

Coronary Artery Disease and Surgery

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I. Coronary Artery Disease & Surgery

- RCA from R sinus . Usually at the middle of the sinus . It may arise close to the anterior commissure (liable to be injured in Konno operation) where a vertical incision across the aortic annulus must be made to the left of the orifice .
- Coronary ostia may be located higher at the tubular aorta 30% in LCA . 8% in RCA
- Origin of both coronaries from the Right sinus is more than from the Left
- The most common anomaly is for the circumflex to arise from the RCA or from the right sinus. It is located behind the aorta

II. Surgical anatomy

- Right Coronary artery orifice is located more anterior and lower than the Left .It passes deep in AV groove then anterior surface of the heart
- First branch; number of small vessels which anastomose on the anterior surface of the ventricle in the pulmonary conus region with the corresponding branch of left coronary (pulmonary conus branch (arterial circle of Vieussens)
- This is an important collateral and keeps the distal LAD open, even when can not be seen on Angio
- Next it supplies multiple Right ventricular branches and SAN artery(60%). Please note that in 40% of cases SAN artery comes from left circumflex. This is not related to R or L domain
- Right marginal artery takes origin at the right border of the heart
- PDA supplies post 1/3 of the septum (most is supplied by LAD)
- Crux. Point beyond the PDA where all chambers are in apposition . AV nodal artery arises there .
- Left Coronary artery from Left sinus
- As an anomaly Left main coronary runs behind the pulmonary artery →sudden death with no atherosclerosis in young adults with exercise with acute MI
- Ramus intermedius: bisects between LAD and circumflex 20% of population
- LAD
- First branch is the Conus branch (circle of Vieussens
- Septal perforators ; first is the largest
- 80 % R domain. 15% L domain .
- In Congenital AS , L domain is seen in 30%

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- Coronary sinus ; drain all except the right ventricle . 85 % of venous drainage
- Association of persistent left SVC with atresia of coronary sinus orifice and absent innominate vein
- O₂ saturation is the lowest of all body 25%
- Retrograde cardioplegia ? R ventricle

III. Anomalies

A. Adults

- Aberrant CX from RCA and origin of LCA from R sinus 0.5%
- Anterior Descending from RCA or R sinus (TOF)

B. Infants

- ALCAPA; abnormal left coronary artery from Pulmonary artery.
- AV fistula from RCA to RV

IV. Coronary Physiology

- 0.8 ml /gm of myocardium /minute
- Oxygen extraction 75% and up 100%
- Most Important factor regulating Coronary inflow is Local autoregulation
- Factors affect Myocardial O₂ consumption
- MVO₂
- HR - afterload (wall stress) - myocardial contractility

V. Pathological Points

- First event is Foam cells into the subintimal
- Worse event is plaque rupture with thrombus platelet thrombus, embolization
- At 75% stenosis. Flow distal depends on the stenosis and not on the pressure gradient any more
- Myocardium requires 1.3 ml O₂ /100 gm /minute . Contracting ventricle 8.0 ml O₂/100 gm/minute
- Hibernating myocardium;
- Moderate persistent reduction in flow
- hypocontractile but viable .return to normal contraction after reperfusion
- Stunned myocardium
- Recovery is subnormal and longer . Cellular proteins change . Calcium influx abnormal

VI. Clinical syndromes

- Stable Angina. Medical treatment if fails then Interventions (Cardiac Cath)
- Unstable Angina
- Acute MI
- Cardiogenic Shock

VII. Interventions Revascularize; CABG or PTCA

A. Indications for CABG

- 1 - Symptomatic 3 vessel CAD with depressed LV function
- 2 - left main disease
- 3 - failed PTCA or complications of PTCA
- Other possible indications are postinfarction angina. Cardiogenic shock.

VIII. BARI study

- EAST trial Emery Angioplasty versus Surgery trial 1990
- Three years follow up PTCA 40% Required repeated procedures. Versus 20% only for CABG
- Preprocedure MI slightly higher in CABG
- But in 3 years no significant difference

IX. Failed PTCA or Complications

- Mortality rate of PTCA <1%
- Common picture is dissection or laceration with extravasation. Management is immediate CABG with SVG rather than LIMA. Intra-aortic balloon pump may help but not essential. Presence of thrombolytics on Board should never delay surgical interventions
- Emergency surgery for failed or complicated PTCA is so rare that it is acceptable to go with PTCA with no need for standby as a standard for care. Studies have even showed it could be done in Hospitals with no cardiac surgery facility.

X. Preop evaluation; CABG

- H/P
- CXR
- Labs . Coagulation tests...PT, PTT, Platelet functions in Vitro response of platelets to ADP, Epinephrine
- Carotid evaluation? Left main disease

A. Question

1. During pre-op evaluation of 68 years old for 4 vessel CABG , a 90% stenosis of Left internal carotid was seen on Angio. Patient is asymptomatic. The most recommended is
 - a. CABG followed by CEA
 - b. Simultaneous CABG ,CEA
 - c. CEA followed by CABG
 - d. stenting Carotid , then CABG
2. Stress test . Detects 1)EKG changes and 2) Changes in metabolic adjustments in response to exercise
3. Thallium stress test . Thallium is taken up intracellular like K . Ischemia defects appear as cold areas which later fills up indicating viability
4. Fixed defects = non viable negative
5. Adenosine or Dipyridmol thallium test

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6. Dobutamine stress echo ; asses wall motion in response to dobutamine . Akinesia or hypokinesia
7. PET scan . More accurate .can determine hibernating myocardium

XI. Risk factors for CABG

A. Several database;

- Preoperative Shock requiring Mechanical or Pharmacological support is the Highest in all studies (Sometimes it is called Emergency surgery)

B. Other factors;

- Decrease in ventricular function
- Age
- High creatinine .1.9
- ESRD (Dialysis)
- Recent MI
- Females>males
- Redo

XII. Question

A. The most common cause of death in coronary redo is?

1. Intractable Arrhythmia
2. Massive stroke
3. Acute renal failure
4. **Perioperative MI**

B. The 2 major morbidity are;

- Sternal wound sepsis 1% with a 20 % mortality rate
- Neuro deficits

C. Which patient most liable for sternal wound infection? Female. Diabetic .Elder .B IMA

D. Which of the following is most responsible for CVA after CABG

1. Heparinization
2. Aortic Cannulation
3. Clamping of Aorta
4. Hypoperfusion

XIII. Survival after CABG

- Advanced age
- Ejection fraction
- Number of diseased vessels
- Diabetes
- Renal dysfunction
- Females have higher mortality

XIV. Surgical technical points

- Extracorporeal circulation

XV. Question

A. What is the concentration of K in Cardioplegia solution ?

- A- 66 mmol/liter
- B- 44 mmol/liter
- C- 22 mmol/liter

B. During Cardiopulmonary Bypass for CABG, the Myocardial septal temperature should be kept approximately at (during cross clamp time)

- A. 32c
- B.28c
- C.20c
- D.16c

XVI. Surgical technical points

- Cardioplegia
- Antegrade 750 to 1500
- Watch for distention e.g. Aortic regurgitation . Stop cardio ?
Right superior pulmonary vein vent . Aortic root vent ...
- Retrograde .(Redo) Could be used alone to induce arrest . R ventricle is not well protected
? Injury coronary sinus

XVII. Question

A. 80 years old female is going Redo CABG with reterograde cardioplegia. Coronary sinus laceration was seen after removing the catheter . Heart is in sinus rhythm . Most recommended action is

- A. Re-Arrest by antegrade by new grafts to repair the sinus
- B. Attempt direct repair or ligation
- C. gently reinsert the retrograde catheter and repair over the catheter

XVIII. Severe calcification of Ascending aorta

- Options for cannulation
- Use epicardial US
- Select an area free of plaque
- Cannulate higher opposite the innominate
- Femoral or Axillary cannulation
- OPCAB
- Hypothermia circ arrest
- Fibrillatory arrest
- Options for grafts;
- LIMA. RIMA
- Sequential grafts
- Grafts from innominate
- LIMA to LAD
- 90% 10 years patency versus 40% for SVG

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- Better survival
- Less reoperations
- Less chance of “late “ MI

XIX. Pitfalls with LIMA

- Subclavian artery stenosis ; suspect with PB difference of 20 mmhg
- Injury to Phrenic nerve
- Early flow ? Spasm

XX. Question

A. During weaning off CPB after 3 Vessels CABG, including LIMA to LAD . Patient shows ST segment changes and Dyskinesia at LAD distribution . Most appropriate action is

- A. IABP and continue weaning
- B. Redo LIMA to LAD
- C. Add SVG to distal LAD
- Radial Artery
- Coronary endarterectomy

XXI. Redo Coronary

- The most common cause of mortality is Perioperative MI
- Stroke is twice as common
- MI is 5 times as common
- Atherosclerosis of The grafts (SVG)is one of the causes

A. Problems with redo

- Conduit available
- More Atherosclerosis of Ascending aorta , consider other options mentioned before
- Cardioplegia delivery . Antegrade is not as effective as in Primary operations . Why? Most grafts and native coronaries are diseased ,so Think of Retrograde .To improve delivery and avoid Atheroembolism
- In A patient for redo of Circumflex , Consider left thoracotomy with A descending aorta to Circ SVG
- A patent LIMA to LAD is a challenge . Avoid injury of the LIMA. Mortality is high but it is rare to happen , so MI is still the most common cause of death in these patients
- LIMA graft has to be occluded before arrest

XXII. TMLR

- Trans myocardial Laser Revasc ;
- Severe Angina (Symptoms) with failure of medical therapy and Unsuitable targets
- Use Viability studies to determine areas of Viable ischemia to be Lasered
- Perioperative Mortality of 9%
- Significant Improvements in Angina class for 1 year follow up
- Could be done alone via left thoracotomy

- Recently FDA approval for TMR to be done in combination with CABG
- Probably no longer survival

XXIII. OPCAB

- Advantages
- Less Systemic inflammatory response
- Less Renal ,pulmonary problems
- Earlier recovery and hospital discharge