SURGICAL INTERVENTIONS IN CORONARY ARTERY DISEASE

A Surgeon’s Perspectives

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Disclosures

None
• As nations become industrialized, economy progresses
• Improved sanitation, housing, health care, nutrition
• “unhealthy lifestyle” – tobacco, high fat diet
• Environmental pollution
EPIDEMIOLOGIC TRANSITION

“shift of mortality from infectious diseases to chronic lifestyle related disorders”

DEMOGRAPHIC TRANSITION

“increasing life expectancy and declining infant mortality lead to large adult population”
GLOBAL PANDEMIC OF CARDIOVASCULAR DISEASES

• CORONARY ARTERY DISEASE

• #1 cause of death in the USA, and worldwide

• In 2010, 20% of adults in USA over 65 have CAD

• In 2015, CAD affected 110 million people with 9 million deaths (16% of all deaths)
Surgicul's Interventions

1920  Surgical sympathectomy to relieve angina
1930  Epicardial and pericardial abrasions to create collaterals
1940  Vascularized pedicles to the heart surface
1950  Retrograde perfusion of coronary veins
1960  Vineberg intramyocardial implantation of internal mammary artery
SURGEON’S INTERVENTIONS

1953  John Gibbon developed heart lung machine (cardiopulmonary bypass)
1957  Mason Sones  selective coronary angiogram
1964  Garrett  first to perform saphenous vein graft
1968  Favaloro  popularized aortocoronary bypass graft
CORONARY ARTERY BYPASS GRAFT (CABG)

Effective operation
  prolonged survival, relieved symptoms
  improved quality of life

widely accepted by surgeons
CABG

• 1980  137,000
• 1985  203,000  *refined in the ‘70s
• 1990  400,000
• 2000  500,000  *flourished in the ‘80s
• 2010  300,000
LANDMARK STUDIES

CABG vs medical treatment of the ‘70s/’80s

• VACOOP  Veterans Administration Cooperative Study
• ECSS    European Coronary Surgery Study
• CASS    Coronary Artery Surgery Study
CONCLUSIONS

Improved survival in
left main disease
proximal LAD or LM equivalent
triple vessel disease with LV dysfunction

Improved quality of life
relief of angina
more functional capacity
less need for medications
STANDARD/CONVENTIONAL CABG

• Technique:
  • Median sternotomy
  • Cardiopulmonary Bypass
  • Aortic cross clamp
  • Cardioplegic arrest
  • Hypothermia
STANDARD/CONVENTIONAL CABG

• Conduit:
  • LIMA – LAD
  • LIMA dissection – pedicle or skeletonized
  • SVG – CX and branches, RCA and branches
  • SVG harvest – open or endoscopic
STANDARD CABG

• COMPLICATIONS:
  • Mortality -- 1-5%
  • Morbidity
    • low output syndrome (perioperative MI)
    • stroke -- 1-5%
    • neurocognitive dysfunction – 40%
STANDARD CABG

• COMPLICATIONS:
  • arrhythmia
  • coagulopathy – transfusion requirements
  • infection
  • renal failure
  • respiratory failure
• CABG recuperation – 6 to 12 weeks
**COMPLICATIONS: GRAFT FAILURE**

<table>
<thead>
<tr>
<th></th>
<th>5 YEAR</th>
<th>10 YEAR</th>
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<tbody>
<tr>
<td>LIMA</td>
<td>95%</td>
<td>90%</td>
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<tr>
<td>SVG</td>
<td>75%</td>
<td>50%</td>
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- early SVG graft failure are due to technical reasons
- < 3 years -------- intimal hyperplasia
- > 3 years -------- graft atherosclerosis

* Re operations !! – carries higher mortality and morbidity!!
Graft patency after CABG

- Internal mammary artery
- Saphenous vein

Graft patency, percent

Years
SURGICAL INNOVATION

• PAN ARTERIAL BYPASS GRAFTS
  • LIMA
  • RIMA
• RADIAL ARTERY
• GASTROEPIPIPOIC ARTERY
RIMA

Pedicle or skeletonized
In situ/free graft/T-graft
Smaller and shorter(?)
RIMA-RCA
Sternal wound complications due to devascularization, obesity, COPD, DM
Patency rate less than LIMA-LAD
RADIAL ARTERY

Graft failure in early experience in the ‘70s
Prone to vasospasm, Rx with cardizem
Check ulnar circulation (Allen’s test)
Bilateral harvest; dialysis access
Good patency rate
Second choice arterial graft
Lateral antebrachial cutaneous nerve
Brachioradialis muscle
Bicep tendon
Flexor carpi radialis
Bicipital aponeurosis
GASTROEPIPILOIC ARTERY

• Abdominal operation
• Traverse the diaphragm anterior to stomach and liver
• Limited target vessels – inferior surface of myocardium
• Beware of future abdominal surgery
• GEA patency – 85% at 5 years, 70% at 10 years
ARTERIAL GRAFTS

• *Arterial grafts have better patency rate than SVGs, but not routinely used*

• Standard CABG remains cornerstone of surgical revascularization

• LIMA-LAD, SVG-CX, SVG-RCA or arterial graft in selected patients
SURGICAL INNOVATION

Minimally Invasive Procedures

• MIDCAB --- minimally invasive direct coronary artery bypass
• Port Access --- (Heartport)
• OPCAB --- off pump coronary artery bypass
• *steep learning curve*
MIDCAB

• Small thoracotomy incisions
• No CPB – warm beating heart
• Avoid deleterious effects of CPB
  • systemic inflammatory response, organ dysfunction, renal,
  • respiratory failure, blood trauma, coagulopathy
• Avoid aortic cross clamp = less emboli, less stroke, less
  • neurocognitive disorder
FIGURE 13-1. Skin incisions used for different approaches to MIDCAB procedures.
MIDCAB

- Special instruments – stabilizers, intraluminal shunts, blower, suction
- Target vessels usually anterior surface – LAD, RCA
- Exposing side or inferior vessels cause hemodynamic instability
- Less precise anastomosis
- Incomplete revascularization
PORT ACCESS (HEARTPORT)

Small thoracotomy ports/incisions
On CPB
Femoral cannulation, endoaortic balloon occlusion, cardioplegic arrest
Steep learning curve
Longer operation
OPCAB

• Similar to MIDCAB, except median sternotomy,
• access to all coronary arteries
• No CPB, warm beating heart surgery
• Same instrumentations
• Same benefits
• Same limitations
OPCAB

Less morbidities related to CPB
Less organ dysfunction
Earlier extubation and ambulation
Less cost, less blood utilization
Less length of stay

- but -

Incomplete revascularization, less graft patency
MINIMALLY INVASIVE CORONARY ARTERY BYPASS SURGERIES

• Despite advances in minimally invasive coronary artery procedures, standard CABG remains the cornerstone and the gold standard for surgical revascularization of the ischemic myocardium.

• Only about 20% of surgeries are being done with minimally invasive procedures.
PTCA/PCI

Across the OR suite to the Cardiac Cath Lab

• 1968 Favaloro CABG
• 1977 Gruntzig PTCA
• CABG has a decade long headstart / experience / data over PCI
PTCA/PCI

1977 Gruntzig PTCA in humans
slow start, improving results
40% re stenosis in 6 months
30% re PTCA in 12 months
*acute recoil, dissection, thrombosis
*surgical team standby, rescue CABG
PTCA / PCI

• 1986 Bare metal stent (BMS)
• 2003 Drug eluting stent (DES)
  • first generation
  • second generation
PCI AND CABG

• Both are effective revascularization approaches

• Higher stroke rate with CABG
• Higher reintervention rate with PCI
• Higher long term survival with CABG
SYNTAX I SCORING

• Based on lesion characteristics, e.g. dominance, length, number, bifurcation, etc.

• Low complexity
• Intermediate complexity
• High complexity
Right dominance: the posterior descending coronary artery is a branch of the right coronary artery (segment 4).

Left dominance: the posterior descending artery is a branch of the left coronary artery (segment 15). Co-dominance does not exist as an option in the SYNTAX score.
PCI OR CABG

Intensive risk modification
Team approach – patient/family, FMD, cardiologist, surgeon

• One vessel = PCI
• Two vessel non LAD = PCI
• Two vessel LAD + Cx/RCA + DM = CABG
• Three vessel = CABG
• Three vessel + low SYNTAX + no DM = PCI
• PCI

IMPACT OF PCI ON CABG

Decline in CABG – 30% in past decade

Changing indication for CABG

LM lesion + low SYNTAX score + no DM =

PCI has comparable results with CABG
HYBRID CORONARY REVASCULARIZATION (HCR)

• Combining the best of both worlds
• MIDCAB + DES
• MIDCAB LIMA-LAD
• PCI (DES) to non LAD territories
• Hybrid Operating Room
HCR – TIMING AND STAGING

• Staged MIDCAB before PCI
  • antiplatelet agent, imaging of LIMA
• Staged PCI before MIDCAB
  • rarely done, delay MIDCAB for months
• Single stage – done in hybrid OR
  • one stop revascularization
STANDARD / CONVENTIONAL CABG

Gold standard / cornerstone of surgical intervention in coronary artery disease
Has not changed much in decades
Arterial grafts in selected cases
About 20% are minimally invasive procedures
Less than 1% are HCR
EPILOGUE