CVS

PBL

Modified NO: 3

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CABG

Coronary Artery Bypass Graft

Fourth Year Cardiovascular System Lectures

Case 1

- 65-years old gentleman
- C/O Stable Angina Pectoris
- Referred from the cardiology clinic

Note:
The gold standard investigation to diagnose coronary abnormalities is
coronary angiography
(قسطرة الشريان التاجي)

If we have a 65-year-old patient complaining of stable angina, and the cardiologists have performed an ECG and coronary catheterization, then he was referred from the cardiology clinic. What should we do for this patient, knowing that he has been diagnosed with coronary disease by coronary angiography?

We should answer some questions on the next slide

- Revascularization a group of medical treatments that restore blood flow to parts of your heart when that flow is limited or blocked.
- Surgical revascularization
- Suitable for surgical revascularization
- Planning of surgery

Types of revascularization procedures include:
1)Coronary artery bypass graft (CABG): Also called heart bypass surgery, it involves rerouting blood flow using grafts.
2)Percutaneous coronary intervention (PCI): A minimally invasive, nonsurgical procedure for coronary revascularize.

We need to answer several questions as surgeons, including:

1- The first question is whether this patient requires revascularization. This is usually answered by cardiologists, but surgeons should readdress this question, as they will be performing the procedure. The answer to this question is often "yes."

2- The second question is whether the patient needs surgical revascularization or if percutaneous coronary intervention (PCI), commonly known as "شبكية" is sufficient.

3- If we decide to proceed with surgery, the third question is whether the patient's condition is suitable for surgery and if their body can tolerate it, and we call it: fitness of surgery.

4- If the patient is deemed fit, we should plan for the surgical procedure.
There are also additional sub-questions, such as necessary tests and an ECG.

Medical history for case 1

- Diabetes mellitus type II
- Arterial hypertension
- Hyperlipidemia
- Smoker 20 pack year

Drug history

- ASA aspirin
- Plavix clopidogrel, anti-platelet
- OHA oral hypoglycemic agents for diabetes
- Statin for hyperlipidemia
- BB beta blocker for cardiac dysfunction
- ARB for hypertension

It is important to know the medications the patient is taking for two reasons:

First, the patient is taking antiplatelet drugs like aspirin and Plavix, so attention must be given to the potential bleeding that may occur after the surgery.

Secondly, pharmacology plays a role in understanding the half-life and mechanism of these drugs. For example, aspirin binds irreversibly, so surgery should be delayed for approximately seven days to produce new platelets, while the half-life of Plavix is about 3-4 days.

One indicator of poor or good perfusion after surgery is the concentration of lactic acidosis or pH. Hyperlactemia is a result of hypoperfusion. Here, the patient is also taking oral hypoglycemic agents (OHA) like metformin, which is commonly associated with lactic acidosis, so it could be masked.

Beta-blockers can cause bradycardia, and the patient may require blood pressure support after surgery. One important thing to monitor postoperatively is the vital signs, including heart rate. The patient might be in shock and have an elevated heart rate, but when measuring it, it could show 70-80, which might seem excellent. However, this might be masked due to the effects of beta-blockers.

ECHO echocardiogram

We always do ECHO to the patient to look for:

- Left ventricular function
- Right ventricular function
- PAP pulmonary artery pressure
- valves

We do this to determine whether the heart can tolerate the procedure, or to identify other cardiac problems that can be addressed during the same surgery, and to assess the risk and mortality rate for the patient in order to obtain their approval, which is known as informed consent.

General condition

- Frail = هشاشة, one simple test is to have the patient walk six meters to assess their endurance. These are clinical indicators that can be observed visually to determine the patient's ability to tolerate the procedure.
- Smoking which is very important for open heart surgeries.

Preoperative evaluation

- Respiratory
- Renal
- Neurological
- Vascular beds mainly 3 beds: cerebral, coronary, peripheral vascular and they usually come together.
- Remote infections we can not do surgery if the patient has infection simultaneously.
- Diabetes control very important to know when and how do the surgery.

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

The **Class of Recommendation (COR)** and **Level of Evidence (LOE)** table is used in clinical guidelines to communicate how strongly a treatment or strategy is recommended and the quality of evidence supporting it. It helps healthcare professionals make evidence-based decisions.

After collecting information from the patient, we need to decide which procedure should be performed. To do this, we refer to guidelines. Guidelines are based on evidence-based medicine, meaning they rely on studies conducted and tested by experts. The strongest studies are **prospective, double-blinded randomized controlled trials (RCTs)**, while the least strong studies are **case reports**. Each guideline is assigned a **level of evidence (LOE)**, which indicates the strength and reliability of the supporting studies. Guidelines also include the **class of evidence (COE)** and the **class of recommendations (COR)**. These guidelines help doctors worldwide treat most diseases consistently. However, there are still gray areas that require clinical judgment and doctors' opinions.

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COR

CLASS (STRENGTH) OF RECOMMENDATION	
CLASS 1 (STRONG)	**Benefit >>> Risk**
Suggested phrases for writing recommendations: • Is recommended • Is indicated/useful/effective/beneficial • Should be performed/administered/other • Comparative-Effectiveness Phrases†: – Treatment/strategy A is recommended/indicated in preference to treatment B – Treatment A should be chosen over treatment B	
CLASS 2a (MODERATE)	**Benefit >> Risk**
Suggested phrases for writing recommendations: • Is reasonable • Can be useful/effective/beneficial • Comparative-Effectiveness Phrases†: – Treatment/strategy A is probably recommended/indicated in preference to treatment B – It is reasonable to choose treatment A over treatment B	
CLASS 2b (WEAK)	**Benefit ≥ Risk**
Suggested phrases for writing recommendations: • May/might be reasonable • May/might be considered • Usefulness/effectiveness is unknown/unclear/uncertain or not well-established	
CLASS 3: No Benefit (MODERATE) **(Generally, LOE A or B use only)**	**Benefit = Risk**
Suggested phrases for writing recommendations: • Is not recommended • Is not indicated/useful/effective/beneficial • Should not be performed/administered/other	
Class 3: Harm (STRONG)	**Risk > Benefit**
Suggested phrases for writing recommendations: • Potentially harmful • Causes harm • Associated with excess morbidity/mortality • Should not be performed/administered/other	

LOE

LEVEL (QUALITY) OF EVIDENCE‡	
LEVEL A	
• High-quality evidence‡ from more than 1 RCT • Meta-analyses of high-quality RCTs • One or more RCTs corroborated by high-quality registry studies	
LEVEL B-R	**(Randomized)**
• Moderate-quality evidence‡ from 1 or more RCTs • Meta-analyses of moderate-quality RCTs	
LEVEL B-NR	**(Nonrandomized)**
• Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies • Meta-analyses of such studies	
LEVEL C-LD	**(Limited Data)**
• 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	
LEVEL C-EO	**(Expert Opinion)**
• 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; EO, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

Revascularization in SIHD (stable ischemic heart disease)

Next slides show the guidelines of SIHD

Revascularization to Improve Survival in SIHD Compared With Medical Therapy

Notice that as we move from 1 to 2a we are getting more into gray zone where cardiologists can argue against and decide to put stent instead of surgery

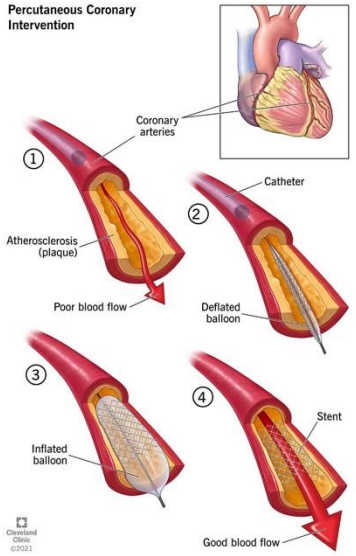
Recommendations for Revascularization to Improve Survival in SIHD Compared With Medical Therapy Referenced studies that support the recommendations are summarized in Online Data Supplement 10.		
COR	**LOE**	**Recommendations**
		Left ventricular dysfunction and multivessel CAD (coronary heart disease)
1	**B-R**	**1. In patients with SIHD and multivessel CAD (three-vessel disease) appropriate for CABG with severe left ventricular systolic dysfunction (left ventricular ejection fraction <35%), CABG is recommended to improve survival.**
2a	**B-NR**	**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.**

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 CAD stenosis, CABG is recommended to improve survival.
2a	B-NR	4. In selected patients with SIHD and significant left main CAD stenosis for whom PCI can provide equivalent revascularization to that possible with CABG, PCI is reasonable to improve survival. A stent is a possible option, and the patient is at high risk for CABG.

PCI (Percutaneous Coronary Intervention)

Non-surgical procedure to improve blood flow through narrowed or blocked coronary arteries (stent)



- A patient with SIHD and significant left main stenosis needs CABG.
- A patient with SIHD and significant left main stenosis, if they can achieve equivalent revascularization from PCI or are at high risk for CABG, should undergo PCI instead.

Proximal left main CAD usually undergo PCI (stent)
Distal left main CAD usually undergo CABG (no stent)

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.**

Cardiologist will prefer stent

Because it is 2B , surgery is not usually performed and a stent is preferred

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

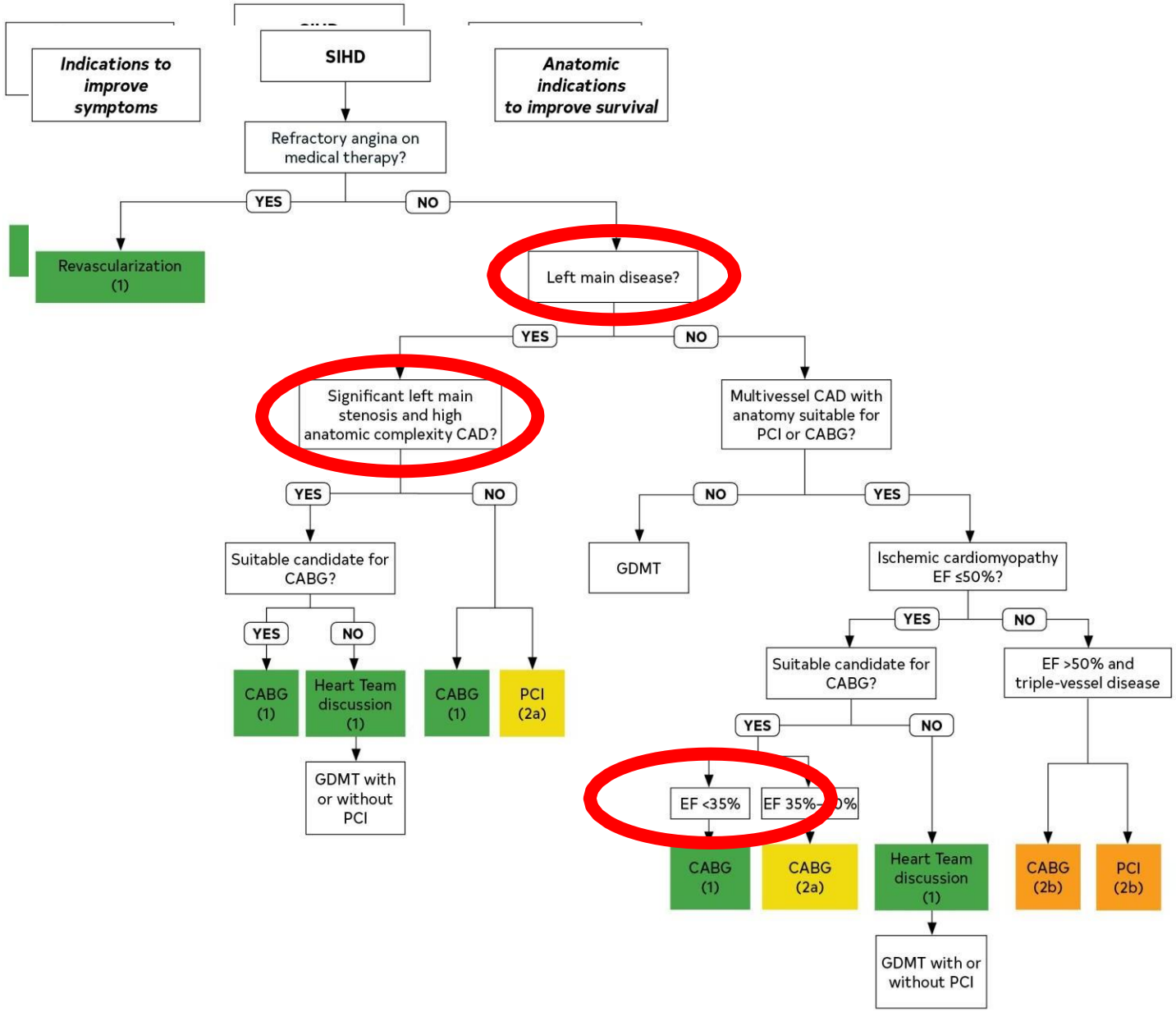
In these cases we use PCI

Stenosis in the proximal LAD artery		
2b	**B-R**	**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.**
Single- or double-vessel disease not involving the proximal LAD		
3: No Benefit	**B-R**	**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.**

Figure 6. Revascularization in patients with SIHD.

Colors correspond to Table 2.

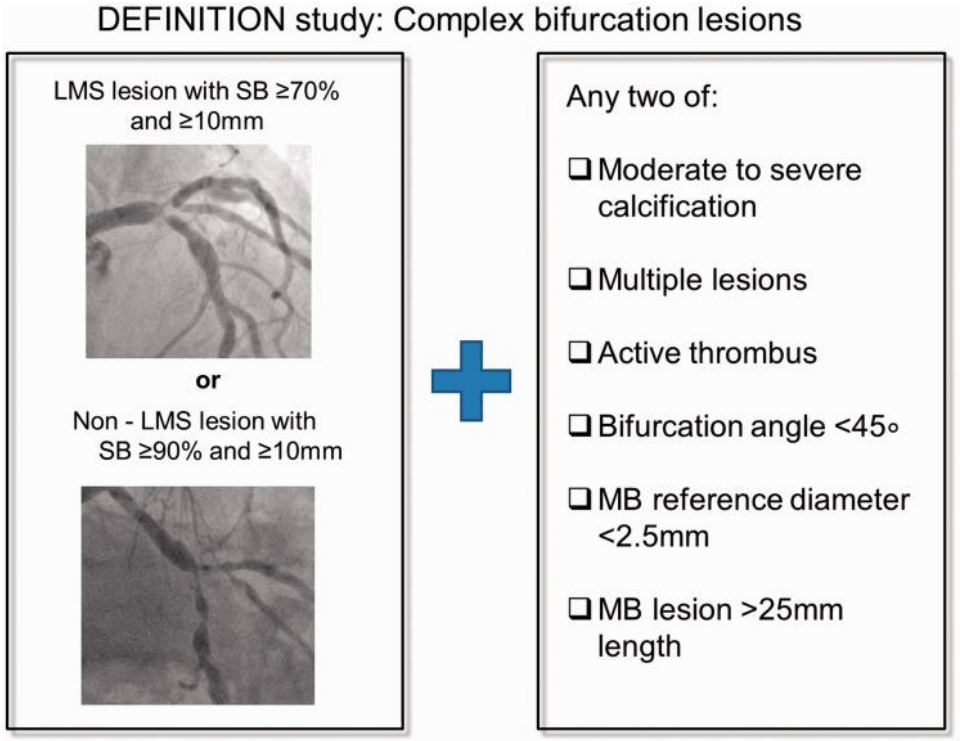
CABG indicates coronary artery bypass graft; CAD, coronary artery disease; EF, ejection fraction; PCI, percutaneous coronary intervention; SIHD, stable ischemic heart disease; and GDMT, guideline-directed medical therapy.



Most left main diseases require CABG except for rare cases

If the patient do not have left main diseases CABG is suitable when the patient suffer from three-vessel disease with depressed ejection fraction

Situations in Which CABG Would Be Preferred over PCI

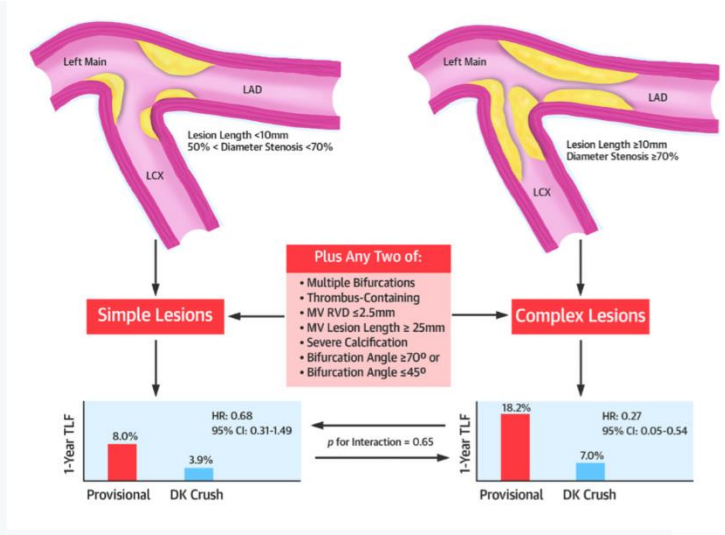


In cases of complex lesions CABG is more better

Complex lesions are lesions on bifurcation of left main for example

Additional

a coronary bifurcation lesion has been described as “a coronary artery narrowing occurring adjacent to, and/or involving the origin of a significant side branch (SB)



Patients With Complex Disease

The doctor did not explain this
So just notice that in cases of
complex lesions → CABG

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Recommendations for Patients With Complex Disease Referenced studies that support the recommendations are summarized in Online Data Supplement 13.		
COR	**LOE**	**Recommendations**
1	**B-R**	**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.**
2a	**B-R**	**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.**

Patients With Diabetes

In general, diabetic patients benefit from CABG more than PCI

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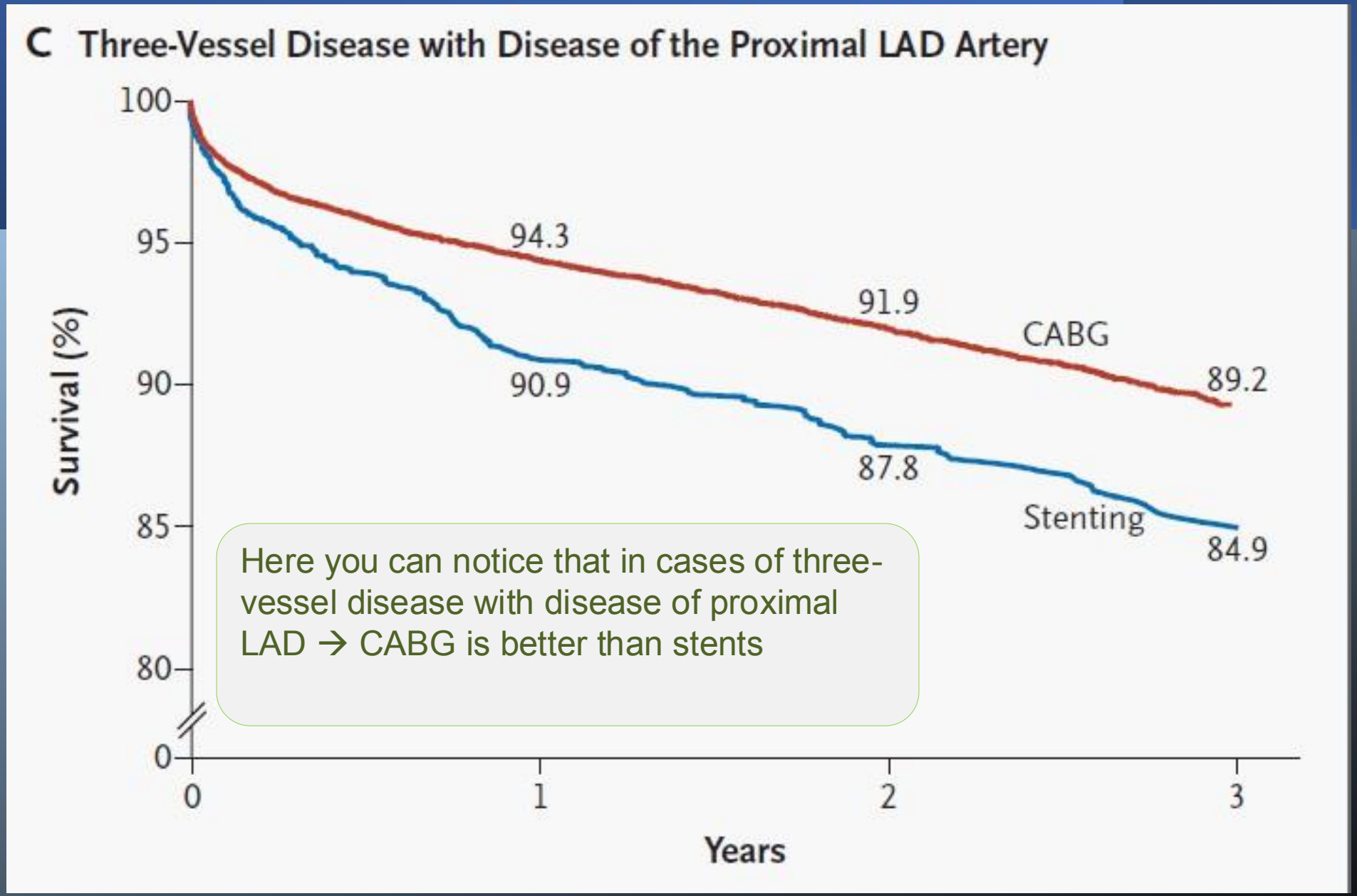
Recommendations for Patients With Diabetes Referenced studies that support the recommendations are summarized in Online Data Supplement 14.		
COR	**LOE**	**Recommendations**
1	**A**	**1. In patients with diabetes and multivessel CAD with the involvement of the LAD, who are appropriate candidates for 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.**

the doctor Did not explain the table


C Three-Vessel Disease with Disease of the Proximal LAD Artery
Survival (%)
100
95
90
85
80
0
0
1
2
3
Years
94.3
91.9
89.2
CABG
90.9
87.8
84.9
Stenting
Here you can notice that in cases of three-vessel disease with disease of proximal LAD → CABG is better than stents

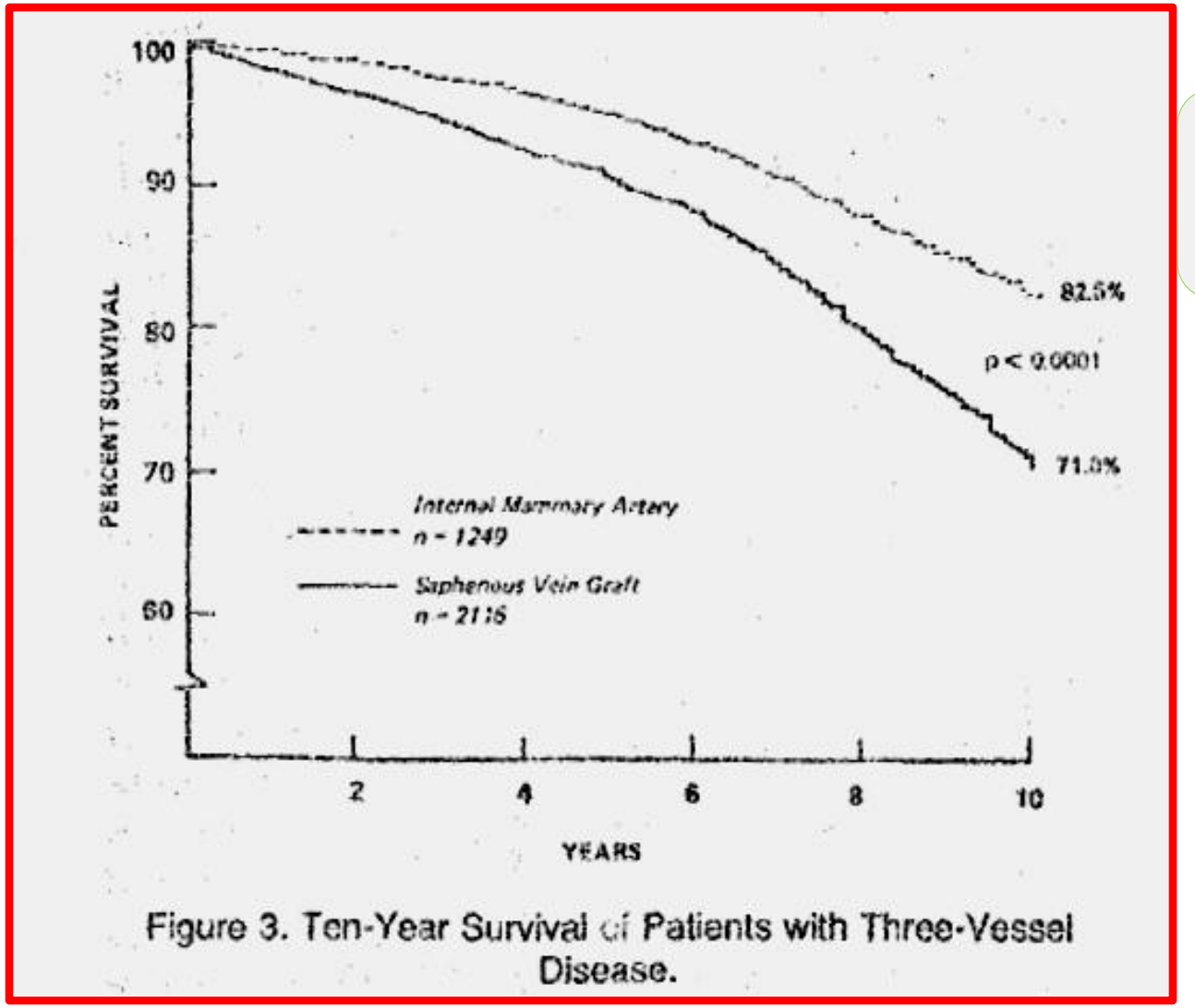


Figure 3. Ten-Year Survival of Patients with Three-Vessel Disease.

Notice here in patients with three vessel disease CABG with LIMA is better than saphenous vein graft

LIMA : left internal thoracic artery

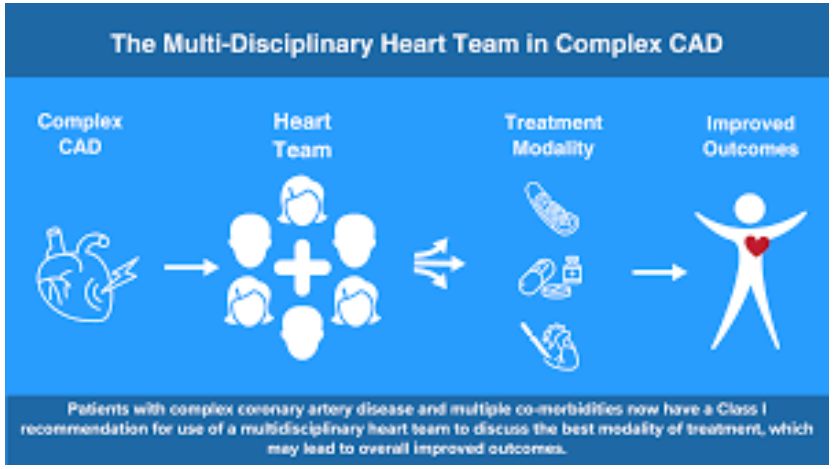
Loop FD et al NEJM 1986

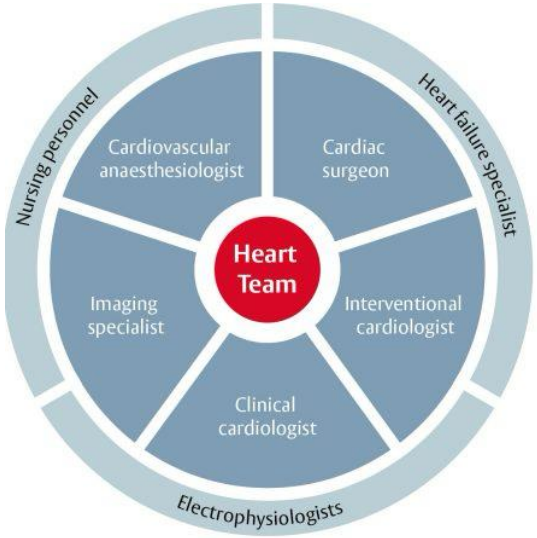
The doctor show a video about patient with three-vessel disease (RCA is occluded) with distal left main complex lesion → need CABG

LINK

Simple lesions → stent

Complex lesions:
Heart team → responsible for choose the best treatment modality to improve outcomes





- Cath showed (in the video)
  - Distal Left Main Stenosis
  - RCA stenosis

And the patient is diabetic

After catheterization, the heart team will discuss the coronary anatomy, comorbidities, procedural risks, and other factors. They will then decide on the best way to treat the patient. Afterward, they will inform the patient of their decision, and the patient will have the right to agree or decline.

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.

American Heart Association.

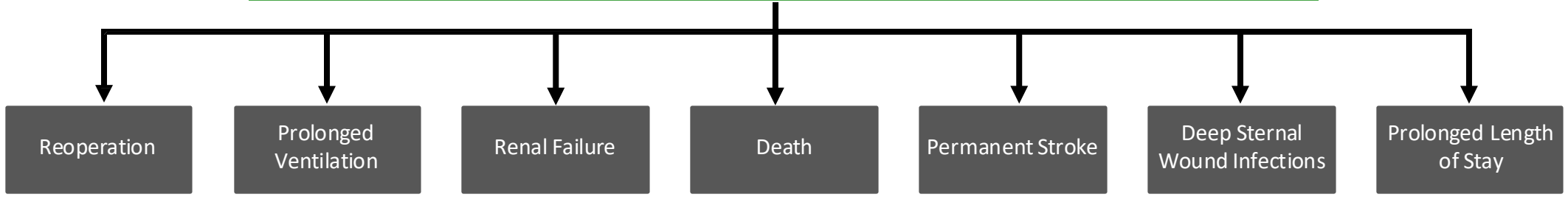
Abbreviations: COPD indicates chronic obstructive pulmonary disease; CVA, cerebral vascular accident; DAPT, dual antiplatelet therapy; ESRD, end-stage renal disease; PCI, percutaneous coronary intervention; and SYNTAX, Synergy Between PCI With TAXUS and Cardiac Surgery.

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

Assessing Risk for Patients Undergoing CABG

Doctor did not explain this slide

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??

Just a summary

Left Ventricular Dysfunction and Multivessel CAD:

1. **SIHD + Multivessel CAD + EF < 35%** → CABG is recommended
2. **SIHD + Multivessel CAD + EF 35–50%** → CABG is resonable

Left Main CAD:

- **SIHD + left main stenosis** → CABG is recommended
- **PCI** is possible in selected cases if:
- CABG is too risky.
- Equivalent revascularization is proven.

Multivessel CAD with Normal EF:

- **PCI** is preferred.

Complex Bifurcation Lesions:

- **CABG** is recommended.

Diabetes:

- **CABG** is preferred.

Left main CAD, three-vessel disease, diabetes and multivessel CAD with EF<35%
All these are indications for CABG

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 <u>improve survival.</u> CABG is not only to reduce mortality but 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.

Let's look at these cases

Case2:
75-Year-old Gentleman
Smoker 20 pock year
BMI 35 (obese)
C/O ACS (unstable angina pectoris) →indication for surgery

Medical History
Type 2 DM
Arterial hypertention
Hyperlipidemia

General condition
Smoking
HbA1c 11 (uncotrolled diabetes)

Drug history

- ASA aspirin
- Plavix clopidogrel, anti-platelet
- OHA oral hypoglycemic agents for diabetes
- Statin for hyperlipidemia
- BB beta blocker for cardiac dysfunction
- ARB for hypertension

Case3:
45-Year-old Gentleman
Distal LM disease with complex lesion
S/P surgery for varicose viens

Medical History
Arterial hypertention
Hyperlipidemia

Drug history
Statins
ARBs
Anti platelets

Both patients need CABG .
But the question is what is the suitable Conduit (graft) ?
Some considerations to choose conduits:
1- Diameter of the vessel must be comparable with the diameter of native coronary
2- The location of vessel
3- type of the vessel

Conduites

Conduits are two types:

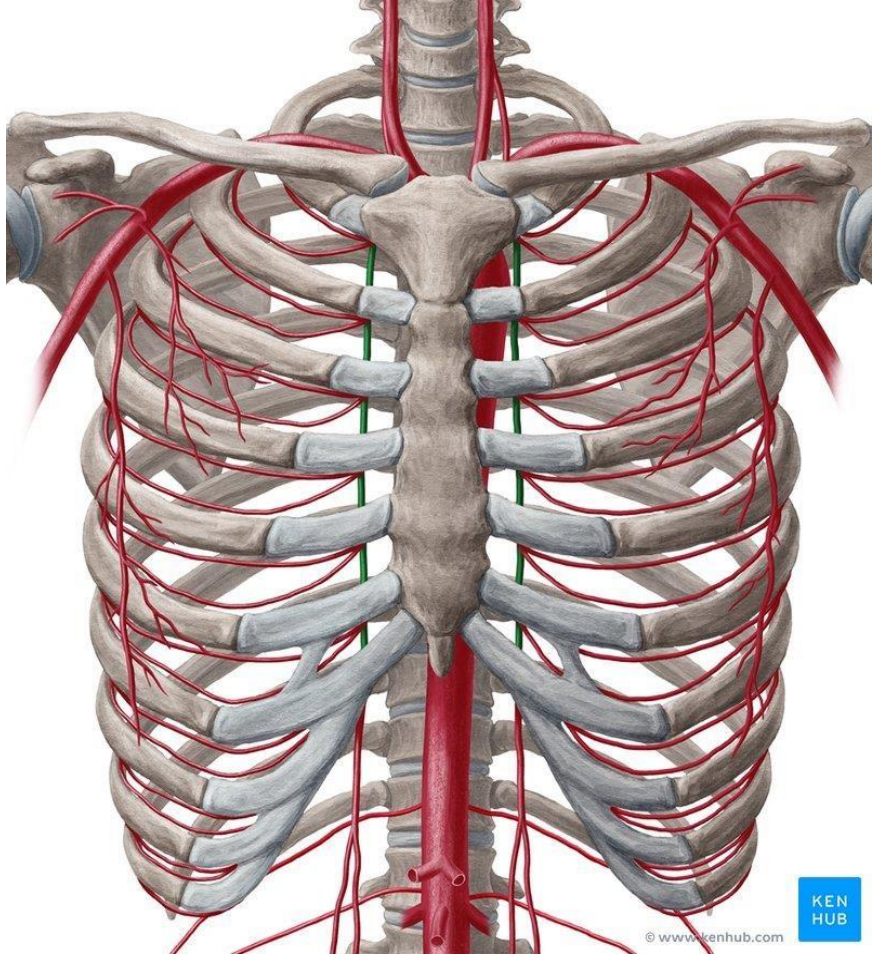
- **Arterial**
  - LIMA (left internal mammary artery)
  - RIMA (Right internal mammary artery)
  - RA (radial artery)
  - GEA (gastroepiploic artery)
  - IEA (inferior epigastric artery)

Most common arterial grafts:
LIMA, RIMA then RA

- **Venous**
  - GSV (great (long) saphenous vein)
  - SSV (small saphenous vein)
  - Arm Veins

Most common venous grafts:
GSV because
It is long and abundantly available
It is superficial vein (so easily harvested)
No serious complications were evident (may cause surgical site infection but do not have high mortality rate)

Do not forget that RIMA=RITA
(right internal thoracic artery) ☺

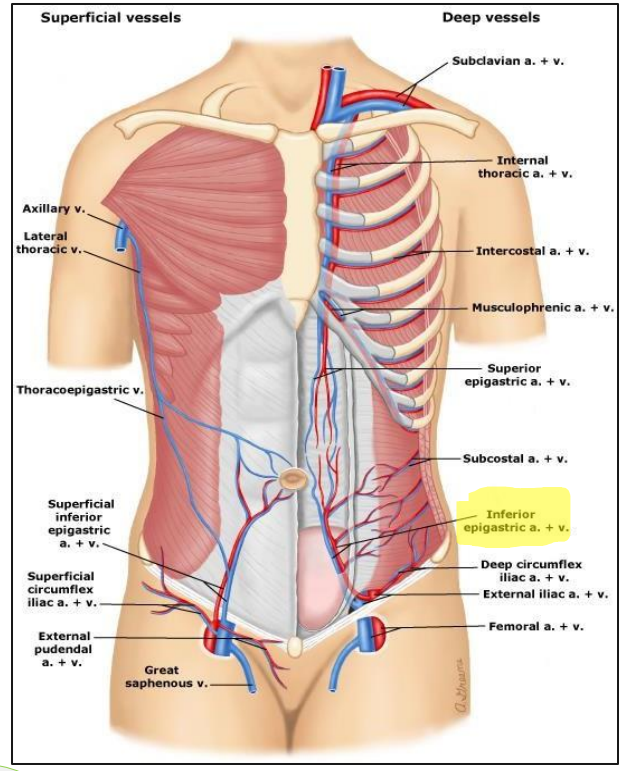


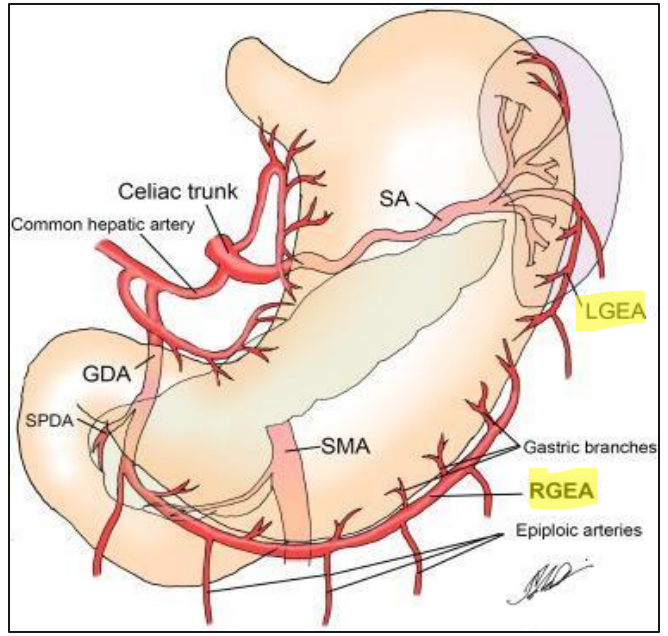
LIMA and RIMA
Lateral to sternum

(a)

Long saphenous vein
It is long and superficial so it is easy to harvest
It has no branches below the knee

We can harvest it in open techniques or endoscopic techniques with 3 holes



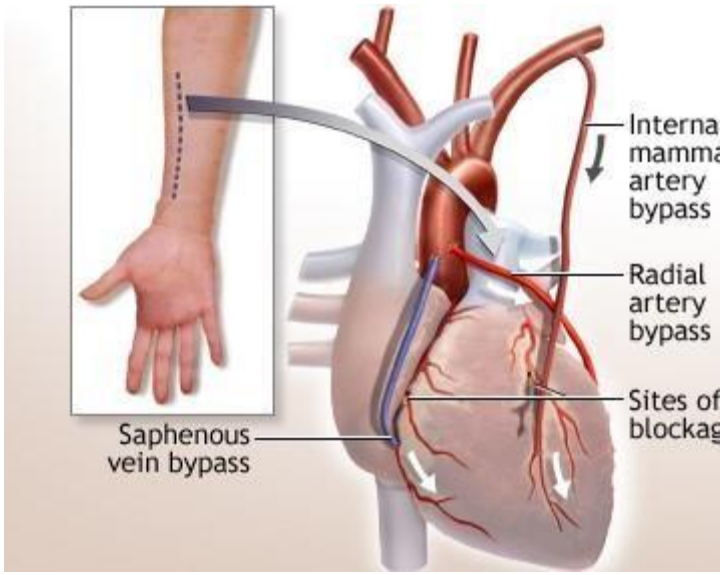


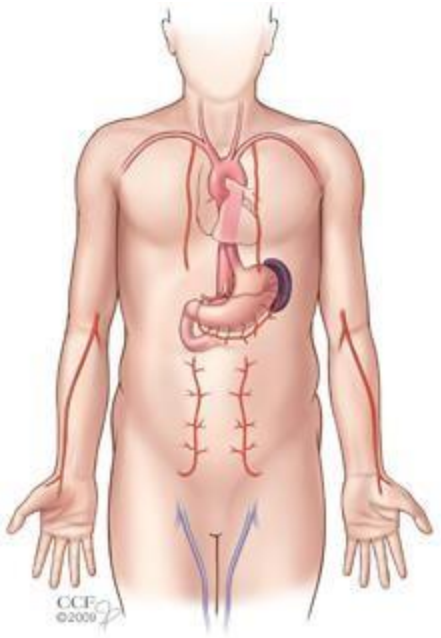
The radial artery is used as a conduit because it can be safely harvested without significant complications, thanks to the dual blood supply in the forearm provided by the radial and ulnar arteries as the major contributors, along with the interosseous arteries as a minor supply. Additionally, the radial artery is more superficial, making it easier to access and harvest during surgical procedures.

Both IEA and GEA are rarely used

Now , how is better, arterial or venous conduits?

Arterial vs Venous conduits



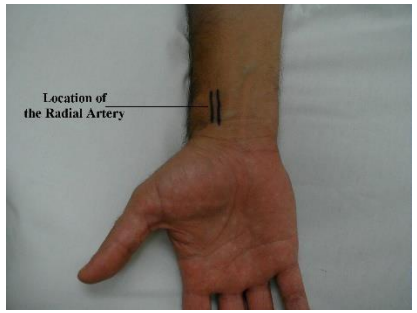


Recommended from the American heart association is to use arterial conduits : BIMA (bilateral IMA) 1. left IMA (internal mammary artery) ,then 2. right IMA (internal mammary artery), 3. radial artery

Bypass Conduits in Patients Undergoing CABG

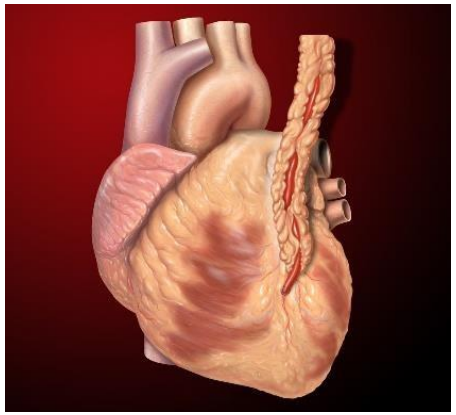
Radial artery

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

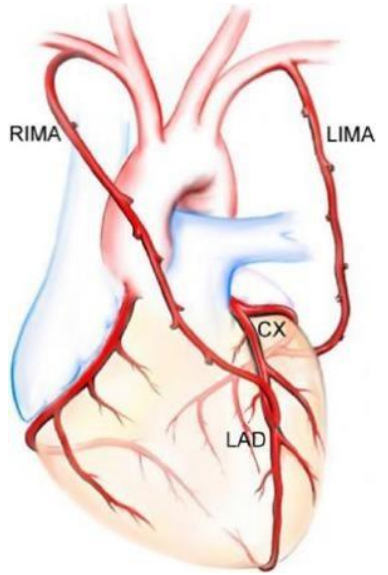


IMA (prefer left)

To LAD (Class 1)



BIMA



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

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

Click here for more best practices

American Heart Association.

Abbreviations: BIMA indicates bilateral internal mammary artery; IMA, internal mammary artery; LAD, left anterior descending; and SVG, saphenous vein graft..

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

- Why the Left IMA (arterial conduit generally) is better as conduit?

Depending on the Betat serrat for ten-year: (related to long term survival conduit)
the Left IMA (arterial conduit generally) is a stronger for the long-term survival and function than the Long saphenous vein

The New England Journal of Medicine

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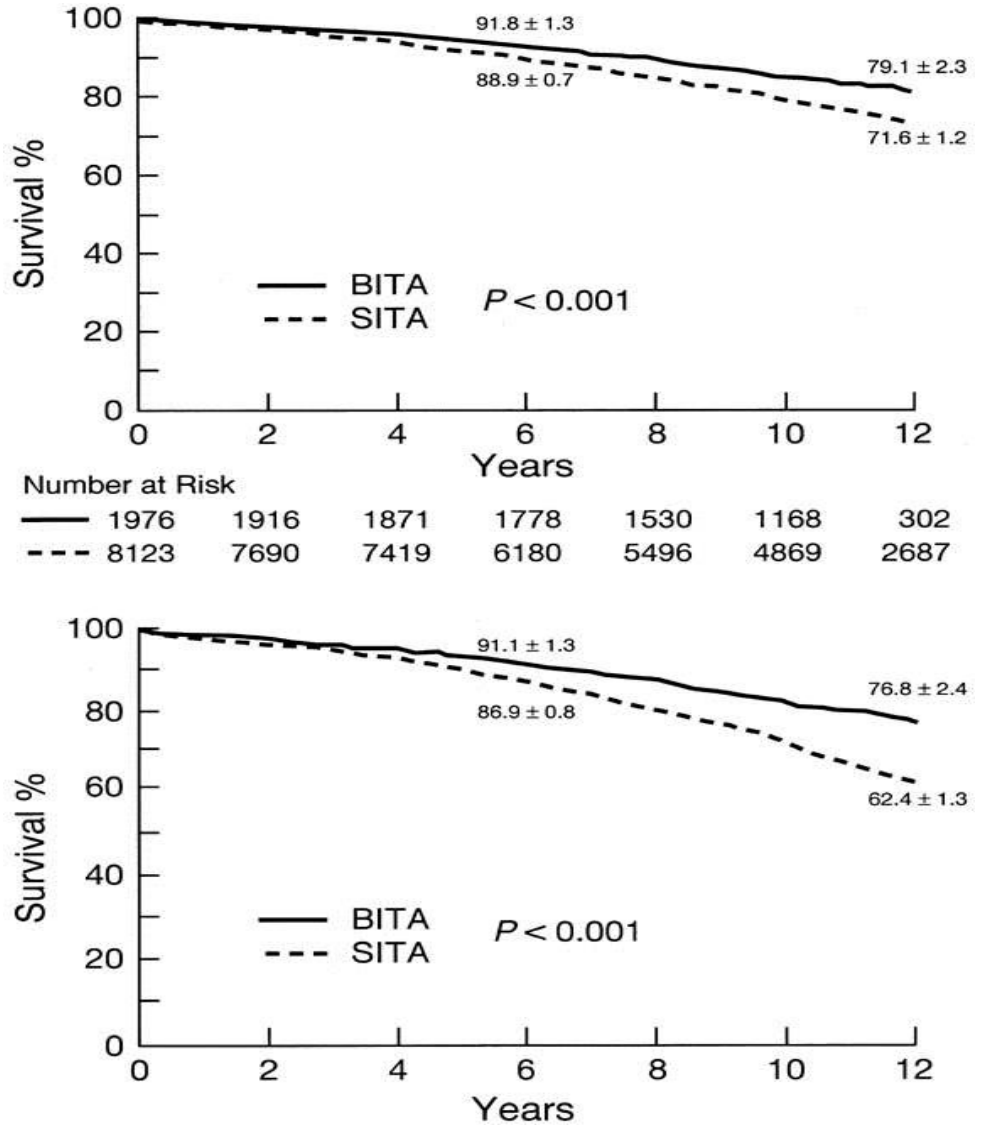
INFLUENCE OF THE INTERNAL-MAMMARY-ARTERY GRAFT ON 10-YEAR SURVIVAL AND OTHER CARDIAC EVENTS

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.)

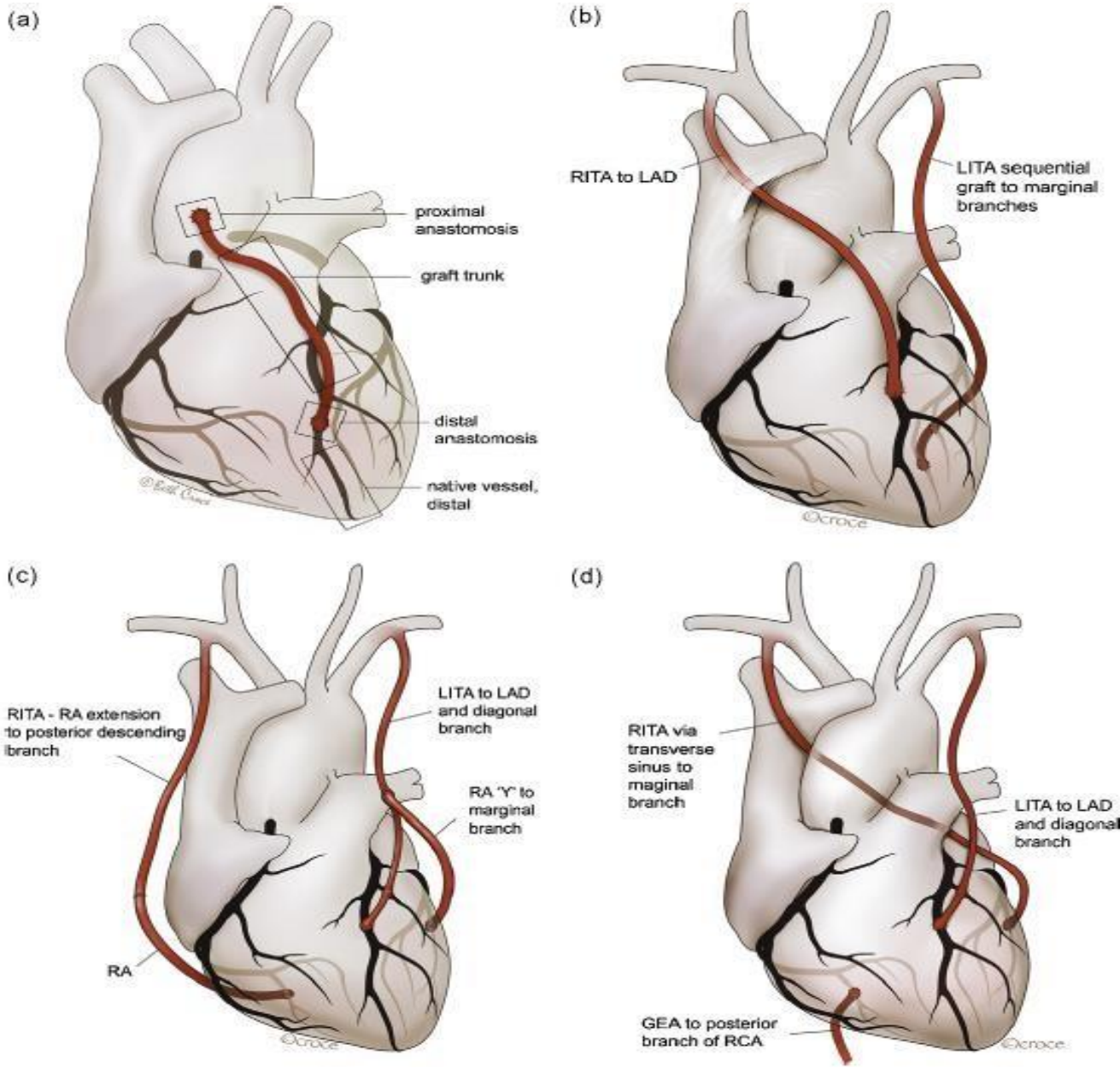
- Using two conduit together is better than a single one, for example :
- using BITA (bilateral internal thoracic artery) is better than SITA (single internal thoracic artery).
- Important note! BIMA and BITA are the same anatomically its just differences in regional naming.



Arterial conduits used for coronary artery bypass grafting

- Internal Thoracic Artery (the left)
- Radial Artery
- Right Gastroepiploic Artery (only the old surgeons use it)
- Inferior Epigastric Artery
- Others

- We can mix any of the previous conduit for example: LIMA and circumflex and other.
- RIMA can be grafted to the aorta before being used as a conduit to a coronary artery.
- Coronary artery bypass graft is named because we use the coronary artery to bypass the occlusion.



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

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Study or Subgroup	log[Hazard Ratio]	SE	BIMA Total	LIMA Total	Weight	Hazard Ratio IV, Random, 95% CI	Year
Naunheim	-0.288	0.265	100	100	1.7%	0.75 [0.45, 1.26]	1992
Dewar	0.01	0.272	377	765	1.6%	1.01 [0.59, 1.72]	1995
Pick	-0.198	0.247	160	161	1.9%	0.82 [0.51, 1.33]	1997
Buxton	-0.342	0.127	1269	1557	4.9%	0.71 [0.55, 0.91]	1998
Jones	-0.288	0.181	172	338	3.1%	0.75 [0.53, 1.07]	2000
Tarelli	0.02	0.349	150	150	1.0%	1.02 [0.51, 2.02]	2001
Berreklouw	-0.274	0.301	249	233	1.4%	0.76 [0.42, 1.37]	2001
Endo	-0.051	0.179	443	688	3.1%	0.95 [0.67, 1.35]	2001
Danzer	-1.347	0.639	382	139	0.3%	0.26 [0.07, 0.91]	2001
Hirotani	-1.386	0.805	179	124	0.2%	0.25 [0.05, 1.21]	2003
Stevens	-0.431	0.106	1808	2498	5.8%	0.65 [0.53, 0.80]	2004
Calafiore	0.642	0.367	570	570	1.0%	1.90 [0.93, 3.90]	2004
Lytle	-0.301	0.071	1152	1152	7.9%	0.74 [0.64, 0.85]	2004
Toumpoulis	-0.117	0.126	490	490	4.9%	0.89 [0.69, 1.14]	2006
Bonacchi	-0.58	0.306	320	332	1.3%	0.56 [0.31, 1.02]	2006
Mohammadi	-3.912	1.528	1388	9566	0.1%	0.02 [0.00, 0.40]	2008
Carrier	-0.431	0.119	1235	5420	5.2%	0.65 [0.51, 0.82]	2009
Kurlansky	-0.186	0.047	2215	2369	9.3%	0.83 [0.76, 0.91]	2010
Kieser	-0.117	0.103	1038	4029	6.0%	0.89 [0.73, 1.09]	2011
Locker	-0.315	0.107	1153	1153	5.8%	0.73 [0.59, 0.90]	2012
Puskas	-0.431	0.155	812	2715	3.8%	0.65 [0.48, 0.88]	2012
Kinoshita	-0.58	0.291	217	217	1.4%	0.56 [0.32, 0.99]	2012
Kelly	-0.198	0.096	1079	6554	6.4%	0.82 [0.68, 0.99]	2012
Joo	-0.01	0.169	366	366	3.4%	0.99 [0.71, 1.38]	2012
Grau	-0.4	0.115	928	928	5.4%	0.67 [0.54, 0.84]	2012
Glineur	-0.301	0.127	297	291	4.9%	0.74 [0.58, 0.95]	2012
Parsa	-0.051	0.065	728	16881	8.2%	0.95 [0.84, 1.08]	2013
Total (95% CI)			**19277**	**59786**	**100.0%**	**0.78 [0.72, 0.84]**	

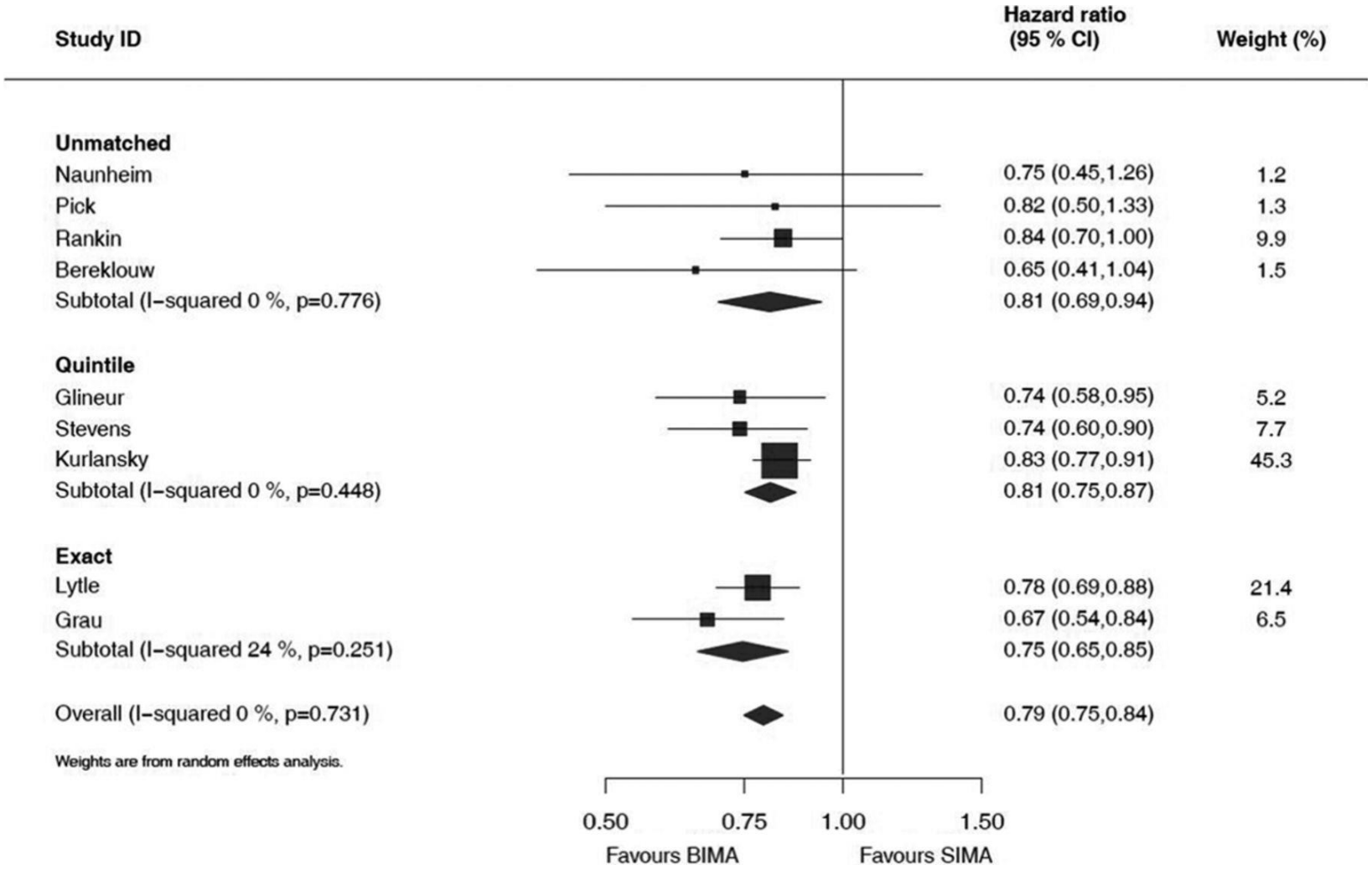
Heterogeneity: Tau² = 0.01; Chi² = 47.10, df = 26 (P = 0.007); I² = 45%
Test for overall effect: Z = 6.61 (P < 0.00001)

Hazard Ratio IV, Random, 95% CI

0.2 0.5 1 2 5
Favours [BIMA] Favours [LIMA]

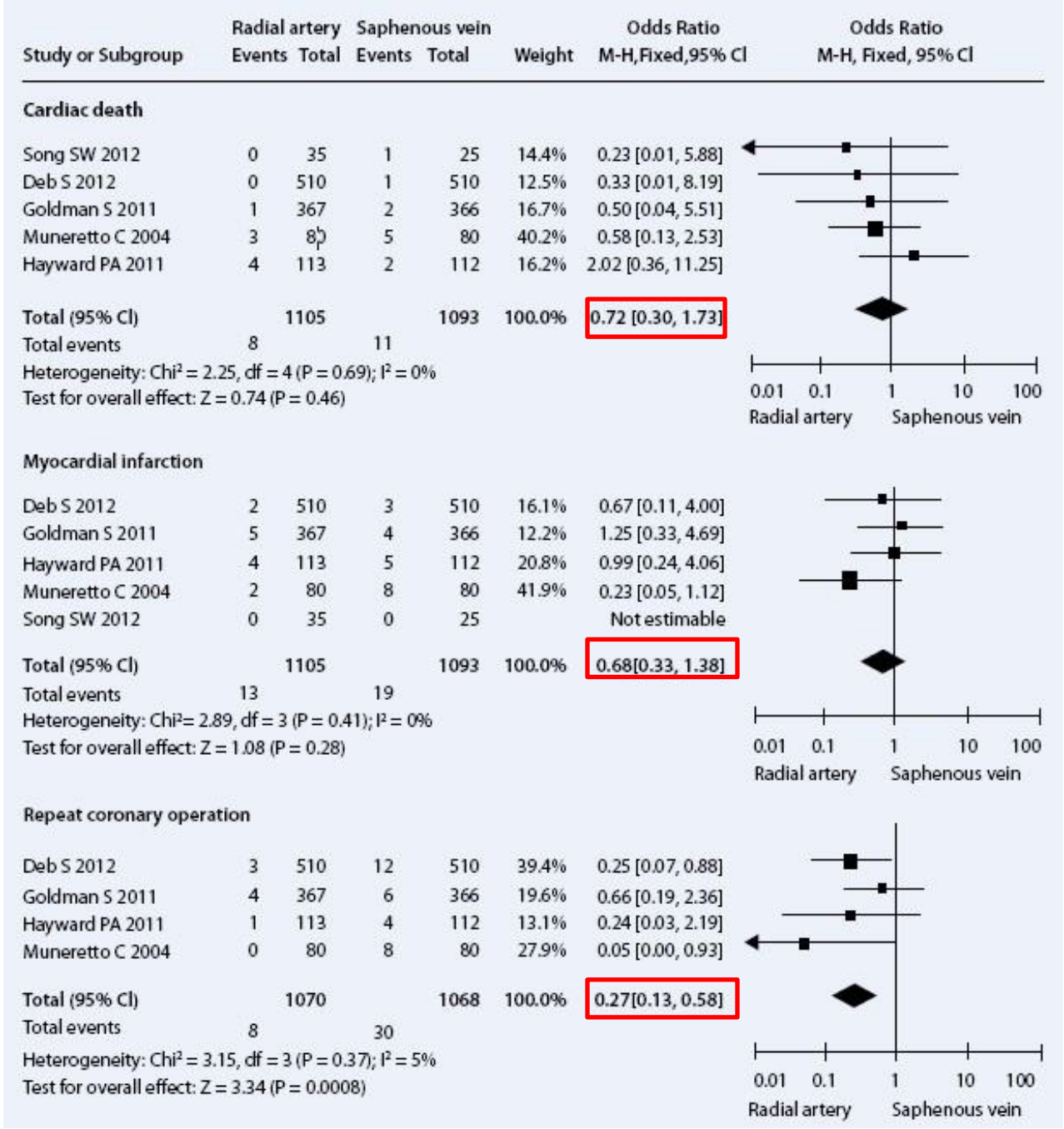
Ann Cardiothorac Surg 2013

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



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

American Heart Association.



Comparison of radial artery versus saphenous vein for clinical outcomes

Zhang H. *Herz* 2013

- "Before being dispatched to the hospital, 10–15% of venous conduits develop thrombus."

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 (≥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.)

- surgical site infections in the vein conduits is 1 to 2 %
- If we use BIMA, we need a longer time in the surgery, and we increase the risk of surgical site infection, but we deprive the sternum from blood supply
- So, the complication of the deep surgical site infection in the thorax and sternum, the mortality rate can reach 20-30%
- So, the surgeons are cautious while using BIMA, and take caution of the factors that increase the risk factor (e.g., overweight, uncontrolled diabetes, COPD, smoking and so on…)
- "If the patient's life expectancy is long, we prioritize arterial revascularization due to its superior long-term patency. However, if the life expectancy is short, LIMA toward LAD and to veins grafts may be preferred."

Let's look at these cases

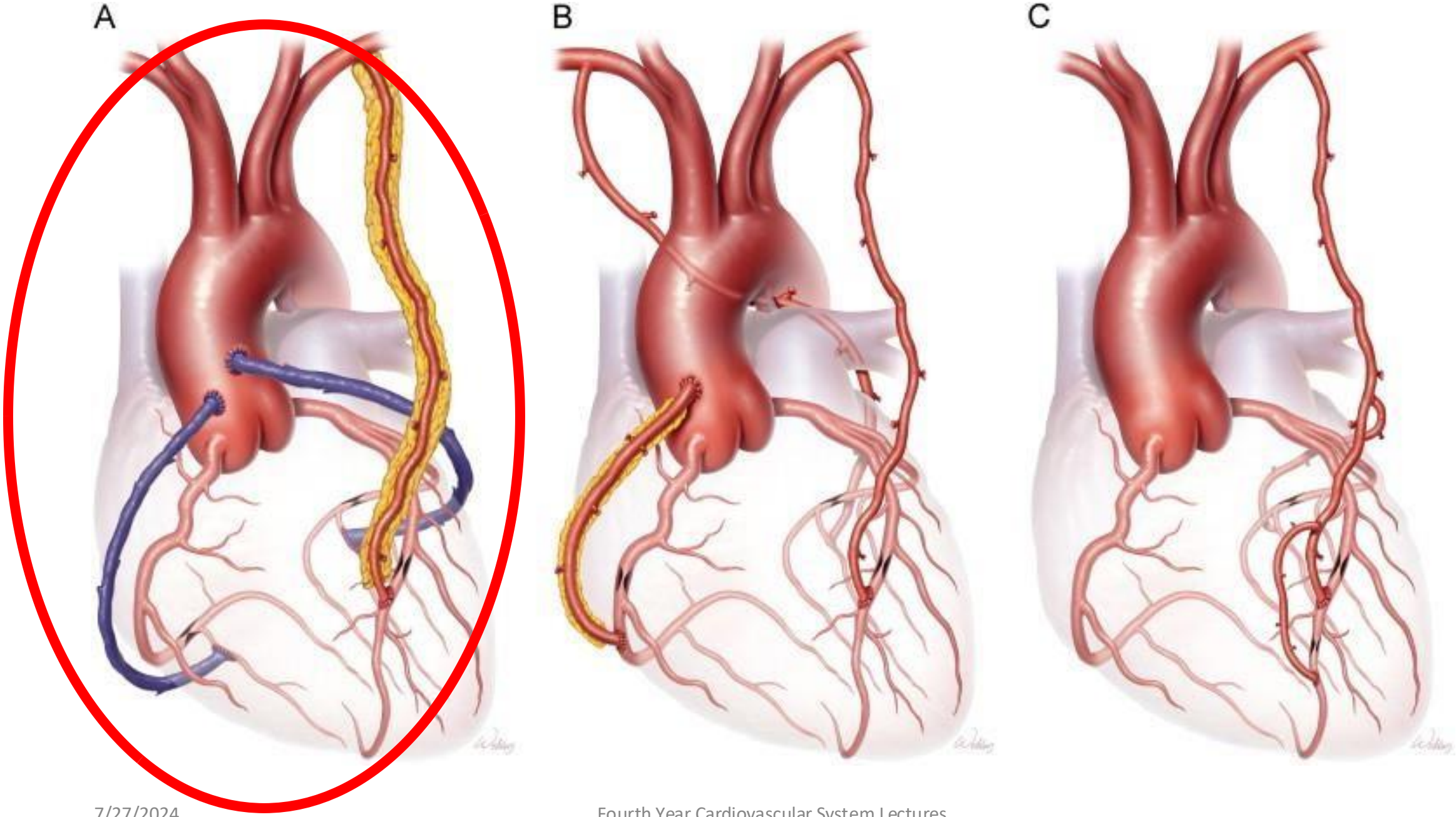
Case2:
75-Year-old Gentleman
Smoker 20 pock year
BMI 35 (obese)
C/O ACS (unstable angina pectoris) →indication for surgery

Medical History
Type 2 DM
Arterial hypertension
Hyperlipidemia

General condition
Smoking
HbA1c 11 (uncontrolled diabetes)

In this case what we will use?

- We have to give all patients LIMA-to-LAD, why? Because its patency is high and have a good survival rate.
- Here in this patient, we also give 2 vein conduit, why? Because the life expectancy is short, his age is 75 (life expectancy in Jordan 72–74 year-old), and have diabetes, COPD, obese, that will increase the surgical site infection at the sternum if we use the BIMA.
- Site infections at the sternum is very hazardous ⚠
- So, for cush patients, when we give vein conduit in 10 years 60-70 % it will be open, with the LIMA-to-LAD it will be sufficient.


A
B
C

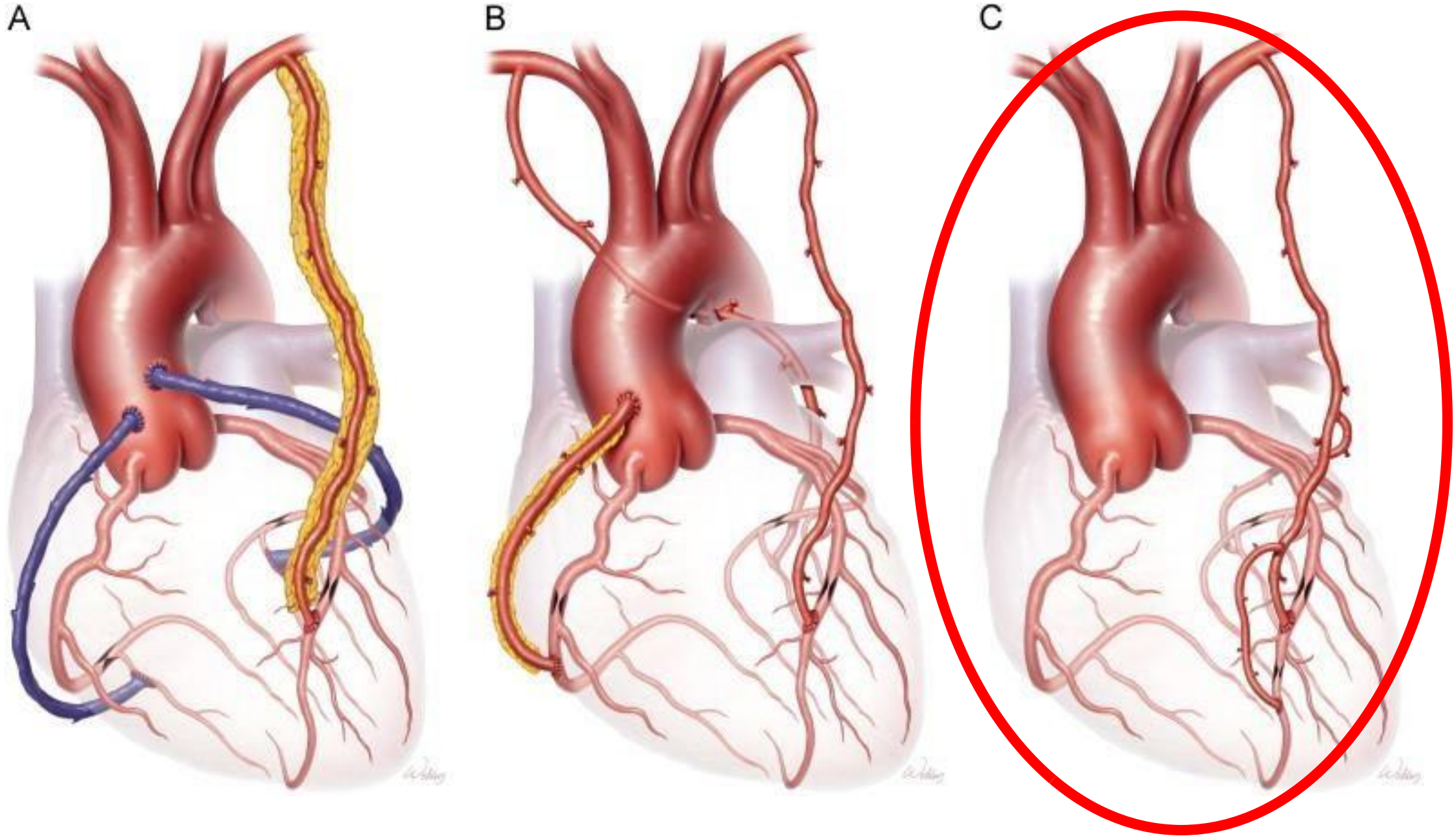
Case3:
45-Year-old Gentleman
Distal LM disease with complex lesion
S/P surgery for varicose viens

Medical History
Arterial hypertention
Hyperlipidemia

Drug history
Statins
ARBs
Anti platelets

In this case what we will use?
Have Distal LM disease with complex lesion so he need a surgery

- This patient have a longer life expectancy so we need a conduit that last more than 20 -30 years, so we search for complete arterial revascularization.
- We use in this case (arterial revascularization)
  LIMA & RIMA in many different combinations, also radial artery have different choices
- This patient can accept the risk for surgical site infection (which increase from 2% to 4%) compared to the huge benefit for the long term conduit.

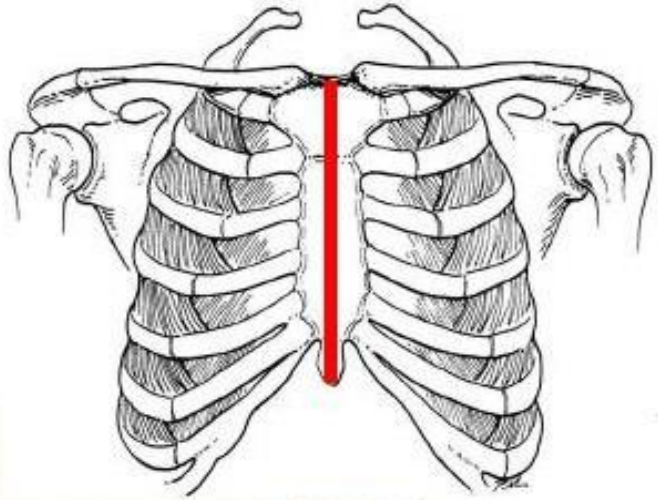

A
B
C

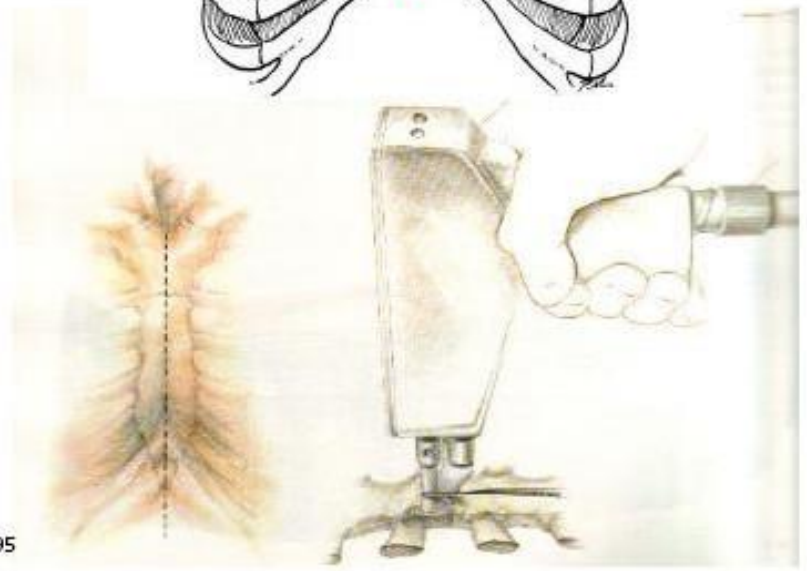
Now let's talk about the surgical techniques:
We start with sternotomy

1. Sterilization of the place and tools
2. Then cut the skin, subcutaneous tissue, and the fatty layer above the sternum
3. The sternum must be opened in midline for better healing
4. We use a variety of drugs, anti-platelet for example
5. Achieving hemostasis is critical to stop bleeding
6. Then we reach the thymus and the pericardium layer which is very thick and cut them
7. We use microscope to see clearly since it's a sensitive procedure

Sternotomy

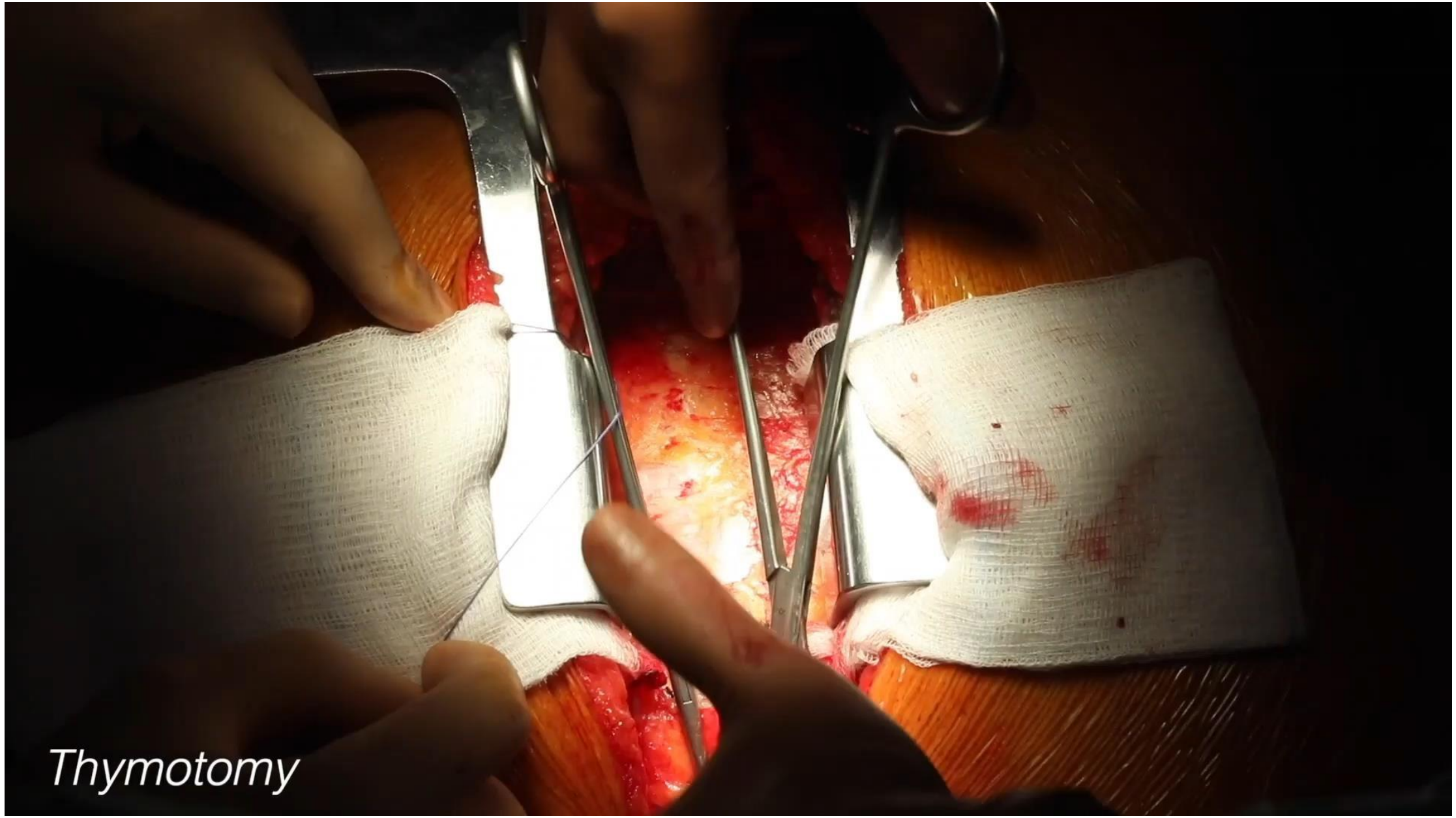
- Sternotomy approach
  - allows almost all cardiac procedures
  - best overall access to the heart
- The sternum is divided with a saw

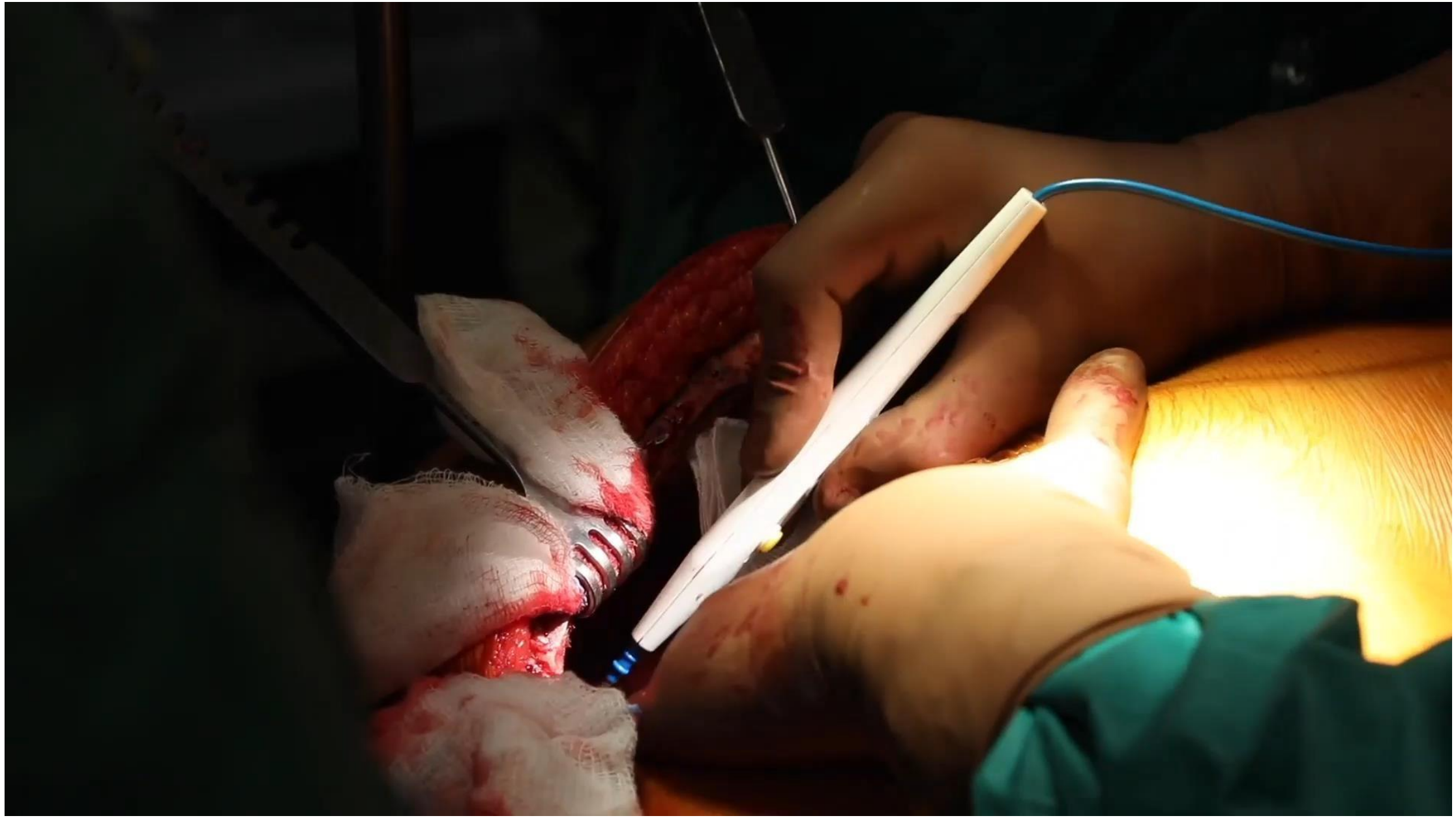


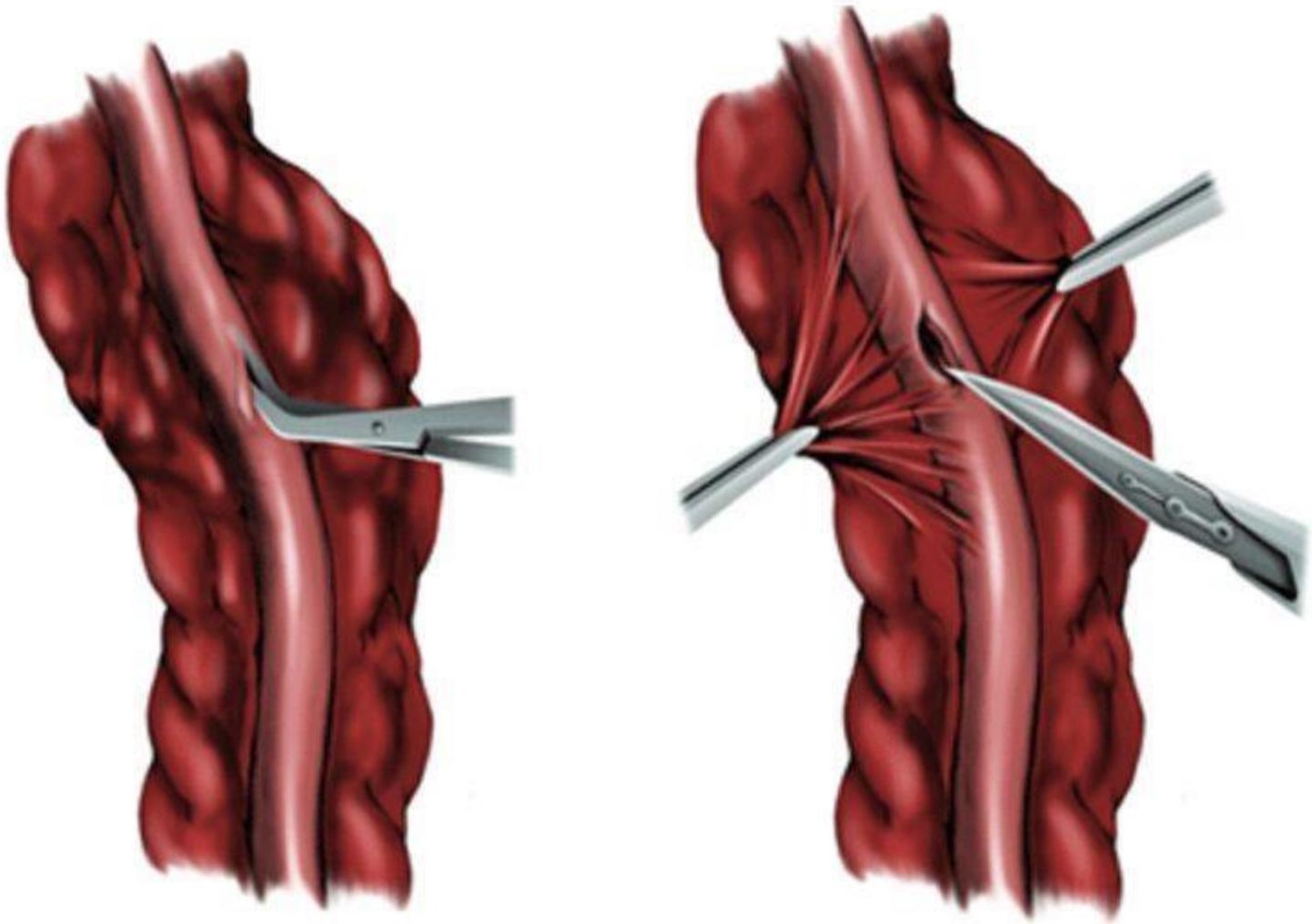


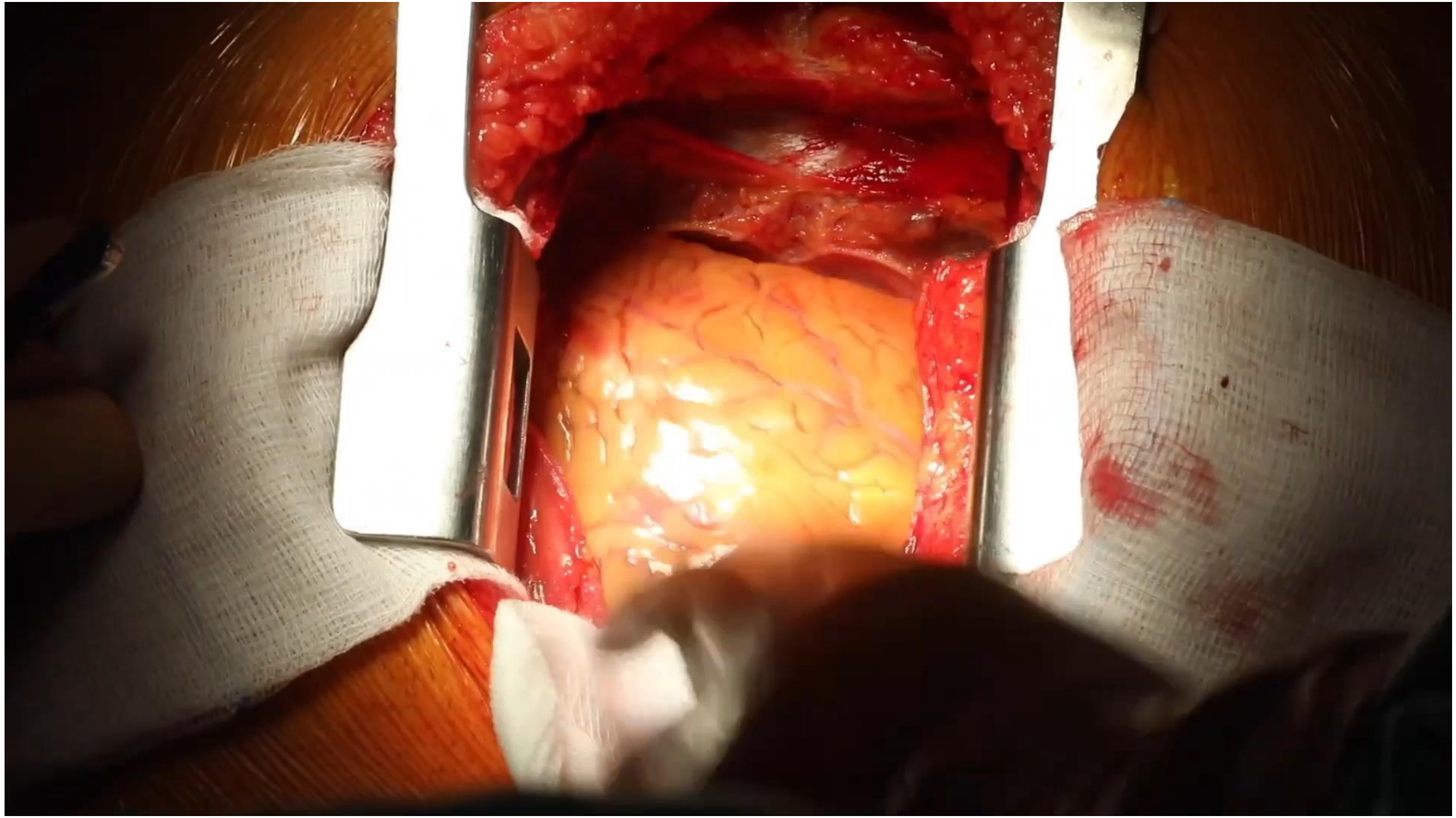
From : Manual of Cardiac Surgery, Harlan & Starr, Springer-Verlag, New York , 1995

- After we have cut all the previous layers, more than one surgeon work together at the same time
- One surgeon will harvest the BITA and another will work on his leg for the long saphenous vain
- That’s why the surgeon love to use LIMA and 2 veins since they can work together and save time
- After we have taken the conduit, we open the coronary artery and anastomose them together by prolene
- We open the vessel 1 -2 mm And suture it
- We use heart-lung machine to maintain the blood supply

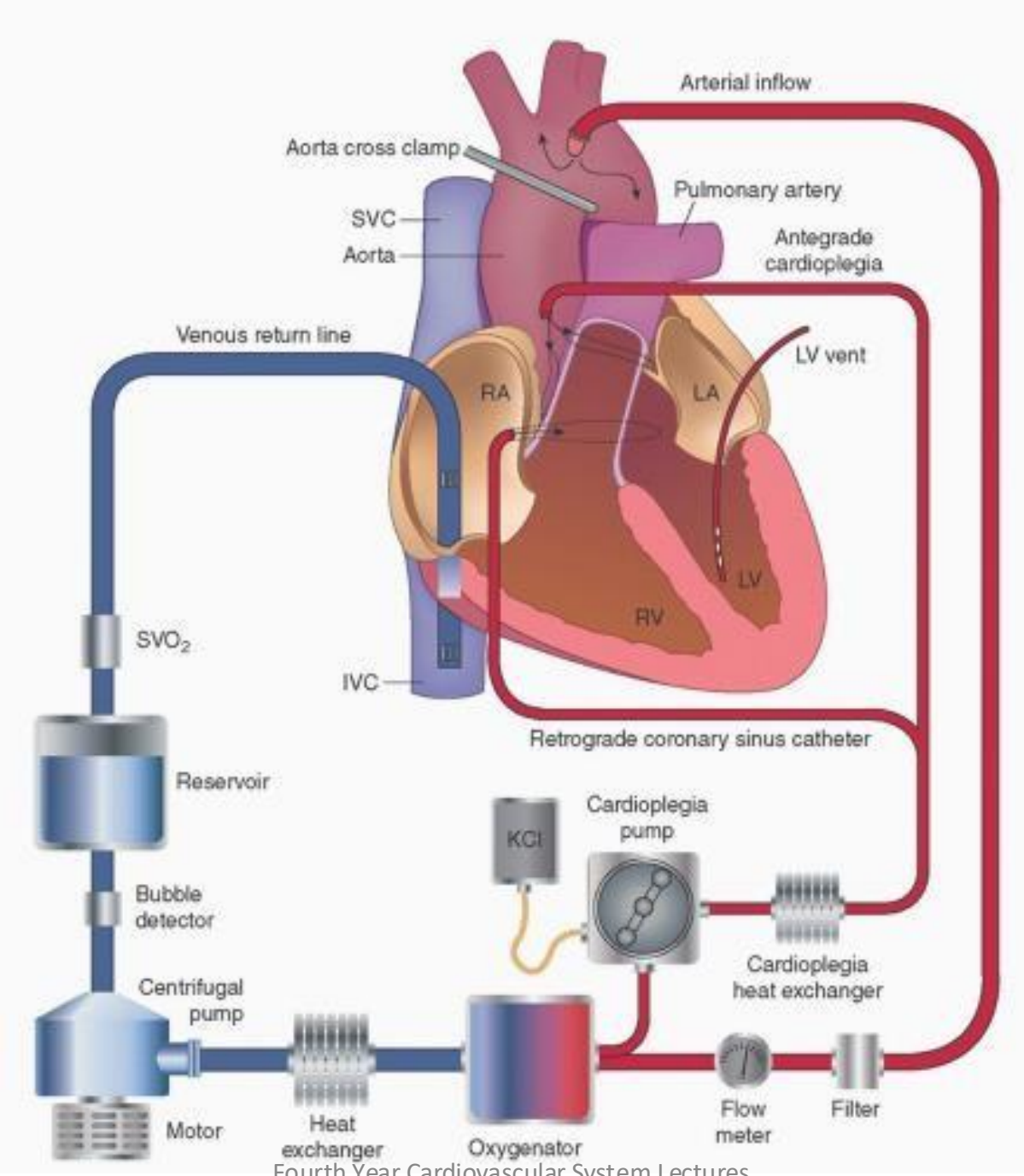

Thymotomy

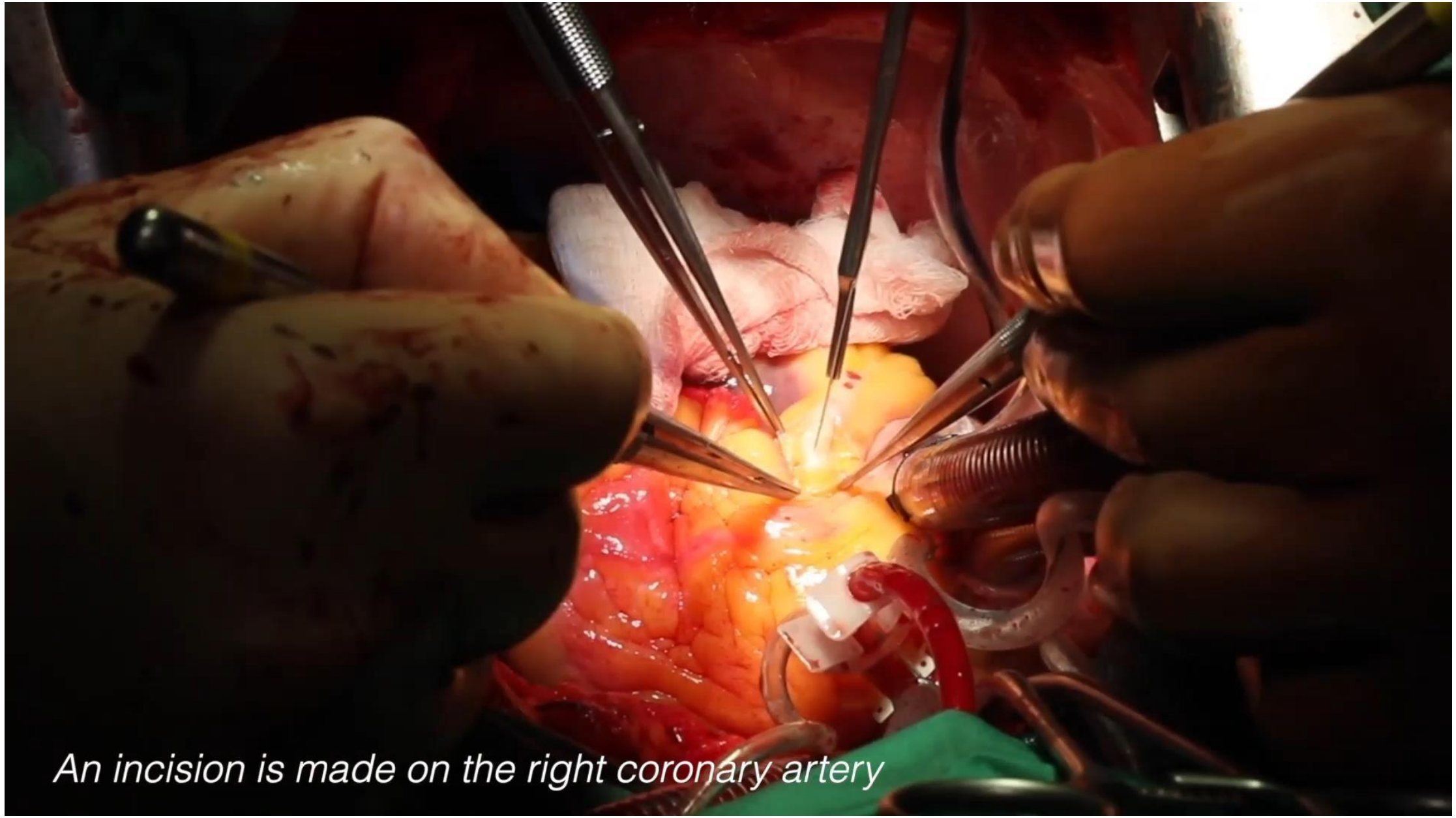






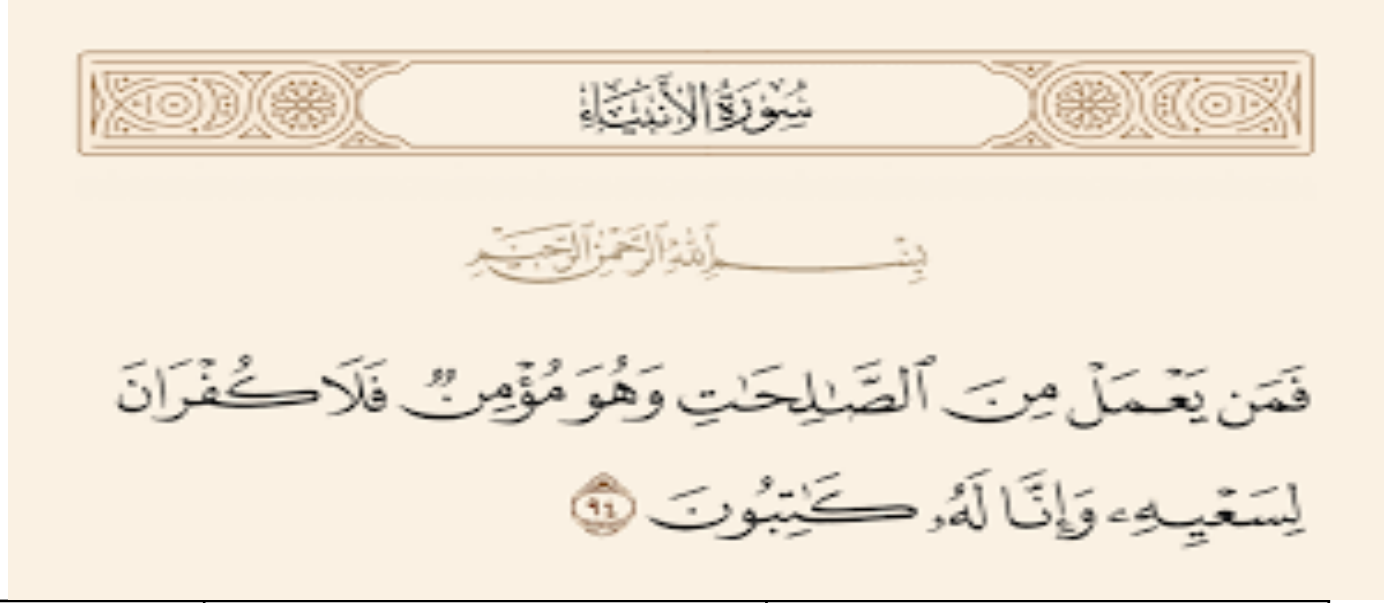
Heart Lung Machine


Arterial inflow
Aorta cross clamp
Pulmonary artery
SVC
Aorta
Antegrade cardioplegia
Venous return line
LV vent
RA
LA
LV
RV
SVO_2
IVC
Retrograde coronary sinus catheter
Reservoir
KCl
Cardioplegia pump
Bubble detector
Cardioplegia heat exchanger
Centrifugal pump
Motor
Heat exchanger
Oxygenator
Flow meter
Filter


An incision is made on the right coronary artery

Thank You for Your Attention

Additional sources



VERSIONS	SLIDE #	BEFORE CORRECTION	AFTER CORRECTION
V1→ V2			
V2→V3			

امسح الرمز و شاركنا بأفكارك لتحسين أدائنا!!