STSA WEBINAR

SCIENTIFIC PAPERS

Tuesday, December 13, 2022

6:00 p.m. – 8:30 p.m. ET

1. Advancing the Treatment Paradigm for Patients with Multivessel Coronary Disease: Long-Term Outcomes After Hybrid Coronary Revascularization (Adult Cardiac)

Authors: Parth Patel*, Ryon Arrington, Amalia Jonsson, Jane Wei, Jose Binongo, Chandan Devireddy, Michael Halkos

Presenter Institution: *Emory University, Atlanta, GA*

Objectives: Hybrid coronary revascularization (HCR) is a minimally-invasive alternative to traditional coronary artery bypass surgery via sternotomy for patients with multivessel disease. The purpose of this study was to examine the long-term outcomes of HCR.

Methods: From 2009 to 2021, 561 consecutive patients (median age 64.0, predicted risk of mortality 1.3±1.8%, 397 (70.8%) with 2-vessel disease and 164 (29.2%) with 3-vessel disease) underwent a planned HCR with a robotic-assisted off-pump left internal mammary artery-left anterior descending (LIMA-LAD) graft via a 4cm non-rib spreading left anterior thoracotomy combined with percutaneous coronary intervention (PCI) of non-LAD vessels. Short-term outcomes were obtained via the STS database and long-term outcomes obtained with phone call follow-up. Multivariable regression analysis was used to identify risk factors for short- and long-term outcomes.

Results: Robotic-assisted LIMA-LAD grafting was performed first followed by PCI in 358 (64%) patients while 137 (24%) patients had PCI first; 66 (11.8%) patients underwent concomitant procedure in a hybrid suite. Operative mortality and stroke occurred in 3 (0.5%) and 5 (0.9%) patients, respectively. Postoperative angiography revealed patent LIMA-LAD grafts in 415/426 (97%) patients. Median follow-up time was 4.9 years and was 93% complete. Forty-three (8%) patients required repeat revascularization at a median of 3.2 years. Of these, target vessel repeat revascularization occurred in 27 (63%) and progression of native vessel disease occurred in 16 (37%) patients. Five-year freedom from repeat revascularization was similar between 3-vessel (91%) and 2-vessel disease (91%), p=0.63. There was no difference in 5-year survival in 3-vessel (93%) compared to 2-vessel (90%) disease patients (p=0.23). Completely revascularized patients had a 91% 5-year survival versus 78% for incompletely revascularized patients (HR 2.8, p=0.01, Figure 1). Age (p=0.03, HR 1.02), renal failure (p<0.0001, HR 4.15), and history of myocardial infarction (p=0.01, HR 1.62) were risk factors for late adverse events.

Conclusions: HCR is a safe and effective minimally-invasive alternative to conventional CABG or multivessel PCI with a low incidence of late repeat revascularization and mortality. HCR can be safely applied to carefully selected patients with either 2- or 3-vessel disease; however, incomplete revascularization results in lower long-term survival.

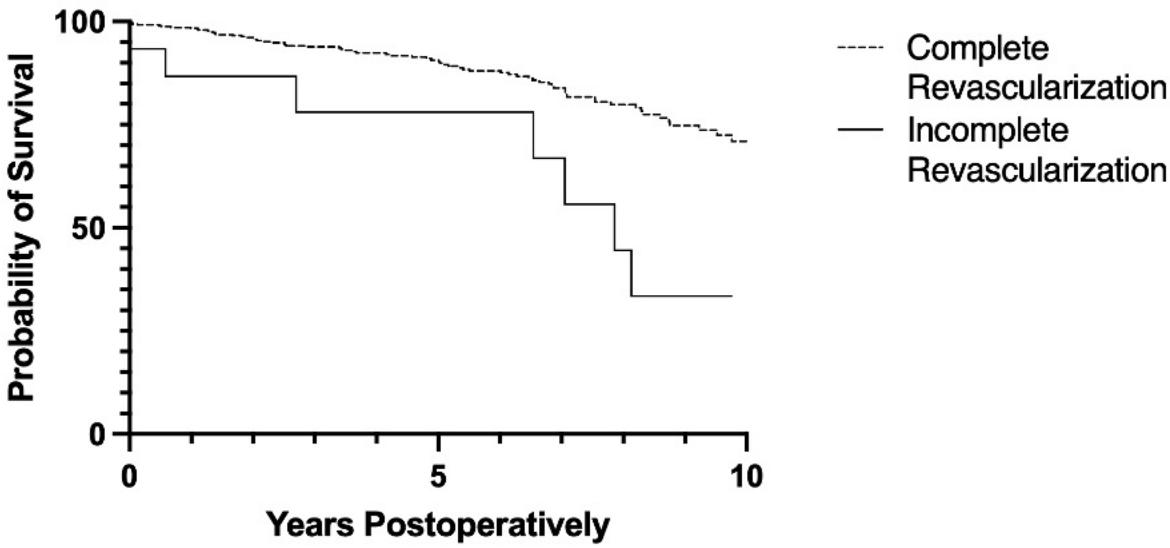


Image Description:
Figure 1: Kaplan-Meier survival curve of complete versus incompletely revascularized patients, hazard ratio 2.76, 95% confidence interval 1.25-6.12, p=0.01 on STSPROM adjusted comparison.

2. Outcomes in Stereotactic Body Radiation Therapy and Wedge Resection in Octogenarian Patients: A Propensity-Score Matched Study (Thoracic)

Authors: Rolfy Perez Holguin*, William Wong, Chan Shen, Matthew Taylor, Michael Reed, Pauline Go

Presenter Institution: *Penn State Health Milton S. Hershey Medical Center, Hershey, PA*

Objectives: Surgical resection is the mainstay of treatment for early-stage non-small cell lung cancer (NSCLC). Stereotactic body radiation therapy (SBRT) has been proposed as an alternative for elderly patients who might benefit from avoiding the morbidity associated with surgery. The aim of these study is to evaluate the two treatment modalities in the octogenarians.

Methods: The National Cancer Database was used to identify patients age ≥80 years with clinical T1N0M0 NSCLC who underwent wedge resection or SBRT. Patients identified as unfit for surgery due to medical comorbidities were excluded. Propensity-score matching (PSM) was used to create a matched cohort. Kaplan-Meier method and multivariable Cox proportional hazard model were used to evaluate overall survival (OS).

Results: 3,755 patients met inclusion criteria. PSM yielded 124 well balanced matched pairs. The unadjusted 5-year OS for the matched wedge resection group was 50.9%, compared to 20.0% for the SBRT group. On multivariable analysis, wedge resection was associated with improved survival compared to SBRT (HR 0.414, p<0.001). In the cohort of patients treated with wedge resection, 5.8% were upstaged on final pathology and 1.4% were found to have positive lymph nodes.

Conclusions: Compared to SBRT, wedge resection is associated with improved survival in octogenarian patients with clinical T1N0M0 NSCLC. Surgical resection allows for pathologic examination and lymph node sampling which can lead to upstaging. Further investigation is warranted to identify the utility of SBRT for octogenarian patients.

Image Description: Kaplan-Meier curves for propensity-matched cohort of patients with early-stage NSCLC stratified by treatment with stereotactic body radiation therapy and wedge resection.

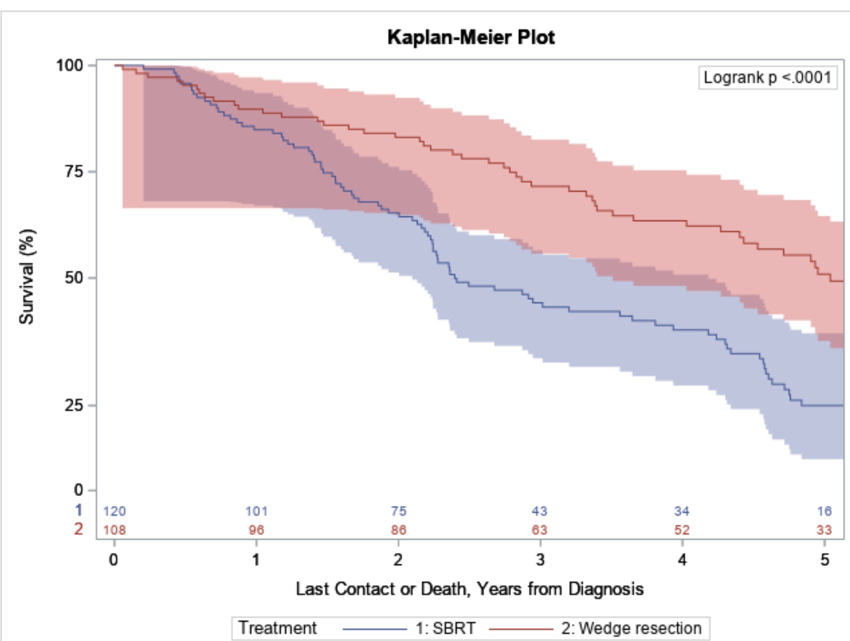


Table Description: Multivariable Cox proportional hazard ratio model for factors associated with overall survival in the propensity-matched cohort.

Table 3. Multivariable Cox proportional hazard ratio model for factors associated with overall survival in the propensity-matched cohort.

	HR	95% CI		p-value
Treatment				
SBRT	reference			
Wedge Resection	0.414	0.291	0.587	<0.001
Age at Diagnosis				
Per 5-year increase	1.213	0.906	1.623	0.195
Sex				
Male	reference			
Female	1.016	0.718	1.439	0.927
Race				
White, Non-Hispanic	reference			
Other (Asian, Black, Hispanic)	0.741	0.405	1.355	0.330
Charlson-Deyo Score				
0	reference			
1	1.232	0.804	1.888	0.338
2	1.993	1.193	3.330	0.008
3	1.406	0.735	2.688	0.303
Distance from home zip code to facility				
1-49 Miles	reference			
≥50 Miles	1.054	0.665	1.669	0.824
Facility Type				
Community Cancer Program	reference			
Academic/Research Cancer Program	0.762	0.519	1.121	0.168
Facility Volume				
Low volume	reference			
High Volume	1.388	0.900	2.142	0.138
Tumor Size				
Per 5mm increase	1.041	0.921	1.177	0.518

HR: Hazard Ratio, CI: Confidence interval, SBRT = stereotactic body radiation therapy

3. Septal Myectomy Outcomes in 199 Children and Adolescents With Obstructive Hypertrophic Cardiomyopathy (Congenital)

Authors: Elaine Griffeth*, Elizabeth Stephens, Hartzell Schaff, Michael Ackerman, Jonathan Johnson, Bryan Cannon, Joseph Dearani

Presenter Institution: *Mayo Clinic, Rochester, MN*

Objectives: Hypertrophic cardiomyopathy (HCM) is an important source of morbidity and mortality for pediatric patients; however prior pediatric myectomy outcomes analyses have been limited by small cohort sizes. Our goal was to evaluate pediatric septal myectomy outcomes in a large referral population.

Methods: From 1976 through 2020, 199 consecutive patients age 18 years or younger with obstructive HCM (median [IQR] age 13 [8, 15] years; 131/199 [66%] males) underwent left and/or right ventricular septal myectomy at our institution. Cumulative incidence with competing risk of death and Kaplan-Meier survival analyses were performed.

Results: 198/199 (99%) underwent left ventricular myectomy (163/198 [82%] transaortic, 16/198 [8%] transapical, and 19/198 [10%] combined), while 13/199 (7%) underwent right ventricular myectomy and 15/199 (8%) had patch reconstruction of the right ventricular outflow tract. Additional details in Table 1. Relief of left ventricular outflow tract gradients was demonstrated by direct intraoperative measurement of resting gradients, pre-bypass mean 54 ± 32 mmHg vs post-bypass mean 6 ± 8 mmHg ($p<0.0001$). Iatrogenic aortic and mitral valve injury occurred in 13/199 (7%) and 1/199 (1%), respectively; however, immediate valve repair was successful for all. Operative mortality was 2/199 (1%). Median (IQR) postoperative hospital length of stay was 5 (4, 7) days. Postoperative ventricular arrhythmias were seen in 19/199 (10%). Other complications included cardiac arrest (8/199 [4%]), complete heart block (7/199 [4%]), delayed sternal closure (7/199 [4%]), mechanical circulatory support (5/199 [3%]), stroke (3/199 [2%]), and reoperation for bleeding (3/199 [2%]). Over a median (IQR) follow-up of 4.8 (1.0, 10.1) years, cumulative incidence of redo myectomy was low, 5.8% at 5 years and 8.3% at 10 years (Figure 1). Other late reoperations included mitral valve surgery (5/177 [3%]), aortic valve replacement (4/171 [2%]), and cardiac transplantation (7/177 [4%]). Redo myectomy patients were younger (median age [IQR] 8 [2.5, 10] vs 13 [9, 16] years; $p<0.001$) and smaller (median body surface area [IQR] 0.78 [0.6, 1.27] vs 1.54 [1.01, 1.87] m2; $p<0.001$) at index operation. 17 patients experienced resuscitated sudden cardiac arrest during the follow-up period, and transplant-free survival was 98%, 96%, 92%, and 84% at 1, 5, 10, and 15 years.

Conclusions: Pediatric septal myectomy is safe and provides effective relief of ventricular outflow tract obstruction. Iatrogenic valve injury remains a low but non-negligible risk in pediatric patients. Recurrent obstruction requiring redo myectomy is infrequent, but most common amongst those younger and smaller at index operation. Long-term survival continues to compare favorably to non-operated HCM.

Table Title: Table 1: Preoperative and Operative Details

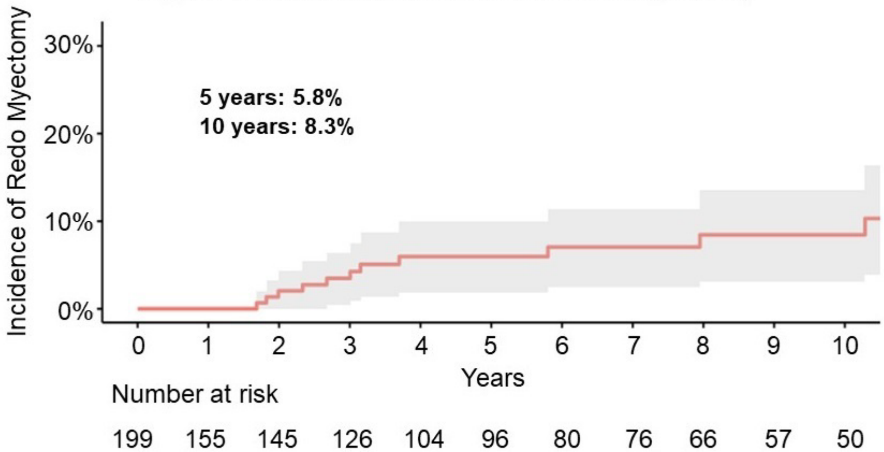
Table Description: Preoperative patient characteristics, cardiac anatomy, operative details.

Preoperative Characteristics	**N (%)**
Symptoms [a]	152 (76%)
Dyspnea at Rest	9 (5%)
Dyspnea with Exertion	130 (65%)
Angina	68 (34%)
Syncope	38 (19%)
History of Sudden Cardiac Death	9 (5%)
History of Ventricular Arrhythmia	24 (12%)
History of Atrial Fibrillation	3 (2%)
Previously Implanted Pacemaker	10 (5%)
Previously Implanted ICD	36 (18%)
ECG Rhythm	
Normal Sinus Rhythm	149 (75%)
Sinus Tachycardia/Bradycardia	39 (20%)
Sinus Arrhythmia [b]	16 (8%)
Anatomy	**N (%)**
Left Ventricular Outflow Tract Obstruction [c]	
Tunnel [d]	2 (1%)
Basal	157 (79%)
Midventricular	130 (65%)
Anomalous Papillary Muscle	16 (8%)
Right Ventricular Outflow Tract Obstruction [c]	
Septal	14 (7%)
Infundibular	13 (7%)
Free Wall	4 (2%)
Mitral Valve Dysplasia	20 (10%)
Operative Details [e]	**N (%)**
Left Ventricular Myectomy	198 (99%)
Right Ventricular Myectomy	13 (7%)
Right Ventricular Outflow Tract Patch Reconstruction	15 (8%)
Concomitant Procedures	78 (39%)
Epicardial ICD	30 (15%)
ASD Closure	12 (6%)
Mitral Valve Replacement	3 (2%)
Mitral Valve Repair	17 (9%)
Aortic Valve Repair	20 (10%)

(a) some patients had multiple symptoms; (b) sinus arrhythmia often present with another underlying sinus rhythm; (c) some patients had multisite obstruction; (d) subvalvular, valvular (bicuspid aortic valves), and supravalvular aortic stenosis; (e) some patients had multiple procedures; ICD=implantable cardioverter-defibrillator; ECG=electrocardiogram; ASD=atrial septal defect

Image Title: Figure 1: Cumulative Incidence of Redo Myectomy

Figure 1: Cumulative Incidence of Redo Myectomy



4. Risk of Permanent Pacemaker Implantation After Degenerative Mitral and Concomitant Tricuspid Valve Surgery (Adult Cardiac)

Authors: Alexander Brescia*, Tessa Watt, Catherine Wagner, Robert Hawkins, China Green, Matthew Romano, Steven Bolling, Gorav Ailawadi

Presenter Institution: *University of Michigan, Ann Arbor, MI*

Objectives: Tricuspid regurgitation (TR) is common in patients with degenerative mitral regurgitation (MR). Recent randomized trial data showed a reduction in progression to severe TR when concomitant tricuspid annuloplasty was performed, but at a cost of 14% permanent pacemaker rate. We present real-world outcomes of surgery for degenerative MR with and without tricuspid annuloplasty at a high-volume mitral center.

Methods: All patients undergoing first-time mitral valve surgery for degenerative MR between July 2011–December 2021 at a single high-volume mitral center were identified (n=1,741). Patients undergoing aortic, aortic valve, or tricuspid replacement procedures were excluded. Remaining patients were stratified into those who underwent mitral surgery alone (n=1,170) versus mitral surgery plus tricuspid annuloplasty (n=445). Preoperative risk profiles and short-term outcomes including operative mortality, new permanent pacemaker (PPM) implantation, and postoperative length of stay were reported. Cumulative mortality is displayed by Kaplan-Meier estimates. Cox regression incorporating 13 preoperative risk factors was utilized to evaluate risk-adjusted all-cause mortality between groups.

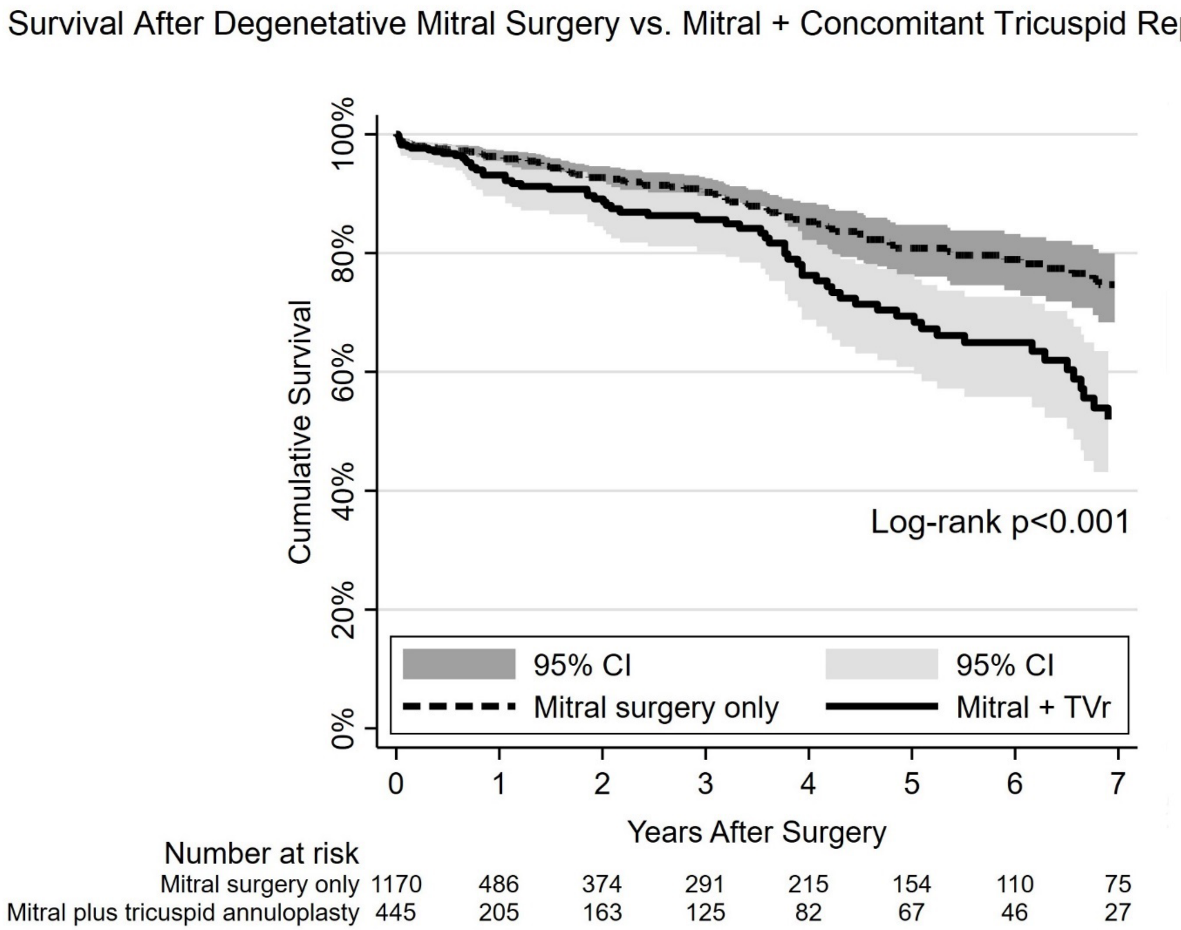
Results: Among all 1,615 mitral patients included, 97.2% underwent mitral valve repair. Compared to concomitant tricuspid annuloplasty patients, those undergoing mitral surgery alone were younger (63±13 vs. 69±12 years, p<0.001) and had lower median STS PROM and Euroscore (Table). Among concomitant tricuspid patients, 84% (374/445) had moderate or less TR, while 16% (17/445) had severe TR. The mitral surgery only group underwent fewer concomitant atrial fibrillation procedures (19% vs. 55%, p<0.001) and mean cross-clamp time was 25 minutes shorter. Overall, operative mortality was 1.5% and did not differ between groups. However, the incidence of new PPM implantation was 0.8% (9/1170) in the mitral only group and 5.6% (25/445) in the mitral plus tricuspid annuloplasty group (p<0.001). Although unadjusted cumulative survival was lower in the concomitant tricuspid annuloplasty group (Figure; p<0.001), concomitant tricuspid surgery was not associated with worse long-term mortality after risk adjustment (HR 1.01 [95% CI, 0.70–1.44], p=0.97).

Conclusions: Concomitant tricuspid annuloplasty during degenerative mitral valve surgery was safe, with no difference in short- or long-term mortality. The new PPM implantation rate was less than 6% at a high-volume mitral center. These data provide real-world context to recent trial data for concomitant tricuspid annuloplasty.

Table Description: Patient characteristics for those undergoing degenerative mitral valve surgery with or without concomitant tricuspid valve annuloplasty.

	Mitral valve surgery alone (n=1170)	Mitral surgery + tricuspid repair (n=445)	P-value
Age, mean years	63 ± 13	69 ± 12	**<0.001**
Female sex	465 (40%)	166 (37%)	0.37
STS PROM, median [IQR] (n=1245)	0.6% [0.3%–1.3%]	1.0% [0.5%–2.2%]	**<0.001**
Euroscore, median [IQR] (n=1615)	1.2% [0.7%–3.3%]	2.9% [1.3%–7.1%]	**<0.001**
Elective status	1117 (95%)	421 (95%)	0.77
Preoperative TR grade			
None	78 (7%)	18 (4%)	**<0.001**
Trivial/trace	382 (33%)	55 (12%)	
Mild	458 (39%)	142 (32%)	
Moderate	136 (12%)	159 (36%)	
Severe	19 (2%)	71 (16%)	
Unknown	97 (8%)	0	
Concomitant procedures			
Anti-arrythmia procedure	221 (19%)	243 (55%)	**<0.001**
CABG	103 (9%)	49 (11%)	0.18
Bypass time, mean minutes	94 ± 45	121 ± 55	**<0.001**
Cross-clamp time, mean minutes	68 ± 34	93 ± 41	**<0.001**
Operative mortality	16 (1.4%)	8 (1.8%)	0.52
New permanent pacemaker implantation	9 (0.8%)	25 (5.6%)	**<0.001**

Image Description: Kaplan-Meier estimates of unadjusted cumulative survival for those undergoing degenerative mitral valve surgery with or without concomitant tricuspid valve annuloplasty. TVr, tricuspid valve repair.



5. Machine Learning Guided Cytologic Optical Visualization With Deep Neural Network Optimized Device Predicts Malignancy Potential of Indeterminate Solitary Pulmonary Nodules (Thoracic)

Authors: Feredun Azari*, Gregory Kennedy, Bilal Nadeem, Ashley Chang, Sardar Azari, John Kucharczuk, Sunil Singhal

Presenter Institution: *Hospital of the University of Pennsylvania, Philadelphia, PA*

Objectives: Sub-centimeter solitary pulmonary nodules are common and often require biopsy for diagnosis. Our group has developed a near-infrared needle-based confocal laser endomicroscopy (NIR-nCLE) imaging system for detecting cancer at the cellular level during biopsy. However, NIR-nCLE imaging sequences are challenging to interpret for non-experts. The purpose of this study was to evaluate a deep neural network (DNN) trained NIR-nCLE image analyzer for rapid diagnosis of indeterminate nodules.

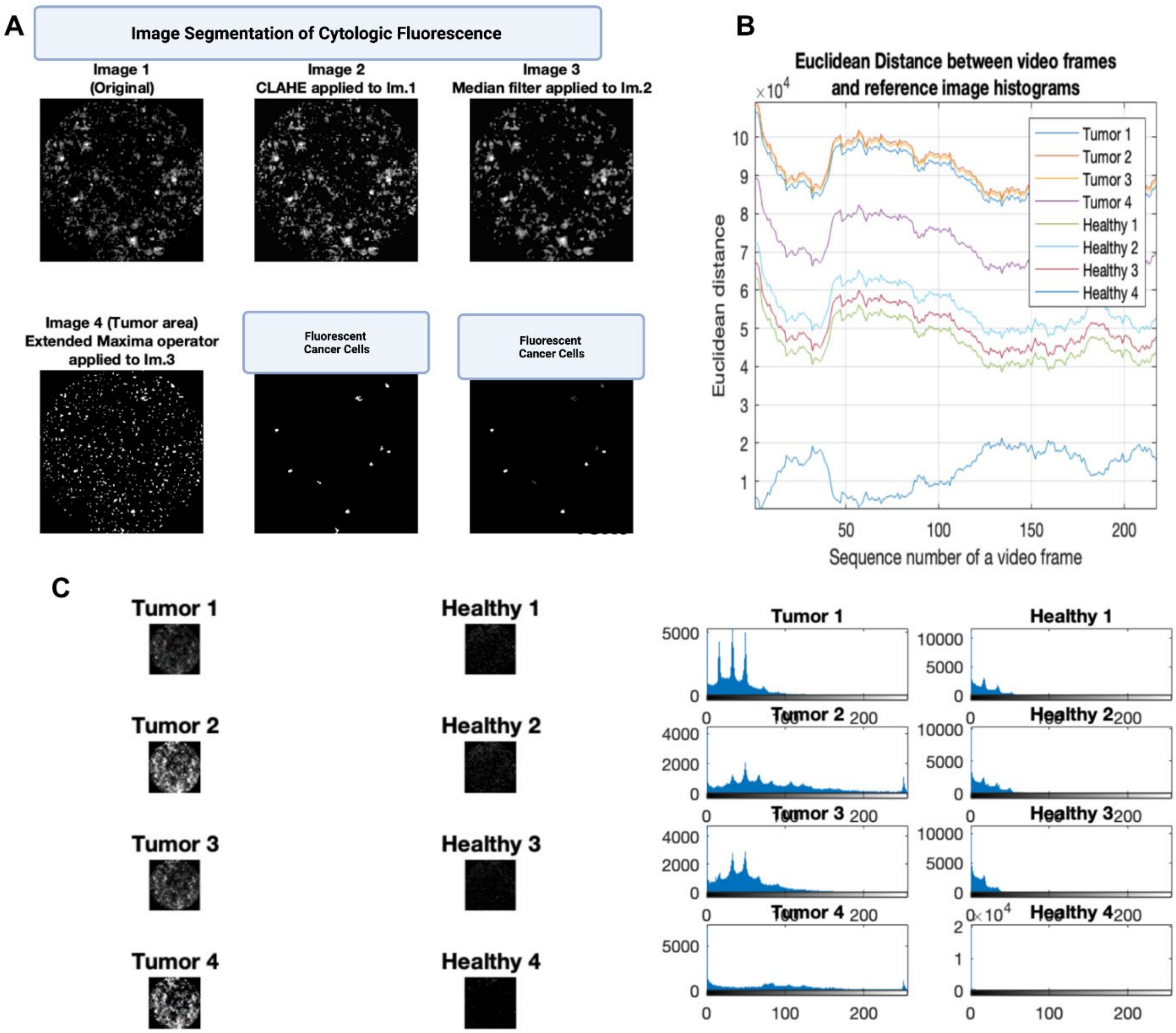
Methods: Predictive DNN test set model was developed by image segmentation of individual microsecond NIR-nCLE frames from 250 pulmonary lesions. Each frame was analyzed 360 degrees in the x,y, and z axes leading to total of 191234 individual fluorescence frame points per second. Optimized DNN model was then evaluated in validation cohort of 50 lesions and the model was further optimized using Euclidian biofluorescence analysis. Predictive nomogram was then generated incorporating histologic diagnosis, demographic factors, and tumor characteristics.

Results: DNN machine learning incorporation of logistic regression kernel, linear support vector machines (SVM) kernel, trilayered neural network, bilayered neural network, and wide neural network of test set cohort produced an accuracy of 98.1% (187600/191234) for diagnosis of malignant NSCLC, and 97.78% (14550/15000) for benign lesions(Figure). Median training time for each individual time frame was 6.27 ms (±0.44) with average prediction ability) of 560 observations (diagnoses) per second(Figure). Model accuracy in the in-validation cohort using the fine gaussian SVM, cubic SVM, quadratic SVM, and linear SVM generated similar diagnostic accuracy of 98.9% for malignant lesions and 98.1% for benign lesions. Analysis off fluorescence Euclidean distances between video frames of benign, indeterminate, and malignant lesions generated an ROC with AUC of 0.94(±0.12)(Figure). The device was able to recognize cytologic biopsy sequences where the operator did not capture adequate sample area and instructed the surgeon to re-assess the tumor site within 2.33 seconds (±1.33) of sample analysis. Final analysis of three output variables in the cross-validation cohort using fine-gaussian SVM yielded diagnostic accuracy of 98.1 % (malignant lesions), 97.8% (benign lesions), and 99.1% (insufficient biopsy area) (Figure).

Conclusions: DNN and machine learning in combination with NIR-nCLE can accurately and rapidly diagnose indeterminate pulmonary lesions during biopsies. The implementation of this objective cytologic analysis technology has the potential of saving significant health-care costs, improving diagnostic accuracy for non-palpable and visually occult lesions.

Image Title: Neural network based image analysis of indeterminate pulmonary nodules with NIR-nCLE.

Image Description: A: deep neural network and machine learning based analysis of the nCLE-NIR video frames. The algorithm identifies areas of tumor fluorescence and performs appropriate thresholding from the test set to clearly recognize cytologic areas of concern. B: Euclidian distances of fluorescence intensity between validation set malignant and benign tumors. C: Histopathologic and DNN image segmentation correlation between benign and malignant tumors.



6. An Analysis of 186 patients with Pediatric and Congenital Heart Disease Undergoing Cardiac Transplantation: The Impact of Pre-Transplant Ventricular Assist Device (Congenital)

Authors: Mark Bleiweis*, Yuriy Stukov, Joseph Philip, F. Fricker, Giles Peek, Dipankar Gupta, Renata Shih, Bill Pietra, Kevin Sullivan, Omar Sharaf, Connie Nixon, Dan Neal, Jeffrey Jacobs

Presenter Institution: *University of Florida, Gainesville, FL*

Objectives: Mechanical circulatory support with ventricular assist devices (VADs) is increasingly utilized to support patients with pediatric and congenital cardiac disease as a bridge to transplantation. We reviewed our management strategy and outcome data for all 186 patients with pediatric and/or congenital heart disease who underwent heart transplantation from 01/01/2011 to 3/1/2022 and evaluated the impact of pre-transplant support with VAD.

Methods: Patient characteristics were assessed stratified by pre-transplant VAD status. Continuous variables are presented as mean(SD); median[interquartile range](range); categorical variables are presented as N(%). P-values are the results of Fisher's exact tests (categorical variables) or Wilcoxon rank sum tests (continuous variables).

Univariate associations with long-term survival were assessed with a Cox proportional hazards model with the factor as the only predictor of survival; hazard ratios (HR) and P-values are reported.

The effect of VAD on survival was estimated with a series of multivariable models, each controlling for one of the factors shown in univariate analysis to be associated with long-term survival.

Kaplan-Meier methods were used to estimate survival for patients stratified by VAD status; log-rank tests were used to compare groups.

Results: Pre-transplant VAD was present in 53/186 patients (28.5%).

Patients with VAD were younger: 4.8(5.6) years;1[0.5,8](0.1,18) versus 12.1(12.7);10[0.7,17](0.1,58), P=0.0001.

Patients with VAD had a higher number of prior cardiac operations: 3.0(2.3);2[1,4](1,12) versus 1.8(1.9);2[0,3](0,8), P=0.0003.

Patients with VAD were more likely to receive ABO incompatible transplant 9/133(6.8%) versus 10/53(18.9%), P=0.028.

Univariate associations with long-term mortality include:

- Prior cardiac surgery: HR=5.5(1.30,23.5), P=0.021
- Number of prior cardiac surgeries: HR multiplies by 1.3 for each additional surgery (1.12,1.50), P=0.0005
- Functionally univentricular heart: HR=2.5(1.12,5.82), P=0.026
- Acquired heart disease (vs. congenital): HR=0.19(.056,.629), P=0.007
- Pre-transplant renal dysfunction: HR=3.2 (1.44,7.01), P=0.004

In multivariate analysis, pre-transplant VAD does not impact survival when controlling for each one of the factors shown in univariable analysis to be associated with long-term survival.

Table 1 shows Kaplan-Meier survival estimates with 95% Confidence Intervals.

Overall Kaplan-Meier 5-year survival (95% Confidence Interval) is 86.3%(80.6-92.3%) and is 84.6%(77.7-92.1%) without pre-transplant VAD and 91.5%(83.8-99.9%) with pre-transplant VAD.

Figure 1 compares Kaplan-Meier survival in patients with and without pre-transplant VAD and documents no significant difference in survival (log-rank P=0.9).

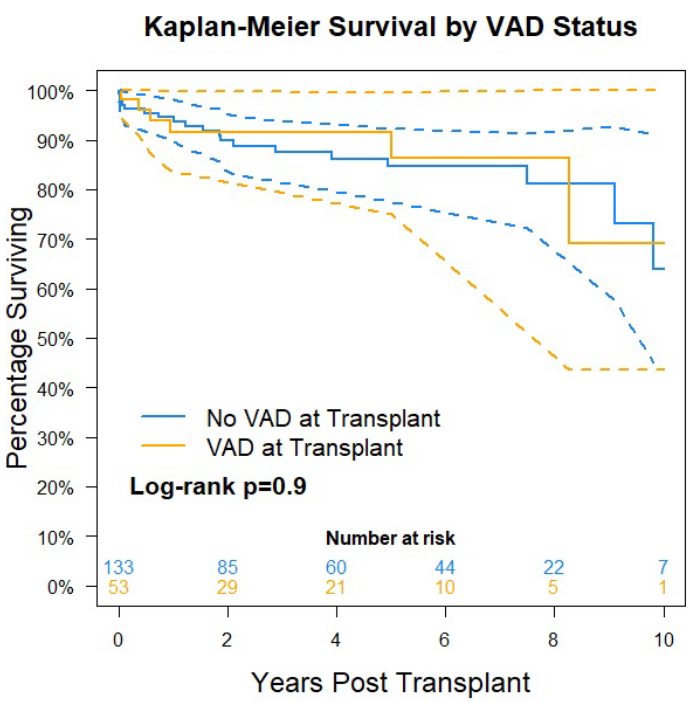
Conclusions: Our single institution analysis of 186 patients undergoing cardiac transplantation over 11.25 years reveals similar survival in patients with (n=53) and without (n=133) pre-transplant VAD. The presence of a pre-transplant VAD is not a risk factor for survival after transplantation for pediatric and/or congenital heart disease.

Table: Kaplan-Meier Survival Estimates with 95% Confidence Intervals

Table Description: Table 1 shows Kaplan-Meier survival estimates with 95% Confidence Intervals at 1, 2, 3, 5, and 10 years for all 186 patients and for those patients with pre-transplant VAD (n=53) and without pre-transplant VAD (n=133).

Kaplan-Meier Survival Estimates with 95% Confidence Intervals			
	All patients	**No VAD**	**VAD**
1-year survival	93.8% (90.2-97.4%)	94.6% (90.7-98.6%)	91.5% (83.8-99.9%)
2-year survival	90.2% (85.7-94.9%)	89.8% (84.4-95.5%)	91.5% (83.8-99.9%)
3-year survival	88.5% (83.6-93.8%)	87.5% (81.6-94.0%)	91.5% (83.8-99.9%)
5-year survival	86.3% (80.6-92.3%)	84.6% (77.7-92.1%)	91.5% (83.8-99.9%)
10-year survival	64.1% (46.5-88.3%)	64.0% (44.9-91.1%)	69.1% (43.6-99.9%)

Image Title: Figure 1: Kaplan-Meier Survival by VAD Status
Image Description: Figure 1 compares Kaplan-Meier survival in patients with and without pre-transplant VAD and documents no significant difference in survival (log-rank P=0.9).



7. Long-Term Results of Stentless Aortic Valve Replacement in 2,000 Patients Over 20 Years (Adult Cardiac)

Authors: Craig Jarrett*, Marc Pelletier, Yasir Abu-Omar, Cristian Baeza, Yakov Elgudin, Kelsey Gray, Omar Hussian, Pablo Ruda Vega, Gregory Rushing, Joseph Sabik, Alan Markowitz

Presenter Institution: *University Hospitals Cleveland, Cleveland, OH*

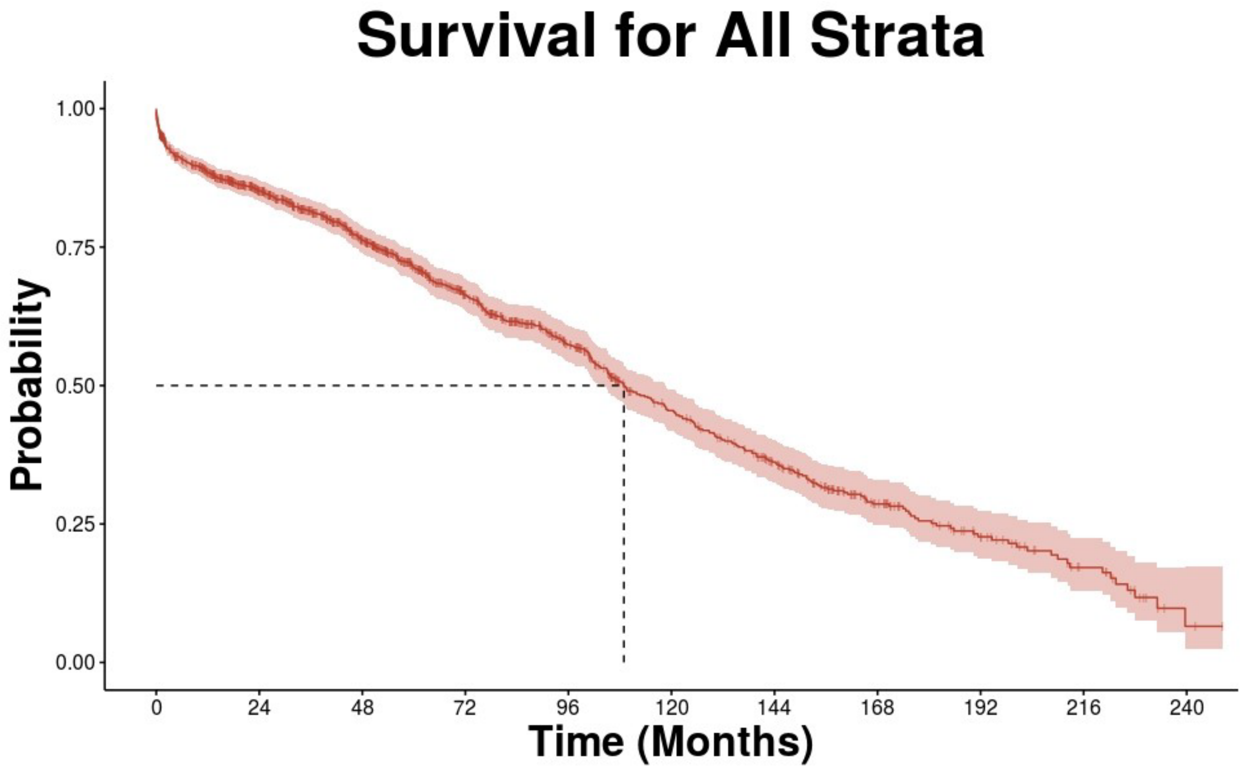
Objectives: Midterm results have shown that stentless xenograft bioprostheses are a durable solution for isolated aortic valve replacement (AVR). We sought to determine the long-term results of AVR with and without concomitant procedures using the Medtronic Freestyle bioprosthesis (Medtronic Inc, Minneapolis, MN).

Methods: From June 1998 through November 2021, 2,043 patients underwent AVR with the Freestyle bioprosthesis at our center—33.8% (691/2,043) underwent isolated AVR (AVR), 20.2% (413/2,043) underwent AVR with CABG alone (AVR + CABG), and 46.0% (940/2,043) underwent AVR with another procedure not including CABG alone (AVR + Other). Implantation techniques included: full root (32.7%), complete subcoronary (2.5%), and modified subcoronary (64.8%).

Results: Mean age was 71 ± 12, 62.1% were male, 18.3% had undergone previous cardiac surgery, 48.8% had coronary artery disease, 6.7% had infective endocarditis, 22.2% had chronic lung disease, 19.3% had cerebrovascular disease, 3.2% were on dialysis, and 25.2% had diabetes. Total follow-up was 12,174 patient-years. In contemporary patients with applicable Society of Thoracic Surgeons (STS) risk scores (AVR and AVR + CABG), median predicted risk of mortality was 2.9% [1.7, 5.2], and median STS predicted mortality and morbidity was 16.7% [11.1, 22.7]. Overall, in-hospital myocardial infarction (0.5%), stroke (1.3%), and renal failure (9.7%) were acceptable. Thirty-day mortality was 4.2% overall—1.7% for AVR, 2.5% for AVR + CABG, and 5.9% for AVR + Other. Across all strata, freedom from all-cause mortality was 88.5% at 1, 71.3% at 5, 45.5% at 10, 25.6% at 15, and 6.5% at 20 years (Figure 1). Freedom from reoperation or re-intervention was 97.9% at 5, 91.1% at 10, and 77.8% at 15 years. Freedom from explant for structural valve degeneration was 99.8% at 5, 94.5% at 10, and 80.4% at 15 years.

Conclusions: Long-term results of AVR with stentless bioprostheses are comparable to or better than published results of stented bioprostheses. Stentless AVR should remain a viable option for AVR with or without concomitant procedures in all patients and the preferred option in younger patients due to its customizability, hemodynamics, and very long-term durability.

Image Title: Survival of Patients with Stentless Bioprostheses
Image Description: Survival of all strata of patients who underwent AVR with a stentless bioprosthesis with or without concomitant procedures over 20 years. AVR = aortic valve replacement.



8. Hospital Level Segregation Among Medicare Beneficiaries Undergoing Esophagectomy and Lung Cancer Resection (Thoracic)

Authors: Sidra Bonner*, Nicholas Kunnath, Justin Dimick, Andrew Ibrahim, Kiran Lagisetty

Presenter Institution: *University of Michigan, Ann Arbor, MI*

Objectives: Reduction of racial and ethnic disparities in healthcare is a current priority of providers, payers, and policymakers. Recent research has raised concern that healthcare segregation, the high concentration of racial groups within a subset of hospitals, are a key contributor to persistent disparities. However, to date the extent and effect of hospital level segregation among patients undergoing esophagectomy and resection for lung cancer remains unclear.

Methods: We conducted a longitudinal cohort study using 100% Medicare fee-for-service claims to evaluate the degree of hospital level racial segregation for patients aged 65-99 years old. We included patients undergoing resection for lung cancer and esophagectomy between 2014-2018. We identified Minority Serving Hospitals as the top decile of hospitals by volume of racial/ethnic minority beneficiaries served. Multivariable logistic regression analysis was used compare surgical outcomes between minority serving vs. non-minority serving hospitals. Covariates included comorbidities, admission type, operation performed, and hospital characteristics (ownership, bed size, geographic region, teaching status and patient/nurse ratio).

Results: Overall, a total of 132,166 patients were included with racial composition of 117,189(88.7%) White, 9,041(6.8%) Black, 2,188(1.7%) Asian, 1,241(0.9%) Hispanic, 388(0.3%) Native American. The degree of hospital level segregation found that 31.1%, 15.7%, 15.4% and 8.2% of all hospitals performed 90% of lung cancer resection and esophagectomies for Black, Asian, Hispanic, and Native American beneficiaries, respectively. For esophagectomy, Minority serving hospitals compared to non-minority serving hospitals had higher mortality (12.1% vs. 8.0%; OR 1.62, 95%CI1.47-1.78; P<0.001), complications (44.8% vs. 36.7%; OR 1..49; P<0.001), re-operations (5.6% vs. 4.8%; OR 1.16, 95%CI 1.04-1.27; P<0.001). Resection for lung cancer performed at minority serving hospitals was associated with higher mortality (3.9% vs. 3.1%; OR 1.19, 95%CI 1.15-1.23; P<0.001), complications (18.0% vs. 15.9%; OR 1.16, 95%CI 1.13-1.19; P<0.001) and readmissions (11.7% vs. 11.2%; OR 1.04, 95%CI 1.02-1.05; P<0.001).

Conclusions: Our findings suggest that a small proportion of hospitals provide a disproportionate amount of surgical care for racial and ethnic minorities with lung and esophageal cancer with inferior surgical outcomes. Future efforts to reduce disparities in complex thoracic oncologic surgery should prioritize quality improvement and resource allocation to these hospitals as an important component to mitigate disparities.

Image Title: Distribution of Racial and Ethnic Minorities compared to White patients across hospitals for esophagectomy and lung cancer resection, 2014-2018.

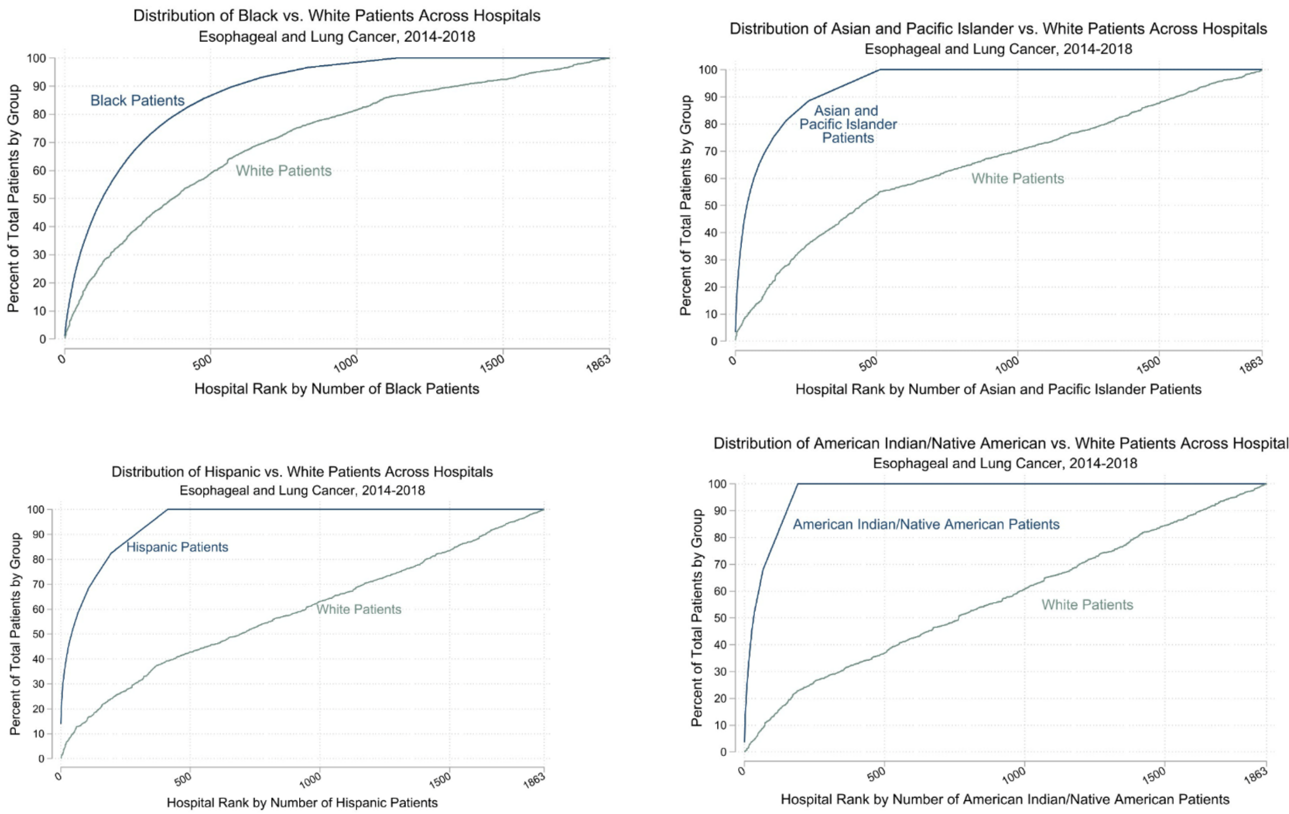


Table Title: Risk Adjusted Surgical Outcomes in Minority Serving Hospitals versus Non-Minority Serving Hospitals for Esophagectomy and Lung Cancer Resection, 2014-2018

	Risk-Adjusted Rates (95% CI), %			
	Non-Minority Serving Hospitals	Minority Serving Hospitals	Odds Ratio	P Value
All Procedures				
Mortality, 30 Day	3.46 (3.32 to 3.60)	4.40 (4.22 to 4.59)	1.20 (1.17 to 1.24)	<0.001
Mortality, In Hospital	1.90 (1.80 to 1.99)	2.39 (2.26 to 2.51)	1.19 (1.15 to 1.23)	<0.001
Complications	17.39 (17.03 to 17.76)	19.63 (19.22 to 20.03)	1.16 (1.14 to 1.19)	<0.001
Serious Complication	9.19 (8.95 to 9.43)	10.99 (10.68 to 11.29)	1.19 (1.16 to 1.21)	<0.001
Reoperations	1.23 (1.16 to 1.29)	1.26 (1.17 to 1.34)	1.00 (0.96 to 1.04)	0.94
Readmissions	11.96 (11.71 to 12.20)	12.31 (12.03 to 12.60)	1.03 (1.01 to 1.04)	0.001
Esophagectomy				
Mortality, 30 Day	8.01 (7.38 to 8.64)	12.08 (10.92 to 13.25)	1.62 (1.47 to 1.78)	<0.001
Mortality, In Hospital	5.34 (4.82 to 5.87)	8.04 (7.05 to 9.04)	1.58 (1.42 to 1.76)	<0.001
Complications	36.69 (35.55 to 37.84)	44.77 (43.15 to 46.40)	1.49 (1.39 to 1.60)	<0.001
Serious Complication	17.85 (16.91 to 18.79)	22.58 (21.16 to 23.99)	1.42 (1.31 to 1.53)	<0.001
Reoperations	4.83 (4.34 to 5.33)	5.60 (4.86 to 6.35)	1.15 (1.04 to 1.27)	0.01
Readmissions	22.10 (21.15 to 23.05)	22.93 (21.60 to 24.26)	1.05 (0.99 to 1.12)	0.13
Lung Resection				
Mortality, 30 Day	3.11 (2.99 to 3.24)	3.93 (3.76 to 4.11)	1.19 (1.15 to 1.23)	<0.001
Mortality, In Hospital	1.64 (1.55 to 1.72)	2.04 (1.93 to 2.16)	1.18 (1.14 to 1.23)	<0.001
Complications	15.94 (15.58 to 16.29)	18.03 (17.62 to 18.43)	1.16 (1.13 to 1.19)	<0.001
Serious Complication	8.54 (8.30 to 8.78)	10.21 (9.91 to 10.51)	1.18 (1.16 to 1.21)	<0.001
Reoperations	0.95 (0.89 to 1.01)	0.99 (0.91 to 1.06)	1.02 (0.97 to 1.06)	0.46
Readmissions	11.22 (10.98 to 11.46)	11.68 (11.40 to 11.97)	1.04 (1.02 to 1.05)	<0.001

9. Impact of Ventricular Dominance on Outcomes After Fontan Palliation: A 25-year Analysis from a Single Institution (Congenital)

Authors: Steven Thornton*, Neel Prabhu, James Meza, Lillian Kang, Mary Moya-Mendez, Lauren Parker, Joseph Turek, Nicholas Andersen

Presenter Institution: *Duke University School of Medicine, Durham, NC*

Objectives: Right ventricular dominance (RVD) is a known risk factor for mortality in patients with single ventricle heart defects undergoing neonatal repair. However, the long-term impact of RVD on patients surviving to Fontan palliation remains controversial. This may be due to limited follow-up, as many complications present years after intervention. We examined the relationship between RVD, transplant-free survival, and freedom from Fontan failure in a single institution cohort of patients undergoing the Fontan operation over 25 years. We hypothesized that patients with RVD would have decreased transplant-free survival and freedom from Fontan failure despite comparable perioperative survival.

Methods: All patients undergoing the Fontan operation at our institution between October 1998 and February 2022 were retrospectively reviewed. The primary outcome was transplant-free survival. Secondary outcomes were perioperative survival and freedom from Fontan failure (a composite of death, transplantation, Fontan takedown, plastic bronchitis, and protein losing enteropathy). Kaplan-Meier methodology was used to compare outcomes stratified by ventricular dominance. Multiphase parametric risk hazard analysis was performed to identify risk factors associated with mortality or transplantation and Fontan failure.

Results: A total of 195 patients were included. Baseline and operative characteristics were comparable between ventricular dominance groups (Table 1). Perioperative survival was similar between groups (97% vs. 100%, p=0.51). During the follow-up period, the rate of death or transplantation was 8.2% (16 of 195 patients) and the rate of Fontan failure was 13.8% (27 of 195 patients). Kaplan-Meier analysis demonstrated reduced transplant-free survival (10-year estimates: 80% (95% CI 70-91%) vs. 92% (83-100%), p=.042) and freedom from Fontan failure (10-year estimates: 73% (62-86%) vs. 92% (83-100%), p=.035) in patients with RVD lesions (Figure 1). Multiphase hazard modeling resolved 2 phases of risk for each outcome. In a multivariable analysis, RVD was an independent risk factor for death or transplantation (parameter estimate 1.3±0.6, p=0.05) and Fontan failure (1.1±0.6, p=0.04) during the second risk phase, which began approximately 6 months after surgery. No significant risk factors were identified in the first risk phase.

Conclusions: In this single institution study, RVD was associated with long-term complications following Fontan palliation, including mortality, transplant, and Fontan failure. These data suggest Fontan patients with RVD morphology should be targeted for heightened surveillance and monitoring after the perioperative period, preferably in a multi-disciplinary Fontan clinic.

Table Description: Baseline characteristics and operative approach for right and non-right ventricle dominant groups

Table 1: Baseline characteristics and operative approach for right and non-right ventricle dominant groups

Characteristics	**Right Dominant** 104 (53%)	**Non-Right Dominant** 91 (47%)	***p-Value***
Male Sex	63 (61%)	45 (49%)	0.12
Age at Fontan, months Median [IQR]	38 [33 – 47]	38 [33 – 45]	0.97
Premature, <37 weeks	12 (12%)	11 (12%)	0.99
Genetic Syndrome	7 (7%)	5 (5%)	0.72
Weight, kg, Median [IQR]	13.5 [12.1 – 15]	13.8 [12.5 – 15.9]	0.25
Underlying Diagnosis	HLHS: 65 (63%) TA: 0 (0%) UAVC: 21 (20%) DORV: 17 (16%) DILV: 0 (0%) PA: 0 (0%) TGA: 1 (1%)	HLHS: 0 (0%) TA: 31 (34%) UAVC: 10 (11%) DORV: 7 (8%) DILV: 18 (20%) PA: 24 (26%) TGA: 1 (1%)	<0.001
First Stage Palliation	Norwood: 70 (67%) BTT Shunt: 13 (13%) PA Banding: 12 (12%) Other: 6 (6%) None: 2 (2%)	Norwood: 11 (12%) BTT Shunt: 47 (52%) PA Banding: 13 (14%) Other: 6 (7%) None: 9 (10%)	<0.001
Pre-Fontan O2 Sat	83 [80 – 86]	83 [80 – 86]	0.47
Pre-Fontan mPAP (mmHg)	11 [9 – 12.3]	10.8 [9 – 12.8]	0.99
Pre-Fontan EDP (mmHg)	7 [6 – 8]	6 [5 – 8]	0.66
Pre-Fontan TPG (mmHg)	4 [3.5 – 5.5]	5 [4 – 6]	0.07
Surgical Technique	ECC: 96 (92%) LT: 8 (8%)	ECC: 86 (95%) LT: 5 (5%)	0.54
Fenestration	70 (67%)	48 (53%)	0.04
Concomitant Procedure	42 (40%)	42 (46%)	0.42

Image Title: Figure 1
Image Description: Figure 1a: Kaplan-Meier analysis of transplant free survival Figure 1b: Kaplan-Meier analysis of freedom from Fontan failure

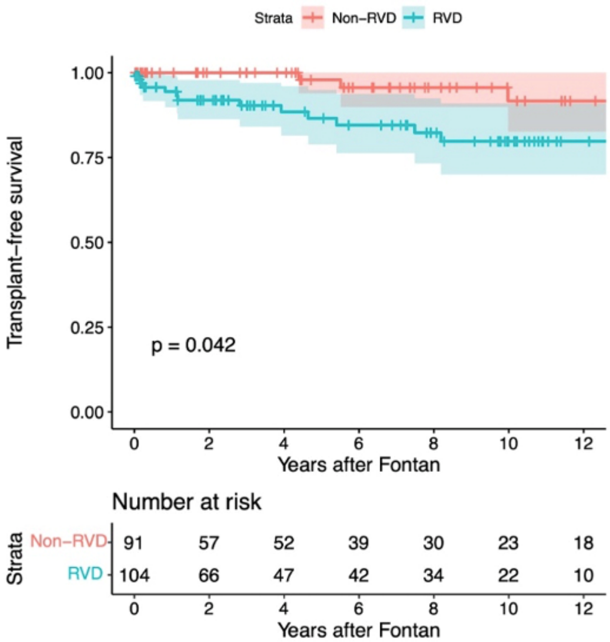


Figure 1a: Kaplan-Meier analysis of transplant free survival

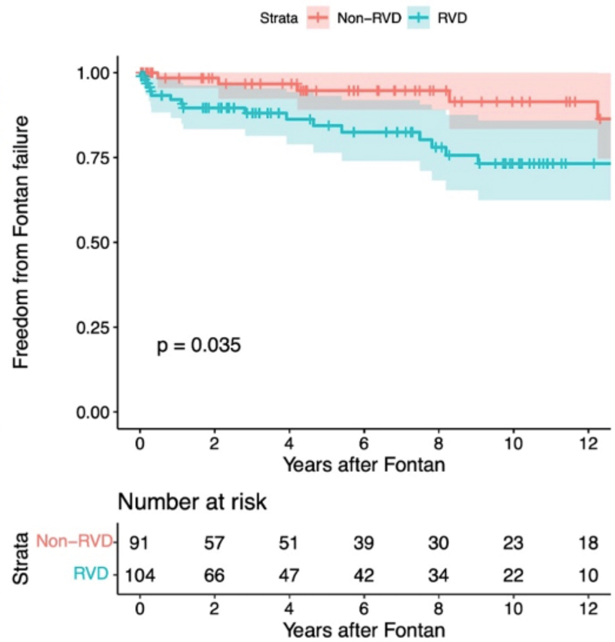


Figure 1b: Kaplan-Meier analysis of freedom from Fontan failure

10. Gender-Related Influences and Barriers in Cardiothoracic Surgery Residents (Surgical Education)

Authors: Kelsey Hoidal*, Katherine Whitehouse, Jaimin Trivedi, Siddarth Pahwa, Mark Slaughter

Presenter Institution: *University of Louisville, Louisville, KY*

Objectives: Women have been a significant minority and underrepresented in the field of cardiothoracic surgery (CTS). However, the field continues to expand as women made up 19-24% of CTS residents in recent years. The aim of our study was to evaluate why this discrepancy continues to exist by exploring factors perceived as barriers to a career in CTS compared to actual job satisfaction amongst women CTS trainees.

Methods: A questionnaire was designed and distributed in the 2020-21 academic year to all women CTS residents through the Thoracic Surgery Residents Association. The 25-question survey was designed to identify perceived barriers and job satisfaction of women CTS residents, including both free response and multiple-choice options. Basic demographic information was also collected. Descriptive and univariate statistics were used for analysis.

Results: The questionnaire was sent to 100 women residents, of which 54 responded (55% in age 25-34 years, 45% age 35-44 years). Of these, 34 (63%) were Caucasian, 32 (59%) were married (or with domestic partner), and 20 (34%) had children. When asked about training, 25 (47%) were PGY-7 or above, 22 (43%) were pursuing training in cardiac surgery, 20 (39%) were pursuing training in thoracic surgery, 3 (6%) were mixed cardiothoracic, and the remainder were pursuing other advanced training. Less than 50% of trainees agreed that factors such as time commitment (45%), gender inequality (44%), maternity leave (26%), family responsibility (34%) and wish to have children (38%) were perceived as barriers (Image 1). Conversely, over 50% of trainees were satisfied by the pay & benefits (63%), professional growth (80%), general work conditions (74%) and relations with colleagues (73%). However, less than 50% of trainees were satisfied by the family responsibility (33%), time commitment (40%), gender equality (33%) and stress level management (29%). Subspecialty and age group were not significantly associated with different levels of job satisfaction. However, having 4 or more women residents at their training program was significantly associated with higher job security. Qualitative analysis displayed themes including lack of women in the field, lack of women mentorship, and lack of support for having children as common barriers to careers in CTS.

Conclusions: Time commitment, gender inequality, family responsibility, and the desire to have children continue to be barriers for women considering a career in CTS. For women who have started their CTS training, fewer are now reporting job dissatisfaction. Overall, our data demonstrates that there has been improvement in the perceived/real barriers for women and additional changes to training program structure and culture need to be made. Free response answers displayed that underrepresentation of women in the field is one of the largest barriers, which can be addressed by recruitment of and support for more women in CTS training.

Image Description: Perceived Barriers versus Level of Satisfaction by Women CTS Trainees