The ABC’s of Heart Disease

In Slide Show mode, to advance slides, press spacebar or click left mouse button
With Acknowledgement
For Its Creation to
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What It Is

- An approach
- For congenital or acquired heart disease in adults
- Asking systematic set of questions
- Answers based on certain fundamental observations
- Visible on frontal chest x-ray alone
One of the easiest observations to make is something you already know: the cardio-thoracic ratio which is the widest diameter of the heart compared to the widest internal diameter of the rib cage.
Sometimes, CTR is more than 50%
But Heart is Normal

- Extracardiac causes of cardiac enlargement
  - Portable AP films
  - Obesity
  - Pregnant
  - Ascites
  - Straight back syndrome
  - Pectus excavatum
Here is a heart that is larger than 50% of the cardiothoracic ratio, but it is still a normal heart. This is because there is an extracardiac cause for the apparent cardiomegaly. On the lateral film, the arrows point to the inward displacement of the lower sternum in a pectus excavatum deformity.
Sometimes, CTR is less than 50%
But Heart is Abnormal

- Obstruction to outflow of the ventricles
  - Ventricular hypertrophy
- Must look at cardiac contours
Here is an example of a heart which is less than 50% of the CTR in which the heart is still abnormal. This is recognizable because there is an abnormal contour to the heart (yellow arrows).
The Cardiac Contours

- Ascending Aorta
- “Double density” of LA enlargement
- Right atrium
- Aortic knob
- Main pulmonary artery
- Indentation for LA
- Left ventricle

There are 7 contours to the heart in the frontal projection in this system.
The Cardiac Contours

Ascending Aorta

“Double density” of LA enlargement

Right atrium

Aortic knob

Main pulmonary artery

Indentation for LA

Left ventricle

But only the top five are really important in making a diagnosis.
Ascending Aorta

Low density, almost straight edge represents size of ascending aorta.
Ascending Aorta

Small

Prominent
Double density of left atrial enlargement

Indentation where “double density” of left atrial enlargement will appear
Even though we are on the right side of the heart, we can see left atrial enlargement. Normally the left atrium sits right in the middle of the heart posteriorly and does not form a normal border on the frontal film.

This inset from a CT scan of the chest shows how RA and LV obscure LA from forming a heart border on the frontal film.
When the LA enlarges, it will do something on the left side of the heart we’ll talk about in a minute. And it may produce a “double-density” on the right side of the heart.
Two shadows, the yellow arrow pointing to the LA and the red arrow to the RA overlap each other where the indentation between the ascending aorta and right heart border meet.
The last bump on the right side is the right atrium. Since there is no disease in an adult that causes isolated enlargement of the RA, we’ll consider the RA together with the RV later.
Aortic Knob

The first bump on the left-side is the aortic arch. We can measure the knob from the lateral border of air in the trachea to the edge of the aortic knob.

Aortic knob should measure < 35mm
Aortic Knob

Enlarged with:

- Increased pressure
- Increased flow
- Changes in aortic wall

42mm
The next bump down is the main pulmonary artery and is the keystone of this system.
Finding the Main Pulmonary Artery
Finding the Main Pulmonary Artery

We can measure the main pulmonary artery . . .
The distance between the tangent and the main pulmonary artery (between two small green arrows) falls in a range between 0 mm (touching the tangent line) to as much as 15 mm away from the tangent line.

If we draw a tangent line from the apex of the left ventricle to the aortic knob (red line) and measure along a perpendicular to that tangent line (yellow line)
Main pulmonary artery ranges from 0 mm–15 mm from tangent line.
Two Major Classifications

- The main pulmonary artery (MPA) projects beyond the tangent line
- The main pulmonary artery is more than 15 mm away from the tangent line
  - Because the MPA is small or absent
  - Because the tangent line is being pushed away from the MPA
Main pulmonary artery projects beyond tangent

Increased pressure

Increased flow
Main pulmonary artery is more than 15 mm from tangent

Small pulmonary artery

Truncus arteriosus

Tetralogy of Fallot
Main pulmonary artery is more than 15 mm from tangent

Left ventricle and/or aortic knob push the tangent away

Common
To recapitulate:
Left atrial enlargement

Concavity where L atrium will appear on left side when enlarged
Left atrial enlargement

Left atrium may enlarge without producing double density

“Straightening of the left heart border”
In the example on the right, not only is the left atrium enlarged, but the left atrial appendage is too. So there is a convexity outward where there is normally a concavity inward.
Left ventricle
Which Ventricle is Enlarged?

The best way to determine which ventricle is enlarged is to look at the corresponding outflow tract for each ventricle.
Which Ventricle is Enlarged?

If Heart Is Enlarged, And Main Pulmonary Artery is Big

Then Right Ventricle is Enlarged
Which Ventricle is Enlarged?

If Heart Is Enlarged, And Aorta is Big

Then Left Ventricle is Enlarged

>50%
Which ventricle is enlarged?

- The best way to determine which ventricle is enlarged is to look at the corresponding outflow tract for each ventricle
  - Aorta for the LV
  - MPA for the RV
Which Ventricle is Enlarged?

Once one ventricle is enlarged, it’s impossible to tell if other ventricle is also enlarged
The Cardiac Contours

Ascending Aorta

"Double density" of LA enlargement

Right atrium

Aortic knob

Main pulmonary artery

Indentation for LA

Left ventricle
The Cardiac Contours

Ascending Aorta

"Double density" of LA enlargement

Right atrium

Aortic knob

Main pulmonary artery

Indentation for LA

Left ventricle
The Pulmonary Vasculature
<table>
<thead>
<tr>
<th>Five States of the Pulmonary Vasculature</th>
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</thead>
<tbody>
<tr>
<td>- Normal</td>
</tr>
<tr>
<td>- Pulmonary venous hypertension</td>
</tr>
<tr>
<td>- Pulmonary arterial hypertension</td>
</tr>
<tr>
<td>- Increased flow</td>
</tr>
<tr>
<td>- Decreased flow</td>
</tr>
</tbody>
</table>
What We’re Going to Evaluate

- Right Descending Pulmonary Artery
- Distribution of flow in the lungs
  - Upper versus lower lobes
  - Central versus peripheral
What to Evaluate

1. 

2. 

3. 

1. 

2. 

3. 

1. 

2. 

3.
1. Right Descending Pulmonary Artery

Right Descending Pulmonary Artery

Serves right middle and lower lobes
1. Right Descending Pulmonary Artery

Diameter can be measured (before bifurcation)

RDPA < 17 mm

Normally, the right descending pulmonary artery should not be more than 17mm in diameter
2. Normal Distribution of Flow
Upper Versus Lower Lobes

In erect position, blood flow to bases > than flow to apices

Size of vessels at bases is normally > than size of vessels at apex

You can’t measure size of vessels at the left base because the heart obscures them
3. Normal Distribution of Flow
Central versus peripheral

Central vessels give rise to progressively smaller peripheral branches.

Normal tapering of vessels from central to peripheral.
Normal Vasculature - review

1. RDPA < 17 mm in diameter
2. Gradual tapering of vessels from central to peripheral
3. Lower lobe vessels larger than upper lobe vessels
Venous Hypertension

RDPA usually > 17 mm

Upper lobe vessels equal to or larger than size of lower lobe vessels = Cephalization
RDPA usually > 17 mm

Main Pulmonary Artery projects beyond tangent line
Pulmonary Arterial Hypertension

Rapid cutoff in size of peripheral vessels relative to size of central vessels

Central vessels appear too large for size of peripheral vessels which come from them = Pruning
Increased Flow

RDPA usually
> 17 mm

All of blood vessels everywhere in lung are bigger than normal
Increased Flow

Distribution of flow is maintained as in normal.

Gradual tapering from central to peripheral.

Lower lobe vessels bigger than upper lobe.
Increased Flow  PAH
Decreased Flow

Unrecognizable most of the time

Small hila

Fewer than normal blood vessels
The Pulmonary Vasculature

- Normal
- Pulmonary venous hypertension
- Pulmonary arterial hypertension
- Increased flow
- Decreased flow - mostly unrecognizable even when it is present
A Is the Left Atrium Enlarged?
  - If yes, then
    - Look at the Pulmonary Vasculature
    - Normal
    - Increased
    - Pulmonary venous hypertension
  - If no, then
    - Mitral Stenosis
    - L Myxoma
    - VSD, PDA

B Is the Main Pulmonary Artery Big or Bulbous?
  - If yes, then
    - Look at the Pulmonary Vasculature
    - Normal
    - Increased
    - Pulmonary venous hypertension
  - If no, then
    - Plum. stenosis
    - ASD (VSD)
    - Cardiomyopathy

C Is the Main Pulmonary Artery Segment Concave?
  - If yes, then
    - Don't Look at Pulmonary Vasculature. Look at Aorta
      - Normal
      - Ascending dilated
      - Whole Ao Dilated
    - Cardiomyopathy
    - Pericardial Effusion
    - Mol. valve dz
  - If no, then
    - Ao Stenosis
    - Ao regurg
    - HBP

D Is the Heart Dilated or Delta-Shaped?
  - If yes, then
    - Don't Look at Pulmonary Vasculature. Look at Aorta
    - Normal
    - Ascending dilated
    - Whole Ao Dilated
    - Cardiomyopathy
    - Pericardial Effusion
    - Mol. valve dz
  - If no, then
    - Mitral regurg
    - Normal
    - Increased
    - Pulmonary venous hypertension

The ABC's
The System

- Those were all of the answers
- Now here are the questions
- The system is successful only if you ask the questions in this order
- The answers are the fundamental observations you make on the frontal film alone
Is The Left Atrium Enlarged?
To answer that question

“Double density” at site of normal indentation

Straight or convex at site of normal concavity
If Answer To Question “A” Is YES
Look At Pulmonary Vasculature
If Answer To Question “A” Is NO Then...
Is The Main Pulmonary Artery Big?
To answer that question

Main pulmonary artery projects beyond tangent line
If Answer To Question “B” Is YES
Look At Pulmonary Vasculature
If Answer To Question “B” Is NO Then...
Is The Main Pulmonary Artery Concave?
To answer that question

Main pulmonary artery is > 15mm away from tangent line
C

If Answer To Question “C” Is YES
Look At Configuration of Aorta
If Answer To Question “C” Is NO Then...
Is The Heart a Dilated Or Delta-Shaped Heart?
1. Pericardial effusion
2. Cardiomyopathy

Cardio-thoracic ratio > 65%
A Is the Left Atrium Enlarged?
   - If yes, then
     - Look at the Pulmonary Vasculature
     - Pulmonary venous hypertension
       - Increased
         - Mitral Stenosis L Myxoma
       - Normal
         - VSD, PDA
   - If no, then

B Is the Main Pulmonary Artery Big or Bulbous?
   - If yes, then
     - Look at the Pulmonary Vasculature
     - Normal
       - Pulmonary stenosis
     - Increased
       - ASD (VSD)
   - If no, then
     - Pulmonary hypertension
       - Idiopathic 2° to lung dz
       - Cardiomyopathy
     - Don't Look at Pulmonary Vasculature. Look at Aorta
       - Normal
       - Ascending dilated
       - Idiopathic
       - Cardiomyopathy

C Is the Main Pulmonary Artery Segment Concave?
   - If yes, then
     - Don't Look at Pulmonary Vasculature
     - Whole Aorta Dilated
     - Aortic regurgitation
     - HBP
   - If no, then

D Is the Heart Dilated or Delta-Shaped?
   - If yes, then
     - Cardiomyopathy
     - Pericardial Effusion
     - Multiple valve dz
   - If no, then
Choose the link “Test Yourself on the ABCs” to see how the system works

For printed notes, choose the link under Cardiac Notes for “The ABCs of Heart Disease”
The End