

Abd Renal  
C5-1  
9Hz 30°  
Z 1.4  
2D  
60%  
Dyn R 48  
P Med  
HGen  
58%  
1169Hz  
VE 64Hz  
48%  
40Hz  
7.5cm

TIS0.6 MI 0.6

M3 M7  
+18.0

+ R Hilar A  
PSV 36.6 cm/s  
EDV 11.5 cm/s  
RI 0.68



-18.0  
cm/s

# Practical Considerations for Renal Artery Duplex Scanning

-60

KOURTNEY SPENCER BS, RVT  
VASCULAR LAB  
UC DAVIS HEALTH



PRACTICAL  
CONSIDERATIONS  
FOR RENAL ARTERY  
DUPLEX SCANNING

# No Disclosures



# Practical Considerations

---



Practical aspects involve **real situations and events**, rather than just ideas and theories.



**PRACTICAL**

**THEORY**





## THEORETICAL KNOWLEDGE

Tells why and how the established practice came into existence

If you do not have the theoretical knowledge of the concepts, then you cannot successfully conduct any practical concepts

Creates a deeper understanding of the concepts.

Is without any doubt a 'must'

**Understand the foundational principles**

## PRACTICAL KNOWLEDGE

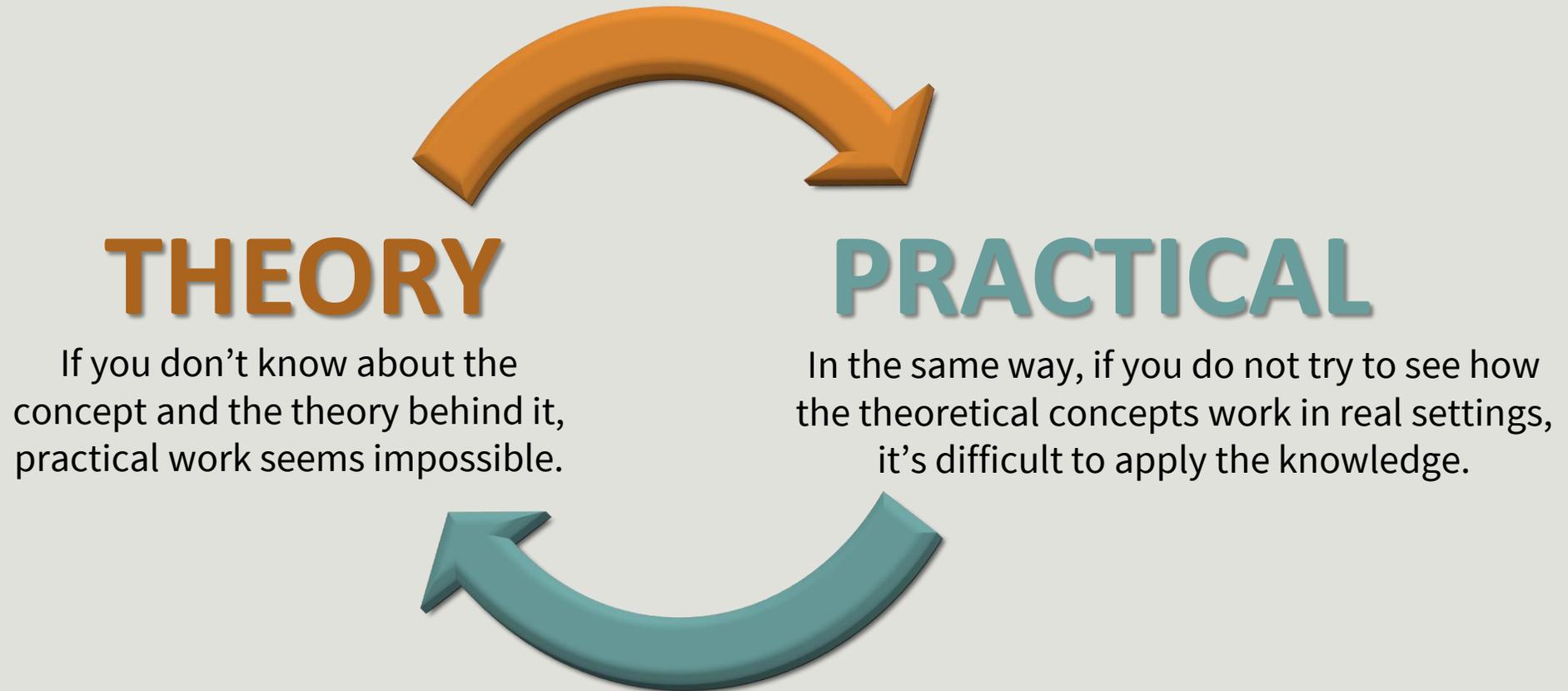


Difficult to apply the read concepts and theories until you try physically doing them on your own

Deeper understanding of the challenges in a way that demonstrates a sensible and practical idea of what can be achieved or expected

Accurate and true to life

**Ability to apply the foundational principles in many settings**

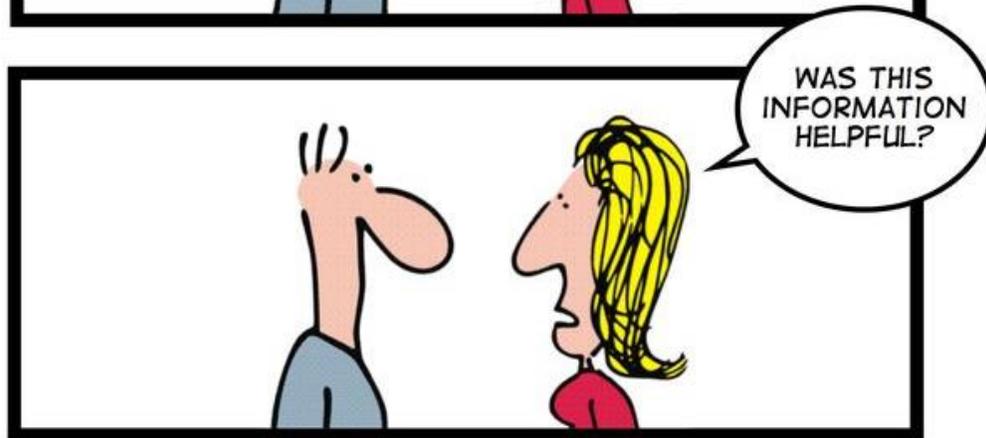
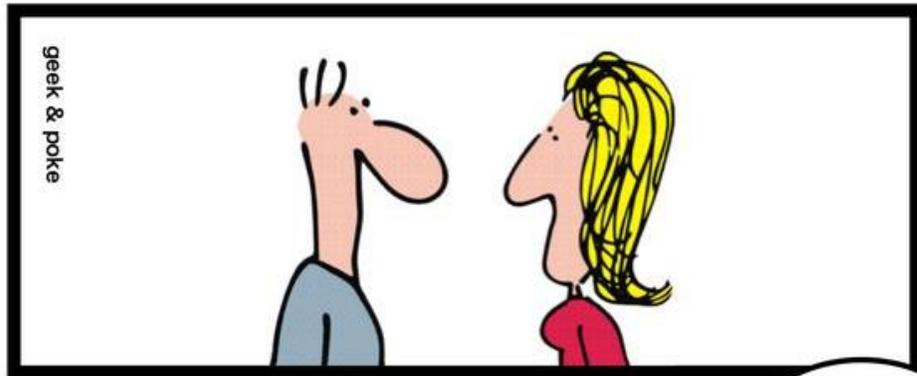
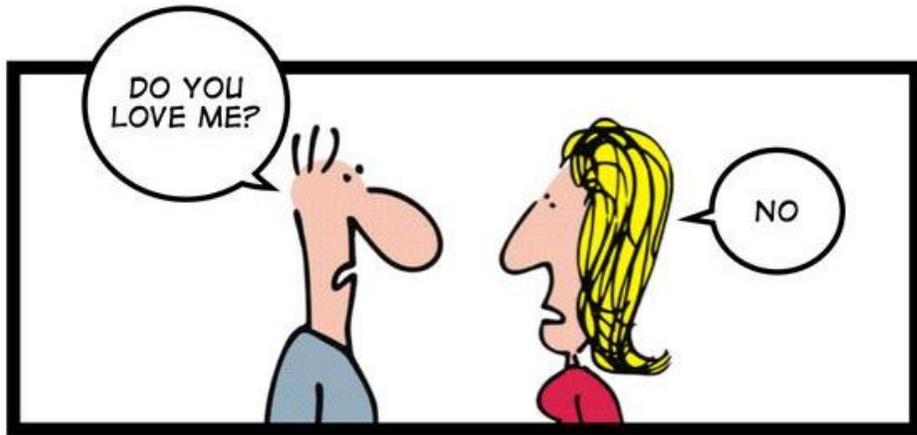


Both are important for the overall understanding of the concepts, go hand in hand  
Without both we lack substantial learning and leads to surface level understanding

# Objectives

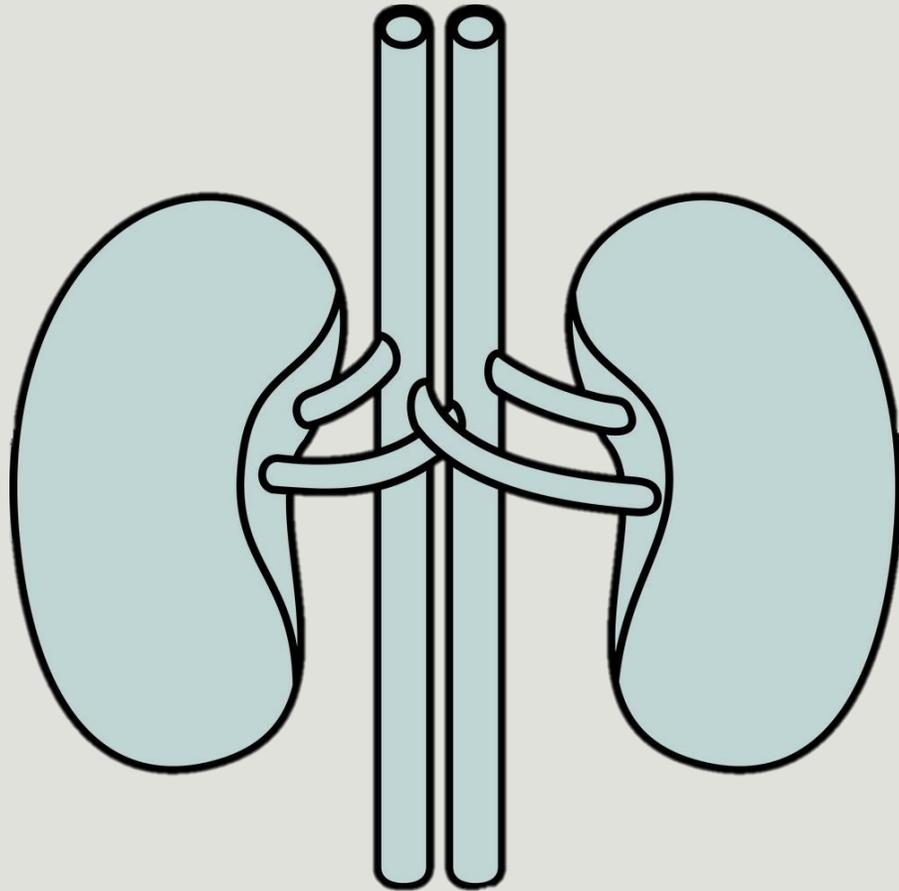
---

1. How is Duplex Imaging helpful?
2. Pitfalls of Duplex Imaging
3. Renal Duplex- Theoretical vs. Practical Images
4. Indirect Findings for Final Impression



# Is Duplex Imaging helpful?

---



## Renal Artery Duplex

---

- Renal Patency
- Identification of initial RAS
- Follow up Disease Progression
- Routine post-endovascular & graft surveillance
- FMD
- Increased Resistive Index (Parenchymal Disease)
- Renal vein thrombosis

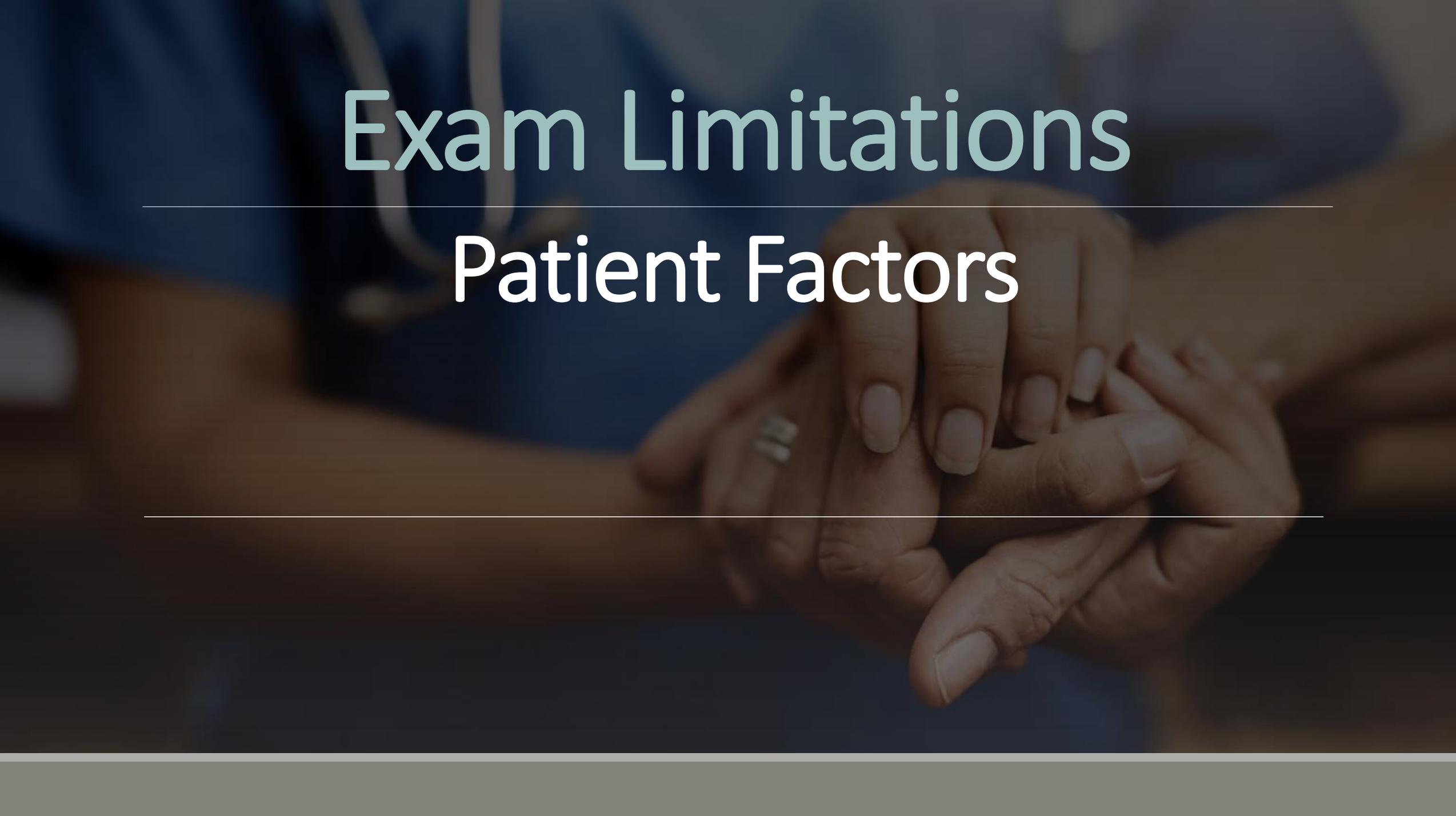


# Renal Duplex Utilization

---

## Preferred Modality

- Inexpensive
- Portable
- Non-invasive, no contrast
- Arteries & Veins
- Instant results at bedside



# Exam Limitations

---

## Patient Factors

---



# Theoretical Patient

---



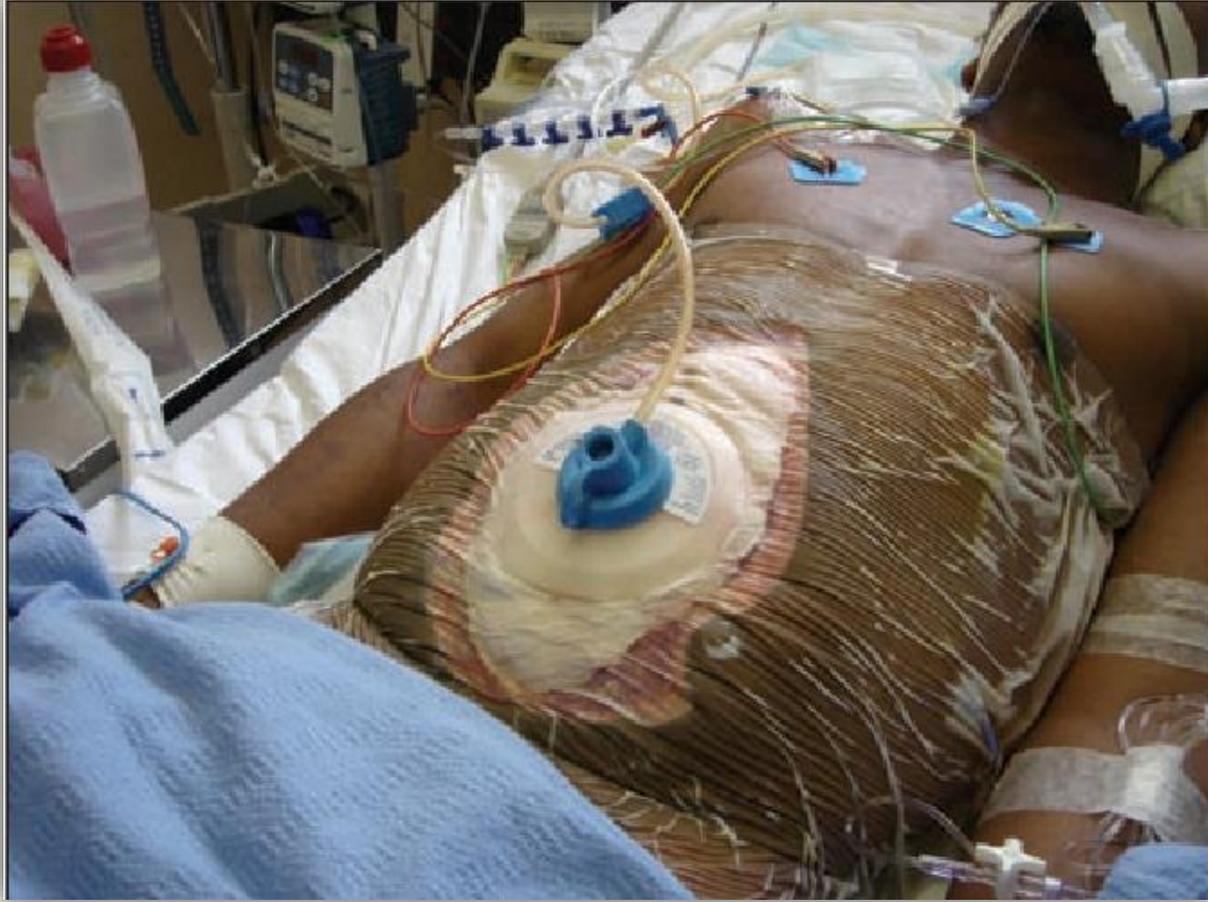
# Practical Patient

---

# Patient Factors

- NPO status
- BMI
- Heavy Respirations
- Breath Holding





# Patient Factors

---

- Abdominal Surgery
- Ability to position  
(turn on side)
- Cooperativeness
- Isolation Status/Precautions

# Exam Limitations

---

## Facility Factors

---



**EXPERIENCE**



# Facility Factors

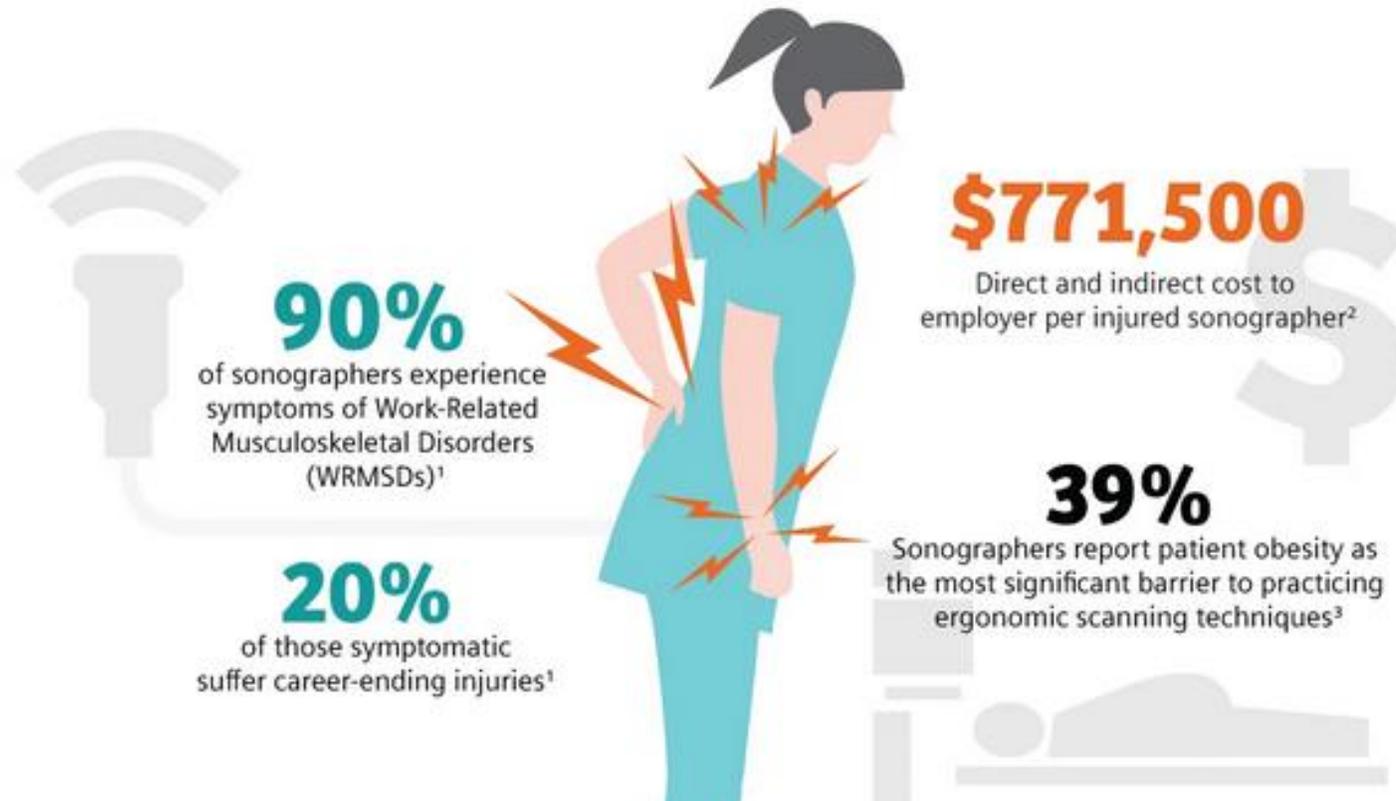
---

- Tech experience
- Equipment
- Inpatient vs. outpatient
- Time Constraints

# Why Reducing Transducer Pressure is a Key to Preventing Sonographer Injury

NOVEMBER 12, 2020

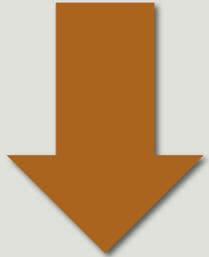
## Sonographers Are in Pain



High Frequency Transducer



Good Image Quality



Low Penetration



Low Frequency Transducer



High Penetration/  
More depth



Sacrifice Image Quality

**“IT’S NOT ALWAYS RAINBOWS  
AND BUTTERFLIES, IT’S COMPROMISE  
THAT MOVES US ALONG.”**

MAROON 5, SHE WILL BE LOVED

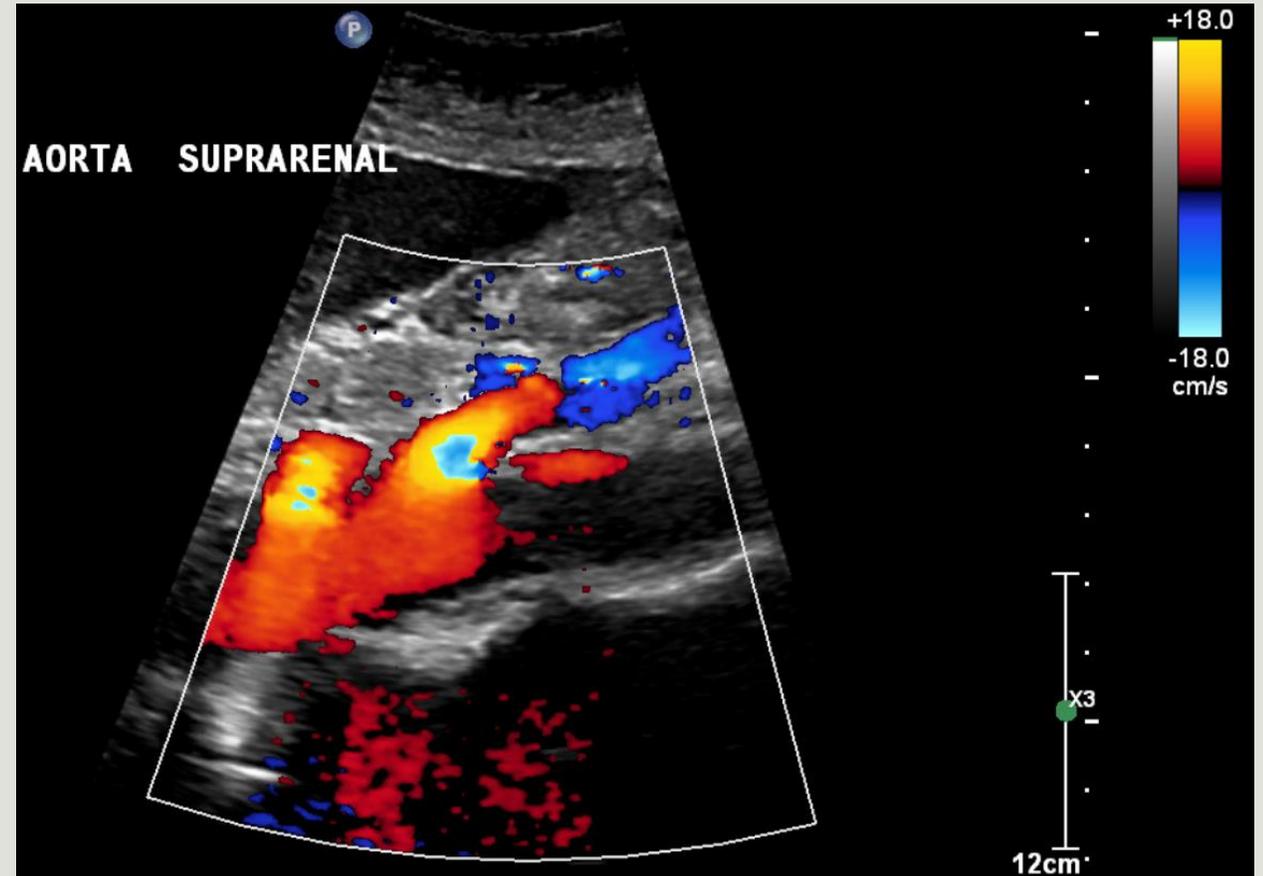
# Objectives

---

1. How is Duplex Imaging helpful?
2. Pitfalls of Duplex Imaging
3. Renal Duplex- Theoretical vs. Practical Images
4. Indirect Findings for Final Impression



# Theoretical Suprarenal Aorta

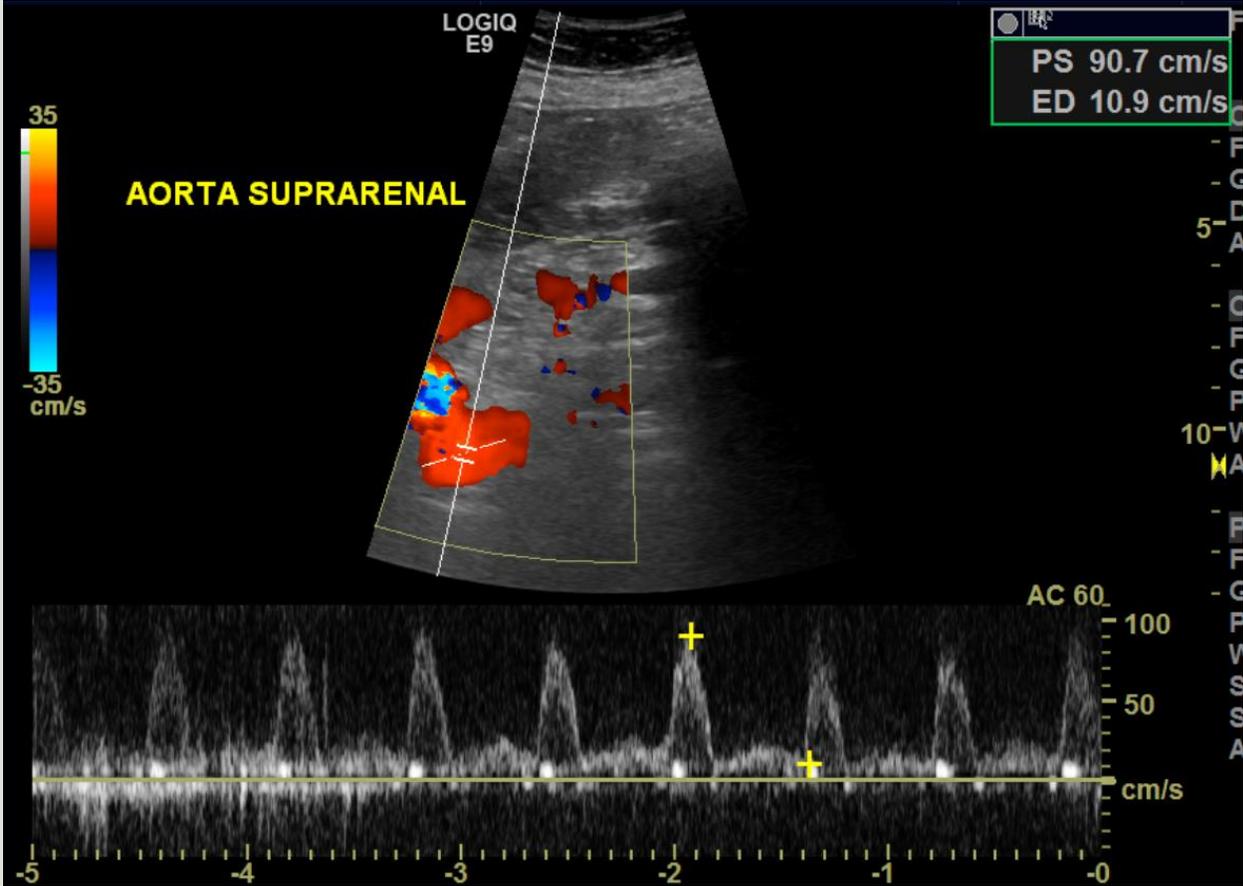
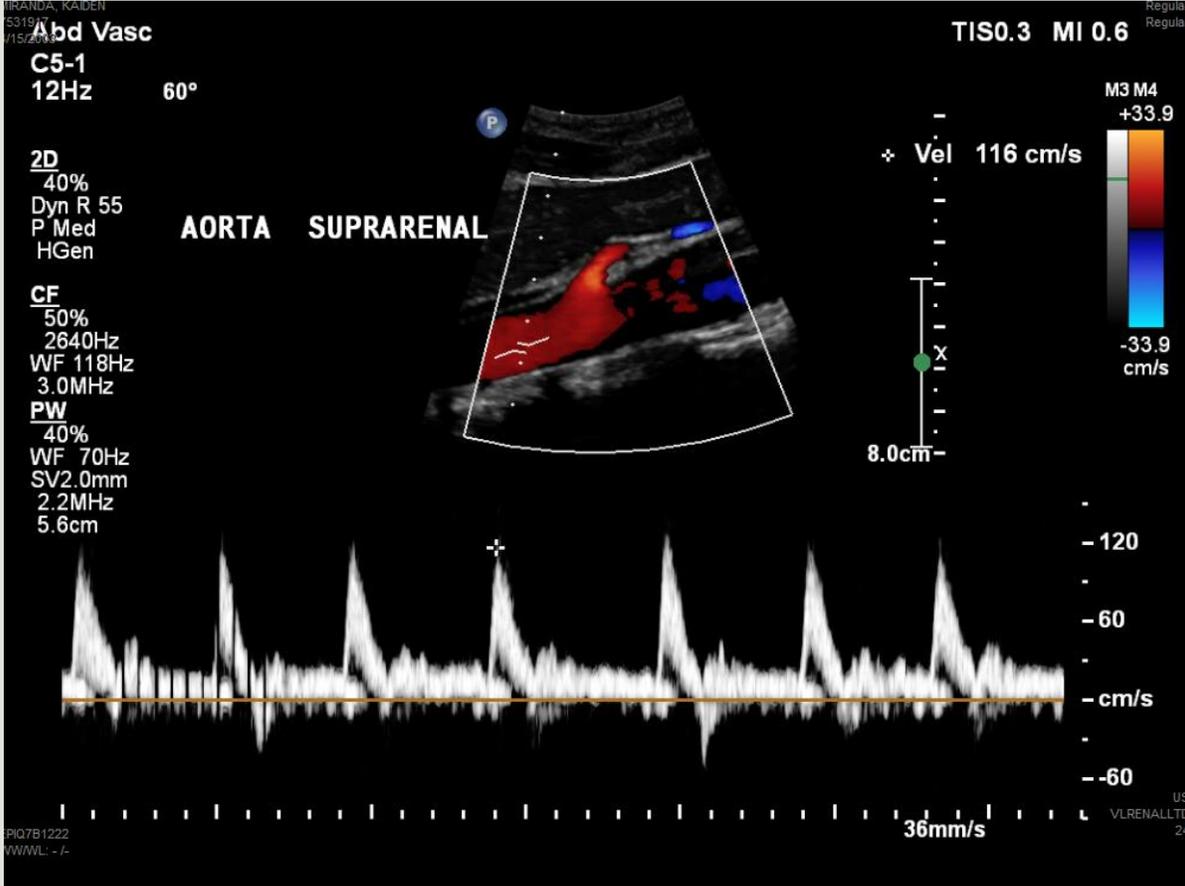


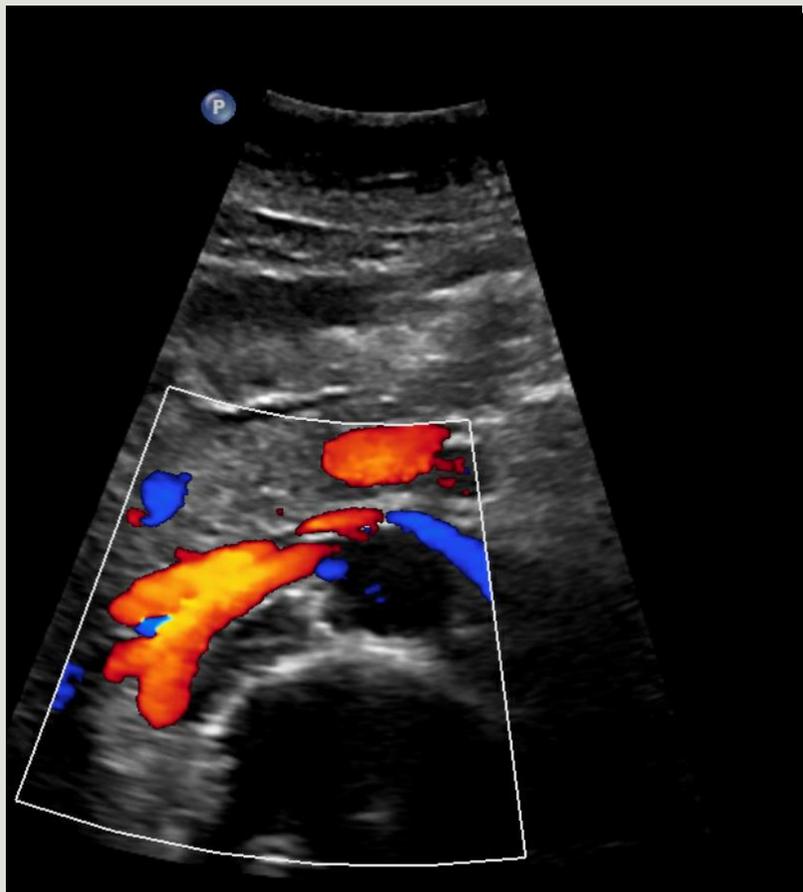
# Suprarenal Aorta



## THEORETICAL

## PRACTICAL

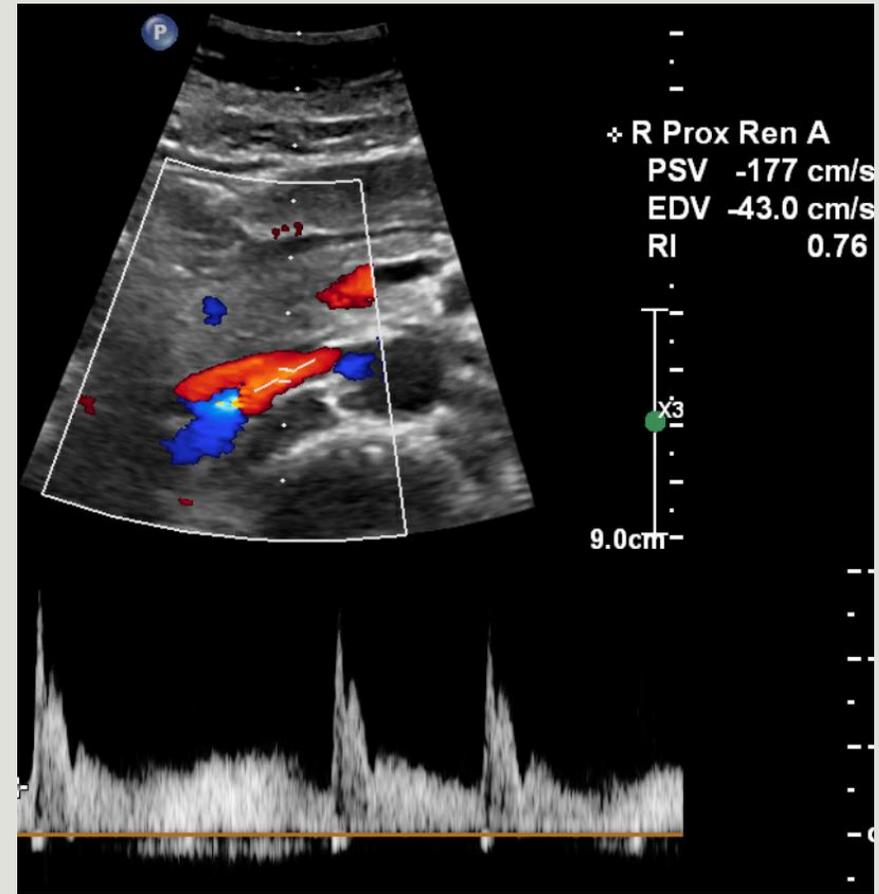




Color



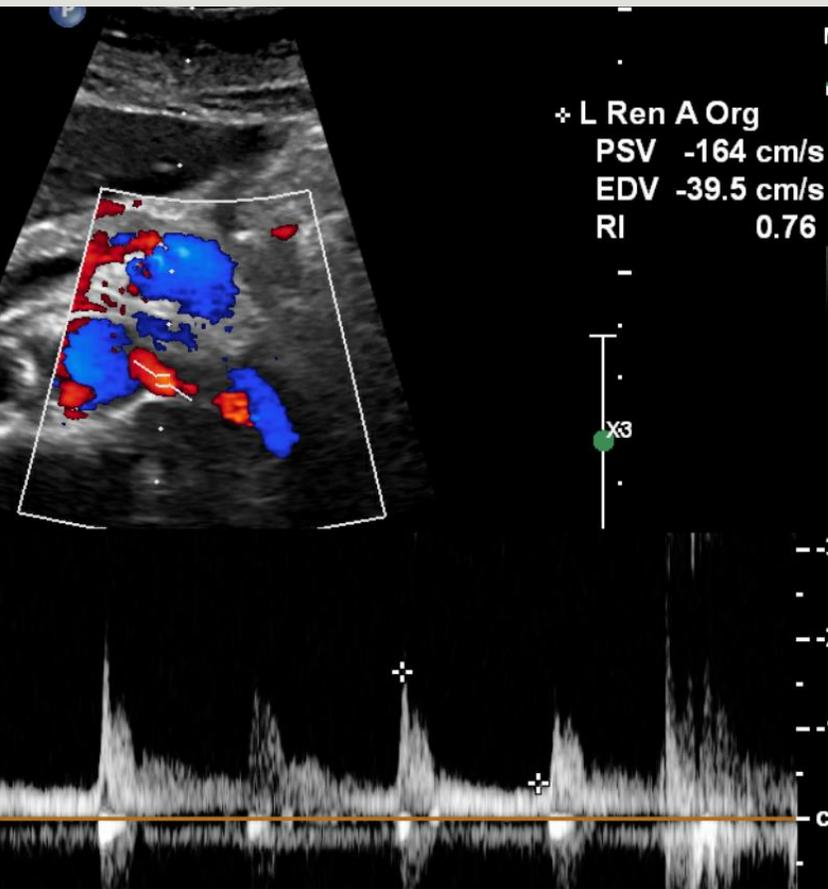
B-mode



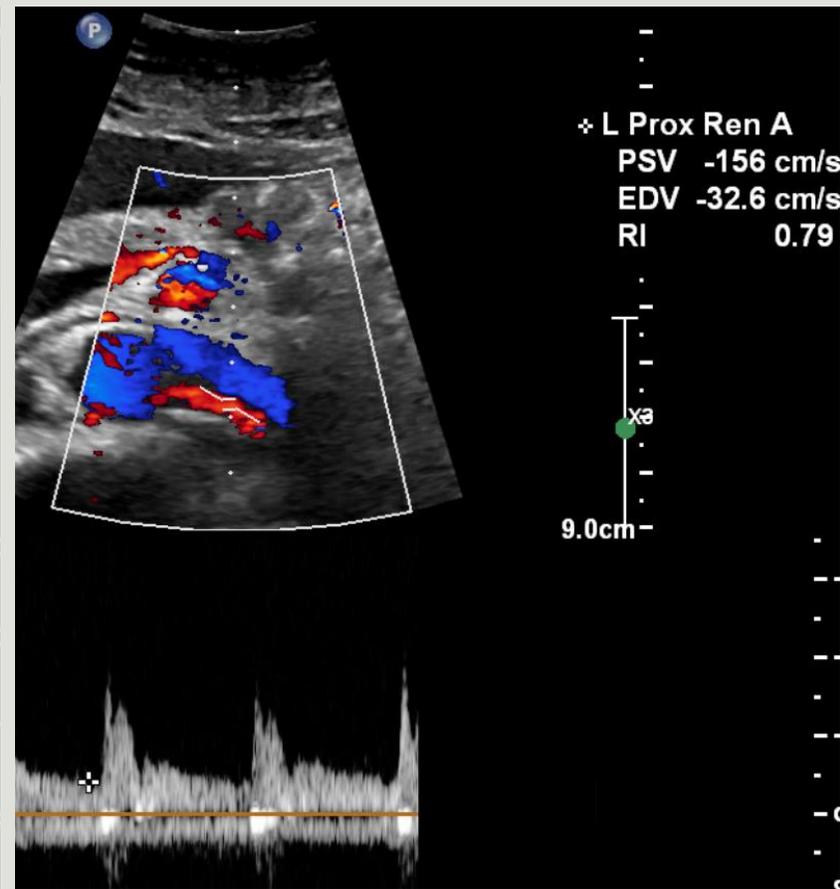
Doppler



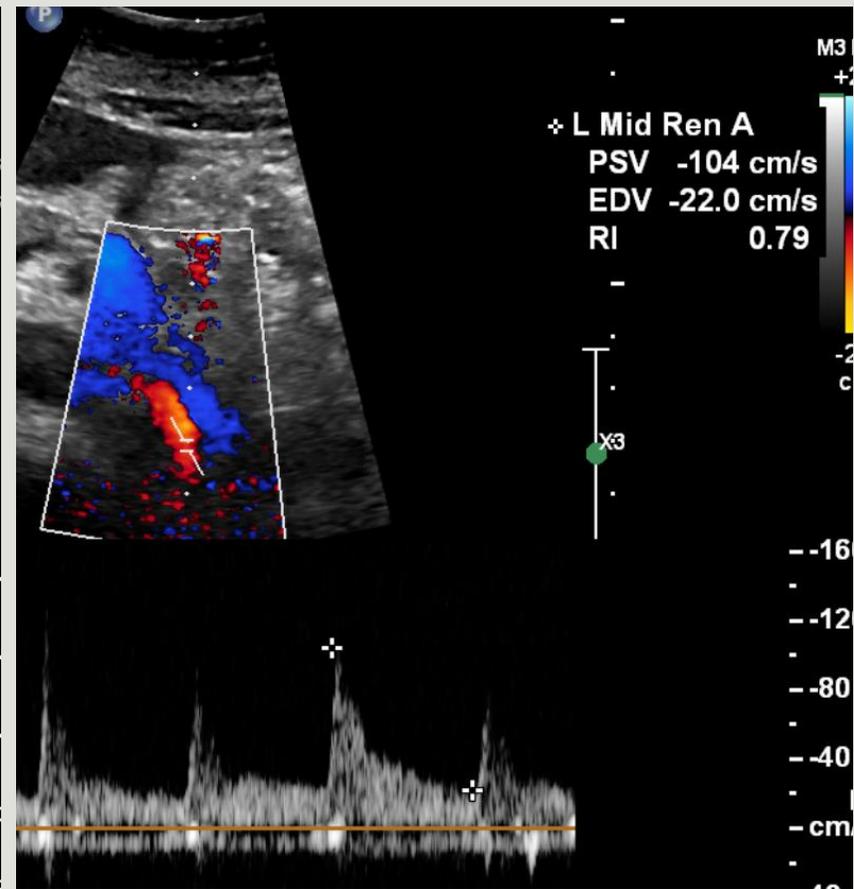
# Theoretical Renal Artery



Origin



Proximal

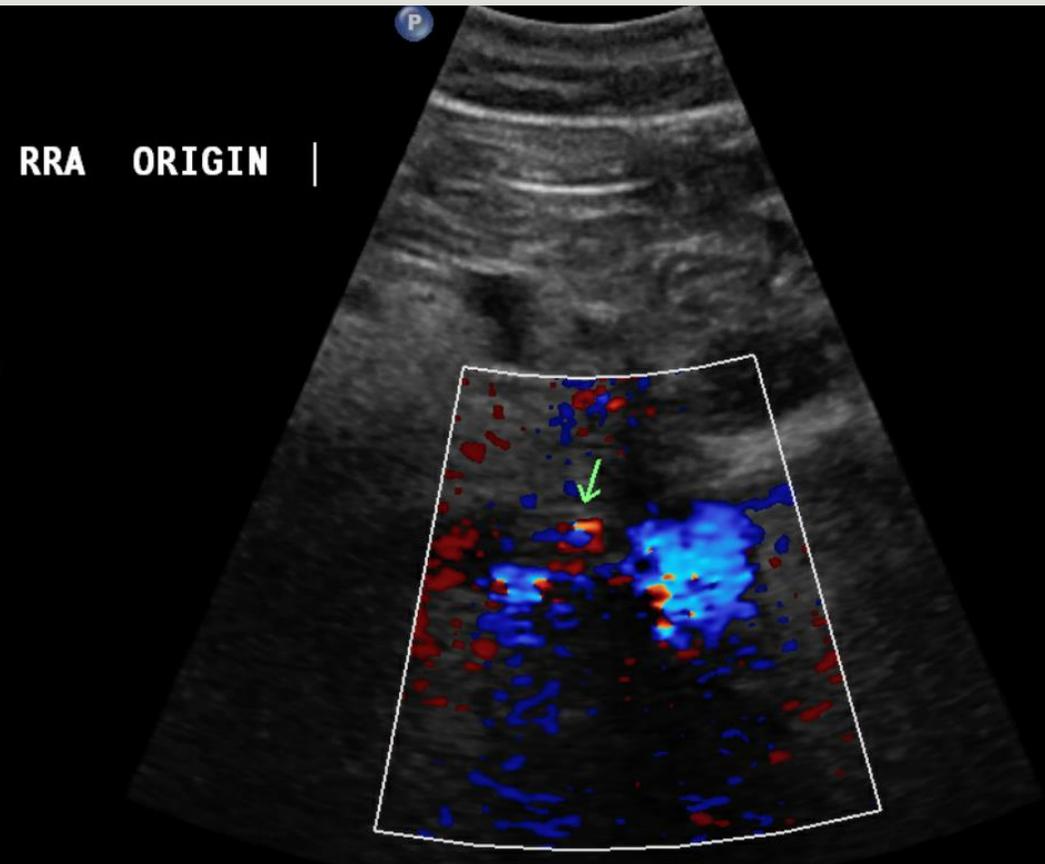


Mid



## Spectral Doppler

Theoretically from mid-line able to insonate the origin, proximal and mid segments of the renal artery



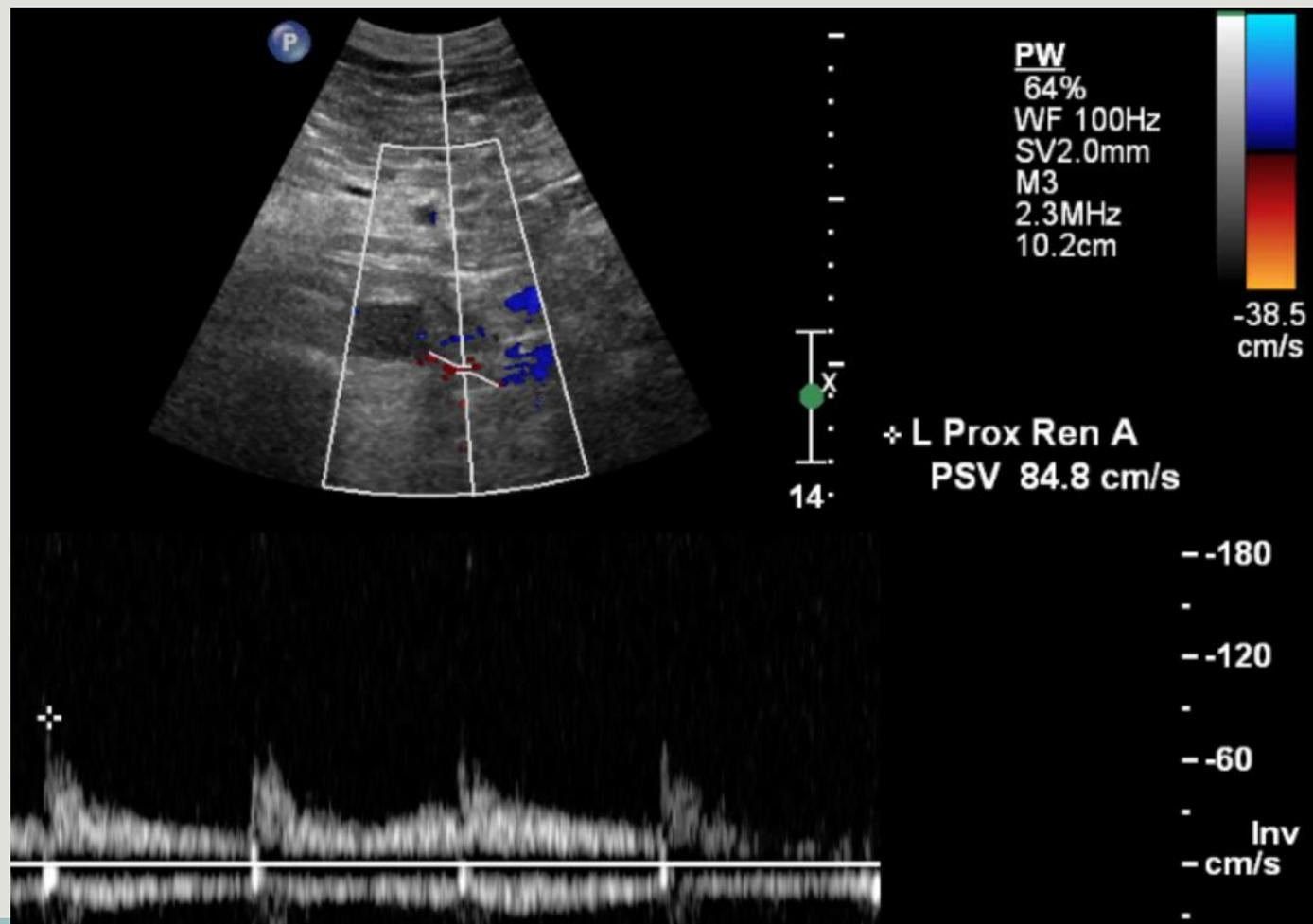
Color



B-mode

# Practical Renal Artery

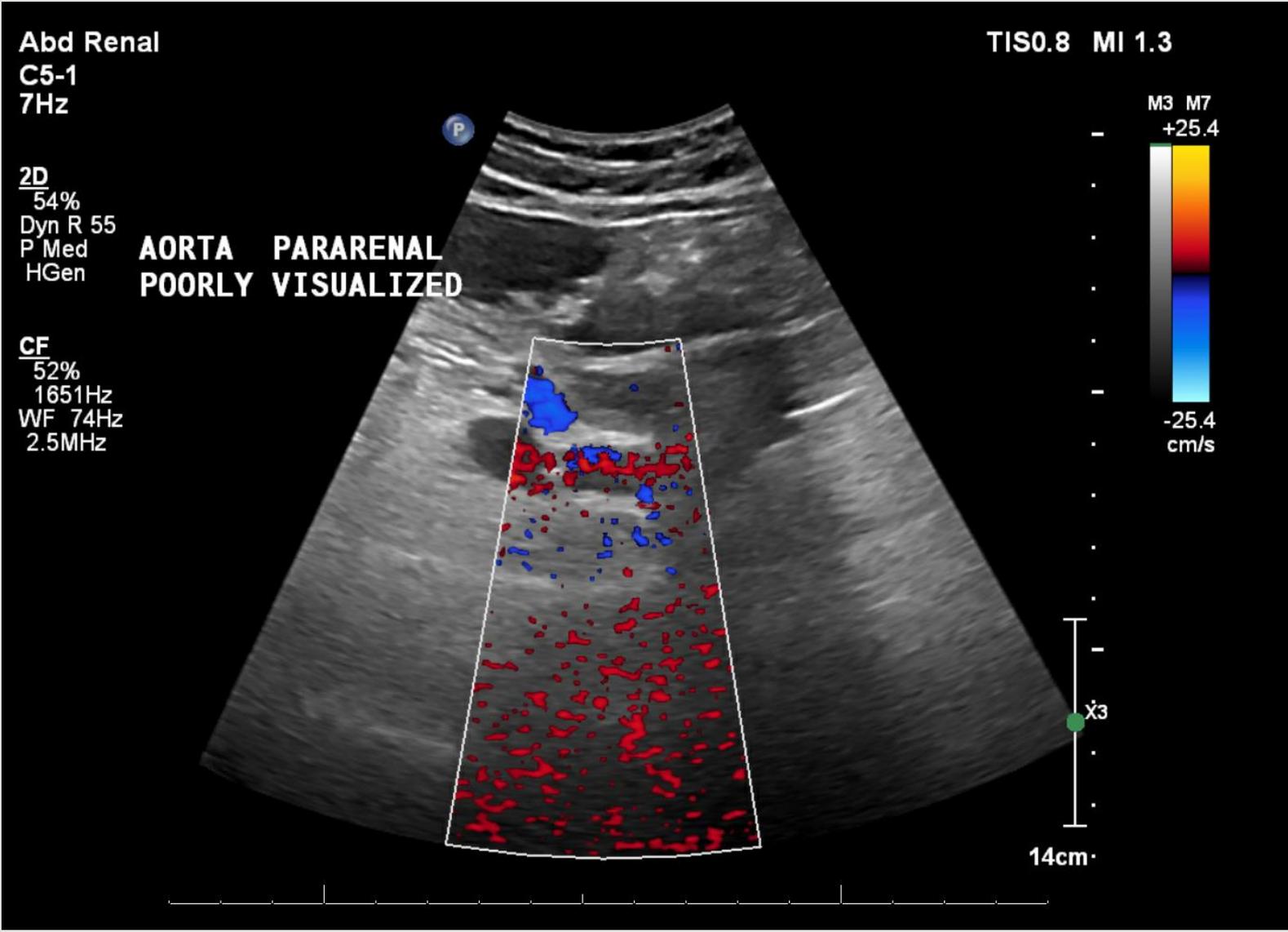




## Spectral Doppler

Practically poor visualization from mid-line  
May only be able to obtain one segment



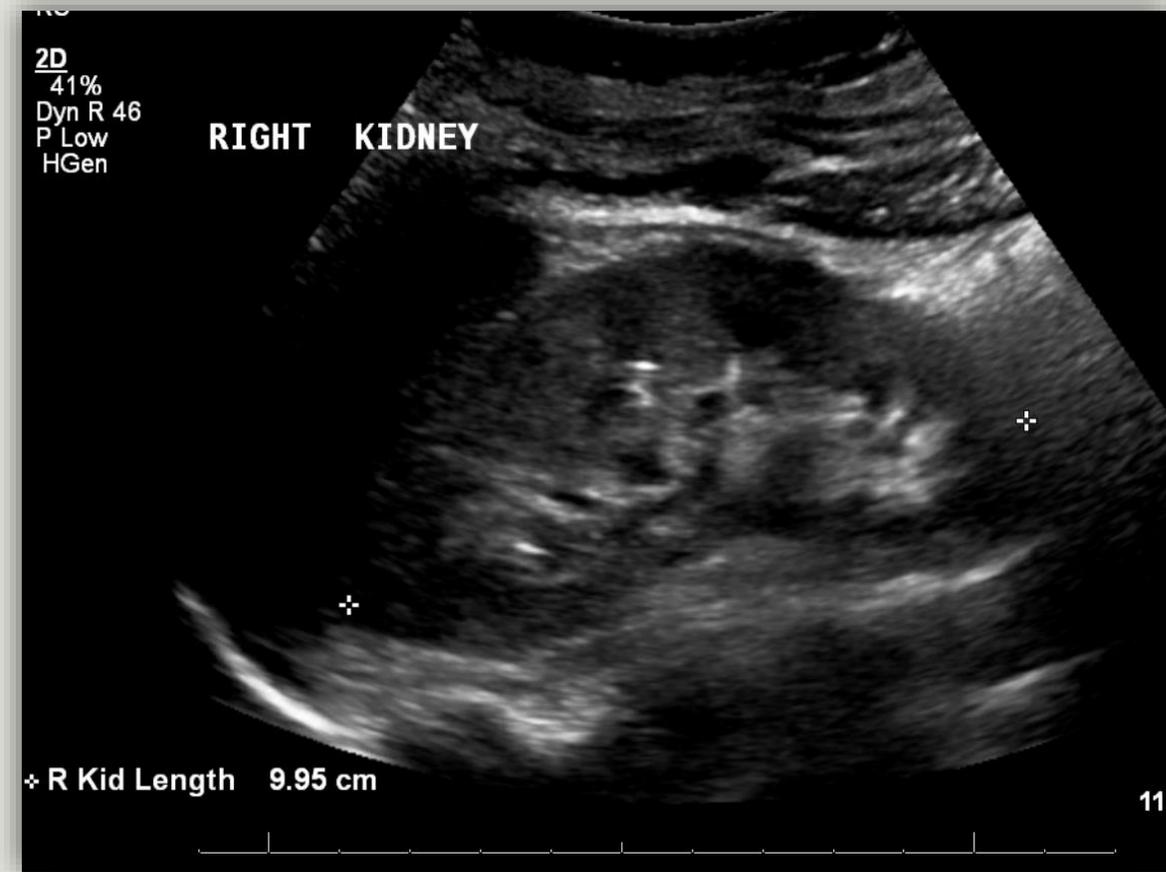


Mid-Line  
Obscured

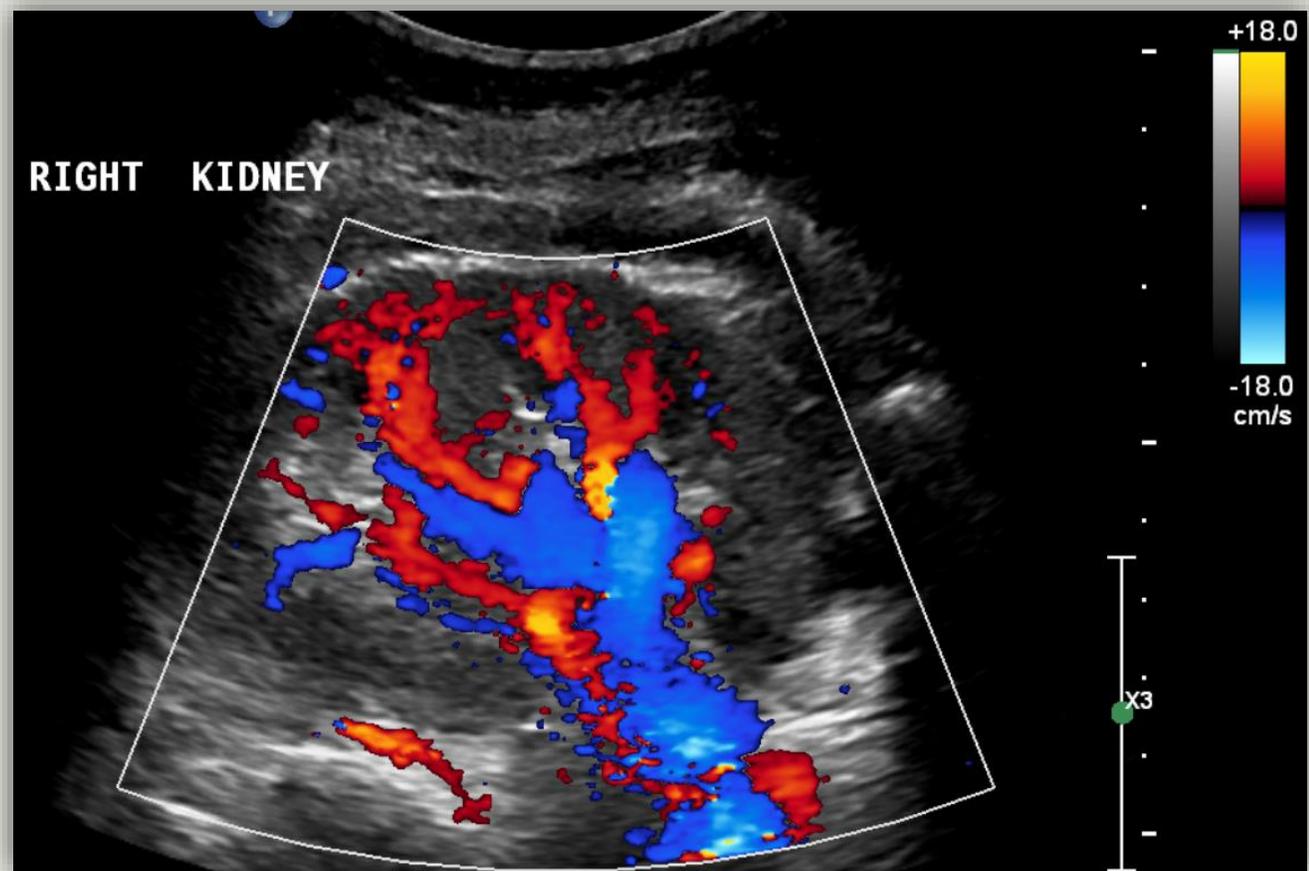


# Lateral Decubitus Approach

KIDNEY LENGTH, SEGMENTAL ARTERIES, HILUM, RENAL VEIN & RENAL ARTERY



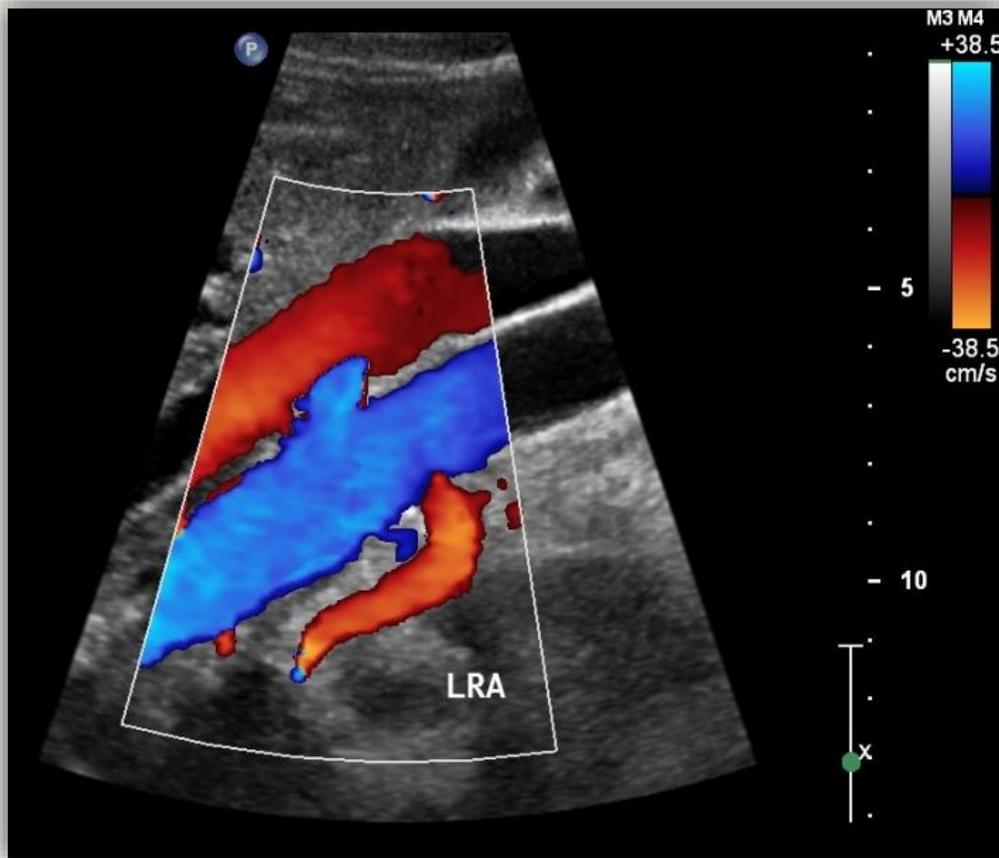
B-mode



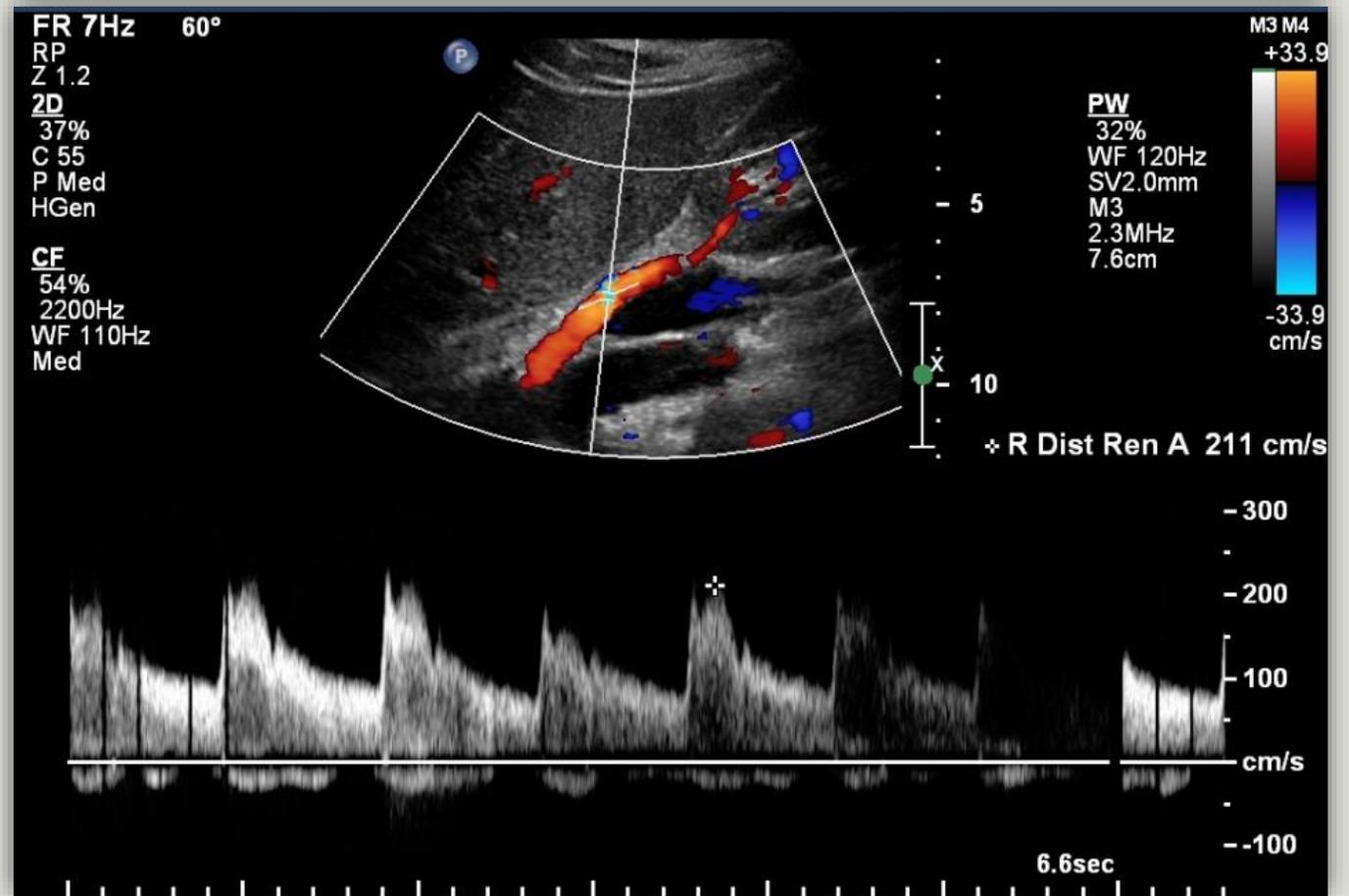
Color



# Theoretical Kidney



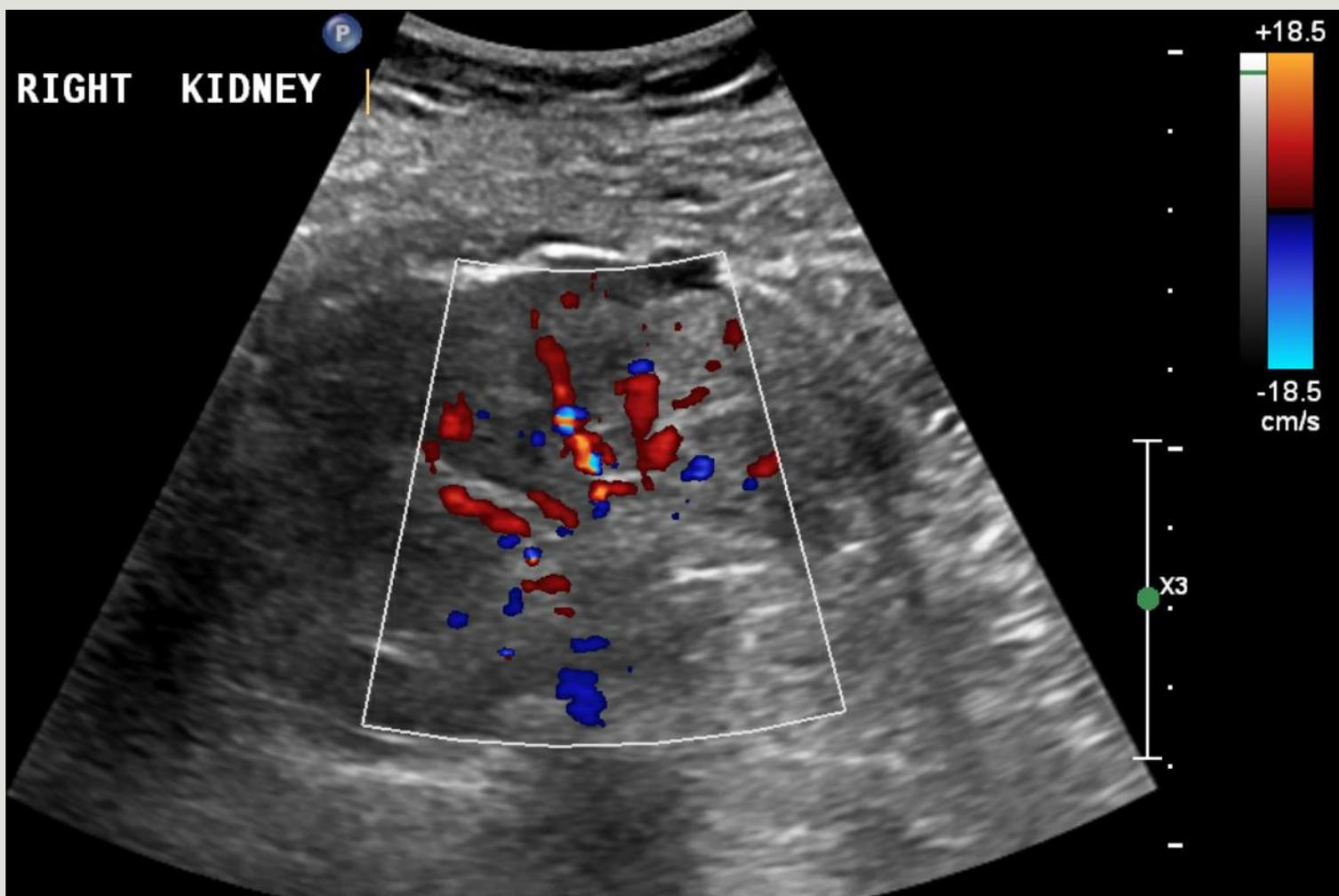
Color



Doppler



# Theoretical Lateral View Renal Artery



# Practical Kidney

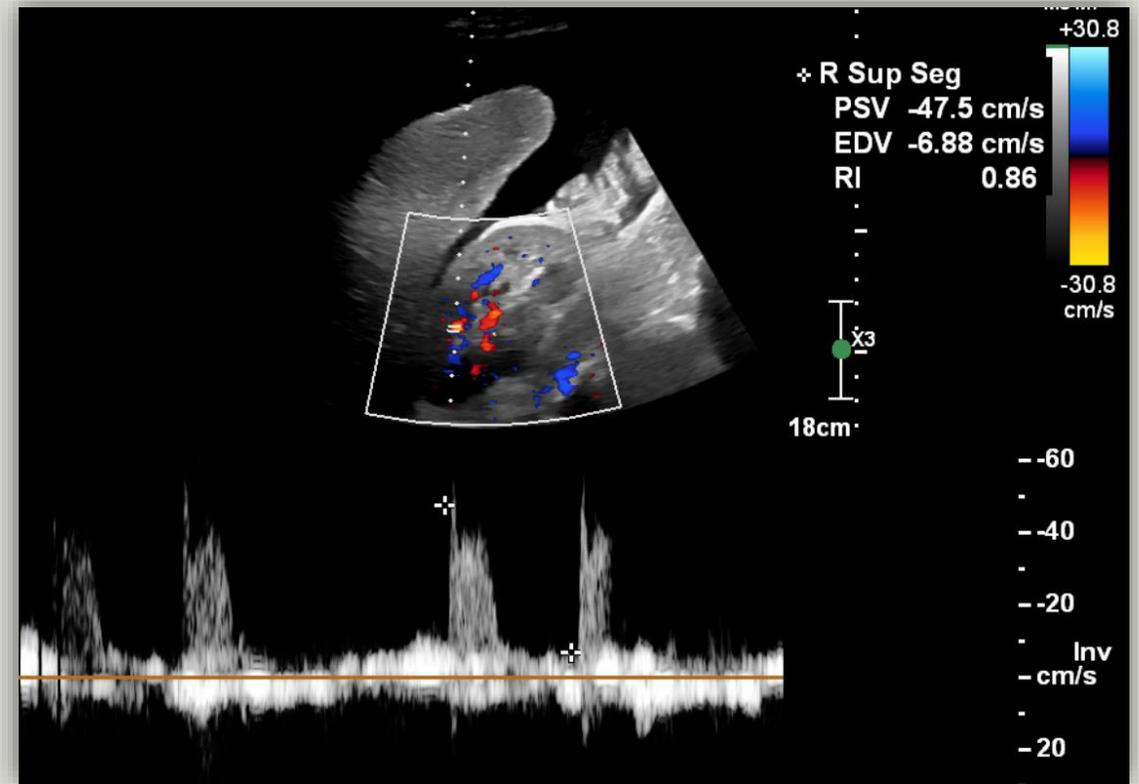
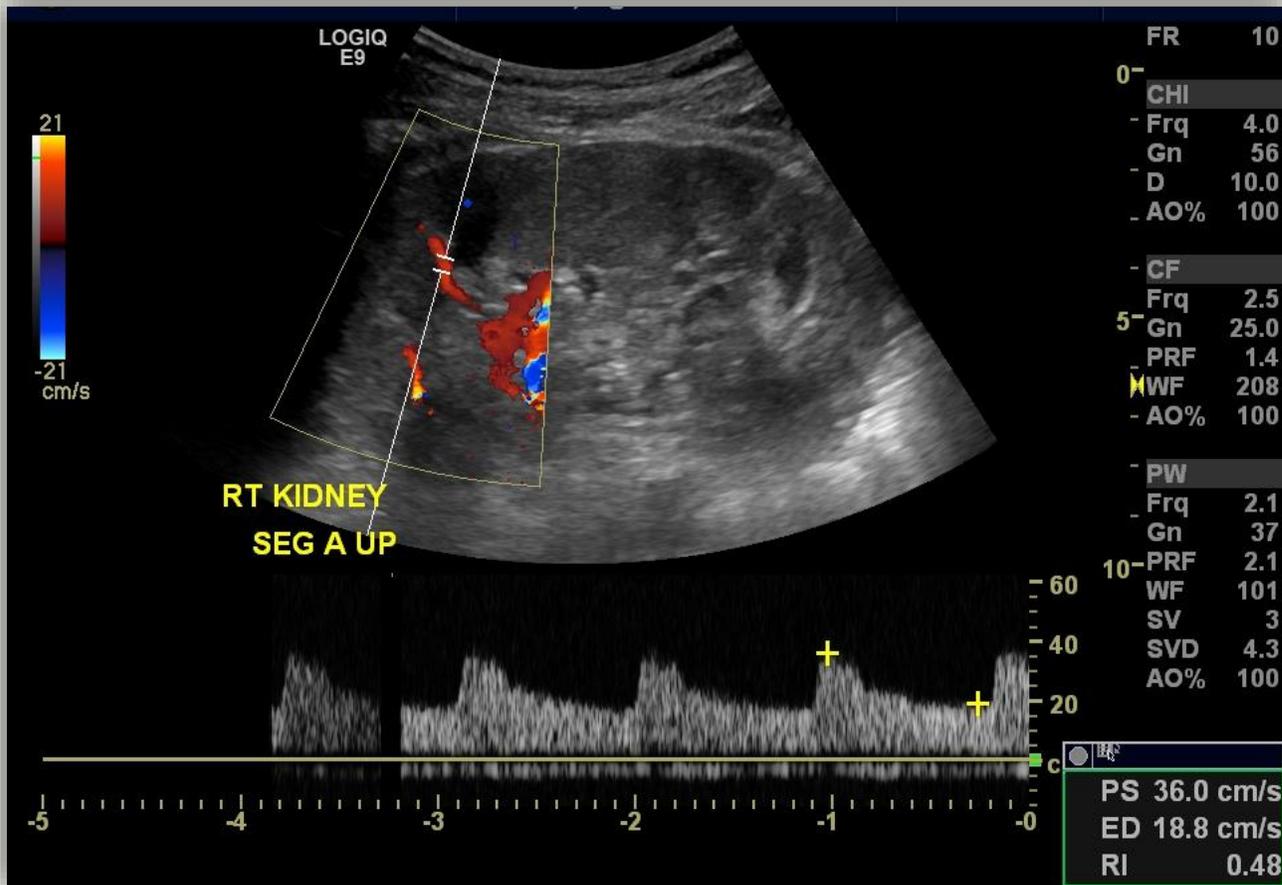
# Lateral View- Segmental Arteries



## THEORETICAL



## PRACTICAL



Clear PSV/EDV, shallow depth & even respirations

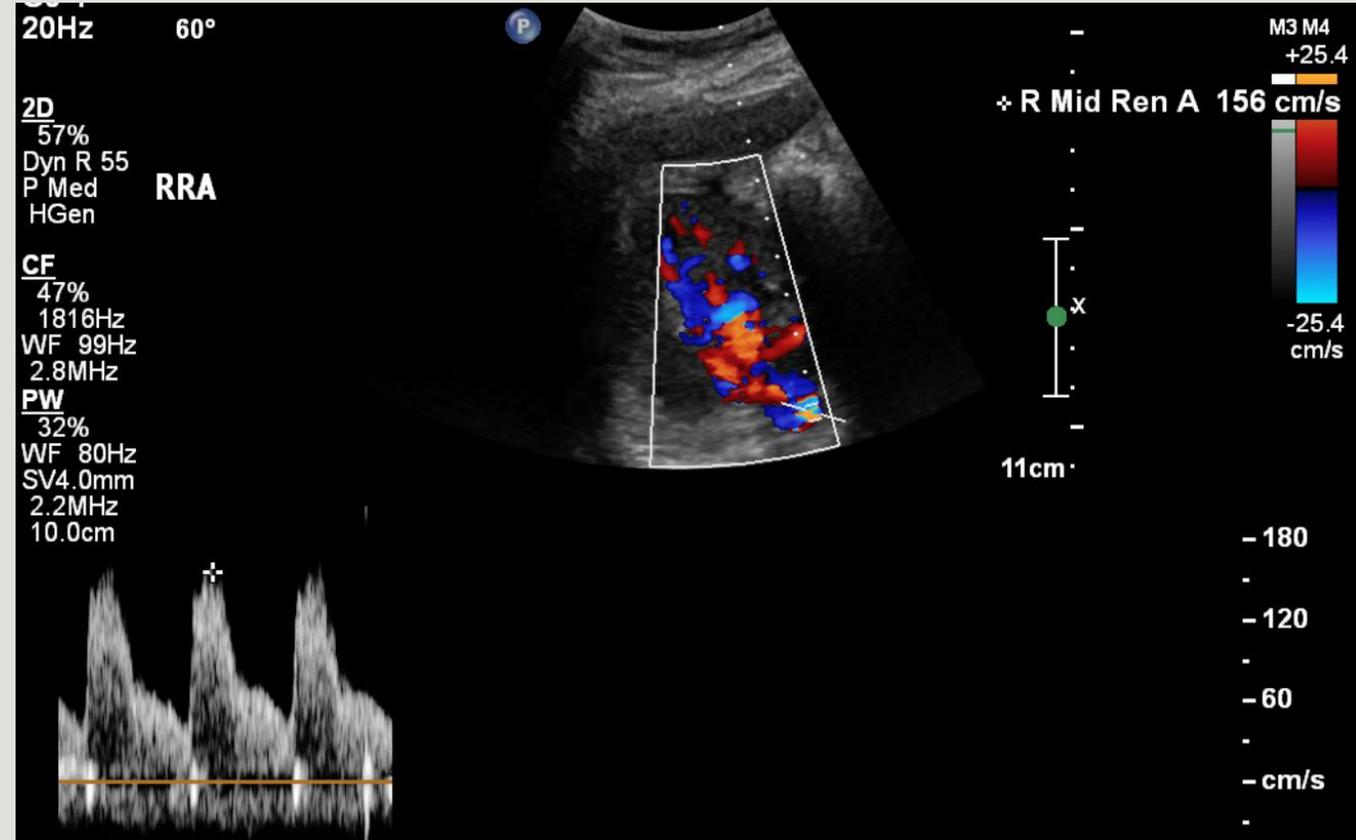
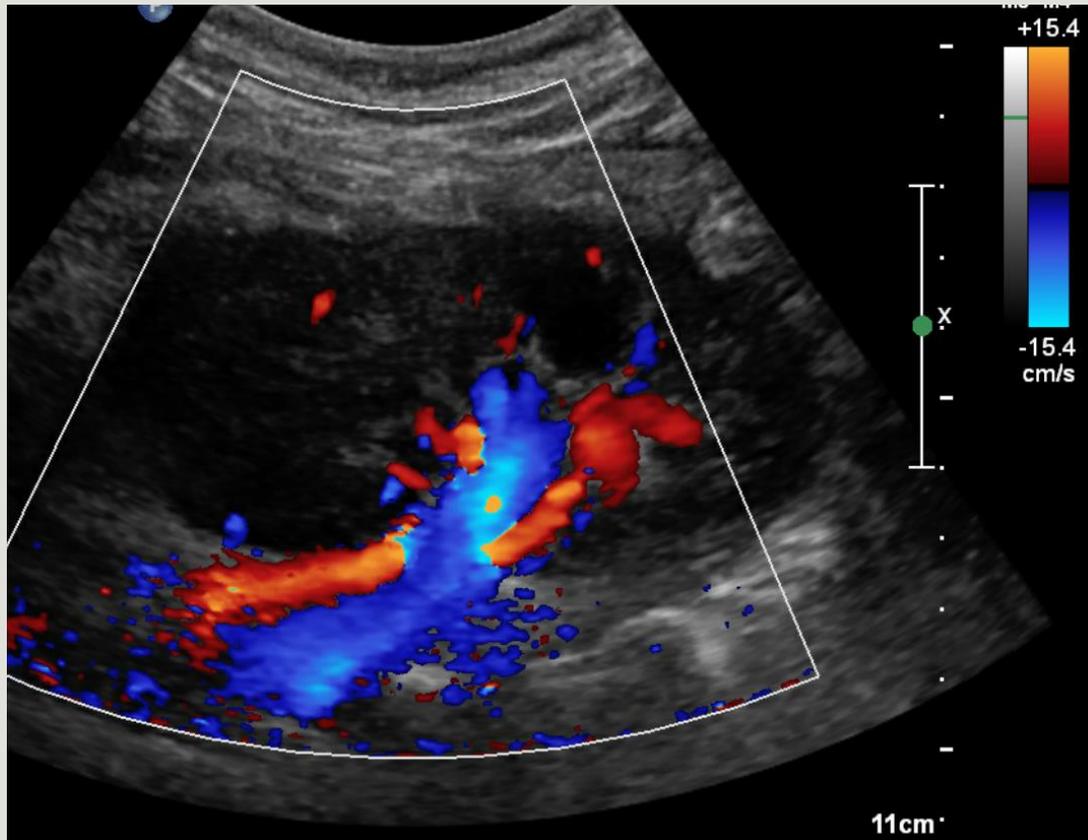
Depth limitations, movement

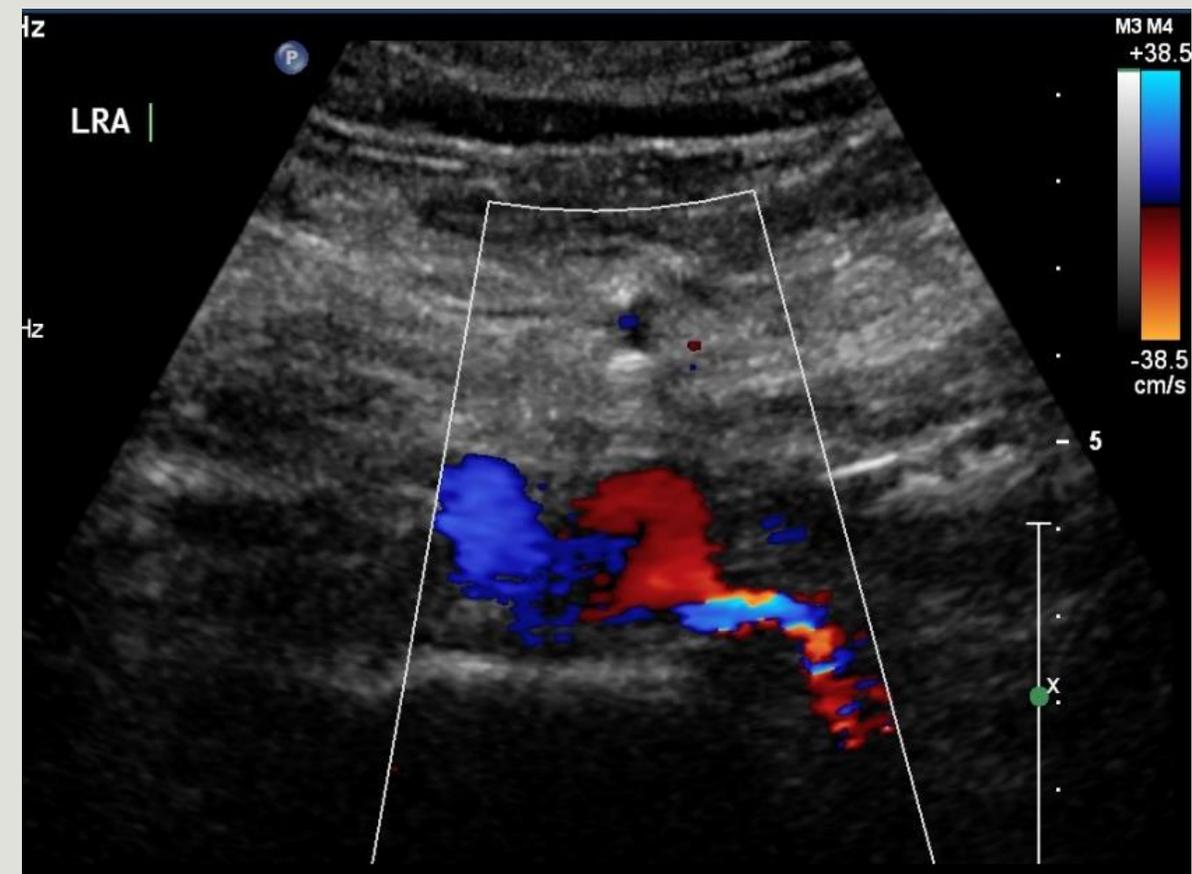
# Lateral View- Renal Artery



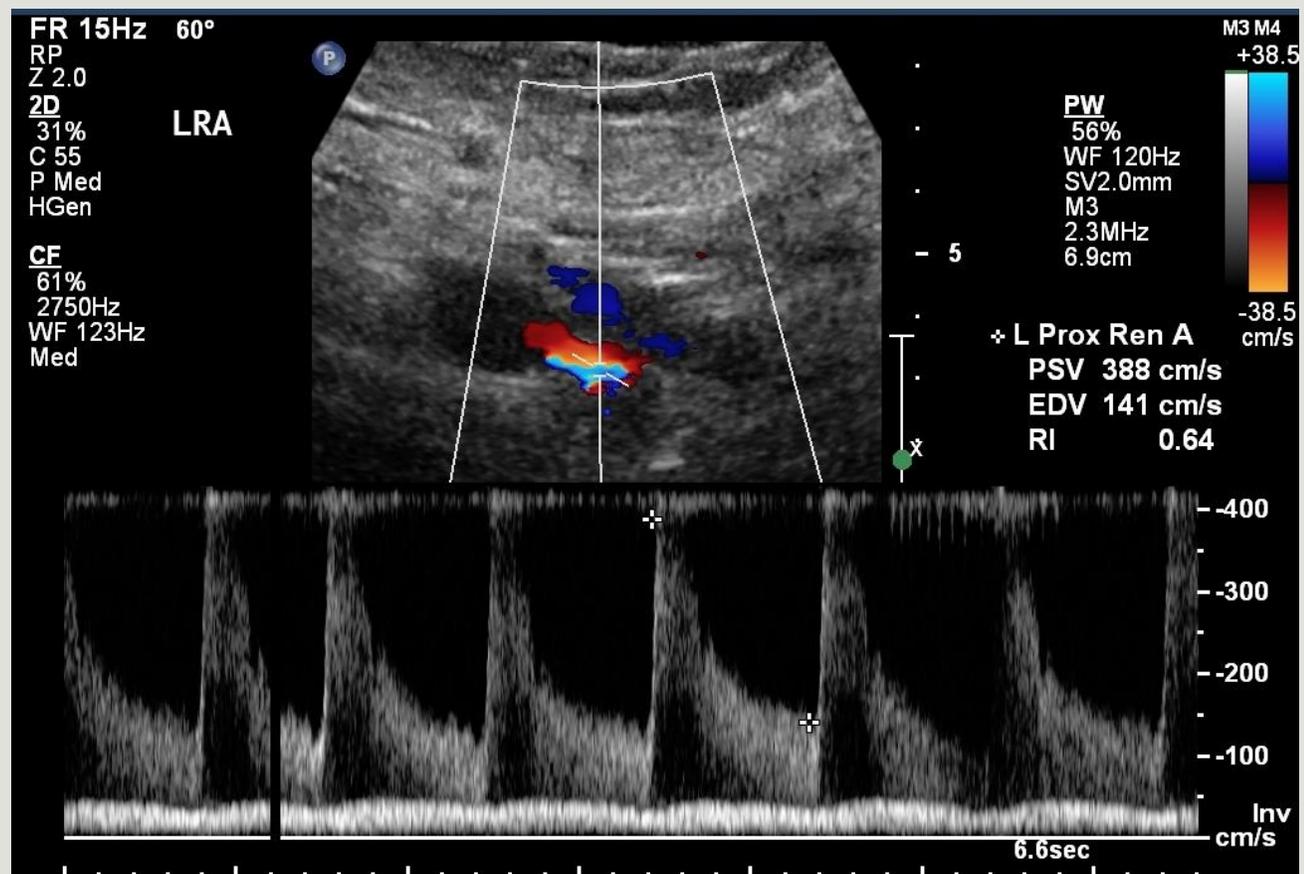
## THEORETICAL

## PRACTICAL





Color

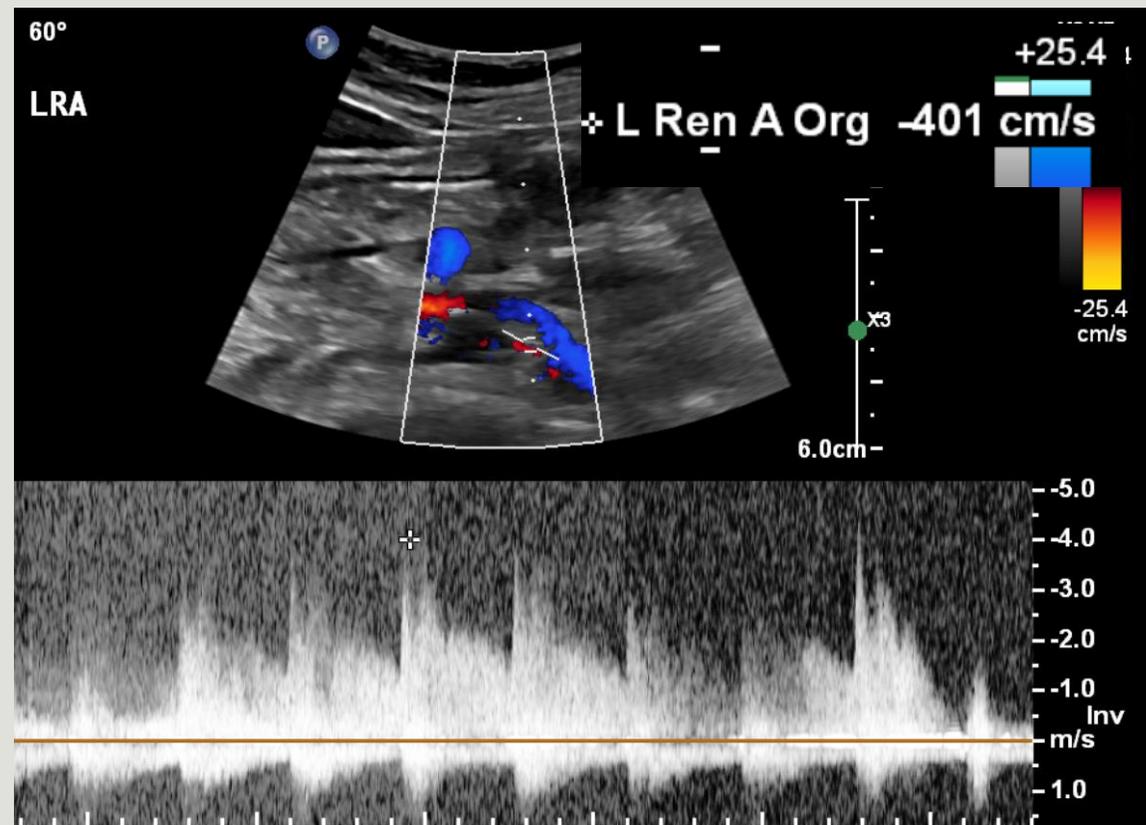


Elevated Velocity

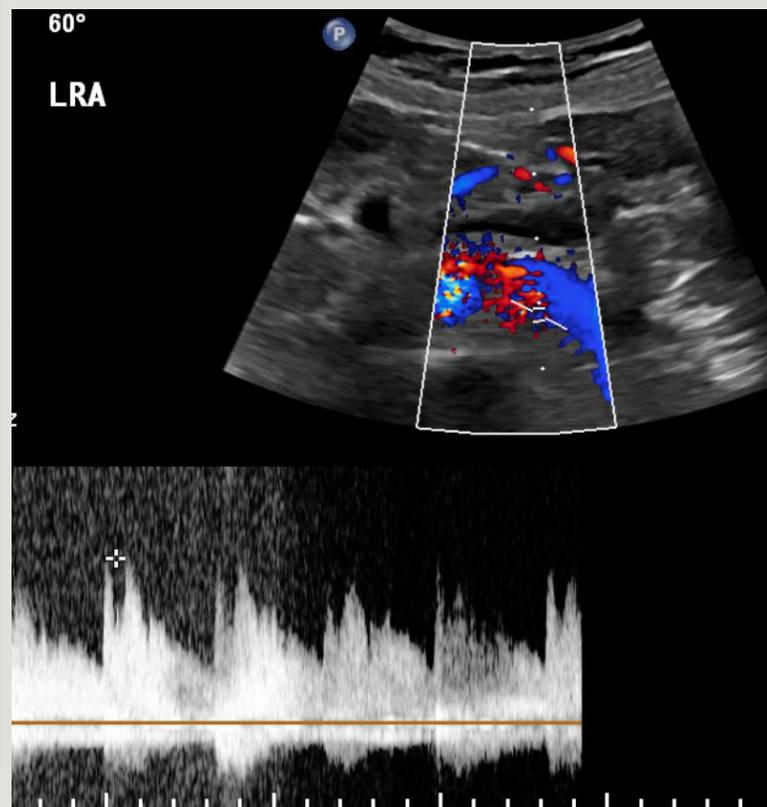


## Stenosis

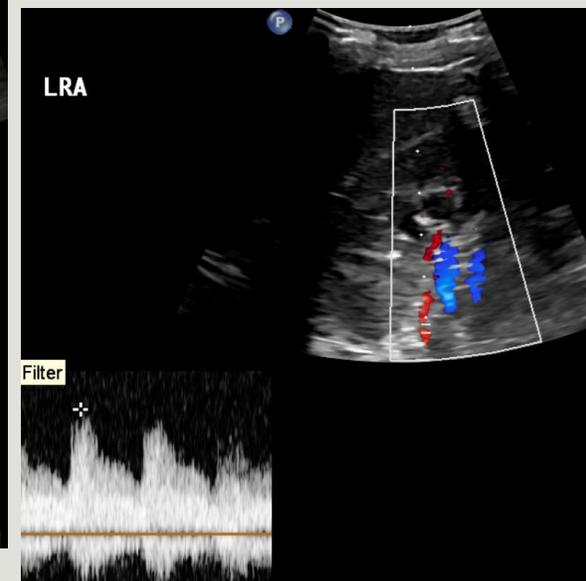
Theoretically we can see focal narrowing with color and elevated PSV with spectral Doppler



Elevated Velocity 401 cm/s



PST

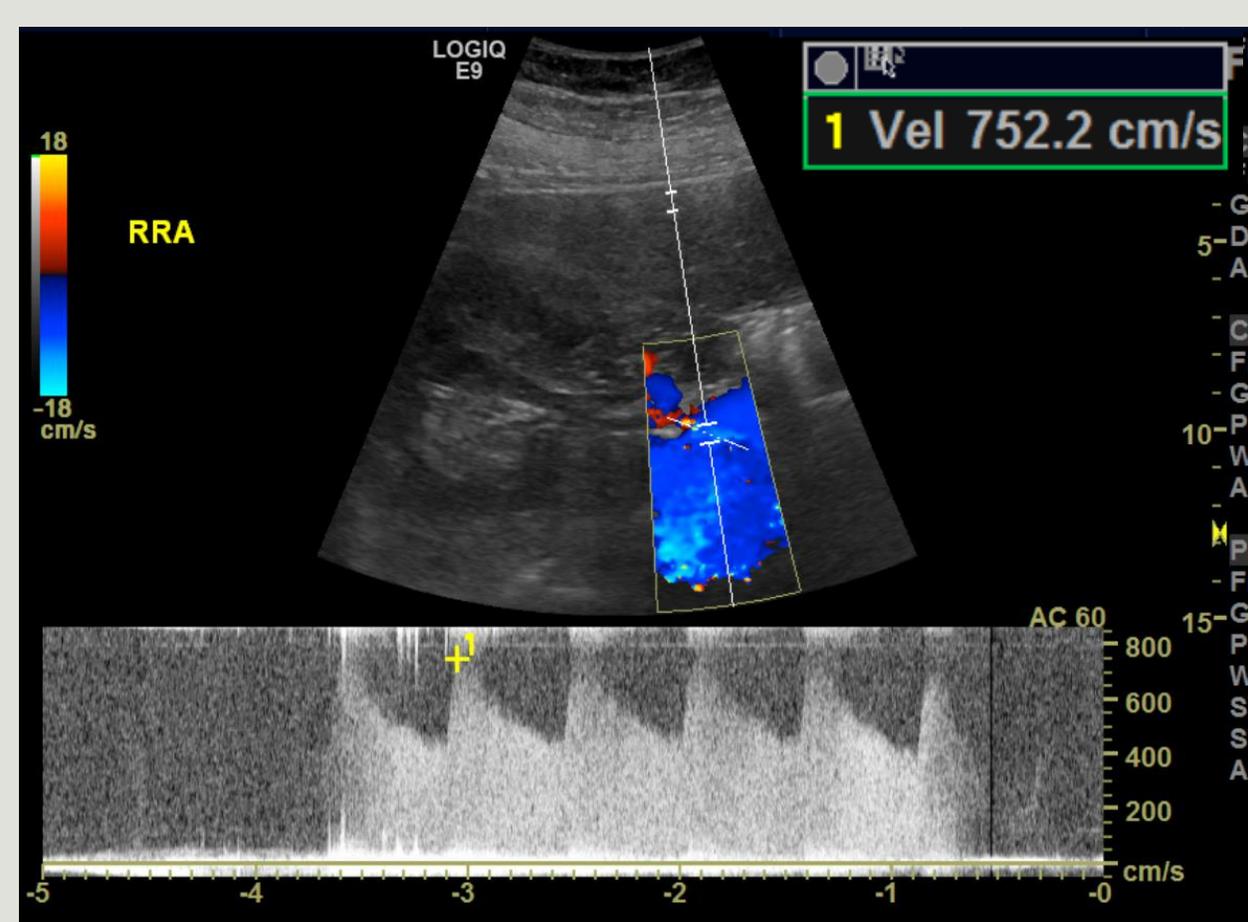


Abnormal waveform

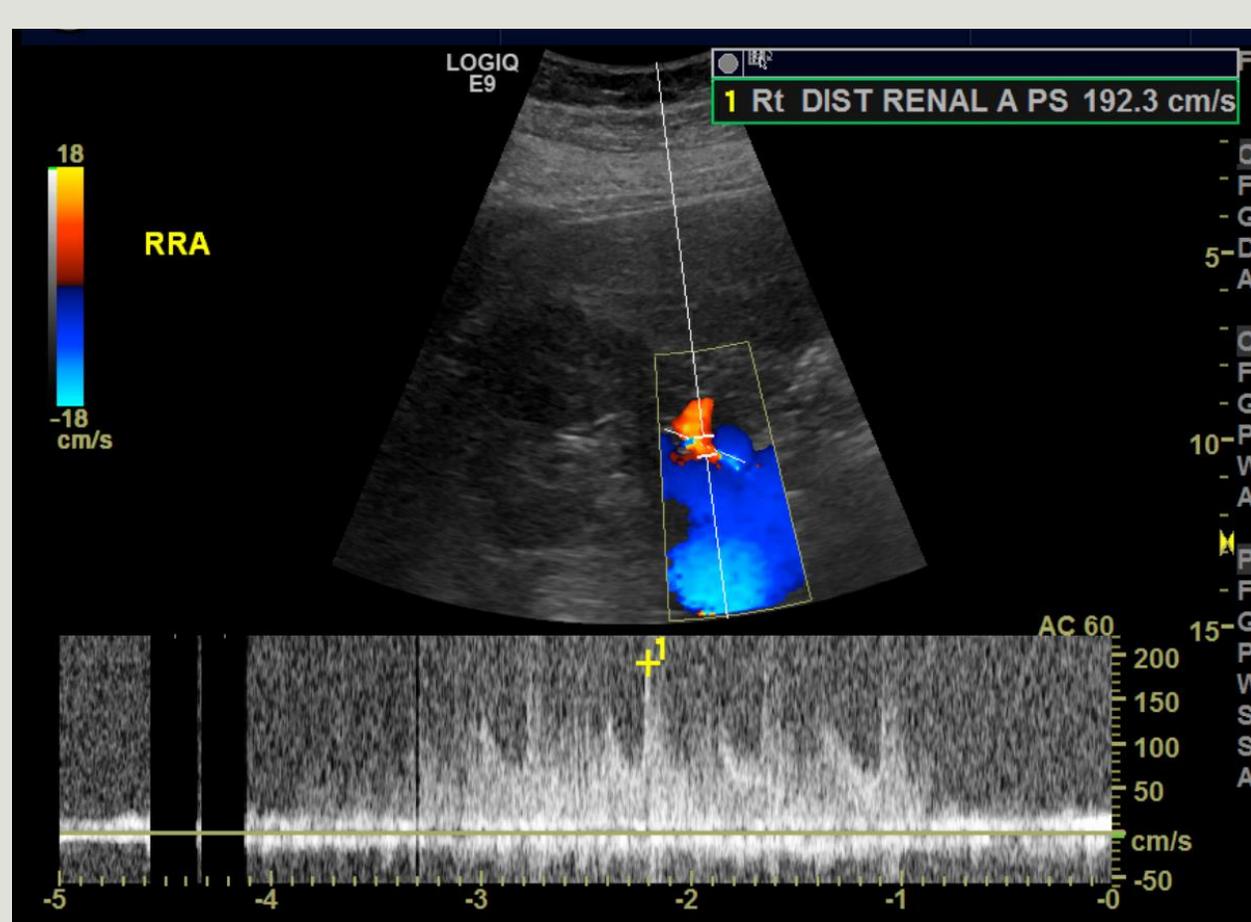


## Stenosis- Spectral Doppler

Theoretically we can see the progression



Elevated Velocity 752 cm/s



Abnormal distal waveform

## Stenosis- Spectral Doppler

Practically- Sometimes only spectral focal segments



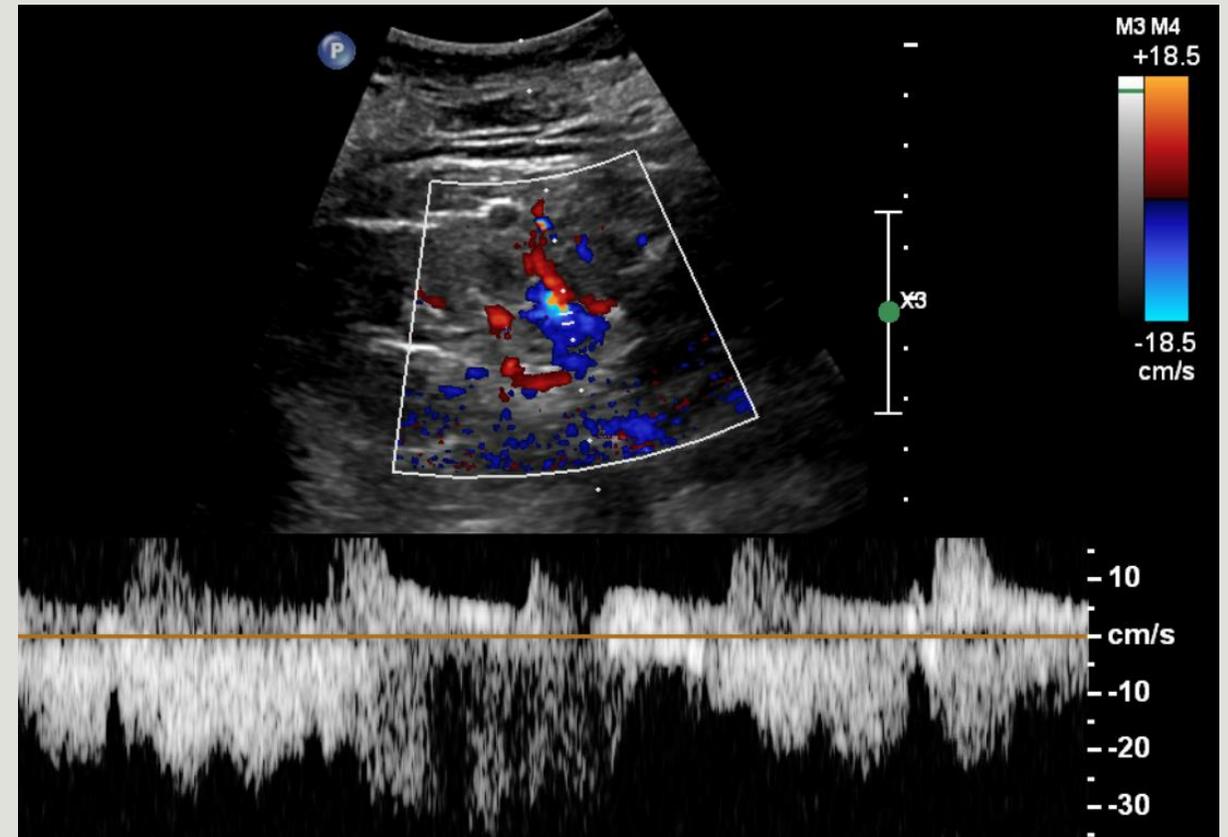
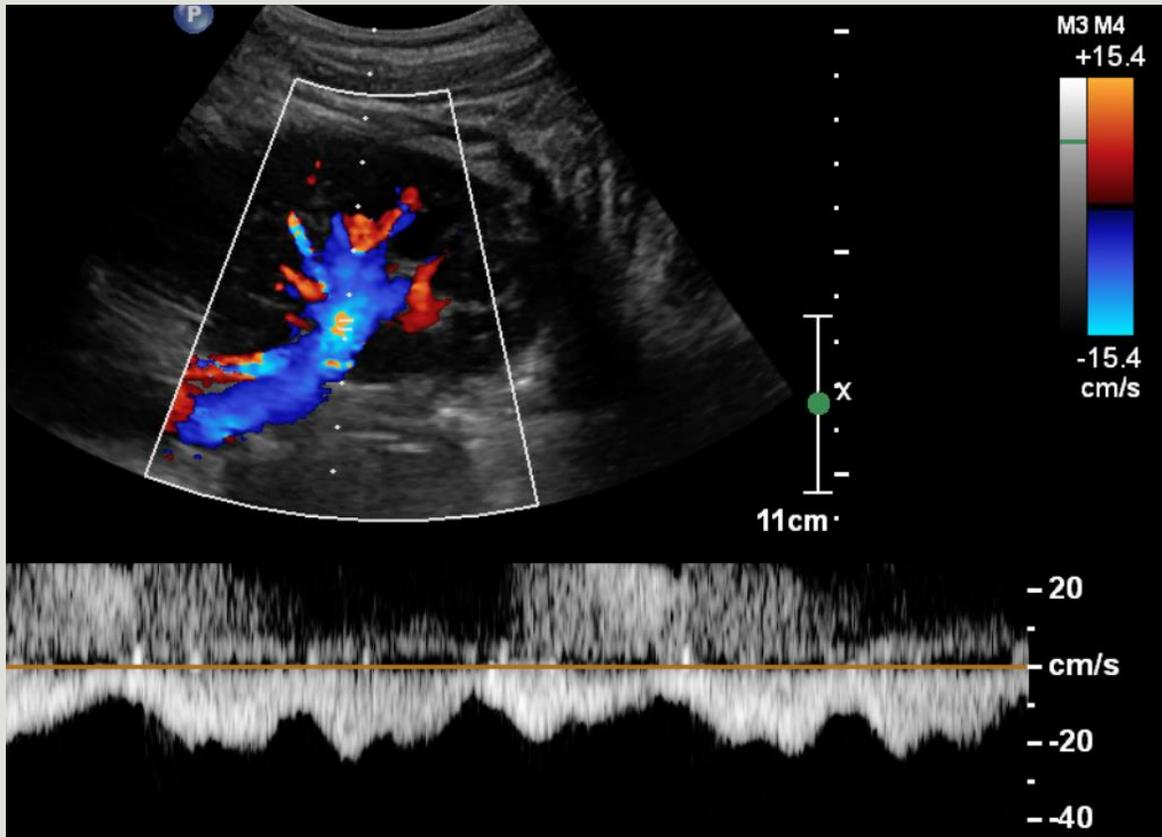
# Lateral View- Renal Vein



## THEORETICAL



## PRACTICAL



**GIVE UP**

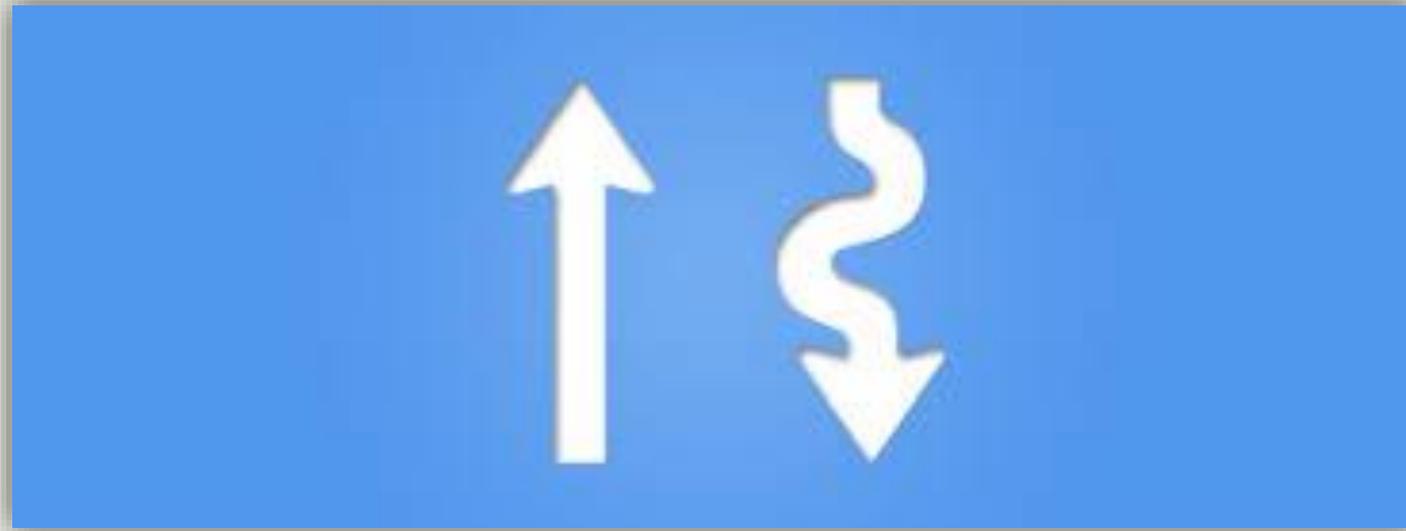
**KEEP GOING**





**KEEP  
GOING**





Indirect Findings

---

## Final Impression

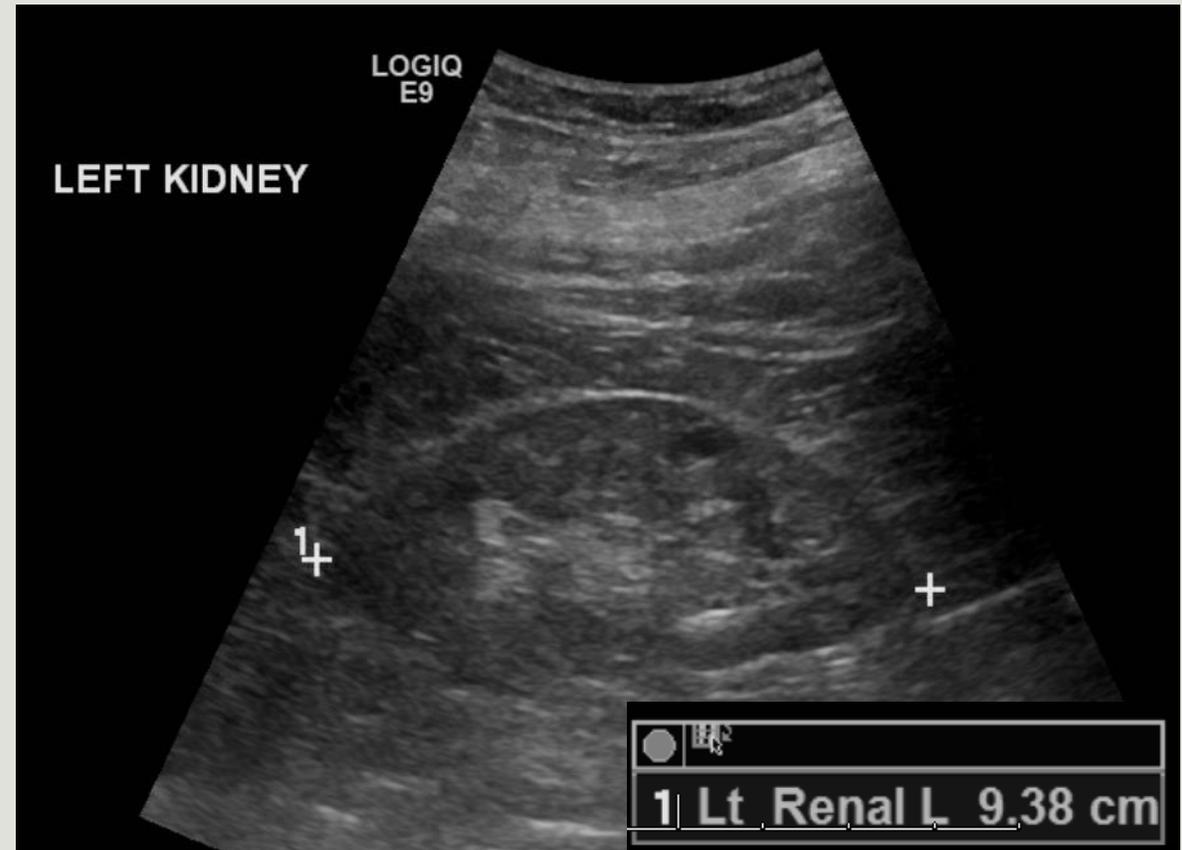
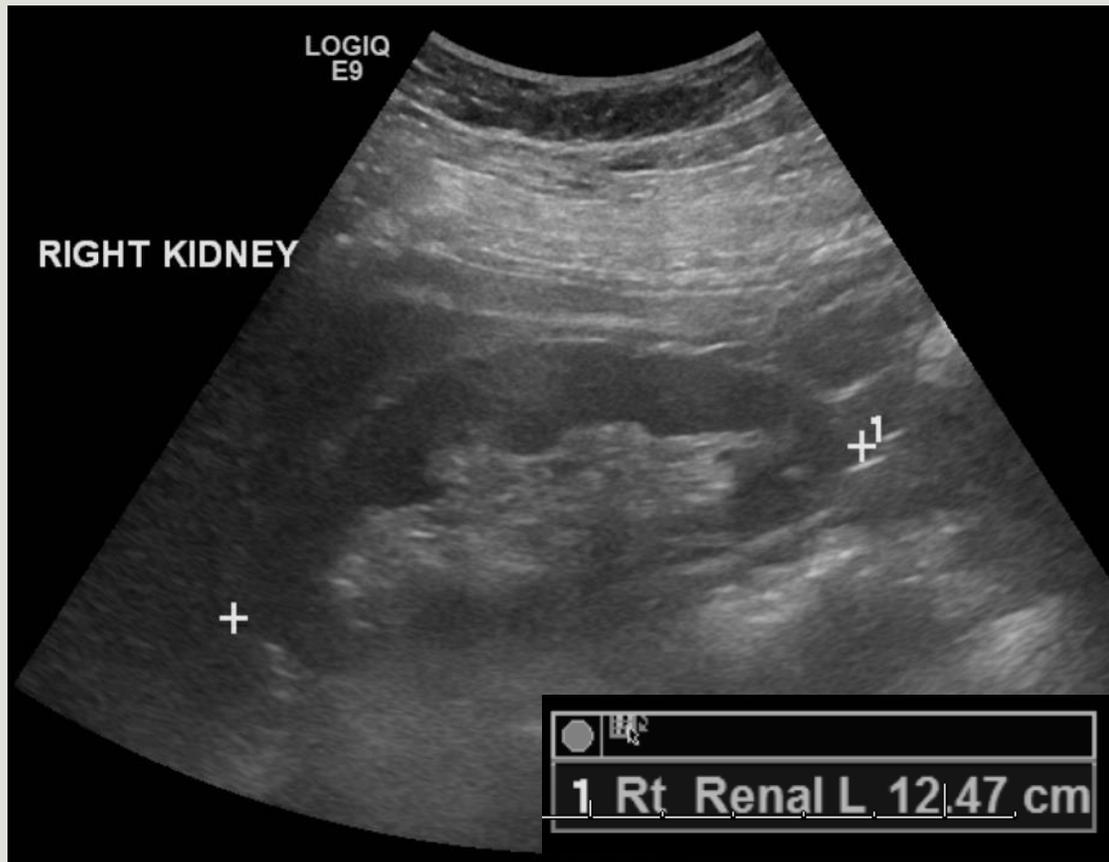
What can we rule out?

What are some possible findings?

Suspect?

Indicate a need for further testing needed?



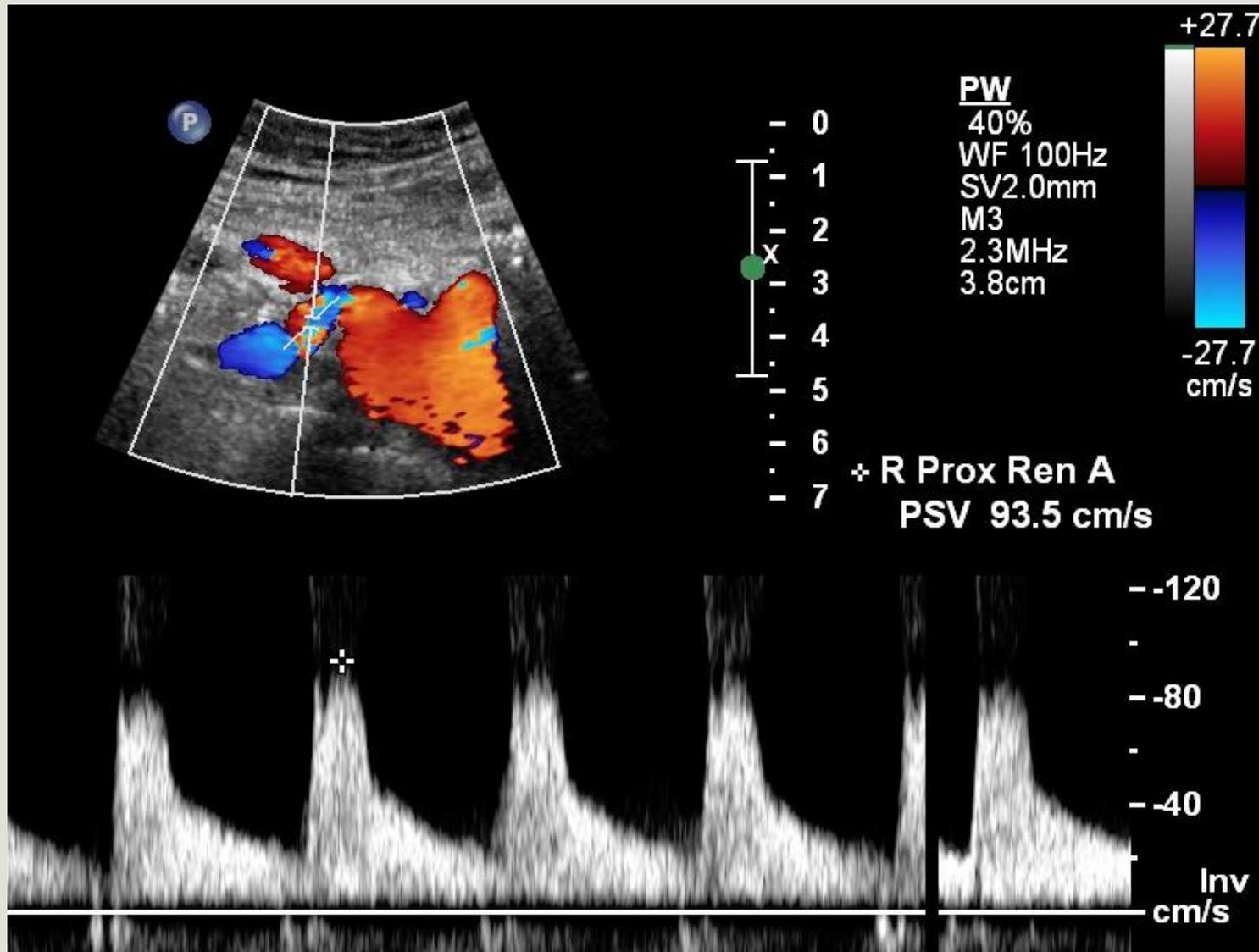


## Indirect Findings: Look at kidney length

Theoretically kidneys should be about the same size

Left kidney is smaller- suggests left renal disease. Chronic?

Further testing?



Spectral Doppler

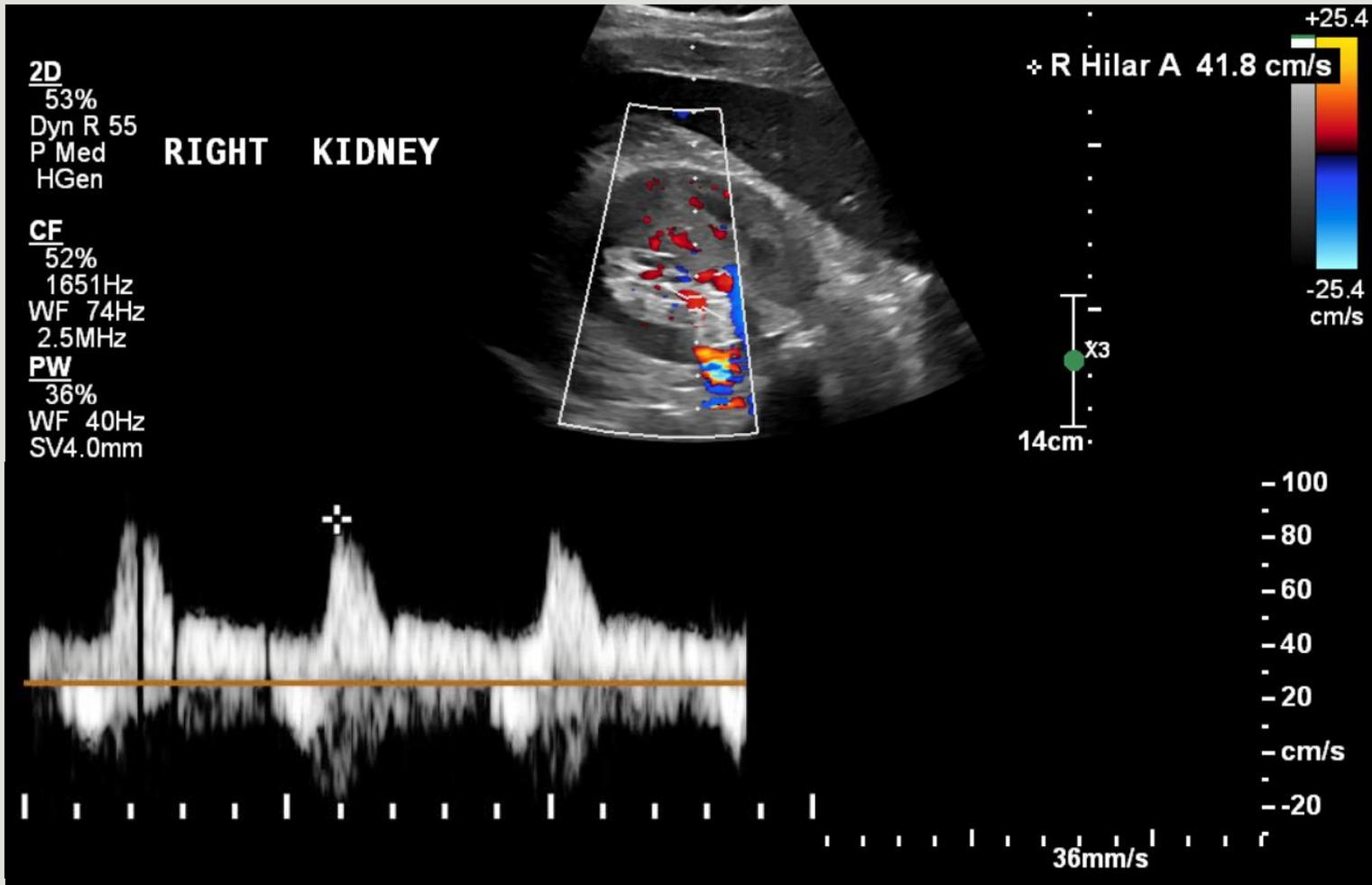
## Normal Renal Artery Waveforms

In the absence of disease, PSV should be:

**Uniform throughout the vessel**

**Rapid upstroke, sharp peak, and a low-resistive, monophasic waveform**

**Consistent with continuous diastolic forward flow**



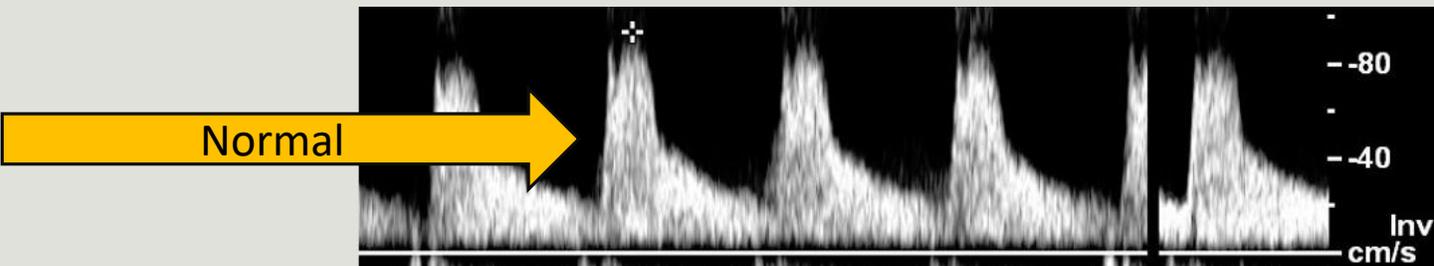
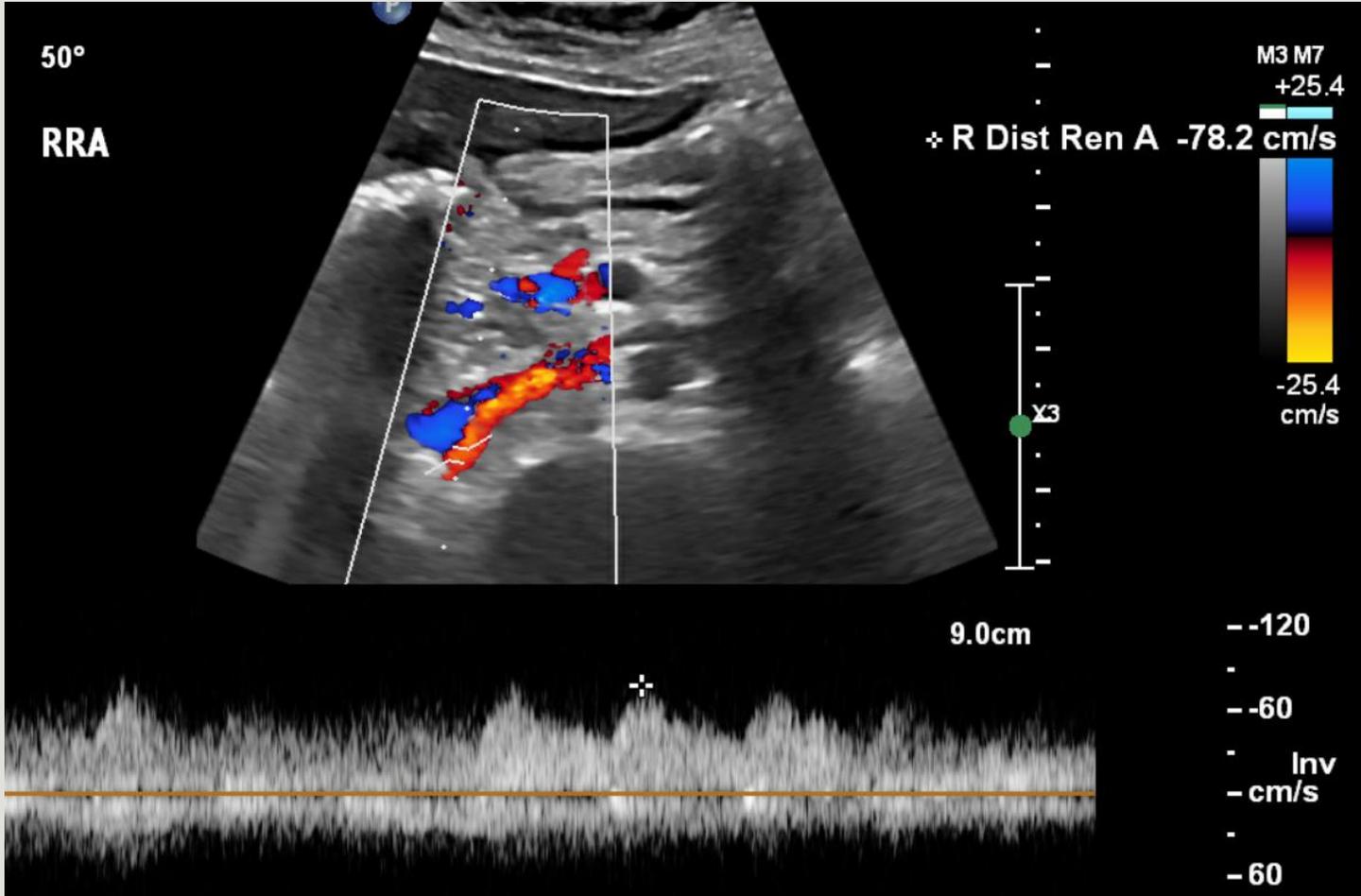
What do the waveforms at the hilum tell us?

- Sharp upstroke
- No PST
- Normal EDV

## Indirect Findings

We can rule out renal artery occlusion or significant stenosis.

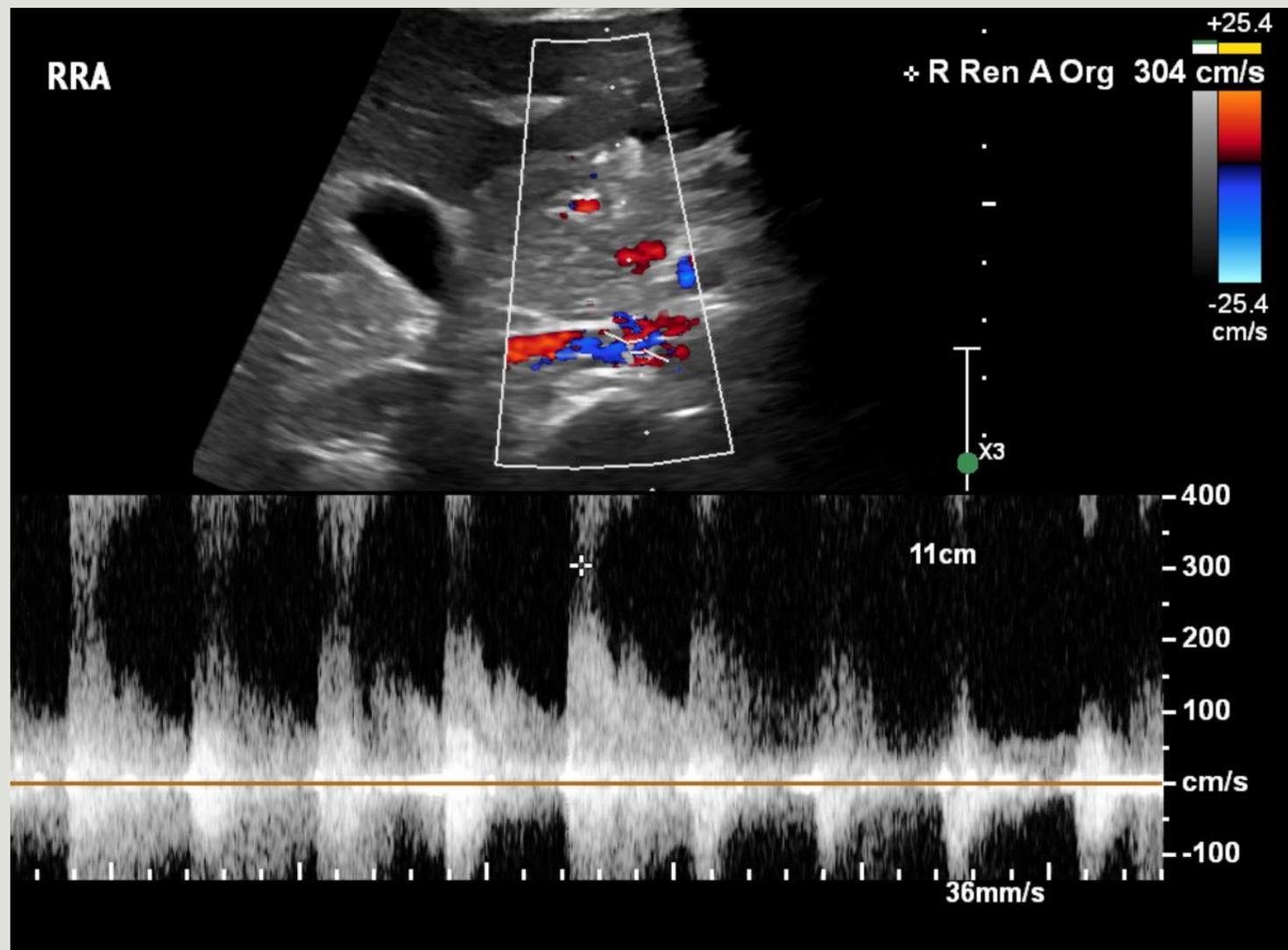
Renal artery is obscured, only able to insonate at the hilum



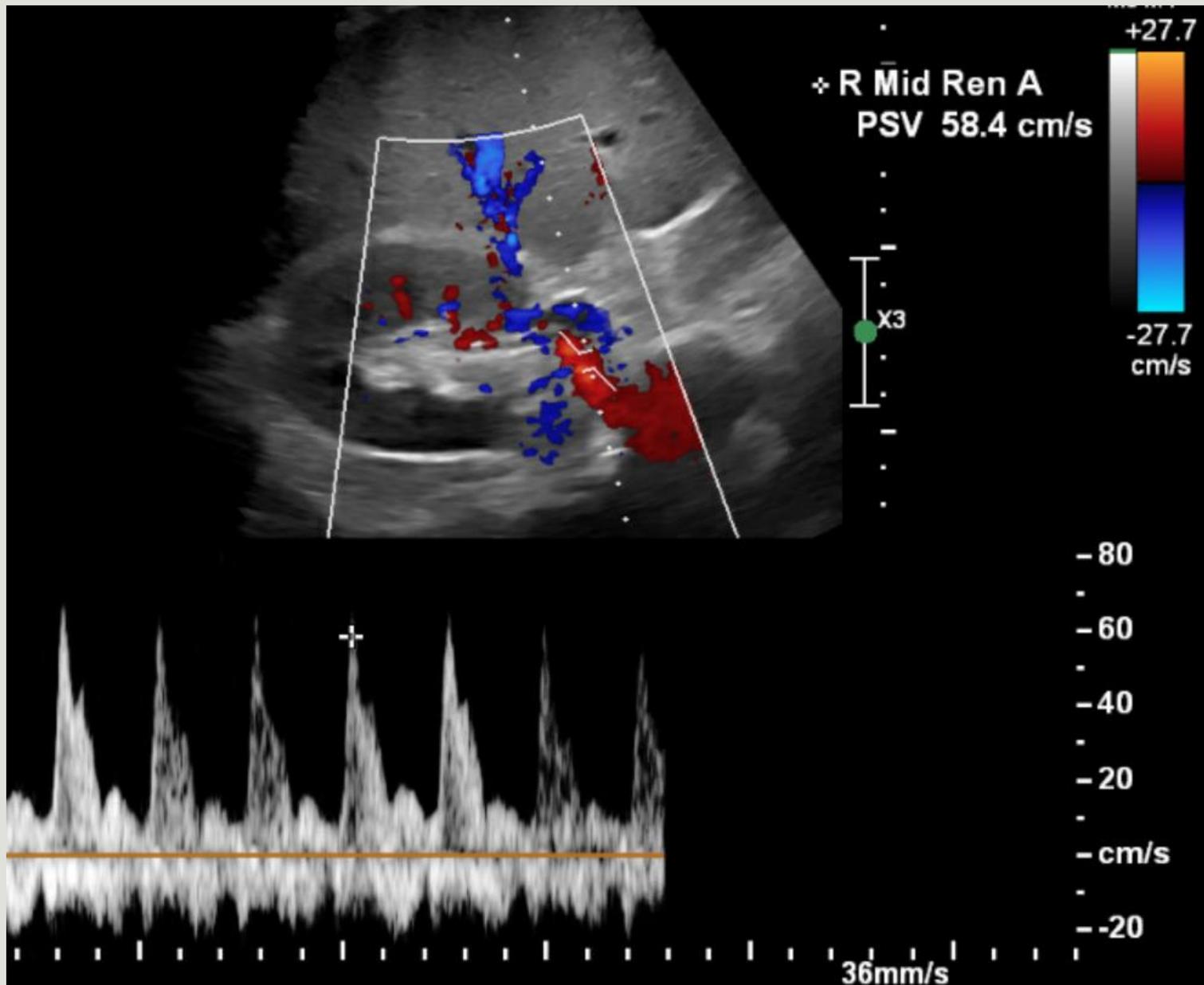
What do the waveforms at the distal renal artery tell us?

- Turbulent
- Antegrade
- Low resistive, dampened
- Not a good angle for velocity

Indirect Findings:  
Cannot rule out a more proximal obstruction



Went back to the origin and confirmed  
>60% renal artery stenosis



What do the waveforms at the mid renal artery tell us?

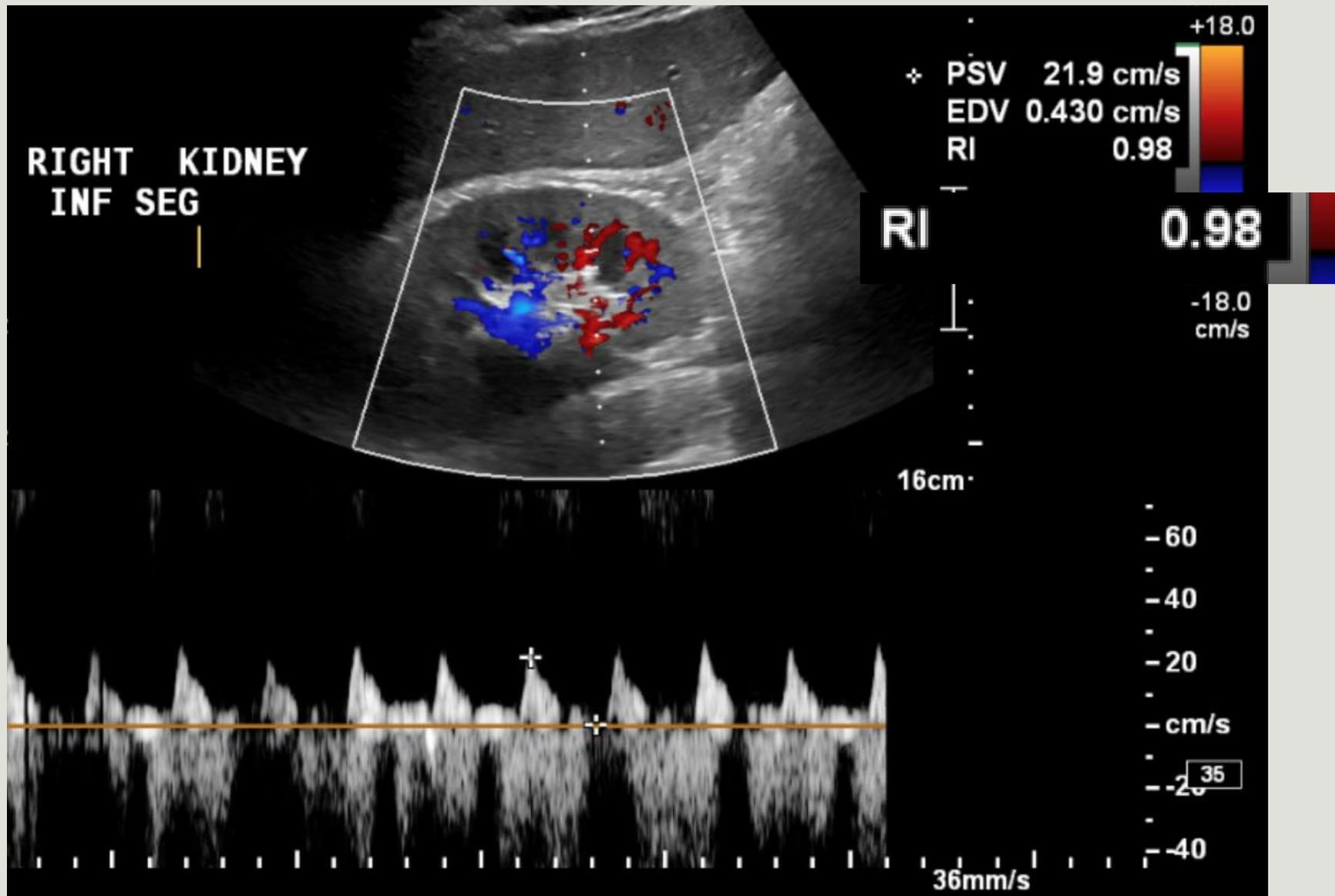
- High Resistive
- Low EDV

Indirect Findings:

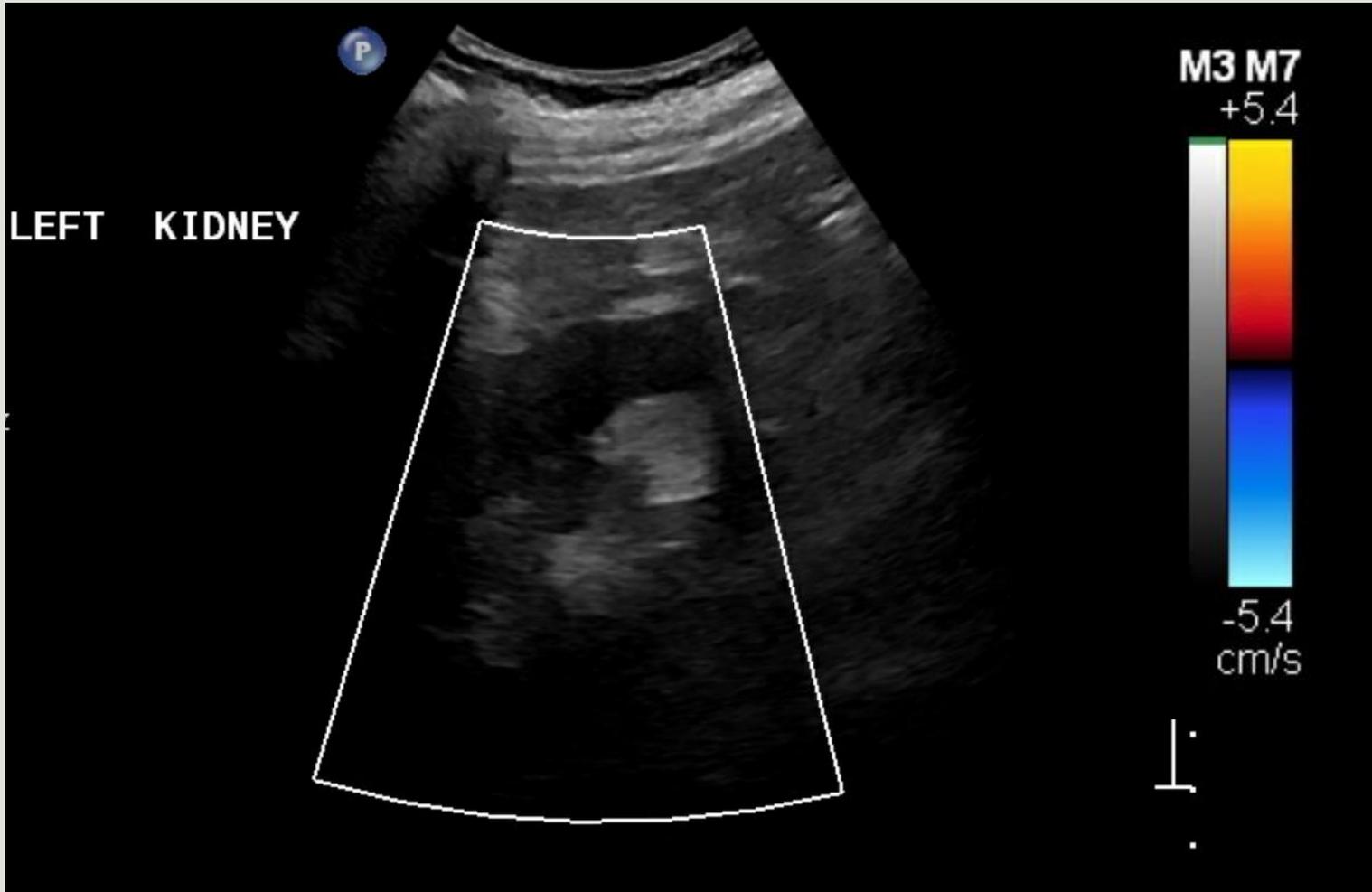
Cannot rule out a more distal obstruction

Expect to find increased resistive index

Possible parenchymal disease



Increased Resistive Index in the segmental arteries



What does this kidney color image tell us?

- No flow in the kidney
- Low Color Doppler Scale

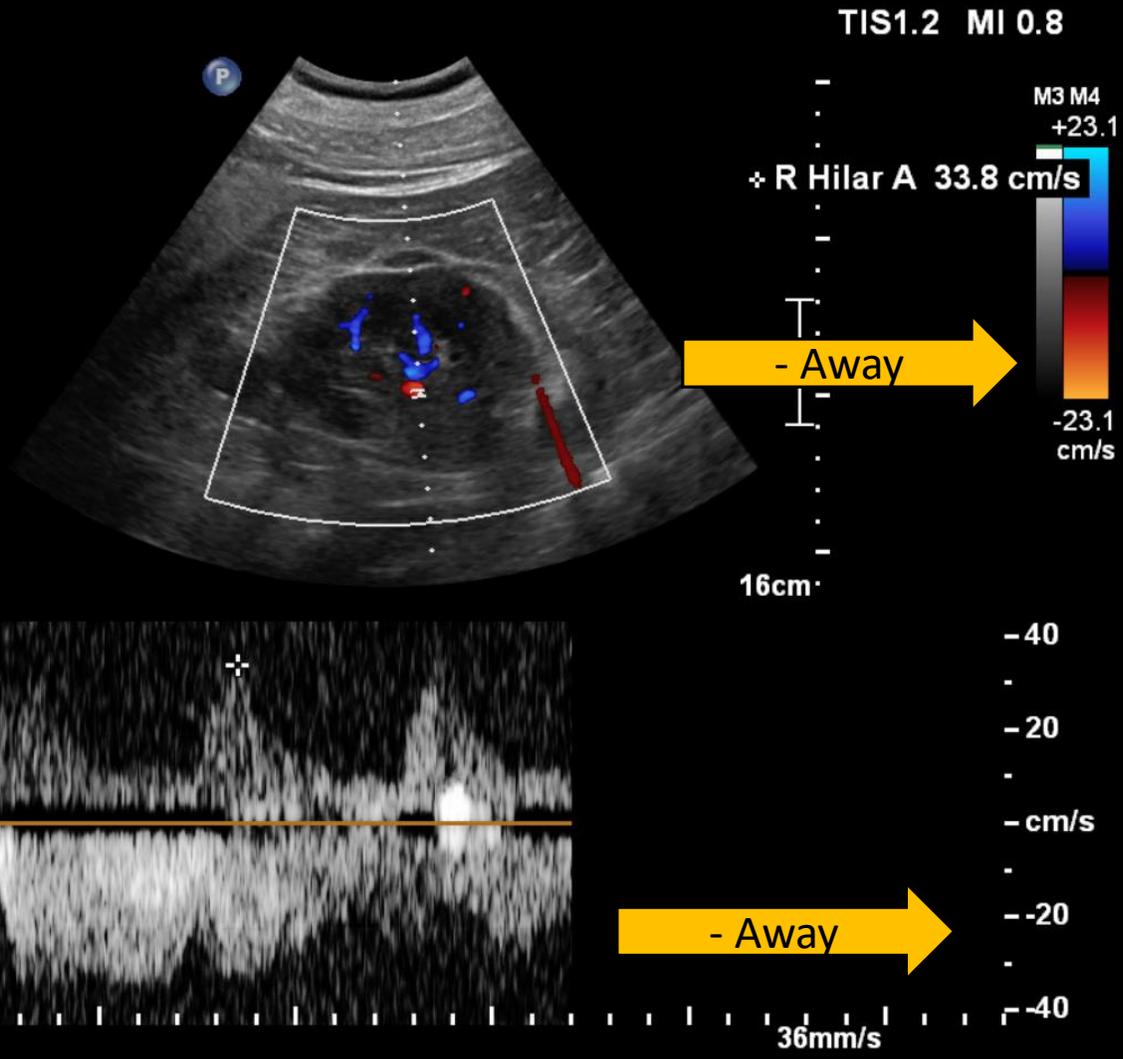
**Indirect Finding:**

Suspect renal occlusion  
Further testing?

Abd Vasc  
C5-1  
9Hz

2D  
66%  
Dyn R 55  
P Med  
HGen

CF  
52%  
1500Hz  
WF 97Hz  
2.5MHz  
PW  
60%  
WF 70Hz  
SV 2.0mm  
2.2MHz  
9.9cm

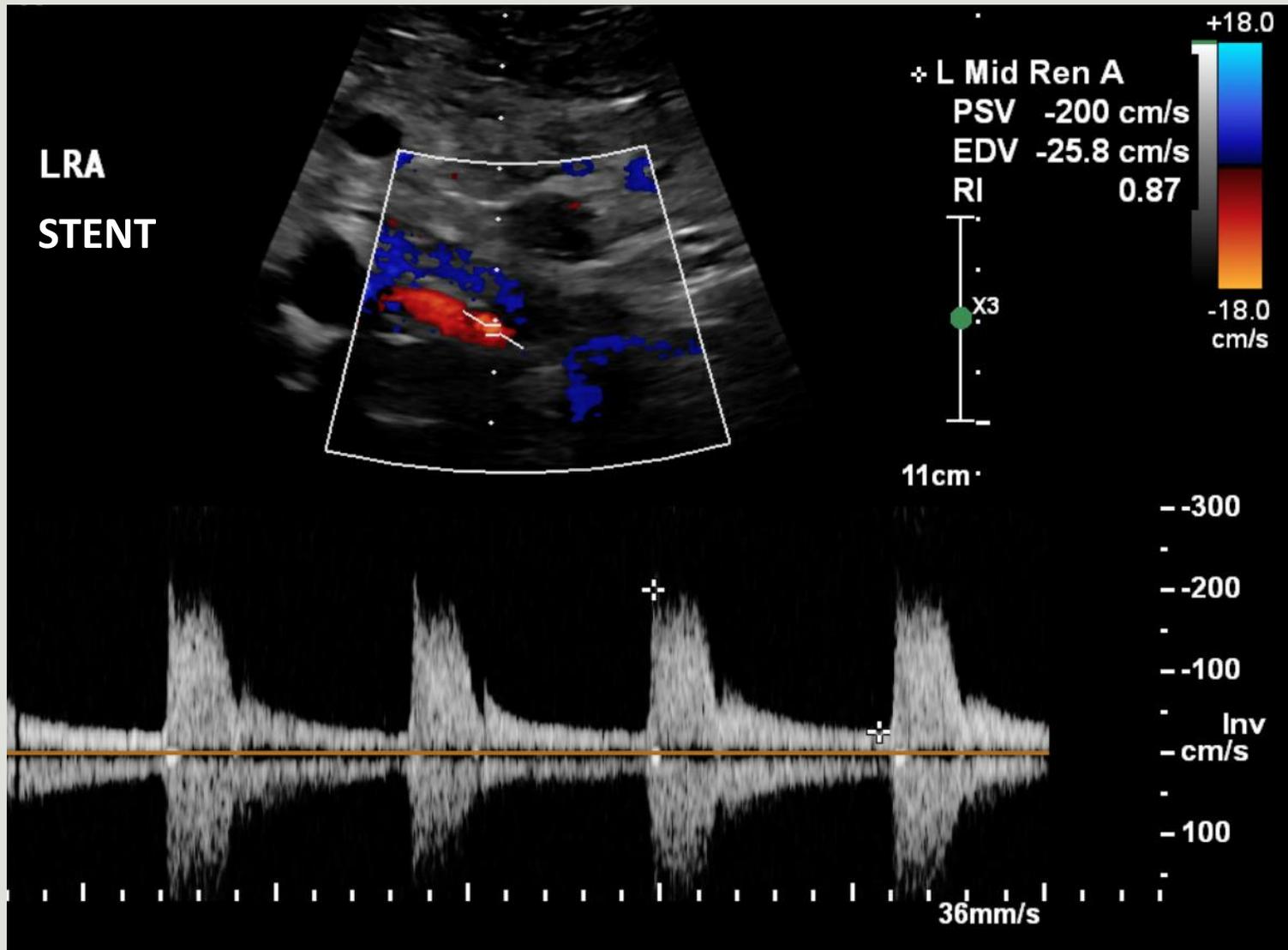


Color is inverted - **Red** is the vein (away from the kidney)  
**Blue** is the arteries (towards the kidney)

# What can we interpret from this image?

- Measuring hilar artery
- Is there more?????
- Spectral Doppler- see venous flow
- Spontaneous & phasic waveforms
- Color Direction?????

## Indirect Findings: Patent renal vein



What can we interpret from this image?

Stent

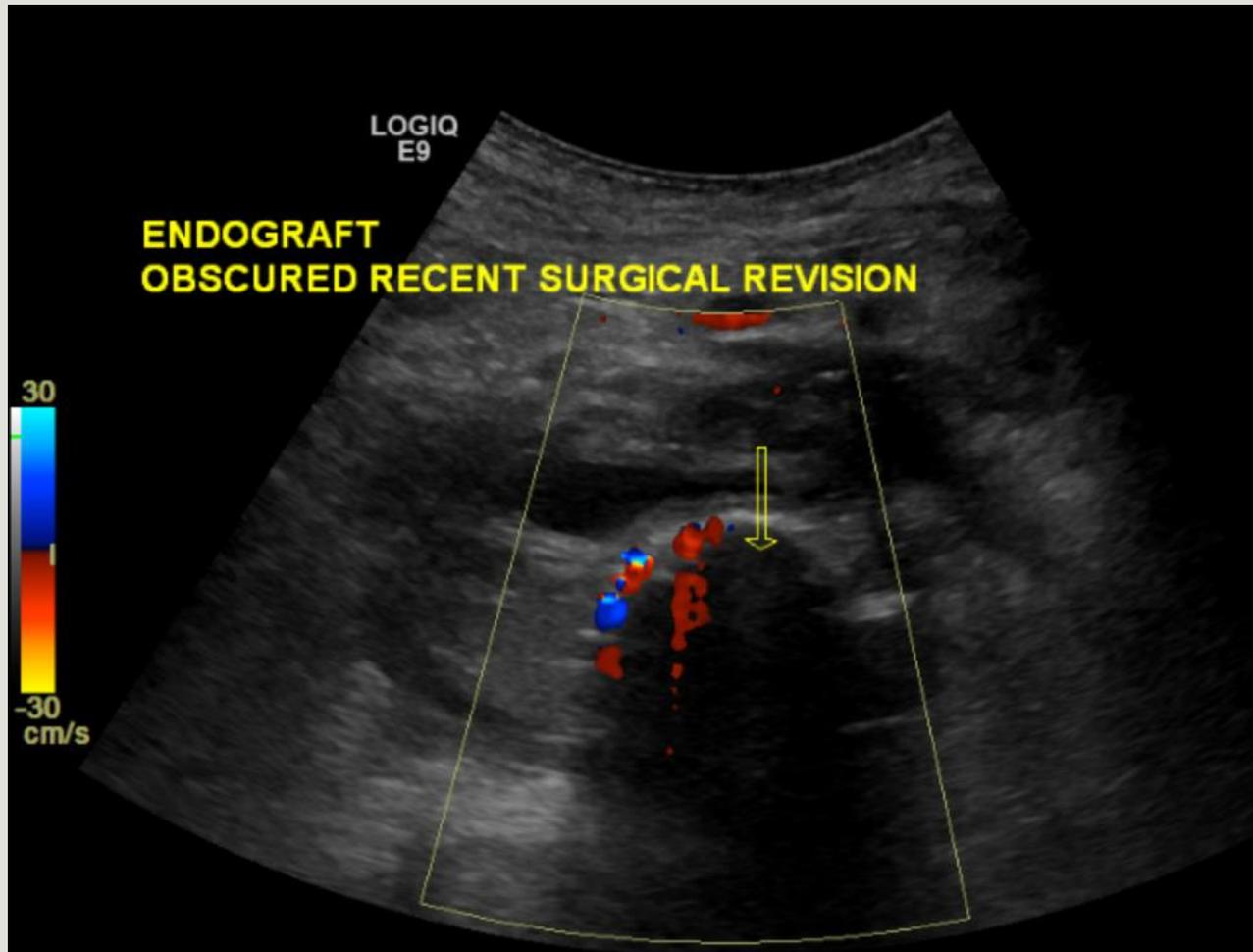
- Unable to visualize stent walls
- Uniform waveforms

Indirect Findings:

Able to see the stent is patent with no significant stenosis



# Case Study



## ICU Patient

- History of prior aorto-bi-iliac bypass with juxtarenal aneurysmal degeneration
- Presented with contained rupture into residual sac around proximal aspect of prior aorto-bi-iliac bypass
- Increased Creatinine

LOGIQ  
E9

LT KIDNEY  
SEG A MID

PS 10.7 cm/s  
ED 8.3 cm/s  
RI 0.23

18  
-18  
cm/s

TARDUS-PARVUS

5  
10  
20  
cm/s  
-10

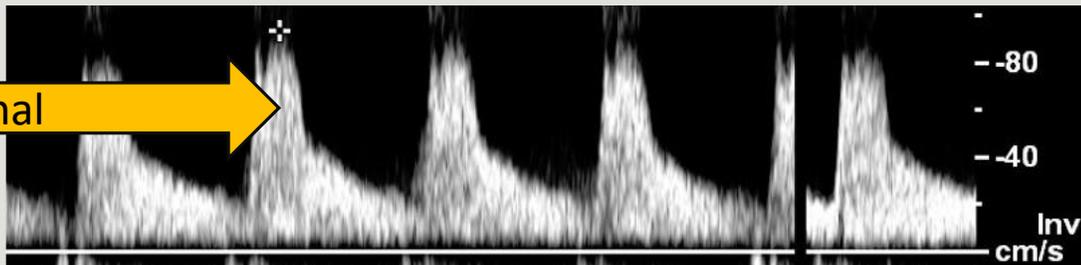
# What does this distal waveform tell us?

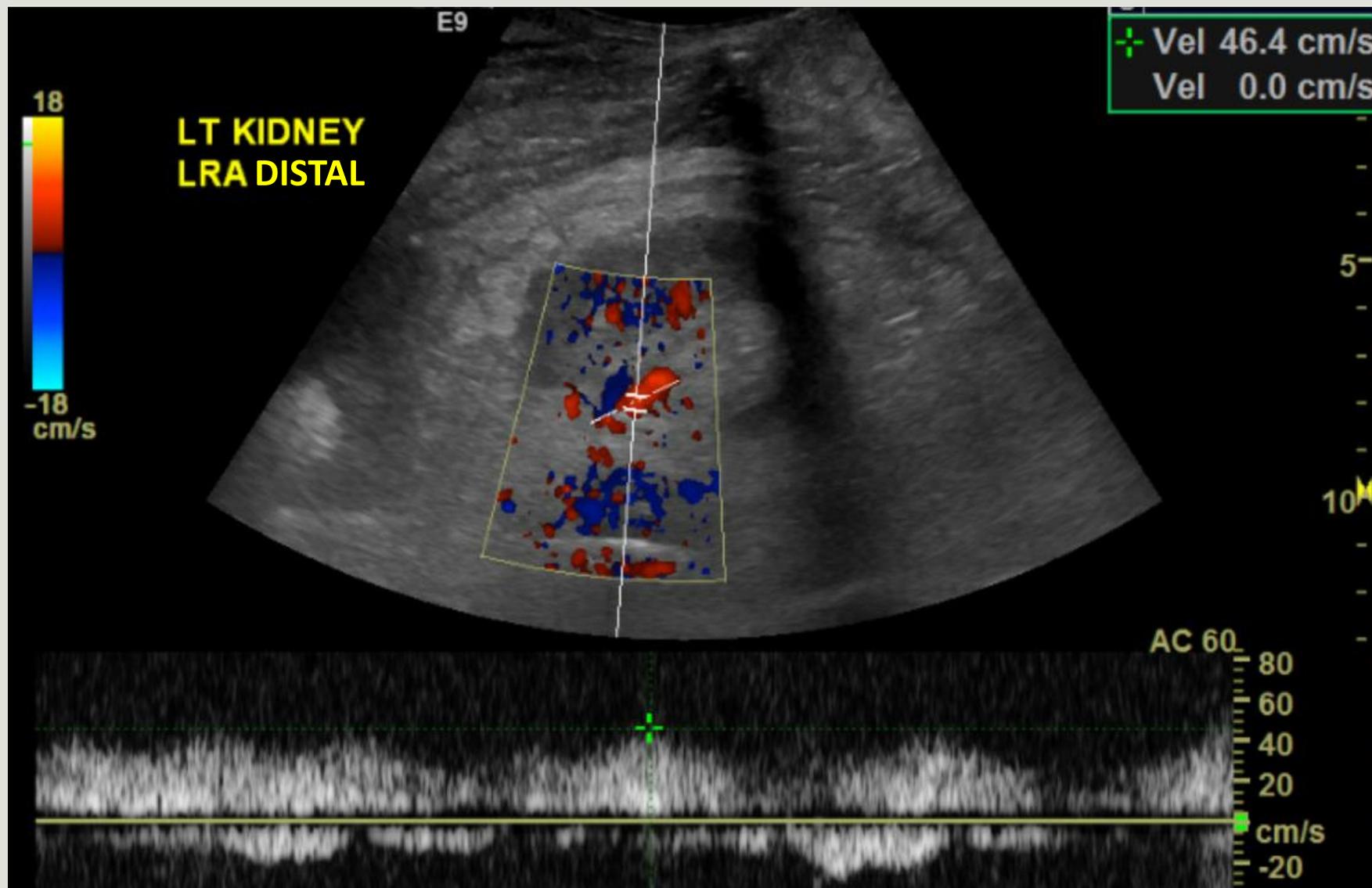
- Tardus-Parvus
- Antegrade
- Low resistive, dampened, and monophasic

## Indirect Findings

Suggests a more proximal obstruction/occlusion

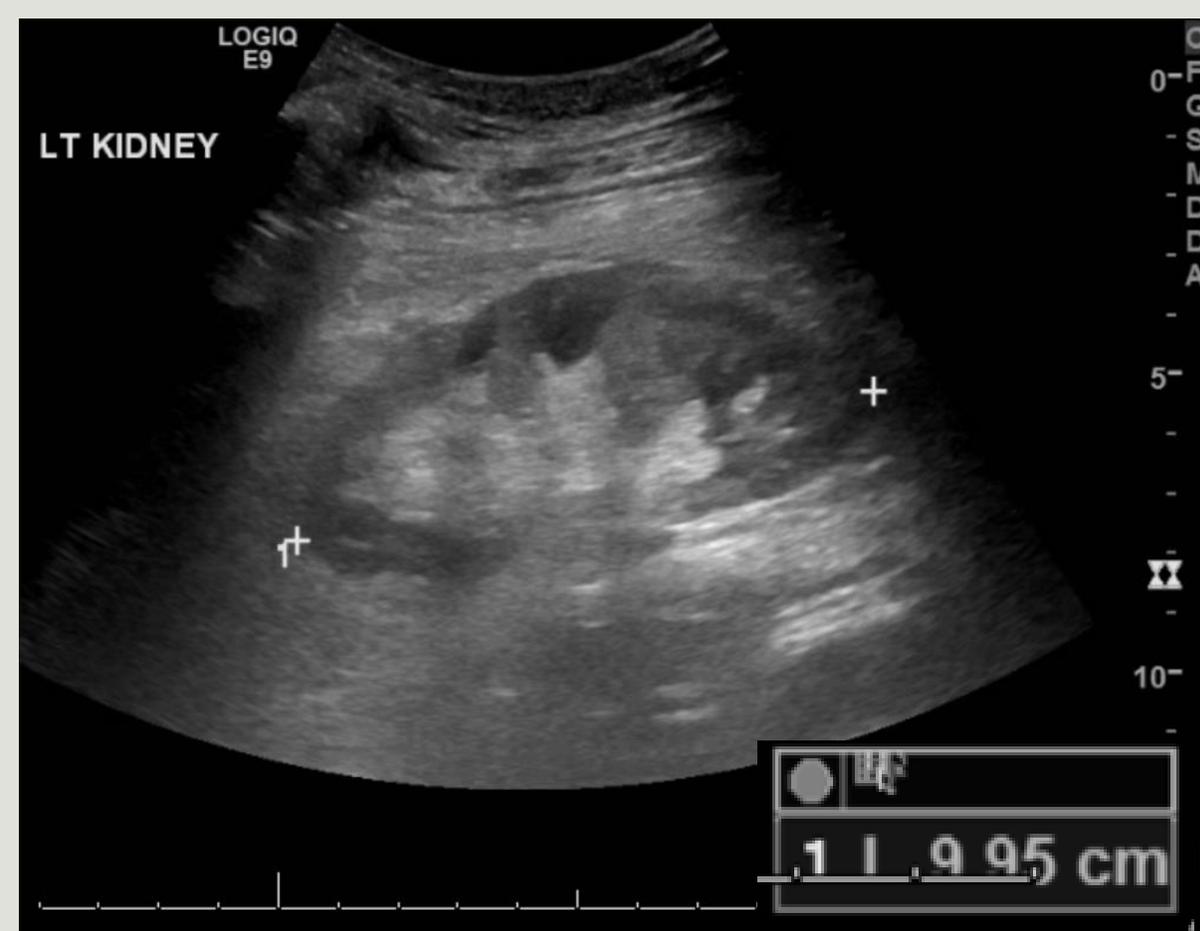
Normal





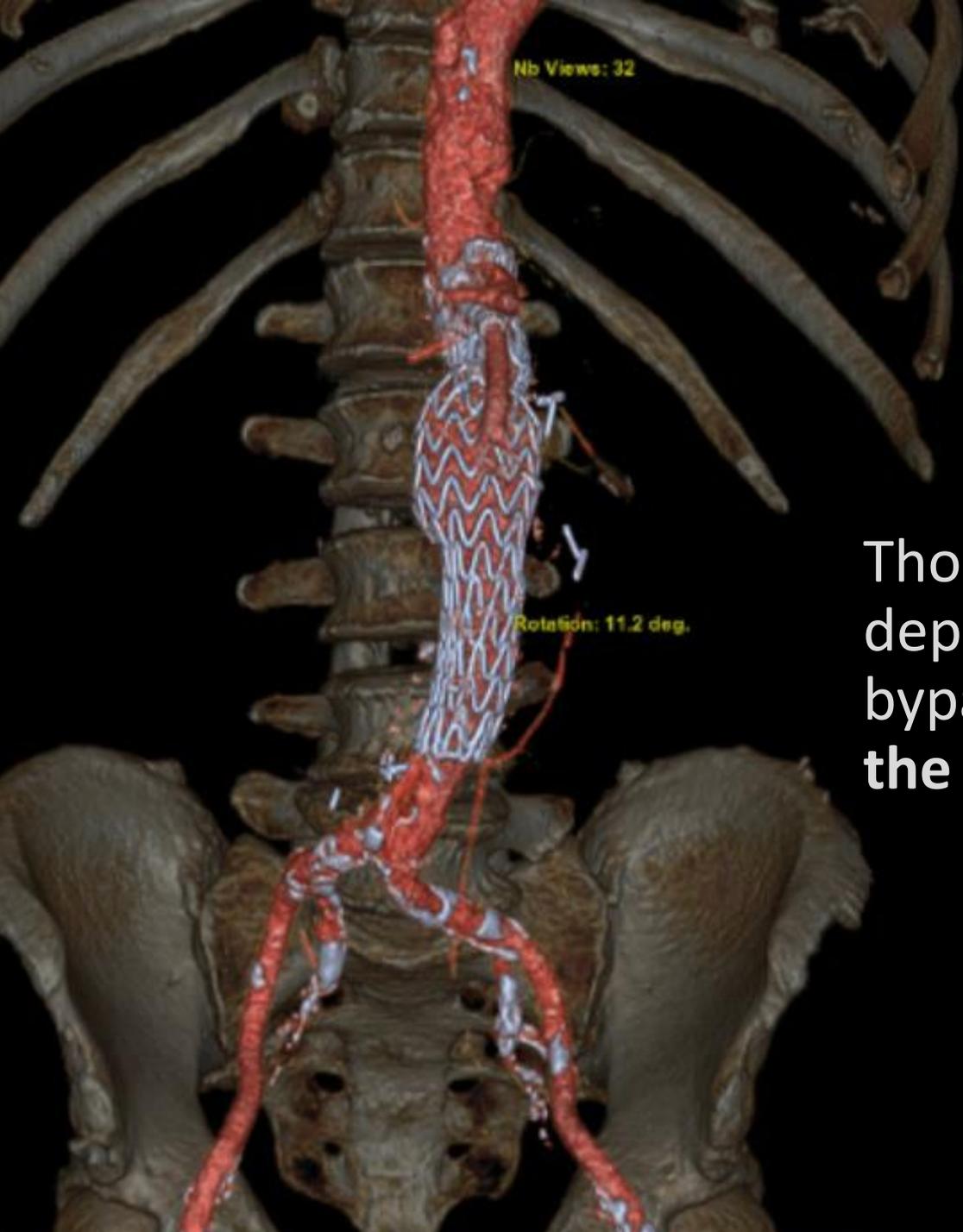
Distal Renal Artery:

Continued dampened waveforms suggest more proximal obstruction/occlusion



## Kidney Size

Same size- Acute thrombosis/occlusion?



Thoracic stent-graft was deployed into the prior aortic bypass graft with **coverage of the bilateral renal arteries**



# Summary

---

1. Duplex imaging is helpful
2. There are pitfalls and limitations to overcome
3. Image quality can vary but still answer the clinical question
4. Indirect findings are important and can provide valuable information

# Thank you for your time!



**UC DAVIS**  
**HEALTH**

Kourtney Spencer BS, RVT  
UC Davis Health  
Vascular Lab  
[kspencer@ucdavis.edu](mailto:kspencer@ucdavis.edu)



[STRANDNESS.ORG](http://STRANDNESS.ORG)