ANGIOGRAPHIC PROJECTIONS

History

- As Andre Cournand said in his Noble lecture on Dec 11 1956 - “The Cardiac Catheter was................The key in the Lock.”
- Cardiac Catheterization was 1st performed [and so named] by Claude Bernard in 1844 on horse.
- In 1929 Werner Forssman, inserted a urologic catheter[65mm] into his right atrium from a left antecubital vein cut down he had performed on himself using a mirror.
- Andre Cournand & Dickinson Rihards 1950’s did remarkable series of investigation to assess Rt heart physiology so got Nobel prize shared with Frossman.
- Percutaneous [rather that cut down] technique was 1st dev by Seldinger in 1953 for both left & right heart catheterization.
- Trans Septal Catheterization by Ross & Cope in 1959-quickly became standard technique.
- Selective Coronary Arteriography in 1959 by Sones & others.
Figure 1.1 The first documented cardiac catheterization. At age 25, while receiving clinical instruction in surgery at Eberswalde, Werner Forssmann passed a catheter 66 cm through one of his left antecubital veins until its tip entered the right atrium. He then walked to the radiology department where this roentgenogram was taken. (Klin Wochenschr 1929;8:2085. Springer-Verlag, Berlin, Heidelberg, New York).

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Femoral Head

Femoral skin crease is well below femoral head in obese patient
Representation of coronary anatomy relative to the interventricular and atrioventricular valve planes. Coronary branches are indicated as L main (left main), LAD (left anterior descending), D (diagonal), S (septal), CX (circumflex), OM (obtuse marginal), RCA (right coronary artery), CB (conus branch), SN (sinus node), AcM (acute marginal), PD (posterior descending), PL (posterolateral left ventricular). RAO, right anterior oblique; LAO, left anterior oblique. [From DS Baim in Grossman’s Cardiac Catheterization, Angiography, and Intervention, 7th ed, DS Baim (ed). Baltimore, Lippincott Williams & Wilkins, 2006.]

*NOMENCLATURE OF ANGIOGRAPHIC VIEWS*

*AP position*
*RAO position*
*LAO position*
*Cranial position*
*Caudal position*
Table 1. Nomenclature for Angiography

- **Anteroposterior (AP) position.** The image intensifier is directly over the patient with the beam traveling perpendicularly back to front (i.e., from posterior to anterior) to the patient lying flat on the x-ray table.
- **RAO position.** The image intensifier is on the right side of the patient (A, anterior; O, oblique).
- **LAO position.** The image intensifier is on the left side of the patient. Note: Think of the oblique view as turning the left or right shoulder forward (anterior) to the camera (image intensifier).
- **Cranial/caudal position.** This nomenclature refers to image intensifier angles in relation to the patient's long axis.
- **Cranial.** The image intensifier is tilted toward the head of the patient.
- **Caudal.** The image intensifier is tilted toward the feet of the patient.

*Note: Cranial and caudal views are used to “open” overlapped coronary segments that are foreshortened or obscured in regular views. Cranial views are best for the LAD and diagonal arteries; caudal views are best for the circumflex and left main arteries.*

Figure 1. Nomenclature for radiographic projections. The small black arrowheads show the direction of the x-ray beam. Top: 3 panels (left to right): right (R) Anterior oblique (AO), anterior-posterior, left (L) AO. Middle panel, anterior posterior viewed from patient's side. Bottom left: If the intensifier is tilted toward the head of the patient, a cranial view is produced. Bottom right: If the intensifier is tilted toward the feet of the patient, a caudal view is produced. (Redrawn from Paulin S. Cathet Cardiovasc Diagn 1981;7:341–344, and reproduced in Kern MJ (Ed) The Cardiac Catheterization Handbook. 5th ed. Elsevier; Philadelphia: Pennsylvania, 2011: 152.)

* **ANGIOGRAPHIC VIEWS FOR SPECIFIC CORONARY ARTERY SEGMENTS**

<table>
<thead>
<tr>
<th>Location</th>
<th>View 1</th>
<th>View 2</th>
<th>View 3</th>
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</thead>
<tbody>
<tr>
<td>Left Main</td>
<td>AP</td>
<td>LAO cranial</td>
<td>LAO caudal</td>
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<tr>
<td><strong>Diagonal</strong></td>
<td>LAO cranial</td>
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<tr>
<td></td>
<td>RAO cranial</td>
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<tr>
<td><strong>Proximal circumflex</strong></td>
<td>RAO cranial</td>
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<td></td>
<td>LAO caudal</td>
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<td><strong>Intermediate</strong></td>
<td>RAO caudal</td>
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<td></td>
<td>LAO caudal</td>
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<tr>
<td><strong>Obtuse marginal</strong></td>
<td>RAO caudal</td>
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<tr>
<td></td>
<td>LAO caudal</td>
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<tr>
<td></td>
<td>RAO cranial</td>
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<tr>
<td><strong>Proximal RCA</strong></td>
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<td></td>
<td>Lateral</td>
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<tr>
<td><strong>Mid RCA</strong></td>
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<td></td>
<td>Lateral</td>
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<td></td>
<td>RAO</td>
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<tr>
<td><strong>Distal RCA</strong></td>
<td>LAO cranial</td>
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<td></td>
<td>Lateral</td>
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<tr>
<td><strong>PDA</strong></td>
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<tr>
<td><strong>Posterolateral</strong></td>
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<tr>
<td></td>
<td>RAO cranial</td>
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Figure 5. Top left: The fingers of the left hand represent the coronary arteries. The colored bars depict the coronary arteries of the drawing in the center. When placed over the heart (fist), the left anterior descending coronary artery (LAD) (red, index finger) runs down the anterior interventricular groove. The circumflex artery (yellow, middle finger) runs over the left side of the fist. The proximal portion of the right coronary artery (RCA) (blue, thumb) starts at the top of the fist and runs to the wrist then down the anterior interventricular (AV) groove (wrist). The posterior descending artery (PDA) will be shown below. Top right: The coronary arteries (fingers) are shown with the heart (fist) removed in the anterior-posterior (AP) projection. The green block represents the left main artery (LM) segment position.

Figure 6a. Coronary angulation showing left anterior oblique (LAO) with cranial (left) and caudal (right) angulations. The coronary arteries (fingers) are tipped downward as the image intensifier (II) moves toward the head (cranially). The arteries are tipped upward (right) as the II moves toward the feet (caudally). The green bar represents the left main artery.
Figure 7a. Top left: The coronary arteries in the right anterior oblique (RAO) view with caudal angulation. As the right shoulder moves anteriorly, the position of the left anterior descending artery (LAD) moves from left side to the right side of the cardiac silhouette. The circumflex artery moves toward the left side or center of the heart. Top right: RAO with cranial angulation showing the turning upward with foreshortening of the circumflex artery.

Figure 8a. The posterior descending (PDA) portion of the right coronary artery (RCA) runs along the inferior interventricular groove. Top left: In the left anterior oblique (LAO) view, cranial angulation, the PDA runs along the bottom of the heart and is tipped downward to better visualize the length without foreshortening. Top right: In the right anterior oblique (RAO) view without cranial or caudal angulation, the PDA is seen lengthwise, running from the base to the apex of the heart.
Clues to LAO angulation

Spine on the Right Side of the image

RAO 20 Caud 20

LAD
LMT
LCx
Septal Perforators
Obtuse Marginal

RAO 20° Caudal 20°
* DEGREE OF ANGULATION

* **Left Coronary Artery**
  - LAO: 30° - 45°
  - Cranial: 20° - 30°
  - Caudal: 20° - 30°
  - RAO: 30° - 45°

* **Right Coronary Artery**
  - LAO: 30° - 45°
  - Cranial: 15° - 20°
  - RAO: 30° - 45°

Figure 2. A) Anterior-posterior (AP) view of heart (closed fist) in chest. B) AP view of left ventricle (LV) shape (open hand) in chest. Diagram to right shows approximate shape as might be seen on x-ray. C) Left anterior oblique (left shoulder forward) LAO rotation causes foreshortening of LV with apex toward viewer and rounding of cardiac silhouette (diagram at right, LAO). D) Right anterior oblique (right shoulder forward, RAO) causes heart to elongate as it rotates with tip of heart to the left side. Diagram on right shows LV image as it might appear on x-ray. These images are put in perspective in the patients on Figure 3.
Biplane cineangiography is required

*For VSD

<table>
<thead>
<tr>
<th>View</th>
<th>Angle</th>
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<tbody>
<tr>
<td>LAO</td>
<td>50° - 60°</td>
</tr>
<tr>
<td>Cranial</td>
<td>20° - 30°</td>
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</tbody>
</table>

*For ASD (Hepatoclavicular angiographic view)

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<tr>
<td>LAO</td>
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<tr>
<td>Cranial</td>
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</tr>
</tbody>
</table>
*For transposition of great arteries (Laid back angiographic view)
  Steep AP caudal - 35°

*Proximal branch pulmonary artery anatomy
  Steep AP cranial - 35°

*Causes of Poor Angiograms

* Patient Factors
  Size
  Movement
  Hardware (Pacemaker, Harrison rods, multiple surgery with clips)

* Angiographer Factors
  Poor catheter seating
  Poor contrast injection

* Equipment Factors
  X-ray generated problem
  X-ray tube problem
  Image intensifier problem
*Contraindications (relative)*

- Coagulopathy
- Decompensated congestive heart failure
- Uncontrolled Hypertension
- CVA
- Refractory Arrhythmia
- GI Haemorrhage
- Pregnancy
- Inability for patient cooperation
- Active infection
- Renal Failure
- Contrast medium allergy

*Complications*

- Major complications are uncommon (<1%)
- Vascular complications related to the arterial puncture site
- Mortality risk is 0.1% or less.
- Allergic contrast reactions, worsening kidney function, and cerebrovascular accidents are rare
- Ventricular fibrillation may be provoked by contrast injection into conal branch of the right coronary artery.
- Iatrogenic coronary artery dissection is a potential life-threatening complication, which usually is handled by either emergent coronary artery stenting or bypass surgery.
THANK YOU