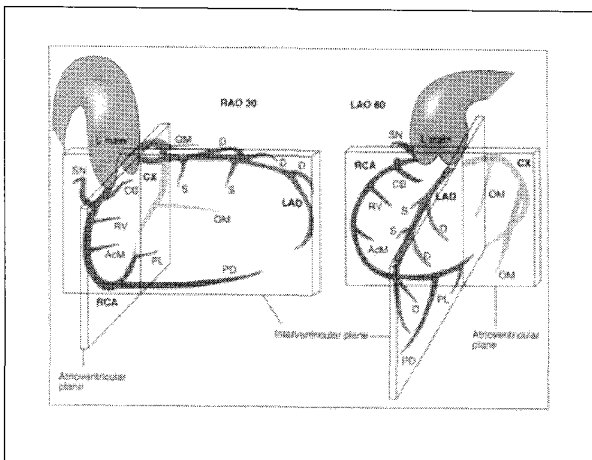
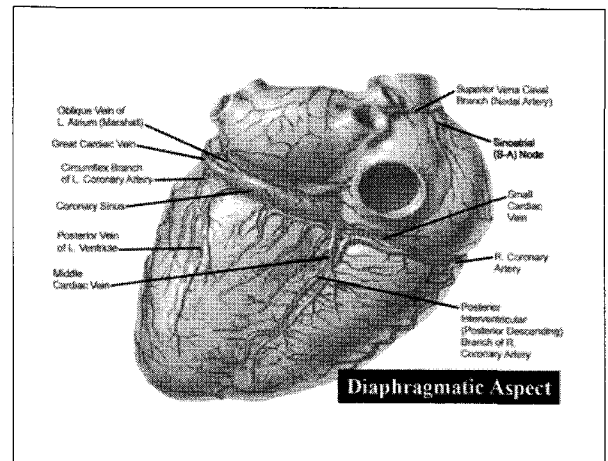
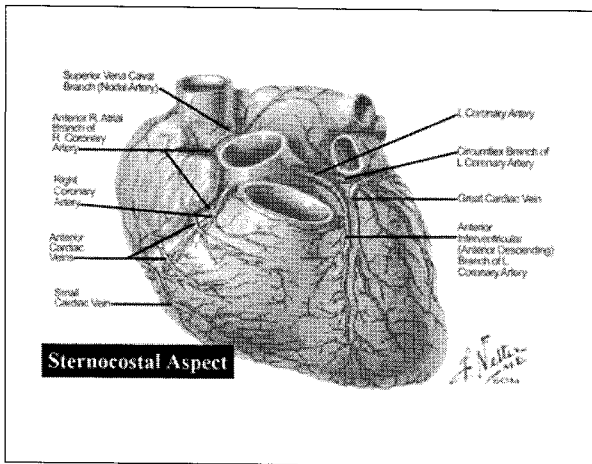


# 핵의학 의사를 위한 심혈관 조영술

전북대학교 의과대학 내과학교실  
채 제 건



## Right Coronary Artery

### Basic Anatomy

- ◆ Origin
  - Right aortic sinus (lower origin than LCA)
- ◆ Course
  - Down right AV groove toward crux of the heart, gives off PDA (85%) from which septals arise, continues in LAV groove giving off posterior LV branches (posterolaterals)
  - PDA may originate more proximally, bifurcate early or be small with part of "its territory" supplied by an acute marginal branch
- ◆ Supplies
  - 25% to 35% of Left Ventricle

## Right Coronary Artery

### Basic Anatomy

- ◆ The acute marginal (AM) branch of the serves as the boundary between the proximal and mid portion of the RCA.
- ◆ The **proximal** RCA: the portion of the artery prior to the origin of the AM
- ◆ The **mid** RCA: the segment just beyond the AM
- ◆ The **distal** RCA: the segment halfway between the AM and the origin of the PDA

## Right Coronary Artery

### Other Branches

- ◆ Conus Artery
  - Usually very proximal; (~50% have a separate origin) courses anteriorly and upward over the RV outflow tract toward the LAD
  - May be an important source of collaterals
- ◆ SA nodal Artery
  - (~60%) usually 2<sup>nd</sup> branch of RCA - courses obliquely backward through upper portion of atrial septum and anteromedial wall of the RA- supplies SA node, usually RA and sometimes LA

## Right Coronary Artery

### Other Branches

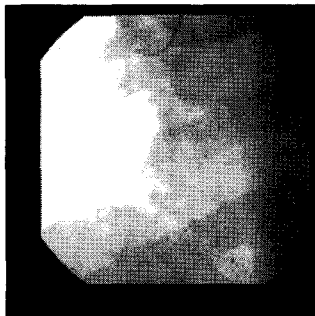
- ◆ Right Ventricular (Acute Marginal) Branches
  - Arises from mid RCA; supply anterior RV; may be a collateral source
- ◆ AV Nodal Artery
  - Arises at or near crux; supplies AV nodes
- ◆ PDA (posterior descending artery)
  - Supplies inferior wall, ventricular septum, posteromedial papillary muscle

## Right Coronary Artery

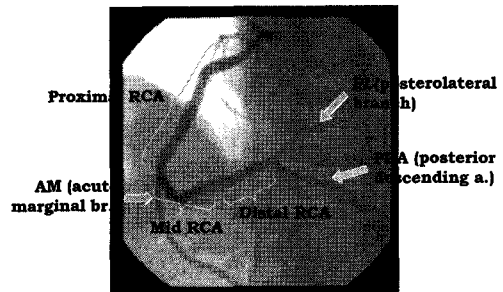
### Optimal View(s)

- ◆ LAO (30) Cranial (30)
  - Particularly for distal bifurcation (AP Cranial may be better)
- ◆ RAO
  - Main shaft; cranial enhances distal vessels and very proximal
- ◆ Lateral
  - Bifurcations with RV branches – distal bifurcation, particularly with cranial

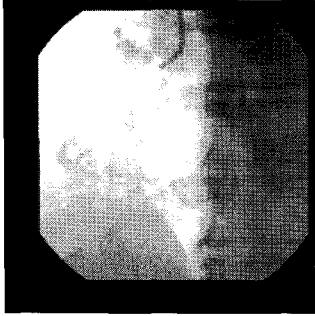
## Right coronary angiogram LAO Cranial I



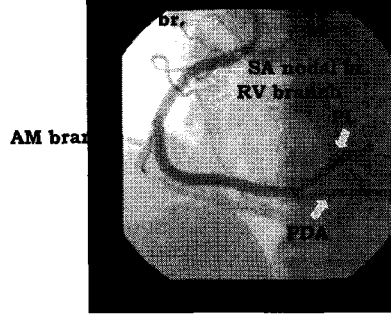
## Right coronary angiogram LAO Cranial I



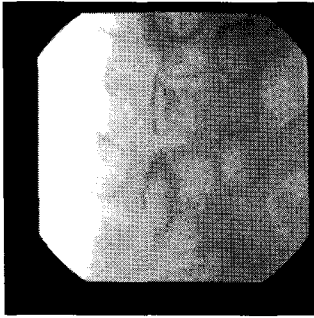
**Right coronary angiogram**  
LAO Cranial II



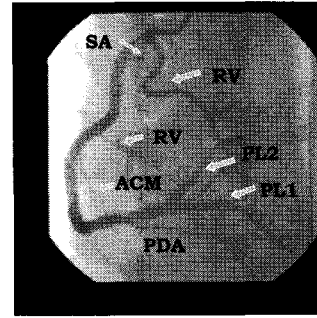
**Right coronary angiogram**  
LAO Cranial II



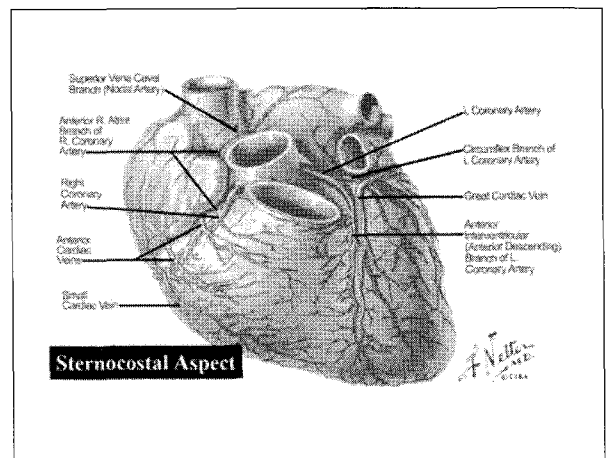
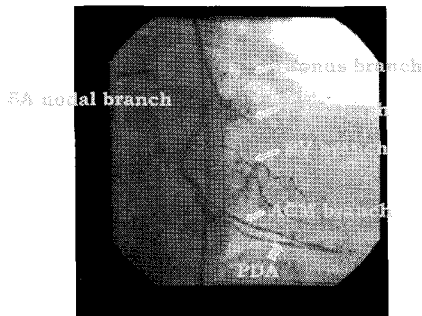
**Right coronary angiogram**  
AP Cranial

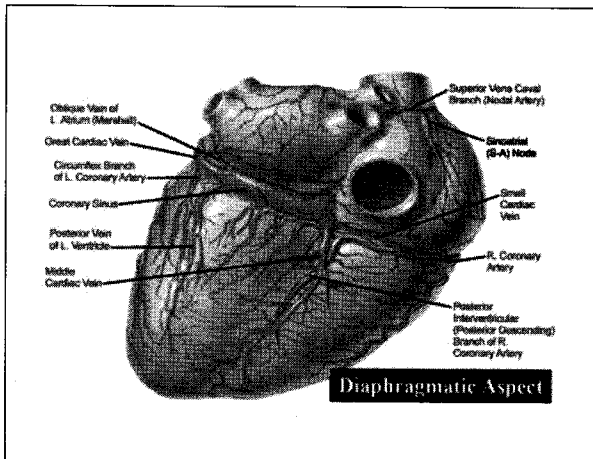


**Right coronary angiogram**  
AP Cranial



**Right coronary angiogram**  
RAO





## Left Coronary Artery

### Left Main Coronary Artery

- ◆ Origin
  - Upper portion of left aortic sinus just below the sinotubular ridge
  - Typically 0~10 mm in length
  - Rarely no LM (separate origins)
- ◆ Optimal Views
  - LAO caudal and cranial; AP or RAO caudal, cranial or flat
  - Limit views
  - May need IVUS

## Left Anterior Descending Artery

- ◆ Course
  - Down the anterior interventricular groove - usually reaches apex
  - 22% of cases does not reach apex
- ◆ Branches
  - Septals and Diagonals - supply lateral wall of LV, anterolateral papillary muscle
  - 37% have median ramus (courses like 1<sup>st</sup> diagonal)
- ◆ LAD
  - Supplies anterolateral, apex and septum
  - 45-55 % of left ventricle

## Left Anterior Descending Artery

- ◆ The first Dx branch serves as the boundary between the **proximal** and **mid** portion of the LAD.
- ◆ The **proximal** LAD: the portion of the artery prior to the origin of the 1<sup>st</sup> Dx
- ◆ The **mid** LAD: the segment just below the 1<sup>st</sup> Dx
- ◆ The **distal** LAD: the terminal third of the artery

## Left Circumflex Artery

- ◆ Origin
  - From distal LMCA
- ◆ Course
  - Down distal left AV groove
- ◆ Branches
  - Obtuse marginal, Posterolaterals - supply posterolateral LV, anterolateral papillary muscle
  - SA node artery - 38%
- ◆ Supplies
  - 15-25% of LV, unless dominant (supplies 40-50% of LV)

## Left Circumflex Artery

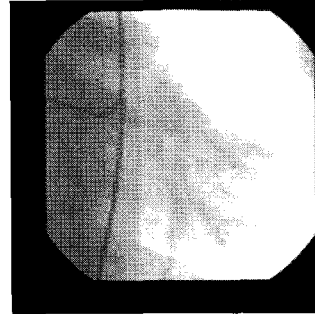
- ◆ The obtuse marginal or OM branch serves as the boundary between the proximal and distal portion of the Cx.
- ◆ The **proximal** Cx: the portion of the artery prior to the origin of the OM
- ◆ The **distal** Cx: the segment just below the OM

## Left Coronary Artery

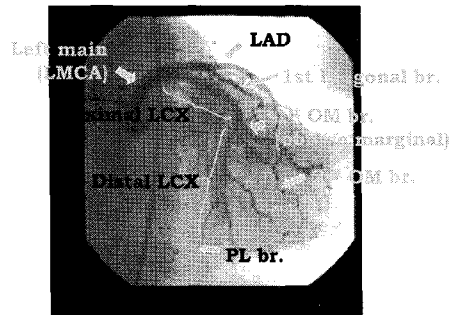
### Optimal Views

- AP (30) Caudal
  - LMCA, proximal LAD, Cx, distal LAD
  - Poor for mid LAD - RAO may be useful
- AP (40) Cranial
  - LMCA, LAD, diagonals, septals, distal Cx
  - May need RAO to separate LAD and Cx
- (45) LAO (35) Cranial
  - LMCA, LAD, diagonals, septals, and distal Cx
- (45) LAO (30) Caudal
  - LMCA, Cx, and prox LAD
- Laterals (cranial, caudal)
  - May be helpful

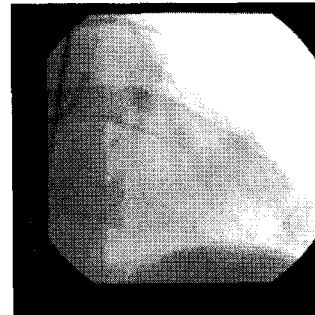
## Left coronary angiogram AP Caudal



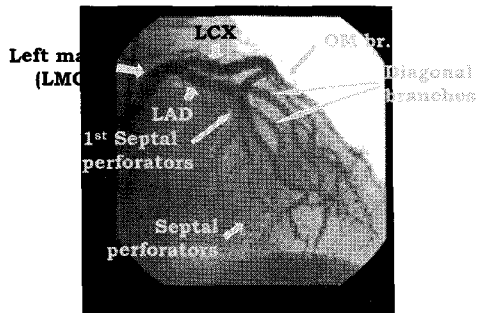
## Left coronary angiogram AP Caudal



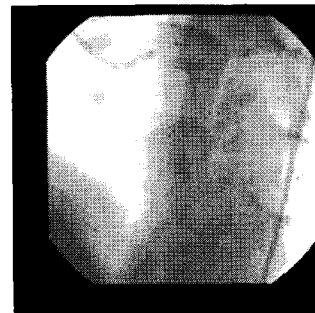
## Left coronary angiogram AP Cranial



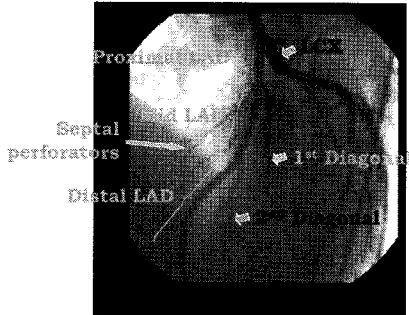
## Left coronary angiogram AP Cranial



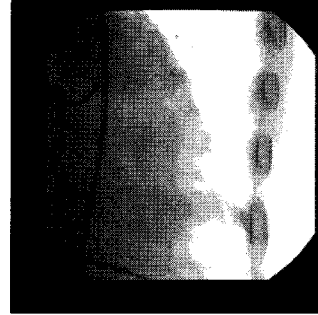
## Left coronary angiogram LAO Cranial I



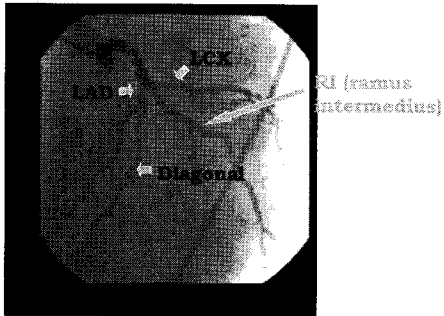
**Left coronary angiogram  
LAO Cranial I**



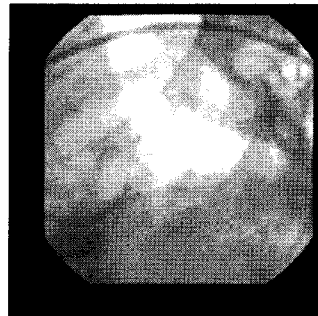
**Left coronary angiogram  
AP Caudal**



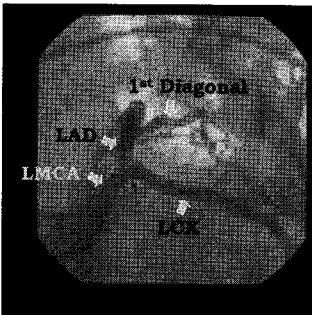
**Left coronary angiogram  
LAO Cranial II**



**Left coronary angiogram  
LAO Caudal (=Spider View)**



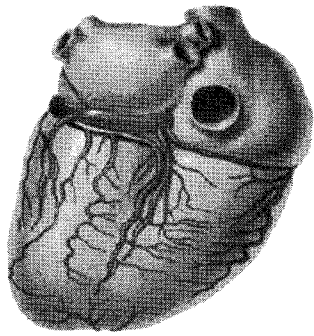
**Left coronary angiogram  
LAO Caudal (=Spider View)**



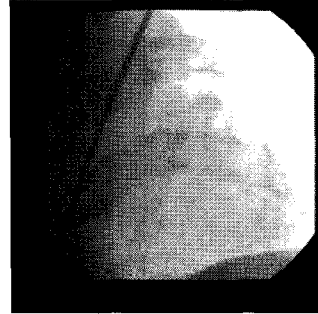
**Dominance**

- ◆ *Definition 1:*
  - The coronary artery which reaches the crux of the heart and then gives off the PDA
- ◆ *Definition 2: (Allows for codominance)*
  - The artery which gives off the PDA as well as a large posterolateral branch

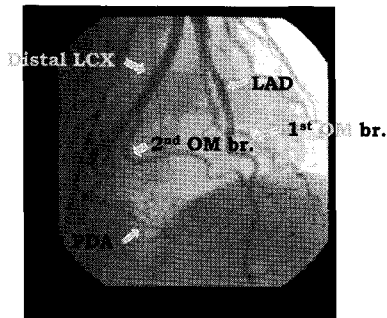
**Left  
Dominant  
Circulation**



**LCA Angiogram  
Dominant Cx - AP Cranial**



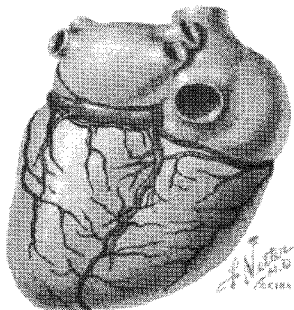
**LCA Angiogram  
Dominant Cx - AP Cranial**



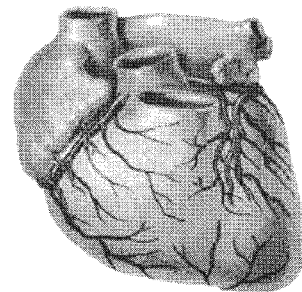
**The Coronary Arteries Are  
Complementary**

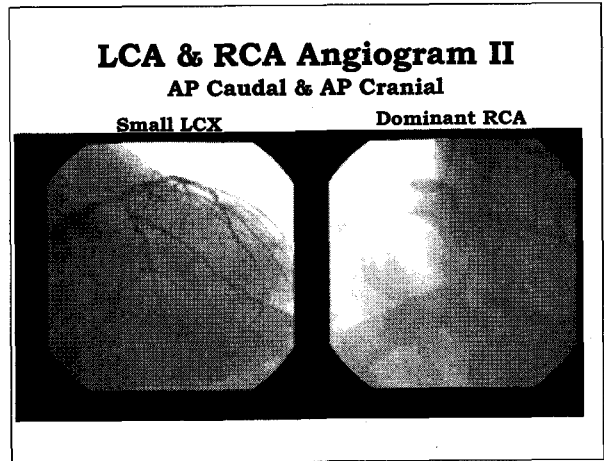
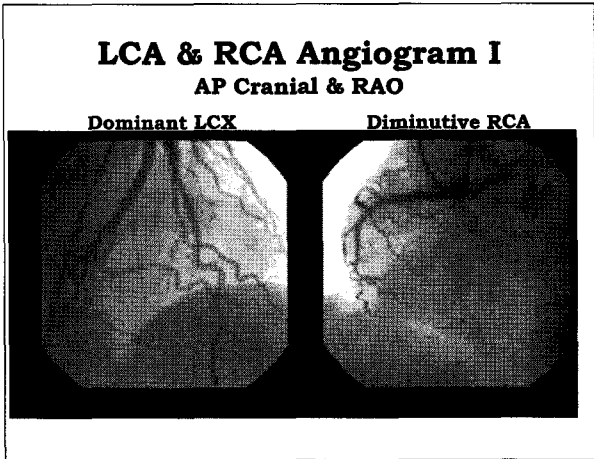
- ◆ Large PDA → Small LAD
- ◆ Huge Cx (Posterolaterals)  
→ Small RCA continuation in AV Groove  
; Diminutive RCA
- ◆ Etc, etc, etc .....

**Wrap Around LAD**



**Short LAD/Large RCA with Apical  
Extension**

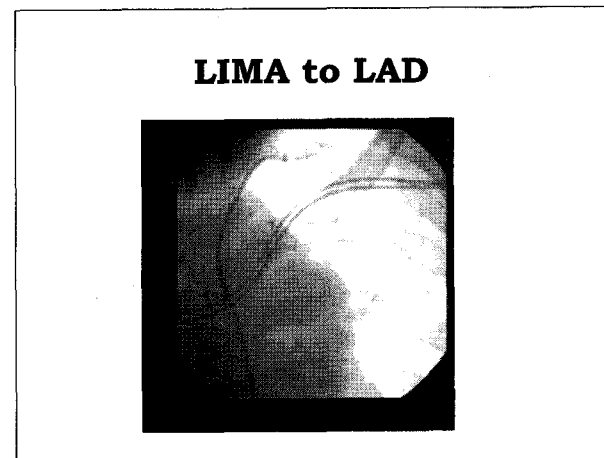
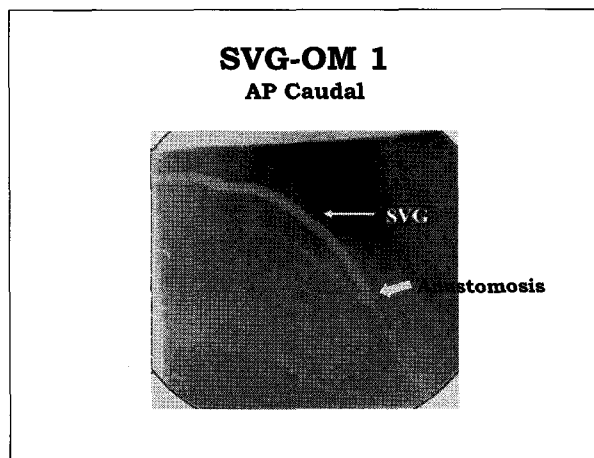
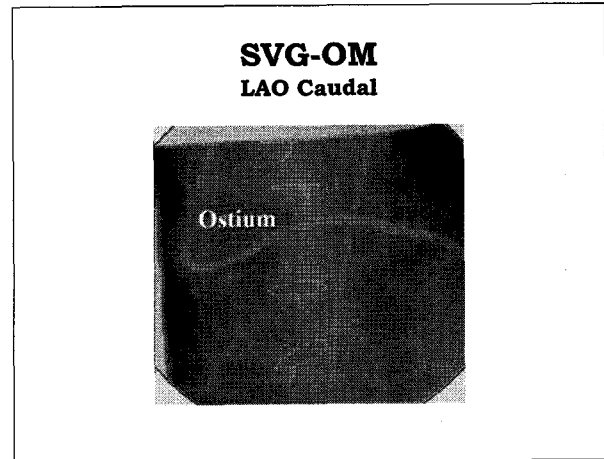




**BYPASS GRAFTS**

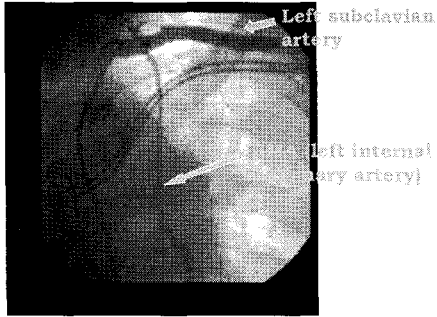
- ◆ SVG (saphenous vein graft)
  - Left coronary grafts generally arise from left side of the aorta
  - Right sided grafts - arise from right side of the aorta
- ◆ IMA (internal mammary artery)
  - Don't forget to check subclavians

*All distal vessels must be accounted for; op notes and old films are extremely helpful*

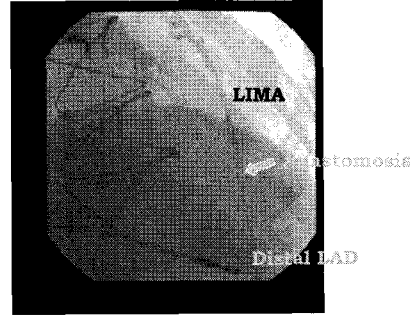




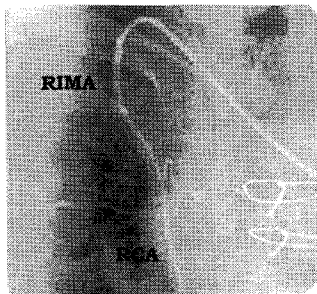
**LIMA to LAD**  
Origin from left subclavian (AP Cranial)



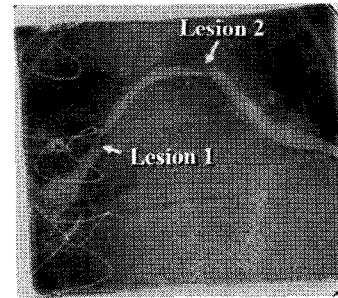
**LIMA to LAD**  
Distal Anastomosis (AP Cranial)



**RIMA to RCA**



**SVG to OM**

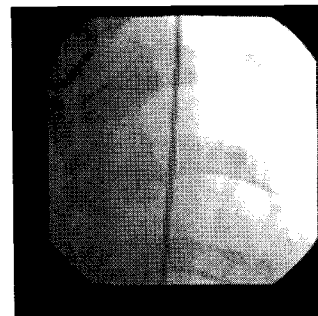


**Myocardial Bridging**

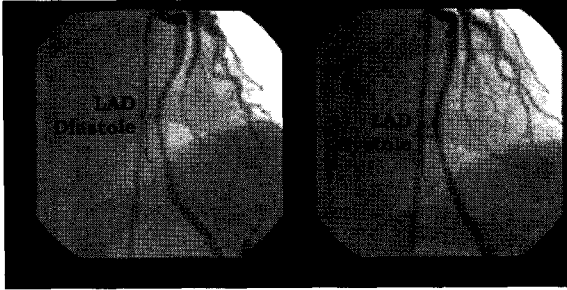
***Intramyocardial Segment***

- “Milking”
- Almost always LAD
- Occurs in 5-12% of patients
- Usually not hemodynamically significant

**Myocardial Bridging**  
LAD - AP Cranial



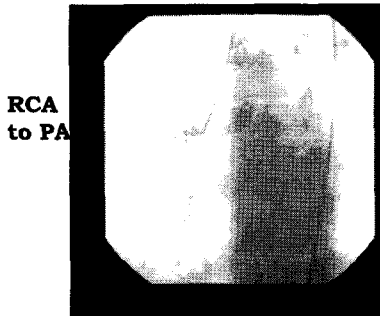
**Myocardial Bridging**  
LAD - AP Cranial



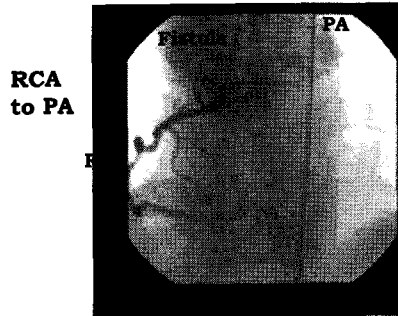
**Coronary Artery Fistula**

- ◆ Origin → 50% RCA
- ◆ Clinical Syndromes:
  - CHF, endocarditis, ischemia, and rupture of aneurysmal fistula
  - 50% are asymptomatic
- ◆ Drainage:
  - RV 41%; RA - 26%; PA - 17%; LV - 3%, and SVC - 1%

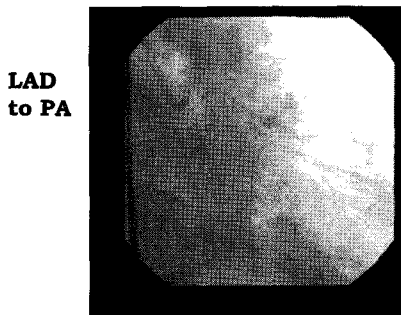
**Coronary Artery Fistula I**  
RCA - LAO Cranial



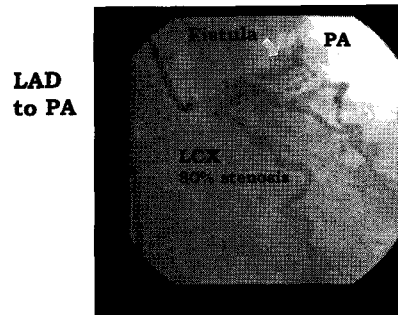
**Coronary Artery Fistula I**  
RCA - LAO Cranial



**Coronary Artery Fistula II**  
LAD - RAO Caudal

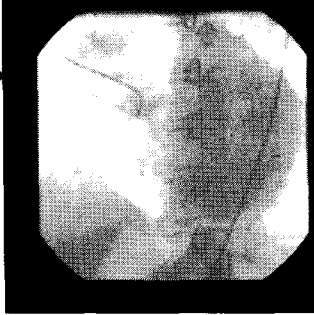


**Coronary Artery Fistula II**  
LAD - RAO Caudal



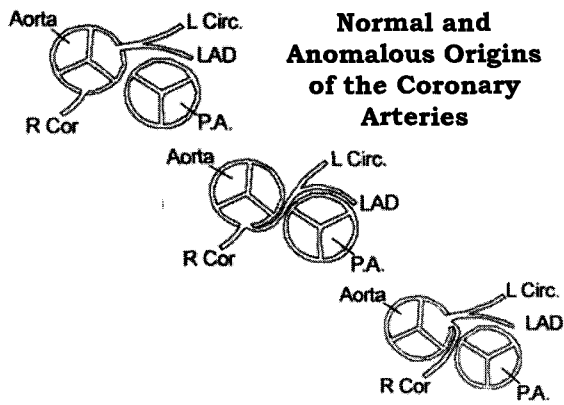
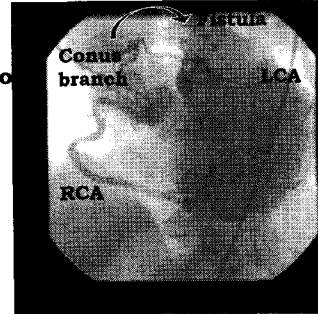
**Coronary Artery Fistula III**  
RCA - LAO Cranial

RCA to  
LAD



**Coronary Artery Fistula III**  
RCA - LAO Cranial

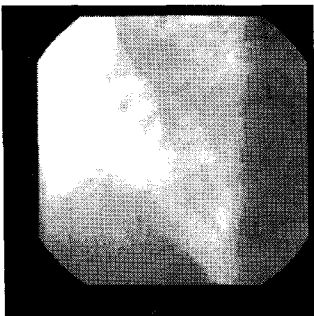
RCA to  
LAD



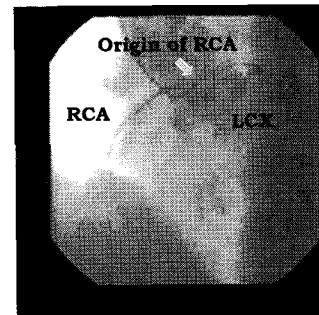
**Benign Anomalies (0.5~1%)**

- ◆ Left Circumflex from Right Sinus of Valsalva
  - > Most common "benign" anomaly
  - > Circumflex courses behind aorta
- ◆ High Anterior Origin of RCA
  - > Above sinotubular ridge

**Anomalous origin of RCA**



**Anomalous origin of RCA**



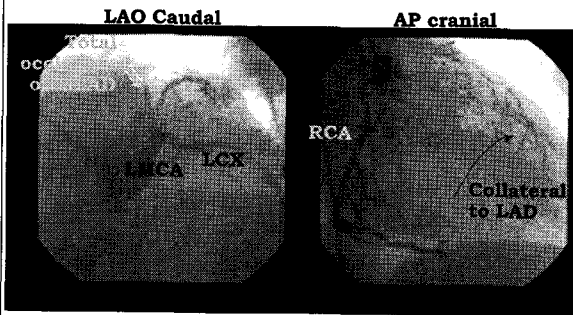
### Collateral Circulation - Development

- ◆ Preexisting – 20 to 200  $\mu\text{m}$
- ◆ First 24 hours – passive widening
- ◆ One day ~ 3 weeks
  - Cellular proliferation, luminal diameter increases 10 fold
- ◆ 3 weeks ~ 6 months
  - More cellular proliferation and development of extracellular matrix
  - Channels may reach 1 mm in caliber

### Collateral Circulation - Development

- ◆ Ischemia and occlusion are the only factors currently recognized to result in significant collateralization
- ◆ Usually need very high grade coronary artery occlusion for collaterals to be angiographically apparent

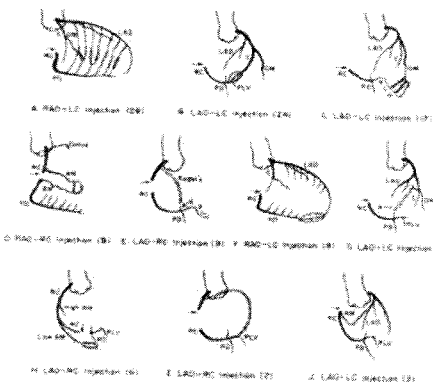
### LCA & RCA



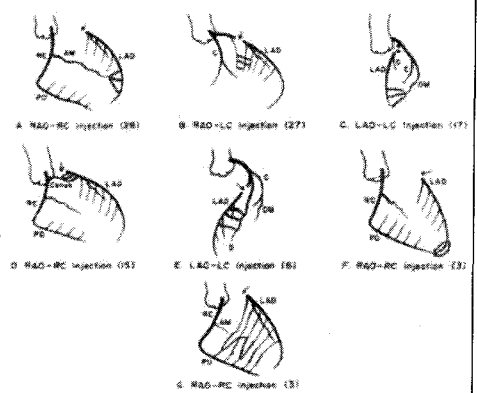
### Collateral "Connections"

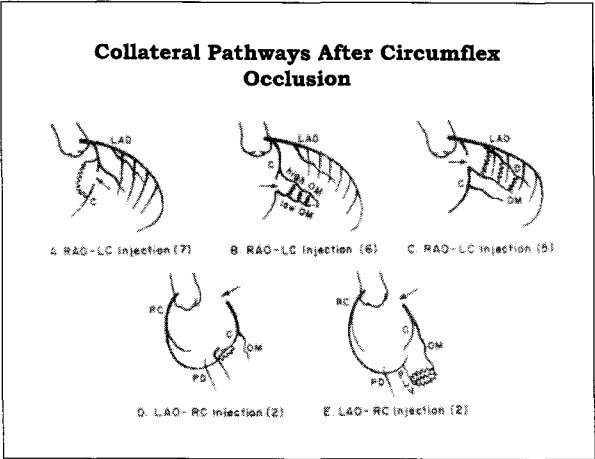
- ◆ Occur where coronary arteries are in proximity
  - Distal LAD → Distal PDA
  - Cx AV groove → R AV groove
  - Septal → Septal
  - Marginal → Marginal
  - Diagonal → Diagonal
- ◆ Also
  - Bridging collaterals-associated with chronicity
  - Kugel's artery-prox RCA to distal RCA via AV groove
  - Always look for conus to LAD collaterals when LAD is occluded and appears uncollateralized

### Collateral Development After RCA Occlusion



### Collateral Pathways After LAD Occlusion





*MEMO*