Amjad Bani Hani

CABG

INTRODUCTION

- HISTORY OF CARDIAC SURGERY
- CORONARY ARTERY ANATOMY
- ATHEROSCLEROSIS CAD
- DIAGNOSIS
- MANAGEMENT
- SURGICAL INDICATIONS /TECHNIQUES

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."

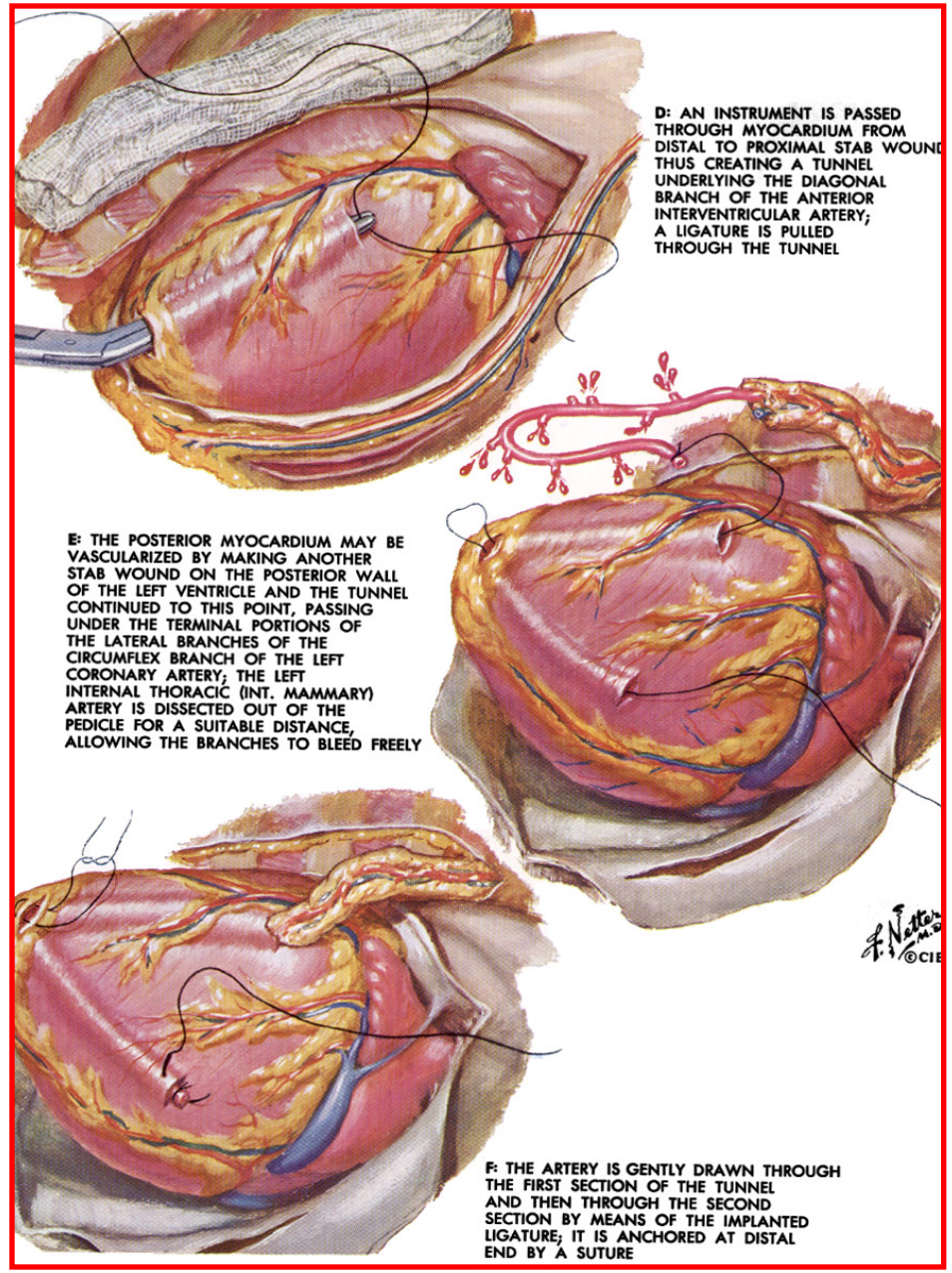
American Surgical Association, 1910

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


D: AN INSTRUMENT IS PASSED THROUGH MYOCARDIUM FROM DISTAL TO PROXIMAL STAB WOUND THUS CREATING A TUNNEL UNDERLYING THE DIAGONAL BRANCH OF THE ANTERIOR INTERVENTRICULAR ARTERY; A LIGATURE IS PULLED THROUGH THE TUNNEL
E: THE POSTERIOR MYOCARDIUM MAY BE VASCULARIZED BY MAKING ANOTHER STAB WOUND ON THE POSTERIOR WALL OF THE LEFT VENTRICLE AND THE TUNNEL CONTINUED TO THIS POINT, PASSING UNDER THE TERMINAL PORTIONS OF THE LATERAL BRANCHES OF THE CIRCUMFLEX BRANCH OF THE LEFT CORONARY ARTERY; THE LEFT INTERNAL THORACIC (INT. MAMMARY) ARTERY IS DISSECTED OUT OF THE PEDICLE FOR A SUITABLE DISTANCE, ALLOWING THE BRANCHES TO BLEED FREELY
F: THE ARTERY IS GENTLY DRAWN THROUGH THE FIRST SECTION OF THE TUNNEL AND THEN THROUGH THE SECOND SECTION BY MEANS OF THE IMPLANTED LIGATURE; IT IS ANCHORED AT DISTAL END BY A SUTURE

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."

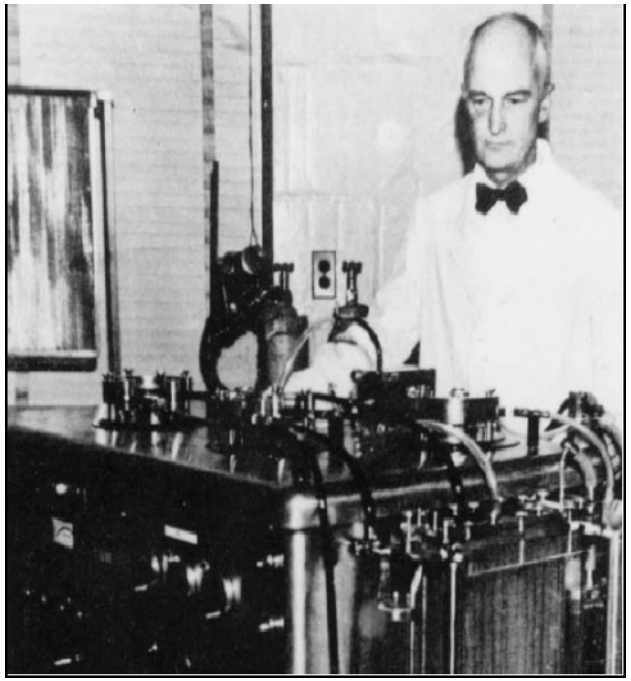
  Floyd Loop, MD

Adult Cardiac Surgery: Ischemic Heart Disease (History)

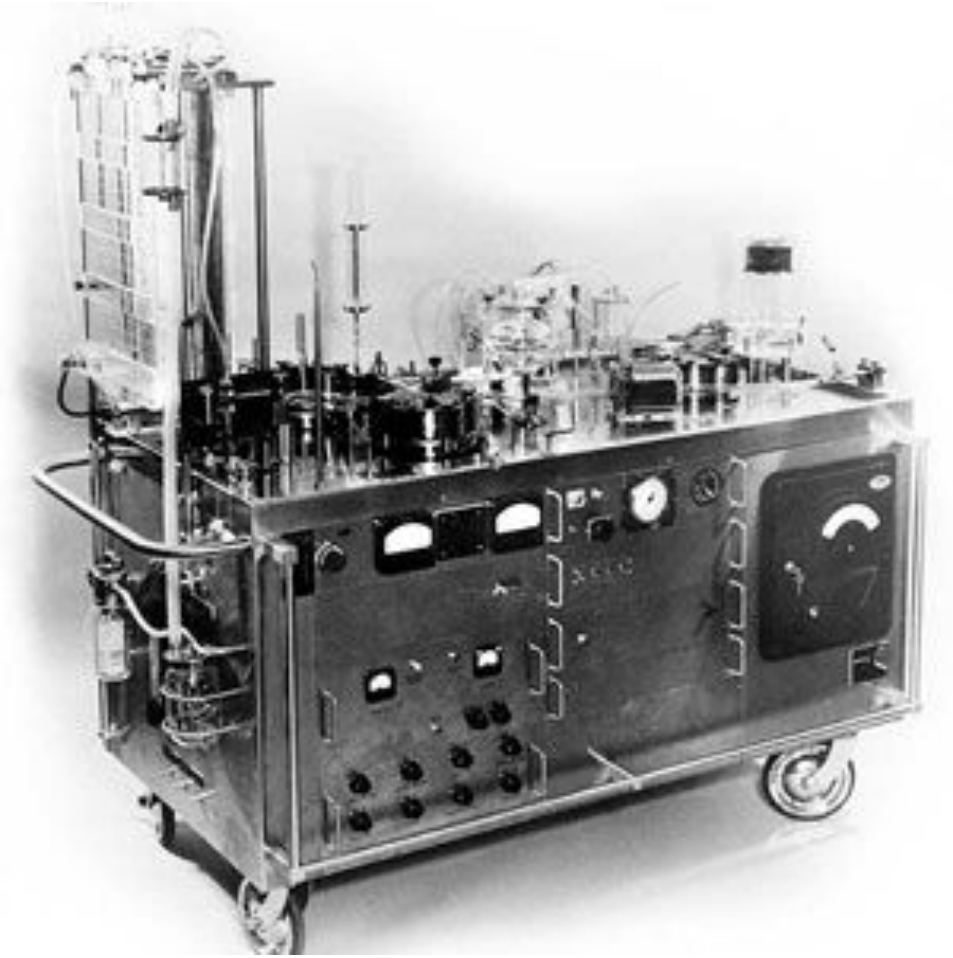
John H. Gibbon, Jr.

"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.

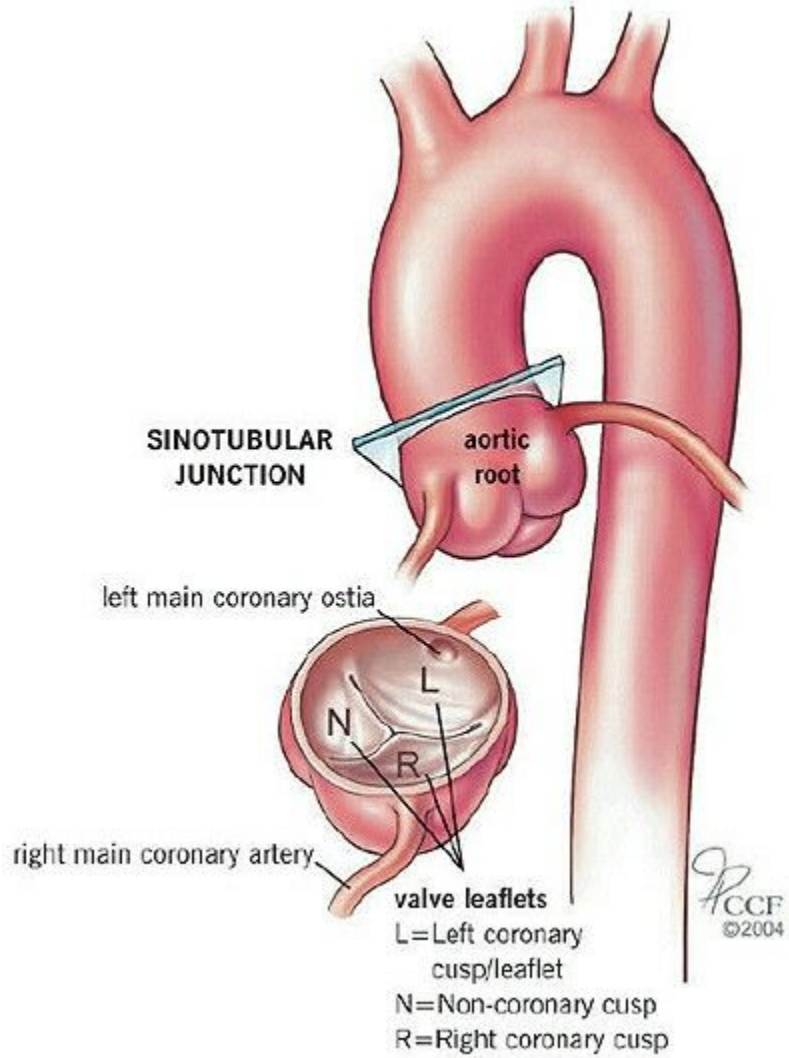
- Best known cooperative studies (1970-80's) were the;

  VA

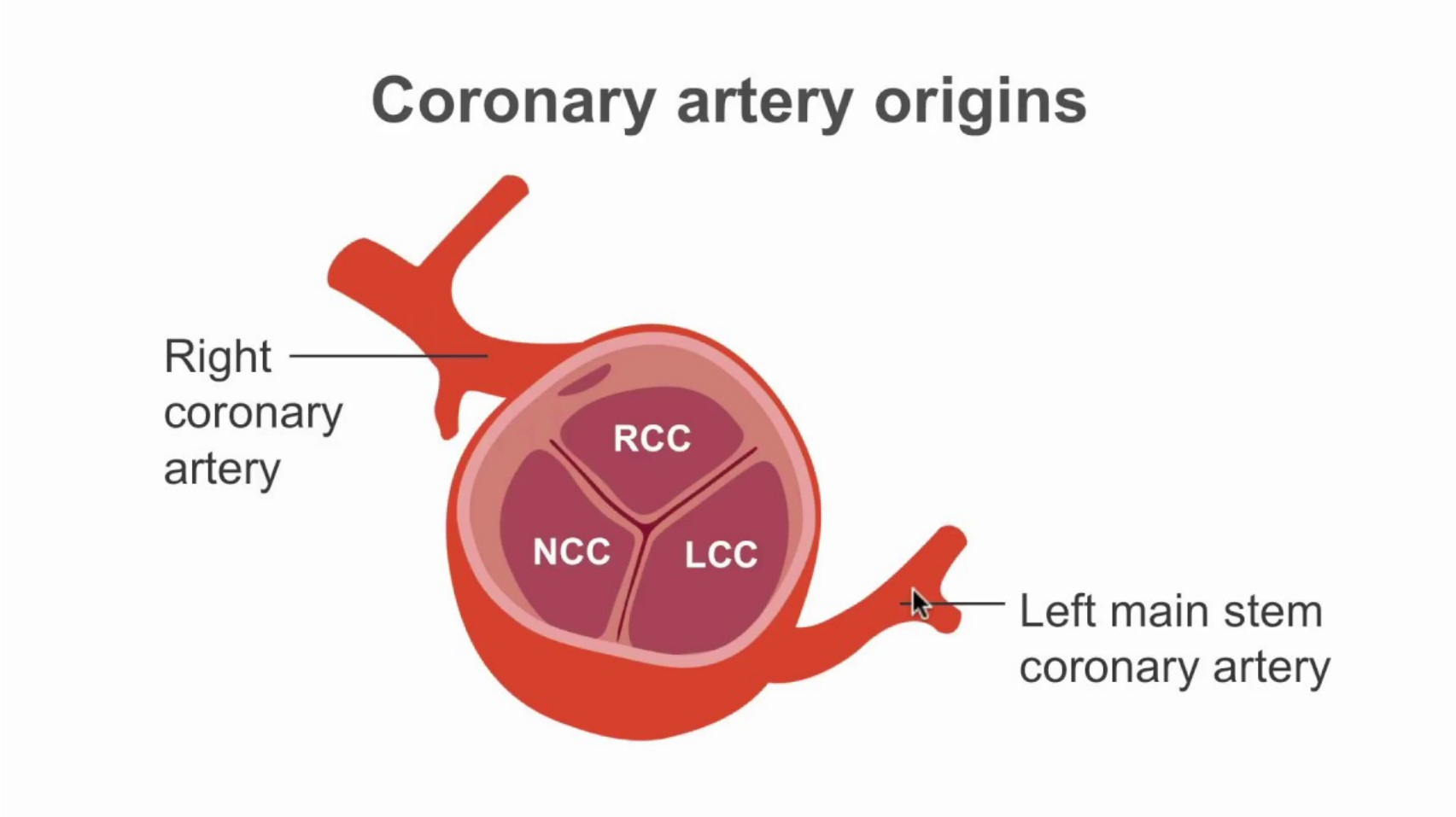
  Coronary **A**rtery **S**urgery **S**tudy

  European Coronary Surgery Study

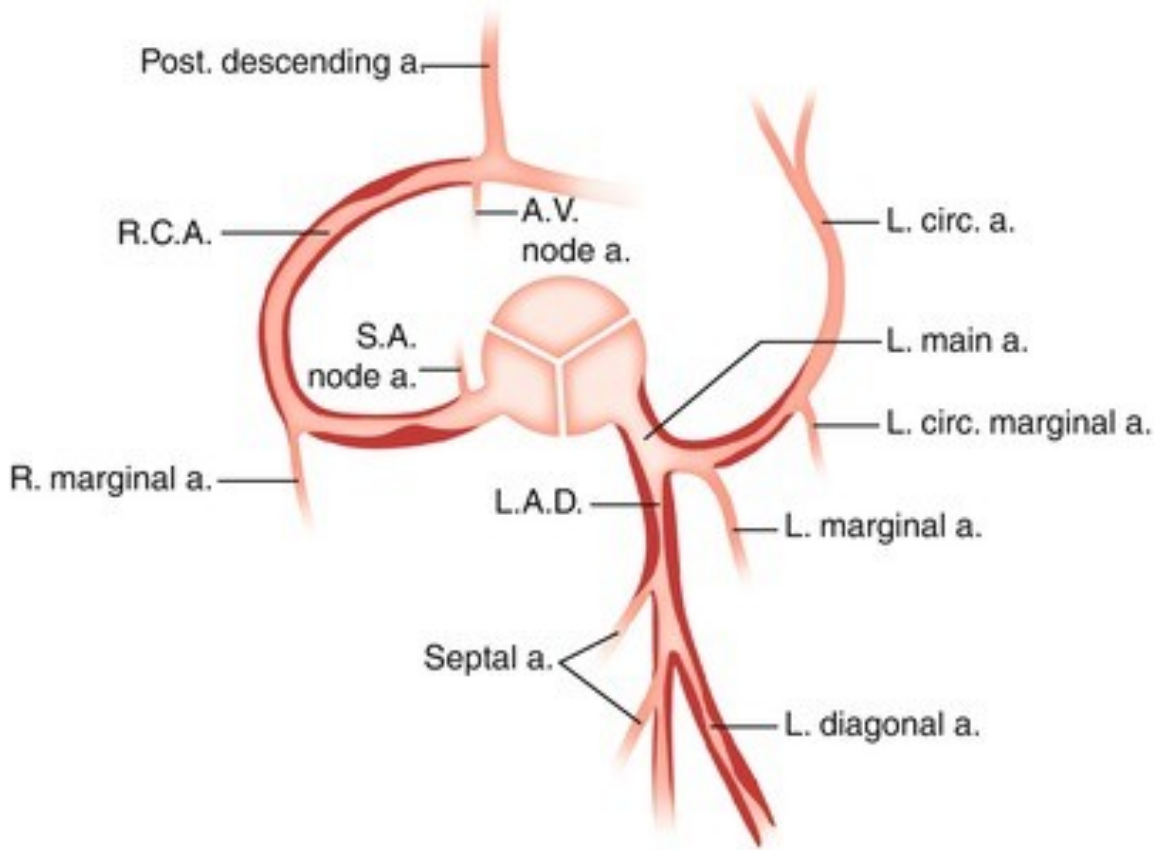
Coronary Anatomy



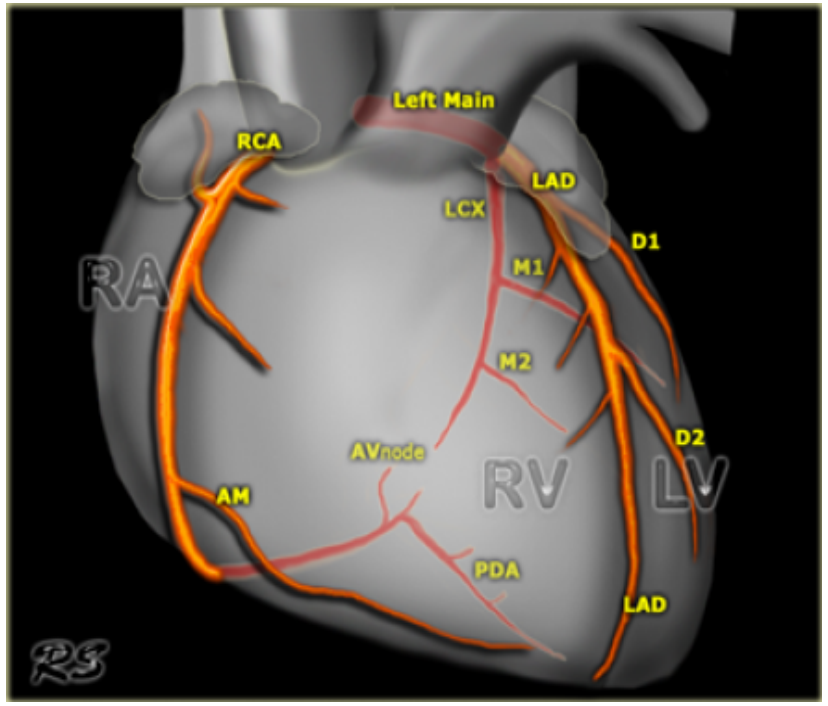
Coronary Anatomy

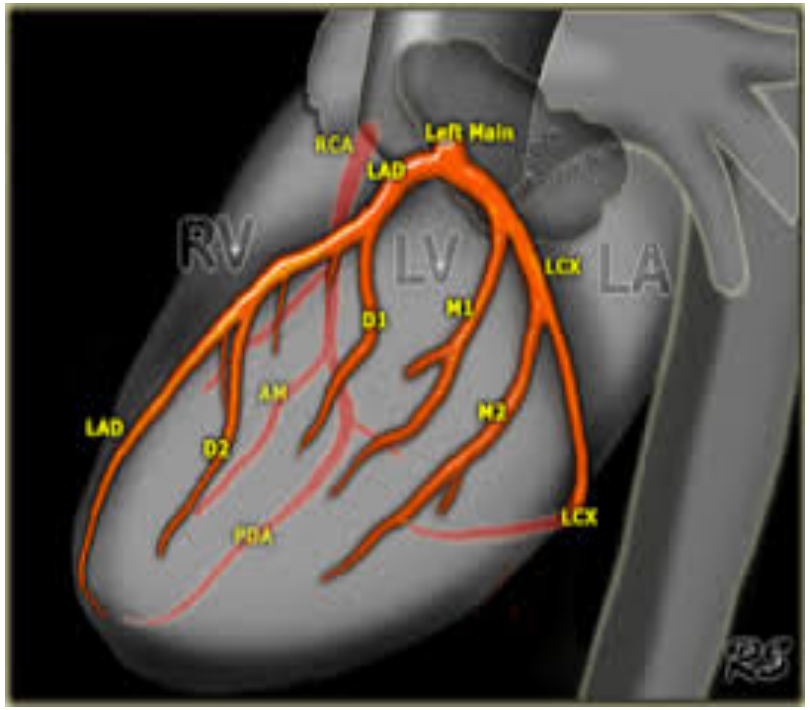


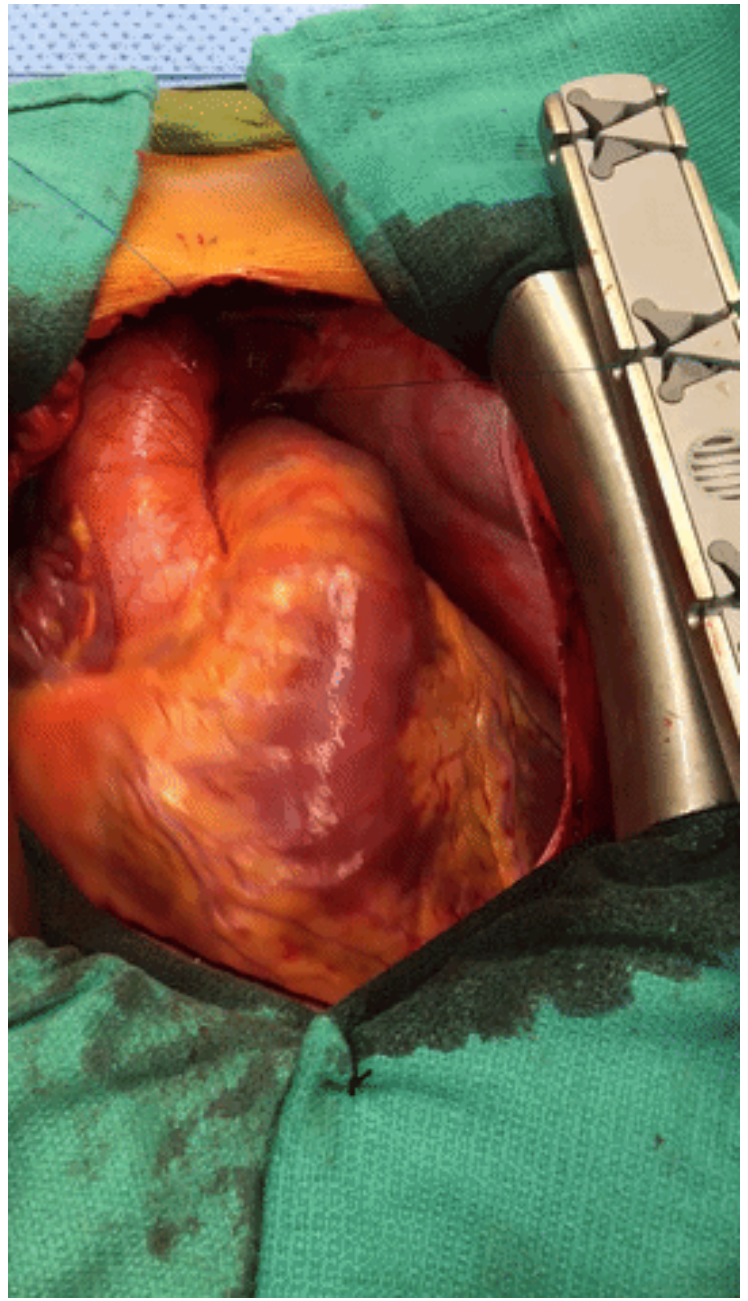
Coronary Anatomy

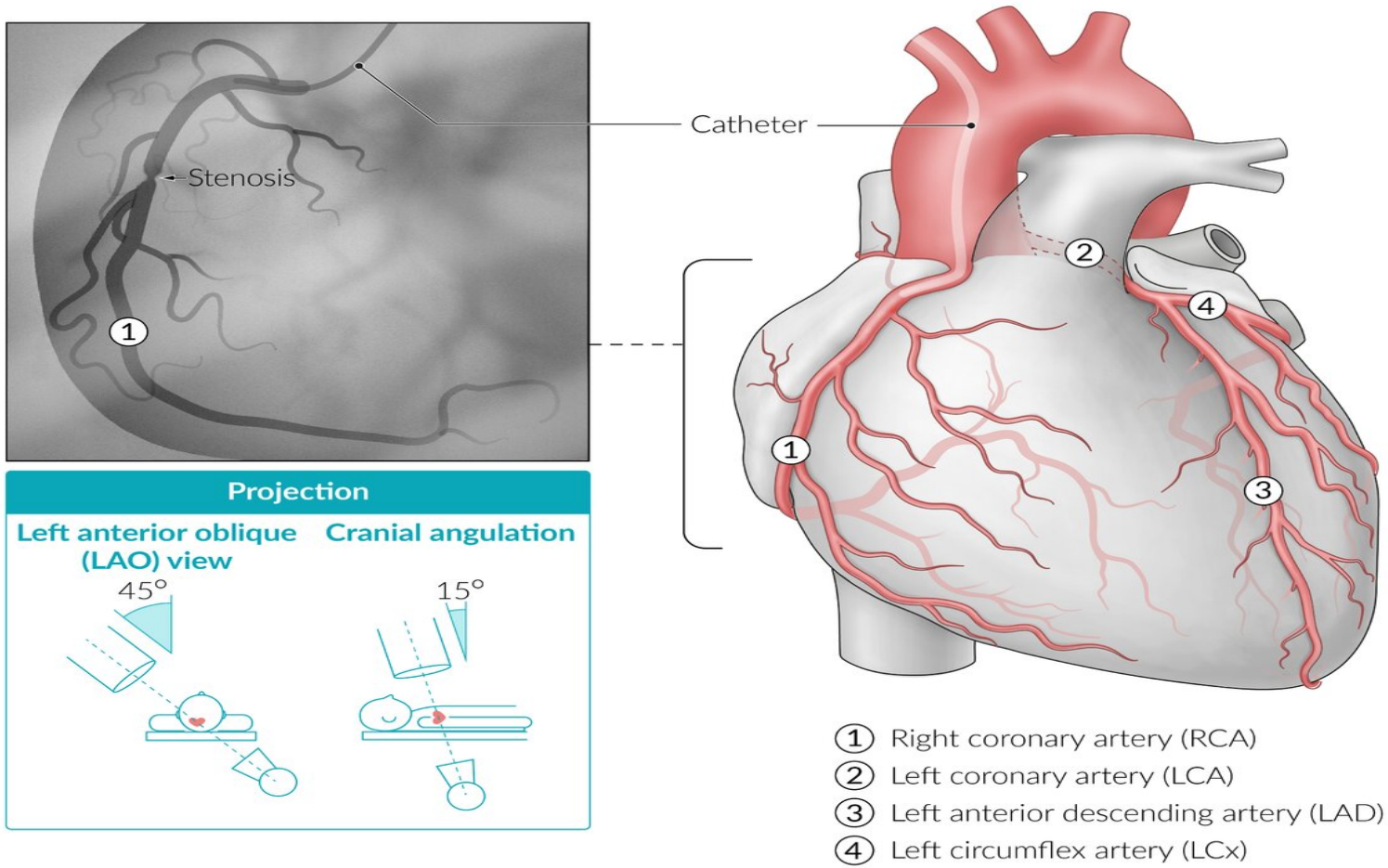


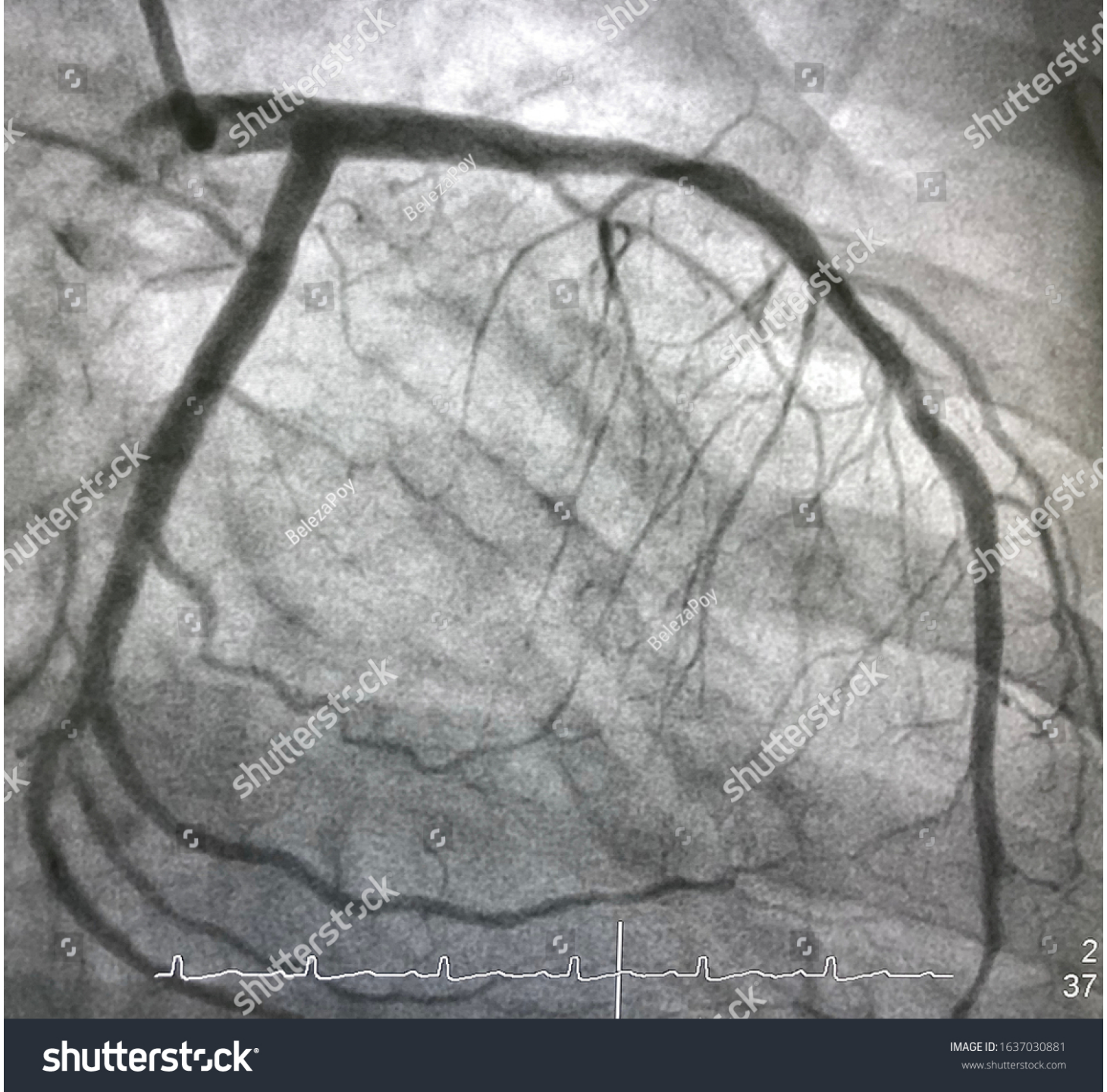
The Normal Heart - Coronary Artery Anatomy








Catheter
Stenosis
1
Projection
Left anterior oblique (LAO) view
45°
Cranial angulation
15°
1
2
3
4
1 Right coronary artery (RCA)
2 Left coronary artery (LCA)
3 Left anterior descending artery (LAD)
4 Left circumflex artery (LCx)




RAO 31 CAUD 20

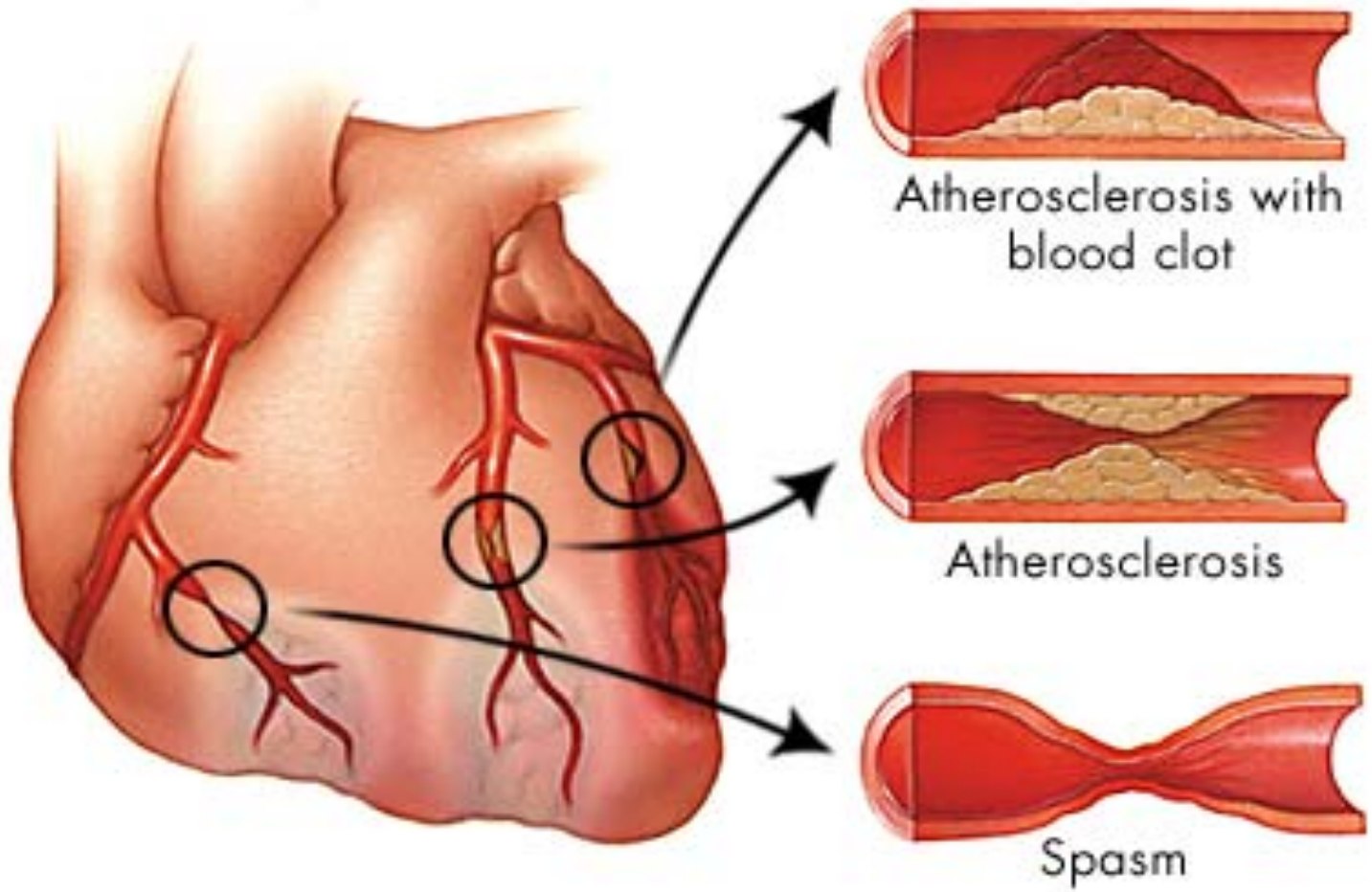

CRA 26.3°
RAO 1.8°

Ischaemic Heart Disease

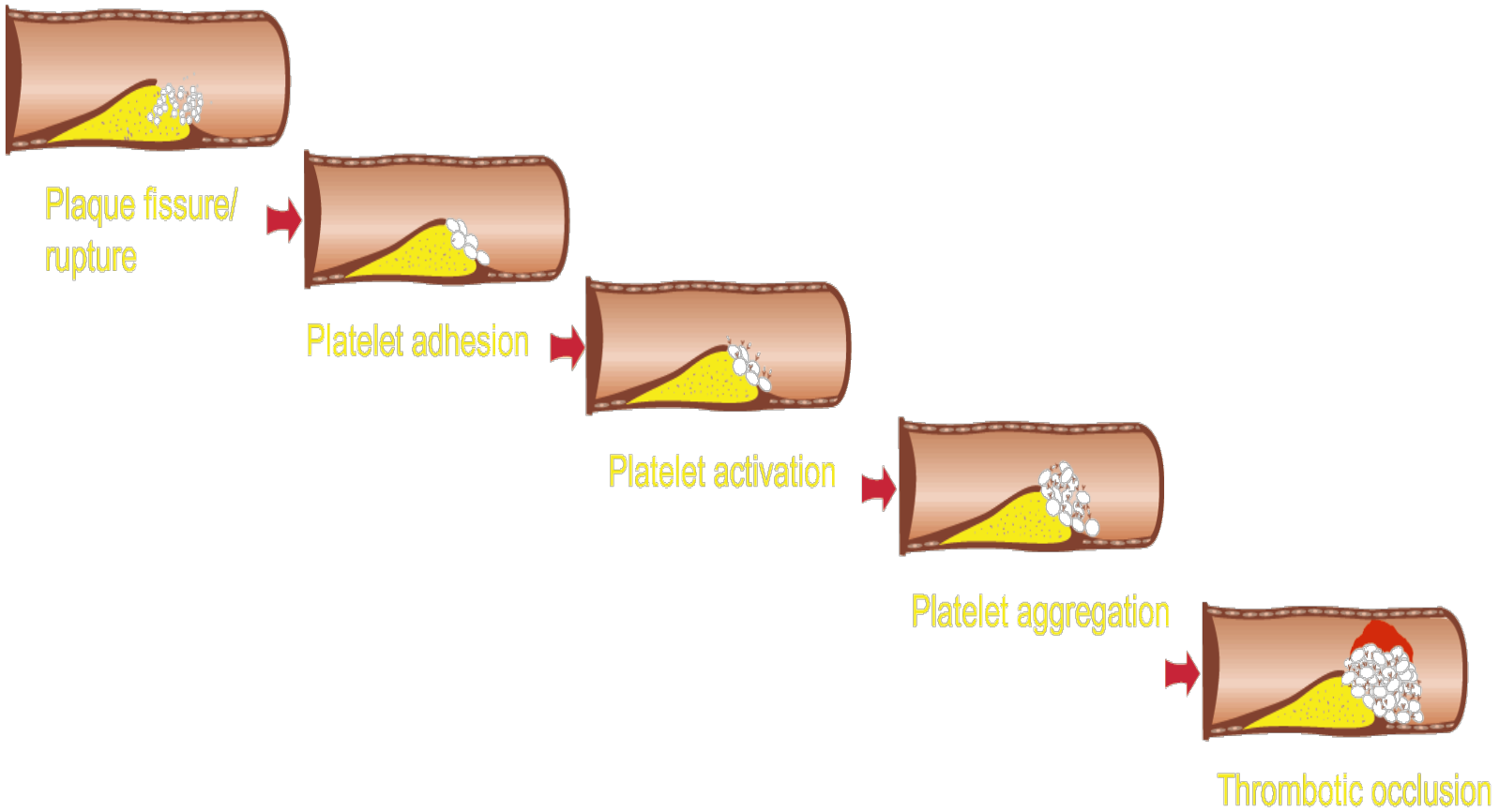
- It results from imbalance between oxygen demand and supply

Aetiology

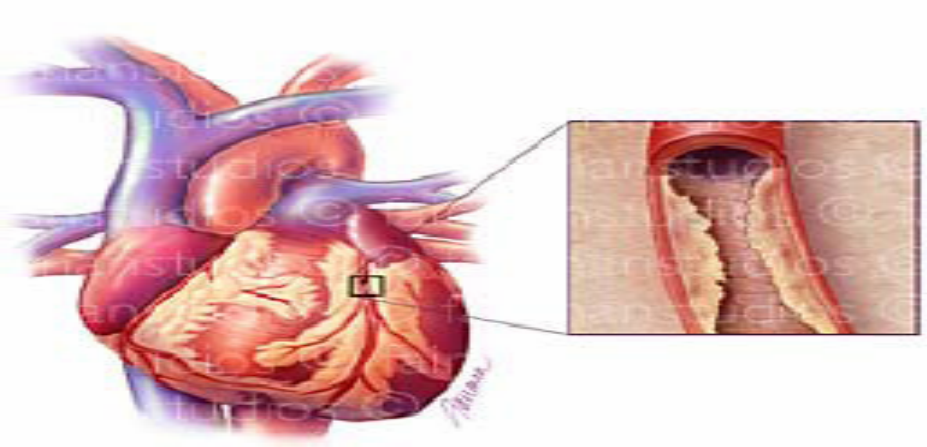
- **Atherosclerosis (>90%)**
- **Embolisation**
- **Coronary spasm**
- **Vasculitis**
- **Ostial stenosis**
- **Severe LVH**
- **Congenital anomalies of the coronary artereis (e.g anomalous origin of LAD artery from pulmonary artery)**


Atherosclerosis with
blood clot
Atherosclerosis
Spasm

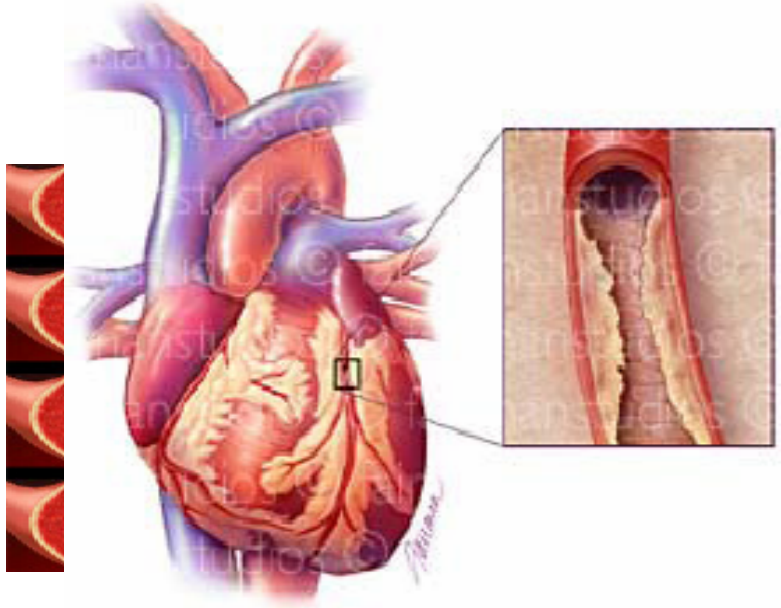
Pathogenesis of ACS

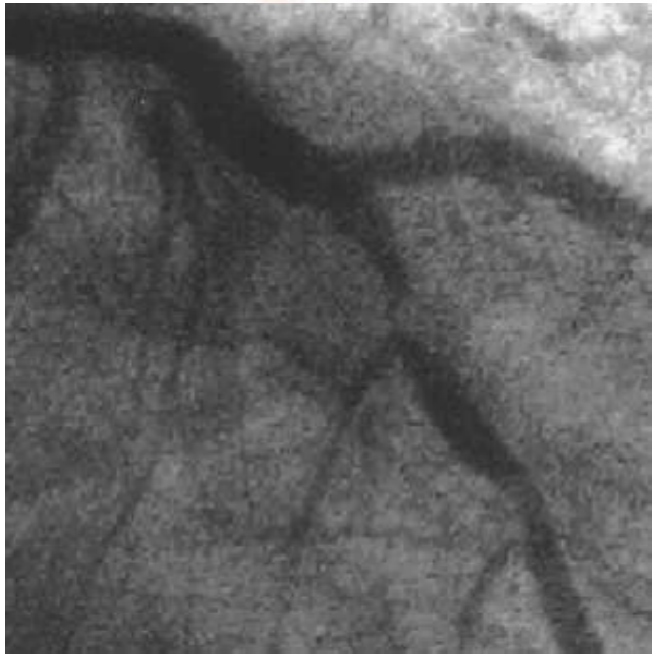


ATHEROSCLEROSIS



ATHEROSCLEROSIS





Risk Factors

Uncontrollable

- Sex
- Hereditary
- Race
- Age

Controllable

- High blood pressure
- High blood cholesterol
- Smoking
- Physical activity
- Obesity
- Diabetes
- Stress and anger

Investigations

- **ECG**
- **Cardiac enzymes**
- **Chest x-ray**
- **FBS**
- **Serum lipids**
- **TMT**
- **Stress or pharmacologic stress myocardial perfusion studies**
- **Cardiac CT-Scan**
- **Coronary angiography**

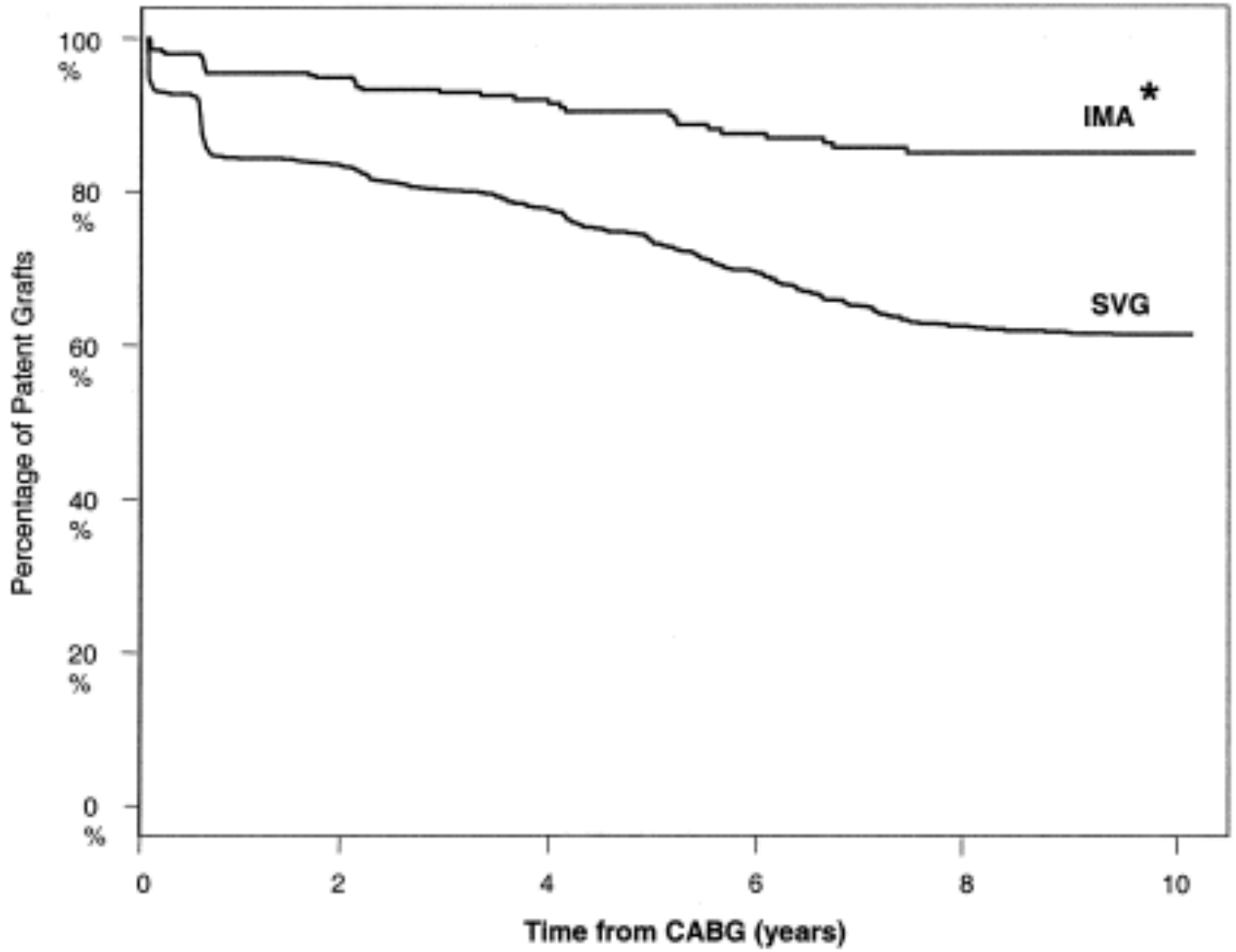
Treatment of CAD

- Nitrates
- Beta blockers
- Aspirin/PLAVIX DUAL ANTIPLATELT THERAPY
- Ca-channel blockers(in coronary spasm)
- Treating the associated risk factors
- Treating the precipitating factor
- Revascularization (if indicated)

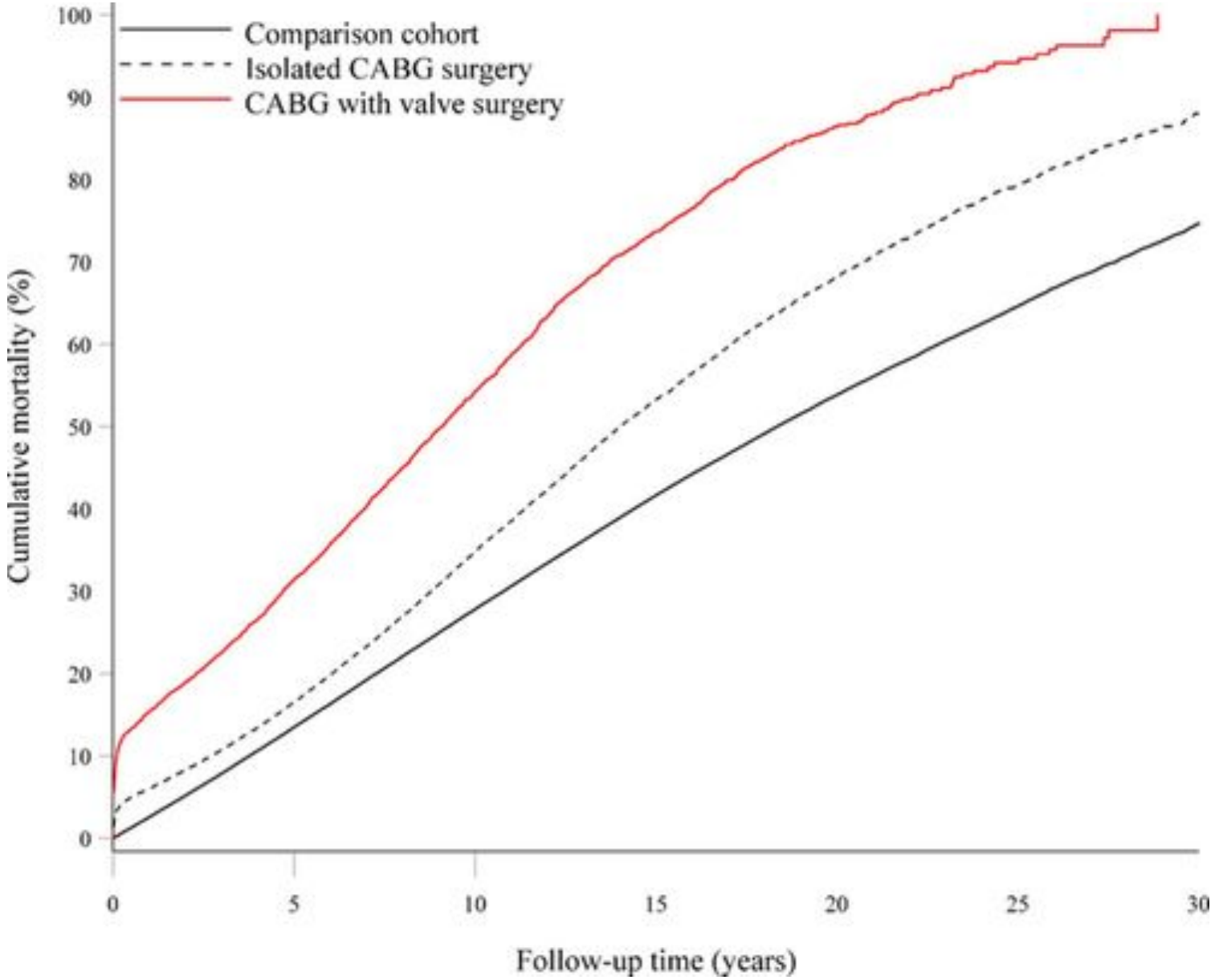
    SURGICAL VS INTERVENTIONAL

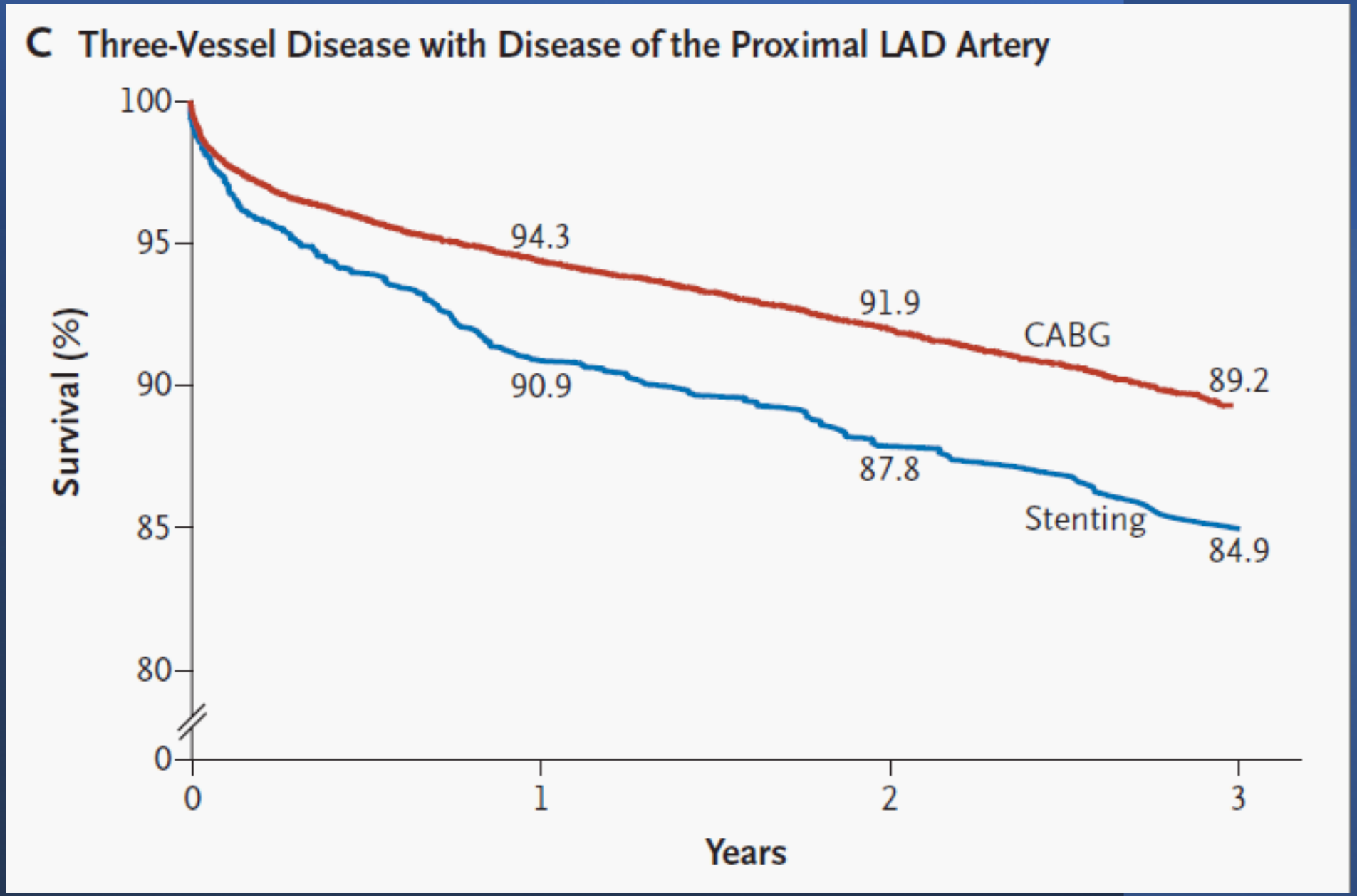
Indications for Coronary Artery Bypass Grafting: (CABG)

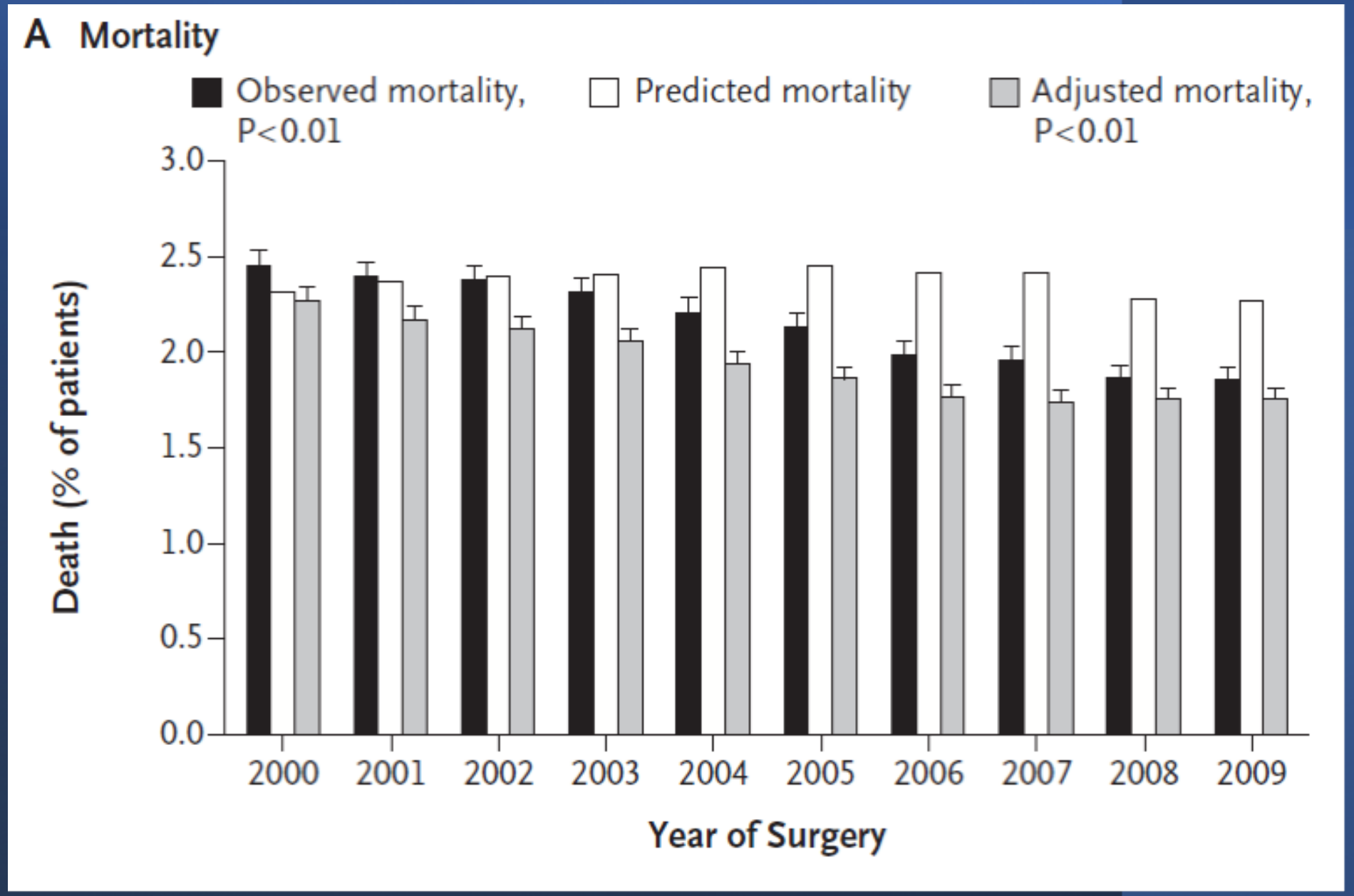
- Triple vessel disease
- Lf main coronary artery disease (Distal)
- Hi risk PCI or not Suitable for PCI
- Complications of PTCA
- Life threatening complications of MI
- Anomalies of Coronary arteries.

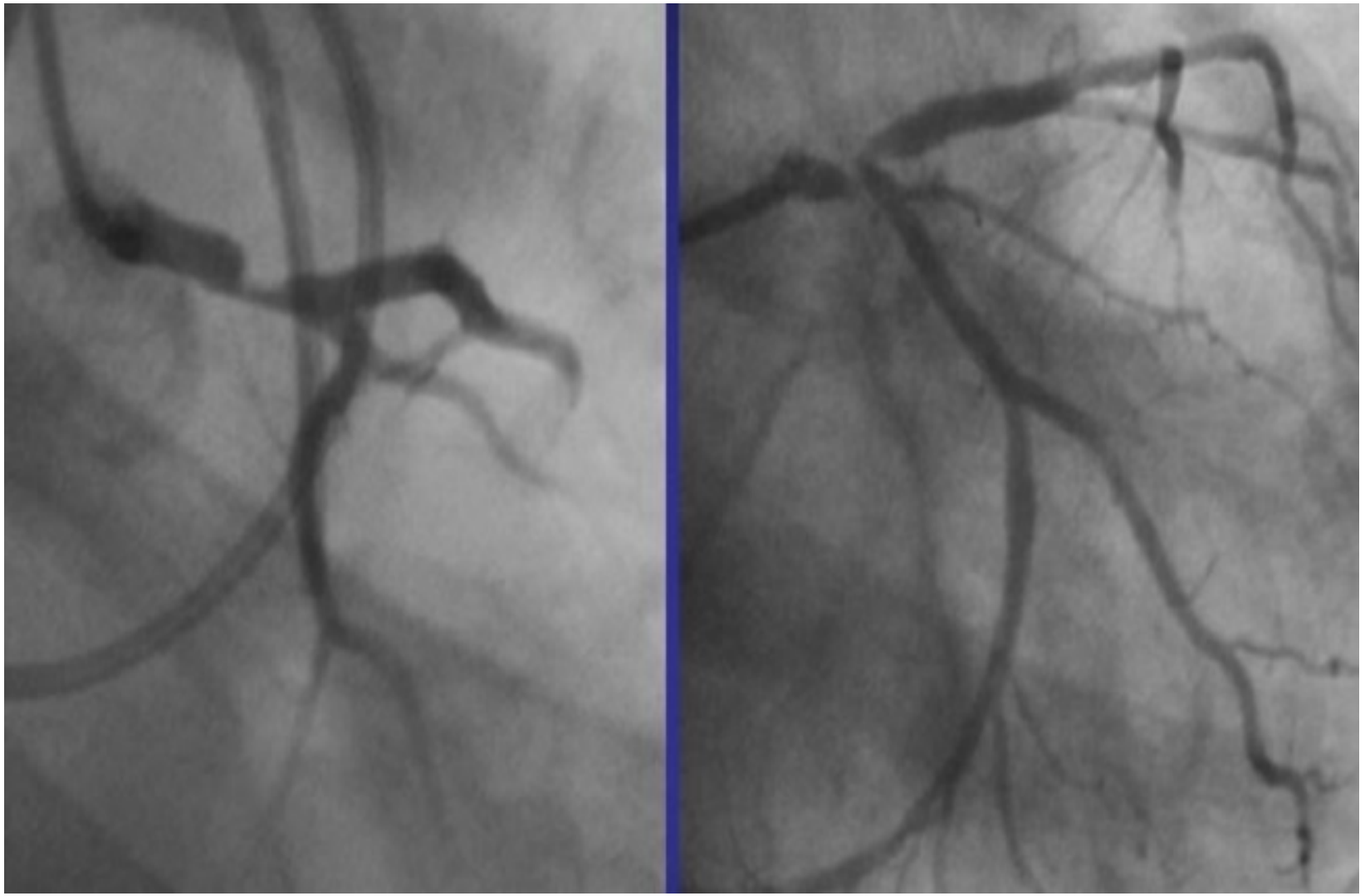


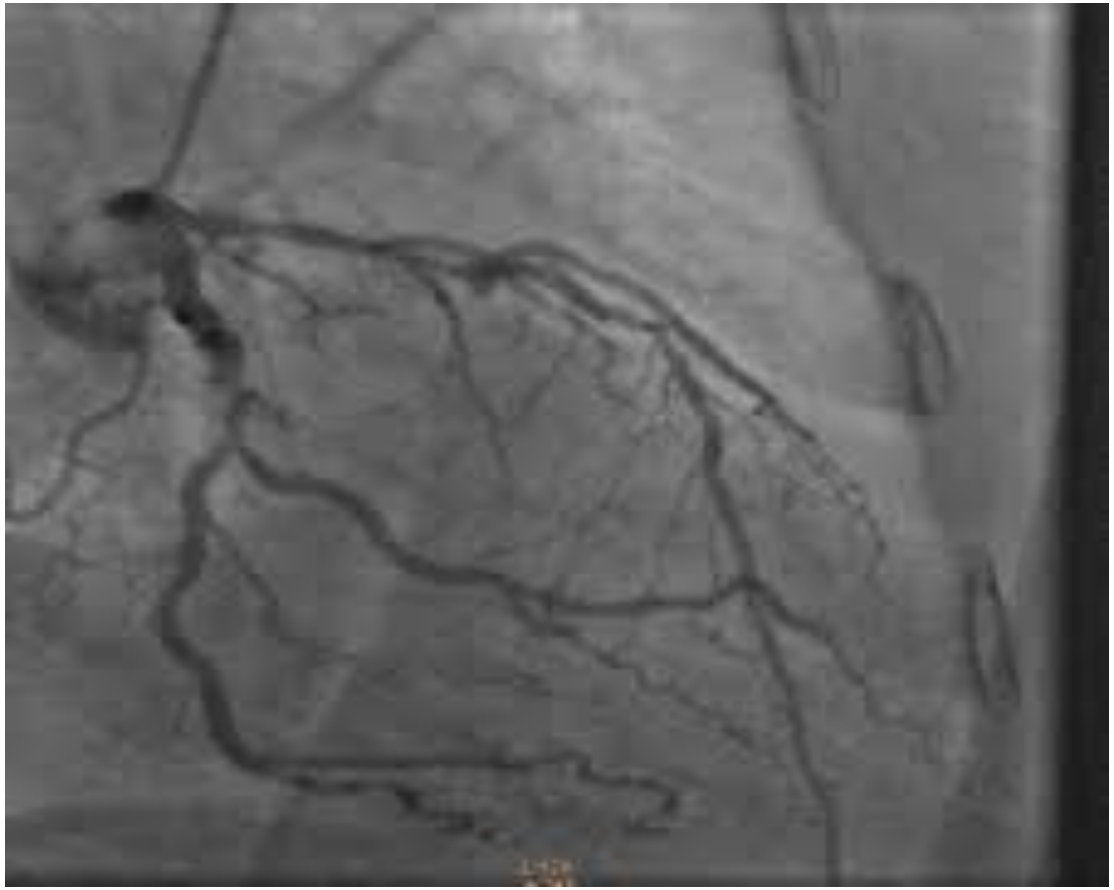
Time	1 Week	1 Year	3 Years	6 Years	10 Years
# Patients	1025	740	484	295	85


Comparison cohort
Isolated CABG surgery
CABG with valve surgery
Cumulative mortality (%)
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
Follow-up time (years)


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


A Mortality
Observed mortality, P<0.01
Predicted mortality
Adjusted mortality, P<0.01
Death (% of patients)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Year of Surgery



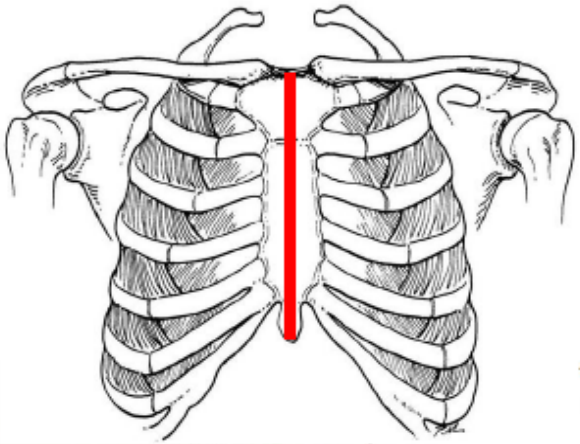


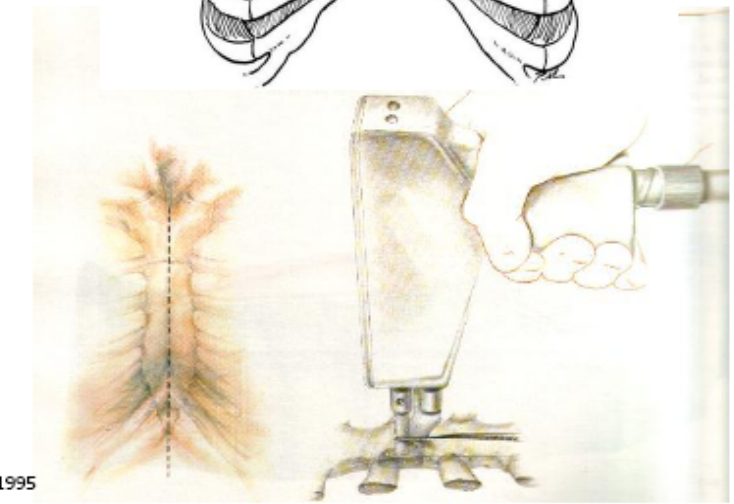
Adult Cardiac Surgery: CABG Techniques

- Median sternotomy
- Cardiopulmonary bypass
- Cardioplegic arrest
- Conduits: Mammary artery, reversed saphenous vein, radial artery.

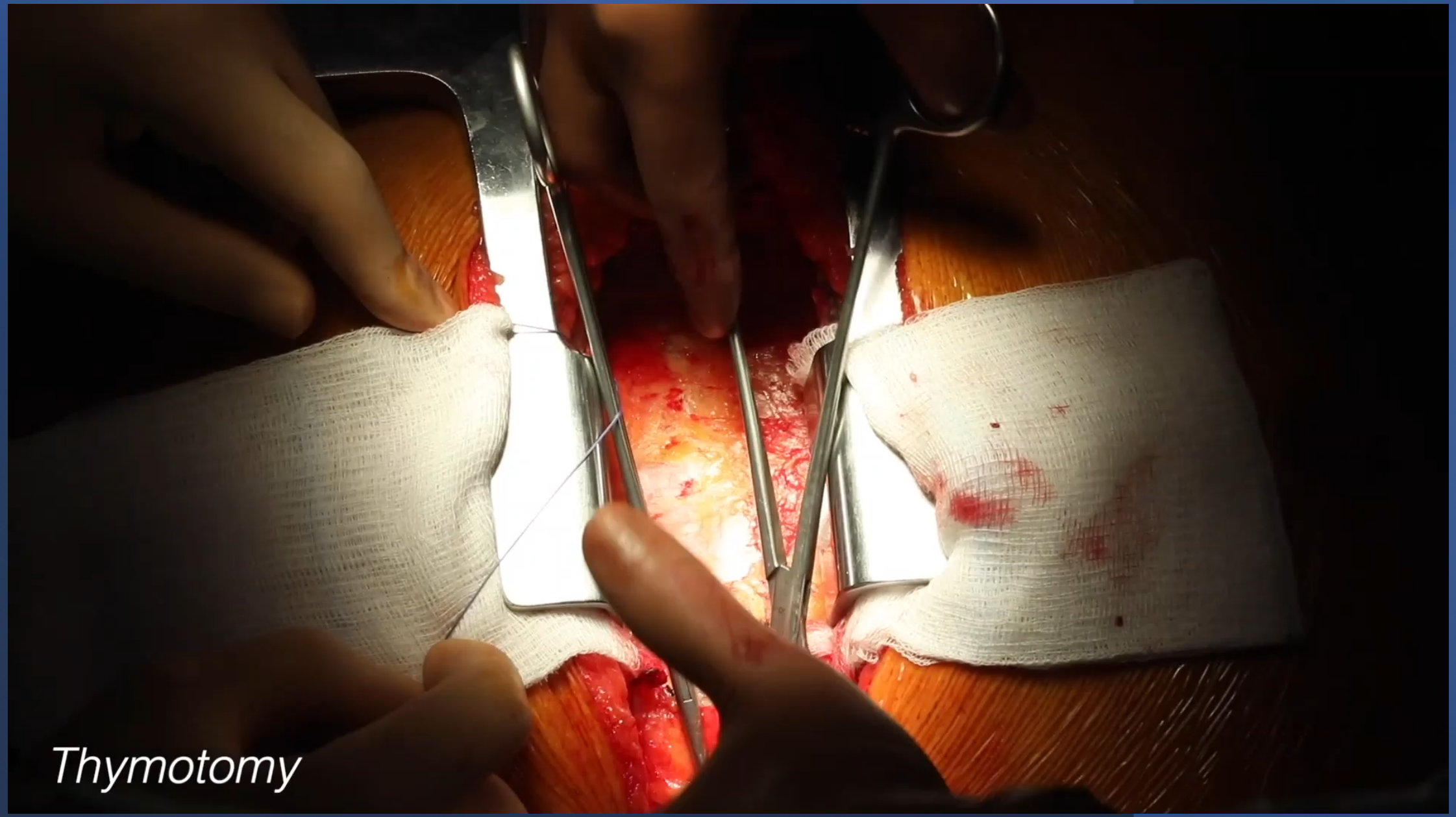
Sternotomy

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

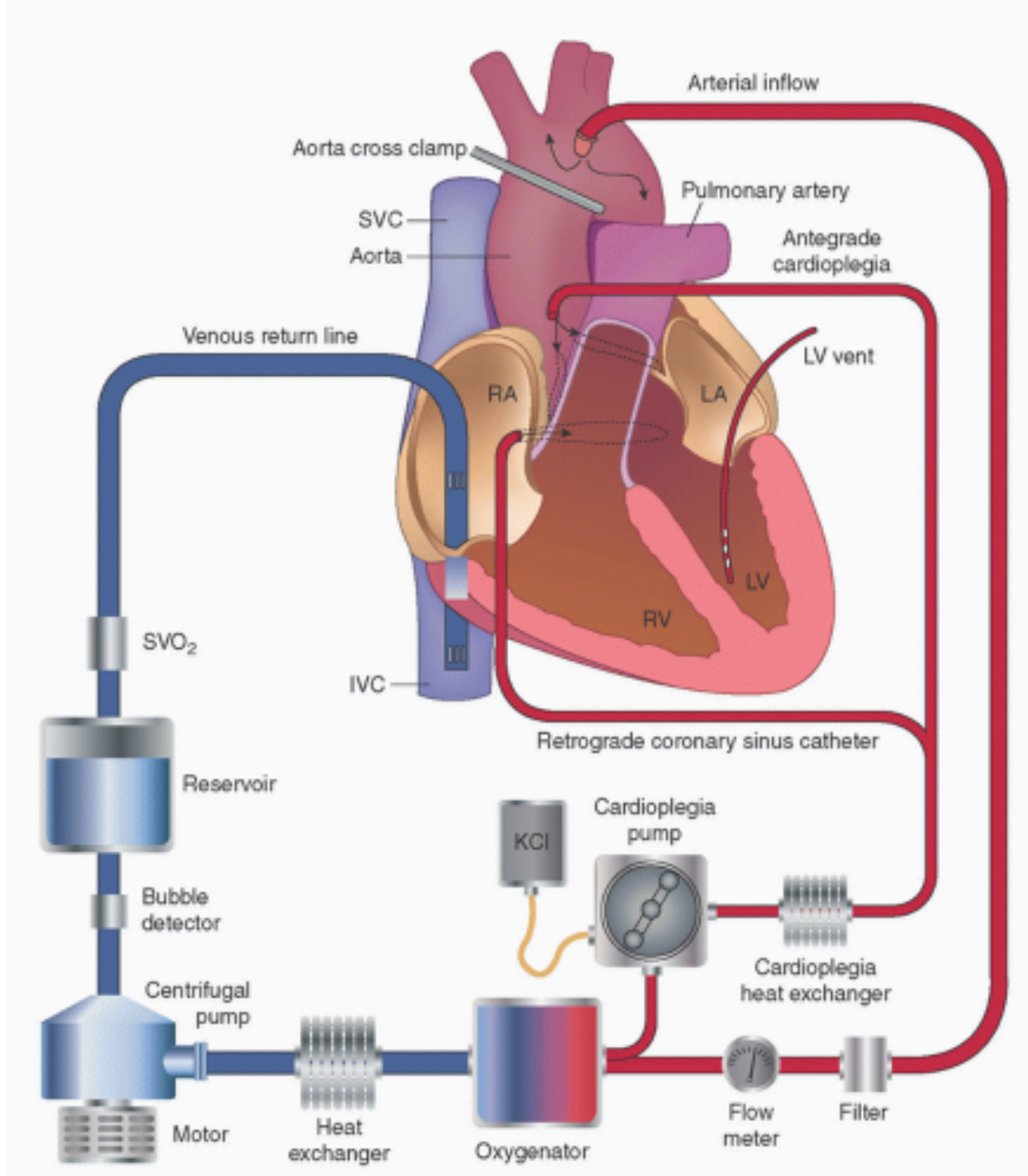


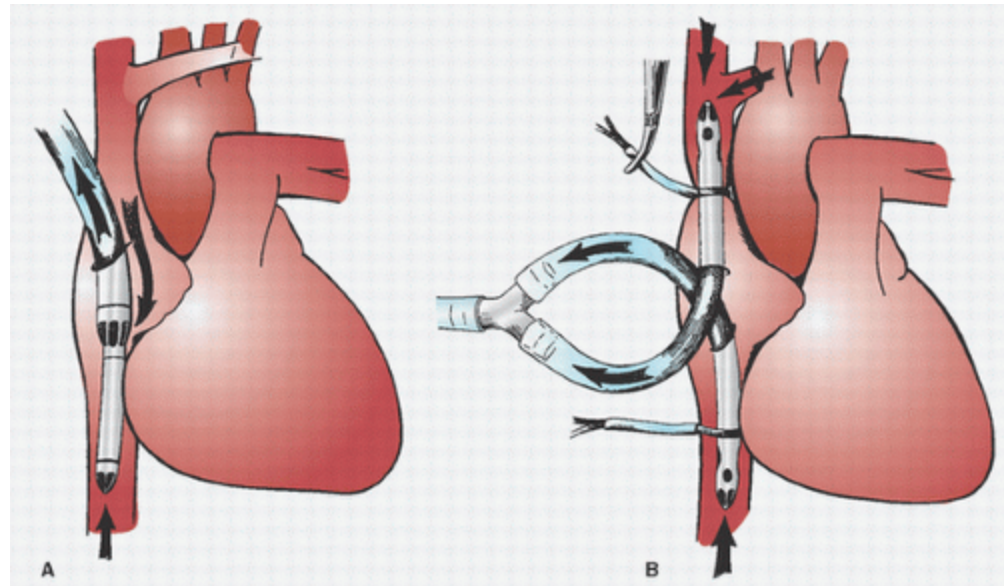


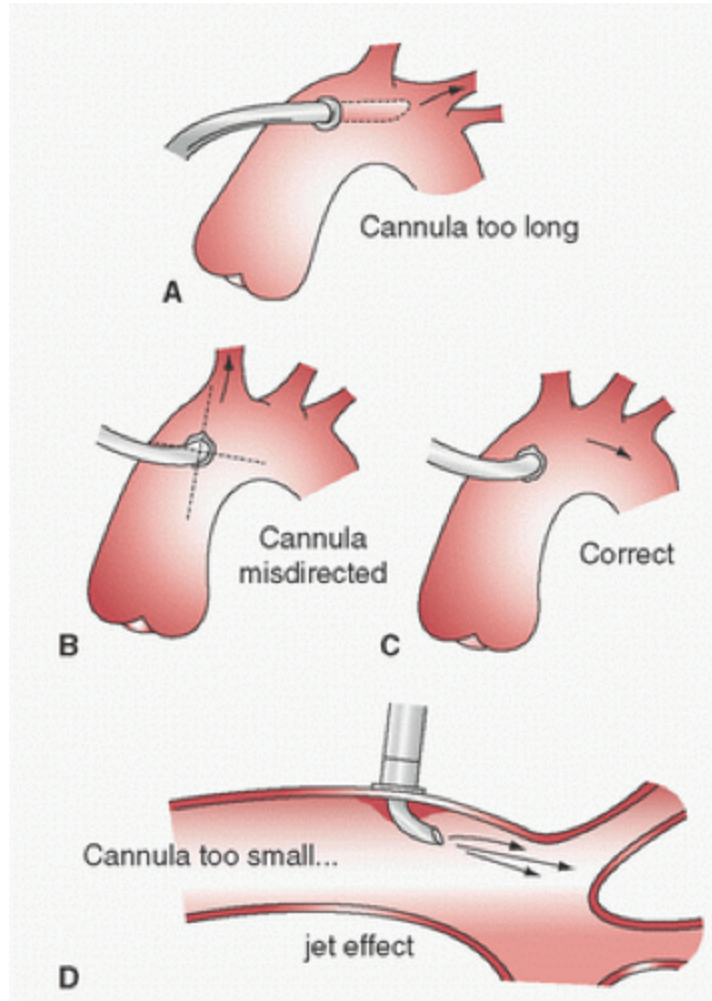
From : Manual of Cardiac Surgery, Harlan & Starr, Springer-Verlag, New York , 1995

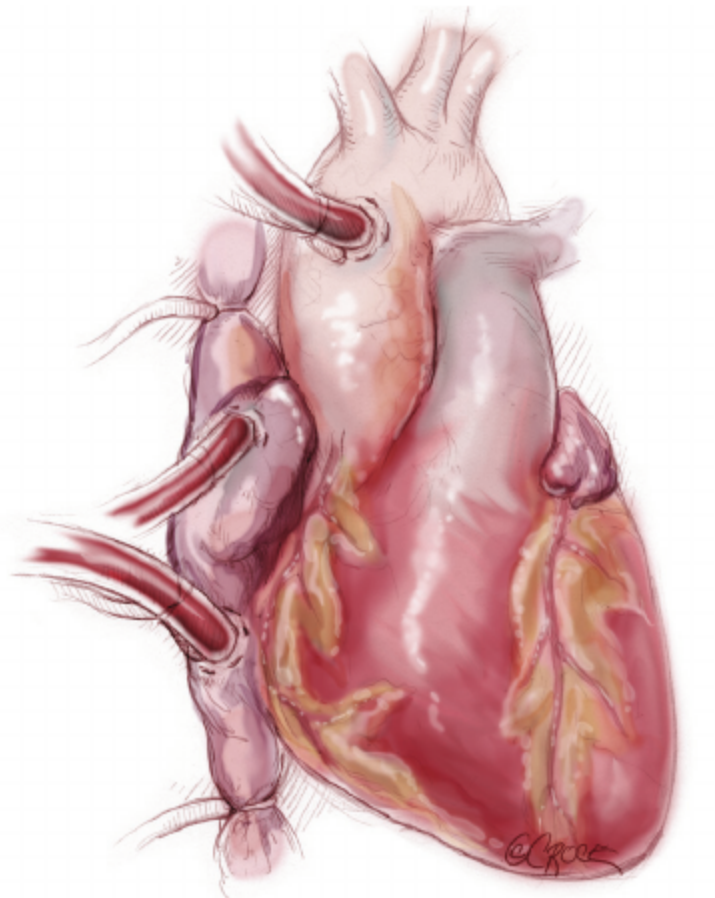

Thymotomy

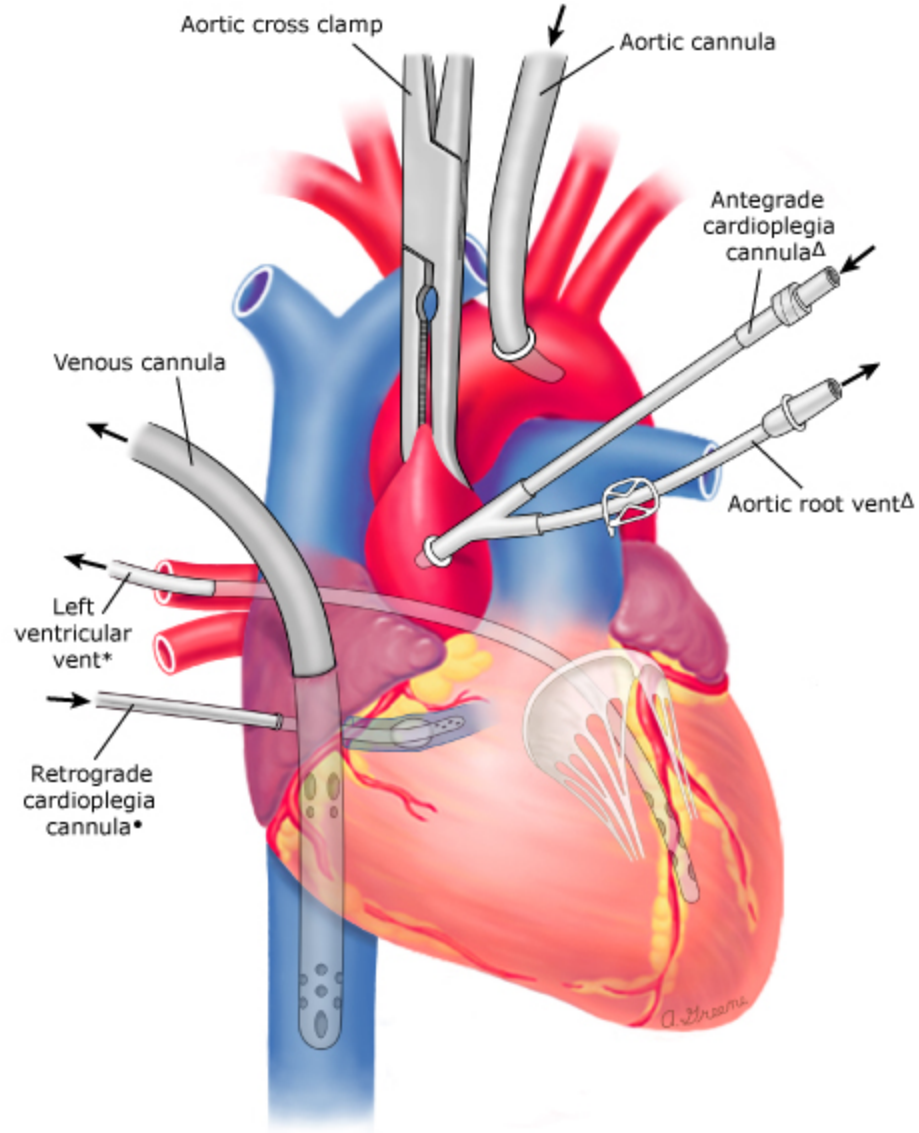
Heart Lung Machine


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


A
B


Cannula too long
A
Cannula
misdirected
B
Correct
C
Cannula too small...
jet effect
D

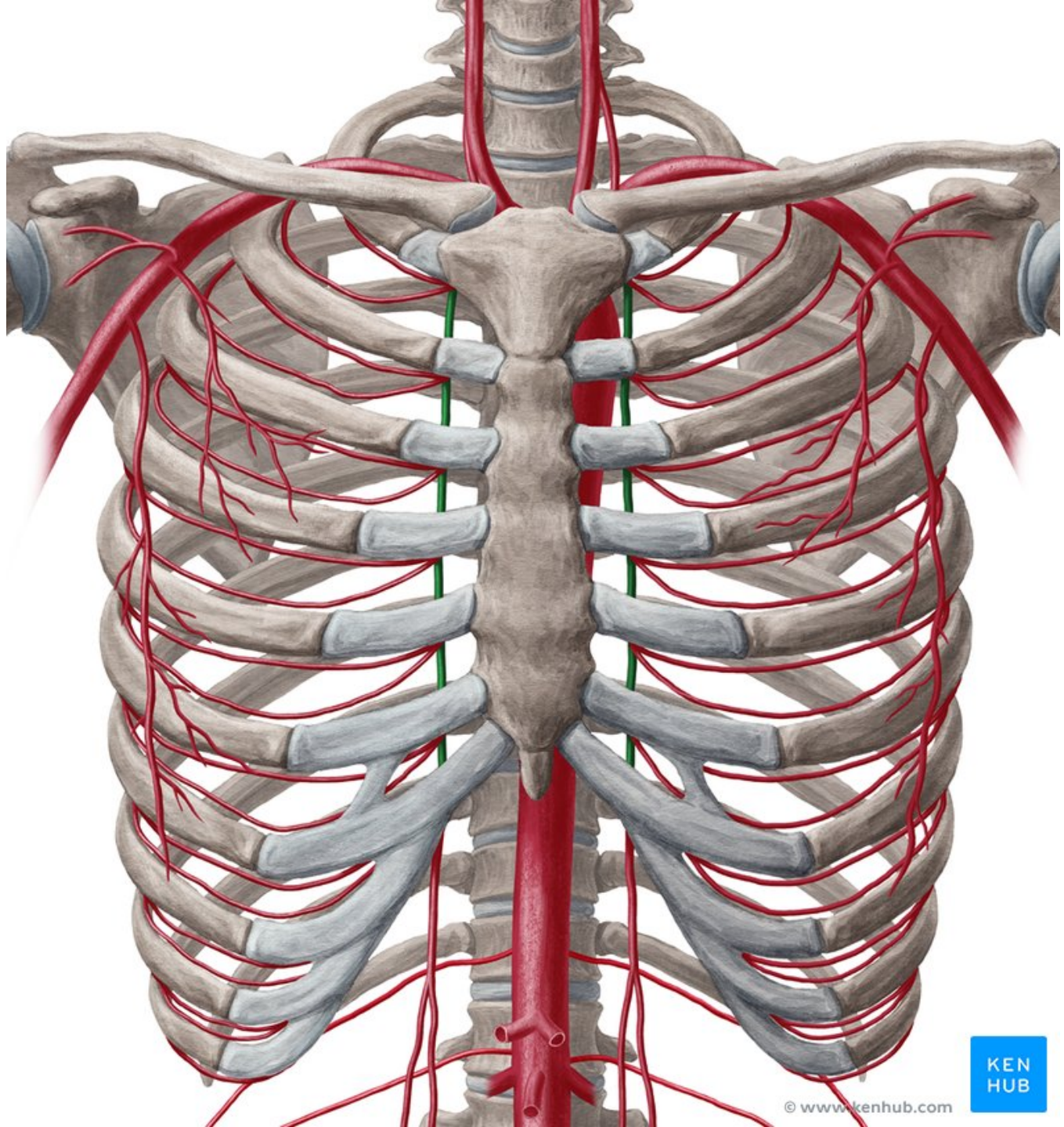



Aortic cross clamp
Aortic cannula
Antegrade cardioplegia cannula△
Venous cannula
Aortic root vent△
Left ventricular vent*
Retrograde cardioplegia cannula•


Cardioplegia is administra

Conduites

- Arterial
  - LIMA
  - RIMA
  - RA
  - GEA
  - IEA
- Venous
  - GSV
  - SSV
  - Arm Veins


KEN
HUB
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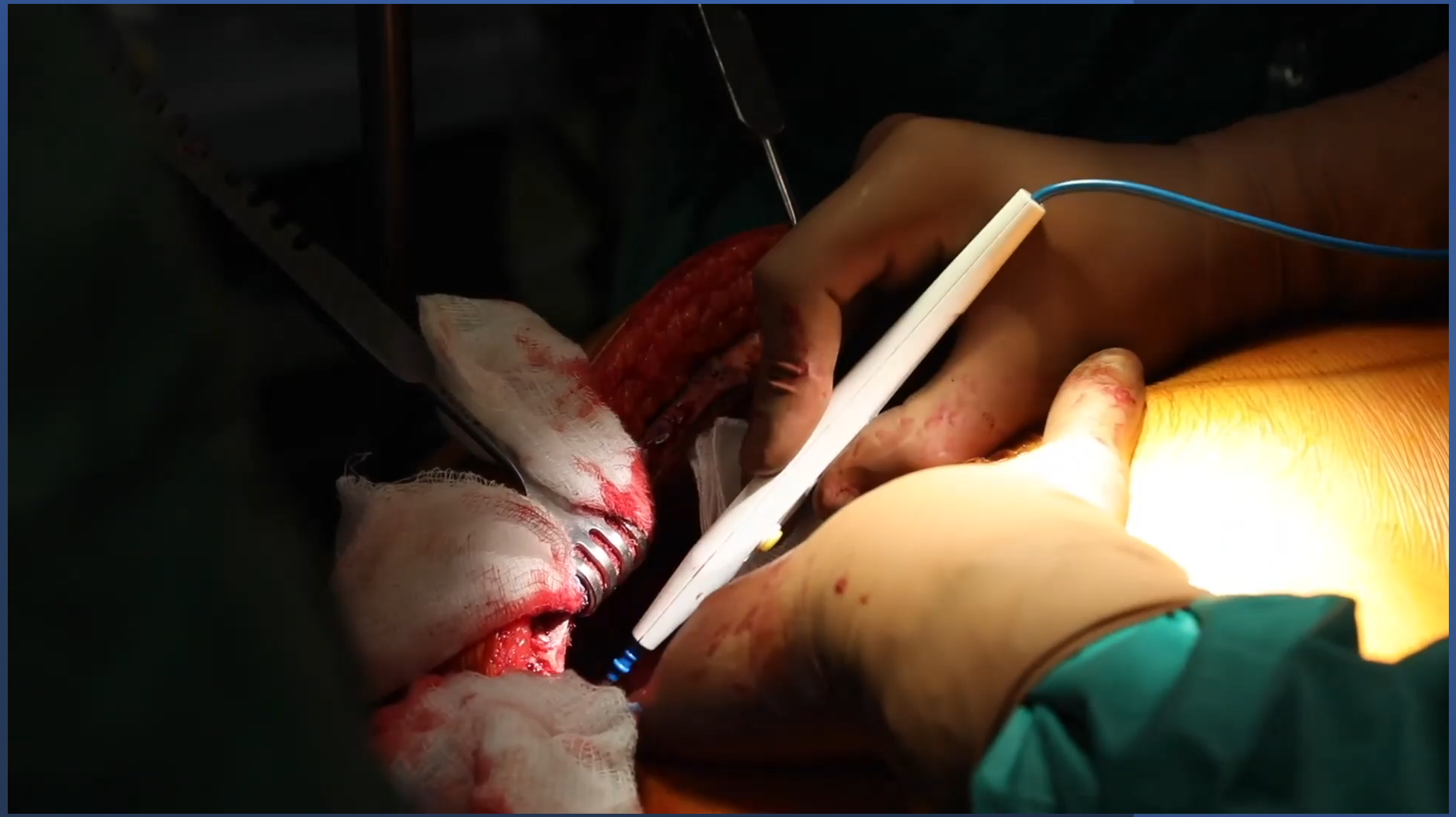
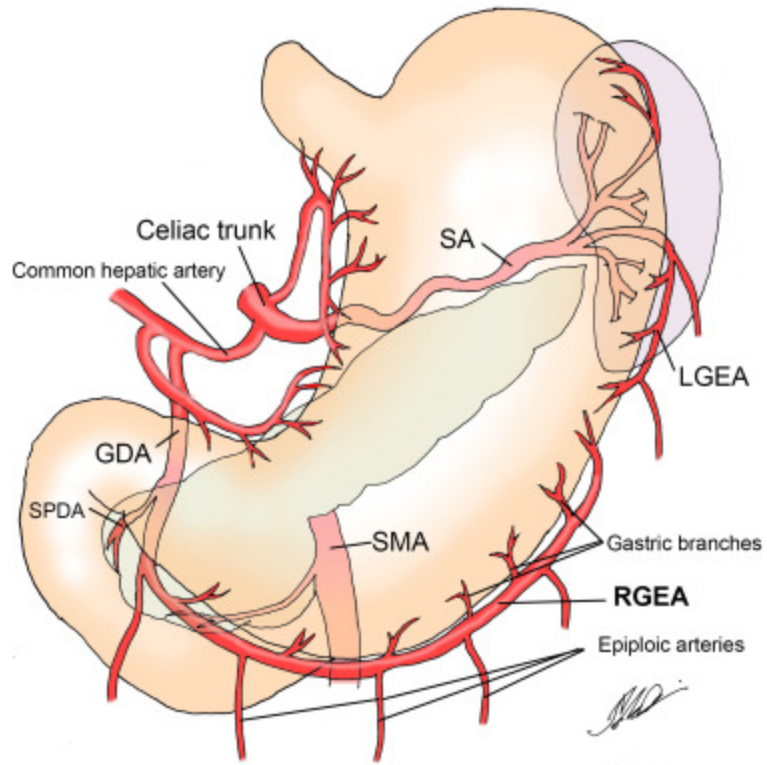
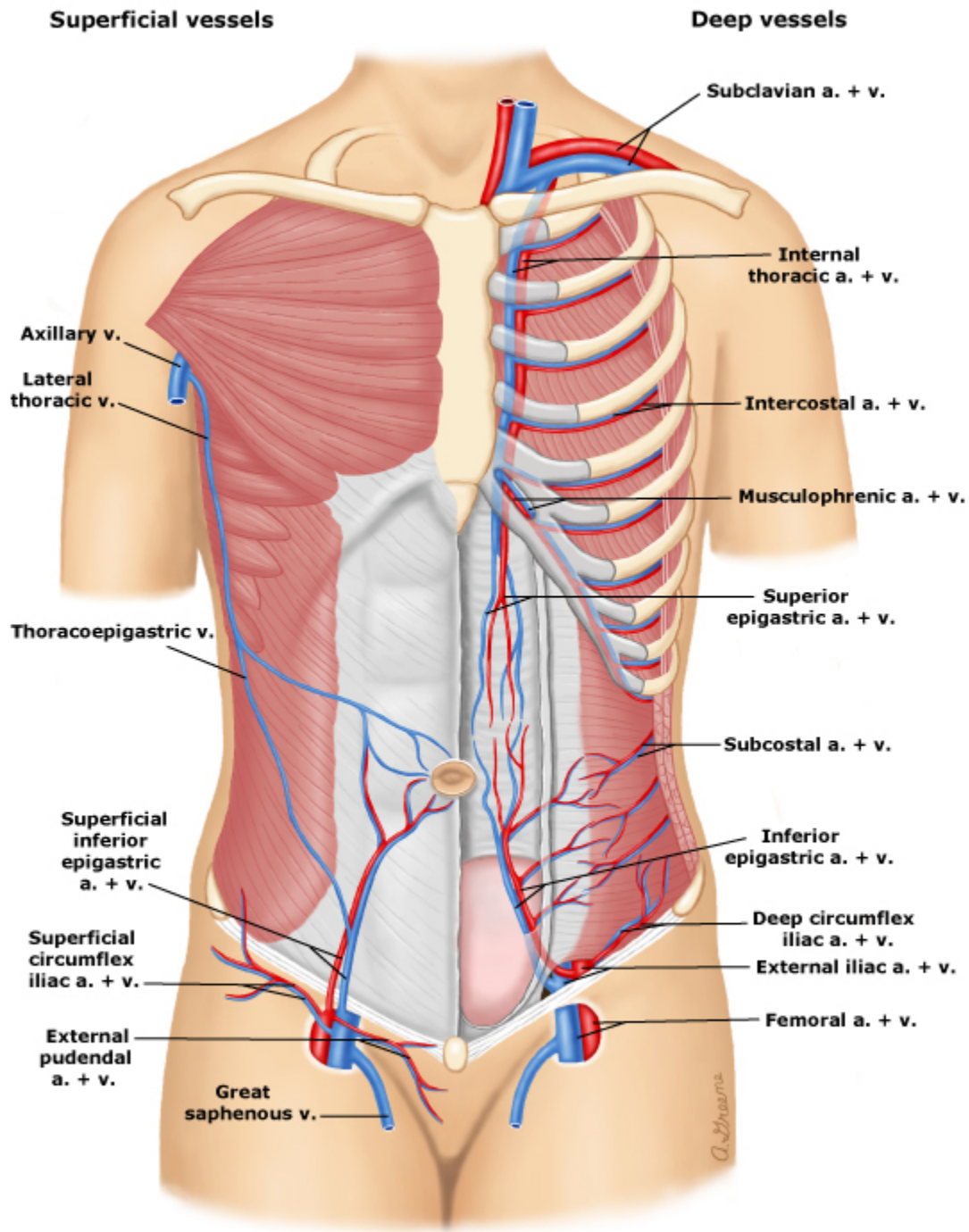
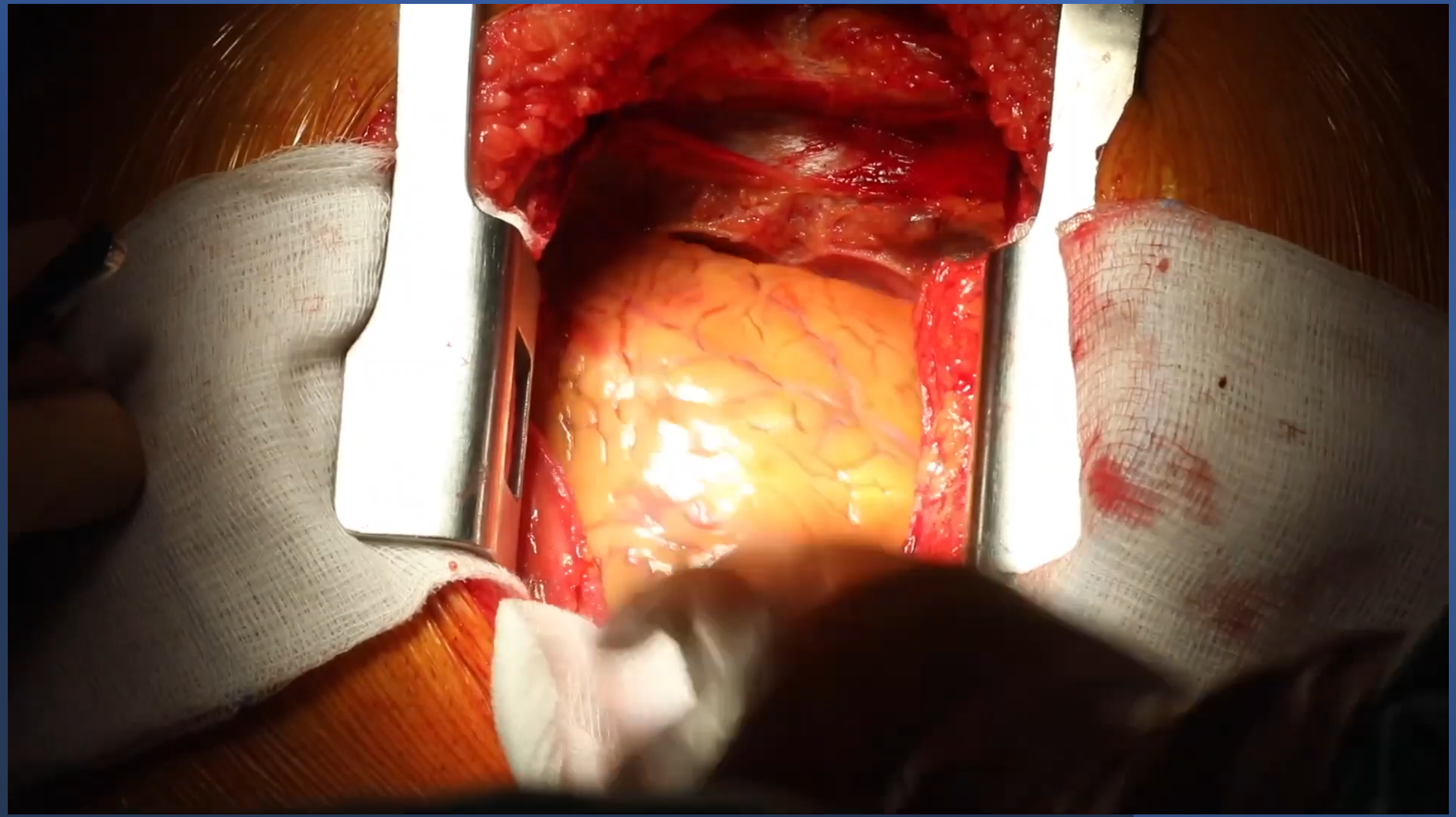
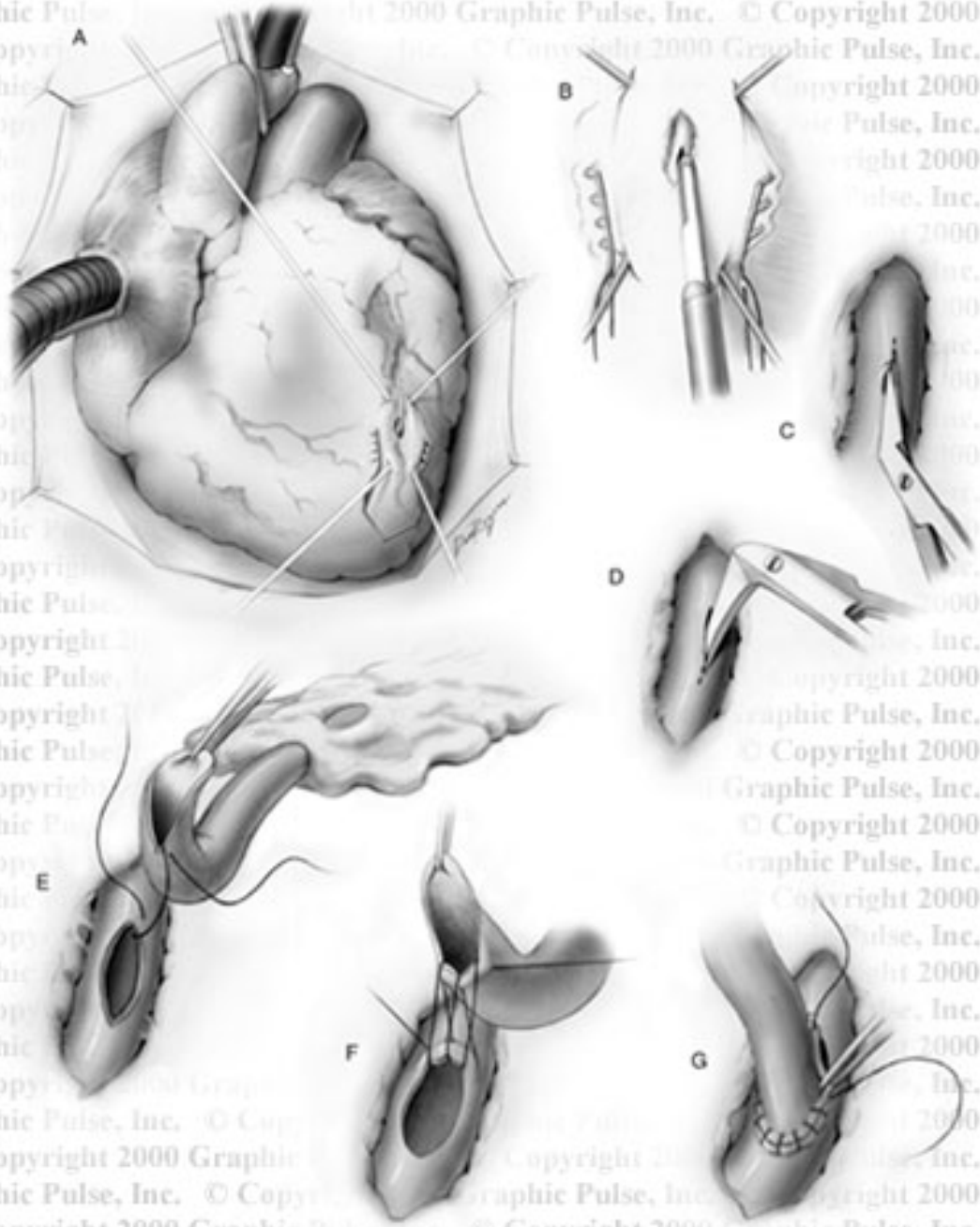


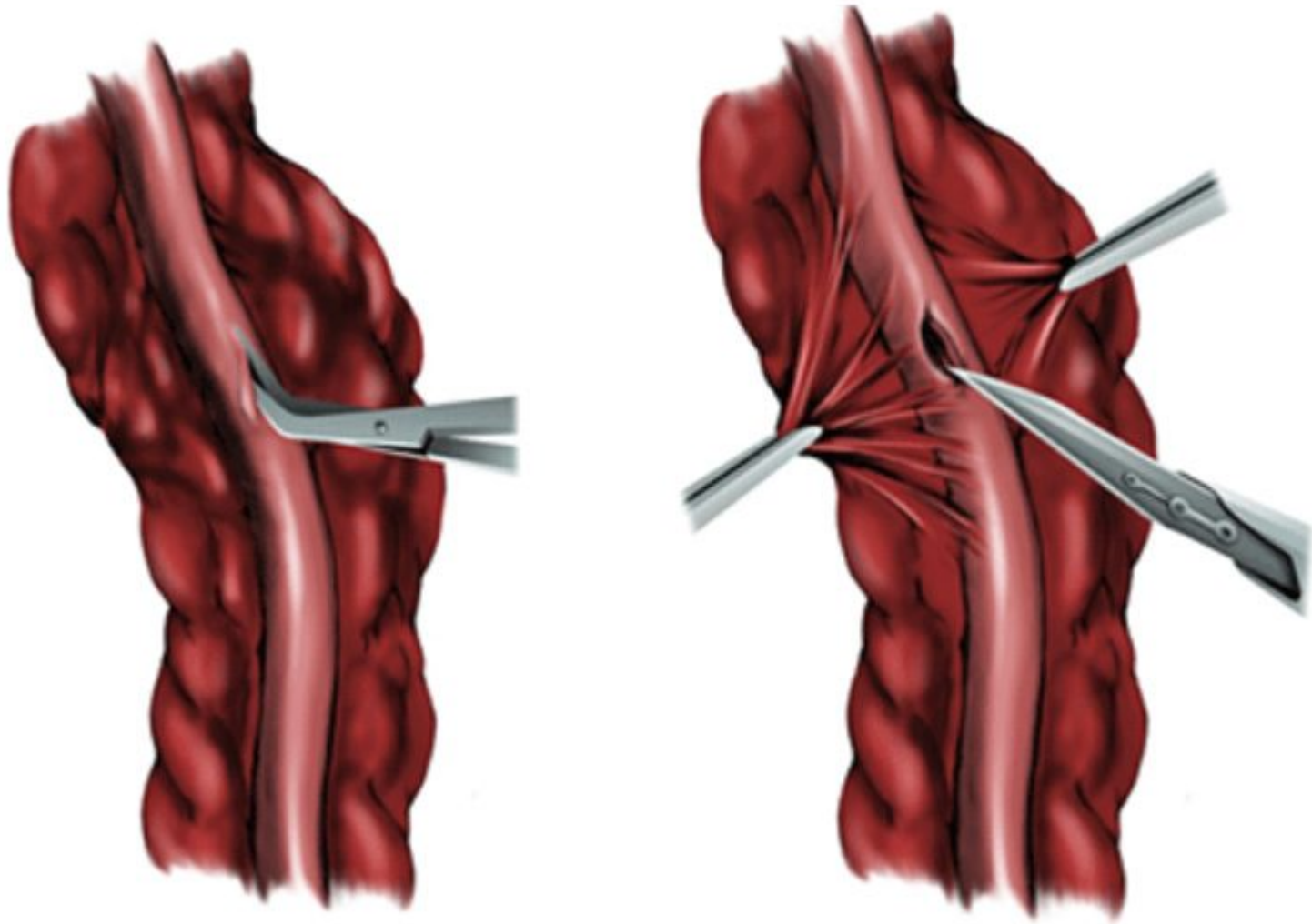
(a)

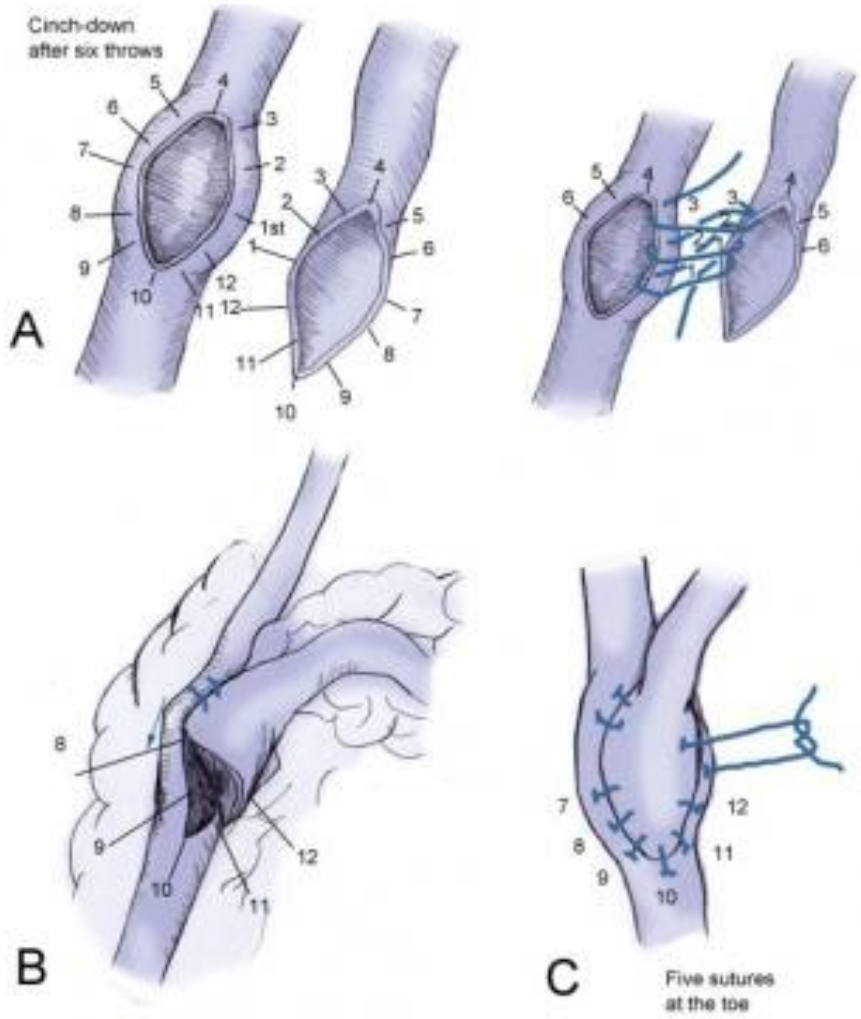

Celiac trunk
Common hepatic artery
SA
LGEA
GDA
SPDA
SMA
Gastric branches
RGEA
Epiploic arteries


Superficial vessels
Deep vessels
Subclavian a. + v.
Internal thoracic a. + v.
Axillary v.
Lateral thoracic v.
Intercostal a. + v.
Musculophrenic a. + v.
Superior epigastric a. + v.
Thoracoepigastric v.
Subcostal a. + v.
Superficial inferior epigastric a. + v.
Inferior epigastric a. + v.
Deep circumflex iliac a. + v.
Superficial circumflex iliac a. + v.
External iliac a. + v.
Femoral a. + v.
External pudendal a. + v.
Great saphenous v.

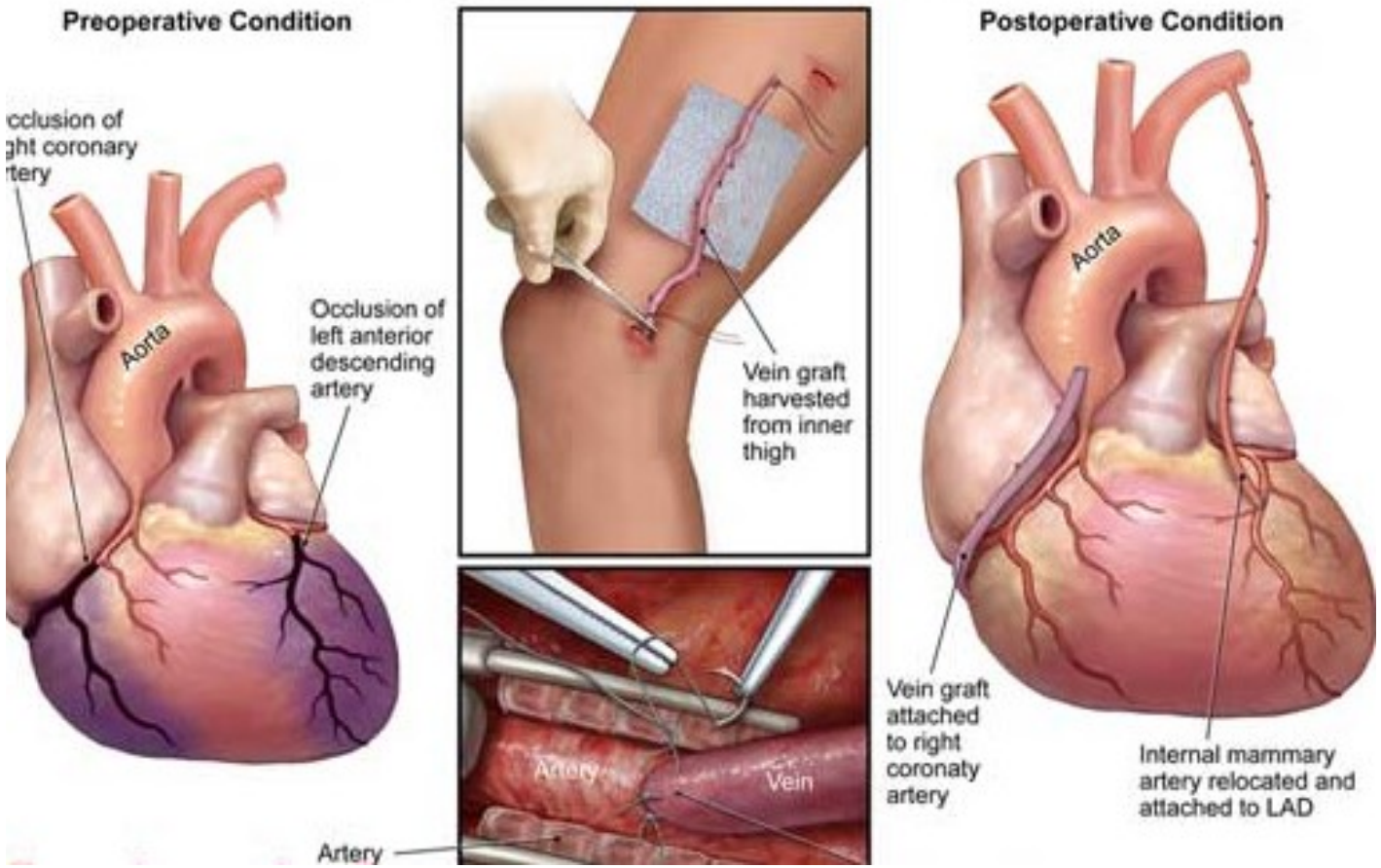




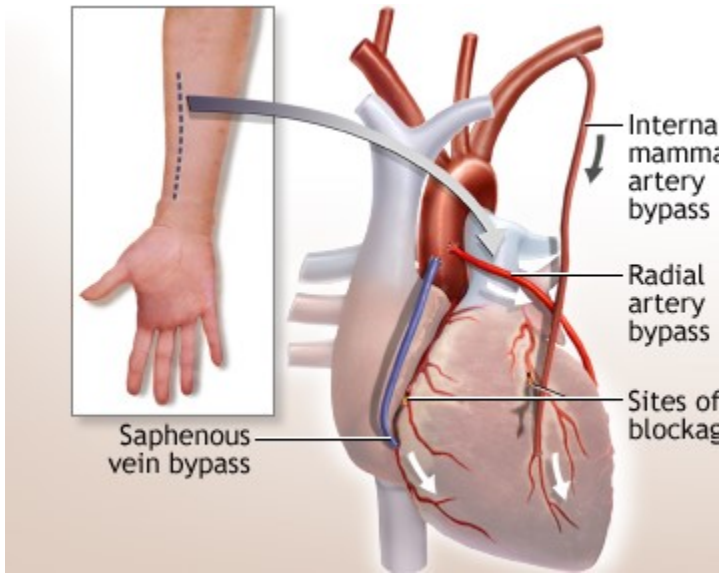


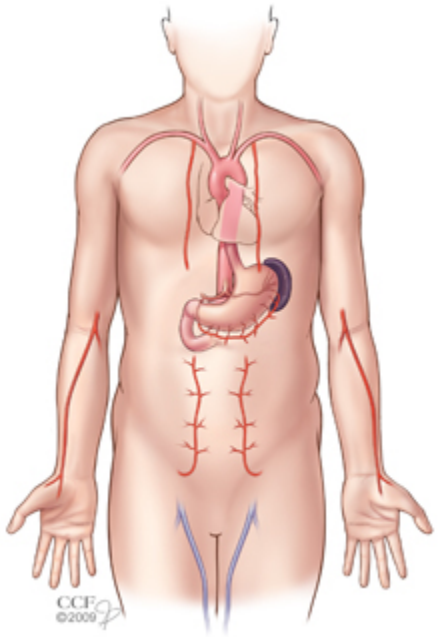

Cinch-down
after six throws
A
B
C
Five sutures
at the toe

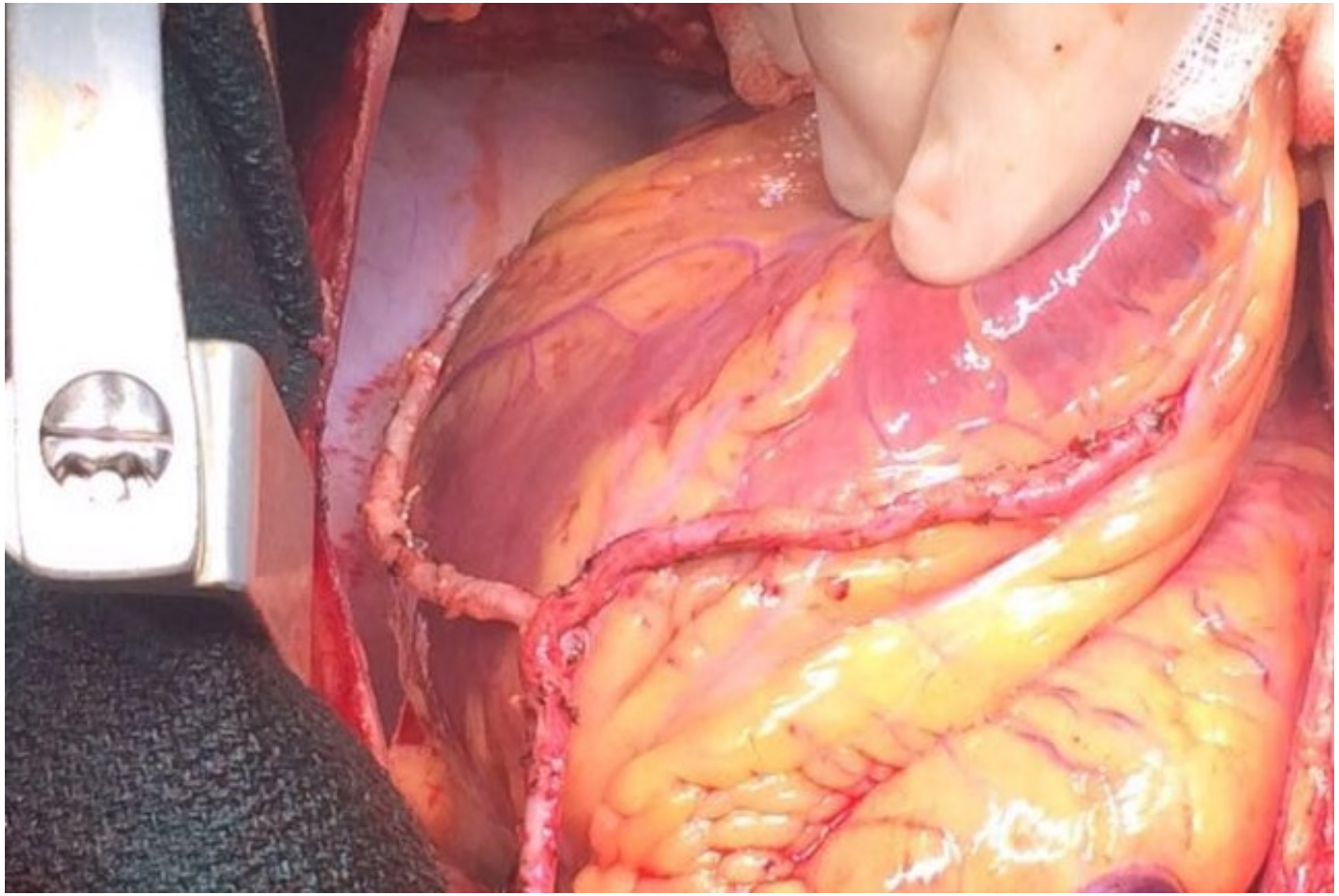
Coronary Artery Bypass Grafts

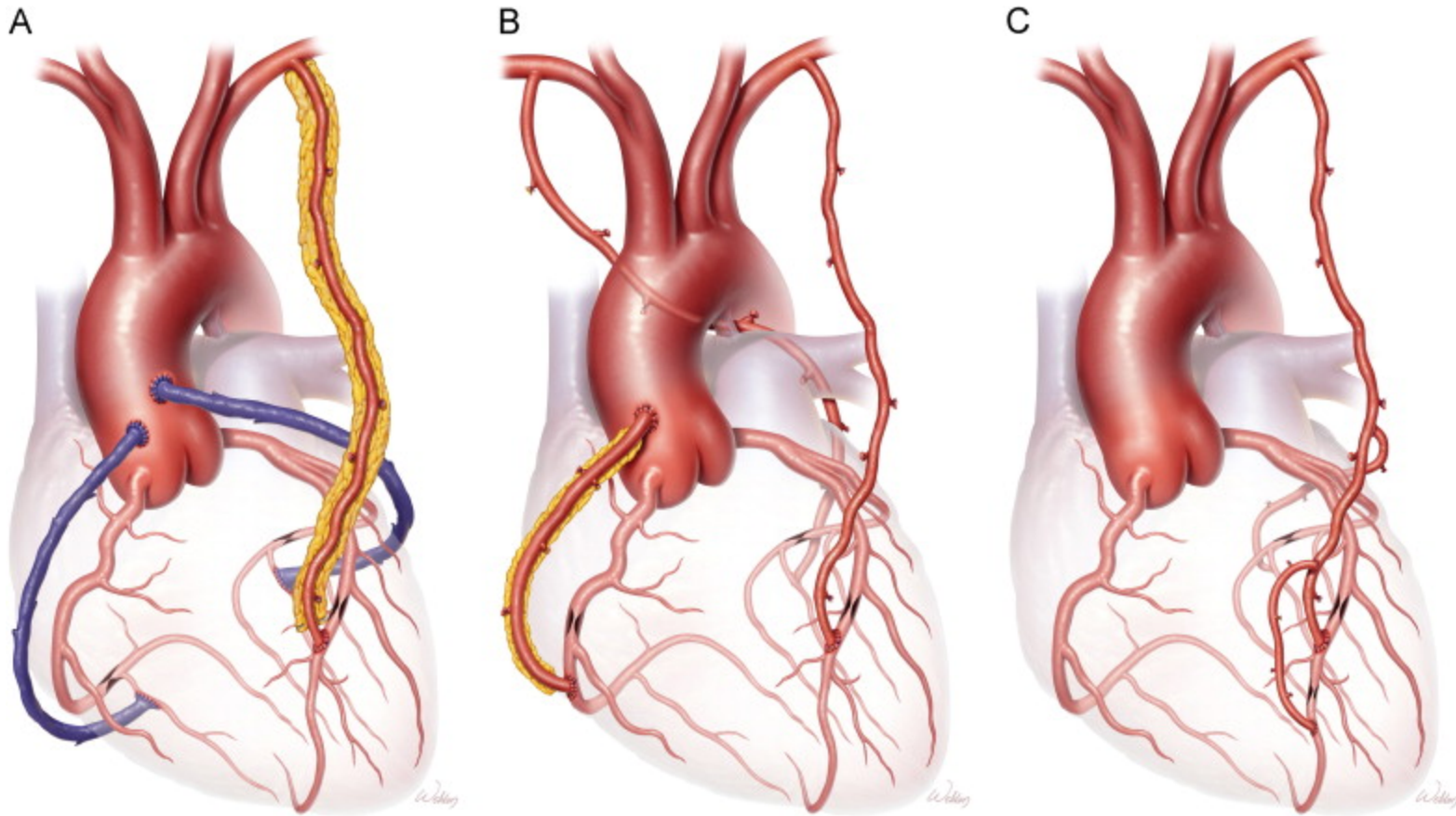


Arterial vs Venous conduits

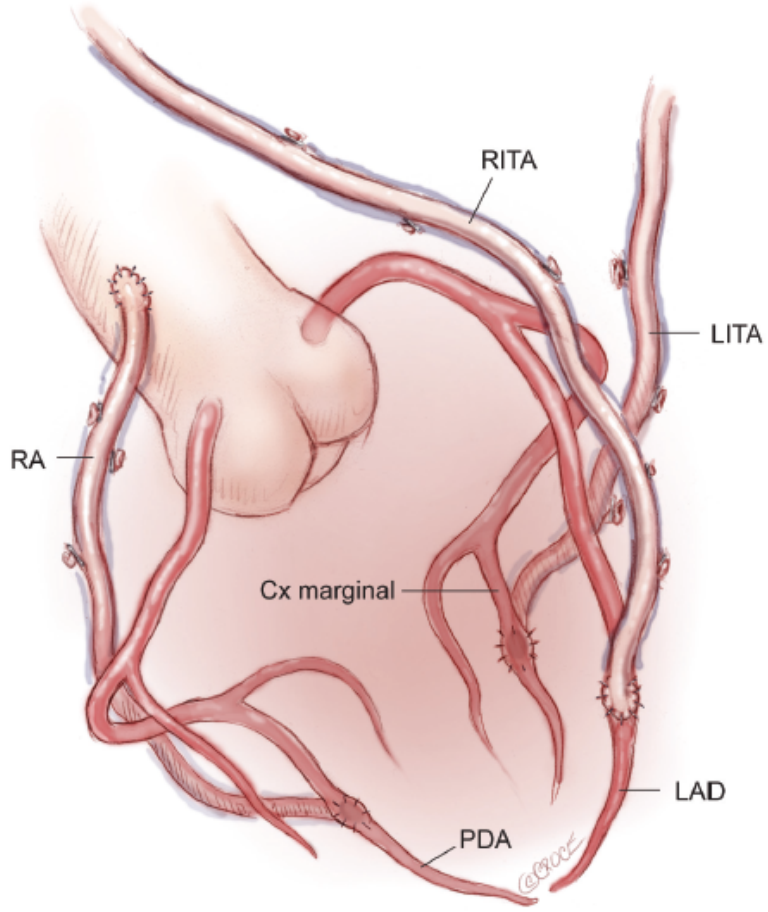


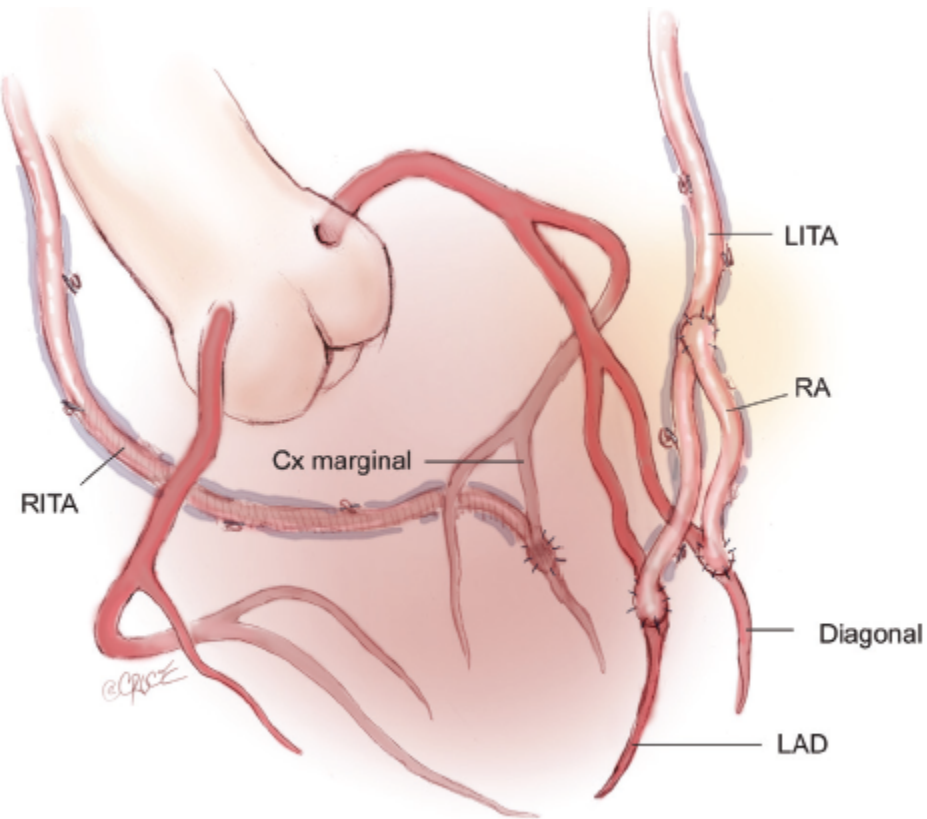


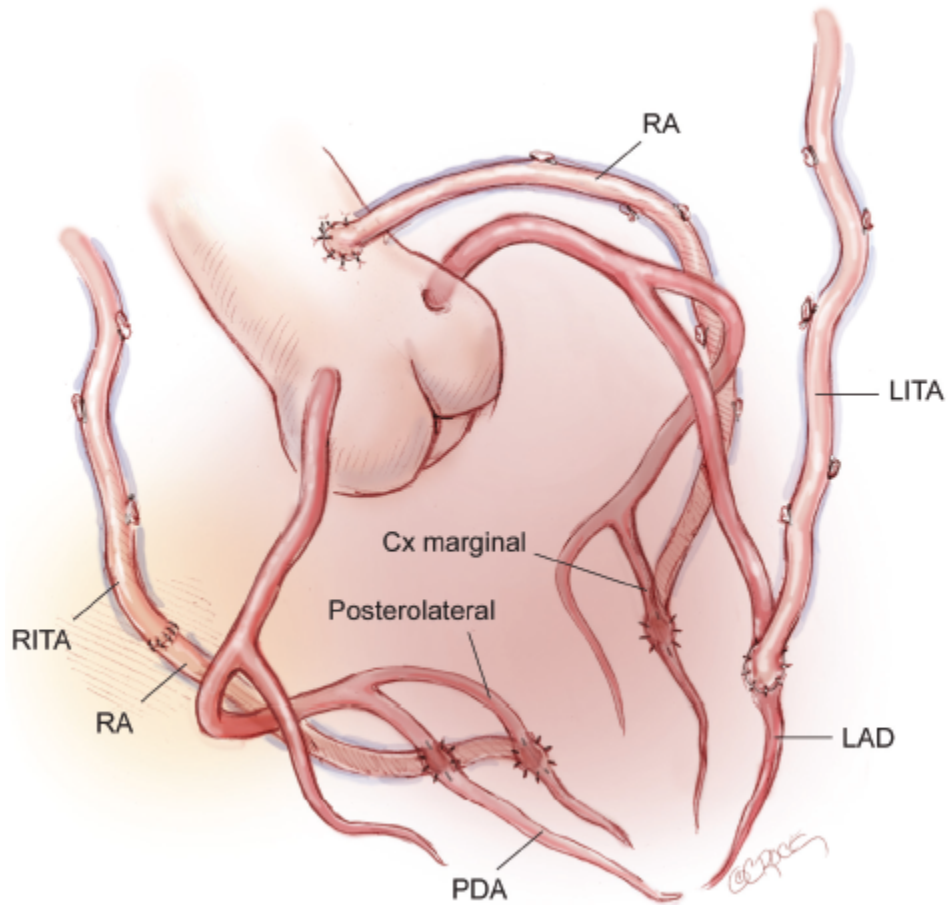


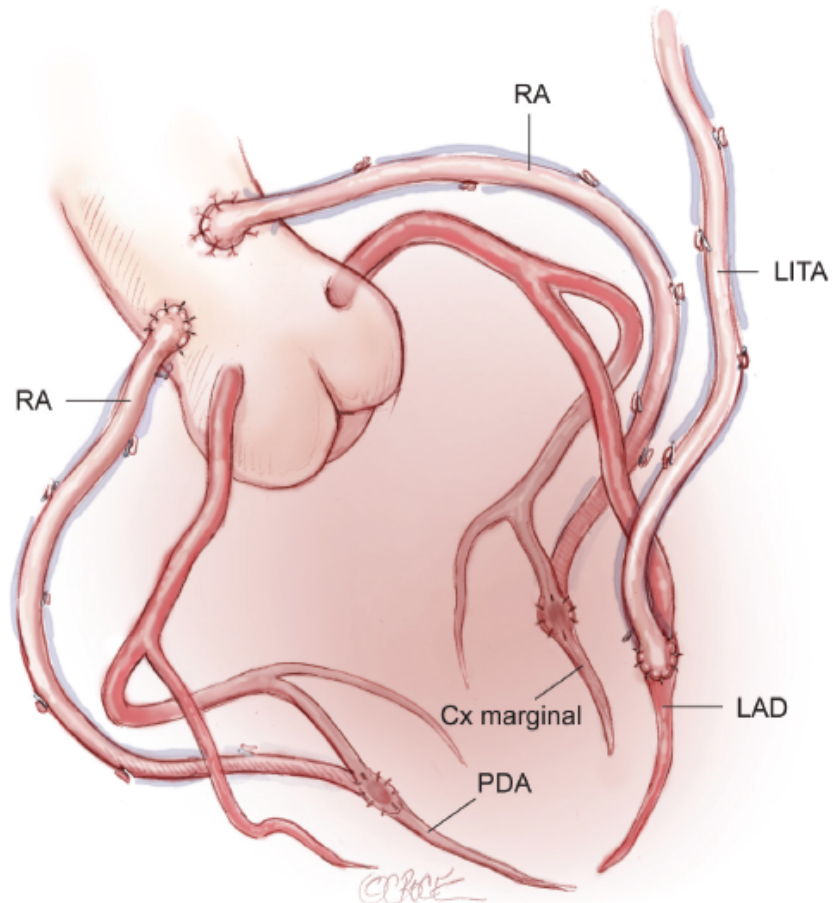

A
B
C

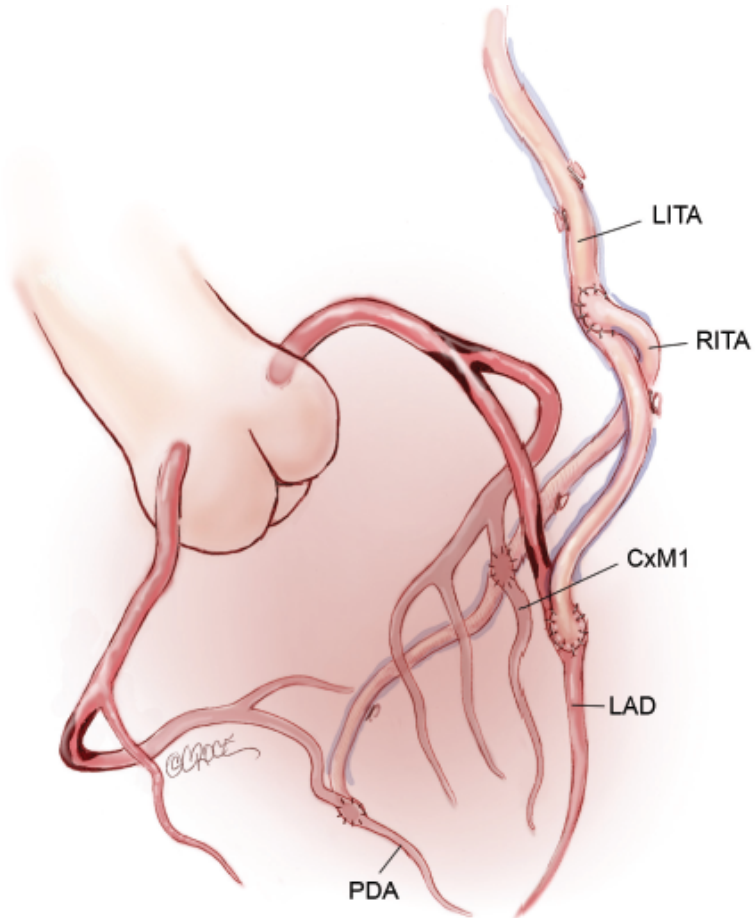
Total arterial revascularization

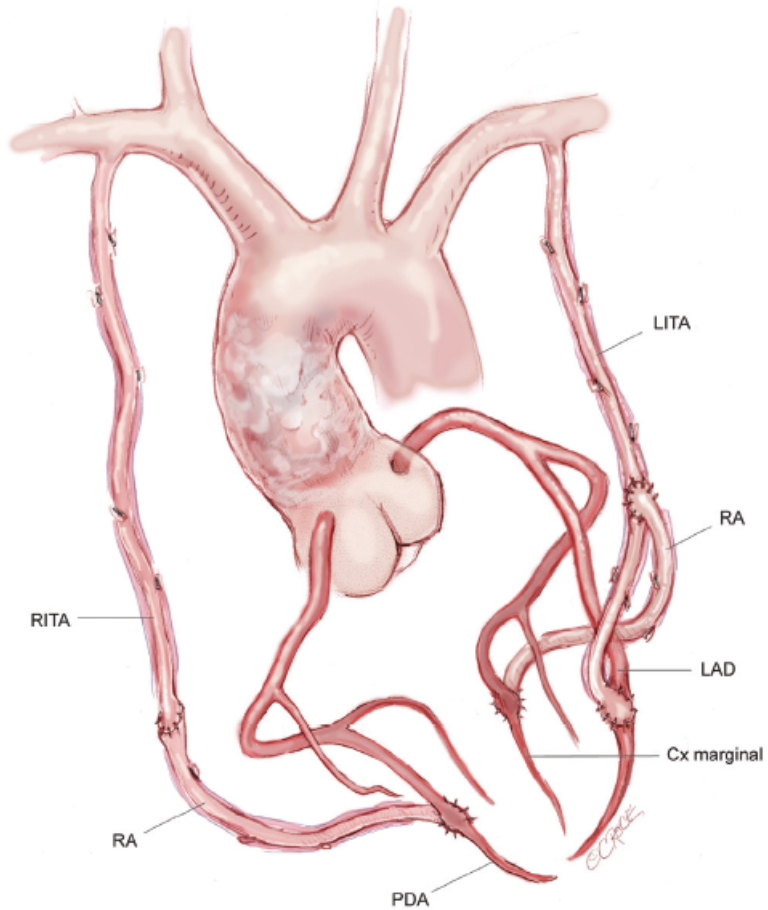



LITA
RA
Cx marginal
RITA
Diagonal
LAD


RA
LITA
Cx marginal
Posterolateral
RITA
RA
LAD
PDA


RA
LITA
RA
Cx marginal
LAD
PDA


LITA
RITA
CxM1
LAD
PDA


LITA
RA
RITA
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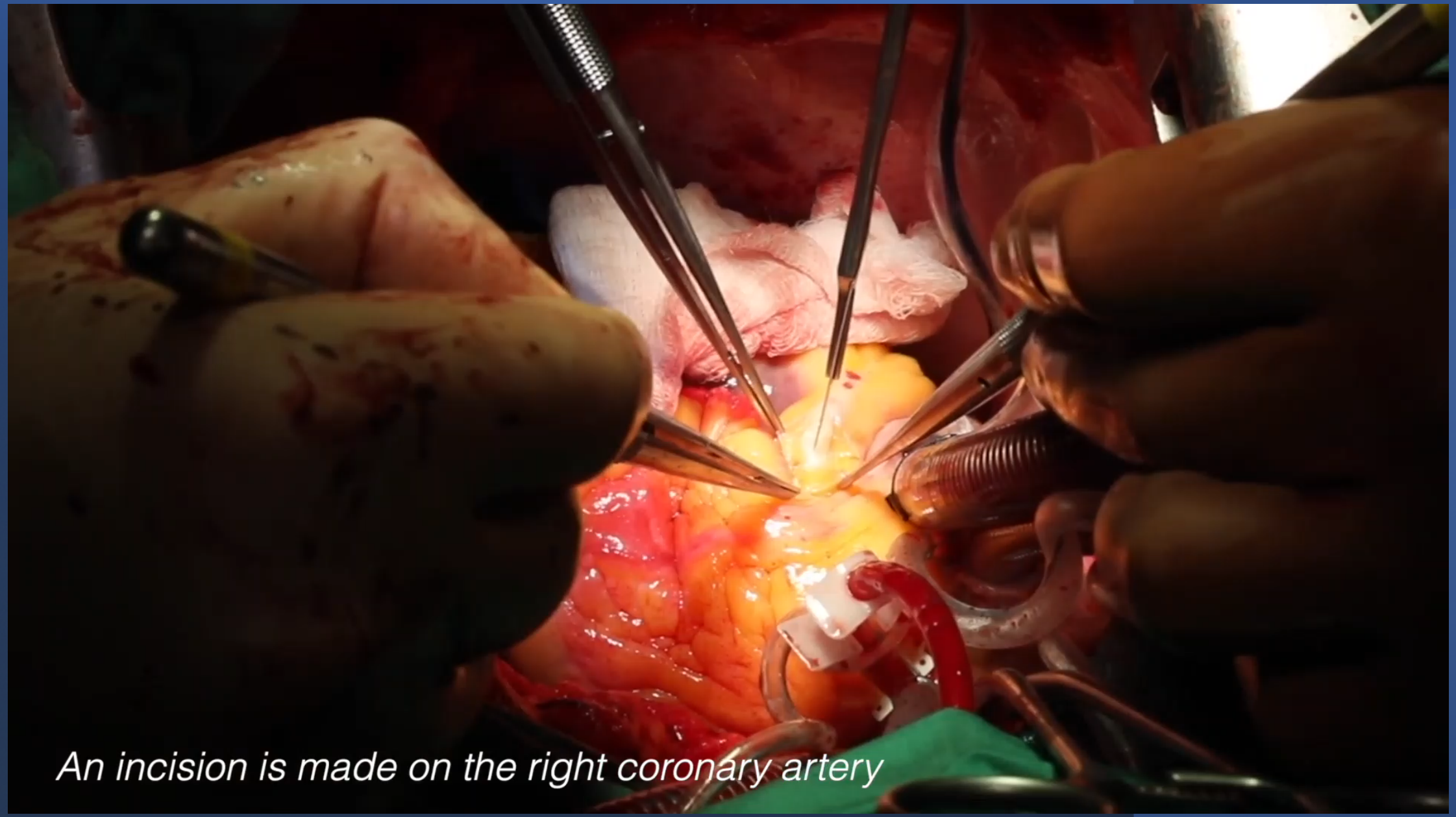
Cx marginal
RA
PDA



An incision is made on the right coronary artery

Arterial conduits in coronary artery bypass grafting: an inconvenient truth

The New England
Journal of Medicine

Volume 314 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.)

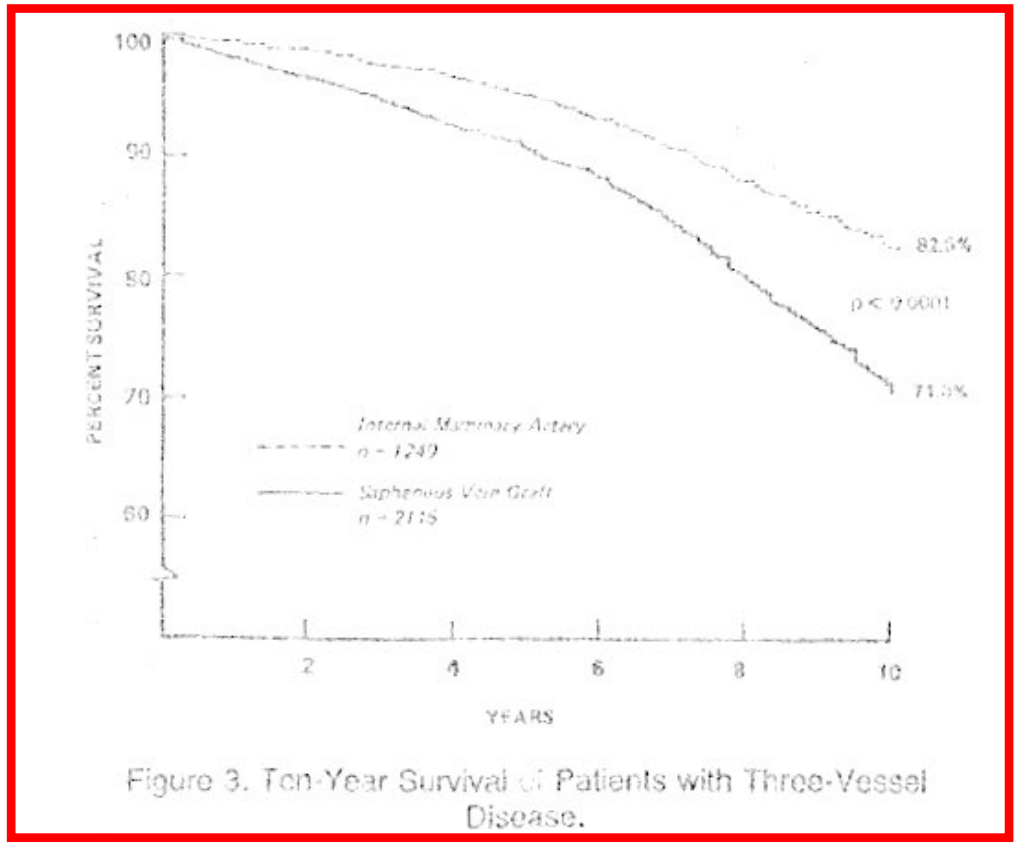


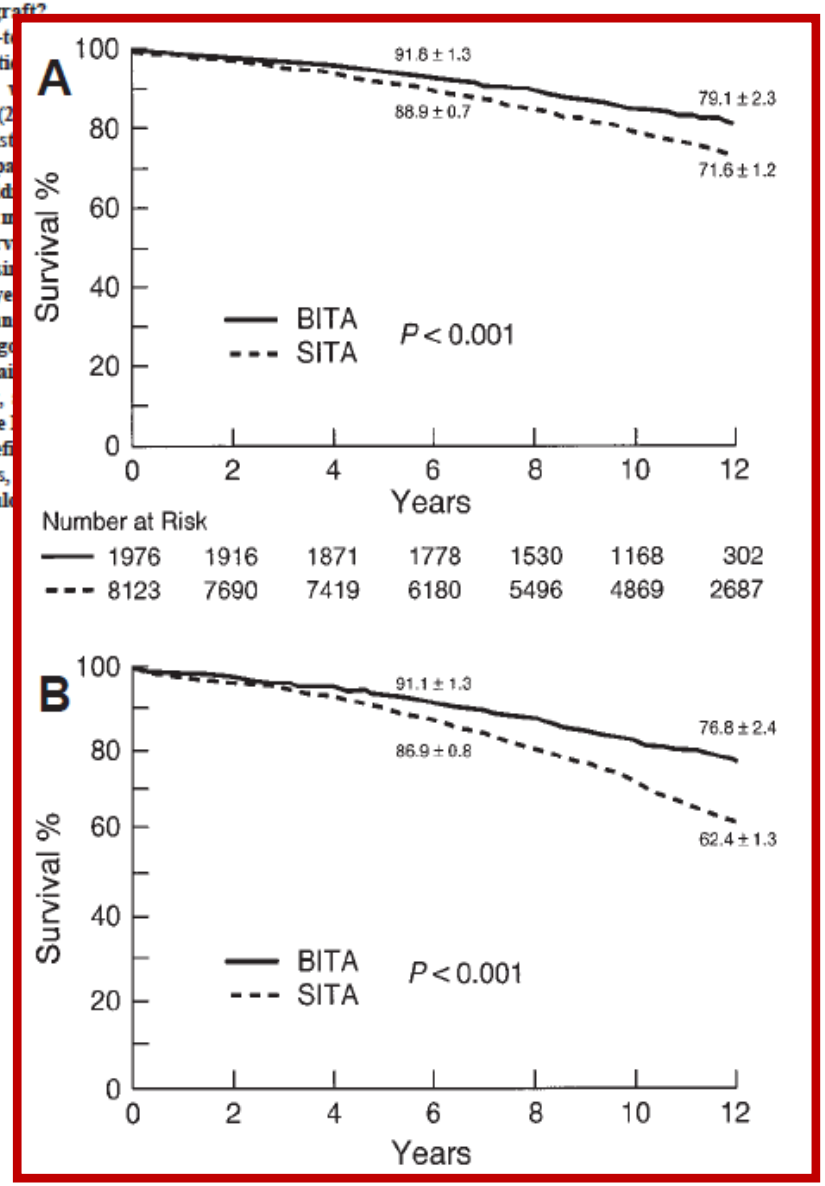
Figure 3. Ten-Year Survival of Patients with Three-Vessel Disease.

Loop FD et al NEJM 1986

TWO INTERNAL THORACIC ARTERY GRAFTS ARE BETTER THAN ONE

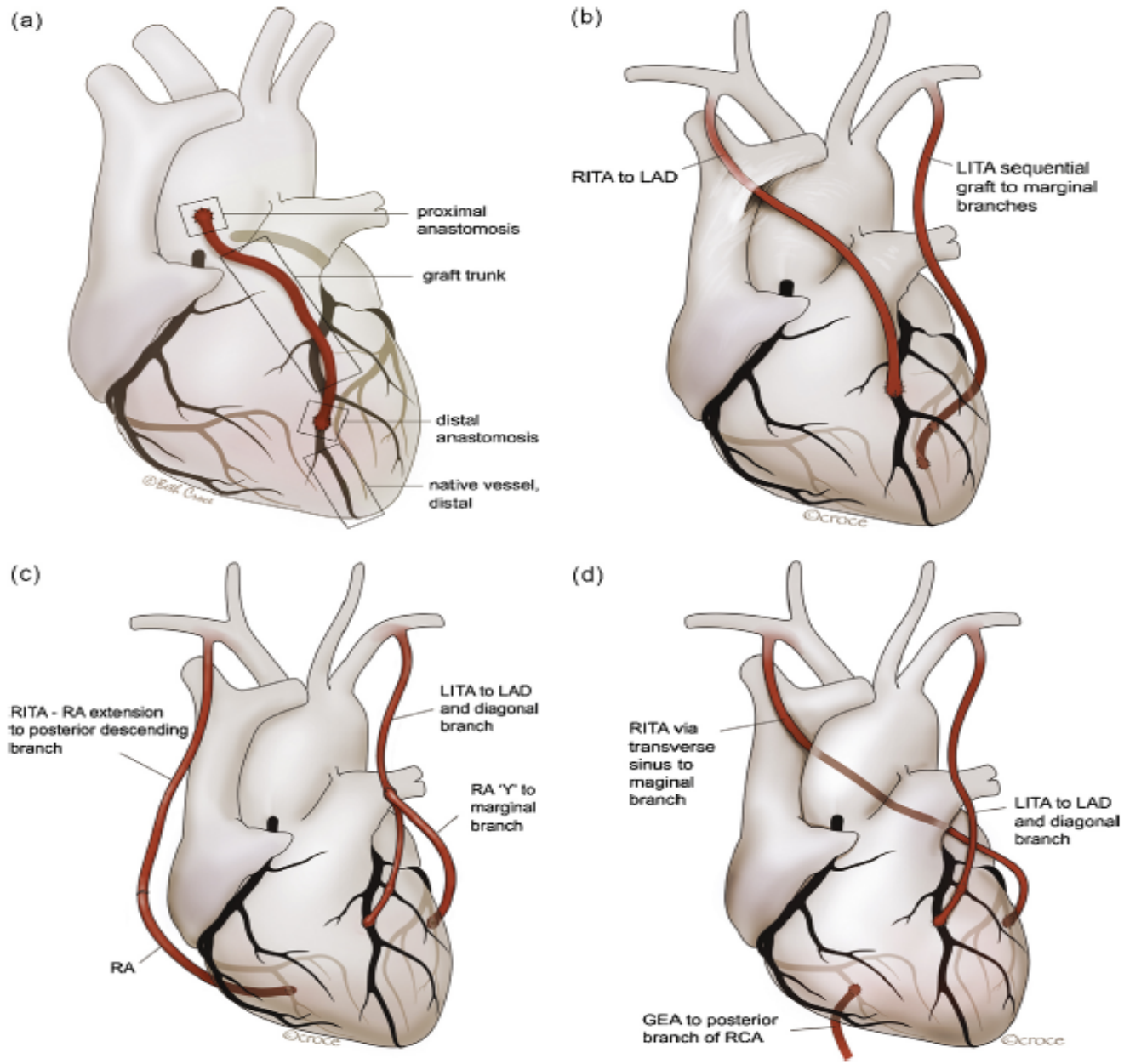
Bruce W. Lytle, MD
Eugene H. Blackstone MD
Floyd D. Loop, MD
Penny L. Houghtaling, MS
John H. Arnold, MD
Rami Akhrass, MD
Patrick M. McCarthy, MD
Delos M. Cosgrove, MD

Objective: **Does the use of bilateral internal thoracic artery (ITA) grafts provide incremental benefit relative to the use of a single ITA graft?** *Methods:* **We conducted a retrospective, nonrandomized, long-t (mean follow-up interval of 10 postoperative years) study of pati undergoing elective primary isolated coronary bypass surgery v received either single (8123 patients) or bilateral ITA grafts (2 patients), with or without additional vein grafts. Multiple statist methods including propensity score matching, and multivariable pa monious and nonparsimonious risk factor analyses were used to add the issues of patient selection and heterogeneity.** *Results:* **In-hospital m tality was 0.7% for both the bilateral and single ITA groups. Surv for the bilateral ITA group was 94%, 84%, and 67%, and for the si ITA group 92%, 79%, and 64% at 5, 10, and 15 postoperative ye respectively ($P < .001$). Death, reoperation, and percutaneous tran minal coronary angioplasty were more frequent for patients undergo single rather than bilateral ITA grafting, and this observation remai true despite multiple adjustments for patient selection, sampling, length of follow-up. The differences between the bilateral and single groups were greatest in regard to reoperation. The extent of benefi bilateral ITA grafting varied according to patient-related variables, no patient subsets were identified for whom single ITA grafting coul**



Arterial conduits used for coronary artery bypass grafting

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


(a)
proximal anastomosis
graft trunk
distal anastomosis
native vessel, distal
(b)
RITA to LAD
LITA sequential graft to marginal branches
©croce
(c)
RITA - RA extension to posterior descending branch
LITA to LAD and diagonal branch
RA 'Y' to marginal branch
RA
©croce
(d)
RITA via transverse sinus to maginal branch
LITA to LAD and diagonal branch
GEA to posterior branch of RCA
©croce

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

Aaron J. Weiss[1,2], Shan Zhao[3], David H. Tian[2], David P. Taggart[4], Tristan D. Yan[2,5]

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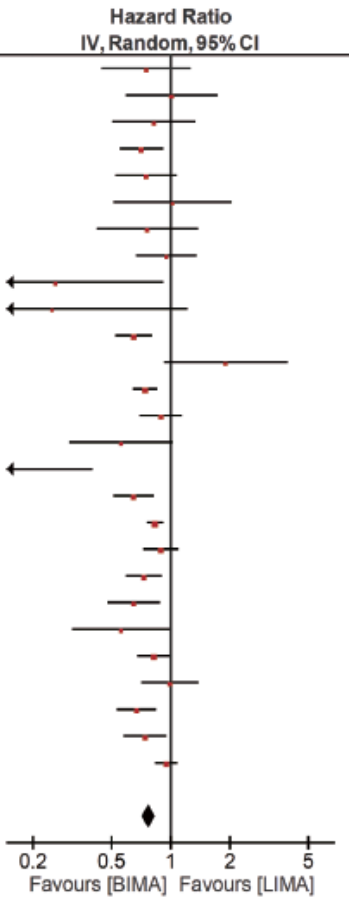
Study or Subgroup	log[Hazard Ratio]	SE	BIMA Total	LIMA Total	Weight	Hazard Ratio IV, Random, 95% CI	Year
Naunheim	-0.288	0.265	100	100	1.7%	0.75 [0.45, 1.26]	1992
Dewar	0.01	0.272	377	765	1.6%	1.01 [0.59, 1.72]	1995
Pick	-0.198	0.247	160	161	1.9%	0.82 [0.51, 1.33]	1997
Buxton	-0.342	0.127	1269	1557	4.9%	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]**	

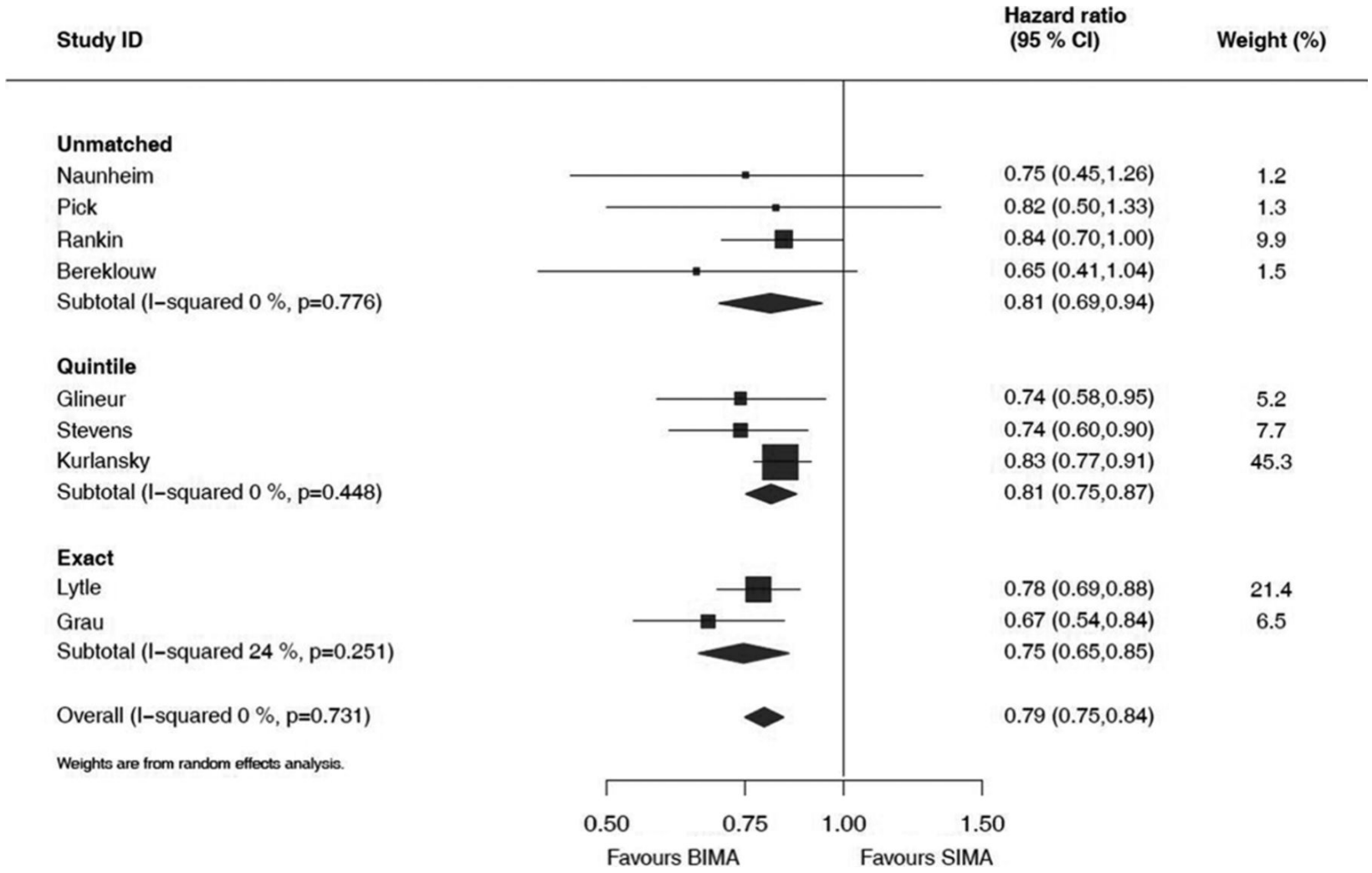
Heterogeneity: Tau² = 0.01; Chi² = 47.10, df = 26 (P = 0.007); I² = 45%

Test for overall effect: Z = 6.61 (P < 0.00001)



Ann Cardiothorac Surg 2013

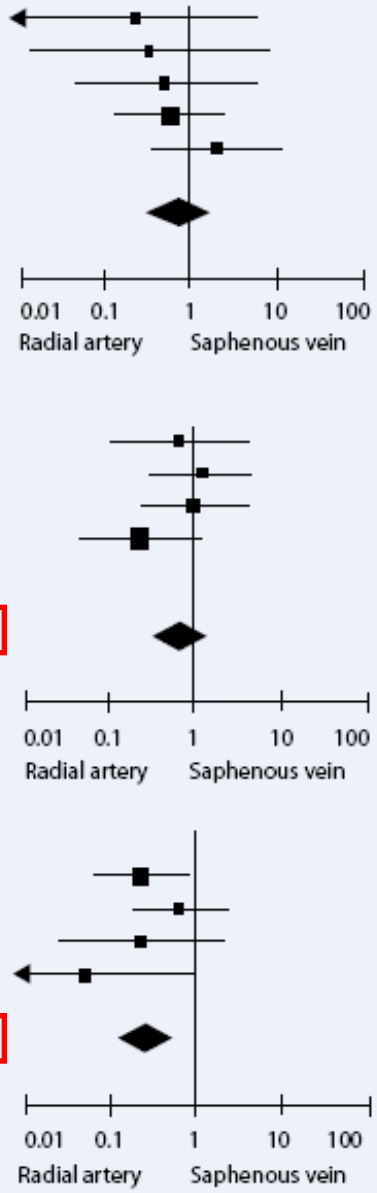
Effects of bilateral internal mammary artery grafting on long-term survival.



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

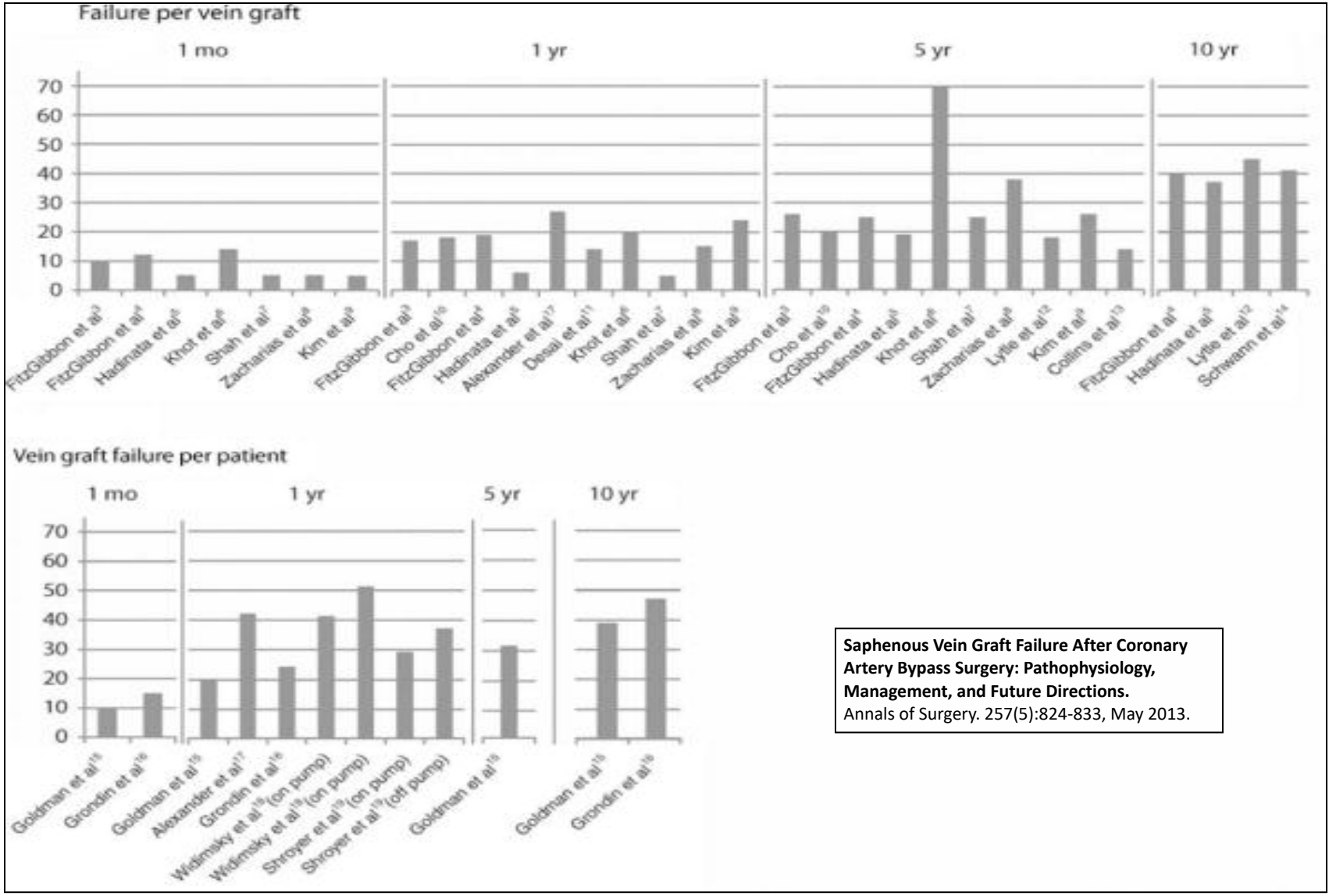
Study or Subgroup	Radial artery Events	Total	Saphenous vein Events	Total	Weight	Odds Ratio M-H,Fixed,95% CI
Cardiac death						
Song SW 2012	0	35	1	25	14.4%	0.23 [0.01, 5.88]
Deb S 2012	0	510	1	510	12.5%	0.33 [0.01, 8.19]
Goldman S 2011	1	367	2	366	16.7%	0.50 [0.04, 5.51]
Muneretto C 2004	3	80	5	80	40.2%	0.58 [0.13, 2.53]
Hayward PA 2011	4	113	2	112	16.2%	2.02 [0.36, 11.25]
Total (95% CI)		1105		1093	100.0%	0.72 [0.30, 1.73]
Total events	8		11			
Heterogeneity: $Chi^2 = 2.25$, df = 4 (P = 0.69); $I^2 = 0\%$						
Test for overall effect: Z = 0.74 (P = 0.46)						
Myocardial infarction						
Deb S 2012	2	510	3	510	16.1%	0.67 [0.11, 4.00]
Goldman S 2011	5	367	4	366	12.2%	1.25 [0.33, 4.69]
Hayward PA 2011	4	113	5	112	20.8%	0.99 [0.24, 4.06]
Muneretto C 2004	2	80	8	80	41.9%	0.23 [0.05, 1.12]
Song SW 2012	0	35	0	25		Not estimable
Total (95% CI)		1105		1093	100.0%	0.68[0.33, 1.38]
Total events	13		19			
Heterogeneity: $Chi^2 = 2.89$, df = 3 (P = 0.41); $I^2 = 0\%$						
Test for overall effect: Z = 1.08 (P = 0.28)						
Repeat coronary operation						
Deb S 2012	3	510	12	510	39.4%	0.25 [0.07, 0.88]
Goldman S 2011	4	367	6	366	19.6%	0.66 [0.19, 2.36]
Hayward PA 2011	1	113	4	112	13.1%	0.24 [0.03, 2.19]
Muneretto C 2004	0	80	8	80	27.9%	0.05 [0.00, 0.93]
Total (95% CI)		1070		1068	100.0%	0.27[0.13, 0.58]
Total events	8		30			
Heterogeneity: $Chi^2 = 3.15$, df = 3 (P = 0.37); $I^2 = 5\%$						
Test for overall effect: Z = 3.34 (P = 0.0008)						

Odds Ratio M-H, Fixed, 95% CI



Comparison of radial artery versus saphenous vein for clinical outcomes

Zhang H. *Herz* 2013



Saphenous Vein Graft Failure After Coronary Artery Bypass Surgery: Pathophysiology, Management, and Future Directions.
Annals of Surgery. 257(5):824-833, May 2013.

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%.

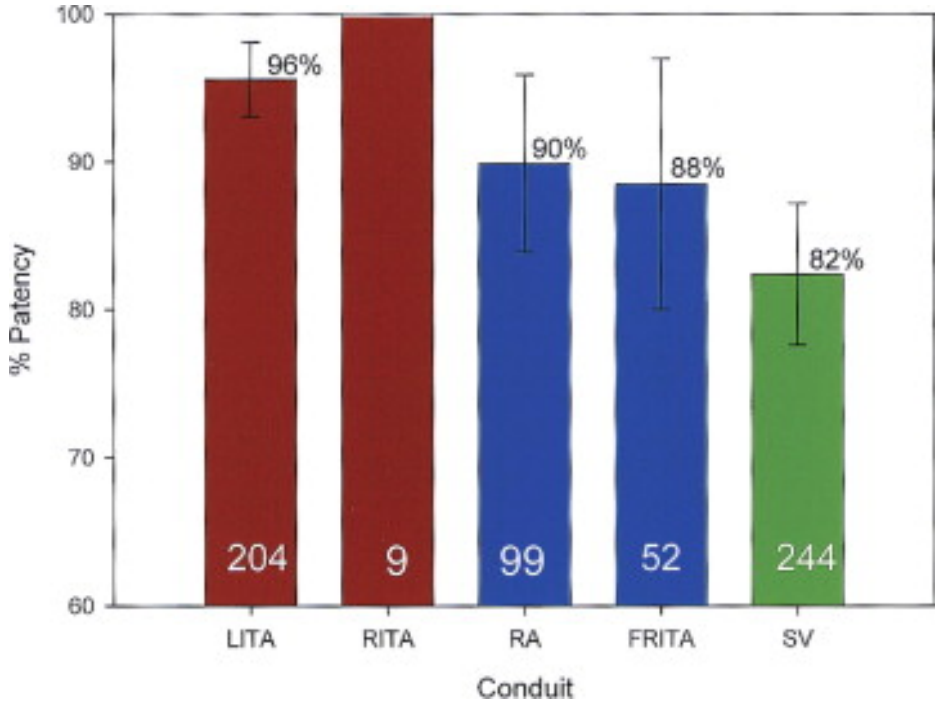
Conclusions—VGF is common and associated with patient and surgical factors. These findings may help identify patients with risk factors for VGF and inform the development of interventions to reduce VGF.

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

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

Table 2. Baseline Procedural Characteristics at the Patient Level According to the Presence or Absence of VGF

Characteristic	With VGF (n=782)	Without VGF (n=1046)	*P* Value
Angiographic classification			
Per protocol angiography only	655 (83.8)	1002 (95.8)	
Early angiography only	64 (8.2)	0 (0.0)	
Early and per protocol angiographies	63 (8.1)	44 (4.2)	
Maximum stenosis of any target vessel ≥75%	790 (72.3)	2317 (71.5)	0.61
Endoscopic vein harvest technique	468 (60.1)	531 (50.9)	<0.001
Any use of composite graft	286 (36.6)	344 (32.9)	0.10
Longest graft length, median (IQR), cm	17.0 (14.3–19.3)	16.0 (14.0–19.0)	0.02
Any proximal (nonsuture)	21 (2.7)	19 (1.8)	0.21
Any distal (nonsuture)	23 (2.9)	27 (2.6)	0.65
Graft source*			0.32
Arm vein	0 (0.0)	2 (0.2)	
Lesser saphenous	12 (1.5)	22 (2.1)	
Greater saphenous	770 (98.5)	1022 (97.7)	
Worst target artery quality			<0.01
Good	308 (39.4)	484 (46.3)	
Fair	281 (36.0)	363 (34.7)	
Poor	192 (24.6)	198 (18.9)	



Comparative patencies of different in situ and free arterial conduits at 5 years.

Hayward PA, Buxton BF. Contemporary Coronary Graft Patency: 5-Year Observational Data From a Randomized Trial of Conduits. Ann Thorac Surg 2007;84:795-9.

The real world

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,
Sean M. O'Brien, PhD; Lawrence H. Cohn, MD; R.

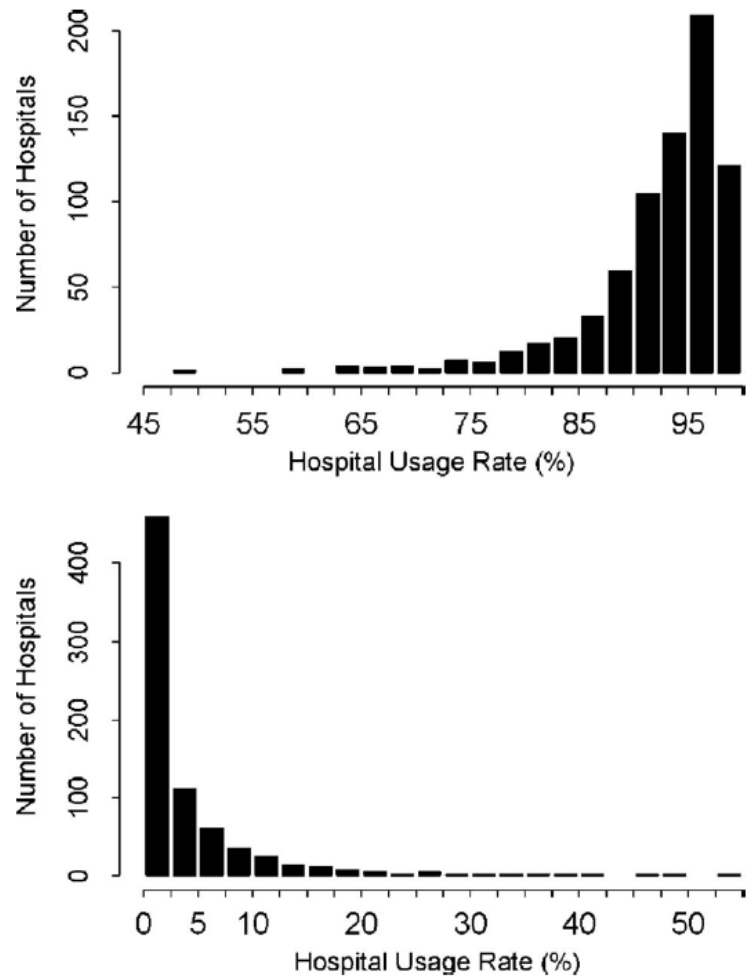
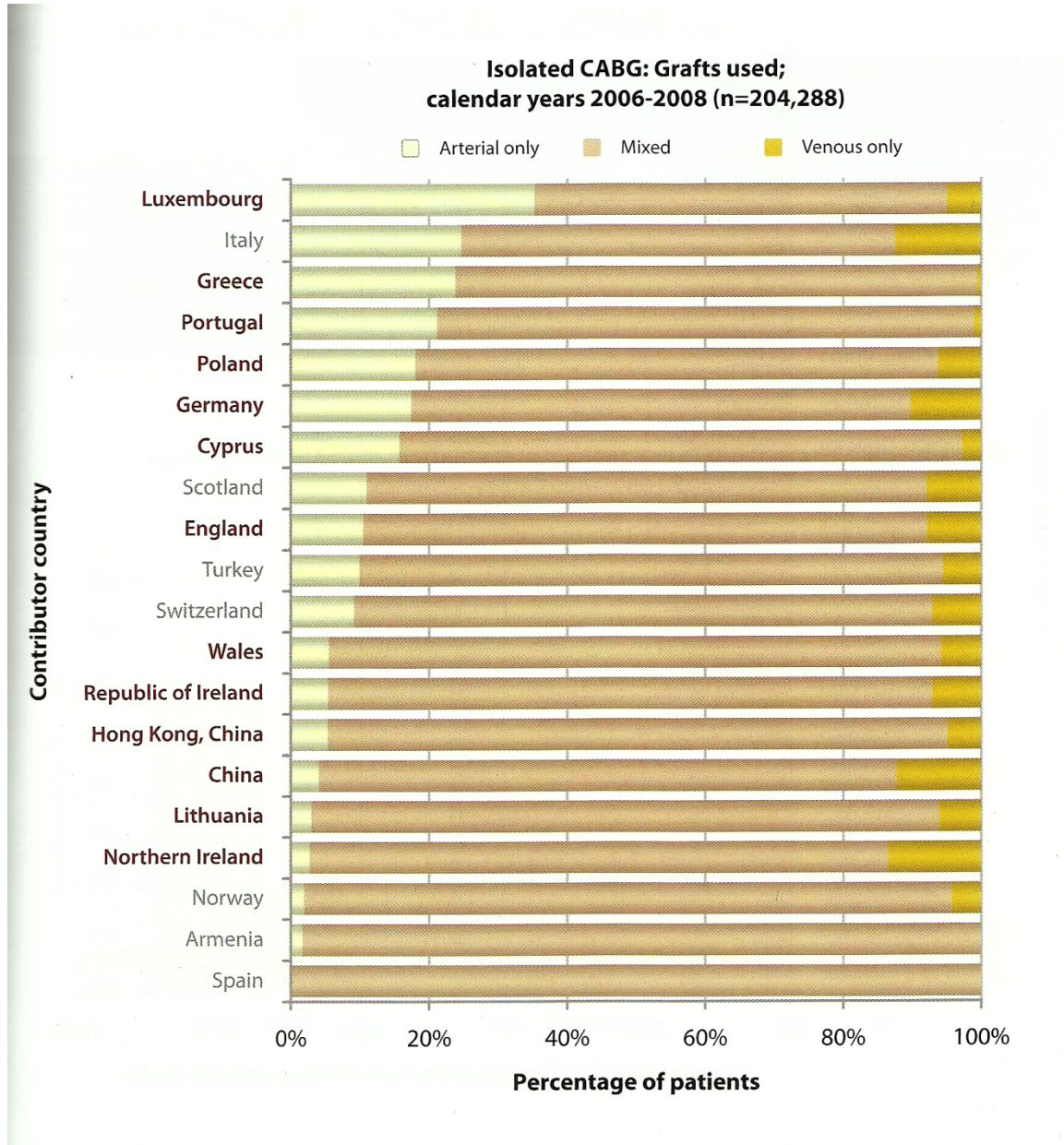


Figure 1. Histograms of the rate of using at least 1 IMA (top) and BIMA (bottom) by hospital.


Isolated CABG: Grafts used;
calendar years 2006-2008 (n=204,288)
Arterial only
Mixed
Venous only
Contributor country
Luxembourg
Italy
Greece
Portugal
Poland
Germany
Cyprus
Scotland
England
Turkey
Switzerland
Wales
Republic of Ireland
Hong Kong, China
China
Lithuania
Northern Ireland
Norway
Armenia
Spain
0%
20%
40%
60%
80%
100%
Percentage of patients

SCIENTIFIC LETTER

Why do UK cardiac surgeons not perform their first choice operation for coronary artery bypass graft?

P A Catarino, E Black, D P Taggart

Heart 2002;**88**:643–644

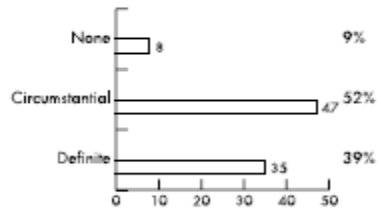
For the past 15 years the "standard" coronary artery bypass graft (CABG) operation for multi-vessel coronary artery disease has used the left internal mammary artery and supplemental saphenous vein segments for conduits.[1] However, increasing evidence suggests that arterial conduits have superior patency rates to vein grafts[2] leading to improved survival and reduced need for reintervention.[3 4]

It is therefore surprising that the uptake of multiple arterial grafts for CABG remains poor. Of 23 000 first time isolated multi-vessel CABG procedures reported in the 1999-2000 database of the Society of Cardiothoracic Surgeons of the United Kingdom and Ireland (SCTS), around 3600 (little over 15%) used more than one arterial graft.

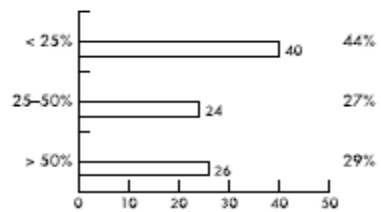
We conducted a postal survey of UK consultant cardiac surgeons to identify what factors contributed to the relatively low proportion of patients receiving multiple arterial grafts.

METHODS

Consultant cardiac surgeons with a predominantly adult practice were identified from the registry of the SCTS. An anonymous postal survey of 142 consultants was carried out in two mailings. A series of questions with fixed possible responses were asked in a brief format. The specific questions and response options are detailed in questions 1–4 and the corresponding figures below.



Question 1 Is there any evidence to show an advantage of using multiple arterial grafts: none; circumstantial; definite.



Question 2 What percentage of your patients might benefit from multiple arterial grafts: < 25%; 25–50%; > 50%.

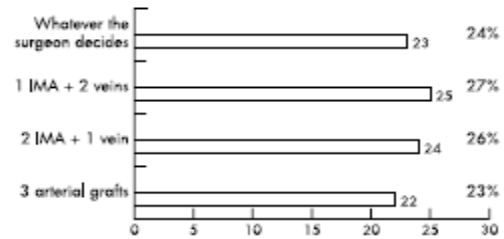
RESULTS

Ninety replies were received (63%). The number of responses to each option is illustrated in the figs. In question 3 some respondents indicated more than one choice and these were all included.

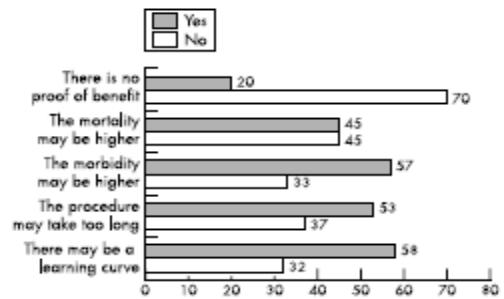
DISCUSSION

Around 85% of first time isolated multi-vessel CABG procedures performed in the UK today do not utilise more than one arterial graft. The relatively low proportion of multiple arterial grafts implies that surgeons do not feel there is a good case for their use in all but a small proportion of patients.

The results of this survey, however, reveal that most surgeons actually believe that there is at least circumstantial evidence of benefit with multiple arterial grafts, with over one third citing definite evidence. This is substantiated by the first part of question 4 where only a minority of surgeons (22%) cite lack of benefit as a reason for not performing multiple

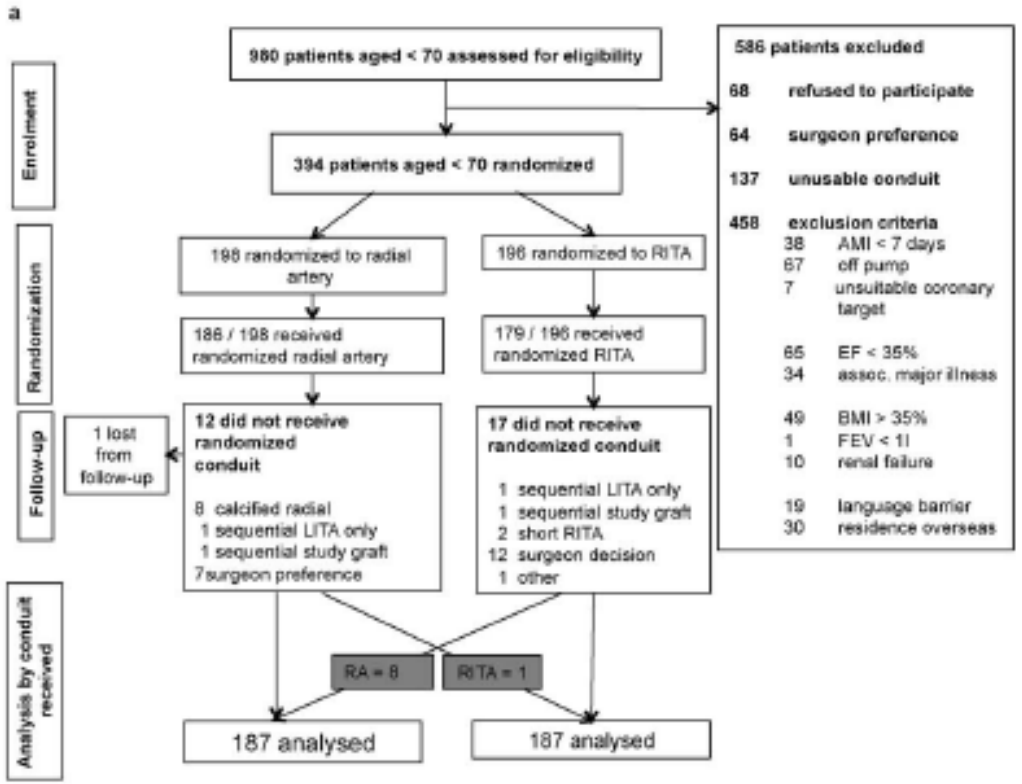


Question 3 If you required elective CABG tomorrow and had typical three vessel disease and reasonable left ventricular function you would wish to have: whatever the surgeon decides, 1 internal mammary artery (IMA) + 2 veins; 2 IMA + 1 vein; 3 arterial grafts.



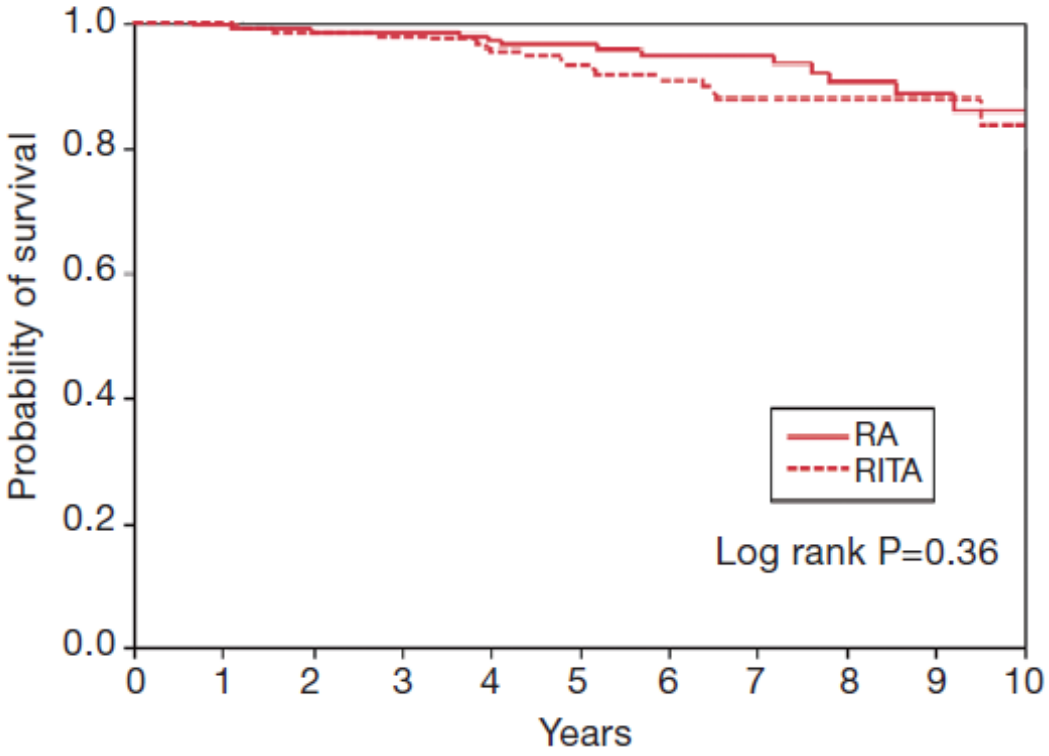
Question 4 Multiple arterial grafts are not commonly performed in the UK because: there is no proof of benefit; the mortality may be higher; the morbidity may be higher; the procedure may take too long; there may be a learning curve.

RAPCO Trial: Assessment, enrolment and randomization - group 1



Hayward et al.The Radial Artery Patency and Clinical Outcomes (RAPCO) Trial: Design, Intermediate Term Results and Future Direction Heart, Lung and Circulation 2011

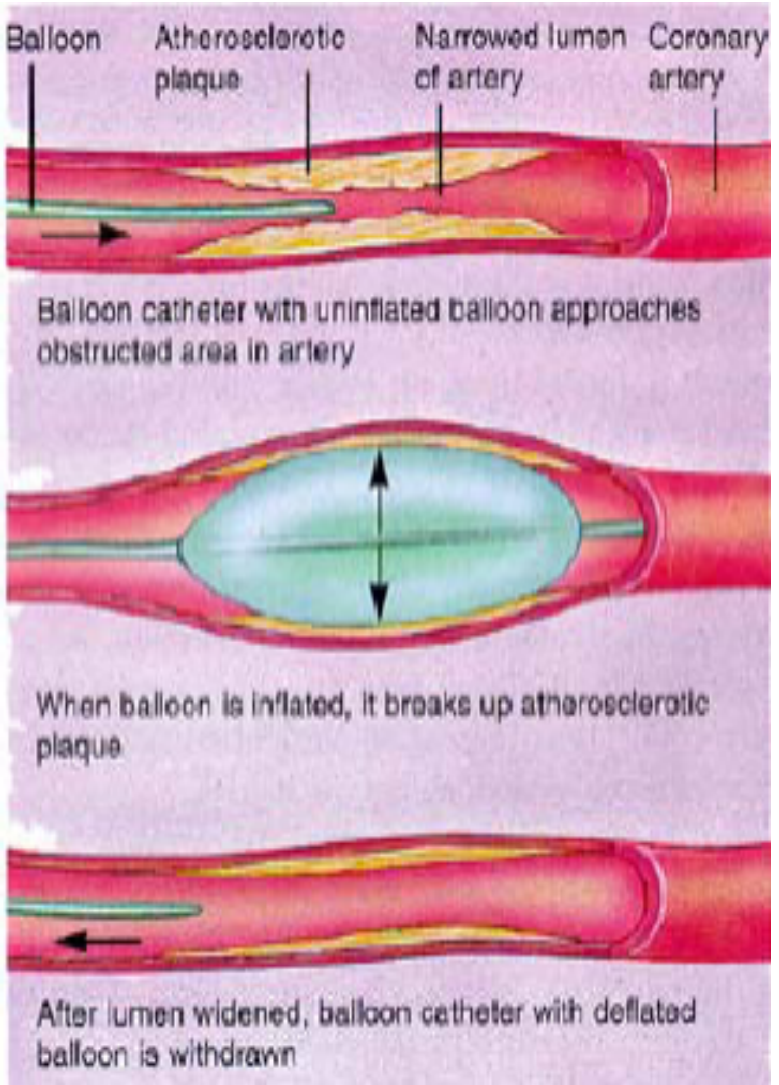
Kaplan-Meier estimates of survival by intention to treat of RA vs. RITA patients, Group 1

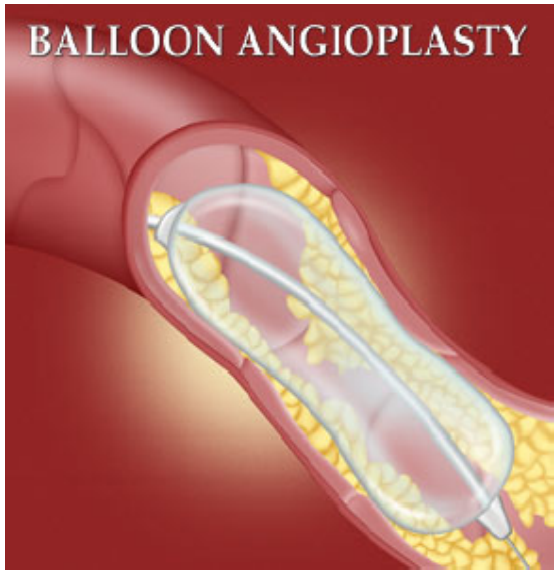


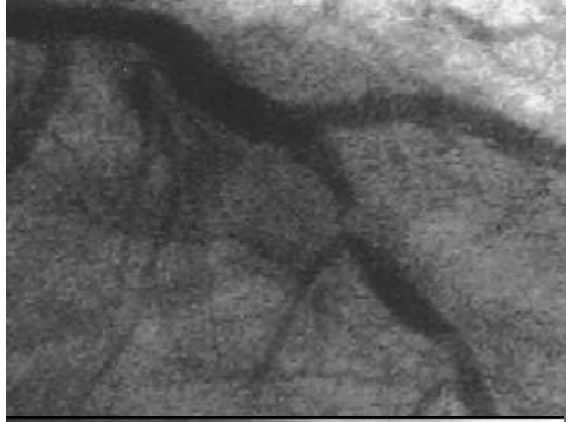
RA	197	196	186	167	143	123	96	74	57	34	2
RITA	196	196	188	169	146	130	94	68	49	28	7

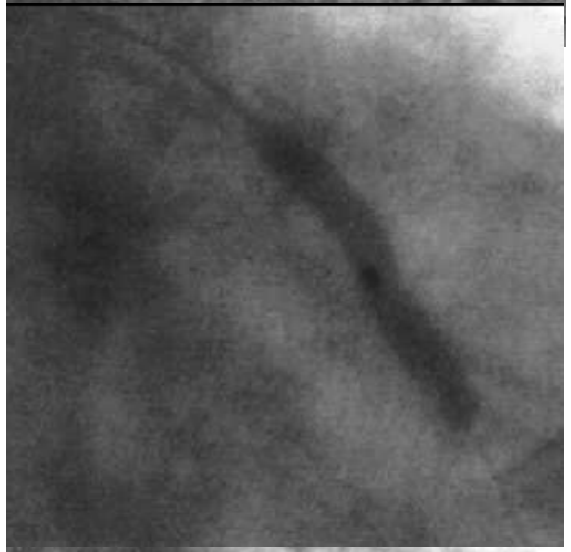
Hayward PA and BuxtonBF *Ann Cardiothorac Surg* 2013;2(4):458-466

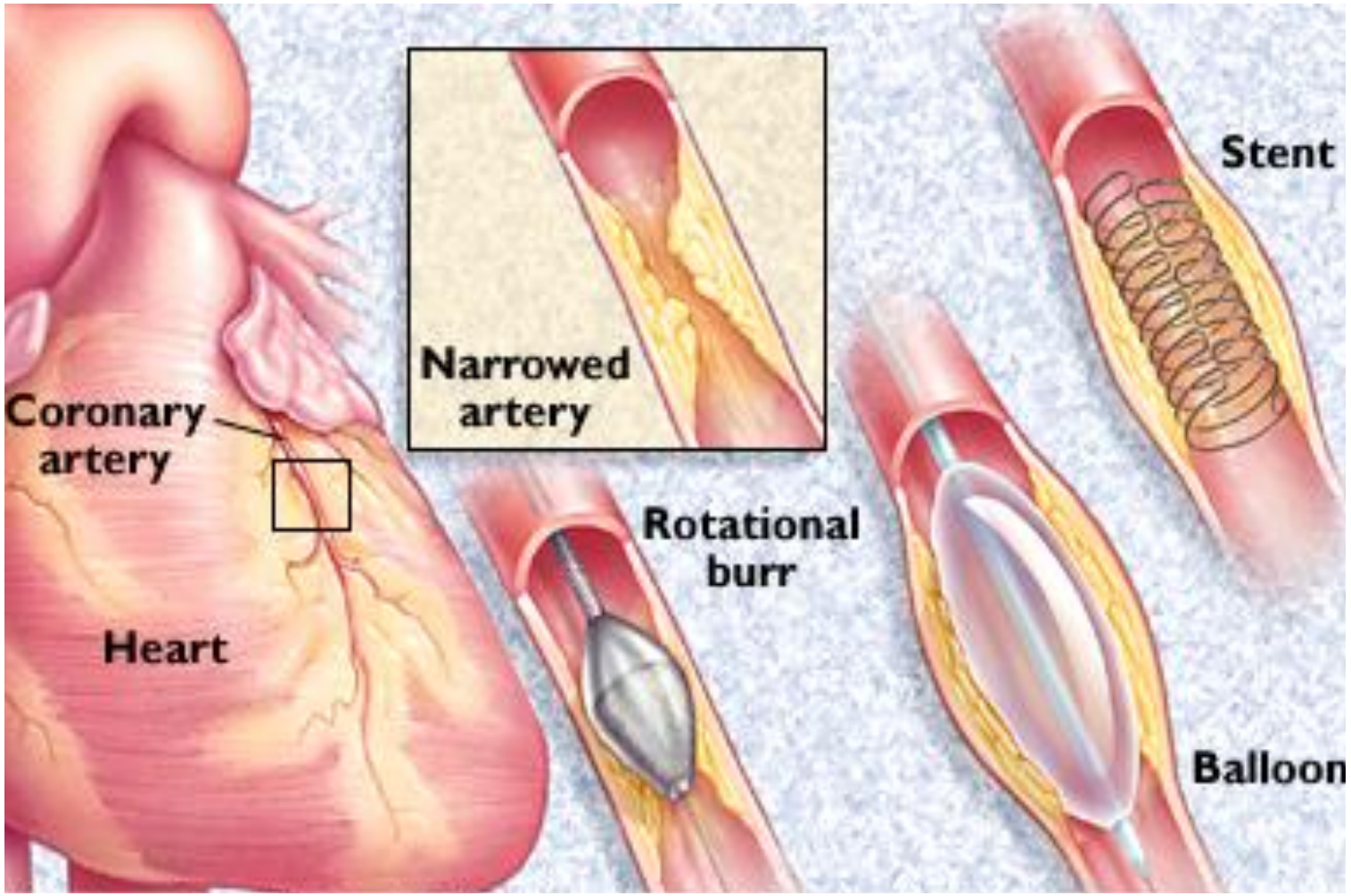
PTCA


Balloon
Atherosclerotic plaque
Narrowed lumen of artery
Coronary artery
Balloon catheter with uninflated balloon approaches obstructed area in artery
When balloon is inflated, it breaks up atherosclerotic plaque
After lumen widened, balloon catheter with deflated balloon is withdrawn


BALLOON ANGIOPLASTY





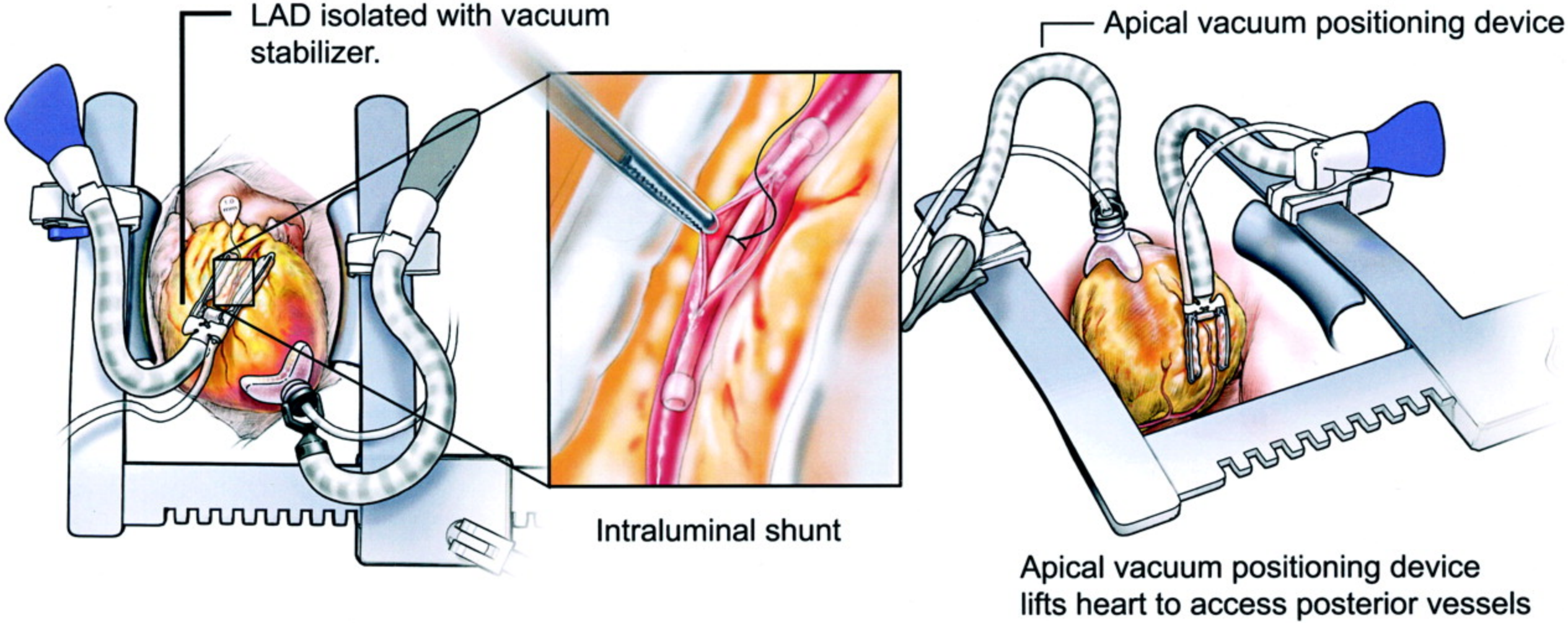

Coronary artery
Heart
Narrowed artery
Rotational burr
Stent
Balloon

Off-Pump Coronary Artery Bypass

(OPCAB)

Procedure

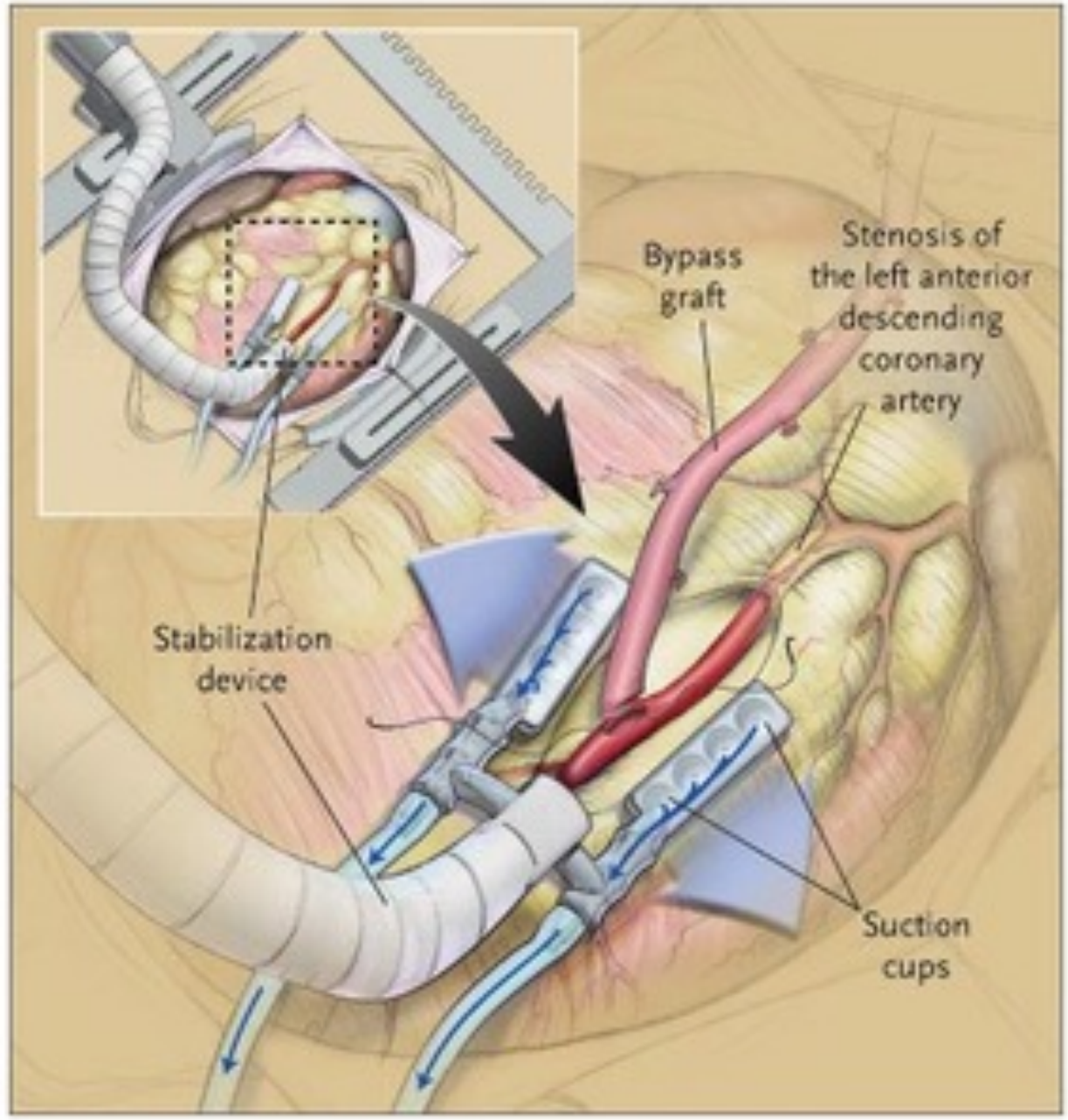
- Median sternotomy of varying sizes.
- Depending on the physiology of the patient, the smallest incision will be made.
- Arteries or veins can be harvested from the patients chest wall, arm, and or leg.
- Betablockers are used to slow the heart rate.
- Deep pericardial sutures and the use of specialized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

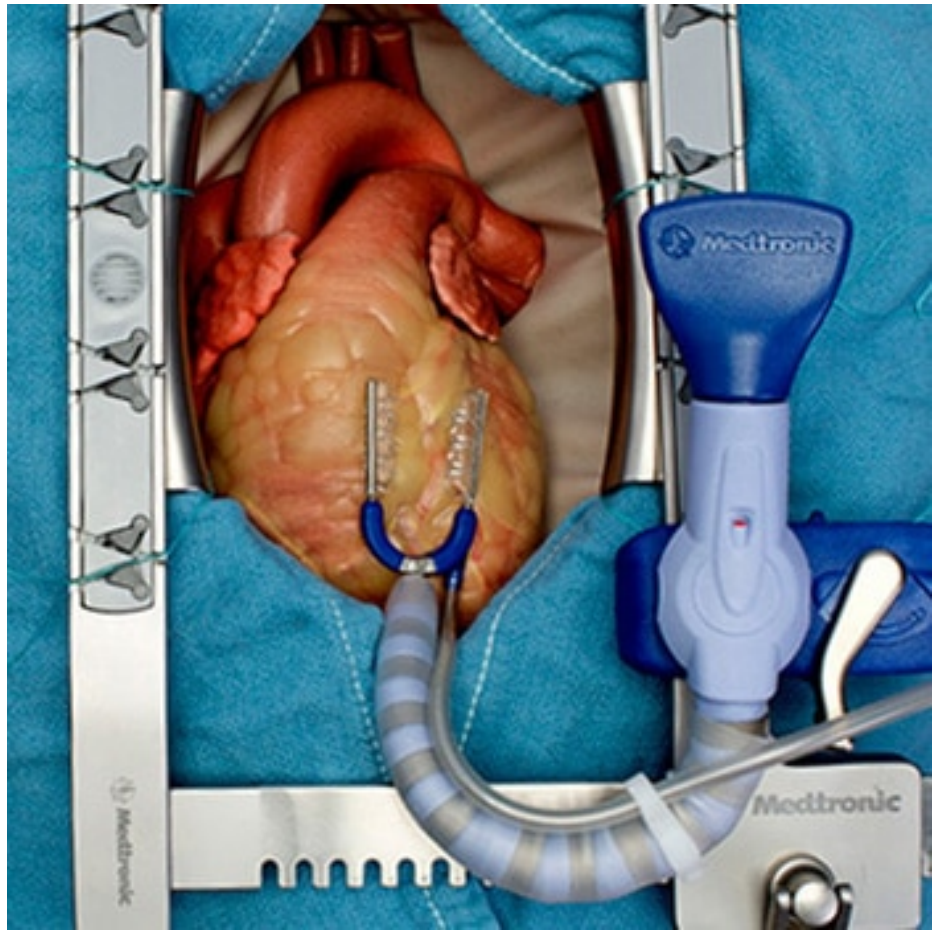

LAD isolated with vacuum stabilizer.
Intraluminal shunt
Apical vacuum positioning device
Apical vacuum positioning device lifts heart to access posterior vessels

Instrumentation

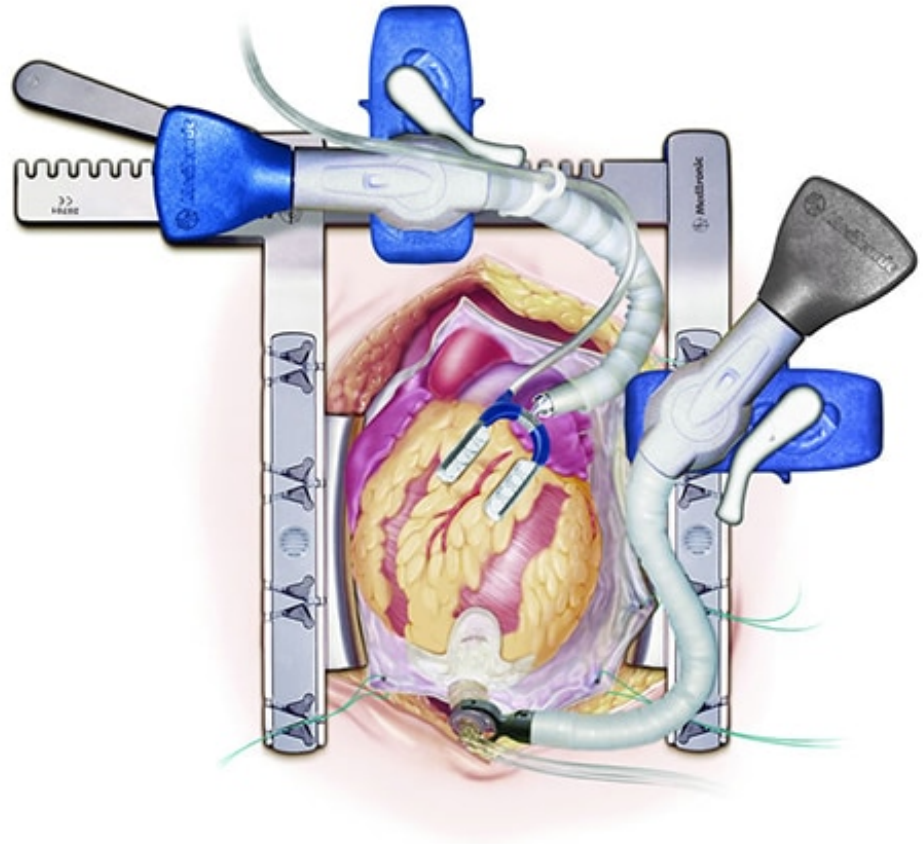
- **Octopus Device**
  - Has multiple small suction cups that are applied to the heart surface.
  - When suction is turned on, the cups stick to the surface, and hold the heart steady, with movement being less than 1 mm.

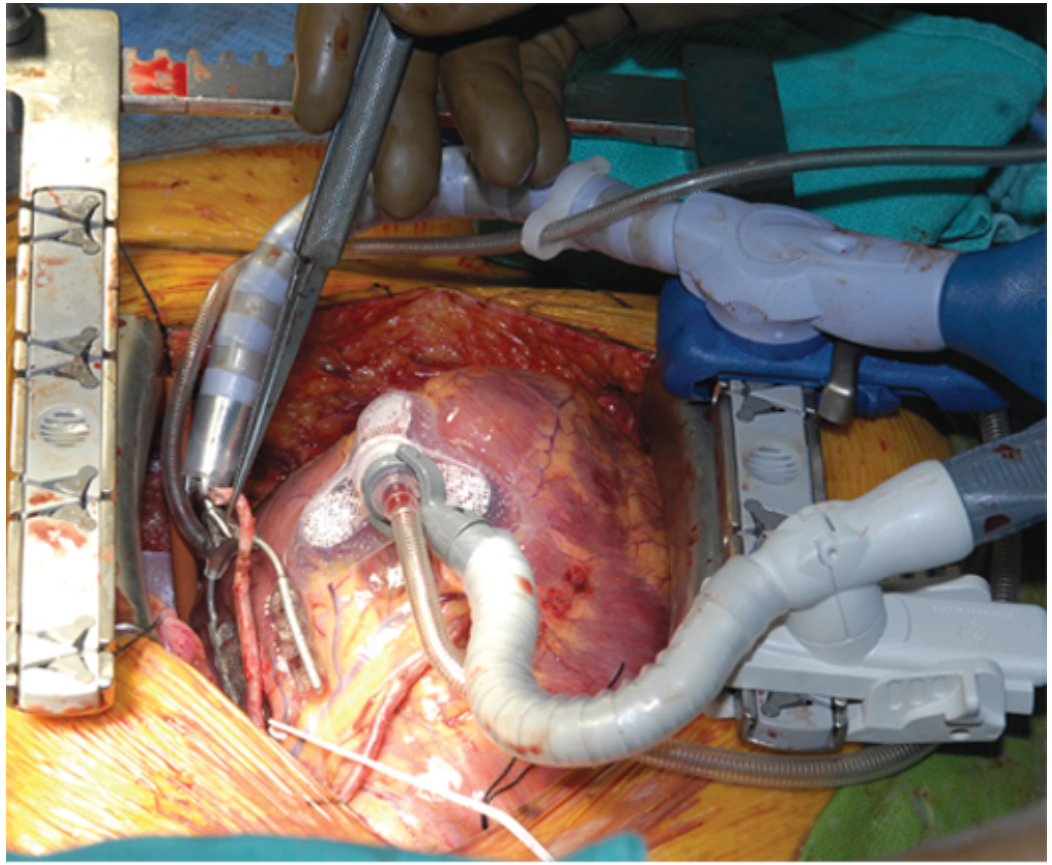
- **Star fish Device**
  - When suction is turned on, the cups stick to the surface, and hold the heart steady


Bypass graft
Stenosis of the left anterior descending coronary artery
Stabilization device
Suction cups


Medtronic
Medtronic
Medtronic


Medtronic


HERE
Medtronic



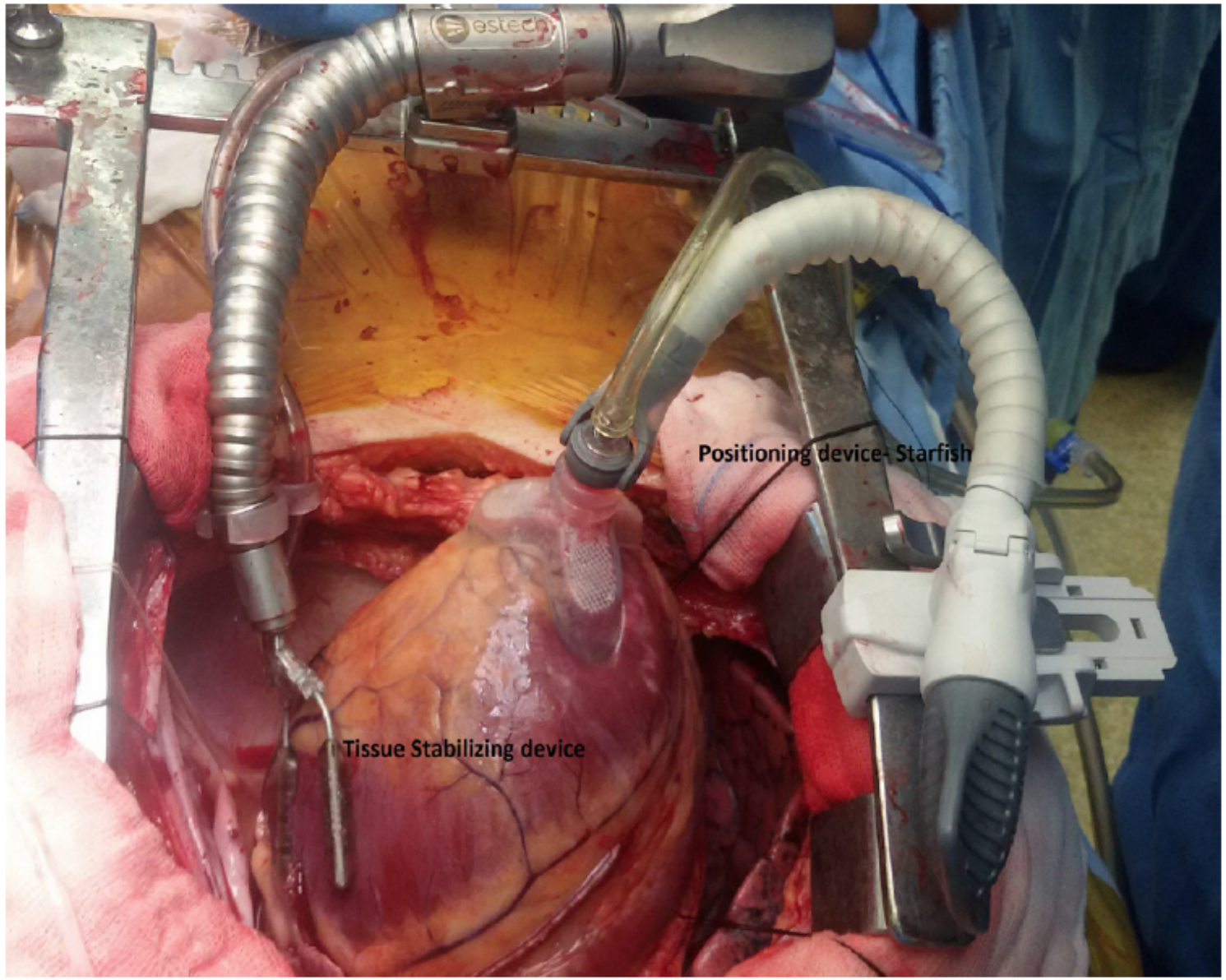


Figure 2. Positioning device (Starfish) and tissue stabilizer device on the epicardial surface

Thank You for Your Attention