Robotic Coronary Artery Revascularization

Makoto Hashimoto, MD
Sapporo Cardiovascular Clinic, Japan

COI Disclosure

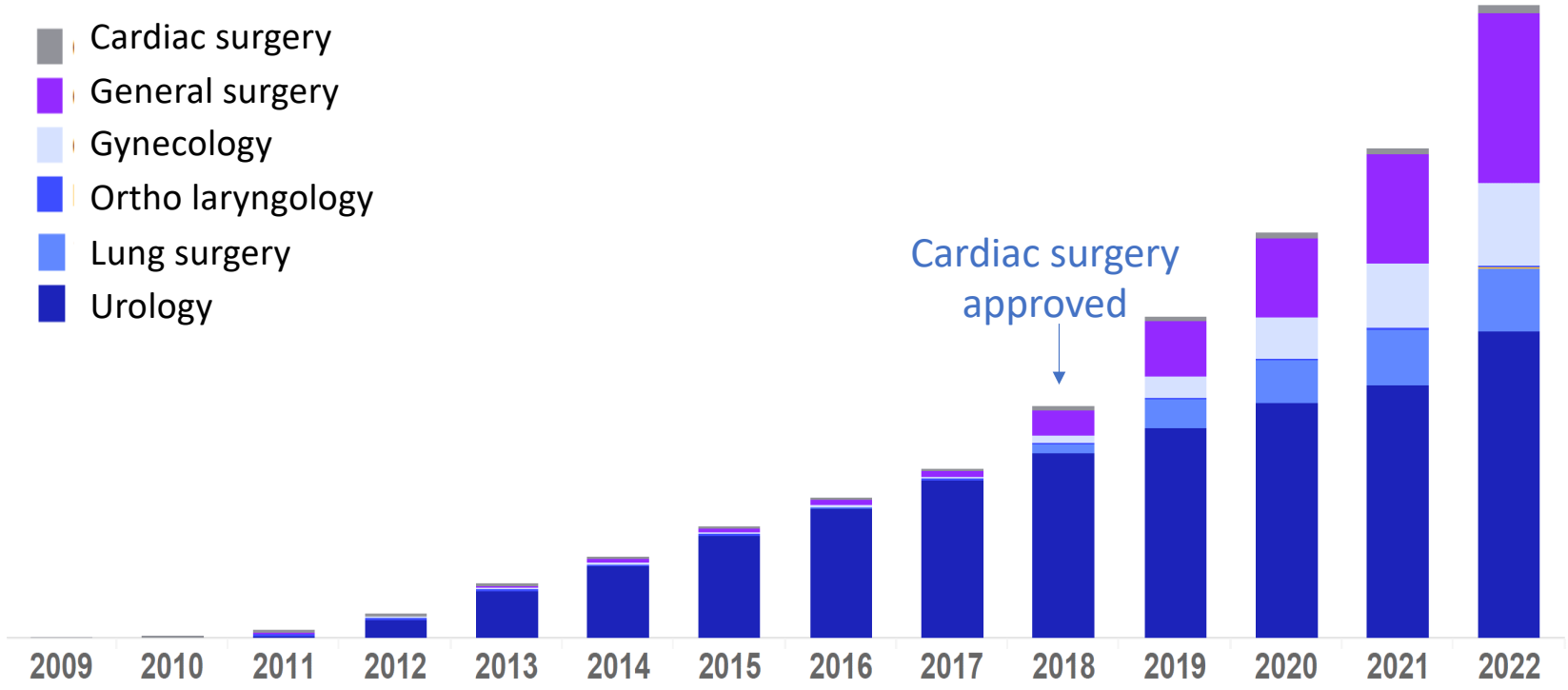
The author have no financial conflicts of interest disclose concerning this presentation.

Robotic Cardiac Surgery in Japan

Approved in 35 hospitals

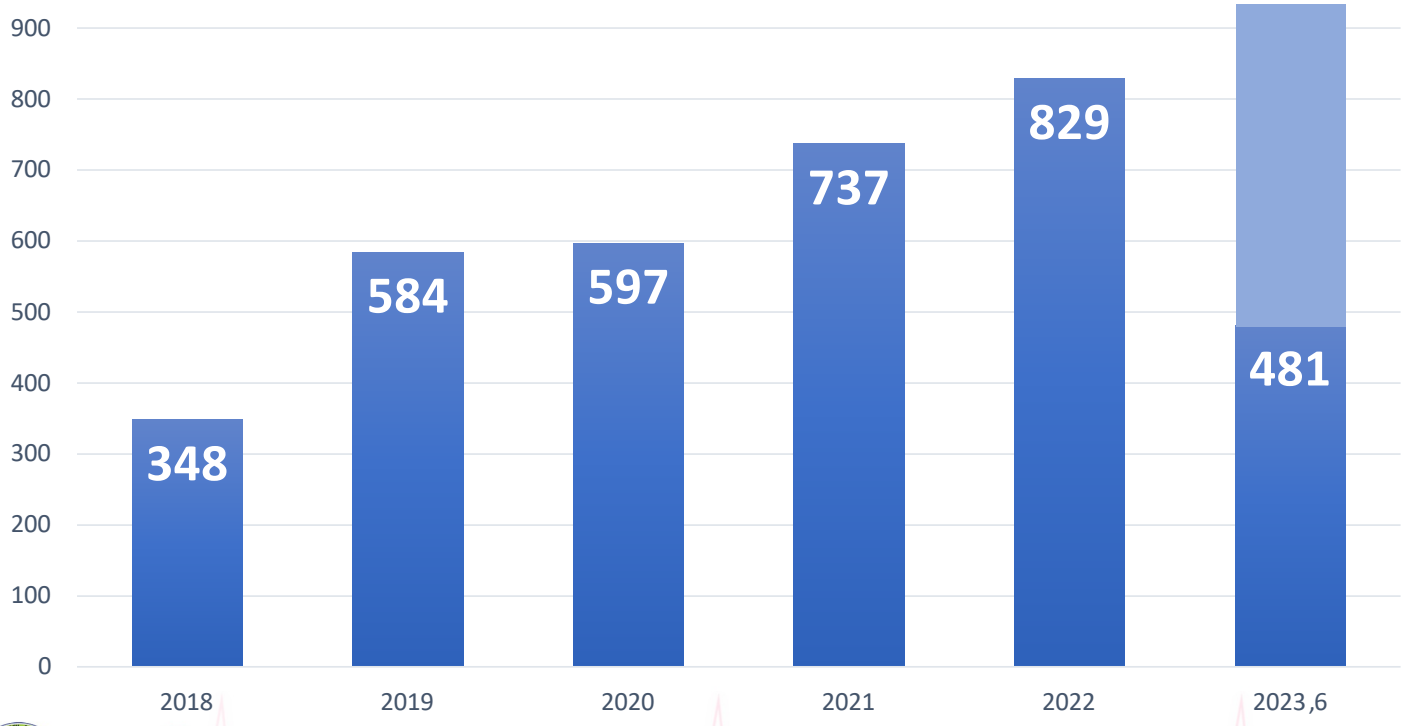
(According to “RACS council“ HP; 2023.10)

Robotic Surgery in Japan



Robotic Cardiac Surgery in Japan

(Covered by Japanese Health Insurance in 2018)

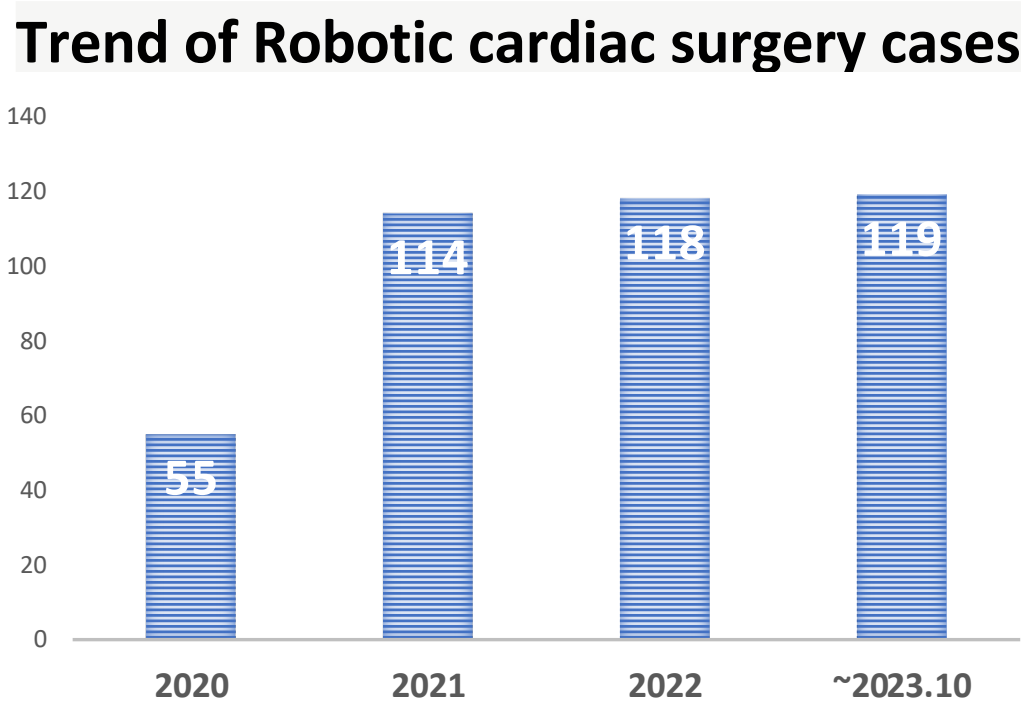


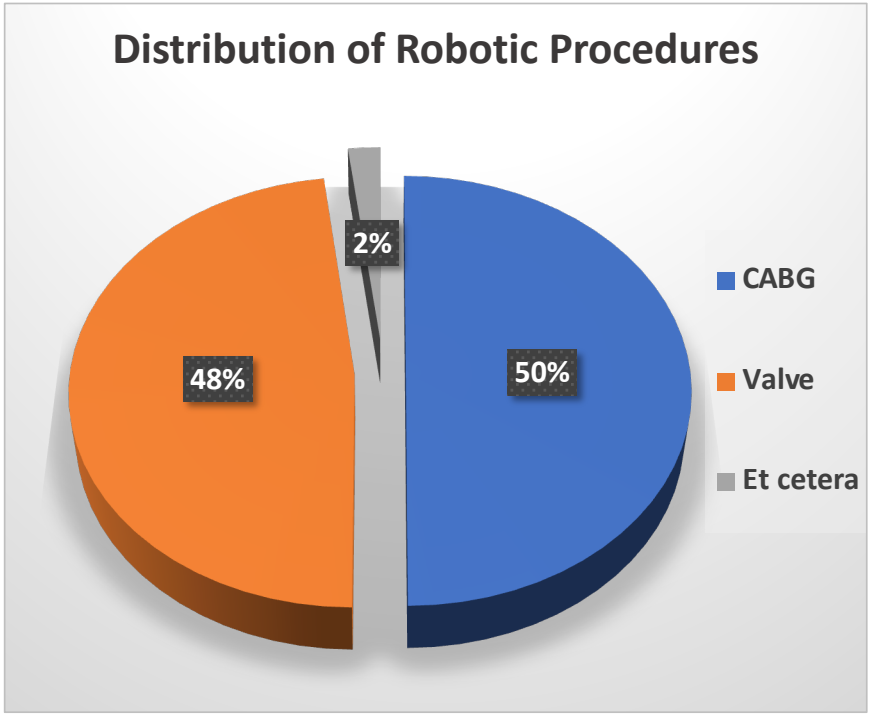
Self-Introduction

Why my passion for Robot grew?

ATCSA2023
Ho Chi Minh city, Vietnam

My Journey with Robot





Robotic-assisted (RA-) MIDCAB

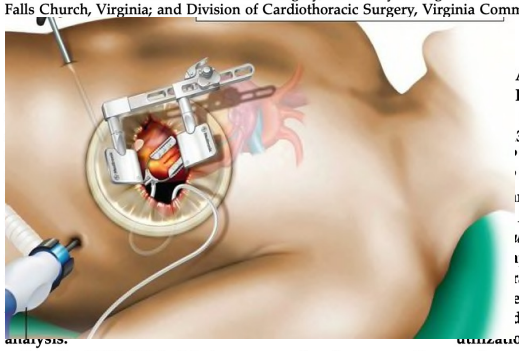
Less Invasive Approaches for Coronary Artery Revascularization

Minimally Invasive vs Open Coronary Surgery: A Multi-Institutional Analysis of Cost and Outcomes

Check for updates

Nicholas R. Teman, MD, Robert B. Hawkins, MD, MSc, Eric J. Charles, MD, PhD, J. Hunter Mehaffey, MD, MSc, Alan M. Speir, MD, Mohammed A. Quader, MD, and Gorav Ailawadi, MD, for the Investigators for the Virginia Cardiac Services Quality Initiative

Division of Thoracic and Cardiovascular Surgery, University of Virginia, Charlottesville, Virginia; INOVA Heart and Vascular Institute, Falls Church, Virginia; and Division of Cardiothoracic Surgery, Virginia Commonwealth University, Richmond, Virginia



ABG, $P = .383$) or major morbidity (7.9% open vs ICS CABG, $P = .795$). However, open CABG received more blood products (22.2% vs 12.2%, 3), and had longer intensive care unit (45 vs 30 $= .049$) as well as hospital lengths of stay (7 vs 6 $= .005$). Finally, median hospital cost was ntly higher in the open CABG group ($35,011 vs $P < .001$) compared with MICS CABG.

usions. Open CABG via sternotomy and MICS pproaches are associated with similar, excellent rative outcomes. However, MICS CABG was ed with fewer transfusions, shorter length of i ~$7000 lower hospital cost, a superior resource on profile that improves patient care and lowers cost.

Results. Of 26,255 isolated coronary artery bypass graft patients, 139 MICS CABG and 278 open CABG patients were well balanced after matching. There was no difference in the operative mortality rate (2.2% open vs 0.7%

(Ann Thorac Surg 2021;111:1478-85)

Robotic Total Endoscopic Coronary Bypass in 570 Patients: Impact of Anastomotic Technique in Two Eras

Check for updates

Husam H. Balkhy, MD, Sarah M. Nisivaco, MD, Makoto Hashimoto, MD, Gianluca Torregrossa, MD, and Kaitlin Grady, PA-C

Department of Cardiothoracic Surgery, University of Chicago Medicine, Chicago, Illinois

ABSTRACT

ily endoscopic coronary artery
We reviewed results in 570 pa-
ominant anastomotic technique:

p TECAB: group 1 consisting of
distal anastomotic stapler (Aes-
), using predominantly a sutured
nes was performed.

rved/expected mortality of 0.6%
only 11% of 305 grafts in group
r bilateral internal thoracic artery
rter in group 1 (242 ± 84 vs 273 ±
ospital stay, which was longer in
group 1 vs group 2, respectively.

utured technique during robotic
es, including graft patency. The
d facilitate broader adoption of
TECAB.

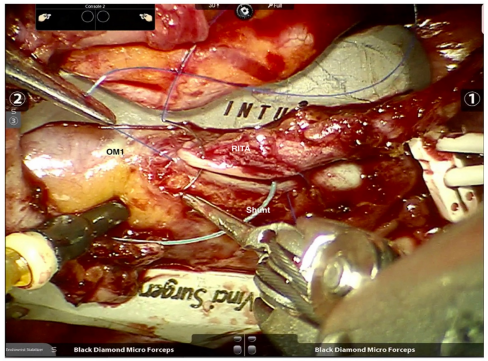


FIGURE 3 Sutured anastomosis, right internal thoracic artery (RITA) to obtuse marginal branch (OM1).

(Ann Thorac Surg 2022;114:476-83)

ATCSA2023
Ho Chi Minh city, Vietnam

RA-MIDCAB

Early clinical and angiographic outcomes after robotic-assisted coronary artery bypass surgery

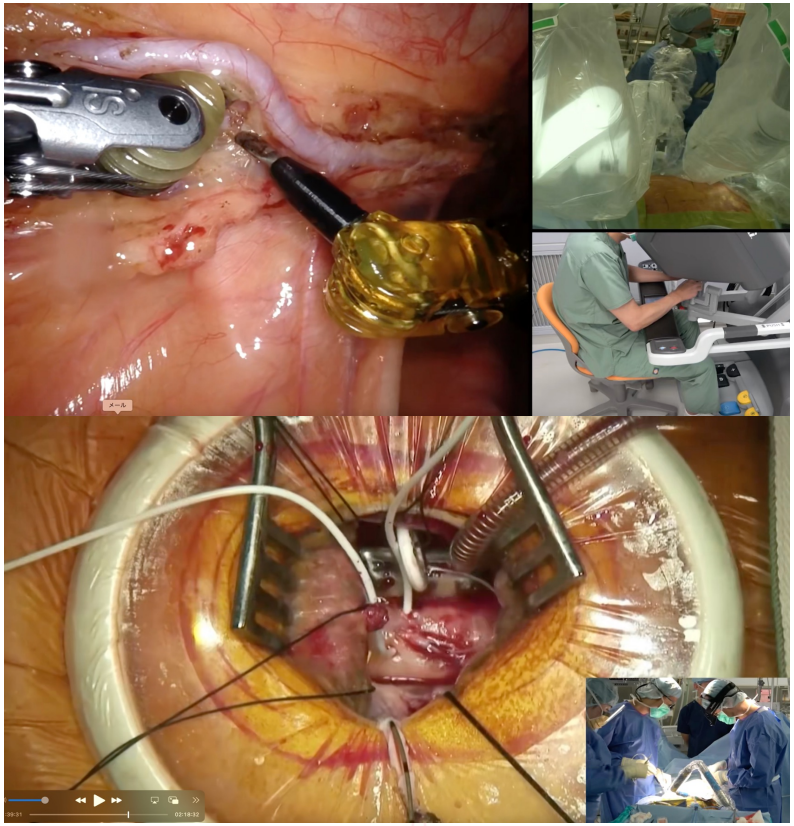
Michael E. Halkos, MD, MSc,[a] Henry A. Liberman, MD,[b] Chandan Devireddy, MD,[b] Patrick Walker, BA,[a] Aloke V. Finn, MD,[b] Wissam Jaber, MD,[b] Robert A. Guyton, MD,[a] and John D. Puskas, MD, MSc[a]

Objective: Robotic-assisted coronary artery bypass grafting has emerged as an alternative to traditional coronary artery bypass grafting or percutaneous intervention for patients with coronary artery disease. However, the safety and efficacy of this minimally invasive procedure have not been established in large series.

Methods: From October 2009 to September 2012, 307 consecutive robotic-assisted coronary artery bypass grafting procedures were performed at a single US institution by 2 surgeons. Isolated, off-pump, left internal thoracic artery to left anterior descending coronary artery grafting was planned via a 3- to 4-cm non–rib-spreading minithoracotomy after robotic left internal thoracic artery harvest in all patients. Hybrid coronary revascularization was planned in 159 patients (51.8%). Of the 199 angiograms (64.8%) performed before discharge, 63 were performed as completion angiograms in a hybrid suite immediately after left internal thoracic artery–left anterior descending artery grafting.

Results: Thirty-day mortality occurred in 4 patients (1.3%), conversion to sternotomy occurred in 16 patients (5.2%), postoperative myocardial infarction occurred in 5 patients (1.6%), and reexploration for bleeding occurred in 7 patients (2.3%). There was 1 (0.3%) postoperative stroke. For the 199 patients with follow-up angiography before discharge, the left internal thoracic artery was confirmed to be patent (<50% stenosis) in 189 patients (95.0%). Among the 10 patients with significant (≥50% stenosis) defects, 5 had graft occlusion or distal left anterior descending occlusion, 2 had poor flow distal to the anastomosis, and 3 had anastomotic lesions (≥50% stenosis). Among the 63 patients with intraoperative completion angiography, 5 patients underwent surgical graft revision, 3 patients underwent minithoracotomy, and 2 patients underwent conversion to sternotomy.

Conclusions: Robotic-assisted coronary artery bypass grafting is an effective alternative to traditional coronary artery bypass grafting for patients with single or multivessel coronary artery disease, with comparable short-term clinical and angiographic results. (J Thorac Cardiovasc Surg 2014;147:179-85)



RA-MIDCAB

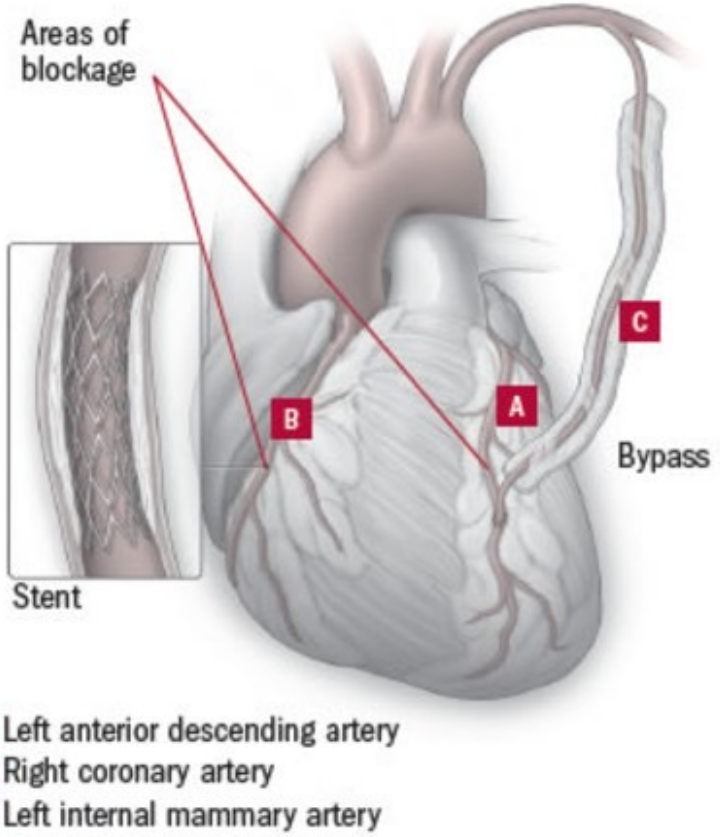
Hybrid Coronary Revascularization Versus Off-Pump Coronary Artery Bypass Grafting: Comparative Effectiveness Analysis With Long-Term Follow-up

Ali Hage, MD; Vincenzo Giambruno, MD; Philip Jones, MD; Michael W. Chu, MD; Stephanie Fox, RRT; Patrick Teefy, MD; Shahar Lavi, MD; Daniel Bainbridge, MD; Christopher Harle, MD; Ivan Iglesias, MD; Woijtecj Dobkowski, MD; Bob Kiaii, MD

Background—Hybrid coronary revascularization (HCR) involves the integration of coronary artery bypass grafting (CABG) and percutaneous coronary intervention to treat multivessel coronary artery disease. Our objective was to perform a comparative analysis with long-term follow-up between HCR and conventional off-pump CABG.

Methods and Results—We compared all double off-pump CABG (n=216) and HCR (n=147; robotic-assisted minimally invasive direct CABG of the left internal thoracic artery to the left anterior descending artery and percutaneous coronary intervention to one of the non–left anterior descending vessels) performed at a single institution between March 2004 and November 2015. To adjust for the selection bias of receiving either off-pump CABG or HCR, we performed a propensity score analysis using inverse-probability weighting. Both groups had similar results in terms of re-exploration for bleeding, perioperative myocardial infarction, stroke, blood transfusion, in-hospital mortality, and intensive care unit length of stay. HCR was associated with a higher in-hospital reintervention rate (CABG 0% versus HCR 3.4%; *P*=0.03), lower prolonged mechanical ventilation (>24 hours) rate (4% versus 0.7%; *P*=0.02), and shorter hospital length of stay (8.1±5.8 versus 4.5±2.1 days; *P*<0.001). After a median follow-up of 81 (48–113) months for the off-pump CABG and 96 (53–115) months for HCR, the HCR group of patients had a trend toward improved survival (85% versus 96%; *P*=0.054). Freedom from any form of revascularization was similar between the 2 groups (92% versus 91%; *P*=0.80). Freedom from angina was better in the HCR group (73% versus 90%; *P*<0.001).

Conclusions—HCR seems to provide, in selected patients, a shorter postoperative recovery, with similar excellent short- and long-term outcomes when compared with standard off-pump CABG. **(*J Am Heart Assoc.* 2019;8:e014204. DOI: 10.1161/JAHA.119.014204.)**



Steep learning Curve for Mastering RA-MIDCAB

Original Article

Safe implementation of robotic-assisted minimally invasive direct coronary artery bypass: application of learning curves and cumulative sum analysis

Jef Van den Eynde[1,2,3^], Hannah Vaesen Bentein[1,2], Tom Decaluwé[1,2], Herbert De Praetere[1,2], MaryAnn C. Wertan[4], Francis P. Sutter[4], Husam H. Balkhy[5], Wouter Oosterlinck[1,2]

Background: Learning curves are inevitably encountered when first implementing an innovative and complex surgical technique. Nevertheless, a cluster of failures or complications should be detected early, but not deter learning, to ensure safe implementation. Here, we aimed to examine the presence and impact of learning curves on outcome after robotic-assisted minimally invasive direct coronary artery bypass (RA-MIDCAB).

Methods: A retrospective analysis of the first 300 RA-MIDCAB surgeries between July 2015 and December 2020 was performed. Learning curves were obtained via logarithmic regression for surgical time. Cumulative sum (CUSUM) analysis was performed for (I) major complications including MI, stroke, repeat revascularization, and mortality, and (II) other complications, including prolonged ventilation, pneumonia, pleura puncture, lung herniation, pericarditis, pleuritis, arrhythmia, wound complications, and delirium. Expected and unacceptable rates were set at 12% and 20%, respectively, for major complications, and at 40% and 60% for other complications, based on historical data in conventional coronary artery bypass grafting (CABG).

Results: Demographic characteristics did not differ between terciles, except for more smokers in the first tercile, and less hypercholesterolemia and more complex procedures in the third tercile. The mean surgical time for all operations was 258±81 minutes, ranging from 127 to 821 minutes. A learning curve was only observed in the first tercile. Subgroup analysis revealed that this learning curve was only observed for procedures consisting of single internal mammary artery (SIMA) with 1 or 2 distal anastomoses but not with bilateral internal mammary arteries (BIMA) or more than 2 distal anastomoses. CUSUM analysis showed that the cumulative rate of major and other complications never crossed the lines for unacceptable rates. Rather, the lower 95% confidence boundary was crossed after 50 cases, indicating improvement in safety.

Conclusions: These results suggest that integration of RA-MIDCAB in the surgical landscape can be safely achieved and complication rates can quickly be reduced below those expected in traditional CABG. Collective experience plays a key role in overcoming the learning curve when more complex procedures and cases are introduced.

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CORONARY | RESEARCH | VOLUME 115, ISSUE 5, P1118-1125, MAY 2023 Download Full Issue

Mastering the Learning Curve for Robotic-Assisted Coronary Artery Bypass Surgery

Amalia Jonsson, MD • Jose Binongo, PhD • Parth Patel, MD • ... Vanessa Garner, RN • Delki Mitchell-Cooks, RN • Michael E. Halkos, MD, MSc • Show all authors

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Abstract

Background

Previous studies have evaluated the learning curve to achieve competency in robotic-assisted coronary artery bypass grafting (CABG) but have not identified thresholds for mastery. Robotic-assisted CABG is a minimally invasive alternative to sternotomy CABG. The purpose of this study was to evaluate the short- and long-term outcomes of this procedure and to estimate the threshold for achieving mastery.

Methods

From 2009 to 2020, 1000 robotic-assisted CABG procedures were performed at a single institution. Robotic left internal mammary artery (LIMA) harvest followed by off-pump, LIMA–left anterior descending artery grafting using a 4-cm thoracotomy was performed. Short-term outcomes were obtained from The Society of Thoracic Surgeons database, and long-term follow-up was obtained by telephone questionnaires from dedicated research nurses for all patients more than 1 year from surgery.

Results

Mean patient age was 64 ± 11 years, Society of Thoracic Surgeons predicted risk of mortality was 1.1% ± 1.5%, and 76% (758) of patients were men. Thirty-day mortality occurred in 6 patients (0.6%; observed-to-expected ratio, 0.53), 5 patients (0.5%) experienced a postoperative stroke, and postoperative LIMA patency was 97.2% (491/505). Mean procedure time decreased from 195 minutes to 176 minutes, and conversion to sternotomy decreased from 4.4% (22/500) to 1.6% (8/500) after 500 cases. Short-term outcomes suggested expertise was reached between 250 and 500 cases. Long-term follow-up was completed in 97% of patients (873/896) with a median follow-up of 3.9 years (interquartile range, 1.8-5.8), and the overall survival rate was 89% (777).

Conclusions

Robotic-assisted CABG can be performed safely with excellent results even during a surgeon's early experience. However the learning curve to achieve mastery is longer than required to achieve competency, with a threshold of approximately 250 to 500 cases.

Ann Thorac Surg. 2023 May;115(5):1118-1125.

Objective

- ✓ Present my experiences and outcomes of RA-MIDCAB
- ✓ Evaluate its clinical impact for early recovery

RA-MIDCAB

- ✓ Study period: Feb.2020 – Oct.2023
- ✓ Isolated Robotically assisted MIDCAB was performed for 200 cases by single surgeon at SCVC during this period.

Patient Data

Variables	
Age, years (range)	69 (27-94)
Preoperative status	
Non Elective, n (%)	8 (4)
on IABP, n (%)	4 (2)
Pre LVEF , mean (range)	60% **(22-75)**
Comorbidities, n (%)	
HT	120 (60)
DL	137 (69)
DM	73 (37)
ESRD on HD	8 (4)
COPD on medication	3 (2)

Patient Data

Hybrid Coronary Revascularization, n	101 (50%)
3 vessels treated	21 %
2 vessels treated	79 %
RA-MIDCAB before PCI	81 %
Mean interval between CABG & PCI	2.1 months

Skin Incision and Port Placement

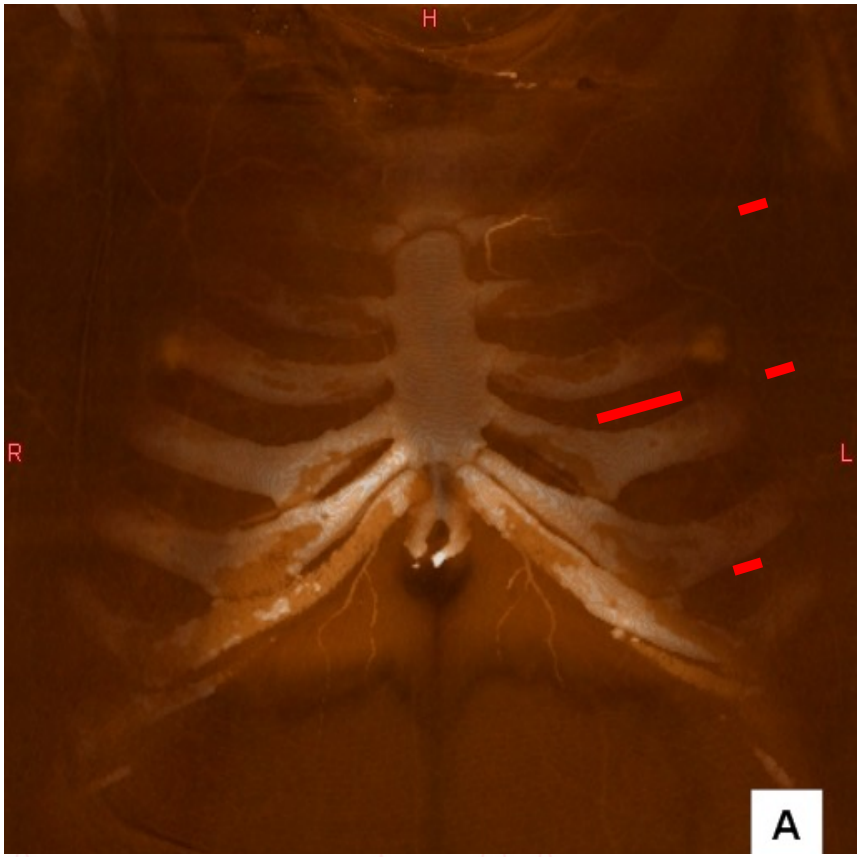
Main incision

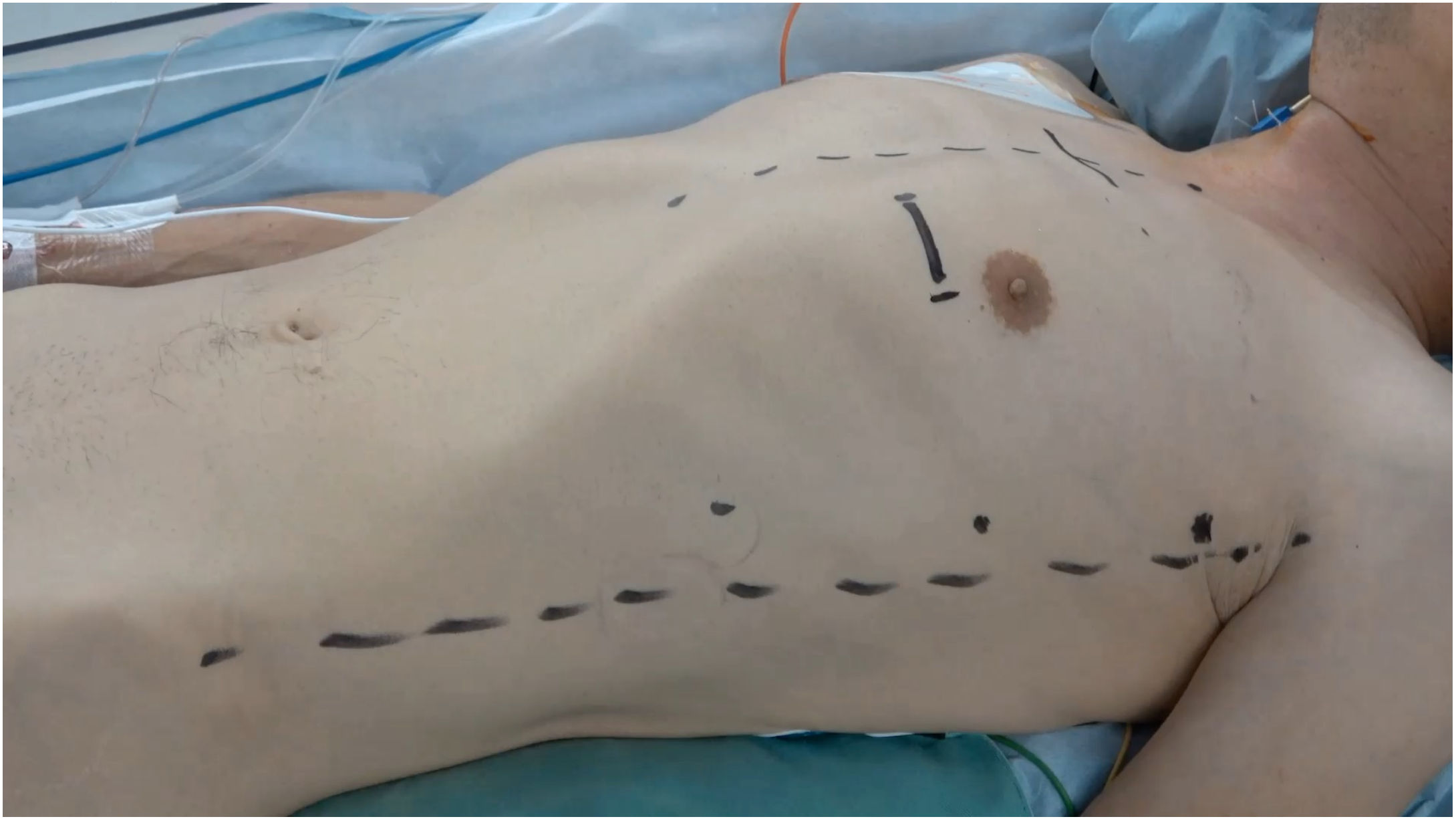
Usually, 4th ICS,

- 3-3.5 cm for CABGx1
- 5-6 cm for CABGx2

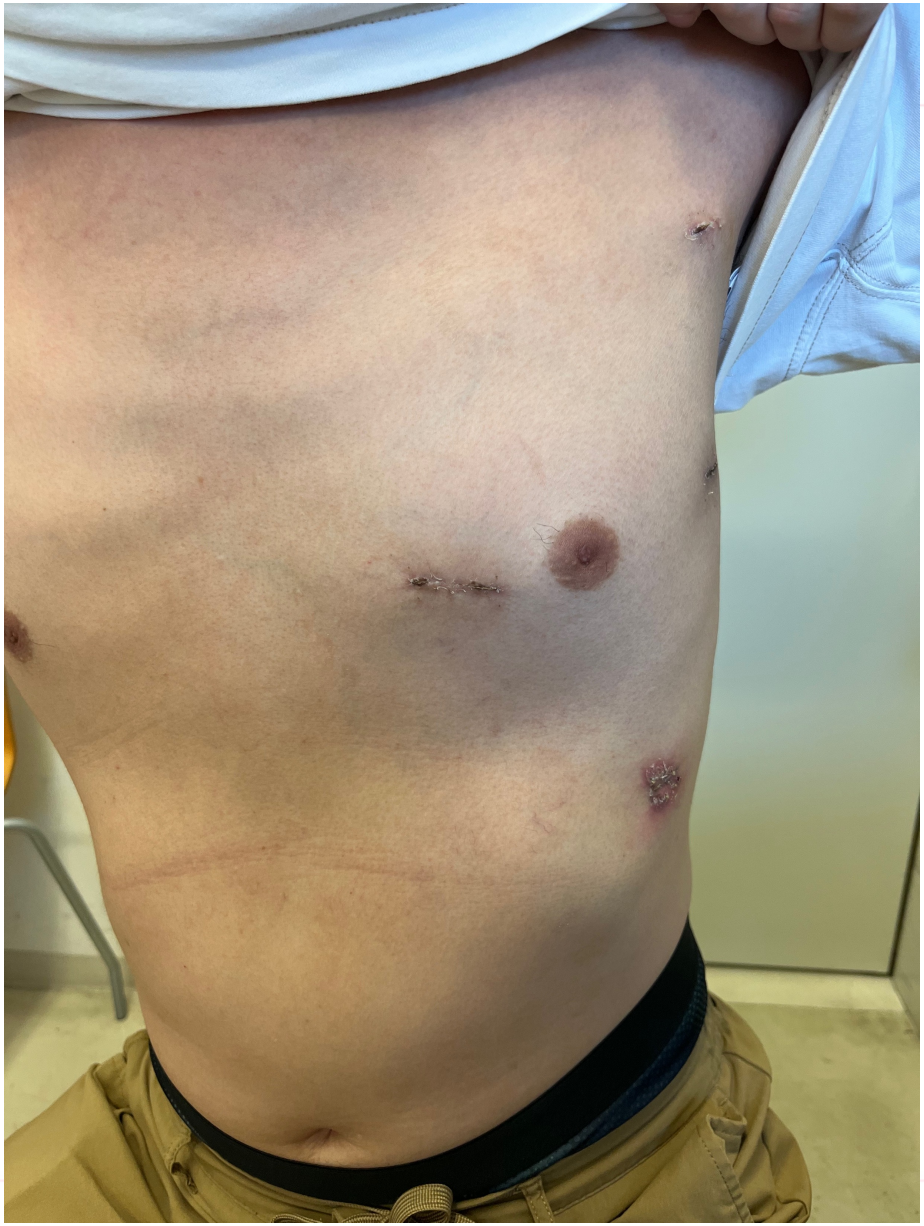
Ports

3rd , 5th , 7th ICS



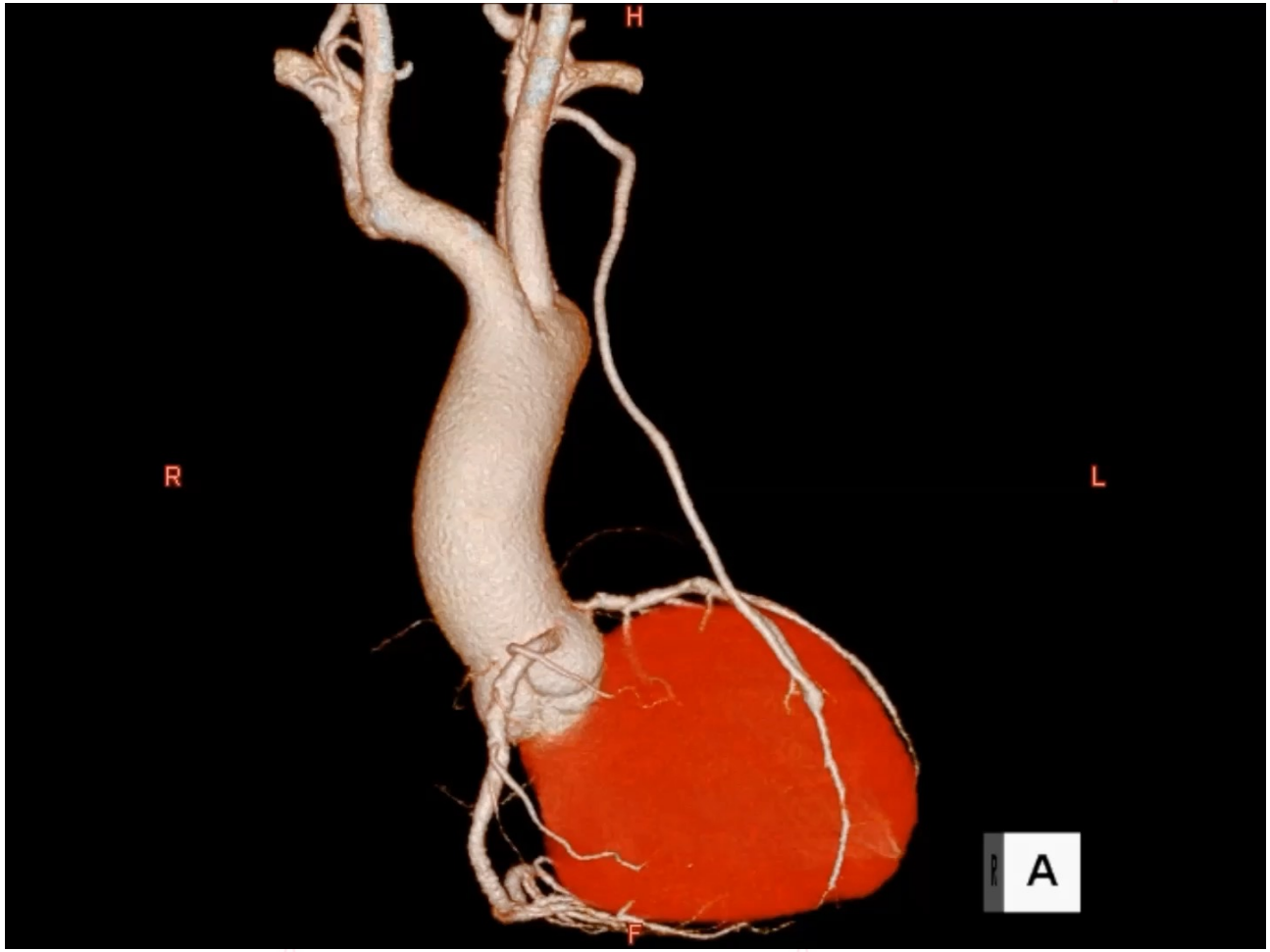


Wound after RA-MIDCAB



Post-operative CTA

One-vessel bypass

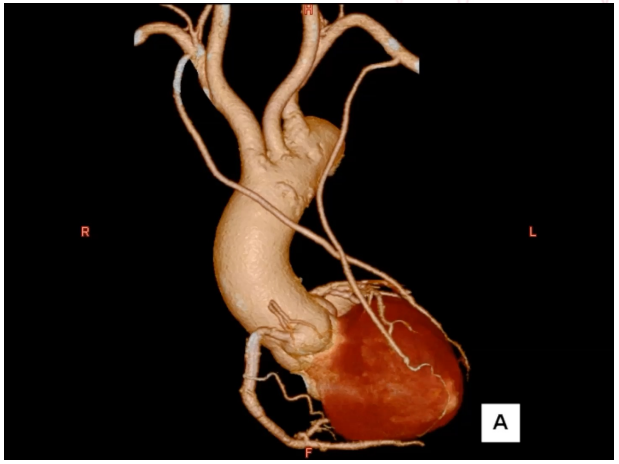


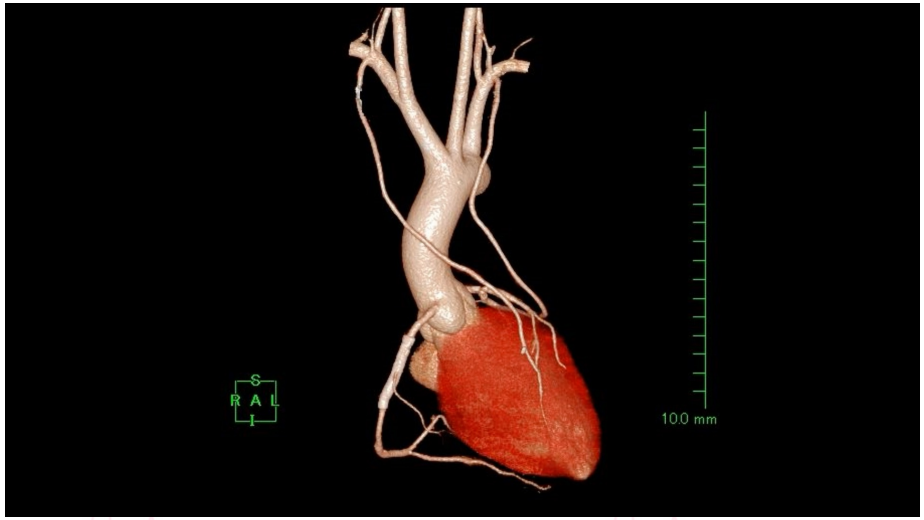
Post-operative CTA

Two-vessels bypass

LIMA-LAD, RIMA-D1

LIMA-LAD, RIMA-Ramus





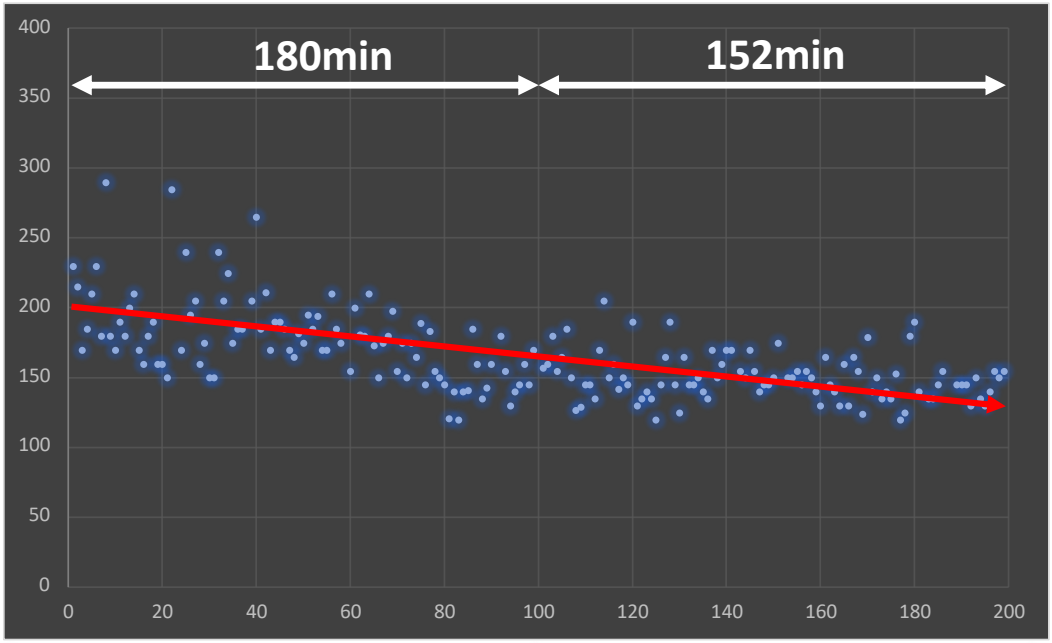
RIMA-LAD, LIMA-OM

Operative Data

VARIABLES	
Operation time, mean	166 min
Robotic operative time, mean	55 min
Mean graft flow, ml/min	48 ± 20
Transfusion, n (%)	24 (12)
Off-pump accomplishment	100%
Conversion to sternotomy	0

Trend of Operative Time

(CABGx1 only, excluding CABGx2 with BIMA)

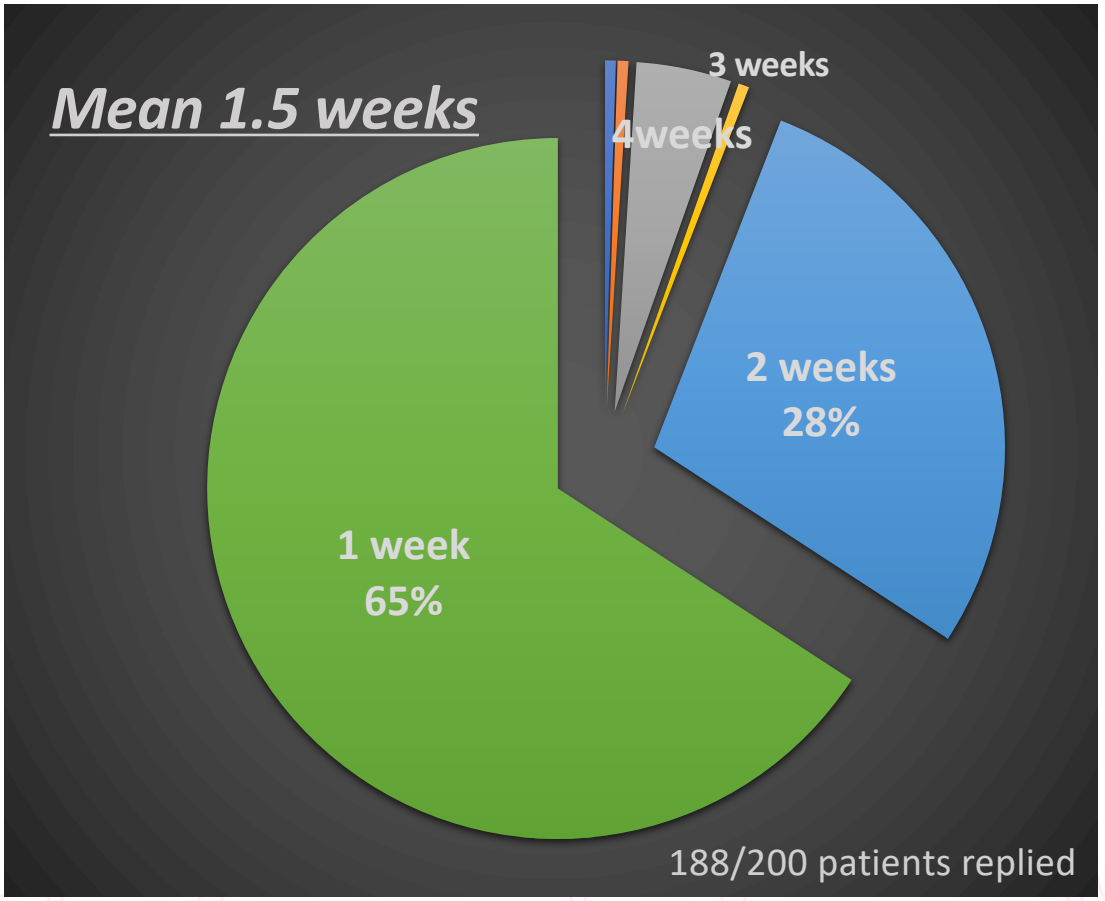


Post-Operative Data

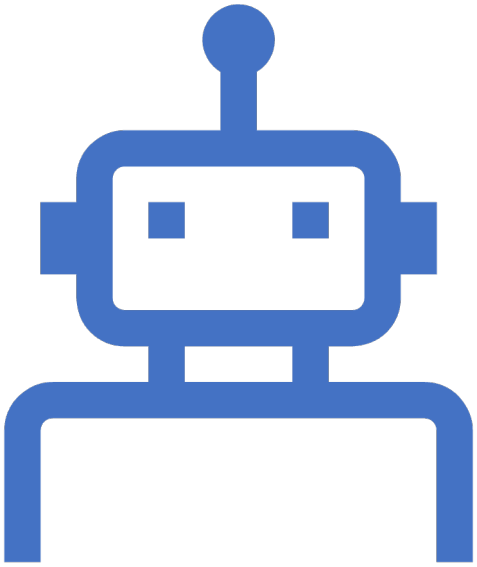
Variables	
Postoperative Complications, n (%)	
Stroke	0 (0)
Reoperation for bleeding	1 (0.5)
Prolonged ventilation (>12h)	0 (0)
Renal failure	0 (0)
Early graft patiency, n (%)	199 (99.5)
Postoperative hospital stay, days	4 ± 1
In-hospital death, n	0 (0)

Does
RA-MIDCAB
promote
early recovery?

Time to return to work and/or daily activity



Conclusion



RA-MIDCAB

- Provides IMA-LAD, the golden standard, *safely and effectively.*
- Has a learning curve and we should be careful especially in the early period.
- Promotes early recovery, which is a huge benefit of this approach.

医療法人 札幌ハートセンター

札幌心臓血管クリニック

https://scvc.jp

Thank you ！

Makoto Hashimoto

Email: makohashi1001@gmail.com