting ability to sustain a biventricular circulation. Staged recruitment and conversion allows recruitment of the hypoplastic ventricles as early as the neonatal period.

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

CATS hybrid approach for pulmonary nodules

Eric Roessner
University Medical Centre Mannheim, Germany



Introduction

Minimally-invasive resection of small, deep intrapulmonary lesions can be challenging due to the difficulty of localising them during video-assisted thoracic surgery (VATS). We report our preliminary results evaluating the feasibility of intraoperative marking wire placement using a cone-beam computed tomography (CBCT) system in a hybrid operating theatre.

Methods

Fifteen patients (5 male, 10 female, mean age 63 years) with solitary, deep intrapulmonary nodules of unknown malignant status were identified for

intraoperative wire marking. Patients were placed on the operating table for resection by VATS. A marking wire was placed within the lesion under 3D laser and fluoroscopic guidance using the CBCT system (Artis zeego, Siemens Healthcare GmbH, Germany). Then wedge resection by VATS was performed in the same setting without repositioning the patient.

Results

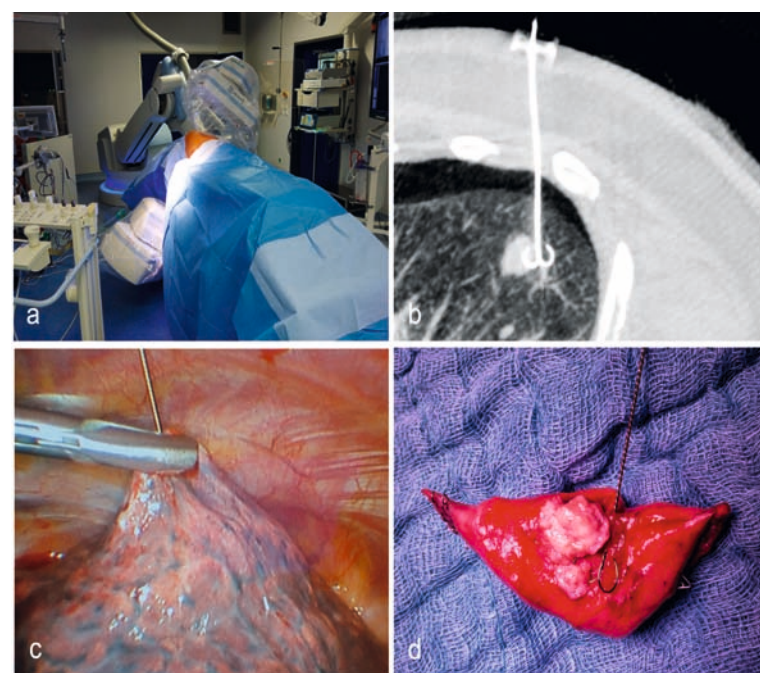
Complete resection with adequate safety margins was confirmed for all lesions. Marking wire placement facilitated resection in 15 out of 16 lesions. 11 lesions proved to be malignant, either primary or secondary, and 5 were benign. Mean lesion size was 7.5 mm; mean distance to the pleural surface was 15.9 mm (mean lesion depth/diameter ratio 2.3). Mean procedural time for marking wire

placement was 35 minutes; mean VATS duration was 36 minutes.

Conclusions

CATS is a new, safe, and effective procedure for minimal invasive resection of small, deeply localised intrapulmonary lesions. The benefits of CATS are: 1) one-stop-shop procedure; 2) lower risk for the patient (no patient relocation, no marking wire loss), and; 3) no need to coordinate scheduling between CT and operating theatre.

Figure 1. CBCT guided guide wire placement prior resection by VATS. A) Setting in the hybrid OR. B) Guide wire placed in the pulmonary lesion. C) Intraoperative view during VATS with the protruding guide wire. D) Resected lung specimen with guide wire in situ



Vascular | Rapid Response | Type A Aortic dissection from research to clinical application

The impact of more aggressive aortic surgery in acute aortic dissection type A

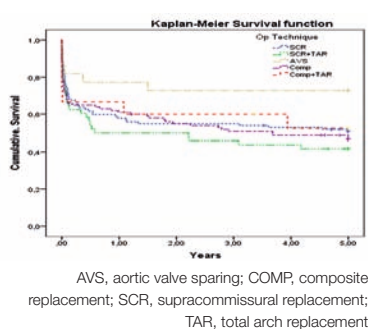
Dib B¹, Seppelt PC², Arif R¹, Weymann A³, Ruhparwar A¹, Karck M¹ and Kallenbach K⁴
1. University Hospital Heidelberg, Department of Cardiac Surgery, Heidelberg, Germany. 2. University Hospital Frankfurt, Department of Cardiology, Frankfurt, Germany. 3. Hospital Oldenburg, Department of Cardiac Surgery, Oldenburg, Germany. 4. INCCI HaerzZenter, Department of Cardiac Surgery, Luxembourg, Luxembourg

Although the surgical outcomes of acute aortic dissection type A (AADA) have significantly improved during recent decades, there has been a lack of standardisation in repair techniques. Moreover, the surgical strategy still mostly depends on a surgeon's preferences and experience. Thus, the surgical therapy for AADA remains controversial,

and the question whether to follow a conservative approach with aortic supracommissural replacement (SCR) or to perform more extensive aortic repair is still open. AADA is a life-threatening event, and surgery aims first of all to save the patient's life. Beyond that, surgery should also treat the acute complications of the dissection and prevent or at least minimise further risks such as early and late aortic dissection complications, e.g. downstream aneurysm formation. Today, surgical approaches for AADA repair range from SCR to complete thoracic aortic replacement. While SCR is technically the simplest and the fastest surgical strategy for AADA repair, many reports mention higher rates of late complications, with increased need for re-interventions. On the contrary, more extended surgery such as aortic root replacement and total aortic replacement (with or

without descending aorta stenting) have proved to be safe, in addition to reduce late complications and the need for re-interventions, but with significant prolongation in operation times. It is obvious that the proper surgical approach for AADA-repair is still evolving and remains uncertain. The main goal of the present study was to analyse and identify factors influencing outcomes in patients who underwent emergent AADA repair over 25 years, and elucidate the best surgical approach. After we obtained the clinical data and follow-up from all patients (n=407) who were treated in the Department of Cardiac Surgery of the University Hospital Heidelberg from 1988 until 2012, we retrospectively compared the different aortic surgical techniques used for AADA repair. The cohort was divided into subgroups according to the surgical approach, and the results from each group were compared with a SCR group,

representing the most conservative surgical approach. Patients in group composite (COMP) and group composite with total arch replacement (COMP+TAR) were younger than SCR patients (p<0.01). There were no further statistical differences in clinical presentation, nor surgical outcomes, among groups, except high intraoperative mortality which was detected in the COMP+TAR group (p=0.002; Table 1). However, patients that underwent aortic valve sparing presented a favourable short- and long-term survival with no significant difference (p=0.250) in comparison with SCR patients (Figure 1). Moreover, the David technique in particular showed excellent results, both for short- and long-term survival, as well as for freedom from aortic root reoperation, suggesting a safety profile applicable to AADA treatment, without increased risk (despite longer operative times).



AVS, aortic valve sparing; COMP, composite replacement; SCR, supracommissural replacement; TAR, total arch replacement

Figure 1. Kaplan-Meier survival curve analysis, subdivided by surgical treatment

This observation contrasts the fact that long bypass and circulatory arrest times were identified as the most important risk factors for early mortality after AADA repair, influencing the surgical outcomes. Finally, we conclude that the operative strategy in acute aortic dissection type A should be highly individualised for each patient. The quickest option is not necessarily the best.

Table 1. Short term follow-up subdivided by treatment method										
Perioperative Data SCR vs. groups	All	SCR	SCR+TAR	P-value	COMP	P-value	COMP+TAR	P-value	AVS	P-value
30-day mortality	83(21)	25(18)	14(20)	0.815	30(25)	0.171	5(29)	0.280	4(16)	0.776
Intraoperative mortality	29(7.3)	5(4)	5(8)	0.278	11(9)	0.066	4(21)	0.002	1(4)	0.911
Reexploration for bleeding	38(9.3)	9(7)	8(12)	0.248	12(10)	0.255	2(13)	0.492	6(25)	0.14
New stroke	52(12)	15(11)	11(17)	0.617	20(17)	0.183	2(13)	0.894	3(13)	0.873
ICU stay (day)	6.5±8.7	8±12	8±12	0.993	9±12	0.685	8±12	0.976	6±6	0.271
Mechanical ventilation (h)	91±201	121±286	89±144	0.369	71±134	0.89	65±188	0.417	69±106	0.382
Dialysis	57(14)	19(15)	15(23)	0.179	18(16)	0.536	2(13)	0.865	1(4)	0.201
Blood transfusion (ml)	2111±1534	2422±3938	2202±2148	0.676	2227±3003	0.659	4186±4929	0.126	1663±382	0.735

Data are presented as n (percentage) or mean ± standard deviation (SD). A probability value (P-value) of <0.05 was considered significant. AVS, aortic valve sparing; COMP, composite replacement; ICU, intensive care unit; SCR, supracommissural replacement; TAR, total arch replacement.

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LAUNCHING 15TH NOVEMBER 2016

Multimedia Manual of Cardio-Thoracic Surgery

All-new MMCTS unveiled at EACTS 2016

The Multimedia Manual of Cardio-Thoracic Surgery (MMCTS), the world's leading online video reference to CT surgery, will be relaunching this November, and its publisher, EACTS, will be offering delegates at its Annual Meeting here in Barcelona a preview of the new website.

The relaunch coincides with the transfer of MMCTS from its current publisher, Oxford University Press, back to EACTS.

Founding MMCTS editor-in-chief Marko Turina joined *EACTS Daily News* to discuss its beginnings: "When I stepped back as editor of the *European Journal of Cardio-Thoracic Surgery* in 2001, I began to realise that surgical education was not keeping track with the tremendous possibilities offered by rapidly improving internet sites.

"But with the internet, one can combine text, schematics, video and audio, colour graphics, and hyperlinks to other web locations. The reader can have instant access to previous literature, quoted or referred to in the text."

The new MMCTS website has been totally redesigned, with improved navigational tools and a vastly more accessible interface. Video tutorials of surgical procedures feature centrally, with brief text descriptions and supporting graphics. Coupled with narration, MMCTS will offer concise, structured learning for surgeons at every level, and on every device from smartphone to desktop.

Turning to the concept of MMCTS, Professor Turina continued: "My original idea was to involve world-best cardio-thoracic surgeons in creating a new online educational program that could take

Marko Turina

advantage of everything the internet has to offer. We asked surgeons to prepare tutorials describing their own technique for performing a particular surgical procedure, with short, multiple video clips, narration, short text blocks, and references to the most important literature.

"Our plan was that MMCTS would provide free surgical education to the whole world of cardio-thoracic surgery. Anybody could access MMCTS, anywhere – in the office, at home, or in the operating theatre – and the education would be free of charge."

And it remains so today, providing surgeons who might not otherwise have access to teaching materials prepared by the world's best specialists with access to up-to-date information on key surgical techniques.

Much of the older material on the current MMCTS will be archived and is scheduled for updating, and MMCTS's Editors-in-Chief, Dr Roberto Lorusso and Dr Rene Prêtre, are actively commissioning new tutorials for the relaunched site.

"We have a lot of work to do," explained Professor Turina. "Our goal is true comprehensiveness at both the topic and the skills level. We want to include tutorials covering common as well as more esoteric procedures, and to demonstrate both fundamental and advanced surgical techniques.

"This is a living textbook that will continually grow and improve," he concluded. "We will never stop updating MMCTS!"

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Please stop by the EACTS stand at EACTS 2016 here in Barcelona for a preview of the new Multimedia Manual of Cardio-Thoracic Surgery.

Cardiac | Rapid Response | Developments in assist devices and transplantation

Is 30-day mortality a reasonable quality endpoint in left ventricular assist device patients?

Danielle Savino, Danielle Spragan, Fenton McCarthy and Nimesh Desai University of Pennsylvania, Philadelphia, USA

Danielle.savino@uphs.upenn.edu / Danielle.spragan@uphs.upenn.edu / Fenton.mccarthy@uphs.upenn.edu / nimesh.desai@uphs.upenn.edu

In the United States, heart failure is the leading cause of hospitalisations in adults over 65, accounting for over a million hospitalisations annually, and costing Medicare approximately \$17 billion USD.¹ As the elderly population in the US grows, these numbers are only expected to rise. By 2030, it is predicted another 3-million individuals will develop heart failure.² However, recent advances in technology, including continuous-flow left ventricular assist devices (LVADs), have provided many elderly heart failure patients who may not be heart transplant candidates with a novel long-term therapy option. According to the seventh INTERMACS annual report, since the introduction of continuous-flow LVADs, heart failure patients have shown better long-term survival, a lower burden of adverse events, and increased quality of life.³

There is ongoing debate as to how best capture and report outcomes of LVAD patients. Historically, common endpoints used include 30-day, 90-day, and one-year mortality, although these vary based on analysis performed.^{3,4} Discrepancy in the literature limits ideal fully informed patient consent, risk adjustment, and comparisons between studies. Our study seeks to evaluate which outcome most accurately captures the perioperative mortality of patients undergoing going LVAD implantation.

Results of our study indicate that mortality during the perioperative period is a significant risk to LVAD patients. Mean hospital length of stay was 36 days (± 27), suggesting that the majority of patients required extensive postoperative care. In fact, overall in-hospital mortality was significantly greater than 30-day mortality (14% vs. 11%, $p < 0.01$), and 31% of all in-hospital deaths occurred more than 30 days postop. The mean follow-up period for this study was 23 (± 16) months,

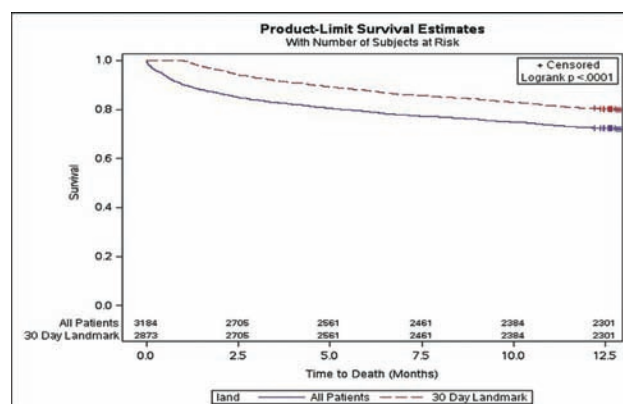


Figure 1. Kaplan Meier Analysis landmark 30-day mortality

and the overall study mortality rate was 37%. Using survival analysis, we landmarked all patient mortalities at 30 days and 90 days. The graphical results show that the initial postop mortality risk extends past 30 days but plateaus around 90. Taken together, these results indicate the importance of management of LVAD patients during the extended postop period, as the risk of mortality between 30 and 90 days postop is significant.

When investigating risk factors for 0 to 30-day mortality and 30 to 90-day mortality, we found different trends in risk factors between the two time periods. Risk factors for 0 to 30-day mortality included many procedure related events including procedural complications, ECMO, and use of pulsation balloon. Risk factors for 30 to 90-day mortality included more device-related events, and comorbidities including mechanical complications, gastrointestinal bleeding, renal failure, and anaemia.

Overall, LVAD patients represent a subset of cardiac surgery patients that require longer, more attentive post-operative care. The extended postop length of stay seen in these patients

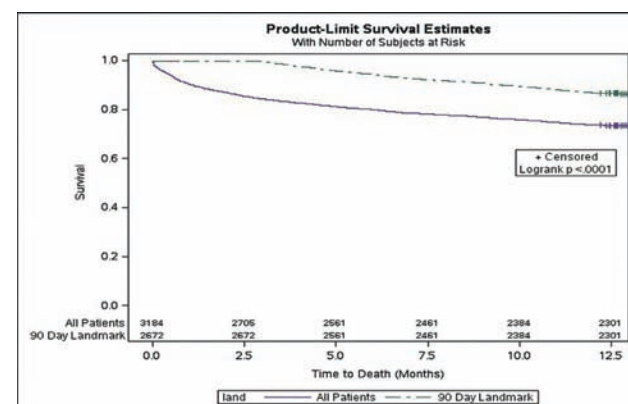


Figure 2. Kaplan Meier Analysis landmark 90-day mortality

is far greater than those seen for CABG, AVR, or even heart transplant patients. This prolonged period of early mortality risk seen in LVAD Medicare patients initially appears to stem from procedural risks, but device associated risk factors become more serious between 30 and 90 days postop. This study provides insight into the landscape of perioperative LVAD mortality risk and highlights the importance of prolonged postop management in this distinct patient population.

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Cardiac | Rapid Response | Adult Cardiac

Can Perceval sutureless valve reduce the patient-prosthesis mismatch rate?

Igor Belluschi^{1*}, Stefano Moriggia¹, Andrea Giacomini¹, Benedetto Del Forno¹, Stefania Di Sanzo¹, Andrea Blasio¹, Antonio Scafuri², Ottavio Alfieri¹

1. Department of Cardiac Surgery, San Raffaele University Hospital, Milan, Italy. 2. Department of Cardiac Surgery, Tor Vergata University of Rome, Rome, Italy

igor.belluschi@gmail.com



hypertrophy after surgery, as well as being an independent predictor of mortality and cardiac events.¹ To prevent PPM, many authors suggest the intraoperative evaluation of the projected EOA for every single patient to be incorporated in the clinical decision making

process along with age, physical activity, LV function and concomitant procedures. If the risk of PPM is considerable, an alternative technique should be taken into consideration. Aortic enlargement procedures, homografts and different suture techniques have been extensively adopted, but they are surgically demanding, require longer learning period and are associated with protracted aortic cross-clamp time. Other alternatives to avoid PPM were mechanical and biological supra-annular valves. However, the risk of bleeding and the introduction of new attractive technologies were determinant in the exploration of new options.

While stentless bioprostheses represented a major advance in haemodynamic performance, the technically complex procedure, along with the longer surgical times, reduced its possible application. It has been shown that TAVI improves the indexed EOA (iEOA). Nevertheless, the PARTNER trial reported higher rates of paravalvular leakage – an independent predictor of mortality. The innovative Perceval bioprosthesis (Sorin Group / LivaNova, UK) is a surgical sutureless self-expanding valve without a sewing ring. It has

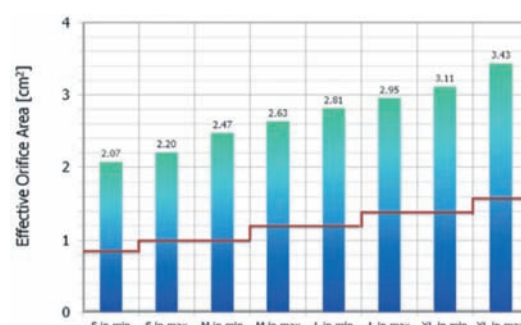


Figure 1. In vitro Perceval projected EOA. For each prosthesis' nominal size (S-M-L-XL), the EOA is expressed as a range (min-max) considering that each size covers a range of 2 annular diameters. The red line refers to the ISO 5840 minimal requirement (Courtesy of Sorin Group S.p.A.).

recently been introduced as an alternative to conventional surgery, to minimise the operative risk in elderly patients. Advantages consist of both shortening the cardiopulmonary bypass (CPB) time, and enhancing the minimally-invasive approach.² It also provides excellent haemodynamic results and adequate EOAs, becoming a possible solution for PPM avoidance.

The aim of our study is to compare the theoretical incidence of PPM in patients undergoing a sutureless or a sutured AVR using an exact statistical matching. Between May 2012 and March 2016, 65 patients with severe symptomatic aortic stenosis underwent a sutureless aortic valve replacement (SU-AVR) with the Perceval bioprosthesis in two centres. Moreover, 177 aortic valve replacements with eight different types of conventional sutured bioprosthesis

were performed between August 2003 and September 2015. Perceval and sutured patients were 1:1-matched for sex and body surface area, resulting in 62 homogeneous couples. PPM was classed as severe if the projected indexed EOA was $\leq 0.65 \text{ cm}^2/\text{m}^2$, moderate if it was >0.65 and $\leq 0.85 \text{ cm}^2/\text{m}^2$, not significant if $>0.85 \text{ cm}^2/\text{m}^2$. For the statistical analysis, we used the projected *in vitro* EOA for the Perceval valve (provided as a range by the manufacturers; Figure 1) and the projected *in vivo* EOA published in literature for the sutured bioprosthesis.

After matching, the iEOA was significantly larger in the sutureless group ($1.50 \pm 0.18 \text{ cm}^2/\text{m}^2$ vs $0.81 \pm 0.19 \text{ cm}^2/\text{m}^2$, $p < 0.001$, Figure 2). In the sutured group ($n=62$), 38 patients (61.3%) developed a PPM, which was moderate in 41.9% ($n=26$) and severe in 19.4% ($n=12$). In other words, more than 2/3

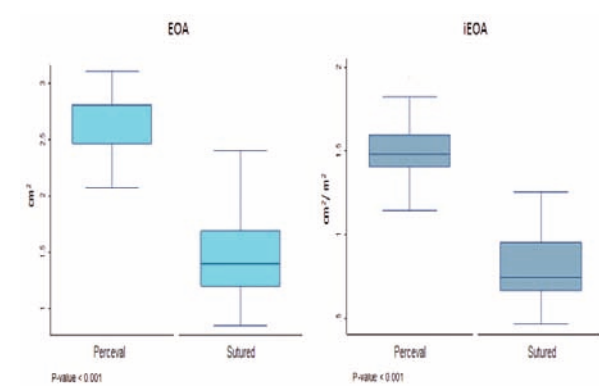


Figure 2. The boxplots show the significant statistical difference of EOAs (on the left) and iEOA (on the right) between the sutureless and the sutured group, always in favour of the sutureless Perceval bioprosthesis.

patients undergoing a conventional sutured aortic valve replacement developed a PPM, which was severe in 1/3 of cases. No PPM occurred in patients who implanted a Perceval bioprosthesis ($n=62$, $p < 0.001$). Therefore, the Perceval sutureless valve provides larger EOAs compared to the sutured conventional bioprosthesis and could be considered as a good option to reduce the risk of PPM. Further studies are necessary to confirm this trend and to fully compare the haemodynamic parameters at follow-up.

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Thoracic | Focus Session | Video & Case Study 1

Video-assisted thoracoscopic resection of the posterior segment of the right upper lobe using a uniportal posterior approach

Davor Stamenovic
St.Vincentius
Kliniken Karlsruhe
/ Thoraxchirurgie,
Karlsruhe, Germany



with video-assisted thoracoscopic (VATS) segmentectomy and lymphadenectomy, if single-lung (lobe) ventilation should allow

Abstract
A 73 year-old patient, with a history of colon carcinoma, prostate carcinoma and contralateral lobectomy for non-small cell lung cancer 5 years before, was admitted for a 12mm-large nodule in the posterior segment of the right upper lobe. Distant metastases had been excluded, and a decision was made to proceed

it. VATS resection of the posterior segment of the right upper lobe using a uniportal posterior approach was successfully conducted without any adverse effects. The postoperative course was complicated by a transient ischemic attack and a urinary tract infection. No respiratory complications developed. Chest tube was removed on the third postoperative

day and the patient was discharged on the 6th postoperative day. The tumour was diagnosed to be a primary acinar adenocarcinoma and the final TNM was pT1aN2M0. Two lymph nodes out of ten at stations 2 and 4 were tumour positive. **Introduction** Uniportal VATS resections offer potential benefit in terms of postoperative pain and cosmesis, therefore potentially a better quality of life. Anatomical segment resections are technically more demanding even with conventional VATS

approach. **Operative technique** A single incision of 3.5 cm was made in the 6th intercostal space, between the latissimus dorsi and trapezius muscles, in the so-called 'triangle of auscultation'. Despite the absence of total lung collapse due to insufficient ventilation with only one remaining contralateral lobe, the procedure was not endangered. Bronchial bifurcation was easily assessed. The fissure was dissected partially sharply and then by staplers. After the removal of local lymph nodes (station 11), segment artery was

assessed and divided. The vein for the posterior segment of the right upper lobe was then approached and divided, while preserving a small vein going out from the apical segment of the lower lobe, as well as a branch from the anterior segment. Following the clamping of the segmental bronchus, bronchoscopy was performed and the bronchus divided. Posterior segment of the right upper lobe was then detached from the rest of the lung parenchyma, using multiple staplers along the potential segmental fissure line. Mediastinal lymphadenectomy

was performed at the end of the procedure. **Comments** Anatomical VATS resections using a uniportal posterior approach, especially for the 'posterior' segments – both apical segments of the lower lobes as well as the posterior segment of the right upper lobe – can be performed safely without any adverse consequences. Uniportal posterior approach allows for easier assessment of the bronchovascular structures of those segments and probably better lymphadenectomy overall.

Thoracic | Focus Session | Video & Case Study 1

Angiomatosis of soft-tissues: an unusual supraclavicular tumour

Julien Guihaire
Marie Lannelongue
Hospital, University of
Paris Sud, Le Plessis
Robinson, France



cervical vessels. He developed intermittent neuropathic pain at the right shoulder and along the lateral aspect of the right arm. Magnetic resonance imaging revealed a 10 cm high lesion with a low signal intensity on the T1-weighted image and high signal intensity on the T2-weighted image (Figure 1). After gadolinium infusion, a remarkable enhancement of the tumour was achieved. The mass surrounded the brachial plexus, and the lower part was in contact with the dome of the right pleura. In the absence of a definitive diagnosis in this symptomatic young patient with a growing tumour, a complete surgical removal was performed through an anterior transcervical approach. The tumour was not well encapsulated and was very close to the brachial plexus inferior trunk, which was preserved. The post-operative course was uneventful and the patient was discharged home after five days. The haphazard proliferation of dilated thick

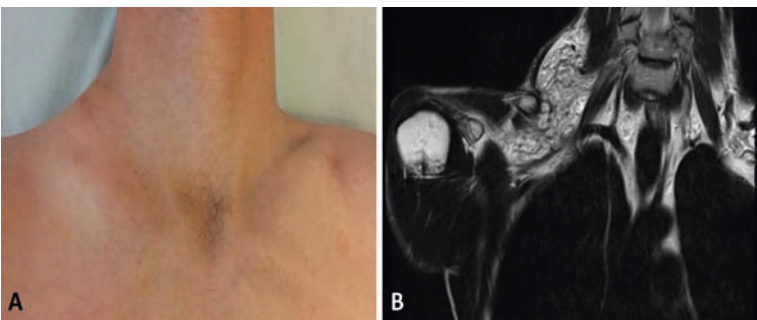


Figure 1. (A) Circumscribed swelling of the right supraclavicular space. (B) T2-weighted magnetic resonance imaging showing a non-homogeneous mass of vascular nature. The lesion invades the thoracic outlet and is close to the right subclavian artery which remains patent.

Soft-tissue angiomatosis (STA) is a rare condition first described by Rao and Weiss.¹ This benign vascular tumour can be considered as congenital or acquired and occurs during the second decade of life in 80% of cases.² Congenital forms may be sporadic or associated with syndromes such as Klippel-Trenaunay-Weber syndrome, Sneddon's syndrome or Gorham disease.³⁻⁵ Chest wall and thoracic outlet locations are very rare and can be misdiagnosed in the absence of specific symptoms. We report the case of a 29-year-old man with a right supraclavicular swelling (Figure 1). He had not experienced any recent thoracic trauma or any catheterisation of the

be useful to exclude arteriovenous malformation or fistula, but does not provide specific patterns for the diagnosis of STA. Surgery is the treatment of choice in localised cases of STA. On follow-up, 90% of patients have local recurrence because of incomplete surgical resection due to the infiltrative nature of the disease, with a mean disease-free interval of five years.¹

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Cardiac | Perfusion Programme | Perfusion - Session 1

Vasoplegic syndrome: be prepared!

Jean-Jacques Lehot
Claude Bernard
University, Lyon, France /
Hôpital Pierre Wertheimer,
Groupement Hospitalier Est,
Hospices Civils de Lyon,
Lyon, France



Vasoplegic syndrome (VS) may occur during/immediately after cardiopulmonary bypass (CPB). Described by Gomes et al. in 1994,¹ incidence of the syndrome varies between 8 and 26%, but after coronary artery grafting without CPB, its incidence is divided by 10. With this in mind, all cardiac surgeons and anaesthesiologists should be prepared for an early diagnosis and treatment. The former is simple: look for low arterial pressure with normal cardiac contractility, with other causes of hypotension, such as hypovolaemia, being ruled out. In reality, VS has two clinical presentations: 1) the common type can be efficiently treated by noradrenaline

infusion during a few hours/more rarely 2 or 3 days; 2) the severe type does not respond to catecholamines and can be rapidly lethal. Unfortunately, VS is difficult to anticipate, but there are predictive factors such as previous treatment with converting-enzyme inhibitor, beta-blocker or heparin, chronic haemodialysis, valve surgery for acute infectious endocarditis, low ejection fractions, need of vasopressor prior to CPB, and blood transfusion. Though the initial mechanism is not well known, a stimulation of nitric oxide (NO) synthesis by inducible NO-synthase in the vascular endothelium occurs. Therefore, NO relaxes vascular muscles and initiate vasoplegia, which in turn induces low arterial pressure, decreasing perfusion pressure in all organs, especially in the coronary arteries, ultimately leading to acute cardiac failure. What's more, visceral hypoperfusion induces circulatory shock, hypoxia, and severe hyperlactataemia. The treatment must precede this late stage in order to prevent irreversible multi-organ failure. If noradrenaline is inefficient at the dose of 0.5 micrograms/kg/min, one of the several

other drugs can be used. Firstly, vasopressin, or terlipressin as vasoconstrictors acting through vasopressin receptors. Then there is methylene blue (MB, methylthioninium chloride) – not a vasoconstrictor, but a NO-synthase and guanylate-cyclase inhibitor. The most used dosage is 2 mg/kg as IV bolus, followed by a continuous infusion because plasma concentrations sharply decrease in the first 40 minutes. MB has not yet secured agreement for use in this indication, but its preventive effectiveness has been demonstrated in a randomised study in patients at risk of VS.² C Current evidence also supports an outcome benefit to MB in VS. In a study of 638 cardiac surgical patients, 56 had VS and were randomly assigned to receive MB or placebo. Mortality was lower in patients receiving MB who fulfilled vasoplegia criteria (0% vs 21.4%).³ An observational study of 54 patients published by Leyh et al.⁴ also showed MB to be effective in treating vasoplegia after CPB, and the successful use of MB for vasoplegia after heart transplant has also been described.⁵ However MB should

not be used in patients taking selective serotonin reuptake inhibitors because of the risk of serotonin syndrome. In conclusion, recent publications suggest that cardiac surgery departments should be prepared to diagnose and treat VS rapidly. MB should be available in order to be administered during an early window.

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Cardiac | Abstract Session | Stand-alone and concomitant MAZE is an evidence based procedure

Hybrid thoracoscopic ablation significantly improves stable sinus rhythm restoration in patients with persistent and long-term persistent AF: the Historic-AF trial

C. Muneretto¹, G. Polvani², R. Krakor³, G. Bisleri¹, L. Giroletti¹, M. Moltrasio², C. Tondo², A. Curnis¹ 1. University of Brescia Medical School, Italy 2. Centro Cardiologico Monzino, Milan, Italy 3. Klinikum Dortmund, Germany



The treatment of persistent and long-standing persistent atrial fibrillation (AF) still represents a major challenge in current clinical practice. Even though there have been consistent improvements in technology over the past decade, catheter-based procedures per se have shown unsatisfactory outcomes at mid- and long-term in spite of multiple repetitions of transcatheter ablation. The Historic-AF Trial is the first prospective, multicentre, single arm study designed to evaluate the outcomes of staged endoscopic and transcatheter ablation in patients with standalone, persistent or long-standing persistent AF.¹ The trial recruited 100 patients with non-paroxysmal AF refractory to medical therapy, at different European sites. Study methods include (1) thoracoscopic surgical approach providing left atrial epicardial isolation (box-lesion); and (2) in the case of AF recurrency after the blanking

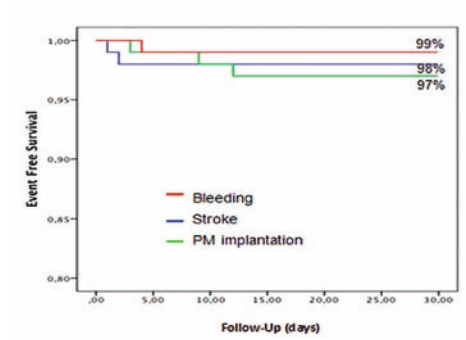


Figure 1. Survival Freedom from MACCEs (bleeding/ stroke/ PM implantation) at 30 days

period (3 months), transcatheter ablation. Trial patients were followed up at 1, 3, 6, 9 and 12 months. Rhythm analysis was performed according to HRS guidelines (24 hours ECG-Holter at 6 and 12 months). In addition, half of the patients received an implantable continuous loop recorder (REVEAL XT, Medtronic, Minneapolis). The Historic-AF Trial was designed and powered according to the following study end-points at 12 months:

- Efficacy**
1. Primary endpoint: success rate of isolated thoracoscopic ablation >60% (defined as freedom from AF according to HRS criteria, without any subsequent EP ablation).
 2. Secondary endpoint: success rate of

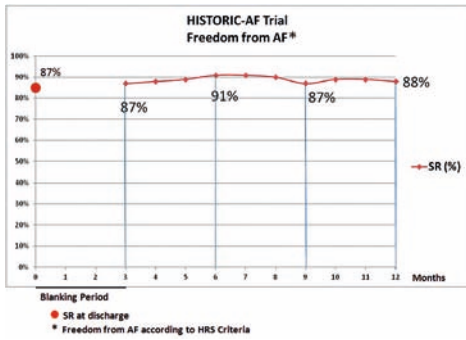


Figure 2. Freedom from AF at 12 months in patients underwent hybrid ablation

hybrid ablation >80% according to HRS criteria (surgical thoracoscopic followed by transcatheter ablation).

Procedural Safety

Primary Safety endpoint: composite outcome of serious adverse events (MACCEs) within 30 days of the procedure. MACCEs includes: all causes of death, bleeding and pericardial tamponade/ effusion requiring interventions, stroke/ TIA, myocardial infarction, access site infection, PM implantation, PV stenosis, oesophageal fistula. Surgical thoracoscopic procedures were accomplished in all patients. There were no conversions to median sternotomy. Mean ablation time was 17±5.5 minutes with an overall procedural time of 122±56 minutes. Following

thoracoscopic ablation, exit-block and entrance-block were confirmed in 94% and 91% of patients, respectively. Survival and freedom from MACCE at 30 days was 94%. Specifically, 30-day mortality was nil, 1 patient required surgical revision for bleeding, and 3 patients required post-operative PM implantation. Two peri-operative strokes occurred on the second and third day post-procedure, both without permanent sequelae. At discharge, 87% of patients were in sinus rhythm (Figure 1). After the three-month blanking period, all patients with AF recurrency (17%) underwent the second step of staged transcatheter ablation. At 12 months follow-up a stable restoration of sinus rhythm, according to HRS criteria, was achieved in 75% of patients following isolated surgical ablation and in 88% of patients following hybrid ablation (Figure 2). The results of the HISTORIC-AF trial demonstrate that thoracoscopic isolated surgical ablation reached both the safety and the efficacy endpoint, with a 75% success rate at one year. Hybrid ablation steadily improved rhythm outcome and may be considered in the future as the treatment strategy of choice for patients with persistent and long-standing persistent AF.

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Cardiac | Techno College | Atrioventricular valve 1

3D endoscopic re-do mitral valve repair using the endoballoon technique

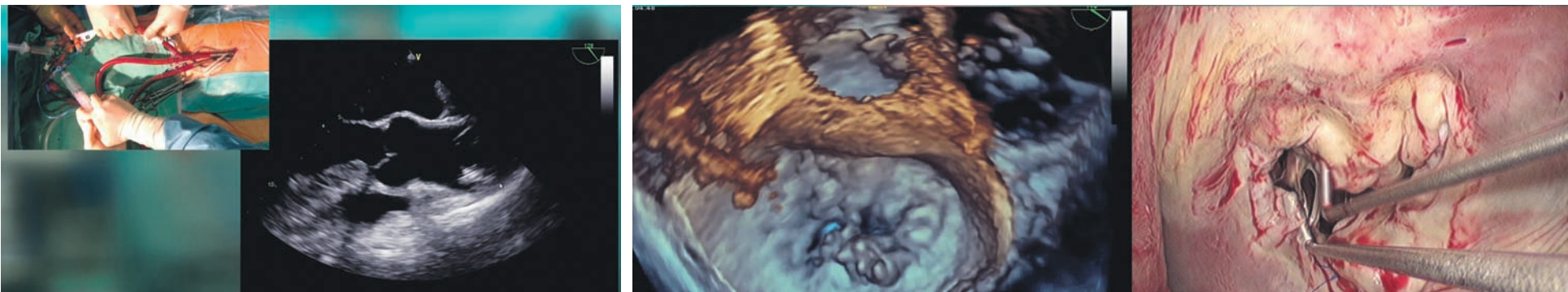


Figure 1.

Jörg Kempfert Deutsches Herzzentrum Berlin, Germany

Minimally-invasive mitral valve surgery for isolated mitral valve repair has evolved to be the standard of care in specialised centres.



The recent introduction of 3D endoscopy facilitates optimal visualisation of the mitral valve itself, even through a “micro invasive”, non-rib spreading access. The use of the endoballoon technique further eases such a fully endoscopic approach. In a case of re-do surgery, a minimally-invasive setting might have the potential to reduce the

operative trauma and the likelihood for re-entry injury. The use of endoaortic clamping in this setting does allow for standard cardioplegic arrest, as opposed to a fibrillating heart approach. During our 3D Live in a Box Case, we will demonstrate our approach to MIS re-do mitral valve repair using 3D endoscopy, the endoballoon technique and a non-rib spreading “nipple cut” access.



Figure 3

Thoracic | Abstract Session | Video & Case Study 2

Intercostal muscle flap to reinforce the bronchial stump after VATS pneumonectomy

Davide Tosi, Lorenzo Rosso, Paolo Mendogni, Alessandro Palleschi, Alessio Mariolo, Mario Nosotti Fondazione Ca' Granda Policlinico, Milan, Italy



In open surgery, buttressing of the bronchial stump is a common procedure, serving to prevent the occurrence of

bronchopleural fistula after pneumonectomy or after anatomic resections in high-risk patients (i.e. induction chemotherapy, inflammatory disease, diabetes mellitus, arteriopathy). Several techniques have been proposed for the prophylactic coverage of the bronchial stump, most of them using parietal pleura, pericardial fat pad, or intercostal muscle flap. In our Institution, we routinely cover the bronchial stump with an intercostal muscle flap after both left and right pneumonectomy. In case of

sleeve lobectomy, the flap is usually prepared before rib spreading, to maintain adequate blood flow. The use of intercostal muscle flap in VATS surgery is rare – even in high-risk patients – with only a few descriptions in the literature. We describe a VATS procedure of protecting the bronchial stump with an intercostal muscle flap, harvested with a harmonic scalpel from the utility incision. We evaluated two patients for VATS pneumonectomy in the last year, both after induction chemotherapy. The first patient was a 54-year-old woman with an adenocarcinoma of the right lung, previously treated with cisplatin and gemcitabine for 3 cycles for a huge hilar nodal involvement. The second patient was a 57-year-old male with an adenocarcinoma of the left lung, treated with 3 cycles of cisplatin and gemcitabine for N2 disease, confirmed by endobronchial ultrasonography. Both patients underwent a three-ports technique approach. In the first case, after the bronchial closure, the stump was verified to have no

air leak. The intercostal muscle flap was harvested with an harmonic scalpel from under the surface of the fifth rib, with attention paid to avoid injury to the vascular structures. The flap was transected and sutured to the bronchial stump with an interrupted 4/0 re-absorbable suture. In the second case, the flap was dissected at the beginning of the operation, after the utility incision, and positioned out from the soft tissue retractor. The technique of flap mobilisation and the suture to the bronchial stump was the same as the previous case. The time required for harvesting the flap was very short, almost five minutes. Both patients had an uneventful postoperative course. This procedure helped to avoid negative consequences of pneumonectomy, without presenting technical difficulties. Caution must be taken, however, to preserve vascular supply. In conclusion, we believe that intercostal muscle flap is a valid choice, increasing the vascularity of the bronchial stump; the procedure is easy to perform, even in VATS.

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

Major intraoperative complications during video-assisted thoracoscopic anatomical lung resections

Herbert Decaluwe¹, René Horsleben Petersen², Henrik Hansen², Cezary Piwkowski³, Florian Augustin⁴, Alessandro Brunelli⁵, Thomas Schmid⁴, Kostas Papagiannopoulos⁵, Johnny Moons¹ and Dominique Gossot⁶

On behalf of the ESTS Minimally Invasive Thoracic Surgery Interest Group (MITIG) 1. Department of Thoracic Surgery, University Hospitals Leuven, Leuven, Belgium 2. Department of Cardiothoracic Surgery, Copenhagen University Hospital Rigshospitalet, Copenhagen, Denmark 3. Department of Thoracic Surgery, Karol Marcinkowski University, Poznan, Poland 4. Department of Thoracic Surgery, Innsbruck Medical University, Innsbruck, Austria 5. Department of Thoracic Surgery, St. James's University Hospital, Leeds, UK 6. Department of Thoracic Surgery, Institut Mutualiste Montsouris, Paris, France

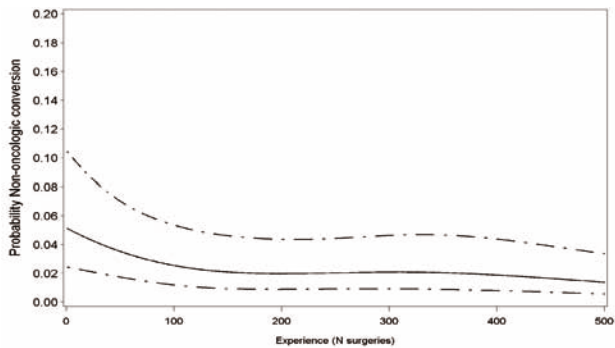


Figure 1: The probability of conversion for non-oncological reasons is significantly related to the experience of the surgeon

The use of minimally-invasive surgery (VATS) for anatomical lung resections is still not standardised amongst European thoracic services. The expectation is an increase in adoption rate as studies of large databases show fewer perioperative complications compared with thoracotomy and equal oncological outcomes. Additionally, the American College of Chest Physicians guidelines now encourage the use of VATS in Stage I non-small cell lung cancer (NSCLC). Most surgeons agree that

there is an important learning curve associated with VATS anatomical resections. Reports on specific intraoperative complications are rare and publications based on large societal databases do not accurately capture conversions to thoracotomy or unintended additional resections such as emergency pneumonectomies. Six European centres submitted their series of consecutive anatomical lung resections with the intention to treat by VATS.¹ A total of 3,076 patients were registered. Most resections (90%, n=2763) were performed for bronchial carcinoma.

Conversion to open thoracotomy was related to surgeon experience (Figure 1) and observed in 5.5% (n=170), of whom 21.8% (n=37) were for oncological reasons, 29.4% (n=50) for technical reasons and 48.8% (n=83) for complications. Vascular injuries were reported in 2.9% (n=88) of patients and led to conversion in 2.2% (n=70).

Major intraoperative complications were identified in 1.5% (n=46) cases. These consisted of erroneous transection of bronchovascular structures (n=9); injuries to gastrointestinal organs (n=5) or the proximal airway (n=6), complications requiring additional unplanned major surgery (n=9) or immediate life-threatening complications

(n=17), e.g. sudden blood loss of 2L. A subgroup analysis was performed using an index of VATS over total anatomical resections per year, per centre. In the subgroup with life-threatening bleeding, the median VATS index was significantly higher [0.82 (IQR 0.57–0.83) vs 0.62 (IQR 0.34–0.83), P=0.0085]. This finding reinforces the assumption that the risk of major bleeding rose when surgeons were less selective and more willing to start operations by VATS. For the same reason, the incidence of major intraoperative complications does not seem to correlate with experience, as experienced surgeons tend to start more complex cases with VATS, thus balancing the beneficial effect of experience.

The different types of major intraoperative complications are uncommon but have an important impact on patient outcome. Overall in-hospital mortality was 1.4% (n=43). Twenty three percent (n=10/43) were related to major intraoperative complications. Eight pneumonectomies (5 intraoperative and 3 postoperative, 0.3%) were a consequence of a major complication.

Based on our observations, the Minimally Invasive Thoracic Interest Group (MITIG – ESTS) produced written recommendations during a panel discussion of the observed major intraoperative complications including, but not limited to, meticulous dissection and identification of hilar structures before transection by removing lymph nodes first, exposing the pulmonary artery branches adequately and performing a ventilation test before transection of bronchi.¹ It was also emphasised that it is more important to prevent intra operative bleeding by developing the skills to identify, judge and prepare well high risk cases. The group has also unanimously agreed that conversion to open thoracotomy, in cases of major bleeding, should not be classed as failure and should be considered early enough to prevent uncontrollable haemorrhage.

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Thoracic | Abstract Session | VATS lobectomy

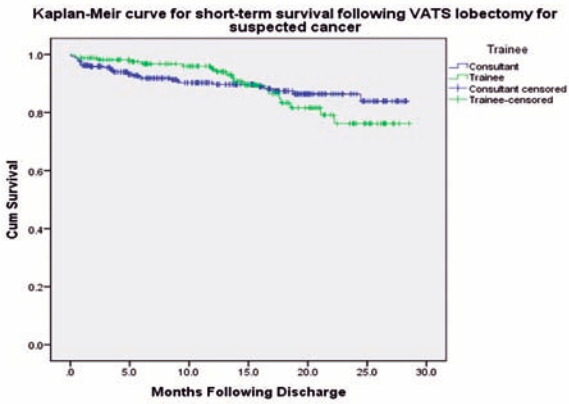
Impact of trainee-led thoracoscopic lobectomies on patient outcomes

Priyadharshanan Ariyaratnam
St James's University Hospital, Leeds, UK



Training the next generation of thoracic surgeons to competently and safely perform video-assisted thoracoscopic (VATS) lobectomies for early stage NSCLC cancer is crucial. Due to the steep learning curve and the greater public scrutiny on surgeon-specific outcomes, there remains a reluctance to aggressively implement VATS training models in many institutions. At our institution, St James' Hospital in Leeds, UK, we have developed a standardised VATS training model over the last two years to train young residents – those competent in basic thoracic surgical techniques – to undertake VATS lobectomies. We have analysed the impact of this VATS lobectomy training model on patient outcomes in our institution, retrospectively

evaluating data that was collected prospectively in our thoracic database. Trainee and consultant groups were controlled using propensity matching. Operative outcomes (time of surgery and conversion from VATS to open) and post-operative outcomes (mortality, length of hospital stay and complications) were analysed. Cox-regression analysis was used to evaluate predictive factors for two-year survival. Between April 2014 and July 2016, 461 consecutive VATS anatomical lung resections for lung cancer were performed. Of these, 168 (36.5%) were performed by trainees as first operator whilst the remaining 293 (63.5%) were performed by consultants. After propensity-matching, the operative complication incidence, operating time, conversion incidence, re-operation incidence and positive resection margin were not statistically significant between the groups. The two-year survival was 83% (±4%) in the consultant group and 76% (±6%) in the trainee group (log rank=0.922; Figure 1). Our results demonstrate that VATS lobectomy training does not



impact adversely on the immediate and short-term outcomes of patients. Despite its perceived steep learning curve, the procedure can be taught safely in the appropriate environment.

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Mini thoracotomy replacement of the ascending aorta and hemi arch with aortic root replacement and re implantation of the coronaries

Joseph Lamelas Florida, USA

Ascending aortic pathology requiring surgical intervention has traditionally been addressed via a sternotomy, or – more recently by some – via an upper hemi-sternotomy. Resection of the ascending aorta and hemi-arch through a small right thoracotomy approach has not been documented in the literature. Furthermore, full root replacement with or without ascending aortic surgery has not been documented through a minimally invasive right thoracotomy approach. There are documented benefits of minimally-invasive surgery in terms of quicker recovery times, reduced blood loss, transfusion requirements, ventilator times and fewer composite complications compared to a standard sternotomy. After acquiring sufficient experience with right thoracotomy valve surgery, a minimally-invasive right thoracotomy approach to address ascending aortic pathologies, with aortic valve involvement and circulatory arrest, is feasible and safe, although the learning curve is steep. For the minimally-invasive small right thoracotomy approach, most patients were

accessed via a right 6 cm anterior thoracotomy incision over the second or third intercostal space. Cannulation for cardiopulmonary bypass was predominately performed from the femoral artery or from the axillary artery and femoral vein. An aortic cross clamp was applied directly through the thoracotomy incision. Cardioplegia was delivered through a catheter placed directly in the ascending aorta or via hand held catheters in the coronary ostia, and hypothermic circulatory arrest was achieved with the patients cooled to 20°C. Retrograde cerebral perfusion was performed with a 24 Fr venous cannula tunnelled through the chest tube incision then into the superior vena cava. Upon initiation of the circulatory arrest, an open distal hemi-arch anastomosis was performed with a HEMASHIELD graft (Maquet Getinge Group, Germany). It is crucial to become facile with long shafted instruments which greatly facilitate the operation. After re-establishing cardiopulmonary bypass, a clamp is placed on the graft, and the remainder of the procedure consists of first replacing the aortic valve and root as well as re-implanting the coronaries. Again, long shafted instruments and a knot setter are utilized.

Thereafter the proximal graft anastomosis is completed. A two-layer closure of both suture lines was then performed. A total of 121 cases requiring circulatory arrest for the treatment of ascending aortic pathologies with aortic valve involvement, were performed via a right mini thoracotomy. Of the 121 cases, 108 were hemi-arch, supra coronary ascending aortic and aortic valve replacements. There were 13 patients that had hemi arch, ascending aortic and root replacement with re-implantation of the coronaries. There were an additional 10 patients, not included in this group that had isolated root replacements with re-implantation of the coronaries without circulatory arrest. The hypothermic circulatory arrest time was a median of 37 minutes for these minimally-invasive patients. It is true that the cross clamp time and the circulatory arrest time are longer in the minimally-invasive group compared to a sternotomy approach, but still remain within safe margins and acceptable times. The minimally-invasive approach has demonstrated a reduction in ventilator time which has also helped reduce ICU length of stay. We have also seen a

reduction in the total hospital length-of-stay for the minimally-invasive approach in an era where cost containment is important, and paying for performance may become more commonplace. Indeed, minimally-invasive approaches may need to become more prevalent. Despite a steep learning curve with this particular pathology, the minimally-invasive platform requires patience and perseverance but also knowledge of when to convert to a sternotomy. In our series we had five conversions early on. In conclusion, the minimally-invasive small right thoracotomy approach for the treatment of ascending aortic pathologies with aortic valve involvement, under circulatory arrest, demonstrates acceptable morbidity and mortality. The ICU and hospital length of stay and transfusion requirements are less when compared to sternotomy cases. As mentioned, there is a learning curve as well as advanced technical complexity with any minimally-invasive procedure. A stepwise approach is necessary for addressing aortic pathology beginning with isolated valve surgeries.

Absorbable pulmonary artery banding: A strategy for reducing reoperations

Michael Daley, Christian Brizard, Igor Konstantinov, Johann Brink, Bryn Jones and Yves d'Udekem The Royal Children's Hospital Melbourne, Parkville, Australia



Despite being first reported back in 1952, the use of pulmonary artery bands still remains in the contemporary armamentarium for several congenital cardiac anomalies. Offering an extracardiac manipulation of pulmonary blood flow, this technique has reserved its place in management of neonates with single ventricle physiology and high pulmonary blood flow, postponing procedures in patients directed to bi-ventricular repair such as neonates with atrioventricular septal defects in heart failure or those requiring complex outflow tract reconstruction, as well as to promote

spontaneous closure of muscular ventricular septal defects or residual small ventricular septal defects (VSDs). Furthermore, exclusively banding the pulmonary artery carries the added benefit of avoiding cardiopulmonary bypass and cardiectomy. Although advances have been made in surgical technique, novel banding equipment and management, reoperation remains mandatory for eventual removal of the band. We sought to assess the efficacy of an absorbable pulmonary artery band in obviating the requirement for reoperation. Ten millimetre polydioxanone (PDS) tape (Johnson



Figure 1. 10mm PDS tape (Johnson and Johnson)

& Johnson, USA), originally designed for augmentation of ruptured anterior cruciate ligaments, was used as the absorbable pulmonary artery band in our study. Forty-five patients (median age 1.6 months; range 2 days – 11 months) underwent placement of an absorbable PDS pulmonary artery band from 2003 to 2015. In 28 patients (62%), the band was placed

concomitantly to a VSD closure and in 17 patients (38%), the band was the sole procedure for the VSDs. Fourteen patients had additional cardiac anomalies and nine patients had aortic arch anomalies, which were repaired at the time of band placement. The band was removed early in three patients, one of whom died in-hospital due to sepsis and multi-organ failure. Mean time to follow-up was 5.2±3.5 years with one patient lost to follow-up. Three patients died during this period from causes deemed unrelated to the pulmonary artery band (two from sepsis, one from ischaemic brain injury). Thirty-two of the 41 patients underwent successful single-stage repair of VSDs with the absorbable pulmonary artery band. Freedom from reoperation related to residual VSDs or

pulmonary artery band obstruction was 78% (95% CI: 61% - 87%) at 10 years. Twelve percent of patients who had concomitant VSD closure underwent reoperation, while 35% of patients who had band placement without VSD closure underwent reoperation, however this difference was not significant. Median time to resorption of the band was 7.2 months. Overall, our experience showed that the use of absorbable pulmonary artery bands is a valuable technique for VSDs prone to closure. The majority of patients avoided reoperations that were previously obligatory for conventional pulmonary artery bands. Although not reaching significance, concomitant closure of large VSDs at the time of band placement may carry added benefit in avoiding reoperations.

Cerebral autoregulation during cardiopulmonary bypass and its effect on postoperative cognitive decline

Nousjka PA Vranken Department of Cardiothoracic Surgery, Maastricht University Medical Centre, Maastricht, the Netherlands

Improvements and new techniques applied in cardiothoracic surgery with cardiopulmonary bypass (CPB) have greatly contributed to decreased postoperative mortality and morbidity rates. Despite these developments, complications including postoperative cognitive decline (POCD) still occur. Accompanied by short- and long-term effects, POCD remains a major burden for patients' quality of life following cardiac surgery with CPB. Although the exact mechanisms are still unknown, POCD is most likely multifactorial and in part caused by non-modifiable factors including the patient risk profile. Advanced age as well as the presence of multiple co-morbidities result in lengthier and more complex surgical procedures, predisposing the patient to an increased risk of POCD occurrence. Moreover, these pre-existing co-morbidities contribute to worsened control of cerebral blood flow, further



increasing the risk of postoperative neurological complications. Two major causative factors for POCD following cardiac surgery with CPB are thought to be brain hypoperfusion and cerebral emboli. In order to prevent or minimise intraoperative cerebral desaturations, non-invasive tissue oximetry using near-infrared spectroscopy has been proposed as a continuous brain monitor. Since its widespread clinical application, several studies suggest that cerebral oximetry is a valuable monitoring tool and imply that early intervention based on cerebral oximetry readings

can potentially decrease or even prevent POCD occurrence. Recent systematic reviews, however, failed to report sufficient support for the causal relationship between cerebral desaturations as identified by cerebral oximetry and POCD occurrence. This can be explained by the fact that the measurement method applied in cerebral oximetry cannot take the intrinsic neuroprotective cerebral autoregulatory activity into account. Although often forgotten, disturbances in cerebral autoregulation (CA) are a potent contributor to POCD risk. This is reflected by previous studies reporting a positive relationship between impaired CA and postoperative stroke, delirium and cerebral oedema in cardiac surgical patients. This underlines the importance of maintaining intact CA in the perioperative period. When intact, the cerebral autoregulatory system maintains stable and adequate cerebral blood flow, providing protection against cerebral hypo- and hyperperfusion. It does so by ensuring constant cerebral blood flow through reactive vasodilation

and constriction of the cerebral vasculature. Certain modifiable variables need to be strictly controlled to enable adequate CA functionality, i.e., physiological and haemodynamic parameters need to be maintained within predefined limits. First, CA can only operate within a certain range of mean arterial blood pressure values, also referred to as the lower and upper autoregulatory limit. Second, arterial carbon dioxide levels need to be strictly controlled since hypercapnia adversely affects cerebral vascular reactivity, disabling CA. Lastly, profound haemodilution is known to directly alter the risk of POCD. In patients undergoing CPB specifically, haemodilution exerts a negative effect on CA efficacy. In summary, focusing on maintaining intact CA during cardiac surgery will most likely decrease POCD risk. Perfusion strategy must be critically evaluated to enable strict control of the haemodynamic parameters affecting CA functionality. In addition, techniques limiting haemodilution may prove beneficial in terms of further POCD risk reduction.

Transcatheter aspiration of atrial and central vein thrombi using an extracorporeal suction device

Christoph T. Starck Department of Cardiothoracic and Vascular Surgery, German Heart Institute Berlin, Germany

starck@dhzb.de

Management of atrial and central vein thrombi is often a therapeutic challenge. Large and mobile thrombi in the right atrium or the central veins pose an immediate threat to the patient due to impending pulmonary embolism. Additionally, such patients are often in critical general condition. It remains unclear what the safest and most efficient therapeutic strategy is in such cases: i.e. thrombolytic therapy, open or percutaneous thrombectomy.^{1,2} Thrombolytic therapy is accompanied by a significant risk of haemorrhagic complications (22% major bleeding, 3% intracerebral haemorrhage).^{3,4} Open surgical thrombectomy carries relevant morbidity and mortality and may not be suitable for patients in a critical general condition.^{2,4}

Percutaneous thrombectomy using an extracorporeal aspiration device (AngioVac, Angiodynamics, USA) seems to be a promising and

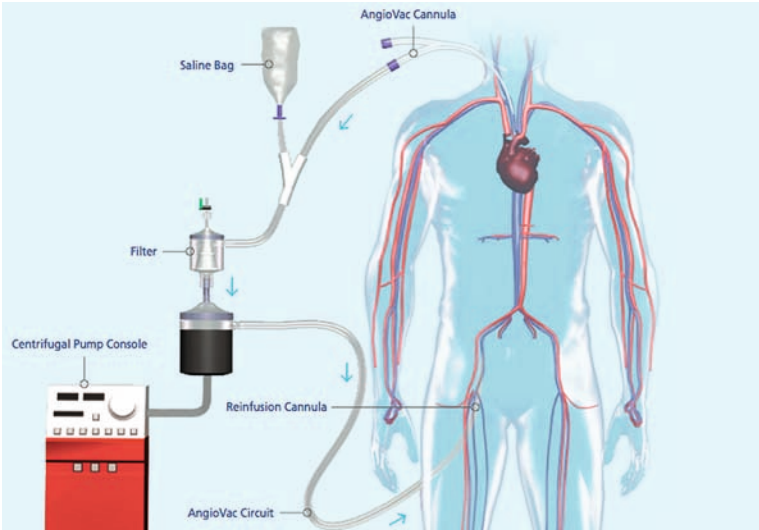


Figure 1. Percutaneous thrombus aspiration using the AngioVac system (Angiodynamics, USA) relies on an extracorporeal circuit used in a veno-venous configuration incorporating a filter/bubble trap system

evolving technology. The device relies on an extracorporeal circuit used in a veno-venous configuration, similar to an ECMO circuit using a filter/ bubble trap system instead of an oxygenator (Figure 1). Depending on the individual pathological situation of each patient, venous access is achieved by cannulating either both

femoral veins or by using one femoral vein and the right internal jugular vein. The AngioVac cannula is a 22F coil-reinforced cannula (length 90 cm) with an expandable funnel shaped distal tip. The expanded funnel-shaped tip improves venous drainage and the aspiration of thrombotic material (Figure 2). The



Figure 2. The AngioVac cannula (Angiodynamics, USA) is a 22F coil-reinforced cannula (length 90 cm) with an expandable funnel shaped distal tip. The expanded funnel shaped tip improves venous drainage and the aspiration of thrombotic material

aspiration procedure is guided by transoesophageal echocardiography and fluoroscopy, which allows for immediate monitoring of procedural success and potential intraprocedural complications. If not performed by a cardiac surgeon, the procedure necessitates immediate and competent cardiac surgical standby. The optimal localisation is a hybrid operating room.

The AngioVac procedure is mainly used for the elimination of ilio caval, central vein and right atrial thrombi. Reported procedural success rates range between 60% and 100%.⁵⁻⁷ In a recently-published single-centre experience of 16 patients, the authors reported a success rate of 87.5% and a major complication rate of 6.3%.⁸ Potential major complications are myocardial or vascular injury and pulmonary embolism,^{5,8,9} which emphasises the immediate availability of cardiac surgical rescue if the procedure is performed by a non-cardiac surgeon.

Further indications for the use of the AngioVac device have been reported to be large vegetations of pacemaker and ICD leads (prior to transvenous lead extraction) as well as pulmonary embolism.^{5,10} However, the treatment of pulmonary embolism still reveals suboptimal results with the current

device design.⁵ Our institutional experience (Figures 3, 4) with the extracorporeal suction device comprises: 13 patients (right atrial & central vein thrombi, 6 patients (46.2%); large lead vegetations prior to extraction, 6 patients (46.2%); pulmonary embolism, 1 patient (7.6%)) with a complete procedural success rate of 84.6%, a partial success rate of 7.7% a complication rate of 7.7%, and no operative mortality.

In conclusion, the aspiration of right atrial and central vein thrombi with the extracorporeal AngioVac suction device is safe and efficient, even in critically ill patients.

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Figure 3. Right atrial thrombi before percutaneous aspiration in transoesophageal echocardiography x-plane view

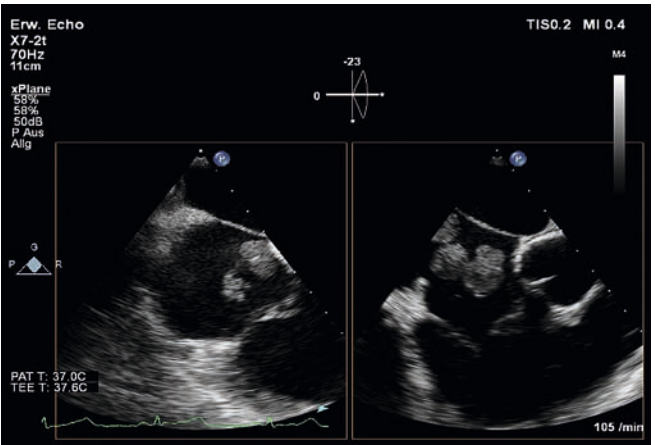
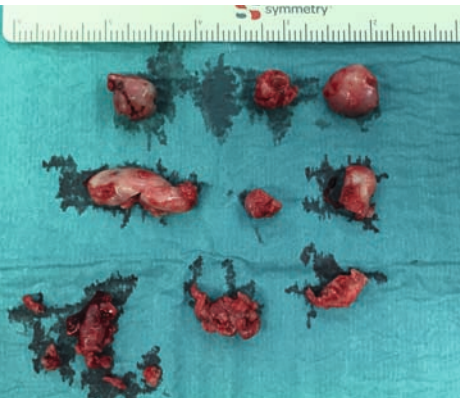


Figure 4. Result of a percutaneous aspiration procedure of right atrial thrombi (echocardiography images see figure 3) using the AngioVac system (Angiodynamics, USA)



Native-Like Hemodynamics of LivaNova's Valve Replacement and Repair Solutions Simplify Procedures, Improve Outcomes

LivaNova

The most effective prostheses exhibit hemodynamics as close as possible to those of native valves. This quality is essential to accommodate increased cardiac output and associated higher pressure gradients during normal daily activities¹. The SOLO SMART™ aortic heart valve and MEMO 3D RECHORD™ mitral annuloplasty ring are the innovative devices developed by LivaNova for valve replacement and repair, respectively. Both represent excellent solutions to valve disease and provide native-like hemodynamics^{2,3,4,5,6} to simplify procedures and deliver better outcomes. The SOLO SMART design accommodates the dynamic physiology of the flexible aortic root, facilitates left ventricular ejection and

produces less stress on leaflets¹. The “temporary stent” provides support, greater visibility and facilitates implantation guaranteeing a short learning curve and an implantation time similar to stented valves⁷. “It’s a simple and smart procedure” said Alberto Repossini, M.D., Cardiac Surgery University of Brescia, Spedali Riuniti, Brescia-Italy. “Thanks to its innovative design and ease of use SOLO SMART maximizes blood flow and delivers excellent hemodynamic performance to accommodate patients’ active lifestyles.” For patients presenting mitral valve regurgitation (MR), the MEMO 3D RECHORD represents the ultimate design for mitral valve repair, optimizing hemodynamics and durability and allowing a truly physiological annular motion^{5,6,8}.

Repair is the preferred surgical option in these patients because it preserves the native valve with lifelong restoration of function⁹. “The revolutionary structure of MEMO 3D RECHORD translates into a simpler, more streamlined procedure,” said Mattia Glauber M.D., Istituto Clinico Sant Ambrogio, Milan-Italy. “It represents a physiological solution to MR, mimicking to the patient’s natural anatomy to preserve the real-life 3D motion of the mitral annulus.” MEMO 3D RECHORD features include a series of loops in the posterior region of the ring that act as temporary reference elements for easier sizing of neochordae length. This innovative chordal guiding system allows a correct implantation of PTFE neochordae without requiring chordal measurement,

thereby improving the accuracy of the artificial chordae replacement technique while streamlining the procedure¹⁰. The result is a reproducible and truly physiological MR solution that preserves the natural structure and dynamics of the mitral valve annulus. Research has demonstrated the MEMO 3D’s ability to maximize blood flow in the early post operation period^{5,6,8} maintaining anterior posterior mobility more than five years after implantation¹¹. Pioneering innovative devices for valve replacement and repair with excellent solutions and optimal hemodynamics, LivaNova is cutting through complexity with simplified procedures and better outcomes. Find out more at LivaNova Booth No. 111.

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How to optimise mechanical support for single ventricle?

A. Di Molfetta¹, G. Ferrari²,
R. Iacobelli¹, S. Filippelli¹,
P. Guccione¹, A. Amodeo¹

1. Department of Pediatric Cardiology and Cardiac Surgery- Pediatric Hospital Bambino Gesù
2. Institute of Clinical Physiology- Italian National Research Council

Introduction

The most common cardiac lesion in congenital heart disease from six-months old to adulthood – and necessitating heart transplantation (HT) – is single-ventricle (SV) physiology.^{1–3} However, because of the lack of donors, this is available only to few patients. Therefore, SV patients could benefit from ventricular assist device (VAD), but currently the survival of SV patients supported by VAD is poor (50%) in comparison with the overall pediatric VAD survival of 70–86%,^{1,2} and the documented experience is limited to isolated case reports.^{1,3–11} Due to the complex anatomy and physiopathology, and due to the limited experience, a mathematical model could support clinical decision. The aim of our work was to develop and test a lumped parameter model to optimise the use of VAD in SV.

Methods

A lumped parameter model was adapted to Norwood, Glenn and Fontan physiology, and the model of different VADs were introduced.^{12–16} and a preliminary model verification was conducted using animal data.¹² Then, clinical and haemodynamic data of 10 Norwood, 10 Glenn and 10 Fontan patients were collected and used to simulate patients baseline, after which the following studies were conducted:

1. The study of the haemodynamic effects of LVAD (ventriculo-aortic connection) on Norwood, Glenn and Fontan physiology
2. The study of the haemodynamic effects of LVAD vs RVAD (cavo-pulmonary assistance) vs BIVAD in failing Fontan affected by isolated systolic dysfunction or isolated diastolic dysfunction or Fontan conduit failure
3. The study of the haemodynamic effects of simultaneous use of a continuous flow VAD and a pulsatile flow VAD for the biventricular assistance in Fontan using a continuous flow LVAD+pulsatile flow RVAD and vice versa

Table 1	
Norwood+LVAD	
Cardiac Output	+42%
SV stroke work	-13%
Mean pulmonary arterial pressure	+32%
Pulsatility Index	-82%
Glenn+LVAD	
Cardiac Output	+30%
SV stroke work	-27%
Mean pulmonary arterial pressure	+11%
Pulsatility Index	-70%
Fontan+LVAD	
Cardiac Output	+19%
SV stroke work	-44%
Mean pulmonary arterial pressure	+5%
Pulsatility Index	-68%

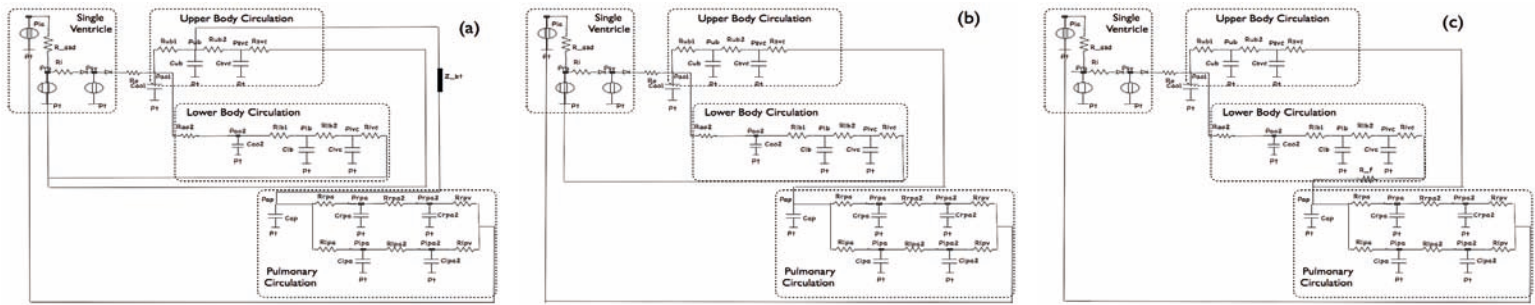


Figure 1A. Norwood circulation electrical analogue Figure 1B. Glenn circulation electrical analogue Figure 1C. Fontan circulation electrical analogue

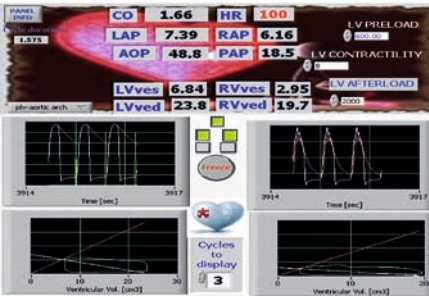


Figure 1D (below). Example of model user interface

Results

Model Verification

Table 1 reports a comparison between data measured on animals and simulated data at the baseline (biventricular circulation), during the Fontan physiology (realised clamping the superior and the inferior vena cava and redirecting the flow to the pulmonary arteries) and the assisted condition (RVAD). We observed that the SV elastance, total circulatory resistances and central venous pressure increased in the Fontan physiology and decreased after the RVAD. On the contrary, aortic pressure, pulmonary pressure, atrial pressure, cardiac output, SV volumes and SV stroke work decreased in the Fontan circulation and increased after the RVAD.

VAD in Norwood, Glenn and Fontan

Table 2 reports the comparison between measured and simulated data at the baseline. Results showed that the haemodynamic outcome differs according to the stage of palliation and that it is difficult to regulate the pulmonary flow in Norwood+LVAD patients (Table 3).

VAD in Failing Fontan

Evidence indicated that in the case of systolic or diastolic dysfunction, haemodynamic outcomes are maximised by a LVAD or BIVAD implantation. However, the LVAD causes an increment of the Fontan system pressure. Finally, in the case of isolated

Fontan physiology failure, the RVAD maximised haemodynamic outcomes, yet increased the SV stroke work. **BIVAD in Fontan** Simulation outcomes showed that the best haemodynamic improvement could be obtained by implanting a continuous flow LVAD and a pulsatile flow RVAD thus increasing the cardiac output, reducing the ventricular stroke work and increasing the pulsatility in the Fontan system (Figure 2).

Conclusion

The developed numerical model can accurately reproduce the SV haemodynamics and permits to evaluate the trend of cardiocirculatory parameters after VAD. The LVAD outcome differs according to the stage of palliation (Norwood vs Glenn vs Fontan). However, the regulation of haemodynamics is difficult in the Norwood procedure. In failing Fontan, the highest haemodynamic improvement is assured by BIVAD or LVAD implantation in the case of systolic or diastolic dysfunction. However, LVAD implantation increases the Fontan conduit pressure, while an RVAD increases the SV stroke work. Finally, in the case of BIVAD in Fontan, the best haemodynamic outcome is obtained with a continuous flow LVAD and a pulsatile flow RVAD.

Table 2. Comparison between Measured and Simulated Data at the Baseline, during the Fontan circulation and during the assisted Fontan circulation.		
Baseline Data	Mesured	Simulated
Cardiac Output (l/min)	3.0±1.5	2.9±1.5
Atrial Pressure (mmHg)	4.2±2.6	6.2±3.5
Mean Arterial Systemic Pressure (mmHg)	44.2±22.4	45.4±23.0
Mean Arterial Pulmonary Pressure (mmHg)	11.8±6.5	14.0±8.1
Ejection Fraction (%)	48±24	48±24
Fontan Data	Measured	Simulated
Cardiac Output (l/min)	0.6±0.4	0.6±0.4
Atrial Pressure (mmHg)	2.6±1.5	3.5±1.8
Mean Arterial Systemic Pressure (mmHg)	21.0±12.1	24±13.8
Mean Arterial Pulmonary Pressure (mmHg)	7.8±5.3	8.6±5.2
Ejection Fraction (%)	50±26	41±21
Assisted Fontan Data	Measured	Simulated
Cardiac Output (l/min)	3.6±1.8	3.7±1.8
Atrial Pressure (mmHg)	6±5.2	9±5.7
Mean Arterial Systemic Pressure (mmHg)	43.4±22.4	44.6±22.4
Mean Arterial Pulmonary Pressure (mmHg)	20.4±11.6	23.6±12.4
Ejection Fraction (%)	51±25	50±25

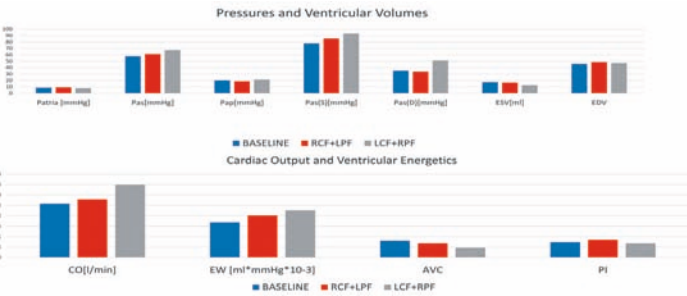


Figure 2. Concomitant use of pulsatile flow and continuous flow VAD in Fontan

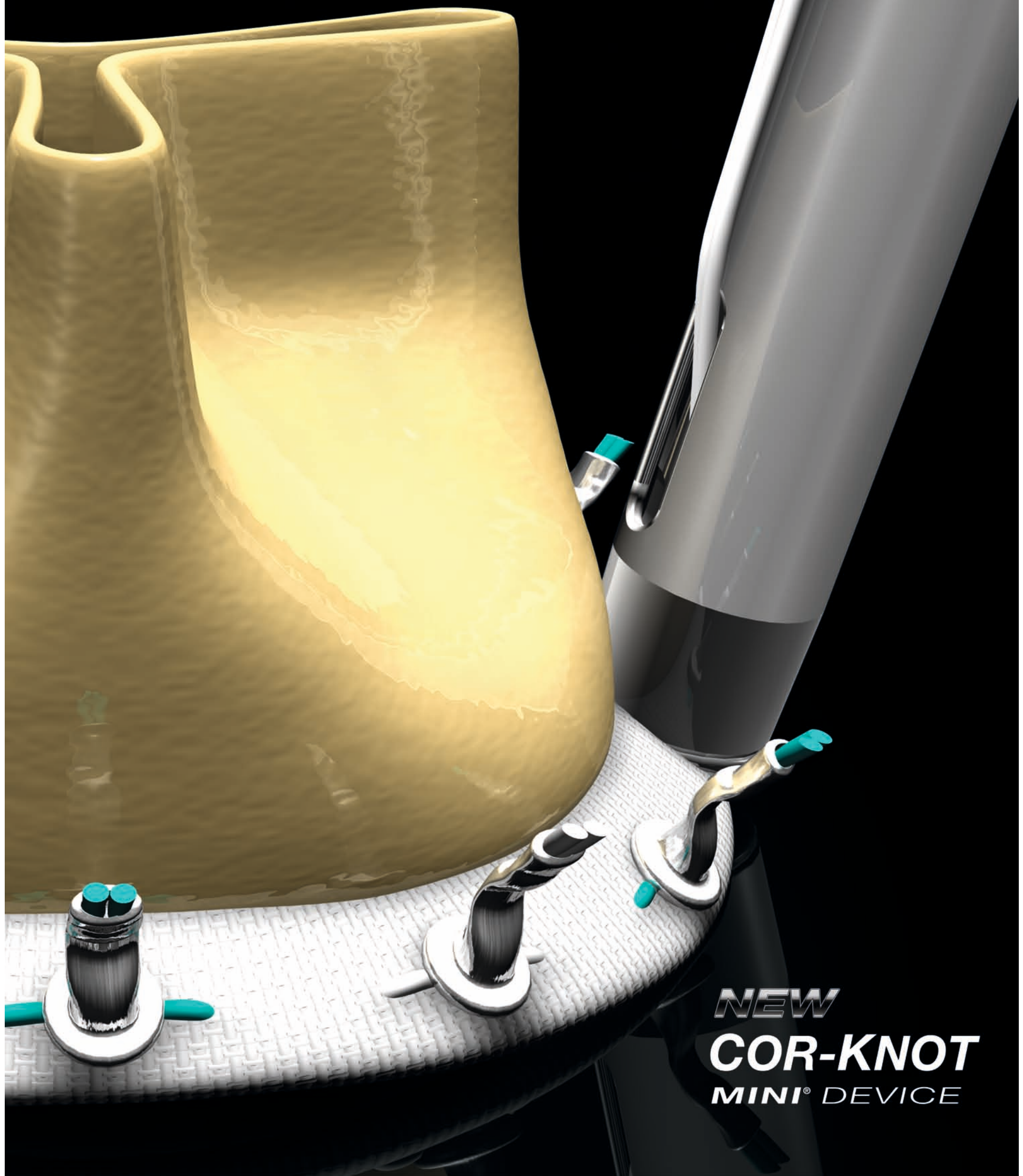
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Table 3. Comparison between Measured and Simulated Data at the Baseline		
Norwood Data	Mesured	Simulated
Cardiac Output (l/min)	1.5±0.8	1.6±0.7
Atrial Pressure (mmHg)	8±3.63	9.4±4.3
Mean Arterial Systemic Pressure (mmHg)	44.3±16.8	40.1±14.4
Systolic Arterial Systemic Pressure (mmHg)	69.3±25.4	64±23.2
Diastolic Arterial Systemic Pressure (mmHg)	26.9±10.7	22±8.2
Mean Arterial Pulmonary Pressure (mmHg)	13.5±7.5	14.7±6.9
End Systolic Volume (ml)	13.2±14.2	11.3±12.6
End Diastolic Volume (ml)	23.8±17.8	24.3±15.6
Ejection Fraction (%)	46±21	54.8±25.6
Glenn Data	Measured	Simulated
Cardiac Output (l/min)	2.3±1.2	2.1±1.1
Atrial Pressure (mmHg)	8.9±3.7	10.1±4
Mean Arterial Systemic Pressure (mmHg)	48.7±17.8	45±15.6
Systolic Arterial Systemic Pressure (mmHg)	69±24.6	69.3±23.9
Diastolic Arterial Systemic Pressure (mmHg)	35.3±13.4	29.4±11.2
Mean Arterial Pulmonary Pressure (mmHg)	14±5.5	16.1±6.4
End Systolic Volume (ml)	16.1±9	15.9±9.7
End Diastolic Volume (ml)	36.1±18.3	37.4±18.8
Ejection Fraction (%)	51±18.3	53.8±19.7
Fontan Data	Measured	Simulated
Cardiac Output (l/min)	2.5±0.9	2.7±1
Atrial Pressure (mmHg)	6.7±2.9	7.6±2.6
Mean Arterial Systemic Pressure (mmHg)	54.1±18.1	50.7±17.1
Systolic Arterial Systemic Pressure (mmHg)	71.6±24.1	75.4±25.3
Diastolic Arterial Systemic Pressure (mmHg)	41.7±14.2	36.3±12.4
Mean Arterial Pulmonary Pressure (mmHg)	10.9±4.2	13.6±4.5
End Systolic Volume (ml)	20.4±10.4	22.7±13.9
End Diastolic Volume (ml)	53.4±25.0	48.9±24
Ejection Fraction (%)	56.7±18.2	49.5±20.6

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EACTS 2016 Agenda

Saturday 1 October														
Techno College														
08:00	Aortic valve	Forum	Cardiac		13:30	Treatment of patients with bicuspid aortic valves	118 & 119	Cardiac		08:15	Joint Session EACTS SBCCV PASCATS – Cardiac surgery in underserved regions	120 & 121	Cardiac	
10:30	Atrioventricular valve 1	Forum	Cardiac		13:30	Basic Science – Cardiac	120 & 121	Cardiac		08:15	Update on thymic surgery	129 & 130	Thoracic	
13:15	Aorta, Ablation, and Assist devices	Forum	Cardiac		13:30	Oncology tumour board	131 & 132	Thoracic		08:15	The aorta and the bicuspid valve	113	Vascular	
15:10	Atrioventricular valve 2	Forum	Cardiac		13:30	Allied Health Professionals Programme – Abstracts	133 & 134	All Domains		10:15	Robotics revisited	122 & 123	Cardiac	
09:00	Beyond conventional video assisted thoracic surgery: Part 1	113	Thoracic		15:15	Expanding indications for transcatheter heart valves	116 & 117	Cardiac		10:15	The future of early stage non-small cell lung cancer	129 & 130	Thoracic	
13:30	Beyond conventional video assisted thoracic surgery: Part 2	113	Thoracic		15:15	Monitoring Quality in Your Unit: State of the Art	112	Cardiac		10:15	Repairing a bicuspid valve	113	Vascular	
Wetlab					15:15	Surgery for advanced infectious disease	131 & 132	Thoracic		10:15	Nightmares in cardiothoracic surgery	115	All Domains	
14:00	Valve sparing aortic root replacement	114	Congenital		15:15	Allied Health Professionals Programme – Closing the day	133 & 134	All Domains		10:15	Your educational pathway in surgery: how can EACTS help you?	118 & 119	All Domains	
Sunday 2 October					15:15	Balancing a surgical career with a family	114	All Domains		10:15	How can we work together? Latin America, Africa and Asia Perspective	120 & 121	All Domains	
Professional Challenge					Abstract Session					14:15	Mitral valve repair beyond P2	116 & 117	Cardiac	
08:15	EACTS/STS – Acute type A dissection	113	Vascular		08:15	Young Investigator Awards	212	Cardiac		14:15	Hypertrophic obstructive cardiomyopathy revisited	115	Cardiac	
10:00	EACTS/STS – Type B aortic dissection	113	Vascular		13:30	Surgical videos	111	Congenital		14:15	How to – video session 1	113	Vascular	
Focus Session					13:30	Defining good outcomes after aortic root surgery	113	Vascular		16:00	Minimally invasive aortic valve replacement – How to do it right in all patients	118 & 119	Cardiac	
08:15	Latest trials in cardiovascular medicine	116 & 117	Cardiac		15:15	Arch and descending aortic pathology	113	Vascular		16:00	Diaphragmatic disease	129 & 130	Thoracic	
08:15	Perfusion – Session 1	115	Cardiac		Abstract Rapid Response					16:00	Thoracic and thoraco-abdominal aneurysms treatment: Surgery after thoracic endovascular aortic repair and thoracic endovascular aortic repair after surgery	113	Vascular	
09:45	TAVR versus SAVR: David and Goliath	116 & 117	Cardiac		15:15	Congenital Rapid Response – Miscellaneous	211	Congenital		16:00	Meet the experts	122 & 123	All Domains	
08:15	State of the art in airway and esophageal endoluminal therapy	131 & 132	Thoracic		15:15	Trends in Aortic valve replacement	212	Cardiac		Abstract Session				
08:15	Basic science: Thoracic	120 & 121	Thoracic		Training in Research Session					08:15	Extra corporeal circulation/Left ventricular assist device/ Transplantation 1	133 & 134	Cardiac	
08:15	Failing Fontan	111	Congenital		08:15	Preparing your scientific breakthrough: from abstract to paper	122 & 123	All Domains		08:15	Univentricular heart – Fontan	111	Congenital	
09:00	Allied Health Professionals Programme – Pain	133 & 134	All Domains		13:30	Statistics from scratch: finding your way through the forest of options...	122 & 123	All Domains		08:15	Oncology I	131 & 132	Thoracic	
10:00	Perfusion – Session 2	115	Cardiac		Plenary					08:15	Work in progress	122 & 123	All Domains	
10:00	When strategy fails – Case based	112	Cardiac		11:45	The whole is greater than the sum of its parts: a strong team for a better outcome	116 & 117	Plenary		10:15	Coronary artery bypass graft and percutaneous coronary intervention	114	Cardiac	
10:00	Training in cardiothoracic surgery	118 & 119	Cardiac		Competition					10:15	Endocarditis	112	Cardiac	
10:00	Meet the experts – nightmare/complicated cases	111	Congenital		13:30	Jeopardy Competition Round 1	212	Competition		10:15	Extra corporeal circulation/Left ventricular assist device/ Transplantation 2	133 & 134	Cardiac	
10:00	Neuroendocrine lung tumours: where do we stand?	131 & 132	Thoracic		Monday 3 October					10:15	Basic science and lung transplantation	131 & 132	Thoracic	
10:00	Allied Health Professionals Programme – Innovation	133 & 134	All Domains		Professional Challenge					10:15	Hypoplastic left heart syndrome	111	Congenital	
10:30	QUIP Adult Database: Present and Future	120 & 121	All Domains		08:15	Wire skills transcatheter aortic valve implantation	116 & 117	Cardiac		14:15	Transcatheter aortic valve implantation	114	Cardiac	
10:45	Allied Health Professionals Programme – Nursing	133 & 134	All Domains		14:15	Rhythm Surgery in the upcoming decade	112	Cardiac						
13:30	Perfusion – Session 3	115	Cardiac		Focus Session									
13:30	Latest news and research on treatment of aortic valve stenosis	112	Cardiac		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						

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			
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Cardiac | Techno College | Aortic valve

A novel self-expanding device using a motorised delivery system

Lenard Conradi University Medical Center, Hamburg, Germany

As the use of transcatheter heart valve (THV) implants proliferates, manufacturers are seeking to facilitate the implant procedure and optimise functional results after transcatheter aortic valve implantation (TAVI). One such innovation is the CENTERA THV and Delivery Catheter from Edwards Lifesciences (USA). This system consists of a self-expandable THV that is pre-attached to a motorised delivery catheter, and designed to provide stable and predictable valve deployment.

Pre-attaching the THV to the delivery catheter eliminates the need to manually attach the THV onto the delivery catheter, streamlining valve preparation. The system's packaging tray enables the user to prepare the system in less than five minutes, using a few quick and simple steps – pouring heparinised saline into the integrated soaking basin, flushing the system, and loading the valve into the delivery capsule at the touch of a button. Designed to enhance the efficiency and reproducibility of valve implantation, the motorised system loads the



The Edwards CENTERA Transcatheter Heart Valve System



The Edwards CENTERA Transcatheter Heart Valve

valve into the delivery capsule and delivers it into the patient's calcified stenotic native aortic valve. The CENTERA THV is designed for transcatheter implantation in patients with severe, symptomatic aortic stenosis who are at high risk for open-chest surgery. It features a discrete nitinol frame in a contoured shape, is available in three sizes, and is compatible with a

14F eSheath for all sizes. The CENTERA handle is a battery powered (6V total) motorised unit that is attached to the delivery catheter. The ergonomic handle features two buttons that allow retraction of the delivery capsule proximally to deploy the THV (deploy button) or advancement of the delivery capsule distally to load/recapture the THV (load button).

Rotational wheels are located on each end of the handle to allow control of catheter flexion and THV release from the catheter. The Edwards CENTERA System is a promising innovation in self-expanding valve technology that has the potential to offer strong clinical outcomes and to also streamline the procedure for the operator.

Cardiac | Techno College | Atrioventricular valve 1

Mitral valve-in-valve implantation

Thomas Modine Chru de Lille, France

Despite the major progress achieved over the past years, a significant proportion of patients who undergo mitral valve surgery require reoperation during follow-up. Because of the favourable clinical results provided by bioprostheses, implantation of biologic valves has continuously increased compared with mechanical prostheses, even in younger patients. This led to an increase in the number of patients requiring redo surgery as a result of degenerated valves. Conventional redo valve surgery, especially in elderly patients with various comorbidities, is still higher risk. During the 10 years following mitral valve replacement or repair, reoperation is needed in 20% to 35% of patients. While redo surgery is the treatment of choice after bioprosthesis or ring annuloplasty failure, it may

be associated with significant early mortality (5% to 12%), especially in patients with concurrent comorbidities. When Walther and colleagues first described the valve-in-valve concept in 2007, a new treatment option was defined for selected high-risk patients requiring redo surgery for degenerated biologic valves. In 2008, Kempfert and colleagues broadened the application spectrum of the valve-in-valve concept by successful animal demonstration. The next step, transapical valve-in-valve TAVI in a human for a degenerated bioprosthesis in the mitral position (transcatheter mitral valve-in-valve implantation, or TAMVI), was performed by Cheung and colleagues in 2009. Since then, various reports have described small case series of successfully performed TAMVI. The choice of the transcatheter heart valve size is based on an integrative approach, taking into account a bioprosthesis' inner diameters, and also the

mean diameter determined from the long and short diameter measurements as assessed by computed tomography (CT) and three-dimensional transoesophageal echocardiography (TEE). The transapical approach is typically performed by left anterolateral minithoracotomy at the fifth or sixth intercostal space. After placement of ventricular pacing wires, two octagonal, Teflon-pledgetted pouch sutures are placed to secure the apex. After puncture of the apex, a soft Judkins guidewire is inserted and placed across the mitral valve bioprosthesis into left atrium, and – after replacement of the soft guidewire by an Amplatz Extra-Stiff wire guide (Cook Medical, USA), the delivery sheath and then the catheter is inserted. Two manufacturers' valves have been used to date: Edwards Lifescience's (USA) Sapien, XT and Sapien S3 valves, and Boston Scientific's (USA) Lotus Valve. The transapical approach allows

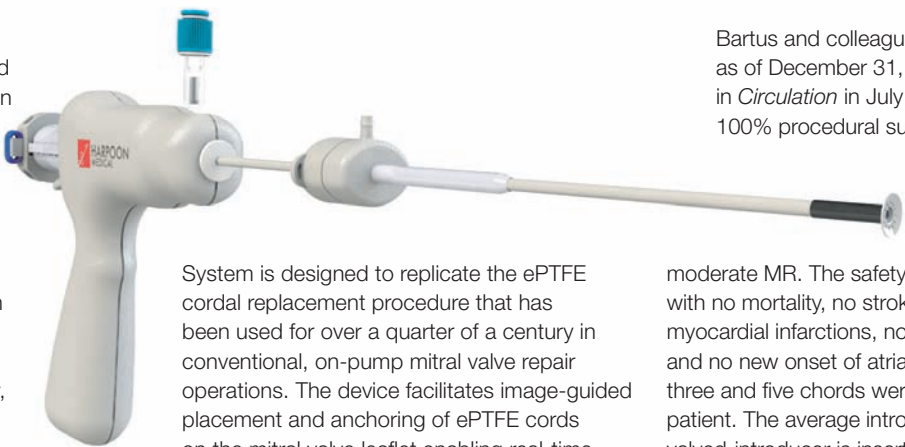
a direct and coaxial access to the mitral valve, and the prior implanted bioprosthesis indicates the landing zone for during deployment. With certain types of surgical valves, the guidance and positioning of the valve is also possible by transoesophageal echocardiography. Thus, the orthogonal positioning of the valve by means of transapical access is convenient and can be precisely performed. However, successful transeptal implantations have been reported successfully with Sapien valves. A hybrid operating room setting with fluoroscopy and transoesophageal echocardiography is mandatory. The transcatheter valve-in-valve concept provides several promising aspects. First, the procedure is straightforward to perform and less invasive than conventional surgery, with reduced mean procedure time which is less resource-consuming for the patient and surgeon in comparison to a complex redo surgery. Excellent

haemodynamic and clinical results can be achieved, however there is a risk of ventricular rupture and LVOT obstruction that requires a great deal of attention on patient selection and during the procedure. Nonetheless, conventional cardiac surgery by means of a sternotomy is still the gold standard and provides good clinical results – especially in high-volume centres. Transcatheter mitral valve in valve implantation is a safe, feasible and innovative approach to degenerated mitral valve prostheses in selected populations. Further detailed and well-organised studies with more patients and longer follow-up are needed to improve patient selection, and exact indications for performing a transcatheter procedure are needed for high-risk patients. Nevertheless, TAMVI remains an interesting alternative strategy that should be considered for patients with high risk for conventional redo surgery.

Cardiac | Techno College | Atrioventricular valve 2

Beating-heart mitral valve repair with artificial ePTFE cords

There is a tremendous amount of interest and excitement focused on minimally-invasive, beating-heart devices to address mitral valve disease as everyone hopes to recreate the success of transcatheter aortic valve replacement (TAVR) in the mitral position. Jagiellonian University's John Paul II Hospital in Krakow, Poland and the Institute of Cardiology in Warsaw, Poland have completed an Early Feasibility Study (EFS) of the Harpoon Mitral Valve Repair System in thirteen patients with excellent early and mid-term results. The Harpoon Medical Mitral Valve Repair



System is designed to replicate the ePTFE cordal replacement procedure that has been used for over a quarter of a century in conventional, on-pump mitral valve repair operations. The device facilitates image-guided placement and anchoring of ePTFE cords on the mitral valve leaflet enabling real-time, beating-heart titration of the artificial cord length to maximise leaflet coaptation and minimise mitral regurgitation (MR). Interim results from Professor Krzysztof

Bartus and colleagues' early experience as of December 31, 2015 were published in *Circulation* in July of 2016,¹ showing 100% procedural success. Nine of eleven patients had none/trace or mild MR at 30 days, with the other two exhibiting moderate MR. The safety profile was excellent with no mortality, no stroke, no renal failure, no myocardial infarctions, no blood transfusions and no new onset of atrial fibrillation. Between three and five chords were implanted in each patient. The average introducer time (the time the valved-introducer is inserted into the left ventricle) was 38 minutes, and the average skin-to-skin procedure time was 110 minutes. During the Techno College 'Atrioventricular valve 2' session, held today at 15:30-18:00,

Professor Bartus will present an update on the Early Feasibility Study with data collected through August 31, 2016. The presentation will include six-month follow-up data on all thirteen patients enrolled in the study, and one-year follow-up data on six patients. The intermediate term data that will be presented at the Techno College is quite compelling and promises to be an exciting presentation. While there is still a lot to learn, this early experience demonstrates that the Harpoon Mitral Valve Repair System can replicate the results of the time-tested on-pump ePTFE cordal replacement procedure that has gained popularity over the last decade.

References
1. Gammie JS, Wilson P, Bartus K, et al. Transapical Beating-Heart Mitral Valve Repair With an Expanded Polytetrafluoroethylene Cordal Implantation Device: Initial Clinical Experience. *Circulation*, 2016;134(3)

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Edwards

Congenital | Abstract Session | Congenital miscellaneous 2

Modified Blalock-Taussig shunt: Perioperative parameters for in-hospital mortality and shunt thrombosis in patients < 3 kg with UVH malformation or aUVP

Voravit Chittithavorn, Pongsanae Duangpakdee, Chareonkiat Rergkliang, and Napat Pruekprasert

Division of Cardiothoracic Surgery, Department of Surgery, Faculty of Medicine, Prince of Songkla University, Hatyai, Songkhla, Thailand

Modified Blalock-Taussig shunt (MBTS), the most common systemic-to-pulmonary artery shunt done in this era, is essential for management of selected patients with cyanotic congenital heart malformation, especially for staged repair in univentricular heart malformation (UVH) and anticipated univentricular palliation (aUVP). Despite improvement in perioperative management, the overall adverse outcomes of the MBTS are relatively high. According to previous studies, risk factors for morbidity and mortality after MBTS included age, weight and underlying cardiac anatomy. Patients with low weight, who are less tolerant to the surgery, have consistently been reported to have poorer outcomes after MBTS. However, limited data from previously reported studies did not clearly demonstrate the factors determining surgical risk in patient-specific conditions with complexity underlying cardiac anatomy. For reduction of the morbidity and mortality in such group of patients, contributing factors are essential.

Therefore, the aim of this study was to determine perioperative parameters associated with the occurrence of in-hospital mortality and shunt thrombosis in patients of less than 3 kg with UVH malformation or aUVP who underwent MBTS (Figure 1).

The analysis included 85 patients, representing

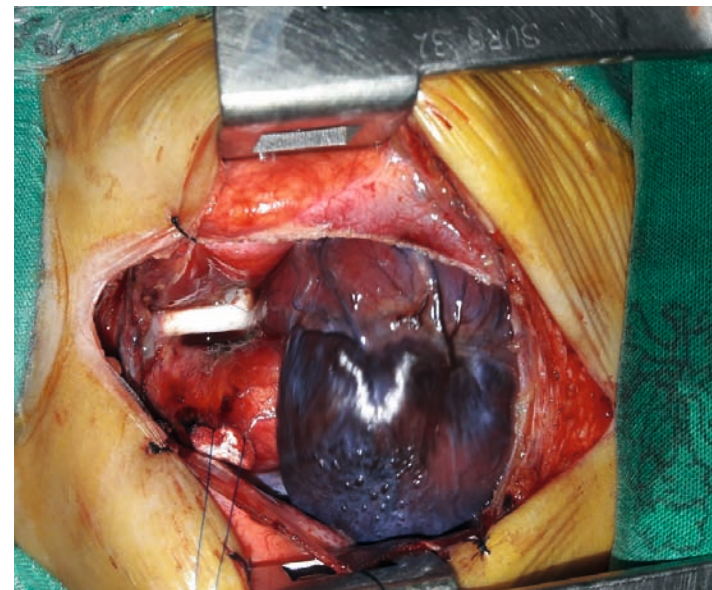
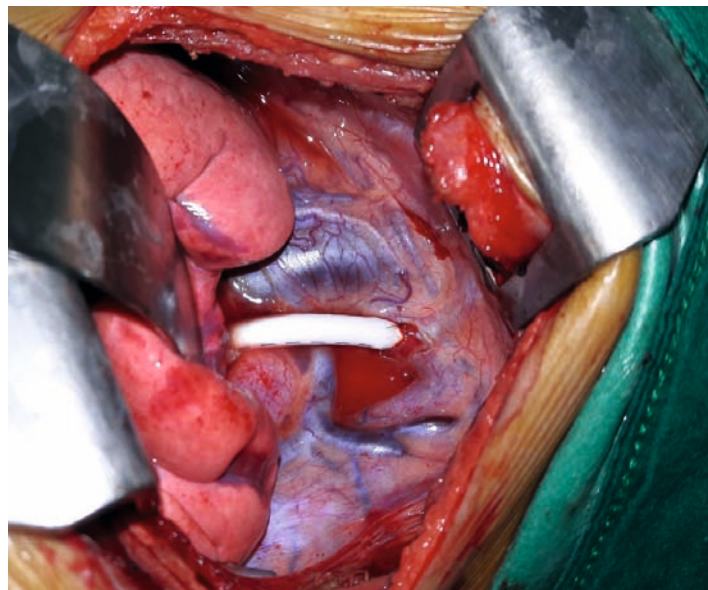


Figure 1. Completed MBTS in thoracotomy and sternotomy approach

18% of all 474 patients who received MBTS procedures between January 2006 and February 2016, and 61% of those who weighed less than 3 kg. There were 48 males (56.5%) with a mean age of 17.4 days (range 1–123 days) and a mean weight of 2.64 kg (1.56–2.98 kg) at the time of surgery.

We reviewed the characteristic and operative parameters of the patients and identified the pattern of interrelation with in-hospital shunt thrombosis and in-hospital mortality, which were our primary outcomes. There was no operative death in this study. In-hospital mortality was 17.6% (n=15) while in-hospital shunt thrombosis was 14.1% (n=12). The analysis did not demonstrate any significant correlation between

all categories of the patients' age, weight, included types of malformations (pulmonary atresia with intact ventricular septum, UVH, tricuspid atresia and aUVP), birth maturity, extracardiac abnormalities, surgical approach (thoracotomy/sternotomy), shunt-size, pulmonary artery shunted size, clamp time, competitive shunt flow, shunt related complications (apart from shunt thrombosis) and primary outcomes.

However, by multiple logistic regression analysis, we found delayed anticoagulant initiation, and postoperative cardiac arrest to be independent risk factors for shunt thrombosis, and low oxygen saturation on postoperative day to be a predictive factor. Also, shunt thrombosis, intraoperative bradycardia and high postoperative

haemoglobin showed significant association with in-hospital mortality.

In conclusion, in-hospital mortality was relatively high in low-weight patients with functional UVH who underwent MBTS. Shunt thrombosis and intraoperative bradycardia were the main factors associated with in-hospital mortality. The results of this study suggest that preventing shunt thrombosis, such as by meticulously managing cardiac arrhythmias, preventing low cardiac output, avoiding unnecessary postoperative blood transfusions, initiating timely anticoagulation, and directing towards quality improvement in perioperative care, could result in improved outcomes in these high-risk patients.

Cardiac | Rapid Response | Cardiac General

Can monitoring central venous saturation replace monitoring mixed venous oxygen saturation in patients after cardiac surgery?

Marek A Deja Department of Cardiac Surgery, Medical University of Silesia, Katowice, Poland

Ensuring optimal oxygen supply is a mainstay of postoperative care of cardiac surgical patients. The current gold standard in haemodynamic monitoring for ensuring the optimal oxygen supply is the Swan-Ganz catheter, which allows for assessment of mixed venous oxygen saturation (SvO₂). The application of the catheter is an invasive procedure which can result in many complications. Some authors claim that central venous oxygen saturation (ScvO₂) has a similarly strong prognostic value, and can efficiently reveal a hidden tissue hypoxia, thus avoiding pulmonary artery catheterisation. Notably, central venous catheters are the standard of care in all cardiac surgical patients, thus substituting SvO₂ with ScvO₂ has prompted such an interest that devices enabling constant ScvO₂ monitoring have been made available on the market.

That being said, doubts remain as to whether such a substitution should be deemed safe for cardiac surgical patients, who by definition are at higher risk of low cardiac output.

Our study was conducted on a sample of 26 cardiac surgical patients who had a Swan-Ganz catheter applied after induction of anaesthesia, as they were considered high risk for postoperative low cardiac output. We measured both SvO₂ and ScvO₂, and evaluated the haemodynamic profile at 113 individual time points (4.3 per patient). The oxygen extraction ratio (O₂ER) was calculated to assess the oxygen wellbeing of the patient, with the normal values falling between 22% and 32%. As such,

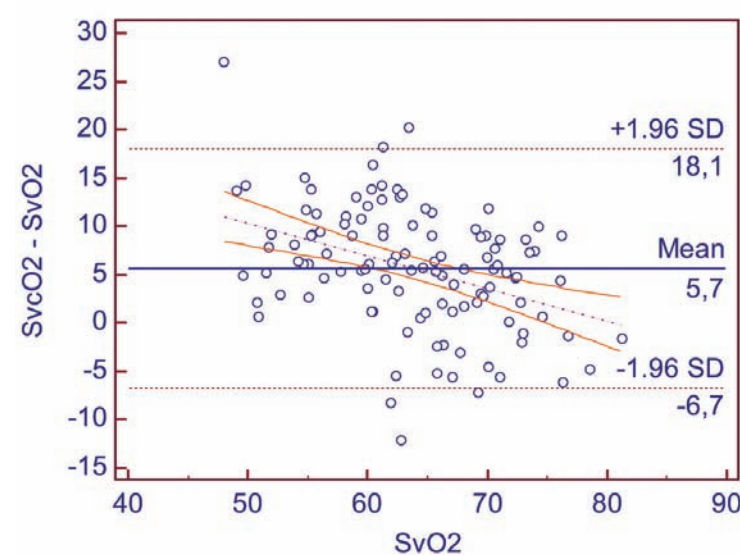


Figure 1. The Bland Altman plot. The agreement of mixed venous oxygen saturation and central venous oxygen saturation is weaker with lower saturation values (SvO₂ = mixed venous oxygen saturation; ScvO₂ = central venous oxygen saturation)

extraction above 32% indicates significant oxygen demand–supply mismatch.

We used the Bland–Altman method to gauge the difference between either of the saturations, while the ROC curve analysis was used to evaluate the ability of SvO₂ and ScvO₂ to predict oxygen extraction ratio >32%. SvO₂ and ScvO₂ are moderately correlated (r=0.64, p<0.001). According to Bland–Altman analysis (Figure 1) ScvO₂ exceeds SvO₂ by 5.7% +/- 6.3%, and

this rises with lower values (i.e. bigger oxygen demand–supply mismatch). While the correlation between oxygen extraction ratio and SvO₂ is very strong (r=-0.91, p<0.001), the correlation between O₂ER and ScvO₂ is moderate (r=-0.64, p<0.001). The ROC curve analysis (Figure 2) proved the significantly-higher ability of SvO₂ to predict excessive O₂ER, with the best cut-off value of SvO₂=65% (negative predictive value 96%). This corresponds to a ScvO₂ cut-off value

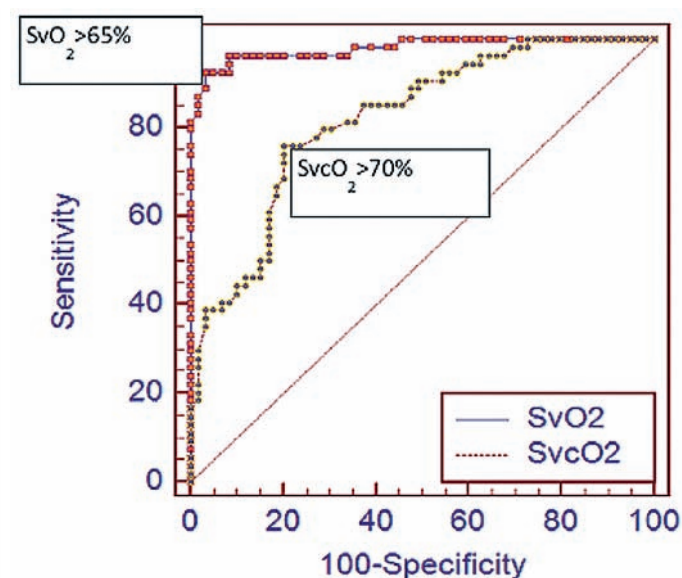


Figure 2. The ability of mixed venous oxygen saturation and central venous oxygen saturation to predict excessive oxygen extraction ratio (O₂ER > 32%). The cut off points are: SvO₂ >65% with Youden index 0.89 and negative predictive value 96.0% (86.3–99.5), ScvO₂ >70% with Youden index 0.56 negative predictive value 70.5% (57.4–81.5). SvO₂ mixed venous oxygen saturation. ScvO₂ central venous oxygen saturation O₂ER oxygen extraction ratio

of 70%, with negative predictive value of 71%.

Thus while ScvO₂ may be used as an additional method of postoperative monitoring in low-risk cardiac surgical patients – with the aim of maintaining values above 70% – the negative predictive value of ScvO₂ is too low to use for high-risk patients, where SvO₂ remains the golden standard (with the aim to maintain values above 65%).

Cardiac | Abstract Session | Coronary artery bypass graft and percutaneous coronary intervention

The No-touch saphenous as the preferred second conduit for coronary artery bypass graft surgery

Mats Dreifaldt^{1*}, John D Mannion², Lennart Bodin³, Håkan Geijer⁴, Mats Lidén⁴, Domingos Souza⁵ 1. Department of Cardiothoracic and Vascular Surgery and University Health Care Research Center, School of Medical Sciences, Örebro University, Örebro, Sweden; 2. Department of Surgery, Bayhealth Medical Center, Dover, Delaware, USA; 3. Institute of Environmental Medicine; Unit of Intervention and Implementation Research, Karolinska Institute, Stockholm, Sweden; 4. Department of Radiology, School of Medical Sciences, Örebro University, Örebro, Sweden; 5. Department of Cardiothoracic and Vascular Surgery, School of Medical Sciences, Örebro University, Örebro, Sweden

* mats.dreifaldt@regionorebrolan.se

There has always been a longstanding concern regarding the low long-term patency rate for saphenous vein (SV) grafts when used as conduits for coronary artery bypass grafting (CABG) surgery. The limitations of current strategies for improving SV graft patency has led to widespread acceptance of the radial artery (RA) as the second conduit for CABG after the internal thoracic artery (ITA).

With conventional harvesting technique (CT) the SV graft is stripped from surrounding tissue, a procedure that damages the adventitia and causes spasm to the graft. In order to overcome the spasm the graft has to be distended with high pressure which severely affects both the intima and the media of the graft. This is the main reason for the poor outcome of the saphenous vein grafts.

Twenty years ago Dr Domingos Souza from the Department of Cardio-Thoracic and Vascular surgery, Orebro, Sweden, started to develop a new harvesting technique, called the No-touch technique (NT), where the SV is harvested with a pedicle of surrounding tissue. This

prevents the graft from going into spasm and distension is therefore not needed.

A longitudinal randomised controlled trial comparing patency for saphenous vein grafts harvested with NT and CT has shown a significantly higher patency for SV

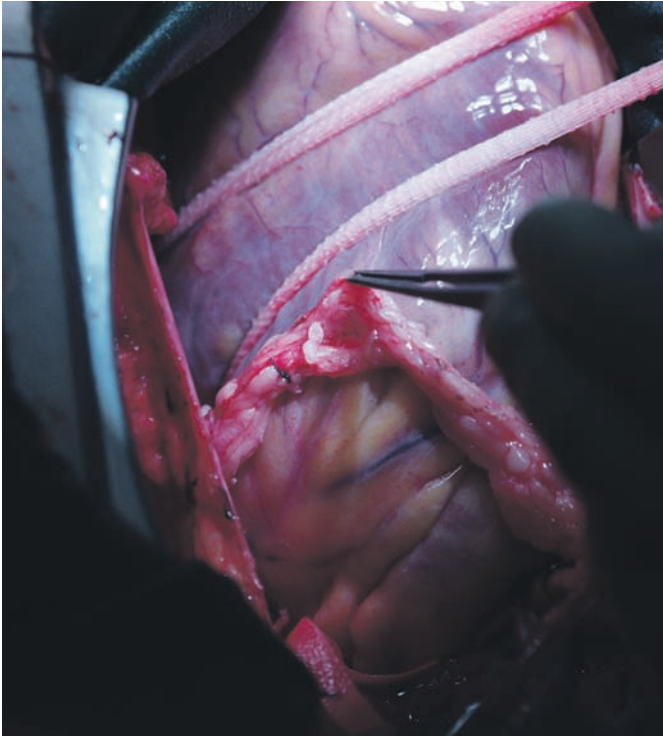
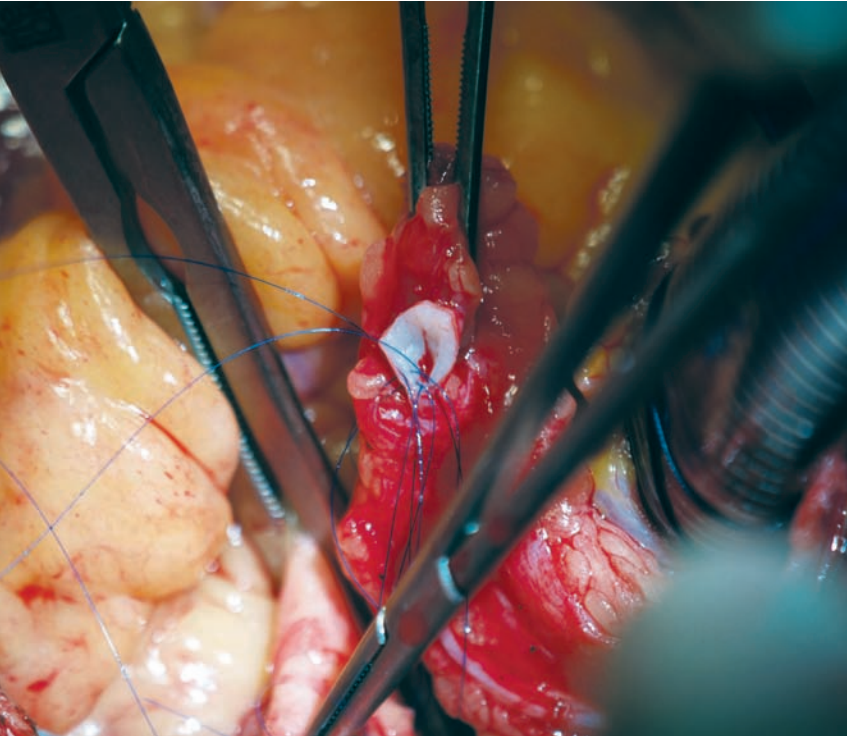
grafts harvested with NT both at 18 months (95 % vs 89 %), 8.5 years (90 % vs 76 %) and 16 years (83 % vs 64 %).

In 2004, a new longitudinal randomised controlled trial comparing patency rates between RA and NT SV grafts was initiated.



This study included 108 patients that were randomised to receive one RA and one NT SV graft to the right and left coronary territory respectively as complementary grafting to the left ITA to the left anterior descending artery. The RA grafts were prepared with similar technique as the NT SV grafts. In summary, the grafts were obtained with a pedicle of surrounding tissue and left in situ until after heparinisation. After

removal, the grafts were stored in heparinised blood and were neither flushed nor distended. The first follow-up, three years after surgery, showed a significantly higher patency for NT SV grafts (95 % vs 84 %). The eight-year outcome of this trial, which is going to be presented at the 30th EACTS meeting also showed a favourable result for No-touch saphenous vein grafts. Our conclusion is that the No-touch saphenous vein graft should be considered as the second conduit for coronary artery bypass grafting surgery.



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In this issue

- Hybrid repair of complex aortic arch pathologies
- "Inside Barcelona" guide
- End of story for interlocks for cardiorespiratory bypass?
- Conventional VATS or single incision approach?
- Coping with the challenges for spinal cord protection
- Understanding brain protection during aortic arch surgery
- A fundamental role for middle esophageal life support?
- Coronary autologization during bypass
- Optimising mechanical support

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 meeting 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 this 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 Guggenheim Museum, to stroll "La Rambla" as well as enjoying tapas and Sagnés with 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

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

Balancing a surgical career with a family

Malakh Shrestha
Hannover Medical School

now they have only been the "exception". And even first objective solutions, which could

The objective of this session is to discuss the problem and to find

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

Cardiac | Abstract Session | Transcatheter aortic valve implantation 2

TAVI vs SAVR: some certainties from the growing evidence

Manuel Carnero-Alcázar and Luis Maroto-Castellanos Department of Cardiac Surgery, Hospital Clínico San Carlos, Madrid, Spain

Comparing results of TAVI and SAVR among moderate- and high-risk patients is a trending topic in cardiology and cardiac surgery nowadays. The efforts of the medical industry in improving the design of transcatheter and SAVR prostheses and the increasing expertise of surgeons and interventional cardiologists have expanded the possibility to treat aortic stenosis to inoperable, high and intermediate risk patients with fairly good results. In less than a decade, the results of four major randomised clinical trials¹⁻⁴, and hundreds of single and multicentre observational studies have been published. Given the growing amount of literature and its huge variability it is difficult to withdraw clear and consistent conclusions from the analysis of individual manuscripts. In order to bring some light into this messy scenario, we performed a meta-analysis comparing TAVR and SAVR among high and intermediate risk patients in terms of ‘heavy’ adverse outcomes (death and stroke) and other clinically relevant events (need for pacemaker, acute kidney



injury, vascular complications, major bleeding, residual aortic regurgitation and haemodynamic performance). With this purpose, we collected 48 manuscripts published in the last decade, pertaining to more than 20,000 patients and comprising randomised clinical trials and propensity score matched observational studies. The pooled analysis demonstrated similar risks of early- and long-term mortality between TAVR and SAVR (OR=1.11, p=0.355; and RR=0.91, p=0.194; respectively). Similarly, the incidence of early and late stroke was not different between the two strategies (OR=0.97, p=0.802; and RR=0.78, p=0.116; respectively). On the contrary, we did find a significant and clinically relevant reduction in the risk of major bleeding (OR=0.42, p=0.001) and acute kidney injury (OR=0.51, p<0.001) after TAVR. Pacemaker implantations (OR=2.31, p<0.001) and vascular complications

Outcome	Pooled OR or RR (95% CI)
Early Mortality	OR 1.11 (0.89 -1.39)
Late Mortality	RR 0.91 (0.78-1.05)
Early Stroke	OR 0.97 (0.75-1.25)
Late Stroke	RR 0.78 (0.56-1.07)
Major Bleeding	OR 0.42 (0.25-0.69)
Acute Kidney Injury	OR 0.51 (0.35-0.74)
Pacemaker Implantation	OR 2.31 (1.73-3.08)
Vascular Complications	OR 4.88 (2.84-8.39)
Residual Aortic Regurgitation	OR 6.83 (4.87- 9.6)

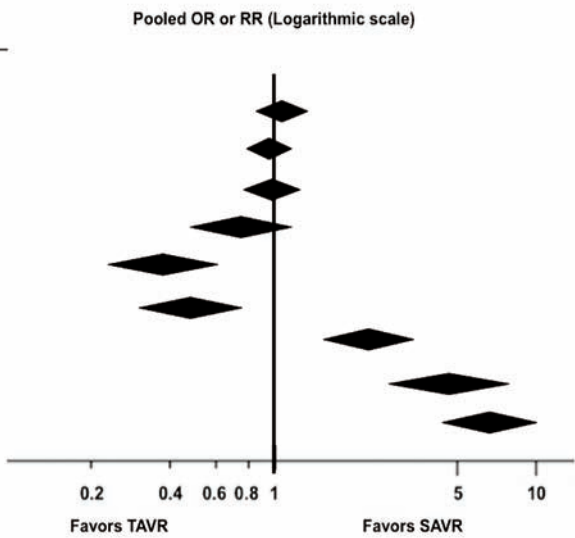


Figure 1. Pooled OR and RR of different outcomes

(OR=4.88, p<0.001) were much more frequent after transcatheter aortic valve implantation. Conventional prostheses had higher trans-prosthetic gradients (mean difference 2.4 mmHg, p<0.001), but the risk of residual aortic regurgitation was greater after TAVR (RR=6.83, p<0.001) (Figure 1). A sensitivity analysis demonstrated that these results were consistent across intermediate or high risk patients, type of TAVR devices, etc. Similar risks of death and stroke after TAVR or SAVR have been previously reported, and are not original findings of this study. On the other hand, this is the first meta-analysis to detect significant, robust and clinically relevant differences in other potentially disabling and life-threatening complications, which must be carefully considered. We hope that the results and interpretation of this meta-analysis, along with a meticulous assessment of patients’ comorbidities, may help Heart Teams to take the most beneficial decisions in the treatment of patients with aortic stenosis.

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Cardiac | Techno College | Atrioventricular valve 2

Mitral valve leaflet augmentation in the setting of rheumatic mitral valve disease using a decellularised pericardial patch

Meindert Palmen Leiden University Medical Center, the Netherlands

Introduction

Rheumatic mitral valve disease is the most common cause of mitral valve stenosis. The feasibility of mitral valve repair is dependent on the status of the subvalvular apparatus and on the surface area, pliability and calcification of valve leaflets and commissures. In order to obtain a durable repair, leaflet augmentation, aimed at restoring the leaflet surface area and improving its pliability, is often inevitable. Although surgical repair of mitral stenosis is feasible, recurrence of mitral stenosis or regurgitation after successful initial surgical repair is a major concern. This might be related to calcification of the pericardial patch.¹ In this paper, we describe a case series of patients undergoing mitral valve repair for rheumatic valve disease with anterior and/or posterior leaflet augmentation using a decellularised pericardial patch that is expected to be more resistant to calcification.

Surgical technique

The mitral valve was approached transseptally. First, the valve was carefully inspected to identify the lesions and assess the degree of dysfunction and the feasibility of valve repair. Commissural fusion was addressed with commissurotomy and papillary muscle splitting. Decalcification of leaflet and annulus was performed when estimated important for durable valve repair and leaflet pliability. Leaflet augmentation was performed in all cases. In cases of leaflet augmentation, the calcified or fibrotic part of the leaflet was resected. Typically, the free edge of the leaflet



was preserved, although not feasible in all. Residual leaflet and annular decalcification was performed as needed. A generous CardioCel® (Admedus, Perth, Australia) pericardial patch was used to restore the leaflet surface, using a continuous 4-0 or 5-0 polypropylene suture. In two cases (and also in the case presented today), posterior leaflet augmentation was needed as severe retraction and calcification of the P2 region was present. The leaflet was excised to the level of the posterior annulus and a quadrangular CardioCel patch was inserted using continuous 4-0 polypropylene sutures. To prevent systolic anterior motion, the targeted height of the posterior leaflet was no more than 15-20 mm. Then, 4-0 polytetrafluoroethylene neochords were implanted on the free edge of the patch for support, and to assure good leaflet coaptation. To decrease the tension on the augmented leaflet(s), annular remodelling using full-ring annuloplasty using a saddle-shaped ring was performed in all cases.

Result

Between January 2014 and January 2016, five patients (four female, one male; mean age 61±7 years) underwent anterior or posterior mitral valve leaflet augmentation in the setting of mitral valve repair for rheumatic mitral valve disease. Two patients presented with severe mitral regurgitation, while three presented with a combined mitral valve lesion. Three patients had severe pulmonary hypertension, while two had a history of atrial fibrillation. All patients were in NYHA class II or III with a good left ventricular function. Previously, percutaneous mitral valve balloon dilatation and open surgical commissurotomy was performed in three patients. All patients underwent mitral valve repair using a combination of techniques described above. Anterior mitral valve leaflet and bileaflet

augmentation were performed in five and two patients, respectively. Echocardiography demonstrated good result of valve repair with none or mild residual regurgitation in all cases and a mean gradient of 4.5 mmHg (in one patient a gradient of 7.8 mmHg was seen). Postoperative course was complicated by re-sternotomy due to persistent postoperative blood loss and/or late cardiac tamponade in three cases, and a pacemaker implantation due to symptomatic sinus bradycardias in one case. Further clinical course was uneventful.

Discussion

Mitral valve repair in the setting of rheumatic valve disease remains challenging due to the complexity of lesions and extent of valve dysfunction. As the disease commonly affects younger people, avoidance of life-long aggressive anticoagulation needed in cases of mechanical mitral valve replacement is highly desired. However, disease progression is responsible for high incidence of recurrent mitral regurgitation and/or stenosis and valve-related reoperation.^{1,2} Leaflet augmentation presents a valuable surgical technique aimed at replacing deficient or destructed native valve tissue. Anterior leaflet augmentation also allows for larger ring annuloplasty size, securing a larger mitral valve orifice area and lowering the probability of excessive residual trans-mitral gradient. Different techniques to augment the disease leaflet are available; the choice depends on whether there is tissue deficiency in height or width. When the latter is present, particular in case of anterior leaflet retraction, a vertical rather than transversal incision can be made. The choice of pericardial patch tissue plays an important role as patch degeneration and patch calcification has been previously reported.¹⁻³ Previously, glutaraldehyde treated autologous pericardium was the most

common choice. In the current series, we utilised CardioCel pericardial patch tissue due to its “off the shelf” availability and better pliability and handling. Moreover, it is expected to be more resistant to calcification and might therefore enhance repair durability. Long-term follow-up is needed to assess the effects on leaflet calcification and the incidence of recurrent mitral stenosis or insufficiency.

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Thoracic | Abstract Session | VATS lobectomy

Thoracoscopic anatomic lung segmentectomy using three-dimensional computed tomography simulation without tumour markings for non-palpable and non-visualised small-sized lung nodules

Hirohisa Kato*, Hiroyuki Oizumi, Jun Suzuki, Akira Hamada, Hikaru Watarai and Mitsuaki Sadahiro Second Department of Surgery, Yamagata University, Yamagata City, Japan

h-kato@med.id.yamagata-u.ac.jp

Objectives

While wedge resection can be curative for small-sized lung tumours, tumour marking is sometimes required for resection of non-palpable or visually undetectable lung nodules. Tumour marking sometimes fails, and occasionally causes serious complications. In our institution, many thoracoscopic segmentectomies using three-dimensional (3D) computed tomography (CT) simulation have been performed for small-sized lung tumours, and no tumour markings have been used. The aim of this study was to investigate whether thoracoscopic segmentectomy can be an alternative to wedge resection requiring tumour marking.

Methods

This study involved 144 consecutive patients who underwent thoracoscopic segmentectomy between January 2012 and March 2016. Among these patients, 58 patients whose tumours were non-palpable or visually undetectable intraoperatively were enrolled. Pulmonary arteriovenous reconstruction was performed using a 3D volume-rendering method, and the operating

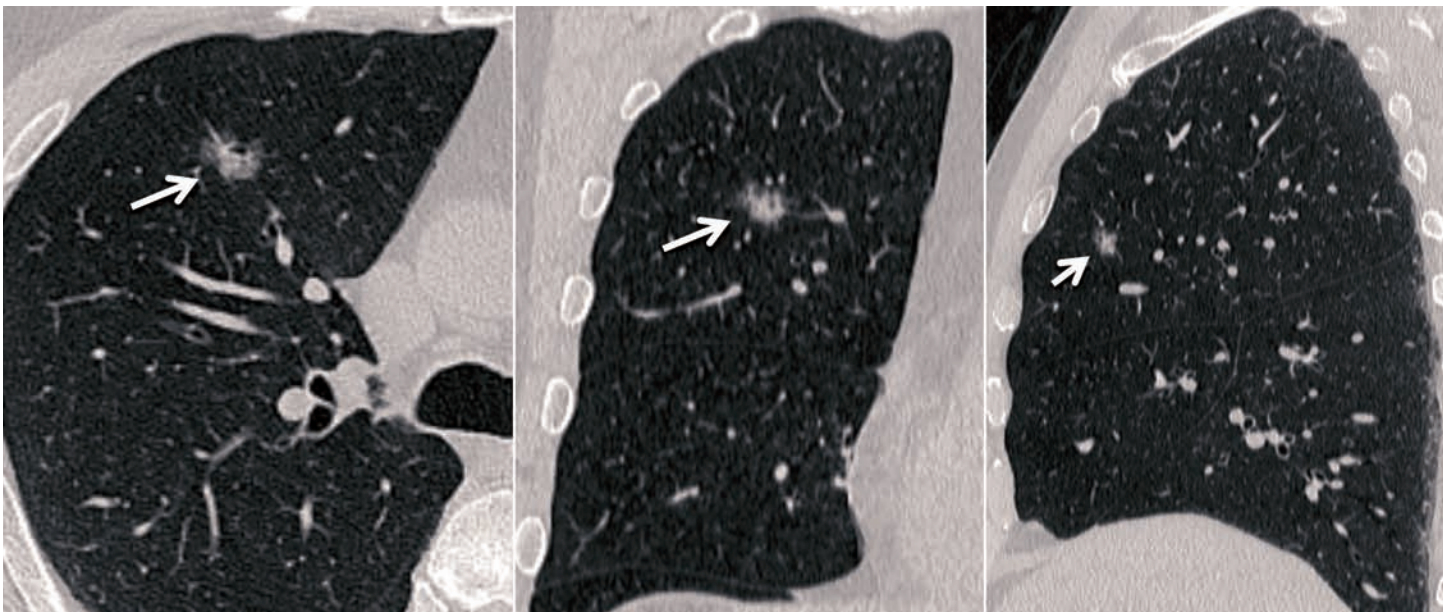


Figure 1. Segment containing the tumour was first identified as a targeted segment on a CT image in the horizontal, coronal, and sagittal planes

surgeon processed the 3D image reconstruction. Based on the CT reconstruction, the segment containing the tumour was first identified as a targeted segment on a CT image in the horizontal, coronal, and sagittal planes (Figure 1). Then, the tumour and the pulmonary artery and veins of the targeted segment were secondarily recognised on the 3D image. Third, the distance between the tumour and segmental veins was measured, and dividing surfaces were selected if the distance was determined to be sufficient to obtain a surgical margin (Figure 2). This simulation was used for planning both before and during surgery (Figure 3A).

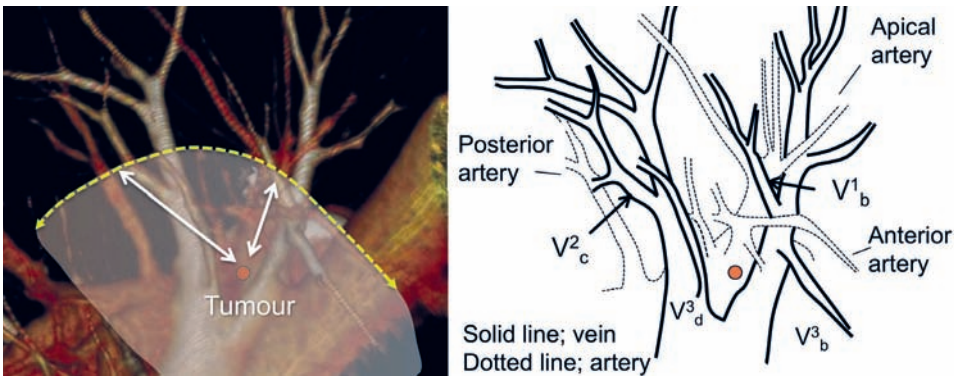


Figure 2. The distance between the tumour and segmental veins was measured, and dividing surfaces were selected if the distance was determined to be sufficient to obtain a surgical margin

Complete resection of non-palpable tumours was attempted by performing segmentectomy for tumours located between intersegmental veins on a preoperative 3D CT simulation (Figure 3B). We calculated the proportion of preserved sub-segments in each lobe as the residual lung ratio for segmentectomy by dividing the number of reserved sub-segments by the number of total sub-segments in each lobe. Finally, surgical outcomes were evaluated.

Results

Thirty-five, fourteen, and nine patients underwent segmentectomy, sub-segmentectomy, and segmentectomy combined with adjacent sub-segmentectomy, respectively. The overall residual lung ratio per targeted pulmonary lobe containing the tumour was 66.0%. All tumours were correctly resected without tumour marking. The median tumour size and depth from visceral pleura was 14±5.2 mm (range, 5–27 mm) and 11.6 mm (range, 1–38.8 mm), respectively. Median values related to the procedures were surgical

time, 176 minutes (range, 83–370 minutes); blood loss, 43 mL (range, 0–419 mL); duration of chest tube placement, 1 day (range, 1–8 days), and postoperative hospital stay, 5 days (range, 3–12 days). Two cases were converted to open thoracotomy due to bleeding. Three cases required pleurodesis for pleural fistula. No recurrences occurred during the mean follow-up period of 44.4 months (range, 5–53 months).

Conclusions

Thoracoscopic anatomic segmentectomy using 3D CT simulation can be performed safely, can precisely resect non-palpable or visually undetectable lung nodules located in particularly deep parenchymas without tumour marking, and can be used for curative removal of lung tumours. Pre- and intra-operative 3D CT simulation can facilitate reliable tumour resection by thoracoscopic segmentectomy. Thoracoscopic anatomic segmentectomy using 3D CT simulation may therefore be used as a substitute for wedge resection requiring tumour marking.

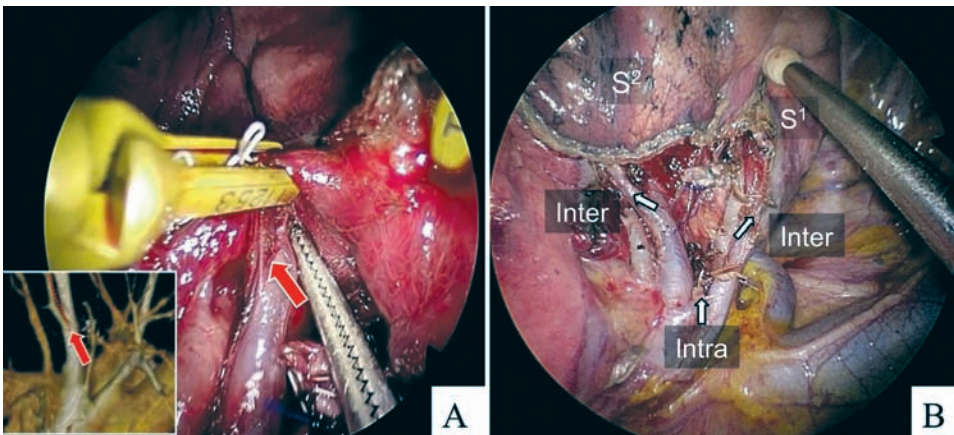


Figure 3. A) The venous branch was correctly identified with of real-time comparisons of 3D images. B) Actual final view of S3 segmentectomy. Intersegmental veins were preserved.



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A new aortic valve reconstruction technique

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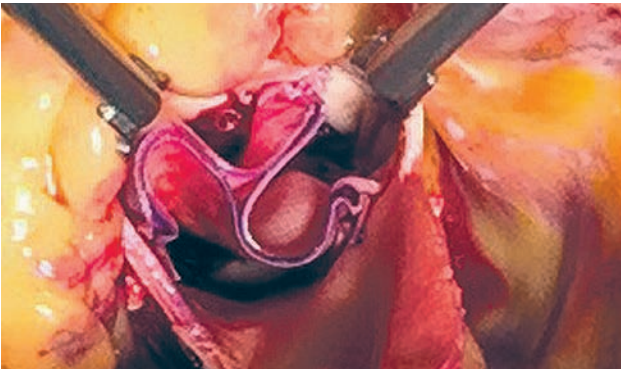
Royal Brompton & Harefield Hospital, London, UK

The addition of the Ozaki AVNeo™ procedure to our armamentarium of aortic valve surgical strategies, for both adult and paediatric surgery, has been an enlightening experience for us.



Together with my colleague, Olivier Ghez, we've performed the first Ozaki AVNeo™ procedures in the UK, with six procedures under the guidance of Professor Shigeyuki Ozaki, who has helped us in refining his technique of aortic valve replacement and repair.

We have treated both younger patients with congenital aortic valve disease and endocarditis, along with older patients with fibrotic aortic valve disease, experiencing excellent short term results. In reviewing Professor Ozaki's outcomes, we are



confident that our mid-term results will be just as good.

Endocarditis in patients has been manageable and the elimination of anticoagulation therapy has been a benefit for patient quality of life, post-surgery. We now feel confident in procedure reproducibility and continue to evaluate potential patients for the Ozaki AVNeo™ procedure, intending to become a national centre of excellence for the UK.



Cut Through the Complexity with Simplified Procedures, Better Outcomes

At LivaNova, we believe that groundbreaking improvements in cardiac surgery methods—along with the technologies that support them—should contribute to reduced complexity, greater ease of use and better outcomes. By drawing on decades of experience in the field, LivaNova is helping health care providers achieve more efficient patient care, increased patient safety and survival, faster recovery and optimal use of hospital resources and budgets.

Reduced Physiological Impact of Surgery

Because of the often highly invasive nature of cardiac surgery, minimizing the impact of surgical procedures is key to improving patient outcomes.¹ That's why LivaNova has created innovative devices to cut through the complexity. Our minimally invasive MICS cannulae are designed to ensure excellent hemodynamics while providing easy insertion and minimal intrusion into the surgical field.² In addition, our PERCEVAL™ bioprosthetic aortic valve and MEMO 3D RECHORD™ mitral annuloplasty ring are specifically designed to reduce the physiological impact of surgery.^{3,4}

Reduced Acute Kidney Injury

It is widely known that the longer the bypass procedure, the greater

the association with acute kidney injury. Severe hemodilution and homologous transfusions can further influence kidney dysfunction. LivaNova's PERCEVAL sutureless valve and HEARTLINK™ perfusion system with GDP Monitor™ enable shortened procedure times, decreased hemodilution and reduce the need for blood transfusions to help avoid renal complications.^{5-9, 10-14}

Native-Like Hemodynamics

Shouldn't aortic and mitral valve prostheses be designed to perform just as well as native valves? We think so, which is why our extensive line of devices for valve repair and replacement, including the SOLO SMART™ aortic heart valve and MEMO 3D RECHORD mitral annuloplasty ring, function as closely as possible to the native valve, providing maximum blood flow for increased cardiac output to support a more active patient lifestyle.¹⁵⁻²⁰

Reducing Transfusions

Homologous blood transfusions are frequently needed in cardiac surgery patients due to prolonged ischemic times and invasive procedures, which result in a higher incidence of complications and increased mortality. LivaNova is working with surgeons to expedite procedures using the PERCEVAL sutureless biological valve, which

may help minimize homologous transfusions.²¹⁻²⁷ In addition, we are working with perfusionists to use our HEARTLINK perfusion system designed for Goal Directed Perfusion to help minimize hemodilution, easily monitor vital parameters and simplify autotransfusions, thus reducing complications and disease transmission.^{14, 28-29}

Enhanced Neurological Protection

Neurophysiological disorders and brain injuries are a persistent problem with cardiac surgery patients. Our BICARBON™ family of heart valves is specifically designed to reduce the risk of thromboembolic complication through optimal thromboresistance, delivering proven safety and durability with no structural valve deterioration.³⁰⁻³³ Our OPTIFLOW™ Aortic Cannulae family plays a critical role in the effective reduction of shear stress on the aortic wall, which is one of the plaque dislodgment causes that can lead to neurologic complications during cardiovascular surgery. Furthermore, the LivaNova INSPIRE™ 6M oxygenator, XTRA™ autotransfusion system and HEARTLINK perfusion system provide a high level of embolic protection during cardiopulmonary bypass.³⁴ This high level of protection is achieved through: prompt air bubble detection in our heart-lung machines and effective gaseous microemboli

removal in our oxygenators, to prevent any massive air or micro bubbles to reach the patient; easy suction blood separation and processing to help reduce inflammatory response; and fast, efficient cardioplegia temperature control to help prevent cerebral hypothermia.^{35,36}

Shorter ICU and Hospital Stay

Today's focus on cost containment requires solutions that permit faster recovery and contribute to the lower overall cost of health care. Our HEARTLINK perfusion system with GDP Monitor, the INSPIRE 6 oxygenator and the XTRA autotransfusion system are reducing complications and helping surgical teams maintain optimal perfusion with low hemodilution, leading to fewer days in the hospital and lower cost of transfusion.^{10,37} Our PERCEVAL sutureless valve is resulting in shorter procedure times and better outcomes, allowing for reduced ICU and hospital stays as well as lowered health care costs.³⁸⁻⁴⁰

Proven Clinical Outcomes

Technological innovation is contributing to personalized, clinically proven treatments to restore the patient's physical condition and provide peace of mind.

The PERCEVAL sutureless bioprosthesis, for example,

demonstrates excellent durability and low, long-term mortality rates for patients with aortic stenosis or steno-insufficiency.⁴¹ The CARBOMEDICS™ and BICARBON families of mechanical heart valves are designed for easier surgical procedures and long-lasting performance.^{31,33,32,42}

The totally supra-annular CARBOMEDICS TOP HAT and BICARBON OVERLINE aortic valves offer 100 percent orifice-to-annulus match in aortic position to optimize hemodynamics, making them viable treatment options for young patients with severe aortic disease.⁴³ Featuring excellent hemodynamics but without the need for lifelong oral anticoagulation, the CROWN PRT™ stented aortic bioprosthesis represents an ideal solution in elderly patients.⁴⁴⁻⁴⁶

The SOLO SMART biological aortic heart valve and MEMO 3D RECHORD mitral annuloplasty ring provide native-like solutions with superior hemodynamic performance,^{18,19,47-48} and like all our innovations, are helping patients resume normal activities after surgery.

Cutting through the complexity with advanced technology and enhanced ease of use, LivaNova allows you to reach new levels of performance and control to improve patient outcomes.

Find out more at LivaNova Booth No. 111.

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Cardiac | Abstract Session | Improving outcomes in hypertrophic obstructive cardiomyopathy

Surgical treatment of hypertrophic obstructive cardiomyopathy in patients with severe hypertrophy, septal myocardial fibrosis and ventricular tachycardia

Konstantin V. Borisov German-Russian Cardiac Clinic, Moscow
kvborisov@inbox.ru

In patients with hypertrophic cardiomyopathy, myocardial fibrosis is an independent predictor of adverse outcome. The mechanism of sudden death in hypertrophic obstructive cardiomyopathy is ventricular tachycardia/fibrillation emanating from areas of fibrosis.¹ Weng et al.² provide further support for late gadolinium enhancement (LGE) as a novel sudden death risk factor marker with important prognostic value. The scars create a potentially arrhythmogenic substrate and increase susceptibility to ventricular tachycardia/fibrillation.³ A new technique of hypertrophic obstructive

cardiomyopathy (HOCM) surgical correction in patients with severe hypertrophy and septal myocardial fibrosis has been proposed in the absence of generally-accepted standards. The excision of the asymmetrical hypertrophied area of the interventricular septum (IVS) causing obstruction was performed from the conal part of the right ventricle corresponding to the zone of obstruction of the left ventricle (LV). The areas of septal myocardial fibrosis were removed corresponding to the zone of delayed enhancement (DE) imaging (Figure 1). This excision was carried out on the right side of the IVS (Figure 2). Myocardial fibrosis was detected by cardiovascular magnetic resonance with DE imaging. Eleven HOCM patients with severe

hypertrophy (NYHA Class 3.1), myocardial fibrosis and episodes of ventricular tachycardia (VT) underwent this procedure between 2008 and 2014. Five patients had biventricular obstruction. The follow-up period was 39±9 months. In the present study of 11 HOCM patients with severe hypertrophy, there were no early or late deaths after surgery, and reoperation was not required in any of the cases. This approach results in substantial and durable improvement in functional status. After surgery, 10 patients were free of symptoms (NYHA class 1) and one patient had only mild limitations. The mean echocardiographic gradient in LV decreased from 88.9±10.0 to 9.7±2.1 mmHg, the mean value of gradient in right ventricular



Figure 1. Delayed hyperenhancement magnetic resonance image in patient with symptomatic hypertrophic obstructive cardiomyopathy demonstrating areas of extensive scarring in the basal and mid-ventricular septum. Myocardial fibrosis was detected by cardiovascular magnetic resonance.

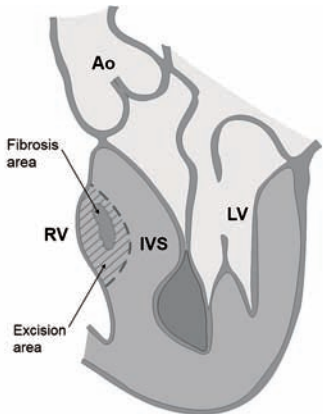


Figure 2. The excision of the asymmetrical hypertrophied area of the interventricular septum (IVS) causing biventricular obstruction was performed from the conal part of the RV on the right side of IVS corresponding to the zone obstruction of the left ventricular (LV). The areas of septal myocardial fibrosis as identified by delayed enhancement (DE) imaging were excised simultaneously using the same approach. The excision was performed corresponding to the zone of DE imaging.

outflow tract was reduced from 45.2±4.7 to 3.8±1.3 mmHg. Echocardiographically-determined septal thickness was reduced from 34.5±3.8 to 15.5±1.6 mm. Sinus rhythm without block of His bundle right branch was noted in all patients after surgery. VT was not registered. None of the patients needed implantation of cardioverter-defibrillator. All our patients before surgery had multiple HCM-related risk factors for sudden death: septal myocardial fibrosis (delayed enhancement on cardiac MR imaging), extreme hypertrophy (IVS thickness 34.5±3.8 mm) and history of non-sustained VT. Asymmetrical area of the IVS causing obstruction and the septal fibrosis area were removed simultaneously using the same approach.

It is easier to remove fibrosis tissue from the right of the IVS side (corresponding to DE) under direct visual inspection. This novel technique of HOCM surgical correction provides the precise removal of the areas of septal fibrosis and effective elimination of biventricular obstruction in patients with extreme hypertrophy who cannot be treated with the current surgical techniques. The approach avoids mechanical damage to the heart conduction system and for the surgeon it improves visual inspection of the area to be resected.

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Cardiac | Abstract Session | Extra corporeal circulation/Left ventricular assist device/Transplantation 1

The value of fluorine-18 deoxyglucose positron emission tomography scans in patients with ventricular assist device-specific infections

Alexander M. Bernhardt

Department of Cardiovascular Surgery, University Heart Center Hamburg, Germany

Al.Bernhardt@uke.de

Long-term support with continuous flow left ventricular assist devices (CF-LVAD) has shown to be beneficial for patients with end-stage heart failure in both bridge to transplant (BTT) and destination therapy (DT) populations.¹ The latest Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS) report presents that second-generation CF-LVAD survival rates reach 80% in the first year after implantation, but despite this survival benefit, infection continues to be a major complication.¹ Treatment modalities are tailored to severity and extent of infection – which widely range from superficial wound infection to systemic inflammatory reaction syndrome – but in defiance of surgical and medical intervention, mortality still remains high.

To increase the survival outcome and reduce the need for explantation and exchange of LVADs, it is essential to detect the infection focus early, and initiate appropriate treatment. However, definitive diagnosis is often



challenging, particularly in early stages of VAD infection. Infections are major complications in patients with ventricular assist devices (VAD) and reasons for high urgency listing for transplantation. Whereas results after transplantation are comparable in patients with and without driveline infections (DI), large registry results showed that the mortality is higher in those with a device infection or mediastinitis.²

Positron emission tomography with fluorodesoxyglucose marked by fluorine-18 (¹⁸F-FDG PET/CT) is a non-invasive imaging modality that uses ¹⁸F-FDG, a positron emitting

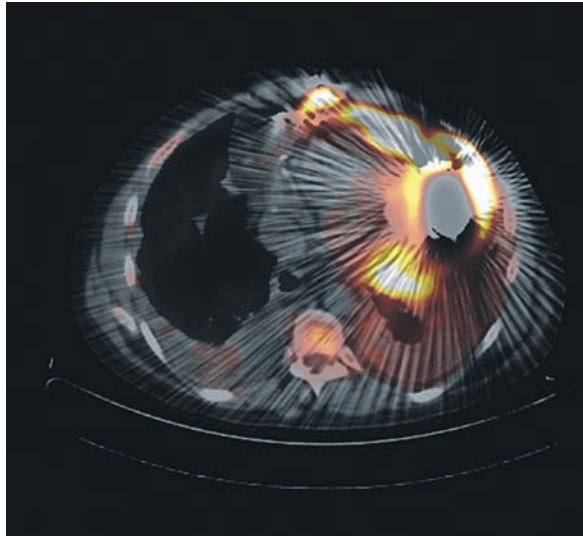


Figure 1: Example of a positive ¹⁸F-FDG PET/CT scan result in a patient with two HeartWare HVAD devices (BiVAD) and a VAD specific pump infection.

glucose analogue, to assess glycolytic activity in cells, which is elevated in those that are subject to malignant or inflammatory processes. Thus, ¹⁸F-FDG PET/CT has become a promising diagnostic tool to locate high metabolic foci such as in infection, allowing early detection and its extent. However, this methodology is limited due to its inability to discriminate between aseptic and septic nativity, potentially delaying or misleading adequate treatment.

The aim of this study was to

evaluate the diagnostic value of ¹⁸F-FDG PET/CT and its contribution to decision making in patients with ventricular assist device specific infections.

The main findings were a sensitivity of VAD-specific infections of 87.5% and a specificity of 100%. The positive predictive value was 100% and the negative predictive value 86.7%. Six patients had more than one PET-CT scans at different time points and the results correlated with clinical improvement of the infection.

Therefore, we believe it may have the potential to guide the clinician in better handling patients with infectious complications after VAD implantation.

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Cardiac | Abstract Session | Coronary artery bypass graft and percutaneous coronary intervention

Surgical revascularisation for coronary artery disease: a report from the CADISTO trial (Coronary Artery Disease and Surgical Therapy: Long-term Follow-up)



Eva Maria Delmo Walter and Roland Hetzer

Trauma Surgery Center Berlin, Germany

Coronary artery bypass graft surgery (CABG) remains the most common operation performed by cardiac surgeons today. Since its infancy in the 1950s, CABG has undergone many developments both technically and clinically. Improvements in intraoperative techniques and perioperative care have led to CABG being offered to a broader patient profile with less complications and adverse events.

Through this rich development of coronary artery bypass grafting, surgeons and clinicians have recognised that numerous factors influence the surgical outcome, such as patients' age, gender, left ventricular function and types of graft employed. Despite vast information on these aspects, little is provided about what happens to this group of patients over a long period of time.

This prompted us to begin the CADISTO trial (Coronary Artery Disease and Surgical Therapy: Long-term Follow-up). This is a single centre, 28-year follow-up study of 2,728 patients with coronary artery disease who underwent surgical revascularisation from April 1986 to December 1988. One-vessel coronary artery disease was found in 234 patients while 2 and 3-vessel diseases were found in 1,031 and 1,463 patients, respectively. Survival was analysed according to age, gender, ejection fraction, and number of arterial and vein grafts (2,165 males, mean age at coronary revascularization 59.4±8.8 years).

Mean duration of follow-up was 27.6±1.3 years. Overall survival was 24.1% (Figure 1). Age-stratified survival was observed to be

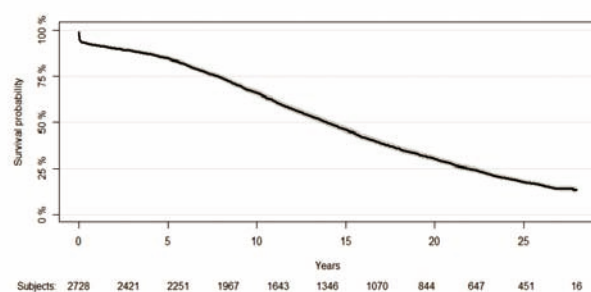


Figure 1. Overall survival

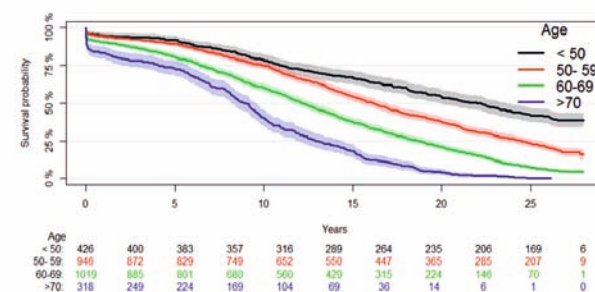


Figure 2. Age-stratified survival

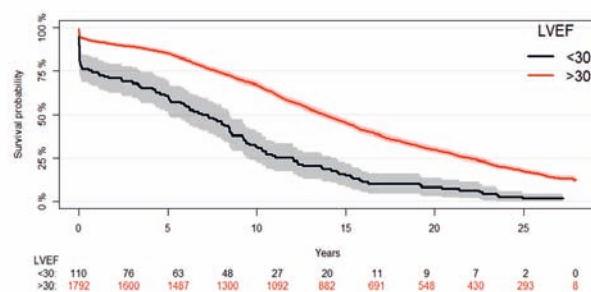


Figure 3. Gender-specific survival

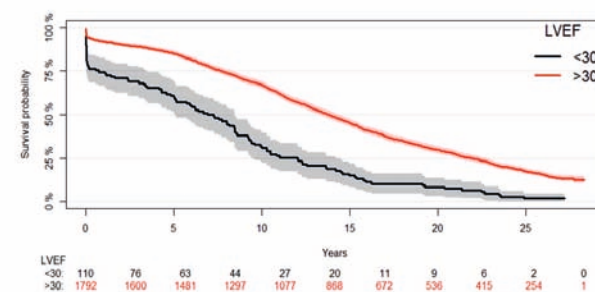


Figure 4. Ejection fraction-specific survival

higher (40%) in those patients <50 years of age at that time of surgery compared to the other age group, i.e. 50-59: 20%, 60-69: 10% and >70: 5% ($p<0.001$) (Figure 2). Women had increased early mortality, hence poorer survival (12%) than men (18%) ($p<0.05$) (Figure 3). However, when age (women=median 64.7, men=58.4, years) was considered between gender, no significant difference ($p=0.13$) in survival was observed. Interestingly, survival rate of patients with ejection fractions of <30% ($n=826$) was 6%, which obviously fared well compared with 18% of those with an ejection fraction of >30% ($n=1902$) at the time of coronary surgery (Figure 4). There was no significant difference between the use of a single internal mammary artery (IMA; left or right) graft and use of two arterial grafts (combined left and right IMA, or IMA

and radial artery) on long-term survival ($p=0.014$). However, the use of an arterial graft combined with vein grafts are favourable ($p<0.001$).

The findings in CADISTO trial showed that after a relatively long-term follow-up, age-based survival was similar compared to the general population. Female gender demonstrated poorer survival than men. However, when this is adjusted for age, no significant difference was shown. Interestingly, several patients with severely reduced ejection fraction, considered inoperable during the early times, have survived for almost 28 years. Use of one internal mammary artery grafts demonstrated better survival than use of only vein grafts. Noteworthy is that the sole use of vein grafts may also lead to an acceptable long-term survival.

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

A Spanish multicentre registry of minimally invasive aortic valve surgery: initial experience

Sara Badía Hospital
Universitari Germans
Trias i Pujol, Badalona,
Barcelona, Spain



Minimal incision surgery has gained a starring role in all surgical areas, recently being demanded by society because it offers advantages over conventional techniques. To cardiac surgery, such techniques have come later than to the rest of the surgical specialties and still have not become routine in most centres. However, in recent years these techniques are becoming more popular. In Spain, there are numerous centres that perform

minimal incision surgery. Traditionally, aortic valve replacement surgery with or without ascending aorta replacement or myectomy of the interventricular septum is performed mainly by median sternotomy with extracorporeal circulation. Such an approach provides an excellent view of the heart and vessels as well as excellent control over possible complications that may occur. However, the emergence of new technologies such as transoesophageal echocardiography (routinely used in all cardiac surgeries in almost all centres that perform heart surgery), new pieces of instrumental specially designed for small approaches, and new generation sutureless and rapid deployment valves, have made it possible to develop minimal access surgery without

increasing the risks to the patient. Many advantages are described for minimally invasive surgery. Among them is the lower rate of bleeding, lower rate of transfusion, lower rate of wound infection, lower respiratory complications, shorter stay in the intensive care unit (ICU) and shorter hospital stay¹. Cosgrove and Sabik described the first cases of mini-incision for aortic valve replacement in 1996². Since then, multiple variations of the technique have been described looking for simplicity and security in the mini-sternotomy. Some works from the late 1990s and early 2000s found no significant differences between the median sternotomy and mini-sternotomy, but these were experiences at the very beginning of the learning curve³. Several advantages



Figure 1. Patient who underwent aortic valve replacement by mini-sternotomy.

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to minimally invasive surgery became more numerous in the following papers, some of which were prospective randomised studies like those of Bonachi or Moustafa^{4,5}. Brown conducted a systematic review and meta-analysis, finding significant benefits in minimally invasive surgery, concluding that mini-sternotomy is safe, that patients have shorter hospital and ICU stays experiencing less bleeding and less pain, but with the disadvantage of longer cardiopulmonary bypass (CPB) time and aortic cross-clamping time¹. The pioneers of the technique in Cleveland published a very important work due to its sample size, analysing 832 pairs of patients by 'propensity score'⁶. In this series no significant differences in mortality were found as it was very low in both groups (0.96%), but they did find differences in bleeding, transfusion, respiratory complications, percentage of patients extubated in the operating room, postoperative pain, CPB and aortic cross-clamping time – all in favour of mini-sternotomy as the less invasive procedure. Such findings mirror those of prospective and randomised studies like Bonachi and Moustafa's^{4,5}, and Paredes's series⁷, as well as a meta-analysis published in 2014 by Phan⁸. All of these advantages also involve significantly lower hospital costs per patient. Despite this, there are few nationwide publications that make you think that these techniques are applied assiduously in Spain in many centres⁷. Because of this, we present the results of a Spanish registry in which 15 centres have participated, where a minimally invasive approach for aortic valve surgery with or without ascending aorta replacement and/or myectomy of the interventricular septum was performed.

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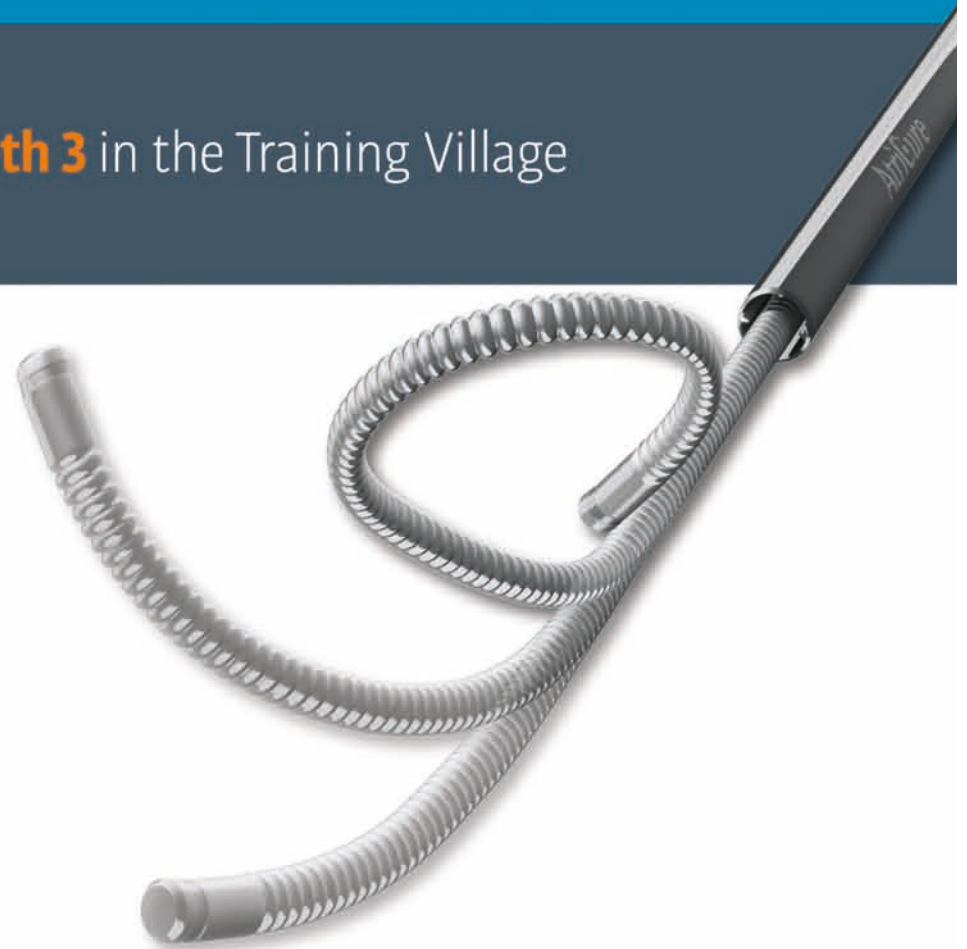
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