



Amjad Bani Hani

Associate Prof. of Cardiac Surgery and Intensive Care

CABG

INTRODUCTION

- HISTORY OF CARDIAC SURGERY
- CORONARY ARTERY ANATOMY
- MANAGEMENT
- SURGICAL TECHNIQUES

INTRODUCTION

- **HISTORY OF CARDIAC SURGERY**
- CORONARY ARTERY ANATOMY
- MANAGEMENT
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Adult Cardiac Surgery: Ischemic Heart Disease

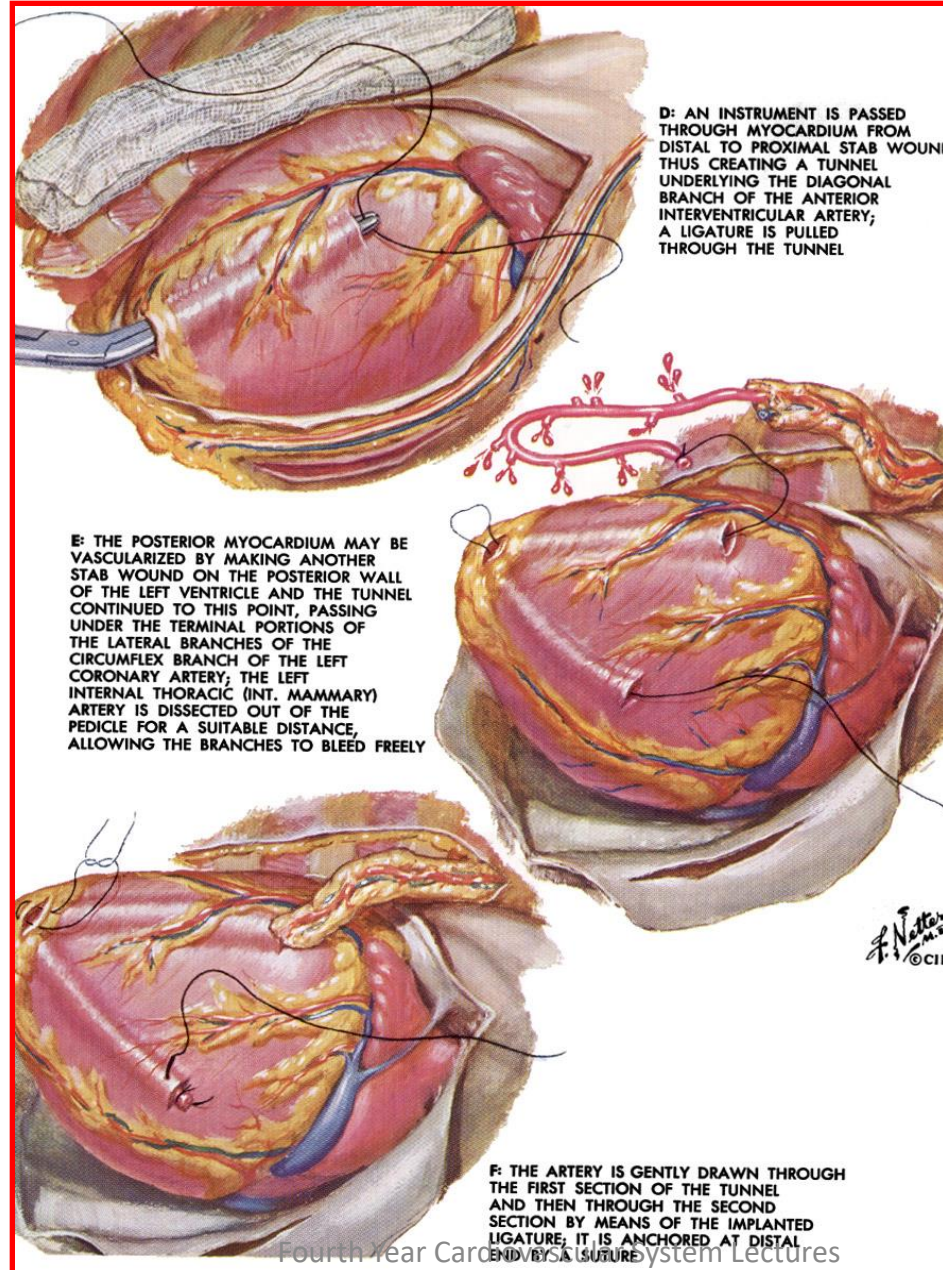
•Alexis Carrel-

“In certain cases of angina pectoris, when the mouth of the coronary is calcified, it would be useful to establish a complementary circulation for the lower part of the arteries. I attempted to perform an...anastomosis between the descending aorta and the left coronary. It was, for many reasons, a difficult operation.”

American Surgical Association, 1910

Adult Cardiac Surgery: Ischemic Heart Disease (History)

- **Claude Beck**
 - **1930's**- sought to increase myocardial blood flow indirectly with pericardial fat and omentum.
- **Arthur Vineberg**
 - **1940's**- Mobilization of left internal mammary artery with implantation of bleeding end into the left ventricle.
 - **1964**- follow-up study on 140 patients
 - 33% mortality
 - 85% relief from angina



Adult Cardiac Surgery: Ischemic Heart Disease (History)

- **Mason Sones,**

1950's- cine coronary arteriography.

1962- direct and reproducible catheterization of the coronary arteries.

“Collectively, all of the cardiological advances in this century pale in comparison with this priceless achievement.”

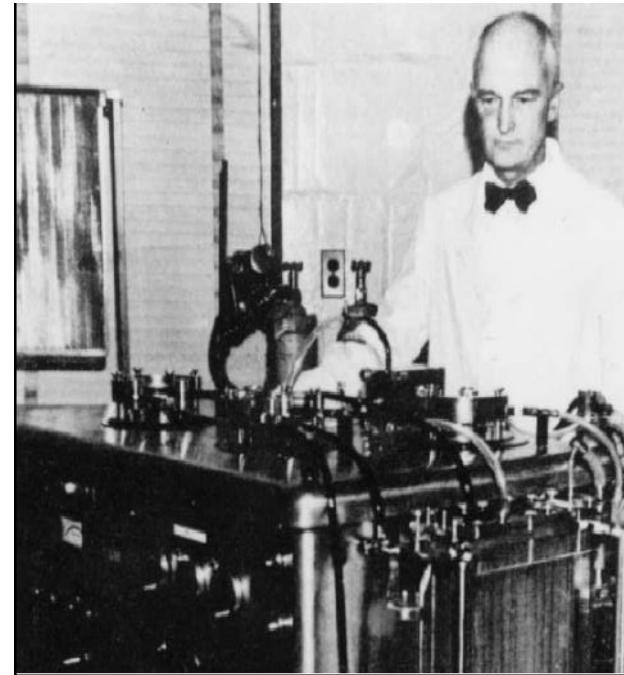
Floyd Loop, MD

Adult Cardiac Surgery: Ischemic Heart Disease (History)

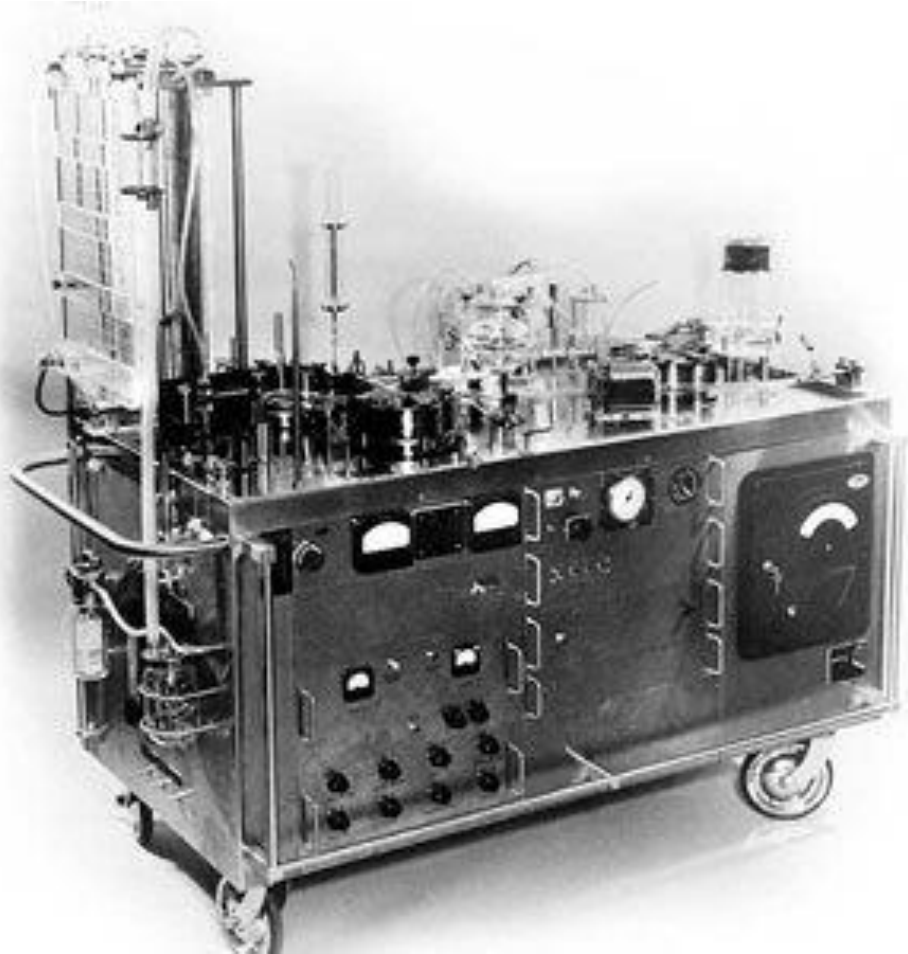
John H. Gibbon, Jr.

“During the long night, helplessly watching the patient struggle for life as her blood became darker and her veins more distended, the idea naturally occurred to me that if it were possible to remove some of the blue blood...put oxygen into that blood and allow carbon dioxide to escape from it, and then to inject continuously the now-red blood back into the patient’s arteries, we might have saved her life.”

- Heart-lung machine
- May 6, 1953- ASD closure



Heart Lung Machine



Adult Cardiac Surgery: Ischemic Heart Disease (History)

- 1962- **David C. Sabiston, Jr.-**
 - Aortocoronary saphenous vein bypass
- 1964-**KOLOSOV** LIMA -LAD IN Russia

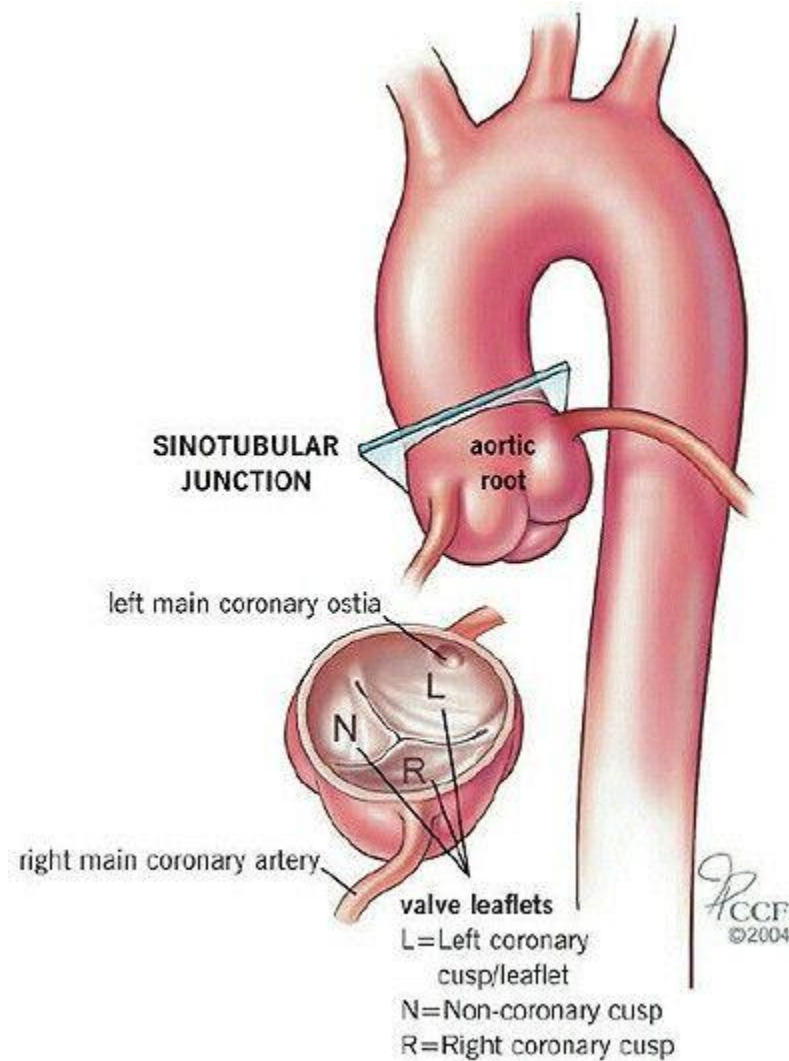
Adult Cardiac Surgery: Ischemic Heart Disease (CABG)

- Early and widespread acceptance of coronary bypass was delayed.
- Best known cooperative studies (1970-80's) were the;
 - VA
Coronary Artery Surgery Study
 - European Coronary Surgery Study

INTRODUCTION

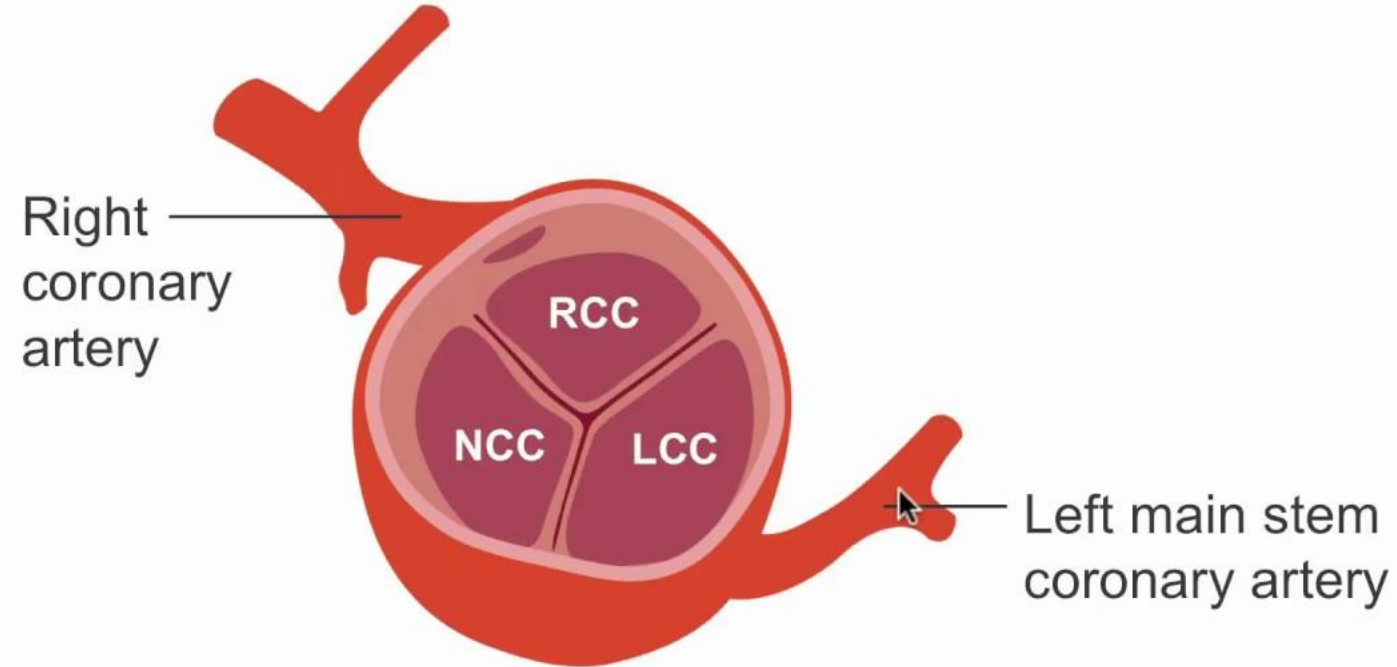
- HISTORY OF CARDIAC SURGERY
- **CORONARY ARTERY ANATOMY**
- MANAGEMENT
- SURGICAL TECHNIQUES

Coronary Anatomy

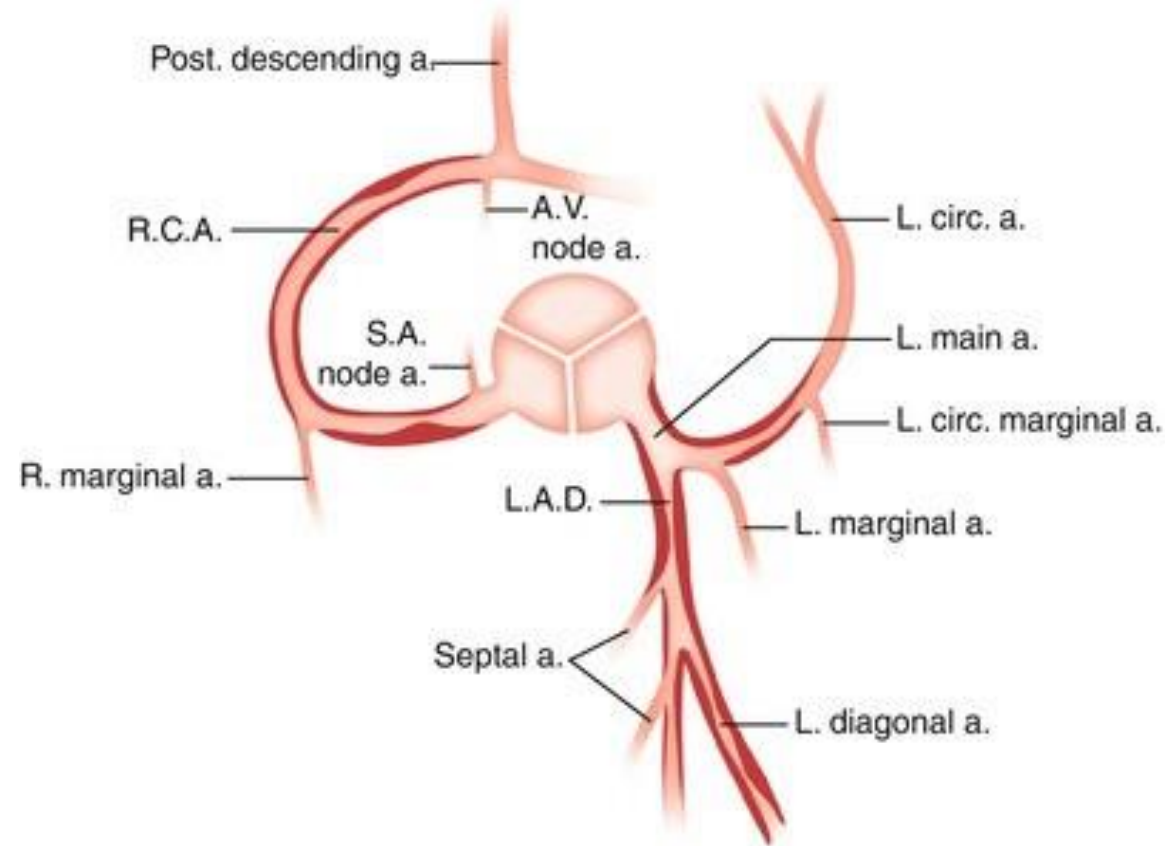


Coronary Anatomy

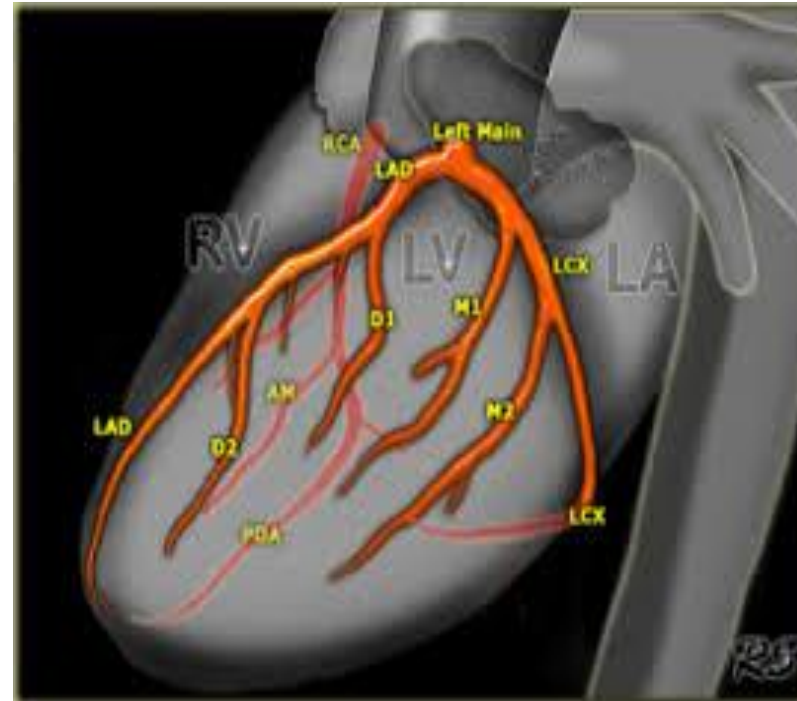
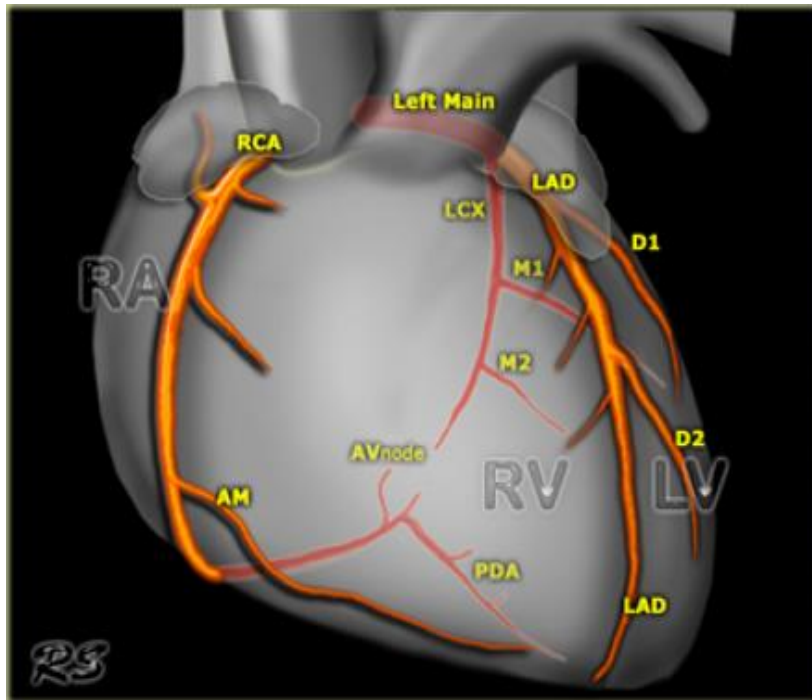
Coronary artery origins

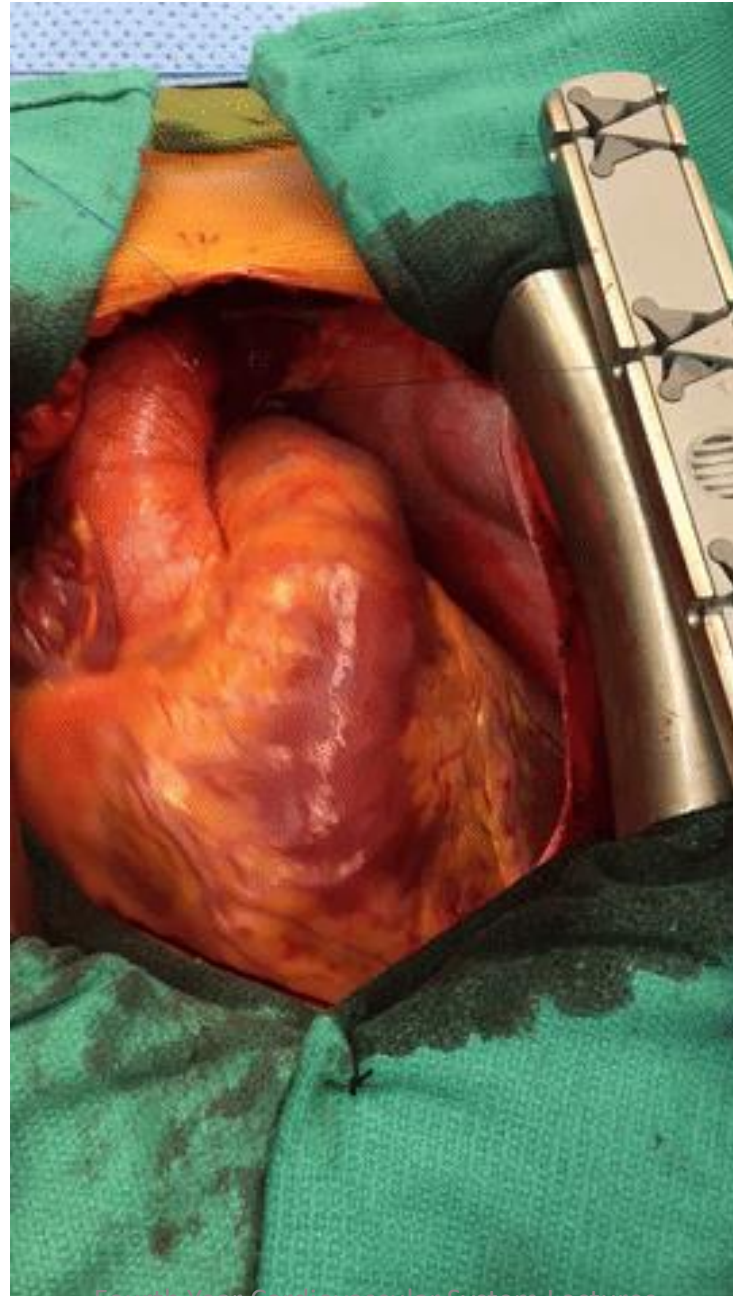


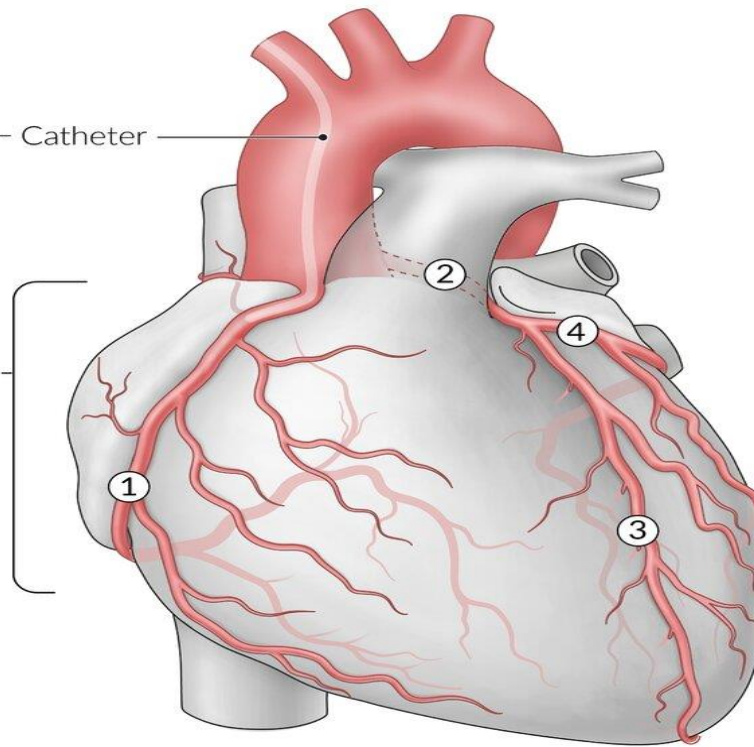
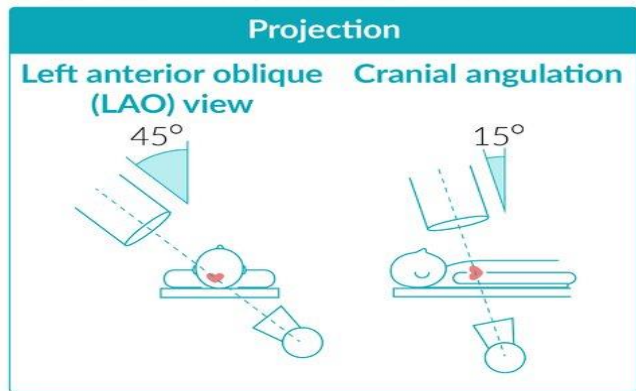
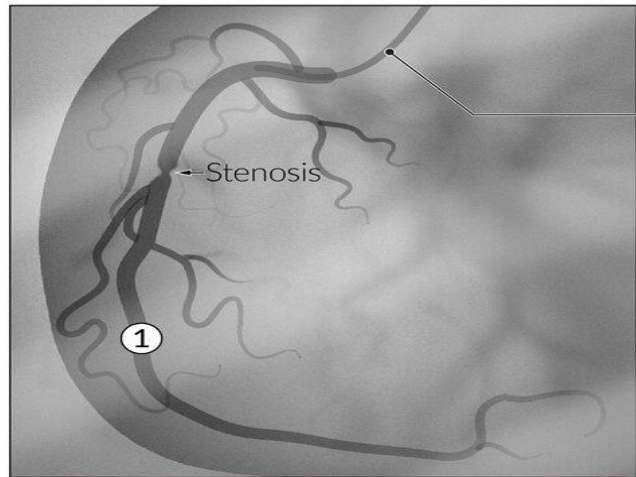
Coronary Anatomy



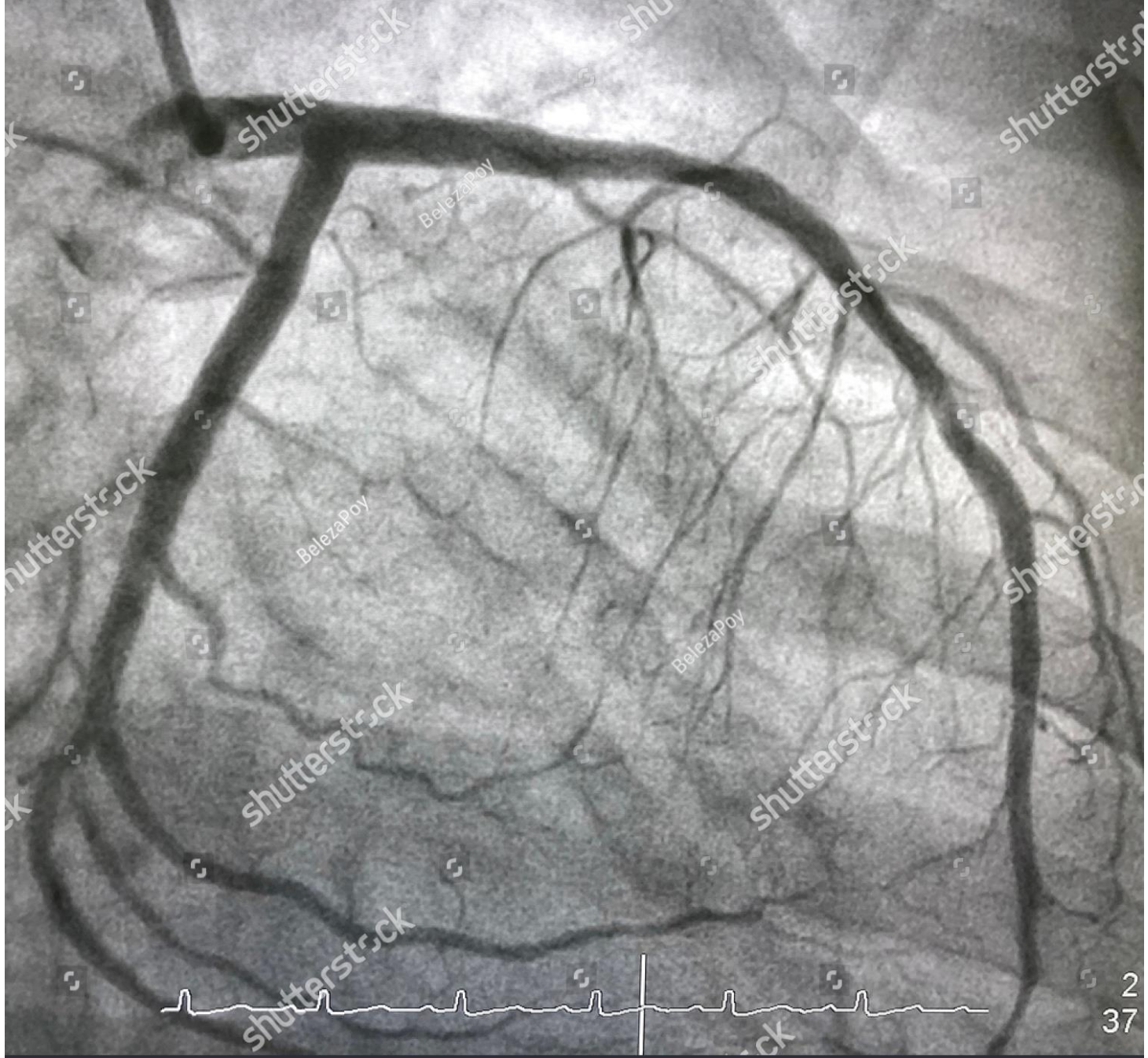
The Normal Heart - Coronary Artery Anatomy







- ① Right coronary artery (RCA)
- ② Left coronary artery (LCA)
- ③ Left anterior descending artery (LAD)
- ④ Left circumflex artery (LCx)



12/4/2023







INTRODUCTION

- HISTORY OF CARDIAC SURGERY
- CORONARY ARTERY ANATOMY
- **MANAGEMENT**
- SURGICAL TECHNIQUES

Management

- Indication For Surgery
- Preoperative Evaluation
- Conduits decision
- Operation Decision
- ERAS

Indications for Coronary Artery Bypass Grafting: (CABG)

- Triple vessel disease with DM and decreased EF
- Lf main coronary artery disease (Distal)
- Hi risk PCI or not Suitable for PCI
- Complications of PTCA
- Mechanical complications of MI
- Anomalies of Coronary arteries.

Table 2. Applying Class of Recommendation and Level of Evidence to Clinical Strategies, Interventions, Treatments, or Diagnostic Testing in Patient Care (Updated May 2019)



CLASS (STRENGTH) OF RECOMMENDATION	LEVEL (QUALITY) OF EVIDENCE†
CLASS 1 (STRONG) Benefit >>> Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Is recommended • Is indicated/useful/effective/beneficial • Should be performed/administered/other • Comparative-Effectiveness Phrases‡: <ul style="list-style-type: none"> – Treatment/strategy A is recommended/indicated in preference to treatment B – Treatment A should be chosen over treatment B 	LEVEL A <ul style="list-style-type: none"> • High-quality evidence‡ from more than 1 RCT • Meta-analyses of high-quality RCTs • One or more RCTs corroborated by high-quality registry studies
CLASS 2a (MODERATE) Benefit >> Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Is reasonable • Can be useful/effective/beneficial • Comparative-Effectiveness Phrases‡: <ul style="list-style-type: none"> – Treatment/strategy A is probably recommended/indicated in preference to treatment B – It is reasonable to choose treatment A over treatment B 	LEVEL B-R (Randomized) <ul style="list-style-type: none"> • Moderate-quality evidence‡ from 1 or more RCTs • Meta-analyses of moderate-quality RCTs
CLASS 2b (WEAK) Benefit ≥ Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • May/might be reasonable • May/might be considered • Usefulness/effectiveness is unknown/unclear/uncertain or not well-established 	LEVEL B-NR (Nonrandomized) <ul style="list-style-type: none"> • Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies • Meta-analyses of such studies
CLASS 3: No Benefit (MODERATE) Benefit = Risk (Generally, LOE A or B use only) Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Is not recommended • Is not indicated/useful/effective/beneficial • Should not be performed/administered/other 	LEVEL C-LD (Limited Data) <ul style="list-style-type: none"> • Randomized or nonrandomized observational or registry studies with limitations of design or execution • Meta-analyses of such studies • Physiological or mechanistic studies in human subjects
Class 3: Harm (STRONG) Risk > Benefit Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Potentially harmful • Causes harm • Associated with excess morbidity/mortality • Should not be performed/administered/other 	LEVEL C-E0 (Expert Opinion) <ul style="list-style-type: none"> • Consensus of expert opinion based on clinical experience

COR and LOE are determined independently (any COR may be paired with any LOE).
 A recommendation with LOE C does not imply that the recommendation is weak. Many important clinical questions addressed in guidelines do not lend themselves to clinical trials. Although RCTs are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.
 * The outcome or result of the intervention should be specified (an improved clinical outcome or increased diagnostic accuracy or incremental prognostic information).
 † For comparative-effectiveness recommendations (COR 1 and 2a; LOE A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.
 ‡ The method of assessing quality is evolving, including the application of standardized, widely-used, and preferably validated evidence grading tools; and for systematic reviews, the incorporation of an Evidence Review Committee.
 COR indicates Class of Recommendation; E0, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

Revascularization in SIHD



Revascularization to Improve Survival in SIHD Compared With Medical Therapy



Recommendations for Revascularization to Improve Survival in SIHD Compared With Medical Therapy

Referenced studies that support the recommendations are summarized in Online Data Supplement 10.

COR	LOE	Recommendations
Left ventricular dysfunction and multivessel CAD		
1	B-R	<p>1. In patients with SIHD and multivessel CAD appropriate for CABG with severe left ventricular systolic dysfunction (left ventricular ejection fraction <35%), CABG is recommended to improve survival.</p>
2a	B-NR	<p>2. In selected patients with SIHD and multivessel CAD appropriate for CABG and mild-to-moderate left ventricular systolic dysfunction (ejection fraction 35%–50%), CABG (to include a left internal mammary artery [LIMA] graft to the LAD) is reasonable to improve survival.</p>

Revascularization to Improve Survival in SIHD Compared With Medical Therapy (con't.)

Left main CAD		
1	B-R	3. In patients with SIHD and significant left main stenosis, CABG is recommended to improve survival.
2a	B-NR	4. In selected patients with SIHD and significant left main stenosis for whom PCI can provide equivalent revascularization to that possible with CABG, PCI is reasonable to improve survival.

Revascularization to Improve Survival in SIHD Compared With Medical Therapy (con't.)

Multivessel CAD		
2b	B-R	5. In patients with SIHD, normal ejection fraction, significant stenosis in 3 major coronary arteries (with or without proximal LAD), and anatomy suitable for CABG, CABG may be reasonable to improve survival.
2b	B-R	6. In patients with SIHD, normal ejection fraction, significant stenosis in 3 major coronary arteries (with or without proximal LAD), and anatomy suitable for PCI, the usefulness of PCI to improve survival is uncertain.

Revascularization to Improve Survival in SIHD Compared With Medical Therapy (con't.)

Stenosis in the proximal LAD artery		
2b	B-R	<p>7. In patients with SIHD, normal left ventricular ejection fraction, and significant stenosis in the proximal LAD, the usefulness of coronary revascularization to improve survival is uncertain.</p>
Single- or double-vessel disease not involving the proximal LAD		
3: No Benefit	B-R	<p>8. In patients with SIHD, normal left ventricular ejection fraction, and 1- or 2-vessel CAD not involving the proximal LAD, coronary revascularization is not recommended to improve survival.</p>

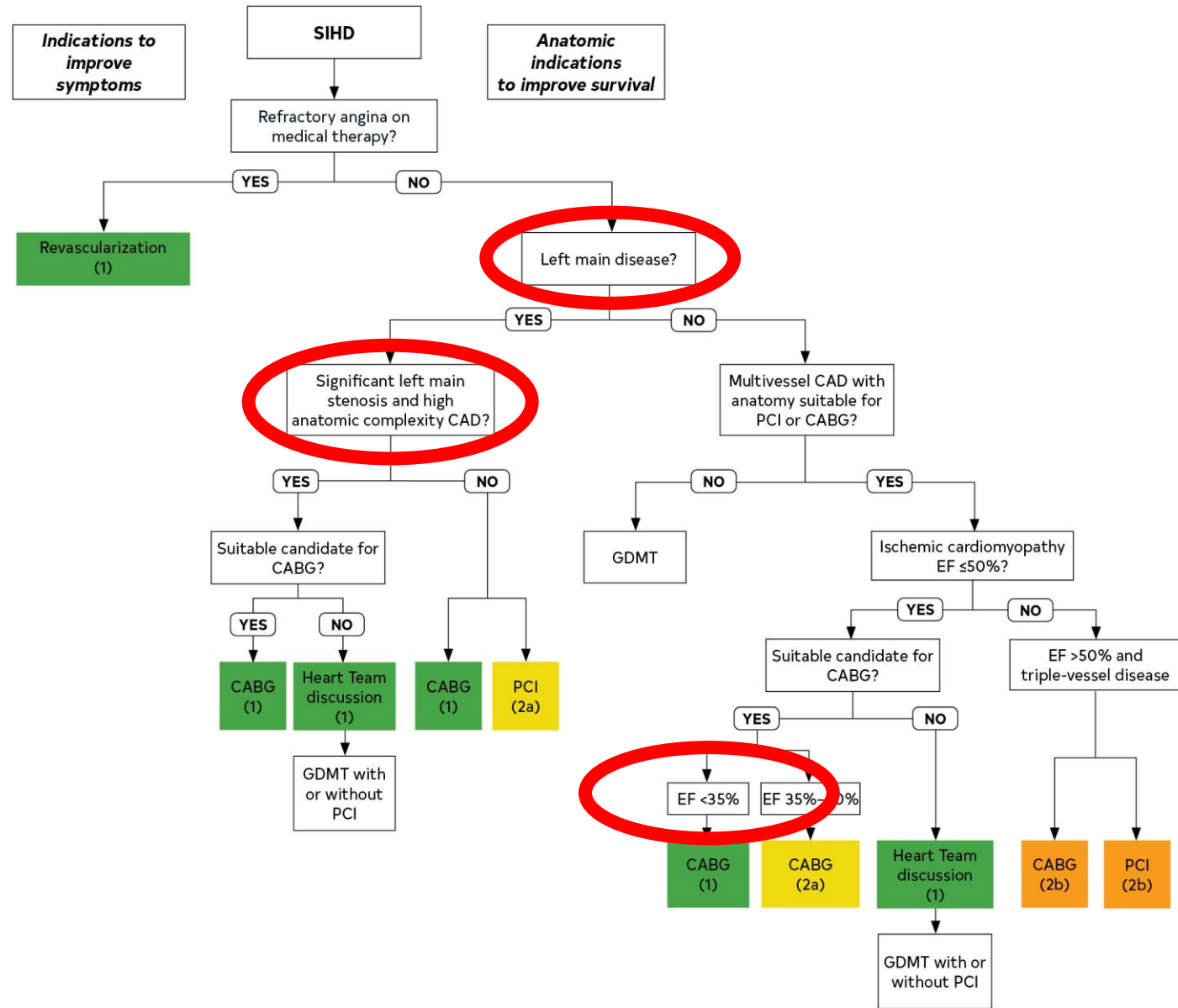


Figure 6.
Revascularization in
patients with SIHD.

Colors correspond to
Table 2.

CABG indicates coronary artery bypass graft; CAD, coronary artery disease; EF, ejection fraction; PCI, percutaneous coronary intervention; SIHD, stable ischemic heart disease; and GDMT, guideline-directed medical therapy.

Situations in Which CABG Would Be Preferred



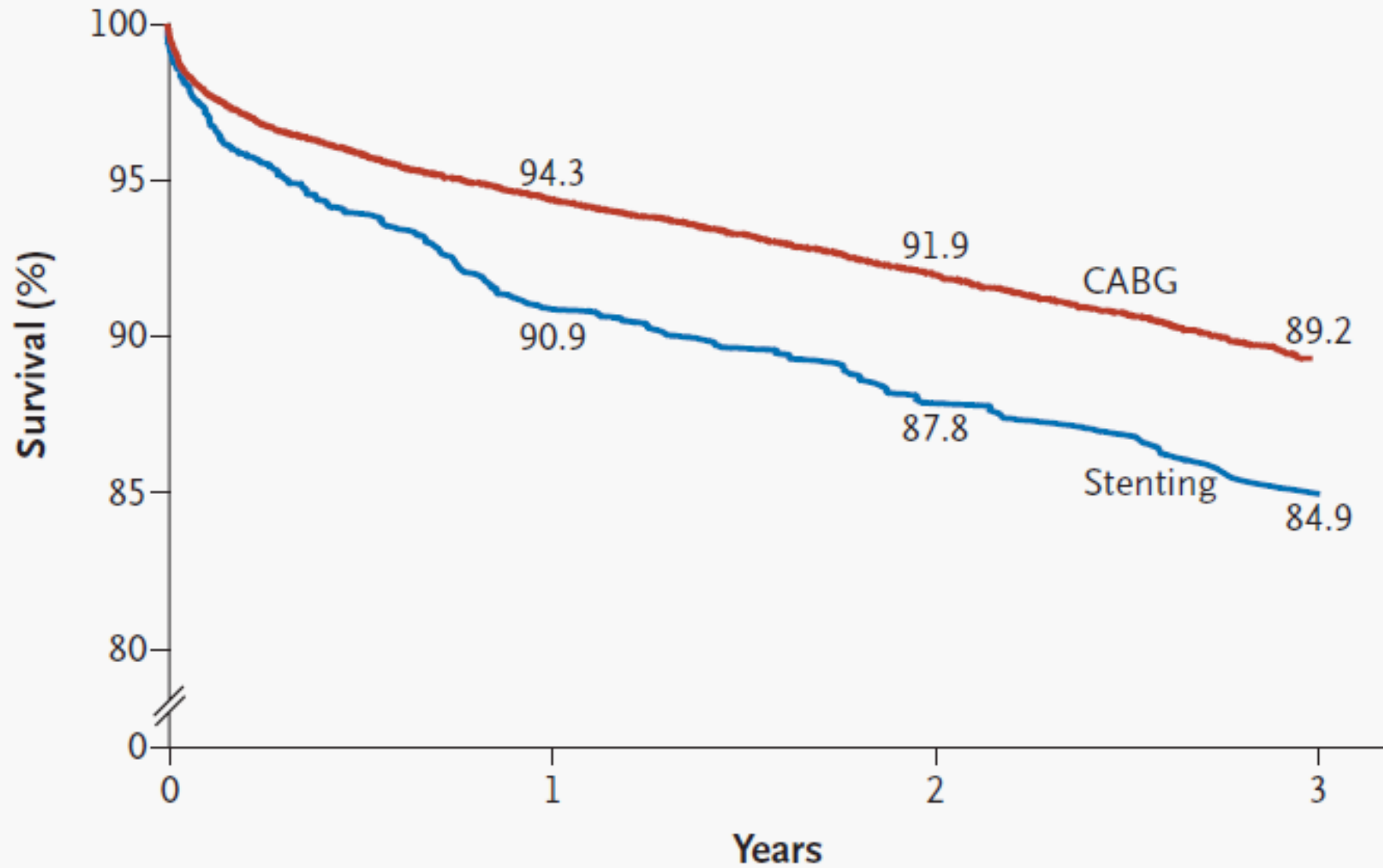
Patients With Complex Disease

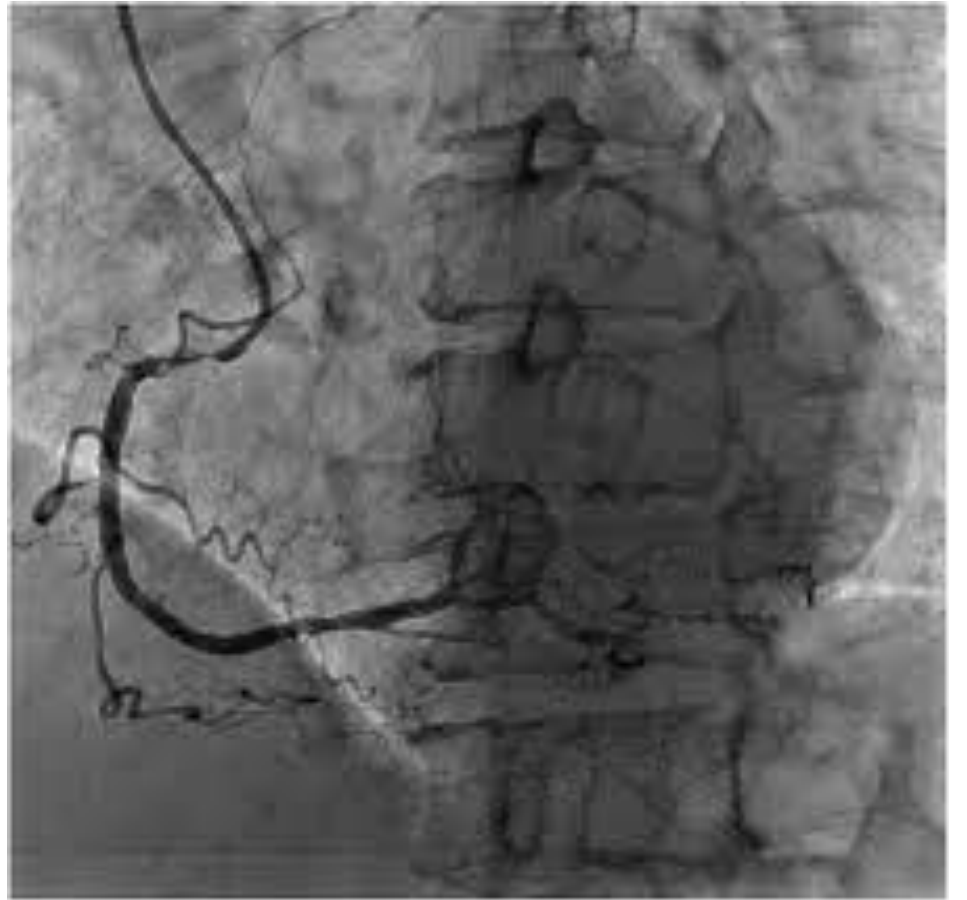
<p style="text-align: center;">Recommendations for Patients With Complex Disease</p> <p style="text-align: center;">Referenced studies that support the recommendations are summarized in Online Data Supplement 13.</p>		
COR	LOE	Recommendations
1	B-R	<p>1. In patients who require revascularization for significant left main CAD with high-complexity CAD, it is recommended to choose CABG over PCI to improve survival.</p>
2a	B-R	<p>2. In patients who require revascularization for multivessel CAD with complex or diffuse CAD (e.g., SYNTAX score >33), it is reasonable to choose CABG over PCI to confer a survival advantage.</p>

Patients With Diabetes

Recommendations for Patients With Diabetes		
Referenced studies that support the recommendations are summarized in Online Data Supplement 14.		
COR	LOE	Recommendations
1	A	1. In patients with diabetes and multivessel CAD with the involvement of the LAD, who are appropriate candidates for CABG, CABG (with a LIMA to the LAD) is recommended in preference to PCI to reduce mortality and repeat revascularizations.
2a	B-NR	2. In patients with diabetes who have multivessel CAD amenable to PCI and an indication for revascularization and are poor candidates for surgery, PCI can be useful to reduce long-term ischemic outcomes.
2b	B-R	3. In patients with diabetes who have left main stenosis and low- or intermediate-complexity CAD in the rest of the coronary anatomy, PCI may be considered an alternative to CABG to reduce major adverse cardiovascular outcomes.

C Three-Vessel Disease with Disease of the Proximal LAD Artery

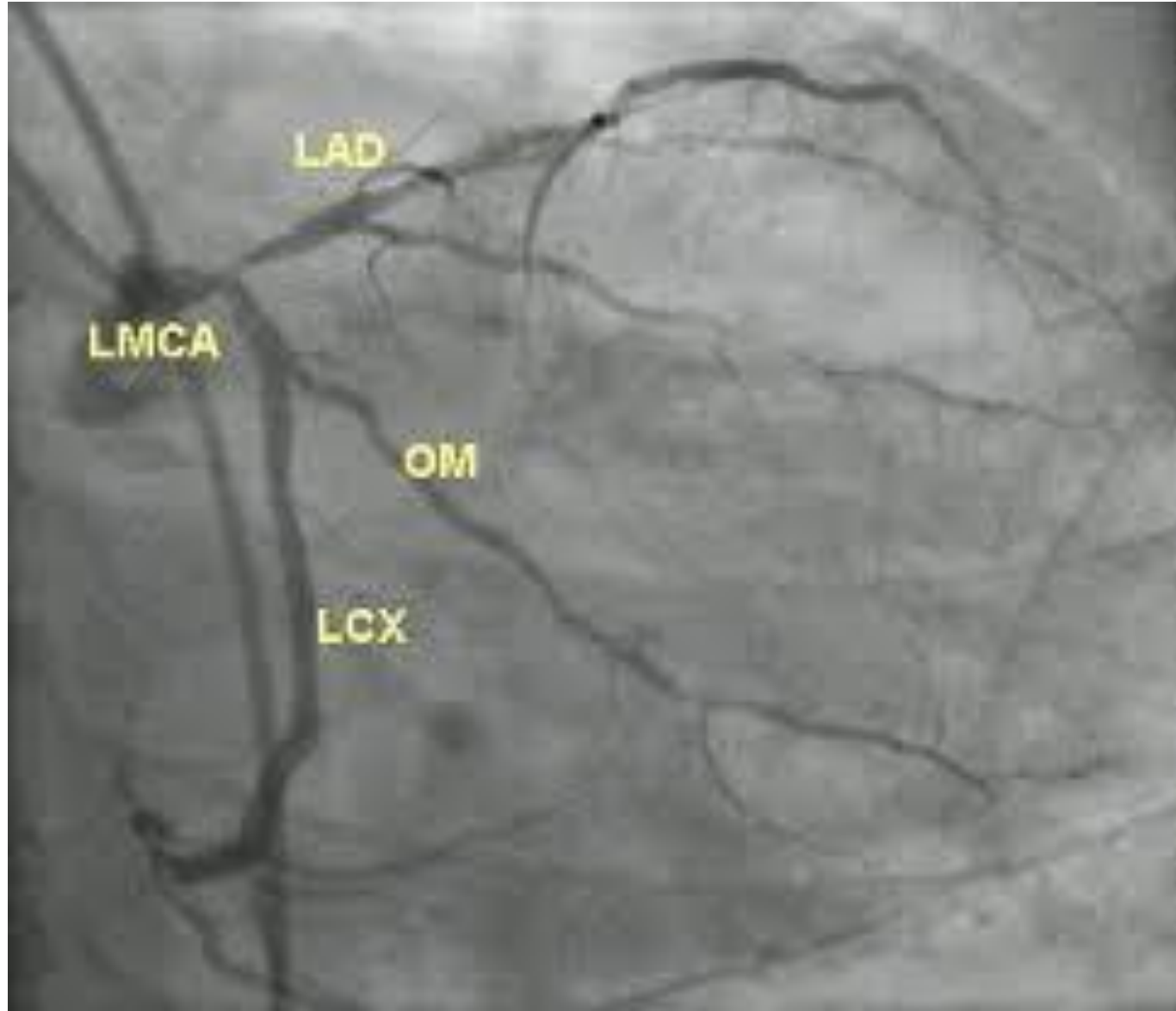




- A 50-year-old male patient
- Diabetic on OHA (Metformin)
- Hypertensive on BB and CCB
- Dyslipidemia on Statin and aspirin
- Presented to the ER with ACS (Unstable Angina)
- He was started on Clopidogrel and admitted for further evaluation

[click here to watch the vedio](#)





- Cath showed
 - Distal Left Main Stenosis
 - RCA stenosis

Factors for Consideration by the Heart Team

Coronary Anatomy

- Left main disease
- Multivessel disease
- High anatomic complexity (i.e., bifurcation disease, high SYNTAX score)

Comorbidities

- Diabetes
- Systolic dysfunction
- Coagulopathy
- Valvular heart disease
- Frailty
- Malignancy
- ESRD
- COPD
- Immunosuppression
- Debilitating neurological disorders
- Liver disease/cirrhosis
- Prior CVA
- Calcified aorta
- Aortic aneurysm

Procedural Factors

- Local and regional outcomes
- Access site for PCI
- Surgical risk
- PCI risk

Patient Factors

- Unstable presentation or shock
- Patient preferences
- Inability or unwillingness to adhere to DAPT
- Religious beliefs
- Patient education, knowledge, and understanding

Guiding Principle: Ideal situations for Heart Team consideration include patients with complex coronary disease, comorbid conditions that could impact the success of the revascularization strategy, and other clinical or social situations that may impact outcomes.



Abbreviations: COPD indicates chronic obstructive pulmonary disease; CVA, cerebral vascular accident; DAPT, dual antiplatelet therapy; ESRD, end-stage renal disease; PCI, percutaneous coronary intervention; and SYNTAX, Synergy Between PCI With TAXUS and Cardiac

Surgery.

Lawton, J. S. et al. 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization. *Circulation*.

Improving Equity of Care in Revascularization



Health disparities by sex and race are evident across the spectrum of CVD in the United States.



Women and non-White patients are less likely to receive guideline-based therapies.



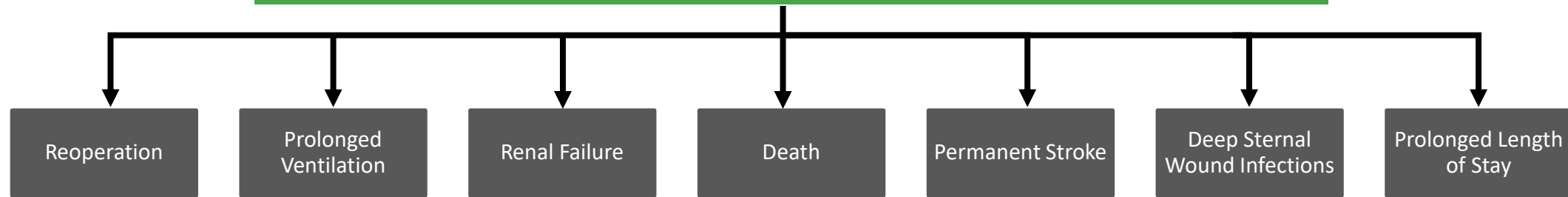
Women and non-White patients derive comparable benefit from revascularization after controlling for other factors.



In patients who require coronary revascularization, treatment decisions should be based on clinical indication, regardless of sex or race or ethnicity, and efforts to reduce disparities of care are warranted (Class 1).

Assessing Risk for Patients Undergoing CABG

In patients who are being considered for CABG, calculation of the Society of Thoracic Surgeons (STS) and EURO II risk score is recommended to help stratify patient risk (Class 1).*



Risk Factors Not Quantified in the STS Score

Cirrhosis	Meld
Frailty	Gait Speed
Malnutrition	MUST

Guiding Principle: In patients who are being considered for CABG, calculation of the STS \ Euro II risk score is recommended to help stratify patient risk. The MELD score, gait speed, and the MUST score may help in patients with cirrhosis, frailty, and malnutrition respectively.

Abbreviations: CABG indicates coronary artery bypass grafting; MELD, Model for End-Stage Liver Disease; MUST, Malnutrition Universal Screening Tool; and STS, Society of Thoracic Surgeons.

* See: <https://www.sts.org/resources/risk-calculator>

Lawton, J. S. et al. 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization. *Circulation*.

INDICATION??

Revascularization to Improve Survival in SIHD Compared With Medical Therapy (con't.)

Left main CAD		
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Patients With Diabetes

Recommendations for Patients With Diabetes		
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2b	B-R	3. In patients with diabetes who have left main stenosis and low- or intermediate-complexity CAD in the rest of the coronary anatomy, PCI may be considered an alternative to CABG to reduce major adverse cardiovascular outcomes.





- Indication For Surgery
- Preoperative Evaluation
- Conduits decision
- Operation Decision
- ERAS

- Respiratory Evaluation
- Renal Evaluation
- Infection Evaluation
- Carotids
- Frailty
- Risk Assessment

- Liver
- Thyroid
- Medications
- Coagulopathy

Perioperative Pharmacotherapy

Pre-op Anti-platelet

PRE-OP ANTI-PLATELET	PLAN TO DECREASE RISK OF BLEEDING
ASA, daily	CONTINUE, if already taking (Class 1)
Clopidogrel & Ticagrelor	 At least 24 hrs, if URGENT (Class 1)
	 { Ticagrelor at least 3d, if elective (Class 2a) Clopidogrel at least 5d, if elective (Class 2a) Prasugrel at least 7d, if elective (Class 2a)
Eptifibatide & Tirofiban	 At least 4 hrs (Class 1)
Abciximab	 At least 12 hrs (Class 1)

Anti-Arrhythmics* Preop

BB and Amiodarone can reduce the incidence of post-op afib (Class 2a)

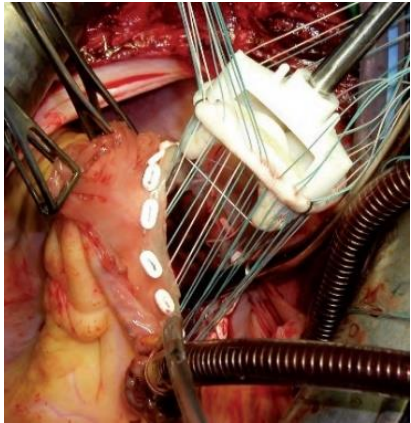
BB may reduce mortality or postop complications (Class 2b)

* In patients with no contraindications to usage

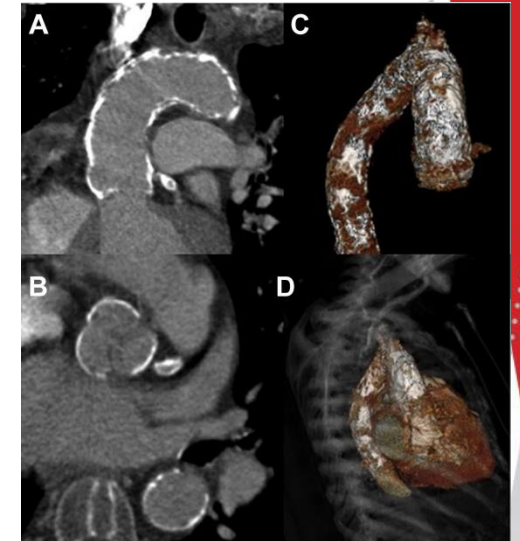
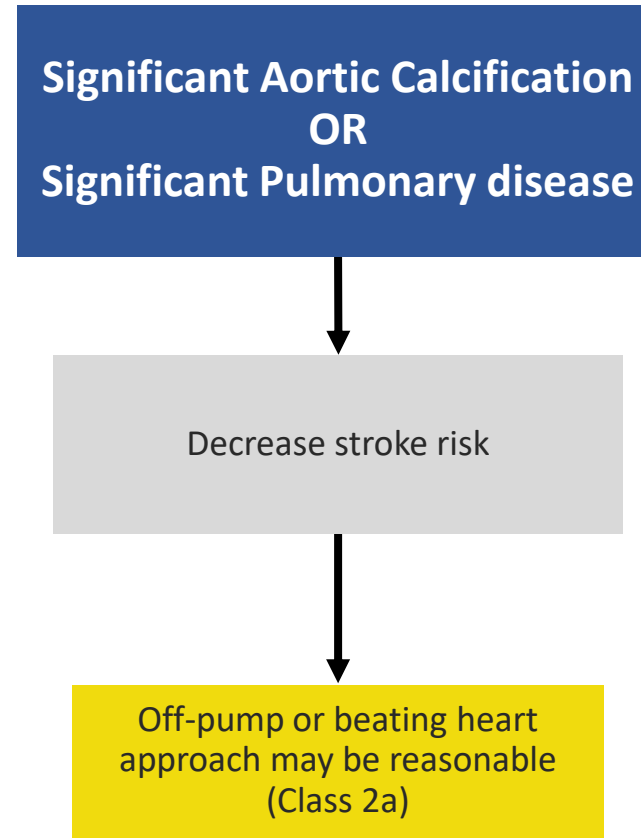
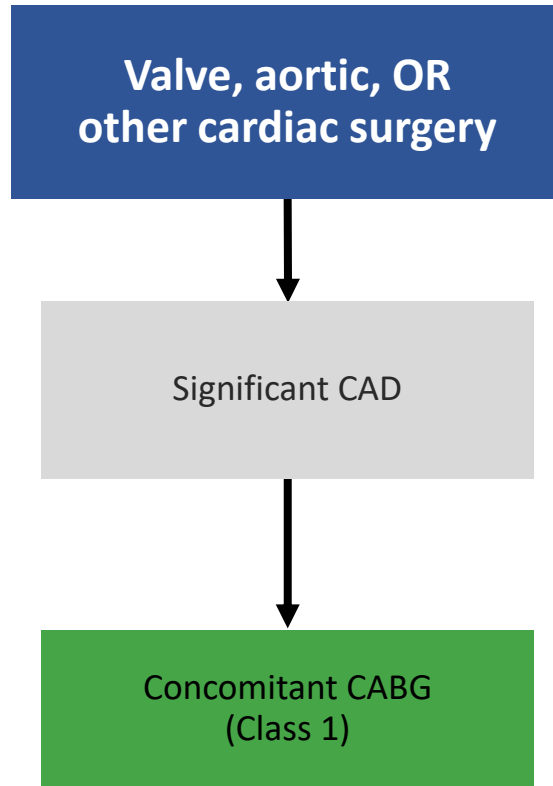
Abbreviations: AFIB indicates atrial fibrillation; ASA, aspirin; BB, beta blockers; D, days; and HRS, hours.

Lawton, J. S. et al. 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization. *Circulation*.

Patients Undergoing Other Cardiac Surgery and Operative Approach



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Shared Decision-Making and Informed Consent



Informed Consent

Clinician provides the best available evidence for treatment options, including the risks & benefits of each option



Patient-Centered Care

Treatment & care options take into consideration individual values & preferences



Shared Decision-Making

A collaborative decision about treatment or care is documented and shared with relevant stakeholders

COR	RECOMMENDATIONS
1	In patients undergoing revascularization, decisions should be patient centered—that is, considerate of the patient’s preferences and goals, cultural beliefs, health literacy, and social determinants of health—and made in collaboration with the patient’s support system.
1	In patients undergoing coronary angiography or revascularization, adequate information about benefits, risks, therapeutic consequences, and potential alternatives in the performance of percutaneous and surgical myocardial revascularization should be given, when feasible, with sufficient time for informed decision-making to improve clinical outcomes.

Table 8. Patient Clinical Status Definitions to Guide Revascularization

Elective

Cardiac function has been stable in the days-weeks before intervention. The intervention could be deferred without increased risk of compromise to cardiac outcome.

Urgent

Intervention is required during the same hospitalization to minimize chance of further clinical deterioration. Examples include worsening sudden chest pain, heart failure, acute myocardial infarction, anatomy, intra-aortic balloon pump, unstable angina, with intravenous nitroglycerin, or rest angina.

Emergency

Patients requiring emergency intervention will have ongoing, refractory, unrelenting cardiac compromise, with or without hemodynamic instability, and not responsive to any form of therapy except cardiac intervention. There should be no delay in providing operative intervention.

Emergency/salvage

Patients requiring emergency/salvage intervention are those who require cardiopulmonary resuscitation in route to intervention, before induction of anesthesia or who require extracorporeal membrane oxygenation to maintain life.

General Procedural Issues for CABG



- Indication For Surgery
- Preoperative Evaluation
- **Conduits decision**
- Operation Decision
- ERAS

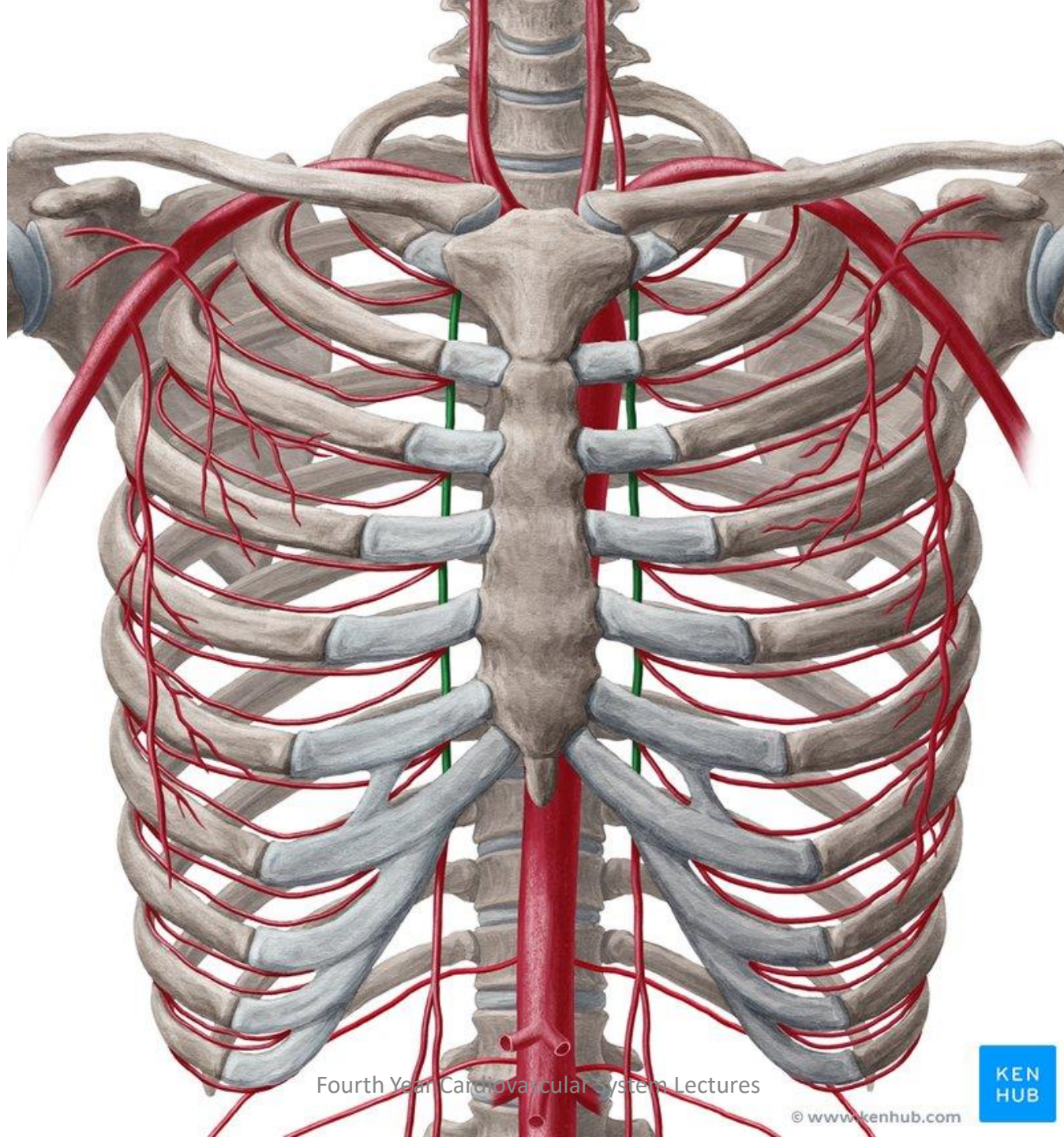
Conduites

- Arterial

- LIMA
- RIMA
- RA
- GEA
- IEA

- Venous

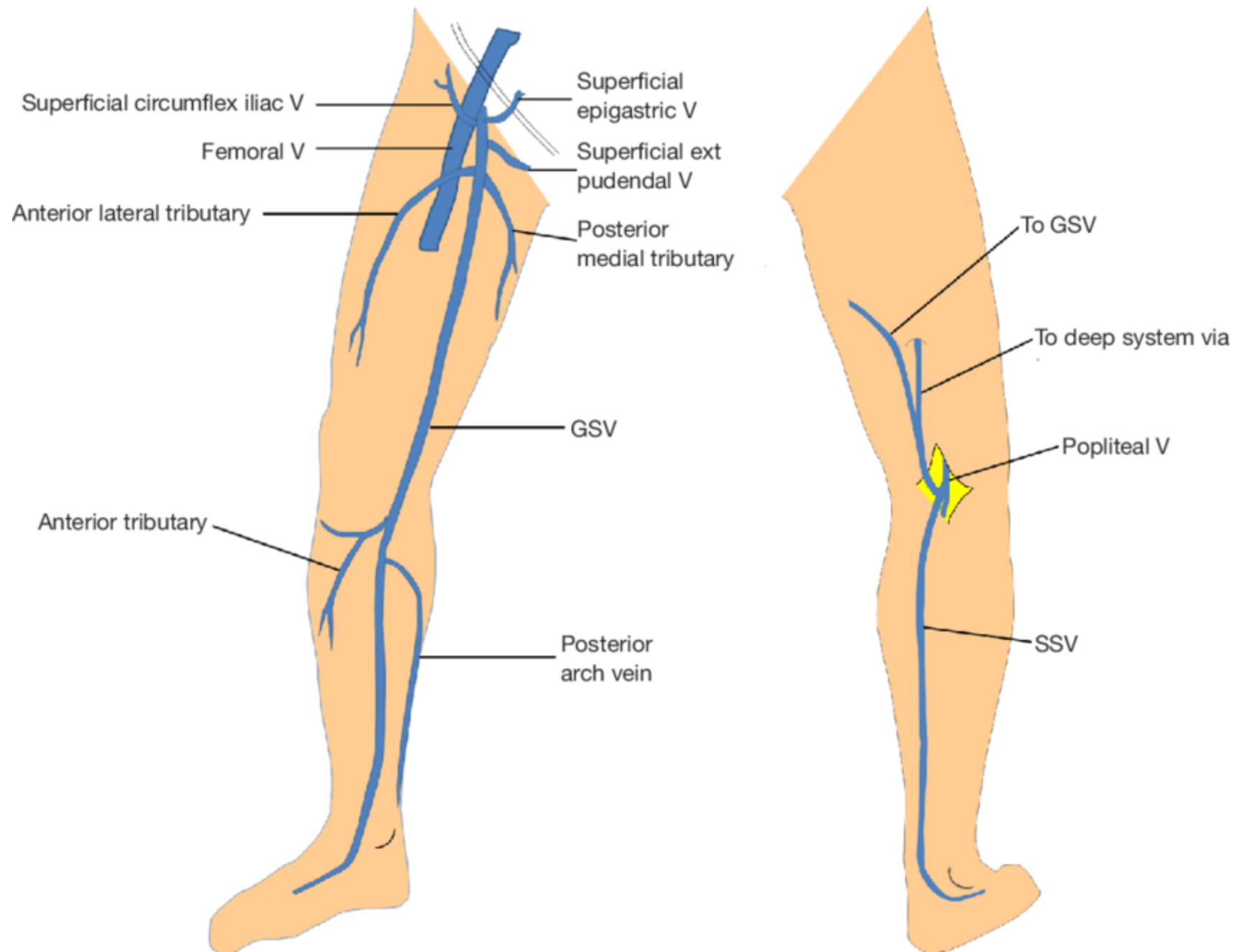
- GSV
- SSV
- Arm Veins



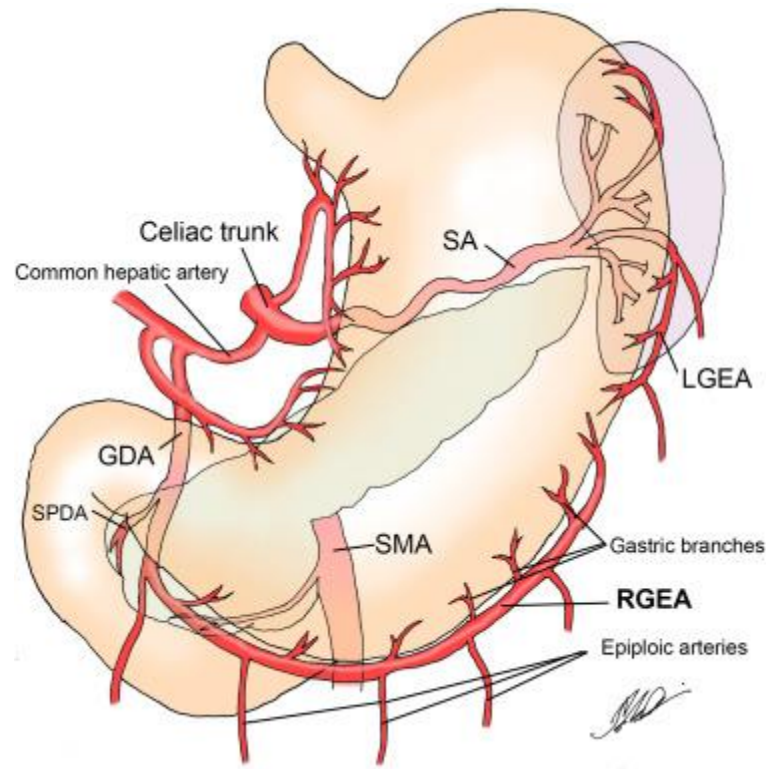
(a)

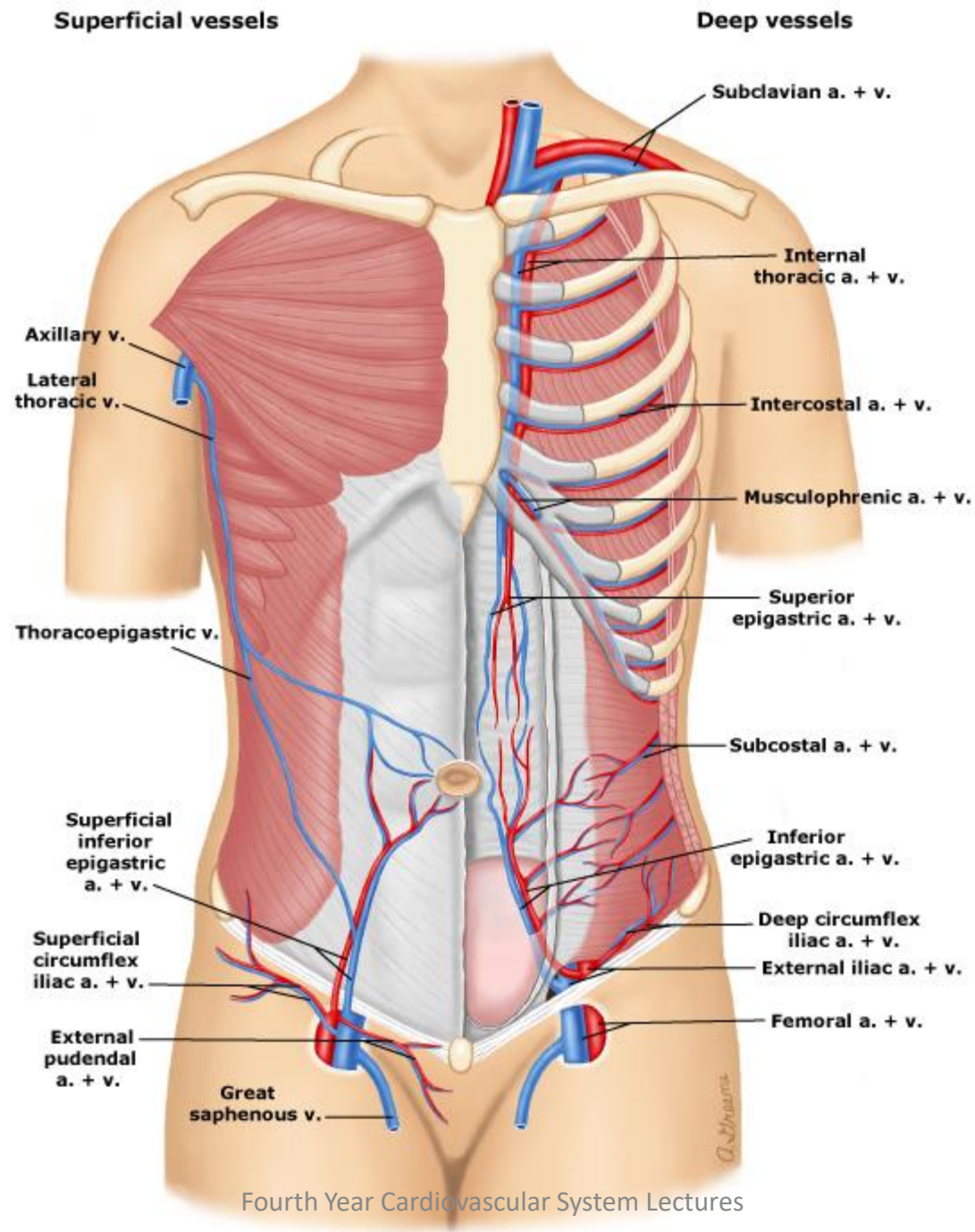




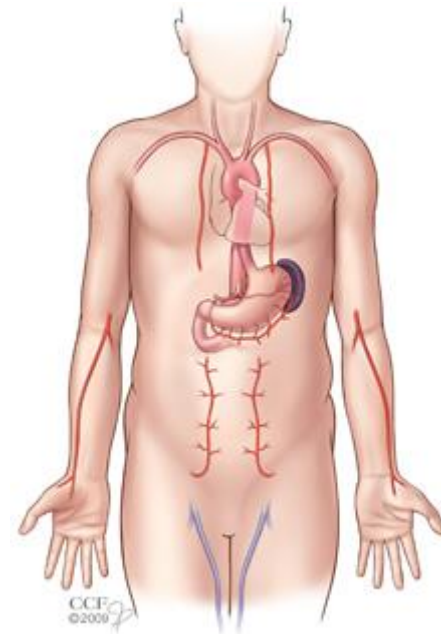
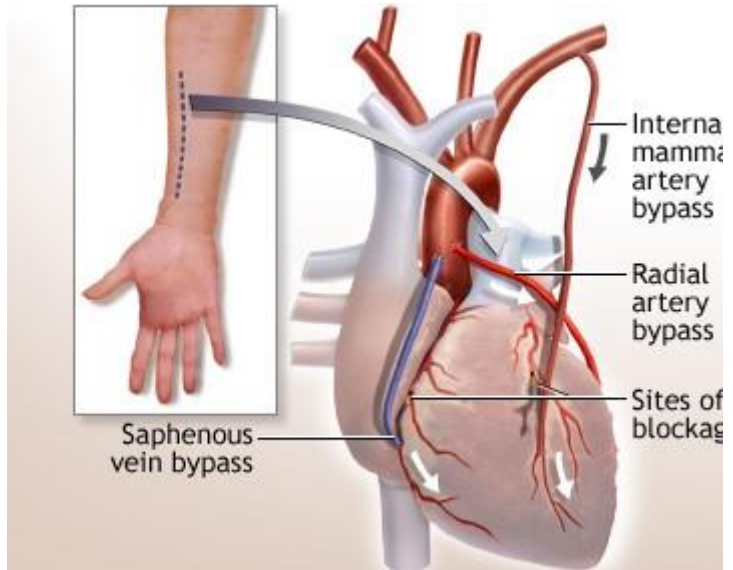








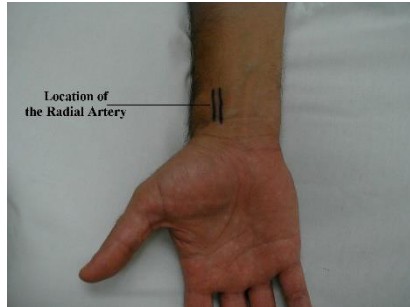
Arterial vs Venous conduits



Bypass Conduits in Patients Undergoing CABG

Radial artery

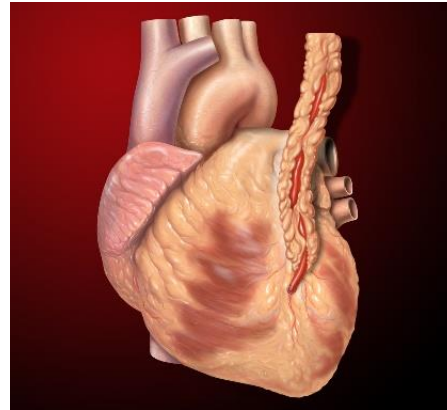
Recommended in preference to a saphenous vein conduit to graft the second most important, significantly stenosed, non-LAD vessel (Class 1)



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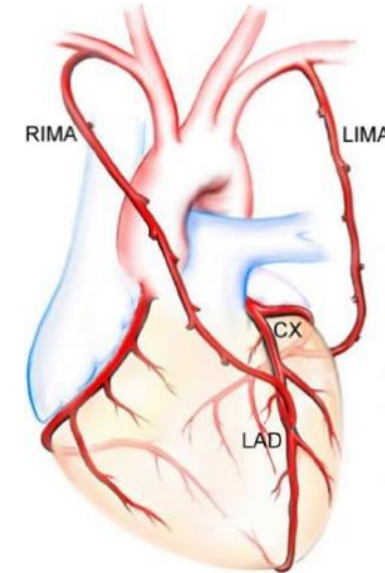
IMA (prefer left)

To LAD (Class 1)



Source: [This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)

BIMA



Source: <https://vpjournal.net/article/view/3141>

Improves long-term outcomes when procedure is done by experienced operators (Class 2a)

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JANUARY 2, 1986

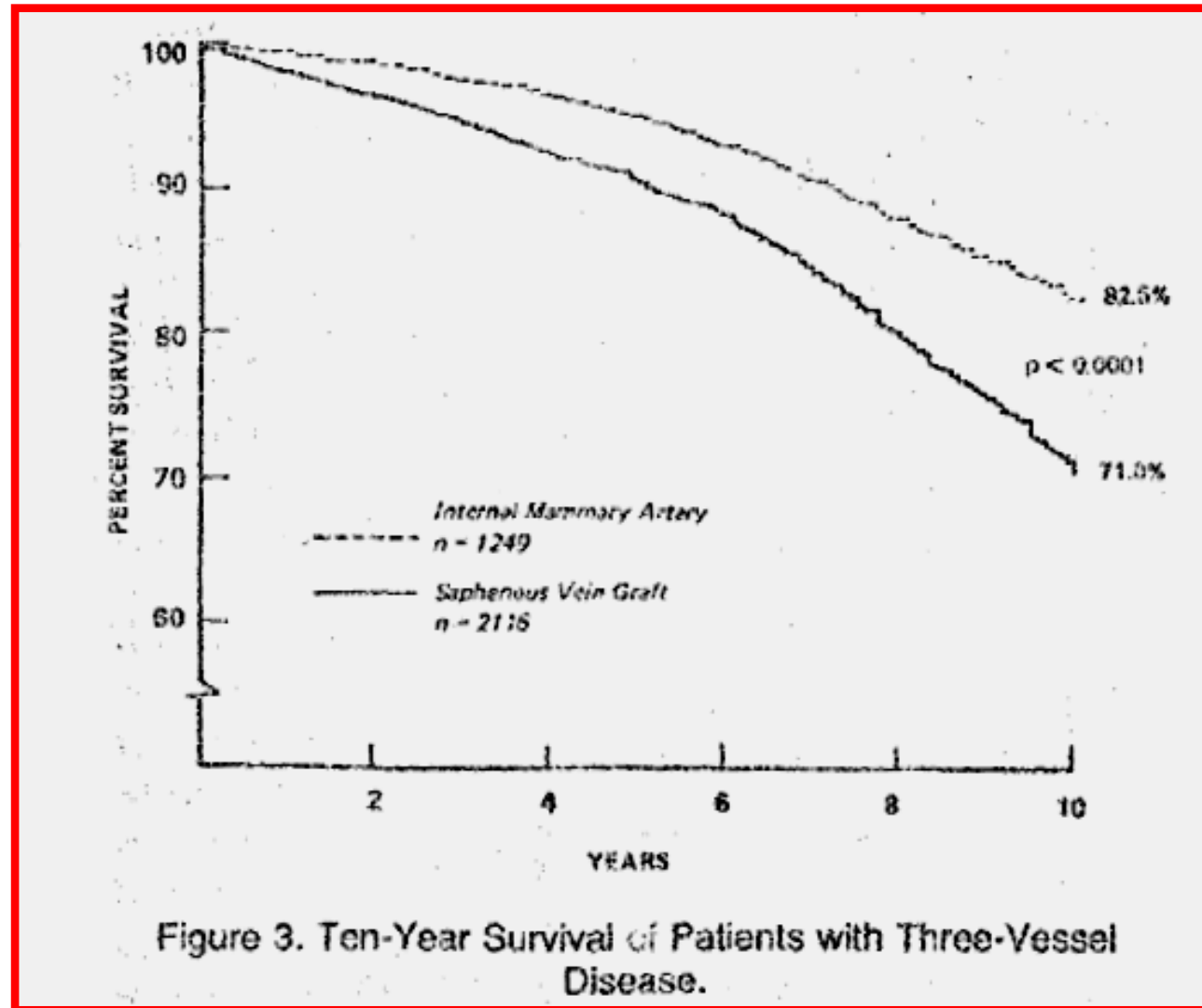
Number 1

INFLUENCE OF THE INTERNAL-MAMMARY-ARTERY GRAFT ON 10-YEAR SURVIVAL AND OTHER CARDIAC EVENTS

FLOYD D. LOOP, M.D., BRUCE W. LYTLE, M.D., DELOS M. COSGROVE, M.D., ROBERT W. STEWART, M.D.,
MARLENE GOORMASTIC, M.P.H., GEORGE W. WILLIAMS, PH.D., LEONARD A.R. GOLDING, M.D.,
CARL C. GILL, M.D., PAUL C. TAYLOR, M.D., WILLIAM C. SHELDON, M.D.,
AND WILLIAM L. PROUDFIT, M.D.

Abstract We compared patients who received an internal-mammary-artery graft to the anterior descending coronary artery alone or combined with one or more saphenous-vein grafts ($n = 2306$) with patients who had only saphenous-vein bypass grafts ($n = 3625$). The 10-year actuarial survival rate among the group receiving the internal-mammary-artery graft, as compared with the group who received the vein grafts (exclusive of hospital deaths), was 93.4 percent versus 88.0 percent ($P = 0.05$) for those with one-vessel disease; 90.0 percent versus 79.5 percent ($P < 0.0001$) for those with two-vessel disease; and 82.6 percent versus 71.0 percent ($P < 0.0001$) for those with three-vessel disease. After an adjustment for demographic and clinical differences by Cox multivariate analysis, we

found that patients who had only vein grafts had a 1.61 times greater risk of death throughout the 10 years, as compared with those who received an internal-mammary-artery graft. In addition, patients who received only vein grafts had 1.41 times the risk of late myocardial infarction ($P < 0.0001$), 1.25 times the risk of hospitalization for cardiac events ($P < 0.0001$), 2.00 times the risk of cardiac reoperation ($P < 0.0001$), and 1.27 times the risk of all late cardiac events ($P < 0.0001$), as compared with patients who received internal-mammary-artery grafts. Internal-mammary-artery grafting for lesions of the anterior descending coronary artery is preferable whenever indicated and technically feasible. (N Engl J Med 1986; 314:1-6.)



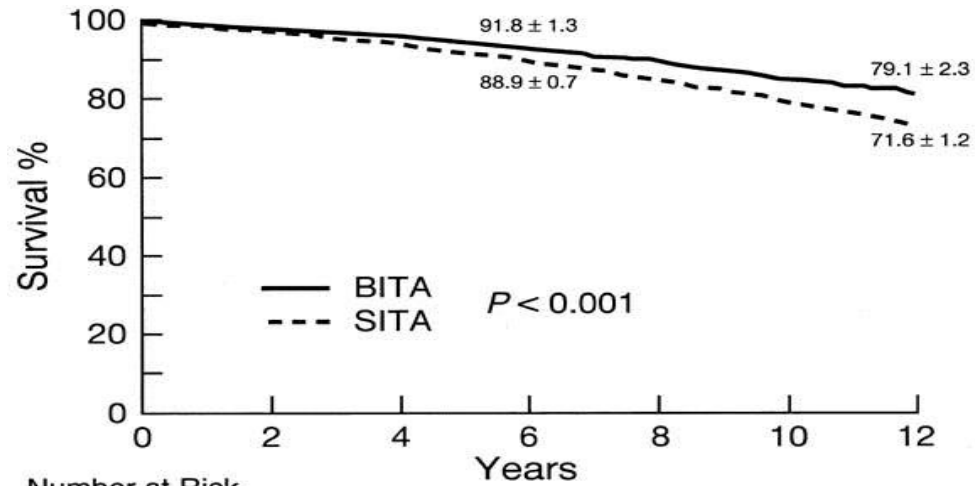
Loop FD et al NEJM 1986

Two internal thoracic artery grafts are better than one

*Bruce W. Lytle, MD, Eugene H. Blackstone, MD, Floyd D. Loop, MD, Penny L. Houghtaling, MS, John H. Arnold, MD, Rami Akhrass, MD,
Patrick M. McCarthy, MD, Delos M. Cosgrove, MD*

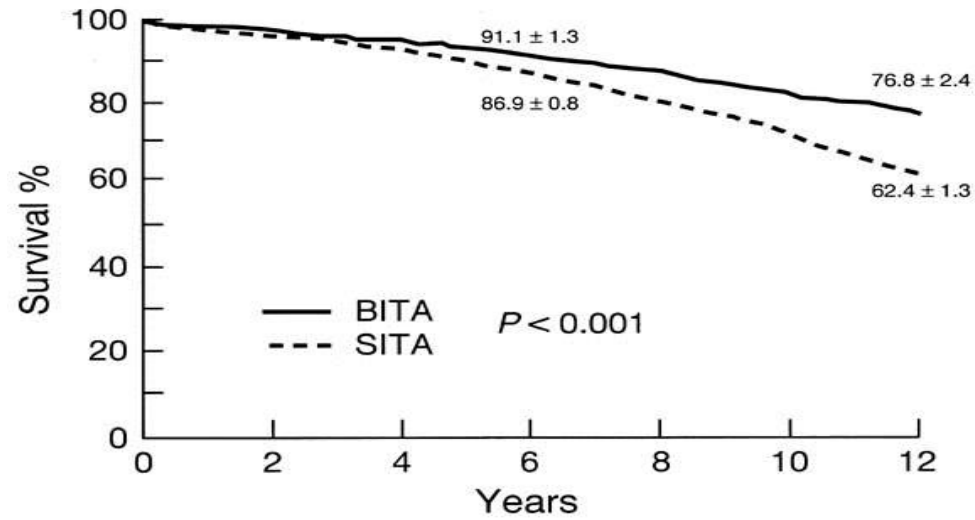
The Journal of Thoracic and Cardiovascular Surgery
Volume 117 Issue 5 Pages 855-872 (May 1999)
DOI: 10.1016/S0022-5223(99)70365-X

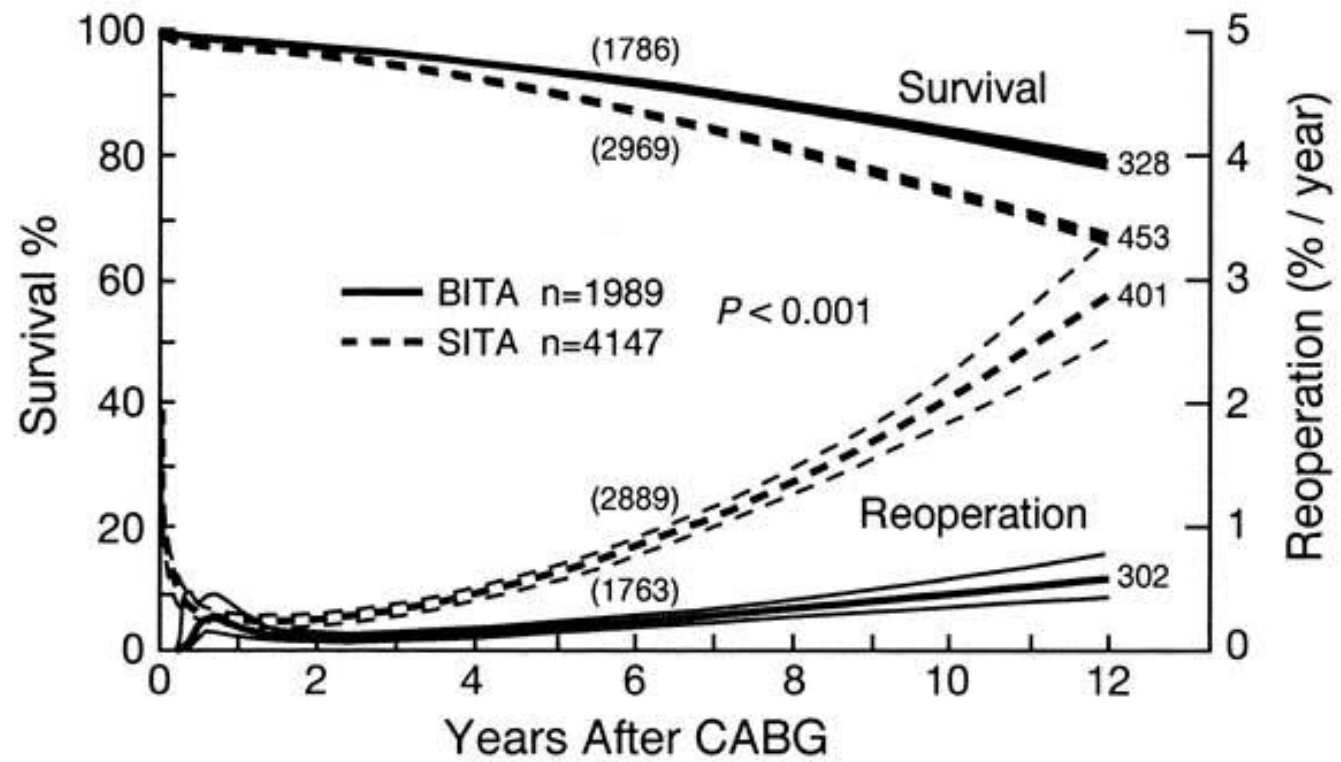




Number at Risk

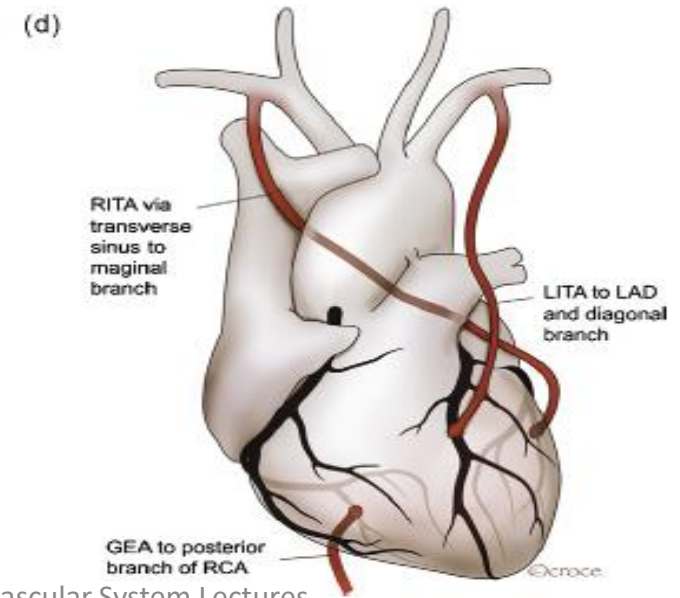
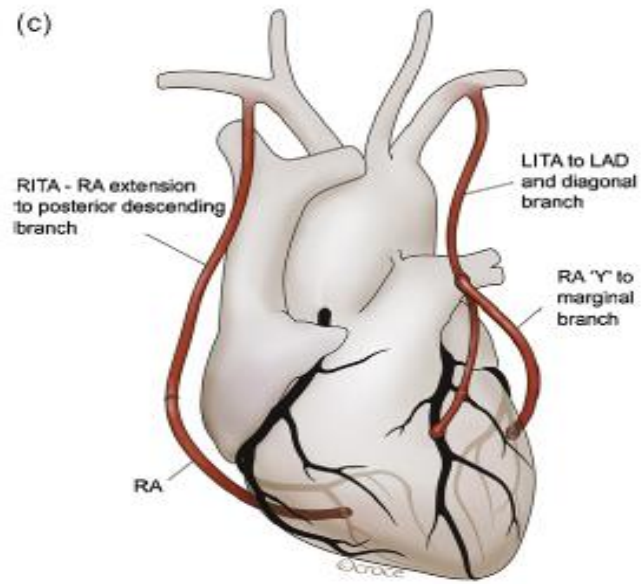
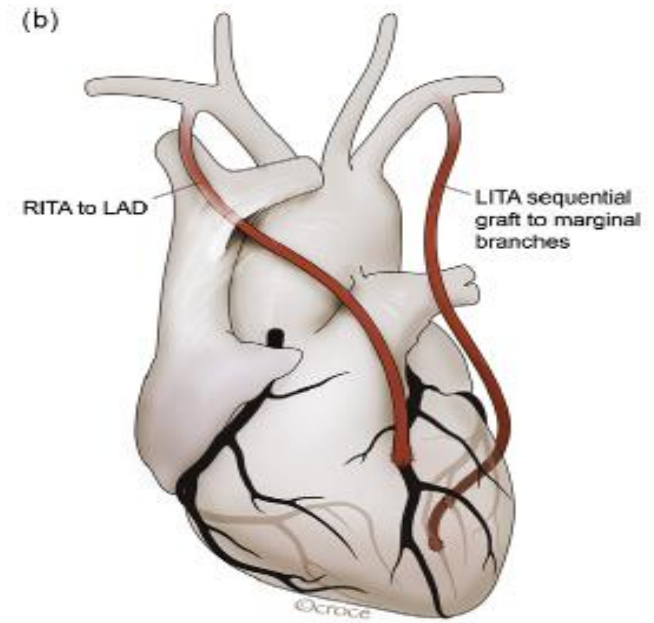
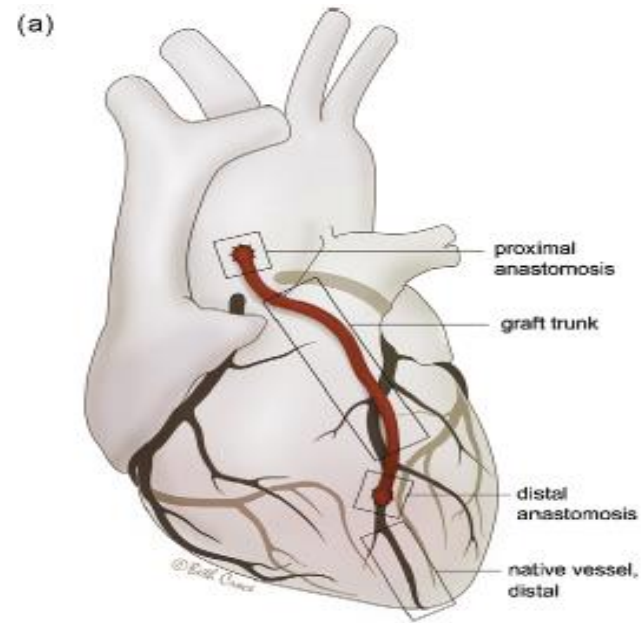
Years	0	2	4	6	8	10	12
— BITA	1976	1916	1871	1778	1530	1168	302
- - - SITA	8123	7690	7419	6180	5496	4869	2687





Arterial conduits used for coronary artery bypass grafting

- **Internal Thoracic Artery**
- **Radial Artery**
- Right Gastroepiploic Artery
- Inferior Epigastric Artery
- Others

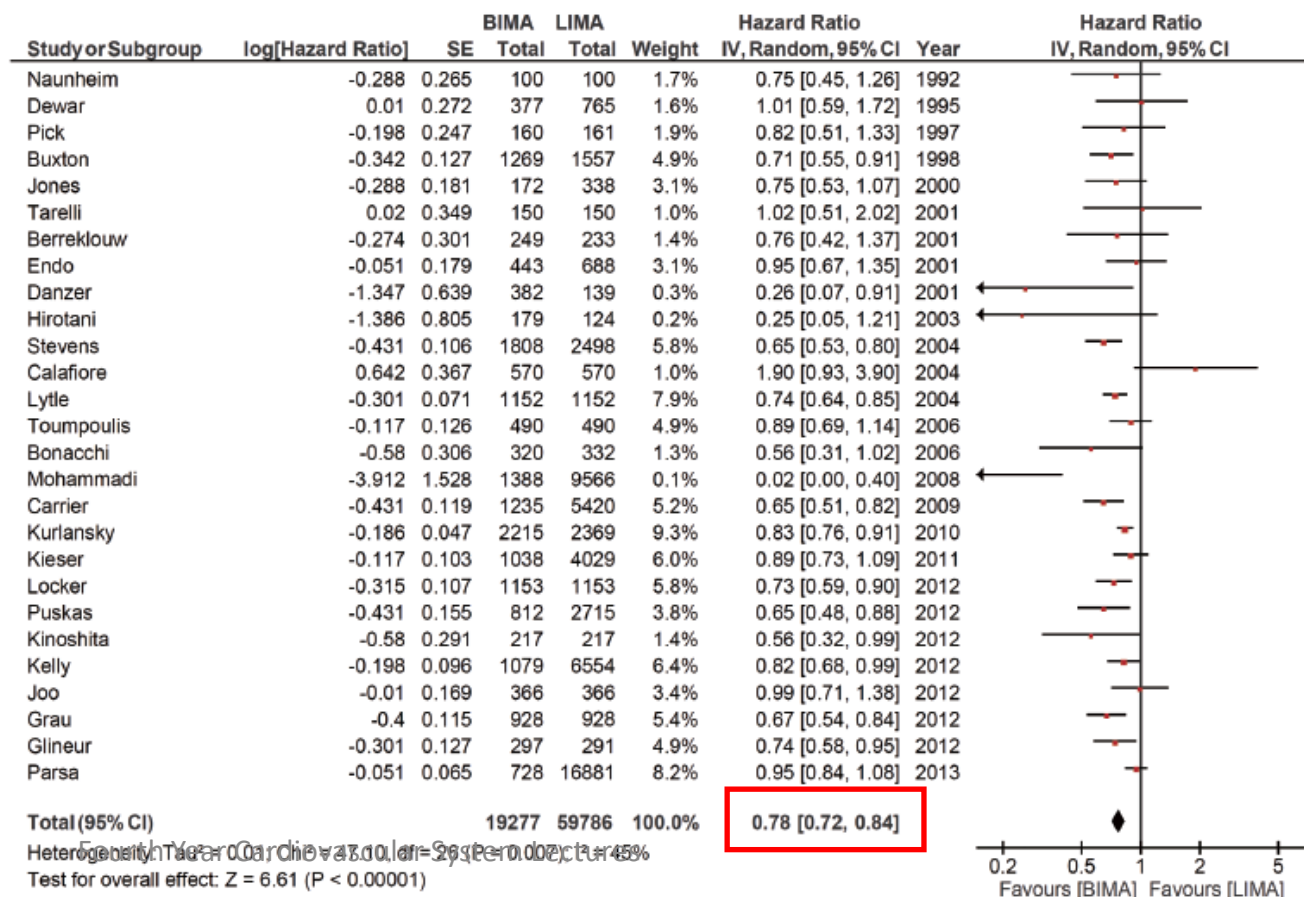


A meta-analysis comparing bilateral internal mammary artery with left internal mammary artery for coronary artery bypass grafting

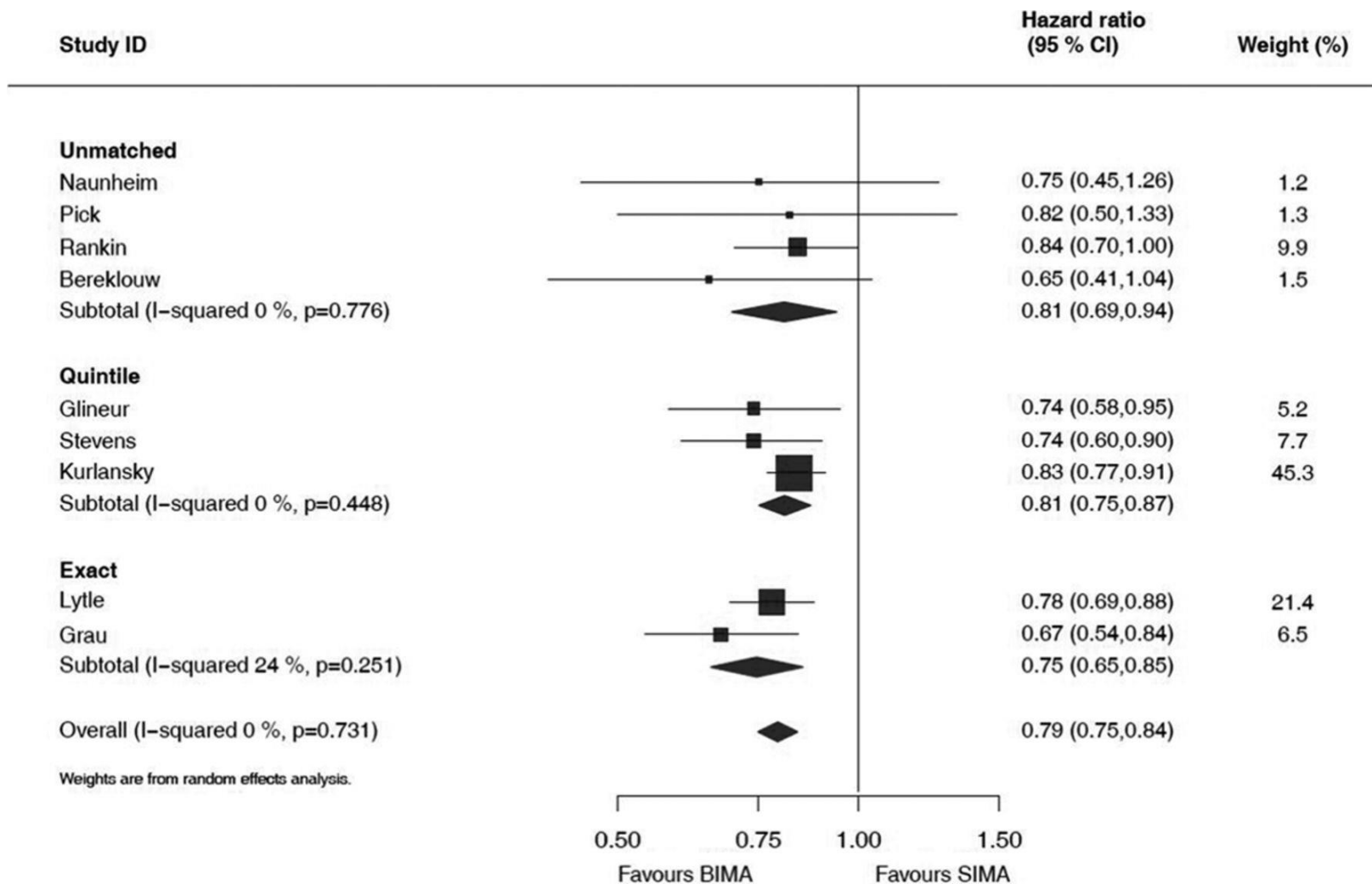
Aaron J. Weiss^{1,2}, Shan Zhao³, David H. Tian², David P. Taggart⁴, Tristan D. Yan^{2,5}

¹Department of Cardiothoracic Surgery, Mount Sinai School of Medicine, New York City, New York, USA; ²The Collaborative Research (CORE) Group, Sydney, Australia; ³Department of Pharmacology and Systems Therapeutics, Mount Sinai School of Medicine, New York City, New York, USA; ⁴Department of Cardiac Surgery, John Radcliffe Hospital, Oxford University Hospitals NHS Trust, Oxford, UK; ⁵Department of Cardiothoracic Surgery, Royal Prince Alfred Hospital, University of Sydney, Sydney, Australia

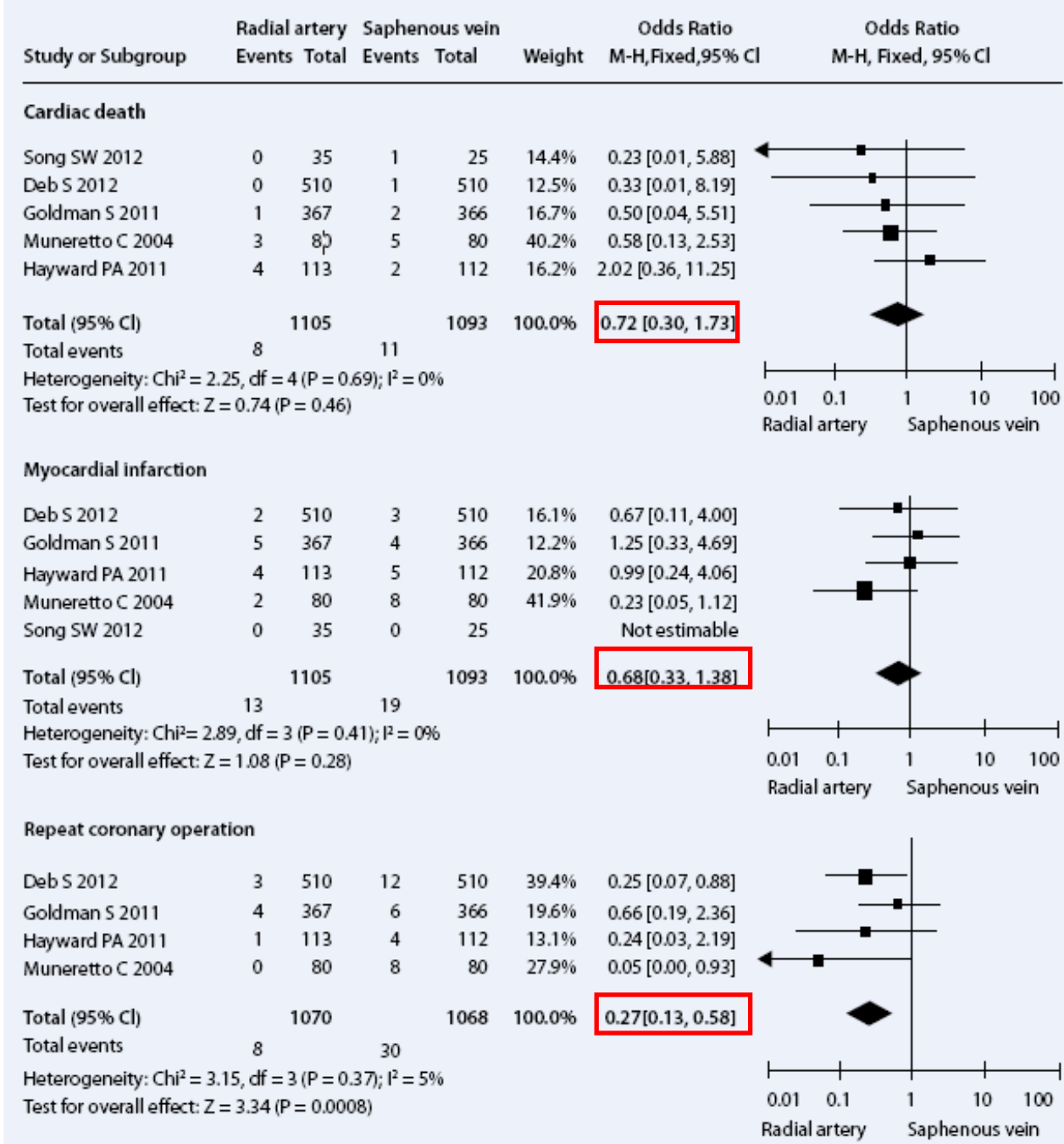
Corresponding to: Aaron J. Weiss, M.D. Department of Cardiothoracic Surgery, Mount Sinai Medical Center, 1190 Fifth Avenue Box 1029, New York, NY 10029, USA. Email: aaron.weiss@mountsinai.org.



Effects of bilateral internal mammary artery grafting on long-term survival.



Gijong Yi et al. *Circulation*. 2014;130:539-545



Comparison of radial artery versus saphenous vein for clinical outcomes

Saphenous Vein Graft Failure After Coronary Artery Bypass Surgery

Insights From PREVENT IV

Connie N. Hess, MD, MHS; Renato D. Lopes, MD, PhD; C. Michael Gibson, MD; Rebecca Hager, MR; Daniel M. Wojdyla, MSc; Brian R. Englum, MD; Michael J. Mack, MD; Robert M. Califf, MD; Nicholas T. Kouchoukos, MD; Eric D. Peterson, MD, MPH; John H. Alexander, MD, MHS

Background—Coronary artery bypass grafting success is limited by vein graft failure (VGF). Understanding the factors associated with VGF may improve patient outcomes.

Methods and Results—We examined 1828 participants in the Project of Ex Vivo Vein Graft Engineering via Transfection IV (PREVENT IV) trial undergoing protocol-mandated follow-up angiography 12 to 18 months post-coronary artery bypass grafting or earlier clinically driven angiography. Outcomes included patient- and graft-level angiographic VGF ($\geq 75\%$ stenosis or occlusion). Variables were selected by using Fast False Selection Rate methodology. We examined relationships between variables and VGF in patient- and graft-level models by using logistic regression without and with generalized estimating equations. At 12 to 18 months post-coronary artery bypass grafting, 782 of 1828 (42.8%) patients had VGF, and 1096 of 4343 (25.2%) vein grafts had failed. Demographic and clinical characteristics were similar between patients with and without VGF, although VGF patients had longer surgical times, worse target artery quality, longer graft length, and they more frequently underwent endoscopic vein harvesting. After multivariable adjustment, longer surgical duration (odds ratio per 10-minute increase, 1.05; 95% confidence interval, 1.03–1.07), endoscopic vein harvesting (odds ratio, 1.41; 95% confidence interval, 1.16–1.71), poor target artery quality (odds ratio, 1.43; 95% confidence interval, 1.11–1.84), and postoperative use of clopidogrel or ticlopidine (odds ratio, 1.35; 95% confidence interval, 1.07–1.69) were associated with patient-level VGF. The predicted likelihood of VGF in the graft-level model ranged from 12.1% to 63.6%.

Conclusions—VGF is common and associated with patient and surgical factors. These findings may help identify patients with risk factors for VGF and inform the development of interventions to reduce VGF.

Clinical Trial Registration—URL: <http://www.clinicaltrials.gov>. Unique identifier: NCT00042081.

(*Circulation*. 2014;130:1445-1451.)

Prevalence and Variability of Internal Mammary Artery Graft Use in Contemporary Multivessel Coronary Artery Bypass Graft Surgery

Analysis of the Society of Thoracic Surgeons National Cardiac Database

Minoru Tabata, MD, MPH; Joshua D. Grab, MS; Zain Khalpey, MD, PhD; Sean M. O'Brien, PhD; Lawrence H. Cohn, MD; R. M. ...

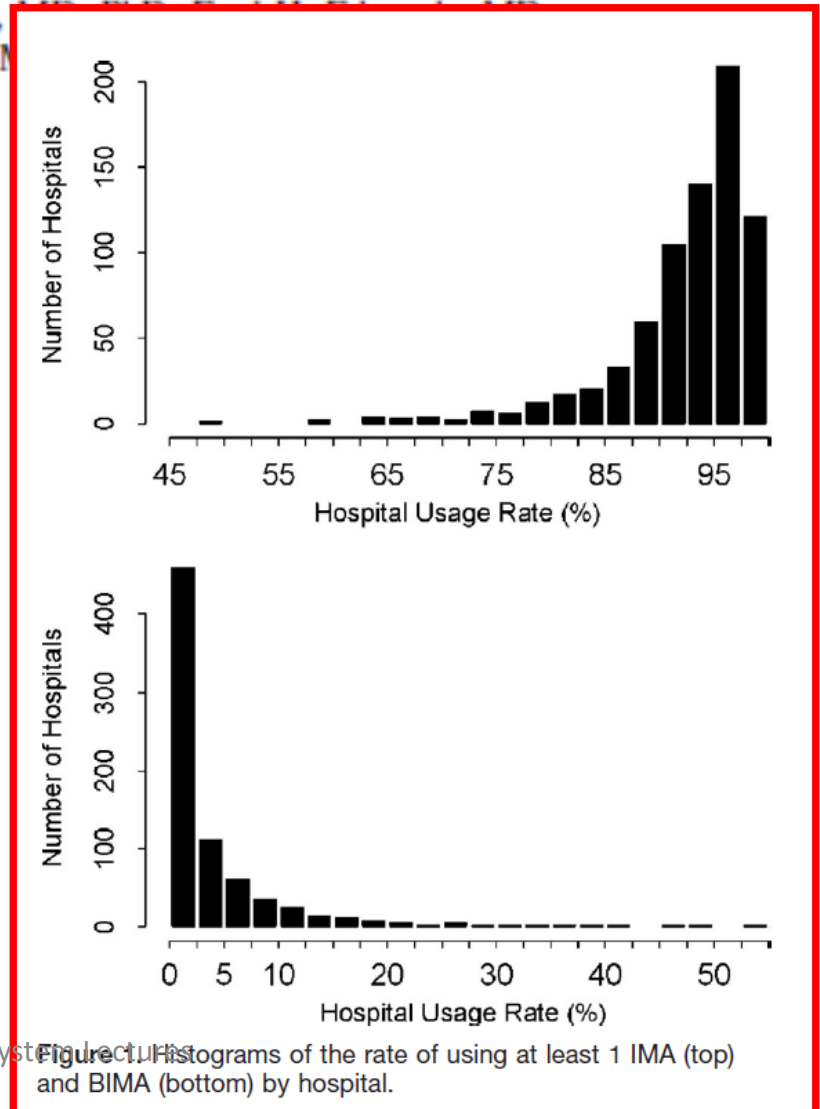
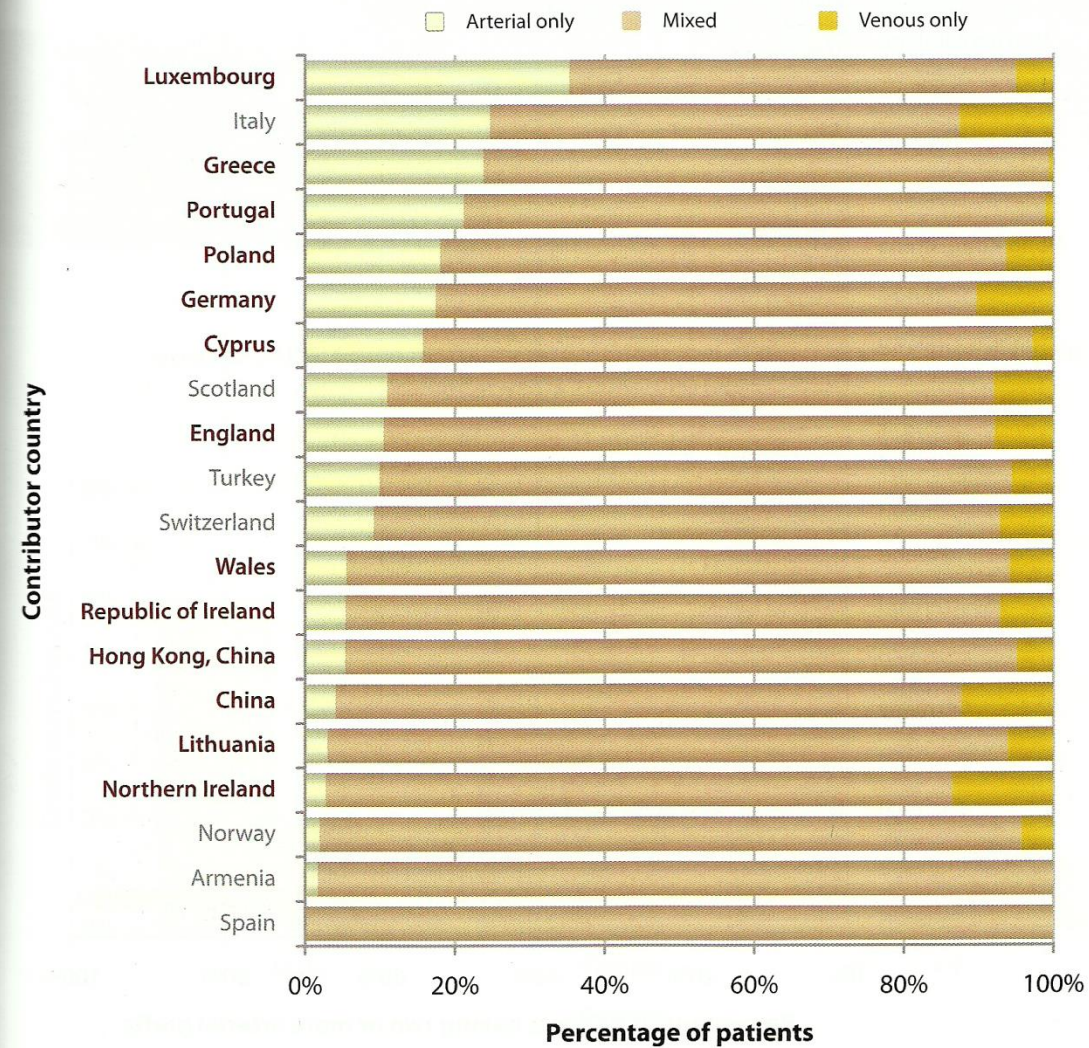


Figure 1. Histograms of the rate of using at least 1 IMA (top) and BIMA (bottom) by hospital.

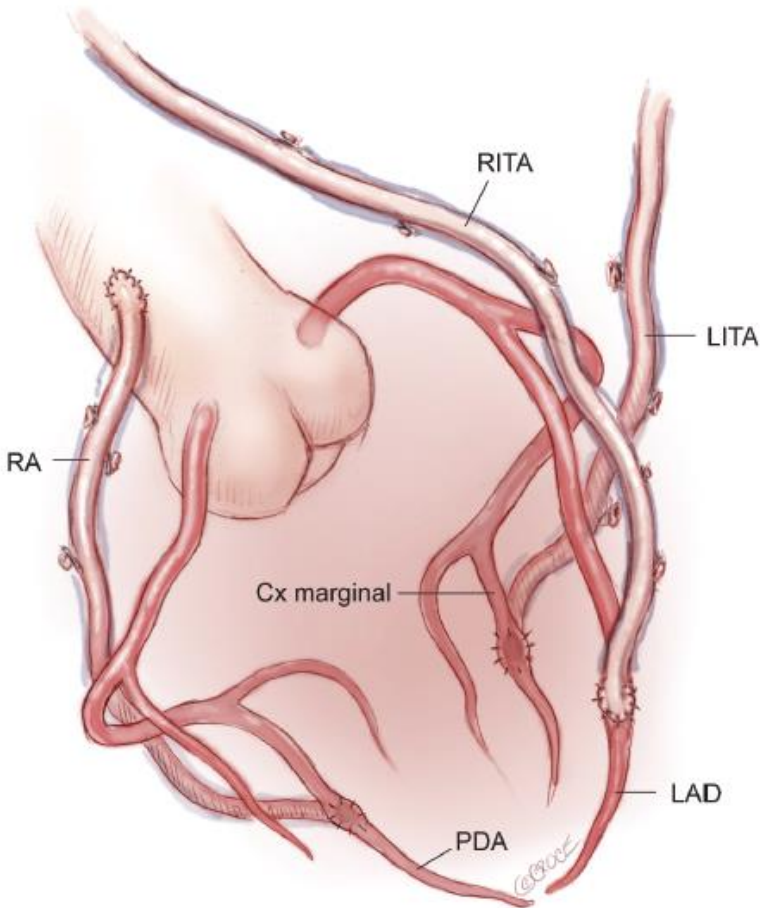
**Isolated CABG: Grafts used;
calendar years 2006-2008 (n=204,288)**

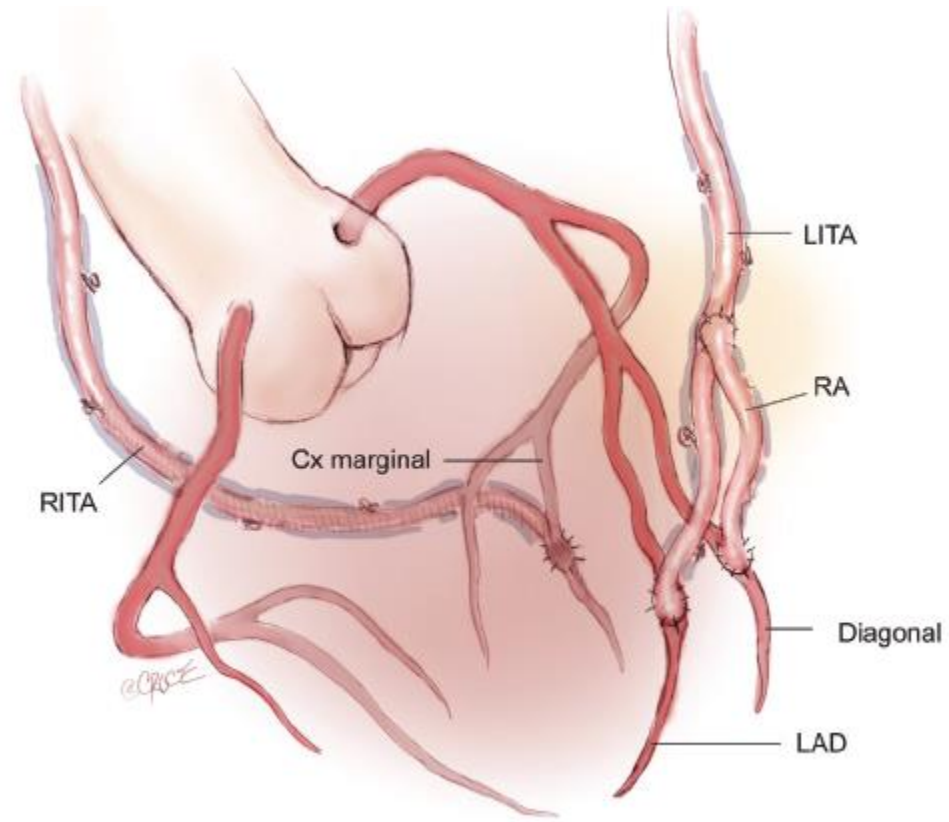


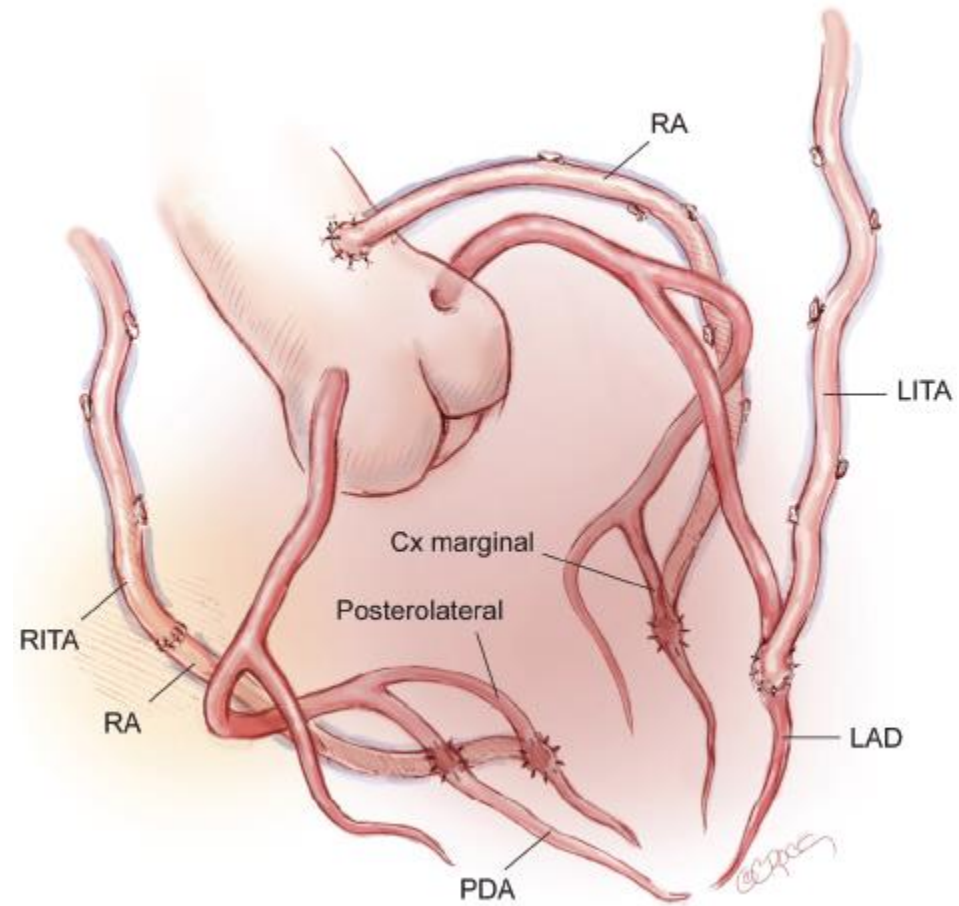
- Indication For Surgery
- Preoperative Evaluation
- Conduits decision
- Operation Decision
- ERAS

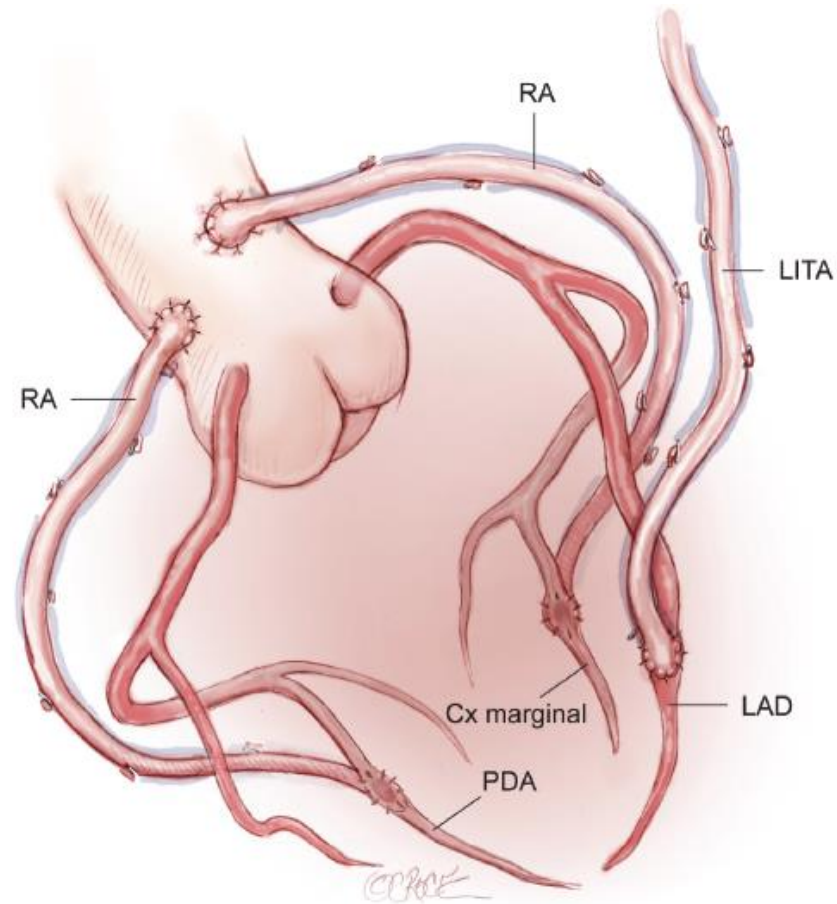
- Conduits combination
- ON Pump Vs OFF Pump

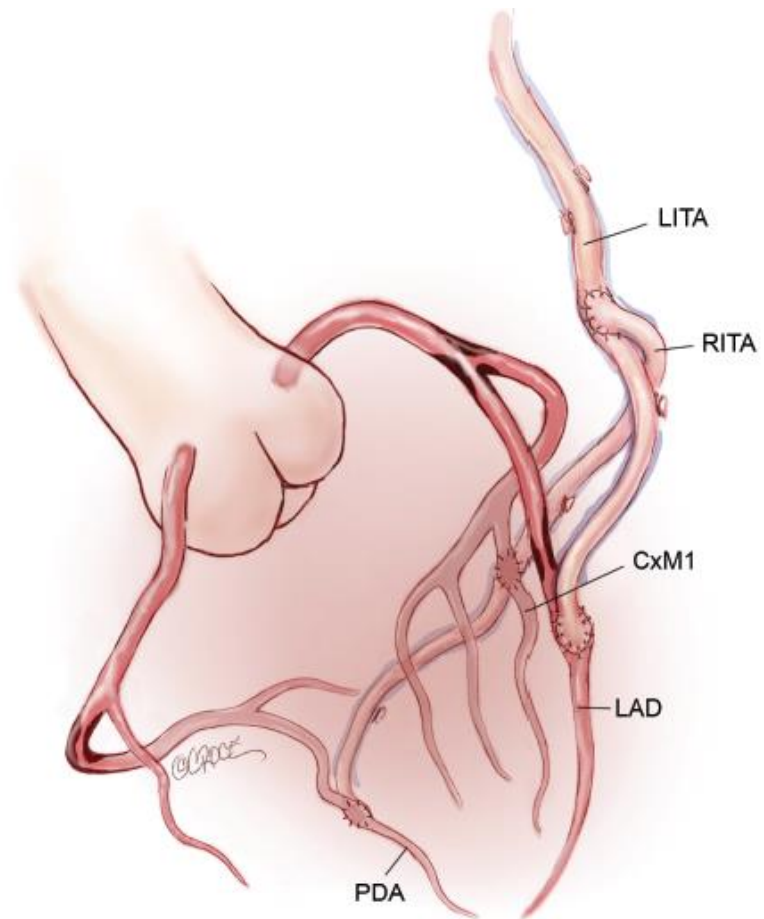
Total arterial revascularization

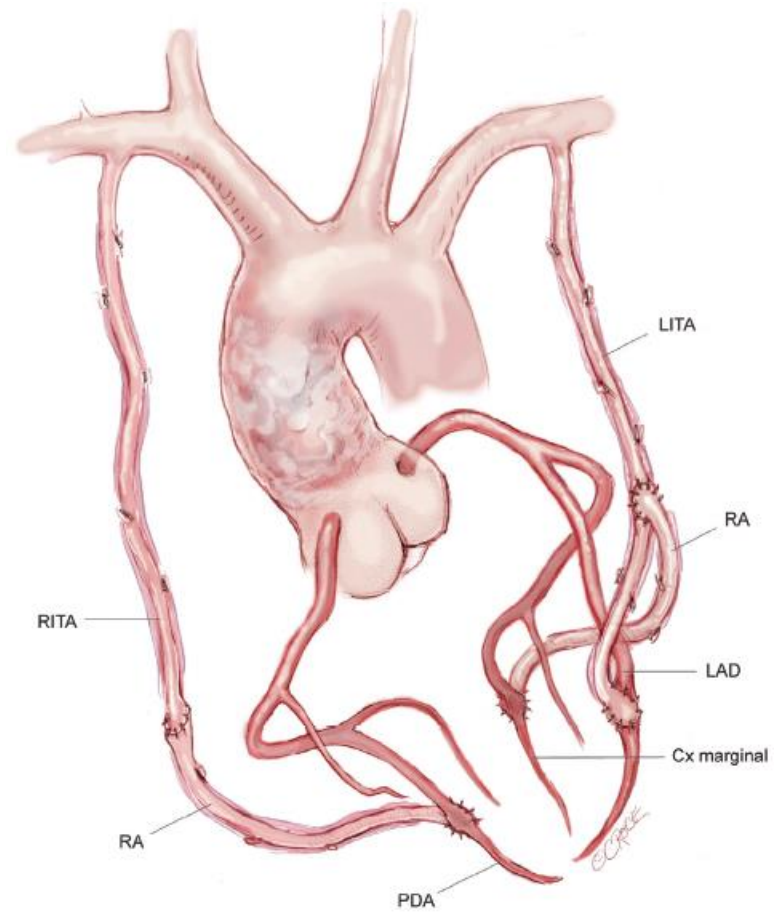




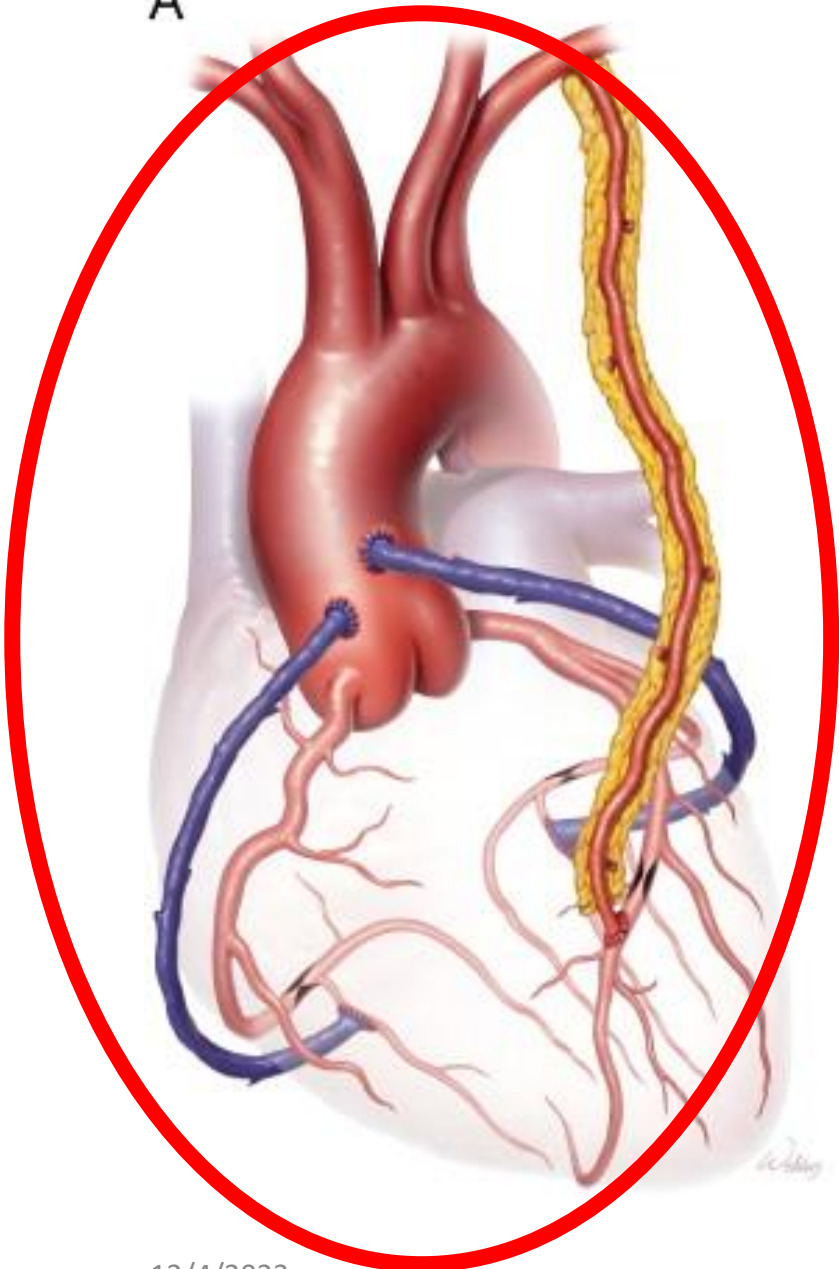




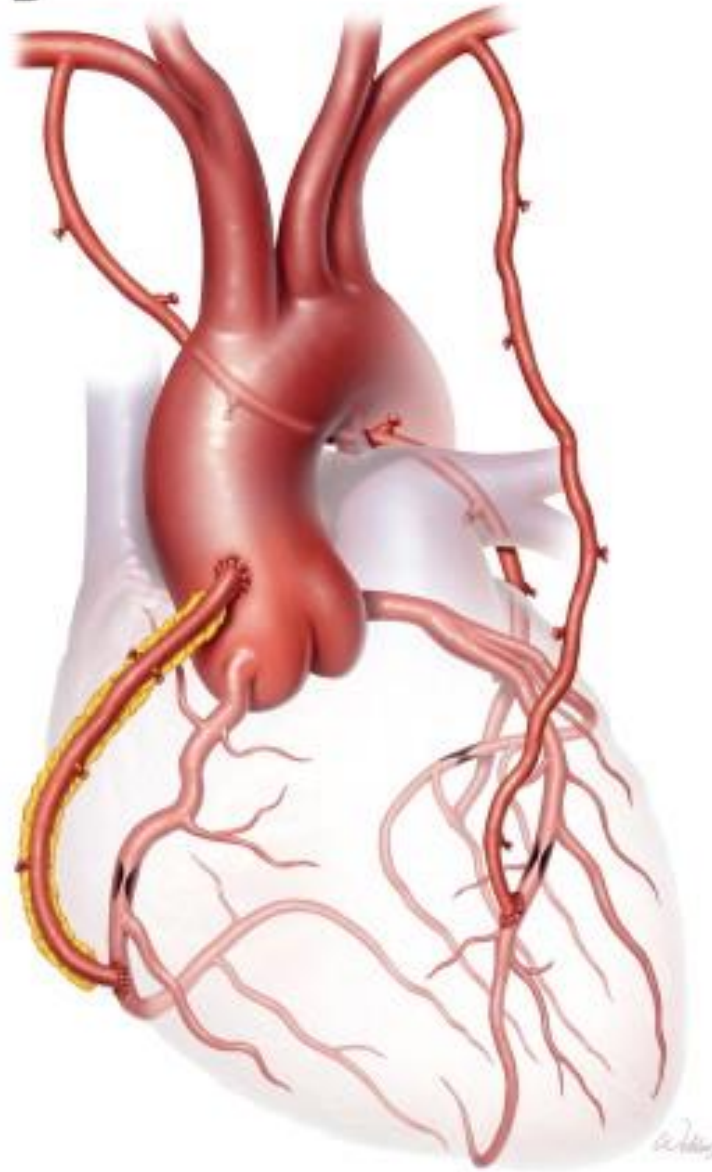




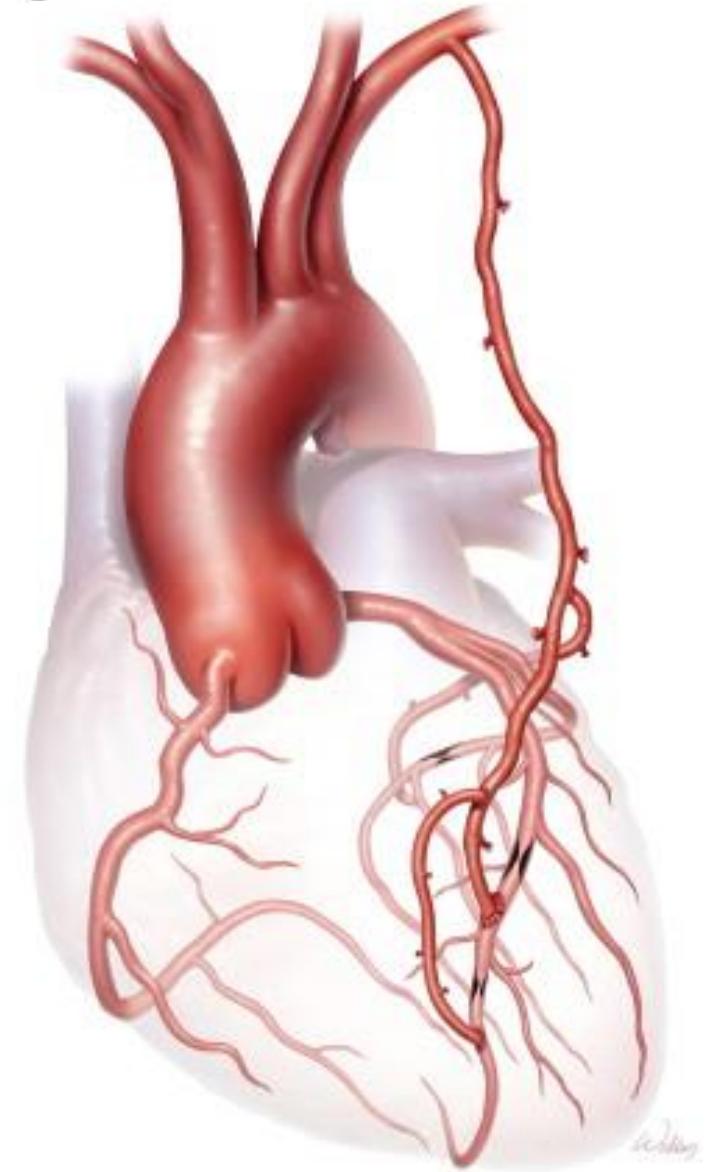
A



B

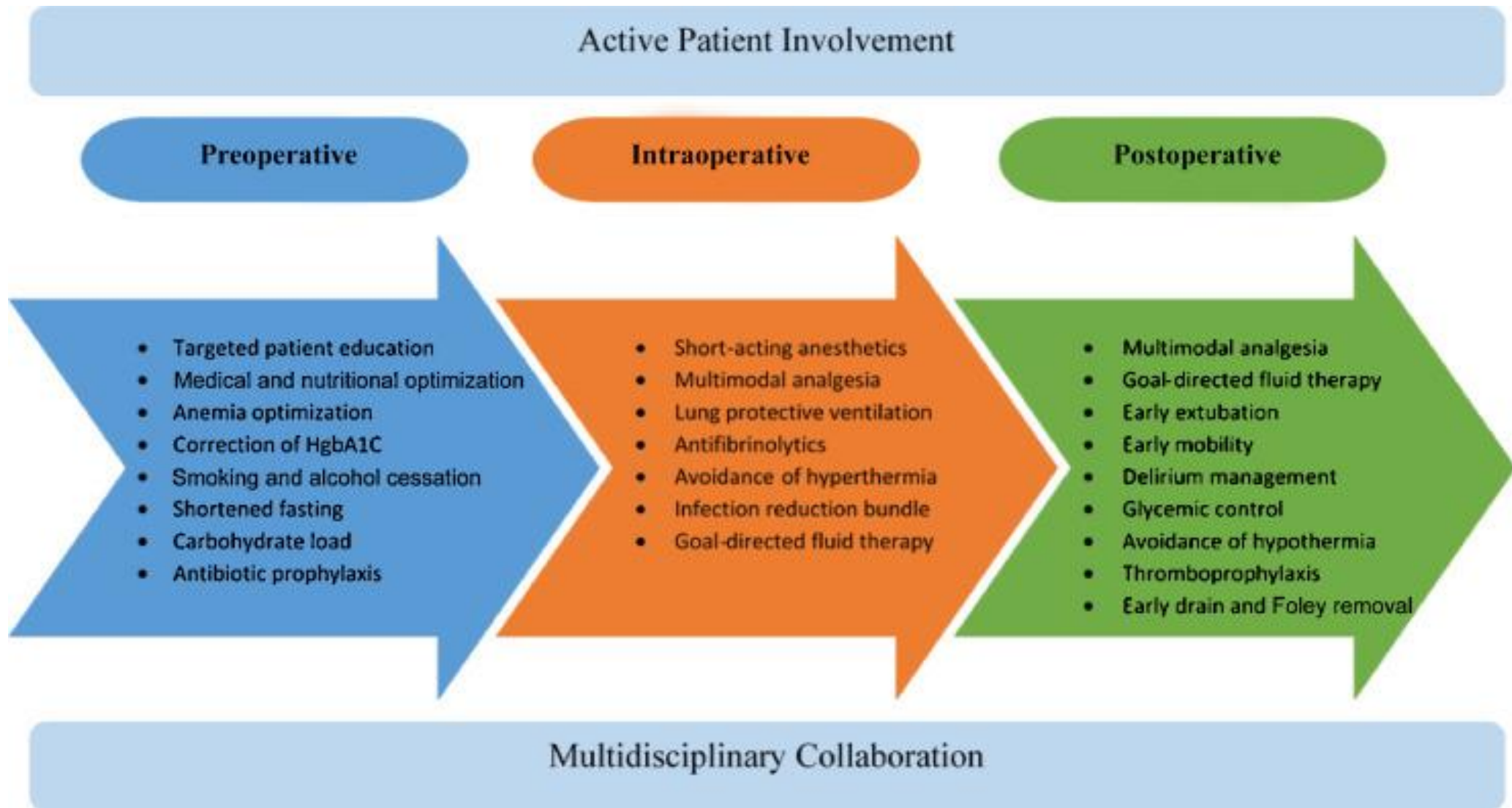


C



Management

- Indication For Surgery
- Preoperative Evaluation
- Conduits decision
- Operation Decision
- ERAS



ERAS CARDIAC PERIOPERATIVE COMPONENTS

1. Preop Education
 2. Prehabilitation
 3. Smoking and Alcohol Cessation
 4. Nutrition Optimization
- DAY OF SURGERY**
5. NPO After Midnight
 6. Carbohydrate Clear Drink 2-4 Hours Preop
 7. Multimodal Analgesia Initiation

1 PREOPERATIVE COMPONENTS



2 INTRAOPERATIVE COMPONENTS

8. Short-acting Anesthetics
9. Continue Multimodal Analgesia
10. Minimize Crystalloid
11. **NO BUGS** Normothermia ($T > 36^{\circ}\text{C}$) • Oxygenation ($\text{FiO}_2 > 0.8$) • anti-Biotic drug/dose(s)/timing
Underventilation ($\text{ETCO}_2 > 38$) • Glycemic control ($\text{Glc} < 180\text{mg/dL}$) • Skin prep (CHG)/no Shaving
12. PONV Prophylaxis Initiated
13. Postop Sedation Started



14. Continue Multimodal Analgesia
15. Early Extubation
16. Continue PONV Prophylaxis
17. Diet/Bowel Regimen
18. Early Ambulation
19. Line/Drain Removal
20. Priority Discharge

3 POSTOPERATIVE COMPONENTS



Heart Care Plus⁺

A WAKEMED + DUKE HEALTH COLLABORATION

WakeMed Duke Health

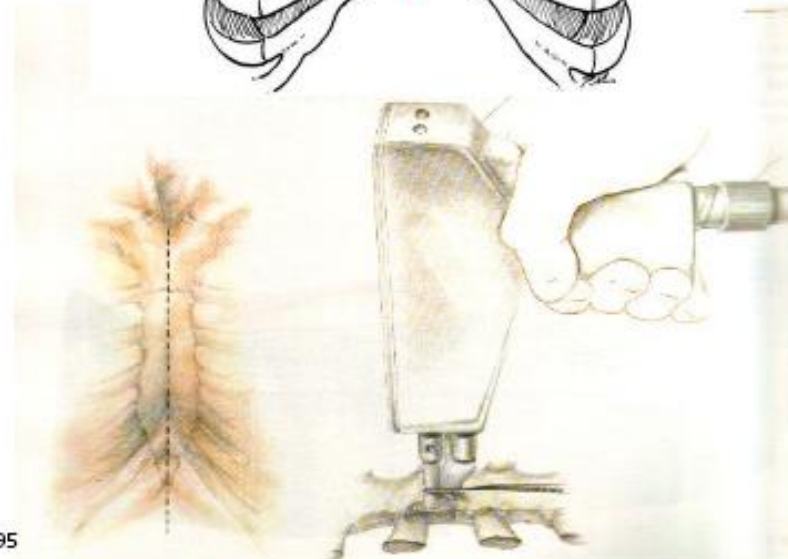
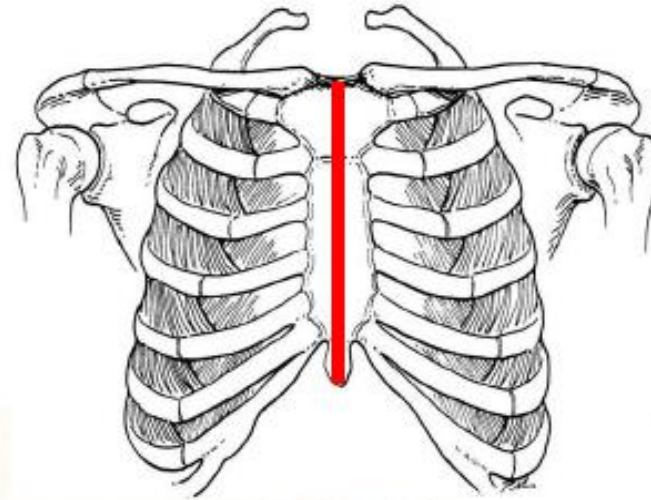
FIGURE 1. Graphic displaying the key components of the ERAS Cardiac protocol through each phase of perioperative care. CHG, Chlorhexidine gluco-

INTRODUCTION

- HISTORY OF CARDIAC SURGERY
- CORONARY ARTERY ANATOMY
- MANAGEMENT
- **SURGICAL TECHNIQUES**

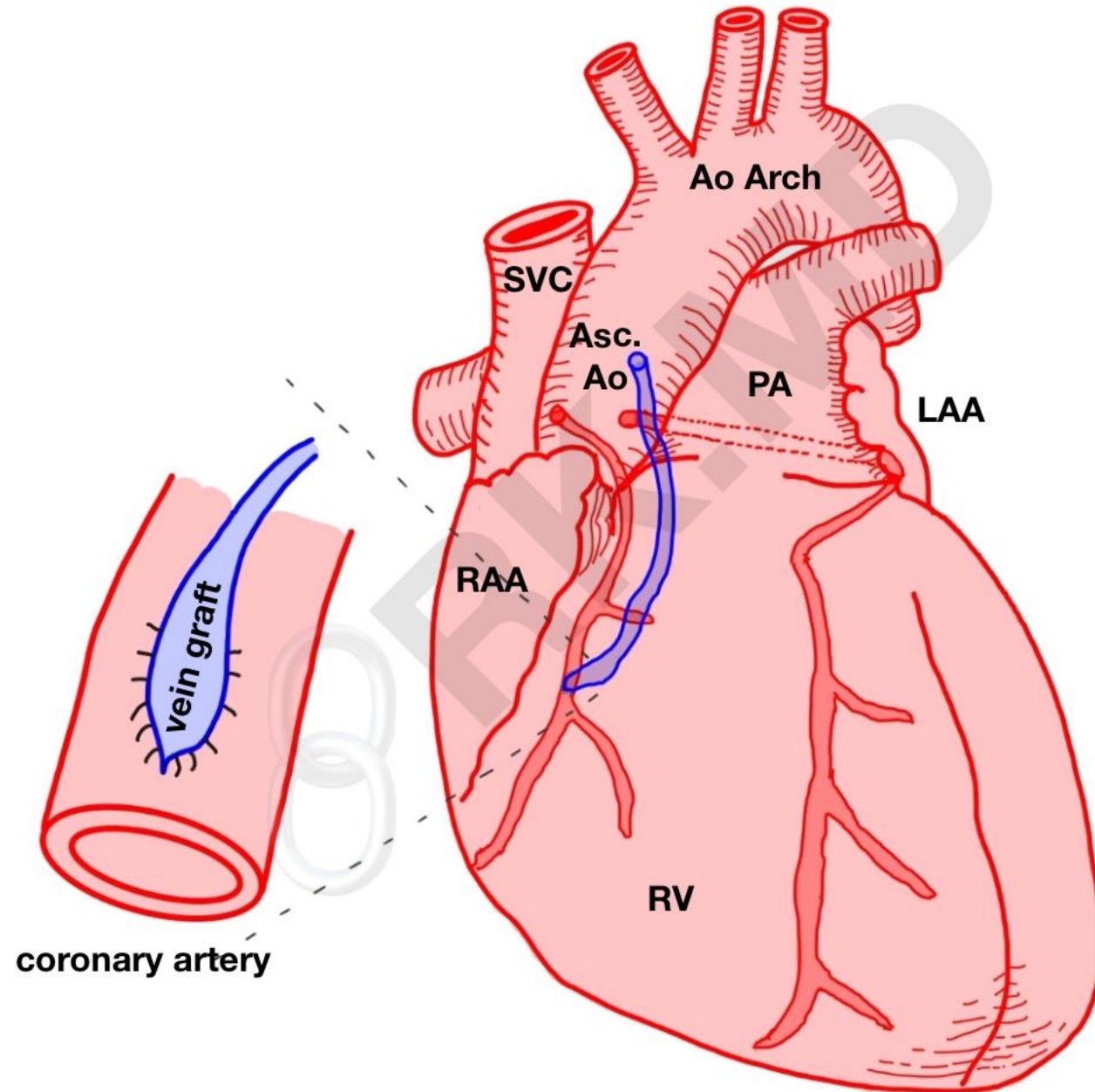
Sternotomy

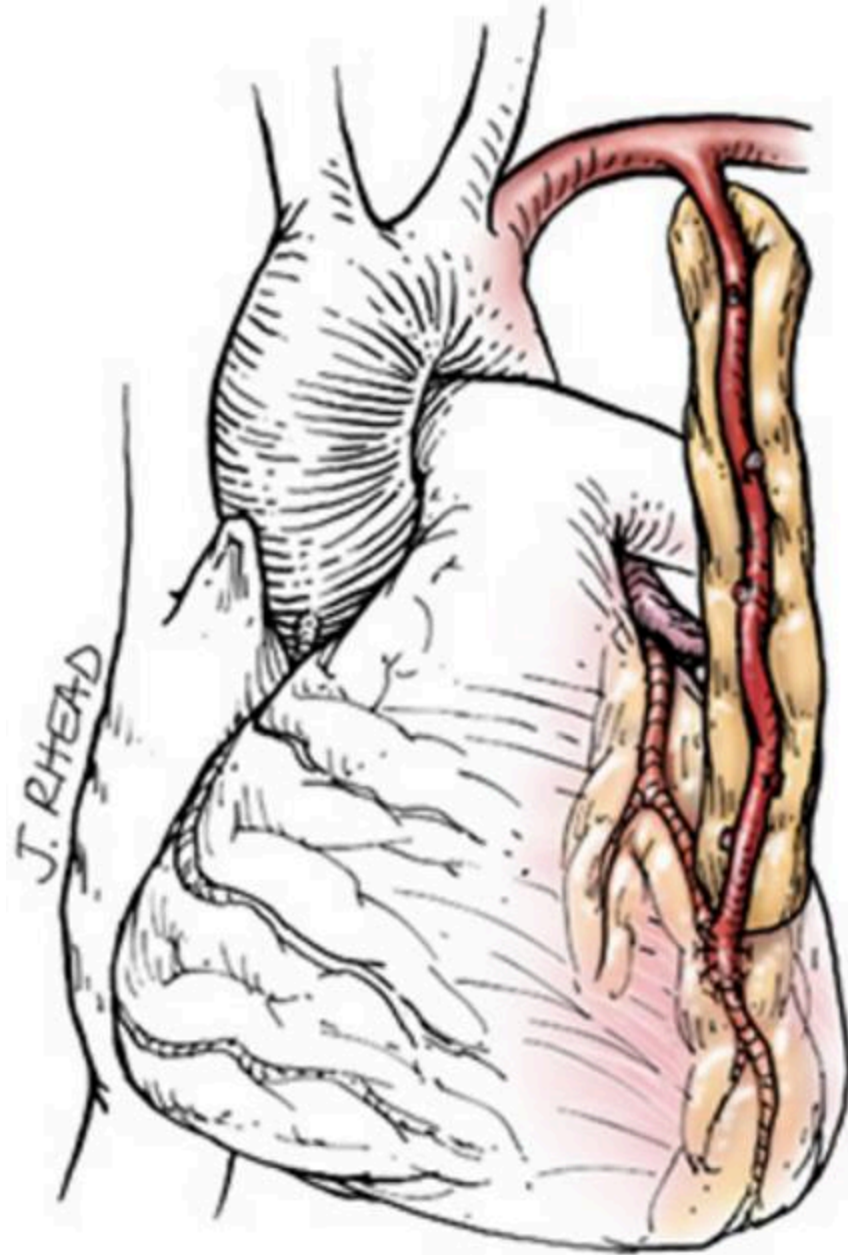
- Sternotomy approach
 - allows almost all cardiac procedures
 - best overall access to the heart
- The sternum is divided with a saw



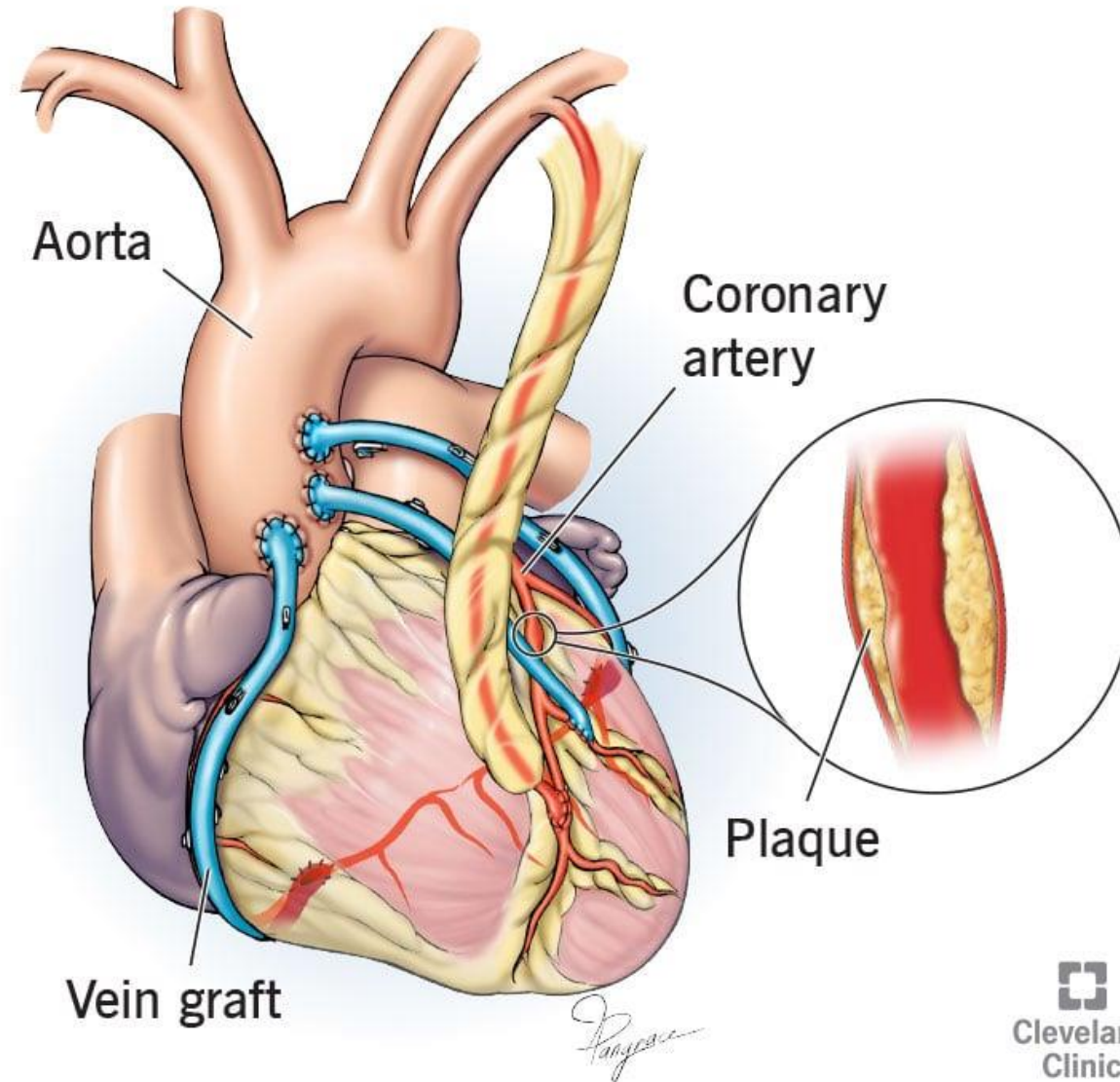
From : Manual of Cardiac Surgery, Harlan & Starr, Springer-Verlag, New York , 1995

CORONARY ARTERY BYPASS





Coronary artery bypass grafting (CABG)



[click here to watch the video](#)



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Fourth Year Cardiovascular System Lectures

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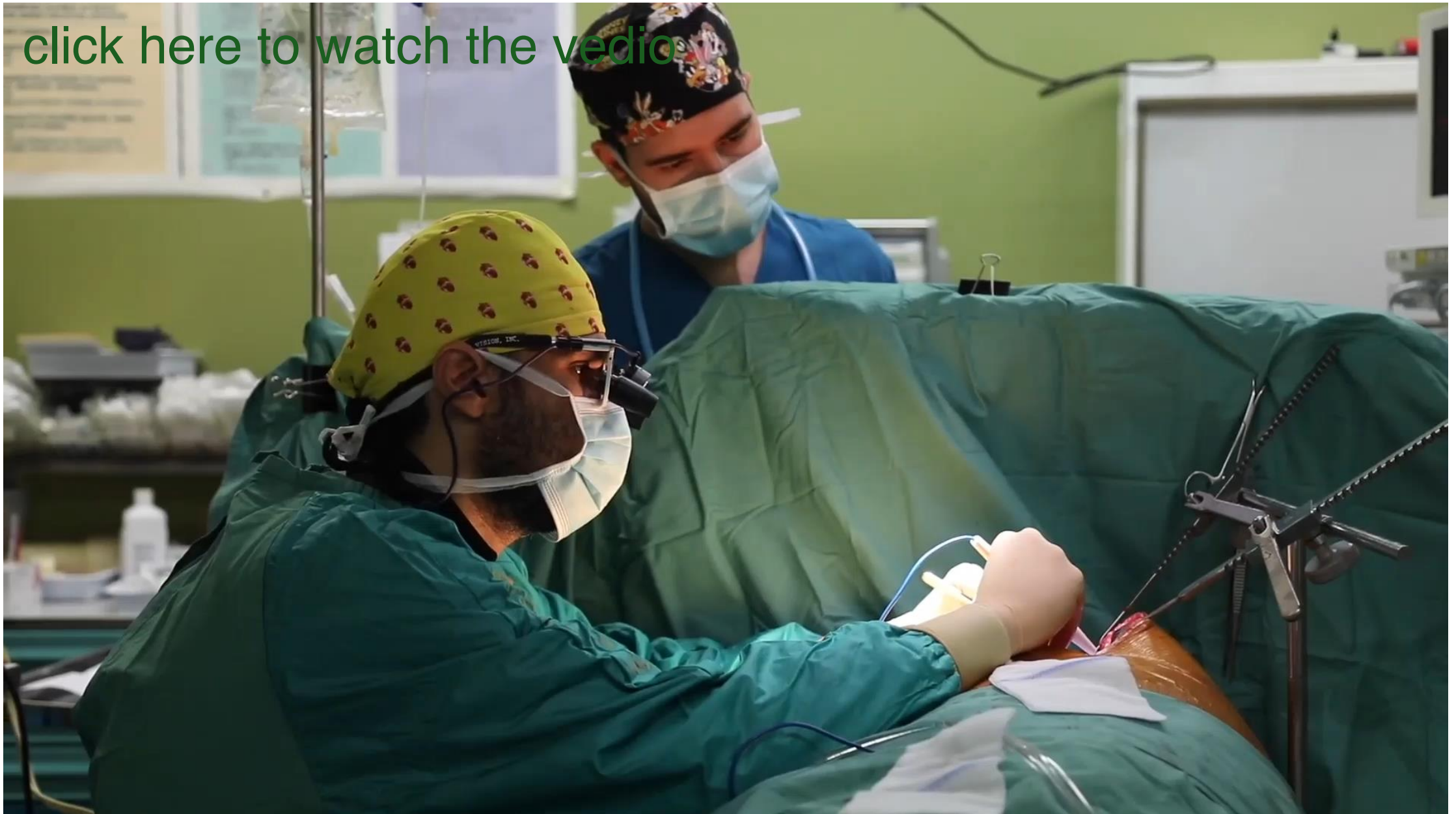


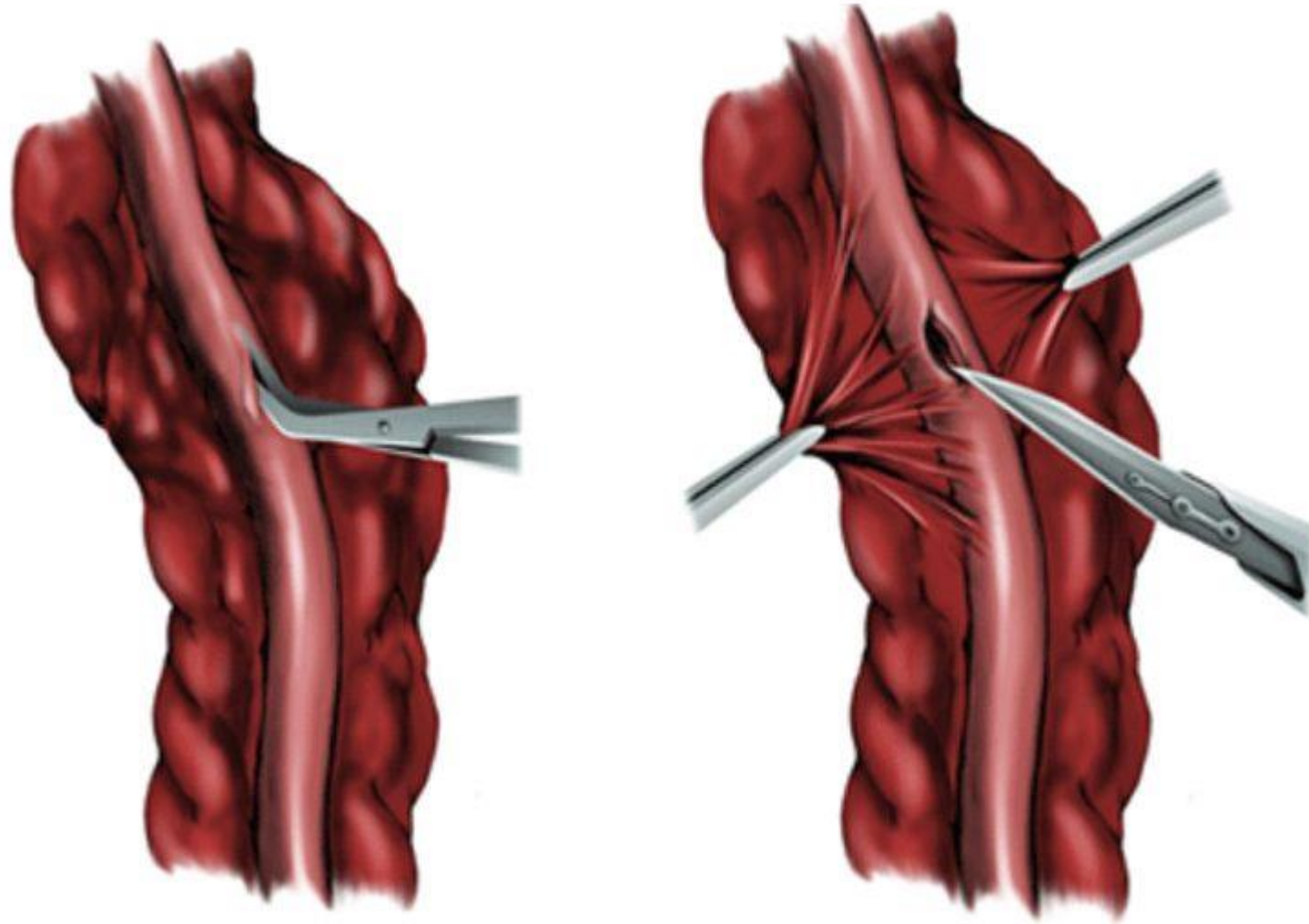
Thymotomy

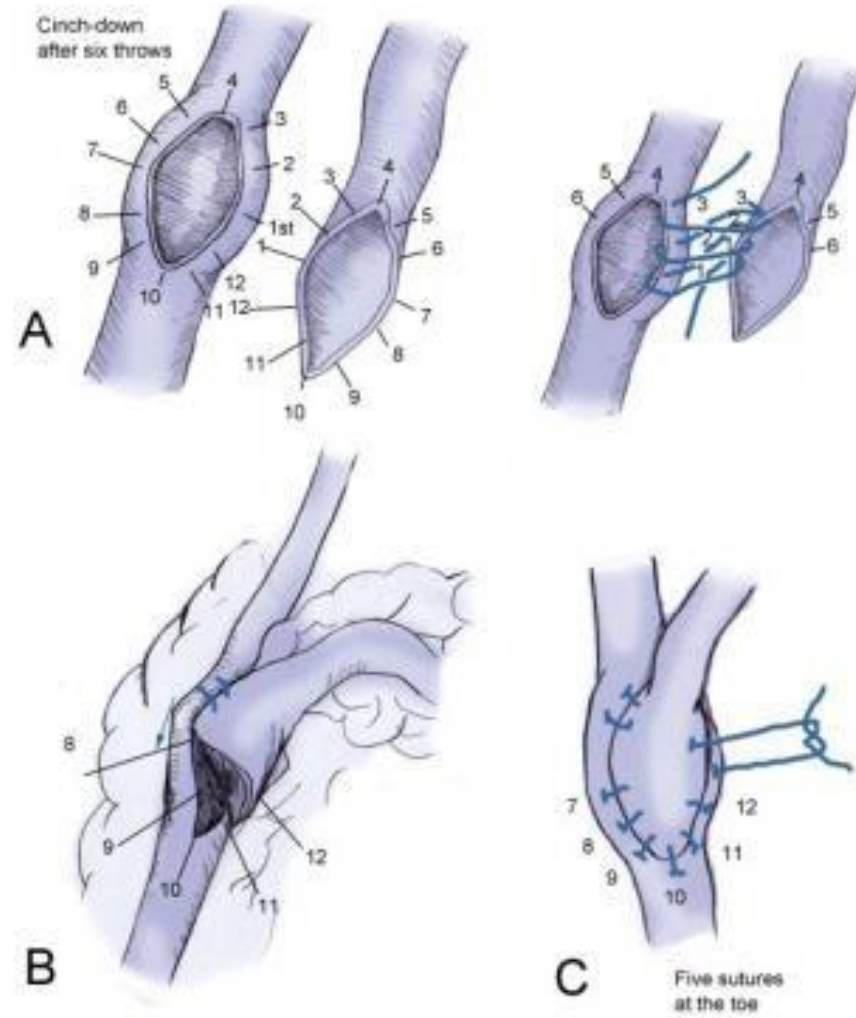
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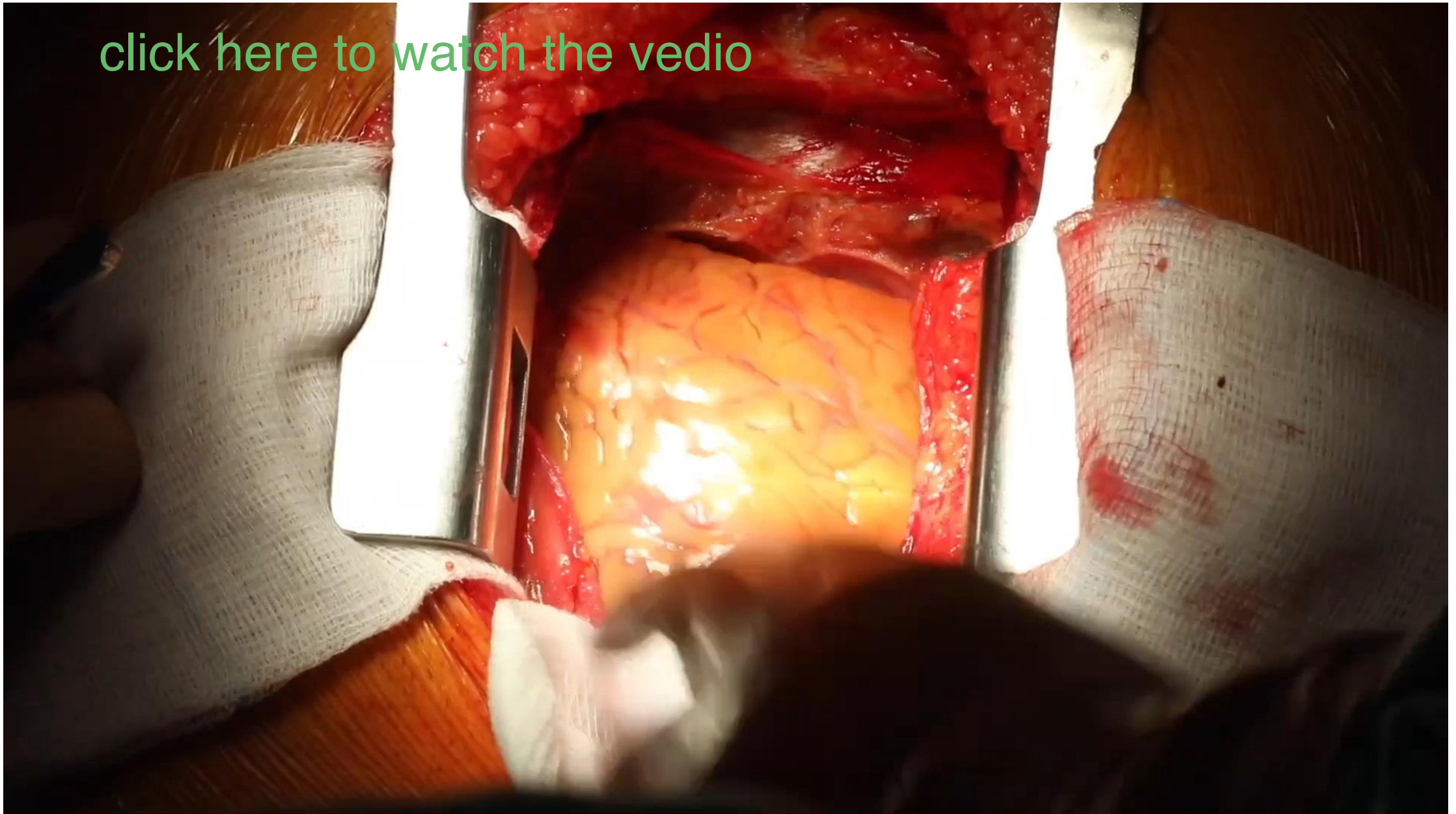
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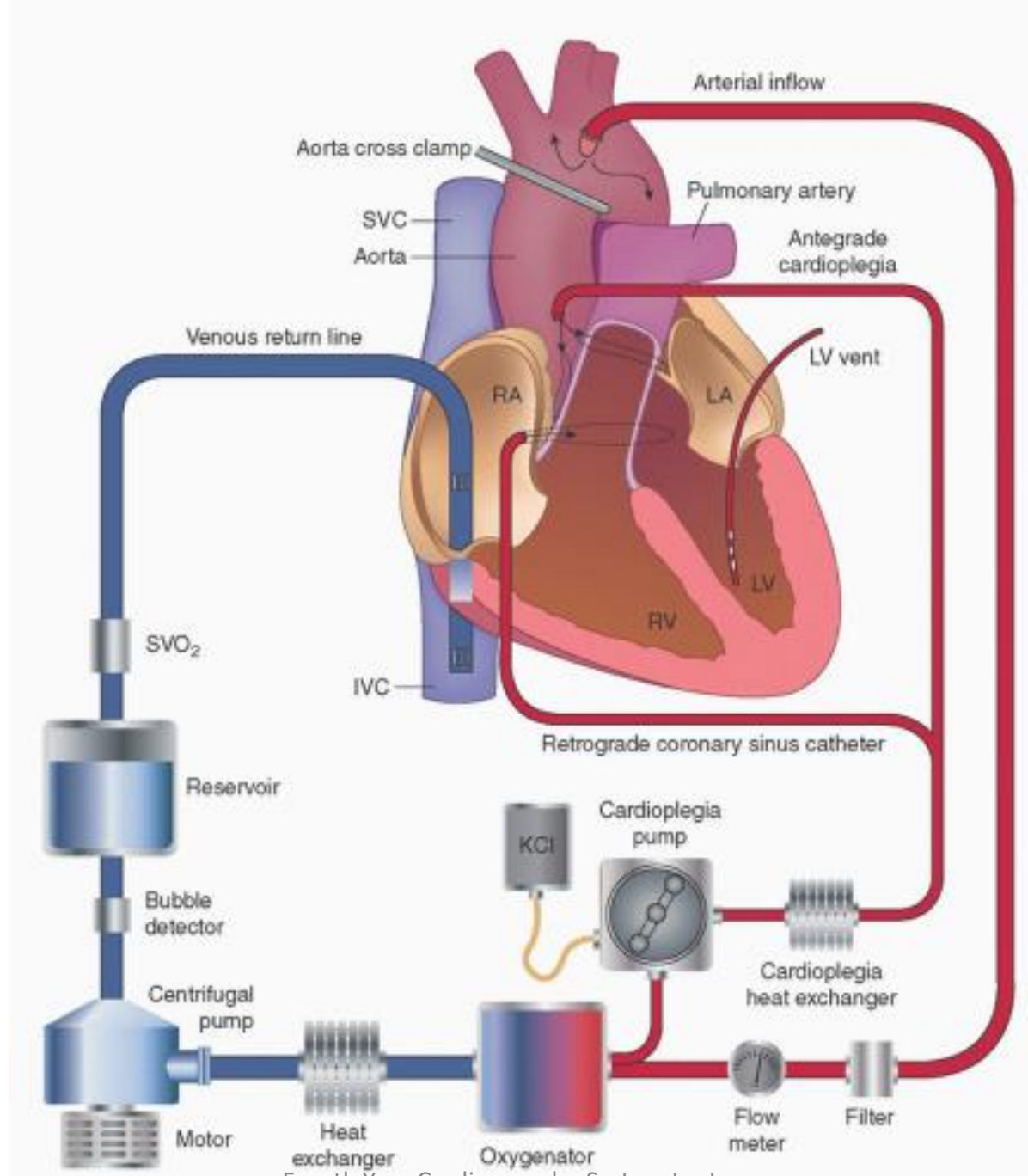


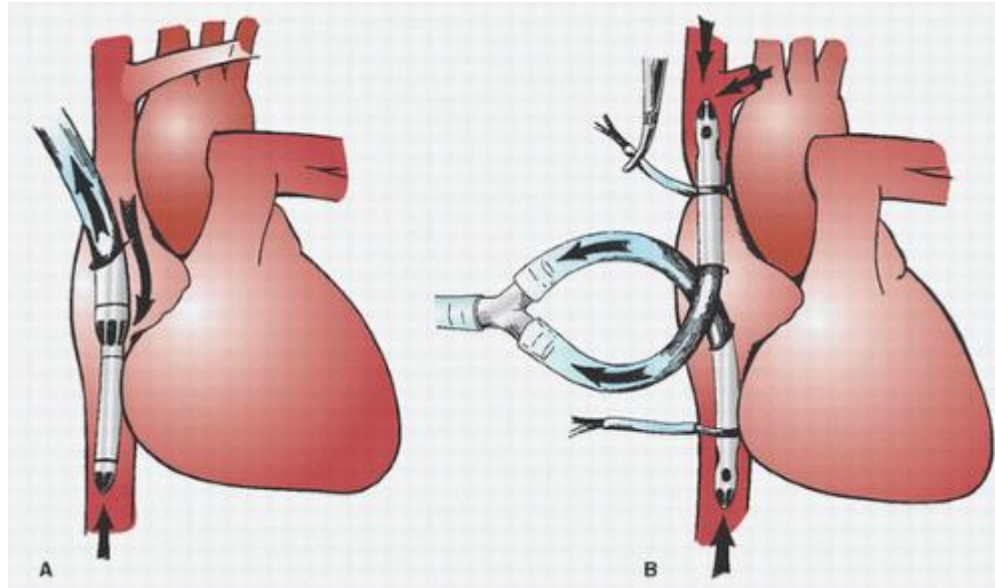
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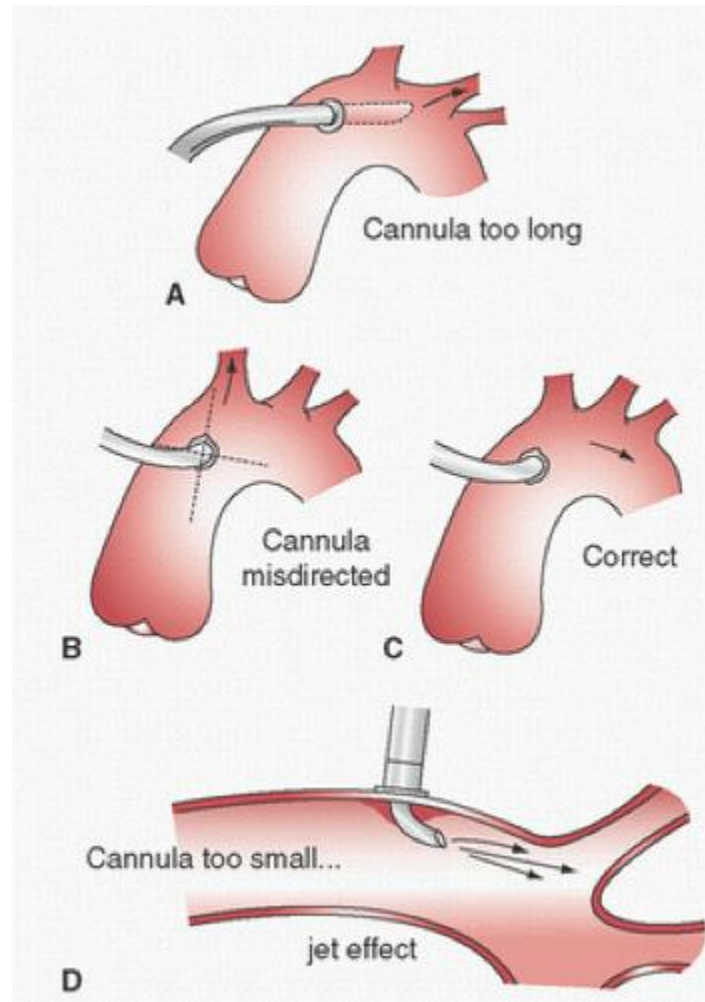


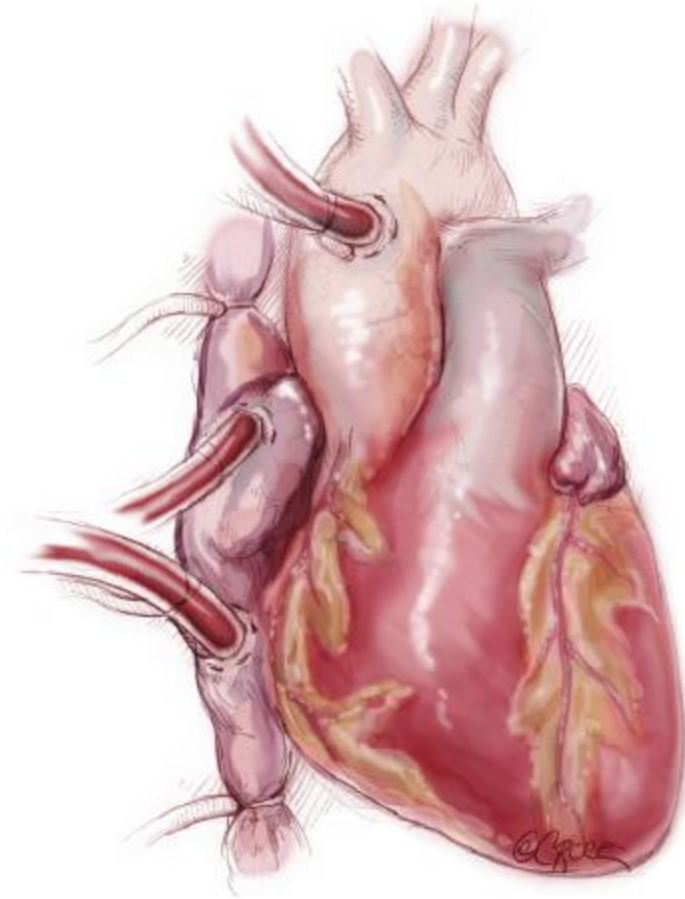
Heart Lung Machine

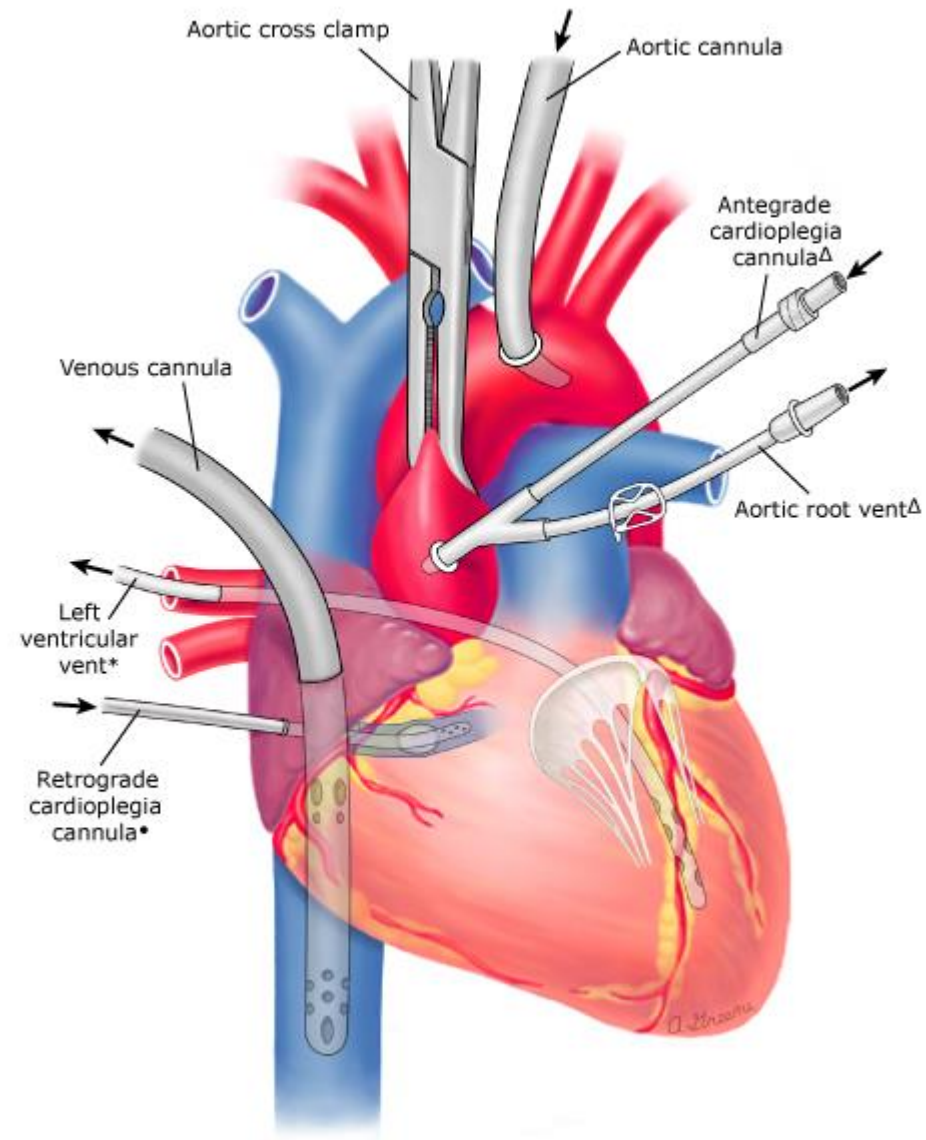












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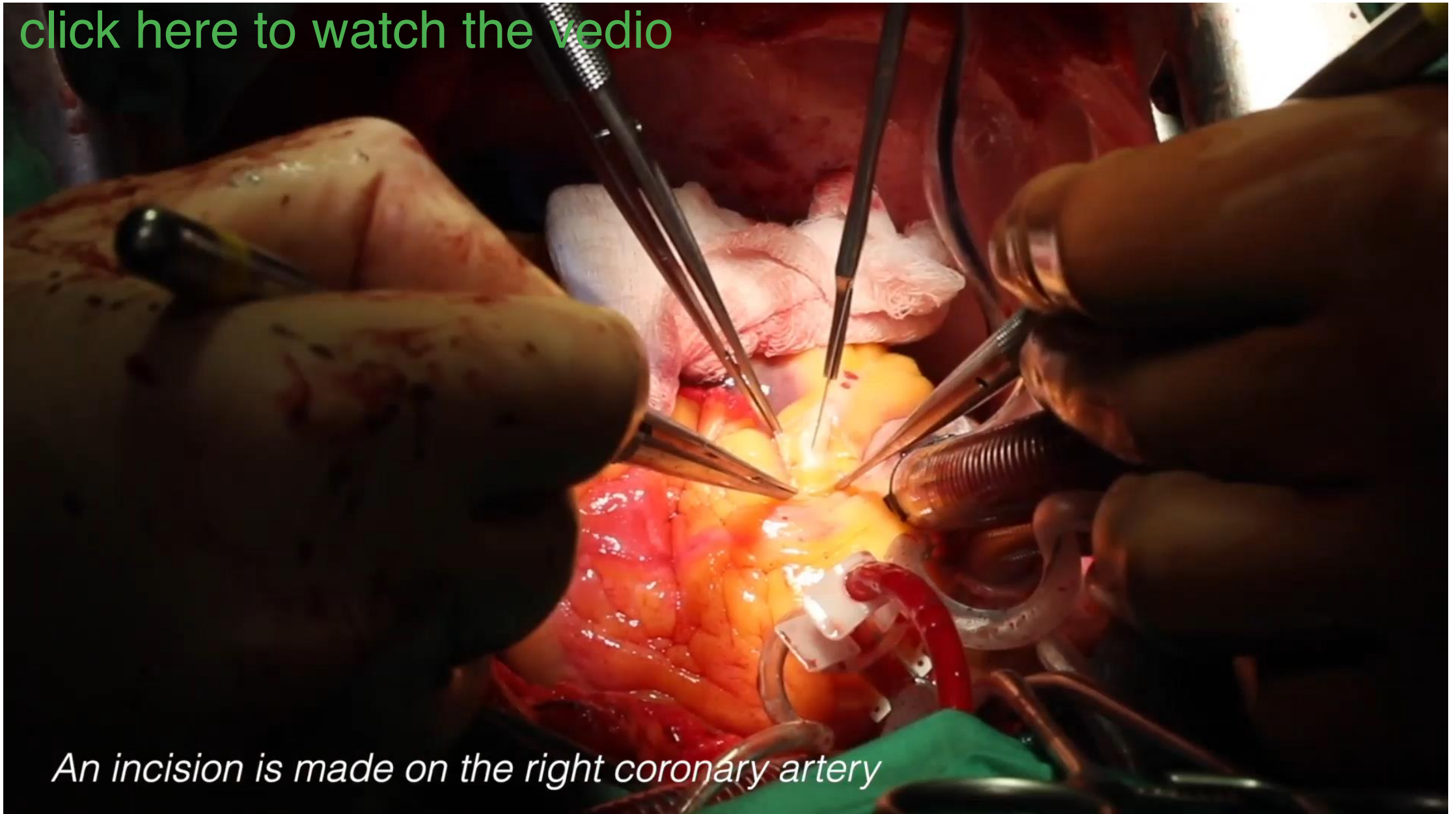
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Cardioplegia is administered

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An incision is made on the right coronary artery

Off-Pump Coronary Artery Bypass (OPCAB)

Use of Cardiopulmonary Bypass in Patients Undergoing CABG

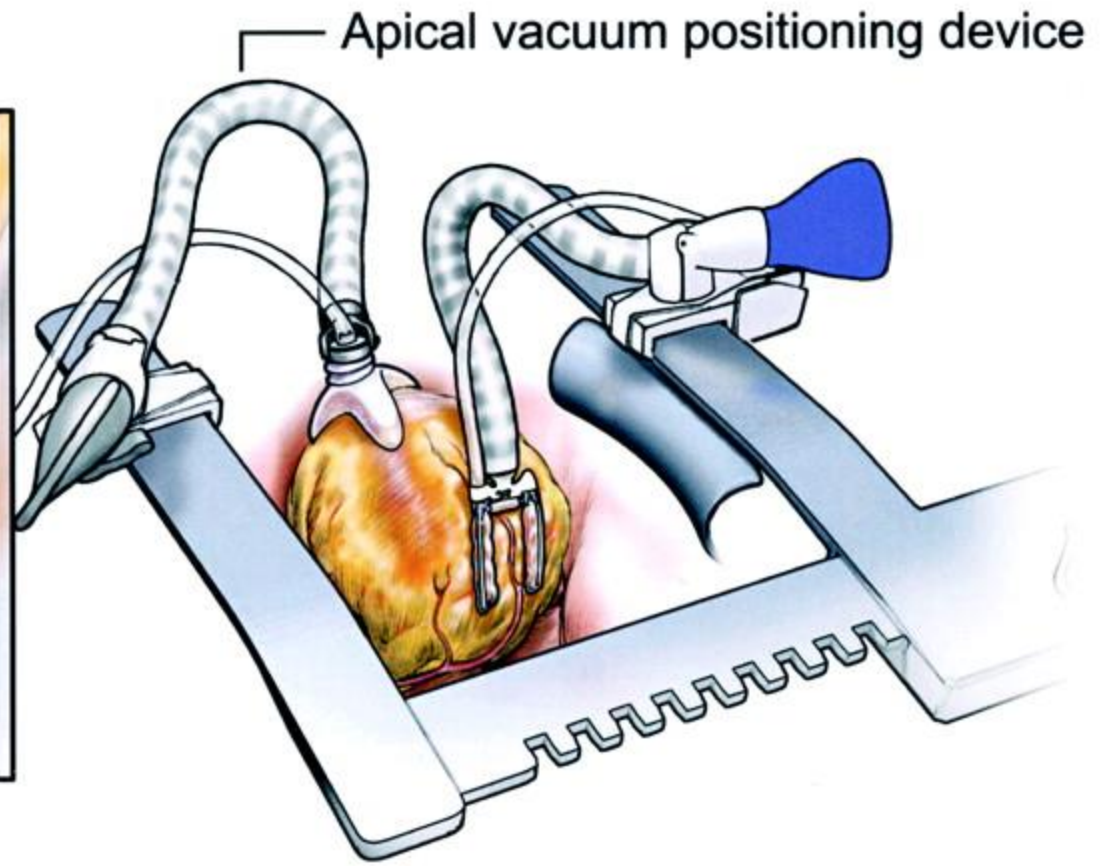
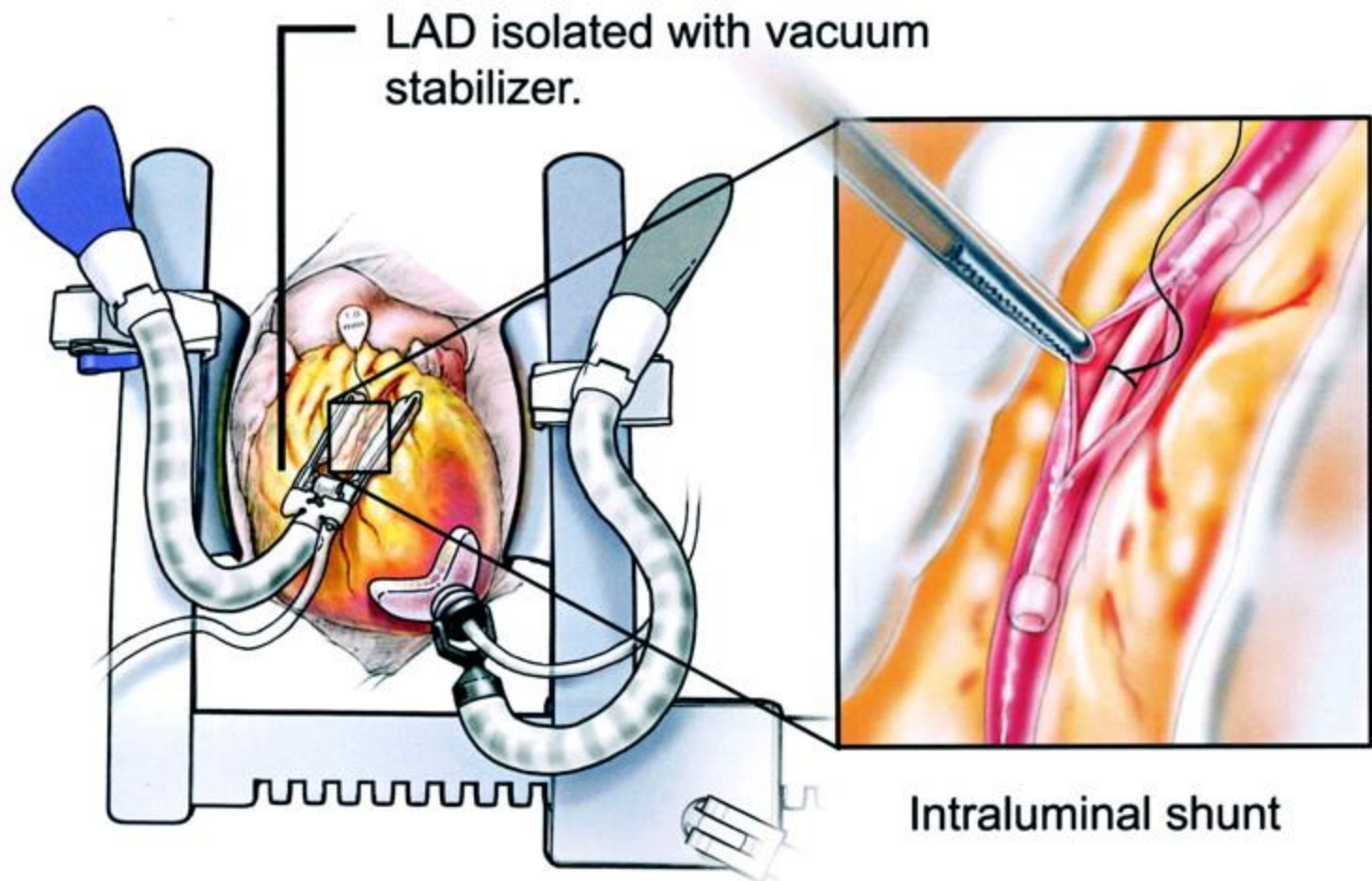
Recommendations for Use of Cardiopulmonary Bypass in Patients Undergoing CABG

Referenced studies that support the recommendations are summarized in Online Data Supplement 40.

COR	LOE	Recommendations
2a	B-R	1. In patients with significant calcification of the aorta, the use of techniques to avoid aortic manipulation (off-pump techniques or beating heart) is reasonable to decrease the incidence of perioperative stroke when performed by experienced surgeons.
2b	B-R	2. In patients with significant pulmonary disease, off-pump surgery may be reasonable to reduce perioperative risk when performed by experienced surgeons.

Procedure

- Median sternotomy of varying sizes.
- Depending on the physiology of the patient, the smallest incision will be made.
- Arteries or veins can be harvested from the patients chest wall, arm, and or leg.
- Betablockers are used to slow the heart rate.
- Deep pericardial sutures and the use of specialized instruments to prop the heart in a position that will allow the surgeon to access occluded arteries.



Apical vacuum positioning device lifts heart to access posterior vessels

Instrumentation

Octopus Device

- Has multiple small suction cups that are applied to the heart surface.
- When suction is turned on, the cups stick to the surface, and hold the heart steady, with movement being less than 1 mm.

Star fish Device

- When suction is turned on, the cups stick to the surface, and hold the heart steady



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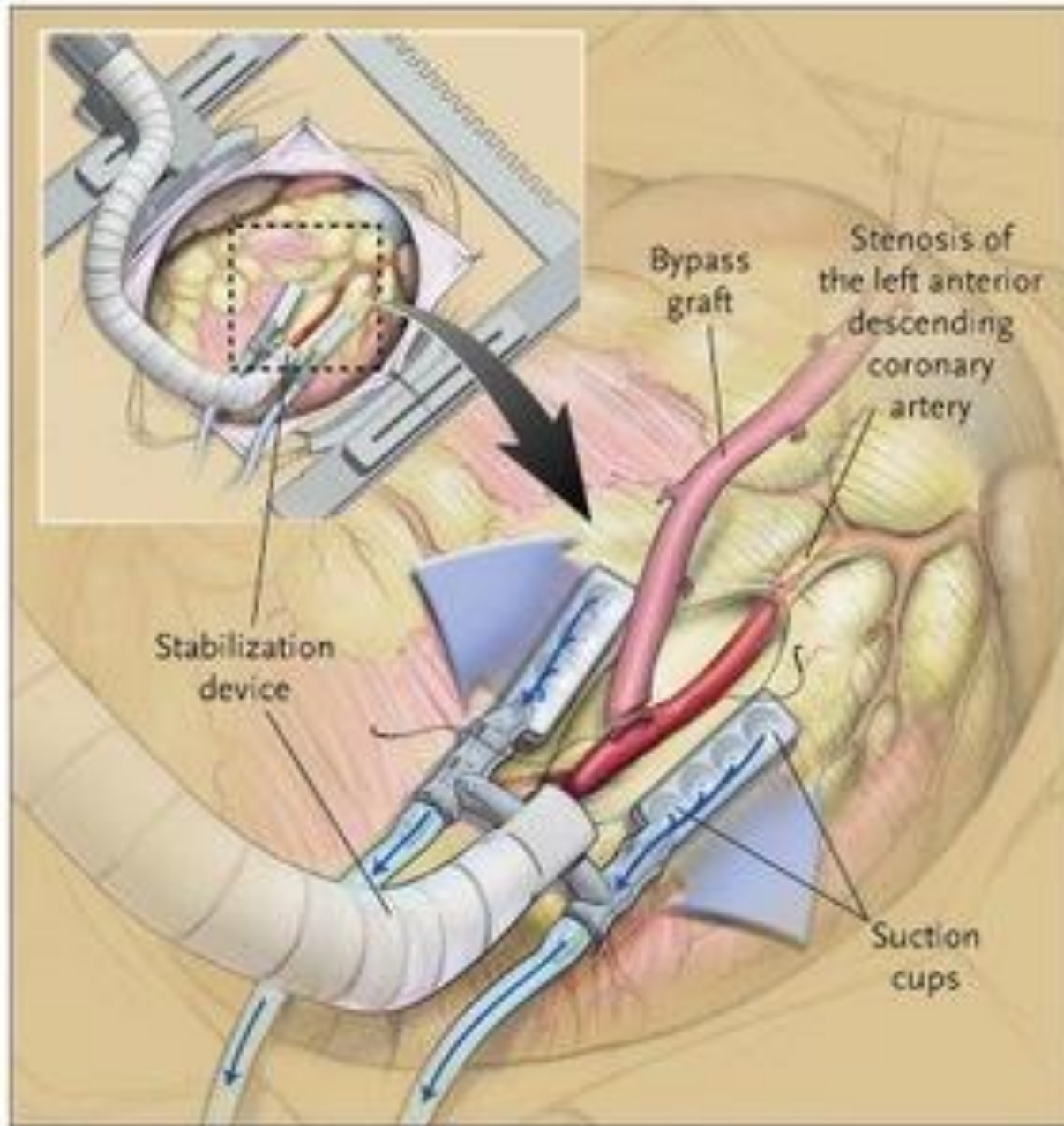


STABILIZER PODS

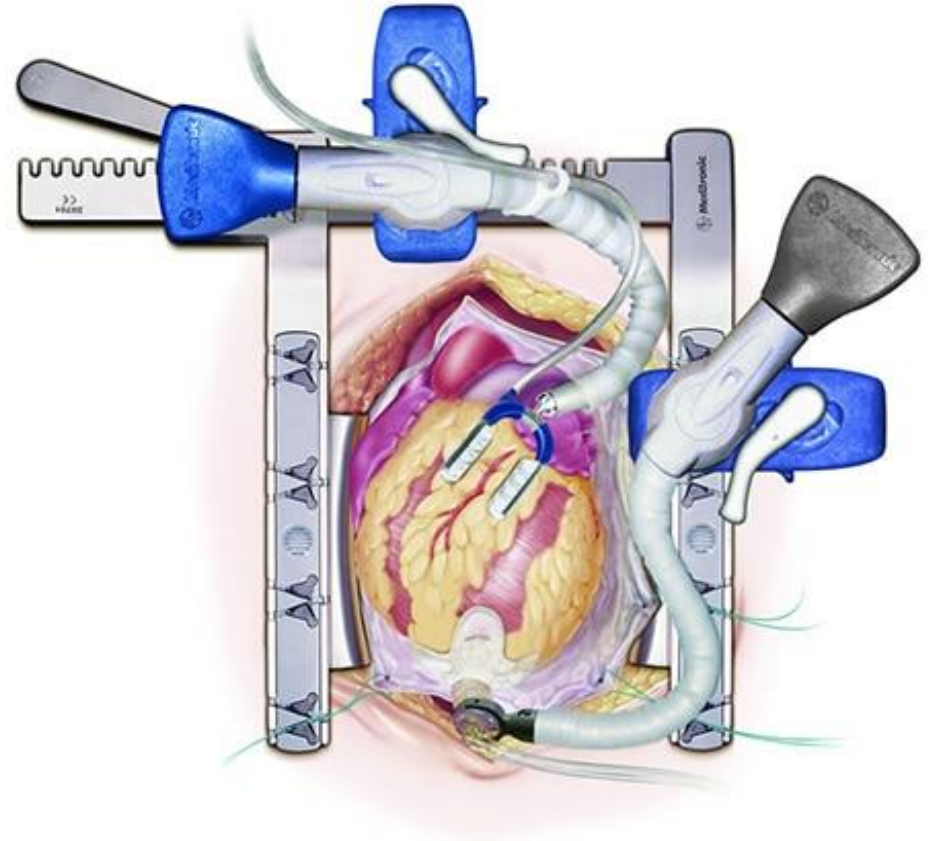


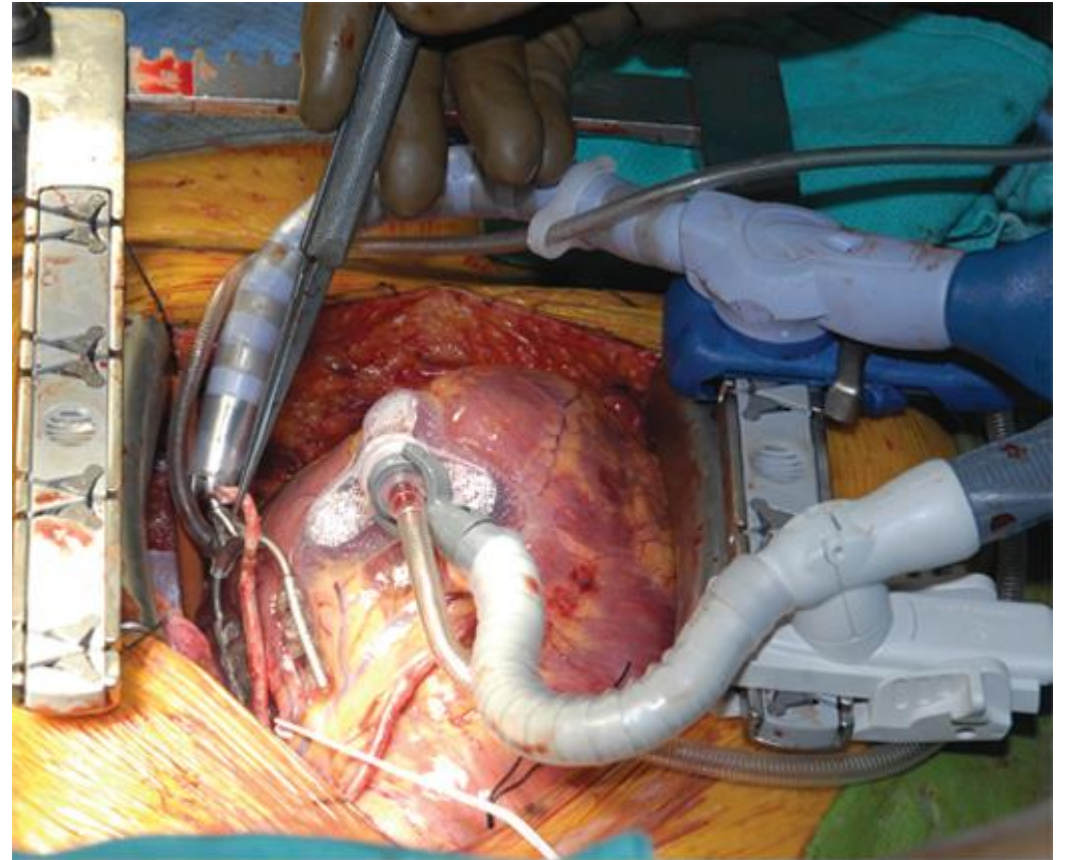
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Source: Lawrence H. Cohn, David H. Adams:
Cardiac Surgery in the Adult, Fifth Edition
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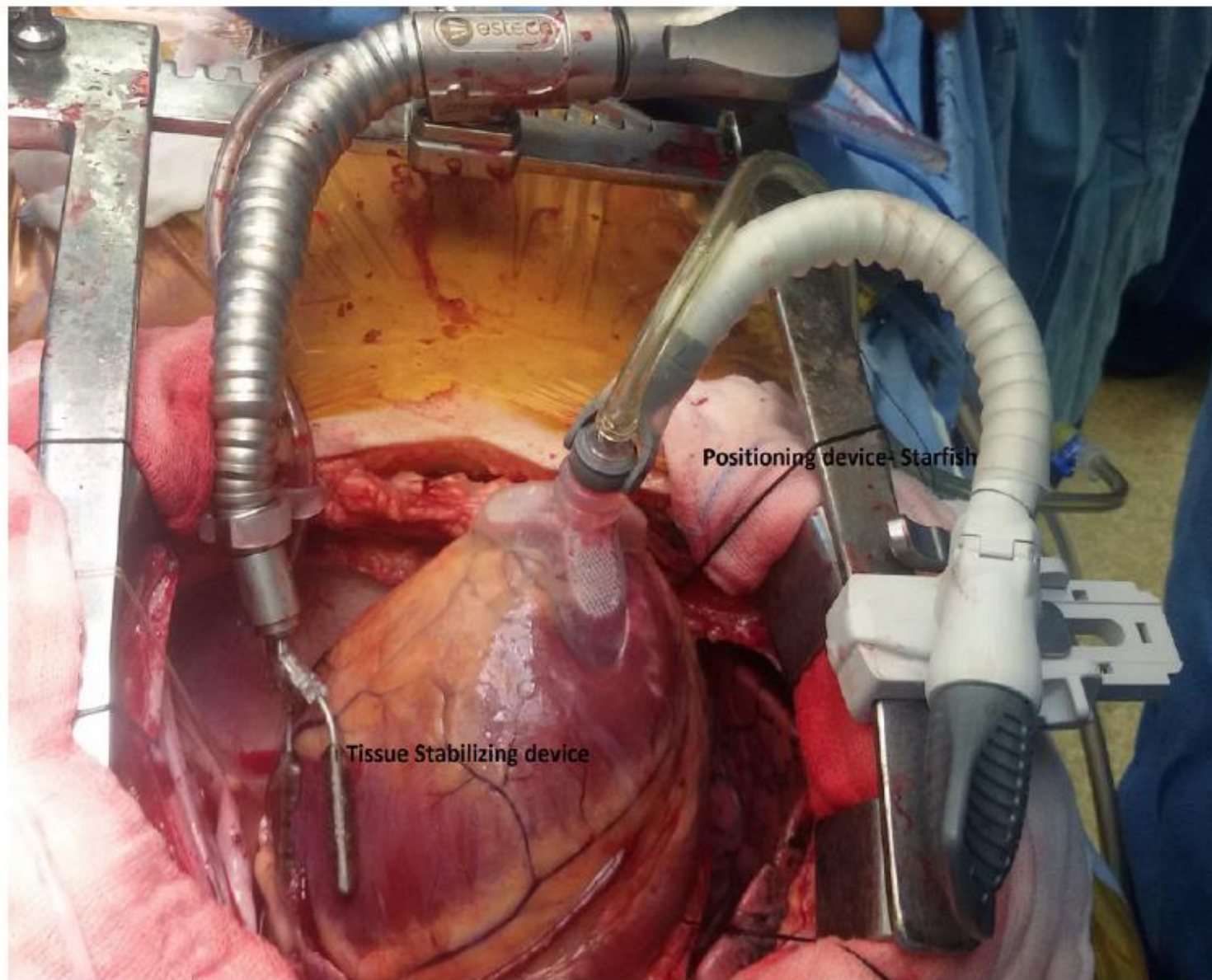
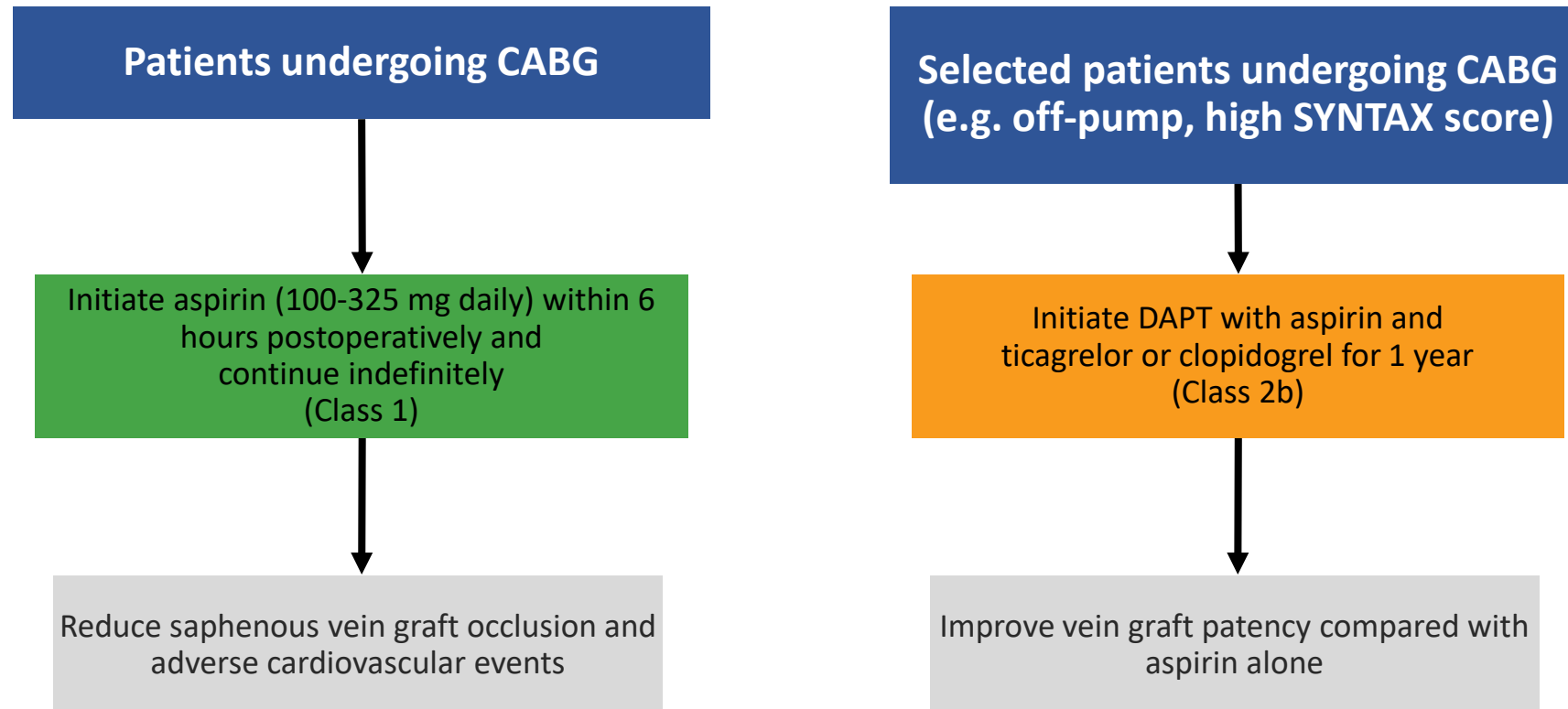


Figure 2. Positioning device (Starfish) and tissue stabilizer device on the epicardial surface

[click here to watch the vedio](#)



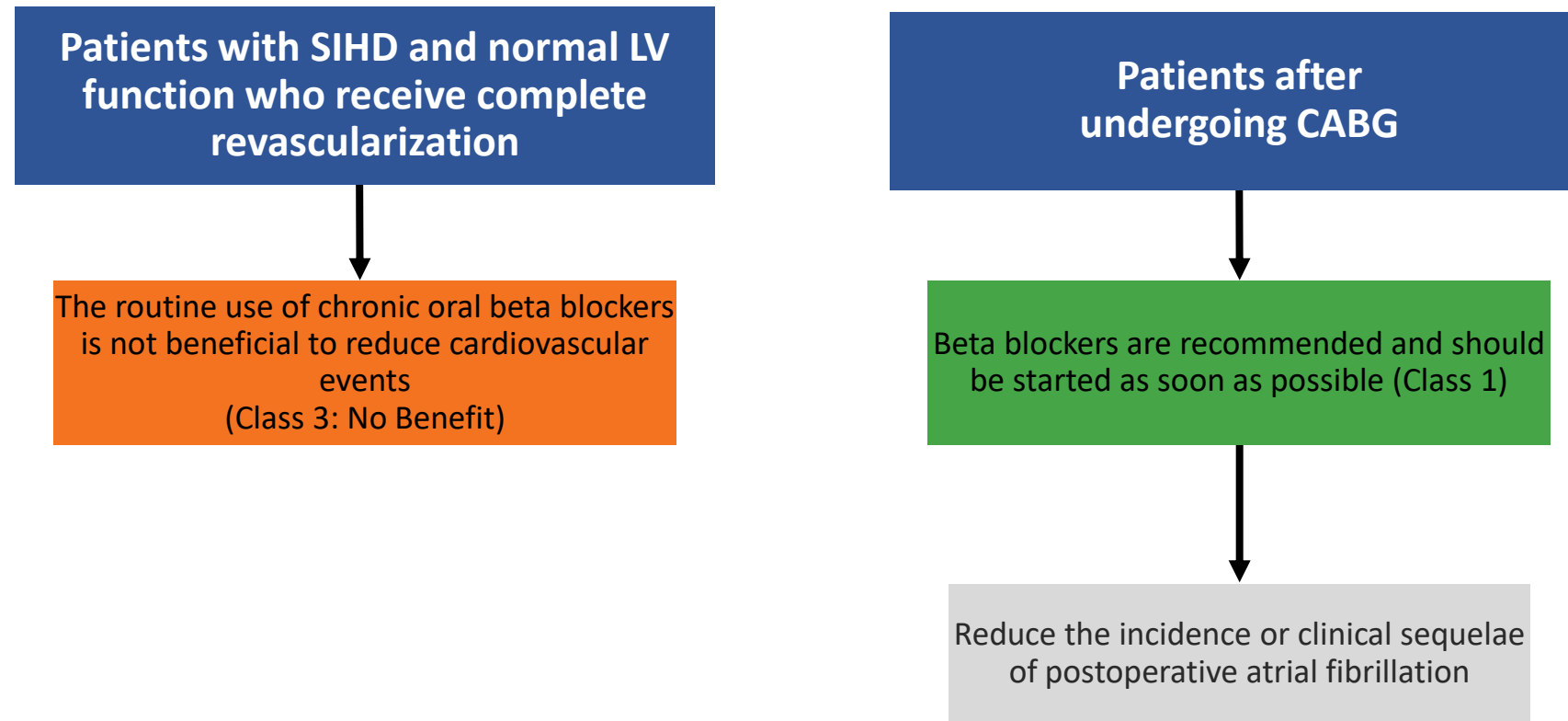
Antiplatelet Therapy in Patients After CABG



Abbreviations: CABG indicates coronary artery bypass grafting; and DAPT, dual antiplatelet therapy.

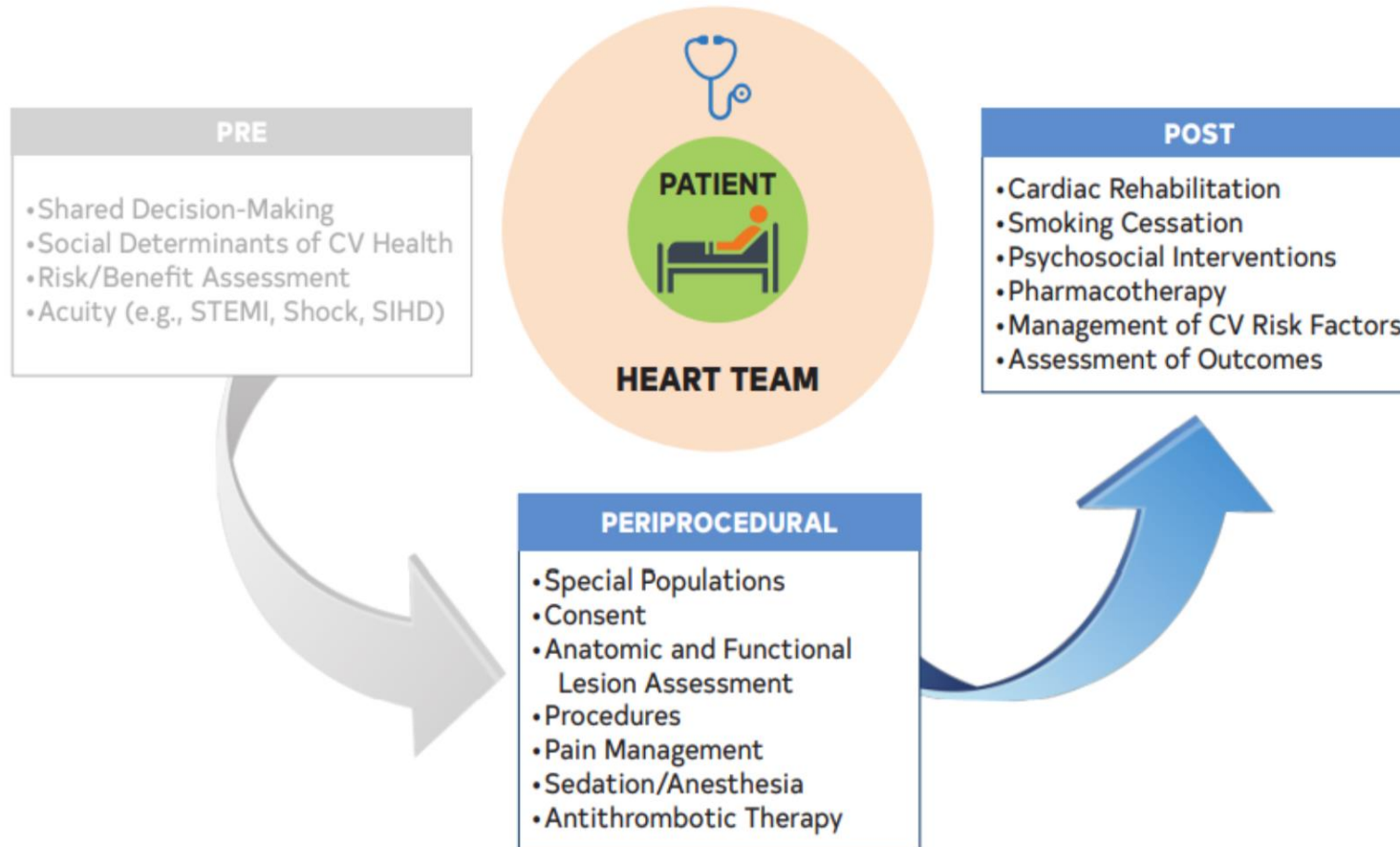
Lawton, J. S. et al. 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization. *Circulation*.

Beta Blockers in Patients After Revascularization



Abbreviations: CABG indicates coronary artery bypass grafting; LV, left ventricle; and SIHD, stable ischemic heart disease.

Focus on Perioperative Considerations in Patients Undergoing CABG and Outcomes



For patients undergoing CABG, establishment of multidisciplinary, evidence-based perioperative management programs is recommended to optimize analgesia, minimize opioid exposure, prevent complications and to reduce time to extubation, length of stay, and healthcare costs. (Class 1)

Abbreviations: CABG indicates coronary artery bypass grafting; CNS, central nervous system; CV, cardiovascular disease; LOS, length of stay; SIHD, stable ischemic heart disease; STEMI, ST segment elevation myocardial infarction; and TEE, transesophageal echo.

Decrease Post-operative Deep Sternal Wound Infections



Intraop + Postop Target Serum Glucose Level:
<180mg/dL
(Class 1)



Administer IV insulin
continuous infusion



AVOID hypoglycemia

[Click here for more best practices](#)

Abbreviations: IV indicates intravenous; and SWI, sternal wound infections.

- Indication For Surgery
- Preoperative Evaluation
- Conduits decision
- Operation Decision
- ERAS

Take-Home Messages

2021 Guideline for Coronary Artery Revascularization

Take Home Messages

Treatment decisions with regard to coronary revascularization in patients with coronary artery disease should be based on clinical indications, **REGARDLESS OF SEX, RACE, OR ETHNICITY**, because there is no evidence that some patients benefit less than others, and efforts to reduce disparities of care are warranted.

Take Home Messages

In patients being considered for coronary revascularization for whom the optimal treatment strategy is unclear, a multidisciplinary **HEART TEAM** approach is recommended. Treatment decisions should be patient centered, incorporate patient preferences and goals, and include shared decision-making.

Take Home Messages

Patients with significant **LEFT MAIN DISEASE, SURGICAL REVASCULARIZATION** is indicated to improve survival relative to that likely to be achieved with medical therapy. Percutaneous revascularization is a reasonable option to improve survival, compared with medical therapy, in selected patients with low to medium anatomic complexity of coronary artery disease and left main disease that is equally suitable for surgical or percutaneous revascularization.

Take Home Messages

Updated evidence from contemporary trials supplement older evidence with regard to mortality benefit of revascularization in patients with stable ischemic heart disease, normal left ventricular ejection fraction, and triple-vessel coronary artery disease. Surgical revascularization may be reasonable to improve survival. A survival benefit with percutaneous revascularization is uncertain. Revascularization decisions are based on consideration of disease complexity, technical feasibility of treatment, and a Heart Team discussion.

Take Home Messages

The use of a **RADIAL ARTERY** as a surgical revascularization conduit is preferred to the use of a saphenous vein conduit to bypass the second most important target vessel with significant stenosis after the left anterior descending coronary artery. Benefits include superior patency, reduced adverse cardiac events, and improved survival.

Top 10 Take Home Messages

Revascularization decisions in patients with diabetes and multivessel coronary artery disease are optimized by the use of a Heart Team approach. Patients with **DIABETES WHO HAVE TRIPLE-VESSEL DISEASE SHOULD UNDERGO SURGICAL REVASCULARIZATION**; percutaneous coronary intervention may be considered if they are poor candidates for surgery.

Thank You for Your Attention

V2

We added links for the vedioes in the slides, you can watch them by clicking on the vedio itself