

## Poster Walk: Mitral and Tricuspid Valve, Transseptal Puncture & Endocarditis

### P100–P107

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### P100

**Perioperative outcomes of minimally invasive mitral valve surgery through right mini-thoracotomy: 6-year experience of a standardized technique**

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**Introduction:** Minimally invasive mitral valve surgery (MIMVS) through right mini-thoracotomy is an established, standardized procedure at our institution. The aim of the current study was to evaluate perioperative outcomes of our patients who underwent MIMVS over the last 6 years.

**Methods:** We retrospectively analysed the preoperative variables, intraoperative data and postoperative results in a series of 219 consecutive patients who underwent MIMVS from January 2013 through December 2018 at our institution. All patients received a central aortic cannulation and a peripheral vein cannulation over the groin via Seldinger technique.

**Results:** Mean patients-age was  $63.4 \pm 13$  years (29% = female; Mean EuroSCORE II =  $2.8 \pm 5\%$ ). Of the whole patient cohort 8 patients (3.65%) had already undergone a cardiac operation. The majority of our patients were presented with a severe mitral valve regurgitation based on fibroelastic deficiency (191 patients, 87.2%), 13 patients (5.90%) required an operation because of active mitral valve endocarditis, whereas 15 patients (6.85%) presented with a severe mitral valve stenosis. 191 patients (87%) underwent a mitral valve reconstruction and 28 patients (13%) a mitral valve replacement. Associated procedures were tricuspid valve annuloplasty (12 patients, 5.5%) and MAZE procedure (45 patients, 21%). Mean cardio-pulmonary bypass and aortic cross-clamp time were  $95 \pm 31$  and  $72 \pm 23$  minutes, respectively. Two patients (0.9%) required conversion to median sternotomy and nine patients (4.01%) underwent postoperative re-exploration for bleeding. The incidence of perioperative neurologic complica-

tions was 1.37% (N = 3). Overall 30-day mortality was 1.8% (4 patients). Latest echocardiographic follow-up (at discharge) revealed sufficient mitral valve function with none or trivial mitral valve regurgitation in 97% of the patients whereas the incidence of early mitral valve reoperation was 2.7% (N = 6).

**Conclusions:** A standardized approach to minimally invasive mitral valve surgery through right mini-thoracotomy with direct aortic cannulation is a feasible, safe, and reproducible technique associated with low perioperative mortality and morbidity.

### P101

**Factors associated with embolization among patients with infectious endocarditis**

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**Introduction:** Systemic embolization remains an important complication of infective endocarditis (IE) leading to high morbidity and mortality. The aim of the present study was to determine the factors associated with systemic emboli among patients with IE.

**Method:** This prospective observational study included all cases admitted for suspected IE during an eleven-month period (January to November 2018) at the University Hospital of Lausanne. IE was defined according to modified criteria of 2015 European Society of Cardiology Guidelines.

**Results:** Fifty-five patients were categorized as definite IE. The majority of patients (52, 95%) had positive blood cultures. Most commonly isolated pathogens included *Staphylococcus aureus* (25, 45%), *Streptococcus* spp. (16, 29%) and *Enterococcus* spp. (8, 15%). Forty-eight patients had a positive imaging (48, 87%). Surgical treatment was performed in 20 patients (36%). The most common area of embolization was the central nervous system (17 patients; 31%). Systemic embolization was observed in 40 patients (73%) and was associated with *S. aureus* (55% vs 20%;  $P 0.032$ ), left heart vegetation >10mm (38% vs 7%;  $P 0.043$ ). No difference was observed among aortic and mitral valve or native and prosthetic. Multivariate analysis found that *S.*

*aureus* ( $P$  0.011; OR 6.9, CI 1.5-30.6) and left heart vegetation  $>10$ mm ( $P$  0.025; OR 12.4, CI 1.4-111.8) were independently associated with systemic emboli.

**Conclusion:** Rate of systemic embolization was high among IE patients. *S. aureus* was the most commonly isolated pathogen and was independently associated with systemic embolization. Large vegetations ( $>10$  mm) put the patient at increased risk from embolic episodes.

## P102

### Minimally invasive mitral surgery with next generation self-expanding percutaneous transfemoral venous cannulas: performances and safety profile

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**Objective:** Devices for venous cannulation during minimally invasive mitral valve surgery (MICS) have seen significant progress over the last decade. Rigid steel cannulas have evolved toward flexible plastic cannulas, which adopt the concept of collapsed insertion and expansion in situ. Inadequate peripheral venous drainage with rigid cannulas can be problematic and not always increasing vacuum or pump speed can solve this issue. The present study is designed to report the performances and institutional experience with virtually wall-less venous cannulas during mitral MICS.

**Methods:** Transfemoral venous cannulation with virtually wall-less cannulas (3/8" 24F 630-730-mm ST) was performed in 73 patients (61±9 years, 52 males, 21 females) undergoing MICS for mitral repair (45), replacement (7) and combination with other procedures (21). Before the femoral insertion of next generation wall-less cannulas, a guidewire was positioned in the superior vena cava under echocardiographic guidance. The wall-less cannula was then advanced over the wire and connected to the extracorporeal circulation. Vacuum assist was used to reach a target flow of (Cardiac Index) 2.4 l/min per mq with augmented venous drainage at less than -45 mmHg.

**Results:** Wall-less venous smart cannulas measuring either 630 mm (n= 13) in length or 730 mm (n = 60) were successfully positioned in all patients undergoing mitral MICS, without any complications. For a body size of 176 ± 13 cm and a body weight of 81.3 ± 26.1 kg, the calculated body surface area was 1.99 ± 0.37 mq, with expected target flow of 4.77 ± 0.79 l/min, whereas the achieved flow accounted for 5.73 ± 0.95 l/min (120% of target) at a vacuum level of 26.3 ± 0.95 mmHg. Exposure of mitral and tricuspid valve was always remarkable, with stable bloodless intracardiac cavities during surgery.

**Conclusions:** The performance of next-generation smart cannulas for venous drainage during MICS proved to be excellent, with a high safety profile. The flows are optimal at negligible vacuum levels, suggesting an enhanced performance over traditional rigid wall cannulas. Improved outcomes are expected during their routine application, with potential for further reduction in suction during venous drainage.

## P103

### Sex-related survival in percutaneous mitral valve repair: results from the MitraSwiss registry

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**Introduction:** Mitral regurgitation (MR) is the most common cardiac valvular heart disease contributing substantially to morbidity and mortality in both sexes.

The aim of this sub-analysis of the prospective Swiss nationwide investigator-initiated MitraClip® registry (MitraSwiss) was to assess and compare the overall survival after percutaneous mitral valve repair (PMVR) in men and women.

**Methods:** All patients included in the MitraSwiss registry between 2011 to 2018 in 10 Swiss cardiovascular centers were divided in two groups according to their sex. Differences in baseline characteristics as well as in the procedural characteristics and short-and long-term results were then compared. Survival was assessed up to 60 months after PMVR.

**Results:** The analysis of the presented work includes 1254 patients, 755 of them were men (60.2%) and 499 women (39.8%). Mean age was 77.4 years. Women were significantly older than men (78.9 years vs 76.4 years;  $p < 0.00001$ ). Women tend to have more frequently degenerative MR than men whereas men more frequently were affected of functional MR ( $p = 0.059$ ). Likewise, women's LVEF was significantly higher and LV volumes significantly lower ( $p < 0.00001$ ). They, however, had equal surgical risk (according to ES II, logES and STS score).

They more likely had an optimal postinterventional result than men ( $p = 0.059$ ).

Survival evaluation after 5 years was possible in 993/1254 pts. (79%). After 60 months 258 deaths were observed in this high-risk population (167 death for men and 91 death for women). However, there was no difference in the mortality rate between the two sexes (50.0% for men; 95% CI 42.8-57.7% vs. 47.4% for women 95%CI 37.7-58.3%).

**Conclusions:** Although there are many differences between men and woman undergoing PMVR in Switzerland, their 60 months survival is equal for both sexes.

## P104

### Catheter-based tricuspid valve replacement with Navigate Bioprosthesis for tricuspid regurgitation: single-center experience

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**Introduction:** Percutaneous/minimally invasive procedures are an interesting alternative to conventional surgery for selected high-risk patients with primary and secondary

tricuspid regurgitation (TR). NaviGate valved-stent has been designed to treat native TR by means of a catheter based valve replacement.

**Methods:** Here we present our single center experience with NaviGate implantation. The procedure was successfully performed in 4 consecutive patients. Patient 1 was 64 years old man with functional tricuspid regurgitation; patient 2 is a 76 years old man with iatrogenic tricuspid valve regurgitation (pace maker extraction for infective endocarditis); patient 3 was a 53 years old woman with tricuspid valve rheumatic disease causing combined stenosis-insufficiency; patient 4 was a 72 years old woman with secondary TR. All patients had clinical sign and symptoms of right heart failure despite optimized medical therapy.

**Results:** The NaviGate prostheses (54 mm for patient 1, 40 mm for patient 2, 44 mm for patient 3, 40 mm for patient 4) were successfully implanted in all the four cases in hybrid room, with antero-lateral right mini-thoracotomy, under general anesthesia and with intra-operative transesophageal guidance. In all cases right atrial access was safe and there were no intra-procedural hemodynamic instability, coronary obstruction, or rhythm disturbance. After valve deployment, there was no antegrade gradient in all cases and no severe residual TR. There were no further complications during hospitalization. All patients experienced clinical improvement. During follow-up, 1 valve dislocation was observed at 30 days, causing severe PVL, which was successfully treated with surgical valve replacement.

**Conclusions:** In our preliminary experience, catheter-based tricuspid valve replacement with the NaviGate device represents a valuable alternative to conventional surgery in high-risk patients and is feasible and safe in different anatomical settings.

## P105

### First-in-human trial of balloon-adjustable mitral annuloplasty ring for post surgical correction of recurrent mitral regurgitation

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**Introduction:** Leaving the operating room with an adequate length of coaptation is crucial to prevent mitral regurgitation (MR) recurrence because even trivial/mild MR can contribute to ventricular remodeling. Adjustable mitral rings may enable the optimisation of mitral leaflet coaptation after surgical repair. A novel, balloon-adjustable mitral-ring was assessed regarding clinical safety and feasibility in this first-in-man trial.

**Methods:** The ring consists of a rigid titanium cage with an internal deformable metallic stent on which surgeon sutures the mitral ring. The ring is connected to a driveline for the insertion of a balloon catheter the deformable stent. The balloon is inflated independently in the area P1, P2 or P3. Balloon inflation leads to extension of the P1, P2 or P3 segment and subsequent reduction of the septo-lateral distance of the mitral valve. Surgical technique to implant the deformable ring is the same describe for full mitral rings. Sutures are placed on the inner side of the ring to enable annular reduction in case of adjustment.

**Results:** Five patients (mean age 75 years; mean EuroSCORE II 2,08; 3 female) were enrolled in the trial and successfully implanted (4 patients with 30 mm ring, 1 patient with 32mm ring). Mechanism of MR was prolapse of the P2-segment in 3 patients and annular dilation in 2 patients. No perioperative-and 30-day mortality was observed. In 1 patient the tricuspid valve was replaced and in 1 patient tricuspid repair was performed. Surgical access was median sternotomy in all patients. Median circulation time and median cross clamp time were 105 (118; 195) and 94 (90, 151) minutes respectively, median ICU stay was 2 (2, 3) days. All patients reached the primary endpoint with no mortality or device related morbidity at 30 days postoperatively. Not related adverse events were pacemaker lead revision, intermittent dialysis and wound infection. No moderate or severe recurrent mitral regurgitation was observed.

**Conclusions:** Successful implantation was completed in 5 patients without device-related adverse events at the 30-day postoperative follow-up. Ring implantation was safe and feasible in all patients. The opportunity of post-implant adjustment to improve leaflet coaptation is a promising new therapeutic strategy for persisting and recurrent mitral regurgitation after mitral valve reconstruction.

## P106

### Novel physical high-fidelity simulator for transeptal puncture procedure: changing the learning approach

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**Introduction:** Training in transcatheter cardiovascular skills represents today a significant challenge due to the complexity of the interventions, an extensive use of multiple and simultaneous live imaging technologies, and the complexity of the 3-dimensional anatomy. Due to these challenges, a lot of efforts have been made to improve simulators and benchtop models for surgical training and qualification checks. Despite that, the translation from bench to bedside of such simulators has been slow and difficult due to the lack of simulator realism and imaging guidance replication.

We describe the design, the face validation, and content validation of a newly developed physical transeptal puncture (TSP) simulator using additive manufacturing techniques and novel imaging simulation solutions.

**Methods:** The TSP simulator contains a femoral vein catheterization pad for femoral venous puncture, a silicon phantom of the venous system and the right atrium, a replaceable silicone interatrial septum, and a set of cameras to mimic live fluoroscopic and echocardiographic imaging. To test the performances of the simulator a validation study was conducted at the University Hospital of Zurich. A total of 14 experienced interventional cardiologists and cardiac surgeons assessed the TSP simulator. Participants were allotted 30 minutes to perform a TSP on the simulator using the standard transeptal puncture toolkit. Face and content validity was demonstrated on a 5-point Likert scale.

**Results:** The developed physical TSP is a new training and qualification tool for left heart transcatheter cardiovascular interventions. All the 14 interventional cardiologists and cardiac surgeons completed the transseptal puncture training exercise and scoring. Overall impression was rated (out of 5)  $4.04 \pm 1.03$ , haptic feedback scored  $4.13 \pm 0.82$ , realism of fluoroscopy simulation  $4.39 \pm 0.79$ , and the realism of echocardiography simulation scored  $3.86 \pm 0.64$ . Usability was rated  $4.50 \pm 0.63$  by the participants, indicating that the simulator would be suitable for training.

**Conclusion:** We demonstrated face and content validity of a new training system for transcatheter cardiovascular interventions. The TSP simulator's usability, haptic feedback, imaging solutions, and the overall impression of its usage were reported as very realistic. The physical TSP simulator represents a promising tool for simulation-based training using real interventional toolkits in a mimicked radiological environment.

## P107

### Operators' visual behavior during the transseptal puncture procedure: a new way to learn from the experts

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**Introduction:** The future of cardiovascular interventions lies in minimally invasive therapies and in the hand of well-trained doctors. The learning curve to master catheter-based cardiovascular interventions (CBCVIs) is however very long. CBCVIs are highly complex professional activities, which primarily rely on visual guidance. Not much

is known about perceptual strategies of experienced operators and how they rapidly and efficiently process and interpret the flood of information displayed to them on various screens and devices. The aim of this study was to gain insights into the visual behavior of operators during CBCVIs. Characterization and externalization of these perception strategies could shorten the learning curve and improve current oftentimes incidental learning.

**Methods:** A total of 29 CBCVIs were performed by three operators, two experts and one novice, while wearing eye tracking glasses. The eye tracking glasses recorded the gaze point and the field of view of the operator. Based on these measures the visual attention distribution on different areas of interest in the operating room were analyzed for the transseptal puncture procedure.

**Results:** Clear visual behavior patterns were observable in all cases. Furthermore, there is a difference in visual attention distribution of the experts compared to the novice. For instance, in one procedural step the experts tend to spend more time focused on the echocardiography screen than on the fluoroscopy screen. The novice, however, focused on each screen for almost the same duration. Furthermore, the novice compared to the expert operators tended to transition their focus more often from one area of interest to another.

**Conclusions:** Operators seem to exhibit identifiable visual behavior patterns for CBCVIs. These identifiable patterns differed between the expert and the novice operators. This indicates that the visual behavior of operators could be used to assist transfer of experts' perceptual and image processing skills to novices, shorten the learning curve and develop tools for objective performance assessment based on visual behavior.