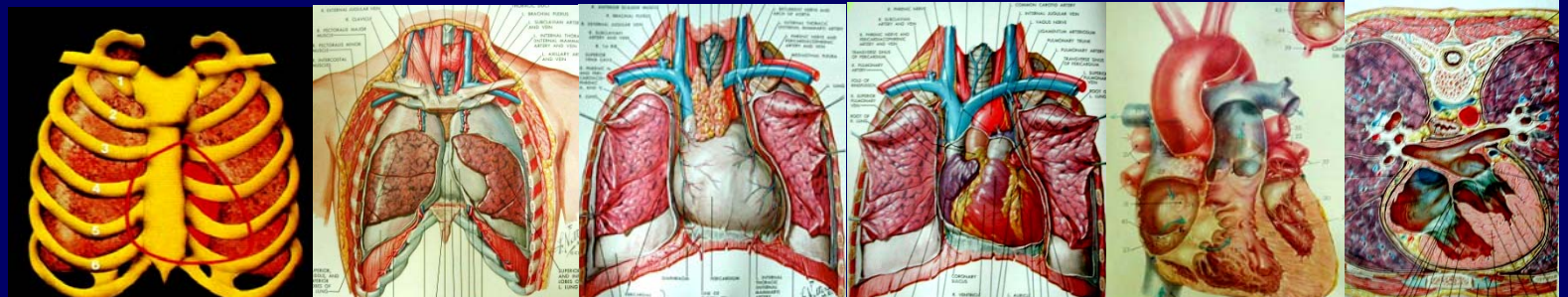
心臟應用解剖學

Applied Cardiac Anatomy

洪瑞松

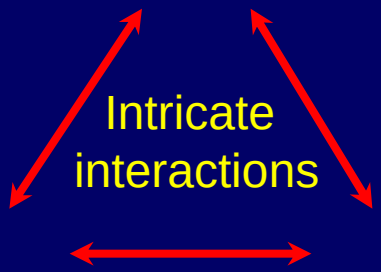
Jui-Sung Hung, MD, FACC, FAHA



Cardiovascular System

Structure and Function
(構造及功能)

Mechanical
(機械)



Electrical
(電氣)

Perfusion
(灌流)

Neuro-humoral regulations
Autonomic nervous system
Endocrine-humoral – catecholamines, RAS, natriuretic peptides, endothelin etc.

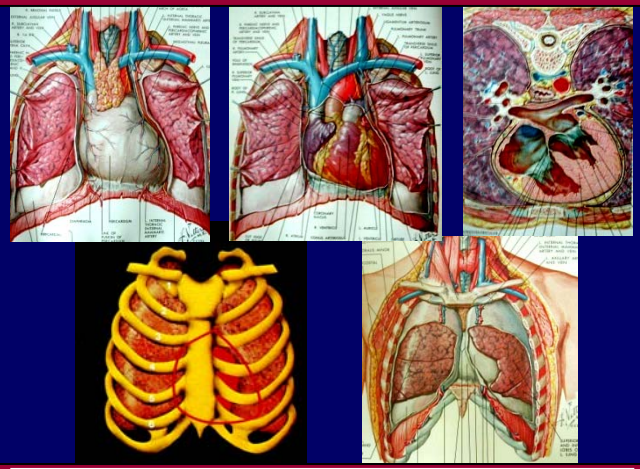
*緊密的互動

問題之剖析、診斷方法 (Means)

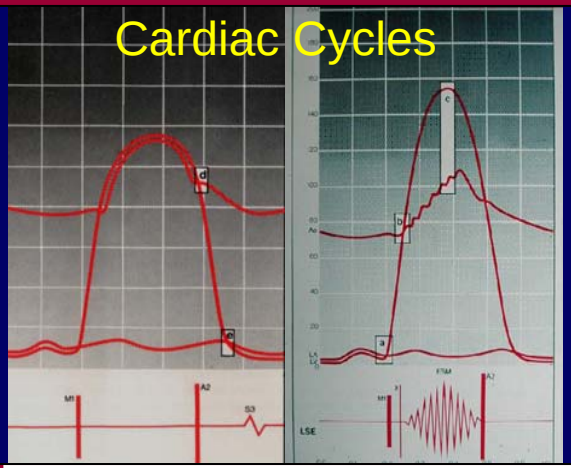
1. 病史 (history)
2. 理學檢查 (physical Exam)
3. 實驗室檢查 (laboratory tests)
   - Proper (適當性)
   - Timely (適時性)

實驗室檢查 (Imagings)*

Physical Exam in CV System



Applied Anatomy



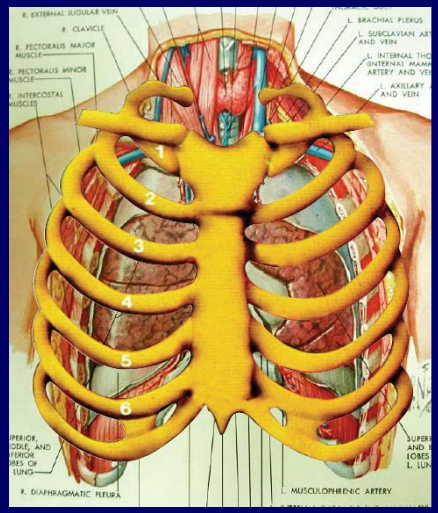
1. Hemodynamic Pressure
2. Volumetric flow
3. Hemodynamic resistance
4. Compliance
5. Laplace law
6. Poiseuille's Law

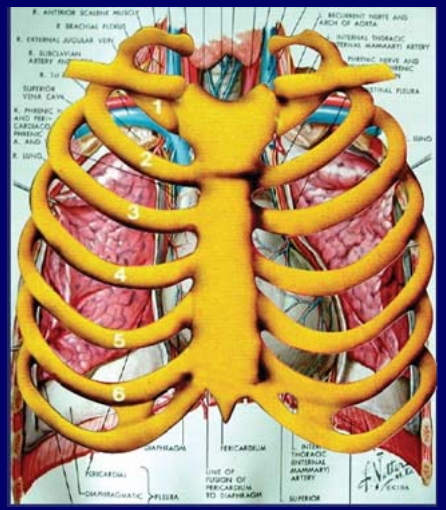
Applied Physiology and Hemodynamics

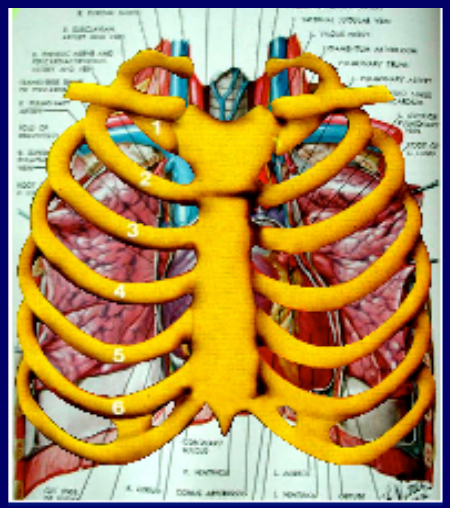
Fundamentals in Clinical Cardiology

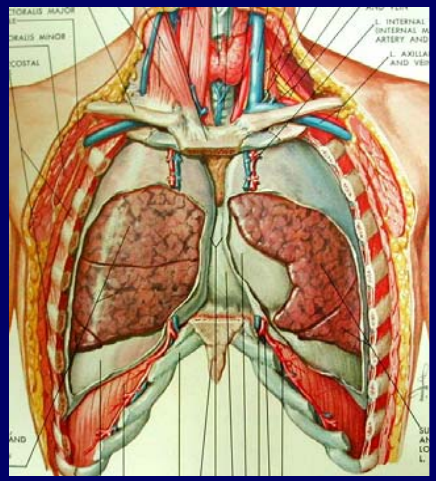
*ECG, radiographs, echo, CT, MRI etc.

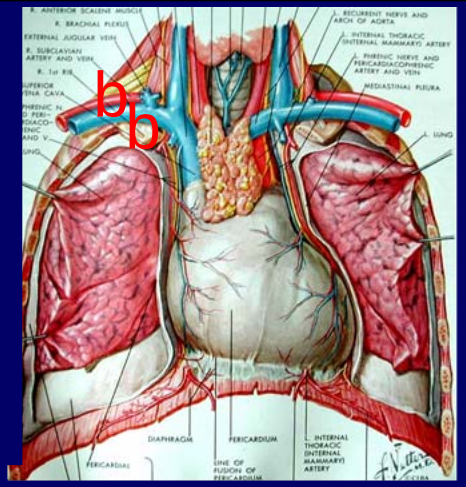
Frontal View (正面圖)

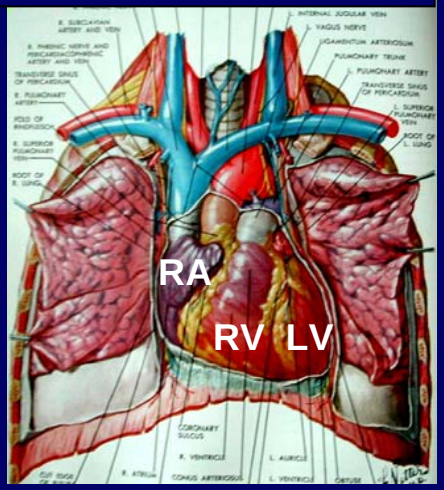




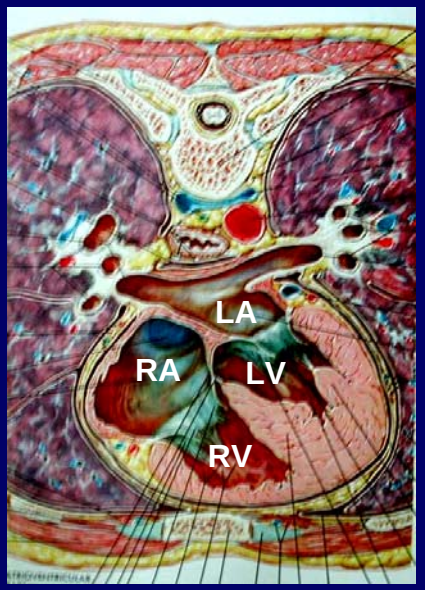








Cross Section View (橫切面圖)



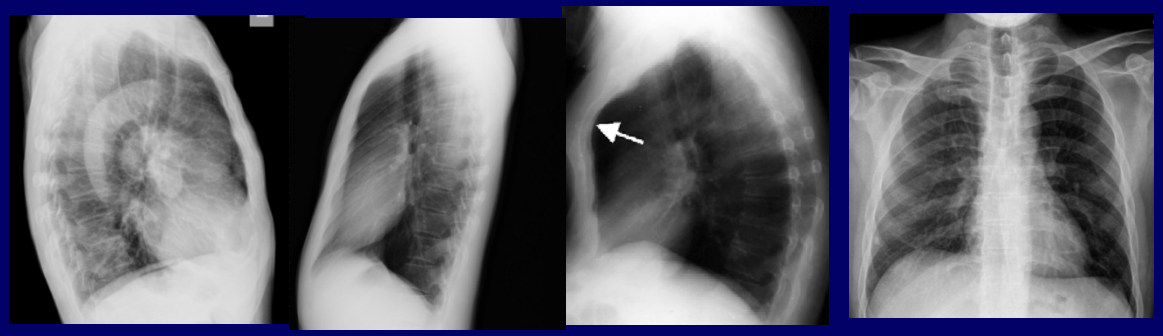
LA = left atrium; LV = left ventricle; RA = right atrium; RV = right ventricle

Thorax（胸廓）Anomaly

Impacts on Clinical Diagnosis, PE, and Imaging Tests

1) Diagnostic clues

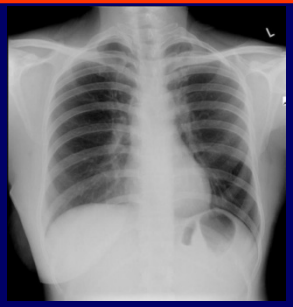
- Barrel chest (emphysema)
- Pectus carinatum* (pigeon chest); Marfan
- Pectus excavatus* Marfan
- Straight spine – MVP, Ankylosing spondylitis
- Left parasternal bulge
- Obese or thin chest wall*
- Left mastectomy**



Barrel Chest | Pectus excavatus | Pectus carinatum | Straight spine

2) Impact on impedance*

- PE - vibration energy
  - Low frequency, sonic
- Electric
- Imaging
  - Ultrasound (ECHO)
  - Radiation –
    - X-ray, CT, MRI



*Left mastectomy

ECG
Expected findings?

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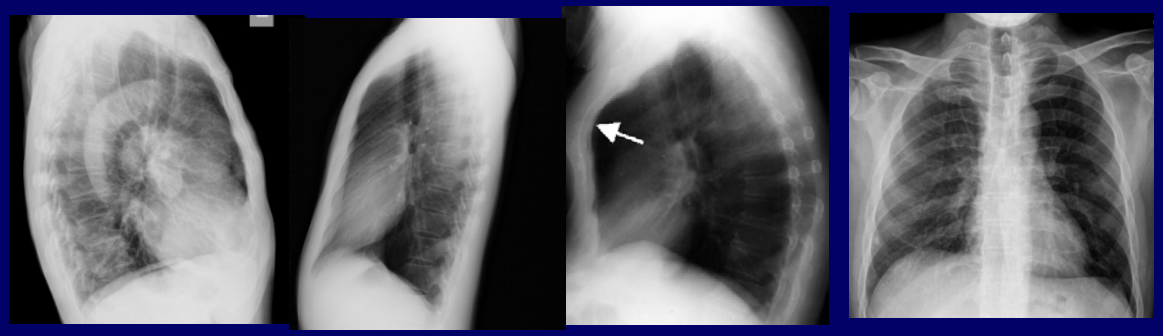

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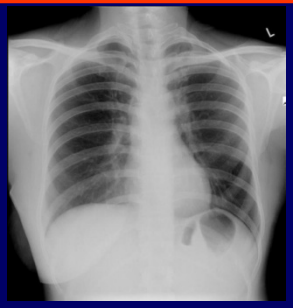

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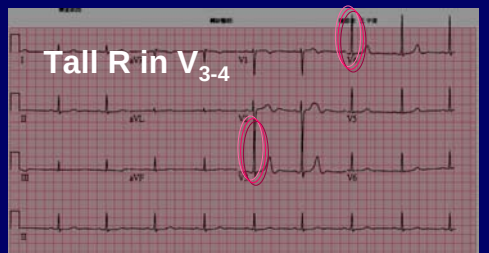

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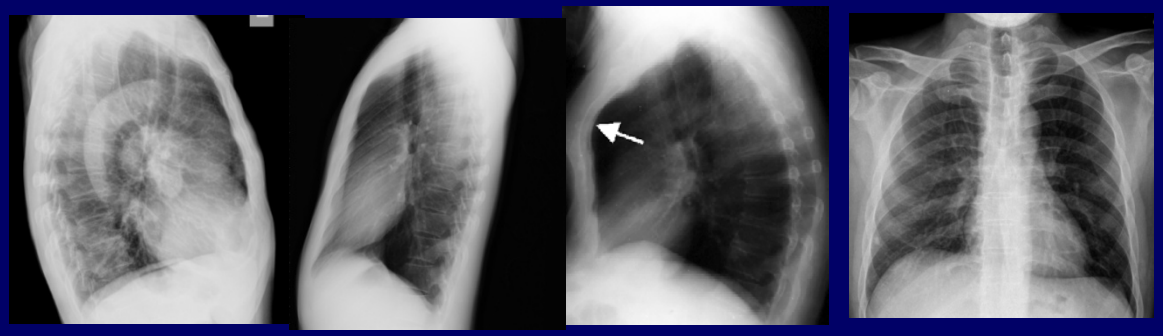

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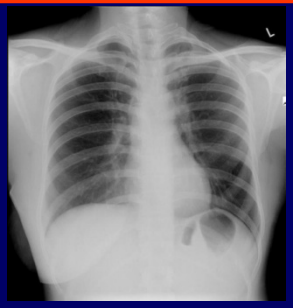

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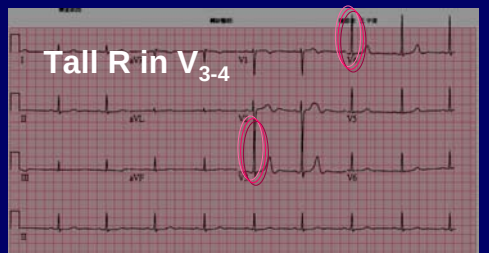
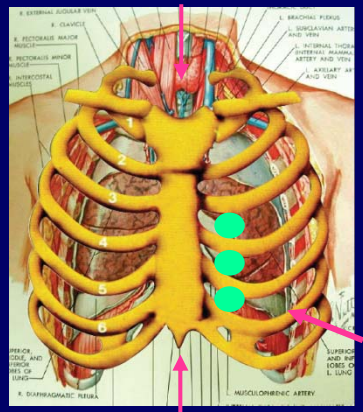


Echo Windows (“Air-free Window”)

TTE - 4 Widows

3) Suprasternal

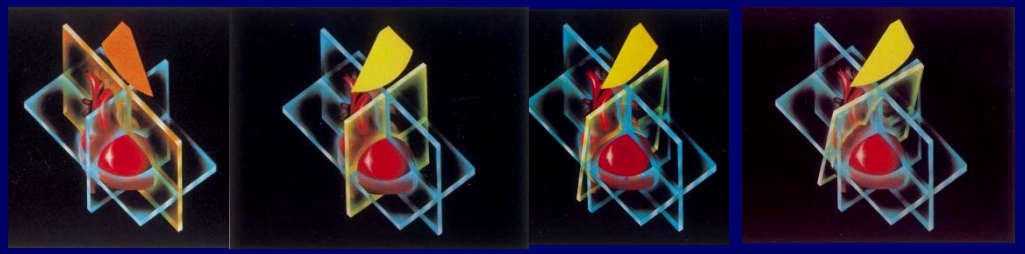


1) Parasternal

2) Apical

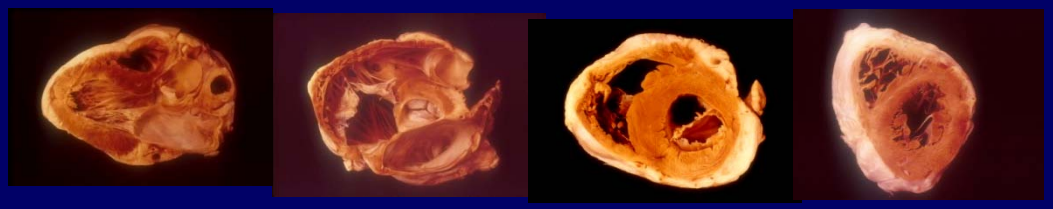
4) Subxyphoid

TEE

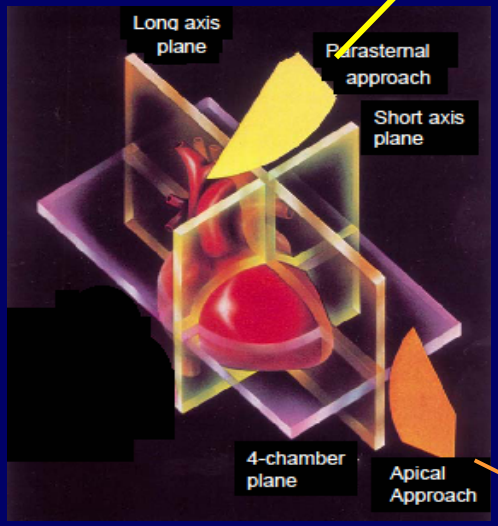


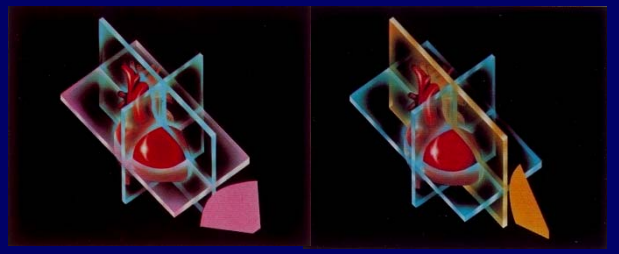
Long axis

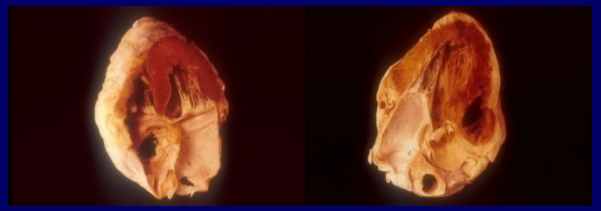
Short-axis views



1) Parasternal Approach

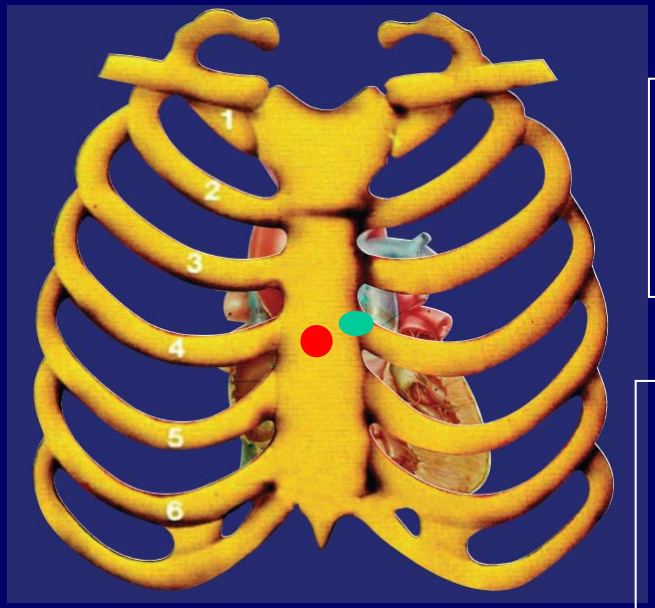






2) Apical Approach

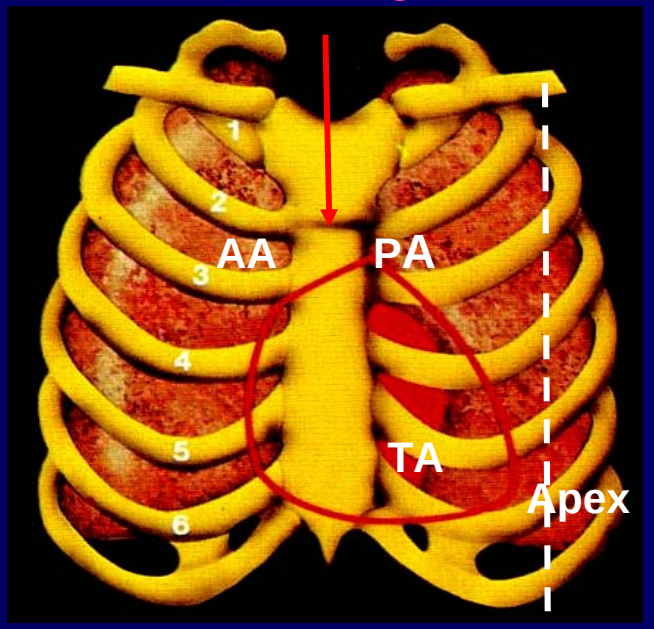
前胸廓 經、緯度地標 (Landmarks)



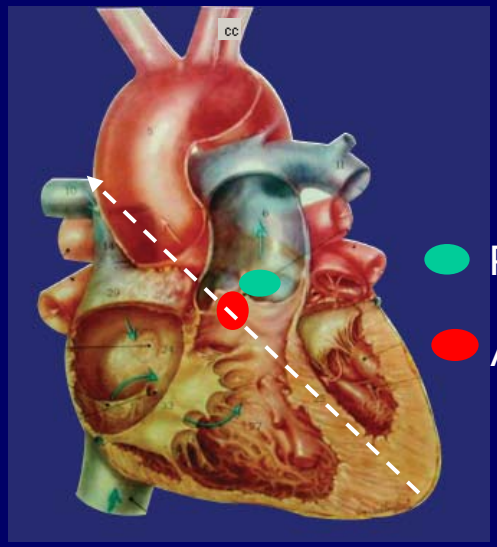
Latitude（緯度）
Intercostal spaces

Longitude (經度)
Parasternal
Mid-clavicular
Axillary line
anterior, mid-posterior

Louis angle



Mid-clavicular Line

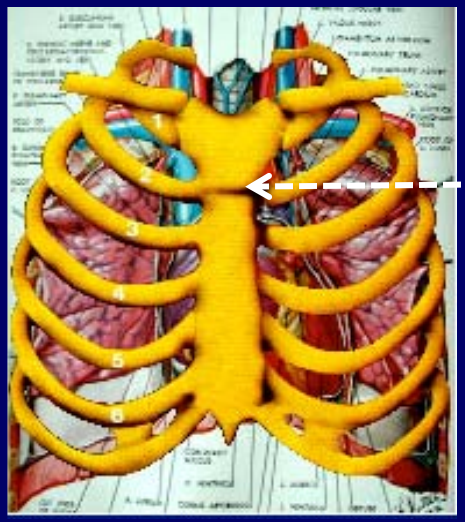


Pulmonic valve

Aortic valve

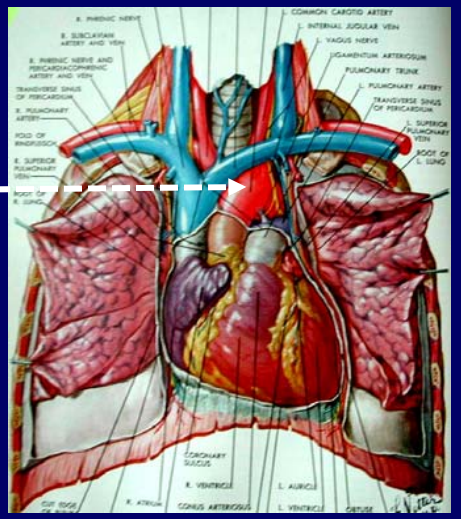
AA = aortic area
PA = pulmonic area
PV = pulmonic valve
TA = tricuspid area

“Angle of Louis” (sternal angle) –
A palpable clinical landmark



A. Approximate level of

1) Trachial bifurcation (carina)
2) Beginning/end of aortic arch
3) Pulmonary trunk bifurcation
4) Upper SVC margin
5) Azygos vein drainage into SVC



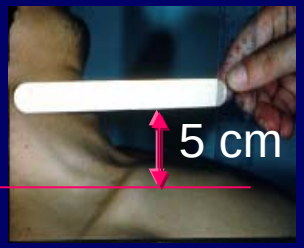
B. Landmark for:

Estimation of internal jugular venous pressure

Louis angle - 5 cm vertical distance from mid-RA (zero reference point)

Supine

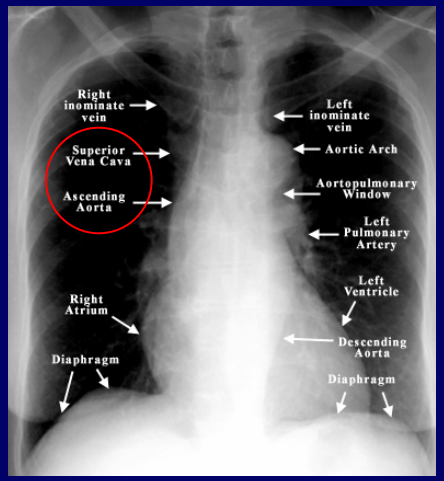
Louis angle



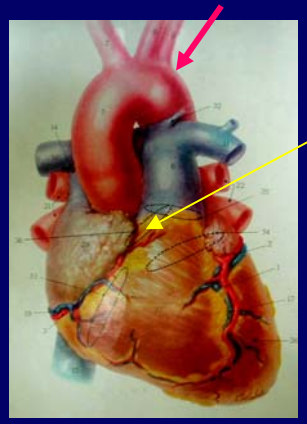
Venous pressure 10 cm H_2O

30° recumbent

Neighborhood Anatomic Relations



Aortic Isthmus



Left recurrent laryngeal nerve

Nerve Palsy

Ortner syndrome

Enlarged PA, LA

Esophagus

食道

1) TEE

2) Dysphagia

Enlarged LA

Aorta, relatively fixed at isthmus in front of vertebra and aortic annulus

1) Isthmus portion, vulnerable to trauma - transection

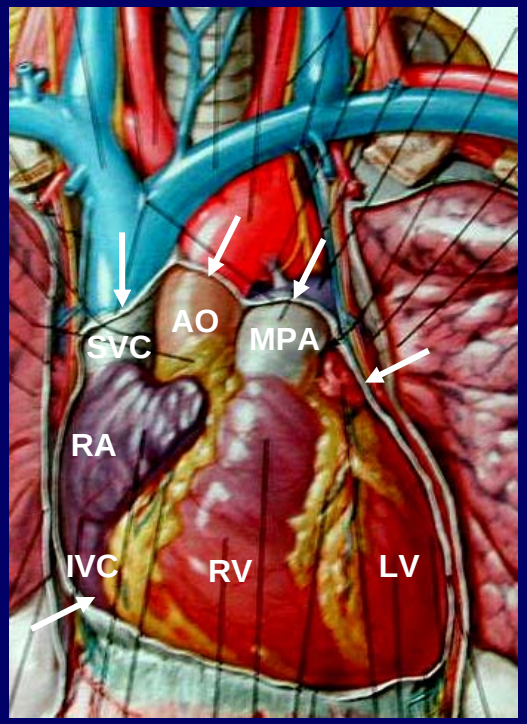
2) Arterosclerotic,aorta, elongated to right and anteriorly; heart, lying more horizontally

Pericardium

Structures
- Two layers
  - Parietal
  - Visceral
- Pericardial reflexion*

Functions
- Cardio-protection
- Restraining
  - cardiac volume

Congenital anomaly
- Absent pericardium
- Partial defect
  - Strangulation or
  - Herniation
    - ventricle, atrium

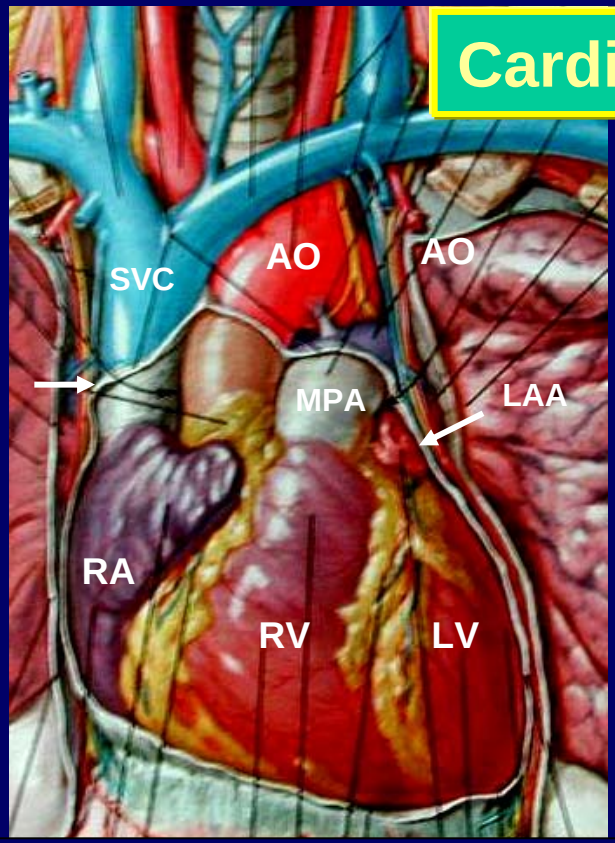


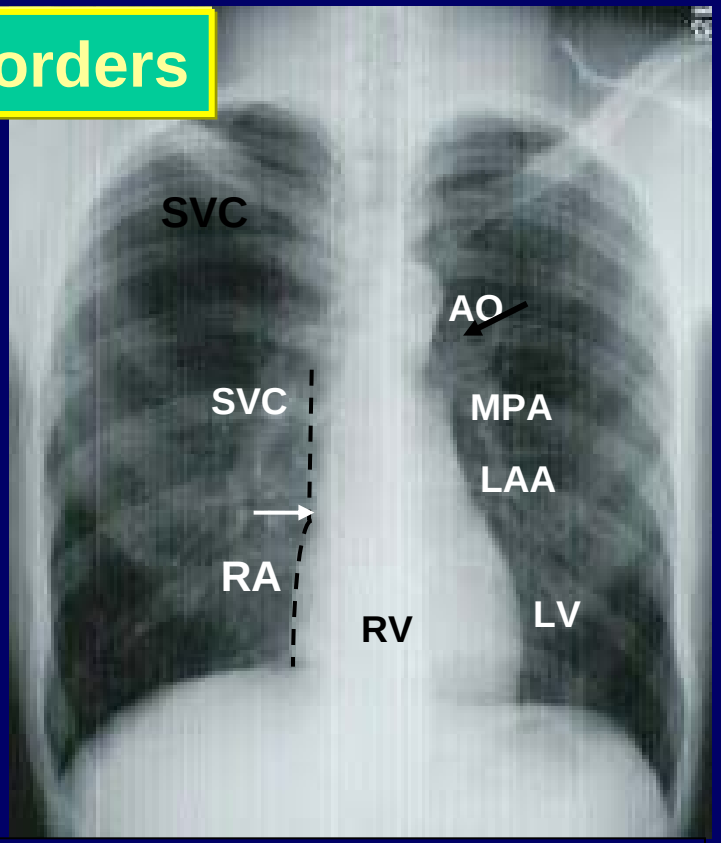
*Pericardial Reflection ↓
about 2 cm from borders of RA, RV, LV; thus,*proximal AO, PA, and distal ends of cavae in pericardial cavity

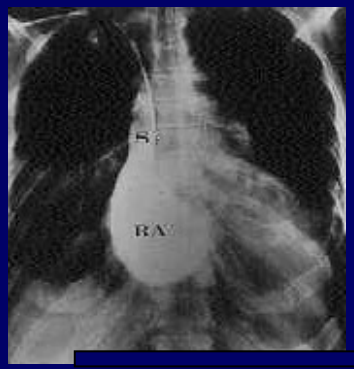
Clinical implications
- Pericarditis w/s
  - effusion
- "Cardiomegaly"
- *Cardaiac tamponade
- *Chronic constrictive
  - pericarditis

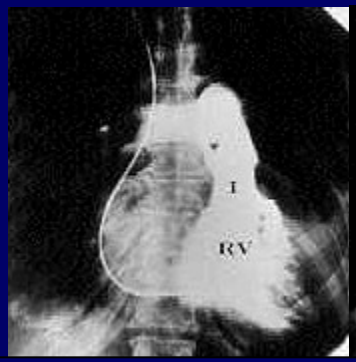
Hemopericardium/ Tamponade
Hemorrhage sources
- Cardiac
  - chambers
  - coronary vessels
- Extra-cardiac*
  - aorta, PA,
  - vena cavae

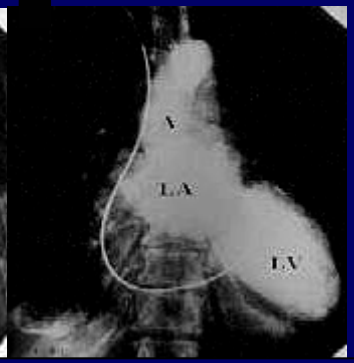
Cardiac Borders

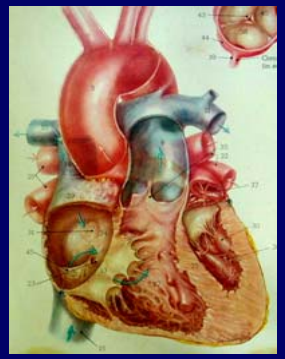




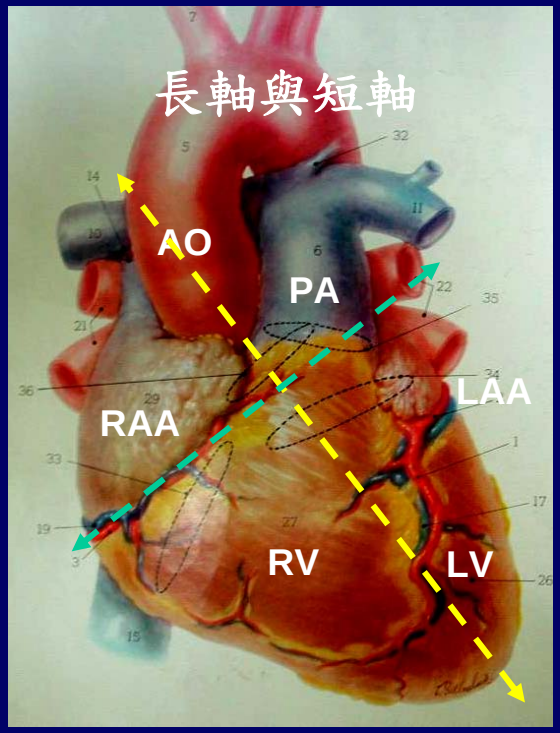




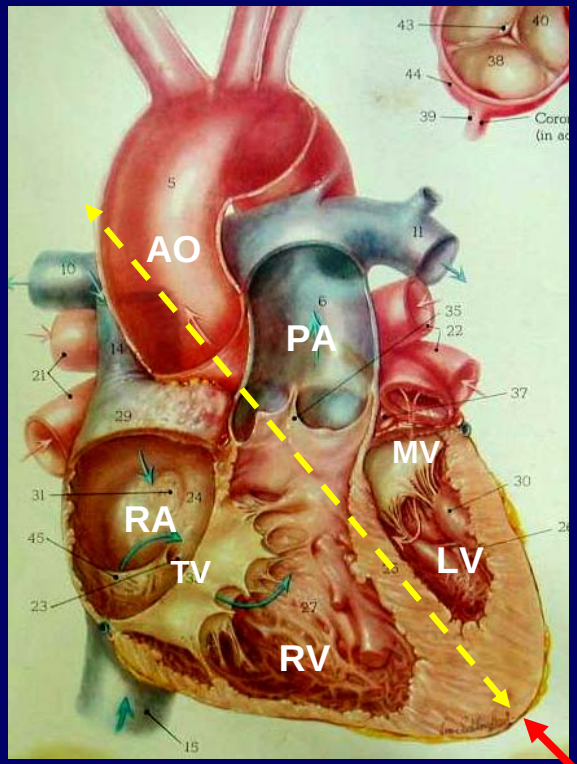


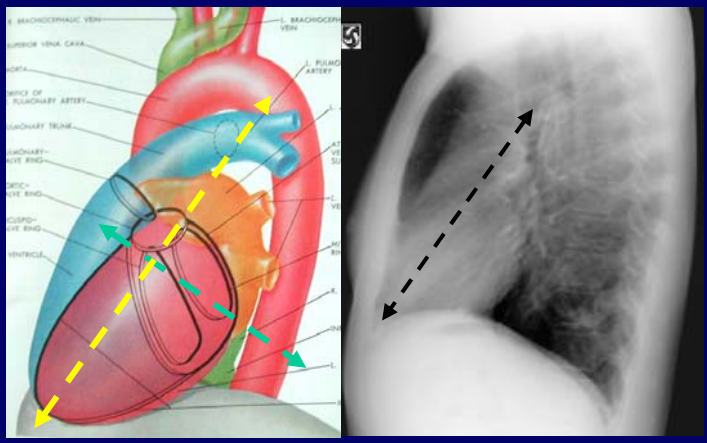


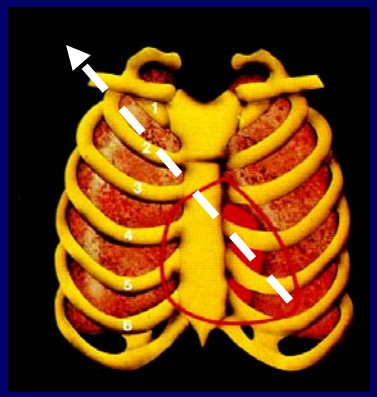
心臟解剖學取向 – 長軸與短軸

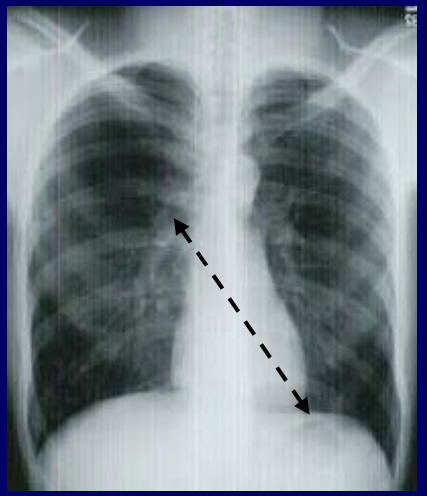


腔室與瓣膜
相關位置



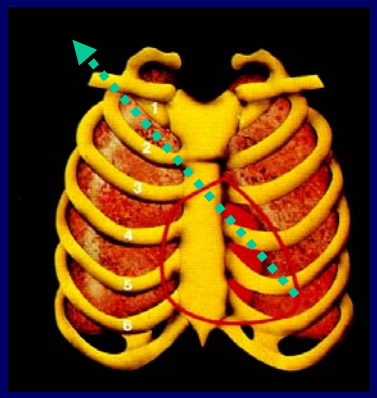


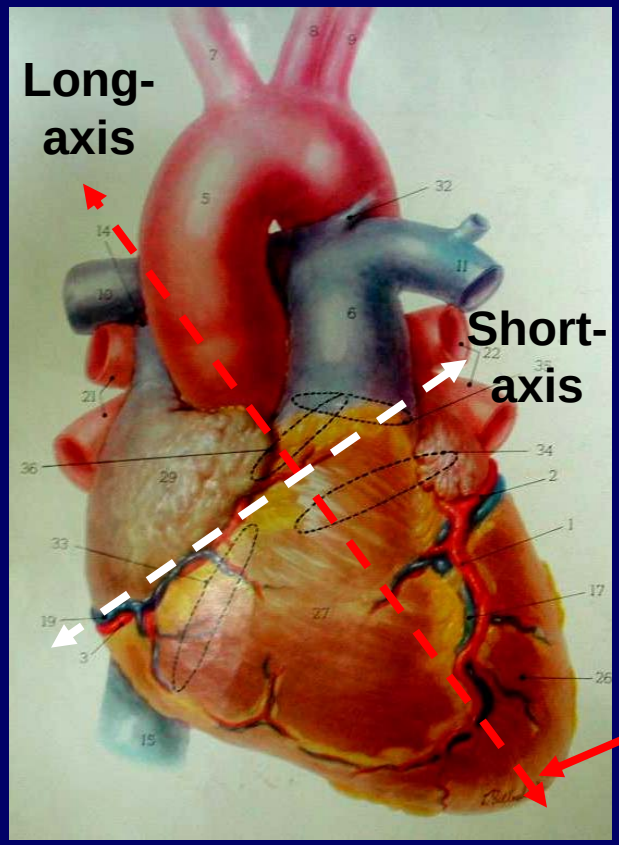


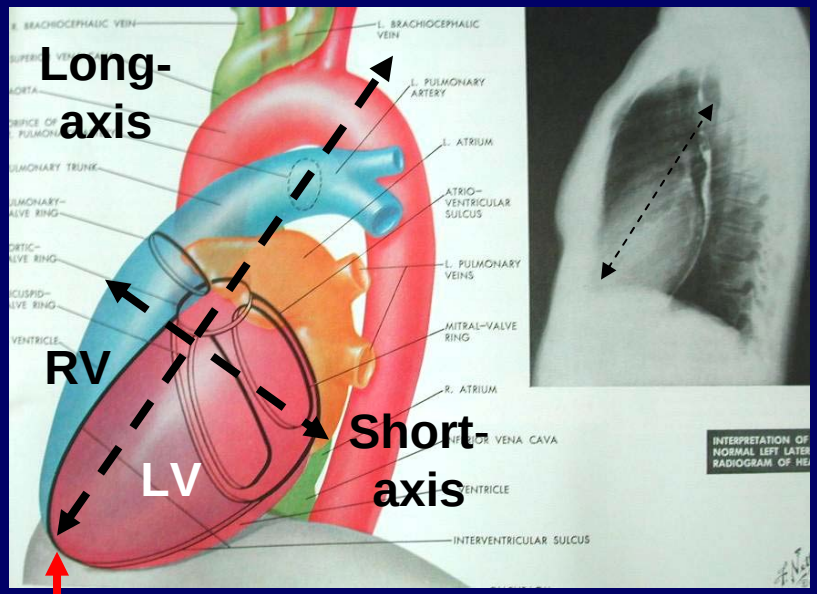


Apex 心尖

心臟解剖學取向-
長軸(Long-axis) 與短軸(Short-axis)



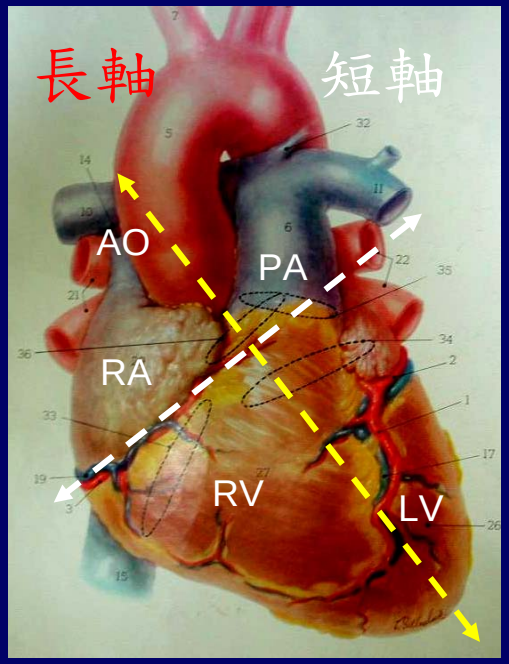




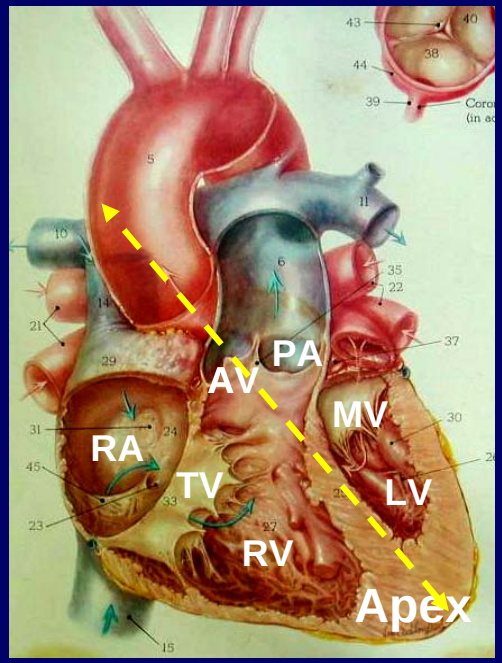
Apex
心尖

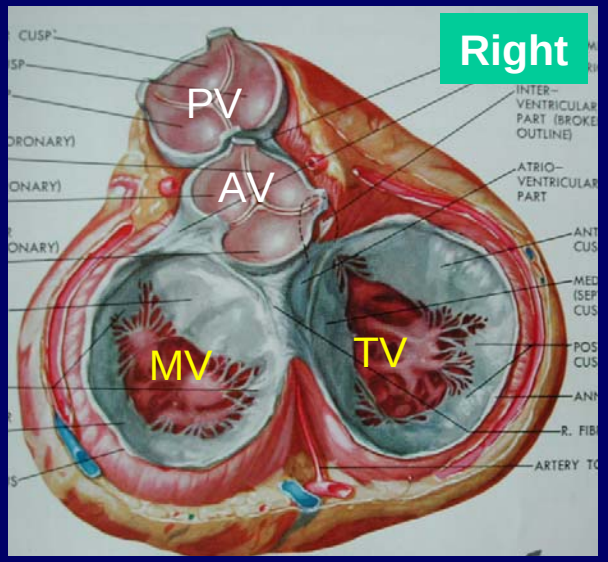
貼心？貼胸？

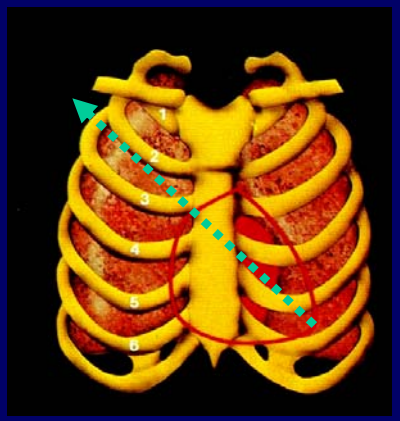
心臟解剖學取向 – 長軸 與短軸



腔室與瓣膜
相關位置







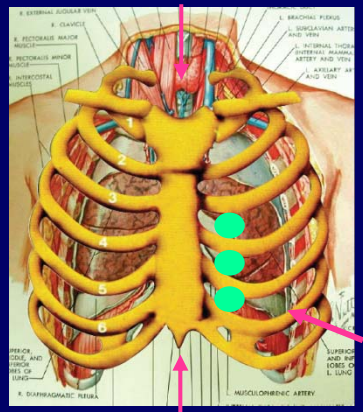
RA (right, anterior, caudal)
LA (left, posterior, cephalid)
RV (right, anterior);
LV (left, posterior)

PV (left, anterior, cephalid);
AV (right, posterior, caudal)

Echo Windows (“Air-free Window”)

TTE - 4 Widows

3) Suprasternal

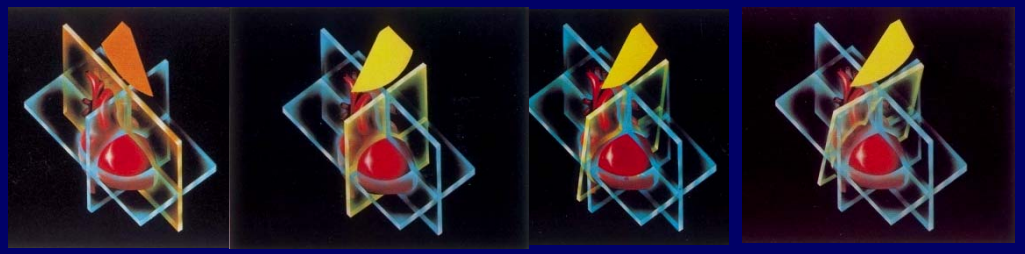


1) Parasternal

2) Apical

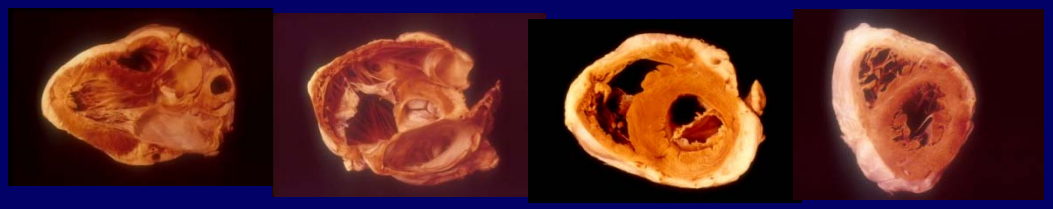
4) Subxyphoid

TEE

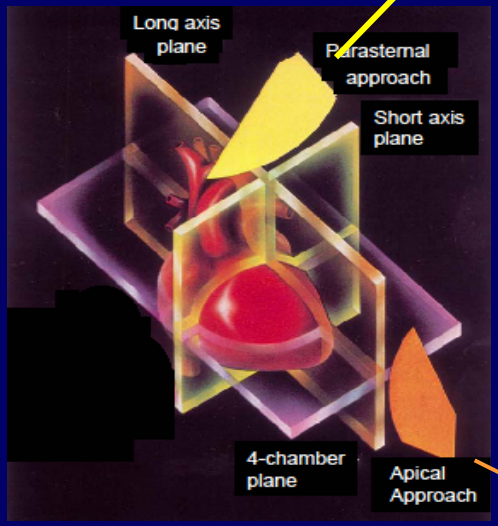


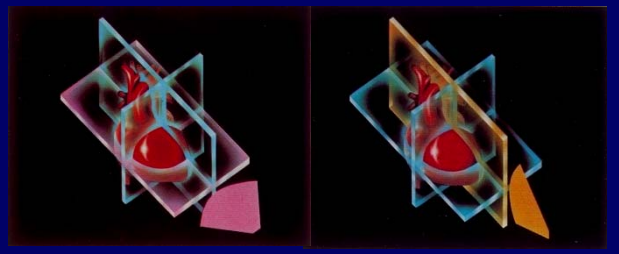
Long axis

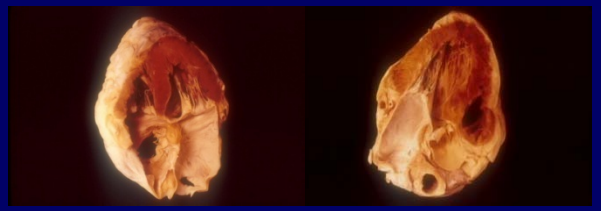
Short-axis views



1) Parasternal Approach

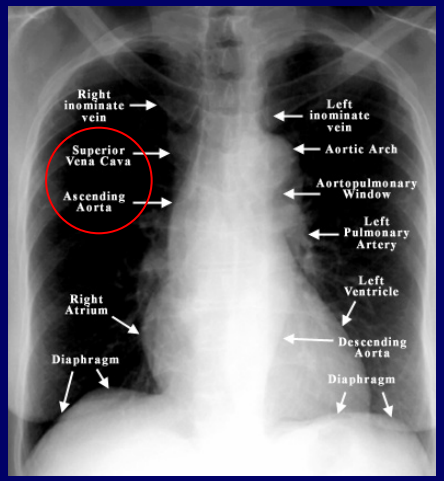






2) Apical Approach

Neighborhood Anatomic Relations



Left recurrent laryngeal nerve

Nerve Palsy

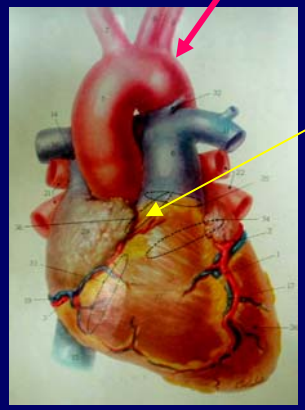
Ortner syndrome

Enlarged PA, LA

Esophagus

食道

Aortic Isthmus



Aorta, relatively fixed at isthmus in front of vertebra and aortic annulus

1) Isthmus portion, vulnerable to trauma - transection

2) Arterosclerotic,aorta, elongated to right and anteriorly; heart, lying more horizontally

1) TEE

2) Dysphagia

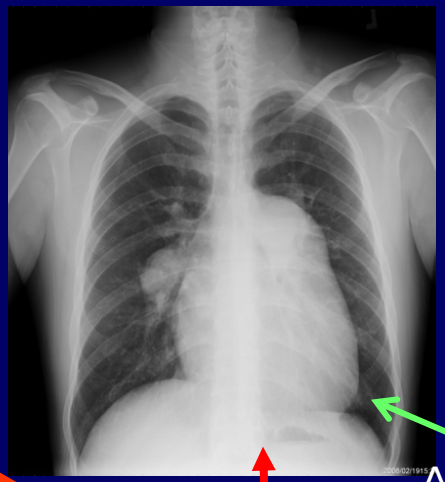
Enlarged LA

Applied Cardiac Anatomy

Case Example

Cardiac PE – ECG/Radiograph /Echo Correlates

Chest radiogram



*PE

Diffuse precordial heave

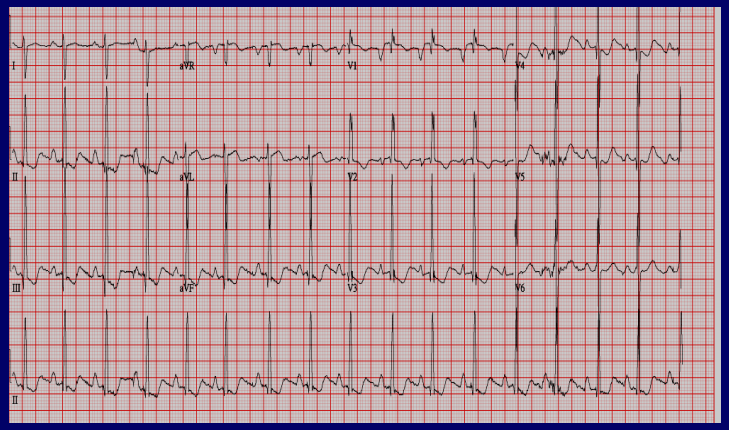
RV rocking motion

Palpable P_2

PA, Loud, P_2

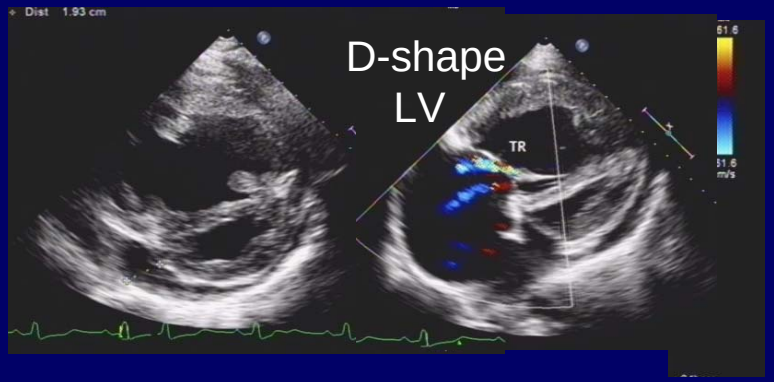
ECG

*PE



Apex

Echocardiography

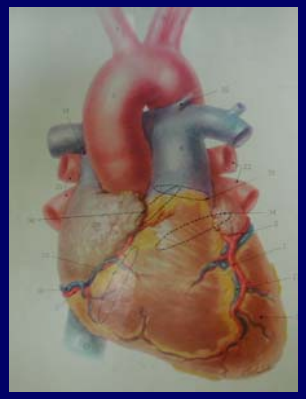


Coronary Arteries

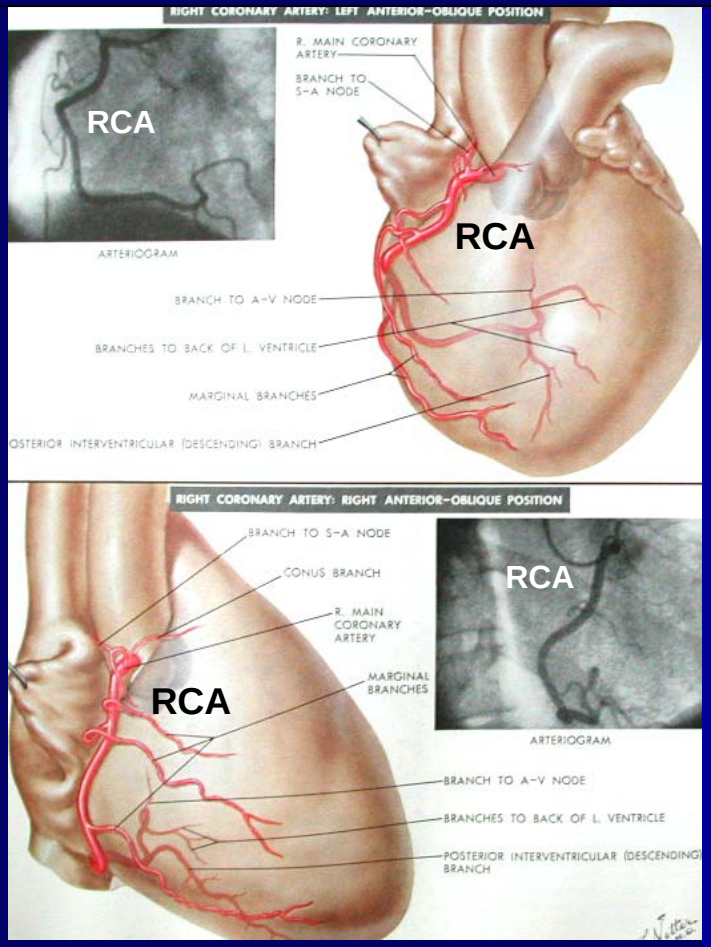
Right Coronary Artery

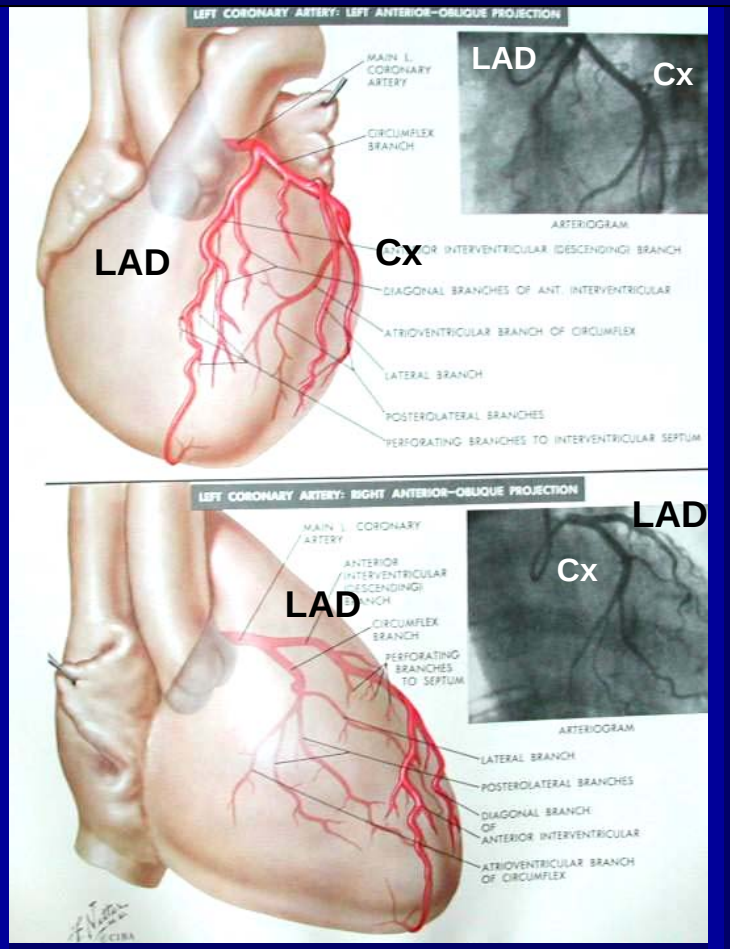
Left Coronary Artery

Front



Back





LAD = left anterior descending artery; RCA = right coronary artery
Cx = circumflex artery

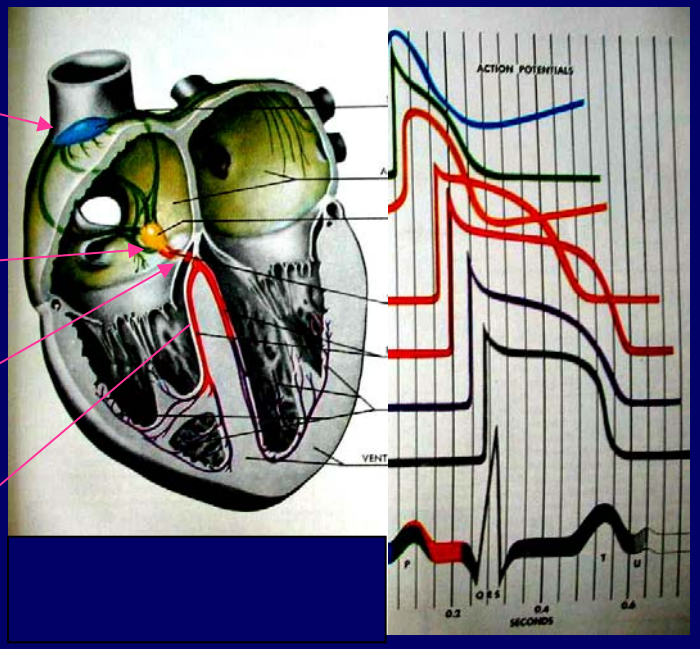
Blood Supplies to Conduction System

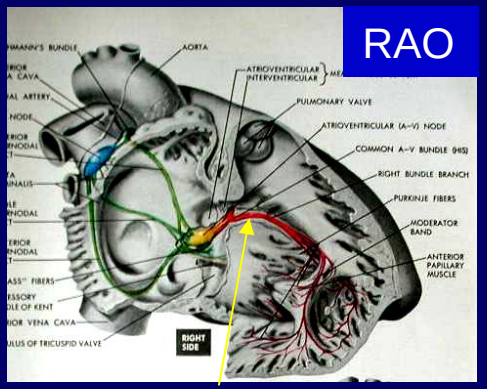
SA node

AV node

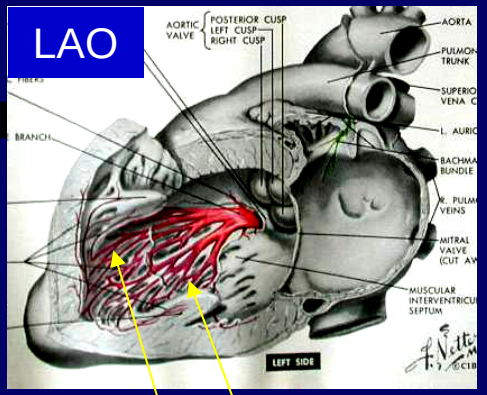
His bundle

Right bundle





Right bundle



Blood supplies

SA node

55% RCA;

45% LCX

AV node

90% RCA;

10%, LCX

Complete AV block in AMI

Inferior MI

AV junctional block;

Transient and self limiting

Anterior MI - Large infarct with tri-fascicular block (also affecting right bundle);

As a rule, poor prognosis

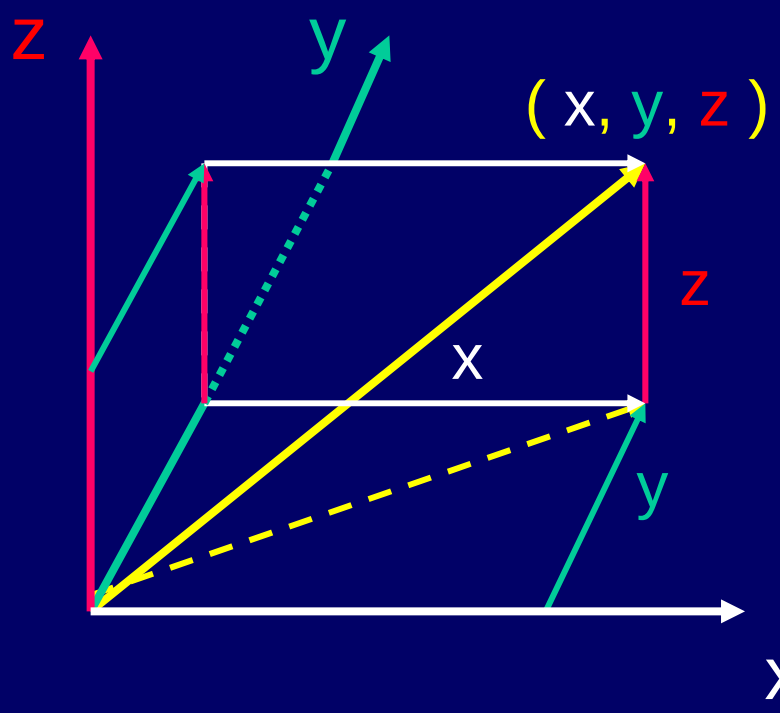
Left bundle (cascade like)

Supeior and Inferior divisions

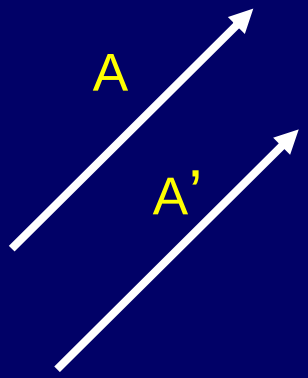
Blood supply: LAD

Application of Vector Concept and Anatomy in ECG

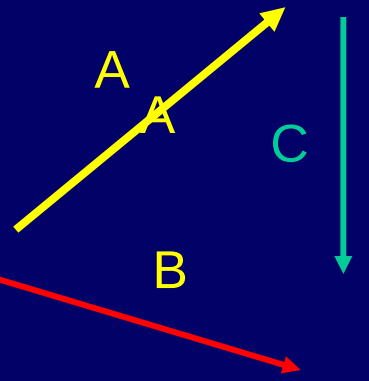
Vector
Magnitude with direction

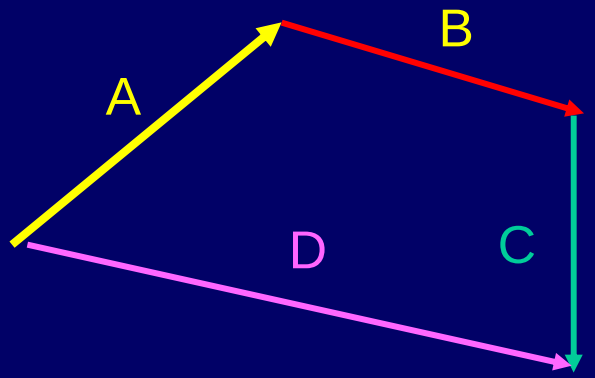


Same vectors



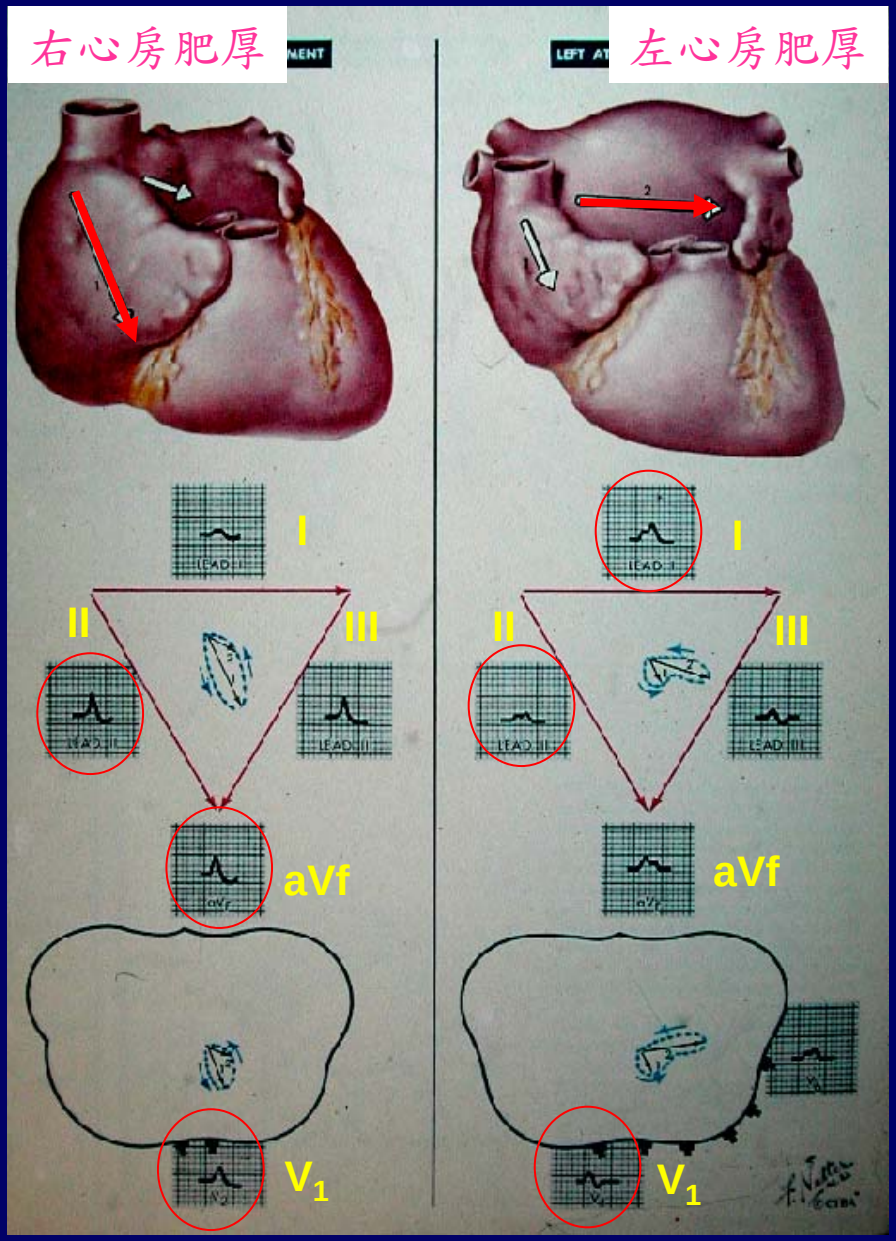
Different vectors



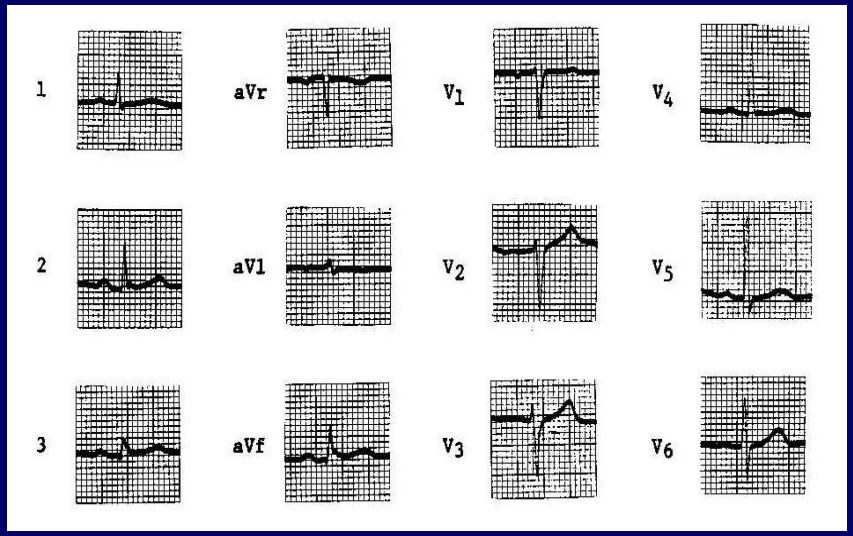


Scaler
Simplely, magnitude; no direction

A + B + C = D



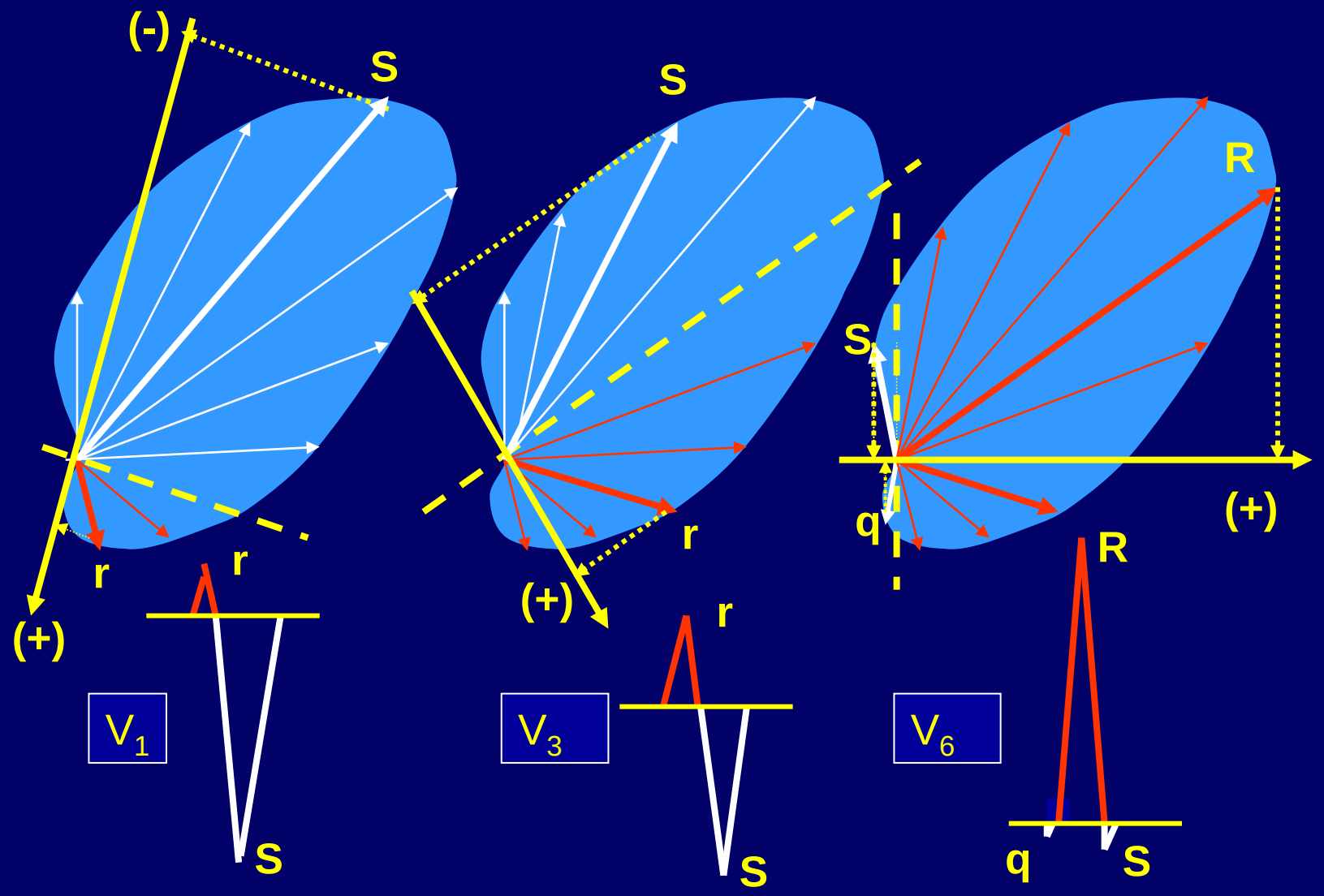
Normal ECG



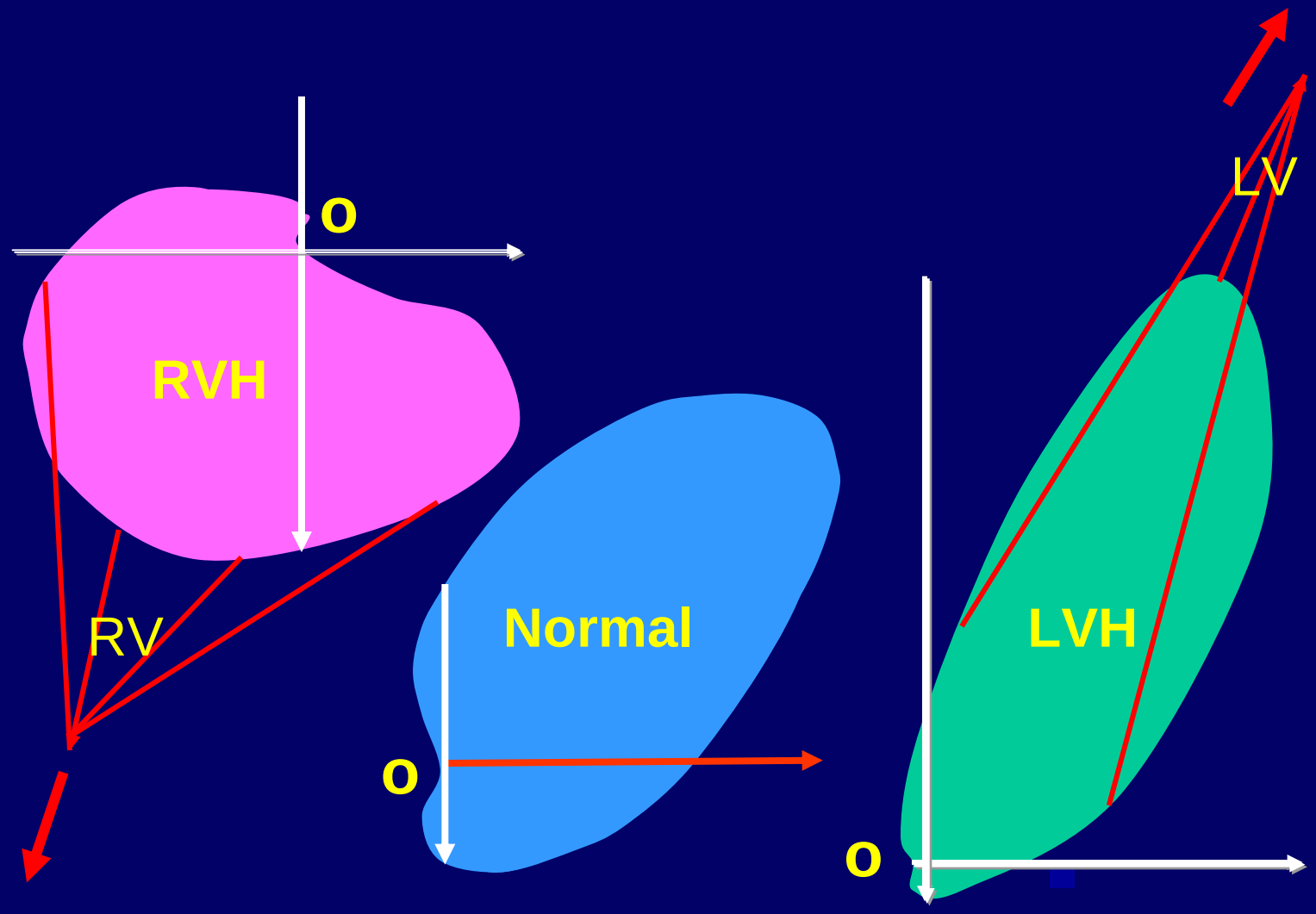
Determinants of P wave changes In hypertrophy of either atrium

1) Depolarization sequence of atria
2) Relative atrial anatomic relations
3) Atrial electrical power shifts

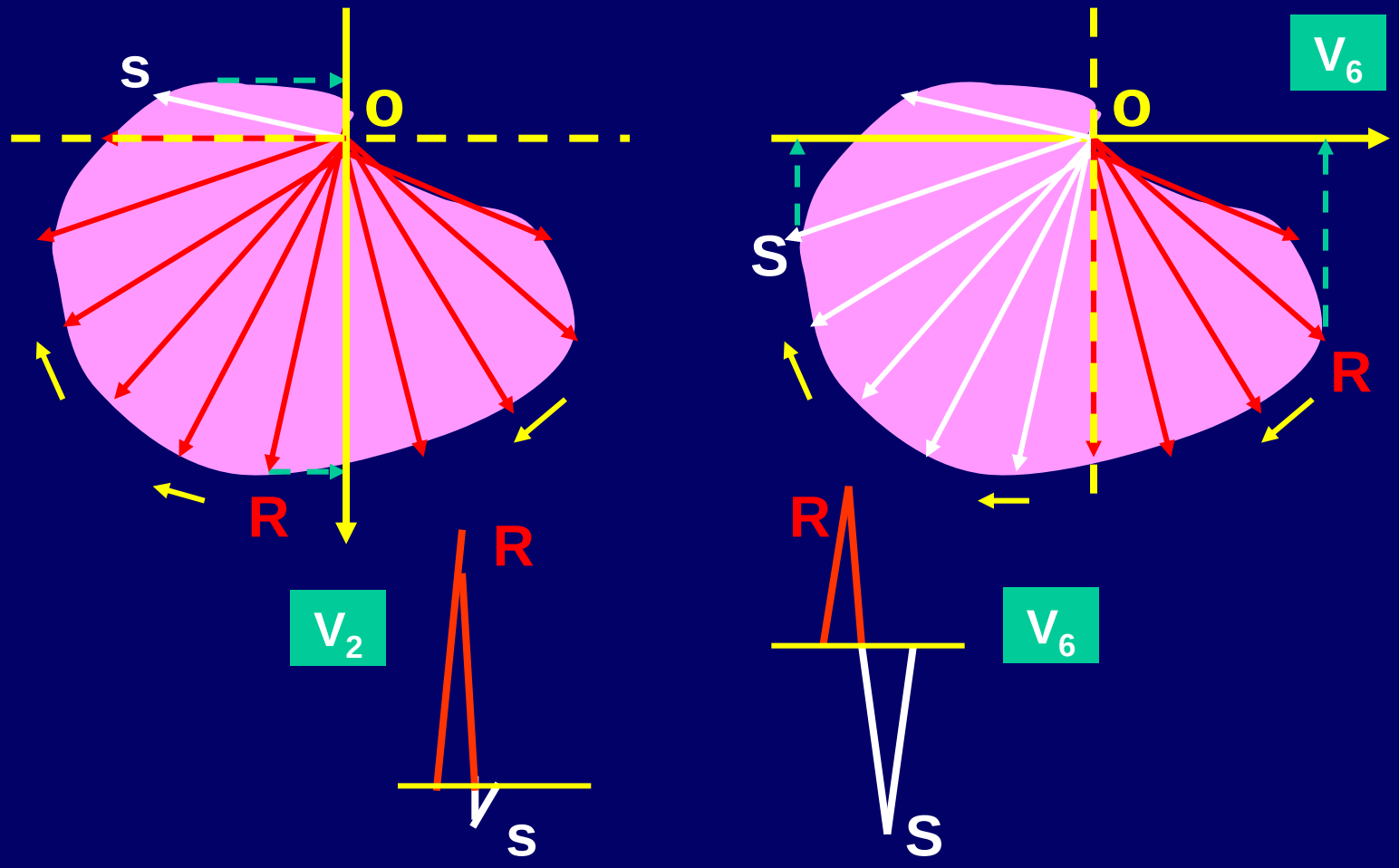
Horizontal Plane – Normal QRSs



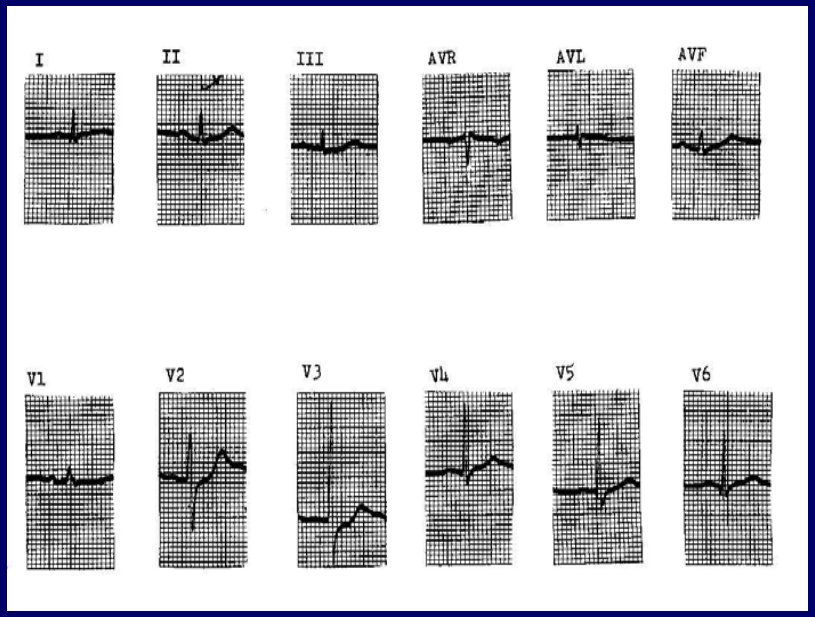
Horizontal Plane



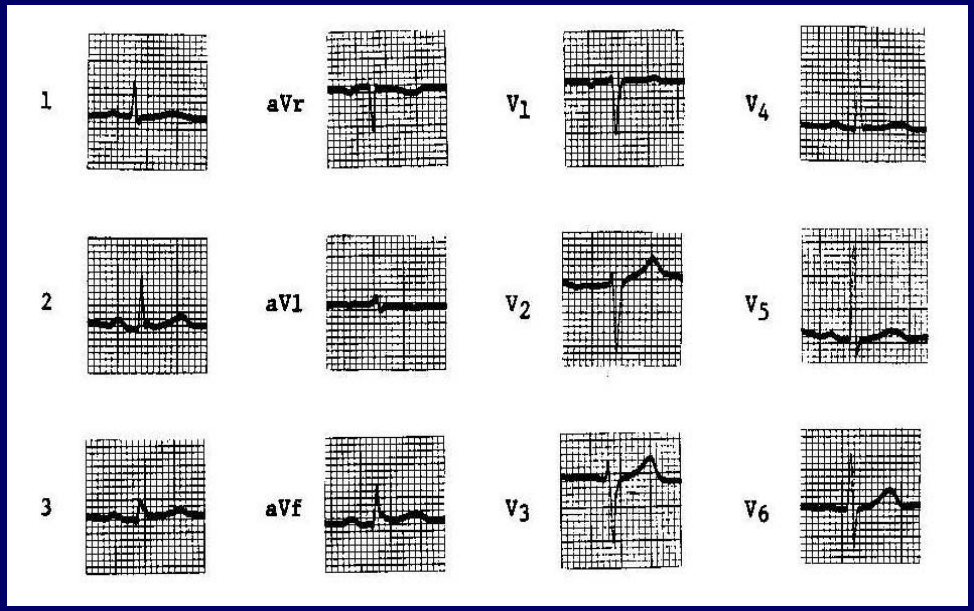
Horizontal Plane - RVH



Posterior MI
（後壁心肌梗塞）



Normal ECG



在後壁心肌梗塞，因為後方力量減弱，力量相對向往前增強，使得右前胸導程V1-3的R波增強 (類似 右心室肥厚，但在後者往前力量則為絕對性增加)

Horizontal Plane - Anteroseptal MI