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D1
A Modified Mini-Maze Procedure: A Biatrial Technique for the Treatment of Long-Standing Persistent Atrial Fibrillation

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Objective: The aim of this study was to determine the safety and feasibility of a modified mini-Maze procedure with a biatrial ablation technique for the treatment of long-standing persistent atrial fibrillation (AF).
Methods: Between January 2016 and June 2016, 10 patients (6 men; mean age, 57.4 ± 8.2 years; preoperative left atrial size, 51.4 ± 6.3 mm) with long-standing persistent AF underwent our modified mini-Maze procedure with bipolar radiofrequency ablation. These patients first underwent a traditional mini-Maze procedure, including video-assisted bilateral minithoracotomy, left atrial appendage excision, bilateral pulmonary vein isolation, ganglionic plexi evaluation and destruction, and left atrial roof connecting lesion. Second, a purse-string suture was inserted on the right atrium, and then 4 ablation lesions were made to the superior vena cava, to the inferior vena cava, to the appendix of the right atrium, and to the tricuspid valve annulus from the point of the purse-string suture by the bipolar radiofrequency clamp. The second step was to eliminate the potential macro-reentries related to the right atrium. All patients were followed up at intervals of 1, 3, and 6 months after the operation.
Results: There were no deaths or surgical reexplorations for bleeding. No permanent pacemakers were implanted. One patient suffered from reventilation on the second day after the operation and was well at discharge. Nine patients were free from AF upon discharge; 1 patient had AF refractory to electric defibrillation. Follow-up examinations at 1, 3, and 6 months showed a success rate free from AF of 90%, 90%, and 80%, respectively.
Conclusions: The modified biatrial mini-Maze is a safe, feasible procedure. Early follow-up results demonstrated an acceptable success rate of freedom from AF.

D2
Advent of Minimally Invasive Descending Thoracic Aortic Surgery

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Objective: Despite advances into the minimally invasive era, descending thoracic aortic surgery remains a large, morbid procedure. Endovascular techniques are suitable for high-risk patients, but the reoperation risk is high, and the survival benefit is lower than that with open surgery after 2 years with low-risk patients. Open protocols must adapt to minimally invasive techniques to provide the durable benefit while optimizing outcomes.
Methods: A minimally invasive descending thoracic aortic aneurysm repair was simulated using a porcine thorax model. Two 5 cm minithoracotomies were performed on the second and fifth intercostal spaces. A port for a 10 mm, 30-degree endoscope was placed for extra visualization. A simulated aortic graft was sewn in place with shafted instruments. Techniques used in a typical open procedure were performed, including proximal anastomosis, intercostal artery ostia closure, intercostal island patch placement, and distal anastomosis.
Results: The descending thoracic aortic repair was performed successfully through the minthoracotomies. The graft was sewn in a manner similar to that used in an open procedure. Different suturing devices were used to perform the necessary suturing. Current suturing technology proved moderately difficult to complete the necessary procedures. Nevertheless, feasibility and the concept of a minimally invasive approach were demonstrated with a porcine thorax model.
Conclusions: Minimally invasive descending thoracic aortic surgery is definitely possible. The current study demonstrates the feasibility of a descending thoracic aortic repair in 2 minithoracotomies with video guidance in a porcine thorax model. Further research is required to refine the technology and techniques.

D3
An Eclectic Approach to the Coronary Bypass Operation

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Objective: The best technical approach to coronary artery surgery has been an ongoing source of contention. Our objective was to identify the best surgical technique for specific groups of patients undergoing coronary bypass (CAB).
Methods: From November of 2005 to May of 2016, 2127 patients underwent isolated CAB at out Institution. Patients were entered into the STS national data registry and were coded using standard STS definitions. Observed to expected mortality was calculated (O/E). No patients were excluded. The mean age was 68 years (30–93). Seventy-six percent were male. Seventy-nine percent of patients (1679) underwent off-pump surgery, 16.2% had an on-pump arrested operation (346) and 4.8% had an on-pump beating heart procedure (102). Complete revascularization and use of both mammary arteries were never compromised (Table D3-1). Angiographic and intraoperative anatomical criteria for each specific approach will be discussed.
Results: The overall mortality was 0.7%. The expected mortality was 2.1% (O/E = 0.33%). In the off-pump group the mortality was 0.6% with an expected of 2.0% (O/E = 0.3%). The mortality in the on-pump arrested group was 1.1% with an expected of 2.0% (O/E = 0.6%). In the on-pump beating the mortality was 1.0% with an expected of 5.2% (O/E = 0.18%). Overall incidence of stroke was 0.89%, reoperations for bleeding, 1.6%, and atrial fibrillation, 21%. Blood transfusions were lower in the off-pump group: 25% vs. 45% in the on-pump group. Prolonged ventilation, requirement for dialysis, and incidence of stroke were lower in the off-pump group but were not statistically significant. There were only 6 conversions from off-pump to on-pump (0.3%) with no deaths.
Conclusions: Avoidance of cardiopulmonary bypass is a favorable approach to coronary artery surgery and our team's first preference. The quality of the revascularization in terms of completeness and conduit selection was never compromised. Flexible intraoperative decision making to conduct the operation on-pump, with the beating heart, or arrested virtually eliminates the need for emergency conversion while allowing consistency of results in this challenging group of patients.

TABLE D3-1. Internal Mammary Artery Utilization

	Grafts per Patient	BIMA Use
All patients (N = 2127)	3.58	25.1%
Off pump (1679 patients)	3.54	25.1
On-pump arrested (346 patients)	3.79	25%
On-pump beating (102 patients)	3.59	10.8%
STS average	3.2	4.5%

BIMA, bilateral internal mammary artery; STS, Society of Thoracic Surgeons.

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D4

Antegrade Aortic Balloon Valvuloplasty Using the Inoue Balloon as an Alternative Approach

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Objective: Surgical aortic valve replacement and transcatheter aortic valve replacement (TAVR) are usually used to treat aortic valve stenosis. However, cardiopulmonary bypass is a more invasive approach used for high-risk patients such as the elderly or those who have severe pulmonary insufficiency or severe atherosclerotic lesions. At our institution, high-risk patients underwent antegrade transseptal aortic balloon aortic valvuloplasty (BAV) with an Inoue balloon catheter. We investigated the results and report the effectiveness of this approach.

Methods: From July 2011, 25 consecutive patients underwent antegrade transseptal BAV using an Inoue balloon. The study group was characterized by their advanced age (mean 80.73 years). The logistic EuroSCORE 2 was 23.62; the Society of Thoracic Surgeons score was 19.23. The mean follow-up period was 17 months. Five patients required hemodialysis. A 14F sheath was placed in the femoral vein, and the left atrium was accessed from the femoral vein with an 8F sheath that was passed through the 14F sheath using a standard transseptal puncture technique under intracardiac echocardiographic or transesophageal echocardiographic guidance. In the distal abdominal or descending aorta, an extra-stiff wire was snared and secured in place via the femoral artery sheath, providing adequate support to advance the Inoue balloon from the femoral vein. The Inoue balloon was inflated 10 to 20 times across the aortic valve, depending on the size of the valve.

Results: There were 3 in-hospital deaths (1 after aortic valve replacement surgery and 2 due to heart failure). Late mortality occurred in 9 patients (7 patients had recurrence of heart failure). Hemodynamics did not improve in 1 patient. The remaining 24 patients had initial hemodynamic improvement. The mean left ventricular ejection fraction improved from 44.76.3% to 55.71%, and the mean aortic valve area improved from 0.67 cm^2 to 0.98 cm^2. Eleven patients required rehospitalization: 2 patients for a bridge to aortic valve replacement and 4 patients for a repeat BAV procedure.

Conclusions: Early findings indicate that antegrade transseptal BAV is a feasible approach. This approach remains an important alternative method for high-risk patients with severe pulmonary insufficiency, anatomical issues unsuitable for TAVR, and unnecessary long-term results from surgical aortic valve replacement or TAVR.

D5

Aortic and Mitral Valve Replacements Through a J-Type Partial Sternotomy Extending to the Third Right Intercostal Space

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Objective: Access to the mitral and aortic valves in patients undergoing combined mitral and aortic valve surgery is traditionally performed via a full sternotomy. We demonstrated the feasibility of performing concomitant aortic and mitral valve replacement procedures via a partial upper sternotomy.

Methods: An 86-year-old man with hypertension and congestive heart failure and without coronary artery disease presented with severe aortic and mitral valve regurgitation. A 6-centimeter skin incision and an upper partial sternotomy with extension to the third right intercostal space were performed. The right common femoral vein was exposed; heparin was administered; and the ascending aorta and femoral vein were cannulated using the Seldinger technique. A separate cannula was placed directly into the right atrium to assist with venous drainage; the aorta was cross-clamped; and the heart was arrested with a single dose of antegrade Custodiol HTK solution.

Results: The aorta was transected 1 cm above the sinotubular junction, and additional cardioplegia was deposited directly into the coronary artery ostia. A pulmonary vent was inserted, and the dome of the left atrium was exposed and incised. The mitral valve was visualized, and the anterior leaflet was removed. A series of interrupted pledgeted sutures were placed into the annulus of the mitral valve, the prosthesis was lowered into place, the sutures were tied with the COR-KNOT device, and the dome of the left atrium was closed. Attention was then turned to the aortic valve. The aortic valve leaflets were resected, and interrupted annular sutures were placed. The annular sutures were brought through the valve sewing cuff, the valve was lowered into place, and the sutures were tied using the COR-KNOT device. The aortotomy was then closed in 2 layers, and the chest was closed in the standard fashion. The patient was weaned off cardiopulmonary bypass without any difficulties. The patient had an uneventful hospital course.

Conclusions: Concomitant aortic and mitral valve surgery can be safely performed via a ministernotomy. This surgical approach provides excellent exposure to both the aortic and mitral valves and has the added benefit of a minimally invasive approach with respect to patient recovery.

D6

Aortic Arch: Hybrid Arch Debranching (Lupiae Technique)

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Objective: The objective of this video was to show how to treat extensive aortic diseases using a hybrid approach (the Lupiae technique).

Patient: An 83-year-old woman, affected with megaaortic syndrome type 1 (dilatation up to the celiac trunk), was treated with the Lupiae technique, a hybrid thoracoabdominal aneurysm repair: ascending aorta and aortic arch replacement with a multibranched prosthesis plus debranching of epiaortic vessels followed by implantation of an endovascular prosthesis in the thoracic aorta. After the endovascular stage, perfect exclusion of the thoracoabdominal aneurysm was achieved.

Conclusions: The Lupiae technique is a safe, feasible technique to achieve complete exclusion of thoracoabdominal aneurysms.

D7

Aortic Calcification Partial Clamp and Choice of Device on Off-Pump Coronary Artery Bypass Graft

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Objective: During off-pump coronary artery bypass grafting, the aortic no-touch technique is an effective method to reduce the number of strokes. However, the use of this technique may limit the revascularization strategy for treating calcification of the ascending aorta. There are many strategies for performing a proximal anastomosis of a saphenous vein graft (SVG). Therefore, we examined the clinical impact of our proximal anastomotic device using an SVG to treat calcification of the ascending aorta.

Methods: We retrospectively reviewed 979 patients undergoing CABG between 2007 and 2014. A total of 40 (4.1%) patients had moderate calcification (M group); 40 (4.1%) had severe calcification (S group); and

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146 (14.9%) had mild calcification. The proximal anastomosis procedure used with each group was the aorta no-touch technique, partial clamping, and a proximal anastomosis with a device such as the PAS-Port (Cardica, Inc, Redwood City, CA USA), Heartstring (Guidant Corporation, Santa Clara, CA USA), or the EncloseII (Novare Surgical System, Inc., Cupertino, CA USA).

Results: The overall perioperative stroke rate was 1/979; 1 patient had mild calcification of the aorta. We used the aorta no-touch technique. Two patients had aortic dissection:1 had mild calcification using a partial clamp and 1 had no calcification using the partial clamp. We used similar methods for each group: for the M group, we used the aorta no-touch technique, 47.5%; device, 42.5%; partial clamp, 10.0%; for the S group, we used the aorta no-touch technique, 57.5%; device, 40.0%, partial clamp, 2.5%. There were no perioperative strokes in either of these 2 groups. There was no difference in complete revascularization (M group: 100%, S group: 97.5%). The impact of the calcified aorta on SVG patency was similar in each group.

Conclusions: Off-pump coronary artery bypass grafting with a proximal anastomotic device provided both complete revascularization and stroke prevention, even in patients with calcified aortas. This device allows an automated, rapid anastomosis with minimal aortic manipulation and can be used in patients undergoing off-pump coronary artery bypass procedures. Ultimately, late angiographic follow-up is required to confirm comparable long-term vein graft patency rates.

D8
Aortic Root Remodeling Technique With External Ring Annuloplasty and Valve-Sparing Root Replacement: How to Start and Review Initial Results

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Objective: Aortic valve replacement is still the most commonly used therapeutic option for patients suffering from aortic regurgitation. Aortic valve repair is an attractive alternative method, because it avoids the risks of prosthesis-related complications. Our goal was to present our experience with the remodeling technique of valve-sparing root replacement with external expansible ring annuloplasty.

Methods: Between November 2014 and December 2016, 42 patients (52.5 ± 11.5 years; 18.9% women, EuroSCORE II 2.8% ± 0.46%) underwent aortic valve repair: 7 due to isolated cusp malcoaptation and 35 with associated aortic root dilatation. Reconstruction was done with the Coroneo Extraaortic Ring [27 (25–29)] and the Gelweave graft [28 (26–32)]. Concomitant procedures included mitral valve repair in 3 patients with tricuspid valve repair in 2 of them, coronary artery bypass grafting in 2 patients, and replacement of the aortic arch and placement of the EVITA hybrid stent graft in 2 patients. Echocardiography was used to determine the severity of aortic regurgitation preoperatively, intraoperatively, and during the immediate postoperative period (within 7 days from the operation) and at early follow-up.

Results: No patients died during the postoperative follow-up period. Freedom from reoperation was 93% (3/42); 2 patients were reoperated due to early postoperative regurgitation; 1 was reoperated because of early cardiac tamponade. A significant decrease in left ventricular end-diastolic diameter was observed (60.3/53.3 mm) with further decrease at early follow-up. At follow-up, none of the patients had major aortic regurgitation (AR 0 = 32, AR 1+ = 8, AR 2+ = 2).

Conclusions: We have proved that this method of aortic root reconstruction and aortic valve repair is a good alternative for patients with aortic insufficiency and leads to left ventricular reverse remodeling with comparable results in terms of left ventricular end-diastolic diameter and left ventricular ejection fraction immediately postoperatively and at early follow-up.

D9
Aortic Valve Repair in Patients with Severe Bicuspid Valve Endocarditis

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Objective: Preserving the native aortic valve, when feasible, in cases of aortic valve endocarditis may be the best option in young patients. We demonstrated the feasibility of performing a complex aortic valve repair for aortic valve endocarditis via an upper partial sternotomy.

Methods: A 31-year-old man presented with fever and lethargy. A computed tomography scan of the abdomen showed multiple left renal infarcts. The blood cultures were positive for streptococcus, and a transesophageal echocardiogram showed a bicuspid aortic leaflet with echodensity and severe aortic valve regurgitation. A 6-centimeter skin incision and an upper partial sternotomy with extension to the right third intercostal space were performed. The right common femoral vein was exposed; heparin was administered; and the ascending aorta was cannulated using the Seldinger technique. A venous cannula was advanced into the superior vena cava using the Seldinger technique under transesophageal echocardiography guidance. The aorta was cross-clamped, and the heart was arrested with a single dose of antegrade Custodiol-HTK solution.

Results: The aorta was transected 1 cm above the sinotubular junction, and additional cardioplegia was administered directly into the coronary artery ostia. The evaluation of the aortic valve showed prolapse of the conjoined left and right leaflets with vegetations in the undersurface of the leaflet, as well as a perforation and vegetations of the noncoronary leaflet. All vegetations were excised. The perforation was cleaned and closed with a piece of xenograft pericardium. The conjoined leaflets and then the noncoronary cusp were plicated on the free edge for an effective height of 9 mm. The root was circumferentially mobilized, and a Teflon felt ring was placed underneath the coronaries to establish an arterioventricular junction of 25 mm. The aortotomy and the chest were closed in a standard fashion. The postoperative TEE showed trace aortic valve insufficiency. The patient had an uneventful hospital course.

Conclusions: Repair of the aortic valve in cases of endocarditis with perforation of the cusp is feasible in selected patients.

D10
Repair of an Atrial Septal Defect Using a Minimally Invasive Approach

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Objective: Our goal was to demonstrate the minimally invasive repair of an atrial septal defect in a 34-year-old woman who presented with an accidentally discovered ostium secundum atrial septal defect.

Patient: We performed a right minithoracotomy and arterial and venous femoral cannulations using a superior vena caval cannulation via the jugular vein. A Chitwood clamp was used for aortic cross-clamping. CO_2 insufflation was used. A pericardial patch was used to close the defect. The patient went home on postoperative day 3.

Conclusions: This procedure is safe and has good cosmetic and clinical results.

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D11

Aortic Root Surgery in Patients with Marfan Syndrome

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Objective: Marfan syndrome is characterized by variable clinical manifestations, including skeletal, ocular, and cardiovascular abnormalities. Dissection and rupture of an ascending aortic aneurysm is the main life-threatening cardiovascular manifestations of Marfan syndrome. The aim of this study was to evaluate the operative results of patients with Marfan syndrome who underwent aortic root surgery.
Methods: The author retrospectively analyzed the data of 72 operations in 68 patients with Marfan syndrome who underwent aortic root surgery between January 1996 and August 2014.
Results: Of the 68 patients, 16 patients (24%) had a family history of Marfan syndrome. A total of 55 patients had aortic root replacement surgery; 17 patients had aortic root sparing surgery. Aortic root replacement surgery included 52 button-type aortic root replacements and 3 Cabrol-type aortic root replacements. The aortic root sparing procedure included 7 root remodeling procedures, 9 root reimplantation procedures, and 1 other type of aortic root sparing procedure. Combined procedures included 9 mitral valve operations, 8 coronary arteries bypass surgical procedures, 2 total aortic arch replacements, and 1 femorofemoral bypass surgical procedure. There was 1 early death. During the follow-up period, 4 patients needed redo aortic root surgery: 3 had recurrent aortic regurgitation and 1 had endocarditis.
Conclusions: Aortic root surgery can be performed in patients with Marfan syndrome with good results. Close follow-up of patients undergoing surgical procedures is important.

D12

Automatic Planning and Simulation for Minimally Invasive Aortic Valve Surgery

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Objective: During the past decades, various less invasive approaches to the aortic valve have been developed. However, their diffusion worldwide remains limited because minimally invasive aortic valve procedures are more complex and technically challenging compared to the conventional full sternotomy operative procedure. Preoperative planning could reduce the risk of anatomical unknowns, the rate of conversion, and the risk to the patient. We developed an automatic tool to identify, optimize, and simulate the patient-specific minimally invasive approach to the aortic valve.
Methods: Angiography/computed tomography images were segmented to visualize chest bones and heart structures using 3-dimensional meshes. The automatic detection of the right border and the centerline of the sternum related to the position of the ascending aorta allowed us to identify the best minimally invasive approach (J- or T-shaped ministernotomy or right minithoracotomy). The intercostal spaces were automatically detected and related to the position of the aortic valve to choose the best intercostal space. The aortic valve plane and its normal vector were computed and visualized into the 3-dimensional mesh, including the patient's skin.
Results: The automatic tool was tested for validation purposes on 50 datasets from patients affected by severe aortic stenosis. The quality of the automatic results was verified by 2 surgeons who felt comfortable in the minimally invasive setting: 93% of intercostal spaces, 96% of the right sternum borders, and 93% of the sternum centerlines were judged by both surgeons as perfectly detected. In the remaining cases, the error was minimal, still permitting a minimally invasive plan. The possibility of modifying the length of the skin incision and the width of the retraction of sternal ribs was also implemented to optimize access. We included a warning concerning the technical difficulty caused by anatomical features such as a deep ascending aorta or a very low aortic valve.
Conclusions: The 3-dimensional reconstruction allows one to simulate the real surgical field area visualized during the minimally invasive approach to the aortic valve in order to choose and optimize the best access point for each patient. This automatic tool could be helpful especially for surgeons just learning minimally invasive aortic valve surgical procedures.

D13

Cardiac Surgery Through a Minithoracotomy

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Objective: Our goal was to determine the mortality rate and major cardiovascular events of minimally invasive cardiac surgery, including the quantity of blood components used, the rate of reoperations, and the length of stay in the intensive care unit.
Methods: We performed a retrospective study between 2013 and 2016. The surgical approach used was a right minithoracotomy with direct vision. Extracorporeal circulation was performed with cannulation of the femoral artery and the femoral and jugular veins (when necessary).
Results: Between 2013 and 2016, we operated on 71 patients through a right minithoracotomy: 80% were men, 20% were women; the average age was 47.8 years; and the average EuroSCORE II was 1.6. We performed 27 interatrial closures (10 with tricuspid valve repair), 29 mitral valve replacements, 6 mitral valve repairs, 5 aortic valve replacements, and 4 intraauricular tumor excisions. The 30-day mortality rate was 1.4% (1 patient who presented with atrioventricular disruption after mitral valve replacement). One patient had a stroke and another patient was returned to the operating room for bleeding. A total of 32 patients (45%) required blood transfusions in the intra- or postoperative period. The mean time to endotracheal intubation was 11.3 hours, and the average stay in the intensive care unit was 2.1 days.
Conclusions: Minimally invasive cardiac surgery through a right minithoracotomy is a safe procedure with acceptable mortality rates in our center.

D14

Comparison of Clinical Results after Selective Cerebral Perfusion Alone and Combined With Distal Perfusion in Aortic Hemiarch Replacement

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Objective: Because the tolerance of the brain to cerebral ischemia is restricted under normothermia to a few minutes and because, even under hypothermia, cerebral ischemia can only be prolonged with limitations, the use of selective cerebral perfusion (SCP) to protect the brain during cardiac surgery became a standard of care for complex procedures like aortic hemiarch replacement (AHR). Although the tolerance of other organs to ischemia is longer than that of the brain, new perfusion strategies, like distal perfusion (DP) in addition to SCP, are being developed to improve organ protection below the neck. The goal of this study was to compare clinical and surrogate outcomes between patients under SCP alone and under DP with SCP during AHR in a cardiovascular referral center in Colombia.
Methods: We performed a cross-sectional study of all consecutive patients who underwent AHR between January 2013 and December 2016.

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Quantitative variables were expressed as mean ± standard deviation. Comparisons between qualitative and quantitative variables were performed using the χ^2 test and the *t* test. The statistical analysis was performed with the SPSS v20.0 (SPSS Inc., Chicago, IL USA). Mortality rate, length of stay, and length of intubation were examined as dependent variables.

Results: A total of 31 patients were included and divided into 2 main groups according to the perfusion technique. Seventeen patients were treated with SCP alone; 14 were treated with DP plus SCP. The groups were comparable (Table D14-1A). With respect to the clinical outcomes (Table D14-1B), in the statistical analysis, no association between the type of perfusion and length of stay, length of stay in the intensive care unit, hours of intubation, intraoperative mortality rate, postoperative mortality rate, or organ dysfunction could be demonstrated. Nonetheless, there was a trend toward fewer deaths and less organ dysfunction that favors combined SCP and distal perfusion.

Conclusions: Although the present study lacks statistical power, combining SCP and DP is a novel technique that may improve clinical results in patients who have complex cardiac operative procedures. More studies are needed to support our findings.

D15
Complete Revascularization May Not Be Necessary Following Robotically Assisted Minimally Invasive Direct Coronary Artery Bypass

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Objective: Until recently, patients with multivessel coronary artery disease (MVCAD) who underwent incomplete revascularization were felt to have poorer outcomes. However, the COURAGE trial found that revascularization did not confer a survival benefit over medical management alone in some patients with coronary artery disease. Furthermore, some patients with MVCAD may have a high risk of perioperative death when undergoing standard coronary artery bypass graft (CABG) surgery. Robotically assisted minimally invasive direct coronary artery bypass (RA-MIDCAB) surgery may allow higher risk patients to receive an internal mammary artery graft to the left anterior descending artery with less risk of death and morbidity than with standard CABG. However, complete revascularization would require stenting other stenosed

TABLE D14-1A. Demographic and Clinical Data Comparison Between Selective Cerebral Perfusion (SCP) Group and SCP Plus Distal Perfusion (DP) Group

			Age	Weight	Perfusion Time	Cross-Clamp Time	Brain Perfusion Time	Basal Lactate	Basal pH	EuroSCORE II	Creatinine Clearance ml/min
	N	17									
SCP alone	Mean		**54**	**70**	**219**	**141**	**52.9**	**1.38**	**7.40**	**5.2**	**91.5**
	Standard deviation		19	16	93	62	61.3	0.56	0.11	4.3	49.3
	Quartiles	25	42	59	147	99	22.5	0.90	7.35	1.4	50.3
		50	56	66	202	122	29.0	1.20	7.43	4.5	82.0
		75	68	79	254	175	60.5	1.75	7.48	8.1	121.0
SCP and distal perfusion	N	14									
	Mean		**54**	**74**	**175**	**126**	**33.8**	**1.50**	**7.42**	**5.6**	**105.9**
	Standard deviation		14	15	45	37	15.6	0.59	0.04	13.2	33.2
	Quartiles	25	47	60	154	108	25.8	1.08	7.39	1.4	86.0
		50	57	70	179	126	28.0	1.30	7.42	1.7	112.5
		75	64	87	195	146	38.0	1.90	7.46	3.1	129.0
P value for comparison between groups			**0.98**	**0.48**	**0.11**	**0.44**	**0.26**	**0.55**	**0.6**	**0.91**	**0.36**

SCP, selective cerebral perfusion.

TABLE D14-1B. Clinical Outcomes Comparison Between Selective Cerebral Perfusion (SCP) Group and SCP Plus Distal Perfusion (DP) Group

			Length of Hospital Stay	Length of ICU Stay	Hours of Intubation	ICU Lactate	Postoperative pH			Intraoperative Mortality	Postoperative Mortality	Organ Dysfunction
SCP alone	N	17						SCP alone	N	1	3	2
	Mean		8.5	3.8	36	3.31	6.92		Percent	5.9	17.6	11.8
	Standard deviation		**4.4**	**1.9**	**33**	**1.73**	**1.79**					
SCP and distal perfusion	N	14										
			8.3	4.5	30	4.34	7.38	SCP and distal perfusion	N	0	1	0
			4.4	4.5	61	2.40	0.70		Percent	0	7.1	0
P value for comparison between groups			0.9	0.6	0.7	0.19	0.43	*P* value for comparison between groups		0.35	0.38	

SCP, selective cerebral perfusion.

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coronary arteries. At our institution, 77 patients with MVCAD had RA-MIDCAB. Of those patients, 22 had stenting of other vessels (hybrid group). We sought to compare outcomes between these patients and the 55 patients who did not (nonhybrid group).

Methods: This retrospective review included patients treated from May 2009 (first RA-MIDCAB case at our institution) to August 2015 (to allow for a 1-year follow-up period). Preoperative factors were compared between the 2 groups using the 2-tailed Student *t* test. Follow-up information was collected at least 1 year postoperatively. Kaplan-Meier survival curves were used to compare survival between the 2 groups.

Results: The mean Society of Thoracic Surgeons risk score for perioperative mortality was higher in the hybrid group than in the nonhybrid group (6.3 ± 2.0 vs. 3.1 ± 1.8, respectively); however, there were no perioperative deaths. Only 1 patient had a major cerebrovascular accident postoperatively, and none of the patients had a wound infection. There was no significant difference in survival observed between the hybrid and nonhybrid groups (log rank test $P = 0.57$).

Conclusions: Our small experience suggests that in certain carefully selected patients with MVCAD, incomplete revascularization with RA-MIDCAB alone may be a reasonable and safe alternative to complete revascularization.

D16
Coronary Surgery With Coincidental Exacerbation of Recurrent Takotsubo's Cardiomyopathy: A Case Report

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Objective: The purpose of this study was to report a case of coronary surgery with coincidental exacerbation of recurrent Takotsubo's cardiomyopathy.

Patient: A 63-year-old woman was admitted to the hospital for chest pain and vague complaints of general malaise. Her troponin level was elevated from 0.017 ng/ml to 0.153 ng/ml. An echocardiogram showed that she was in sinus rhythm without St-segment elevation. Coronary angiography revealed multivessel coronary artery disease with total occlusion of the first obtuse marginal artery. The ejection fraction was calculated to have a value of 15%, making the diagnosis of Takotsubo cardiomyopathy probable. Bypass surgery was indicated. Before sending the patient to bypass surgery, echocardiography was repeated.

Conclusions: Generally, Takotsubo cardiomyopathy is described in cases where coronary artery disease with a stenotic lesion other than in the left anterior descending coronary artery was found.

D17
Development of a New Sternal Fixation Device: An Uncalcined Hydroxyapatite Poly-l-Lactide Corrugated Sheet

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Objective: Wire cerclage is the most frequently used sternotomy closure technique after a median sternotomy. However, wire cerclage sometimes has an insufficient fixation effect on the sternotomy halves. Bioabsorbable uncalcined hydroxyapatite poly-l-lactide (uHA/PLLA) sternal pins (Takiron Co., Ltd., Osaka, Japan) are inserted in the sternal bone marrow to prevent displacement of the sternum. However, the sternal pins do not provide an adequate fixation effect in older patients, whose bone marrow is too fragile to retain the pin in the same position. Therefore, we developed a new sternal fixation device.

Methods: The new sternal fixation device is a corrugated sheet made of uHA/PLLA (length 30 mm × width 21 mm) (Fig. D17-1) and designed to be easily inserted in the bone marrow. In 18 cadavers, insertion feasibility of the device was assessed in relation to the hardness of the bone marrow. Following insertion of the device, the position of the device was evaluated by computed tomography scans in 6 cadavers. In 3 cadavers, shear force to displace the cerclaged sternal halves was measured with or without the device.

Results: The upper limit of sternal bone marrow hardness that could accept the device was 0.85 megapascals. Accordingly, application of the device was feasible in 10 of the 18 cadavers, whose mean age was 65 ± 10 (48–80) years. The mean age of the remaining 8 cadavers was 42 ± 14 (21–66) years. Computed tomography scans showed proper positioning of the device in all 6 cadavers. The shear force of the sternum displacement was significantly higher when the device was implanted (5.6 ± 1.0 kg) in comparison with that without the device (2.8 ± 0.3, $P < 0.05$).

Conclusions: This new sternal fixation device would provide stronger fixation of the sternum than simple wire cerclage, especially in elderly patients with fragile bone marrow.

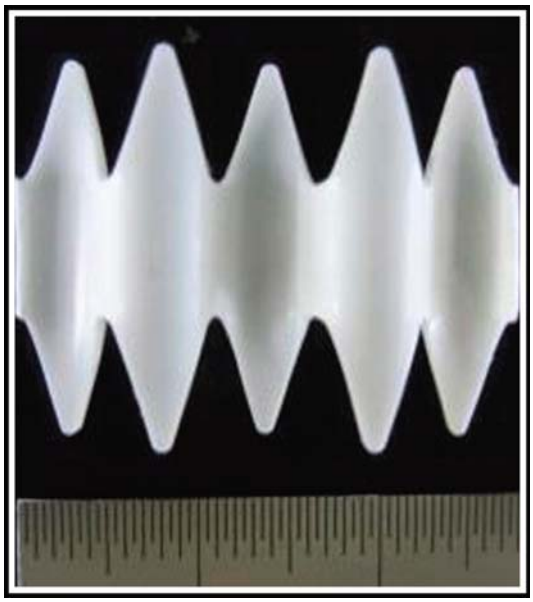

FIGURE D17-1. New sternal fixation device is consisting of a corrugated sheet, which is expected to increase the retention force against shear stress.

D18
Diabetes Predisposes Patients to Atrial Fibrillation After Robotic-Assisted Videothoracoscopic Pulmonary Lobectomy

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Objective: We sought to determine whether preexisting diabetes in patients undergoing robotic-assisted pulmonary lobectomy is a risk factor for development of atrial fibrillation (AF) in the early

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postoperative period and whether associated comorbidities worsen prognosis.

Methods: Excluding patients with a preoperative history of AF, 353 consecutive patients who underwent robotic-assisted videothoracoscopic (RAVTS) lobectomy by 1 surgeon from September 2010 through August 2016 were retrospectively analyzed. Patients were studied with respect to presence of diabetes, coronary artery disease, heart failure, kidney failure, peripheral vascular disease, and other known associated comorbidities. The χ^2 test, the Fisher exact test, and the Student *t* test were used to compare variables, with significance at $P \leq 0.05$.

Results: In this study, 64 patients with diabetes were identified, 11 (17.2%) of whom developed AF following RAVTS lobectomy. Patients with diabetes were at higher risk of developing AF following surgery [odds ratio (OR) 2.52, 95% confidence interval (CI) 1.15–5.50, $P = 0.02$]. The mean age of patients with diabetes who developed AF was 72.7 years and 68.4 years for those who did not ($P = 0.07$). Known comorbidities in patients with diabetes did not confer additional risk, including hypertension ($P = 1.00$), hyperlipidemia ($P = 1.00$), cardiomyopathy ($P = 0.17$), coronary artery disease ($P = 0.27$), and obesity ($P = 0.67$). There was a trend toward increased risk in patients with diabetes and kidney disease, although it failed to reach significance ($P = 0.07$). Being a former smoker was the only associated risk factor identified, because 90.9% of the patients with diabetes with AF were former smokers (OR 10.38, 95% CI 1.24–86.95, $P = 0.03$). Pack-years did not increase risk for AF, with 47.2 pack-years on average being reported in those who developed AF, whereas patients without AF averaged 49.6 pack-years ($P = 0.87$). Furthermore, there was no significant difference in preoperative percent forced expiratory volume in 1 second between patients with diabetes who did and who did not develop AF (87.0% vs. 80.4%, $P = 0.45$).

Conclusions: Patients with diabetes are at higher risk for developing AF after RAVTS lobectomy. Known comorbidities of diabetes, including obesity, hyperlipidemia, and kidney disease, did not confer an increased risk for development of AF after surgery. However, being a former smoker put a patient with at a 10-times greater risk than current or never smokers with diabetes.

D19

Early Experience and Midterm Outcomes of a Venoarterial Extracorporeal Membrane Oxygenator

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Objective: A venoarterial extracorporeal membrane oxygenator was implanted in 14 patients with refractory cardiogenic shock in our recently developed program. We sought to evaluate this early experience in terms of successful weaning, the 30-day survival rate, and early results.

Methods: Our retrospective 14-patient study was carried out from January 2014 to March 2016 (51.0 ± 6.6 years) (M = 85.7%). Two groups could be identified according to the cause of the refractory cardiogenic shock, namely, the postcardiotomy (P-C) group: 5/14 (36%) (M = 60%) (50.4 ± 5.46 years) and the non-postcardiotomy (non-P-C) group, which was predominantly the postanterior myocardial infarction (P-AMI) group: (9/14: 64%) (M = 100%) (51.3 ± 7.45 years). The standard cutdown femoral exposure was used in all members of the P-C group except 1 (central insertion) due to severe peripheral vascular disease. In the non-P-C group, we used the Seldinger technique with antegrade perfusion of the ipsilateral lower limb percutaneously inserted in all but 2 cases, in whom the usual cutdown surgical method was performed (1 due to obesity and the other due to bad back flow).The non-P-C group (9 cases) included 7/9 (77.8%) with P-AMI, 1 case (1/9: 11.1%) with fulminant myocarditis, and 1 case (1/9;11.1%) in whom we had to use venoveno-arterial extracorporeal membrane oxygenation due to adjuvant acute respiratory failure.

Results: Seven patients (7/14: 50%) had early complications (3 had wound infections; 1, a local dissection; 1, a large hematoma; 1, compartmental syndrome; and 1, acute limb ischemia). All patients were managed successfully with a mean duration of support of 8.43 ± 5.64 days. In the P-C group (10.2 ± 7.33) and in the non-P-C group (7.44 ± 4.67) ($P = 0.4$), 10 patients (10/14, 71.4%) were weaned successfully from extracorporeal membrane oxygenation in the total population: 2/5 (40%) in the P-C group and 8/9 (88.9%) in the non-P-C group. The 30-day survival rate was 8/14 (57.1%) in the total population: 1/5 (20%) in the P-C group (1 patient died of intracranial hemorrhage) and 7/9 (77.8%) in the non-P-C group (1 patient died of acute stent thrombosis).

Conclusions: Building an extracorporeal membrane oxygenation program can be achieved in a reasonable time with an acceptable early outcome. Extracorporeal membrane oxygenation is a practical bridge to recovery or further intervention.

D20

Early Follow-Up of Transesophageal Echocardiography to Guide the Right Jugular Internal Vein for Closure of Atrial Septal Defect

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Objective: Our goal was to summarize the preliminary experience and early-stage follow-up results of simple transesophageal echocardiography (TEE) to guide the right jugular internal vein for closure of an atrial septal defect (ASD) and to determine its feasibility.

Methods: Data from 32 patients with ASD (15 boys,17 girls), treated in our center from February 2015 to June 2016 by transcatheter ASD closure under the sole guidance of TEE, were summarized. The mean age was 3 to 26 (8.6 ± 4.3) years; body weight was 13 to 60 (30.1 ± 8.4) kg; the average diameter of the ASD was 5 to 20 (11 ± 2.8) mm. All patients were treated by transcatheter closure of the right jugular internal vein under the sole guidance of TEE. The efficiency of immediate postoperative TEE was estimated; follow-ups were done at 24 hours,1 month, and 3, 6, and 12 months after the procedures by transthoracic echocardiography, radiographic examination, and electrocardiograms.

Results: A total of 31 patients were treated successfully under the guidance of TEE only. The diameter of the device was 10–28 (15.5 ± 4.1) mm. The procedural time was 20.5 ± 7.2 minutes. One patient who had 2 ASDs was treated with a traditional thoracic surgical procedure because the small ASD had a 5 mm residual shunt after the procedure. There were 3 cases with trivial residual shunts immediately after the procedures. All patients could move immediately after the operation. The average follow-up time was 3 to 12 (10.6 ± 2.2) months. No patients had a residual shunt, occluder malposition, peripheral vascular injury, pericardial effusion, or cardiac perforation during the follow-up period.

Conclusions: For some selected patients, simple TEE guiding the right jugular internal vein for closure of ASD is appropriate. The method not only prevents injury from radiation but also shortens the time in bed and avoids the lower limbs breaking, with good early-stage follow-up results.

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D21
Early Outcome of Fully 3-Dimensional Endoscopic Mitral Valve Surgery

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Objective: Minimally invasive mitral valve surgery has significant advantages for minimizing surgical trauma. This procedure is a widely used technique with endoscopic guidance. However, robotic assistance is used for totally endoscopic procedures in many institutions. We performed a fully 3-dimensional endoscopic procedure through a 5 to 7 cm right mini thoracotomy without rib spreading and robotic assistance from January 2013. Our goal was to present the results of our early experience.
Methods: From January 2013 to November 2016, a total of 35 patients underwent full 3-dimensional endoscopic mitral valve repair for severe degenerative mitral regurgitation or functional mitral regurgitation. The procedure was performed through a 5 cm skin incision in male patients and a 7 cm inframammary skin incision in female patients using a soft tissue retractor. An 11 mm endoscopic port, a 5 mm thoracic port, and a trans thoracic aortic clamp were used.
Results: The 3-dimensional totally endoscopic procedures were successful in 31 patients. One patient had a full sternotomy conversion. Mean cardiopulmonary bypass time and cross-clamp time were 251 minutes and 141 minutes, respectively. Resection techniques for the posterior leaflet were performed in 9 patients and chordal replacement for the posterior leaflet was performed in 8 patients. Chordal replacement for the anterior leaflet was performed in 6 patients, and the resection technique for the anterior mitral leaflet was performed in 1 patient. The combined procedure for both leaflets was done in 3 patients. Ring annuloplasty was combined with these procedures in all patients. Three patients had annuloplasty alone. Endocardial surgical Cox-Maze ablation for the left atrium using a pen-type radiofrequency device was performed in 6 patients with persistent atrial fibrillation. There were no deaths and no reexploration due to bleeding. One patient underwent mitral valve replacement 11 days after the first operation. Twenty-eight patients had no or trivial mitral regurgitation, and 2 patients had mild regurgitation at discharge. One patient required reoperation due to recurrence of moderate regurgitation, and 1 patient required reoperation due to hemolysis 2 months after the operation.
Conclusions: We performed standard mitral valve repair techniques using a 3-dimensional endoscope with good visualization. This procedure is a safe and cost-effective technique compared with robotic mitral valve procedures.

D22
Endobronchial Ultrasound–Transbronchial Needle Aspiration in the Diagnosis of Mediastinal Lesions: Cases in a Single Center in Brazil

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Objective: Mediastinal lesions are commonly assessed by imaging methods, especially computed tomography (CT). Symptoms do not always define the specific diagnosis of the lesion. Therefore, a biopsy is required if active mediastinal disease related to cancer or infectious/inflammatory disease is suspected. Surgical procedures and mediastinoscopy are established methods of approaching the mediastinum. Conventional transbronchial needle aspiration (C-TBNA) is a recognized method for collecting tissue and cell samples through flexible bronchoscopy, but it does not allow real-time lymph node vision. The endobronchial ultrasound associated with needle aspiration (EBUS-TBNA) is used preferentially to collect lymph nodes and peribronchial or peritracheal masses. The technique was recently introduced in Brazil, and little has been published about the results. Our goal was to describe the results of EBUS-TBNA in the diagnosis of mediastinal lesions of different causes in a private institution in São Paulo, Brazil.
Methods: We performed a retrospective cross-sectional study of patients biopsied with EBUS. We included all cases referred between June 2013 and October 2016 for collection of lymph nodes or peritracheal or peribronchial masses using EBUS-TBNA and studied with CT or positron emission tomography. All cases were performed by interventional pulmonologists and thoracic surgeons with experience in the procedure. Rapid on-site evaluation of fine-needle aspiration biopsy was performed in all cases by an experienced pathologist, and the materials were prepared on slides and sent for histopathological analysis and other tests as needed.
Results: We identified 72 patients. Of these, 6 were excluded because they had endobronchial lesions that could be biopsied or intrathoracic lesions not accessible by EBUS. Thus, a total of 66 patients were included in the analysis. The mean age was 61.17 (±14.67) years and men predominated (42%–64%). EBUS-TBNA was definitive for diagnosis in 60 cases (91%); 3 (4.5%) were inconclusive; in 1 (1.5%), the result was false negative. In 2 (3%) cases, there was loss of follow-up. There were no complications during or after the procedure.
Conclusions: In our series, EBUS-TBNA had a high diagnostic yield, with minimal morbidity, constituting an excellent option for patients with lymphadenopathy or intrathoracic expansive lesions.

D23
Efficacy of Wound Analgesia for Postoperative Pain Control

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Objective: Continuous wound infusion of local anesthetics has been successfully applied for postoperative pain control in several procedures but, surprisingly, it is underused in cardiothoracic surgery. Our goal was to investigate the effects of wound analgesia associated with systemic patient-controlled analgesia in patients undergoing myocardial revascularization from a left anterior small thoracotomy.
Methods: Forty-two consecutive patients who had myocardial revascularization via a left anterior small thoracotomy were randomized into 2 groups (wound analgesia and systemic patient-controlled analgesia). In the wound group, bupivacaine was injected using a multiholed catheter connected to an elastomeric pump inserted at the end of the operation above the intercostal muscles and removed 48 h later. The intergroup differences were assessed using the following criteria: pain on a visual analogue scale at rest and consumption of narcotic and nonsteroidal antiinflammatory medications at different time points postoperatively.
Results: All 42 patients were included into the analysis. Thus, the wound and systemic analgesia groups comprised 22 and 20 patients, respectively. The wound analgesia group had a significant decrease in pain scores at rest ($P < 0.001$) and a reduction in the amounts of piritramide ($P < 0.002$) and metamizole ($P < 0.003$) taken during the entire postoperative course compared with the systemic analgesia group.
Conclusions: Our data show that wound analgesia is an effective, easy, and safe procedure. It significantly reduces pain scores and the intake of analgesic medications. Catheter placement does not require particular maneuvers by the surgeon nor does the elastomeric pump need any adjustment or care by physicians or nurses.

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D24
Endoconduit for Transcatheter Aortic Valve Implantation

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Objective: Access challenges are sometimes encountered in patients indicated for transcatheter aortic valve implantation (TAVI). Transapical access is a well-established alternative, but it is more invasive than the standard transfemoral access. We present the iliac endoconduit technique to perform transfemoral TAVI in 2 patients with small-caliber, heavily calcified iliac arteries.
Methods: The procedure was performed in a fully equipped hybrid operating room. A 3 cm left inguinal incision was made, and the common femoral artery or the distal external iliac artery (EIA) was exposed. Two pieces of stent graft were deployed to cover the full length of the EIA in 1 and from the common iliac to the distal EIA in another patient. Then, controlled rupture of the iliac artery was conducted with an 8 to 10 mm balloon. Angiography did not revealed hemorrhage. The TAVI procedure was performed through this stent graft or endoconduit.
Results: The valve was implanted successfully, and the retrieval of the sheath was uneventful. Angiography showed no hemorrhage of the iliac arteries and that the stent graft was patent; however, it also revealed a small external iliac dissection distal to the edge of the stent graft in 1 patient and stenosis at the insertion site in another. Postoperative evaluation revealed patency of the conduit in both cases.
Conclusions: This technique could provide an adequate access route for TAVI from the groin, even in patients with prohibitive iliac anatomy.

D25
Endoscopic Mitral Valve Repair: Minimize to the Max

Alaaddin Yilmaz, Pascal Starinieri, Boris Robic. *Jessa Hospital, Hasselt, Belgium.*

Objective: Mitral valve surgery using video-assisted thoracoscopy without the use of robotics is a new closed-chest technique. It has been developed in an attempt to decrease postoperative pain, reduce recovery time, and speed up resumption of daily activities.
Methods: The procedure is performed through 3 ports with the right hemithorax positioned in an elevated status. Cardiopulmonary bypass is done through bicaval remote access perfusion. Cardiac arrest was initiated with a transthoracic clamp. An automated knotting device was used to reduce clamping and perfusion times.
Results: Thirty-three patients were successfully operated on with this approach. Less pain and quicker postoperative recovery times were observed.
Conclusions: Mitral valve surgery through video-assisted thoracoscopy is a new endoscopic technique that provides good clinical results.

D26
Evaluation of Bypass Graft Flow Using a Computational Flow Dynamics Model

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Objective: Our goal was to create a systematic coronary arterial model after coronary artery bypass grafting (CABG) using computational fluid dynamics and to validate the accuracy of the simulation with actual intraoperative flow measurements of the internal thoracic artery to the left anterior descending coronary artery graft.
Methods: Using 3-dimensional computational models based on postoperative coronary computed tomography, which was performed 1 week after CABG, we simulated coronary arterial flow in 3 cases with left main disease or triple-vessel disease. We compared the simulated graft flow to intraoperatively measured graft flow using a transit-time flow meter. Two types of conditions with different coronary vascular resistance were simulated: hyperemia during the operation and rest after discharge. Peripheral coronary resistance was estimated from ventricular muscular volume perfused from each branch.
Results: The median difference in graft flow between the simulated graft flow in hyperemia and the actual graft flow from the transit-time flow meter was −4.3 ml/minute (range −12.3 ± 9.2 ml/minute). In 1 case, the internal thoracic artery-left anterior descending artery occluded 1 year after the operation regardless of confirmed patency without graft stenosis on postoperative computed tomography. In this case, the simulated graft flow in hyperemia was 20.2 ml/minute (intraoperative flow; 11 ml/minute). However, in the rest condition, the simulated graft flow was 6.4 ml/minute with reverse flow from the native coronary artery, which had not been seen in the other cases.
Conclusions: We performed systematic flow simulation of CABG and validated the system with actual graft flow measurements. This system enabled evaluation of flow competition. We may be able to predict graft flow before an operation to avoid graft occlusion risk in the future.

D27
First European Case of Transcervical Transcatheter Aortic Valve Replacement

Otto E. Dapunt[1], Birgit Zirngast[1], **Cristiano Spadaccio[2]**, Fraser WH Sutherland[2]. *[1]Medical University of Graz, Graz, Austria; and [2]Golden Jubilee National Hospital, Glasgow, United Kingdom.*

Objective: Our goal was to report the short-term outcomes of the first European case of transcervical transcatheter aortic valve replacement (TAVR) performed using the CoreVista Retractor.
Methods: An 84-year-old man with symptomatic (New York Heart Association class III) degenerative aortic stenosis was a candidate for TAVR and considered unsuitable for the conventional transfemoral (TF) approach because of the hostile ileofemoral anatomy. Exposure of the brachiocephalic artery at its origin from the aorta was obtained using the CoreVista retractor, and a single 26 mm Edwards SAPIEN S3 TAVI valve prosthesis was successfully deployed according to standard procedure (Fig. D27-1). Valve performance and clinical outcomes were evaluated using the latest version of the Valve Academic Research Consortium criteria.
Results: Vascular access to the origin of the brachiocephalic trunk at the aorta was achieved without major vascular injury or other complications. A single prosthesis was implanted in the correct final position without valve migration or embolization. A trace of prosthetic central regurgitation was detected and deemed acceptable. The patient made an unremarkable recovery and was discharged home on postoperative day 6 without complications. During his hospital stay, the transcervical wound healed normally without the need for transfusions or drains. At the 30-day follow-up, the patient was asymptomatic (New York Heart Association class I) with no major cardiac events, aortic re-intervention, or need for a pacemaker. Imaging confirmed good valve performance with no paravalvular leaks.
Conclusions: Transcervical TAVR is feasible and permits safe exposure and access to the aorta and closely related structures to perform the procedure. The transcervical access might minimize the risk of

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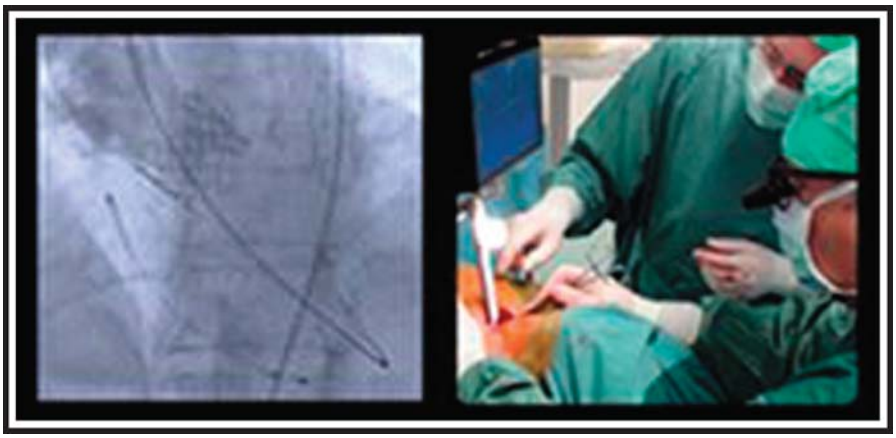

FIGURE D27-1. Left, Angiographic control of Edwards SAPIEN S3 TAVI valve prosthesis deployment. Right, Transcervical access to aorta and brachiocephalic artery using the CoreVista Retractor system. The device allows for a combination of retraction, targeted illumination, and on-screen visualization of the vascular structure to be accessed, allowing vessel control and safe placement of purse strings to perform direct aortic TAVI.

major access-related complications and blood transfusion requirements, which often affect the postoperative outcomes of TAVR patients, especially those unsuitable for TF approaches. Avoidance of a chest incision and a ventricular puncture in combination with the possibility of direct access to the aorta through a rapidly healing and relatively pain-free entry site might render the transcervical approach a valid alternative for non-TF candidates. The ease of recovery after the operation might also reinforce the prospect of transforming TAVR into a same-day or next-day discharge procedure. Further experience with this technique is warranted.

D28

First Perventricular Insertion of a Melody Valve-in-Valve in the Neo-Aortic Position in a Single Ventricle

Raghav Murthy, Howaida El-Said, John J. Lamberti. *Rady Children's Hospital, San Diego, CA USA.*

Objective: Our goal was to describe the first reported case of the perventricular insertion of a Melody valve in a failing previously implanted bioprosthetic valve in the neoaortic position in a patient with hypoplastic left heart syndrome.

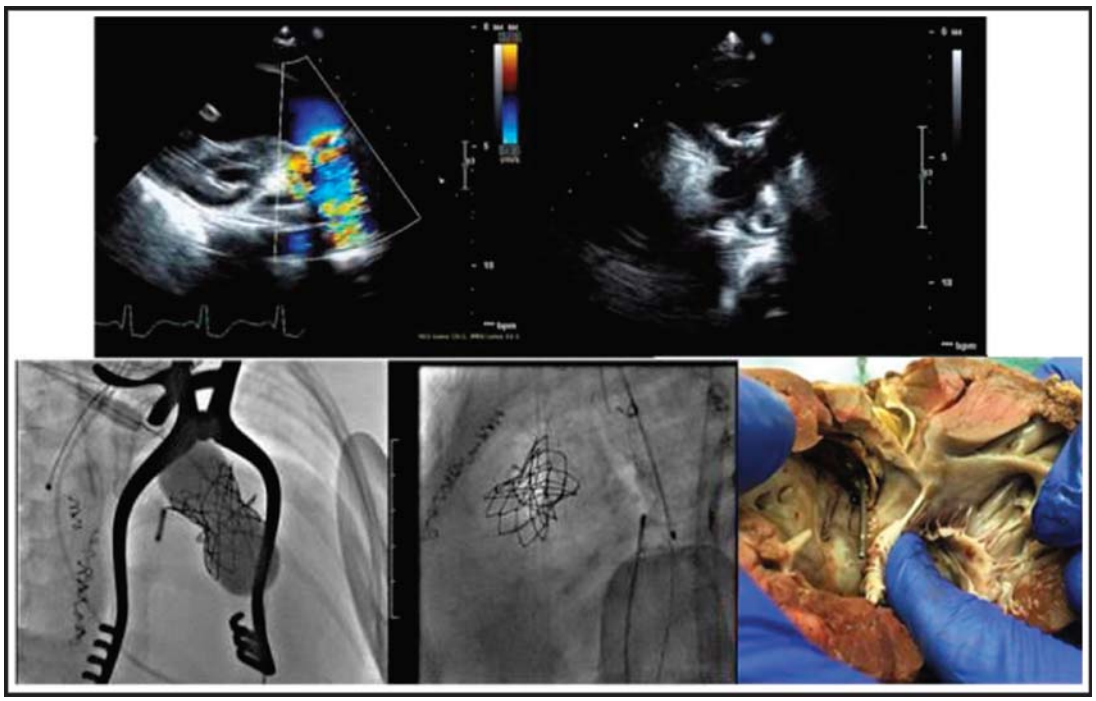

FIGURE D28-1. The image shows the preoperative echocardiogram with severe prosthetic valve stenosis, cardiac catheterization images during perventricular implant of the Melody valve-in-valve, and the heart at autopsy. The Melody valve and leaflets are intact and functional with compression of the stent from cardiopulmonary resuscitation.

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Patient: A 3-kg baby boy with a diagnosis of hypoplastic left heart syndrome (mitral stenosis, aortic stenosis) and a quadricuspid pulmonary valve underwent a Norwood procedure with a modified Blalock-Taussig shunt (3.5 mm) in April 2013. Following discharge, his course was complicated by multiple admissions for poor ventricular function, neoaortic regurgitation, and failure to thrive. Cardiac catheterization and stenting of the modified Blalock-Taussig shunt, ballooning of the stenotic pulmonary veins, and dilation of coarctation were performed. At 5 months of age (4.9 kg), a 21 mm Mitraflow bioprosthetic valve was implanted in the neoaortic position using a modified Konno technique. At 1 year of age (7.3 kg), the child underwent repair of the tricuspid valve for moderate insufficiency, shunt up-sizing to 5 mm, and sutureless repair of the left lower pulmonary vein stenosis. Secondary to progressive decline in ventricular function and severe prosthetic valve stenosis, he was evaluated and declined for a heart transplant. At age 2 years (9.2 kg), he underwent perventricular placement of a Melody valve, as a valve-in-valve, into the bioprosthesis (Fig. D28-1). The postoperative course required a Nissen fundoplication, a gastrostomy tube, and a tracheostomy. He suffered cardiac arrest at age 2.5 years and was not deemed to be a candidate for extracorporeal membrane oxygenation and died. Autopsy revealed a severely hypertrophied ventricle and a compressed Melody valve stent secondary to chest compressions.

Conclusions: We successfully implanted the Melody valve-in-valve perventricularly; the patient survived for 5 months. Perventricular placement of the Melody valve is a treatment option for management of failing bioprosthetic valves in the neoaortic position in patients who are poor surgical candidates.

D29
Five-Year Experience of Hemodynamic Performance of the St. Jude Medical Trifecta Aortic Bioprosthesis

Benjamin Adams, Jacob Chacko, Joy Edlin, Shirish Ambekar, John Yap, Kulvinder Lall. *Barts Heart Centre, London, United Kingdom.*

Objective: The St. Jude Medical Trifecta aortic supraannular bioprosthesis is regarded as the next generation in pericardial stented tissue valves. The unique design of the tissue leaflets attached to the exterior of the valve stent provide unrivalled in vivo mean gradients and hemodynamics. The aim of this prospective study was to evaluate the 5-year hemodynamic performance of the Trifecta valve.

Methods: Four hundred and nineteen consecutive patients undergoing aortic valve replacement using the St. Jude Medical Trifecta valve at a single UK center over a 5-year period were included in this study. Patients undergoing concomitant cardiac procedures were included. All implanted valves were 19, 21, 23, 25, 27, and 29 mm in size. Assessment of hemodynamic function was carried out using transthoracic echocardiography preoperatively and at follow-up as well as transesophageal echocardiography intraoperatively.

Results: The study population comprised 419 patients (245 men, 174 women). The mean age was 72.7 ± 9.3 years. Implanted valve sizes were 19 mm (n = 27), 21 mm (n = 124), 23 mm (n = 147), 25 mm (n = 95), 27 mm (n = 13), and 29 mm (n = 1). The overall mean postoperative pressure gradients were 9.27 ± 5.3 mmHg (mean) and 17.5 ± 9.45 mmHg (peak). Subgroup mean postoperative pressure gradients were 12.5 ± 3.9 mmHg, 10.5 ± 7.4 mmHg, 8.8 ± 4.3 mmHg, 8.0 ± 3.7 mmHg, 7.5 ± 3.7 mmHg, 6.86 ± 0 mmHg, for the 19, 21, 23, 25, 27 and 29 mm cohorts, respectively. The overall mean postoperative left ventricular ejection fraction was 55.1 ± 12.1%. The overall mean effective orifice area was 1.81 ± 0.55 cm^2.

Conclusions: These results of our experience demonstrate excellent hemodynamic performance of the Trifecta bioprosthetic valve.

D30
Heterotopic Heart Transplants in Mice to Study Mechanical Unloading

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Objective: Unloading failing hearts by left ventricular (LV) assist devices can impair LV function, thus increasing the rates of mortality and morbidity. To clarify mechanisms underlying the detrimental effects on cardiac myocyte physiology, the heterotopic heart transplant (hHTX) in transgenic mice would be an adequate animal model. Because the procedure is technically demanding with a low error tolerance, it is rarely used. Our goal was to present our experience establishing the hHTX technique in mice and our first results.

Methods: Initial technical training was performed using video education, a rat hHTX procedure that is well-established in our institution, and training procedures in 2 institutes that successfully established the method in mice. "One-mouse training transplantations" were initially performed in dead mice by transplanting the orthotopic heart into the abdomen of the same animal. When technical confidence was reached, transplantation of a donor heart from 1 mouse to the abdomen of a syngeneic recipient ("two-mouse-transplantation") was performed (FVB mice, age 7–10 weeks).

Results: Twenty "one-mouse training operations" were performed. Operation time and cold/warm ischemia times decreased significantly with the procedures. The first successful transplant with a well-beating graft and survival of the recipient for more than 24 hours was achieved after 20 "two-mouse transplantations." A first success rate of 90% was reached after 60 "two-mouse transplantations" with further operations needed to stabilize this success. Despite a large heterogeneity in response to unloading, 14 days of unloading induced a significant weight reduction of the graft compared to that implantation and to orthotopic hearts of the recipient animals. Key factors for success included renunciation of cardioplegia, continuous topical cooling of the donor heart, de-airing of the anastomosis, loose suturing of the venous anastomosis, and avoidance of torsion of the donor heart and recipient intestine.

Conclusions: We successfully established the hHTX in mice, which resulted in a significant reduction of LV weight, and proof of an effective LV unloading. Learning to perform hHTXs in mice is laborious, time-consuming, and costly. It can be improved considerably by sharing expertise and a structured educational program. To avoid incorrect results, each transplant has to be examined individually with special attention paid to secondary processes, i.e., valvular leakage, which underlines the complexity of this procedure.

D31
Hybrid Approach for Intravenous Lead Extraction

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Objective: As the number of transvenous electrophysiological device implantations increases, the incidence of the extractions of chronically implanted leads is also increasing. Although most of the leads can be removed percutaneously with an excimer laser

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sheath, some difficult cases need surgical interventions. We defined a scheduled surgical intervention for lead extraction in conjunction with laserextraction as a hybrid approach. The purpose of this study was to review our hybrid approach for lead extraction.
Methods: Between 2013 and 2016, 128 consecutive patients underwent lead extraction at our institution. Of the 128, 4 (3.1%) patients required the hybrid approach. In 2 cases, a right minithoracotomy was planned preoperatively. However, as a result, full sternotomy was selected in all cases. Before cardiopulmonary bypass, transvenous lead dissection was performed from the subclavian vein to the superior vena cava with an excimer laser sheath. Then, the intracardiac portion of the leads was removed surgically through a right atriotomy. A tricuspid valve repair was performed concomitantly if necessary.
Results: The indications for surgical intervention are severe adhesion to the tricuspid valve, a large vegetation, tricuspid regurgitation, and severe adhesion to the innominate vein. In 1 case, the exposure of the right atrium was started via a right minithoracotomy approach. However, the exposure was difficultbecause of the fourth cardiac operation followed by the conversion to a median sternotomy. In another case, the minithoracotomy approach was abandoned preoperatively because of the calcified aorta. In this case, the right ventricle was perforated after lead extraction. The perforation could be easily and directly closed via a sternotomy. In another case with severe adhesion to the innominate vein, the laser sheath could not dissect the lead from the innominate vein. The innominate vein was opened and the lead was removed surgically. There was no procedural failure and no deaths related to the lead extractions.
Conclusions: Lead extraction with our hybrid approach for complicated cases was useful for safety and complete lead extraction. Remarkably, full sternotomy was more valuable than a right minithoracotomy for the management of unpredictable complications.

D32

Hybrid Coronary Revascularization: da Vinci Xi Versus da Vinci Si. Is the Future Better? Comparison of Two Generations of the da Vinci System

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Objective: The da Vinci system (da Vinci Surgical System, Intuitive Surgical, Sunnyvale, CA USA) has rapidly developed in several years from the S system to the Si system and now the Xi System. Our goal was to compare our experience using the da Vinci robot Si system versus the Xi system as a guide for surgeons who are willing to perform the transition using the 2 systems.
Methods: We compared our early experience with robotic coronary revascularization using the da Vinci robot Xi versus our previous cases using the da Vinci robot Si system. Patients were classified into 2 groups (Xi, n = 5 vs. Si, n = 35), and perioperative outcomes were analyzed.
Results: The new surgical robotic system has been upgraded in all respects. The da Vinci Xi robotic platform is easy to move, allows easier patient side-docking with the help of its boom feature, and exhibits easy, swift movements of the robotic arms. The telescope and camera were incorporated into 1 system, with a digital end-mounted camera. Overhead boom rotation allows multiquadrant access without axis limitation, and the arms are now thinner and longer with grabbing movements for easy adjustments. The patient clearance feature can be used to avoid collision with the robotic arms or the patient's body. In patients with a challenging body habitus, modifications can be made by reassigning the camera to a different port. In our experience, the outcomes with our first 5 cases with the da Vinci Xi system were similar to outcomes with the Si system, but the total operating time was longer.
Conclusions: Subjectively and objectively, there is a learning curve to progress from the Si to Xi da Vinci surgical platform, but it does not negatively impact the outcome.

D33

Incidence of Postoperative Atrial Fibrillation in Minimally Invasive Mitral Valve Surgery

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Objective: Atrial fibrillation after cardiac surgery is still a common complication in patients who have had mitral valve procedures. In our institution, the minimally invasive approach is the standard choice for valve operations. Our objective was to determine the incidence of postoperative atrial fibrillation associated with this surgical approach.
Methods: We conducted an observational, descriptive, and retrospective study from January 2013 to November 2015, including patients who had a minimally invasive mitral valve procedure and who had postoperative atrial fibrillation and excluding patients with a history of arrhythmias, previous cardiac operations, active infective endocarditis, and emergent procedures.
Results: Among the 166 patients who had a minimally invasive mitral valve procedure, 53% (88/166) had replacements and 47% (78/166) had repairs. Eighty-seven patients had no history of arrhythmias; 23% (20/87) had postoperative atrial fibrillation; 55% (11/20) were women. The average age was 60 years (±SD 11.08 years); 70% (14/20) were over 60 years of age. The mean body mass index was 24. The comorbidities were arterial hypertension 55% (11/20), smoking 40% (8/20), dyslipidemia 25% (5/20), and hypothyroidism 25% (5/20). Of those who were medicated in the preoperative period, 35% (7/20) had beta blockers, 30% (6/20) had statins, 25% (5/20) had angiotensin II, and 5% (1/20) had angiotensin converting enzyme inhibitors. The mean times of aortic cross-clamping was 99.6 minutes (±SD 41.5 minutes) and of perfusion was 141.8 minutes (±SD 61.7 minutes). The median stays in the intensive care unit and the hospital were 2.5 days (1–20) and 8 days (4–34). There was no reintervention due to bleeding; there was 1 re-entry for other medical issues. There were no deaths at 30 days.
Conclusions: The minimally invasive approach for isolated cardiac valvular procedures did not increase the incidence of postoperative atrial fibrillation.

D34

Intraoperative Management of Histidine-Tryptophan-Ketoglutarate Solution: Clinical and Neurological Outcomes in Standard and Minimally Invasive Cardiac Operative Procedures

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Objective: In adult patients, the administration of high-volume, single-shot histidine-tryptophan-ketoglutarate (HTK) solution for myocardial preservation during cardiac surgery is a standard procedure, especially in minimally invasive cardiac surgical procedures. The aim of this study was to determine the impact of HTK infusion on the crystalloid and colloid balance and on the neurological outcomes of patients undergoing open heart surgery.
Methods: In this prospective, observational study, conducted between March 2015 and June 2015, we analyzed 121 consecutive patients undergoing open heart procedures who received HTK solution. We

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created 2 groups according to interventions performed. Group 1 (45 patients) included patients who received ultrafiltration and/or aspiration of cardioplegic solution (active management); group 2 (76 patients) included patients with passive management of HTK solution. We performed a perioperative balance of crystalloid and colloid infusion. At the end, we analyzed the neurological responsiveness of the patients on the Richmond Agitation-Sedation Scale (RASS). In all patients, we examined single variables such as age, body surface area, lower natremia, maximum change of natremia (delta max), aspiration of HTK, ultrafiltration, administration of therapies like albumin and bicarbonate in relation to sodium fluctuation, and neurological impairment.
Results: In both groups, we observed a rapid decrease in natremia after administration of HTK (129.2 ± 5.5 mEq/L) and a progressive return to the original state 3 hours postoperatively. There was no significant differences in the RASS value at 6 and 24 hours in the 2 groups. No significant difference has been observed in any patients in terms of neurological impairment at 6, 12, and 24 hours when related to sodium fluctuation such as lower natremia and maximum change of natremia, aspiration of HTK, ultrafiltration, bicarbonate and/or albumin infusion.
Conclusions: The rapid decrease of natremia after administration of an HTK solution could be a risk factor for postoperative neurological impairment. Our data demonstrate that acute iponatremia, provoked by HTK administration, does not determine a worse neurological outcome. Therapeutic maneuvers designed to actively restore the physiological serum osmolarity, like ultrafiltration and aspiration of HTK, or therapies like bicarbonate and albumin, do not seem to have a protective effect.

D35
Introduction to Right Anterior Minithoracotomy Subaortic Membrane Resection

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Objective: Subaortic membranes are a congenital heart defect that causes discrete subaortic stenosis and aortic insufficiency. The current standard treatment is to perform a subaortic membrane resection via a median sternotomy. Our goal was to present the first case of a subaortic membrane resection performed in an adult patient via a right anterior minithoracotomy with video guidance.
Methods: A subaortic membrane resection was performed via a right anterior 5 cm minithoracotomy in the second intercostal space. Cardiopulmonary bypass was installed via central arterial and peripheral venous cannulation. After placement of an aortic cross-clamp and delivery of antegrade cardioplegia, an aortotomy revealed the aortic valve. Videoscopy provided further evaluation of the valve and the subaortic membrane. Shafted instruments and scalpels were used to complete a partial septal myectomy and subaortic membrane resection. After careful inspection of the left ventricular outflow tract with the endoscope, the incision was closed in a traditional fashion.
Results: Total aortic cross-clamp and cardiopulmonary bypass times were 45 and 63 minutes, respectively. Post-bypass transesophageal echocardiography showed complete removal of the subaortic membrane, a mean gradient of 5 mmHg, and trivial aortic regurgitation. The patient was transferred to the intensive care unit while intubated. Extubation occurred 6 hours after the procedure, and the patient was transferred to the floor on postoperative day 1. Pain was controlled orally, and the patient was able to ambulate on postoperative day 2. Her hospital course remained uneventful and she was discharged on postoperative day 3. A 3-week follow-up examination revealed no new symptoms or complaints.
Conclusions: A right anterior minithoracotomy subaortic membrane resection is feasible and effective in adult cardiac patients. Patients experience fewer postoperative complications including pain or hemorrhage. They are also much more satisfied with the minimal trauma and the quick recovery.

D36
Laparoscopic Repair of a Perforated Giant Paraesophageal Hernia in a Nonagenarian with Staging Endoscopic Decompression of the Volvulus

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Objective: We describe a management strategy for endoscopic and minimally invasive techquies for salvage of a complex foregut emergency. The described techniques can be applied for elective or emergent issues.
Patient: A 90-year-old woman with an extensive medical and surgical history was admitted with a diagnosis of urosepsis; she had an incarcerated giant paraesophageal hernia with a complete intrathoracic stomach that progressed to a perforated ischemic gastric volvulus with both an organoaxial and a mesentericoaxial twist. Management was staged with endoscopic-fluoroscopic volvulus decompression followed by medical optimization and eventual laparoscopic hernia repair, partial gastrectomy, and gastropexy. We obtained a complete live video record of the endoscopic, fluoroscopic, and laparoscopic interventions. The video was edited to emphasize the radiological indicators of the hernia, the endoscopic maneuvers for volvulus decompression, the laparoscopic principles of giant hernia management, and the intraoperative decisions for damage assessment and control. The patient was managed satisfactorily and was able to tolerate solid food. She was discharged to a skilled rehabilitation facility. Follow-up images including a postoperative esophagram and CT imaging at 6 weeks are presented.
Conclusions: Endoscopic fluoroscopic decompression of a giant paraesophageal hernia is feasible as a means to temporize and optimize an acutely ill patient for eventual intervention. The laparoscopic approach is then tolerated and permits the required aspects of hernia repair, damage control of a partial gastrectomy, and gastropexy.

D37
Long-Term Results of Mitral Valve Repair of Posterior or Bileaflet Prolapse With Two Different Concepts

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Objective: The long-term outcome rather than the successful operative results of mitral valve repair remains the corner stone for selecting the most suitable technique. Our goal was to evaluate the results of 2 simple techniques we use to correct posterior or bileaflet prolapse. We had no incidence of postoperative systolic anterior motion (SAM) of the anterior mitral leaflet and excellent operative results.
Methods: From June 2010 to June 2016, 64 patients with isolated posterior leaflet prolapse (n = 23) or bileaflet prolapse (n = 41) with or without chordal rupture underwent mitral valve repair. Edge-to-edge, our initially preferred technique, used in 35 patients (group A), was compared to the newly developed Uniscallop (U) technique, used in 29 patients (group U). In both groups, the annulus was reshaped using

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a 3-dimensional ring annuloplasty (30–32 mm). Postoperative echocardiography was performed in all patients after a mean follow-up of 58 ± 13 months in group A and 42 ± 16 months in group U.

Results: There were no early or late deaths. Both surgical techniques showed excellent immediate postoperative results regarding reduction of the grade of mitral regurgitation (none to trivial) with highly accepted mean pressure gradients through the mitral valve (2.3 ± 0.6). Left ventricular function was maintained, and the tricuspid regurgitation grade was reduced overall. During the follow-up period, we observed a significant increase in the mean pressure gradient in group A with no significant change in the degree of mitral regurgitation. Analysis of this increase showed that the majority of significant increases were due to rheumatic disease (9/12). The patients became symptomatic and left the study after a follow up-period of 41 ± 13 months; their valves were replaced. Those patients with nonrheumatic diseases maintained a reasonable gradient. Redo mitral valve replacement was done in only 1 patient in group U due to early endocarditis.

Conclusions: Even though the rationale is completely different in in each technique [double orifice, double leaflet (A) versus unileaflet, uniorifice (U)], the long-term results are comparable in both. The U technique is better in patients with rheumatic diseases; more follow-up is needed on larger numbers of this patient group.

D38

Midterm Hemodynamic Performance of the St. Jude Medical Trifecta Valve in the Small Aortic Annulus

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Objective: The St. Jude Medical Trifecta aortic supraannular bioprosthesis is regarded as the next generation in pericardial stented tissue valves. The unique design of the tissue leaflets attached to the exterior of the valve stent provides unrivalled in vivo mean gradients and hemodynamics. The aim of this prospective study was to evaluate the midterm hemodynamic performance of the Trifecta valve in patients with a small aortic annulus (sizes 19 mm and 21 mm).

Methods: One hundred and forty-two consecutive patients undergoing aortic valve replacement using the St. Jude Medical Trifecta valves (sizes 19 mm and 21 mm) at a single UK center over a 38-month period were included in this study. Patients undergoing concomitant cardiac procedures were included. Assessment of hemodynamic function was carried out using transthoracic echocardiography preoperatively and at follow-up and transesophageal echocardiography intraoperatively.

Results: The study population consisted of 142 patients. The mean age was 78.7 ± 10.4 years. Implanted valve sizes were 19 mm (n = 26) and 21 mm (n = 116). The mean postoperative pressure gradients in the subgroups were 11.4 ± 3.6 mmHg, 10.7 ± 6.3 mmHg, 19 mm and 21 mm respectively. The overall mean postoperative left ventricular ejection fraction was 53.2% ± 9.8%.

Conclusions: Clinicians have traditionally been reluctant to insert 19 mm and 21 mm valves due to patient-prosthesis mismatch and have resorted to aortic root enlargement procedures with the associated increase in risk. Our experience demonstrates excellent hemodynamic performance of the Trifecta bioprosthetic valve in the small aortic annulus. Should longer-term results continue to show persistently low gradients in the smaller annulus, clinicians should carefully consider the necessity for an aortic root enlargement operation.

D39

Minimally Invasive Aortic Valve Replacement Offers Superior Respiratory Outcomes and Mitigates Atrial Fibrillation in Women with a High Body Mass Index

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Objective: The incidence of respiratory complications in cardiac operations following complete sternotomy ranges between 8% and 79%, and postoperative atrial fibrillation occurs in 30% to 50%. Morbidity and mortality rates in women with a high body mass index (BMI >25) are of significant concern. We explored the value of minimally invasive aortic valve replacement using a partial upper sternotomy approach and its effect on postoperative outcomes in this group of patients.

Methods: All patients undergoing isolated aortic valve replacement in a single surgeon's practice were included. Data were recorded prospectively between October 2010 and September 2016 in the National Adult Cardiac Surgical Database. Female patients with a BMI >25 undergoing aortic valve replacement were analyzed in 2 groups: upper partial sternotomy and complete sternotomy.

Results: Isolated aortic valve replacement was performed on 165 consecutive patients between October 2010 and September 2016. Of these, 17 patients underwent minimally invasive aortic valve replacement with an inverted J-shaped partial upper sternotomy. Only female patients with a BMI >25 (overweight and obese) were analyzed for postoperative outcomes. The results are summarized in Table D39-1. No differences in the use of blood and blood products were observed between the 2 groups. There were no respiratory complications or deaths in the minimally invasive aortic valve replacement group.

Conclusions: In this study, respiratory complications are conspicuous by their absence in the minimally invasive aortic valve replacement group despite the high-risk population with a median BMI of 34.6. Due to the relatively small numbers of patients in the study,

TABLE D39-1. Patient Characteristics and Results

	Partial Upper Sternotomy	Complete Sternotomy	*P* Value
	9	45	
Age (median)	69	75	
Median logistic EuroSCORE	3.99	6.71	
Urgency of operation			
Elective	77.7%		
Urgent	22.2%	31.1%	
Emergency	0%	2.22%	
Mechanical prosthesis	30%	26.66%	
Median body mass index	34.63	30.82	
Sternal wound complications	0	4.4%	0.52
Hours of ventilation (median)	8	10.5	0.49
Pulmonary complication including reintubation	0%	15.5%	0.17
Blood products used	30%	Total number of patients	0.90
Postoperative atrial fibrillation	6.66%	35.5%	0.03
Mortality rate	0%	4.4%	0.52

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the analysis does not reach statistical significance. However, the rate of respiratory complications (0% vs. 15.5%) in this high-BMI group has significant clinical impact. The partial upper sternotomy approach avoids the mobility of the sternal plates, maintains the integrity of the chest wall, and preserves the mechanics of the diaphragm. Furthermore, the fact that the incidence of postoperative atrial fibrillation is significantly less (*P* value 0.03) with the minimally invasive approach may be related to the limited handling of the heart. Our study supports the safety and feasibility of minimally invasive aortic valve replacement in women with a high body mass index.

D40
Minimally Invasive Treatment Method for Complicated Forms of Lung Cancer

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Objective: Lung cancer is a leading and challenging oncological disease due to the progression of the disease and its complications, such as bleeding and atelectasis caused by tumors obstructing the bronchi. The number of cases with these complications is not decreasing because of the lack of methods to manage them.

Methods: We present a group of palliative methods for the treatment and management of generalized forms of lung cancer and its complications. These methods include roentgen-endovascular embolization of bronchial arteries, followed by radiofrequency ablation (RFA) and recanalization of the bronchial stenosis by the tumor.

Results: These methods were applied in 68 patients aged 52 to 78 years. The patients were diagnosed with lung cancer, stages III–IV. In this group of patients, radical operative treatment was not possible because of tumor progression accompanied by bleeding and other factors that impaired lung function. All had lung bleeding in the lungs with blood loss of 200 to 400 ml per day, which is a contraindication for palliative chemotherapy. In addition, they had lung atelectasis due to tumor obstruction of the main bronchus or the lobar bronchi. The hemostatic effect was seen in 65 patients immediately; others had repeated embolization of the intercostal arteries, additionally vascularizing the tumor. Recanalization of the bronchial stenosis was achieved in all of these patients, which improved their quality of life. It was recommended that the patients have chemotherapy or radiotherapy depending on the morphological character of the tumor. In the following 10 months, no signs of bleeding in the lungs or of bronchial atelectasis were seen.

Conclusions: Thus far, with the positive experiences observed in this group of patients, we can prove that this group of methods is effective in the treatment of complicated forms of lung cancer. These methods not only eliminate the complications but also improve the quality of life.

D41
Minimally Invasive Aortic Surgery: Safe and Feasible

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Objective: Aortic surgery is often a challenge, and there are doubts about the feasibility of the minimally invasive approach. Our goal was to describe our experience with aortic procedures performed using the minimally invasive approach.

Methods: Since 2011, 39 consecutive patients underwent an aortic procedure performed by a single surgeon (36 patients with associated aortic valve surgery, 2 patients with the ascending aorta only, 1 patient also with the aortic arch). We recorded the peri- and postoperative outcomes to determine the safety and the feasibility.

Results: Four patients had emergent procedures; the other 35 had elective procedures. Two patients had redo procedures. The mean age was 64 years (18–84 years). The logistic EuroSCORE was 21 (4–84). The cross-clamp time was 104 minutes (52–166 minutes); the cardiopulmonary bypass time was 185 minutes (100–317 minutes); and the surgical time was 309 minutes (193–526 minutes). Transfusions were required as follows: intraoperatively, 1.2 units/patient; postoperatively, 2.8 units/patient. The mean drainage was 610 mL; rethoracotomy was needed in 6 patients (15%). One patient had sternal instability. No neurological complications were recorded. Three patients had a tracheotomy, and 2 required temporary dialysis. The stay in the intensive care unit was 4.5 days. Three patients died, 2 (5%) of cardiac causes.

Conclusions: Minimally invasive aortic surgery is safe and feasible in different categories of patients; low-to-high risk and also in the emergent setting. It is not time-consuming, and it results in a good neurological outcome. Its reproducibility by different surgeons and its use without patient selection have to be demonstrated.

D42
Minimally Invasive Aortic Valve Reoperation as a Possible Response to Transcatheter Aortic Valve Implantation

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Objective: Valve-in-valve transcatheter aortic valve implantation (TAVI) is considered a feasible option for patients with degenerated bioprosthetic aortic valves, especially high-risk patients. Considering the increasing age of cardiac surgery survivors and the still unsolved problems of valve-in-valve TAVI, such as paravalvular regurgitation after surgical aortic valve replacement (AVR), the presence of high residual gradients after valve-in-valve TAVI and the necessity of concomitant aortic surgery,

TABLE D42-1. Operative and Perioperative Outcomes After Minimally Invasive Redo Aortic Valve Replacement

Operative Results	**n = 32**
Operative time (min)	198 (141–288)
Cardiopulmonary bypass time (min)	115 (96–136)
Cross-clamp time (min)	69 (50–81)
Intubation time (hours)	10 (5–26)
Intensive care unit stay (hours)	24 (18–72)
Hospital length of stay (days)	8 (6–9)
Perioperative Results	**n = 32**
Mortality	1 (3)
Myocardial infarction	1 (3)
Stroke	2 (6)
Renal replacement therapy	1 (3)
Sternal complications	0 (0)
Wound infection	0 (0)
Reoperation for bleeding	4 (13)
Valve-related reoperations	0 (0)

Continuous variables are expressed as median and interquartile; categorical variables are expressed as absolute numbers and percentages, n (%).

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alternative minimally invasive treatment strategies for high-risk patients need to be investigated further. Therefore, we retrospectively analyzed the perioperative outcome of minimally invasive aortic valve reoperations in a 2-center study.

Methods: We prospectively included 32 patients in our study. Previous procedures were either surgical aortic valve replacement (41%), coronary artery bypass grafting (28%), other valve surgery (19%), or miscellaneous (12%). Minimally invasive aortic valve replacement was performed either via an upper partial sternotomy (78%) or a right anterior minithoracotomy (22%). Patients were studied retrospectively in terms of operative and perioperative outcomes.

Results: The median operative time was 198 (141–288) minutes; the median cardiopulmonary bypass time was 115 (96–136) minutes; the median aortic cross-clamp time was 69 (50–81) minutes and the median hospital length of stay was 8 (6–9) days. The perioperative mortality rate and the myocardial infarction rate were each 3%. Two patients had a stroke. Table D42-1 gives an overview of detailed operative and perioperative outcomes.

Conclusions: Minimally invasive redo aortic valve replacement is feasible and safe. Perioperative results are comparable to those of valve-in-valve TAVI with the benefit of lower postoperative transaortic gradients compared to valve-in-valve TAVI.

D43
Minimally Invasive Atrial Septal Defect Closure and Transseptal Left Atrial Appendage Ligation

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Objective: Minimally invasive closure of atrial septal defect (ASD) has become common, either via a right minithoracotomy or robotic approaches. Atrial fibrillation is common in these patients perioperatively, and left atrial appendage ligation should be considered. The objective of this report was to review our experience with transseptal closure of the left atrial appendage at the time of minimally invasive closure of an atrial septal defect.

Methods: From May 2016 to October 2016, we performed 4 minimally invasive ASD closure operations (on patients who were ineligible for catheter-based approaches) via a right minithoracotomy or a partial sternotomy. Of these, 2 patients underwent concomitant transseptal direct suture ligation of the left atrial appendage. The charts of these patients were reviewed to highlight the technical aspects.

Results: Two patients (mean age 42 years) underwent minimally invasive patch closure of a secundum ASD via a right minithoracotomy. Both patients underwent percutaneous cannulation of the superior vena cava with a 15F cannula and open femoral arterial and venous cannulation and exposure via a right minithoracotomy. Patient 1 (a 49-year-old woman) had undergone catheter ablation for supraventricular tachycardia prior to her operation. Patient 2 (a 35-year-old man) had significantly dilated right-side cardiac chambers. Because both patients were felt to be at high risk for perioperative atrial arrhythmias, transseptal direct suture ligation of the left atrial appendage was performed before patch implantation for ASD closure. Transesophageal echocardiography on completion of the operation confirmed the exclusion of the left atrial appendage and an intact interatrial septum. The patients had uneventful hospital stays and were discharged on postoperative days 5 and 6, respectively.

Conclusions: In patients undergoing minimally invasive right-chest operations for ASD closure, transseptal direct suture ligation of the left atrial appendage is feasible and can be performed safely. We believe that consideration should be given to this valuable adjunct procedure, particularly in those patients who are at especially high risk for perioperative atrial fibrillation.

D44
Minimally Invasive Beating Heart Coronary Anastomosis Training Kit

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Objective: Training platforms for coronary anastomosis abound. However, simulating the beating heart in the wet laboratory has been a challenge. Our goal was to design a beating-heart anastomosis training kit for the challenges of a limited-access milieu.

Methods: We made a steel framework simulating a chest with an opened-out chest spreader. A steel plate with a narrow opening to limit access was fitted onto the top with the ability to alter the position. A suction stabilizer was mounted on the steel framework, and a motor was used to move the arm of the stabilizer to simulate cardiac action. The stabilizer could be moved into any position to simulate the desired coronary artery position. The porcine or bovine heart or a portion of the bovine myocardium with a coronary vessel of appropriate size could be attached to the stabilizer. Turning on the motor moved the stabilizer arm up and down, simulating cardiac action. A rheostat was used to vary the speed of the motor. Omental vessels harvested previously were used as conduits, and the anastomosis was performed on a "beating" heart through the limited access (Fig. D44-1).

Results: We designed and made the minimally invasive beating heart coronary anastomosis training kit.

Conclusions: This model enables one to get used to the limited access, the working angles, and the movements of the heart.

FIGURE D44-1. Minimally invasive beating heart anastomosis training kit.

D45
Minimally Invasive Cardiac Surgery Using a Lower Hemisternotomy Approach: Our Initial Experience With 51 Cases

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Objective: Our goal was to share our initial experiences with a lower hemisternotomy approach in 51 patients.
Methods: Patients with morbid obesity, emergency surgery, severe pulmonary arterial hypertension, and redo surgery were not included in this study. Primary median lower hemisternotomy was performed without any lateral extension. A slow, gradual opening is a crucial step in preventing sternal fracture. Roberts's retractor was used to pull the aorta for cannulation. A straight high-flow aortic cannula was preferred in most of the cases. Cardiopulmonary bypass was established (aortic and bicaval) with routine instruments and cannula.
Results: Between January 2014 and December 2015, 51 patients (23 men and 28 women; age range 15–62 years) with atrial septal defect (n = 21), a mitral valve (30), mitral and aortic valves (01), and tricuspid valve disease (5) due predominantly to rheumatic heart disease were operated on using this technique. Mitral valve replacement was done in all 30 patients with valvular issues: 1 patient underwent double valve replacement; 3 patients had a tricuspid valve repaired with Teflon ring annuloplasty; 2 patients had a large left atrial clot removed from the left atrium; and 5 patients had placation of the left atrium (Fig. D45-1). There were no perioperative deaths. Two patients required conversion to full sternotomy. The mean aortic cross-clamp time was 27.5 minutes (18–45), and the mean cardiopulmonary bypass time was 45.7 minutes (35–65). The average stays in the intensive care unit and the hospital were 1.3 and 5.5 days, respectively. Follow-up of the remaining 49 patients ranged from 12 months to 36 months. No procedure-related complication was observed in this group of patients.
Conclusions: Minimally invasive surgery through a lower hemisternotomy is a safe, effective, and cosmetically acceptable procedure that does not cause an extra financial burden because it can be done using routine instruments. The advantages of the procedure are central cannulation, easy access to the ventricle, ease of extension if required, cosmetic acceptability, and preservation of the function of the manubrium and the shoulder. It also prevents sternal dehiscence in case of infection. This procedure is easily reproducible with equal efficacy and safety in comparison with the conventional technique.

D46
Minimally Invasive Cardiac Surgery in High-Risk Patients

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Objective: The efficacy of minimally invasive cardiac surgery (MICS) through a right minithoracotmy in high-risk patients has not been fully discussed. The goal of this study was to compare early surgical outcomes of and postoperative recovery after MICS in high-risk patients with the same results in low-risk patients.
Methods: We reviewed our database of 250 consecutive patients who underwent MICS at our institution from 2014 to 2016. The patients were stratified into a high-risk group (group H: EuroSCORE II 5 or greater) and a low-risk group (group L: EuroSCORE II less than 5).
Results: Group H included 45 patients with a mean age of 75 ± 8 years and the L group included 205 patients with a mean age of 69 ± 13 years. The mean EuroSCORE II was 11.9 ± 8.5 in group H and 1.8 ± 1.1 in group L ($P < 0.01$). There was no significant difference in the preoperative comorbidities (hypertension, diabetes mellitus, chronic kidney disease, chronic obstructive pulmonary disease, congestive heart failure, and infective endocarditis) except for end-stage renal failure on hemodialysis (9% group H vs. 1% group L). There was 1 hospital death in each group. There were no significant differences in the postoperative complication rate (stroke, respiratory failure, cardiac failure, reexploration, acute kidney injury, atrial fibrillation, and wound infection). The blood transfusion rate was significantly higher in group H (82% in group H vs. 30% in group L, $P < 0.01$). Postoperative intubation time (17 hours, group H vs. 11 hours, group L, $P < 0.01$), stays in the intensive care unit (5.3 days, group H vs. 2.9 days, group L, $P < 0.01$) and the

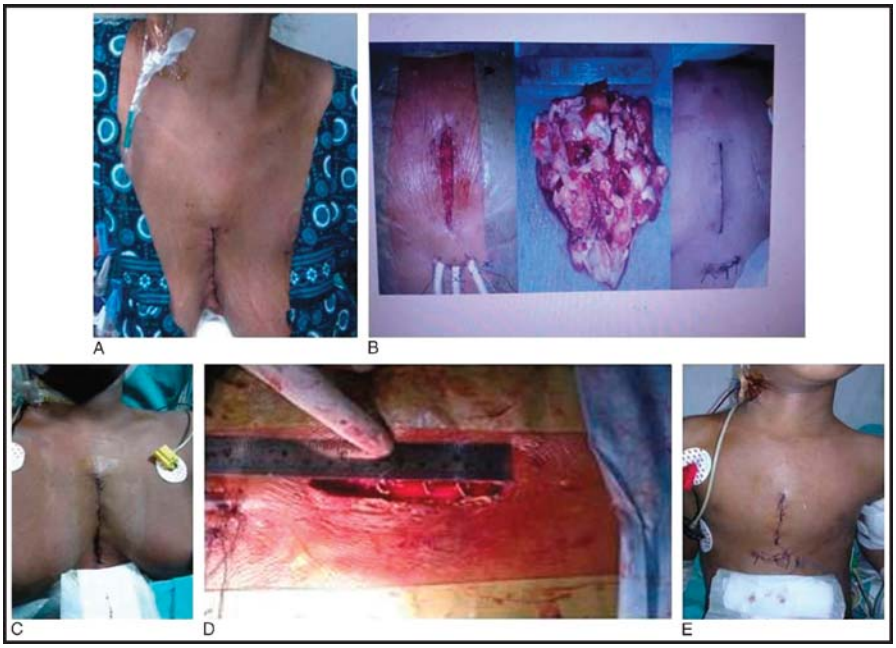

FIGURE D45-1. A, Mitral valve replacement. B, Mitral valve replacement with a clot in the left atrium. C, Double valve replacement. D, Incision. E, Atrial septal defect.

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hospital (19.0 days, group H vs. 11.8 days, group L, $P < 0.01$) were longer in group H.

Conclusions: MICS provides satisfactory surgical outcomes for high-risk patients as well as low-risk patients, although postoperative recovery was delayed in high-risk patients.

D47
Minimally Invasive Combined Mitral Valve Surgery and Right Coronary Artery Bypass Graft with Right Internal Thoracic Artery

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Objective: Minimally invasive techniques in mitral valve surgery and direct coronary artery bypass grafting have been reported with important benefits such as reduced postoperative pain, improved cosmetic results, fewer blood transfusions, shorter lengths of stay, and faster return to activities. A right anterior small thoracotomy approach to the right coronary artery (RCA) has also been proposed recently, especially in redo coronary artery bypass grafting and combined operations. However, bypass grafting of the right internal thoracic artery (RITA) to the RCA is rarely performed, and single-lung ventilation for RITA harvesting in patients with mitral valve disease can be challenging. Therefore, our goal was to determine the safety and feasibility of a combined video-assisted minimally invasive mitral valve procedure and arterial revascularization with the RITA to the RCA through a right minithoracotomy.

Methods: From February 2016 to August 2016, 3 patients underwent minimally invasive mitral valve surgery and RITA bypass to the RCA through a right minithoracotomy. Two patients had a mitral valve replacement and in situ RITA to RCA grafting, and 1 patient had mitral valve repair and RITA as a free graft to the RCA.

Results: No deaths occurred perioperatively or during the early follow-up period. The mean age was 73.3 years (range 59–82 years). The mean operation, cardiopulmonary bypass, and aortic cross-clamp times were 303 ± 29, 161 ± 16, and 105 ± 13 minutes, respectively. The duration of mechanical ventilation and the length of stay in the intensive care unit were 19.3 ± 2.9 and 38.6 ± 12.1 hours, respectively. No conversion to sternotomy was required, and there were no postoperative myocardial infarctions or strokes. One patient developed an aortic intramural hematoma after femoral cannulation intraoperatively and required a right axillary artery cannulation.

Conclusions: Concomitant minimally invasive port-access mitral valve surgery and RCA bypass grafting through the RITA can be achieved in selected patients through a right minithoracotomy with good early outcomes.

D48
Minimally Invasive Direct-Vision Right Minithoracotomy Technique for Mitral Valve Repair

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Objective: A minimally invasive right minithoracotomy has become an alternative to the median sternotomy approach for diseased mitral valves. Our goal was to report a single-center experience with the direct-vision minithoracotomy technique for mitral valve repair.

Methods: From September 2013 to September 2016, we performed 55 operations using the direct-vision minithoracotomy technique for mitral valve repair. There were 25 men and 30 women; the average age was 45.4 ±11.6 years (range 21–68 years). All patients had prevalent mitral insufficiency (effective regurgitant orifice 0.4 ± 0.12 cm^2, regurgitant volume 52 ± 14 ml) due to the primary prolapse of the posterior leaflet in 36, anterior leaflet prolapse in 6, and bileaflet prolapse in 13 cases. Eight (14.8%) patients were in New York Heart Association class III. We used a 5 to 7 cm right minithoracotomy in the fourth intercostal space; cardiopulmonary bypass was implemented with the femoral artery and vein and right internal jugular vein (8 cases) cannulations. A mitral ring was implanted in all patients: expanded polytetrafluoroethylene neochordae implantation in 6 (11%), resection of the leaflet in 25 (45%), edge-to-edge repair in 5 (9%), sliding plasty in 5 (9%), and plication of the leaflet in 16 (29%).Concomitant procedures were the Maze procedure (n = 2) and closure of an interatrial defect (n = 3).

Results: The mean cardiopulmonary bypass time and cross-clamp time were 125 ± 20.76 and 84.5 ± 14.8 minutes, respectively. There were no in-hospital deaths, no major neurological events, and no conversions to sternotomy. We had 1 rethoracotomy for bleeding and transient ischemia of the right foot in 2 cases. We achieved good results with the mitral valve repair in the operating room in all cases. In the follow-up (mean 16 months) period, we observed no or trivial mitral regurgitation in 46 (84%) patients and mild mitral regurgitation (1+) in 9 (16%) patients. There were no late deaths.

Conclusions: Minimally invasive direct-vision right minithoracotomy is a safe, reproducible technique for mitral valve repair with low rates of periprocedural complications and good midterm results.

D49
Minimally Invasive Mitral Valve Repair Using the Neochordal Creation Technique

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Objective: Our goal was to evaluate our center's experience and outcome with minimally invasive mitral valve repair using the neochordal creation technique.

Methods: Between January 2005 and November 2016, we identified 386 patients who had minimally invasive mitral valve surgery; in 80 of these patients, we used the neochordal creation technique at the King Fahad Armed Forces Hospital. All patients had annuloplasty along with neochordal creation. The mean age was 43 ± 15 years, and the mean left ventricular ejection fraction was 40%. Patients were followed for an average of 36 ± 12 months.

Results: Intraoperatively, the mean bypass time was 110 ± 20 minutes; the cross-clamp time was 80 ± 15 minutes, and the conversion to sternotomy was 1.25% (n = 1). The in-hospital mortality rate was 1.25% (n = 1), the mean length of stay in the intensive care unit was 4 ± 2 days, and that in the hospital was 7 ± 2 days. There were no strokes and no lower limb ischemia; 3.75% (n = 3) of patients had a groin wound infection. The 4-year freedom from mitral valve-related reoperation was 93.7% (n = 75), and we had no deaths.

Conclusions: When combined with minimally invasive cardiac surgical procedures, the neochordal technique in mitral valve repair results in low rates of mortality and morbidity, short stays in the hospital and the intensive care unit, and excellent midterm results.

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D50
Minimally Invasive Mitral Valve Surgery

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Objective: Minimally invasive mitral valve surgery has gained popularity over the last decade. In this study, we reported the early outcomes of patients undergoing minimally invasive mitral valve surgery.

Methods: All patients who underwent minimally invasive mitral valve surgery between January 2013 and November 2016 were included. Submammary (n = 73) and periareolar incisions (n = 69) were performed for all patients. Cardiopulmonary bypass (CPB) was achieved peripherally. Quadrangular/triangular resection or artificial chordal techniques were combined with rigid ring annuloplasty for mitral repair. Patients were evaluated for early deaths, the need for sternotomy, and lengths of stay in the intensive care unit and the hospital.

Results: A total of 42 patients (M/F: 56/86; age: 41.12 ± 10.46 years) underwent minimally invasive mitral valve surgery. Ninety-six patients had rheumatoid and 46 had degenerative mitral valve disease (26/20, posterior leaflet/bileaflet prolapses). Thirty-six patients underwent mitral valve replacement and 28 had mitral valve repair as a unique procedure; 78 patients underwent concomitant procedures such as tricuspid valve surgery (n = 42, 29.5%), atrial septal defect closure (n = 4, 2.8%), and surgical ablation for atrial fibrillation (n = 87, 61.4%). The mean left atrium size and mean systolic pulmonary artery pressure were 5.13 ± 0.48 cm and 51.96 ± 12.79 mmHg, respectively. There were no early deaths. Two patients (1.4%) were returned to the operating room due to bleeding. Six patients (4.2%) underwent median sternotomies. The stay in the intensive care unit was 15.9 ± 4.57 hours; the stay in the hospital was 6.29 ± 1.66 days. We performed radiofrequency or cryoablation combined with LA plication in AF patients with atrial fibrillation: 54% of these converted to sinus rhythm. The mean cross-clamp and cardiopulmonary bypass times were 57.9 ± 6.06 and 96.8 ± 8.12 minutes, respectively.

Conclusions: A minimally invasive approach is a safe, effective alternative to full sternotomy. It can be performed on a large population with few perioperative complications.

D51
Minimally Invasive Mitral Valve Surgery: A Single-Center Experience

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Objective: The objective of this prospective cohort observational study was to assess the outcomes of deaths, bleeding, length of stay in the hospital, bypass time, and pain.

Methods: From January 2013 through December 2016, surgeons at the JSC National Research Cardiac Surgery Center in Astana, Kazakhstan performed 229 operations through minimally invasive access using thoracoscopic video equipment. A total of 115 (50.21%) patients had mitral valve operations. Sixty-six (57%) patients had mitral valve regurgitation; 41 (36%) had mitral valve stenosis; and 8 patients (7%) had mixed conditions. The types of mitral valve diseases were rheumatic, 51 (44.4%); myxomatous, 54 (47%); anterior leaflet prolapse, 23 (42.6%); posterior leaflet prolapse, 30 (55.5%); 1 bileaflet prolapse, 1 (1.9%); dilatative cardiomyopathy, 7 (6%); endocarditis, 2 (1.7%); and congenital, 1 (0.9%). The patients had the following procedures: mitral valve repair, 64 (56%); annuloplasty, 14 (22%); chordoplasty, 31 (48%); posterior leaflet resection and sliding valvuloplasty, 16 (25%); augmentation, 2 (3%); cleft closure, 1 (2%); and mitral valve replacement, 51 (44%) [26 (51%) biological and 25 (49%) mechanical valves]. Four cases had mitral valve surgery with monopolar radiofrequency ablation of the left atrium.

Results: There were no hospital deaths. Rethoracotomy for bleeding from the intercostal arteries occurred in 1 case. Conversion to sternotomy occurred in 2 patients because of adhesive pericarditis. After the operation, the hospital stay was 4 to 5 days. The average times of cardiopulmonary bypass and aortic cross-clamping were 125.4 ± 15 minutes and 65.8 ± 5 minutes, respectively.

Conclusions: Our experience with mitral valve repair and replacement through a right minithoracotomy demonstrates that minimally invasive mitral valve surgery is a feasible method that can be performed safely and effectively. It is associated with very low conversion rates. The failure rate of repairs was extremely low, especially in the hands of experienced surgeons. Thus, about half of our cases were complicated, and most of them had rheumatic heart diseases. This type of complexity makes the valve harder to repair. In some cases, the only solution is replacement. Implantation of a biological prosthesis using a minimally invasive procedure with a right thoracotomy should ease performance of a medium sternotomy afterwards, thus making a second intervention more bearable and with fewer complications.

D52
Minimally Invasive Repair of a Hernia After Esophagectomy

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Objective: Hiatal hernia after esophagectomy is a known but rare complication, likely due to the opening of the diaphragmatic hiatus to improve exposure to the mediastinal dissection of the esophagus and to allow the transposition of the conduit to the chest or neck. Since the introduction of minimally invasive techniques, we have seen an increase in the incidence of this complication with a high morbidity rate after repair.[1]

Methods: In this video, we show the technique for the successful repair of such conditions.

Results: The main steps of the procedure are reduction of the hernia in the abdomen; straightening of the gastric conduit; closure of the hiatus; and fixation of the conduit to the crus.

Conclusions: In our experience, a transabdominal minimally invasive approach is preferred in most cases and a transthoracic exposure is rarely needed.

1. Oor JE, Wiezer MJ, Hazebroek EJ. Hiatal hernia after open versus minimally invasive esophagectomy: A systematic review and meta-analysis. *Ann Surg Oncol*. 2016;23:2690–2698.

D53
Minimally Invasive Surgical Treatment of an Atrial Septal Defect: Early Outcomes from a Single-Center Experience

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Objective: Our goal was to evaluate the immediate and early outcomes after minimally invasive treatment of atrial septal defect (ASD) and to compare this approach with a standard full sternotomy.

Methods: Fourteen consecutive patients (mean age, 50.07 ± 15.95 years; mean logistic EuroSCORE, 2.65 ± 2.06) underwent minimally invasive

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surgery for the repair of ASD. Two of those patients had a mitral valve repair. The data were compared with a subgroup of 11 patients who underwent ASD ± mitral valve replacement with a standard full sternotomy (mean age, 53.27 ± 15.83 years, mean logistic EuroSCORE, 2.64 ± 0.96).
Results: Minimally invasive repair of ASD was successfully achieved in all patients (success rate, 100%). There were no in-hospital deaths. The most common ASD was an ostium secundum (n = 24, 96%), whereas an ostium primum was observed in only 1 patient (4%). The mean aortic cross-clamping time of the minimally invasive procedures was 70.21 ± 15.92 minutes, significantly lower for isolated ASD (68.83 ± 13.89 minutes) than for ASD plus mitral valve replacement, (78.5 ± 31.81 minutes, $P < 0.05$). The cohort of patients underwent minimally invasive ASD closure presented with a larger ASD (22.43 ± 11.06 mm vs. 19.27 ± 8.52 mm) with major right ventricular dysfunction (QP/QS: 2.24 ± 0.62 vs. 1.87 ± 0.56). Minimally invasive treatment was associated with a shorter hospital stay than a full sternotomy approach (5.71 ± 1.2 vs. 6.45 ± 2.7 days), but this difference was not significant. Freedom from residual ASD, stroke, and reoperation for bleeding was 100% in all the cases.
Conclusions: Minimally invasive repair of ASD is associated with satisfactory immediate and early outcomes in high-risk patients (size of ASD and right ventricular impairment) and appears to provide satisfactory clinical and hemodynamic results. It is an easily reproducible technique with a low incidence of failure.

D54
Minimally Invasive Transmitral Septal Myectomy, Concomitant Mitral Repair Without Annuloplasty, and Left-Sided CryoMaze Procedure

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Objective: Various minimally invasive surgical approaches to hypertrophic cardiomyopathy have been described. However, the combination of septal myectomy and surgical atrial fibrillation (AF) ablation have typically been performed via a sternotomy. Our goal was to report a case of minimally invasive transmitral septal myectomy, concomitant mitral valve repair without annuloplasty, and a left-sided cryoMaze procedure to highlight the decision-making and technical aspects.
Patient: The chart of a patient referred for surgical myectomy and concomitant atrial fibrillation ablation was reviewed. In addition, a MEDLINE search was performed to obtain articles on minimally invasive approaches to septal myectomy. The patient was a 70-year-old woman who had severe systolic anterior motion-related mitral regurgitation, peak and mean left ventricular outflow tract gradients of 86 and 43 mmHg, respectively, and paroxysmal AF. She underwent femoral cannulation, a right minithoracotomy, and transmitral septal myectomy with a left atrial cryoMaze procedure including left atrial appendage ligation. The augmentation of the anterior mitral leaflet was achieved with glutaraldehyde-fixed autologous pericardium. No annuloplasty was performed to avoid altering the mitral geometry and creating postoperative systolic anterior motion. Transesophageal echocardiography immediately after the operation showed no residual systolic anterior motion; the mean left ventricular outflow tract gradient was 11 to 14 mmHg, and she exhibited mild-moderate mitral regurgitation under hypovolemic conditions. She was discharged on postoperative day 7after an uneventful hospital stay. An echocardiogram at 2 months postoperatively showed mild mitral regurgitation, no dynamic left ventricular outflow tract obstruction, and a mean transaortic gradient of 12 mmHg. The patient remains in New York Heart Association class I at 3 months. A literature review identified 6 papers including 58 patients treated with minimally invasive approaches to septal myectomy. Robotic transmitral, partial upper sternotomy, right minithoracotomy transmitral, and right minithoracotomy transaortic approaches have been reported. Excellent relief of left ventricular outflow tract obstruction and systolic anterior motion-related mitral regurgitation was documented.
Conclusions: Right minithoracotomy transmitral septal myectomy and concomitant mitral valve repair without annuloplasty and the left-sided cryoMaze procedure comprise a useful therapeutic strategy. The addition of surgical ablation for atrial fibrillation would warrant selection of a minimally invasive transmitral versus transaortic approach. As experience accumulates with the lateral approaches for septal myectomy, we believe that, similar to degenerative mitral valve repair, sternotomy will be used less frequently, perhaps only when there are anatomical contraindications to the lateral approach.

D55
Minimally Invasive Mitral Approach: The Way Ahead

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Objective: Mitral valve disease is a tremendous burden in developing countries like India. The conventional midsternotomy approach to the mitral valve has been traditionally well accepted. Lately, the minimally invasive approach to the mitral valve through a right minithoracotomy is evolving as the standard of care for mitral access as a safe and effective way with minimum surgical trauma and multiple additional advantages.
Methods: We performed a randomized prospective observational study in 90 patients with mitral valve stenosis undergoing mitral valve replacement from December 2013 to December 2016 who met the inclusion criteria of being 18 to 75 years of age and of having an isolated mitral valve procedure. The study population was divided into 2 groups based on approach: group 1 had minimally invasive cardiac procedures and group 2 had conventional midsternotomies. The primary end points studied were deaths, length of hospital stay, and blood product usage; the secondary end points were risk factors for mortality and morbidity.
Results: The primary end point of death was not significantly different statistically (2.22% vs. 6.67%, $P = 0.616$) between the 2 groups. The mean blood product usage was not significantly different between the 2 groups (394.7 ml in those having minimally invasive procedures vs. 460.4 ml in those having the conventional surgical procedure, $P = 0.60$). The mean hospital stay in the minimally invasive group was 6.1 days and 8.2 days in the conventional group, which was statistically significant ($P = 0.04$). Statistically significant differences were observed in total bypass time (145.4 vs. 97.4 minutes, $P = 0.00009$), cross-clamp time (102.1 vs. 71.8 minutes, $P = 0.000003$), and early return to work (31.3% vs. 36.6%, $P = 0.000008$) in the minimally invasive compared to the conventional approach, respectively. No statistically significant difference was found for other risk factors like incidence of AF, stroke rate, ventilation time, reintubation, ejection fraction, mean pulmonary arterial pressure, pleural effusion, renal dysfunction, reexploration, wound infection,

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paravalvular leak, pain score, New York Heart Association class readmission, and need for reoperation.

Conclusions: Minimally invasive mitral valve replacement is as safe and as effective as the standard conventional midsternotomy approach and has various advantages over the conventional approach, such as better cosmesis, shorter hospital stay, faster return to work, and complete avoidance of complications like sternal wound dehiscence.

D56
Minimally Invasive Approach for Reoperation for Secondary Mitral Valve Regurgitation After Coronary After Bypass Surgery: 5-Year Follow-Up

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Objective: In recent years, the number of cases of mitral valve insufficiency has been increasing rapidly due to the number of late reoperations. This group of patients is a challenge both for the surgeon and for those caring for the patients postoperatively. The minimally invasive approach was designed to provide a number of advantages in the primary operation. We analyzed the minimally invasive approach as a reoperation in patients with secondary mitral valve regurgitation after a previous cardiac operation.

Methods: We performed mitral valve repairs using a minimally invasive approach via a minithoracotomy between November 2011 and January 2016 in 250 patients. We performed the procedure in 16 patients with secondary mitral valve regurgitation as a reoperation after previous cardiac surgery. Surgical access was via a right lateral minithoracotomy with the use of extracorporeal circulation via the femoral vessels.

Results: The mean (SD) age was 62.9 ± 11.5 years. Preoperative comorbidities included insulin-dependent diabetes mellitus in 18.1% and chronic renal failure in 18.1%. The mean ejection fraction was 48.3% ± 11.2%. The mean EuroSCORE II was 14.9% ± 12.9%. In this group of patients, we did not observe conversion to full sternotomy. The mean cardiopulmonary bypass time was 148.1 ± 79.7 minutes. In this group of patients, the blood transfusion rate was 1.8 ± 2.3 units. During first 24 hours, we observed a mean drainage of 427.0 ± 235.2 ml. Ten mitral repairs and 6 mitral replacements were performed. One patient died within 30 days. We did not observe postoperative bleeding, strokes, or neurological incidents. The mean time of ventilation was 54.9 ± 91.8 hours. There was no wound infection and no neurological or vascular complications. At the end of the I5-year follow-up period, 60 ± 1.7% of the patients were alive with normal echocardiographical findings and New York Heart Association class I to II (Fig. D56-1). In this group, we did not observe recurrence of any mitral valve disorders.

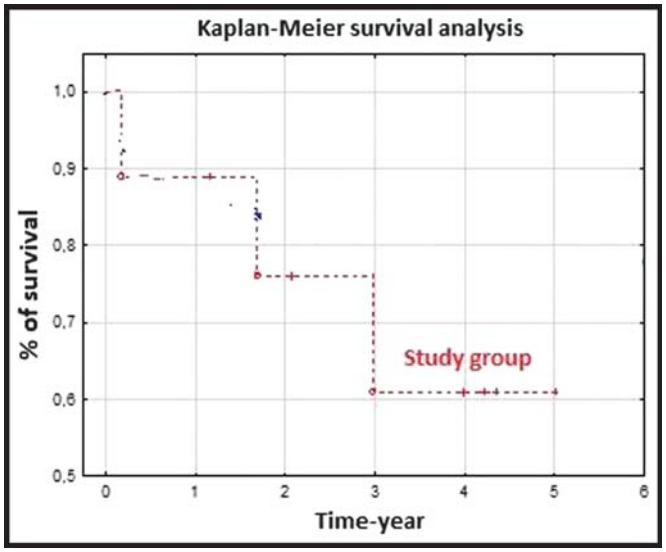

FIGURE D56-1. Kaplan-Meier 5-year survival analysis in patients having redo procedures.

Conclusions: The minimally invasive approach for reoperation for secondary mitral valve regurgitation after previous cardiac surgery is a safe, feasible, and effective method.

D57
Mitral Valve Repair by a Minimally Invasive Approach in a Colombian Center

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Objective: Mitral valve repair is the technique of choice in patients with mitral regurgitation in 95% of successful centers. Our goal was to describe minimally invasive mitral valve repair results in our institution.

Methods: We did a retrospective descriptive observational study of mitral valve repairs using minimally invasive procedures from January 2013 to November 2016. The results are described as of 30 postoperative days.

Results: We performed 225 mitral valve operations using a minimally invasive approach:114 replacements and 111 repairs. A total of 97.3% (108/111) were successful repairs, and 2.7% (3/111) of the patients required conversion to sternotomy. A total of 77.5% (86/111) of the patients were men. The average age was 55.4 ± 11.9 years (24–78 years). The body mass index was 24.7 ± 3.6 (17–35). The procedure was elective in 98.2% (109/111). The etiology of the valve was degenerative-myxomatous in 92.8% (103/111). The median ejection fraction was 60% (20%–78%), with severe insufficiency in 81.1% (90/111) of the cases. The right lateral minithoracotomy approach was used in 88.3% (98/111) of cases and the periareolar approach in 9% (10/111). Ring annuloplasty was performed in 99% (109/110) of patients. Technically, we performed a neochordal procedure in 78.2% (86/110) and resection in 22.7% (25/110) of patients. We found affected posterior leaflets in 72% (79/111). Additional procedures in 12% (13/111) included tricuspid repair, foramen ovale/interatrial communication closure, and the Maze procedure. We had 1 (1/111) failed repair because of systolic anterior motion. The mean aortic cross-clamp time was 103 ± 30 (34–228) minutes and the perfusion time was 148 ± 42 (71–293) minutes. Transthoracic echocardiography before discharge showed no mitral regurgitation in 68% (75/110); it showed trivial mitral regurgitation in 17% (19/110), mild in 13% (14/110), and moderate in 2% (2/110) of the cases. Major adverse events were 1 (0.9%) case of systolic anterior motion, 4 (3.6%) reinterventions due to bleeding, 1 (0.9%) case of postoperative endocarditis, 1 (0.9%) of postoperative acute infarction, 4 (3.6%) cases of acute renal failure (dialysis), and 2 (1.80%) abdominal surgical complications. The median stay in the intensive care unit was 2 days (1–106) and in the hospital, 4 days (2–194). There were no deaths within 30 days postoperatively.

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Conclusions: Mitral valve repair by minimally invasive surgery is a safe technique in our institution, with results comparable to those of centers that specialize in mitral valve repair.

D58

Mitral Valve Replacement with a One-Caliber-Fits-All Mechanical Prosthesis: The Value of Minimally Invasive Oral Anticoagulation

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Objective: Retrospective evaluation of the results of mitral valve replacement using a full pyrolytic carbon supraanular valve with 1 size (outer diameter of valve 25 mm, cuff diameter 33 mm) that can fit a native mitral annulus of any diameter. The design and the materials confer to the prosthesis a low risk of thromboembolic events, which is the reason for the low range of the anticoagulation regimen.

Methods: Between April 2002 and April 2014, the pyrolytic carbon supraanular prosthesis was implanted in 126 patients. Echocardiographic and clinical follow-up were performed to analyze the performance of the prosthesis and the clinical events related to thromboembolic and hemorrhagic events.

Results: The mean age was 62.97 ± 9.114 years; there were 53 men (42%) and 73 women (58%). Isolated mitral valve replacement was performed in 48 patients (38%). Additional procedures were performed in 78 patients (62%). The mean follow-up time was 76.97 months (maximum 144, minimum 10). The early mortality (<30 days) rate was 7.9% (10 patients), and the late mortality (>30 days) rate was 17% (20/116 patients). Adverse events were 1 heart transplant (0.9%; 0.1% patient-year) after 41 months; 1 reoperation for paravalvular leak after 86 months (0.9%; 0.1% patient-year); 7 patients (6%; 0.9% patient-year) with symptoms of heart failure, and 2 patients with strokes (1.7%; 0.3% patient-year); there were no bleeding events. Echocardiography was performed in 96 patients. The ejection fraction was 60% ± 8%; the end-diastolic volume was 118 ml ± 35; the end-systolic volume was 50 ml ± 21; the left atrium area was 20 cm^2 ± 11; the continuous wave velocity was 163 cm/s ± 28; the peak gradient was 11 mmHg ± 3; the mean gradient was 5 mmHg ± 2; effective orifice area (body surface area, 1.1 cm^2/m^2 ± 0.3); 2 (2%) permanent pacemakers (effective orifice area/body surface area <0.75); mild leakage in 2 (2%); and systolic pulmonary artery pressure, 35 mmHg ± 0.

Conclusions: In our experience, this full pyrolytic mitral valve prosthesis provides good long-term clinical and echocardiographic results with a low rate of thromboembolic or hemorrhagic events.

D59

Mitral Valve Surgery for Patients With Severe Comorbidities: Minimally Invasive Video-Assisted or Conventional Valve Surgery

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Objective: The goal of this report was to determine the feasibility and safety of minimally invasive video-assisted mitral valve surgery for patients with severe cardiac lesions and comorbidities.

Methods: Six patients diagnosed with severe mitral stenosis, left atrial thrombus, giant left atrial enlargement, severe tricuspid regurgitation, and severe pulmonary arterial hypertension, with the comorbidities of obesity, breast tumors, and cerebral vascular accidents underwent minimally invasive video-assisted mitral valve replacement and concomitant left atrial thrombectomy, left atrial appendage closure, left atrial reduction, and tricuspid annuloplasty ring. Peripheral extracorporeal circulation was set up through the femoral vessels and right internal jugular vein cannulation. A small right lateral minithoracotomy with a 6 cm incision through the fourth intercostal space was used. A Chitwood transthoracic aortic cross-clamp and myocardial protection with antegrade cardioplegia (Custodiol solution) were inserted through a needle placed in the aortic root.

Results: All patients were successfully operated on. The average aortic cross-clamp time was 150 minutes; the average cardiopulmonary bypass duration was 210 minutes. The mean time in the intensive care unit was 3 days; the mean hospital stay was 2 weeks. There were no complications.

Conclusions: Minimally invasive video-assisted mitral valve surgery is feasible and safe. It is not contraindicated in severe cases. Surgical experience, advancements in anesthesia, intensive care, medications, and other supportive devices help to overcome the disadvantage of the prolonged operative time.

D60

Monitoring of Lower Leg Regional Oxygen Saturation During Groin Cannulation in Minimally Invasive Cardiac Surgery

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Objective: In minimally invasive cardiac surgery (MICS) via a right minithoracotomy, retrograde perfusion with femoral artery cannulation is a fundamental technique to provide an optimal working space under a small thoracotomy. Ischemia of the lower leg is a serious complication in femoral artery cannulation. To clarify the severity of lower-leg ischemia in MICS and to propose an effective preventive method, we analyzed the results of regional oxygen saturation (rSO_2) monitoring by near-infrared spectroscopy (NIRS) in MICS.

Methods: In 21 cases who had MICS with femoral artery cannulation (mitral valve repair, 20; myxoma resection, 1), NIRS using an INVOS Cerebral/Somatic Oximeter (Medtronic, Inc., Dublin, Ireland) was used to monitor the rSO2 of the blood. The right femoral artery was cannulated using the Seldinger technique with no taping or clamping of the femoral artery. The size of the arterial cannula was determined by the pump flow based on the body mass index. When rSO_2 occurred, distal perfusion using a 5F sheath was added or the position of the cannula was moved slightly.

Results: Although a depression of rSO_2 greater than 30% from the baseline (48.7 ± 13.7%; 31.8%–4.1%) was observed in 9 cases (42.9%), no apparent compartment syndrome of the lower leg was observed. Distal perfusion was added in 2 cases, and the position of the cannula was changed in 2 cases. When the 2 groups (A: rSO2 depression, B: without depression) were compared, no statistically significant difference was found in the base parameters, including body size, sex, and cannula size for the femoral artery. There was no difference in postoperative blood creatine kinase and blood lactate levels between the 2 groups.

Conclusions: Lower leg ischemia was prevented by using NIRS monitoring of the lower leg and appropriate reaction in MICS with femoral artery cannulation. Because significant rSO_2 depression occurs at a high

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rate (42.9%), NIRS monitoring is indispensable in MICS. The current study did not clarify a predictive factor for rSO_2 depression.

D61
Myocardial Ischemia and a Friable Left Ventricular Mass: A Simplified Cardioscopic Approach

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Objective: Transaortic resection utilizing video-assisted cardioscopy has been described for left ventricular masses including myxomas and formed mural thrombi; however, the feasibility of this approach with large, friable thrombi is less recognized. Our goal was to describe the use of transaortic cardioscopy in a recent patient with a sizeable left ventricular thrombus who presented with probable coronary embolization.

Patient: This 45-year-old woman had been symptom-free after a small myocardial infarction 6 years earlier until she presented with angina, deep precordial T-wave inversions, absent R-wave progression, and a troponin level of 4.01 ng/mL. Echocardiography showed a solitary, mobile 4.2 cm left ventricular mass attached anteroapically without a stalk and a 40% ejection fraction with global hypokinesis. Coronary angiography demonstrated left dominance and trivial coronary disease. The patient became catecholamine-dependent preoperatively. At operation, a complete transverse aortotomy was performed with handheld retraction of the right and noncoronary leaflets. A 5 mm, 30° rigid video telescope was exclusively used to visualize the mass, aided by dual left atrial vent catheters, 1 positioned under direct vision through a small left atrial dome incision. The mass had a shaggy appearance consistent with thrombus and disintegrated when touched, revealing a central cavity; therefore, it was necessary to debride the bulky, immediately visible portion piecemeal, using thin-shafted thoracoscopic instruments, to expose the broad apical attachment (Fig. D61-1). The thrombus was interwoven over a 3 × 3 cm area with apical trabeculae, which were also resected. Echocardiographic scans after the operation showed excellent aortic valve competence. The patient, whose history included migraines, awoke without neurological deficits and was discharged without complications on postoperative day 7, having been prescribed oral anticoagulant medication. The diseased area, in addition to an organized thrombus, demonstrated enlarged myocytic nuclei and a lymphocytic infiltrate consistent with chronic myocarditis. The patient was referred for specialized treatment.

Conclusions: Among the few published reports, this unique case may represent the largest thrombus removed transaortically with video-assisted cardioscopy, with parameters that create more surgical risk than formed mural thrombi. Complete aortic transection combined with a conventional 5 mm, 30° rigid telescope provided excellent visualization for a safe, complete resection.

D62
Nonresectional Posterior Leaflet Remodeling Through a Free-Margin Running Suture for Minimally Invasive Mitral Repair

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Objective: Our goal was to illustrate a novel technique for nonresectional posterior leaflet remodeling to achieve minimally invasive mitral valve repair in a patient with degenerative disease.

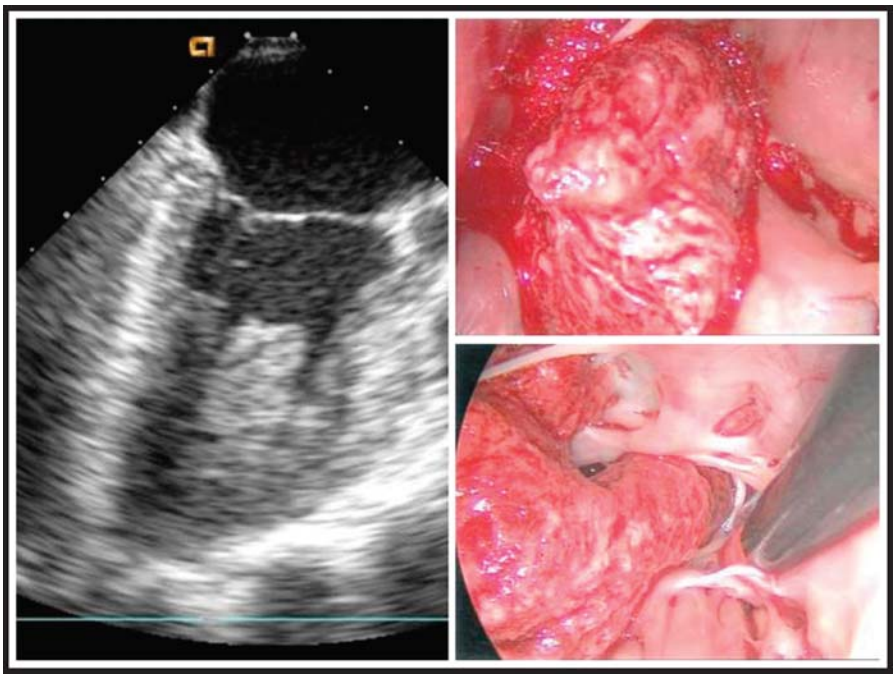

FIGURE D61-1. A 4.2 cm left ventricular thrombus detected after non-ST-elevation myocardial infarction. Transesophageal echocardiography (left panel) showing the mobile mass; a central cavity was visualized on other views. Right panels show intraoperative images of the intact, bulky thrombus (upper right) and retraction to show its complex apical attachments (lower right) during cardioscopic resection.

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Previously reported strategies for nonresectional leaflet remodeling are based on ventricularization of the excess leaflet tissue. Nonetheless, such strategies may be limited in the case of a large amount of redundant tissue and multisegment prolapse. The technique presented herein is aimed at overcoming such limitations.

Patient: The technique is presented in Video 1 (endoscopic view). The patient is a 56-year-old woman with severe mitral regurgitation and normal left ventricular function. Minimally invasive mitral repair was indicated; the approach was through a 4 cm right minithoracotomy (fourth intercostal space) with endoclamping (HeartPort). When the valve was analyzed, a prolapse with a large amount of excess tissue of P2 and P3 segments with chordal elongation and rupture was seen. The P1 segment was normal in height and morphology, and no alterations were evident for the anterior leaflet. A continuous Gore-Tex 4–0 suture was passed at the level of the free margin of the posterior leaflet, starting from the prolapsing edge of P3, through P2, and to the midportion of P1. The suture was tied at P1; residual leaks between P2 and P3 were corrected with a Gore-Tex suture. Hence, the prolapsing tissue was constrained at height of the P1 segment and redistributed over the length of the posterior leaflet, with ensuing coaptation. Complete annuloplasty was performed. Requirements for this technique are a large prolapsing area (mainly if exceeding P2) and redundant tissue, normal P1 (or P3 for inversed technique) and avoidance of undersized annuloplasty to minimize the risk of systolic anterior motion.The saline test showed good valve continence and morphology. Transesophageal echocardiography showed no residual regurgitation. Predischarge transthoracic echocardiography confirmed this finding with normal transvalvular gradients.

Conclusions: Due to its straightforward application, nonresectional leaflet remodeling with a free-margin running suture is particularly suited for minimally invasive operative procedures with favorable anatomical conditions. It avoids leaflet resection and more complex, time-consuming techniques. Compared to previously reported methods, the technique illustrated herein is adaptable to a large array of leaflet lesions, in particular, a large prolapse extending beyond P2.

D63

Off-Pump Intraabdominal Rerouting of Patent Gastroepiploic Arterial Grafts at the Time of Laparotomy After Coronary Artery Bypass Grafting

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Objective: Right gastroepiploic artery (GEA) grafts have been used for severely stenotic right coronary arteries because the GEA provides good patency after coronary artery bypass grafting (CABG). However, abdominal operations in patients with patent GEA grafts have been of concern because of adhesions or the need to resect the GEA.

Methods: At our institution, the GEA has been used in approximately 300 patients since 1991, and we performed 12 laparotomies in 9 patients with a patent GEA. We investigated the results and the management of the patent GEA in those 9 patients.

Results: The mean duration from CABG to laparotomy was 92 months (21–180 months). The abdominal adhesions around the GEAs were minimal in all cases. The GEA could be preserved in 6 of the 9 patients (gastric cancer in 4 patients, duodenal papilla cancer in 1 patient, and cholecystitis in 1 patient). Rerouting of the GEA was necessary in 3 patients who had pancreatic cancer or cholangiocarcinoma, because the proximal portion of the GEA had to be resected with the cancers. Off-pump intraabdominal rerouting of the GEA at the time of laparotomy for the cancers was performed instead of redo CABG via resternotomy. After laparotomy, the patent GEA was exposed, and a branch of the celiac artery that could be preserved was also exposed. After heparinization, the branch was clamped, and a short saphenous vein was anastomosed to the branch (the primary hepatic artery in 2 patients and the left gastric artery in 1 patient). Then, the GEA was incised near the liver, and an intraluminal coronary shunt tube was inserted into the GEA to perfuse the grafted coronary artery. The saphenous vein was anastomosed to the GEA. After confirmation of good flow through the saphenous vein graft, the proximal part of the GEA was ligated and resected. After rerouting of the GEA, pancreaticoduodenectomy was performed with no cardiac event.

Conclusions: Laparotomy for patients with patent GEA coronary grafts can be safely performed. Intraabdominal rerouting of the GEA with a short saphenous vein is thought to be a good option if pancreaticoduodenectomy is necessary.

D64

Off-Pump Coronary Artery Bypass Grafting Surgery in Patients with Significant Bilateral Carotid and Coronary Diseases

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Objective: Patients with concomitant significant bilateral carotid and coronary vascular disease indicating the need for coronary artery bypass grafting (CABG) are more liable to have intraoperative cerebral ischemia during the CABG procedure and subsequently a postoperative stroke. Off-pump CABG is our technique of choice in these patients to avoid the hazardous effects of the cardiopulmonary bypass (CPB) in this high-risk group of patients. We sought to evaluate the intraoperative feasibility, findings, and early follow-up results of 2 different methods used to manage these patients.

Methods: Retrospective data were collected from January 2011 to June 2016 for 88 consecutive patients who had off-pump CABG in which a carotid endarterectomy was done as a first stage (group I) using a local anesthesia while the patients were awake compared to 50 consecutive patients who had off-pump CABG with no carotid endarterectomy and who maintained good cerebral perfusion pressure and oxygenation (rSO2) guided with near-infrared spectroscopy. Group 1 was also categorized according to the type of local anesthesia: group1-S if superficial and group1-I if intermediate.

Results: There were no significant differences between the 2 groups regarding the preoperative demographic data. The number of patients with preoperative transient ischemic attacks (TIAs) was significantly higher in group 1 (42%) than in group 2 (18%) ($P < 0.001$) and in those with hypoechoic soft plaques (33% vs. 16%, $P < 0.001$), but no significant difference was observed in the number of preoperative strokes (3.4% vs. 8.0%). No intraoperative deaths occurred in either group. Both superficial (group1-S, 38 patients) and intermediate (group1-I, 50 patients) cervical local anesthesias are safe and give nearly equal excellent

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outcomes. Two cases out of 88 were aborted due to brain ischemia during carotid clamping (2.2%), 1 in each group. One patient developed hemiparesis 6 hours after carotid endarterectomy (1.1 %) (transient ischemic attacks). Significant differences between the 2 subgroups were noted regarding the need for incremental local xylocaine infiltration in the wound and postoperative analgesia (P = 0.000). No significant difference was noted between the groups regarding the incidence of postoperative ventilation time, stroke, myocardial infarction, atrial fibrillation, and stays in the intensive care unit and in the hospital.

Conclusions: Both a carotid endarterectomy in an awake patient using local cervical anesthesia as a first stage and near-infrared spectroscopy for continuous brain monitoring are safe procedures in patients with significant carotid stenosis listed for off-pump CABG. No significant differences were noted in the early outcomes of either group.

D65
The Off-Pump Coronary Artery Bypass Technique: How I Do It

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Objective: The technique for off-pump coronary artery bypass (OPCAB) varies from surgeon to surgeon worldwide. The purpose of this presentation was to describe my technique for performing OPCAB.

Methods: The commercial conditions in India are different from those in the rest of the developed world. In India, cardiac stabilizers are more expensive than oxygenators. For that reason, to minimize the cost of the operation, we re-use the stabilizers and other accessories. Since 2000, I have performed OPCAB as a default option, with exceptions such as catheterization laboratory emergencies, acute stent thrombosis with unstable hemodynamics, and severe hypertrophic cardiomyopathy with multivessel coronary artery disease. The operative approaches that I use for OPCAB, after administration of standard general anesthesia, include the following: median sternotomy in the majority of patients; a left lateral thoracotomy in some redo CABG with a patent left internal mammary artery; rarely, a right thoracotomy for RCA stenosis; use of the left internal mammary artery in 99% of OPCAB cases; skeletonized harvest of the left internal mammary artery; harvest of the left and right internal mammary arteries for total arterial OPCAB; either pedicled left and right internal mammary artery grafts plus or minus a radial artery graft or a left and right internal mammary artery (Y) configuration. The pericardium is opened longitudinally, veering to the right and left of the cardiophrenic angles; opening the right pleura is not usually done; 2–3 deep pericardial sutures (left internal mammary artery) in the left pericardial cavity inferiorly; Octopus used Guidant/Mackey—I never use an apical cardiac positioner; I always use an intracoronary shunt; inotrope, rarely; temporary pacing as required; I use an intraaortic balloon pump only rarely; and in an emergency, if a CPB conversion is needed, it is done early. When a grafting sequence for left internal mammary artery-saphenous vein graft OPCAB is needed, I nearly always do the left internal mammary artery–left anterior descending coronary artery anastomosis first, especially in critical left anterior descending artery or critical left main stenosis followed by posterior descending artery/posterolateral branch territory prior to lateral circumflex branches, distal coronary anastomosis first prior to proximal aortic anastomosis using side-biting clamp. The other intraoperative measures are an activated clotting time check after the second distal anastomosis (ideal level, 250–350), serial blood gas analysis after induction, after second distal grafts, or in the event of hemodynamic instability, optimal correction of acid–base and serum K+. with regard to postoperative ventilation, nearly all patients were either extubated on the operating table or within 6 hours of the operation.

Results: I have personally performed >2500 cases; my emergency CPB conversion rate is 1.2%.

Conclusions: I consider that the way I perform OPCAB is simple, reproducible, and safe in the majority of patients undergoing OPCAB.

D66
Outcome After Mitral Valve Replacement Using Biological Versus Mechanical Valves

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Objective: The aim of this study was to compare the outcomes (30-days) after biological (B) versus mechanical (M) mitral valve replacement (MVR) in case mitral valve repair was not feasible.

Methods: From 2005 until 2014 a total of 1121 patients received mitral valve surgery at our institution. Amongst those 275 patients who received MVR, 218 received B-MVR and 57 patients received M-MVR. Minimally invasive surgical access was used in 49.1% of patients, thereof in 45.2% (B) versus 63.8% (M); P = 0.012. Combined tricuspid valve repair (TVR) was necessary in 19.0%, thereof in 19.4% (B) versus 17.2% (M); P = 0.851, ablation for atrial fibrillation in 27.7%, thereof in 26.7% (B) versus 31.6% (M); P = 0.507 and LAA-closure in 26.9%, thereof in 27.2% (B) versus 25.9% (M); P = 1.00. Underlying mitral valve pathology was degenerative in 95.6%. Amongst those, 12.7% had acute endocarditis, 28.7% had MV stenosis and 46.2% had restrictive leaflets.

Results: Mean patient age was 70.0 years (B) versus 56.0 years (M), P < 0.001; 50.2% (B) versus 43.1% (M) were female, P = 0.376. NYHA III-IV occurred in 82.5% (B) versus 82.7% (M), P = 0.967; and preoperative emergency/urgent indication for operation occurred in 16.8% (B) versus in 17.1% (M), P = ns; acute endocarditis was the reason for operation in 12.0% (B) versus in 15.5% (M), P = 0.507. A simultaneous tricuspid valve repair had to be performed in 19.4% (B) versus 17.2% (M), P = 0.851; and cryoablation was done in 26.8% (B) versus in 31.6% (M), P = 0.507. Median MV prosthesis size was 31.0 ±1.9 (B) versus 31.0 ±1.7 (M), P = ns. Mean red blood cell transfusion was 2.6 ± 7.6 (B) versus 7.2 ± 25.1 (M); P = 0.591. Re-thoracotomy rate was 8.8% (B) versus 20.7% (M); P = 0.018; wound infection occurred in 2.3% (B) versus in 1.7% (M), P = ns; and 30-day mortality was 7.4% (B) vs. 10.3% (M), P = 0.427. Median LOS time was 11 days in (B) versus 14 days in (M), P = 0.008.

Conclusions: Mitral valve replacement in case MV repair is not feasible leads to acceptable results. Differences between mechanical and biological prostheses are mostly due to the underlying conditions of the patients. Longer term outcomes will be evaluated.

D67
Outcome of Minimally Invasive Aortic Valve Surgical Procedures in the Era of Transcatheter Aortic Valve Replacement

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Objective: The indications for transcatheter aortic valve replacement (TAVR) for the treatment of severe aortic stenosis have gradually expanded to lower risk patients. However, in contrast to surgical prostheses, the durability of the TAVR prosthesis is unknown. Minimally invasive surgical aortic valve replacement (SAVR) might be the ideal solution: combining the small surgical access route with the well-known long-term durability of the prosthesis.
Methods: We retrospectively analyzed all patients undergoing minimally invasive SAVR from January 2013 to December 2015 at our institution. Transthoracic echocardiography was performed in all patients prior to discharge.
Results: During the study period, 232 patients (102/232 were women) underwent minimally invasive SAVR. The mean (±SD) age was 69 ± 11.2 years; the preoperative ejection fraction was 59.9 ± 8.2%; the log EuroSCORE was 4.4% ± 3.4%; the EuroSCORE II was 1.6% ± 1.1%. The operation was performed through a 6 to 8 cm skin incision and a J-shaped upper partial sternotomy into the third or fourth intercostal space. The mean cross-clamp time was 62.2 ± 17.8 minutes. The mean cardiopulmonary bypass time was 89.4 ± 30.7 minutes. Conversion to full sternotomy was necessary in 2.6% (6/232) of the patients. Revision or re-exploration was performed in 6.9% (16/232) of the patients. Predischarge echocardiography showed a mean gradient of 14.1 ± 5.3 mmHg. Furthermore, 8.6% (20/232) of the patients had mild aortic regurgitation; most of the cases (13/20) were caused by a central, not a paravalvular, leak. The 30-day survival rate was 100%.
Conclusions: Because minimally invasive SAVR can be performed safely and effectively, it should be considered in all patients undergoing isolated aortic valve replacement.

D68
Outcomes of Coronary Revascularization Based on Race at a Veterans Affairs Medical Center

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Objective: Studies have proven and disproven the impact of a patient's race on postoperative coronary artery bypass grafting (CABG). The Veterans Affairs Medical Center (VAMC) is unique in that it provides easy access to medical care and a robust infrastructure to facilitate postoperative compliance and follow-up. Our goal was to analyze the impact of race as a predictor of postoperative death in patients undergoing CABG at a VAMC.
Methods: We reviewed African American and white American men who underwent CABG at a single VAMC, by a single surgeon, between 2004 and 2016. Comorbid conditions, socioeconomic factors, and preoperative factors of these 753 men were similar. The primary outcome of interest was all-cause mortality at 180 days, 1 year, and 5 years. Statistical analyses were performed using independent sample *t* tests and binomial regression modeling.
Results: The mean age was 63 years for African American (n = 255) men and 66 years for white American men (n = 498, $P < 0.001$); both groups received an average of 1 arterial and 1 venous graft per person. Prior percutaneous catheter interventions, heart operations, and myocardial infarctions were similar between the cohorts. Cardiopulmonary bypass time was slightly lower for African American men (40 minutes versus 48 minutes, $P = 0.037$). All-cause mortality at 180 days (3.4% versus 3.9%, $P < 0.001$) and at 1 year (5.9% versus 5.8%, $P < 0.001$) was similar between the groups but slightly favored African American men at 5 years (17% versus 21%, $P < 0.001$). Regression analysis of race did not show a significant impact of overall mortality at 180 days ($P = 0.56$) or at 1 year ($P = 0.713$) but trended towards significance at 5 years (HR 0.629, $P = 0.072$). Age had a small impact on overall mortality at 180 days (HR 1.051, $P = 0.19$), 1 year (HR 1.025, $P = 0.33$), with increasing significance on 5-year survival (HR 1.079, $P < 0.001$) following surgery.
Conclusions: Race does not appear to play a large role in all-cause mortality during the first year following cardiac surgery. However, following this cohort to 5 years shows some indication that race may be a risk factor. This result may be confounded by the effects of age and the effects of comorbid conditions that do not affect mortality in the 180-day or 1-year period.

D69
Pathway to a Successful Laser Lead Extraction Program: Lessons Learned

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Objective: The last 2 decades have witnessed a decline in cardiac surgical procedures. Cardiovascular implantable electronic devices are widely used. Continued population growth and expanding indications have resulted in a progressive increase in the number of implanted cardiovascular electronic devices. Mirroring this growth, an increasing number of leads require removal for a variety of indications. Indications for removal are underrecognized. Our department had been offering this procedure sporadically. In 2015, we implemented some strategies to attract more patients and to increase the safety of the procedure.
Methods: We reviewed our experience from January 2013 until mid-December 2016, including yearly case volume, major complications, and indications for removal. We established safety protocols based on extraction risk stratification. Extraction risk stratification included age of the leads, type of lead, comorbidities such as renal insufficiency, and location of the leads based on noncontrast computed tomography of the chest. In 2015, we assembled a multidisciplinary "extraction team" that included members from cardiac surgery, cardiac electrophysiology, and interventional radiology. We gave informal talks on indications for lead extraction, targeting emergency medicine physicians and hospitalists.
Results: Our lead extraction volume remained constant over the first 3 years. Strategy implementation in 2015 had a dramatic impact on the volume of cases performed by our team. The most common indication for extraction was infection. On average, each patient had 2 leads extracted. Our major complication rate was 4.2% including 2 deaths secondary to innominate and superior vena cava laceration.
Conclusions: A team approach is fundamental in the building of a successful lead extraction service. Raising awareness among primary care physicians of the indications for extraction is essential and proved to increase our referral volume. Risk stratification is paramount and must be validated to increase the safety of the procedure. In times in which traditional cardiac surgical procedures are declining, a team approach offers an opportunity to capture this patient population.

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D70

Percutaneous Pulmonary Venting via the Jugular Vein While on Peripheral Extracorporeal Membrane Oxygenation

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Objective: Peripheral extracorporeal membrane oxygenation (ECMO) remains a valid option for treating cardiogenic shock. We investigated a novel percutaneous approach to unload the left ventricle while the patient is on venoarterial femorofemoral ECMO support.

Methods: In December 2016, 2 patients (a 59-year-old man and a 40-year-old woman) suffered refractory cardiogenic shock due to primary graft failure after a heart transplant and acute myocarditis, respectively. The multidisciplinary shock team discussed the cases and decided to proceed with percutaneous femorofemoral venoarterial ECMO placement and percutaneous left ventricle venting with a Bio-Medicus NextGen (Medtronic, Inc., Dublin, Ireland) cannula via the right internal jugular (IJ) vein access to reach and drain the main pulmonary artery (PA) in the hybrid operating room. Femoral cannulation was performed traditionally via the Seldinger technique using DLP Bio-Medicus (Medtronic, Inc.) cannulas (21F, venous drainage and 19F, arterial return) in both patients. The permanent life support system with the Quadrox D oxygenator (Maquet) circuit was connected to the cannulae and the pump system (Levitronix CentriMag in 1 and Cardiohelp in 1, respectively). A right internal jugular venous access was established using direct ultrasound visualization. A Lunderquist guidewire (Cook) was advanced under fluoroscopic guidance into the right atrium. A 15F Bio-Medicus NextGen (Medtronic, Inc.) cannula was then advanced over the Lunderquist wire with its distal tip positioned at the level of the tricuspid valve. The Lunderquist wire was removed, and a Swan-Ganz catheter was advanced into the Bio-Medicus cannula with its distal tip positioned in the main PA. The cannula was then advanced over the Swan-Ganz catheter to get the PA too. The Swan-Ganz catheter was removed, and the cannula was connected through a "y" line to the ECMO circuit.

Results: ECMO support time in the 2 cases was 5 and 8 days, respectively. Both patients were successfully weaned from ECMO after full recovery of myocardial function; the ECMO system was explanted in the intensive care unit. No ECMO-related adverse events occurred.

Conclusions: The use of venoarterial femorofemoral ECMO support associated with PA drainage via the internal jugular vein enables the rapid onset of extracorporeal life support with an effective biventricular unloading. The hybrid operating room might be the correct location for appropriate cannulae placement.

D71

Predictors of Postoperative Atrial Fibrillation in Patients Undergoing Coronary Artery Bypass Grafting

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Objective: The reported incidence of atrial fibrillation (AF) after coronary artery bypass grafting (CABG) varies from 20% to 40%, with arrhythmia usually occurring between the second and fourth postoperative days. Many perioperative factors have been suggested to increase the incidence of postoperative AF after conventional CABG. Our goal was to examine some of these risk factors as predictors for postoperative AF in our patients.

Methods: Our patients were divided into 2 groups: Group A included patients who did not develop postoperative AF (179 patients), and group B included patients who did develop postoperative AF (96 patients). Perioperative data, including gender, age, demographic variables, and postoperative morbidity and mortality, were extracted from the medical records.

Results: This retrospective cohort study was conducted on 275 consecutive adult patients who underwent CABG with or without valve surgery, at the King Faisal Specialist Hospital and Research Center in Jeddah, Saudi Arabia. The mean age of patients with postoperative AF was 63 years ($P = 0.0001$). Eighty-eight patients (52.7%) in group A had diabetes and 65 patients (74.4%) in group B had diabetes ($P = 0.0001$). Patients who developed postoperative AF had a lower ejection fraction (45.7%) ($P = 0.0001$), lower diastolic dysfunction ($P = 0.0001$), and larger left atrial volume ($P = 0.0001$). Bleeding requiring re-opening for exploration and postoperative shock was identified as a significant predictor for postoperative AF. Multivariate logistic regression (odds ratio ± 95% CI, *P* value) was performed to identify the effect of age, preoperative heart rate, ejection fraction, postoperative bleeding, shock, and ventilator time. Sensitivity was 89.5%; specificity was 94.6%; the positive predictive value was 89.5%, and the negative predictive value was 94.6%.

Conclusions: Age, diabetes mellitus, left atrial volume, and low ejection fraction were found to be significant predictors for postoperative AF in patients undergoing CABG.

D72

Preoperative Empyema From Non-Small-Cell Lung Cancer: Does Video-Assisted Thoracoscopy Achieve Control or Delay Treatment?

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Objective: Preoperative empyema is rare in patients with lung cancer but has been described as occurring from tumor rupture after chemoradiotherapy. Video-assisted thoracoscopic drainage has been advocated for the control of pleural space infection with definitive resection 2 or more weeks later. Our goal was to question the utility of such an approach in a recent patient.

Patient: A 66-year-old man with a >7 cm stage IIIA left lower lobe squamous cell carcinoma presented with fever, hypoxemia, leukocytosis, and a large pleural effusion containing an air-fluid level. He had not yet started chemoradiotherapy. After diagnostic thoracentesis, video-assisted thoracoscopic surgery was performed through a 1-inch port, with evacuation of a multiloculated fibrinopurulent empyema and aggressive decortication. The source of the empyema was a 2 cm superior segment cavity filled with caseous purulent and necrotic debris that was also evacuated (Fig. D72-1) and biopsied. Three full-length channel drains provided complete pleural space drainage. Postoperative imaging showed markedly improved lower lobe expansion. Cultures grew pan-sensitive *Streptococcus anginosus*, but neither pleural fluid cytological tests nor cavity biopsies showed malignancy. The patient initially improved, but by day 4, fever, tachycardia, and leukocytosis worsened, despite dual intravenous antibiotics and chest tubes draining a thin, nonturbid fluid. A computed tomography scan showed no residual pleural fluid collections. A lobectomy was planned to control the sepsis. Through a complete muscle-sparing thoracotomy, extensive

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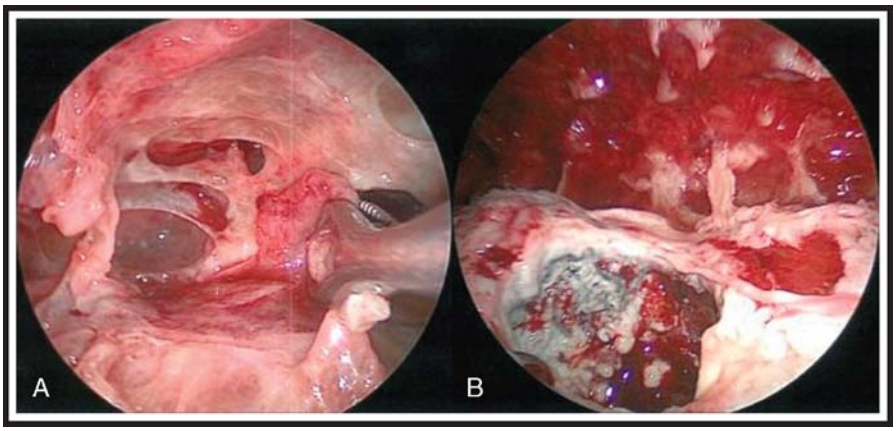

FIGURE D72-1. Single-port thoracoscopic decortication of empyema from ruptured lung cancer. Image A shows the initial appearance of an extensive left fibrinopurulent empyema that developed 5 weeks after diagnosis of a stage IIIA left lower lobe squamous cell cancer. During aggressive decortication, a 2 cm superior segment cavity (lower half of Image B) was recognized to be the source of the empyema.

extrapleural video-assisted dissection was necessary to expose densely adherent upper and lower lobes. There was no undrained pleural space purulence. A well-vascularized intercostal muscle flap provided generous bronchial stump coverage. Postoperatively, the patient was extubated promptly. Chest tubes were removed beginning on day 3, with discharge to a rehabilitation facility on day 7 after a course complicated only by mild *Clostridium difficile* colitis and atrial fibrillation.

Conclusions: In our patient, unlike other reports, lung cancer rupture producing empyema was not preceded by chemoradiotherapy. Although the video-assisted operation and adequate drainage limited contamination of the pleural space, it did not control the source of the sepsis. Moreover, our patient's favorable course after the urgently performed lobectomy with bronchial coverage favors reconsideration of prolonged tube drainage before resection.

D73
Primary Aortoenteric Fistula

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Objective: A primary aortoenteric fistula is a rare cause of gastrointestinal bleeding but is associated with high rates of morbidity and mortality. Our goal was to describe a patient with a primary aortoenteric fistula who underwent endovascular stent graft placement.

Patient: The patient was a 64-year-old man with a history of hypertension who was admitted to the general surgical service for 4 days with complaints of hematemesis and hematochezia. An endoscopic examination and a colonoscopy performed during the first hospitalization indicated no active bleeding center except for gastritis and a duodenal ulcer. An emergency abdominal computed tomography angiogram was taken because hemodynamic instability developed on the fourth day and the hematocrit gradually fell. The contrast extravasation at the level of the distal abdominal aorta and some soft tissue density were seen on the abdominal computed tomography angiogram. An aortoenteric fistula was diagnosed with clinical correlation. The patient was immediately taken to the angiography laboratory. The location of the fistula was determined in the aortogram performed under local anesthesia (Fig. D73-1A). The Anaconda stent graft (Vascutek TERUMO) was successfully placed; an aortogram was taken to confirm that the aortoenteric fistula was

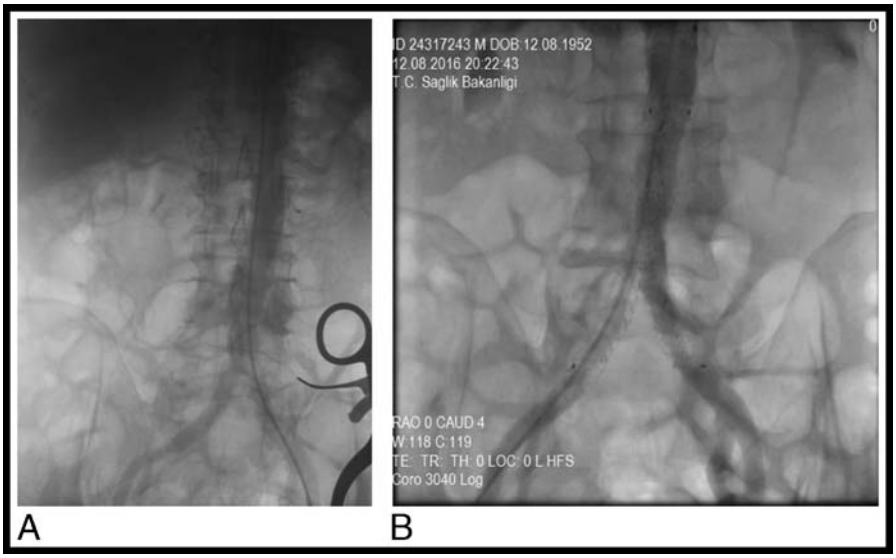

FIGURE D73-1. A, Angiogram demonstrating the aortoenteric fistula; B, Control angiogram demonstrating intact endovascular stent graft and closed fistula.

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closed (Fig. D73-1B). The patient was discharged on the third postoperative day. At the 1-month postoperative follow-up examination, the hematocrit value was 31.4. No disease was detected in the contrast-enhanced abdominal computed tomography scan.

Conclusions: It is often difficult to diagnose an aortoenteric fistula in a patient with gastrointestinal bleeding because there is little evidence. One must make a quick decision because the condition is rare and hemodynamically unstable.

D74
Quadrivalvular Aortic Valve Replacement Through a Ministernotomy Incision

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Objective: Our goal was to describe a quadrivalvular aortic valve replaced through a ministernotomy.

Patient: A 51-year-old woman diagnosed with severe aortic regurgitation was admitted to our institution for elective aortic valve surgery. She had progressive worsening of symptoms of fatigue and dyspnea on exertion during the last 12 months. Her blood pressure at admission was 142/50 mmHg. A transthoracic echocardiogram confirmed severe aortic regurgitation and normal systolic left ventricular (LV) function. The end-diastolic LV diameter was 56 mm. Intraoperative transesophageal echocardiography revealed a quadrivalvular aortic valve with a clear cusp malcoaptation and severe regurgitation (Fig. D74-1). She had a minimally invasive aortic valve operation through a right ministernotomy by an L-inverted incision in the fourth right intercostal space. The extracorporeal circulation apparatus was placed in the right femoral artery and vein. The aortic valve was replaced with a Braile 23 bovine pericardium bioprosthesis. The procedure was successful, with a short postoperative recovery period (6 days). Six months after the procedure, she remains asymptomatic.

Conclusions: A quadrivalvular aortic valve is a rare cardiac malformation with an incidence of 0.003% to 0.043% of all congenital heart defects. Many cases are diagnosed incidentally during aortic operations or autopsies. The exact mechanism responsible for this abnormality is not known, but the strongest hypothesis is abnormal septation of the embryological truncus arteriosus. Functionally, a quadrivalvular aortic valve tends to evolve with progressive regurgitation for decades (rarely before adulthood), due to the asymmetry in the distribution of the transvalvular flow and the inequality of valvular coaptation. Minimally invasive aortic surgery is an excellent option for selected patients because it provides good clinical and cosmetic results.

D75
Right Atrium Positioning for Exposure of Right Pulmonary Veins During Off-Pump Atrial Fibrillation Ablation

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Objective: Concomitant surgical ablation of atrial fibrillation (AF) is recommended for patients undergoing off-pump coronary revascularization in the presence of this arrhythmia. Achievement of optimal

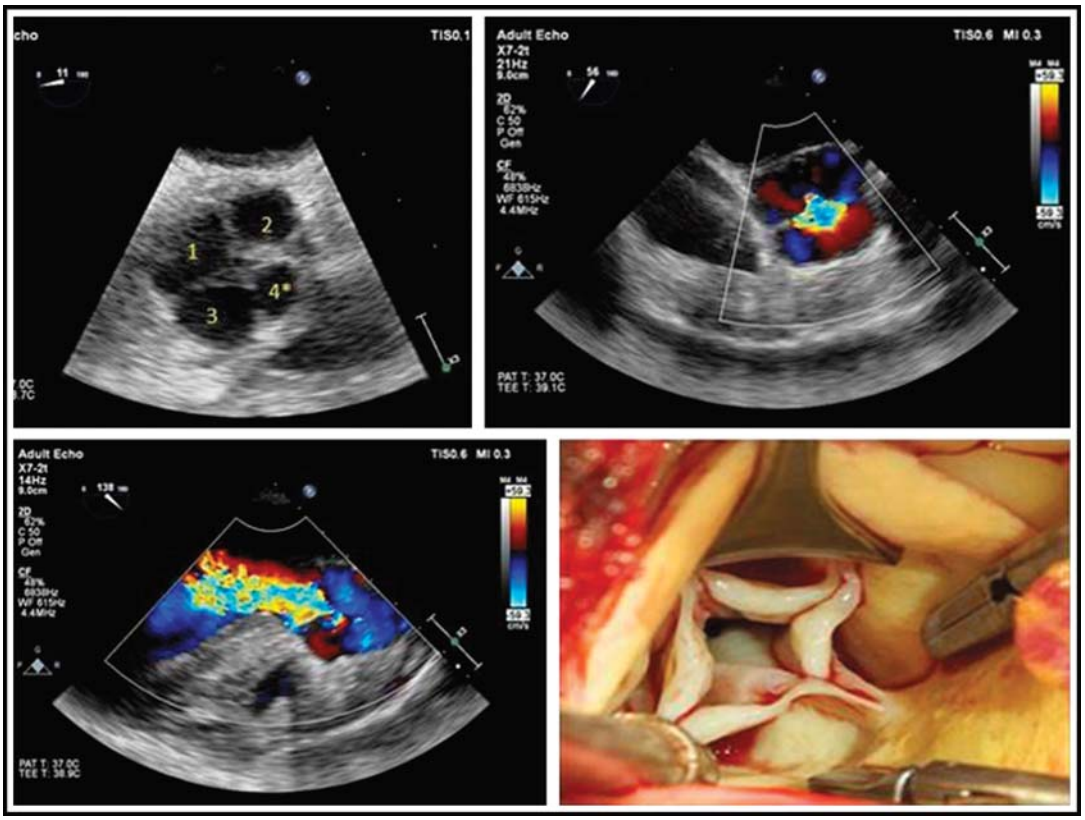

FIGURE D74-1. Intraoperative transesophageal echocardiogram demonstrating the quadrivalvular aortic valve with the malcoaptation of its cusps and the severe aortic regurgitation. The surgical field of view of the quadrivalvular aortic valve.

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visualization of pulmonary veins while maintaining stable hemodynamic conditions is crucial for proper completion of the ablation procedure. This study evaluates the safety and feasibility of right atrial positioning using a suction-based cardiac positioner rather than compressive maneuvers for exposure during off-pump surgical ablation for AF.

Methods: Thirty-four consecutive patients underwent pulmonary vein isolation, ganglionated plexi ablation, and left atrial appendage occlusion during off-pump coronary artery bypass grafting. Right atrial suction positioning was used to visualize the right pulmonary veins. Safety and feasibility end points were analyzed intraoperatively and during the early postoperative course.

Results: In all patients, right atrial positioning created optimal conditions to complete transverse and oblique sinus blunt dissection, correct placement of a bipolar ablation probe, detection and ablation of ganglionated plexi, and conduction block assessment. In all patients, the entire right-sided ablation procedure was completed with a single exposure maneuver. Feasibility end points were achieved in all patients.

Conclusions: This report documents the safety and feasibility of right atrial exposure using a suction-based cardiac positioner to complete ablation for AF concomitant with off-pump coronary revascularization. This technique may be widely adopted to create stable hemodynamic conditions and provide optimal visualization of the right pulmonary veins.

D76
Risk Factors of Limb Ischemia in Minimally Invasive Cardiac Surgery

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Objective: In minimally invasive cardiac surgery (MICS), cannulation of the common femoral artery (CFA) during cardiopulmonary bypass can cause limb ischemia. To date, cannula–artery discrepancy is noted mainly to avoid limb ischemia. We hypothesized that no or poor collateral circulation via the deep femoral artery (DFA) may be more significant than the cannula–artery size discrepancy in causing limb ischemia. This study evaluates the risk factors of limb ischemia in MICS from the point of view of the anatomy of the femoral arteries.

Methods: We performed a retrospective review of 48 patients who underwent MICS without a prosthetic graft conduit for femoral arterial cannulation between February 2013 and December 2016 at our institution. We used the maximum value of postoperative creatine kinase (CKmax) levels as the index of postoperative limb ischemia. To exclude the influence of each muscle mass, we used CK to divide the area of the muscles of femoral regions: CK/MA. The predictors for limb ischemia, including age; sex; body mass index; cardiopulmonary bypass time; the diameter of the CFA, the superficial femoral artery (SFA), and the DFA; and the size of the lumen of the CFA after the cannulation, were analyzed.

Results: Critical limb ischemia occurred in 1 of 48 (2%) patients. This patient's laboratory data showed high levels of CK (CKmax 87,910 IU/L, CK/MA 563.5 IU/L/cm^2), and his DFA was much smaller than his SFA (SFA 9.3 mm, DFA 6.8 mm). In this cohort, the median CKmax was 2154 U/L (1404–3157) and the median CK/MA was 17.4 U/L/cm^2 (11.4–21.8). In multivariate analysis of CK/MA > 20, DFA < SFA was the only independent predictor (odds ratio 4.035, 95% CI 1.058–15.395, $P = 0.041$), and the remaining lumen size of CFA was not a risk factor.

Conclusions: Our results suggested the DFA < SFA was a risk factor for limb ischemia in MICS. In patients in whom DFA < SFA, attention should be paid to the choice of the cannulation site.

D77
Robotic-Assisted Repair of Persistent Left Superior Vena Cava Draining in the Left Atrium

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Objective: Persistent left superior vena cava (PLSVC) is the most common variation of the thoracic venous system. It results from failure of the left anterior cardinal vein to involute. The incidence is approximately 0.5% in the normal population and 5% in patients with congenital heart disease. PLSVC drains into the right atrium via the coronary sinus in 80% to 90% of cases and into the left atrium in the remaining cases. The innominate vein is absent in 65% of cases. This case report describes a new method for correction of PLSVC using robotic technology.

Patient: Our patient was a 32-year-old woman with dyspnea at rest, important hepatomegaly, jugular vein stasis, and mild peripheral edema. A transthoracic echocardiogram showed the left superior vena cava (LSVC) draining into the left atrium, the presence of the innominate vein with a left-to-right shunt, pulmonary hyperflow, dilation of the right atrium and the right ventricle, anomalous drainage of the hemizygous vein in the LSVC, normal-sized left atrium and left ventricle, and good biventricular function. Computed tomography angiography with 3-dimensional reconstruction was performed to plan the procedure. A robotic-assisted operation was performed with single-lung ventilation, using a 12 mm trocar in the third left intercostal space for the camera and three 8 mm trocars for robotic instruments. Cardiopulmonary bypass was established via left femoral cannulation; CO2 was insufflated in the left hemithorax for dissection; LSVC and hemizygous veins were closed using polytetrafluoroethylene sutures; cardiopulmonary bypass was discontinued; femoral decannulation was performed; the left hemithorax was drained, the trocars were removed, and the ports were closed. There were no complications during the procedure and no need for conversion to thoracotomy. The patient was extubated in the intensive care unit after 36 hours, following resolution of acute pulmonary edema. An echocardiogram showed an enlarged left atrium and good biventricular function. No major bleeding and no complications related to the peripheral cannulation were noted. The patient was discharged from the hospital on the postoperative day 4.

Conclusions: The use of robotic technology allowed the effective and optimized manipulation of cardiac structures with a short hospital stay. The patient showed early recovery, returned to social activities, and had an excellent aesthetic result at the short-term follow-up examination. Therefore, we concluded that the robotic-assisted technique was a safe, effective option for the correction of PLSVC.

D78
Harvesting Robotic Bilateral Internal Mammary Arteries: A One-Way Approach

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Objective: Robotic assistance offers internal mammary artery (IMA) mobilization in coronary artery bypass graft surgery. Our goal was to

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present our early and short-term experience using robotics to mobilize bilateral internal mammary arteries using a one-way approach.
Methods: From August 2014 to December 2016, 28 patients had da Vinci robotic-assisted bilateral internal mammary arteries take-down and left thoracotomy to complete coronary artery bypass grafting in our institute. There were 21 men and 7 women; the mean patient age was 62.31 years (from 29 to 80 years).
Results: The bilateral internal mammary arteries were all harvested with robotic assistance in a skeletonized manner. In these 28 patients, all 56 internal mammary arteries were mobilized smoothly. We mobilized the bilateral mammary arteries from the left-sided pleura in 27 patients and from the right-sided pleura in 1 patient due to previous permanent pacemaker implantation in the left chest wall. There was no internal mammary artery injury with the robotic internal mammary artery takedown. All 28 patients received a left thoracotomy for coronary artery bypass grafting that was completed without conversion to median sternotomy.
Conclusions: Mobilization of the bilateral internal mammary arteries using a one-way approach and the robotic da Vinci device can be done safely without any complications.

D79
Robotic Cardiac Surgery: Impact of a New Patient-Side Assistant on Outcomes

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Objective: Numerous studies have emphasized the importance of the experience and training of the console robotic surgeon in achieving good outcomes. Few studies have focused on the experience level of the assistant on the patient's side. We investigated whether the retirement of a highly experienced robotic patient-side assistant and replacement with a new assistant influenced robotic cardiac surgical outcomes.
Methods: We performed 989 robotic cardiac surgical procedures (single-surgeon) over a 9-year period (January 2007–December 2016). In April 2016, the established patient-side assistant retired after spending 8 months training a new patient-side assistant. A retrospective analysis of 216 patients was performed; 108 patients were treated over a 9-month period just before the arrival of the new patient-side assistant (group 1), and 108 patients over 8 months just after the departure of the established assistant (group 2). Case distribution, preoperative characteristics, and surgical outcomes were collected and compared.
Results: The experienced assistant had performed 762 robotic procedures. The new assistant had 7 years' experience in cardiac surgery but no prior robotic experience. The 8-month training period comprised 117 robotic procedures with gradual assumption of responsibility in patient-side assisting, starting with off-pump procedures (e.g., ablation and totally endoscopic coronary artery bypass) and progressing to more demanding on-pump cases (e.g., mitral valve and other intracardiac procedures). Case volume increased in group 2. The mean age for group 1 was slightly lower but otherwise patient demographics were not significantly different. Group 1 had more intracardiac cases and group 2 had more triple-vessel totally endoscopic coronary artery bypass procedures. Outcomes were similar, with the only significant differences being a lower rate of return to the operating room and less chest tube drainage in group 2. Results are shown in Table D79-1.
Conclusions: We conclude that the transition to a new robotic cardiac surgical patient-side assistant does not have to affect the progress of a busy robotic program. If adequate time for training and gradual assumption of responsibility are ensured, it is feasible to make this transition without loss of volume or compromise in patient outcomes.

TABLE D79-1. Surgical Procedures and Outcomes

	Group 1 (n = 108)	Group 2 (n = 108)	*P* Value
TECAB (off-pump) n (x1, x2, x3)	54 (25,28,1)	53 (20,25,8)	0.946
Valve/intracardiac (on-pump) n (%)	44 (40)	38 (35)	0.432
Other (off-pump) n (%)	11 (10)	17 (16)	0.216
Mean robotic time (dock to undock), min	223.8	218.7	0.689
Conversion to sternotomy, n (%)	1 (0.9)	1 (0.9)	.994
Mean total chest tube output, mL	878	596	0.004
Return to operating room, n (%)	4 (3.7)	0	0.045
Median hospital length of stay, days	3 (1–12)	3 (1–19)	0.267
Mortality rate, n (%)	2 (1.8)	1 (0.9)	0.568

TECAB, Totally Endoscopic Coronary Artery Bypass.

D80
Robotic Heller Myotomy With Intraoperative Endoscopy for Assessment

Nguyen M. Le, Paul C. Lee. *Northwell Health, New York, NY USA.*

Objective: This video demonstrates a robotic-assisted Heller myotomy with Toupet fundoplication. We used intraoperative endoscopy to assess the adequacy of myotomy length.
Patient: A 19-year-old man with dysphagia was diagnosed with achalasia from the results of a barium swallow and manometry. Because of his young age, we decided to proceed with a robotic-assisted Heller myotomy. The patient was approached in the supine position with 4 ports for the robot and one 5 mm liver retractor. Once the myotomy was completed, endoscopy was used to assess the adequacy of the length of the myotomy. Once the length was deemed satisfactory, we then proceeded with the Toupet fundoplication. The procedure was performed without complications, and endoscopy helped ensure adequate myotomy length. The results of a barium swallow on POD1 showed no evidence of obstruction or leak. He was advanced to a clear liquid diet and discharged home that same day. A 2-week postoperative visit showed marked improvement in his dysphagia, such that he could tolerate a regular oral diet.
Conclusions: Robotic-assisted Heller myotomy with Toupet fundoplication continues to be a safe and effective surgery for the management of achalasia. Intraoperative endoscopy is an important tool to help confirm adequate length of a myotomy.

D81
Robotic Mitral Valve Repair: An Institutional Start-Up

Erik Herou, Shahab Nozohoor, Igor Zindovic, Sigurdur Ragnarsson, Per Wierup, Mårten Larsson, Johan Sjögren. *Lund University Hospital, Lund, Sweden.*

Objective: Excellent long-term mitral valve repair outcomes in combination with early referrals for asymptomatic patients have shifted the focus towards less invasive options, including robotic repair. Outside of the largest centers, robotic programs be challenging to institute. Our goal was to describe our midsize institutional start-up and our early results.
Methods: Skane University Hospital, Lund is a tertiary care teaching hospital whose cardiac surgery unit serves a population of approximately 1.3 million people. Robotic-assisted mitral valve repair (the da Vinci surgical system; Intuitive Surgical) was introduced in September 2012. Between September 2012 and December 2016, 34 patients (mean

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age 54 years; range 31–73 years) underwent mitral valve repair through a right minithoracotomy with robotic support. Patients with concomitant coronary artery disease, known peripheral vascular disease, or prior right thoracotomy were not accepted for robotic-assisted mitral valve repair. Follow-up was performed in December 2016 (mean follow-up, 18 months).

Results: The 30-day mortality rate was 0%. Two patients were reoperated for postoperative bleeding. The mean extracorporeal circulation times from 2012 to 2014 (7 patients) and 2015 to 2016 (27 patients) were 221 ± 72 and 186 ± 54 minutes, respectively, and the mean cross-clamp times were 152 ± 43 minutes and 96 ± 26 minutes, respectively (Fig. D81-1). All patients had a successful valve repair without significant regurgitation at discharge (none/trivial regurgitation), and none were converted to sternotomy based on a failed mitral valve repair. The median length of stay in our intensive care unit was 1 day and in our department, 7 days. All patients were alive at late follow-up. Three patients were reoperated with conventional mitral valve repair due to significant mitral regurgitation found on late follow-up.

Conclusions: Our initial experience suggests that even with a limited number of cases, robotic mitral valve repair may be performed with satisfying outcomes in selected patients. Operating time has been reduced with greater experience; however, prolonged surgical times did not seem to influence early and midterm mortality.

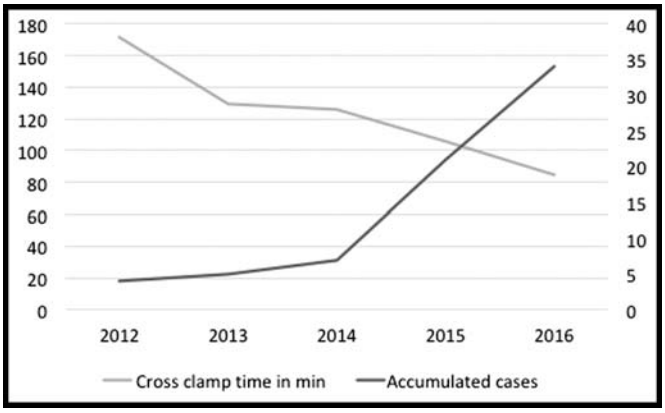

FIGURE D81-1. Aortic cross-clamp time in correlation with accumulated number of robotic assisted mitral valve repairs.

D82
Robotic Mitral Valve Repair Using Artificial Chordae and a Standardized Chordal Length Measurement System

Sahin Senay, Ahmet Umit Gullu, Muharrem Kocyigit, Cem Alhan. *Acibadem University School of Medicine, Istanbul, Turkey.*

Objective: This video presentation describes the use of a standardized chordal length measurement system during robotic mitral valve repair using artificial chordae.

Methods: The da Vinci XI or SI system was used for the operations. The classical setup for robotic mitral operations was described previously. A 3 cm incision was made between the anterior axillary line and the midclavicular line at the fourth intercostal space. Peripheral cannulation was used. A complete ring with a chordal guiding system was used for both the anterior and posterior (or bileaflet) prolapses using routine artificial chordae.

Results: We have used this system in 15 patients. There was no need for intraoperative reintervention to size the artificial chordae. The procedure for implanting the artificial chordae was straightforward in all patients. No mitral insufficiency was evident on the transesophageal echocardiographic examination performed after completion of the cardiopulmonary bypass.

Conclusions: This system enables a safe mitral valve repair with a standardized artificial chordal length during robotic operations.

D83
Scan, Map, and Bridge: The Poor Man's Endoscopic Vein-Harvesting Method

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Objective: The purpose of these studies was to demonstrate a technique that reduces leg wound incisions during saphenous vein harvesting in patients undergoing coronary artery bypass surgery. During the challenging financial climate and in the absence of endoscopic vein harvesting, "scan, map, and bridge" could be considered a cost-effective option for the future.

Methods: Two prospective studies were undertaken: a pilot study and a comparative study. In the pilot study, we collected data on 87 patients scanned at a single institution during 1 year. Demographics, site of scan, time scan was taken, change of strategy, and benefit to procedure were noted. In the comparative study, we collected data on 172 patients in 2 cohorts: mapped and nonmapped veins. We noted the length of the incision, the length of the vein harvested, and the length of the unusable vein. Both studies were undertaken by the Surgical Care Practitioner Team.

Results: The pilot study showed that information gained by vein mapping resulted in a change of strategy or aided the procedure in 63% of patients and, in 1 instance, resulted in the patient not moving forward to a futile exploration of the conduit. Similarly, a patient was considered to have no suitable conduit; after scanning, a usable vein was identified, and an operation was performed. In the comparative study, 40% (69) of the patients were mapped, 36% (25) of which resulted in a change in strategy including change of leg, aided bridging, change of radial artery harvest to vein harvest, and change in confirmed best site. Eighteen percent (31) of patients had unusable segments of vein: 42% (13) of these were mapped and 58% (18) were unmapped.

Conclusions: Ultrasound vein mapping is an effective way of assessing the anatomy and quality of conduit in patients undergoing coronary artery bypass surgery. It also aids bridging, because tributaries can be identified and marked in order to appropriately place incisions, thereby facilitating ease of dissection and tunneling of the vein, thus using a less invasive technique than open vein harvesting.

D84
Scoring in Robotic Coronary Artery Surgery

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Objective: Our goal was to assess the robotic performance for totally endoscopic coronary artery bypass (TECAB) surgery on the beating heart.

Methods: Robotically assisted procedures are very demanding in terms of resources, technical skills, and costs. Team building and surgical technique need to be developed jointly and monitored in order to assure efficacy and safety. First, we reviewed different robotic skills assessment scores available in the literature. Second, we standardized the procedure for TECAB surgery on the beating heart step by step: a single coronary artery bypass with the internal mammary artery to the left anterior descending coronary artery. Then we proposed a new scoring

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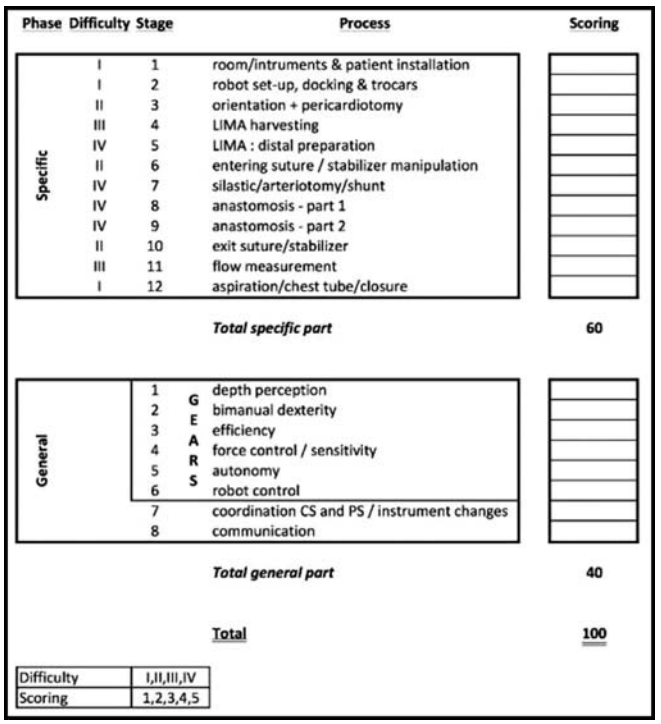
system to evaluate the learning curve in starting robotic coronary revascularization programs.

Results: The main assessment scores described in the literature are neither specific for the robot nor specifically made for evaluating cardiac operations. Indeed, the Healthcare Failure Mode and Effect Analysis is a form of human risk analysis derived from aviation and validated for use in health care but not specifically for surgical procedures. The Objective Structured Assessment of Technical Skills is a pure measurement of the surgical performance for specific noncardiac procedures. Similarly, the Global Evaluation Assessment of Robotic Surgery is an adaptation of the Global Operative Assessment of Laparoscopic Skills score and was modified to include the parameters of robotic and force controls, which makes this score the most accurate for robotic assessment and seems by now to be validated for other robotic operations such as those in urology. But, it considers the surgeon's performance separately from the procedure. We combined the Global Evaluation Assessment of Robotic Surgery with our standardized TECAB surgery on the beating heart and developed a new score. The specific evaluation describes and assesses the procedure itself. The general part considers the skills of the console surgeon (Fig. D84-1). The 2 sections involve both the console and patient surgeons as well as their interactions with the whole team.

Conclusions: Standardized scoring systems help newly formed teams and fellows to practice under monitoring and allows comparisons between centers.



Phase	Difficulty	Stage		Process	Scoring
Specific	I	1		room/intruments & patient installation	
	I	2		robot set-up, docking & trocars	
	II	3		orientation + pericardiotomy	
	III	4		LIMA harvesting	
	IV	5		LIMA : distal preparation	
	II	6		entering suture / stabilizer manipulation	
	IV	7		silastic/arteriotomy/shunt	
	IV	8		anastomosis - part 1	
	IV	9		anastomosis - part 2	
	II	10		exit suture/stabilizer	
	III	11		flow measurement	
	I	12		aspiration/chest tube/closure	
				Total specific part	60
General		1	G	depth perception	
		2	E	bimanual dexterity	
		3	A	efficiency	
		4	R	force control / sensitivity	
		5	S	autonomy	
		6		robot control	
		7		coordination CS and PS / instrument changes	
		8		communication	
				Total general part	40
				Total	**100**

Difficulty	I,II,III,IV
Scoring	1,2,3,4,5

FIGURE D84-1. Assessment score for totally endoscopic coronary artery bypass surgery on the beating heart.

D85
Setting Up a Minimally Invasive Mitral Service

Ishtiaq Ahmed, Andrew Hill, Ashok Narayanasamy, Mauricio Vieira, Jonathan Sheppard, Jennifer Santos, Jocelyn Baluyot, Victoria Parish, Joon Lee, Uday Trivedi. *Royal Sussex County Hospital, Brighton, United Kingdom.*

Objective: Minimally invasive mitral surgery is established practice in many high-volume centers across the world. However, <5% of mitral operations in the United Kingdom are performed via this procedure. The reasons for this are varied and include learning curves, governance, and the financial implications of setting up such a service. Our goal was to set up a new service and demonstrate the steps taken so our experience can be reproduced in other units to help facilitate the growth of this procedure.

Methods: The approach involved a specific "team approach" for a surgeon, an anesthetist, and perfusion and scrub nurses. A stakeholder analysis was important to obtain support from management, cardiologists, and radiologists. Multiple meetings established the importance, challenges, and benefits of setting up such a program. A cost-benefit analysis demonstrated that this was feasible even in the difficult economic climate in the National Health Service. A separate multidisciplinary meeting was set up to plan technical aspects and review 3-dimensional echocardiographic and computed tomographic imaging preoperatively. Multiple aspects were initially adopted during the usual sternotomy cases, including the use of an endoscope, specialized peripheral cannulation, organization of the ergonomics of the operating room, and increased use of automatic suturing devices. This process was used to increase the familiarity of the whole team with the procedure. Multiple dry laboratory simulations were also carried out.

Results: By using a step-by-step process and maintaining a close team environment, all of the equipment was used initially very successfully during the sternotomy cases and also during the re-do cases. The team progressed to moving from simulation to using long shafted instruments and endoscopes routinely during sternotomy. Finally, the team moved to minimally invasive mitral surgery via a limited working port in the right chest. The team has now completed 8 cases. All cases had successful mitral repairs, with no intraoperative complications.

Conclusions: Although much of the literature on starting a minimally invasive program focuses on the surgeons and their technical ability, we demonstrated a step-by-step way to engage with more members of the operating room, cardiovascular, management, and radiology teams to ensure a smooth, safe adoption of this technically challenging procedure.

D86
Simple Measuring Procedure to Determine Precise Aortic Annular Size in External Correction

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Objective: Precise annular fixation is essential to perform reliable valvuloplasty. There are numerous ways to fix the aortic annulus during valve-sparing aortic root operations and aortic valvuloplasty; however, there are few ways to obtain precise annulus size if the annulus is fixed externally, such as in a reimplantation procedure or external fixation rings like the Lansac ring. This problem happens because of discrepancies between the aortic annulus and the external circumference due mainly to the difficulty of dissection around the right coronary cusp. So, we invented a simple, reliable way to determine aortic annular size at the time of external correction.

Methods: An ideal annular size depends on the size of the leaflet. After dissection around the aortic root itself, a braided suture is passed through the external aortic basal ring or the bottom of the dissection in which the ring or graft will be located. A sizer corresponding to the ideal annular size is inserted into the aortic annulus and the braided suture is tied (Fig. D86-1). After removing the sizer, the suture is cut in any portion surrounding the annulus. To measure and calculate the length of the suture, the ideal ring or graft size can be obtained. One to 6 months

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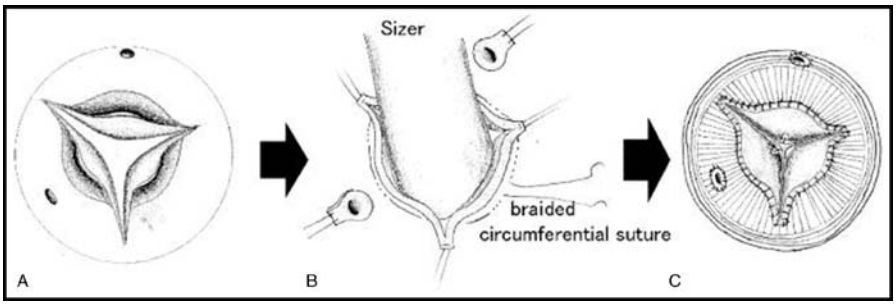

FIGURE D86-1. A, An ideal annular size is calculated from the size of the leaflets. B, After the dissection around the aortic root, a braided suture is passed through the external basal ring and the Heagr dilator corresponding to the ideal annular size is inserted into the annulus and the braided suture is tied. C, The graft size is obtained from the circumferential diameter of the braided suture.

after the operation, the size of the annulus was checked with a cardiac computed tomographic scan.
Results: We applied this formula for determining graft sizes to 3 patients. One patient had annuloaortic ectasia involving the tricuspid valve and 2 patients had acute aortic dissection involving the tricuspid and bicuspid valves. The ideal annular size calculated from the leaflet sizes was 26 mm in all cases. The postoperative annular diameter from the computed tomographic scan was 26.2 ± 0.7 mm.
Conclusions: This procedure is easy and seems reliable when one needs to correct the aortic annulus externally.

D87
Simplified Acute Physiology Score 2 as an Outcome Predictor for Transcatheter Aortic Valve Implantation: A Single-Center Experience in 599 Patients

Francesco Pollari[1,2], Michela Cuomo[1], Claudius Söhn[2], Jill Marianowicz[2], Pia Wiehofsky[2], Jürgen Jessl[3], Ferdinand Vogt[1], Theodor Fischlein[1], Steffen Pfeiffer[1]. *[1]Cardiac Surgery, Klinikum Nürnberg - Paracelsus Medical University, Nuremberg, Germany; [2]Paracelsus Medical University Nuremberg, Nuremberg, Germany; and [3]Cardiology, Klinikum Nürnberg - Paracelsus Medical University, Nuremberg, Germany.*

Objective: Simplified Acute Physiology Score 2 (SAPS2) is a prognostic score for predicting outcomes of critically ill patients on admission in intensive care units (ICU). Our aim was to assess its utility in patients having transcatheter aortic valve implantation (TAVI).
Methods: We retrospectively analyzed data from patients who underwent a TAVI procedure from 2010 to October 2016. Patients who survived TAVI were extubated in the hybrid operating room according to our fast-track protocol and were thereafter admitted to the intensive care unit, where SAPS2 was prospectively calculated. Outcomes (length of ICU and hospital stay and 30-day mortality rate) were measured in transfemoral (TF) and in transapical (TA) groups, separately. A Pearson test of linear correlation was applied. Discrimination and goodness-of-fit for predicting 30-day mortality rates were assessed through the receiver-operating characteristic (ROC) curve and the Hosmer-Lemeshow test, respectively.
Results: A total of 699 TAVI procedures were performed in 696 patients (mean age, 81.6 ± 6 years; 52% women; mean logistic EuroSCORE I 25.08% ± 15.87%). For 599 patients, SAPS2 was disposable (mean 30.33 ± 14.3; range 12–101); 229 patients underwent TA-TAVI (age 81.65 ± 5.9 years) and 370 underwent TF-TAVI (age 81.71 ± 6.1 years). The logistic EuroSCORE in the TA group was significantly higher than in the TF group (29.66% ± 16.1% vs. 22.59% ± 15.16%, $P < 0.05$, Student *t* test). In the TA group, the mean SAPS2 was 29.73 ± 11.27 (range 13–101) with an observed 30-day mortality rate of 7%. The mean ICU and hospital stays were 3.98 ± 6.6 and 14.28 ± 8.85 days, respectively. The Pearson test showed a significant correlation between SAPS2 and hospital stay ($P = 0.03$; R statistic 0.148), but no statistical significance with ICU stay and the 30-day mortality rate ($P > 0.05$). In the TF group, the mean SAPS2 was 30.82 ± 11.27 (range 12–98) with an observed 30-day mortality rate of 2.7%. The mean ICU and hospital stays were 1.63 ± 3 and 11.33 ± 8.14 days, respectively. The Pearson test showed no significant correlation between SAPS2 and the 30-day mortality rate ($P = 0.35$), ICU stay ($P = 0.25$), and hospital stay ($P = 0.06$). The Hosmer-Lemeshow test was not significant in either group, meaning a good calibration, but the ROC curve showed poor discrimination (TF group, $\chi^2 = 2.73$, $P = 0.95$; area under curve = 0.594 ± 0.089, 95% CI: 0.418–0.769; TA group $\chi^2 = 6.829$, $P = 0.447$; area under curve = 0.587 ± 0.068, 95% CI: 0.455–0.720).
Conclusions: SAPS2 does not correlate with the 30-day mortality rate or with the stay in the ICU in patients who have TAVI. A correlation between SAPS2 and hospital stay was found only in patients having TA-TAVI.

D88
Simultaneous Mitral and Tricuspid Valve Plasty and Maze Procedure Through a Lower T-Shaped Sternotomy

Ichiro Hayashi[1], Ichiro Kashima[2], Hitoshi Nakanowatari[2], Mitushiko Konno[2]. *[1]Self-Defence Forces Central Hospital, Tokyo, Japan; and [2]Saitama East Circulation Hospital, Tokyo, Japan.*

Objective: Good results of the mitral valve procedure (MVP) under right minithoracotomy or inverted J-shaped lower partial sternotomy have been reported. On the other hand, with these incisions, coronary anastomosis, left internal thoracic artery (LITA) harvesting, left pulmonary vein isolation, left atrial appendage excision, and tricuspid annuloplasty are challenging. In recent years, due to the increasing number of patients with advanced diseases, the number of complex operations performed concomitantly with the MVP have also increased. Our goal was to describe the successful completion of an MVP and a concomitant surgical procedure through a lower T-shaped sternotomy.
Patient: The patient presented with mitral and tricuspid valve regurgitation and chronic atrial fibrillation, due to mitral valve prolapse involving both the anterior and posterior leaflets. The diffuse stenosis of the left anterior descending coronary artery was identified in preoperative coronary angiograms. LITA harvesting, anterior mitral leaflet artificial chordae implantation, posterior leaflet triangular resection, tricuspid valve segmental annuloplasty, LITA-left anterior descending coronary artery anastomosis, and the Maze procedure were performed under a lower T-shaped sternotomy. To prevent a postoperative nonunion with the sternum, a mesh-type absorbable bone plate is available for reinforcement of the vertically split sternum. This patient had no serious adverse events.

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Conclusions: One can use a lower T-shaped sternotomy for patients who need a concomitant procedure with the MVP including left pulmonary vein isolation, LITA harvesting, and coronary anastomosis. Although the risk of mediastinitis is a fault of the sternotomy, the lower T-shaped sternotomy showed almost the same operative field of view with a median full sternotomy incision, providing a useful option as a small-incision procedure.

D89
Single-Port Left Upper Lobe Lobectomy Combined With Adrenalectomy and Posterior Hepatic Segmentectomy

Dohyung Kim, Mi Hee Lim, **Bong Soo Son.** *Pusan National University Yangsan Hospital, Yangsan, Republic of Korea.*

Objective: A patient who has a lobectomy and a mediastinal lymph node dissection (MLND) via single-port video-assisted thoracoscopic surgery (VATS) experiences less postoperative pain and a shorter recovery time. If the patient has a larger size of lung mass than can be removed with a single port incision (3 cm), we cannot use single-port VATS. However, if there is another way to remove a huge mass, it can be performed via a single port VATS to relieve the pain and reduce the recovery time.
Patient: A 63-year-old man, a heavy smoker, complained of a cough and blood-tinged sputum for 3 months. He had a 6.4 cm lung lesion in the left lingular segment with left interlobar, hilar, and aortopulmonary window lymph node enlargement visible on the initial computed tomography scan of the chest. Because of the 4.9 cm right adrenal gland nodule, he was diagnosed as stage IV (cT2N2M1b); he was scheduled to have an adrenalectomy for the pathological diagnosis of the adrenal gland. We collaborated with the general surgical team to use their subcostal skin incision to remove the huge lung mass using a substernal dissection. The substernal dissection was successful, and we were able to remove the huge primary lung cancer through a 3 cm skin incision.
Conclusions: This patient had a large primary lung cancer and a metastatic region on the adrenal gland. Because the lung mass was so large (6.4 cm), we felt that it would not be possible to remove it using a single-port VATS procedure. However, we were able to carry out a single-port VATS procedure via a substernal approach combined with adrenalectomy and hepatic segmentectomy.

D90
Single-Port Video-Assisted Thoracoscopic Surgery for a Huge Epiphrenic Esophageal Diverticulum

Do Kyun Kang, **Ji Yong Kim,** Ho-ki Min, Hee Jae Jun, Youn-Ho Hwang. *Haeundae Paik Hospital, Busan, Republic of Korea.*

Objective: Many surgeons have attempted minimally invasive operations for epiphrenic esophageal diverticula. They reported that minimally invasive surgery for epiphrenic esophageal diverticula was a safe and feasible approach that had many advantages. Although a number of surgical approaches are available for the minimally invasive treatment of epiphrenic diverticula, the best surgical approach remains uncertain. Our goal was to report the case of a huge epiphrenic esophageal diverticulum that was successfully treated by single-port video-assisted thoracoscopic surgery.
Methods: The patient, who was diagnosed with a huge epiphrenic diverticulum (6.7 × 5.1 cm), underwent video-assisted thoracoscopic surgery through a 4 cm single incision. The incision was made in the left sixth intercostal space on the midaxillary line. An extra-small wound retractor was used to secure the intercostal space; a 5 mm, 30° thoracoscope was used. The diverticulum was dissected away from the pleura and the adherent muscle fiber to avoid mucosal perforation into the lumen using a 5 mm endoscopic grasper, spatula-shaped electrocautery, and a 5 mm endoscopic ultrasonic scalpel (Fig. D90-1A). The entire diverticular neck was exposed and divided with an endoscopic linear stapler (Fig. D90-1B). The overlying muscle layers were reapproximated over the stapler line by an interrupted suture with 3-0 black silk (Fig. D90-1C). A myotomy was performed on the contralateral side of the stapler line from the upper level of the diverticulum to the upper level of the lower esophageal sphincter. The myotomy was not extended onto the lower esophageal sphincter. The incised mediastinal pleura was closed by an interrupted suture (Fig. D90-1D).
Results: The operation time was 155 minutes. The patient was kept fasting for 6 days after the operation. On the 6th day after the operation, an esophagogram with gastrografin was performed, which revealed no

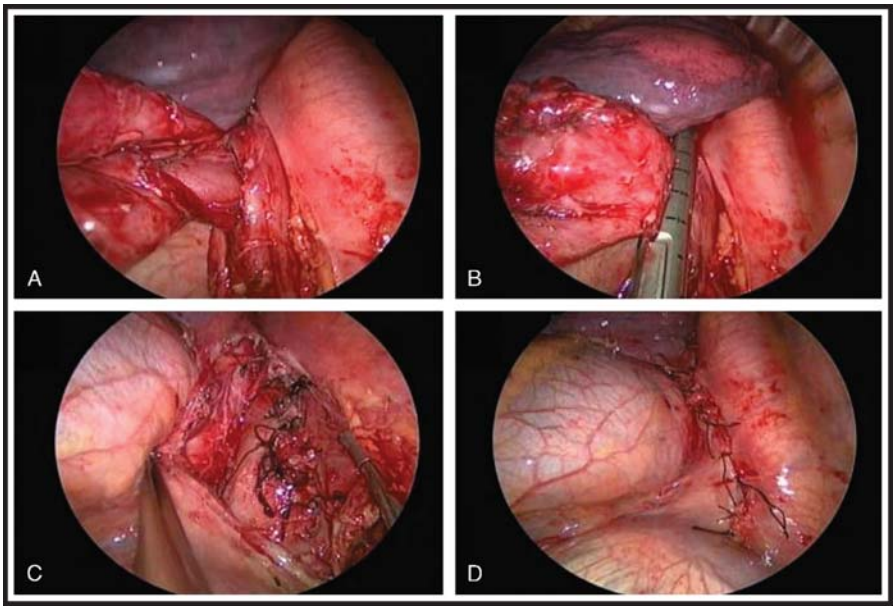

FIGURE D90-1. Intraoperative photographs illustrating surgical procedures. A, Dissection of the diverticular neck; B, Stapled diverticulectomy; C, Approximation of the overlying esophageal muscle layer; and D, Mediastinal pleura.

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stapler line leak and no stenosis. The patient resumed an oral diet on postoperative day 7. The patient was discharged on postoperative day 8 with no symptoms of dysphagia or regurgitation. The patient was followed up without recurrent disease for 6 months.
Conclusions: Single-port VATS could be a useful option among various surgical approaches for epiphrenic esophageal diverticula in carefully selected patients.

D91
Subannular Technique to Correct Severe Carpentier Type IIIb Mitral Regurgitation: A Minimally Invasive Fully Endoscopic Approach

Evaldas Girdauskas, Lenard Conradi, Eva Harmel, Ulrich Schäfer, Johannes Petersen, Stefan Blankenberg, Hermann Reichenspurner. *University Heart Center Hamburg, Hamburg, Germany.*

Objective: Functional mitral regurgitation (FMR) is the result of a progressively increasing distance between the papillary muscle tips and the mitral annular plane. The standard surgical treatment for FMR (i.e., Carpentier type IIIb dysfunction) using an undersized mitral annuloplasty is associated with a high recurrence rate. Although subannular techniques have been suggested as a way to improve the operative results, none of them have been implemented systematically or via a minimally invasive procedure.
Methods: We proposed a simple, reproducible subannular maneuver to correct FMR by combining a standard mitral annuloplasty with the controlled realignment of both papillary muscles, thereby fixing the distance between the mitral annular plane and the papillary muscle tips, which may be easily done via a minimally invasive, fully endoscopic mitral valve procedure (Fig. D91-1).
Results: We applied minimally invasive mitral valve repair of severe type IIIb mitral valve insufficiency, which includes a subannular maneuver to realign both papillary muscles (i.e., feasibility study). The first 10 patients with severe FMR (i.e., left ventricular ejection fraction <40%) who underwent this procedure at our institution showed no in-hospital deaths, and predischarge echocardiography demonstrated no residual (or only trivial) mitral regurgitation.
Conclusions: Our initial experience indicates that adding this subannular maneuver to the standard annuloplasty during minimally invasive mitral valve surgery, thereby fixing the distance the between papillary muscles and the mitral annular plane, has the potential to improve the results of surgical treatment of FMR.

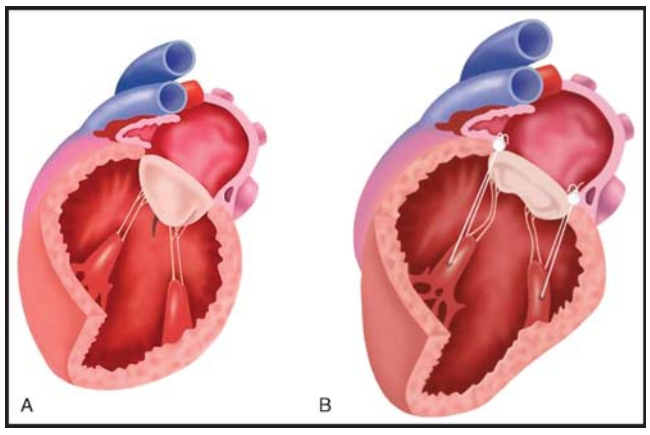

FIGURE D91-1. A, Pathophysiological mechanism of functional type IIIb mitral regurgitation. B, Subannular procedure to correct papillary muscle dislodgement and tethering of both mitral valve leaflets.

D92
Successful Management of Chylothorax After Thoracoscopic Removal of a Cystic Mediastinal Lymphangioma

Ju Sik Yun[1], Sang Gi Oh[2], Sang Yun Song[1], Seok Kim[1], Kook Joo Na[1]. *[1]Chonnam National University Hwasun Hospital, Hwasun-gun, Jeollanam-do, Republic of Korea; and [2]Chonnam National University Hospital, Gwangju, Republic of Korea.*

Objective: Lymphangiomas are rare benign tumors that present mainly in childhood in the cervical region. Less than 1% of the cases of cystic lymphangiomas occur in the mediastinum. Surgical resection is the preferred treatment modality, although complete excision is impossible in most cases with the involvement of vital structures, and some postoperative complications have been reported.
Patient: A 37-year-old asymptomatic man was referred to our center with a cystic mass located in the superior mediastinum. The lesion was incidentally detected on a computed tomography (CT) scan obtained during a routine health check-up. A CT scan of the chest showed a 7 × 11 cm, nonenhancing cystic mass with a well-defined border in the posterior mediastinum, compressing the tracheal and upper esophageal lumen. We planned a video-assisted thoracoscopic procedure based on a presumed diagnosis of a benign bronchogenic or esophageal cyst. A cystic tumor was located at the superior mediastinum, which was abutting the trachea and upper esophagus. During dissection of the cystic wall from the base, the cyst was ruptured and yellowish serous fluid was released. Although a large portion of the cystic wall was removed, the cyst was excised incompletely because of the risk of vascular injury and a presumed diagnosis of a benign cystic tumor. On postoperative day (POD) 2, the pleural drainage changed from yellow serous to milky white, and the diagnosis of chylous leakage was made with elevated level of the pleural fluid triglyceride. On POD 4, the patient complained of a left-sided neck swelling. The chest radiograph showed an enlarged upper mediastinal shadow. Contrary to expectation, the pathological examination confirmed the diagnosis of lymphangioma. The patient underwent clipping of the thoracic duct with VATS immediately. The pleural drainage became serous, and the preoperative neck swelling was relieved. On POD 8 (4 days after reoperation), the patient was discharged with no other complications.
Conclusions: Although cystic lymphangiomas are extremely rare, they should be considered in the differential diagnosis of patients with a cystic mediastinal tumor. Complete surgical resection is recommended for definitive diagnostic and therapeutic purposes.

D93
Surgical Considerations for Extended Myocardial Bridging

Lucian Lozonschi, Paul C. Tang, **Takushi Kohmoto.** *University of Wisconsin School of Medicine, Madison, WI USA.*

Objective: Myocardial bridging can present with symptoms of myocardial ischemia, syncope, or even sudden death. In a review on this topic, Corban[1] (suggested that coronary artery bypass grafting with the saphenous vein is preferable to that with the left internal mammary artery. This suggestion was based on 1 published retrospective study from Russia. Our goal was to describe surgical revascularization with a saphenous vein graft.
Patient: A 43-year-old woman with primary hyperparathyroidism and Raynaud syndrome presented with a few months' history of severe exertional angina and 1 syncopal episode. She was diagnosed with a long (>2.5 cm), deep (>5 mm) myocardial bridge in the left anterior descending coronary artery with a fractional flow reserve of 0.7. She underwent robotic-assisted left internal mammary artery takedown and off-pump coronary artery bypass grafting × 1 with the left internal mammary artery- left anterior descending coronary artery through an inframammary

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left minithoracotomy. The flow in the left anterior descending coronary artery graft had a mean of 13 ml/minute, a pulsatility index of 2.9, and a diastolic flow of 77%. The patient had complete resolution of her symptoms postoperatively and was discharged home in 3 days.
Conclusions: Although rare, clinically symptomatic myocardial bridge can present a treatment dilemma. Published data come from series with very small numbers of patients. An international database with prospective enrollment and follow-up is needed.

[1] Corban MT, Oy H, Eshtehardi, et al. Myocardial bridging: contemporary understanding of pathophysiology with implications for diagnostic and therapeutic strategies. *J Am Coll Cardiol.* 2014;63:2346–2355.

D94
Surgical Retrieval of an Embolized Ductus Arteriosus Occluder Device Without Cardiopulmonary Bypass via a Left Thoracotomy

Vijayant Devenraj, Sushil Kumar Singh, Vivek Tewarson, Sarvesh Kumar, Navneet Devenraj. *King George's Medical University, Lucknow, India.*

Objective: Our goal was the surgical removal of an embolized patent ductus arteriosus (PDA) duct occluder from a left pulmonary artery without cardiopulmonary bypass (CPB) and sternotomy via a left thoracotomy.
Patient: A 9-year-old girl was diagnosed with persistent PDA 7 mm in diameter on 2-dimensional echocardiography. She underwent the percutaneous transcatheter closure of the PDA with the Cocoon Duct Occluder (Vascular Innovations Co., Nonthaburi, Thailand) (Fig. D94-1). The device became dislodged immediately after being released across the PDA and embolized into the left pulmonary artery. Several attempts by interventional cardiologists to retrieve the embolized device failed. Cardiothoracic surgeons were called for help. A left posterolateral thoracotomy approach was planned for retrieval of the embolized device and closure of the PDA at the same time, hopefully without CPB and sternotomy.The patient underwent the successful emergency removal of the embolized duct occluder and triple ligation of the PDA without the need for CPB or sternotomy.
Conclusions: We present an innovative technique for removing an embolized PDA duct occluder in the left pulmonary artery via a left posterolateral thoracotomy, thus avoiding the adverse effects of CPB and sternotomy and at the same time facilitating surgical closure of PDA.

D95
Sutureless Aortic Valve: A Boon to Challenging Cases

Rajneesh Malhotra, Ratna Malika Kumar, Ashish Asija, Madhav Shinde, Sachin Chatterjee, Sanjoy Majhi, Rajesh Chand, Kewal Krishan. *Max Superspeciality Hospital, Saket, New Delhi, India.*

Objective: The prosthetic aortic valve has come a long way since a ball valve prosthesis was introduced in 1951. After more than 60 years, an ideal valve for all circumstances should have emerged. The surgeon chooses from a wide array of mechanical and tissue valves: The choice is usually based on patient-surgeon preferences, handling characteristics, availability, and cost. Yet in challenging situations, such as octogenarians, the morbidly obese, comorbid conditions, and combined procedures, there is little choice. Our goal was to discuss how the use of sutureless aortic valves using minimal-access surgery has opened up new vistas in this field.
Methods: We present 4 patients operated on at our center over a 4-month period, all of whom were surgically challenging. The first was a 65-year-old woman of foreign origin (height, 161 cm; weight, 122 kg) with a body mass index of 47.16 and a body surface area of 2.34 with severe aortic stenosis. Apart from being morbidly obese, she was also hypertensive and diabetic. The second case was a 79-year-old woman with severe aortic stenosis, a left ventricular ejection fraction of 30%, diabetes mellitus, coronary artery disease, and bronchial asthma for whom a combined procedure (coronary artery bypass grafting + aortic valve replacement) was mandated. She underwent coronary artery bypass grafting × 3 with sutureless aortic valve replacement. The third patient was a 57-year-old woman of foreign origin (height,161 cm; weight, 08 kg; body mass index, 41.5, body surface area, 2.19). The fourth patient was an 83-year-old man who had undergone coronary artery bypass grafting 9 years ago and now required aortic valve replacement and redo coronary artery bypass grafting.
Results: All patients did well in the postoperative period and were discharged home with an average stay of 7 days in the hospital. They all exhibited superior hemodynamic performance (narrow aortic root!). Reduced cross-clamp time and bypass time facilitated the broader application of minimally invasive approaches for aortic valve replacement.
Conclusions: Sutureless valves are safe, particularly in high-risk groups. They reduce cross-clamp time and bypass time. They also provide better hemodynamic results than conventional tissue valves. They also have better clinical outcomes in combined procedures because they reduce the total operating time.

D96
Totally 3-Dimensional Thoracoscopic Mitral Valvuloplasty

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Objective: Our goal was to summarize our clinical experience with 60 patients who underwent 3-dimensional video-assisted thoracoscopic mitral valvuloplasty.
Methods: Sixty patients were enrolled retrospectively from March 2014 to January 2016 in the Department of Cardiovascular Surgery, Guangdong

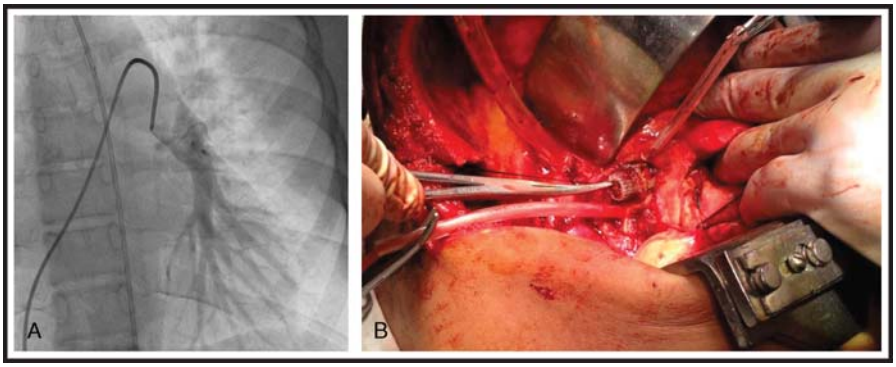

FIGURE D94-1. A, Pulmonary angiography showing the embolized Cocoon Duct Occluder in the left pulmonary artery. B, Operative view of the left pulmonary artery and removal of the Cocoon Duct Occluder via a thoracotomy.

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Cardiovascular Institute. They underwent 3-dimensional video-assisted thoracoscopic mitral valvuloplasty. There were 37 men and 23 women. The age range was 15 to 78 years (median age, 47 years). The mitral valvuloplasty techniques were chordae tendineae transplantation (53 patients), annuloplasty (58 patients), posterior leaflet resection (13 patients), anterior leaflet resection (2 patients), and commissure resection (1 patient). The data were obtained from the patients' charts. The follow-up time was 3 to 25 months by telephone or outpatient department interview. The data were analyzed via the paired *t* test or the Wilcoxon signed-rank test.

Results: Conversions to mitral valve replacement were performed for 2 patients. No patients underwent thoracotomy. The operation time was 213 ± 37 minutes; cardiopulmonary bypass time was (129 ± 31) minutes; aortic cross-clamp time was 81 ± 21 minutes. The postoperative hospital stay was (7 ± 3) days. During the follow-up period, there were no reoperations and no deaths. Mitral regurgitation level and the New York Heart Association class were both improved ($z = -6.286$, $P = 0.000$ and $z = -6.237$, $P = 0.000$), respectively. In addition, no patient had new atrial fibrillation.

Conclusions: Three-dimensional video-assisted thoracoscopic mitral valvuloplasty maintains the advantages of both 2-dimentsional thoracoscopy and median thoracotomy. This technique shows promising clinical value.

D97
Transcatheter Aortic Valve Implantation After the David and Yacoub Procedures With a Straight or Sinus Prosthesis: An In Vitro Investigation

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Objective: Transcatheter aortic valve implantation (TAVI) is an evolving treatment strategy for degenerated native and surgical aortic valve bioprostheses. It remains unclear if TAVI is feasible in patients who have had a previous valve-sparing operation (reimplantation technique, David procedure or remodeling technique, Yacoub procedure). Despite excellent hemodynamics in TAVI prostheses, there is some concern regarding fixation of the TAVI prosthesis in these patients and about coronary obstruction. Our goal was to determine differences in coronary flow after TAVI in noncalcified aortic valves after the David and the Yacoub procedures with a straight or sinus prosthesis in an in vitro investigation.

Methods: We constructed aortic root models with both the David and Yacoub procedures, performed with a straight or a sinus prosthesis, and inserted a CoreValve Evolut R (Medtronic, Inc.) or SAPIEN S3 (Edwards Lifesciences Corp.) TAVI prosthesis. Hemodynamic performance (transvalvular gradients and geometric orifice area) was measured before and after TAVI. Left and right coronary flow (LCF, RCF) were also examined

Results: The prostheses used in TAVI were not dislocated in any of the David experiments but they were dislocated in all of the Yacoub experiments. Therefore, we performed additional stabilization of the annulus either with a CV-2 Gore-Tex suture or a ring for annuloplasty in the Yacoub model. After implementation of these measures, fixation prosthesis used for the TAVI after the Yacoub procedure was possible. We found no significant reduction in coronary flow in any of the models, straight and sinus prostheses as well as the CoreValve Evolut R and the SAPIEN S3 (all *P* values nonsignificant). TAVI resulted in no significant increase of transvalvular gradients and a decrease of geometric orifice area.

Conclusions: In our in vitro model of the David and Yacoub procedures, TAVI with a balloon-expandable transcatheter heart valve (SAPIEN S3) and with a self-expanding transcatheter heart valve (CoreValve Evolut R) seem to be feasible procedures with very good hemodynamics and no risk of coronary obstruction. After the Yacoub procedure, additional measures for fixation of the TAVI prostheses in the annulus were necessary.

D98
Evaluation of the Safety of Minimally Invasive Mitral Valve Repair: Preoperative Assessment of the Shape of the Thorax

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Objective: Minimally invasive approaches to mitral valve surgery have prevailed recently but have potential pitfalls because of the limited

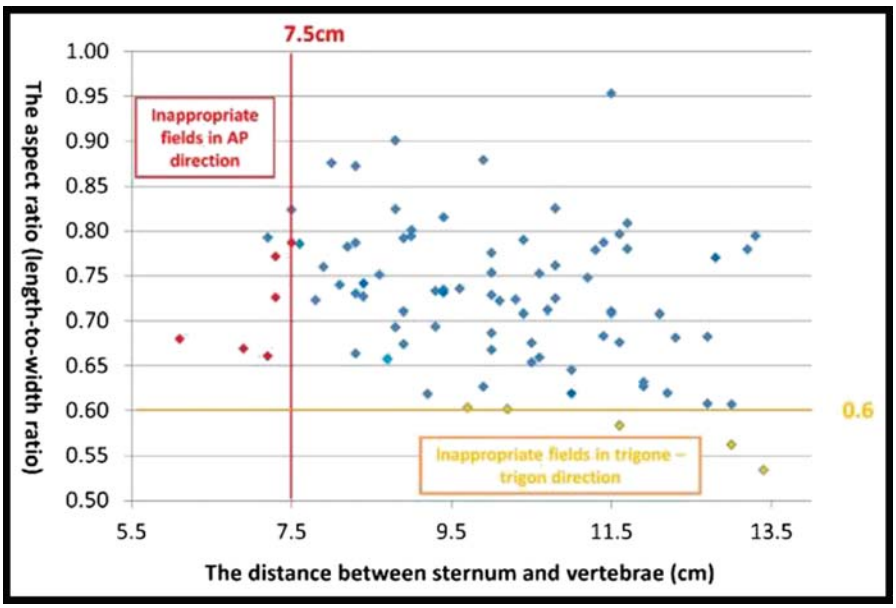

FIGURE D98-1. The distance between the sternum and vertebrae and the aspect ratio of the thorax.

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operative field. Clinical outcomes should not be compromised at the cost of a smaller incision. To ensure the patient's safety, access to a good operative field is mandatory, but unexpectedly poor operative fields are sometimes encountered. Our goal was to focus on the shape of the thorax and determine whether good operative fields were acquired.

Methods: Between 2011 and December 2016, 90 minimally invasive mitral valve procedures were performed. The distance between the sternum and the vertebrae and the aspect ratio of the thorax (length-to-width ratio) (ART) were evaluated preoperatively by enhanced computed tomography, and the difficulty of accessing the operative field was evaluated.

Results: No conversion to full sternotomy occurred. Mitral valve repairs were successfully done in all cases. The average distance between the sternum and the vertebrae was 10.0 ± 1.8 cm (in women, 8.7 ± 1.6; in men, 11.0 ± 1.4). The average aspect ratio of the thorax was 0.72 ± 0.08 (in women, 0.75 ± 0.08; in men, 0.71 ± 0.08). In 8 patients, the distance between the sternum and the vertebrae was less than 7.5 cm; 5 of 8 patients had poor operative fields in the anterior-to-posterior direction. In 5 cases, the aspect ratio of the thorax was less than 0.6, and all of these patients had poor operative fields in the trigone-to-trigone direction (Fig. D98-1).

Conclusions: The patients who had less than 7.5 cm distance between the sternum and the vertebrae, a so-called flat chest, and who had an aspect ratio of the thorax that was less than 0.6, a so-called barrel chest, tended to have poor operative fields. We concluded that a distance between the sternum and the vertebrae greater than 7.5 cm and an aspect ratio of the thorax greater than 0.6 were the thresholds for acquisition of good operative fields.

D99
The Impact of the Myocardial Protection Technique on the Incidence of Postoperative Coronary Bypass Atrial Fibrillation/Flutter

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Objective: Our goal was to determine whether any of the myocardial protection techniques influence the incidence of postoperative AF/flutter.

Methods: We performed a single-center retrospective study of 3614 patients who underwent an isolated on-pump coronary artery bypass grafting using different myocardial protection strategies. All patients who were in sinus rhythm preoperatively had the coronary artery bypass grafting procedure. Patients who had combined procedures or were in AF or paced rhythm were excluded. Patients were divided into 2 groups: group 1 had cardioplegia; group 2 had cross-clamping and fibrillation. Comparisons between groups were made using the χ^2 test or the Fisher exact test for categorical variables and the one-way ANOVA or Kruskal-Wallis test for quantitative variables. Univariate logistic regression analysis was performed to identify potential risk factors for postoperative AF/flutter. Potential confounding risk factors were then included in an adjusted multivariate logistic analysis

Results: We identified 3614 patients in the period between 2004 and 2015; 2805 were in group 1 and 809 were in group 2. A history of pulmonary disease and older age were significant potential predictors of postoperative AF ($P = 0.002$, OR = 1.40, 95% CI = 1.13–1.73 and $P < 0.001$, OR = 1.06, 95% CI = 1.05–1.07), respectively. On the contrary, cumulative cross-clamp time and cumulative bypass time were not significant predictors of postoperative AF ($P = 0.285$, $P = 0.470$). We performed a subgroup analysis in the cardioplegia group and found that the incidence of AF in the top ends when we used a side clamp was not significantly different from that with a single cross-clamp operation (OR = 1.05, 95% CI = 0.81–1.37, $P = 0.709$). Patients in group 2 (cross-clamp and fibrillation technique) had a higher incidence of postoperative AF that remained significantly high after adjusting for a history of pulmonary disease compared with group 1 (OR = 1.31, 95% CI = 1.02–1.68, $P = 0.032$). There was no significant age difference between the 2 groups. No significant differences were found in terms of the secondary outcomes of mortality rate and length of stay in the intensive care unit or in the hospital postoperatively.

Conclusions: The cross-clamp fibrillation technique is associated with a significantly higher incidence of AF. A history of pulmonary disease and age were strong predictors of postoperative AF.

D100
The Kiel Experience with the Transaortic Approach for Transcatheter Aortic Valve Implantation Procedures: An Update

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Objective: The field of transcatheter aortic valve implantation (TAVI) has undergone a rapid evolution in recent years. A number of valve prostheses, various devices, and different implantation techniques are available for routine clinical use. The transaortic approach has evolved as the standard surgical approach at our center since 2012. Our goal was to present our experiences with transaortic TAVI procedures using 2 different valve prostheses.

Methods: All TAVI cases were discussed in our interdisciplinary heart team meetings, and the patients were included in a prospective registry. Consecutive transaortic TAVI procedures using either the balloon-expandable SAPIEN 3 (S3; Edwards Lifesciences Corp.) or the self-expandable CoreValve Evolut R (ER; Medtronic, Inc.) were analyzed. Baseline demographics and periprocedural characteristics were documented. Follow-up evaluations included 7-day, 30-day, and annual visits. Transthoracic echocardiography was focused on valve performance, and TAVI results were categorized according to the current Valve Academic Research Consortium-2 criteria.

Results: A total of 149 patients between February 2014 and September 2016 had a transaortic TAVI procedure. The S3 valve was used in 75.2% (n = 112) and the ER, in 24.8% (n = 37) of cases. The mean age at the time of implantation was 81 ± 6 years; 61.7% (n = 92) were women. The preoperative EuroSCORE II was 7.68 ± 6.01 and the Society of Thoracic Surgeons score was 6.19 ± 4.42. The transaortic procedure was a redo cardiac operation in 20.8% (n = 31). The mean procedure duration was 110 ± 38 minutes. According to the Valve Academic Research Consortium-2 criteria, life-threatening bleeding occurred in 4.7% (n = 7) of cases. Conversion to open cardiac surgery was required in 1 case (0.7%). A cardiac tamponade occurred in 2.7% (n = 4). Stroke, including a transient ischemic attack, was diagnosed in 3.4% (n = 5). The 7-day transthoracic echocardiography scan showed no paravalvular leakage (PVL) in 77.1% (S3 83%; ER 58.1%) and only moderate PVL in 1.5% (S3 0%; ER 6.5%); there was no occurrence of severe PVL. A low rate of required permanent pacemaker implantation was noted (8.7%, n = 11). The 30-day mortality rate was tolerably low at 5.4% (n = 8).

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Conclusions: We have presented further results with the current TAVI devices using the transaortic approach. A low periprocedural complication rate occurred after the transaortic TAVI procedure.

D101
The Long-Term Results of Coronary Artery Bypass Grafting for Patients with Left Ventricular Dysfunction

Hiroshi Seki, Dai Une, Atsushi Kurata. *Yamato Seiwa Hospital, Yamato, Japan.*

Objective: The cornerstone of treatment for patients with reduced left ventricular function and ischemic cardiomyopathy is guideline-driven medical therapy for all patients and implantable device therapy for appropriately selected cases. The role of surgical revascularization in these highest-risk patients remains controversial due to the high perioperative risks and lack of proven benefits in the long term. Our goal was to assess the perioperative morbidity and mortality rates and the long-term results in this group of patients.
Methods: The records of patients who underwent an isolated coronary artery bypass grafting procedure at our institute between 2008 and 2012 were reviewed. All patients with preoperative left ventricle dysfunction and an ejection fraction (EF) less than 40%, including emergency and urgent cases, were included.
Results: The mean age was 69.0 ± 10.3 years and the majority (86.7%) were men. Thirty-three patients (36.7%) had a history of congestive heart failure. Twenty-three patients (25.6%) had a history of percutaneous coronary intervention. The preoperative ejection fraction was on average 31.6% ± 6.2%. Nine (10%) patients were in cardiogenic shock. In 56 cases (62.2%), surgery was performed off-pump. The mean number of distal anastomoses was 3.5 ± 1.5. There were 2 (2.2%) 30-day hospital deaths. Freedom from all-cause death was 89.7% and 80.4%, and freedom from major adverse cardiac events (cardiac death, revascularization, myocardial infarction) was 91.8% and 76.5% after 1 year and 5 years, respectively. The average follow-up time was 24.8 months (max 92.4 months).Left ventricular function was assessed with measurements obtained via transthoracic echocardiography. The average ejection fraction was 32.0% ± 6.3% preoperatively, and it improved in 67% cases. The ejection fraction measured at the last follow-up was on average 42.1% ±10.3%. In about half of the cases, the improvement in the ejection fraction was greater than 10%. This finding correlated with the use of beta-blockers (HR 3.3, $P = 0.01$) and off-pump cases (HR 2.8, $P = 0.03$).
Conclusions: Coronary artery bypass grafting can be performed safely in patients with left ventricular dysfunction with minimal postoperative morbidity and mortality. Postoperative optimal medical therapy and use of the off-pump technique may be beneficial for this high-risk group of patients.

D102
The Next Best Approach for Left Atrial Myxomas After Right Minithoracotomy: Video-Assisted Biatrial Inversion Exposure

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Objective: Right lateral thoracotomy with video assistance provides excellent exposure of the interatrial septum, the attachment site for 70% of left atrial myxomas. Most, however, are still approached from a full or abbreviated sternotomy due to tumor fragility. Alternatives to Sondergaard's groove atriotomy, including superior septal and biatrial approaches with a right transseptal incision, have been used for large tumors, but we recently performed a biatrial approach with video-assisted inversion to nearly replicate right minithoracotomy exposure.
Patient: This 69-year-old man presented with dyspnea during mild exertion, orthostasis, and incidental detection of a left atrial mass on contrast computed tomography obtained for prostate cancer treatment surveillance. Echocardiography demonstrated a solitary 4.1 × 3.2 cm mobile mass attached to the septum prolapsing across the mitral valve. Coronary angiography showed mild disease. The patient preferred sternotomy. At operation, using bicaval cannulation, a left atriotomy with handheld retraction exposed the mass but not its attachment. A 4 cm right atriotomy paralleling the crista teminalis was performed. Handheld retraction on the lip of the left atriotomy, and simultaneous pulsion with a Kittner dissector on the interatrial septum from the right inverted the septum (image sequence) and exposed the sessile attachment, with a 10 mm, 30° telescope providing illumination and circumferential exposure of the attachment point. Septal attachment resection proceeded entirely from the left atrial aspect without tumor contact or traction on the septal margin, with part of the resection defect being full-thickness (Fig. D102-1). The defect was closed with an autologous pericardium patch against the left atrial septum, confirming patch security from the right septal exposure and post bypass echocardiography. The patient awoke neurologically intact and was discharged home on day 8 after a course complicated only by supraventricular tachycardia.
Conclusions: Existing transsternal biatrial exposure techniques have not afforded the excellent single-chamber exposure of the septal myxoma

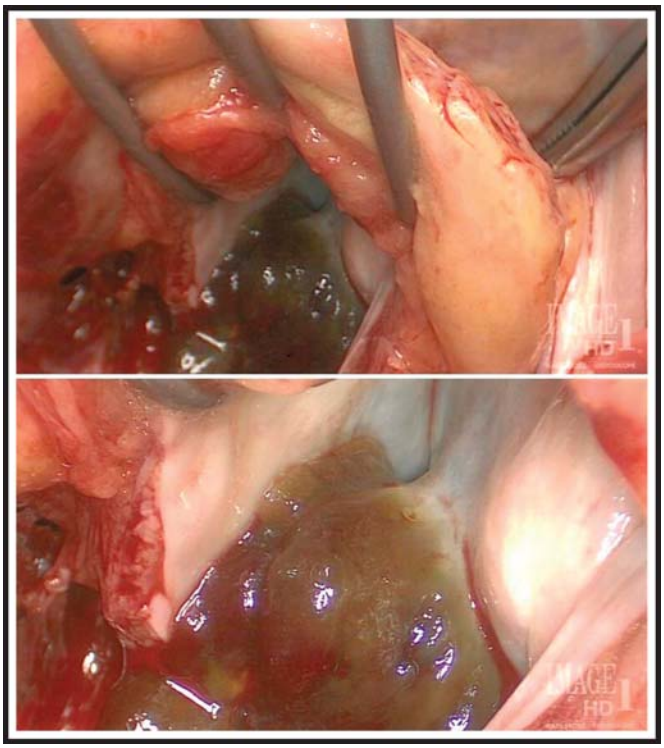

FIGURE D102-1. Pre-postinversion of left atrial myxoma septal attachment. Limited exposure (upper panel) of the myxoma attachment improved with video-assisted septal inversion using Kittner pulsion on the right atrial septum, achieving exposure (lower panel) that permitted resection entirely from the left atrial aspect, similar to right minithoracotomy.

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attachment provided by a right lateral thoracotomy. Our approach, using a parallel right atriotomy for targeted pulsion combined with video assistance, produces septal inversion and provides visualization comparable to that of a lateral thoracotomy for surgeons transitioning from sternotomy.

D103
Three Risk Scores for Mortality Prediction in Minimally Invasive Cardiac Surgery: Performance and Comparison

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Objective: Prediction of operative risk in adults undergoing minimally invasive cardiac operations remains a challenge. The EuroSCORE II and The Society of Thoracic Surgeons (STS) score are most commonly used in clinical settings but are not calibrated for minimally invasive cardiac operations. A simpler alternative risk scoring system is provided by the Age, Creatinine, and Ejection Fraction (ACEF) score.
Methods: We sought to test the discrimination power and calibration of the previously mentioned scores. We identified patients who underwent minimally invasive cardiac surgery from 2007 to 2016 from a prospective cardiac surgical database in a single institution. Additional variables were included if necessary for STS, EuroSCORE II, and ACEF score calculation.
Results: A total of 2747 patients were identified from the main database. There were 27 (1.4%) hospital deaths. The mean STS score predicted mortality rate was 1.2 ± 1.1%. The discriminatory power was uniformly good [for STS mortality: the area under the curve (AUC) was 0.87; the 95% CI was 0.81–0.93]. The mean EuroSCORE II-predicted mortality rate was 2.4 ± 3.4%. The discriminatory power was good but inferior to that of the STS score (for EuroSCORE II mortality: AUC was 0.84; 95% CI, 0.77–0.92). The mean ACEF predicted mortality rate was 2.4 ± 2.3%. The discriminatory power was good but inferior to that of the STS score and the EuroSCORE II (for ACEF mortality: AUC 0.72; 95% CI, 0.63–0.82). The STS score underestimated mortality ($P < 0.01$); the EuroSCORE II and ACEF scores overestimated mortality ($P < 0.01$ and $P < 0.01$, respectively; Fig. D103-1).
Conclusions: The STS score and the EuroSCORE II have good discriminatory powers for subsets of patients having minimally invasive cardiac operations. However, they are not calibrated for the same subset. The ACEF score, which is very simple to calculate, performs with decent discriminatory power but is not calibrated for the subset of patients having minimally invasive cardiac surgery. No algorithm seems well calibrated for accurate risk estimation.

D104
Tips for Use of a Novel Method for Easy Adjustment of Appropriate Artificial Chordae Length in Patients Undergoing Minimally Invasive Mitral Repair

Hiroyuki Nishi, Kimihiro Kurose, Kohei Horikawa, Go Kanazawa, Toshiki Takahashi. *Department of Cardiovascular Surgery, Osaka Police Hospital, Osaka, Japan.*

Objective: Our goal was to present our experience using the Memo 3D Rechord, a complete prosthetic ring associated with a temporary chordal guide system, which comprises yellow loops that function as a reference for automatically determining the height of the neochordae. A video presents some tips for the successful use of this novel system as part of a minimally invasive right thoracotomy approach.
Patient: A 44-year-old woman with severe mitral regurgitation (A2-3 prolapse) underwent mitral valve repair via a right thoracotomy approach. At first, after careful inspection, the center of the anterior leaflet was determined. Two polytetrafluoroethylene (PTFE) sutures were passed through the posterior papillary muscle and the free margin of the A2-3 leaflet. By performing the saline test, we confirmed the appropriate position of the PTFE chordae. After parachuting the annuloplasty ring, the PTFE chordae were passed through the loops, and the free margin of the A2-3 leaflet was brought to the posterior annulus. Then, the PTFE sutures were tied and the temporary loop system was removed, which provided appropriate chordal length.
Conclusions: Postoperative transesophageal echocardiography findings revealed trivial mitral valve regurgitation. There was no need to adjust the position of the artificial chordae. Our mitral valve repair using the Memo 3D Rechord with some tricks is a simple and reproducible technique suitable for treating leaflet prolapse.

D105
Total Arterial Multivessel Minimally Invasive Coronary Artery Bypass Grafting

Shinji Ogawa, Yasuhide Okawa, Koshi Sawada, Yoshihiro Goto, Soh Hosoba, Syunsuke Fukaya. *Toyohashi Heart Center, Toyohashi, Japan.*

Objective: Minimally invasive multivessel coronary artery bypass grafting (CABG) was introduced in our institute in May 2016. We reviewed the clinical outcomes of total arterial multivessel minimally invasive CABG through a left minithoracotomy.
Methods: Five patients underwent total arterial multivessel minimally invasive CABG at our institute from May 2016 to November 2016. Their mean age was 65.2 ± 9.1 years, and all of them were men. None of the procedures were converted to sternotomy.

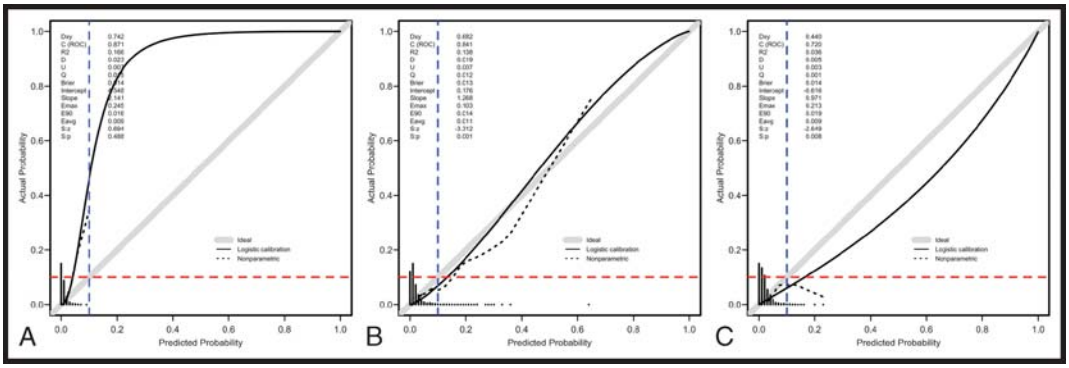

FIGURE D103-1. Three calibration plots for the scores: Left panel, Society of Thoracic Surgeons score; middle panel, EuroSCORE II; right panel, age, creatinine, and ejection fraction score.

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Results: There were no operative deaths, strokes, or surgical site infections during the hospital stay. All of the procedures were performed using the off-pump technique. The bilateral internal thoracic arteries and the right gastroepiploic artery were used as arterial grafts. The number of grafts in all of the procedures was 2. Only 1 right internal thoracic artery demonstrated a string sign on early postoperative angiography. The median number of days in the hospital was 7 (range 5–9 days).
Conclusions: Total arterial multivessel minimally invasive CABG with bilateral internal thoracic arteries and the right gastroepiploic artery can be safely performed using the off-pump technique and can provide favorable clinical and angiographic outcomes.

D106
Transareolar Video-Assisted Approach to an Atrial Septal Defect and Tricuspid Valve

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Objective: The goal of this study was to review the initial outcomes of atrial septal defect (ASD) closure and tricuspid annuloplasty (TAP) using a transareolar approach.
Methods: We performed a retrospective review of in-patient records. Five cases were identified from January to December 2016. Four were women; the mean age was 47 years (range 20–68 years). Four patients had ASD closure and TAP, and 1 had ASD closure. Three-dimensional computed tomography was used to determine the approach and the intercostal space to enter. With the patient under general anesthesia with double-lumen intubation, the right internal jugular vein was punctured for superior vena caval drainage, and the right femoral artery and vein were cannulated under transesophageal echocardiography guidance. Two-fifths of the perimeter of either the superior or inferior margin of the areola was incised according to the anatomy, and the chest was entered through a transareolar minithoracotomy. Cardiopulmonary bypass was established, and a videoscope was inserted through a port posterior to the wound. After pericardiotomy, the superior and inferior vena cavae were snagged, the right upper pulmonary vein was cannulated for a left atrial vent, and a needle was placed for antegrade cardioplegia with endoscopic assistance. The aorta was cross-clamped with transthoracic forceps followed by antegrade cardioplegia and right atriotomy. The atrial septal defect was closed using a 0.4 mm e-polytetrafluoroethylene patch under direct vision, and tricuspid annuloplasty using a rigid ring was performed with endoscopic assistance. A temporary pacing lead was placed on the diaphragmatic surface of the right ventricle and the aorta was declamped. Cardiopulmonary bypass was discontinued and, after confirming hemostasis, the chest was closed with an intercostal analgesic catheter.
Results: All operations were safely performed with endoscopic assistance. None of the patients needed a blood transfusion.
Conclusions: The transareolar approach is feasible and useful in ASD closure and TAP.

D107
Transcatheter Aortic Valve Replacement: Efficiency and Safety Improvements with Progressive Experience

Seyed Hossein Aalaei Andabili[1], R. David Anderson[2], Anthony Bavry[2], Teng C. Lee[1], Siddharth Wayangankar[2], Charles Klodell[1], Thomas Beaver[1]. *[1]Division of Thoracic and Cardiovascular Surgery, Gainesville, FL USA; and [2]Division of Cardiology, Department of Medicine, University of Florida, Gainesville, FL USA.*

Objective: Transcatheter aortic valve replacement (TAVR) has emerged as a treatment for high-risk patients with severe aortic stenosis (AS). In this study, we investigated changes in the safety and efficiency of the TAVR procedure and in-patient outcomes by comparing the first 100, the second 100, and the last 100 patients.
Methods: From March 2012 to June 2016, 600 patients underwent TAVR at our center. Three hundred patients were selected for this study and were categorized in 3 groups; group A: the first to the 100th patient; group B: the 101st–200th patient, and group C: the 501st–600th patient.
Results: A total of 300 patients with a mean age of 79.10 ± 8.93 years were included. Fluoroscopy time and dose were significantly lower in group B than in group A: 12.19 ± 6.39 minutes versus 18.6 ± 10.59 minutes ($P < 0.001$) and 568.27 ± 425.68 mGy versus 2082.42 ± 1943.61 mGy ($P < 0.001$), respectively. The mean contrast volume was 106.06 ± 47.61 ml in group A and 76.50 ± 27.39 ml in group B ($P < 0.001$). The fluoroscopy dose and the contrast volume were

TABLE D107-1. Comparison of Preoperative and Postoperative Characteristics

Variable	Group A	Group B	*P* Value (A vs. B)	Group C	*P* Value (B vs. C)
Male, n (%)	50 (50)	54 (54)	0.67	58 (58)	0.66
Age, year, mean ± SD	80.64 ± 8.13	78.78 ± 8.12	0.10	77.85 ± 10.25	0.48
Diabetes, n (%)	31 (31)	37 (37)	0.45	36 (36)	1.0
Peripheral artery disease, n (%)	14 (14)	21 (21)	0.26	29 (29)	0.25
Hypertension, n (%)	71 (71)	88 (88)	0.005	91 (91)	0.64
Heart failure, n (%)	35 (35)	59 (59)	0.001	25 (25)	<0.001
Preoperative aortic valve gradient, mmHg, mean ± SD	46.53 ± 18.6	42.72 ± 17.17	0.14	38.98 ± 14.24	0.103
Preoperative aortic valve area, cm^2, mean ± SD	0.61 ± 0.28	0.70 ± 0.20	0.02	0.66 ± 0.26	0.301
Ejection fraction, %, mean ± SD	51.43 ± 15.75	52.36 ± 14.05	0.66	50.12 ± 14.62	0.271
Creatinine, mg/dl, mean ± SD	1.18 ± 1.07	1.28 ± 1.11	0.51	1.30 ± 1.01	0.87
Operation time (minutes), mean ± SD	156.84 ± 54.30	136.61 ± 32.13	<0.001	106.81 ± 35.10	<0.001
Incision time (minutes), mean ± SD	122.58 ± 52.93	98.90 ± 28.26	<0.001	54.89 ± 23.78	<0.001
Length of ICU admission (hours), mean ± SD	94.46 ± 88.53	93.58 ± 110.18	0.95	56.14 ± 81.80	0.007
Length of hospital stay (day), mean ± SD	7.92 ± 6.25	6.72 ± 4.94	0.14	2.57 ± 2.49	<0.001
Postoperative acute kidney injury, n (%)	26 (26)	23 (23)	0.74	1 (1)	<0.001
Postoperative stroke/ TIA, n (%)	5 (5)	2 (2)	0.44	0 (0)	0.49
ICU readmission, n (%)	2 (2)	4 (4)	0.68	0 (0)	0.12
Re-intubation, n (%)	6 (6)	7 (7)	0.78	0 (0)	0.014
In-hospital death, n (%)	5 (5%)	4 (4%)	1.0	1 (1)	0.36

ICU, intensive care unit; SD, standard deviation; TIA, transient ischemic attack.

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significantly lower in group C than in group B (285.4 ± 276.20 mGy vs. 568.27 ± 425.68 mGy, $P < 0.001$ and 56.85 ± 37.72 ml vs. 76.50 ± 27.39 ml, $P < 0.001$, respectively). Operation and incision times were also significantly lower in group B than in group A: 136.61 ± 32.13 versus 156.84 ± 54.30, $P < 0.001$ and 98.90 ± 28.26 versus 122.58 ± 52.93, $P < 0.001$. The operation and incision times were even lower in group C than in group B: 106.81 ± 35.10 versus 136.61 ± 32.13 and 54.89 ± 23.87 versus 98.90 ± 28.26 (both P values < 0.001). The acute kidney injury rate was 26% (n = 26) in group A versus 23% (n = 23) in group B ($P = 0.743$) and 1% (n = 1) in group C ($P < 0.001$). Five (5%) strokes were detected in group A and 2 (2%) strokes, in group B ($P = 0.44$), but no patient in group C had a stroke ($P = 0.059$). The in-hospital mortality rate was 5% (n = 5) in group A, 4% (n = 4) in group B, and 1% (n = 1) in group C ($P = 0.21$) (Table D107-1).
Conclusions: Increased experience with TAVR procedures increases the operators' expertise, making TAVR both more efficient and perhaps safer. The improving trend in patient outcomes would likely be significant if one compared a larger group of patients over a longer period.

D108
Treatment of Pure Aortic Regurgitation Using a Novel Transcatheter Aortic Valve Implantation System

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Objective: Experience with transcatheter aortic valve implantation (TAVI) for pure aortic regurgitation (AR) is limited due to the risk of insufficient anchoring of the valve stent within the noncalcified aortic annulus. The aim of this study was to investigate the safety and feasibility of using a novel transcatheter aortic valve implantation system (J-Valve system) in the treatment of patients with pure AR.
Methods: Transapical TAVI with the J-Valve system was performed in 43 patients with pure AR with a mean age of 74.3 ± 5.6 years. All patients were considered high risk for open-heart surgery with a mean logistic EuroSCORE of 25.2 ± 5.4%. Clinical and echocardiographic evaluations were performed at baseline, postprocedure, and at follow-up. Procedural success and complications were reported according to Valve Academic Research Consortium-2 definitions.
Results: Implantation was successful in 41 of 43 cases (success rate 95%).The all-cause mortality rate was 2.3% (1/43) at 1 month and 4.7% (2/43) at the 1-year follow-up. Two patients were converted to surgical valve replacement due to moderate paravalvular AR after valve implantation and valve embolism into the aortic arch. Pacemaker implantation for new onset conduction disorders was necessary in 3 patients [6.9% (3/43)]. Major access complication was noted in 1 patient [2.3% (1/43)] and 1 patient [2.3% (1/43)] had a major cerebrovascular event during the follow-up period. No patient had moderate or severe paravalvular AR. At the 1-year follow-up, paravalvular AR was none/trace in 28 of 39 (71.8%) and mild in 11 of 39 patients (28.2%). The mean transvalvular gradient was favorable after valve implantation with a mean pressure gradient of 10.2 ± 3.5 mmHg at the 1-year follow-up.
Conclusions: Pure AR remains a challenging disease for TAVI. The J-Valve system demonstrated feasibility, safety, and effectiveness in the treatment of patients with pure AR.

D109
Ultrafast-Track Minimally Invasive Aortic Valve Replacement: A Paradigm Shift to a Real Minimally Invasive Approach

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Objective: Our goal was to present our multidisciplinary minimally invasive program to treat patients who require aortic valve replacement (AVR).
Methods: Our approach involved (1) a smaller chest incision to decrease the "invasiveness" of the surgical procedure and to improve the clinical and cosmetic outcomes; (2) rapid deployment of aortic valve replacement (RD-AVR), to reduce operative times, to facilitate the minimally invasive approach, and to improve hemodynamic outcomes; (3) a minimally invasive extracorporeal circulation system, to improve circulatory support, provide end-organ protection, and promote fast-track anesthesia and (4) ultrafast-track anesthesia, to assure better comfort and outcomes for patients and to promote early recovery.
Results: RD-AVR was performed through a J-ministernotomy at the fourth intercostal space. Cross-clamp time and cardiopulmonary bypass times were 31 and 42 minutes, respectively. The patient was extubated in the operating room. Total blood loss was 90 cc, and no transfusions were required. Mobilization therapy and oral feeding were started 14 hours after the intervention. The patient was uneventfully discharged on postoperative day 5.
Conclusions: We advocate that this multidisciplinary minimally invasive approach may be associated with superior patient outcomes, faster recovery, and increased comfort compared to conventional AVR.

D110
Upper Hemisternotomy with Bilateral Transverse Split for Minimally Invasive Cardiac Surgery: Atrial Septal Defect Repair

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Objective: The standard paradigm of completing cardiac operations through a median sternotomy has been modified in recent years by the upsurge of minimally invasive techniques that allow surgeons to safely perform cardiac operations with better cosmetic results and the potential benefits of faster postoperative recovery and faster return to baseline functional activity. An upper hemisternotomy with a right-sided split is the most popular minimally invasive approach for minimally invasive aortic valve replacement. This method has also been used anecdotally for replacement of the ascending aorta and aortic root operations. Its main limitation is the compromised exposure compared to the standard full sternotomy, with the downside that operations other than aortic valve replacement can become more challenging and less safe.
Methods: We used a simple modification of the standard upper hemisternotomy incision, adding a transverse split to the left side of the sternal incision, completing a "reverse T" partial upper sternotomy. With this modification, we improved significantly the exposure compared to the traditional upper hemisternotomy, which allowed us to safely perform more challenging procedures.
Results: We applied this technique initially to minimally invasive aortic valve replacement procedures in patients with a body mass index above 30. Subsequently, we were able to safely perform operations of root and ascending aortic replacement, correction of anomalous coronary arteries, and tricuspid valve repair or replacement. A video shows the pericardial patch repair of a secundum type atrial septal defect to illustrate the versatility of this approach. The closure of the reverse-T upper hemisternotomy is completed using stainless steel sternal wires in a

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modified double-looped technique as demonstrated in the video. We did not encounter any intraoperative or postoperative complications with this approach, and the results were perfectly comparable to those of our traditional upper hemisternotomy aortic valve replacements.
Conclusions: We believe that this simple modification can increase the safety of operations performed through an upper hemisternotomy and expand the applicability of this approach to cardiac surgery procedures.

D111
Vacuum-Assisted Closure in the Management of Wound Dehiscence After Cardiac Surgery

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Objective: Although the incidence of surgical wound dehiscence after cardiac surgery is an uncommon complication, it is considered a major complication if it is deep and infected. Sternal wound dehiscence is the most common complication. It influences perioperative morbidity and mortality. We sought to evaluate the results of the recent introduction of vacuum-assisted closure (VAC) in the management plan compared with those of previous conventional treatments.
Methods: We collected data retrospectively for 2 groups of consecutive patients with wound dehiscence after cardiac surgery from January 2008 to June 2016. Group 1, the VAC group, comprised 50 patients, and group 2, the conventional therapy group, comprised 25 patients. We evaluated preoperative risk factors, degree of wound infection, incidence of mortality, mediastinitis, sepsis, and hospital course.
Results: The major preoperative comorbidities were comparable in both groups. There were statistically significant better results in group 1. The mortality rate was 0 vs. 3 (12%; $P < 0.05$). The incidence of mediastinitis was 1 (2%) vs. 6 (24%; $P < 0.01$); sepsis, 0 vs. 4 (16%; $P < 0.05$); surgical sternal revision 1 (2%) vs. 16 (64%; $P < 0.000$); surgical superficial revision, 7 (14%) vs. 9 (36%; $P = 0.21$); delayed infection, 1 (2%) vs. 6 (24%; $P < 0.01$), and referral to a plastic surgeon for muscle flaps, 0 vs. 6 (24%; $P < 0.001$). There was a statistically significant difference regarding the length of stay in the intensive care unit and in the hospital in group 1 (5 ± 6 vs. 8 ± 11 days; $P < 0.05$) and group 2 (32 ± 25 vs. 43 ± 36 days; $P < 0.05$). The combination of the VAC and the titanium plates significantly decreased the need for sternal revision and gave the best outcome. The use of VAC extended beyond the sternal wound dehiscence to other surgical sites. We recorded good outcomes in 2 cases of lower limb post-fasciotomy (due to pos-tcardiac surgery compartmental syndrome) and 2 other deep pocket infections (with insertion of a permanent pacemaker and a left ventricular assistant device).
Conclusions: The use of VAC is essential in the management of all types of post-cardiac surgery wound dehiscence. VAC seems to open the door to less invasive management of these cases essentially amenable for sternal revision and its associated risk. It is considerably effective in decreasing mortality and morbidity and has a better hospital course.

D113
Valve-in-Valve Replacements for Degenerated Xenografts and Homografts with Regurgitation

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Objective: Valve-in-valve (VIV) replacement is an alternative to redo open heart surgery in patients with degenerated bioprostheses. Regurgitant xenografts and homografts present special challenges regarding the selection and sizing of the transcatheter valve (THV) because the surgical bioprostheses tend to dilate. The lack of calcium landmarks as well as the disappearance of the contrast medium may result in a demanding implantation process.
Methods: Sizing was done by computed tomography reconstruction. All procedures but one were performed using a transapical approach. Fast pacing was done to retain the contrast in the aortic root. One procedure was an emergency case; hence no CT scan was available.
Results: Seven patients (3 men, mean age 56 years [27–87 years]) were treated from 2012 to 2016 at a mean of 10.1 years (6–14 years) after the first operation. The ratio of homografts to xenografts was 4:3, all with aortic regurgitation and a mean given size of 25.3 mm. The transcatheter valves used were 1 self-expandable, 2 self-expandable with control arms, 1 self-expandable with stabilization arches, and 3 balloon-expandable (Table D113-1). They had a mean size of 26.5 mm. The implantation success was 86%. Two patients had a second catheter valve implanted. There were no periprocedural deaths, cerebral strokes, coronary obstructions, or new pacemaker implantations. The mean observation time was 20 months (1–40 months); there were no early deaths; total survival was 83%. One patient had more than a trace paravalvular leak. The mean gradient was 14 mmHg; at the latest follow-up examination, it was 23 mmHg.
Conclusions: The balloon expandable valve provided good hemodynamic results but was difficult to place; a second valve implantation was needed in 2 patients. The self-expandable valve with control arms was easy to deploy but subsequently demonstrated high gradients (withdrawn from market). The self-expandable valve with stabilization arches was easy to deploy but has shown good hemodynamics. We had no access to the Conformité Européene-approved self-expandable valve with feelers at the beginning of our transcatheter valve program. Repositionable and resheathable transcatheter valves with tactile feedback may be preferred in the valve-in-valve procedure for xenografts and homografts, though the current lack of larger sizes is a limitation. Computed tomography reconstruction for annulus sizing is mandatory.

TABLE D113-1. Summary of Procedures

Patient	Age	Date	Value	Size, mm	Time*	THV	Size, mm	Perioperative Gradient	PVL	FU Gradient
1	87	13.06.12	XG	23	14	SE	26	9	0	5
2	27	19.12.13	HG	25	6	SECA	26	28	0	52
3	33	19.03.14	HG	23	11	SECA	23	15	0	42
4	68	09.06.15	XG	29	10	BE	29**	4	0	14
5	68	24.08.15	XG	25	12	BE	26	16	0	9
6	43	30.05.15	HG	23	8	SEA	M	Na	0	15
7	68	18.08.16	XG	29	10	BE	29***	10	1.5	Na

*Time since operation.
**Two valves implanted, same procedure.
***Two valves implanted, the second 2 months later.
FU, follow-up; HG, homograft; SE, self-expandable valve; SEA, self-expandable with stabilization arches; SECA, self-expandable with control arms; THV, transcatheter heart valve; XG, xenograft.

D114
Valve-Sparing, Sternum-Sparing, Robotic-Assisted Resection of Aortic Valve Fibroelastoma

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Objective: When feasible, valve-preserving resection of an aortic fibroelastoma is the ideal therapeutic approach. Traditionally, full median

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sternotomy has been the most common surgical approach. Here we report a series of 3 patients who underwent valve-sparing, sternum-sparing, robotic-assisted resection of an aortic valve fibroelastoma.
Methods: A retrospective chart review of the 3 patients was performed. Perioperative variables and outcomes were collected.
Results: Three patients (2 women and 1 man) had an incidental mass on the noncoronary aortic valve leaflets consistent with fibroelastoma. Patient 1 (42-year-old woman) had no prior cardiac comorbidities. Patient 2 (69-year-old woman) had 2 prior cardiac surgical procedures (for atrial fibrillation ablation and mitral valve repair, respectively). She underwent concomitant dissection of significant cardiac and right lung adhesions. Patient 3 (79-year-old man) underwent concomitant atrial fibrillation ablation at the time of the operation. Three robotic ports were placed in the first, second, and fourth intercostal spaces, and a 3 cm nonrib-spreading working port was placed in the second intercostal space lateral to the camera port. Femorofemoral cannulation for cardiopulmonary bypass was used. A Chitwood aortic clamp was applied for cardiac arrest, and antegrade Del Nido cardioplegia solution was given via a catheter placed through the working port. The mass was excised using sharp dissection and low electrocautery. The largest diameter of each of the masses measured 9, 8, and 5 millimeters, respectively. The surgical time was 240 minutes, and the mean cardiopulmonary bypass time was 122 minutes. The transesophageal echocardiogram confirmed complete resection and no aortic insufficiency. There were no postoperative complications. All patients stayed in the intensive care unit for 1 night and were discharged home on postoperative day 3 or 4.
Conclusions: Valve-sparing, sternum-sparing, robotic-assisted excision of an aortic fibroelastoma is feasible. In comparison to a complete or partial transsternal approach, the preliminary results of this series suggest equivalent operative success with shorter lengths of stay. This approach may have implications for robotic-assisted aortic valve replacement with sutureless valves.

D115
Video-Assisted Nodal Dissection: How to Avoid Damage to the Recurrent Laryngeal Nerves

Khalid Amer. *Southampton General Hospital, Southampton, United Kingdom.*

Objective: Complete nodal dissection as part of mediastinal nodal staging in lung surgery has been historically hampered by the technical inability to harvest stations 4L and 2L. The main impediment is the devastating complication of loss of voice due to recurrent laryngeal nerve (RLN) damage. No wonder the majority of node-dissecting thoracic surgeons deliberately avoid this group: The price of complications is high. A video clip describes the detailed anatomy of the course of this nerve through the right and left chest, with emphasis on what is safe and what is not during nodal dissection.
Methods: Video-assisted mediastinal adenopathy is described in minute details. The emphasis is on describing the course of the left recurrent laryngeal nerve and showing the areas of danger where it can be damaged during nodal dissection. The right RLN is briefly demonstrated in relation to harvesting stations 2-4R and 3p.
Results: There was no damage to the RLN after resorting to a flexible bipolar energy device to harvest nodes around the right and left RLN. By improving exposure of the RLN and being armed with knowledge of the detailed anatomy, it was possible to describe a safe way to harvest the nodes in stations 2-4R, 3p, 4L, and 2L
Conclusions: Absolute mastery of the anatomy of the RLN is mandatory to avoid damaging it. Despite its complex interaction with station 4L nodes, it is always possible to harvest this group with consistently good results. Finally, complete adenectomy is a practical tool in the hands of thoracic surgeons who believe in its worth.

D116
Video-Assisted Plication of the Diaphragm: A Triportal Procedure of Convenience

Khalid Amer. *Southampton General Hospital, Southampton, United Kingdom.*

Objective: Patients with symptomatic diaphragm paralysis are being denied a simple, safe minimally invasive procedure that can transform their lives. Our goal was to describe our technique of triportal video-assisted plication of the diaphragm, in single and simultaneous bilateral procedures.
Methods: We show in detail the practical steps of how to perform a video-assisted diaphragmatic plication and review the caveats and alternatives.
Results: Video-assisted plication of the diaphragm in selected cases is safe and feasible. The hospital stay is usually short (1–2 days), but severely symptomatic patients might require prophylactic admission to the intensive care unit.
Conclusions: Even in severely symptomatic patients with minimal lung capacity reserve, paralysis of the diaphragm could be improved by video-assisted plication. Subjective results are impressive and sometimes life changing.

D117
What if Valve Disease Plus Mobile Atheroma Occurs in the Aortic Arch? Modified Isolation Selective Cerebral Perfusion Technique

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Objective: A mobile atheroma in the proximal aorta is a risk factor for a stroke after cardiopulmonary bypass (CPB). CPB perfusion through a diseased aorta or axillary artery may cause atheromatous emboli. The isolation selective cerebral perfusion (ISCP) technique was described for replacing the ascending aorta and the aortic arch with mobile atheroma to prevent aortogenic brain embolisms. Our goal was to report the use of the ISCP technique for a patient with infective endocarditis plus mobile atheroma in the aortic arch.
Patient: A 77-year-old man was referred to our hospital because of persistent high fevers. A transthoracic echocardiogram revealed vegetations on both the aortic and mitral valves. An enhanced computed tomography scan showed thick atheromatous plaque in the aortic arch, which might be mobile. To avoid a stroke during valve surgery on CPB, we decided to adopt the modified ISCP technique. Replacing the diseased aortic arch was not an option to minimize the use of a prosthesis in this infectious case. The arch vessels were dissected through a median sternotomy, and both axillary arteries were encircled simultaneously. An epiaortic echogram showed thick mobile atheroma in the aortic arch. After systemic treatment with heparin, the FEM-FLEX II cannulas were inserted in both axillary arteries (20F to the right, 12F to the left, respectively), and the 3.4 mm JMS cannula (JMS Singapore Pte Ltd, Singapore) was inserted into the left carotid artery. Then we started CPB perfusion (the flow rate: 1.5 L/minute from the right axilla cannula, 1.5 L/minute from the left axilla and left carotid cannula, respectively); we cooled the core to obtain a bladder temperature of 28°C. The aortic cross-clamp was placed on the nondiseased portion of the ascending aorta; both the aortic and mitral valves were replaced with Edwards Lifesciences Corp. bioprostheses.

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Results: Postoperative computed tomography scans showed no stroke and no atheroembolism in the abdominal organs and lower extremities. After 6 weeks of antibiotic treatment, the patient was discharged (Fig. D117-1).
Conclusions: This modified ISCP technique is feasible for patients with valve disease plus mobile atheroma in the ascending and transverse aorta.

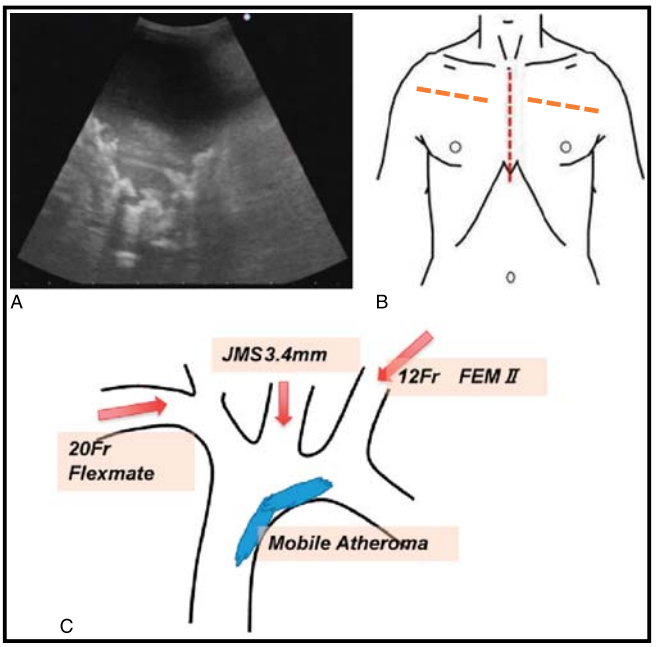

FIGURE D117-1. A, Epiaortic echocardiogram: mobile atheroma in the arch; B, Modified isolation selective perfusion technique; C, Modified isolation selective cerebral perfusion technique.

D118
When Asthma Is Not Asthma: A Tracheal Schwannoma Masquerading as a Small Airway Obstruction

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Objective: Primary tracheal tumors are rare entities and tracheal schwannomas even more uncommon. The latter can grow slowly and have minimal symptoms until nearly the entire airway is obstructed. The management of primary tracheal tumors may often require surgical resection or rigid bronchoscopy, which have their own risks. Our goal was to present the management of a 90% obstructing tracheal schwannoma via a minimally invasive approach using a bronchoscope passed through a laryngeal mask airway (LMA) with the assistance of a CO_2 laser and wire loop.
Patient: The patient was put under general anesthesia and ventilated with an LMA. Upon inspection with the flexible bronchoscope, the mass appeared to be a heterogeneously lobulated soft tissue mass occluding nearly the entire lumen and oscillating on a pedicle. We first utilized a CO_2 laser to free the mass from the wall and achieve hemostasis. We then placed the patient in the Trendelenburg position and captured the mass with a wire loop, which was removed simultaneously with the LMA due to its size. A 3.7 cm × 1.9 cm × 1.6 cm mass was removed from the tracheal lumen. Pathological examination showed the mass to be composed of spindle cells consistent with the diagnosis of schwannoma. The patient tolerated the procedure well and was discharged home from the recovery room the day of the operation.
Conclusions: This patient presented late with a tracheal mass occluding more than 90% of his airway; he had attributed his symptoms to asthma for years. Management of large, nearly occlusive tracheal masses can be challenging with regard to the best approach and depends on the size, location, and character of the mass. When a benign mass is suspected or proven in a location accessible via bronchoscopy, we prefer to start with a flexible bronchoscope to assess the mass. Preoperative computed tomography is invaluable in delineating macroscopic detail and defining nearby structures. In this case, the patient's tumor was pedunculated from the lateral tracheal wall and occluded >90% of the airway. The mass was freed from its tracheal attachment with a flexible bronchoscope using a CO_2 laser before being withdrawn from the airway with a loop wire.

D119
Modified Occluders Can Decrease the Incidence of Complete Atrioventricular Block in a Device Closing a Perimembranous Ventricular Septal Defect

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Objective: Perimembranous ventricular septal defect (pmVSD) is the most common congenital heart defect. Although effective, transcatheter closure of a pmVSD using an Amplatzer occluder has been associated with a substantial risk of complete atrioventricular block (cAVB), prompting many centers to abandon this intervention. However, percutaneous or periventricular closing of a pmVSD using a modified occluder has widely been applied with promising results in China. The purpose of this study was to describe the characteristics of Amplatzer and modified pmVSD occluders in shape and structure, to clarify the potential reason for the cAVB.
Methods: All published studies about pmVSDs closed with devices were identified and analyzed. Amplatzer and modified pmVSD occluders were collected and compared. We designed and used a new concentric occluder to close most pmVSDs.
Results: From the data published, we calculated the incidence of cAVB to be 3.8% and 0.15% in the Amplatzer and Chinese modified occluder groups, respectively. The modified occluder has 2 remarkable changes. First, the dimension of the waist of the modified occluder was enlarged from 3 mm to 7 mm with 1 mm increments. In contrast, the Amplatzer occluder has only 1 waist specification of 1.5 mm. From the viewpoint of the cardiac surgeon, properly increasing the waist of the occluder, corresponding to the thickness of the intraventricular septum, will alleviate entrapment of the adjacent intraventricular septum and then theoretically minimize the cAVB. Secondly, the concentric occluder is more stable in vivo and easier to deploy than eccentric ones.
Conclusions: The structure of the occluder is important in the successful treatment of severe AVB. The Chinese modification may be an important reference for further redesigning new pmVSD occluders.

D120
No 30-Day and In-Hospital Deaths in Consecutive Isolated Cardiac Valve Operations: The Continuing Lifetime Quest of Single Cardiac Surgeon

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Objective: In the last 2 decades, minimally invasive valve surgery (MIVS) has advanced while providing improved quality, safety, and patient satisfaction. However, the exact outcomes and safety of a full sternotomy have not been recently revisited. The goals of our study were (1) to compare the lifetime experience of a single surgeon's perioperative outcomes and 30-day and in-hospital survival rates in patients undergoing full sternotomy or MIVS for isolated valve surgery and (2) to establish a new benchmark when expanding indications for transcatheter aortic valve replacement (TAVR) to the low surgical risk population.
Methods: A total of 261 consecutive isolated aortic and mitral valve operations were performed by a single surgeon at our institution from November 2004 to October 2016. Of those, 34 interventions were MIVS (lower partial sternotomy: 25 aortic valves and 9 mitral valves). A lower partial sternotomy was chosen because identical surgical techniques including cannulation through 1 incision can be achieved, and exactly the same steps were taken with the full sternotomy and the MIVS.
Results: Preoperative comorbidities were similar in the 2 groups except for a lower incidence of diabetes in the MIVS group (18% vs. 37%, $P = 0.03$). Operating room time (hours) was shorter in the MIVS group (5 ± 1 vs. 6 ± 2), although the difference did not reach statistical significance ($P = 0.077$). Patients undergoing MIVS had significantly shorter intubation times and hospital stays (Table D120-1). Although the number in the MIVS group was small, there were no postoperative complications such as bleeding, infections, renal failure, and stroke (Table D120-1). Most notably, there were no 30-day and in-hospital deaths in either group in this lifetime consecutive series of a single surgeon.
Conclusions: There were no 30-day or in-hospital deaths in this series of isolated aortic and mitral valve surgeries with conventional full sternotomy or MIVS. These results demonstrate that a low-volume surgeon can achieve excellent outcomes. In carefully selected patients, MIVS improves the quality and the outcomes. Extremely low complication and mortality rates are needed when expanding the indications for TAVR to the low surgical risk population.

TABLE D120-1. Demographics and Outcomes

	Full Sternotomy (n = 227)	MIVS (n = 34)	*P* Value
Body mass index	29 ± 6	28 ± 7	0.893
Intubation time (h)	23 ± 22	12 ± 6	<0.001
Prolonged ventilation (>24 h)	23 (10%)	1 (3%)	0.186
Median ICU stay (h)	41 (24, 70)	41 (39, 43)	0.830
Hospital stay (d)	9 ± 6	6 ± 3	<0.001
Reoperation for bleeding	5 (2%)	0	0.597
Wound Infection	2 (<1%)	0	0.556
30-Day readmission	21 (9%)	2 (6%)	0.557
30-Day deaths	0	0	1.000

ICU, intensive care unit; MIVS, minimally invasive valve surgery.

D121
Completion Middle Lobectomy with Videothoracoscopy

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Objective: Completion lobectomy is a complex procedure performed mostly in patients with tumor recurrence or after the presence of complications like lobar torsion or bronchopleural fistula. This operation is generally done via an open technique. Our goal was to present a case of completion middle lobectomy via videothoracoscopy (VATS) after an upper lobectomy with thoracotomy.
Patient: A 50-year-old man was admitted with hemoptysis. Computed tomography (CT) of the thorax showed an 8×7 cm mass in the right upper lobe. Fiber-optic bronchoscopy revealed that the posterior ostium of the right upper lobe was obstructed with a mass; the results of the biopsy revealed an adenocarcinoma. The maximum standard uptake value (SUVmax) in positron emission tomography was 43.5. The patient underwent right upper lobectomy by thoracotomy. Lobar torsion was suspected after viewing the results from a postoperative chest radiograph, a CT scan, and a rigid bronchoscopic examination. Completion middle lobectomy was performed on postoperative day 2 using VATS. The patient was discharged on postoperative day 4 after the second operation (shown in a video).
Conclusions: Reoperations in thoracic surgery such as completion lobectomies are difficult procedures for patients because these operations usually result in more complications. Also, they are technically challenging procedures for the thoracic surgeons. Performing these operations via open techniques is more burdensome for the patient. Minimally invasive surgery is generally accepted in the literature as beneficial in terms of pain, cosmetics, and hospital discharge time. Therefore, we believe that all operations must be tried or even forced to be completed with minimally invasive techniques if possible.

D122
Tracheoinnominate Artery Fistula Following Percutaneous Tracheostomy

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Objective: Our goal was to identify a tracheoinnominate artery fistula as a complication in a patient post-tracheostomy.
Patient: A 58-year-old woman with known cirrhosis from chronic hepatitis C virus infection and a history of hepatocellular carcinoma treated with transarterial chemoembolization presented with hematemesis and hypotension. She underwent esophageal variceal banding. Her hospital course was further complicated by acute kidney injury, hepatorenal syndrome, and ventilator-dependent respiratory failure. We elected to perform a bedside percutaneous tracheostomy to help wean her from mechanical ventilation and to better manage her lung secretions. A size 8 Shiley tracheostomy tube was inserted using the Seldinger technique without any complications. Fiber-optic bronchoscopy after the procedure showed a clear airway and no bleeding. Three weeks later, after gradually being weaned from the mechanical ventilator, she developed torrential bleeding around the tracheostomy site. The bleeding was controlled with a finger; she was reintubated with an endotracheal tube and the balloon was placed distally. The patient was taken emergently to the operating room. A median sternotomy was performed. After the pericardium was opened, the innominate artery was dissected out and clamped proximally and distally. The artery was carefully separated from the trachea and the fistulous arterial segment was removed. End-to-end primary anastomosis of the innominate artery was carried out. The large tracheal defect was repaired using a bovine pericardial patch. Postoperatively, no further bleeding was seen, but the patient deteriorated overall and ultimately received palliative care per the wishes of her family.

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Conclusions: Tracheoinnominate fistula after percutaneous tracheostomy is a rare but recognized complication and has to be kept in mind in any patient presenting with any degree of bleeding from the tracheostomy site. Prompt recognition and management can be lifesaving.

D123

One-Stop Electromagnetic Navigation Bronchoscopy-Guided Dye Marking Lobectomy: The Role of Cone-Beam Computed Tomography When Navigation Is Deviated

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Objective: Electromagnetic navigational bronchoscopy (ENB)-guided pleural dye marking is an effective technique for localizing small lesions during video-assisted thoracoscopic surgery (VATS). Our goal was to report an interesting case using the novel technique of the one-stop, hybrid operating room, single-staged approach for ENB-guided dye marking and VATS lung resection. The importance of hybrid operating room real-time cone beam computed tomography (CT) in identifying deviated ENB navigation and guiding correct navigation and marking of the target lesion is highlighted.

Patient: A 56-year-old man with an incidental 1.4 cm lesion in the peripheral right lower lobe with a standardized uptake value of 3.8 on positron emission tomography was scheduled for ENB-guided dye marking and resection. With the patient under general anesthesia in a hybrid operating room, we achieved virtual navigation to the lesion with the locatable guide (SuperDimension 7, Medtronic, Inc., Dublin, Ireland) to a distance within 0.8 cm directly in front of the target. However, verification by cone-beam CT in the hybrid operating room showed at least a 2 cm inferior discrepancy between the ENB-guided catheter and the lesion. With the 3-dimensional CT airway roadmap under fluoroscopic guidance, we performed renavigation to the target lesion. The position was further confirmed with repeat cone-beam CT. Methylene blue was injected in the lesion and at the adjacent pleura. An immediate single-stage VATS in the hybrid operating room showed the pleural dye effectively localizing the targeted lesion. A VATS right lower lobe wedge resection and frozen section indicated an adenocarcinoma. We performed a completion lobectomy of the right lower lobe. The postoperative course was uneventful, and the patient was discharged on postoperative day 4.

Conclusions: Inaccurate navigation by ENB is a known limitation of ENB technology. The ability to identify such an error is paramount. Hybrid operating room cone-beam CT provides the best imaging information to confirm failed and successful navigation dye marking, which combined with the one-stop, hybrid operating room, single-stage VATS, offers superior management for localization resection of lung nodules.

D124

Thoracic Endovascular Aortic Repair for Treatment of Distal Aortic Arch Dissected Aneurysm Associated with Coarctation

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Objective: Late aneurysm formation of the proximal aorta or distal aortic arch is a well-recognized complication of untreated aortic isthmus stenosis and is associated with a significant risk of aortic rupture. Late aneurysm formation may occur at the site of the repair as a complication resulting from any type of surgical technique for coarctation repair. Our goal was to describe the case of a young man, a Jehovah's Witness, with an untreated coarctation of the aorta and a dissected prestenotic thoracic aortic aneurysm, emergently treated with thoracic endovascular aortic repair (TEVAR).

Patient: A 44-year-old man with an untreated aortic coarctation was admitted emergently with a diagnosis of a ruptured thoracic aortic aneurysm. The patient knew he had an aortic coarctation complicated by a large prestenotic aortic aneurysm but had been refused for conventional surgery because it required blood transfusions because of the high risk of bleeding. The patient was a Jehovah's Witness and therefore refused blood transfusions. Computer tomography showed a voluminous fissured aneurysm of the descending thoracic aorta. Endovascular surgery appeared to be a safe alternative. The procedure was performed in a hybrid operating room with the patient under general anesthesia. Femoral access was achieved by surgical dissection of the right femoral artery. Several attempts at cross coarctation and to treat a tortuous aorta with a guidewire from the femoral artery had failed. A stiff guidewire was inserted from the right radial artery up to the common right femoral artery to backwardly introduce a pigtail catheter with a "cable-car system". The aorta was straightened with 2 extrastiff guidewires. Two Medtronic Valiant stent grafts were deployed at the level of the distal aortic arch over 1 of the extrastiff guidewires. We deliberately covered the left subclavian artery. The patient was discharged from the hospital within 1 week. Follow-up CT scans were performed at 3, 6, 18, and 36 months. Complete thrombosis of the aneurysmal sac was achieved. The patient has not reported any symptoms related to the intentional occlusion of the left subclavian artery.

Conclusions: Our encouraging experience suggests that endoluminal repair is a useful alternative treatment to open surgical operation for aneurysms associated with coarctation of the aorta.

D125

Interrupted Aortic Arch

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Objective: Interruption of the aortic arch (IAA) is a rare congenital malformation. It is classified into 3 types: type B is the most common and type C is the least common. Our goal was to describe our experience of treating a patient with this condition.

Patient: Our patient was a 22-year-old woman with the diagnoses of type A IAA and multiple aneurysms of the collateral circulation. We performed an extraanatomical aortic bypass with ligature of the left subclavian artery and descending thoracic aorta proximal to the distal anastomosis (Fig. D125-1A, B).The extraanatomical bypass procedure has proved to be a safe technique to correct aortic disease when the surgeon prefers to avoid complex dissection and risky collateral circulation. Our patient presented no major complications while in the hospital and at the 1-year follow-up.

Conclusions: Extraanatomical aortic bypass is an attractive and efficient surgical strategy for IAA with complex collateral arteries. This approach allows the surgeon to minimize the perioperative risks and to avoid thoracotomy and challenging surgical dissection in high-risk bleeding areas.

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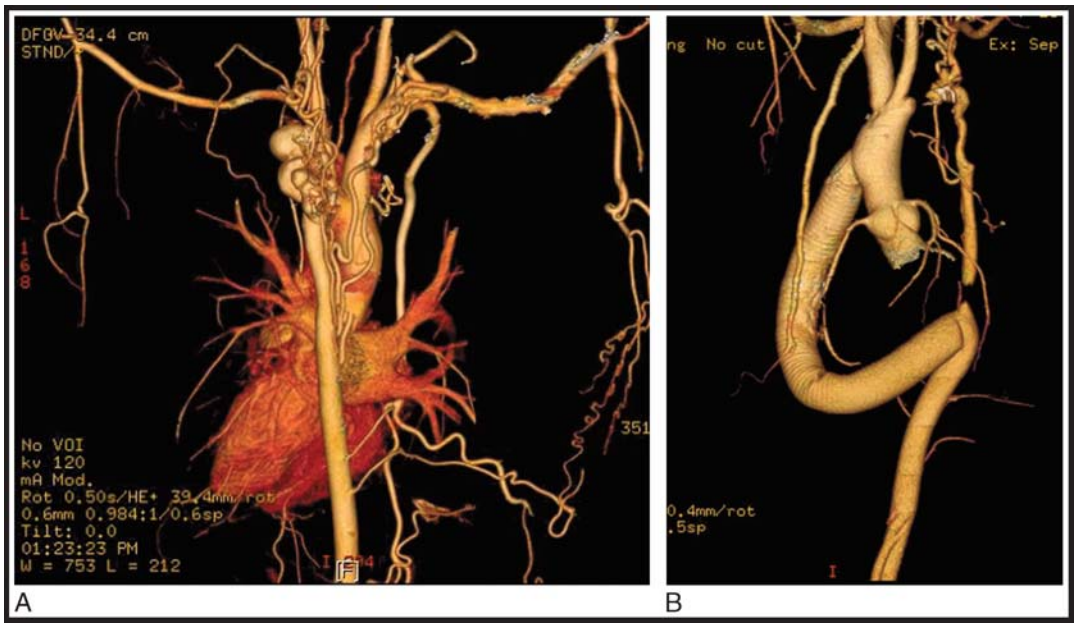

FIGURE D125-1. A, Computed tomographic scan taken before surgery for interruption of the aortic arch. B, Computed tomographic scan taken after the bypass procedure.

D126

Creation of a Design Map for Minimally Invasive Mitral Valve Repair Using Preoperative 3-Dimensional Echocardiography Findings

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Objective: In patients who require mitral valve repair, it is difficult to determine the appropriate length, position, and number of artificial chordae, lesions for resection, and prosthetic ring size prior to surgery. Preoperative determination of those factors may help increase the success rate of minimally invasive mitral valve repair. We developed a simple, reproducible method to determine those factors using preoperative 3-dimensional echocardiography and assessed its effectiveness.

Methods: Fifteen patients (10 men; mean 58.7 ± 10.7 years old) underwent a minimally invasive mitral valve repair at our institution. Prior to the operation, we assessed the prolapse position using 3-dimensional echocardiography to decide whether to cut as well as resect the lesion. In addition, 3-dimensional echocardiography was used to select the papillary muscle for loop attachment and to determine the number and positions of the loops when artificial chordae were needed. To determine annulus height (AH), we measured the distance from the tip of the papillary muscle to the level of the mitral annulus, which revealed that the appropriate length was 7 to 9 mm shorter than the AH measurement. Finally, based on the length of the anterior leaflet, we chose the appropriate prosthetic ring size.

Results: Three patients had anterior leaflet prolapse, whereas 10 had posterior and 2 had bileaflet prolapse. All patients with anterior leaflet and bileaflet prolapse and 6 with posterior leaflet prolapse received artificial chordae. The base of the loops was attached to the anterior papillary muscle in 5 patients and to the posterior papillary muscle in 4, with the other end attached to the anterior leaflet in 3, posterior in 7, and both in 2. The mean anterolateral and posteromedial AH lengths were 23 and 27 mm, respectively. According to the length of the anterior leaflet, a 28 mm prosthetic ring was selected in 2, a 30 mm ring in 8, and a 32 mm ring in 2 cases. All mitral valve repairs were performed according to the presurgical plan, and success was achieved in each case.

Conclusions: Using our comprehensive, reproducible strategy, it was possible to decide on the appropriate minimally invasive mitral valve repair procedure prior to surgery, which led to successful results in all cases.

D127

Laser Extraction of a Retained Right Atrial Pacemaker Lead via a Mini-Redo Sternotomy

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Objective: Infection of implantable cardiac devices can be a catastrophic complication. Transvenous lead extraction (TLE) is commonly used for device removal; however, surgical lead extraction, cardiopulmonary bypass, and cardiotomy are required in some cases and can result in rates of high morbidity. We describe the first use of antegrade TLE via an upper ministernotomy to resect a retained pacemaker lead.

Patient: Our patient was a 73-year-old man who underwent pacemaker implantation for syncope secondary to bradyarrhythmia and carotid hypersensitivity. Seven years later, he presented with *S. epidermidis* bacteremia and pacemaker lead endocarditis. After a failed TLE via the device pocket, the patient underwent open surgical lead extraction, though he had a retained right atrial (RA) lead segment. A 20-year regimen of rifampin was begun. Six months after the rifampin dose was reduced, he developed a draining granulomatous mass within the pacemaker pocket, for which he presented to us. Computed tomography demonstrated the retained pacemaker lead within a nearly occluded brachiocephalic vein and an occluded superior vena cava. We suspected an infected sinus tract was present between the pacemaker pocket and the tip of the lead, which sat in the left subclavian vein. After exploring the left chest wall incision, we discovered and resected the granuloma

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and amputated the sinus tract, which was connected to the retained wire. We subsequently returned the patient to the operating room to remove the retained lead via a second intercostal space, inverted T, redo, upper ministernotomy. We obtained vascular control of the occluded innominate vein and opened it longitudinally. Two leads were identified: the retained RA lead and a separate plastic insulating sheath. The insulating sheath was removed uneventfully with simple traction, and the retained RA lead was removed using antegrade TLE via the exposed innominate vein in cooperation with the electrophysiology team. The patient progressed without complications following both operations, and he was weaned from the antibiotics 6 weeks postoperatively.

Conclusions: This case demonstrates the advantage of a multidisciplinary approach to reduce surgical risk in challenging, complex clinical scenarios. The novel combination of antegrade TLE and minimally invasive exposure of the required anatomy obviated the need for a redo median sternotomy, cardiopulmonary bypass, cardiotomy, and their associated risks.

D128

A Standardized Transcatheter Staged Approach for Aortomitral Valve Stenosis: Presentation of Three Consecutive Cases

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Objective: Treating a failing mitral bioprosthesis in elderly patients with coexisting severe aortic valve stenosis is challenging for the heart team because the operative risk increases in simultaneous procedures. Our aim was to report our experience with a standardized staged transcatheter approach.

Methods: Patients with native aortic and prosthetic mitral valve stenosis underwent a scrupulous workup including left-right heart catheterization and computed tomography. Patients with confirmed double valve stenosis underwent an elective transfemoral (TF) transcatheter aortic valve implantation (TAVI) intervention as a first step. After discharge and complete recovery, the patients underwent a second operation with transapical (TA) implantation of a transcatheter prosthesis in the mitral position (TMVI) as a valve-in-valve procedure.

Results: Between 2010 and October 2016, 708 transcatheter heart valve procedures were performed in our institution. A total of 168 patients had previous cardiac surgery [including 21 mitral valve replacements (MVR) with a bioprosthesis]. Three patients had severe native aortic valve stenosis combined with the degeneration (stenosis) of their mitral bioprosthesis. The first patient was a 76-year-old woman (MVR 9 years before, logistic EuroSCORE = 38.8%, EuroSCORE 2 = 10.7% considering 2 combined procedures vs. 6.5% if considering a single noncoronary artery bypass grafting procedure). A TF-TAVI with a 23 mm transcatheter heart valve (THV) was successfully implanted. Ten weeks after discharge, the patient underwent a TA-TMVI as a valve-in-valve procedure, without complications. She was discharged on postoperative day 8. The second patient was an 81-year-old man with a 29 mm bioprosthesis (11 years before, logistic EuroSCORE = 38.9%, EuroSCORE 2 = 13.1% for 2 procedures vs. 8% for a single procedure). A TF-TAVI with a 26 mm THV, and after 8 weeks, a TA-TVMI with a 29 mm THV were performed successfully. The third patient was a 76-year-old woman with a low ejection fraction (20%), a degenerated 27 mm mitral valve bioprosthesis, and a tricuspid valve repair 10 years before (logistic EuroSCORE = 65.4%, EUROSCORE 2 = 29.4% for 2% vs. 19.4% for a single procedure). Eight weeks after the TF-TAVI (23 mm THV), a TA-TMVI with a 26 mm THV was performed. She was also discharged home in good condition.

Conclusions: The combination of severe aortic stenosis and mitral bioprosthesis failure can be successfully treated with a catheter-based staged approach, with reduced risks and good clinical outcomes.

D129

Concomitant Off-Pump Coronary Artery Bypass Grafting and Beating Heart Mitral Valve Replacement in a Patient with Stent Occlusion, Severe Mitral Regurgitation, and Poor Left Ventricular Function

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Objective: Cardiac reperfusion injury is a well-described complication occurring after ischemia or following cardioplegic arrest. This reperfusion injury can become more pronounced in a patient with a poor left ventricular ejection fraction. Various strategies have been developed to prevent ischemic repercussion injury. Our goal was to describe a patient with intracoronary stent occlusion, severe mitral regurgitation (MR), and poor left ventricular function who had concomitant off-pump coronary artery bypass (OPCAB) and mitral valve replacement in the beating heart without aortic cross-clamping.

Methods: A 55-year-old man with diabetes developed an acute myocardial infarction that was thrombolyzed with STK/TNR. After a couple of months, percutaneous transluminal coronary angioplasty and stenting with a drug-eluting stent (DES) were performed for critical proximal stenosis of the left anterior descending coronary artery. After several months, he presented with cardiogenic shock and acute shortness of breath requiring mechanical ventilation. Once the cardiac condition improved, the patient was weaned from ventilatory support. Two-dimensional echocardiographic Doppler studies revealed globally hypokinetic left ventricular dysfunction (ejection fraction less than 30%), grade IV MR, severe pulmonary arterial hypertension (pulmonary artery systolic pressure = 92 mmHg), with no aortic regurgitation. Because of his poor general condition, no repeat coronary angiography was performed. The patient was submitted for urgent mitral valve replacement and coronary artery bypass grafting even though it was assumed that his DES could be patent. Through a median sternotomy incision, OPCAB was performed with a saphenous vein graft distal to the DES. There was no antegrade flow following the left anterior descending arteriotomy. Following OPCAB, MVR was performed on the beating heart without aortic cross-clamping with preservation of the posterior leaflet.

Results: The patient was weaned from CPB with no inotropic support. His postoperative course was uneventful, and he was discharged on postoperative day 8. His follow-up reports after 6 months were satisfactory.

Conclusions: Our results show that a patient with severe MR and associated critical coronary stenosis or coronary stent occlusion and severely impaired left ventricular function can undergo concomitant OPCAB and on-pump beating mitral valve surgery with a good clinical outcome.

D130

Right Minithoracotomy for Aortic Valve Replacement in 519 Patients

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Objective: Over the past decade, minimally invasive cardiac surgery has emerged as a valid alternative treatment for aortic valve disease. Various techniques have been developed but surgeons seem to prefer a partial sternotomy instead of a right minithoracotomy. Longer cardiopulmonary

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bypass time and the need for peripheral cannulation are the main disadvantages reported in the literature for the minithoracotomy. The aim of this retrospective study was to present clinical results from more than 500 patients treated with a right minithoracotomy and to show that these pitfalls can be solved.

Methods: From January 2010 to June 2016, 519 adult patients underwent isolated aortic valve replacement through a right minithoracotomy in 2 separate cardiac centers managed by a single team of cardiac surgeons. There were 286 men (55.1%) with a mean age of 71.7 ± 11.9 years (range 16–93 years). The mean body mass index was 26.9 ± 4.5 kg/m^2 (range 17.3–52.7 kg/m^2) and the mean logistic EuroSCORE was 6.3 ± 4.2% (range 0.88%–34.48%). Only 1 patient was previously operated on.

Results: Minimally invasive aortic valve replacement was successfully performed through a 4 to 6 cm long right minithoracotomy at the third intercostal space without rib avulsion or ligation of the right internal mammary artery. All patients received an aortic valve replacement implanted using three 2-0 Prolene running sutures (median prosthesis implanted, 23 mm diameter) with total central cannulation in more than 400 patients. The overall mean cardiopulmonary bypass time was 60.5 ± 19.9 minutes and the aortic cross-clamping time was 47.8 ± 16.1 minutes. The median ventilation time and intensive care stay were 7 hours and 1.7 days. The in-hospital mortality rate was 1.3% (7/519).

Conclusions: After 6 years of experience with the right minithoracotomy approach for isolated aortic valve replacement, it is possible to assert that central cannulation can be easily used and that operative times are competitive with those reported with other approaches. Rib avulsion and right mammary artery ligation are not necessary nor is a preoperative computed tomography scan. The only real exclusion criterion is a previous left pneumectomy. Advantages include early mobilization and rehabilitation, an excellent aesthetic result, and lower risk of wound complications. In conclusion: Why not?

D131
Minimally Invasive Surgery for Aortic Valve Replacement in Octogenarians or Obese Patients

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Objective: Ministernotomy and right minithoracotomy for aortic valve surgery are well-known approaches, but controversial opinions exist concerning their use in high-risk patients. The aim of this study was to show the potentially positive role of minimally invasive surgical procedures in octogenarians or obese patients.

Methods: Between January 2010 and November 2016, 1875 patients underwent isolated aortic valve replacement at our institution. Of these, 498 patients were older than 80 years and 462 were obese (body mass index ≥ 30). The surgical approach for octogenarians included a standard full sternotomy (group 1: 171), a minimally invasive technique using an upper J hemisternotomy (group 2: 212) or a right anterior minithoracotomy (group 3: 115). The obese patients were treated with a full sternotomy (group 1: 148), a minimally invasive technique using an upper J hemisternotomy (group 2: 201), or a right anterior minithoracotomy (group 3: 113).

Results: Statistical analysis showed no difference in intensive care unit stay for octogenarians (group 1: 69.1 ± 104.3 hours; group 2: 73.7 ± 109.8 hours ; group 3: 67.8 ± 109.3 hours, $P = 0.85$ ANOVA one-way), hospital stay (group 1: 9.1 ± 8.6 days; group 2: 13.0 ± 28.1 days; group 3: 9.2 ± 6.9 days, $P = 0.10$ ANOVA one-way), and hospital mortality rate (3.5% vs. 2.8% vs. 3.5%, $P = 0.92$). Similar results were obtained for obese patients in terms of intensive care unit stay (group 1: 77.5 ± 138.4; group 2: 67.0 ± 130.2; group 3: 85.9 ± 228.8, $P = 0.61$ ANOVA one-way), hospital stay (group 1: 8.9 ± 7.1; group 2: 10.1 ± 12.3; group 3: 9.7 ± 10.4, $P = 0.57$ ANOVA one-way), and mortality rate (3.4% versus 1.0% versus 0%, $P = 0.06$). For both categories of patients, operative times were statistically significant in favor of the minimally invasive approaches (octogenarians: cardiopulmonary bypass time: 68 ± 31 versus 68 ± 20 versus 55 ± 16 minutes, $P < 0.01$ and cross-clamp time: 52 ± 21 versus 56 ± 18 versus 43 ± 15 minutes, $P < 0.01$; obese patients had cardiopulmonary bypass time: 73 ± 33 vs. 73 ± 22 vs. 59 ± 17 minutes, $P < 0.01$ and cross-clamp time: 58 ± 24 vs. 60 ± 18 vs. 47 ± 15 minutes, $P < 0.01$).

Conclusions: Severe aortic valve stenosis in octogenarians or obese patients can be treated with minimally invasive approaches with biologically minimally invasive surgery in terms of operative times. Thanks to a standardized technique and to a scrupulous learning curve, excellent results can be offered also in high-risk patients.

D132
Live Procedure and the Revivent Myocardial Anchoring System: A New Heart Team Approach in the Treatment of Patients with Heart Failure

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Objective: Left ventricular (LV) dilatation in ischemic cardiomyopathy results in severe disturbance to the mechanics of ventricular contraction. Less Invasive Ventricular Enhancement (LIVE) using the Revivent TC Myocardial Anchoring System (BioVentrix Inc., San Ramon, CA USA) is a new therapeutic option for patients with heart failure, myocardial infarction, and marked anteroseptal or apical scars to reduce left ventricular volumes without the need of a sternotomy or cardiac arrest.

Patient: We report the case of a 77-year-old man with ischemic cardiomyopathy and severely impaired left ventricular function. The patient had a history of multiple myocardial infarctions with consecutive coronary interventions and a remaining anteroseptal aneurysm. Left ventricular restoration was performed in a hybrid operating room under transesophageal echocardiography and fluoroscopy guidance. A left-sided, 6 cm anterolateral minithoracotomy was chosen as the surgical access while venous catheters were introduced via the right jugular vein. The surgeon punctured the free wall of the left ventricle at the edge of the aneurysm with a specialized curved needle and continued through the interventricular septum into the right ventricle (RV). A guidewire was passed into the RV through this needle. The guidewire was caught with a snare and pulled back via the jugular venous port where the internal anchor was assembled externally. With the internal anchor at the interventricular septum, the external anchor could be advanced until the scar was excluded in the myocardial plication. In total, 4 anchors were successfully placed and produced an immediate reduction of left ventricular volume by excluding the aneurysm (preoperative values: end diastolic volume = 593 ml; end systolic volume = 545 ml; stroke volume = 48 ml; postoperative values: end diastolic volume = 442; end systolic volume = 377 ml; stroke volume = 65 ml).

Conclusions: The LIVE Procedure and Revivent Myocardial Anchoring System is a promising new therapeutic approach for patients with heart failure who have anteroseptal scars. Given the large number of frail patients who have ischemic cardiomyopathy, less invasive therapeutic

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strategies are indispensable. We demonstrated this technique to be a safe procedure, but further investigation and a larger number of patients are necessary to evaluate the long-term clinical effects.

D133

Persistent Iatrogenic Catheter-Induced Atrial Septal Defect Complicating Minimally Invasive Atrial Fibrillation Ablation

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Objective: Persistent iatrogenic atrial septal defect (iASD) is a recognized complication of interventional procedures involving the puncture of the interatrial septum. The use of this technique has rapidly increased over the last few decades as a result of the increasing number of catheter ablations, which require left heart catheterization through the transseptal approach. Our goal was to report a case of persistent iASD complicating thoracoscopic minimal access atrial fibrillation ablation surgery.
Patient: A 46-year-old man with an increased body mass index and permanent atrial fibrillation was referred for elective surgical ablation. He had previous catheter-based atrial fibrillation ablation that failed. He had uncomplicated bilateral video-assisted thoracoscopic atrial fibrillation and left atrial appendage occlusion surgery. The procedure was performed with single-lung ventilation on either side, with the patient under general anesthesia; he was transferred to the intensive care unit after extubation. However, his postoperative recovery was complicated by profound hypoxemia with increasing oxygen requirements, even though he did not have any preexisting respiratory conditions. Chest physiotherapy, mobilization, and increased diuresis did not improve his hypoxemia. Meanwhile, his central venous pressure remained elevated with a dilated right ventricle and right heart dysfunction. Computed tomography pulmonary angiography ruled out a pulmonary embolism. Transesophageal echocardiography showed a 12 mm persistent iASD with a right-to-left reversal of a shunt and bidirectional flow across the atrial septal defect. He subsequently had a successful percutaneous closure of the persistent iASD with a 12 mm Amplatzer septal occluder device. Echocardiography confirmed no residual shunting across the atrial septal defect. He made a quick recovery and was discharged home.
Conclusions: Persistent iASD has been described as a well-known complication of numerous cardiac surgical and percutaneous procedures including catheter ablations via the transseptal approach. In this case, the clinicians were aware of the persistent iASD preoperatively, which was inconsequential under optimal conditions but later caused profound hypoxemia when there was right-to-left reversal of shunting and improved dramatically after the atrial septal defect was closed. Hence, in patients who have had previous catheter ablations, clinicians should not overlook the possibility of persistent iASD in patients who become (or remain) hypoxic postoperatively.

D134

Can Atypical Mycobacterium Root Abscess in an Immunocompromised Patient Be Successfully Treated?

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Objective: Mycobacterium avium complex (MAC) usually affects immunocompromised patients and is identified through blood cultures. Our goal was to report the case of a root abscess in an immunocompetent individual, who underwent aortic root replacement for type A aortic dissection.
Methods: A 55-year-old man underwent a Bentall procedure for type A aortic dissection in February 2015 at an outside institution. He had a ligation of the right coronary artery (RCA) and a saphenous venous graft (SVG) to the RCA. His postoperative course was complicated by acute renal and respiratory failure, cardiac arrest, and treatment for multiple wound infections. In April 2016, in a follow-up computed tomography scan, a pseudaneurysm of the aortic root was diagnosed that was precipitated by dehiscence of the proximal anastomosis of the SVG to the Dacron graft. The results from blood cultures and a gallium scan were negative. The dissection was repaired with an Amplatzer septal occluder.
Results: In August 2016, he was admitted with pancytopenia and a high fever. Blood culture results were negative, and a bone marrow biopsy excluded hematological causes. He was prescribed a triple antibiotic regimen. His CT scan demonstrated a recurrent aortic root pseudoaneurysm, an occluded RCA, and an RCA vein graft. The patient underwent redo sternotomy, aortic root replacement with a composite valve graft, and reimplantation of the left coronary artery using the Cabrol technique. An SVG was used to bypass the RCA. The aortic arch was replaced, and the brachiocephalic and left carotid arteries were reimplanted using a bifurcation graft. The patient was extubated on postoperative day 2. On postoperative day 8, the MAC was identified both from the operative specimen and mediastinal drains. A MAC-specific regimen was initiated. The patient was taken back to the operating room for washout and placement of an omentum flap. The rest of his postoperative course was uneventful. He was discharged home and continued to do well at the 6-month follow-up.
Conclusions: A MAC infection should be considered in a neutropenic patient with high fevers and negative cultures who underwent cardiac procedures in the recent past. A combination of medical therapy and aggressive operative resection of the infection was important to achieve a cure in this patient.

D135

The Left Atrial Roof Approach Is Better for a Mitral Valve Operation in Patients with Kyphoscoliosis

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Objective: Patients with kyphoscoliosis who have mitral valve procedures via Sondergaard's groove (SG) can experience a number of complications, including difficulty of exposure, long operating times, atrial tears, postoperative bleeding, resternotomy, and tamponade. All of these complications can be avoided if the surgeon uses a left atrial roof (LAR) approach.
Methods: The first 3 patients who were operated on via SG had the above-mentioned complications. When we tried the LAR approach in 10 patients, no such complications were observed.
Results: The standard SG approach caused the above-mentioned complications in 3 young patients (1 mitral valve replacement, 2 mitral valve repairs) due to inadequate exposure results and an inadvertent tear of the atrium. LAR resulted in no such complications in 10 young patients (2 mitral valve replacements, 8 mitral valve repairs) due to excellent exposure.
Conclusions: The LAR approach offered excellent exposure to the mitral valve in all patients. SG compromised the exposure of the mitral valve due to the spinal abnormality, which was secondarily affected by the anatomy of the heart. The most posterior aspect of the heart is the left atrium. Despite the enlarged LA, due to the concavity of the spine, the pulmonary veins are crowded because the left atrium is shortened cephalocaudally, i.e., SG shortened. Because the left atrium is enlarged

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side-to-side, the mitral valve is pushed away from the SG. Exposure of the mitral valve is difficult if both anatomical alterations are present. The thoracic anteroposterior dimension is increased in patients with kyphoscoliosis. The LAR approach eliminates anatomical difficulties, provides excellent exposure, and prevents a left atrial tear and all the potential complications.

D136

Minimally Invasive Resection of an Atrial Myxoma With a Patent Foramen Ovale and an Embolic Phenomenon

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Objective: The purpose of this study was to describe rare intraoperative findings in a patient with a left atrial myxoma with an embolic phenomenon, a completely occluded right femoral artery found on attempted cannulation of a patient with new onset, unexplained transient ischemic attacks.
Patient: The minimally invasive surgical resection for atrial myxoma required ectopic sites for arterial and venous cannulation. After attempts in the right femoral artery failed, we succeeded in inserting a cannula in the left femoral artery. A polypoid lesion of 70 grams was extracted without complication from the left atrial cavity. The patient experienced resolution of his transient ischemic attacks and of numbness in the right leg. A postoperative computed tomography angiogram indicated partial occlusion of the right femoral artery.
Conclusions: The minimally invasive procedures provide an opportunity to limit pain, infection, and hospital stay following a minithoracotomy for operative exposure of the heart. Cannulation of ectopic sites must be fully evaluated in order to successfully place such patients on bypass. In our case report, we described a patient whose primary lesion caused secondary complications in regard to achieving successful cannulation of the right femoral artery. Due to concurrent transient ischemic attacks in the patient, we chose magnetic resonance imaging over computed tomography imaging and found a tumor embolus of the brain. Magnetic resonance imaging did not allow the surgical team to identify the distal arterial obstruction. Intraoperative changes were required to successfully complete the resection.

D137

Early Results of Complex Fractionated Atrial Electrogram Mapping-Guided Atrial Fibrillation Surgery

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Objective: Although the Cox-Maze operation is the standard surgical procedure for treatment of permanent atrial fibrillation (AF), conversion to sinus rhythm is limited by patient characteristics, including the duration of AF, atrial size, and voltage of the fibrillation waves. An operative strategy based on structural alteration of the electrical substrates of AF is required to achieve better outcomes of AF surgery. A complex fractionated atrial electrogram (CFAE) plays an important role in the electrical substrate of AF. We performed an operation for AF guided by preoperative CFAE mapping using a 3-dimensional (3D) mapping system. The goal of this study was to evaluate the early results of our procedure.
Methods: From January 2015 to August 2016, 8 patients (mean age, 66.5 ± 6.4 years) underwent CFAE mapping-guided surgery for AF. In the preoperative electrophysiological study using 3D mapping, CFAE was defined by a low-voltage electrogram (0.05–0.25 mV) with a highly fractionated potential (short cycle length < 120 msec). First, right atrial CFAE sites were ablated using a catheter ablation system. Several days after the right-sided CFAE ablation, a modified Cox-Maze operation was performed with additional cryoablation of the CFAE sites.
Results: There were 1 to 3 (mean, 2.5 ± 0.8) CFAE sites in the right atrium and 2 to 4 (mean, 2.4 ± 0.7) sites in the left atrium. The mean CFAE mapping time was 87.6 ± 24.6 minutes, the fluoroscopy time was 53.1 ± 22.2 minutes, and the contrast dose was 44 ± 3 ml. Concomitant cardiac surgery included mitral valve plasty in 6 patients and aortic valve replacement and mitral valve replacement in 1 patient each. The mean time for CFAE mapping-guided AF surgery was 25.7 ± 5.6 minutes. At discharge, 7 patients were in sinus rhythm and 1 patient still had AF, but sinus rhythm returned 3 months postoperatively in this patient without antiarrhythmic medication. After a mean follow-up of 11.7 ± 8.5 months, all patients remained in sinus rhythm.
Conclusions: Early results suggest that CFAE mapping-guided atrial fibrillation surgery is feasible and effective. Although the long-term effect of CFAE ablation on the maintenance of sinus rhythm and atrial function should be evaluated, this novel method could provide an alternative strategy for the surgical treatment of AF.

D138

Pleural Adhesion Does Not Influence Recurrence and Survival After Lobectomy for T1-2n0 Non-Small-Cell Lung Cancer

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Objective: Various factors are related to the prognosis of complete resection of non-small-cell lung cancer. The relationship between pleural adhesion, the recurrence rate, and overall survival after lobectomy for non-small-cell lung cancer is unclear. The aim of this study was to determine the survival and recurrence rates of patients with -2N0 lung cancer with pleural adhesions after lobectomy.
Methods: The retrospective analysis included 142 patients diagnosed as clinical T1-2N0 after video-assisted thoracoscopic surgery (VATS) or thoracotomy lobectomy for treatment of non-small-cell lung cancer from January 2006 to August 2011. To determine the impact of pleural adhesions, the patients with N stage and T3 were excluded. The definition of pleural adhesion includes diffuse adhesion to the adhesion on the lobe where the tumor is located. The patients were divided into 2 groups: adhesions (group A, 40 patients) and no adhesions (group N-A, 102 patients). The chest wall dissection including intercostal muscle was done in the clinical T2 patients if pleural adhesions existed on the lobe on which the tumor was located.
Results: Histological analysis identified the following types of lung cancer: adenocarcinoma in 81 patients, squamous cell in 47, and other types in 14. The median follow-up time was 66.5 months (range 1–122 months). The overall 5-year survival rate was 90.3%. The disease-free, 5-year survival rate was 80.1%. There was no statistical difference in the disease-free, 5-year survival rate ($P = 0.6$) and no difference in the overall survival ($P = 0.691$) rate when the 2 groups were compared.
Conclusions: Pleural adhesions did not affect the prognosis of patients who had lobectomy for clinical T1-2N0 non-small-cell lung cancer.

D139

Three-Year Experience With Minimally Invasive Left Ventricular Assist Device Implantation

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Objective: A left ventricular assist device (LVAD) as a bridge to transplant is well established. However, the implantation of an LVAD is invasive and associated with significant perioperative complications in these critically ill patients. A less-invasive implantation technique might have the potential to enhance results in these high-risk patients The aim of this study was to present the results of our 3-year experience with the minimally invasive implantation of the left ventricular assist device, the HeartWare HVAD (HeartWare Int., Framingham, MA USA).
Methods: Twenty-nine patients underwent minimally invasive implantation of the left ventricular assist device Heartware HVAD between November 2013 and December 2016 as a bridge to a heart transplant in our center. Twenty-eight patients were men; 1 patient was a woman. The mean age of the patients was 54 ± 9.8 years. The basic diseases were dilated cardiomyopathy in 16 patients (55%), ischemic cardiomyopathy in 4 patients (38%), and hypertrophic cardiomyopathy in 2 patients (7%). The mean value of the left ventricular ejection fraction was 14.2 ± 4.2%; that of the right ventricular ejection fraction was 30.9 ± 5.4%. The left ventricular apex was accessed by a left anterior thoracotomy (approximately 8 cm incision). To access the ascending aorta, we used an upper J ministernotomy.
Results: Minimally invasive implantation was successful in all patients. In 1 patient, closure of the foramen ovale was performed simultaneously. Most patients (79%) were extubated on the first postoperative day. In 2 cases (7%), the right ventricle failed, which necessitated use of a temporary percutaneous right-sided circulatory support, the Centrimag. The overall 30-day survival rate was 94%; the 1-year survival rate was 76%. Fourteen patients (48%) underwent successful heart transplants; 8 patients (28%) remain on LVAD support.
Conclusions: Minimally invasive LVAD implantation is feasible and safe and allows easier reentry for a subsequent transplant. There is also a promising tendency for a lower incidence of perioperative right heart failure. After the initial experiences with this technique, it has become the method of choice in our center.

D140
Convergent Ablation for Persistent Atrial Fibrillation: A Single-Center Experience

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Objective: Although endocardial catheter ablation has been shown to be effective in patients with paroxysmal atrial fibrillation (AF), the same efficacy has not been demonstrated in patients with persistent AF. Lately, there was a trend toward a hybrid approach in the treatment of persistent AF where epicardial ablation through a minimally invasive approach is combined with endocardial catheter ablation. It is believed that this comprehensive approach may offer a more effective treatment for persistent AF.
Methods: We performed a single-center retrospective analysis of 25 patients with persistent AF who underwent the convergent procedure between October 2013 and March 2016. Demographics and intraoperative and postoperative outcome data were collected retrospectively. All patients underwent surgical epicardial ablation of the posterior LA through a subxiphoid transdiaphragmatic approach, followed by radiofrequency endocardial ablations on the same day. Patients were followed at 3-month intervals after a blanking period of 3 months with static electrocardiograms (n = 9), loop recorders (n = 6), or implanted pacemaker/defibrillator devices (n = 10).
Results: Sinus rhythm was achieved intraoperatively in all patients. Recurrence was defined according to Heart Rhythm Society definitions. At a median follow-up of 13.5 months (interquartile range 7.1–24.7 months), 78.3% of patients were in sinus rhythm at the last follow-up. At 6, 12, 18, and 24-months follow-up, 91.3%, 93.3%, 90.9%, and 80% of patients were in sinus rhythm, respectively. After a blanking period of 3 months, freedom from recurrence of AF at any point up to the last follow-up was 78.3%, 62.5%, 50%, and 40% at 6, 12, 18, and 24 months. Kaplan-Meier event-free survival analysis revealed an AF-free survival of 91.3%, 83.7%, 74.4%, and 49.6% at 6, 12, 18, and 24 months, respectively (Fig. D140-1). Three patients (12%) had complications: 1 suffered a minor cerebrovascular accident with no residual deficit; the other 2 developed hemopericardium with tamponade physiology that required emergent pericardial drainage.
Conclusions: Our experience showed that the hybrid procedure is a relatively safe and effective option for patients with persistent AF.

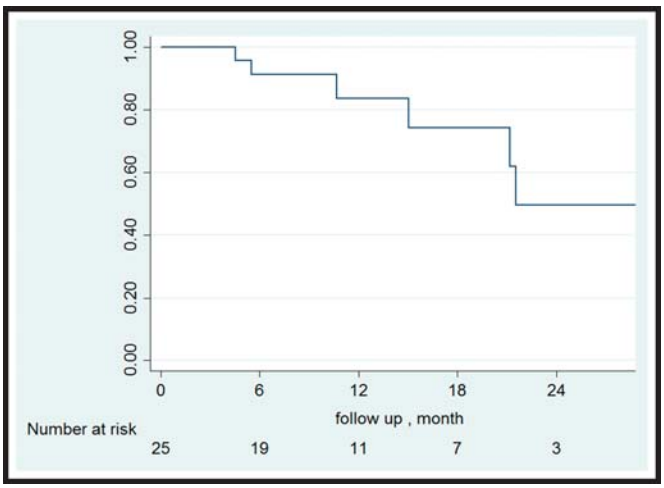

FIGURE D140-1. Kaplan-Meier estimate of recurrence-free atrial fibrillation.

D141
Real-Time Identification of a Sentinel Lymph Node During Video-Assisted Lobectomy Using Percutaneous Injection of Indocyanine Green

Kook Nam Han, **Hyun Koo Kim,** Young Ho Choi. *Korea University Guro Hospital, Seoul, Republic of Korea.*

Objective: A fluorescence thoracoscopic system could enable us to perform image-guided minimally invasive surgery and mediastinal lymph node dissection using indocyanine green (ICG). This video shows the potential application of such a fluorescence system in a minimally invasive lung cancer operation.
Patient: A 64-year-old man with non-small-cell lung cancer (cT1bN0, peripheral location) at the right upper lobe had a thoracoscopic lobectomy and mediastinal lymph node dissection under a near-infrared fluorescence thoracoscopic system. We performed preoperative computed tomography-guided hook wire localization and injected lipiodol and ICG 1 hour before the operation. ICG fluorescence was clearly identified in the peribronchial and mediastinal lymphatic flow (Fig. D141-1). Lobectomy and lymph node dissection were performed under the guidance of the concept of the sentinel lymph node to determine the extent of node dissection in early lung cancer. Additional subpleural lymphatic flow was clearly identified during the procedure, thereby revealing the possible route of skip metastases to hilar and upper mediastinal lymphatics.

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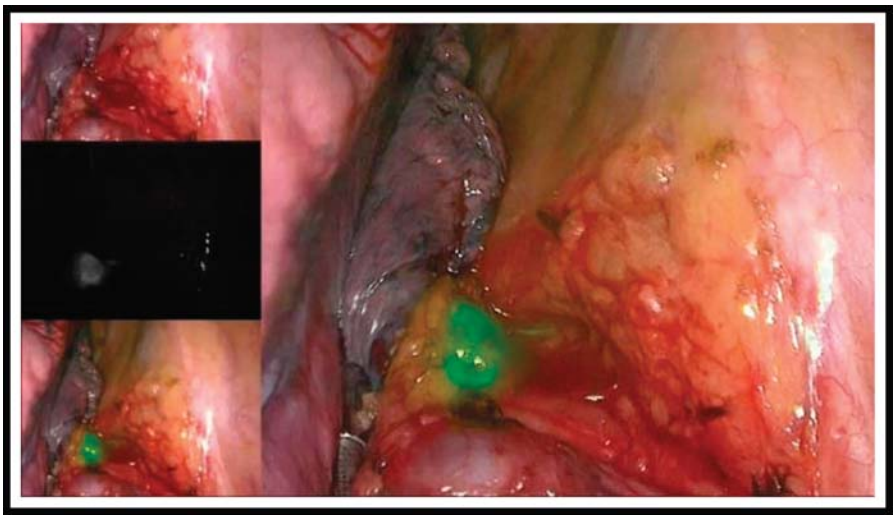

FIGURE D141-1. Fluorescence on perivascular lymph node after percutaneous injection of ICG.

Conclusions: A near-infrared fluorescence thoracoscopic system with ICG injection might be a feasible option to identify the real-time lymphatic flow during video-assisted lobectomy in patients with early lung cancer.

D142

Surgical Outcomes of Native and Prosthetic Valve Infective Endocarditis

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Objective: Infective endocarditis is a serious, life-threatening disease with significant rates of morbidity and mortality. We evaluated the early- and long-term postoperative outcomes of native valve and prosthetic valve infective endocarditis.

Methods: We retrospectively reviewed 72 patients (25 men and 47 women, mean age = 51 years, range 17–80 years) with proven infective native (n = 53) or prosthetic valve (n = 19) endocarditis who underwent a heart valve operation between December 1999 and August 2016 by a single surgeon. Of 53 patients with native valve infective endocarditis, 26 (49%) had aortic procedures (19 replacements, 5 homografts, and 1 repair and 1 Bentall procedure, respectively); 26 (49%) had mitral procedures (17 repairs and 9 replacements); 6 (11%) had tricuspid procedures (4 repairs and 2 replacements); and 2 (4%) had pulmonic procedures (1 repair and 1 replacement, respectively). Of 19 cases of prosthetic valve infective endocarditis, a redo operation was performed from 2 months to 252 months postoperatively; 10 patients (53%) had redo mitral procedures, 5 (26%) had redo aortic procedures, 3 (16%) had redo aortic and mitral procedures, and 1(5%) had a redo Bentall procedure.

Results: The overall hospital mortality rate was 2.7% (n = 2). No patients with native valve infective endocarditis died; deaths in 2 (10.5%) patients with prosthetic valve infective endocarditis died. Causes of early death were sepsis with multiorgan failure and intracranial hemorrhage, respectively. During the follow-up from 1 to 199 months (mean = 78 months), 4 (5.5%) patients had redo cardiac surgery (tricuspid valve replacement and coronary bypass surgery, respectively, in native valve infective endocarditis, and aortic valve repair and redo mitral valve replacement, respectively, in prosthetic valve endocarditis).

Conclusions: We report satisfactory early- and long-term results in patients with native and prosthetic valve infective endocarditis. However, the outcomes are worse in patients with prosthetic valve endocarditis. Thus, we recommend aggressive surgical procedures in patients with native valve and prosthetic valve endocarditis.

D143

Thoracoscopic Extended Thymothymectomy for Myasthenia Gravis and Thymic Malignancies: A Bilateral Minimally Invasive Approach

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Objective: Studies of the usefulness of thoracoscopic extended thymothymectomy for myasthenia gravis and thymic malignancies have reported equivalent early and midterm outcomes, shorter lengths of stay, and low rates of postoperative complications. We performed thoracoscopic extended thymothymectomies on 4 patients. Our goal was to present surgical tips for maximizing the operative field and minimizing chest wall trauma using a bilateral minimally invasive approach based on our experience.

Methods: In our procedure, the patient is placed in a left semilateral position under general anesthesia using a double-lumen tube. Then, using a 5 mm flexible thoracoscope and a bipolar sealing device, the thymic tumor is removed to avoid tumor implantation. The thymic tissue is detached from the anterior mediastinum and inferior pole of the thymus on the right side via a 3-port thoracoscopic surgical procedure in the right chest wall. Next, the thymic tissue is detached from both inferior poles of the thyroid gland to the superior mediastinum by pushing the upper mediastinal organs using cotton swabs. After turning the patient over, we detach the left-side thymic tissue through 3 ports. Finally, the thymus, including the anterior mediastinal fat, is removed under thoracoscopic view.

Results: The surgical procedure was completed in all patients, with operating times ranging from 270 to 300 minutes, and with less than 50 g hemorrhage. There was little postoperative pain due to the port sites. The postoperative courses were uneventful; all 4 patients were discharged 3 to 5 days postoperatively and have had no recurrence for 1 to 28 months.

Conclusions: Using a bilateral minimally invasive approach, we excised sufficient fat from around the left brachiocephalic vein and excised the thymoma in 1 piece with the mediastinal parietal pleura. For safe manipulation, we think that the use of a 5 mm flexible thoracoscope is effective for decreasing the invisible areas, particularly the space behind the sternum.

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