

2024 STS Coronary Conference Accepted Abstracts

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Friday, June 7, 2024

Session 4: Proximal and No Touch Aortic Technique (2:25 - 3:30 p.m.)

2:41 p.m.

Abstract: Piggyback Proximal Anastomosis Technique for Coronary Artery Bypass Grafting

Author List: Massimo Baudo, MD; Courtney Murray, CRNP; Amanda Yakobitis, PA-C; Gianluca Torregrossa, MD

Purpose: Multiple methods aim to reduce aortic manipulation during CABG proximal anastomosis. The “piggyback” technique (PBT) involves a single aortic hole for all proximal graft connections. Our team routinely uses PBT for sternotomy CABG with multiple proximal anastomoses. This study examines mid-term outcomes of CABG with the piggyback technique.

Methods: This was an observational study in which all consecutive patients undergoing CABG with PBT (Figure) by a single surgeon between June 2021 and November 2023 were enrolled. The main objective was to examine the transient time flow measurements (TTFM) of this technique. Secondary endpoints encompassed overall mortality, cardiac-related mortality, cardiac readmission, post operative catheterization, stroke, myocardial infarction, and repeat revascularization.

Results: A total of 115 patients were enrolled with a mean age of 67.6 ± 8.5 years. Most patients (90.4%) underwent off-pump CABG with a mean 3.4 ± 0.7 number of anastomoses. At TTFM all grafts showed sufficient flow to their target coronary (Table). The second graft demonstrated superior flow rates, especially when an artery was utilized, as compared to either a second venous graft or the first venous graft ($p=0.0034$). Importantly, no strokes or myocardial infarctions occurred, and only one (0.9%) patient needed surgical re-exploration for bleeding. At a mean follow-up of 11.4 ± 6.7 months there were no further deaths, strokes, myocardial infarctions, or repeat interventions. Post operative catheterization was performed in 5 patients and showed patency of all the grafts. O/E mortality of this population was STS: 1.03 [0.6-2.0] vs. 1 patient died (0.87%).

Conclusion: The piggyback technique showed excellent TTFM, particularly when arterial grafts were used, while postoperatively no strokes or new myocardial infarctions were reported. Longer term outcomes will be important to confirm the excellent patency showed in early outcomes.

Table: *(Image: Depiction of Piggyback proximal anastomosis)*

Piggyback	Overall	OM Graft	Diagonal Graft	PDA Graft
Piggyback Vein on Vein (ml/min) mean \pm SD	42.0 \pm 23.5	44.8 \pm 26.3	36.1 \pm 18.8	39.1 \pm 21.7
Piggyback Artery on Vein (ml/min) mean \pm SD	58.0 \pm 24.3	55.1 \pm 22.3	-	79.3 \pm 29.1
Piggyback Vein on Aorta (ml/min) mean \pm SD	50.0 \pm 25.2	44.6 \pm 22.8	54.3 \pm 18.6	52.4 \pm 26.8
p-value	0.0034	0.0876	0.0467	0.0141



Session 4: Proximal and No Touch Aortic Technique (2:25 p.m. - 3:30 p.m.)

3:02 p.m.

Case Presentation: Minimally Invasive Redo Coronary Artery Bypass Grafting Using the Right Gastro-epiploic Artery to Posterior Descending Artery

Author List: Chidiebere Peter Echieh, Alex Ryan, Abel Cherian, Yash Rohilla, Kevin Wang, Toshinobu Kazui

Purpose: A redo coronary artery bypass grafting (CABG) with patent grafts adds complexity to the redo surgery. In the setting of multiple failed repeat percutaneous coronary interventions in previous CABG, redo CABG may be indicated. We performed minimally invasive redo CABG to the posterior descending artery (PDA) with the gastroepiploic artery (GEA).

Case presentation: A 57-year-old male with dyslipidemia, diabetic peripheral neurovascular disease, and end-stage renal disease on peritoneal dialysis presented with a non-ST elevation myocardial infarction (NSTEMI). He had a history of CABG [left internal mammary artery (LIMA) to left anterior descending artery (LAD), saphenous vein graft (SVG) to obtuse marginal 2 (OM2)] 2.5 years ago. He also had two previous percutaneous coronary interventions (PCI) on the right coronary artery (RCA), with stents inserted into the proximal and mid-RCA. Coronary angiography demonstrated patent previous grafts (LIMA to LAD and SVG to OM2). The mid-RCA had diffused in-stent restenosis with 99% occlusion and severe calcification. Given his history of multiple PCIs to the RCA with significant calcification, we decided to proceed with a minimally invasive redo CABG with GEA. We approached via sub-xyphoid and harvested the right GEA using a harmonic scalpel in a skeletonized fashion. The diaphragm and the pericardium were incised. The diaphragmatic surface of the heart was dissected. An off-pump retractor was placed on the abdominal wound. The Octopus stabilizer was used to expose the PDA. We used ultrasound to identify the optimal site for the anastomosis. Anastomosis of right GEA to PDA was performed in end-to-side fashion. Postoperative recovery was uneventful, and the patient was discharged on postoperative day 4.

Conclusion: To treat RCA stenosis in patients with previous CABG and patent grafts, minimally invasive redo CABG utilizing GEA can be a good option to minimize surgical trauma and potential injury of patent grafts.

Session 5: Off Pump CABG: How I Do It: Tips and Tricks (4:00 - 4:45 p.m.)

4:22 p.m.

Video: New Pig-Tail Hooks and Distributed Multi-Directional Heart Positioners Enabled Excellent Long-Term Results of OPCAB

Author List: Yuki Endo, MD, PhD and Yoshiei Shimamura, MD, PhD

The educational/technical point that this video addresses: The positioning of the heart, the scope of coronary artery anastomosis, and the maintenance of hemodynamics are important techniques in OPCAB. In our facility, in addition to the conventional dispersed multi-directional heart positioner (Tentacles), we use a pig-tail type hook developed in-house to achieve stable hemodynamics and scope expansion, successfully completing OPCAB procedures. This study aims to examine its usefulness and the long-term outcomes of OPCAB procedures.

Summary of the Surgical Video: The pigtail-shaped hook, which is a 3-mm-thick round bar-shaped alloy tip wound 480 degrees into a 10-mm-diameter coil, was fixed to the thoracotomy with a universal stabilizer arm with Tentacles. Tentacles is a decentralized multi-directional heart positioner with 3 suctions. The versatility selection of the suction site and traction direction reduces the deformation of the heart which enables stabilization of hemodynamics, excellent development of the visual field and fixation of anastomosis surface. By attaching a traction tube to the hook, the new pig tail hook enables the heart to be positioned at a higher position than before and prevent exacerbation of Mitral regurgitation during cardiac prolapse with more stable hemodynamics. Stable hemodynamics and securing of visual field are considered to have achieved good surgical results even in this study with a high average age. The results of OPCAB with new pig-tail hook and Tentacles were excellent. It was suggested that the new heart positioner could be one of the treatment options for CABG.

Session 6: How I Do It Case Presentations (4:45 - 5:30 p.m.)

5:21 p.m.

Video: Surgical Management Strategy for Repair of Coronary Artery Aneurysms

Author List: Parker Mullen, MD, Nina Delavari, DO, Athanasios Tsiouris, MD, PhD, Ashok Coimbatore Jeyakumar, MD

The educational/technical point that this video addresses: Coronary artery aneurysms are relatively rare findings with no consensus on management. Here we present both a right and left sided coronary artery aneurysm, as well as our management strategy for each.

Summary of the Surgical Video: This video demonstrates repair strategies for both a right and left sided coronary artery aneurysm in two selected patients. It highlights considerations such as age, urgency of repair, conduit choice, and techniques. The preoperative presentation and imaging, technique photographs and video recordings, and postoperative course and discussion are presented.

Session 6: How I Do It Case Presentations (4:45 - 5:30 p.m.)

5:25 p.m.

Video: SVG Pseudoaneurysm in a CABG Patient: Surgical Technique

Author List: Mahbub Jamil, MD, Joseph Petro, MD, Zhandong Zhou, MD

The educational/technical point that this video addresses: Pseudoaneurysm of the saphenous vein graft (SVG) following coronary artery bypass grafting (CABG) is a rare but potentially lethal condition. The natural history of SVG aneurysm is unknown. We present a rare case of contained rupture of a massive SVG pseudoaneurysm with compression of the right ventricle. We also demonstrate the safe technique of re-entry when there are potential sources of massive bleeding under the posterior sternal plate.

Summary of the Surgical Video: The patient is a 62-year-old female with a history of CABG performed 10 years ago. She presented with heart failure, chest pain, and elevated troponin levels. Subsequent evaluation revealed a 10 cm pseudoaneurysm of the SVG connected to the right coronary system, causing significant compression on the right ventricle. Urgent resection and revascularization procedures were performed.

Cardiopulmonary bypass was achieved through right femoral artery and vein cannulation. The patient was cooled to 25°C prior to making skin incision. During sternal entry, the pseudoaneurysm was breached. Bleeding was stopped with circulatory arrest. A rapid and careful entry into the chest was accomplished. The affected venous graft was isolated and clamped within eight minutes of circulatory arrest. Subsequently, cardiopulmonary bypass was resumed, and the patient was rewarmed. Large amounts of clots of varying ages were evacuated. Revascularization of the posterior descending artery and a diagonal artery was performed. The rest of the surgery was uneventful. The patient experienced complications during recovery, including refractory seizures and respiratory failure. After a prolonged hospitalization, she was discharged to rehab 8 weeks after surgery.

In summary, this case underscores the challenges and complexities involved in the management of a massive substernal SVG pseudoaneurysms.

Saturday, June 8, 2024

Rapid Fire Abstract Session (7:00 - 8:00 a.m.)

7:00 a.m.

Abstract: Coronary Artery Bypass Grafting versus Percutaneous Coronary Intervention in Women with Left-Ventricular Dysfunction

Author List: Philipp Angleitner, MD, PhD; Iryna Skoblenko; Eva Steinacher, MD; Andreas Hammer, MD; Irene M. Lang, MD; Alexander Niessner, MD, MSc; Daniel Zimpfer, MD, MBA; Sigrid Sandner, MD, MSCE

Purpose: Women are underrepresented in cardiovascular trials. No trials have evaluated the preferential treatment strategy in females presenting with complex coronary artery disease (CAD) and systolic left-ventricular dysfunction (LVD). Our aim was to compare long-term outcomes after coronary artery bypass grafting (CABG) versus percutaneous coronary intervention (PCI) in this patient population.

Methods: A retrospective analysis of female patients undergoing primary, isolated CABG or PCI between 2009 and 2019 at a tertiary care hospital was performed. Only patients presenting with CAD equally suitable for CABG and PCI as well as echocardiographically determined left-ventricular ejection fraction (LVEF) < 50% were included. The primary outcome was major adverse cardiac and cerebrovascular events (MACCE; defined as a composite of death, stroke, myocardial infarction, or ischemia driven re-revascularization). Mortality was the secondary outcome. Multivariable Cox proportional-hazards regression models were generated to evaluate associations between treatment strategies and outcomes.

Results: The study cohort included 100 patients undergoing CABG (50.3%) and 99 patients undergoing PCI (49.7%). Overall, 107 MACCE events were documented during a mean follow-up period of 5.2 years. Both groups showed significant differences regarding age, cerebrovascular disease, chronic obstructive pulmonary disease, history of myocardial infarction, SYNTAX Score I, and presence of acute coronary syndrome, among others. No between-group differences were present regarding diabetes, LVEF, and Charlson Comorbidity Index. Image 1 shows Kaplan-Meier curves out to 5 years, demonstrating significantly higher freedom from MACCE in patients undergoing CABG (log rank $p = 0.014$). A multivariable Cox proportional hazards regression model confirmed significantly lower independent risk of MACCE in patients undergoing CABG (hazard ratio 0.43, 95% confidence interval 0.23 to 0.78, $p = 0.006$) (Table 1). There was no independent association between CABG and the risk of mortality (hazard ratio 0.58, 95% confidence interval 0.30 to 1.12, $p = 0.105$).

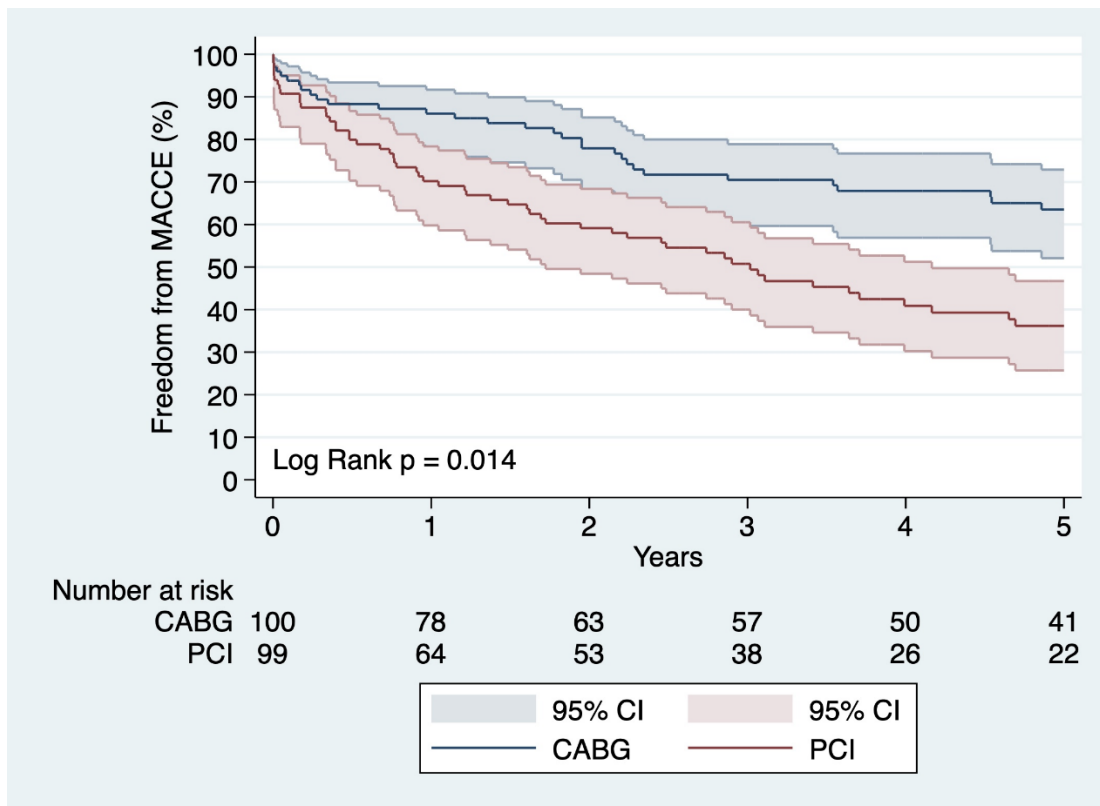
Conclusion: Our analysis suggests that CABG is associated with significantly lower independent risk of MACCE in female patients presenting with complex CAD and systolic LVD. Analyses of larger patient cohorts are required to corroborate our results.

Image Title: *Kaplan-Meier curves show significantly higher freedom from MACCE out to 5 years in patients undergoing CABG (log rank $p = 0.014$).*

Table 1: Primary Outcome Variable: Risk of MACCE (Multivariable Cox Proportional Hazards Regression Model)

Variables	HR	95% CI	P-Value
CABG versus PCI	0.43	0.23 to 0.78	0.006
Charlson Comorbidity Index	1.35	1.22 to 1.50	<0.001
Age (y)	0.99	0.97 to 1.01	0.193
SYNTAX Score I	1.01	0.99 to 1.03	0.452
Left-Ventricular Ejection Fraction	0.99	0.97 to 1.02	0.532
Acute Coronary Syndrome	0.89	0.58 to 1.37	0.602
Complete Revascularization	0.65	0.43 to 1.00	0.050
Optimal Medical Therapy	1.08	0.72 to 1.63	0.714

Bold indicates statistical significance (p < 0.05).



Rapid Fire Abstract Session (7:00 - 8:00 a.m.)

7:06 a.m.

Abstract: Racial Disparities in Mortality Rates Following Coronary Artery Bypass Grafting: An Evaluation of Reporting Methods and Trends

Author List: Tiffany Hsiung, BS, Les James, MD, MPH, Huzaifa A. Shakir, MD

Purpose: Racial disparities in post-operative mortality following coronary artery bypass grafting (CABG) have been investigated, although underlying causes have yet to be elucidated. This study aims to analyze historical trends in 30-day post-operative mortality rates between black and white patients, as well as the accuracy and methods used to elicit them.

Methods: Studies published between 1984 and 2023 were collected from a nonstructured review in PubMed. Article inclusion criteria were patients of all ages who underwent CABG and explicit reporting of 30-day post-operative mortality in black and white patients. Studies that focused on non-CABG cardiac surgeries and studies that did not report 30-day mortality rates stratified by race were excluded. Studies meeting inclusion criteria were evaluated using title and abstract review. Subsequent full-text screening and data extraction were performed.

Results: Differences in 30-day post-operative mortality rates still exist following CABG between black and white patients. (Image 1) Several studies have analyzed 30-day mortality rates stratified by race following CABG, however, there is a paucity of large database studies. (Table 1) Angraal et al. recently utilized Medicare data from the Centers for Medicare & Medicaid Services (CMS) to report on CABG outcomes in patients over age 65 among different races between 1999-2014. (1) Between 2011 and 2020, the mean age of a patient undergoing primary isolated CABG was 66.0 years. (2) In our experience, 61.3% of patients who underwent CABG in the past five years at our academic inner-city hospital were below 65 years of age and exhibited a greater number of comorbid conditions compared with their older counterparts, and there may not be a database that accurately captures the scope of outcomes and disparities that exist in and between patients of different racial backgrounds.

Conclusion: There is no standardized way to evaluate CABG outcomes between patients of different racial backgrounds, leading to potential discrepancies between true and reported 30-day mortality rates. However, previous studies show differences. Thus, a standardized system is necessary to accurately assess mortality between races and to define areas for quality improvement.

Image 1: Trends in 30-day post-operative CABG mortality in national database studies in white and black patients

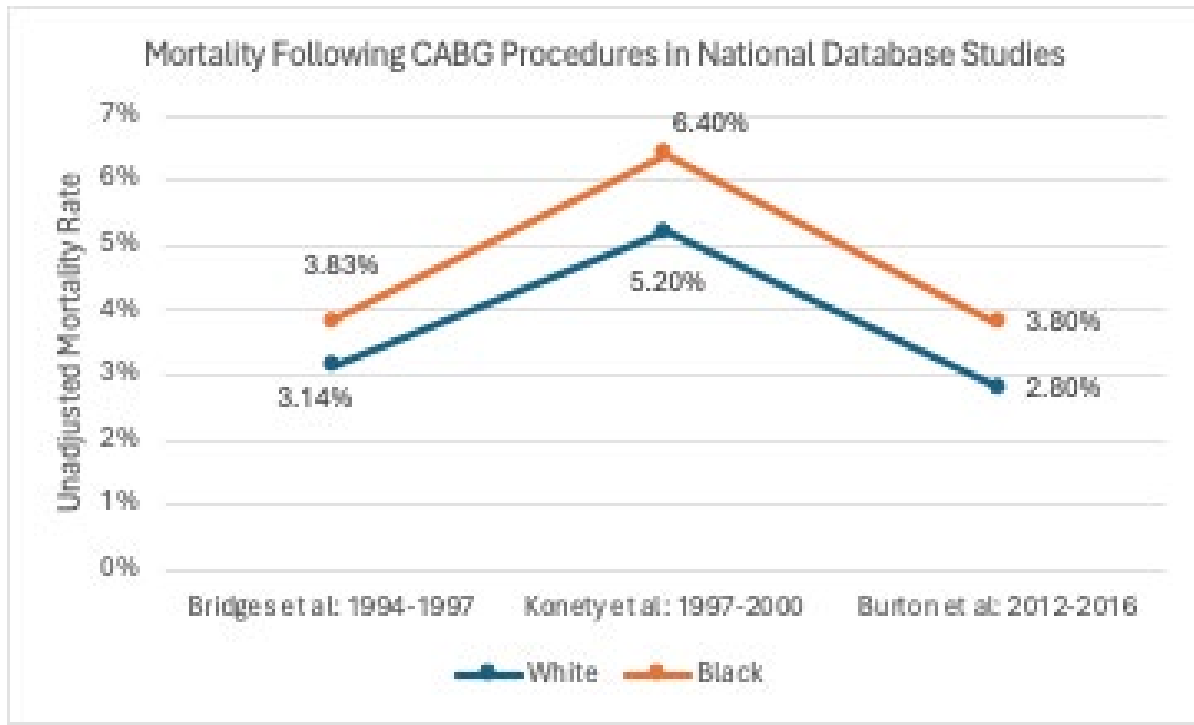


Table 1: 30-day post-operative mortality rates after CABG in white and black patients

Study	Database Used	30-day Mortality-White Patients, n (%) (unadjusted unless otherwise stated)	30-day Mortality-Black Patients, n (%) (unadjusted unless otherwise stated)	P-Value
Guy et al. (1984-1992)	Single Center	154 (4.6)	7 (3.5)	0.48
Higgins et al. (1990-1996)	Single Center	58 (2.5)	25 (5.5)	<0.003
Smith et al. (1993-2005)	Single Center	44 (2.3) (risk-adjusted in hospital mortality)	22 (3.4) (risk-adjusted in hospital mortality)	0.134
Bridges et al. (1994-1997)	The Society of Thoracic Surgeons National Database	17456 (3.14)	990 (3.83)	<0.001
Konety et al. (1997-2000)	Centers for Medicare & Medicaid Services Database	26473 (5.2)	1559 (6.4)	<0.001
Koelling et al. (2002-2014)	Single Center	168 (1.2)	50 (1.8)	0.1
Castellanos et al. (2003-2006)	Single State (a modified version of the The Society of Thoracic Surgeons National Database)	1287 (2.58) (risk adjusted)	272 (2.96) (risk adjusted)	<0.001
Pollock et al. (2004-2011)	Single Center	169 (2.66)	20 (3.27)	>0.99
Burton et al. (2012-2016)	ACS National Surgical Quality Improvement Program Database	169 (2.8)	23 (3.8)	<0.001

Rapid Fire Abstract Session (7:00 - 8:00 a.m.)

7:12 a.m.

Case Presentation: Minimally Invasive Direct Double Vessel CABG Using Radial Artery a Bridge Graft

Author List: George M. Comas, MD, Craig Ingermann, PA-C, Richard Amato, PA-C

Full Case Scenario:

The patient was a 63-year-old man with a previous medical history of hyperlipidemia, benign prostatic hypertrophy, and inguinal hernia repair. He was a former 30 pack/year smoker who quit 16 years ago. He had no family history of coronary artery disease. He was the owner of several gyms in the area and was quite active physically.

He presented with worsening chest pain with activity. The pain radiated to his jaw and was relieved with rest. His episodes worsened in intensity and frequency over the past months. He had mild dyspnea on exertion but had exercise tolerance of over 10 blocks.

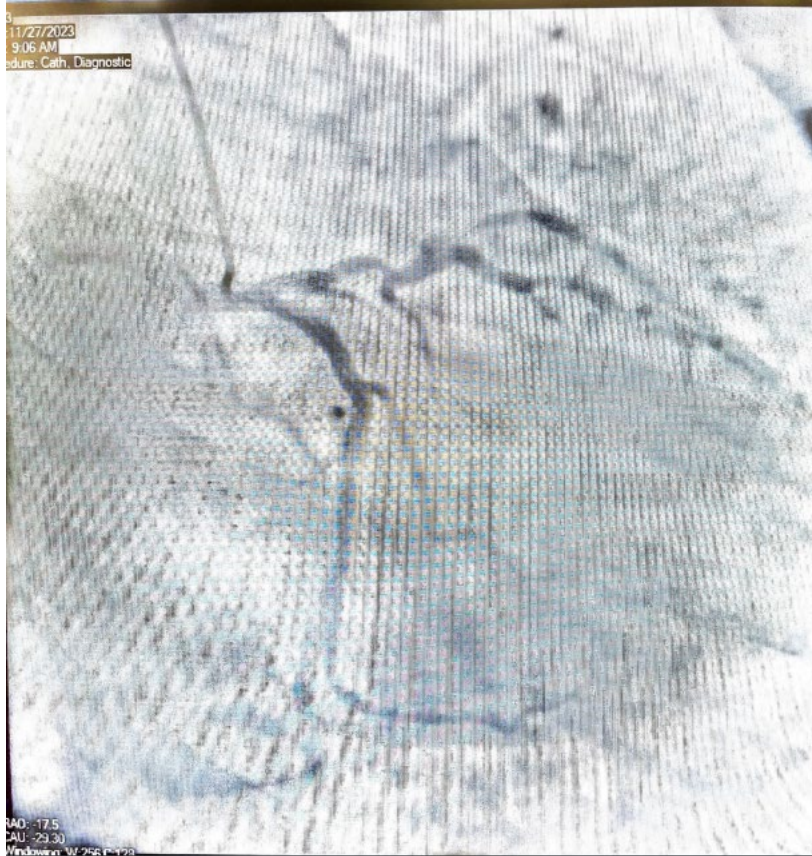
Workup by a cardiologist led to a left heart catheterization that revealed 75% LAD lesion and 99% diagonal lesion (see attachment). Left ventricular size and function were normal on echocardiogram. EKG showed left bundle branch block. He was right handed with a normal Allen's test on the left hand.

A two vessel midcab was performed. The left radial artery was taken skeletonized and endoscopically. A left mini thoracotomy was performed in the left 5th intercostal space anterior axillary line. Using a specialized midcab retractor and electrocautery, the Lima was taken down semi-skeletonized down to its bifurcation. The pericardium was opened longitudinally 3 cm anterior to the phrenic nerve. Using a soft tissue retractor and stay sutures, the Lima and diagonal were exposed.

The diagonal was opened and radial artery to diagonal anastomosis was performed end to side with running 7-0 prolene and a 1.5cm shunt. Subsequently, the radial was then anastomosed end to side to the Lad with 7-0 prolene and a 2cm shunt. The Lima was then anastomosed with minimal tension with running 8-0 prolene to the mid point of this arterial bridge graft.

Two chest tubes were placed, Hemostasis was assured. The patient was extubated in the OR. No blood products were given. The patient had an uneventful recovery and was ready for discharge on postop day four with dual anti platelet therapy.

Pre-Operative Imaging



Postoperative discussion points/questions:

A radial artery graft was used as a bridge graft from Lad to diagonal coronary arteries. The Lima was then anastomosed to the midpoint of this graft. This allowed for easier exposure for the distals and a more tension free anastomosis. This technique can be used to facilitate multi target midcab procedures.

Rapid Fire Abstract Session (7:00 - 8:00 a.m.)

7:18 a.m.

Abstract: Gradual Oxygen Reexposure Improves Outcomes After CABG During Acute Myocardial Infarction

Author List: Neil J. Thomas, MD

Purpose: Our objective was to determine the safety and impact of limiting initial oxygen exposure and avoiding hyperoxic pO₂'s during CABG on reducing mortality, improving ventricular recovery, reducing readmission, and reducing the requirement for defibrillator insertion in this high-risk group of patients. Results in cardiogenic shock remain poor with conventional hyperoxia.

Methods: We retrospectively analyzed the records of a consecutive cohort of emergency bypass surgery patients at a single institution who were taken directly from the lab to surgery. Patients were excluded if they had concerning anatomy (eg, left main or severe three vessel) but who presented electively for a stress test. We compared surgical mortality, follow-up readmission for heart failure with reduced EF, incidence of ambulatory heart failure and requirement for AICD as well as a longitudinal analysis of ejection fraction.

Results: Unlike many other analyses that exclude patients displaying shock or clinical instability, 42.4% (28/66) of the patients included in the analysis displayed these clinical manifestations. Surgical mortality was observed to be improved in the treated group (2.4% vs. 16%, RR 0.15 [95% CI: 0.018, 1.2881] p=.04). This difference was even more pronounced (on the additive scale) in the group with cardiogenic shock (7.6% vs. 42.9 %, RR 0.18 [95% CI 0.018, 0.98] p = 0.015). Readmission for heart failure with reduced EF was 12.2% vs. 40.0%, RR 0.30 [95% CI 0.12, 0.79] p = 0.009) and requirement for AICD was 4.9% vs. 20% RR 0.24 [95% CI 0.051, 1.16] p = 0.053. Analysis of paired LV function profiles, using paired t-tests showed an estimate of 11.13% higher in the treated group (95% CI: 5.4, 16.9 p-value = 0.0003).

Conclusion: Avoidance of hyperoxia and gradually increasing the pO₂ of cardioplegia and systemic perfusates while on bypass was associated with improved mortality, decreased readmission for heart failure or ambulatory HFrEF, the requirement for AICD, and better ventricular recovery in this real world, retrospective review of consecutively operated high-risk patients.

Rapid Fire Abstract Session (7:00 - 8:00 a.m.)

7:24 a.m.

Abstract: A Propensity-Matched Comparison of Robotic Multi-Vessel Coronary Artery Bypass Grafting and Conventional Multivessel Sternotomy Coronary Artery Bypass Grafting

Author List: Zhandong Zhou, MD, PhD; Anna Gleboff, MPH, MS; Karikehalli Dilip, MD; Ahmad Nazem, MD; Anton Cherney, MD; Gary Randall Green, MD; Charles Lutz, MD

Purpose: This study compares outcomes of robotic multi-vessel minimally invasive direct coronary artery bypass grafting (RMIDCAB) with conventional multi-vessel sternotomy coronary artery bypass grafting (CSCABG) to address the lack of such quality comparisons in literature. Emphasizing the rarity of Multivessel RMIDCAB, we provide insights into its efficacy compared to conventional approaches.

Methods: All CABG cases from 2014 to 2023 performed in our hospital were identified. Propensity matching on age, STS PROM and BMI using the Nearest Neighbor algorithm with a caliper of 0.1 yielded 338 cases in each of the RMIDCAB and CSCABG groups. In the RMIDCAB group, left and/or right internal mammary arteries were harvested through a standard three port technique. Distal anastomoses were done by direct hand suturing through 6 cm thoracotomy in left 4th or 5th intercostal space with/without peripheral cardiopulmonary bypass support. Sternotomy cases were done through conventional midline incision either with/without Cardiopulmonary bypass and Cardioplegic arrest.

Results: Multivessel RMIDCAB demonstrated significant advantages over CSCABG in reducing postoperative ventilation hours (9.91 vs. 15.32, $p = 0.053$), fewer initial ICU hours (51.03 vs. 60.39, $p = 0.027$), shorter OR total times (304.16 vs. 326.28 minutes, $p < 0.001$), and lower rates of postoperative complications such as sepsis (0% vs. 2.37%, $p = 0.0004$), prolonged pulmonary ventilation (2.37% vs. 8.28%, $p < 0.001$) and Post operative Atrial fibrillation (18.93% Vs 31.66%, $p < .001$)

There were no significant differences between the two groups with respect to post operative rebleeding, post op CVA/TIA, post op renal insufficiency, post op reintervention for myocardial ischemia and for 30-day readmissions. CSCABG had more grafts per patient (3.04 vs 2.46) Postoperative length of stay was significantly shorter in robotic group (5.90vs. 7.24 days, $p = <.001$). There was no significant difference between the two groups with respect to 30 day and hospital mortality (0.89% vs 1.48% $p=0.477$)

Conclusion: Multi vessel RMIDCAB offers superior perioperative outcomes compared to CSCABG, with reduced postoperative complications, and lower length of hospital stay. These findings underscore the importance of integrating robotic techniques into coronary surgery to improve patient care and outcomes. A prospective randomized trial may eliminate any bias and could be useful.

Table: Robotic Multivessel CABG Vs Conventional Sternotomy Multivessel CABG

Matched Group Outcomes				
		Robotic CABG n=338	Sternotomy n=338	p-value
BMI	Mean (SD)	30.28 (5.4739)	30.38 (5.876)	0.808
Age		68.20 (10.5195)	68.53 (9.6518)	0.675
Cardiopulmonary Bypass Time		113.23 (30.3671)	104.69 (26.9913)	0.005
Total Postoperative Vent Hours		9.91 (29.8048)	15.32 (36.767)	0.053
Initial ICU Hours		51.03 (52.2696)	60.39 (57.5816)	0.027
OR Total Time		304.16 (5.4739)	326.28 (54.1938)	<.001
Predicted Risk of Mortality		0.02 (.0316)	0.02 (.0283)	0.664
LOS Surgery-Discharge		5.90 (3.354)	7.24 (5.111)	<.001
Gender - Female - Yes	Frequency (%)	73 (21.6%)	70 (20.71%)	0.778
Diabetes- Yes		150 (44.38%)	169 (50.%)	0.143
Left Main Stenosis - Yes		76 (22.49%)	36 (10.65%)	<.001
Cardiac Arrhythmia - Yes		51 (15.09%)	38 (11.24%)	0.208
OPCAB - Yes		203 (60.06%)	81 (23.96%)	<.001
PADCAB- Yes		135 (39.94%)	6 (1.78%)	<.001
ConventionalCABG-Yes		0 (.%)	251 (74.26%)	<.001
Post Op Reop Bleed-Yes		8 (2.37%)	3 (.89%)	0.129
Post Op Sepsis -Yes		0 (.%)	8 (2.37%)	0.004
Post Op Neuro Encephalopathy-Yes		4 (1.18%)	2 (.59%)	0.412
Post Op Effusion Req Drainage-Yes		49 (14.5%)	38 (11.24%)	0.206
Post Op Other Afib -Yes		64 (18.93%)	107 (31.66%)	<.001
Post Op Renal Failure-Yes		1 (.3%)	4 (1.18%)	0.178
Post Op Other GI Event -Yes		12 (3.55%)	11 (3.25%)	0.832
Readmission -Yes		19 (5.62%)	20 (5.92%)	0.146
IABP - Yes		5 (1.48%)	24 (7.1%)	<.001
Post Op Pulm Vent Prolonged -Yes		8 (2.37%)	28 (8.28%)	<.001
Mortality In Hospital - Yes		1 (.3%)	4 (1.18%)	0.178
Mortality Operative - Yes		3 (.89%)	5 (1.48%)	0.477
Mortality 30 Day Status- Dead		3 (.89%)	5 (1.48%)	0.477
Non-matched Grafts by Surgery Type				
		Robotic CABG n=338	Sternotomy n=4028	
CABG2	Frequency (%)	245 (45.04%)	1498 (32.86%)	
CABG3		78 (14.34%)	1314 (28.82%)	
CABG4		23 (4.23%)	792 (17.37%)	
CABG5		3 (.55%)	324 (7.11%)	
CABG6		0	87 (1.91%)	
CABG7		0	13 (.29%)	
Average Grafts		Mean	2.46	3.06

Rapid Fire Abstract Session (7:00 - 8:00 a.m.)

7:30 a.m.

Case Presentation: Anomalous Right Coronary Artery from the Pulmonary Artery (ARCAPA) Presenting as a Sudden Death Event in an Adult Woman

Author List: Theodore C. Koutlas, MD, Brydan D. Curtis, DO, Deirdre Mooney, MD, Carl P. Garabedian, MD, Branden R. Reynolds, MD

Case Presentation: The patient is a 65-year-old female with a 10-day history of dyspnea on exertion who had a witnessed out-of-hospital cardiac arrest. She received 10 minutes of CPR and was cardioverted and intubated in the field. She presented to the hospital in atrial fibrillation with rapid ventricular response and was given intravenous amiodarone and subsequently converted to normal sinus rhythm. She improved rapidly and was extubated, her only neurologic sequelae was some memory loss. She had a mild elevation in her serum troponin, and her only cardiac risk factors were hypertension and tobacco use. A transthoracic echo was performed and showed an left ventricular ejection fraction (LVEF) of 15-20%. Cardiac catheterization was then performed and demonstrated retrograde flow from the right coronary artery (RCA) into the main pulmonary artery on injection into the left coronary, She then underwent a cardiac MRI which showed viable myocardium throughout. Because she had several broken ribs from CPR and still had some memory issues, we elected to treat her medically with afterload reduction and beta blockers, and placed an implantable cardioverter defibrillator (ICD) prior to discharge. We discussed operative intervention 4-6 weeks later to allow some recovery before surgery.

In the interim she was seen in follow-up and only complained of dyspnea on exertion and extreme fatigue. She denied chest pain.

At the time of surgery her LVEF had improved to 40% on trans-esophageal echo. She underwent successful re-implantation of the right coronary artery and reconstruction of her main pulmonary artery on cardiopulmonary bypass with a short cardioplegic arrest period. Her LVEF post-cardiopulmonary bypass was 60% without inotropic support. She tolerated the procedure well and made an uneventful recovery.

Pre-Operative Imaging



Postoperative discussion points/questions: Anomalous right coronary artery from the pulmonary artery (ARCAPA) is a rare coronary anomaly. Unlike the more common anomalous left coronary artery from the pulmonary artery (ALCAPA), which usually presents in infancy, ARCAPA often presents in older children. While sudden death has been reported, patients usually present with murmur, chest pain, or congestive heart failure. Our patient presented comparably late in life with a sudden death event, without any prior cardiac history. Once the diagnosis of ARCAPA was made we elected to defer surgery to give her time to recuperate from her sudden death event, with the hope her cardiac function would improve somewhat on medical management until surgery.

We discussed 3 options for management of her anomalous right coronary artery from the pulmonary artery (ARCAPA):

1. Re-implantation of the right coronary artery (RCA) into the aortic root.
2. Coronary artery bypass grafting and ligation of the proximal RCA.
3. Ligation of the RCA or percutaneous coil embolization.

The decision between re-implantation of the RCA and coronary bypass was going to hinge on her LVEF at the time of surgery. Both could be performed with cardio-pulmonary bypass without cardioplegic arrest of the heart, but coronary artery bypass could be performed off-pump if necessary. We felt re-implantation of the RCA was the preferable long-term approach to establish dual ostial circulation in this otherwise healthy and active woman, and did not feel simple ligation or coil embolization was appropriate for the same reasons.

At the time of surgery since her LVEF had improved somewhat we felt it best to go ahead with re-implantation of the RCA. While we were hoping for some recovery in cardiac function after re-implantation, we were surprised to see essentially normal cardiac function post-cardiopulmonary bypass.

This case presentation poses a number of management questions, including the diagnosis of coronary anomalies, timing of surgical intervention, and the various surgical options to treat this coronary anomaly with each of their positives and negatives. We also approached this patient in a multi-disciplinary manner with involvement and discussion among the cardiology, electrophysiology, cardiac surgery, and adult congenital heart disease teams at our institution.

Saturday, June 8, 2024

Rapid Fire Abstract Session (7:00 - 8:00 a.m.)

7:36 a.m.

Case Presentation: Life or Limb: Lower Extremity Ischemia after Coronary Artery Bypass Grafting

Author List: Giovanna Grigsby-Rocca, BA; John Stulak, MD; Arman Arghami, MD, MPH

Case Presentation: Over a third of patients with coronary artery disease have concomitant peripheral artery disease.ⁱ In peripheral artery disease, especially aortoiliac occlusive disease, collateral flow from the internal mammary artery to the inferior epigastric artery gains importance and can account for over a third of lower limb perfusion.ⁱⁱ Use of the gold-standard left internal mammary artery (LIMA) as a conduit for coronary artery bypass graft in patients with aortoiliac occlusive disease can disrupt this collateral flow. We present two cases where use of the LIMA resulted in lower limb ischemia and chronic neuropathic changes due to disruption of the LIMA to inferior epigastric collateral.

Patient 1: A 52-year-old male with past medical history of ischemic cardiomyopathy, aortoiliac occlusive disease, and known peripheral artery disease with left lower extremity claudication underwent planned coronary artery bypass grafting (CABG). LIMA was anastomosed to the left anterior descending (LAD) artery and saphenous vein was used as the conduit for the posterior descending coronary artery.

Shortly after extubation, the patient experienced pain, reduced sensation and mobility in his left lower extremity. Physical examination was consistent with acute leg ischemia, and was notable for cool skin, pallor, reduced sensation and motor function, and absence of Doppler signal. Careful review of prior CTA revealed complete occlusion of the infrarenal aorta with collateralization of LIMA to the femoral artery via the epigastric artery (IEA) (Figure 1). Diagnosis of acute limb ischemia due to interruption of the internal mammary to epigastric collaterals was made, leading to emergent surgery and for right axillo-bifemoral bypass. Two compartment fasciotomy incisions were made on the left lower extremity. His postoperative course was complicated by poor wound healing of the fasciotomy site and chronic neuropathic pain of the left foot following revascularization. The patient was discharged two weeks after the initial CABG procedure with chronic neuropathic changes and no evidence of acute lower limb ischemia.

Patient 2: A 50-year-old female with history of aortoiliac occlusive disease, peripheral artery disease, and rest ischemia of the lower extremities was referred to our institution for evaluation of CABG eligibility. CT abdomen revealed occlusion of the left common iliac artery at its origin with reconstitution of flow in the proximal left external iliac artery, and plaque with moderate stenosis at the proximal and midportion of the right common iliac artery. CTA also

revealed a large and long collateral from LIMA to the left external iliac artery via the IEA (Figure 2). CABG was deferred to after vascular surgery due to concerns that using the LIMA for LAD bypass would remove the collateral blood supply to the left lower extremity and produce significant limb ischemia.

Despite this, the patient underwent CABG at an outside institution, where the procedure was performed using the harvested LIMA and saphenous vein. The patient continued to experience claudication symptoms consistent with her chronic history at the time of discharge from the outside hospital stay. Three months later, she presented to vascular surgery at her institution with complaints of pain upon walking in her entire left extremity and constant neuropathy in her left foot. Examination revealed no palpable pulses in the left lower extremity. Shortly after, she underwent successful angioplasty and stent placement of the abdominal aorta, bilateral common iliac artery and left external iliac artery. The patient was discharged on the same day with continued left lower extremity dysesthesia and numbness, which is ongoing.

Pre-Operative Imaging

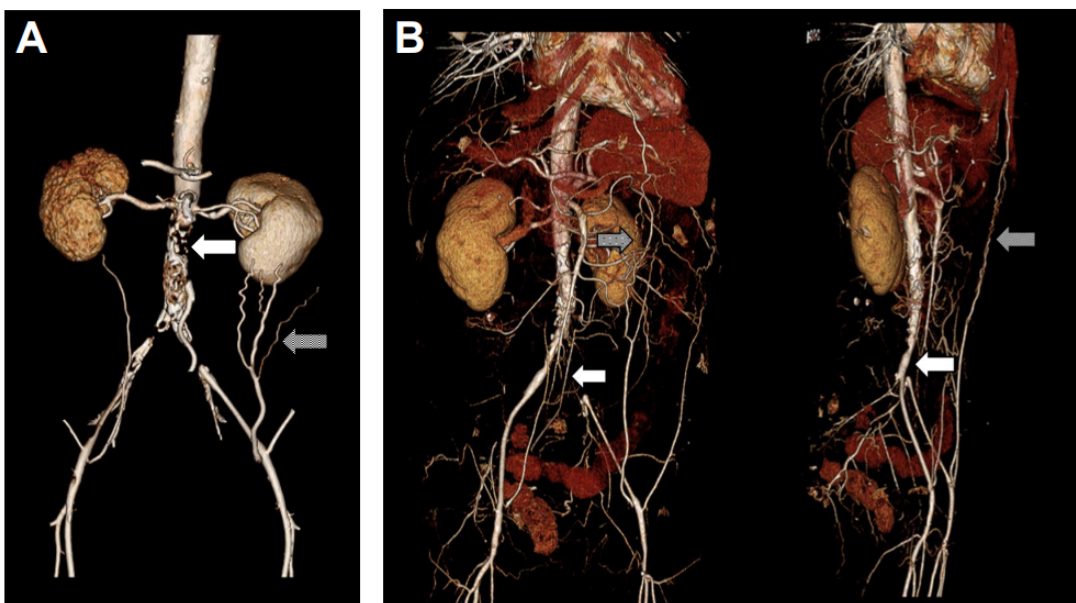


FIGURE 1: (A - Patient 1) Occlusion of the infrarenal abdominal aorta and both common iliac arteries (white arrow). Bilateral external and internal iliac arteries are patent and reconstituted via collateral flow from patent inferior epigastric arteries (grey arrow). **(B - Patient 2)** Occlusion of the left common iliac artery at its origin with reconstitution of flow in the proximal left external iliac artery (white arrow). Collateralization between left internal mammary artery and left inferior epigastric artery (grey arrow).

Postoperative discussion points/questions: Disruption of collateral blood supply to the left lower extremity following LIMA to LAD bypass is a long-established but infrequently documented complication of CABG surgeries. In these two cases, LIMA to LAD connection bypass produced potentially avoidable ischemic disease in the post-operative setting.

In patients with aortoiliac occlusive disease, IMA collateral to the IEA can contribute over 38% of the lower-extremity perfusion.ⁱⁱⁱ When peripheral artery or aortoiliac occlusive disease is present in patients undergoing CABG, IEA flow reversal can be assessed with Doppler ultrasound to identify LIMA to IEA collateral.^{iv} If indicated, CTA can be performed to evaluate aortoiliac occlusion and the extent of LIMA to IEA collateralization. If not evaluated pre-operatively, a larger-than-normal LIMA identified intraoperatively may indicate significant LIMA to IEA collateral development. Distal pulse evaluation via Doppler ultrasound can also be performed intraoperatively.

When substantial collateralization between IMAs to IEAs is identified prior to surgery, precautions should be considered. Precautions include staged revascularization with CABG following lower extremity revascularization or vice versa depending on the acuity of ischemia, strict postoperative observation of lower extremity perfusion, and selecting alternative conduit option (such as contralateral internal mammary, saphenous vein, or radial artery). These measures aim to mitigate the risk of collateral disruption and subsequent ischemic complications in the postoperative period, while still allowing for treatment of coronary artery disease.

Rapid Fire Abstract Session (7:00 - 8:00 a.m.)

7:42 a.m.

Case Presentation: Surgical treatment of myocardial bridging: A case series

Author List: Maria Andrea Medina, MD, Javier D. Garzon, MD, Felipe Noriega, MD

Case Presentation:

Patient 1

A 47-year-old male with history of hepatic steatosis, ankylosing spondylitis, psoriatic arthritis, and MB in left anterior descending (LAD) artery treated with Beta-blocker who comes to the ER with a one-day complaint of chest pain. On the work-up, ECG showed anteroseptal subendocardial ischemia, cardiac biomarkers were negative, transthoracic echocardiogram (TTE) showed a left ventricle with preserved ejection fraction (EF) (60%), non-dilated right ventricle with preserved EF and no significant valvulopathies. Coronary angiography (CA) revealed absence of coronary artery disease (CAD) and MB that occlude 70% of the artery lumen in systole. Due to the persistence of symptoms despite medical therapy and favorable anatomy, myotomy was indicated. Following median sternotomy, cardiopulmonary bypass (CBP) was initiated with a single, dual-stage venous cannula via the right atrial appendage (RAA) and aortic cross-clamp performed, LAD artery was carefully dissected, a 2 centimeters MB between the first and second diagonal arteries was identified and a supra-arterial myotomy was performed. The patient and was discharged 4 days after surgery

Patient 2

A 25-year-old male with no cardiovascular risk factors, who presented to a local ER with sudden chest pain and dyspnea during a soccer match. On the work-up, ECG showed anteroseptal ST elevation with positive cardiac biomarkers. STEMI was diagnosed, fibrinolysis was performed followed by referral to our centre. TTE showed a hypertrophic left ventricle with mild hypokinesia of the septal wall and preserved EF (60%), non-dilated right ventricle with mild systolic dysfunction and no significant valvulopathies. CA revealed absence of CAD and an occlusive MB in the LAD midpart. Due to the diagnosis of MINOCA and favorable anatomy, myotomy was indicated. Following median sternotomy, CBP was initiated with a single, dual-stage venous cannula via the RAA and aortic cross-clamp performed, LAD artery was carefully dissected, after the first diagonal artery a 5-millimeter depth and 5 centimeters length MB was identified and a supra-arterial myotomy was performed. The patient was discharged home 6 days after surgery.

Patient 3

A 32-year-old male with no cardiovascular risk factors, who presented to the ER with chest pain and dyspnea. On the work-up, cardiac biomarkers were positive. NSTEMI was diagnosed. TTE showed a non-dilated left ventricle and preserved EF (60%), non-dilated right ventricle with adequate systolic dysfunction and no significant valvulopathies. CA revealed absence of CAD and an occlusive MB in the LAD midpart. Due to the diagnosis of MINOCA and favorable anatomy,

myotomy was indicated. Following median sternotomy, CBP was initiated with a single, dual-stage venous cannula via the RAA and aortic cross-clamp performed, LAD artery was carefully dissected, after the first diagonal artery a 3-millimeter depth and 7 centimeters length MB was identified and a supra-arterial myotomy was performed. The patient was discharged home 3 days after surgery.

Pre-Operative Imaging

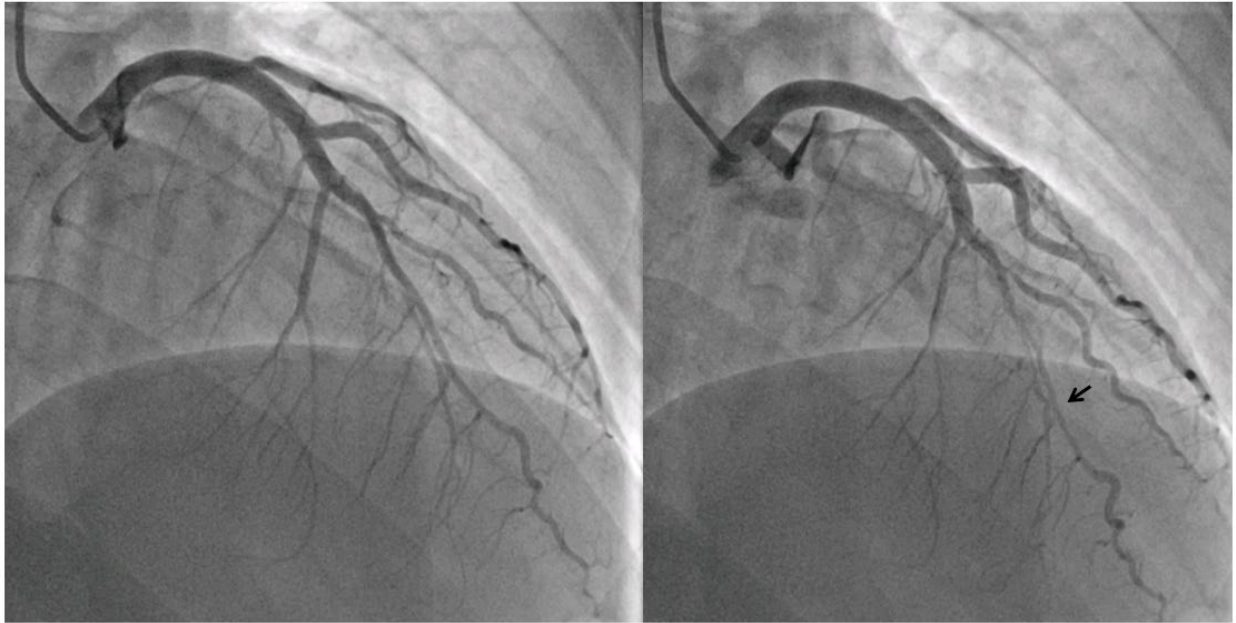


Image 1. Coronary arteriography with the presence of myocardial bridging and subsequent coronary artery compression (Black arrow)

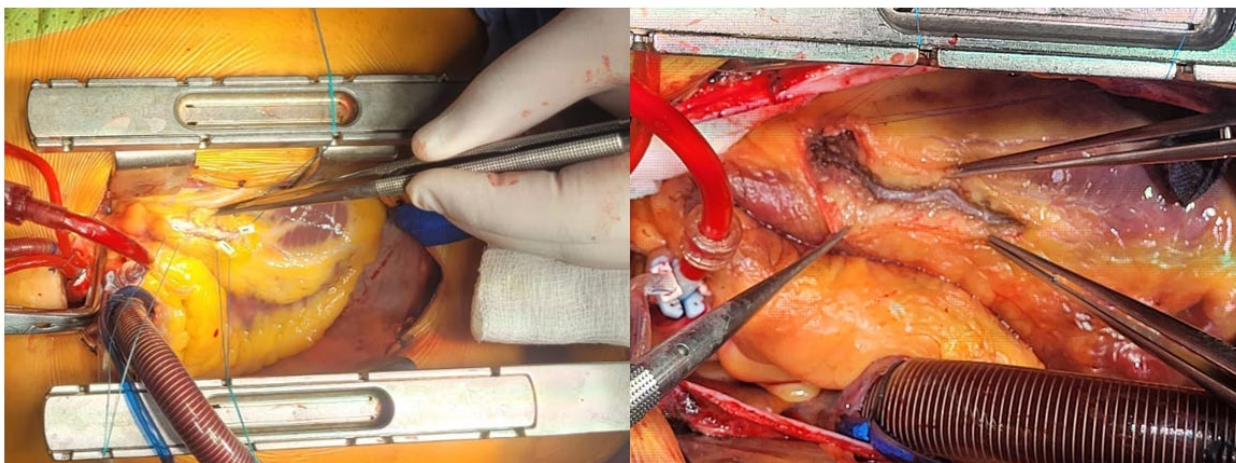


Image 2. LAD myocardial bridging removal with a supra-arterial myotomy.

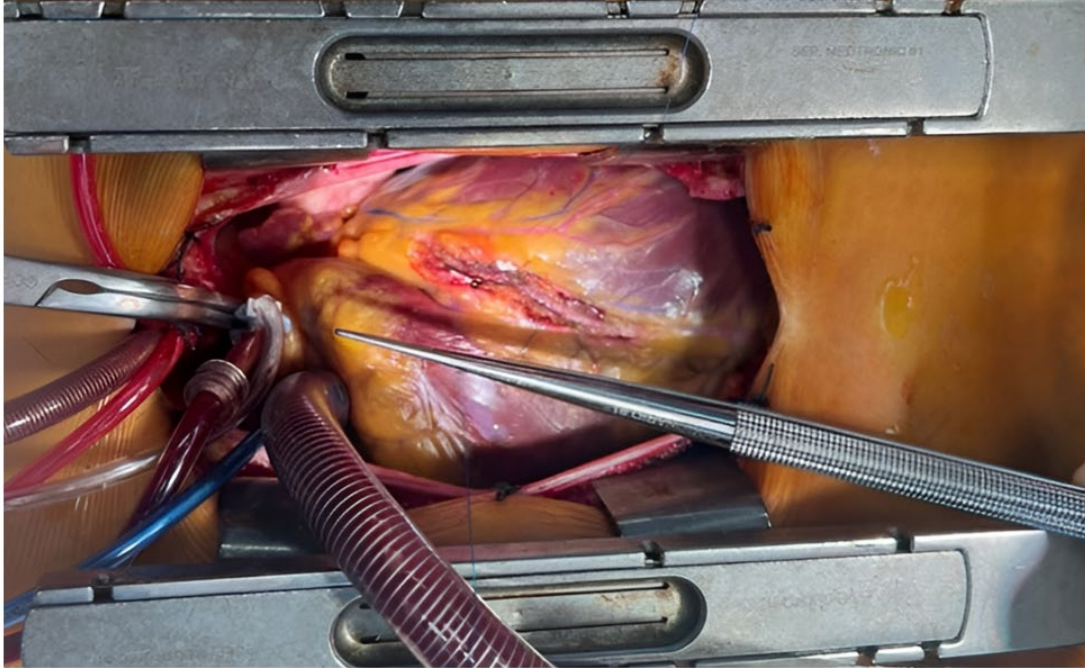


Image 3. Comparing the size of the LAD myocardial bridging removed with a forceps

Postoperative discussion points/questions: Although MB is considered a benign condition, it represents a diagnostic and therapeutic challenge in symptomatic patients with life-threatening complications. Surgical treatment between CABG and supra-arterial myotomy has been proposed. Supra-arterial myotomy can be a safe, effective, and feasible approach to MB because it aims to correct the underlying pathology improving symptoms and quality of life.

Saturday, June 8, 2024

Rapid Fire Abstract Session (7:00 - 8:00 a.m.)

7:54 a.m.

Case Presentation: Infected Coronary Stent with Cardiac Abscess: A Case of an Unusual Presentation and Successful Surgical Management

Author List: Catherine E. Stauber, BA, Shangir Siddique, MD, MPH, Francisco Diaz Viera, MD, Prithvi Vallabh, MD, Senthil Sivam, MD, William Kessler, MD, Sneha Vakamudi, MD, George J. Arnaoutakis, MD

Case Presentation: This is a 45-year-old woman with a history of poorly controlled type 2 diabetes mellitus, coronary artery disease, and recent myocardial infarction status-post percutaneous coronary intervention (PCI) with drug-eluting stent (DES) to the right coronary artery (RCA), posterior descending artery (PDA), and posterolateral branch (PL) vessels. She was admitted with two weeks of fever, dysuria, worsening back pain, and a one-day history of non-radiating substernal chest pain.

In the emergency department, the patient was febrile to 103.2F with a leukocytosis to 25,000 and elevated troponins. Physical exam was significant for a lethargic woman with tachycardia, irregular rhythm, and bilateral flank tenderness. Electrocardiogram was significant for junctional tachycardia and a recent inferior infarct. Urinalysis and computed-tomography scan confirmed acute pyelonephritis and showed an incidental finding of fluid density and gas at the base of the left ventricle, leading to increasing concern for coronary stent infection in the setting of severe sepsis and bacteremia. Blood and urine cultures were sent, and the patient was started on broad-spectrum intravenous antibiotics.

Echocardiogram showed mildly depressed systolic function of 45-50%, regional wall abnormalities consistent with prior myocardial infarction, and an area of echolucency at the base of the inferior left ventricle. CTA showed a 2.5 x 3.6 cm area of localized fluid and gas surrounding the bifurcating PDA and PL branch stents, consistent with coronary artery abscess (Figure 1). A cardiac catheterization showed severe multivessel epicardial coronary artery disease involving the left anterior descending (LAD), left circumflex (LCx), and PL vessels. Blood and urine cultures returned positive for *Klebsiella pneumoniae* and the patient was diagnosed with severe sepsis and bacteremia from *Klebsiella* pyelonephritis with seeding of recently placed coronary stents. After the patient's blood cultures cleared, the patient was taken to the operating room for explant of infected coronary stents, PDA endarterectomy with vein patch, and 2-vessel coronary artery bypass grafting (CABG).

In the operating room, the distal RCA, PDA, and PL were exposed and revealed extensive inflammation with a dense phlegmon mass visualized in the posterior septum. The phlegmon was debrided extensively to ensure drainage of the infection. Portions of the phlegmon were sent for culture. The stents were identified and arteriotomy was made in both the PDA and PL

and the stents were removed. The PL was an occluded branch on repeat left heart catheterization, thus it was mass ligated. The PDA was a viable target and a segment of vein was used to perform PDA endarterectomy with vein patch reconstruction. We then proceeded to a 2-vessel CABG to LAD and obtuse marginal (OM). The patient recovered well. Her post-operative course was complicated by intermittent complete heart block and junctional tachycardia that resolved without intervention. Pathology of the phlegmon was significant for a benign, reactive lymph node and cultures of the specimen showed no growth, likely attributable to preoperative antibiotics.

Pre-Operative Imaging

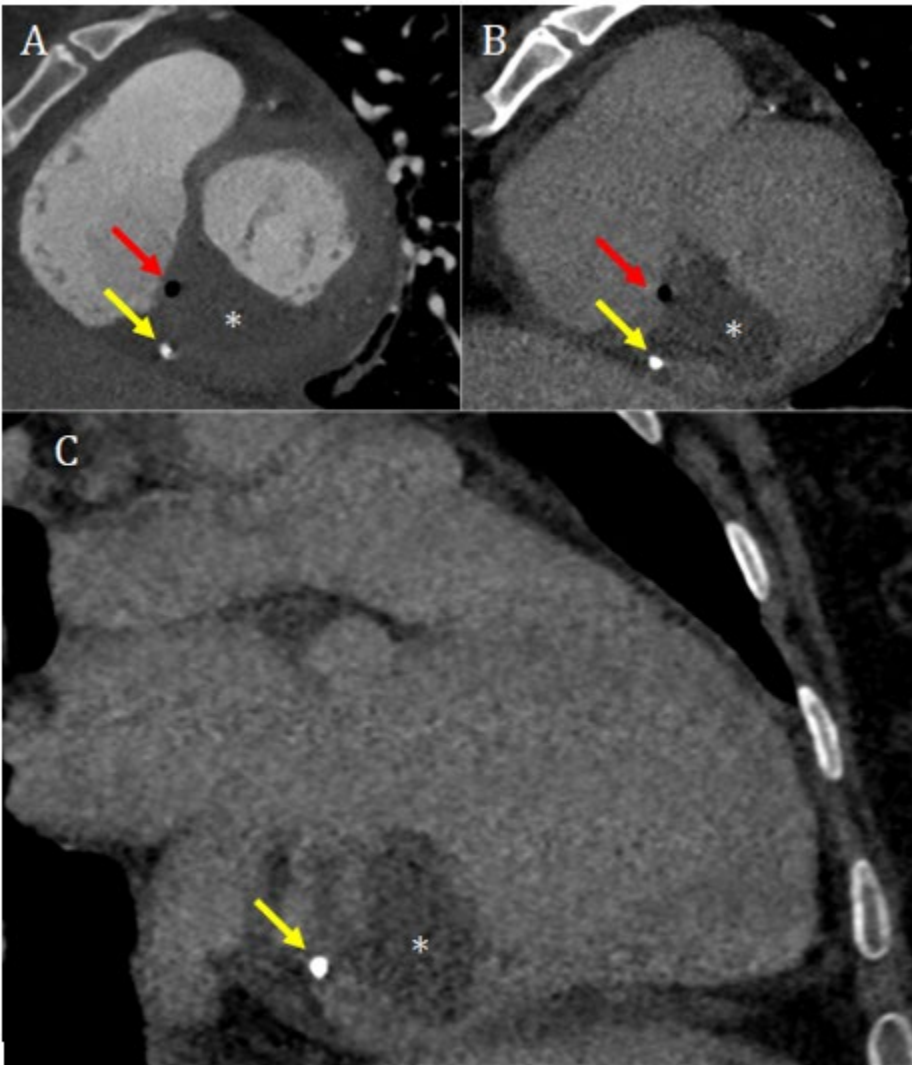


Figure 1. ECG gated cardiac CTA. A) Axial view of arterial phase image demonstrating abscess (*), coronary stent (yellow arrow), and periabscess gas formation (red arrow). B) Axial view of delayed phase imaging demonstrating abscess, stent, and periabscess gas. C) Sagittal view demonstrating abscess with hyper-enhancing rim.

Postoperative discussion points/questions: This case describes a unique presentation of coronary stent abscess, a rare presentation of bacterial endocarditis. In this patient's case, routine CT Imaging to evaluate possible etiology for infection resulted in abnormal presence of gas within the left ventricle, which prompted further evaluation with cardiac specific imaging leading to a diagnosis. Multimodality imaging as well as multidisciplinary care by internal medicine, infectious disease, cardiology, and cardiothoracic surgery resulted in this patient receiving a complex surgical intervention that provided optimal treatment for infection as well as appropriate coronary revascularization.

Given the rarity of coronary abscesses, there is a lack of generalizable guidelines regarding management, and cases have discussed the need for antimicrobial therapy paired with cardiac surgical intervention. For these reasons, it remains of value to routinely screen patients presenting with anginal symptoms for signs of active, recent, or partially treated distant or systemic infections prior to stent placement unless revascularization is urgent.

7:54 a.m.

Abstract: Mini-thoracotomy versus Median Sternotomy for Off-Pump Coronary Artery Bypass of the Left Anterior Descending Artery with the Left Internal Thoracic Artery

Author List: Saad Salamate, MD, Farhad Bakhtiary MD PhD, Ali Bayram, MD, Sami Sirat, MD, PhD, Veaceslav Ciobanu, MD, Nadejda Monsefi, MD, and Ali El-Sayed Ahmad, MD, PhD

Purpose: Minimally invasive approach through left mini-thoracotomy is a promising alternative to the median sternotomy for coronary artery bypass. The aim of this study is to compare the short-term outcomes of patients undergoing minimally invasive coronary artery bypass (MIDCAB) with off-pump coronary artery bypass through sternotomy (OPCAB) for single vessel disease.

Methods: From January 2017 to February 2023, 377 consecutive patients aged above 18 years undergoing off-pump bypass of the left anterior descending artery (LAD) with the left internal thoracic artery (LITA) were included. MIDCAB was performed on 277 (73.5%) patients while 100 (26.5%) patients underwent OPCAB. Propensity score matching was then applied. Primary endpoints were in-hospital mortality and 30-day mortality.

Results: Prior to matching, 30-day mortality occurred in 2 (0.7%) of patients withing the MIDCAB group versus 1 (1%) patient in the OPCAB group ($p=1$). Transfusion of red blood cells (RBC) was required in 9.4% and 29% of patients within the MIDCAB and the OPCAB group, respectively ($p<0.001$). Median intensive care stay (ICU) was 1 [1–2] day in the MIDCAB group, versus 2 [1–3] in the OPCAB ($p<0.001$). In the matched cohort, 10% of MIDCAB patients received RBCs versus 27.5% of OPCAB patients ($p=0.006$). Median ICU stay was significantly lower in the MIDCAB group, 1 [1–2] versus 2 [1–3] days.

Conclusion: MIDCAB is as safe and effective as OPCAB for single coronary artery bypass of the LAD with the LITA in select patients. It is associated with a decreased ICU stay and lower transfusion rates when compared with OPCAB.

Saturday, June 8, 2024

Session 10: Minimally Invasive CABG, MIDCABG - How I Do It (11:25 AM - 12:30 PM)

11:41 a.m.

Abstract: Starting a Minimally Invasive Coronary Surgery Program: Initial Results after 200 MIDCAB Cases

Author List: Kelsey Gray, MD, Yakov Elgudin, MD, PhD, Gregory Rushing, MD, Marc Pelletier, MD, Joseph F. Sabik III, MD, Pablo Ruda Vega, MD

Purpose: Minimally invasive CABG (MIDCAB) with LIMA to LAD is an established technique associated with less pain, shorter hospital stay, and faster recovery. However, less than 2% of CABGs done last year were MIDCABs. We aim to describe our experience starting a MIDCAB program by reviewing our first 200 cases.

Methods: This is a retrospective review of the first 200 patients that underwent MIDCAB within an academic hospital system between August 2021 and February 2024. Within this system, MIDCAB was performed at 5 different institutions by 4 surgeons. The primary outcome metrics examined were mortality, stroke, renal failure, post-operative ventilator hours, and post-operative length of stay. We also examine the use of multi-vessel grafting, combined procedures, and transition to robotic assisted MIDCAB.

Results: Of the 200 patients that underwent MIDCAB, the average age was 67 and 28 (14%) patients were 80 years or older. The majority of patients were male, 148/200 (74%). Overall, 30 day mortality was 1%(2/200) with zero strokes, no renal failure, and no wound infections. Three patients underwent conversion to sternotomy. LIMA to LAD was used in 100% of patients. Multi-vessel bypass grafting was performed in 23(11.5%) of patients - 4 bilateral mammary, 12 radial, 7 vein. Average predicted post operative mortality was 1.8% with 20% (39/200) at 2% or higher predicted risk. Average post-operative ventilator time was 6.5 hours and average post-operative length of stay was 6 days. Forty-one patients underwent hybrid revascularization with LIMA to LAD and PCI. Five patients underwent combined MIDCAB with Convergent and 8 patients underwent MIDCAB with LAA ligation. Twenty three patients underwent robotic assisted MIDCAB with the first case occurring in December 2023.

Conclusion: Our experience suggests that MIDCAB can initially be performed safely, with lower than predicted mortality, can be combined with other minimally invasive procedures, and can be a reasonable option for patients with higher preoperative risk profiles who will benefit from LIMA to LAD bypass.

Featured Abstract Session (1:30 - 2:00 p.m.)

1:30 p.m.

Abstract: How Soon Is Too Soon? Impact of Early Post-Discharge Visit After Coronary Artery Bypass Grafting on Readmission Rates

Author List: Michael Dorsey, MD, Michael Allison, BS, MBA, Eugene Grossi, MD, Deane Smith, MD, Elias Zias, MD

Purpose: Unplanned readmissions after coronary artery bypass grafting (CABG) significantly burden US healthcare systems and yield worse outcomes. Interventions to reduce readmissions include improved patient education, thorough medication reconciliation, and earlier follow-up. We report our experience with early in-person clinic visits after CABG discharge and their impact upon readmission rates.

Methods: A retrospective cohort review of adult patients who underwent non-emergent isolated CABG by a single surgeon was conducted between 1/2017 and 12/2022. Patients were excluded if they underwent re-operative or concomitant procedures at the time of CABG. Beginning in 2019, the discharge protocol was modified to ensure patients had a clinic visit scheduled on post-discharge day 1. Therefore, patients were stratified into two groups: Pre-Protocol and Post-Protocol. Baseline and perioperative characteristics were compared between the groups, and propensity score matching was performed to generate cohorts with comparable baseline characteristics. The primary outcome was the rate of 30-day readmission.

Results: Over the study period, 689 patients underwent isolated CABG and were stratified into Pre-Protocol (N=223) and Post-Protocol (N=466). Median age was 65 among the entire cohort (Table 1). Operatively, patients in the Post-Protocol group had longer bypass times (111 vs 94 minutes, $p<0.005$) and cross-clamp times (98 vs 82 minutes, $p<0.005$), while receiving more grafts (4 vs 3, $p<0.005$). Over time, more patients were extubated in the OR (61% vs 4%, $p<0.005$), experienced shorter lengths of stay (3 vs 6 days, $p<0.005$), and were more likely to be discharged home (97% vs 91%, $p<0.005$). There were no 30-day mortalities. Prior to matching, the Post-Protocol group experienced fewer 30-day readmissions (2% vs 4%, $p=0.065$), though the difference did not reach statistical significance. After propensity score matching (Table 2), there was no difference in 30-day readmissions between the groups (4% vs 4%, $p=1.0$).

Conclusion: Limiting hospital readmissions after CABG is important for improved patient care and for cost-effectiveness. In isolation, follow-up appointments on post-discharge day 1 do not appear to reduce readmissions significantly. While early follow-up is likely an important component of reducing post-operative readmissions, the optimal day for first post-discharge contact remains unclear.

Title of Image: Table 1. Unmatched Cohort Characteristics and Outcomes

Table 1. Unmatched Cohort Characteristics and Outcomes

Baseline Characteristics	Total Cohort N=689	Pre-protocol (2017-2018) N= 223	Post-protocol (2019-2022) N= 466	p-value
Age, years, median (IQR)	65 (59-71)	65 (59-71)	64 (58-71)	0.231
Race, n (%)				0.069
White	380 (55)	136 (60)	244 (53)	
Other	311 (45)	91 (40)	220 (47)	
*Gender, n (%)				<0.005
Male	565 (82)	166 (74)	399 (86)	
Female	124 (18)	57 (26)	67 (14)	
BMI, kg/m², median (IQR)	28 (25-31)	28 (25-31)	28 (25-32)	0.640
Hypertension, n (%)	622 (90)	206 (92)	416 (89)	0.198
Diabetes, n (%)	415 (60)	142 (64)	273 (59)	0.201
Renal failure on dialysis, n (%)	14 (2)	6 (3)	8 (2)	0.397
Cerebrovascular disease, n (%)	96 (14)	32 (14)	64 (14)	0.827
Prior cerebrovascular accident	56 (8)	21 (9)	35 (8)	
STS Risk Score, %, median (IQR)	0.9 (0.5-1.5)	0.9 (0.5-1.5)	0.9 (0.6-1.4)	0.541
*Ejection Fraction, %, median (IQR)	60 (53-65)	60 (49-64)	60 (55-65)	<0.005
Perioperative Variables				
*Cardiopulmonary bypass time, minutes, median (IQR)	106 (89-123)	94 (80-109)	111 (93-128)	<0.005
*Cross-clamp time, minutes, median (IQR)	92 (76-107)	82 (68-95)	98 (81-111)	<0.005
Number of grafts, mean ± SD	4 ± 1	3 ± 1	4 ± 2	<0.005
Extubated in operating room, n (%)	294 (43)	9 (4)	285 (61)	<0.005
Prolonged ventilation, n (%)	13 (2)	6 (3)	7 (2)	0.284
Stroke, n (%)	2 (0)	0 (0)	2 (0)	0.328
SSI/Sternal Infection, n (%)	0 (0)	0 (0)	0 (0)	NA
Reoperation for bleeding, n (%)	6 (1)	3 (1)	3 (1)	0.355
Renal failure requiring dialysis, n (%)	2 (0)	0 (0)	2 (0)	0.328
*Atrial fibrillation, n (%)	44 (6)	41 (18)	3 (1)	<0.005
*ICU length of stay, hours, median (IQR)	17 (13-24)	21 (18-30)	15 (12-21)	0.017
*Postoperative length of stay, days, median (IQR)	3 (2-5)	6 (5-7)	3 (2-3)	<0.005
*Discharge disposition, n (%)				<0.005
Home	654 (95)	202 (91)	452 (97)	
Acute rehabilitation/Subacute rehabilitation	35 (5)	21 (9)	14 (3)	
Outcomes				
30-day mortality, n (%)	0 (0)	0 (0)	0 (0)	N/A
30-day readmissions, n (%)	21 (3)	10 (4)	11 (2)	0.065

BMI: Body mass index; STS: Society of Thoracic Surgeons; SSI: Surgical site infection; ICU: Intensive care unit; IQR: Interquartile range; SD: Standard deviation

Table 2. Matched Cohort Characteristics and Outcomes

Baseline Characteristics	Pre-protocol (2017-2018) N= 125	Post-protocol (2019-2022) N= 125	p-value
Age, years, median (IQR)	63 (58-70)	65 (58-71)	0.504
Race, n (%)			0.076
White	73 (58)	59 (47)	
Other	52 (42)	66 (53)	
*Gender, n (%)			0.066
Male	97 (78)	84 (67)	
Female	28 (22)	41 (33)	
BMI, kg/m², median (IQR)	28 (25-31)	28 (24-32)	0.312
Hypertension, n (%)	116 (93)	112 (90)	0.372
Diabetes, n (%)	79 (63)	86 (69)	0.350
Renal failure on dialysis, n (%)	2 (2)	3 (2)	0.651
Cerebrovascular disease, n (%)	16 (13)	13 (10)	0.554
Prior cerebrovascular accident	7 (6)	8 (6)	
STS Risk Score, %, median (IQR)	0.7 (0.4-1.3)	1.1 (0.7-1.9)	0.009
*Ejection Fraction, %, median (IQR)	60 (50-65)	60 (50-65)	0.984
Perioperative Variables			
*Cardiopulmonary bypass time, minutes, median (IQR)	97 (82-112)	111 (90-125)	<0.005
*Cross-clamp time, minutes, median (IQR)	85 (73-95)	96 (79-108)	<0.005
Number of grafts, mean ± SD	4 (3-4)	4 (3-4)	<0.005
Extubated in operating room, n (%)	6 (5)	44 (35)	<0.005
Prolonged ventilation, n (%)	0 (0)	4 (3)	0.044
Stroke, n (%)	0 (0)	1 (1)	0.318
SSI/Sternal Infection, n (%)	0 (0)	0 (0)	N/A
Reoperation for bleeding, n (%)	1 (1)	2 (2)	0.563
Renal failure requiring dialysis, n (%)	0 (0)	1 (1)	0.318
*Atrial fibrillation, n (%)	5 (4)	3 (2)	0.474
*ICU length of stay, hours, median (IQR)	21 (18-36)	17 (13-25)	0.902
*Postoperative length of stay, days, median (IQR)	5 (4-6)	4 (3-6)	0.758
*Discharge disposition, n (%)			0.803
Home	117 (94)	116 (93)	
Acute rehabilitation/Subacute rehabilitation	8 (6)	9 (7)	
Outcomes			
30-day mortality, n (%)	0 (0)	0 (0)	N/A
30-day readmissions, n (%)	5 (4)	5 (4)	1.000

BMI: Body mass index; STS: Society of Thoracic Surgeons; SSI: Surgical site infection; ICU: Intensive care unit; IQR: Interquartile range; SD: Standard deviation

Saturday, June 8, 2024

Featured Abstract Session (1:30 - 2:00 p.m.)

1:37 p.m.

Abstract: Sequential Grafting of the LITA to LAD Is Not Associated with Increased Risk of Graft Failure

Author List: Jordan Leith, BS, Kevin R. An, MD, MPH, Lamia Harik, MD, Gianmarco Cancelli, MD, Sofia Camilla Rossi, MD, Giovanni Jr. Soletti, MD, Tulio Caldonazo, MD, Mario Gaudino, MD, PhD, MSCE

Purpose: Sequential grafting of the left internal thoracic artery (LITA) may help maximize available arterial grafts in coronary artery bypass graft (CABG) surgery. However, the risk of graft failure with this technique is unclear. We investigated the incidence of graft failure in sequential vs. single LITA-left anterior descending (LAD) grafts.

Methods: Pooled individual patient data from 10 randomized clinical trials with systematic CABG graft imaging were analyzed to assess the incidence of graft failure and its association with sequential vs. single LITA-LAD grafting. Mixed-effects multivariable logistic regression models were performed adjusting for baseline patient characteristics and clustering of grafts within patients as well as patients within trials.

Results: Of 3969 patients included in the analysis, 283 patients received sequential LITA-LAD grafts. Sequential grafting patients were older (65.6 vs. 64.1 years, $p=.009$) and more often male (3069 [88.0%] vs. 249 [83.2%], $p=.039$). Graft failure occurred in 368 (9.4%) patients with LITA to LAD grafts with no difference between single (350 [9.5%]) and sequential grafts (18 [6.4%], $p=.018$) at a median time to imaging of 1.03 years (IQR 1.00-1.1). After adjustment, sequential grafting was not associated with graft failure (adjusted odds ratio [aOR]: 1.25; 95% CI: 0.69-2.27; $p=0.5$) whereas age (aOR: 1.02; 95% CI: 1.01-1.03; $p=.011$), history of smoking (aOR: 1.53; 95% CI: 1.14-2.04; $p=.004$), and lack of antiplatelet use (aOR: 3.4; 95% CI: 2.30-5.03; $p<.001$) were associated with graft failure. Sequential grafting patients had a lower mortality (5 [1.8%] vs. 178 [4.8%], $p=.018$), but there was no difference between groups in the incidence of myocardial infarction, revascularization, or stroke.

Conclusion: Sequential grafting of the LITA to LAD was not associated with graft failure. Despite increased technical challenge and previous concerns of early graft failure due to another anastomotic site, sequential grafting of the LITA to LAD may be considered to maximize arterial revascularization safely during CABG in carefully selected patients.

Table 1. Logistic Regression of Patient Characteristics and their Association with Graft Failure

Characteristic	aOR¹	95% CI¹	p
Age	1.02	1.01, 1.03	0.011
Female Sex	1.29	0.93, 1.78	0.130
Hypertension	0.85	0.64, 1.14	0.300
Diabetes	0.90	0.69, 1.18	0.400
Dyslipidemia	0.76	0.57, 1.03	0.076
Peripheral Vascular Disease	1.33	0.92, 1.92	0.130
Smoking History	1.53	1.14, 2.04	0.004
Postoperative Statin Use	0.95	0.70, 1.30	0.800
Prior Percutaneous Coronary Intervention	1.12	0.83, 1.50	0.500
Prior Myocardial Infarction	1.15	0.88, 1.51	0.300
Elective (non-urgent) Case Status	1.14	0.88, 1.48	0.300
CBP ² used	1.08	0.79, 1.48	0.600
Antiplatelet Use			
Single antiplatelet therapy	—	—	
No antiplatelet therapy	3.40	2.30, 5.03	<0.001
Dual antiplatelet therapy	1.19	0.85, 1.65	0.300
Sequential LITA-LAD ³ Grafting	1.25	0.69, 2.27	0.500

¹ aOR- Adjusted Odds Ratio, CI = Confidence Interval

² CPB- Cardiopulmonary Bypass

³ LITA- Left Internal Thoracic Artery, LAD- Left Anterior Descending Artery

Saturday, June 8, 2024

Featured Abstract Session (1:30 - 2:00 p.m.)

1:44 p.m.

Abstract: The Impact of Impella 5.5 Use in High-Risk Coronary Artery Bypass Grafting

Author List: Takashi Murashita, MD, Kunal D. Kotkar, MD, M. Faraz Masood, MD, Amit Pawale, MD, Tsuyoshi Kaneko, MD

Purpose: The Impella 5.5 (Abiomed Inc) is a surgically implanted endovascular microaxial left ventricular assist device. In this study, we evaluated the impact of perioperative use of Impella 5.5 at the time of high-risk coronary artery bypass grafting in patients with low left ventricular ejection fraction (<30%).

Methods: This was a single-institution retrospective study. The patients with preoperative left ventricular ejection fraction < 30%, who underwent isolated coronary artery bypass grafting between 2020 and 2023 were reviewed. The patients who underwent concomitant procedures, redo coronary artery bypass grafting, preoperative Impella support, or the patients who received other types of mechanical circulatory assist devices were excluded.

Results: There were 68 patients who met the inclusion criteria of this study. Fifty-eight patients (85.3%) were male. The median age was 62 years old. The median preoperative LVEF was 23%. Among 68 patients, 25 patients received postoperative Impella 5.5 (Impella group), whereas 43 patients did not (Non-Impella group). The use of Impella 5.5 was determined by multidisciplinary team based on cardiac viability, left ventricular size, severity of coronary artery disease, the presence of valvular disease, and so on. Preoperative left ventricular ejection fraction or left ventricular end-diastolic diameter were not different between 2 groups. Thirty-day mortality rate was 4.0% in Impella group, and that of 4.7% in Non-Impella group (p-value was not significant). The rate of complications such as bleeding, infection, acute kidney injury were not different between 2 groups either.

Conclusion: The perioperative use of Impella 5.5 in high-risk coronary artery bypass grafting in patients with low ejection fraction seemed to provide positive impact on postoperative outcomes. Patient selection would be of utmost importance and requires further experience with this device to determine who will benefit from insertion.

Saturday, June 8, 2024

Featured Abstract Session (1:30 - 2:00 p.m.)

2:21 p.m.

Abstract: External Vein Graft Stenting for Coronary Bypass Grafting: Mid-Term Clinical Follow-Up of a Multicentric Cohort

Author List: Luca Paolo Weltert MD, Paolo Centofanti MD, Samuel Fusca MD, Philipp Angleitner MD, Marija Pljakova MD, Vittoria Lodo MD, Sigrid Sandner MD

Purpose: Bypass grafting is the gold standard for severe coronary disease, yet most repeat revascularizations target previously grafted territories. External stenting of saphenous vein grafts (SVG) has been shown to minimize intimal hyperplasia, a marker of late SVG failure. This study evaluates mid-term clinical outcomes in real world routine practice.

Methods: Three centers prospectively enrolled a cohort of CABG patients who had received external SVG stenting into a dedicated registry between September 2015 and December 2023. All patients received an internal mammary artery graft to the left anterior descending artery and additional arterial and/or venous grafts. One or more SVG were externally stented. Choice of conduits, use of cardiopulmonary bypass, and vein harvesting technique were performed according to the routine practice of each surgeon. All patients were prescribed standard of care medication and were followed via on site visits or phone interviews for major adverse cardiac and cerebrovascular effects.

Results: A total of 385 patients, treated with 398 arterial grafts and 647 SVG, including 457 (70.63%) SVG with external stents, were followed for a mean median of 24 (1-87) months. Patient baseline and surgical characteristics (Table 1), are typical of contemporary CABG patients. No technical failure in external stent deployment was reported. Actuarial KMr freedom from any MACCE was 90.7% of patients were free from any MACCE (Figure 1). A total of 20 repeat revascularization events were observed, none of which targeted the externally-stented SVG territory. One vein graft treated with external stent was observed to be occluded on angiography. Actuarial KM Mortality rate for any cause was 3.77%.

Conclusion: External stenting of vein grafts in coronary artery bypass grafting seems a safe adjunct technique to standard CABG positively affecting clinical outcomes. Overall occurrence of major adverse cardiovascular events is low compared to contemporary CABG literature and repeat revascularization of territories treated with external stents is minimal.

Title of Image: Baseline Characteristics and Follow-Up MACCE

Table 1

	Mean \pm SD or n (%)
Age (yrs.)	65 \pm 8.61
Gender (male)	336 (84.42%)
BMI>30 (kg/cm ²)	41 (10.3%)
Hypertension	385 (96.7%)
Dyslipidemia	196 (49.25%)
Diabetes	162 (40.7%)
Peripheral arterial disease	74 (18.59%)
Chronic obstructive pulmonary disease	33 (8.29%)
End-stage renal disease	5 (1.26%)
Critical pre-operative state	5 (1.26%)
Prior myocardial infarction in the past 90 days	95 (23.87%)
Prior cardiac surgery	0
Ejection fraction	53 \pm 10.48
Euroscore II	1.58 \pm 1.41
STS score	1.31 \pm 1.11
Off pump	100 (25.13%)
Number of grafts	3 \pm 0.9
Number of arterial grafts	398 \pm 0.5
Number of vein grafts	647 \pm 0.6
Number of external stents	457 \pm 0.4
Cardiopulmonary bypass time (min)	104.33 \pm 24.94
Cross clamp time (min)	68.77 \pm 19.57

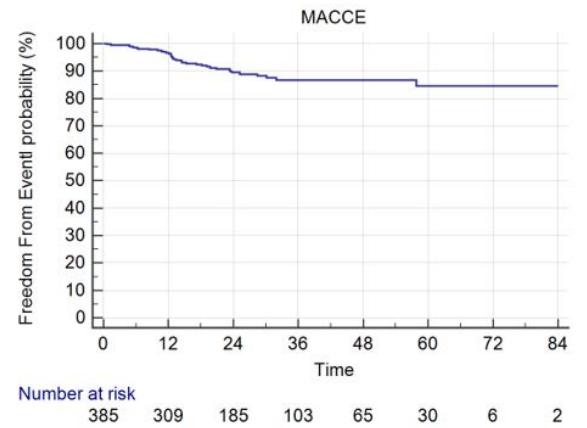


Figure 1f

Session 12: Advance Minimally Invasive CABG, MVST: How I Do It (3:30 – 4:45 p.m.)

4:14 p.m.

Abstract: Clinical and Hospital Costs Outcomes of Octogenarians Undergoing Robotic-Assisted vs. Traditional Sternotomy Coronary Artery Bypass Grafting

Author List: Aleksander Dokollari, MD, PhD; Serge Sicouri, MD; Noah Sicouri, Msc; William Gray MD; Timothy A. Shapiro, MD; Frank McGeehin; Marwan Badri, MD; Eric Gnall, MD; Paul Coady, MD; Mara Caroline, MD; Amid A. Khan, MD; Stephanie Kjelstrom, MD; Georgia Montone, MD; Farah Mahmud; Nitin Ghorpade, MD; Tarek Kandeel, MD; Massimo Baudo, MD; Yoshiyuki Yamashita, MD, PhD, Mary Ann Wertan, MD; Basel Ramlawi, MD; Francis Sutter, MD.

Purpose: Outcomes of octogenarians undergoing coronary artery bypass grafting (CABG) remain hindered. We aim to compare mid-term clinical outcomes and hospital costs in octogenarians undergoing robotic-assisted vs traditional CABG.

Methods: All consecutive 315 octogenarians undergoing robotic-assisted left internal thoracic artery (LITA) harvesting and CABG through a 4cm left minithoracotomy with manual LITA to left anterior descending (LAD) anastomosis and 185 octogenarians undergoing traditional CABG between 2005-2021, were included. A propensity-matched analysis was used to compare baseline characteristics. Cost-analysis included surgical intervention, hospital stay, hybrid PCI, robot-cost and spare parts, hospital readmission, surgeon salary, etc.

Results: After matching, mean age was 86.3 vs 86.2 years ($p=0.833$), mean STS-PROM was 3.4% vs 3.3% ($p=0.505$) and intraoperatively, 118 (94.4%) vs 119 (95.2%) patients received 1 LITA, while 37 (29.6%) vs 0 had on pump CABG in traditional vs robotic-assisted CABG, respectively. Postoperatively, mean intensive care unit stay (67.6 vs 47.6 hours, $p=0.018$), hospital stay (7 vs 6 days, $p=0.002$), blood products transfusion (84 vs 47; $p<0.01$), and new dialysis (7 vs 0; $p=0.008$) were higher in traditional vs robotic-assisted CABG. There was no 30-day mortality in either group. Mean-follow-up was 2.9-years while incidence of all-cause death, major adverse cardiac and cerebrovascular events (MACCE), stroke, myocardial infarction (MI), and repeat intervention with stents were not different between groups. Hospital costs were similar among traditional (\$54.619 per patient) vs robotic-assisted CABG (\$46.361per patient) ($p=0.115$).

Conclusion: Robotic-assisted CABG in octogenarians evidenced better in-hospital outcomes compared to traditional CABG while mid-term incidence of all-cause death, MACCE, stroke, MI, and repeat intervention with stents were similar. In addition, similar hospital costs were observed between groups.

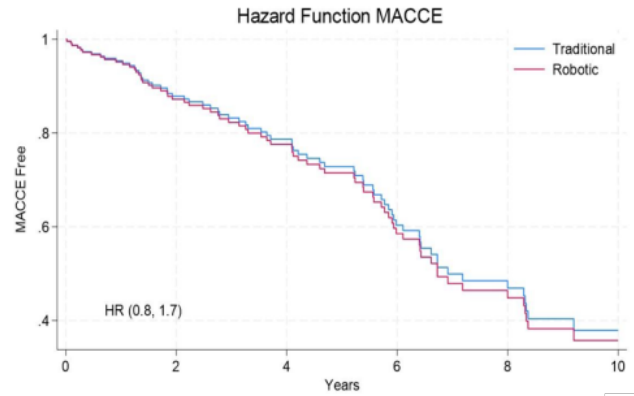
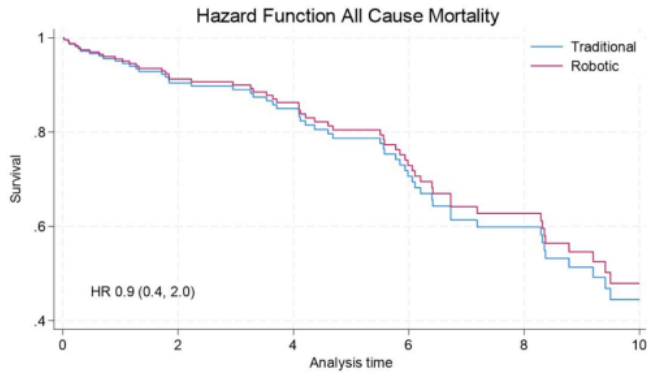
Title of Image: Mid-term Clinical and Costs Outcomes of Robotic-Assisted vs Traditional CABG

Table 1A: Mid-term Clinical Outcomes.

Mid-term Outcomes	Unmatched			Matched		
	Traditional CABG n = 185	Robotic CABG n = 315	p-value	Traditional CABG n = 125	Robotic CABG n = 125	p-value
All Cause Mortality n (%)	42 (22.7%)	61 (19.4%)	0.373	29 (23.2%)	30 (24.0%)	0.882
MACCE (Mortality, MI, stroke, repeat intervention) n (%)	51 (27.6%)	85 (27.0%)	0.887	34 (27.2%)	39 (31.2%)	0.484
Stroke n (%)	5 (2.7%)	3 (0.9%)	0.132	2 (1.6%)	0 (0)	0.157
Myocardial Infarction n (%)	4 (2.2%)	12 (3.8%)	0.312	2 (1.6%)	3 (2.4%)	0.655
Repeat Intervention n (%)	10 (5.4%)	29 (9.2%)	0.126	7 (5.6%)	14 (11.2%)	0.127

Mean/SD	Traditional CABG n = 32	Robotic CABG n = 32	p-value
Total Cost	\$54,619	\$46,361	0.115
Direct Cost	\$31,334	\$27,159	0.144
Indirect Cost	\$23,285	\$19,202	0.09

Robotic-assisted vs Traditional Costs



Session 13: MIS How I Do It Case Presentations (4:45 - 5:45 p.m.)

5:18 p.m.

Video: Total Endoscopic Coronary Artery Bypass

Author List: Stephen Waterford, MD, Luis Ramirez, MD, Mahnoor Imran, MD, Ashley Lee, MD, Michael Massey, MD, Michael Boisen, MD, Ibrahim Sultan, MD, Johannes Bonatti, MD

The educational/technical point that this video addresses: The video demonstrates the technical aspects of total endoscopic coronary artery bypass grafting. The technical points involve performing mammary artery harvest with use of the robotic instruments, positioning and preparing the heart for anastomosis, opening the target vessel with robotic instruments, performing the coronary anastomosis robotically, and assessing graft flow.

Summary of the Surgical Video: The video demonstrates a total endoscopic coronary artery bypass (TECAB), with exclusive use of small ports in the chest. The case shown is a left internal mammary artery to left anterior descending artery anastomosis, with the assistance of cardiopulmonary bypass and use of an endoballoon. The hybrid operating suite is shown, and the case then focuses on the technical aspects of TECAB from the robotic console. We have uploaded the video with the course organizers, and we thank you for reviewing our video. As a file was required on this page, we uploaded a small one, but the main video is with the course organizers.

Abstract: Semaglutide Induced Euglycemic Diabetic Ketoacidosis Post Off-pump Coronary Artery Bypass

Author List: Nina Delavari, DO, Charles M. Coleman, Parker Mullen, MD, Athanasios Tsiouris, MD, Ashok Kumar Coimbatore Jeyakumar, MD

Purpose: With the expanding patient population taking semaglutide, we discuss the post-operative complication of euglycemic diabetic ketoacidosis (DKA), and management strategies to ensure a good outcome.

Methods: A review of the literature of euglycemic DKA in patients taking glucagon-like peptide 1 (GLP-1) analogs after cardiac surgery was conducted. We present our patients hospital course including patient presentation and off pump coronary revascularization. We discuss our strategy in diagnosing this condition, physical exam findings, lab values, consult services, and treatment strategies.

Results: Our patient was on a weekly GLP-1 analog for type 2 diabetes mellitus prior to a four vessel off-pump coronary artery bypass. His procedure was successful and he was fast track extubated post operatively. He subsequently developed euglycemic DKA with bicarbonate of 12, anion gap of 23, beta-hydroxybutyrate 60/5.7, and normal lactate. He was started on an insulin infusion with Dextrose 10% with improvement of symptoms and lab findings.

Conclusion: This is one of the first documented cases of post-operative euglycemic DKA related to GLP-1 analog use in off pump cardiac surgery. Caution should be taken perioperatively with this class of medications, and patients should be counselled to stop their medication a week in advance to prevent complications.

Abstract: Comparative Efficacy of Long-acting Cardioplegic Solutions on Myocardial Protection via Mitochondrial Integrity and Viability

Author List: Serdar Gunaydin, MD, PhD; Kevin McCusker, PhD

Purpose: Mitochondria are known to be intimately involved in the processes leading to cell death following reperfusion and so are potential targets for protective intervention. The aim of this study was to develop a method to compare the mitochondrial content and viability of different long-acting cardioplegic solutions frequently used in CABG.

Methods: Cardioplegia delivery was simulated from an 80-kg patient undergoing CABG at moderate hypothermia (32°C) as follows:

Group 1: Histidine–tryptophan–ketoglutarate (HTK)

Group 2: del Nido cardioplegia (1:4) (DNC)

Group 3: 4:1 Cold Blood Cardioplegia (BC)

HTK-DNC (4°C) (200 mL/well) were added and kept for 90 minutes and BC (4°C) (150 mL/well) for 20 min where half dose (75 mL) was repeated three times to a total of 80 minutes.

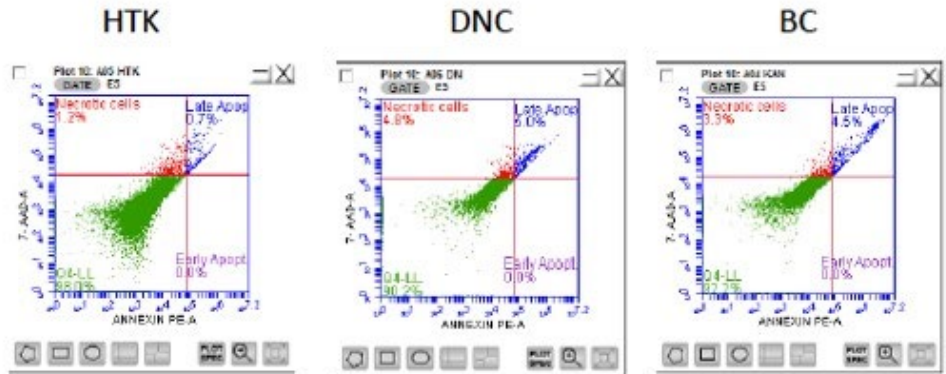
The comparative evaluation of cardioplegic solutions on mitochondrial parameters were all measured by flow cytometry at 6th hour: Annexin V (viability-necrosis/apoptosis), mitotracker red and mitotracker green (membrane integrity-quality).

Results: Mean necrotic cell percentage of HTK was $1.2\pm 0.1\%$ versus $4.8\pm 0.3\%$ in DNC ($p=0.024$) and $3.3\pm 0.1\%$ in BC. Late apoptosis was $0.7\pm 0.08\%$ in HTK (control/BC: $4.5\pm 0.2\%$) versus $5\pm 0.2\%$ in DNC ($p=0.001$). Mean mitotracker red positive cell percentage of HTK was $99.5\pm 5\%$ (control/BC: $89.4\pm 5\%$) versus $61.6\pm 4\%$ in DNC ($p=0.01$). Mean mitotracker green positive cell percentage of HTK was $98.7\pm 5\%$ (control: $92.9\pm 5\%$) versus $87.4\pm 5\%$ in DNC ($p=0.02$). HTK is significantly better in the prevention of necrosis/ apoptosis via preservation of membrane integrity. Data is represented in Figure.

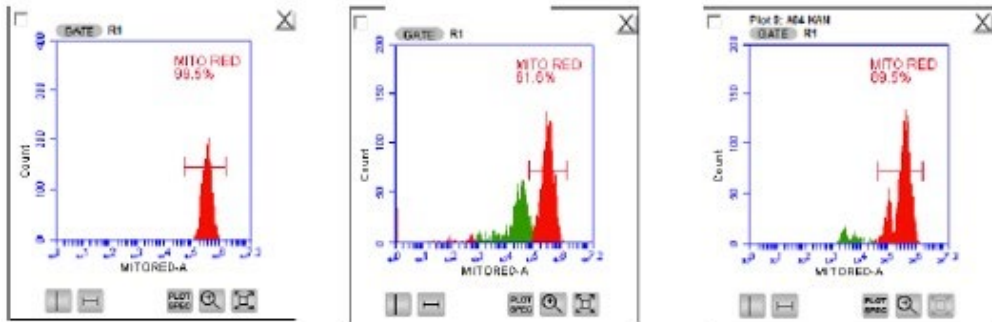
Conclusion: Given the essential role cardiac mitochondria play in providing the energy requirements for preventing dysfunction during ischemia-reperfusion is an important therapeutic strategy for cardioprotection. We documented the impact of different cardioplegic solutions on mitochondrial content to document long-term effects that we believe are the most underestimated fact in the literature.

Title of Image: Mitochondrial parameters of long-acting cardioplegic solutions versus cold blood cardioplegia

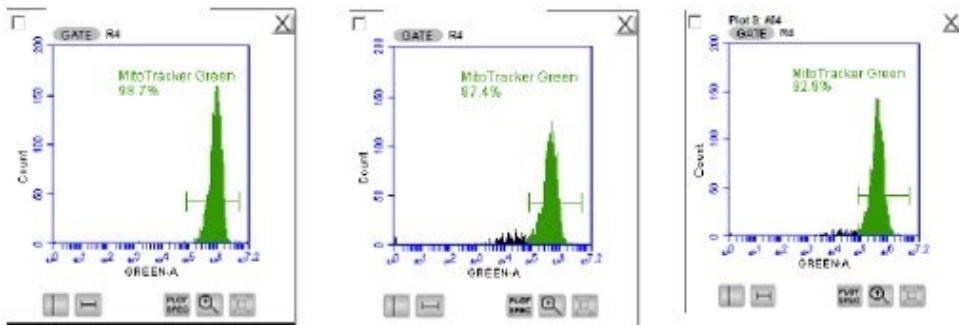
Figure: Mitochondrial parameters of long-acting cardioplegic solutions versus cold blood cardioplegia



A: Annexin- Necrosis/Apoptosis



B: Mitotracker Red: Quality/Integrity



C: Mitotracker Green: Quality/Integrity

HTK: Histidine-tryptophan-ketoglutarate; DNC: del Nido Cardioplegia, BC: Cold blood cardioplegia

Abstract: Survival After CABG: Is Low LVEF a Mortality Marker?

Author List: Reinhard Ortiz-Beitz, MD, Sofia de la Cruz-Perez, MD, Frida Rivera-Buendia, MD, Ivan Hernandez-Mejia, MD

Purpose: This study aimed to investigate whether a left ventricular ejection fraction (LVEF) of less than 35% is a factor that contributes to increased mortality in patients undergoing coronary artery bypass grafting (CABG).

Methods: Between 2020 and 2022, we included 112 patients underwent CABG at a reference center in Mexico and complete electronic records and divided into two groups: LVEF \geq 35% and $<$ 35%. The outcomes were 30-day mortality and post-operative complications (perioperative myocardial infarction, mediastinitis, and bleeding). Data on clinical, surgical and post-surgical characteristics were collected. Univariate and multivariate logistic regression analyses were performed to identify an association between LVEF $<$ 35% and 30-day mortality, and post-surgical outcomes. Variables with a p-value lower than 0.1 were included in the multivariate logistic regression; however, variables with an abnormally confidence interval were excluded from the multivariate analysis.

Results: The study included 22 patients with a LVEF $<$ 35% and 90 patients with a LVEF of \geq 35%. No association was found between having a LVEF $<$ 35% and 30-day mortality after CABG ($p=0.741$). Other factors associated with mortality included age ($p=0.045$), euroscore ($p=0.025$), previous myocardial infarction ($p=0.026$), III and IV NYHA classification ($p=0.002$), presence of a left main disease ($p=0.005$), right internal mammary artery graft ($p=0.023$), pump time during surgery ($p<0.001$) and aortic cross-clamp time ($p=0.015$). The multivariate logistic regression analysis showed no factors associated with 30-day mortality, including low LVEF (OR 1.16, 95% CI 0.60-6.22, $p=0.872$). Regarding post-surgical complications, LVEF $<$ 35% was not associated with perioperative myocardial infarction, mediastinitis, surgical site infection nor bleeding ($p=0.784$, $p=0.994$, $p=0.216$ and 0.317 respectively).

Conclusion: In our study of ischemic heart disease patients, we found that a low LVEF does not independently increase the risk of death in patients undergoing CABG, these results support that surgery in this subgroup of patients in whom long-term improvement is presumed should not be ruled out.

Abstract: Bilateral Skeletonized IMAs Used as “in Situ” Grafts for Different Coronary Territories: Long-Term Propensity Matching Study

Author List: Živojin S. Jonjev, MD, PhD; Ilija Bjeljic, MD; Aleksandar M. Milosavljević, MD; Mirko Todić, MD; Strahinja Mrvić, MD; Novica Kalinić, MD

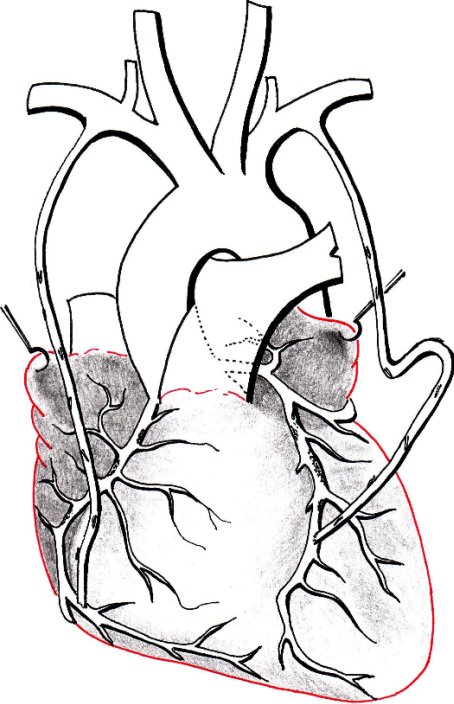
Purpose: Bilateral internal mammary arteries (BIMAs) have been recognized as the most advanced surgical option for CABG. The aim of this study is to compare outcomes in propensity score matched patients with skeletonized BIMAs used as in-situ grafts for different coronary territories with patients using single internal mammary artery in CABG.

Methods: In 20013-2023, 7543 patients underwent primary CABG for multivessel coronary artery disease at our institution. In 283 (3.75%) patients BIMAs in situ grafting were performed. Right IMA was used to revascularize right coronary artery, and left IMA for the LAD territory. BIMA patients (n=280) were compared with single IMA patients (n=280) in propensity score matching analysis. Primary outcome measures were identified as all-cause mortality at 30-days, 5 years and 10 years, while secondary outcome measures were length of hospital stay, the incidence of postoperative major adverse cardiovascular and cerebrovascular events (MACCE), sternal wound infection and need for subsequent percutaneous revascularization.

Results: There was no immediate postoperative mortality (30 days) in both groups. There was no perioperative MACCE or deep sternal wound infection as well. Patient in both groups had similar length of hospital stay (BIMA=7.8±1.5 days vs. SIMA=8.2±1.4 days; p<0.05). Mean follow-up was 9.78 ± 0.62 years with freedom from death 86.07±3.0% in BIMA group vs. 78.6±4.1% in SIMA group 10 years after surgery (p<0.05).

Conclusion: The results indicated that BIMAs as in situ grafts used for different coronary territories in CABG is associated with better long-term survival then SIMA grafting. Our conclusion is independent of traditionally accepted risk factors incorporated in the Logistic EuroSCORE II and SYNTAX score II and is exclusively method related.

Title of Image: Bilateral IMA grafting for different coronary territories



Abstract: Comparative Efficacy of Hybrid Coronary Revascularization versus Minimally Invasive Direct Coronary Artery Bypass in Patients with Low Ejection Fraction and Non-Diabetic Multivessel Coronary Artery Disease: A Retrospective Cohort Analysis

Author List: Weixun Duan, MD; Wei Yi, MD; Xiaochao Dong, MD; Jincheng Liu, MD; Shiqiang Yu, MD

Purpose: The study aims to address the deficiency in empirical data comparing Hybrid Coronary Revascularization (HCR) and Minimally Invasive Coronary Artery Bypass Grafting (MICS CABG) within the context of non-diabetic patients with multivessel coronary artery disease (MVCAD) exhibiting low LVEF, contributing to the refinement of treatment modalities in this patient cohort.

Methods: This retrospective analysis reviewed MVCAD patients without diabetes and LVEF < 40% treated at Xijing Hospital from 2015 to 2019. Participants were allocated to either HCR, starting with minimally invasive LIMA-LAD bypass then PCI for non-LAD lesions 1-4 weeks later, or MICS CABG via left anterior thoracotomy for multivessel grafting. Key outcomes assessed were perioperative mortality, troponin I levels, ventilation duration, transfusion requirements, drainage volumes, and graft patency over a 48-month follow-up, aiming to discern the comparative efficacy, safety, and recovery profiles of these minimally invasive approaches.

Results: In this study of 53 non-diabetic MVCAD patients with LVEF < 40%, 36 underwent HCR and 17 received MICS CABG. The preoperative SYNTAX score was significantly higher in the MICS CABG group (34.2 ± 3.8) compared to the HCR group (29.1 ± 3.8), indicating more complex coronary artery disease. Postoperatively, MICS CABG patients had higher troponin I levels (0.79 ± 0.61 ng/ml vs. 0.36 ± 0.21 ng/ml), greater drainage volumes (475.9 ± 154.9 ml vs. 356.4 ± 152.1 ml), and needed more transfusions, with longer ventilation times than HCR patients. After a 48-month follow-up, all patients survived, and all LIMA-LAD grafts were patent. The re-stenosis rate in HCR-treated non-LAD lesions was comparable to the failure rate of vein grafts in the MICS group (21.7% vs. 25.9%) within 36 m post-op. Both treatments significantly improved LVEF and reduced left ventricular end-diastolic diameter at 12 months post-surgery, demonstrating the clinical efficacy and safety of both minimally invasive approaches for this patient population.

Conclusion: Both HCR and MICS CABG offer effective, minimally invasive treatments for non-diabetic MVCAD patients with low LVEF, showing satisfactory clinical outcomes and graft patency. These findings suggest HCR should be preferred when non-LAD lesions are PCI-eligible, highlighting the need for tailored treatment strategies based on individual patient profiles.

Table 1 & 2:

Comparative Efficacy of Hybrid Coronary Revascularization versus Minimally Invasive Direct Coronary Artery Bypass in Patients with Low Ejection Fraction and Non-Diabetic Multivessel Coronary Artery Disease: A Retrospective Cohort Analysis

Table 1: Preoperative Baseline Clinical Data

Baseline Clinical Data	HCR Group (n=36)	MICS Group (n=17)	Statistical Value	P Value
Gender (F/M)	12/24	5/12	0.001#	0.77
Age (years)	64.6±6.9	61.5±6.1	0.05*	0.12
LVEF (%)	37.0±1.9	37.5±1.9	0.02*	0.35
LVEDD (mm)	60.9±4.7	59.6±4.5	0.02*	0.35
NT-ProBNP (pg/ml)	443.6±155.1	538.1±199.6	0.07*	0.07
SYNTAX 评分	29.1±3.8	34.2±3.8	0.30*	<.001

Statistics Value: #, pseudo R-squared, Multinomial (polytomous) logistic regression; *, R-squared, Linear regression.

Table 2: Postoperative Clinical Data

Postoperative Clinical Data	HCR Group (n=36)	MICS Group (n=17)	Statistical Value	P Value
Ventilator Support Time (hours) [median (25 th , 75 th)]	6 (5, 8.5)	8 (7, 14)	0.10*	0.02
Troponin I at 24h Post-op (ng/ml)	0.36±0.21	0.79±0.61	0.25*	<.001
Drainage Volume at 24h Post-op (ml)	356.4±152.1	475.9±154.9	0.12*	0.01
Red Blood Cell Transfusion Volume [Units] [median (25 th , 75 th)]	0 (0, 0)	0 (0, 2)	0.10*	0.02
IABP Use (n)	0	2	0.28#	0.03
Perioperative Myocardial Infarction (n)	0	1	0.23#	0.13
Perioperative Stroke (n)	0	0	N/A	N/A

Statistics Value: #, pseudo R-squared, Multinomial (polytomous) logistic regression; *, R-squared,

Table 3:

Linear regression.

Table 3: Comparison of Clinical Data Pre- and Post-Operation at 12 Months

Clinical Data	HCR Group (n=36)				MICS Group (n=17)			
	Pre-op	Post-op 12 Months	Statistical Value	<i>P</i> Value	Pre-op	Post-op 12 Months	Statistical Value	<i>P</i> Value
LVEF (%)	37.0±1.9	46.4±6.5	0.49	<.001	37.5±1.9	47.3±7.3	0.47	<.001
LVEDD (mm)	60.9±4.7	55.9±4.6	0.23	<.001	59.6±4.5	56.4±4.6	0.11	0.05
NT-ProBN P (pg/ml)	443.6±155. 1	208.1±11 6.8	0.43	<.001	538.1±199. 6	212.1±13 4.2	0.49	<.001

Statistics Value: R-squared, Linear regression.

Abstract: Analysis of the Performance of the CRUSADE Score as a Predictor of Bleeding in the Postoperative Period of Coronary Artery Bypass Graft Surgery

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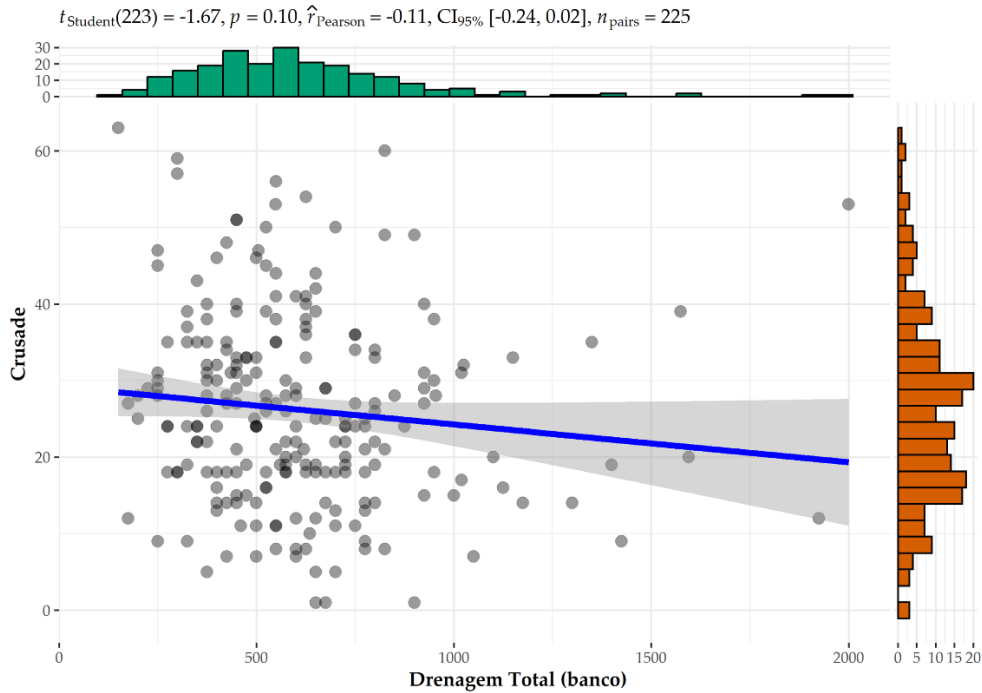
Purpose: Coronary artery bypass grafting surgery is a crucial therapy of the coronary artery disease, but postoperative complications remain a challenge. The aim of this paper is evaluating the performance of the CRUSADE score as a predictor of major bleeding in patients undergoing coronary artery bypass grafting surgery.

Methods: An observational, retrospective study was conducted, evaluating patients who underwent isolated coronary artery bypass grafting surgery in 2016 at the Dante Pazzanese Institute of Cardiology, using medical records and databases, applying the CRUSADE score to these patients preoperatively. The primary outcome was the occurrence of major bleeding after coronary artery bypass grafting surgery, defined by the BARC concept. Statistical analysis included various methods, including chi-square test, MannWhitney test, Pearson chi-square test, Fisher's exact test, and descriptive measures. The R programming environment was used, with a significance level of 5% in all tests.

Results: In 2016, at the Dante Pazzanese Institute of Cardiology, 398 patients underwent coronary artery bypass grafting surgery, but only 223 medical records contained complete information, excluding 175 patients. The mean age of the patients was 62.4 years, with 26.9% being women and 73.1% men. The mean weight was 77.3 kg. Regarding diabetes, 50.7% did not have it, while 49.3% were diabetic. Spearman correlations showed no significant relationships between total drainage and age, weight, presence of diabetes, peripheral vascular disease, or congestive heart failure. However, there were moderate positive correlations with baseline hematocrit and creatinine. Total drainage did not correlate significantly with the CRUSADE score.

Conclusion: The CRUSADE score, applied preoperatively to patients undergoing coronary artery bypass grafting surgery, did not perform well as a predictor of major bleeding in this study population.

Title of Image: scatter plot



	n	%	Média (DP)	Mediana [IIQ]
Idade			62,4 (8,8)	63 [56-68]
Sexo				
Feminino	60	26,9		
Masculino	163	73,1		
Peso			77,3 (14,6)	75 [67-85]
DM				
Não	113	50,7		
Sim	110	49,3		
DVP (avc/carotida/vasculo)				
Não	198	88,8		
Sim	25	11,2		
Sinais de ICC				
Não	184	81,8		
Sim	39	17,5		
HCT de base			41,8 (4,9)	42,1 [38,7-44,8]
Creatinina			1,1 (0,8)	1 [0,8-1,2]
Clearance de CR			85,5 (29,1)	84,2 [64-100,8]
FC de base			69,6 (11,6)	68 [61-78]
Drenagem total (banco)			608,6 (281,4)	560 [425-725]
Sangramento Maior	4	1,8		
Sangramento intracraniano 48hrs pós cirurgia	0	0,0		
Reoperação para hemostasia	2	0,9		
Transfusão de 5 ou mais concentrados de hemácias em 48hrs pós cirurgia	2	0,9		
Saída de > 2 litros de sangue em drenos em 24hrs	0	0,0		

Legenda: n – frequência absoluta. % – frequência relativa percentual. DP – Desvio Padrão. IIQ – Intervalo Interquartil.

Abstract: Evaluation of Radial Duplex Ultrasonography Among Patients Undergoing Radial Harvest: Low Palmar Arch Velocities are not Associated with Hand Ischemic Events

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Purpose: There are no guidelines for using duplex ultrasonography to determine the suitability of the radial artery harvest. This study aims to establish baseline flow characteristics from duplex ultrasonography studies of patients undergoing radial artery harvest for bypass surgery and determine an association of flow characteristics and major ischemic hand complications.

Methods: From January 2016 to June 2023, 584 patients underwent a coronary artery bypass grafting using a radial arterial graft. Radial arterial duplex ultrasonography studies were retrospectively collected for the radial arterial diameters, and velocities (with and without occlusion) for the radial artery, ulnar artery, and palmar arch. Patients were divided into three groups based on the velocity reversal in their palmar arch after radial artery occlusion: normal (> 20 cm/s), marginal (10-20 cm/s), and low (< 10 cm/s). One-factor ANOVA and difference-in-differences test were conducted to compare arterial diameter and flow characteristics between groups.

Results: With regards to palmar arch reversal with radial occlusion, 421 (72.1%) patients had normal velocities (>20cm/s), 139 (23.8%) patients had marginal velocities (10-20cm/s), and 24 (4.1%) patients had low velocities (<10cm/s) (Table 1). Reversal of Palmar arch velocities with radial occlusion ranged from 5 to 137 cm/s. There were no major hand ischemic events in any of the groups. There were no significant differences in radial artery diameters between groups. Low velocity and marginal velocity patients had significantly greater decreases in flow reversal of the palmar arch (68.9% and 60.0 %, respectively) when the radial artery was occluded as compared to normal velocity patients (24.6% decrease). The augmentation of ulnar velocities with radial artery occlusion was similar between groups and was 45.1% in patients with normal velocities, 43.5% in those with marginal velocities, and 40.4 in those with low velocities (p=0.69).

Conclusion: Historically, our institution has avoided harvesting radial arteries with marginal and low reversal velocities in the palmar arch based on duplex ultrasonography. However, this study demonstrates that patients with marginal and low reversal velocities in the palmar arch can safely undergo radial artery harvest without risk for major ischemic events.

Table 1: Radial Duplex Ultrasonography Characteristics					
	Normal Flow (Greater 20 cm/s)	Marginal Flow (10-20cm/s)	Low Flow (Less 10 cm/s)	<i>p</i> -value	All Patients
<i>N</i> (%)	421 (72.1%)	139 (23.8%)	24 (4.1%)		584 (100%)
Proximal Radial Diameter (cm)	0.3	0.3	0.3	0.87	0.3
Mid Radial Diameter (cm)	0.3	0.3	0.3	0.88	0.3
Distal Radial Diameter (cm)	0.4	0.3	0.3	0.80	0.3
Radial artery velocity (cm/s)	73.4	65.5	58.3	< 0.001	70.9
Ulnar Velocity (cm/s)	71.5	64.0	54.6	< 0.001	69.0
Ulnar Velocity w/ radial occlusion (cm/s)	102.5	91.0	73.6	< 0.001	98.4
Ulnar Velocity Augmentation w/ radial occlusion (%)	45.1%	43.5%	40.4%	0.69	44.3%
Palmar Velocity (cm/s)	63.3	44.1	35.8	< 0.001	57.5
Reversal Palmar Velocity w/ radial occlusion (cm/s)	-42.6	-15.4	-9.2	< 0.001	-30.9
Percent change Palmar Velocity w/ radial occlusion (%)	24.6%	60.0%	68.9%	< 0.001	35.1%

Abstract: Multiple Arterial Grafting in Michigan: It Keeps Getting Better!

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Purpose: Our statewide, surgeon-led Quality Collaborative has been implementing initiatives to improve utilization of multi-arterial grafting (MAG) since 2016. This initiative resulted in a significant increase in rate of MAG from 2016 to 2019.¹ We sought to determine whether this trend has persisted and define determinants associated with the increased rate.

Methods: The Michigan Society of Thoracic and Cardiovascular Surgeons Adult Cardiac Database was queried for adults undergoing isolated coronary artery bypass grafting between 1/1/2016-9/30/2023. Patients were excluded for: a single graft, emergent/salvage procedure, subclavian artery stenosis, absence of left anterior descending artery disease, previous cardiothoracic surgery, or previous mediastinal irradiation. MAG was defined as ≥ 2 distal arterial anastomoses. Surgeons were categorized into terciles based on their rate of MAG in 2015 or first year of practice (Table). Logistic regressions with MAG rate as outcome and surgery year and surgeon tercile as predictors were built using the restricted cubic spline model.

Results: The study cohort included 32,984 operations (mean age 66.2 years, 23.1% female) from 101 surgeons. The overall percent of patients receiving MAG increased from 11.3% in 2016 to 21.7% in 2019 and 36.3% in 2023. All three surgeon terciles demonstrated an increasing trend in odds of performing MAG from 2016 to 2023 (Figure). The upward nonlinear trends of MAG rate over years were significantly different between surgeon terciles ($p < .0001$). The odds ratios (OR) for performing MAG decreased, although at a different pace, over time for the high- and middle-MAG terciles when compared to the low-MAG surgeon tercile: The OR for high-versus low-MAG tercile decreased from 22.1 (95% CI 16.1;30.0, $p < .0001$) in 2016 to 4.9 (95% CI 3.9;6.0, $p < .0001$) in 2023. The OR for middle- versus low-MAG tercile decreased from 4.2 (95% CI 2.9;6.00, $p < .0001$) in 2016 to 2.7 (95% CI 2.2;3.0, $p < .0001$) in 2023.

Conclusion: The odds of performing MAG continuously increased in Michigan as a direct result of surgeon-led quality improvement efforts. The increase in MAG rate was generated by all surgeon terciles of MAG adoption. Regional Quality Collaboratives are essential in improving the quality of cardiothoracic surgical patient care through quality improvement initiatives.

Title of Image: Table: Surgeon terciles by multi-arterial grafting rates in 2015 (prior to quality initiative) or first year of practice if surgeon started practice after 2015; Figure: Trends in odds of multi-arterial graft utilization by surgeon tercile and surgery year

MAG rate in 2015 or first year of practice				
	Mean±SD	Median	Minimum	Maximum
Low-MAG utilizers (n=33)	0.1%±0.2%	0.0%	0.0%	0.9%
Middle-MAG utilizers (n=33)	4.3%±2.2%	4.0%	1.1%	9.3%
High-MAG utilizers (n=35)	24.7%±13.7%	20.6%	9.4%	60.6%
All surgeons (n=101)	10.0%±13.6%	4.4%	0.0%	60.6%

MAG: multiple arterial grafting; SD: standard deviation

