Coronary Anomalies

Hany Abdel Shakour; M.Sc.
Cardiology
Assistant lecturer, Mansoura University
Causes of SCD

- Over 35 yrs. of age
  - Coronary Heart Disease
- Under 35 yrs.
  - Cardiomyopathies
  - Congenital Heart Disease
  - ‘Structurally Normal Heart’ (ion channel disorders, conduction disease) = SADS
  - Anomalous coronaries (abnormal anatomical position of coronary blood vessels)
  - Myocarditis (infection or inflammation of heart muscle)
AV stenosis 5%
Myocarditis 4%
DCM 3%
ARVC 3%
Myocardial Scarring 3%
MVP 2%
Atherosclerotic CAD 2%
LQTS 0.5%
Congenital HD 2%
Sarcoidosis 1%
Sickle cell Trait 1%
Normal heart 2%
coronary anomalies 25%
Unexplained Cardiac Mass 10%
HCM 37%
- Left Main or left coronary artery (LCA)
- Left anterior descending (LAD)
  - diagonal branches (D1, D2)
  - septal branches
- Circumflex (Cx)
  - Marginal branches (M1, M2)
- Right coronary artery
  - Acute marginal branch (AM)
  - AV node branch
  - Posterior descending artery (PDA)
LEFT CORONARY ARTERY (Right Oblique)

Proximal Circumflex
Atrial Branch
1st Septal Perforator
Obtuse Marginal
Distal Circumflex
Posterior Lateral

Left Main
Proximal LAD
1st Diagonal
Mid LAD
2nd Diagonal
Distal LAD

FIGURE 108-37  Anatomy of the left coronary tree in the right oblique view.
The LCA divides almost immediately into the circumflex artery (Cx) and left anterior descending artery (LAD). On the left an axial CT-image. The LCA travels between the right ventricle outflow tract anteriorly and the left atrium posteriorly and divides into LAD and Cx.
In 15% of cases a third branch arises in between the LAD and the LCx, known as the **ramus intermedius** or intermediate branch. This intermediate branch behaves as a diagonal branch of the LCx.
The LAD travels in the anterior interventricular groove and continues up to the apex of the heart. The LAD supplies the anterior part of the septum with septal branches and the anterior wall of the left ventricle with diagonal branches. The LAD supplies most of the left ventricle and also the AV-bundle.
The diagonal branches come off the LAD and run laterally to supply the antero-lateral wall of the left ventricle. The first diagonal branch serves as the boundary between the proximal and mid portion of the LAD (2). There can be one or more diagonal branches: D1, D2, etc.
The LCx lies in the left AV groove supplies the vessels of the lateral wall of the left ventricle. Obtuse marginal (OM1, OM2).

10% of patients have a left dominant circulation in which the LCx also supplies the posterior descending artery (PDA).
- In 50-60% the first branch of the RCA - Rt conus branch.
- In 36%- Directly from aorta.
Also known as – ARTERIA CONI ARTERIOSI, THIRD CORONARY.

Anastomoses with a similar left coronary branch around pulmonary trunk – ANNULUS OF VIEUSSENS
In 60% a sinus node artery arises as second branch of the RCA. The RCA continues in the AV groove posteriorly and gives off a branch to the AV node.

In 65% of cases - right dominant circulation. The PDA supplies the inferior wall of the left ventricle and inferior part of the septum.
The large acute marginal (AM) or RV branch supplies the lateral wall of the right ventricle.
Figure 1.51. Cardiac veins. The great, middle, and small cardiac veins; the oblique vein of the left atrium; and the left posterior ventricular vein are the main vessels draining into the coronary sinus. The coronary sinus, in turn, empties into the right atrium. The anterior cardiac veins drain directly into the auricle of the right atrium.
Definitions
The definition of a coronary artery should be made without taking into account of its origin and proximal course but focusing on its intermediate and distal segments and/or its dependent micro vascular bed.
<table>
<thead>
<tr>
<th>CORONARY ARTERY</th>
<th>MINIMALLY REQUIRED FEATURES</th>
</tr>
</thead>
</table>
| Left anterior descending (LAD)         | Location: the anterior interventricular sulcus  
Subepicardial position (but not infrequently intramyocardial)  
Provides septal branches and follows the direction of the septum.  
Accompanied by a conspicuous venous branch (greater cardiac vein) |
| Circumflex (Cx)                        | Location: the left side of the coronary sulcus  
Subepicardial position  
Provides at least one marginal branch |
| Right coronary artery (RCA)            | Location: the right side of the coronary sulcus  
Subepicardial position  
Provides at least the right ("acute") marginal branch |
<table>
<thead>
<tr>
<th>LEVEL</th>
<th>VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ostium</td>
<td>Number of ostia&lt;br&gt;Location&lt;br&gt;Size&lt;br&gt;Angle of origination&lt;br&gt;Shape (e.g. slit-like; membrane)</td>
</tr>
<tr>
<td>2. Size</td>
<td>Small size</td>
</tr>
<tr>
<td>3. Proximal course</td>
<td>Especially intramural tract&lt;br&gt;Consider angle of origin</td>
</tr>
<tr>
<td>4. Mid-course</td>
<td>Intraseptal tract or looping</td>
</tr>
<tr>
<td>5. Termination</td>
<td>Fistula</td>
</tr>
<tr>
<td>Coronary anomalies of clinical and surgical relevance</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>anomalous pulmonary origins of the coronaries (APOC);</td>
<td></td>
</tr>
<tr>
<td>anomalous aortic origins of the coronaries (AAOC);</td>
<td></td>
</tr>
<tr>
<td>congenital atresia of the left main (CALM)</td>
<td></td>
</tr>
<tr>
<td>coronary aterio-venous fistulas (CAVF);</td>
<td></td>
</tr>
<tr>
<td>coronary bridging (myocardial bridging);</td>
<td></td>
</tr>
<tr>
<td>coronary aneurysms (CAn);</td>
<td></td>
</tr>
<tr>
<td>coronary stenosis</td>
<td></td>
</tr>
</tbody>
</table>
# ANOMALOUS PULMONARY ORIGIN OF THE CORONARY ARTERIES

<table>
<thead>
<tr>
<th>APOC</th>
<th>&quot;Major anomalies&quot;</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ALCAPA</td>
<td>severe</td>
<td>Origin form Pulmonary sinus: 1, 2 or NF</td>
</tr>
<tr>
<td>ARCAPA</td>
<td>severe, rare</td>
<td>-do-</td>
</tr>
<tr>
<td>ACxPA</td>
<td>Severe, rare</td>
<td>-do</td>
</tr>
<tr>
<td>ARCLCPA</td>
<td>Severe, rare</td>
<td>-do-</td>
</tr>
</tbody>
</table>
Left Coronary Arising From PA
Bland-White-Garland Syndrome

Blood flows from the RCA via collaterals to the left coronary artery, and then into the pulmonary artery.
ALCAPA results in the left ventricular myocardium being perfused by relatively desaturated blood under low pressure, leading to myocardial ischemia.

L-R SHUNT
# ANOMALOUS AORTIC ORIGIN OF THE CORONARIES

<table>
<thead>
<tr>
<th>AAOC</th>
<th>&quot;Minor anomalies&quot;</th>
<th>1/3 of all coronary anomalies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LMCA from sinus 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RCA from sinus 2 LAD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LAD from sinus 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LAD from RCA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cx from sinus 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cx from RCA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Single coronary artery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inverted coronary arteries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>
Left Main Arising from Right Coronary Sinus

- **Subtypes:**
  - Anterior free-wall course
  - Retro-aortic course
  - Septal course
  - Inter-arterial- incidence 1:12,500 [Accounts for 60% of anomalous left main from right coronary sinus (2.8% overall coronary anomalies). Recognized association with ischemic symptoms and sudden death >50%]
Anomalous RCA
Takeoff From Left Coronary Sinus

The most common, potentially serious coronary anomaly, accounting for 8.1% of serious coronary anomalies (25% incidence of sudden cardiac death).
Congenital atresia of the left main coronary artery (CALM)
## INTRAMYOCARDIAL COURSE

<table>
<thead>
<tr>
<th>Bridging</th>
<th>LAD</th>
<th>LCx</th>
<th>RCA</th>
<th>Multiple</th>
<th>Other atypical / rare</th>
<th>Symptomatic or asymptomatic may require surgery</th>
</tr>
</thead>
</table>
Myocardial Bridging
Tunneled LAD

- Autopsy: ~30%, Angiographically: <5%
- Prevalent in HCM patients
- Segment proximal to bridge frequently shows atherosclerotic plaque (tunnel spared)
- Symptomatic patients may be treated with β-blocker or CCB
- Myotomy, CABG, and stenting in refractory cases
<table>
<thead>
<tr>
<th>CAVF</th>
<th>&quot;Major anomalies&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RCA to RV</td>
</tr>
<tr>
<td></td>
<td>LAD to RA</td>
</tr>
<tr>
<td></td>
<td>RCA, LAD to LV</td>
</tr>
<tr>
<td></td>
<td>LCx to PA</td>
</tr>
<tr>
<td></td>
<td>Diag to CS</td>
</tr>
<tr>
<td></td>
<td>OM to SVC</td>
</tr>
<tr>
<td></td>
<td>congenital / acquired</td>
</tr>
<tr>
<td></td>
<td>single / multiple</td>
</tr>
<tr>
<td></td>
<td>associated with: TOF, ASD, VSD, PDA</td>
</tr>
<tr>
<td></td>
<td>Pulm. atresia + intact septum</td>
</tr>
</tbody>
</table>
## CORONARY ANEURYSMS

<table>
<thead>
<tr>
<th>CAn</th>
<th>CAØ &gt; 1.5 x diameter of adjacent normal coronary artery RCA</th>
</tr>
</thead>
</table>
|     | Cx and LAD  
Cx and RCA  
LAD and RCA  
Cx, LAD and RCA  
Cx and LAD  
Cx and RCA  
LAD and RCA  
Cx, LAD and RCA  |
|     | Type I  
(diffuse, 2-3 vessels)  
Type II  
(diffuse in 1 vessel +  
Localized in other)  
Type III  
(diffuse in 1 vessel)  
Type IV  
(localized in 1 vessel) |
|     | 88% in males  
Congenital (types I-IV)  
Acquired:  
- atherosclerotic;  
- Kawasaki, Marfan,  
Ehlers-Danlos, Takayasu  
- other systemic diseases, polyarteritis,  
scleroderma  
- infectious (incl. syphilis)  
- traumatic  
Aneurysm +/- stenosis |
Thank you