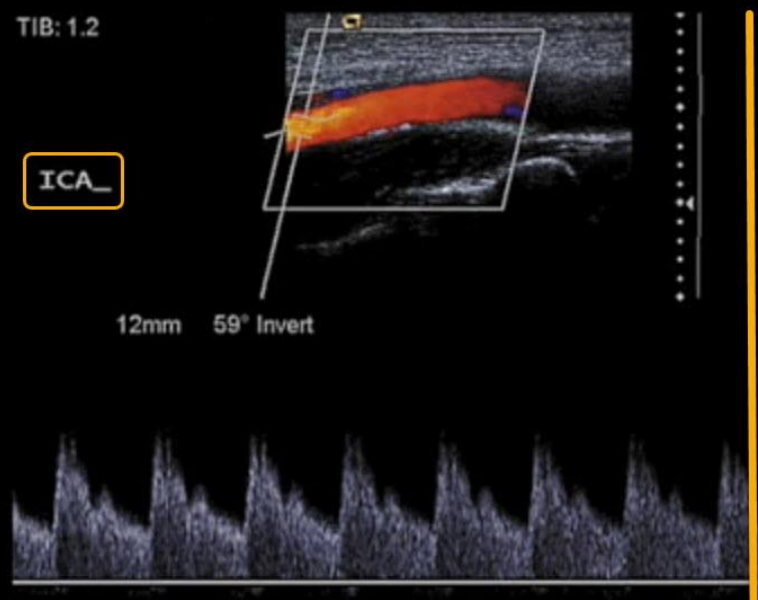
Lecture 2 and 3

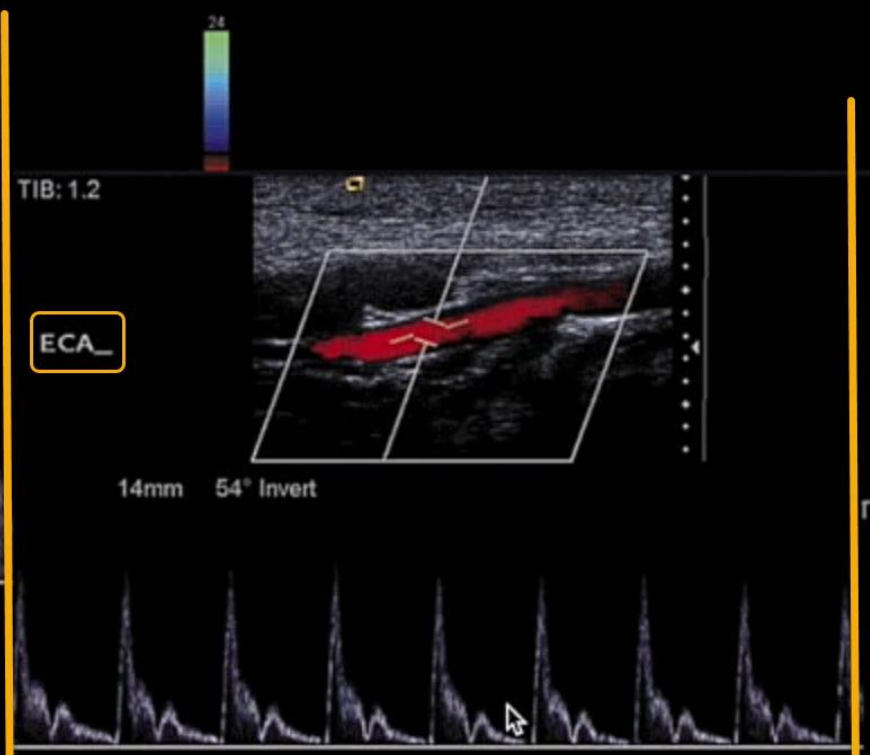
Doppler Ultrasound

Tutor: Dr. Wisam Aziz Yousif

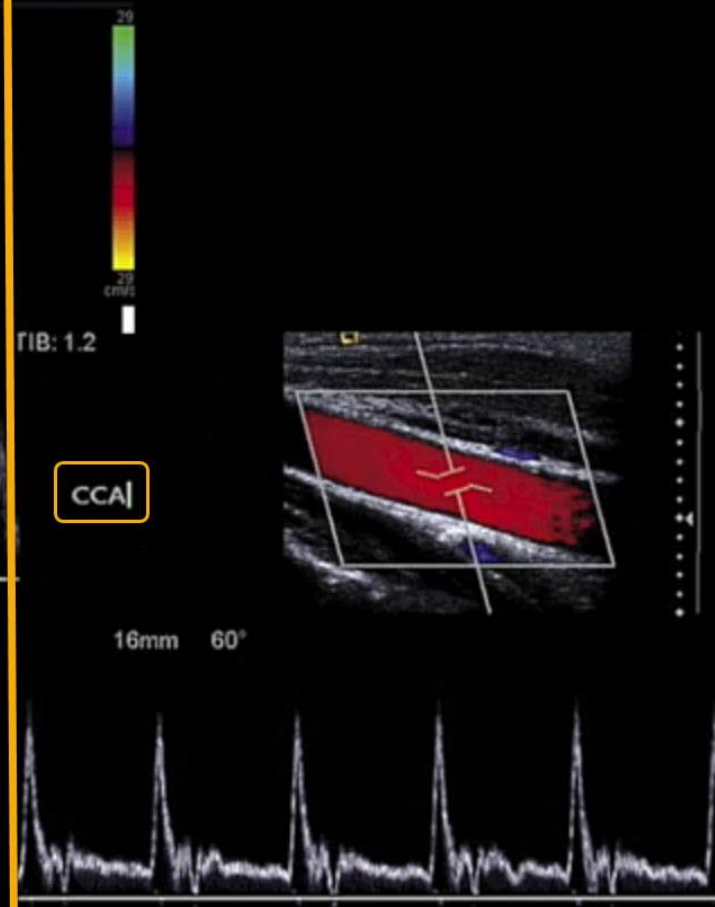
Normal Neck Vessels



Low R.



High R.



Mix

Carotid Artery Stenosis:

What are the causes and risk factors for carotid artery stenosis?

- Smoking and using tobacco products.
- Having obesity.
- Sedentary lifestyle.
- High blood pressure (hypertension).
- High cholesterol.
- Diabetes.
- Age.

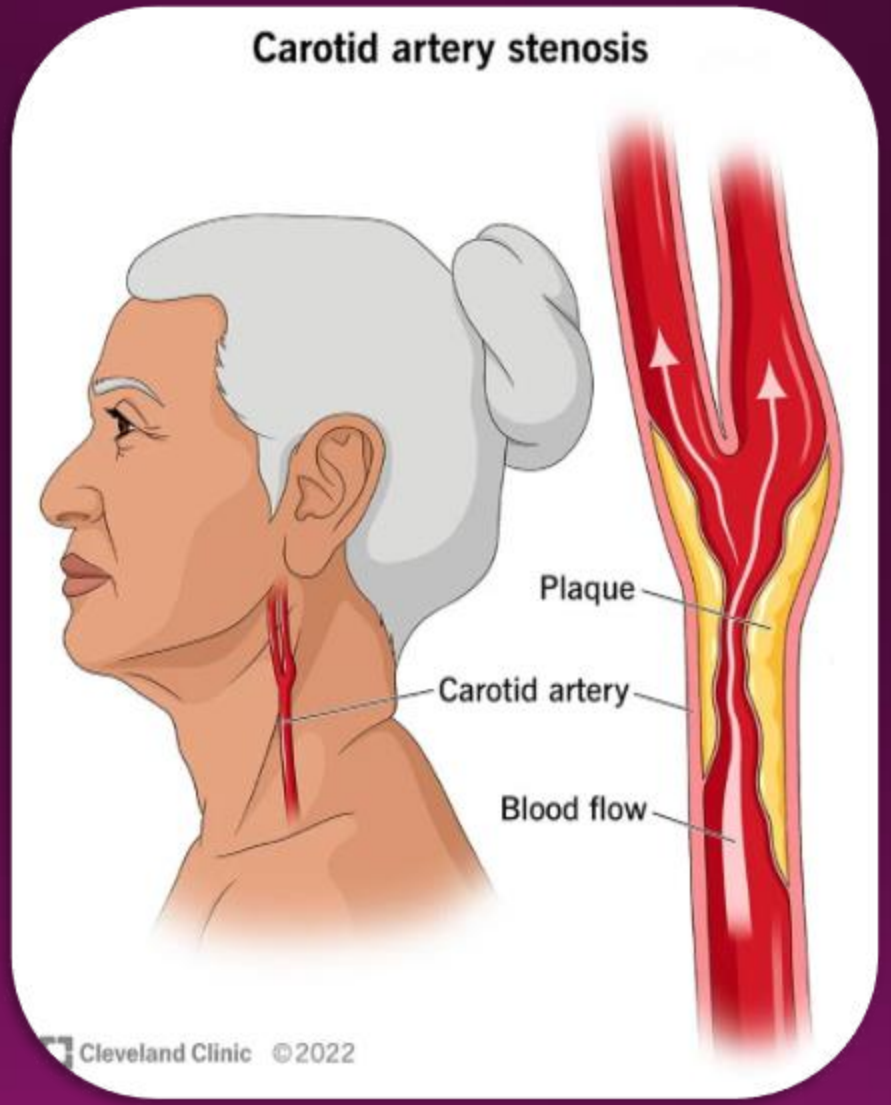
What are the symptoms of carotid artery stenosis?

Carotid artery stenosis can cause a stroke. The kind of stroke that usually happens from carotid stenosis is "ischemic" stroke.

What are the symptoms of a stroke?

The symptoms of a TIA or stroke can include:

- Drooping of one side of your face.
- Slurred speech or trouble forming words and communicating with others.
- Losing vision in one eye with the experience of a dark shade coming down over your field of vision.
- Losing feeling on one side of your body.
- Losing muscle strength and having weakness on one side of your body.



Diagnosis and Tests

1. symptoms of a stroke.
2. bruit (whistling sound) or murmur — during an exam of neck with a stethoscope.

There are several tests providers use to confirm a diagnosis of carotid artery stenosis and learn more about the size and location of the blockage. These tests can include:

•**Ultrasound**: Also called a duplex ultrasound, this type of test uses sound waves to create an image of your body's internal structures. An ultrasound is a painless test that is done on top of your skin. An ultrasound is used to see how blood is flowing through your arteries and find any places where the arteries may be blocked or narrowed.

•**Computed tomography angiography (CTA).**

•**Cerebral angiography**

How is carotid artery stenosis classified?

During the diagnosis process, your healthcare provider will look to see if you have the condition, how large it is, and where it's located. Carotid artery stenosis is generally divided into three groupings: mild, moderate and severe.

A. Mild blockage is one that's less than 50%.

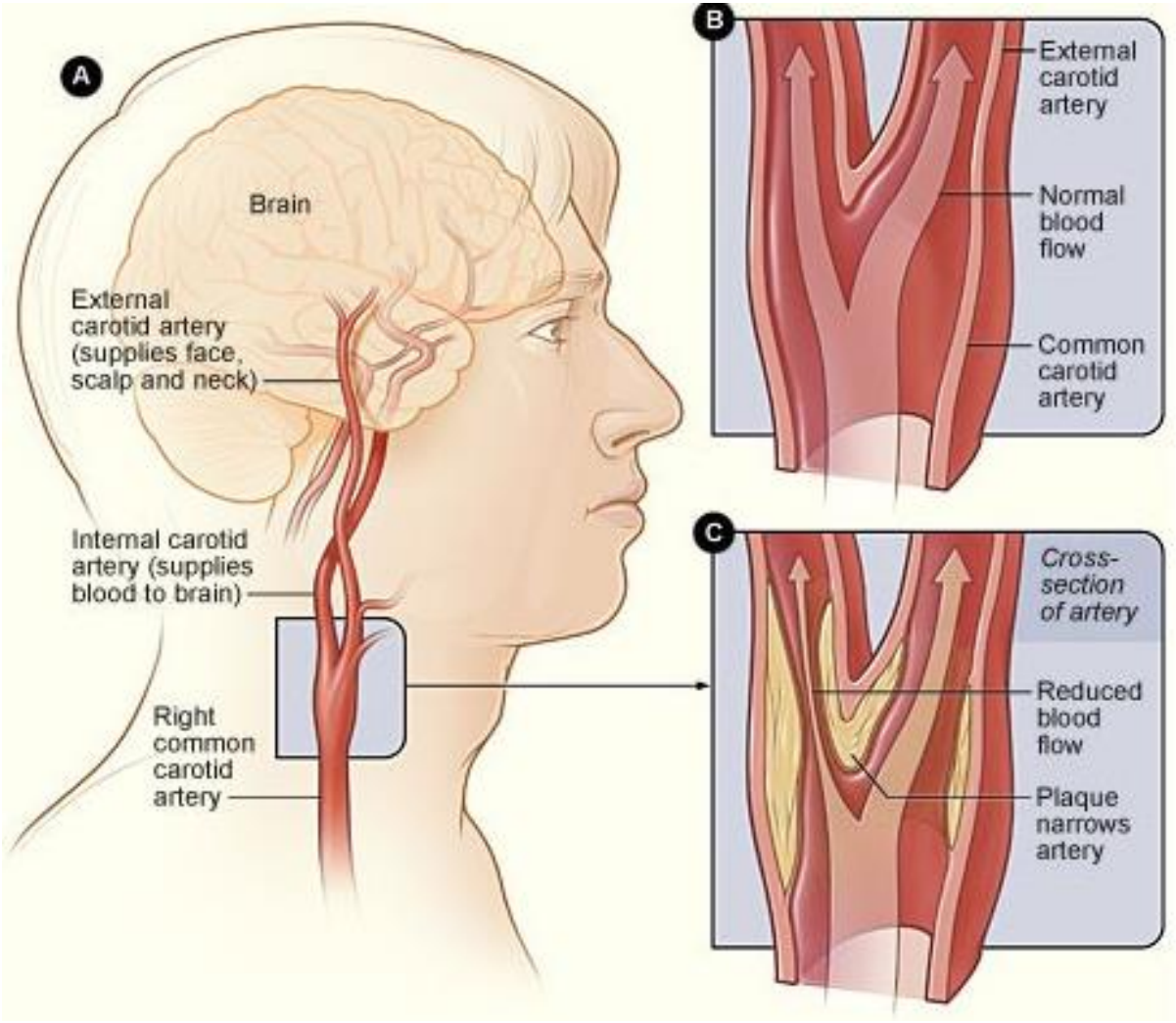
This means that less than half of the artery is blocked.

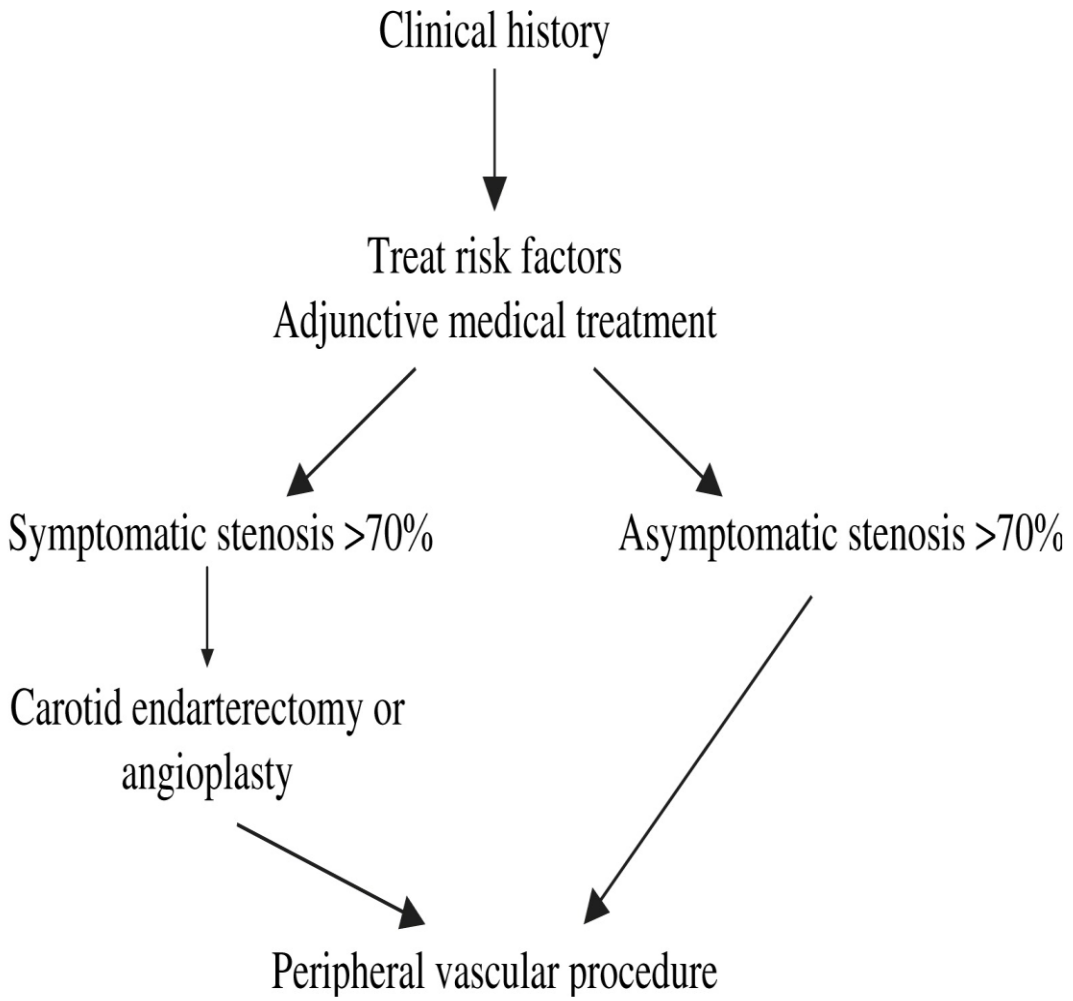
A. Moderate blockage is between 50% and 79%.
B. Severe blockage is from 80% to 99%.

Degree of Stenosis	PSV, cm/s
Mild (0–29%)	<150
Mild to moderate (30–49%)	<190
Moderate (50–69%)	<270
Severe (70–99%)*	≥270
Occlusion (100%)	No detectable flow

DUS criteria were defined in a pilot series at the University Medical Center Utrecht before the start of the study.[24]

*Slow flow in combination with visualized severe stenosis was defined as 99% stenosis.


A
Brain
External carotid artery (supplies face, scalp and neck)
Internal carotid artery (supplies blood to brain)
Right common carotid artery
B
External carotid artery
Normal blood flow
Common carotid artery
C
Cross-section of artery
Reduced blood flow
Plaque narrows artery


Clinical history
Treat risk factors
Adjunctive medical treatment
Symptomatic stenosis >70%
Asymptomatic stenosis >70%
Carotid endarterectomy or angioplasty
Peripheral vascular procedure

Case:

•John Doe, 68 years, Male, has long Hx. of Hypertension and Diabetes, he is former Smoker
• presents with a history of transient weakness in his right arm and leg, lasting for approximately 10-15 minutes before resolving spontaneously. He also mentions a recent episode of slurred speech.

Clinical Examination:

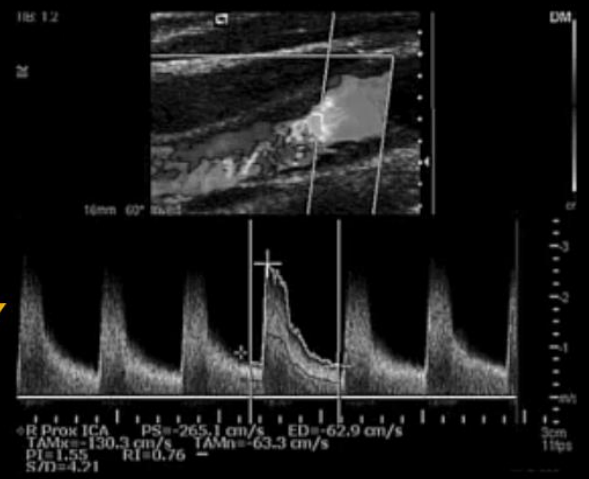
•Blood Pressure: 150/95 mmHg
•Heart Rate: 78 bpm, regular
•Neurological Examination: Normal at the time of examination
•Carotid Auscultation: A bruit is heard over the left carotid artery.

Investigations:

•Carotid Doppler Ultrasound.
•Echocardiogram.
•Blood Tests.

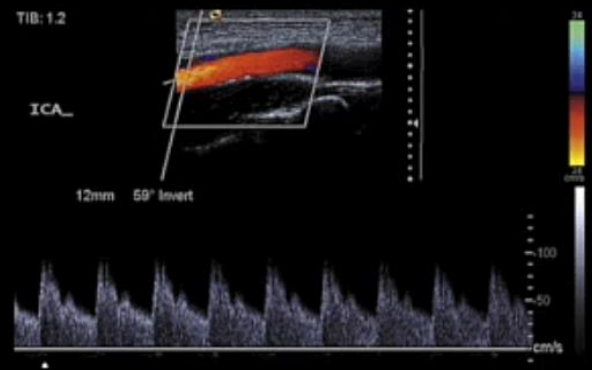
Diagnosis: ?

Left ICA



PSV 265 cm/s

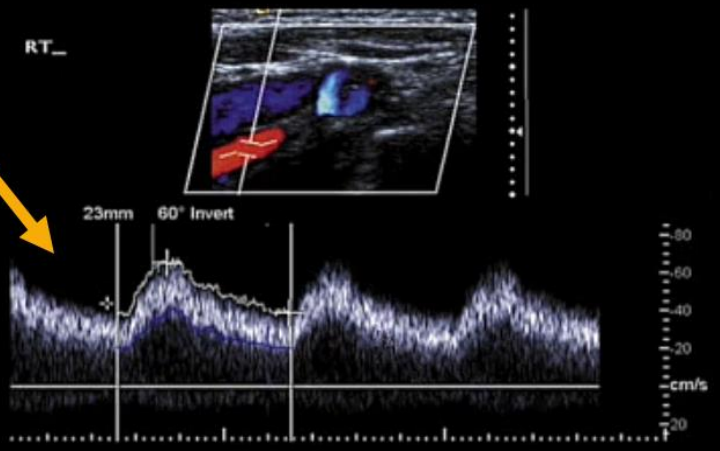
Right ICA



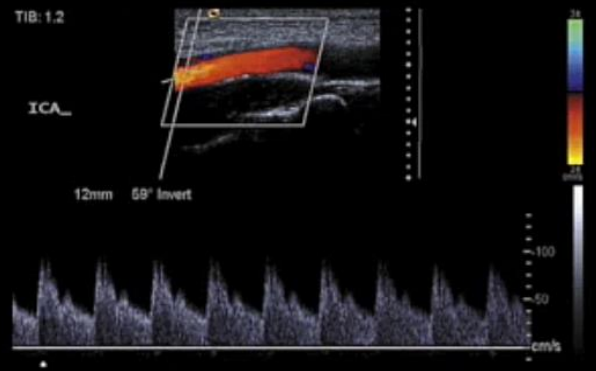
Right Proximal ICA

PSV 90 cm/s

Left Distal ICA



Right Distal ICA



ICA Stenosis

50 – 69%: PSV 125 – 230 cm/s, ICA/CCA PSV 2.0 – 4.0

>70%: **> 230 cm/s,** ICA/CCA > 4.0

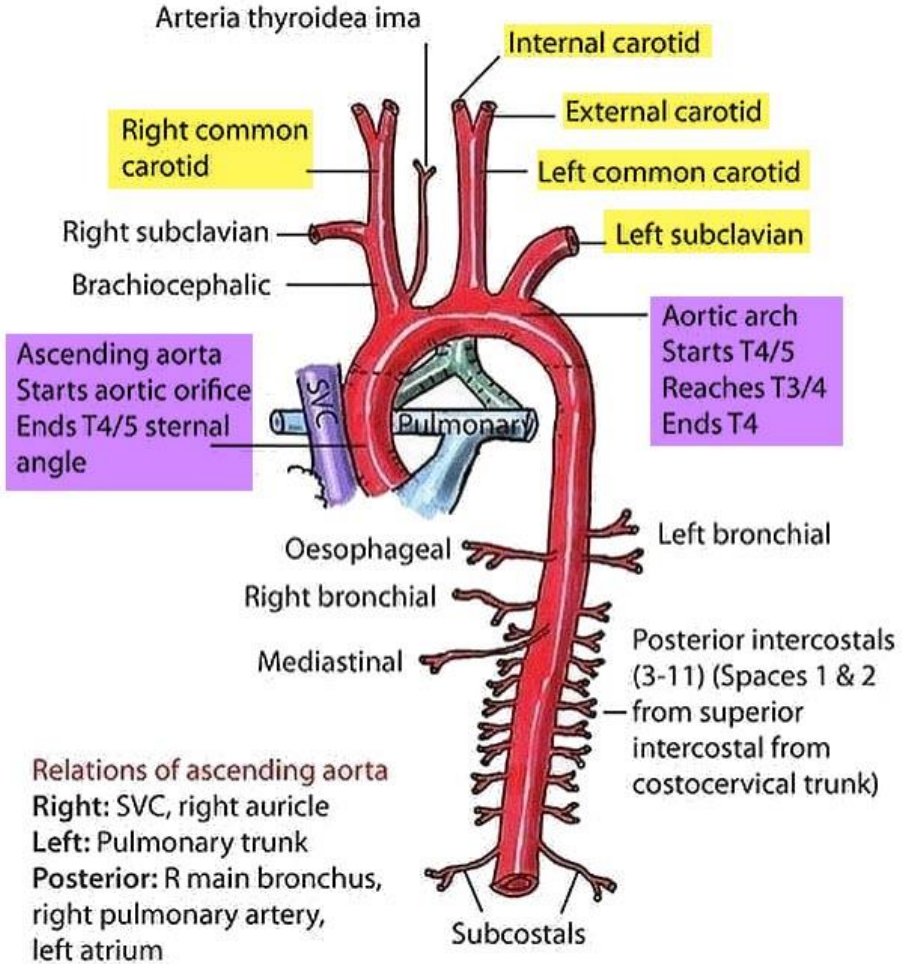
Occlusion: no flow

Other Clinical Situations

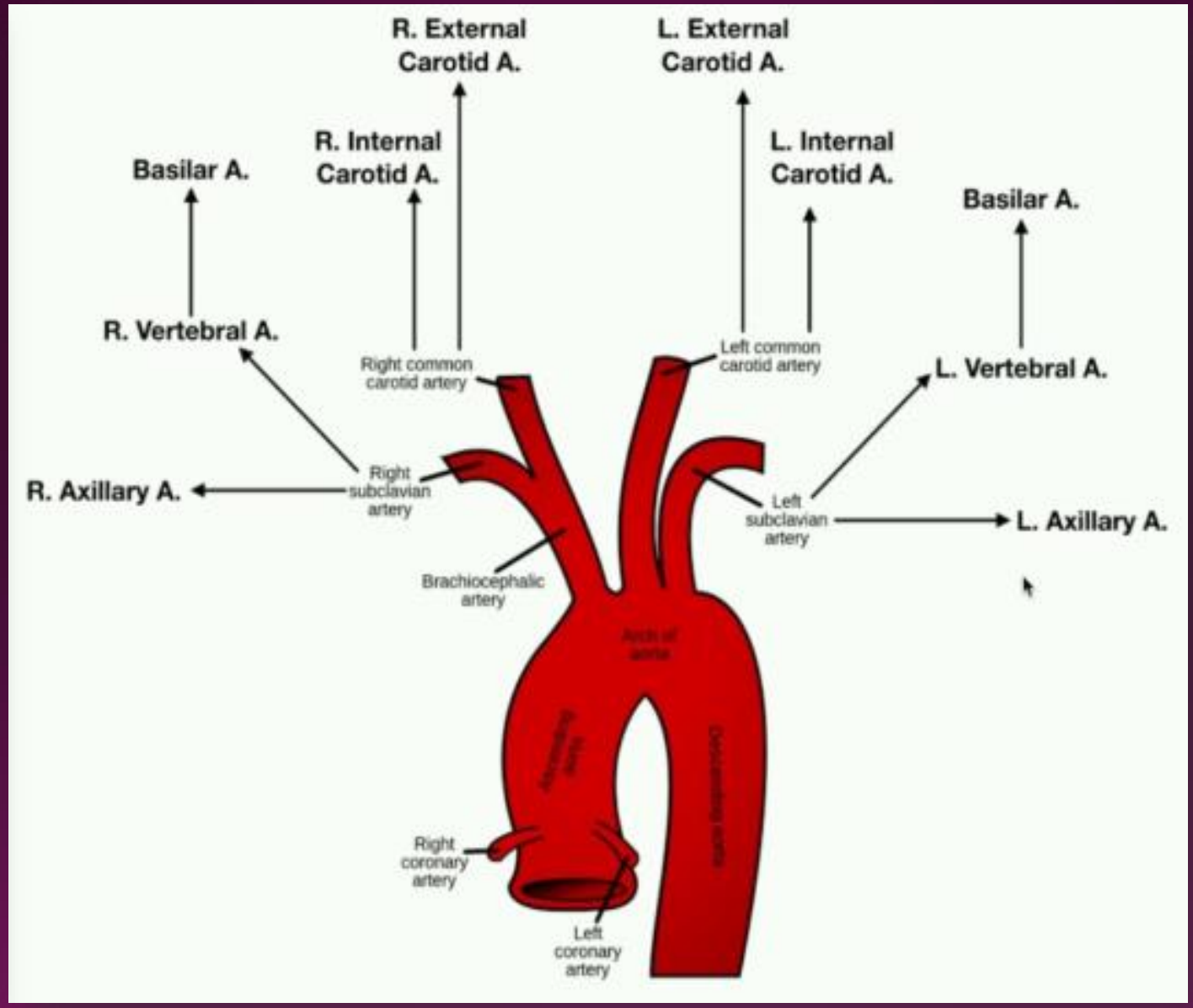
- Intracranial ICA stenosis
  - Only see upstream (high resistance)
- Aortic stenosis
  - Neck vessels all downstream
  - (tardus parvus in carotid and vertebral arteries)

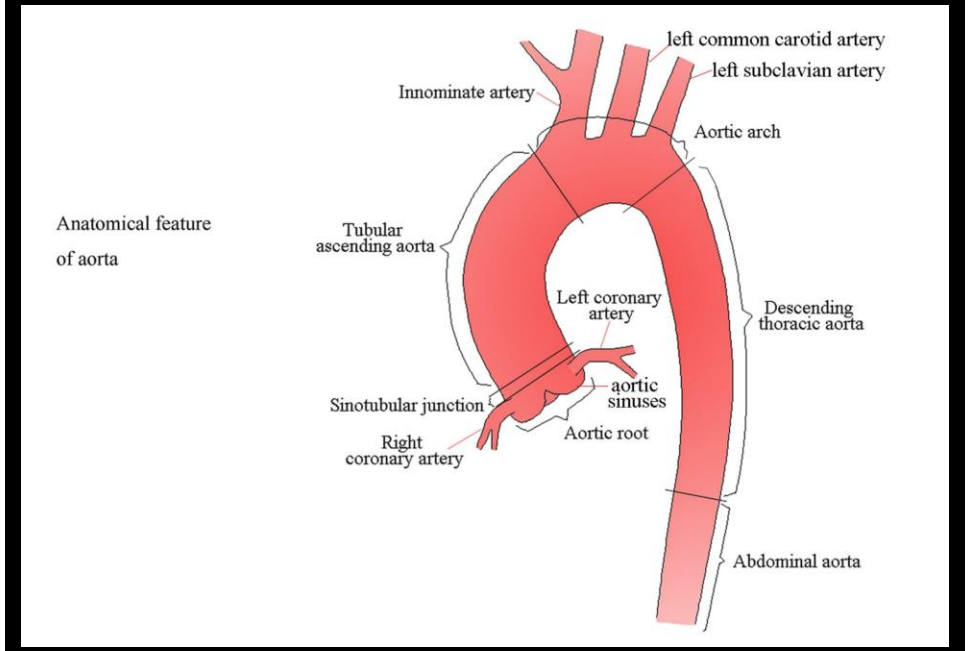
Other Clinical Situations

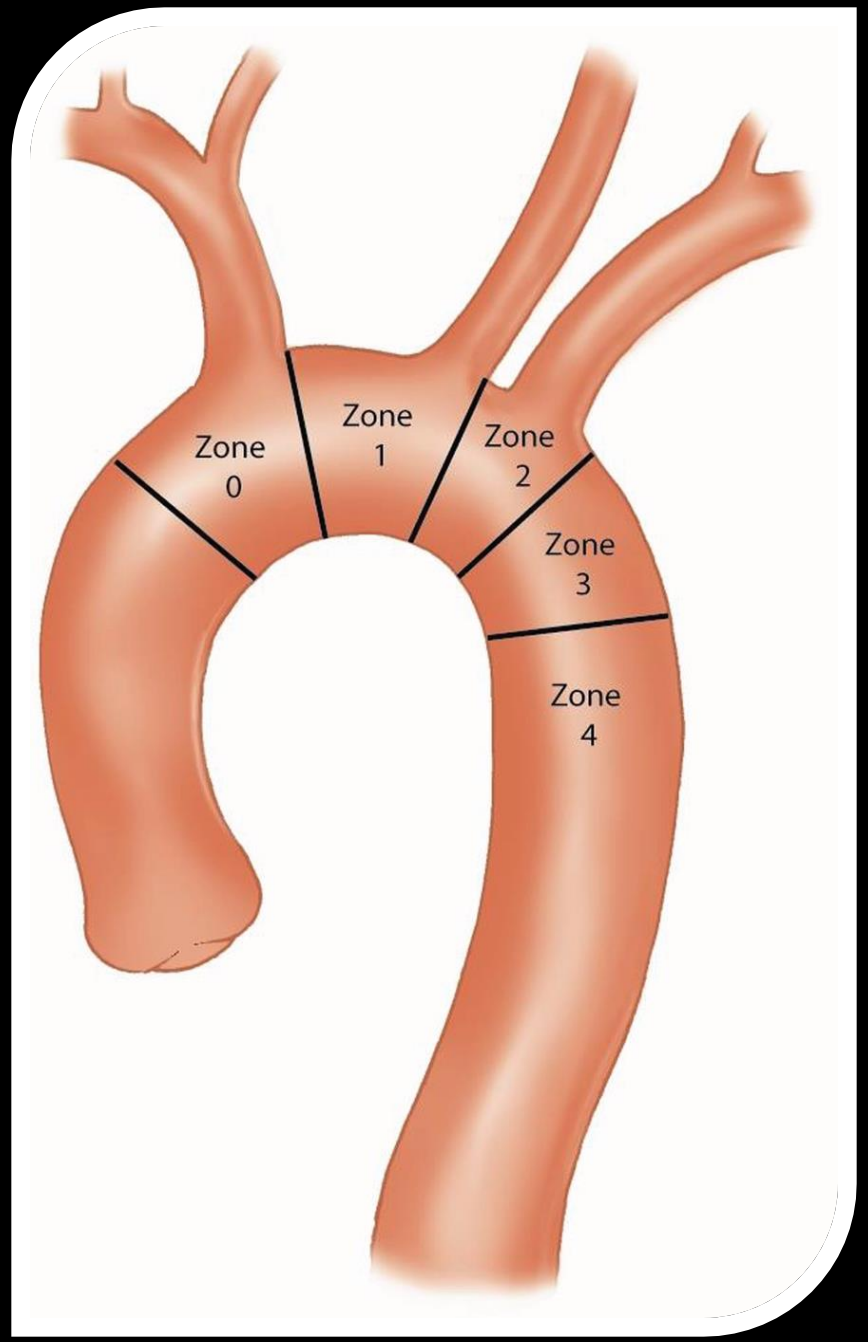
- Intracranial ICA stenosis
  - Only see upstream (high resistance) → in Neck ICA
- Aortic stenosis
  - Neck vessels all downstream
  - (tardus parvus in carotid and vertebral arteries) → In all branches of Aorta

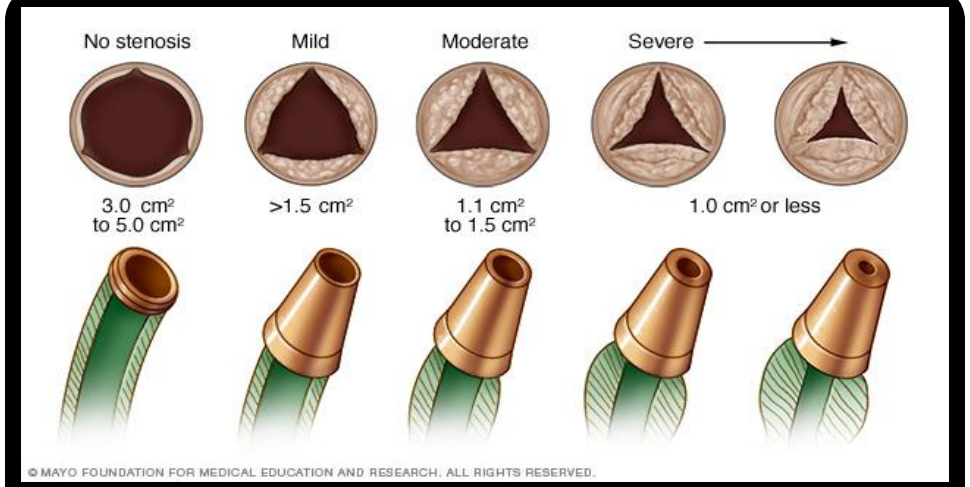


Relations of ascending aorta
Right: SVC, right auricle
Left: Pulmonary trunk
Posterior: R main bronchus, right pulmonary artery, left atrium
Anterior: Sternum, pulmonary trunk, infundibulum of right ventricle




Anatomical feature
of aorta
left common carotid artery
left subclavian artery
Innominate artery
Aortic arch
Tubular
ascending aorta
Left coronary
artery
Descending
thoracic aorta
aortic
sinuses
Sinotubular junction
Aortic root
Right
coronary artery
Abdominal aorta


Zone
0
Zone
1
Zone
2
Zone
3
Zone
4


No stenosis
Mild
Moderate
Severe
3.0 cm²
to 5.0 cm²
>1.5 cm²
1.1 cm²
to 1.5 cm²
1.0 cm² or less
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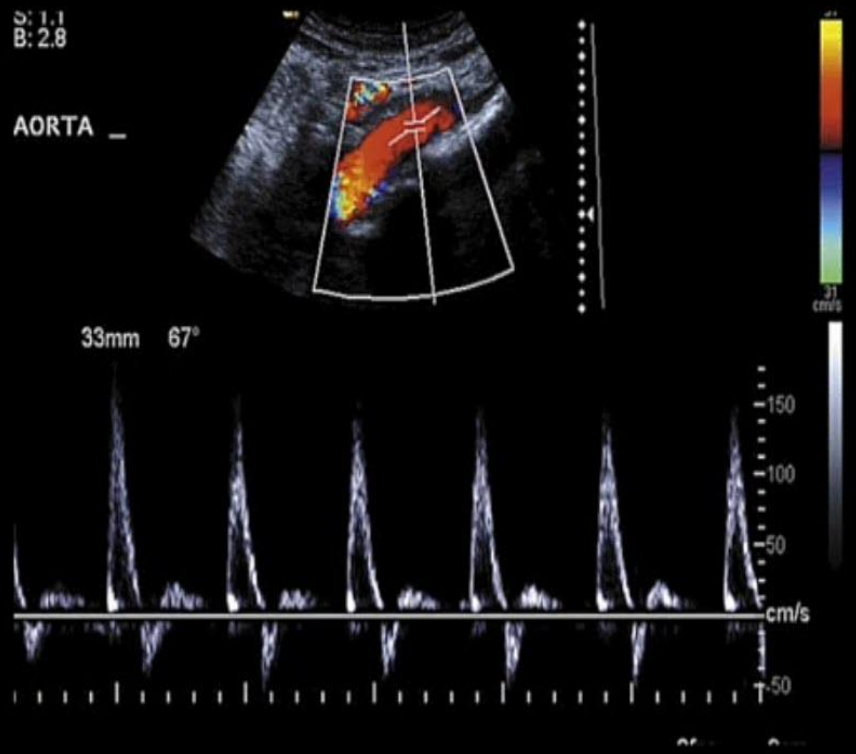
Abdominal Aorta

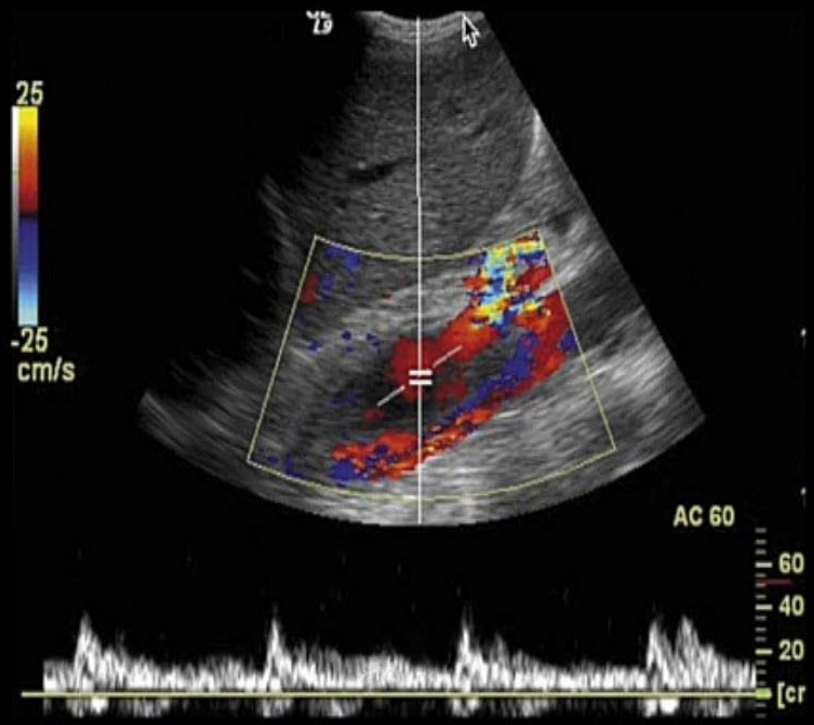
High R.
High V.
Thin spectrum

Normal



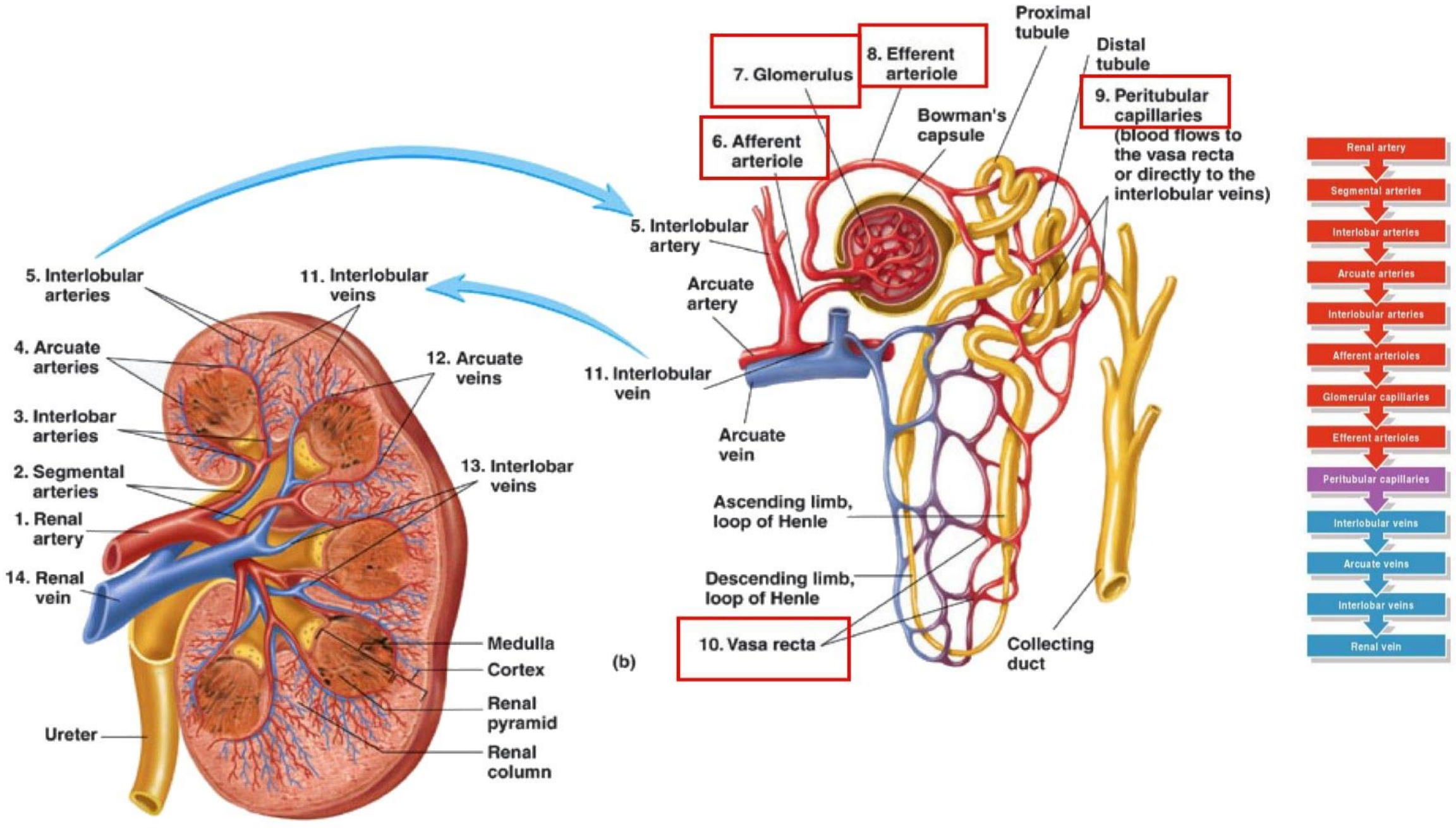
Low R.
Low V.
wide spectrum

Aneurysm



Renal Vasculature (i.e. Transplant)

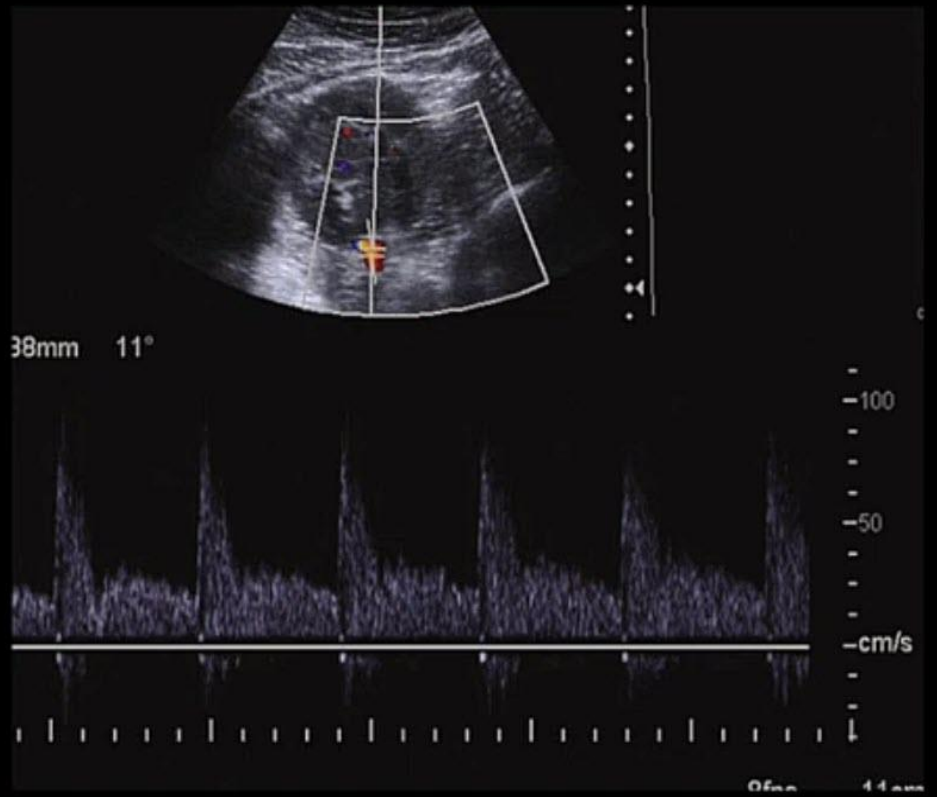
1. **Renal Artery** – detect stenosis
2. **Renal Vein** – detect thrombosis
3. *Kidney parenchymal abnormality (i.e. ATN, rejection)*
4. *Collecting system abnormality (i.e. hydronephrosis)*
5. *Peri-transplant collections*


5. Interlobular arteries
11. Interlobular veins
4. Arcuate arteries
12. Arcuate veins
3. Interlobar arteries
2. Segmental arteries
13. Interlobar veins
1. Renal artery
14. Renal vein
Medulla
Cortex
Renal pyramid
Ureter
Renal column
(b)
7. Glomerulus
8. Efferent arteriole
Proximal tubule
Distal tubule
9. Peritubular capillaries (blood flows to the vasa recta or directly to the interlobular veins)
Bowman's capsule
6. Afferent arteriole
5. Interlobular artery
Arcuate artery
11. Interlobular vein
Arcuate vein
Ascending limb, loop of Henle
Descending limb, loop of Henle
10. Vasa recta
Collecting duct
Renal artery
Segmental arteries
Interlobar arteries
Arcuate arteries
Interlobular arteries
Afferent arterioles
Glomerular capillaries
Efferent arterioles
Peritubular capillaries
Interlobular veins
Arcuate veins
Interlobar veins
Renal vein

Renal Artery

Low R. Bl.v.

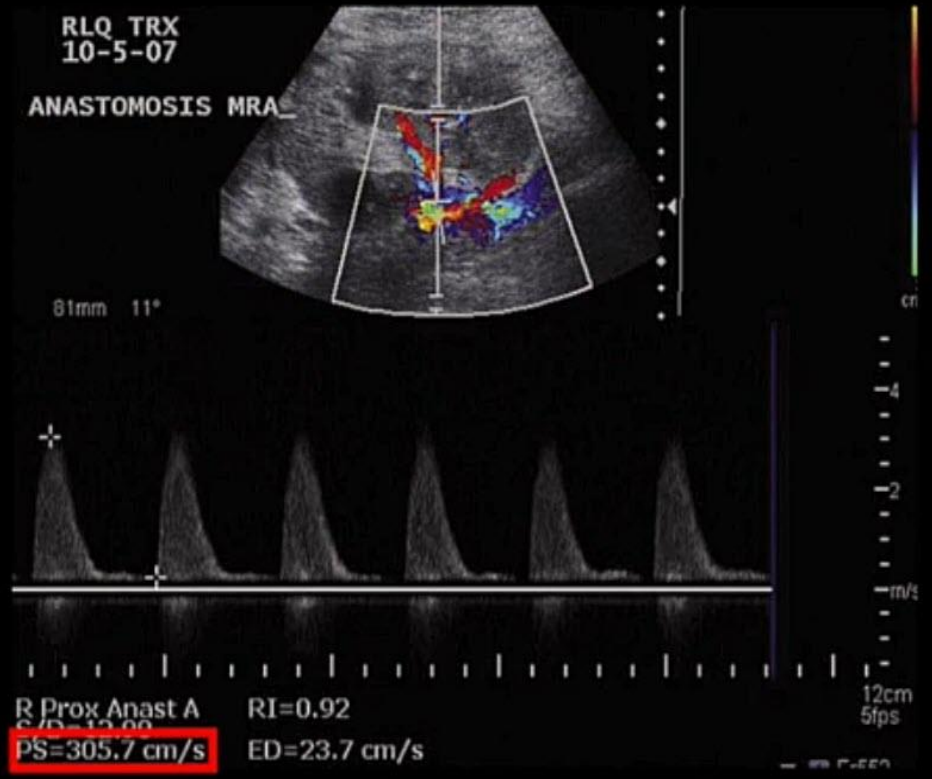
Normal



PSV < 200 cm/s

Stenosis

High R. Bl.v.

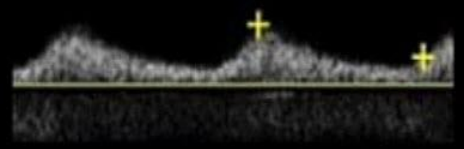


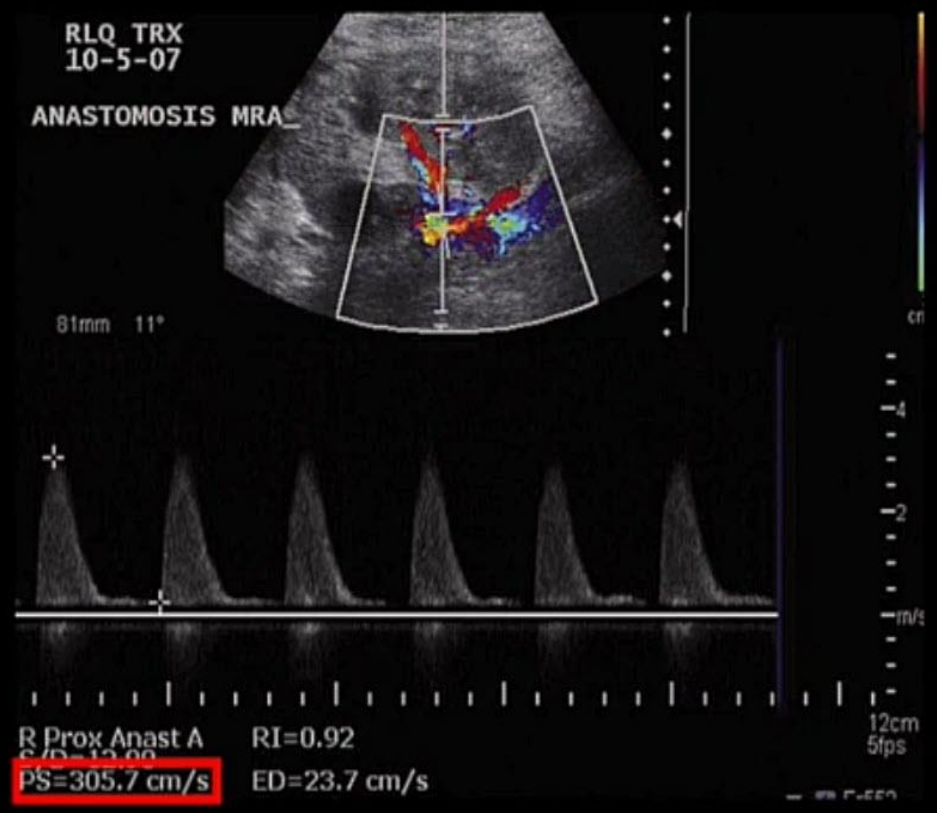
PSV = 305.7 cm/s

Renal Artery Stenosis

- **PSV > 200 cm/s** (at stenosis, usually at anastomosis)

- Tardus Parvus downstream
  - Usually assess 'arcuate artery' waveforms in upper, inter, and lower pole in post-transplant evaluation

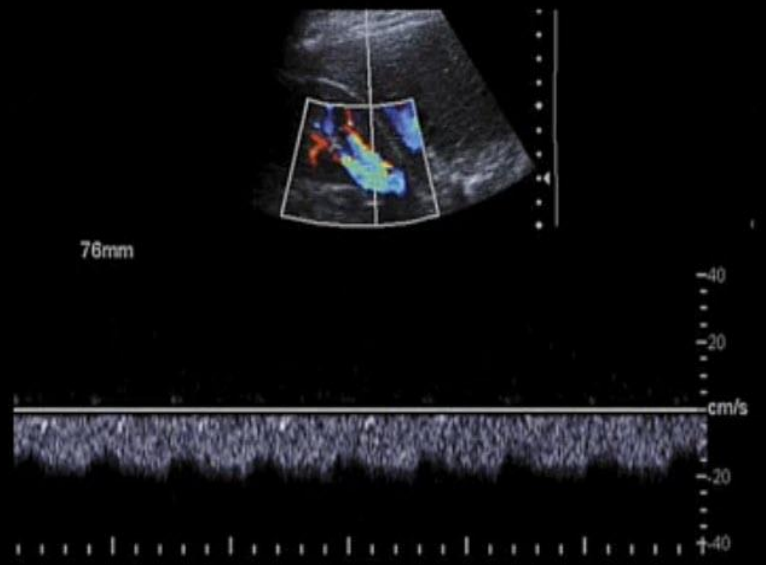




PSV = 305.7 cm/s

Renal Vein

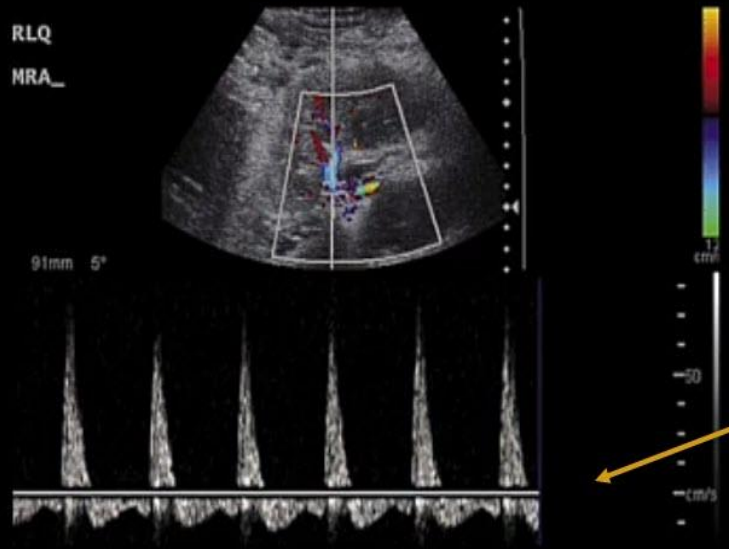
Normal



The flow is negative = away from T.

Thrombosis

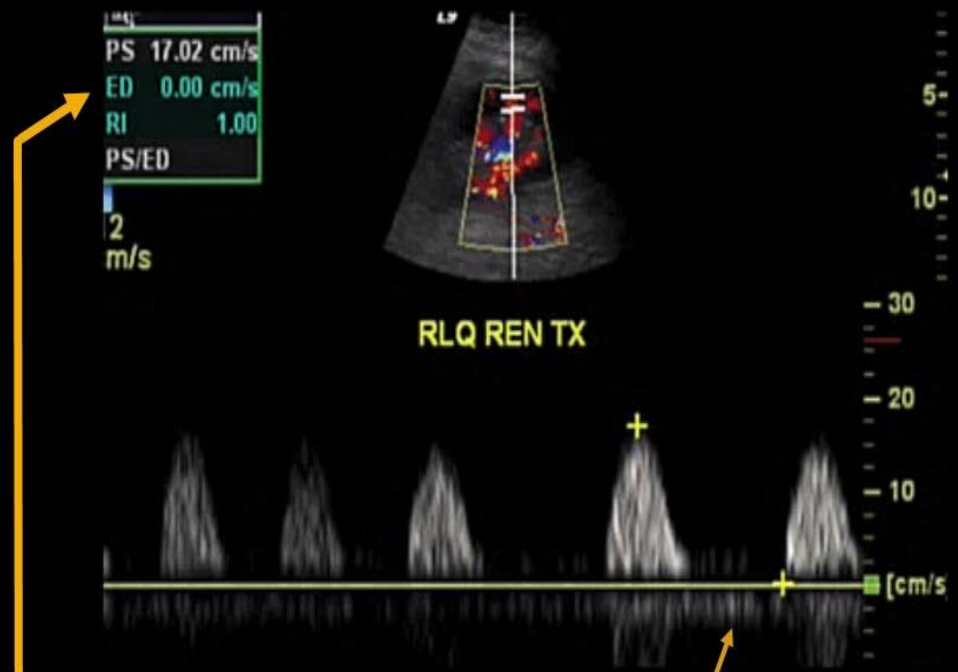
1. No Renal Vein flow detected
2. **Renal artery** high resistance (reversed end diastolic flow) → Very High R.



high V. with Reverse Flow

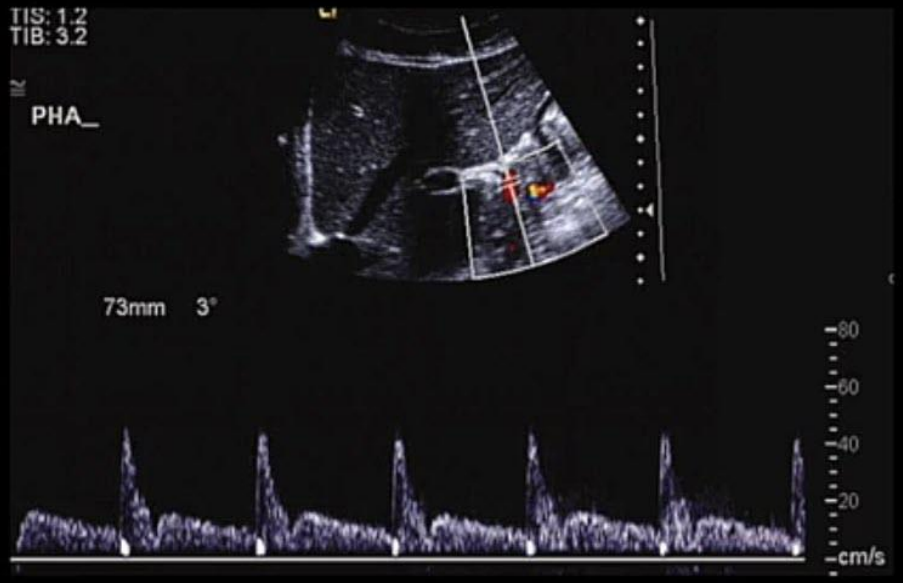
ATN / Rejection / Toxicity: High renal RIs

1. Assess upper, inter, and lower pole **intra-renal 'arcuate artery'** RIs
2. Normal 0.5 – 0.7
3. **RI > 0.8** associated with renal dysfunction (native kidneys, transplant)



Hepatic Artery

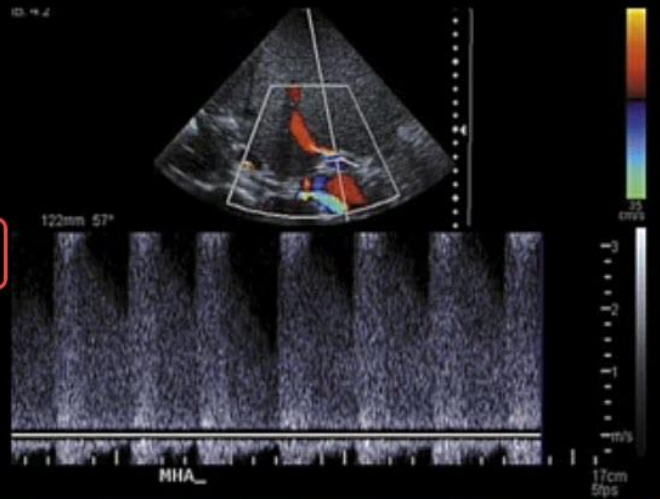
Normal



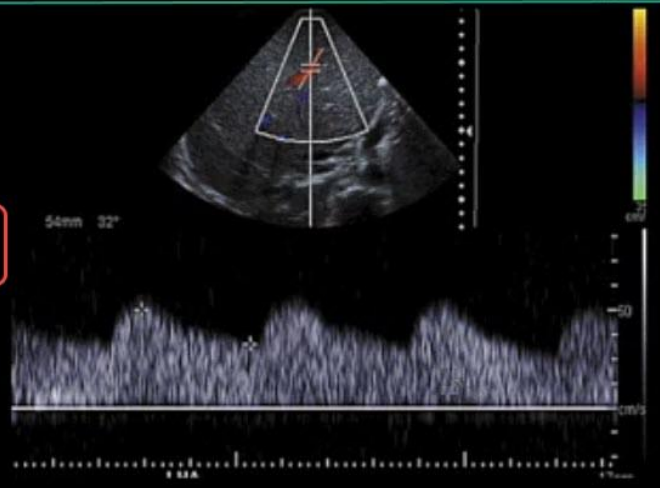
Low R. with Forward (+) flow

Stenosis

At stenosis

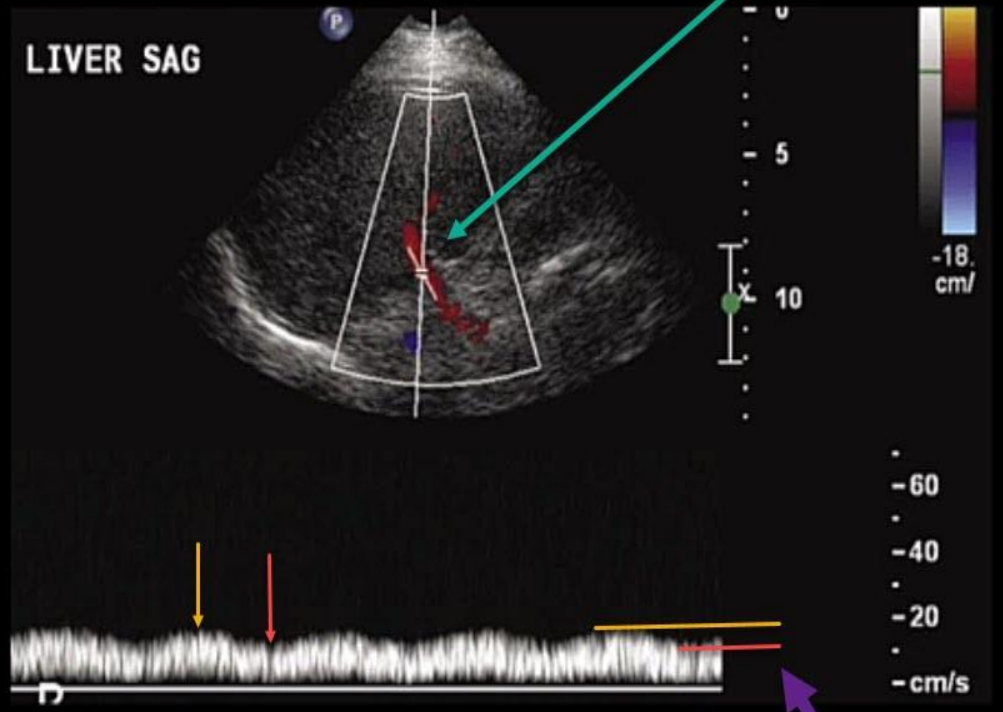


Distal (LHA)



T.P Flow

Normal Portal Vein



1. **Continuous hepatopetal** flow (towards liver) → Foreword (+) Flow
2. Velocity ≈ 16 – 31 cm / s
3. **Biphasic** (slight variability)
   - Variability < 15 cm / s

Portal Vein

Abnormal

1. Any reversal of flow
2. Slow flow (< 16 cm/s)
3. **Pulsatile** flow
   - Variability > 15 cm / s
4. Absent

Normal

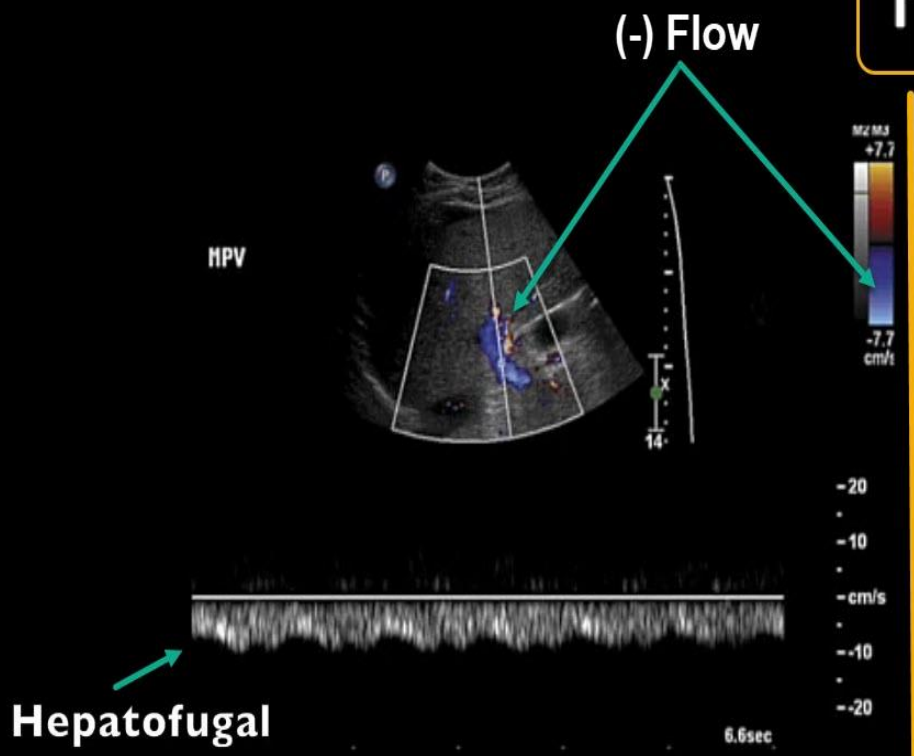
1. **Continuous hepatopetal** flow (towards liver)
2. Velocity ≈ 16 – 31 cm / s
3. Biphasic (slight variability)
   - Variability < 15 cm / s

Abnormal Portal Vein

Abnormal

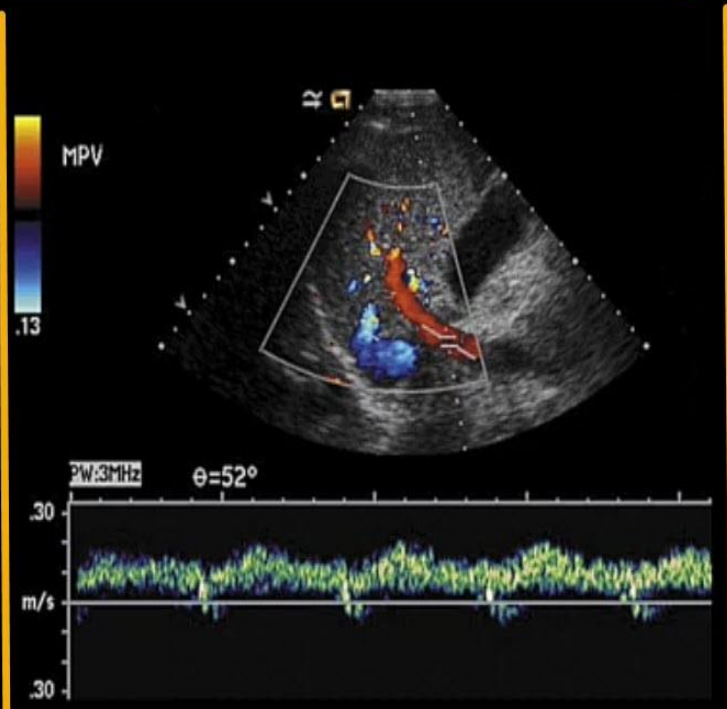
- Any reversal of flow → **Portal Hypertension**
- Slow flow (< 16 cm/s) → **Portal Hypertension**
- **Pulsatile** flow
  - Variability < 15 cm / s →
    1. **Tricuspid regurgitation**
    2. **Right CHF**
    3. Cirrhosis with arterioportal shunting
    4. AVM (rare)
- Absent →
  1. **Portal Hypertension (very slow flow)**
  2. **Thrombosis (bland)**
  3. **Thrombosis (tumor)**

Portal Vein Cases



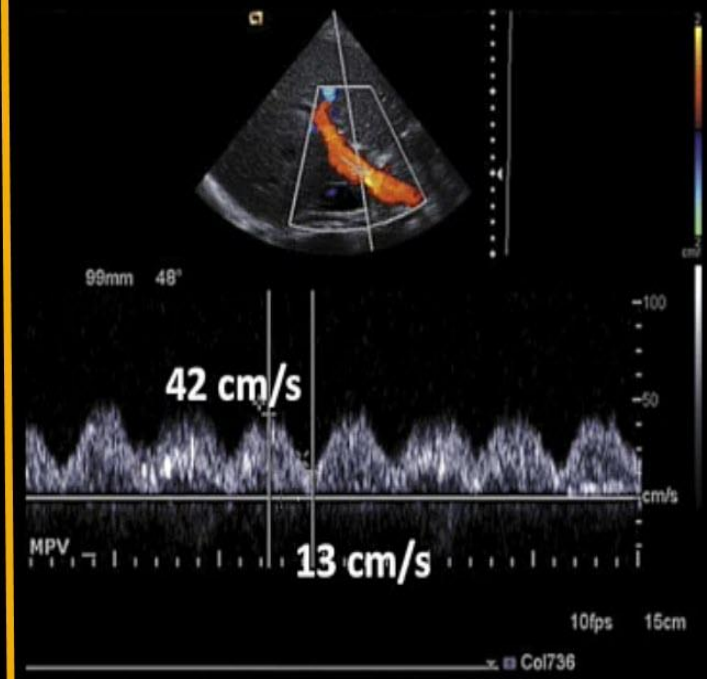
Portal Hypertension

Moderate / Severe



Portal Hypertension

Mild



Cardiac cause (Tricuspid Regurg)

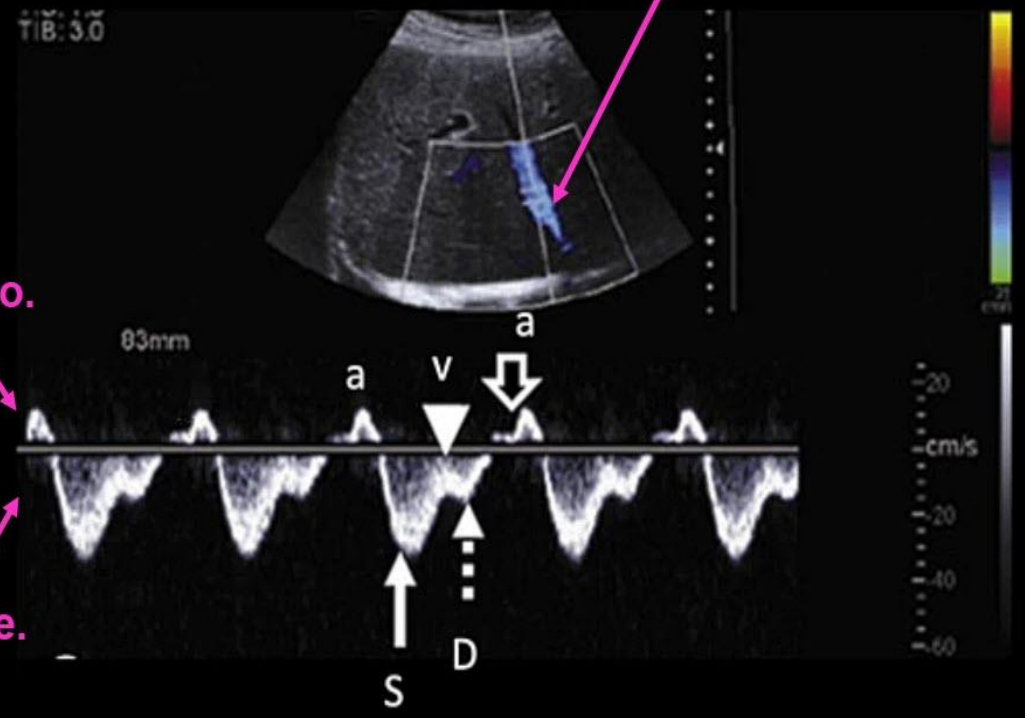
Variability = ?

What is the cause of Variability?

Normal Hepatic Vein

Retrograde means away from heart
Antegrade means towards the heart
they are not related to (+ or -) flow

Hepatic vein Normally away from T. (-) flow



(+) retro.

(-) ante.

a,v → Retrograde
S,D → Antegrade

V= Valve open

A **Predominantly Antegrade (below the baseline)** → towards the heart

B **Multiphasic**

C Two large antegrade waves (systolic, diastolic)

D Two smaller retrograde (atrial kick, atrial overfilling)

S

D

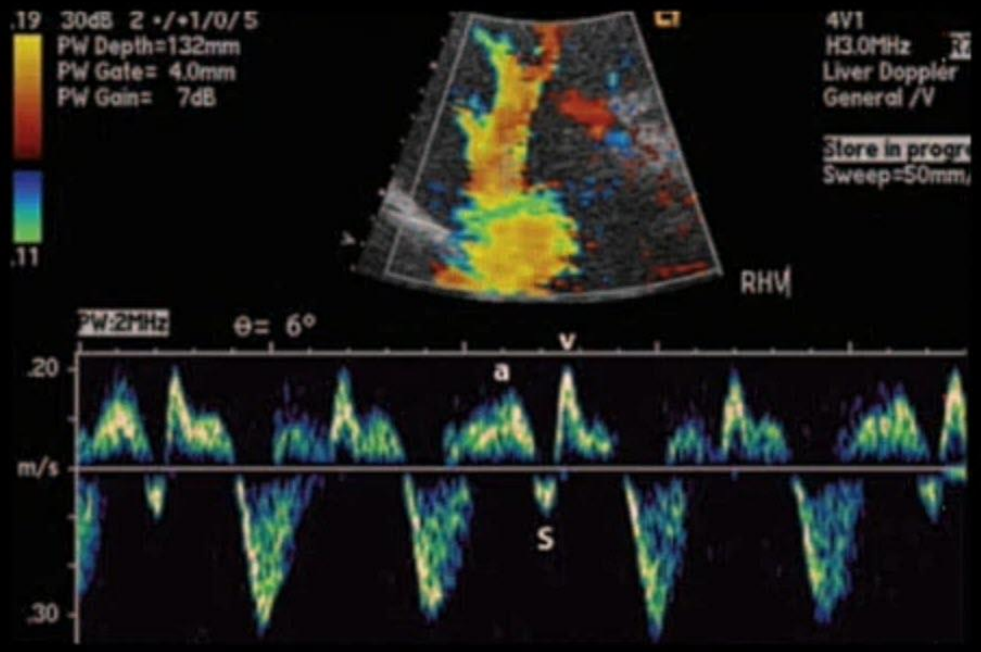
a

v

A differ than V → Its Larger and wider

Abnormal Pulsatility

- Increased antegrade and retrograde peaks (big fluctuations)



1) Increased Pulsatility

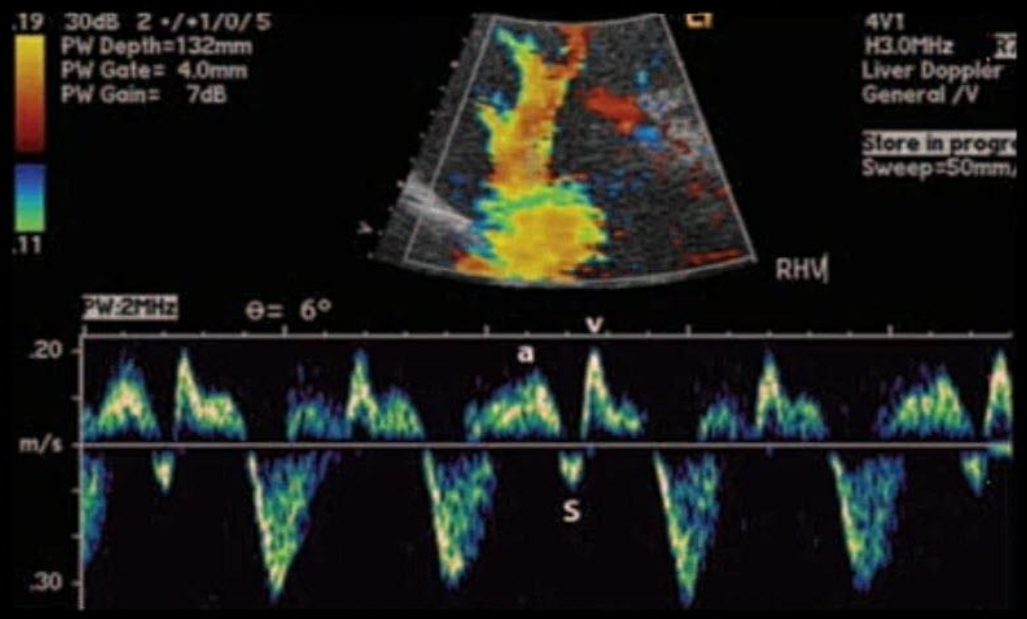
2) Decreased Pulsatility

3) Absent

1 Increased Pulsatility

- Increased antegrade and retrograde peaks (big fluctuations)

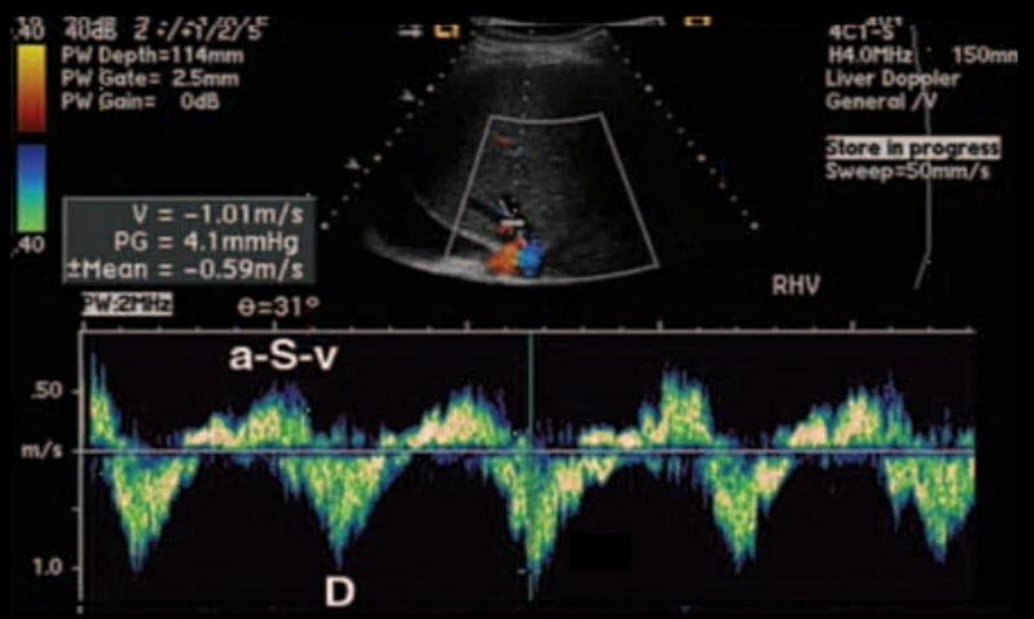
Tricuspid Regurgitation



Decreased S wave

a and v waves upwards (retrograde)
S wave still (antegrade) but decreased

Severe Tricuspid Regurgitation



reversed S wave

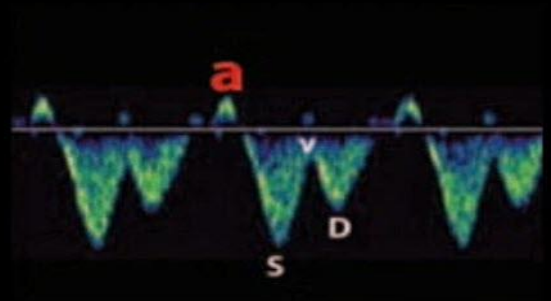
a-S-v waves upwards (retrograde)

2 Decreased Phasicity/Pulsatility

Hepatic Vein Compression

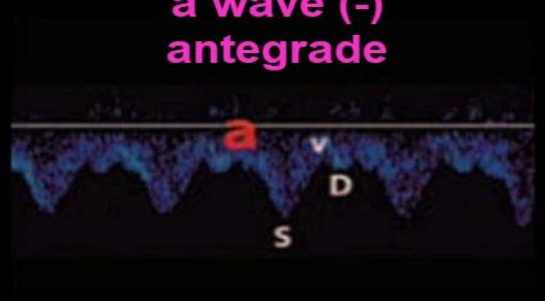
- Cirrhosis (by far most common)
- Hepatic vein thrombosis (Budd Chiari)

If a wave (-) this is completely abnormal while v wave could be(-) normally



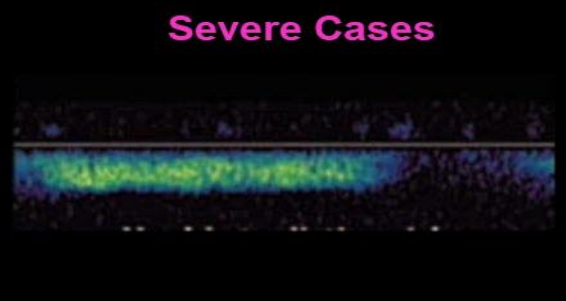
Normal

a wave (-)
antegrade



Decreased

Severe Cases



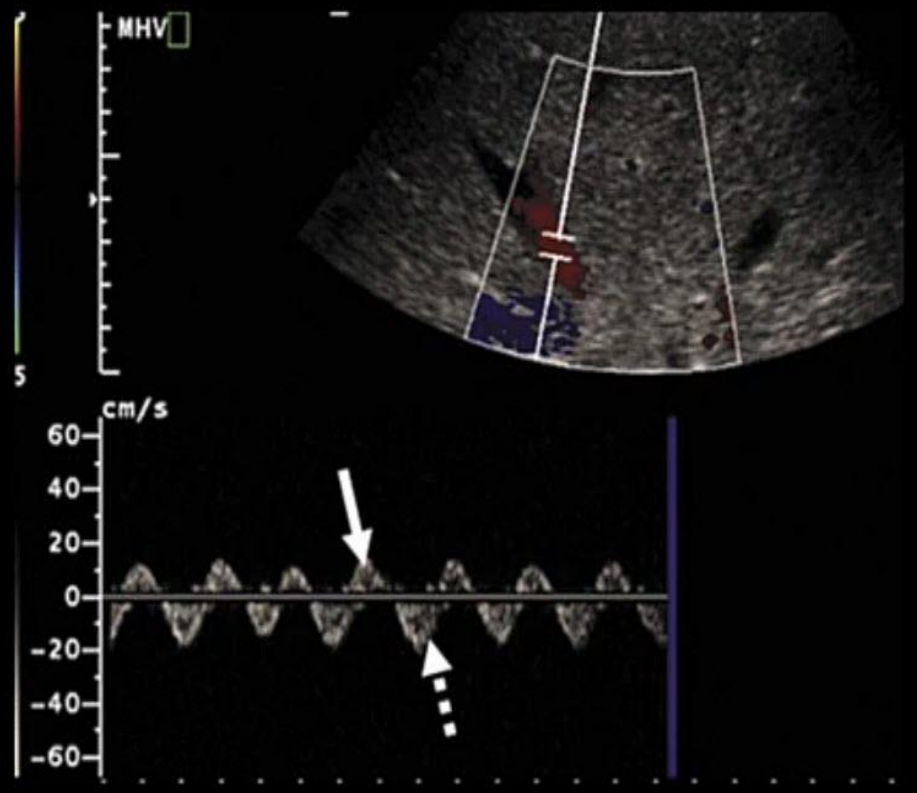
Nonphasic

3 Absent Hepatic Venous Flow

Venous outflow obstruction (i.e. Budd Chiari/thrombosis)

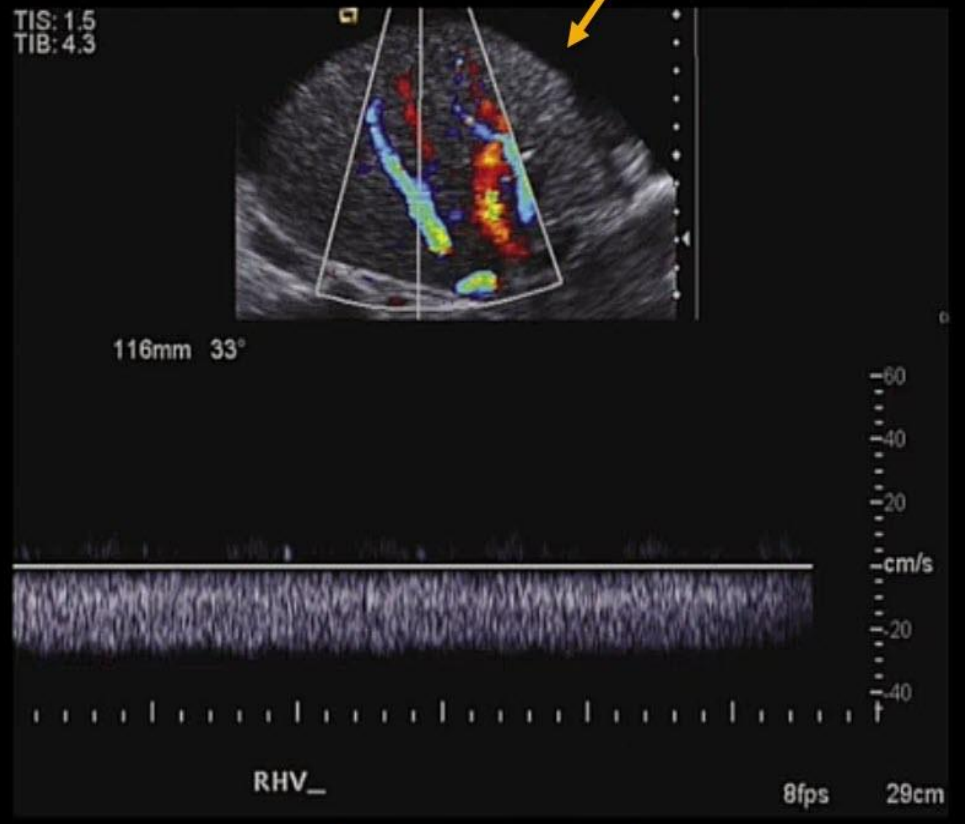
Abnormal Hepatic Vein

1 Case 1



Tricuspid Regurgitation

2 Case 2



Cirrhosis


THANK YOU
LISTENING TO
OUR
MEDICAL SESSION