CORONARY ARTERY BYPASS GRAFTS, STENTS, AND EXTRACORONARY CARDIAC DZ

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CORONARY ARTERY BYPASS GRAFTS

- First performed in US in 1960
- 350,000 per year
- Indications
  - L main disease
  - 3-vessel disease
  - Refractory symptoms
Bypass grafting uses a conduit harvested from the patient to bypass an atherosclerotic lesion in a coronary vessel.
CORONARY ARTERY BYPASS GRAFTS

Two major options

- **On-Pump**
  - Traditional technique
  - Requires open sternotomy

- **Off-Pump (Beating heart)**
  - Can be done open or through “keyhole”
  - Associated with fewer complication/shorter length of stay
CORONARY ARTERY BYPASS GRAFTS

GRAFT OPTIONS

- Internal Mammary (thoracic) Artery Graft (IMA)
  - Left
  - Right
- Saphenous Vein Graft (SVG)
- Radial Artery Graft
- Gastroepiploic Artery Graft
INTERNAL MAMMARY ARTERY (IMA)

- Graft of choice
- Best patency (85%-90% @ 10 years)
- Using grafted to LAD (L>R)
- Grafting options
  - Dissected from sternum – retains connection with subclavian
  - Free graft – aortocoronary

Courtesy: A. Frazier MD
CORONARY ARTERY BYPASS GRAFTS

SAPHENOUS VEIN GRAFT (SVG)

- From leg - most available for multiple bypass grafting
- Lower patency – 50% @ 5 years
- Largest caliber
- Bypasses: Diagonal, obtuse marginal, PDA (occ LAD)

Courtesy: A. Frazier MD
CORONARY ARTERY BYPASS GRAFTS

RADIAL ARTERY
- Third choice
- Intermediate patency rate
- Spasm

GASTROEPIPLOIC ARTERY
- Technically difficult – fourth choice
- Usually RCA
SCANNING PROTOCOLS

BYPASS GRAFT

- Similar to coronary CTA
- FOV restricted to heart
- Retrospectively gated
- Extends from apices
# BYPASS GRAFTS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>COR CTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>kV</td>
<td>120</td>
</tr>
<tr>
<td>mAs</td>
<td>600</td>
</tr>
<tr>
<td>FOV</td>
<td>250</td>
</tr>
<tr>
<td>Collimation (mm)</td>
<td>0.625</td>
</tr>
<tr>
<td>Recon (mm)</td>
<td>0.675/0.9</td>
</tr>
<tr>
<td>Direction</td>
<td>Caudal-Cranial</td>
</tr>
<tr>
<td>Time (sec)</td>
<td>15</td>
</tr>
</tbody>
</table>
LIMA AND SVG
RADIAL AND GASTROEPITHELIC
CORONARY BYPASS GRAFTS
CORONARY BYPASS GRAFTS
ACUTE COMPLICATION
CORONARY BYPASS GRAFTS
ACUTE COMPLICATION
CORONARY BYPASS GRAFT COMPLICATION
CORONARY BYPASS GRAFTS
STENOSIS

Courtesy: Dr. Choi
CORONARY BYPASS GRAFTS
STENOSIS
GLOBAL SVG STENOSIS

Perioperative

1 year F/U

Neointimal hyperplasia
CORONARY BYPASS GRAFT OCCLUSION
CORONARY BYPASS GRAFTS

The “nubbin” sign
THE NUBBIN SIGN
CORONARY BYPASS GRAFT OCCLUSION
CORONARY BYPASS GRAFT OCCLUSION
GRAFT COMPLICATION

Courtesy: L. Haramati MD
GRAFT COMPLICATION
## CORONARY BYPASS GRAFTS

<table>
<thead>
<tr>
<th></th>
<th>Pts</th>
<th>Grafts</th>
<th>Occlusion (Se,Sp)</th>
<th>Stenosis (Se)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBCT</td>
<td>50</td>
<td>135</td>
<td>(80%-100%)</td>
<td>N/A</td>
</tr>
<tr>
<td>SSCT</td>
<td>985</td>
<td>2200</td>
<td>(81%,89%)</td>
<td>N/A</td>
</tr>
<tr>
<td>4-DCT</td>
<td>441</td>
<td>1246</td>
<td>(93%,96%)</td>
<td>74%</td>
</tr>
<tr>
<td>16DCT</td>
<td>144</td>
<td>416</td>
<td>(99%,98%)</td>
<td>88%</td>
</tr>
</tbody>
</table>

Adapted from Stein PD AJC 2005
Sixty-four-slice CT angiography can be used for accurate exclusion of greater than 50% graft stenosis, but detection of distal anastomotic stenosis is limited, and the degree of stenosis can be overestimated.

Feuchtner G. AJR 2007;189:574
CORONARY STENTS
CORONARY STENTS

- Initial human use in 1986
- Reduced restenosis compared with 30% rate of angioplasty
- 1M implanted yearly in US
- Two main types:
  - Bare metal stents
  - Drug eluting stents

www.health-alliance.com
CORONARY STENTS

Bare metal stents
- Initial type of stent
- Eliminated risk of immediate artery collapse seen with angioplasty
- Due to scarring, had a 25% rate of restenosis at 6 months

medicals-united.com
CORONARY STENTS

Drug-eluting stents
- Impregnated with drugs to retard restenosis process
- Associated with much lower rate of restenosis (<10%)
- Rarely, develop late potentially fatal restenosis from blood clot
- Require long term anticlotting drugs
**CORONARY STENT TYPES**

<table>
<thead>
<tr>
<th>Stent Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug-eluting stent</td>
<td>A stent that slowly releases a drug to block cell proliferation and/or restenosis</td>
</tr>
<tr>
<td>Bare metal stent, stainless steel</td>
<td>A vascular thin metal wire or mesh stent without a coating, typically first-generation technology</td>
</tr>
<tr>
<td>Bare metal stent, CoCr</td>
<td>A vascular thin metal wire or mesh without a coating, typically next-generation technology</td>
</tr>
<tr>
<td>Absorbable stent</td>
<td>Completely biodegradable, bioabsorbable stent, typically polymer or magnesium, sometimes coated with anti-restenotic agent</td>
</tr>
<tr>
<td>Bioactive stent</td>
<td>A stent that reacts with the body’s natural processes to achieve an anti-restenotic effect</td>
</tr>
<tr>
<td>Radioactive stent</td>
<td>Stent with a radiation-emitting coating</td>
</tr>
<tr>
<td>Drug-eluting balloon</td>
<td>Angioplasty balloon that, after deflation, leaves behind an anti-restenotic drug</td>
</tr>
</tbody>
</table>
CORONARY STENTS – CT FACTS

- CT is effective for thrombosis in larger stents (3.5 mm and greater)
- Good for occlusion vs non-occlusion
- Difficult to assess in-stent restenosis
EFFECT OF STENT SIZE

4 mm stent

3.0 mm stent

2.25 mm stent

Courtesy: J. Earls MD
STENT ASSESSMENT
CORONARY STENTS – CT/CATH

Courtesy: Sang-Ill Choi, M.D
## CORONARY STENTS

<table>
<thead>
<tr>
<th></th>
<th>Pts</th>
<th>Stents</th>
<th>Slices</th>
<th>Se,Sp,PPV,NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitagawa (IJC)</td>
<td>42</td>
<td>61</td>
<td>16</td>
<td>89,95,94,90</td>
</tr>
<tr>
<td>Gilard (Heart)</td>
<td>143</td>
<td>232</td>
<td>16</td>
<td>86,100,100,99</td>
</tr>
<tr>
<td>Rist (AR)</td>
<td>25</td>
<td>45</td>
<td>64</td>
<td>75,92,67,94</td>
</tr>
<tr>
<td>Oncel (Rad)</td>
<td>30</td>
<td>39</td>
<td>64</td>
<td>89,95,94,90</td>
</tr>
</tbody>
</table>
In selected patients with previous stent implantation, 64-section CT can be used to evaluate in-stent restenosis with high accuracy.
For longitudinal reformations, scanners from the four leading vendors do not differ in artificial luminal narrowing, but there are differences in artificial luminal attenuation and image noise. The quality of images of the in-stent lumen is better on longitudinal reformations and for stents with a diameter greater than 3 mm.
Multienergy Photon-counting K-edge Imaging: Potential for Improved Luminal Depiction in Vascular Imaging

The purpose of this study was to investigate whether spectral computed tomography (CT) has the potential to im-
NEWER APPROACHES
TECAB – DAVINCI ROBOTIC SURGICAL SYSTEM

TECAB - Totally Endoscopic Coronary Artery Bypass
TECAB
HYBRID REVASCULARIZATION

Broadly speaking, hybrid revascularization entails performing both a PCI procedure and the surgical grafting of the LIMA to the LAD, using a minimally invasive approach, typically within one to two days of each other. As interventional

Two approaches
1) PCI first – permits fallback to open procedure if complications arise
2) CABG first – permits cath verification that LIMA graft is patent
Hybrid Procedure (High risk pt)
- Bypass Graft – cardiac surgeon
  » Often LIMA-LAD
- Stent placement - cardiologist
  » Variable – often LCX
CONCLUSIONS

- CCTA is valuable for assessing CABG and its complications
- CCTA can assess stents but has difficulty defining stenoses in smaller stents due to strut artifacts