Transcranial Doppler Non-Imaging Technique

Brenda Rinsky, RDMS, RVT, NVS

Assistant Manager, Stroke Program
Technical Director, Neurovascular Ultrasound Laboratory
Dept. of Neurology
Cedars-Sinai Medical Center

Vessel Identification

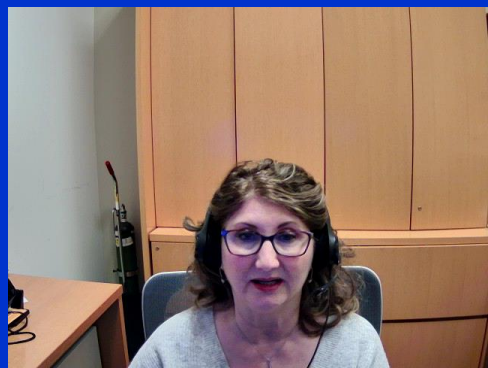
No Visual Map - Audio

1. Find the best window (signal intensity and **pitch**)

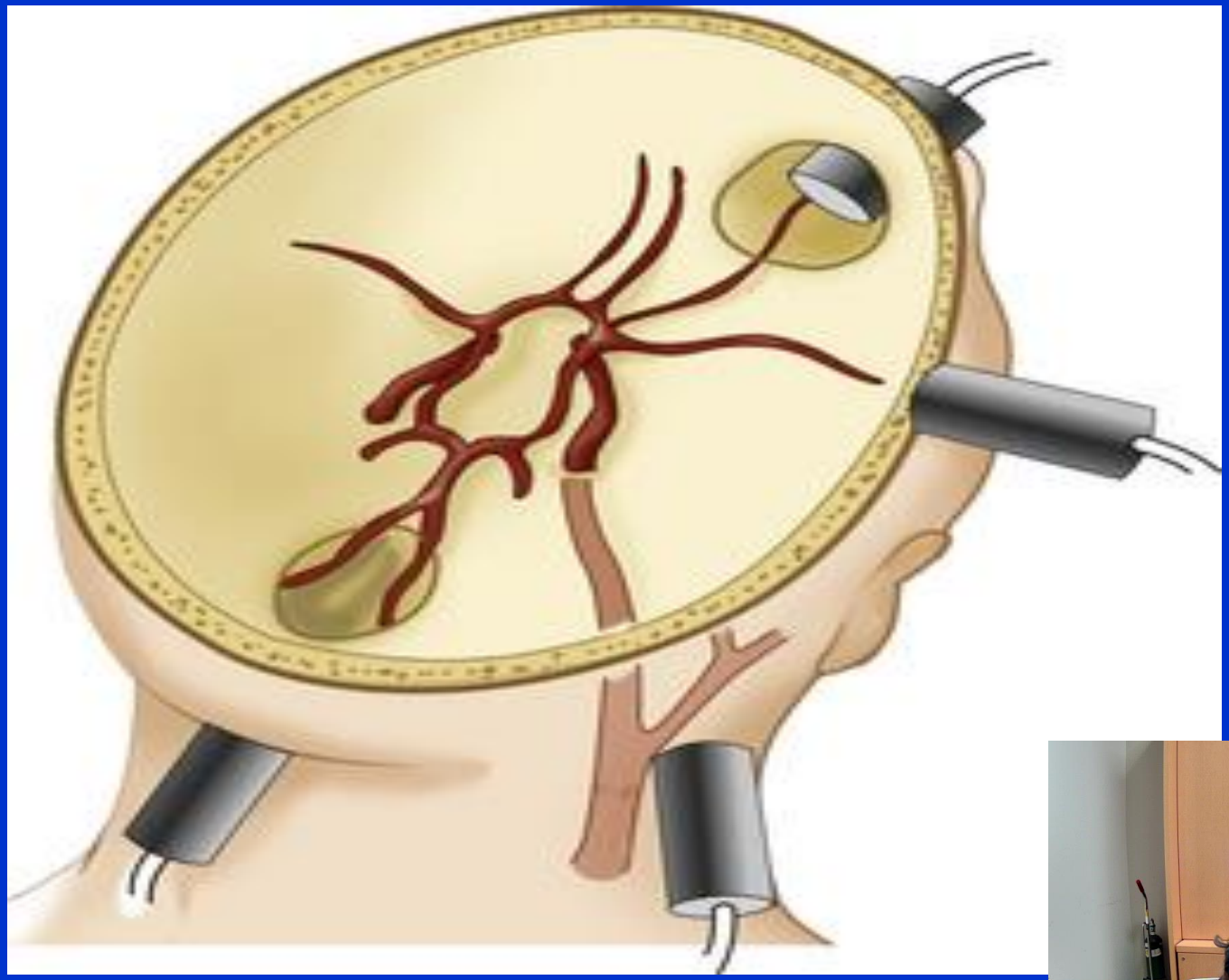
2. Follow the anatomical landmarks and adjust depths for age and head size: Infant, Child, Adult

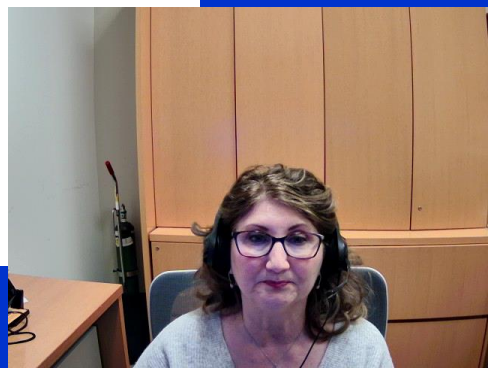
3. Determine Flow Direction

4. Spatial relationship with other vessels:
   - Anterior to Posterior circulation
   - Develop a mental 3-D image

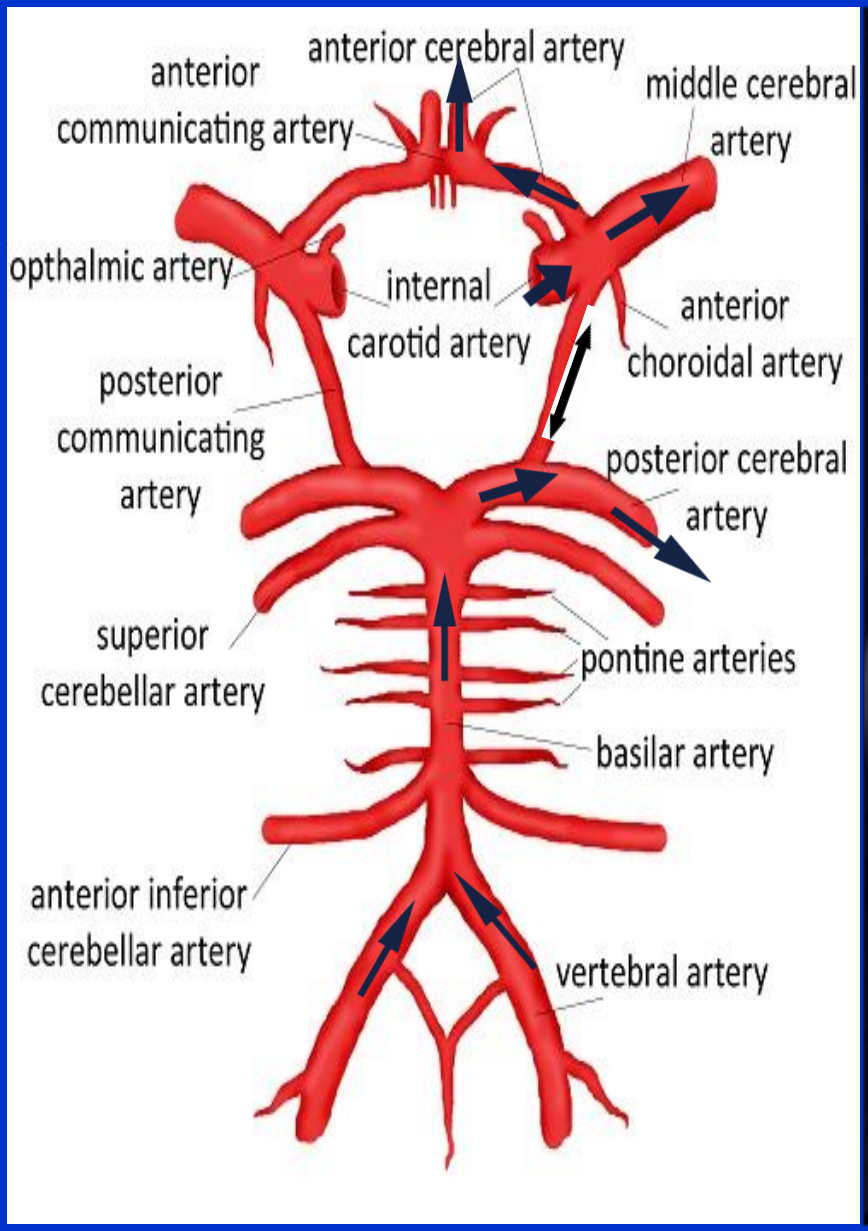


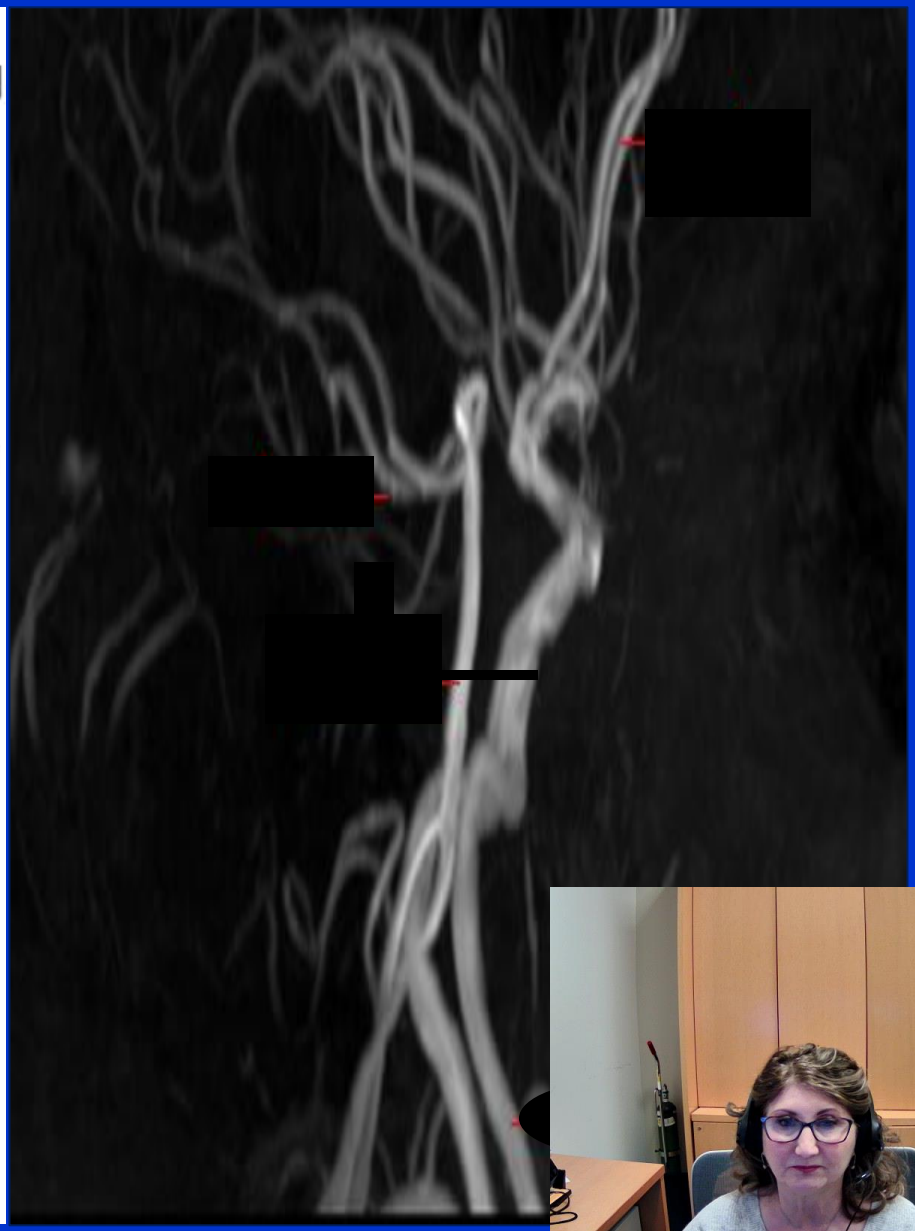
Acoustic Approaches





Navigating through the Circle of Willis



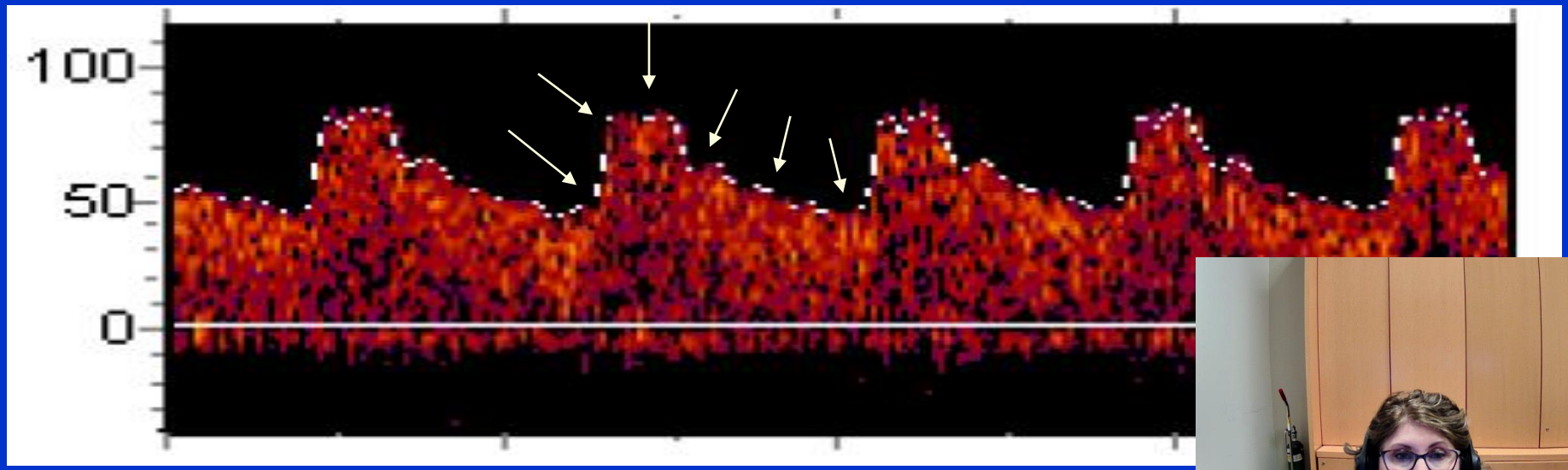


Velocity

All Peaks Velocities are Averaged Within A Single Cardiac Cycle

Time -Averaged Mean Velocities (TAMV)

“Envelope Fit”



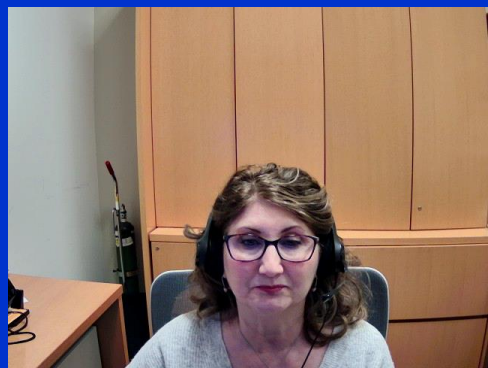
Vessel Velocity Hierarchy

Anterior Circulation:

- MCA
- ACA
- PCA

Posterior Circulation:

- Basilar
- Vertebral

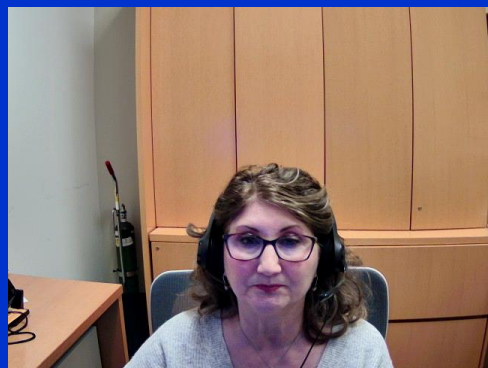


Normal Values

Artery	Window	Depth (mm)	Direction	Mean Flow Velocity
MCA	Temporal	30 to 60	Toward probe	55 ± 12 cm/s
ACA	Temporal	60 to 85	Away	50 ± 11 cm/s
PCA	Temporal	60 to 70	Bidirectional	40 ± 10 cm/s
TICA	Temporal	55 to 65	Toward	39 ± 09 cm/s
ICA (siphon)	Orbital	60 to 80	Bidirectional	45 ± 15 cm/s
OA	Orbital	40 to 60	Toward	20 ± 10 cm/s
VA	Occipital	60 to 80	Away	38 ± 10 cm/s
BA	Occipital	80 to 110	Away	41 ± 10 cm/s

TCD, transcranial Doppler; MCA, middle cerebral artery; ACA, anterior cerebral artery; PCA, posterior cerebral artery; TICA, terminal internal carotid artery; ICA, internal carotid artery; OA, ophthalmic artery; VR, vertebral artery; BA, basilar artery.

Reference:: R. Aaslid



Pulsatility Index Calculation

Vessel Flow Resistance

$$PI = \frac{PSV - EDV}{\text{Mean Velocity}}$$

Below Normal = < .6

Normal = .6 to 1.1

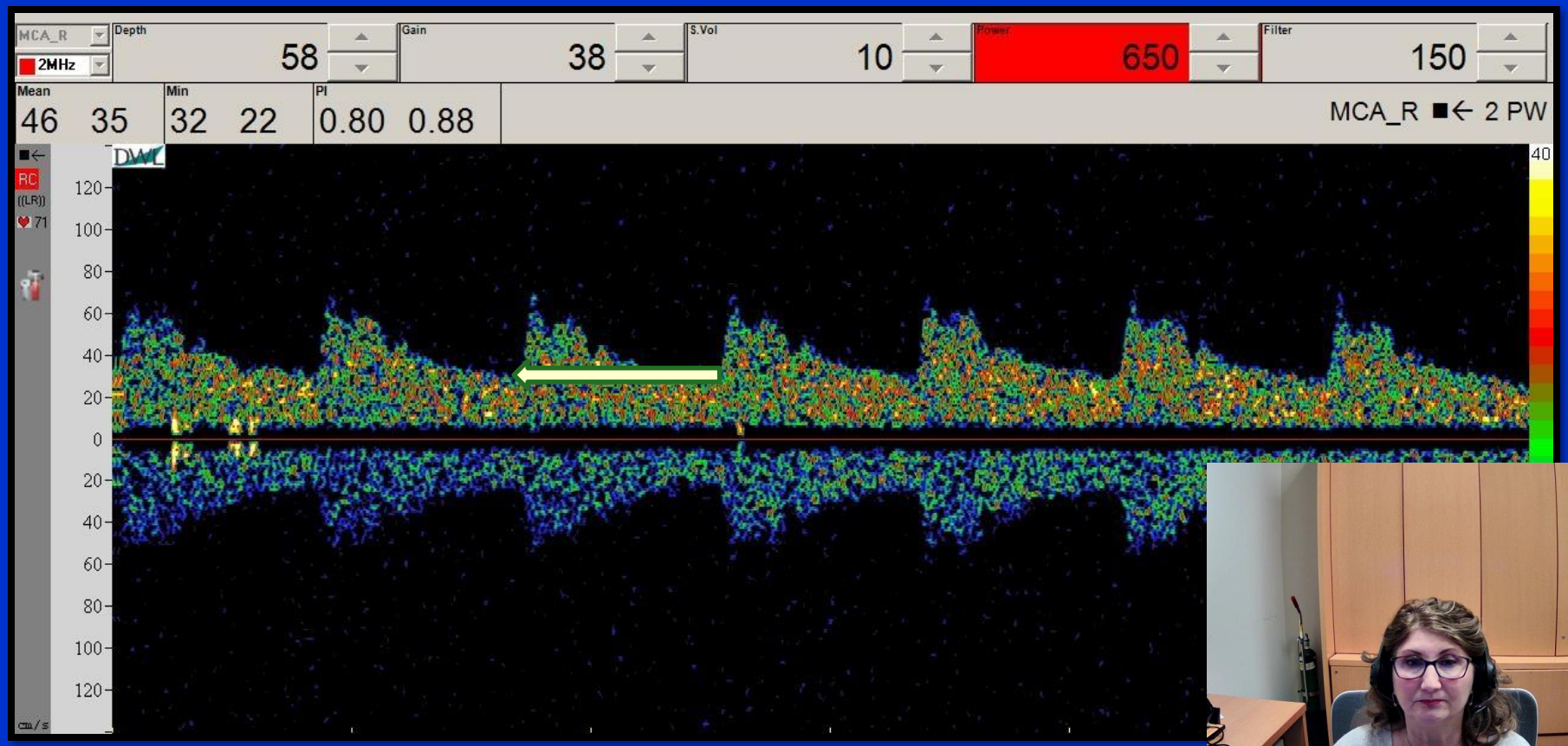
Above Normal = 1.2 to 1.5

Abnormal = > 1.5

Visual Measure of Resistance

Normal Resistance:

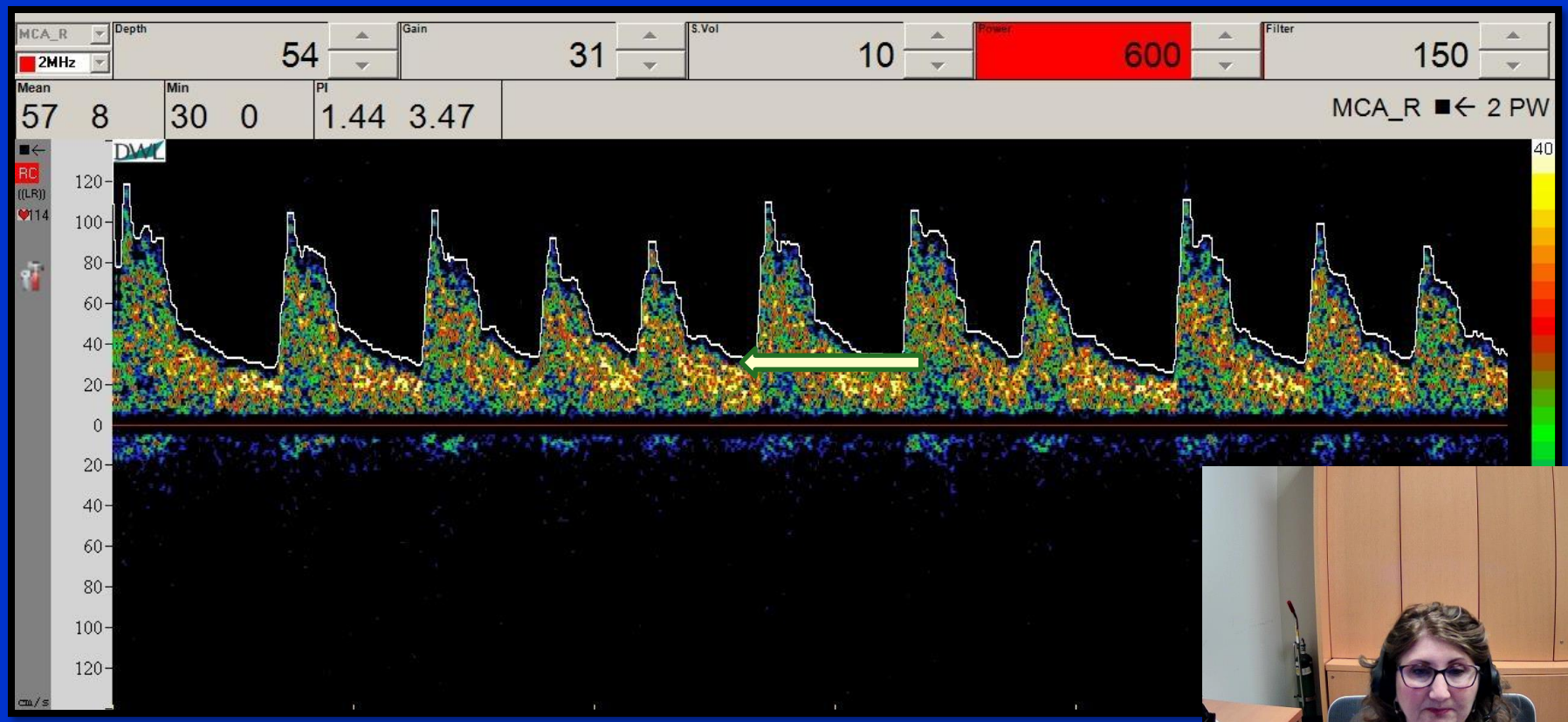
End Diastole Reaches to ½ of The Total Height of The Waveform



Visual Measure of Resistance

High Resistance:

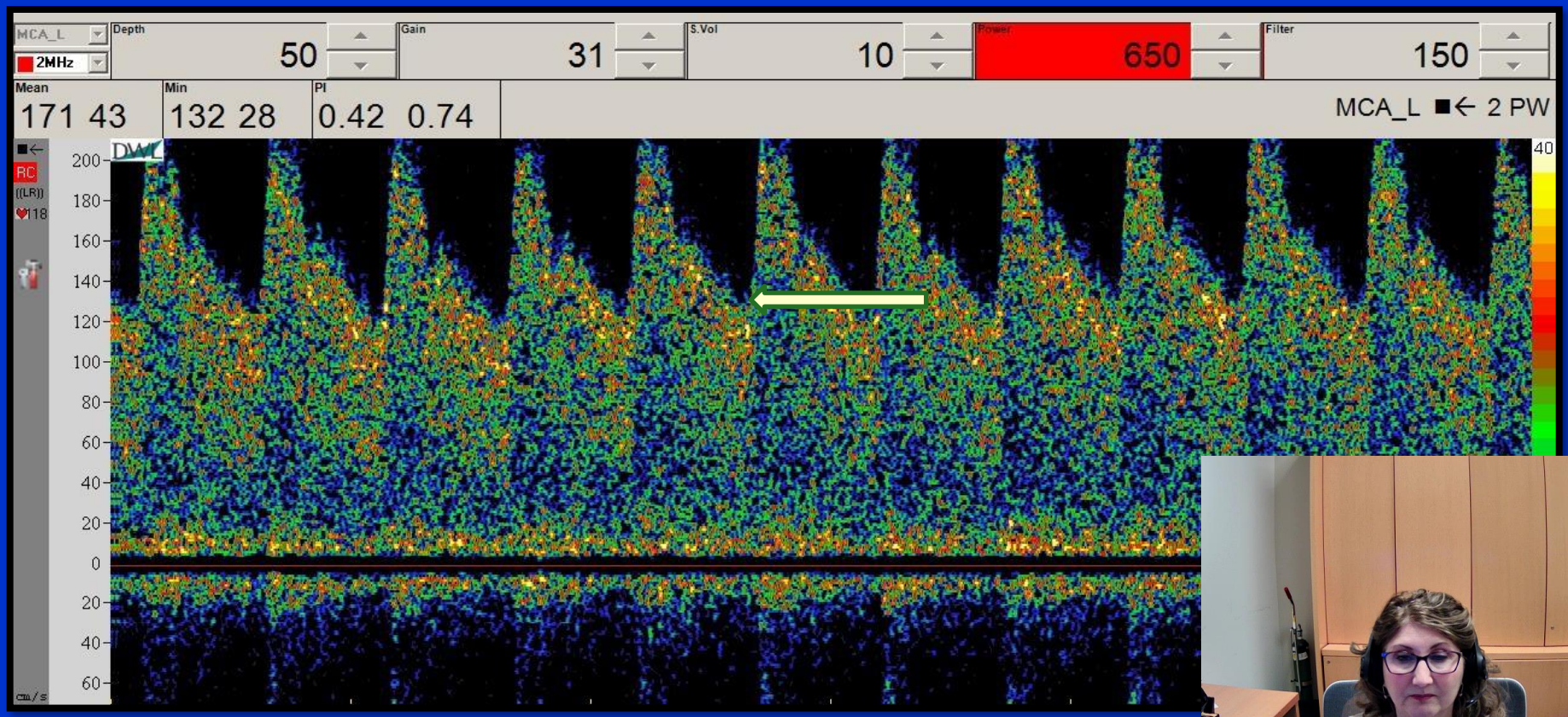
End Diastole Reaches Only 1/3 of The Total Height of The Waveform



Visual Measure of Resistance

Low Resistance:

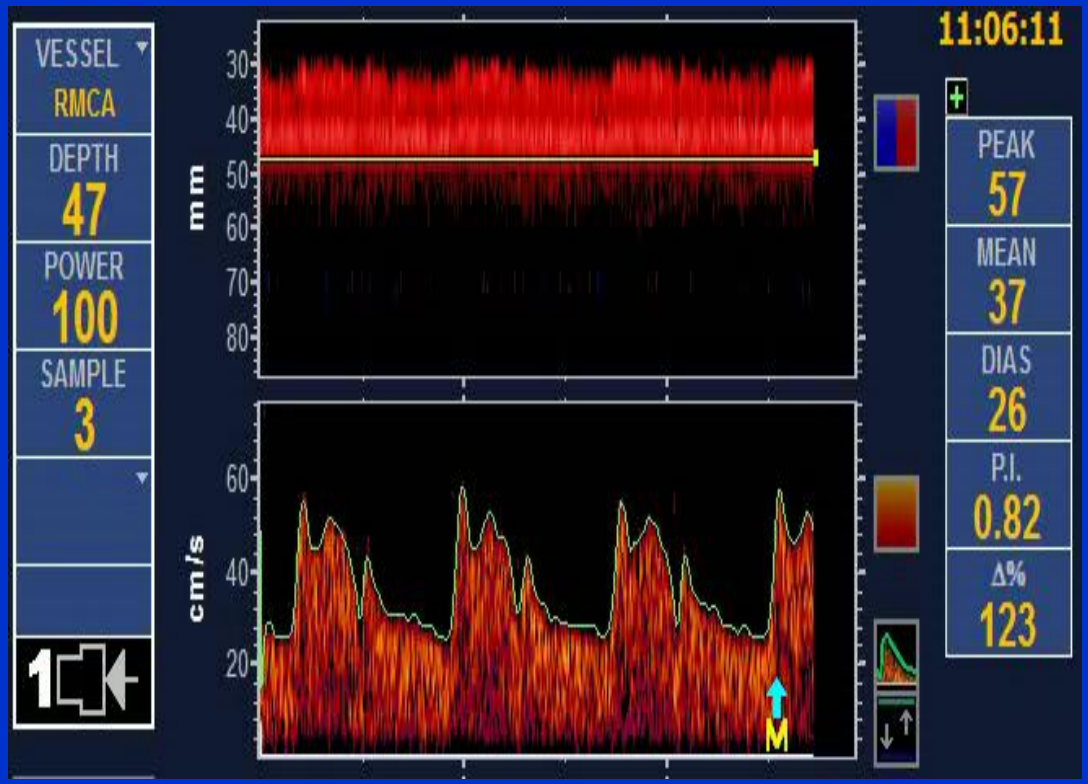
End Diastole Reaches Up To 2/3 The Total Height of The Waveform



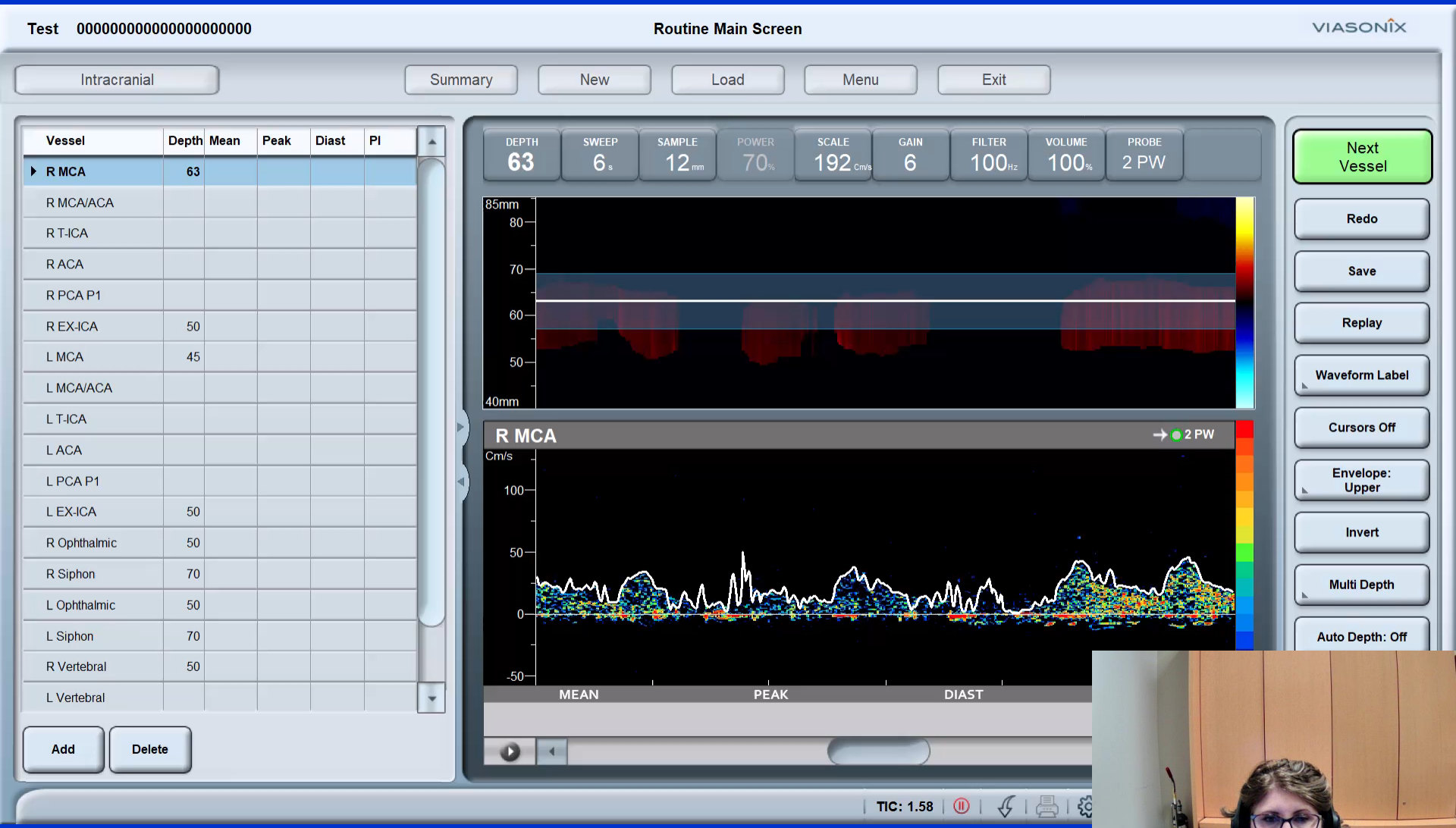
Normal Waveform

How To Identify:

1. Normal velocity
2. Normal P.I.
3. Straight Upstroke
4. No significant bruit



The Importance of Angle: Highest Pitch = Highest Velocity



Transducer Technique

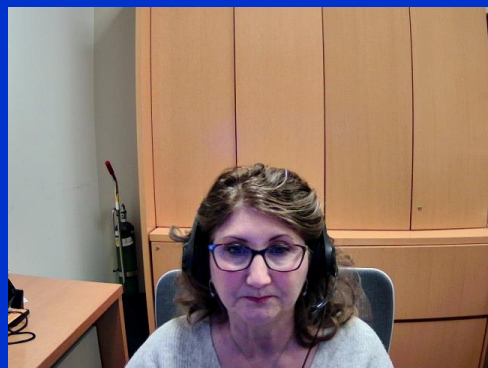
3 Ways to Improve the Doppler Signal:

1. **Angulation:** Tipping the probe on its edge
2. **Push- Pull:** Pushing or pulling against the skin without an angle change
3. **Sliding:** Sliding the probe over the skin to a different location

Transducer Technique:

Overhand

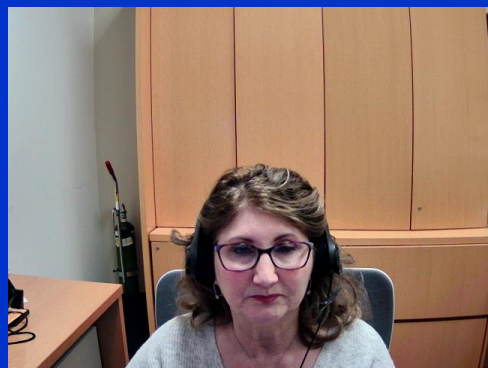
General all-purpose hand-hold



Transducer Technique:
Underhand

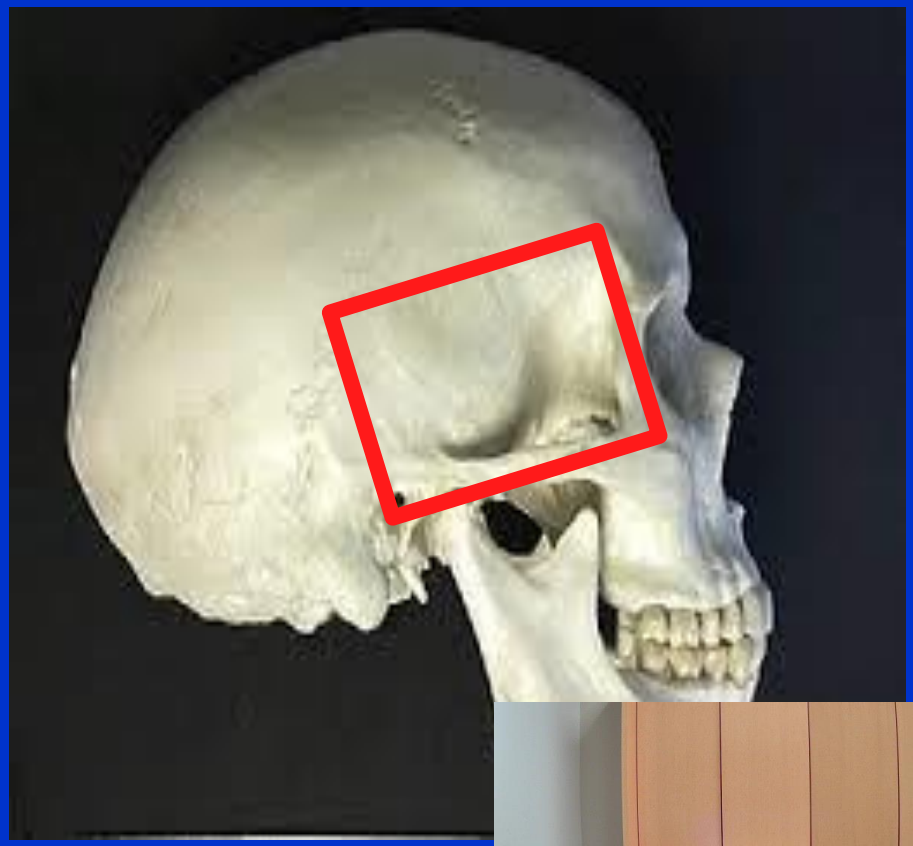
Transforamenal Approach

Transducer Technique:
Backhand



Where Do I Begin?
The Transtemporal Approach

- Above the Zygomatic Arch
- Behind the Orbital Ridge



Anterior Circulation

The Temporal Window

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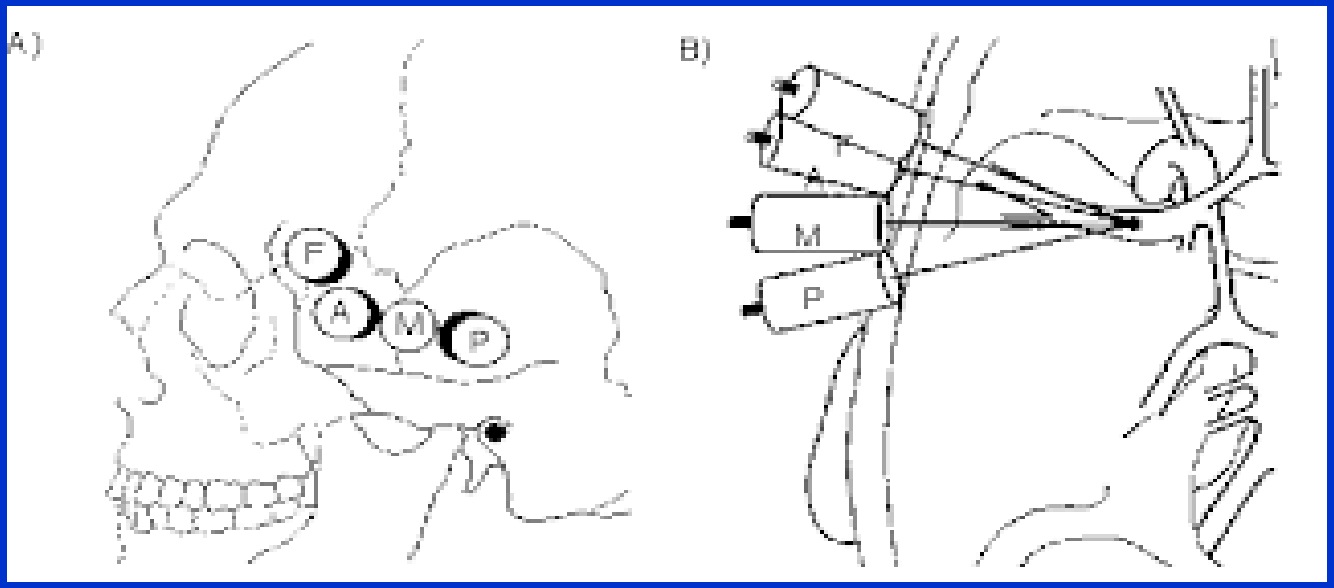
- **Anterior**
- **Middle**
- **Posterior**
- **Frontal**



How do I Angle the Transducer?
-MCA-

- Temporal Bone
- Angle **Superiorly**
- Depth: 40-65mm
- Flow Direction: **Toward**

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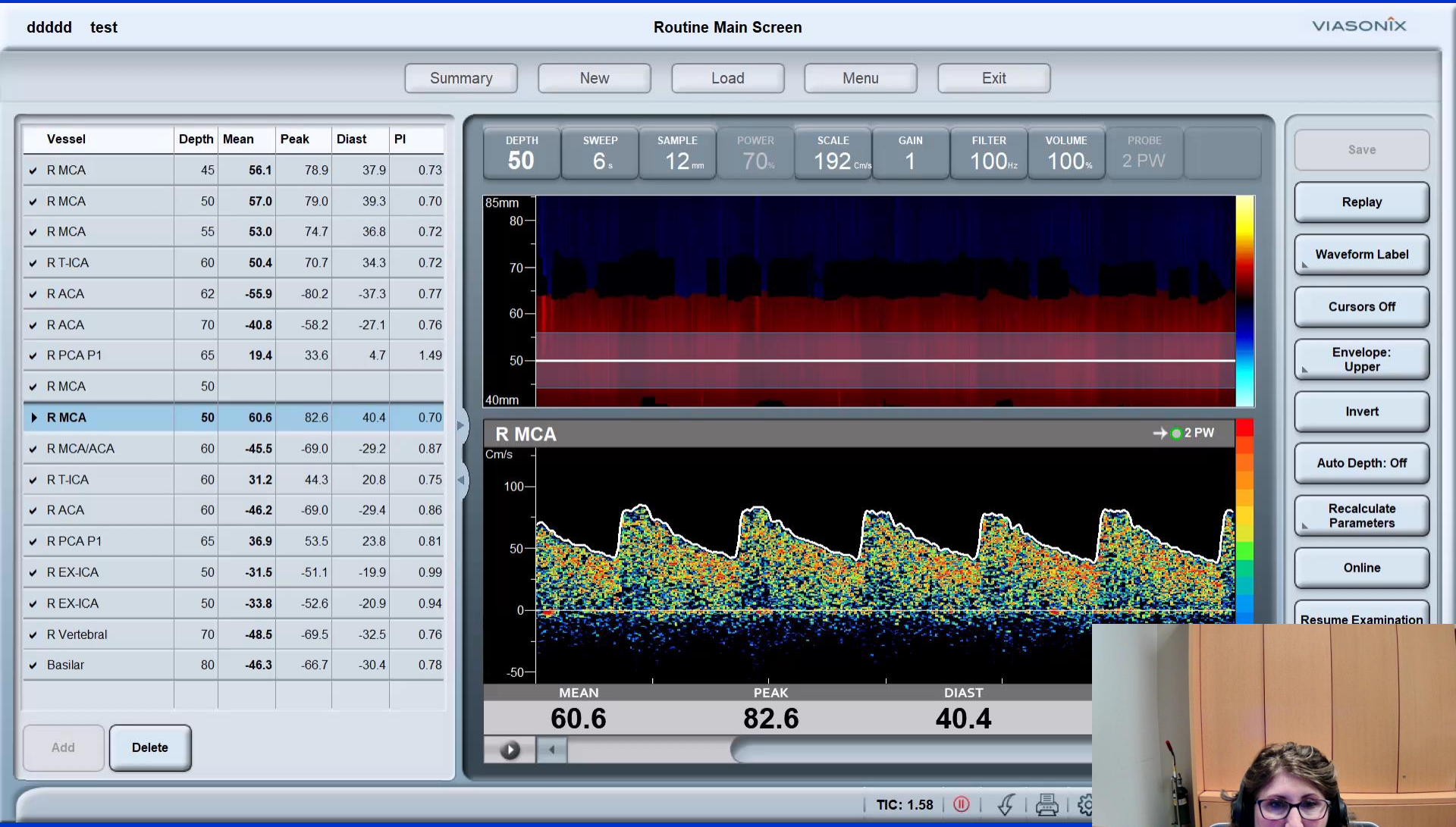
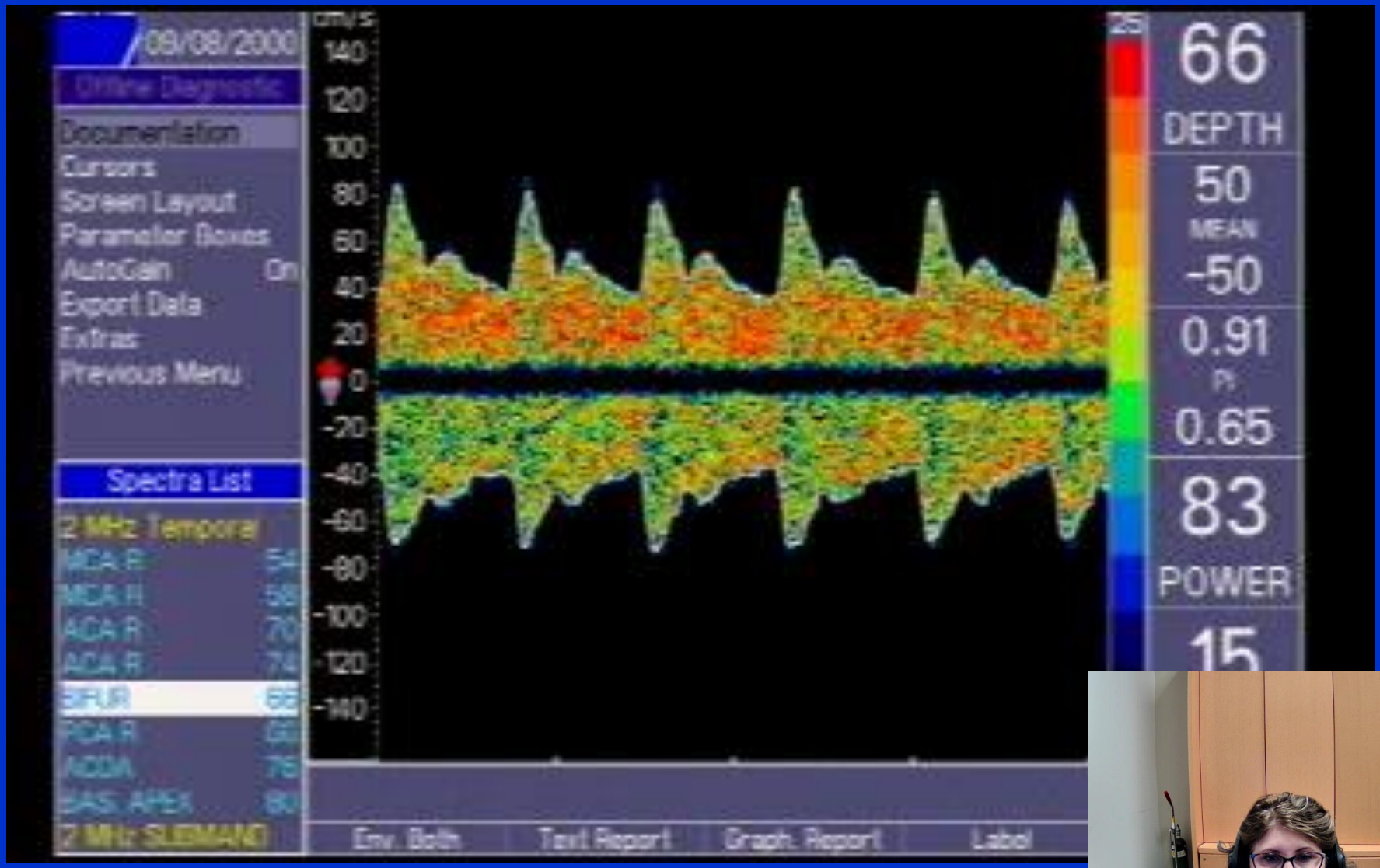
MCA (40-60mm)
Angle: Superior and Anterior

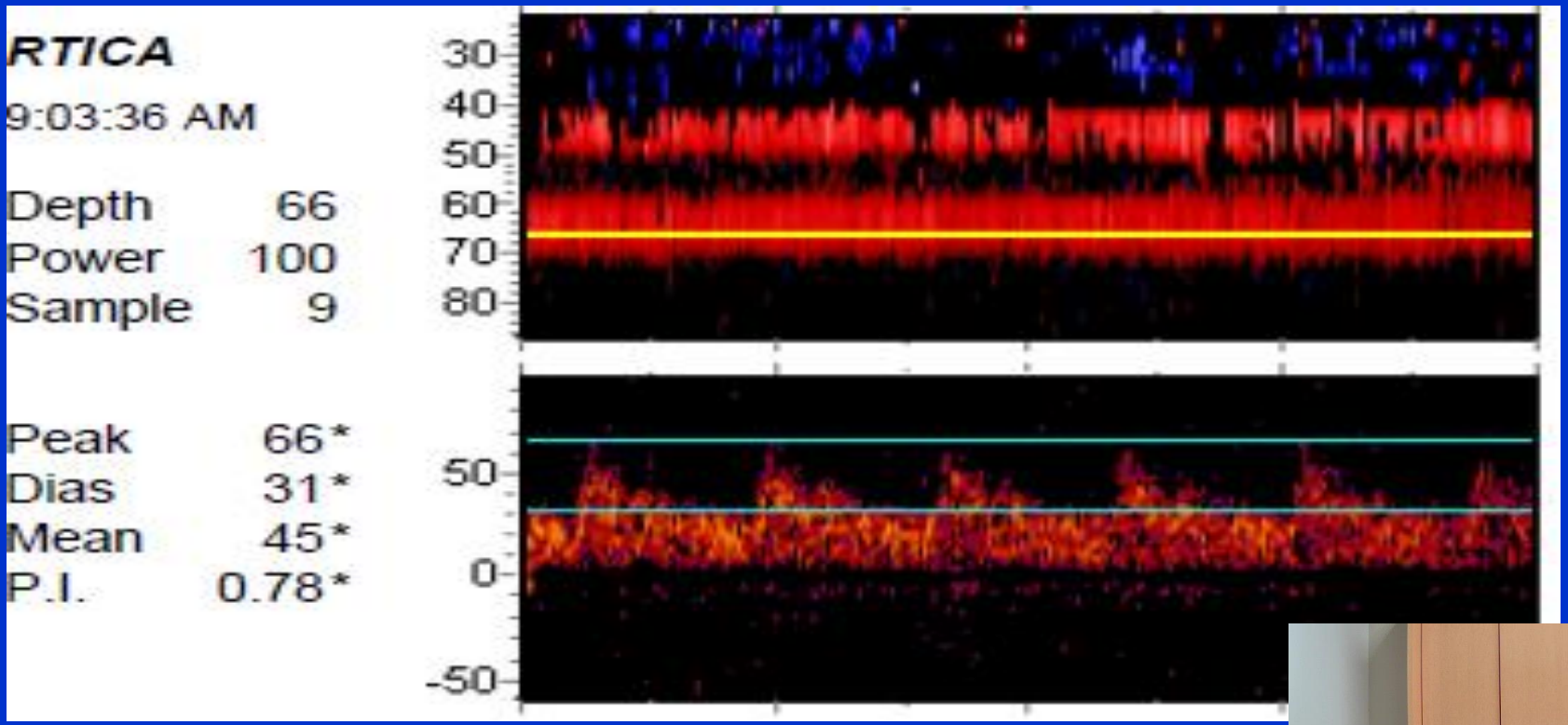


MCA/ACA Bifurcation (60-70mm)



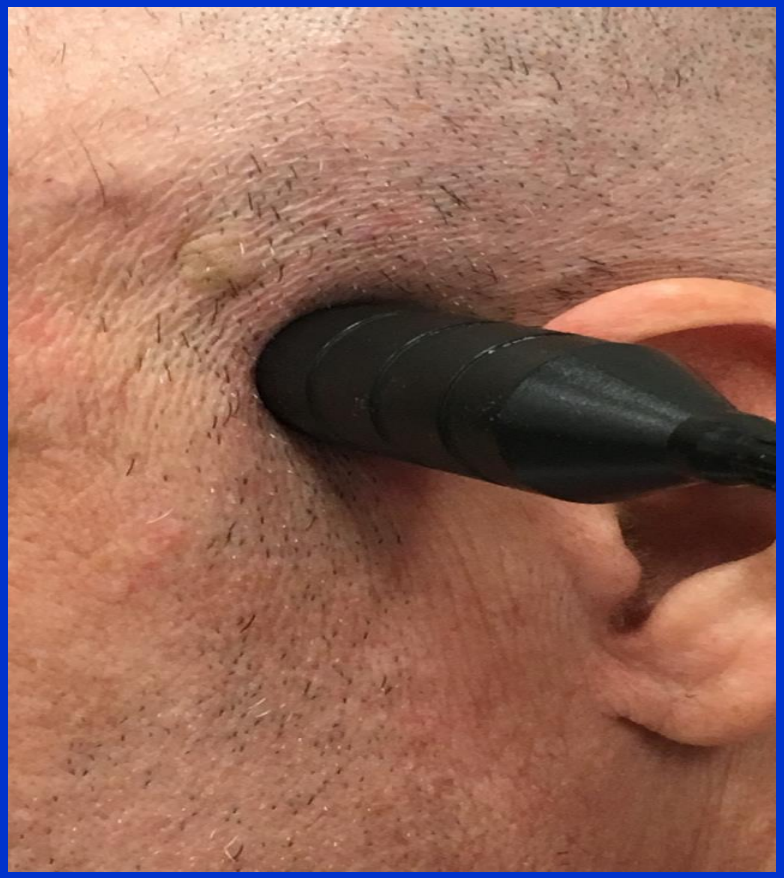
TICA (Terminal ICA)

Find the Bifurcation - Then Angle Toward the Feet



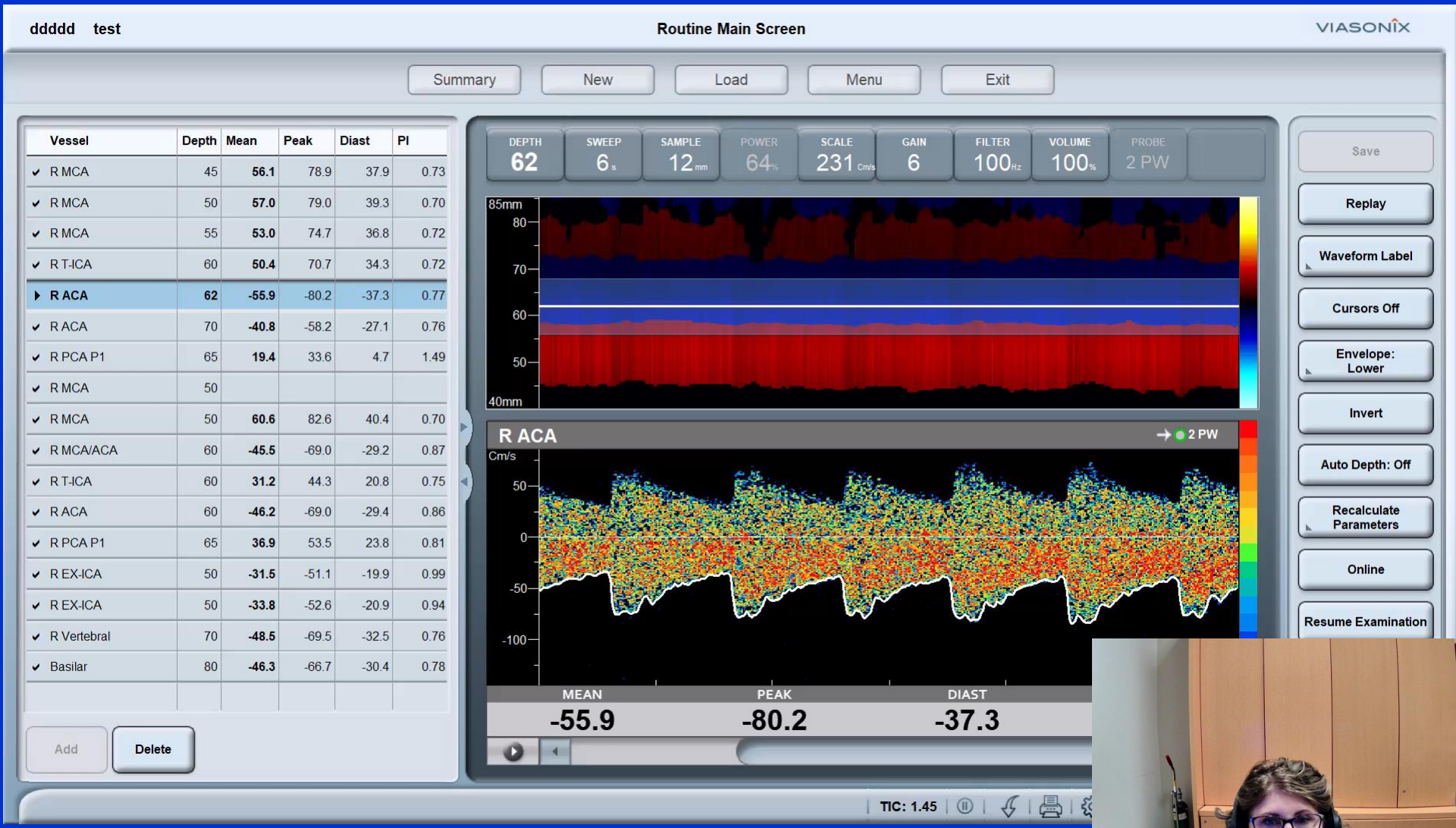
How Do I Angle the Transducer?

-ACA-

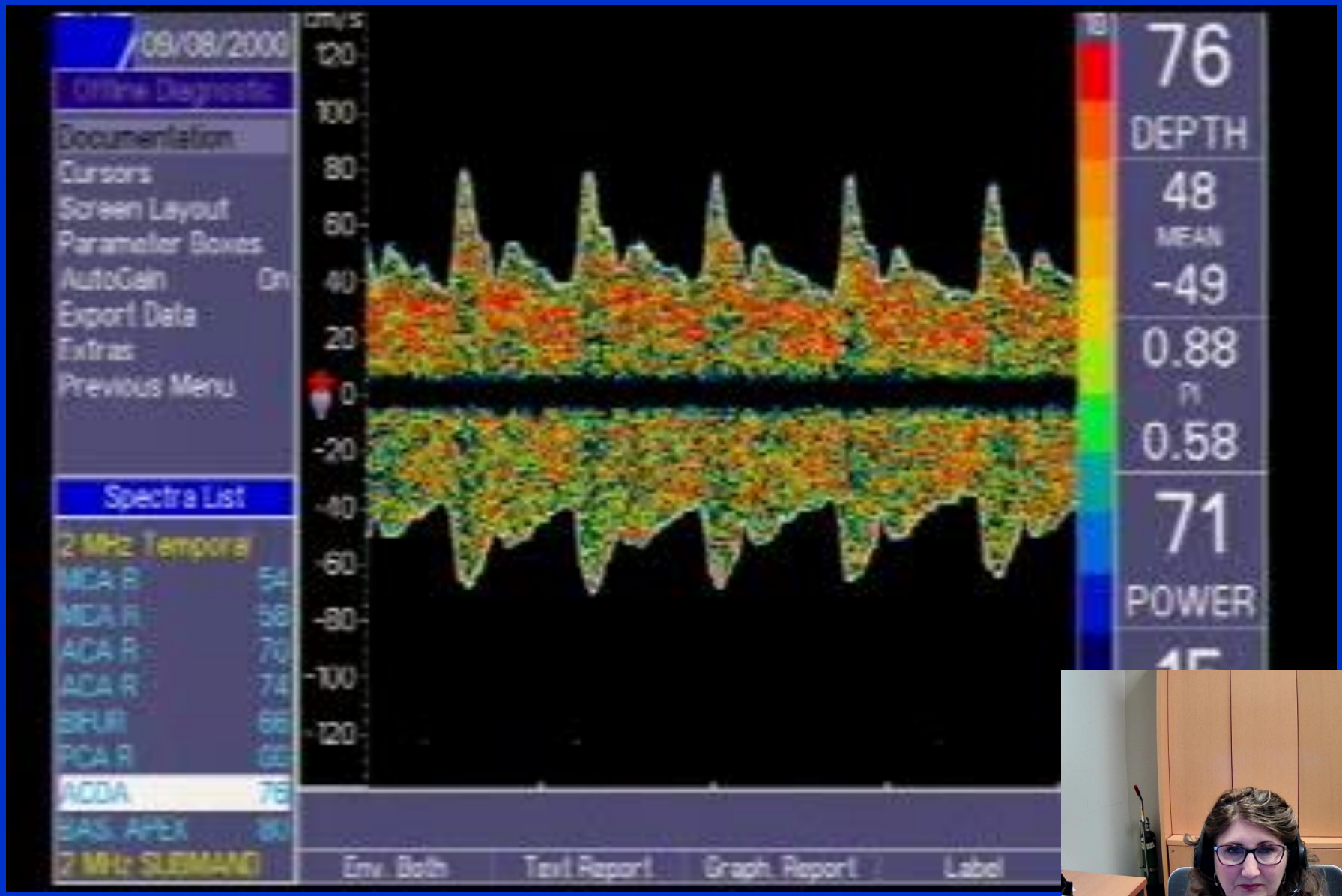


- Temporal Bone
- Angle **Anteriorly**
- Depth: 60-75mm
- Flow Direction: **Away**

ACA (60-75mm)
Angle: Anterior



ACoM (75-80mm)

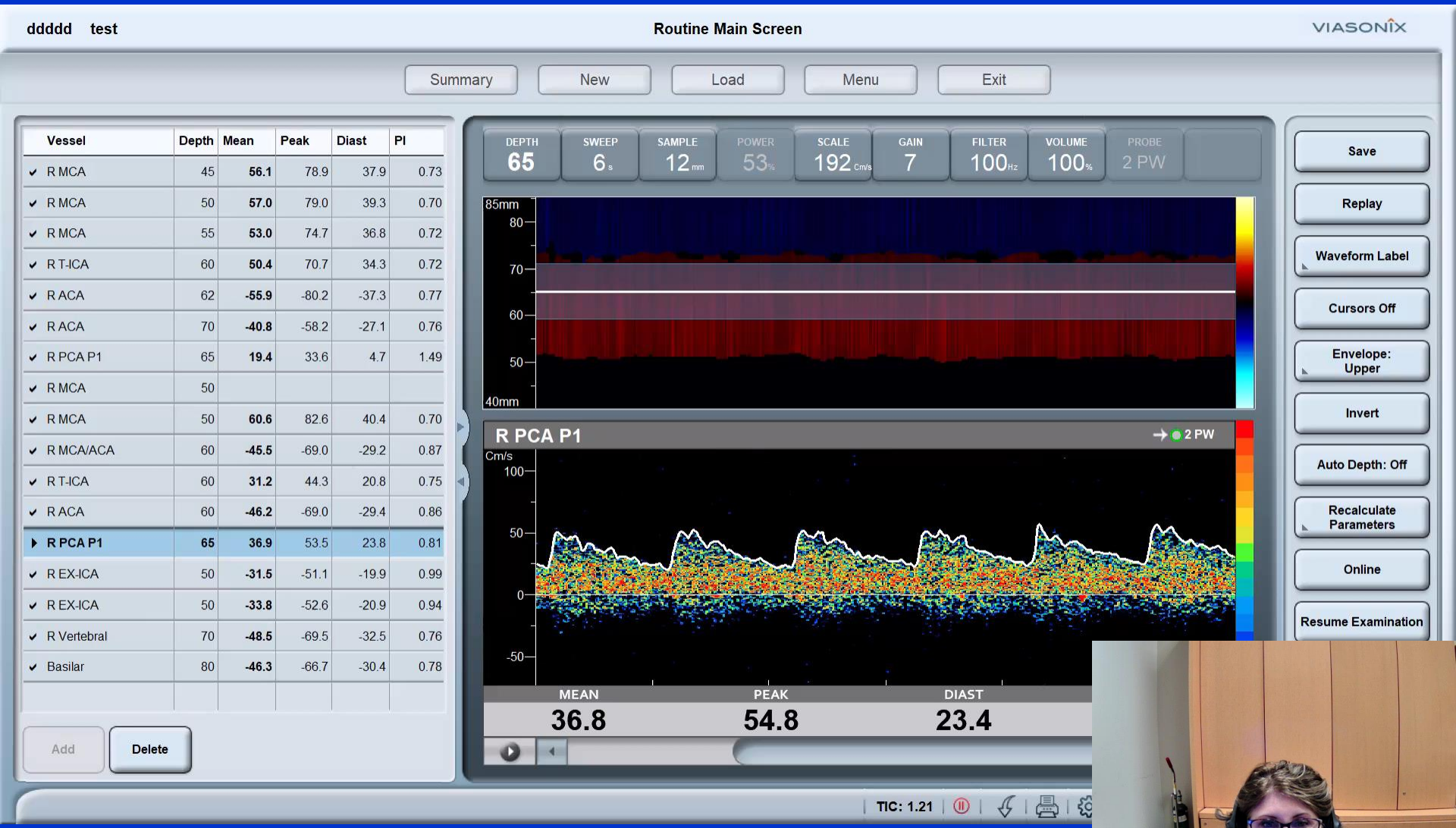

09/08/2000
Online Diagnostic
Documentation
Cursors
Screen Layout
Parameter Boxes
AutoGain On
Export Data
Extras
Previous Menu
Spectra List
2 MHz Temporal
MCA R 54
MCA R 58
ACA R 70
ACA R 74
BRUR 66
PCA R 65
ACOA 76
BAS. APEX 80
2 MHz SUBMAND
cm/s
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
76
DEPTH
48
MEAN
-49
0.88
PI
0.58
71
POWER
Env. Both
Text Report
Graph Report
Label

How Do I Angle the Transducer?

-PCA-

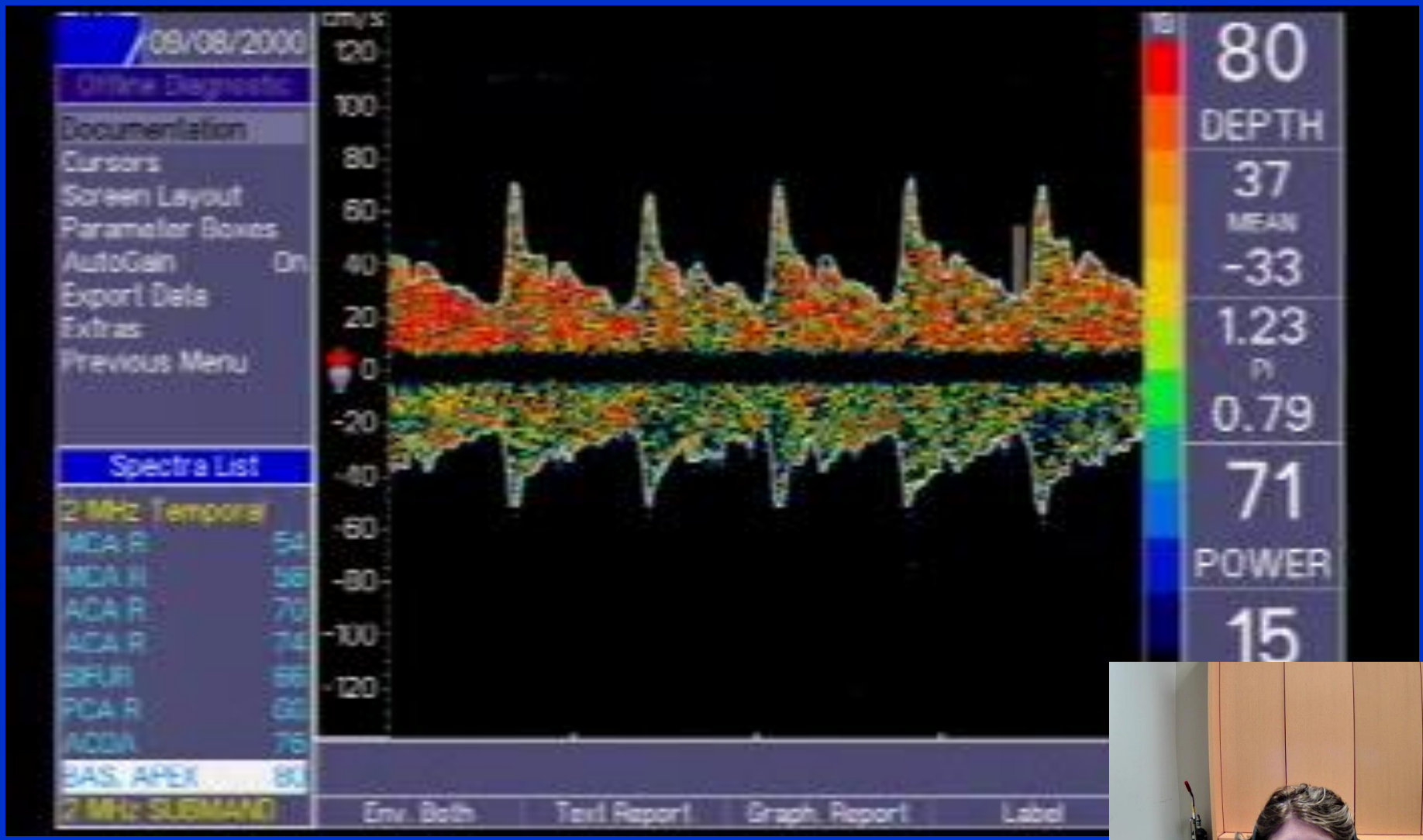
- Temporal Bone
- Angle **Posterior and Inferior**
- Depth: 55-79mm
- Flow Direction: **Toward**

PCA (55-75mm)
Angle: Posterior and Inferior



Top of Basilar (STOP Protocol)

Locate the P1, then increase the depth to midline

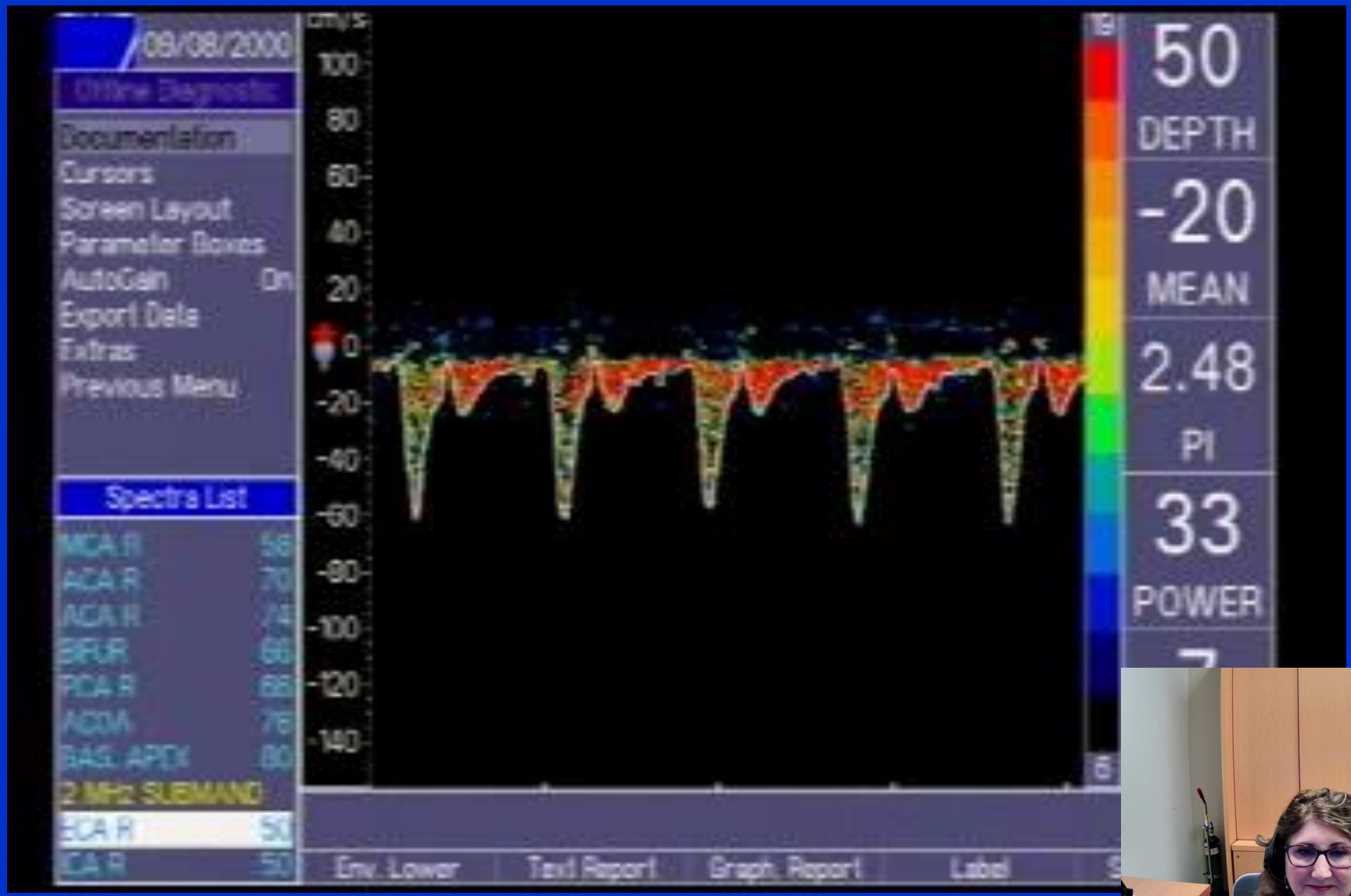


How Do I Angle the Transducer?
Extracranial ICA (ICAec)

- Under the Ramus of the mandible (submandibular)
- Angle **Superior and Medial**
- Depth: 50mm
- Flow Direction: **Away**

ICAec (50mm)
Angle: Superior and Medial

ECA- High Resistance



Ophthalmic and Siphon

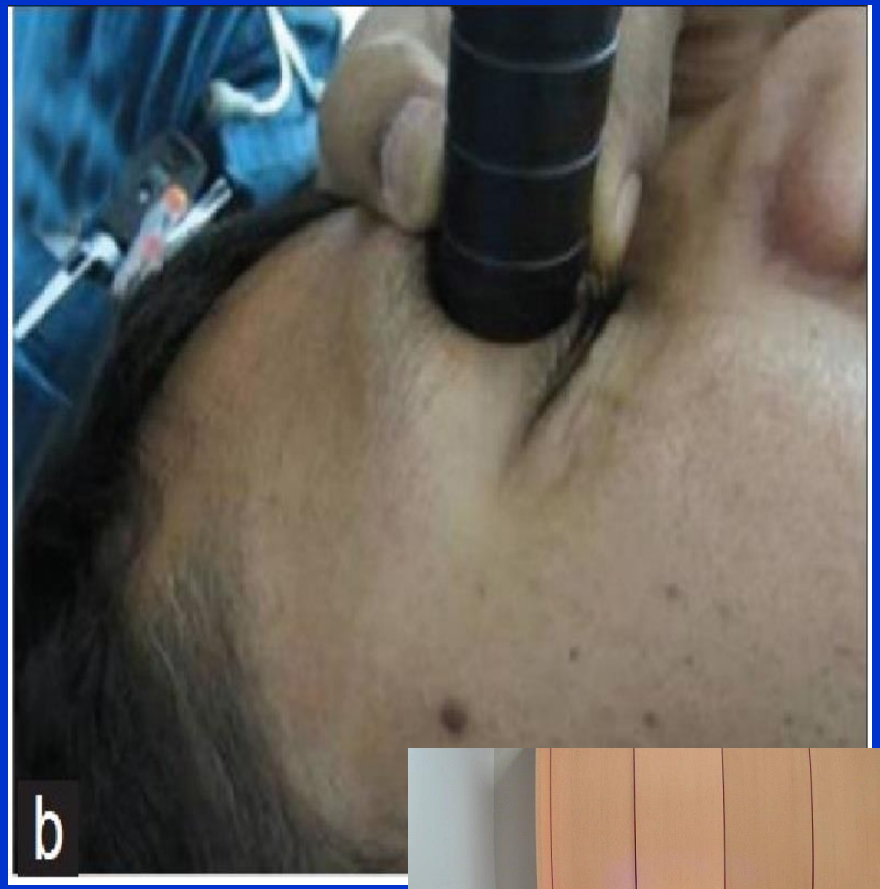
- **Decrease Power to ≤ 10%**
- Close the eyelid and use light pressure!
- Should Not Scan: prosthetic eye, recent eye surgery, hard contact lenses
- Siphon: Sliding lateral toward the outer edge of eyelid
- The Contralateral ACA: 80mm- Medial Superior angle

How Do I Angle the Transducer?
Transorbital

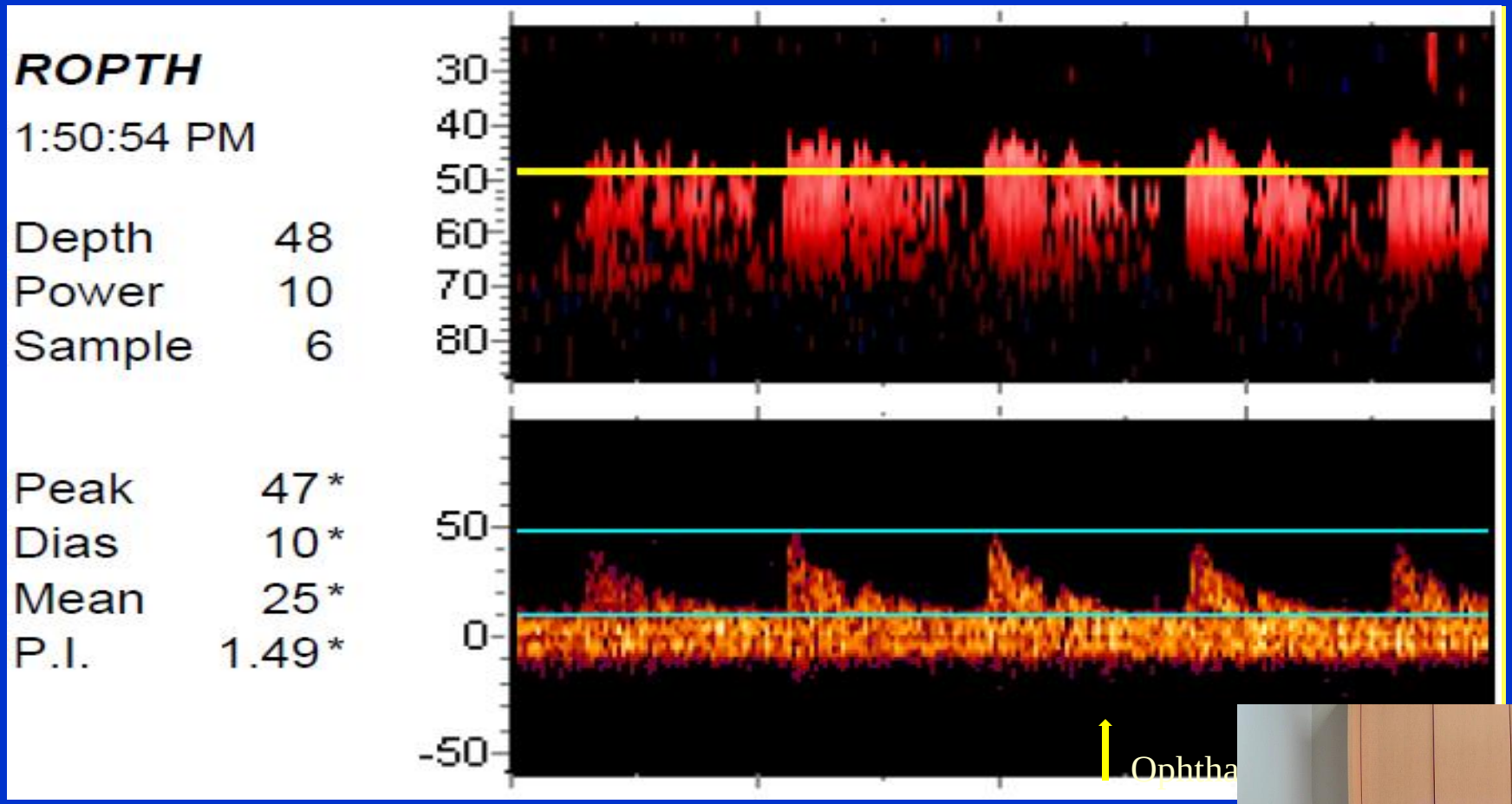
Ophthalmic Artery-

- **Angle: Medial and Inferior**
- **Depth: 50mm**
- **Flow Direction: Toward**

- **Siphon-**
- **Angle: Medial – angle varies**
- **Depth: 60-70mm**
- **Flow Direction: Away or Toward**



Ophthalmic Artery (50mm)
Angle: Inferior and Medial

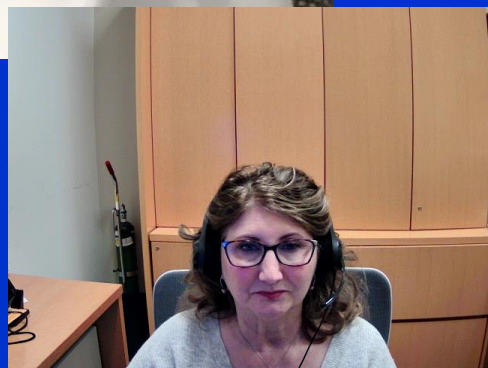


Siphon (60-70mm)

How Do I Angle the Transducer?
-Subforamenal/ Vertebrobasilar

- **Vertebral: 50-80mm**
  - **Direction : Away**
  - **Place probe under Mastoid**
  - **Flat, medial angle: Shallow**
  - **Superior, Medial: Deep**

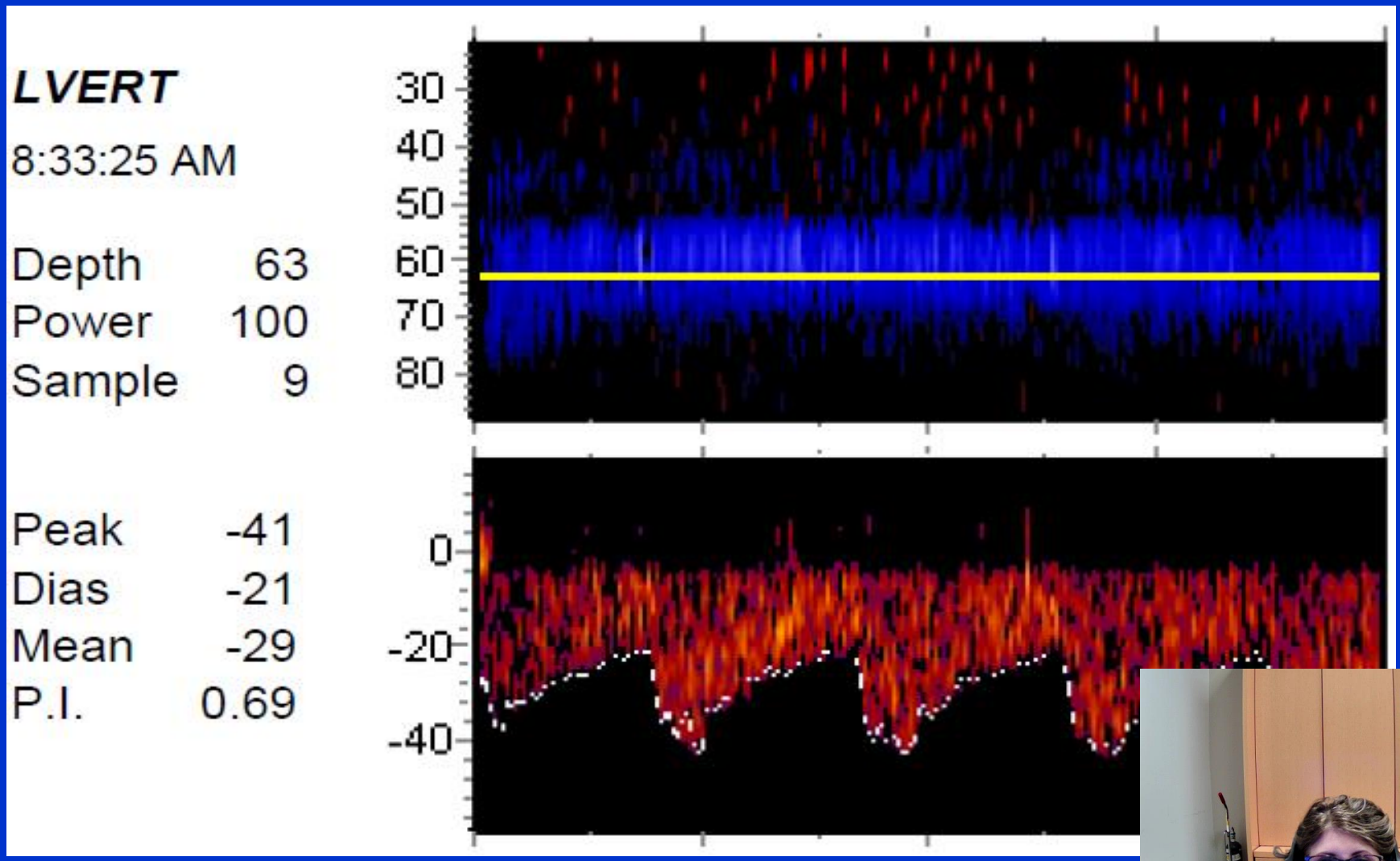
- **Basilar: 80-110mm**
  - **Direction: Away**
  - **Move Probe toward the foramen**
  - **Push and scoop wrist motion**

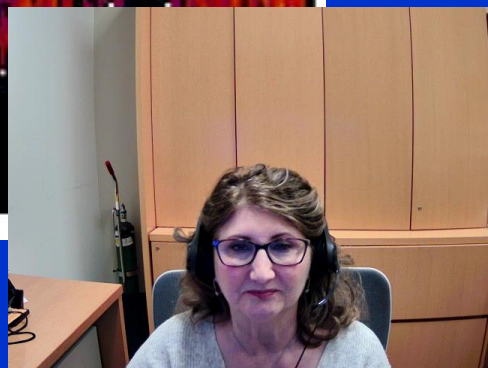


Posterior Circulation

Vertebral Artery (60-80mm)

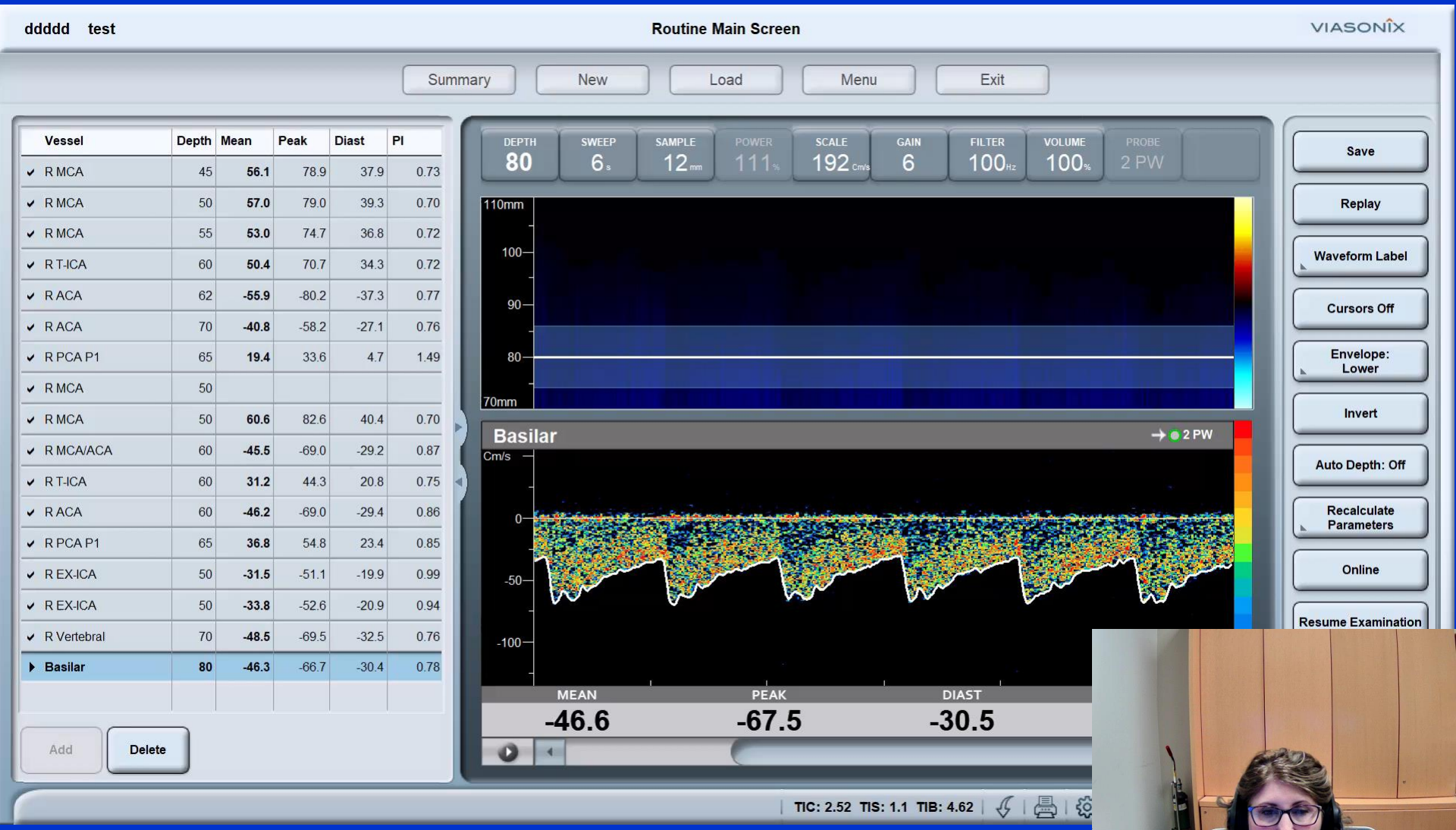
Angle: Superior and Medial





Basilar Artery (85-115mm)

Angle: Superior- Can Be Tortuous



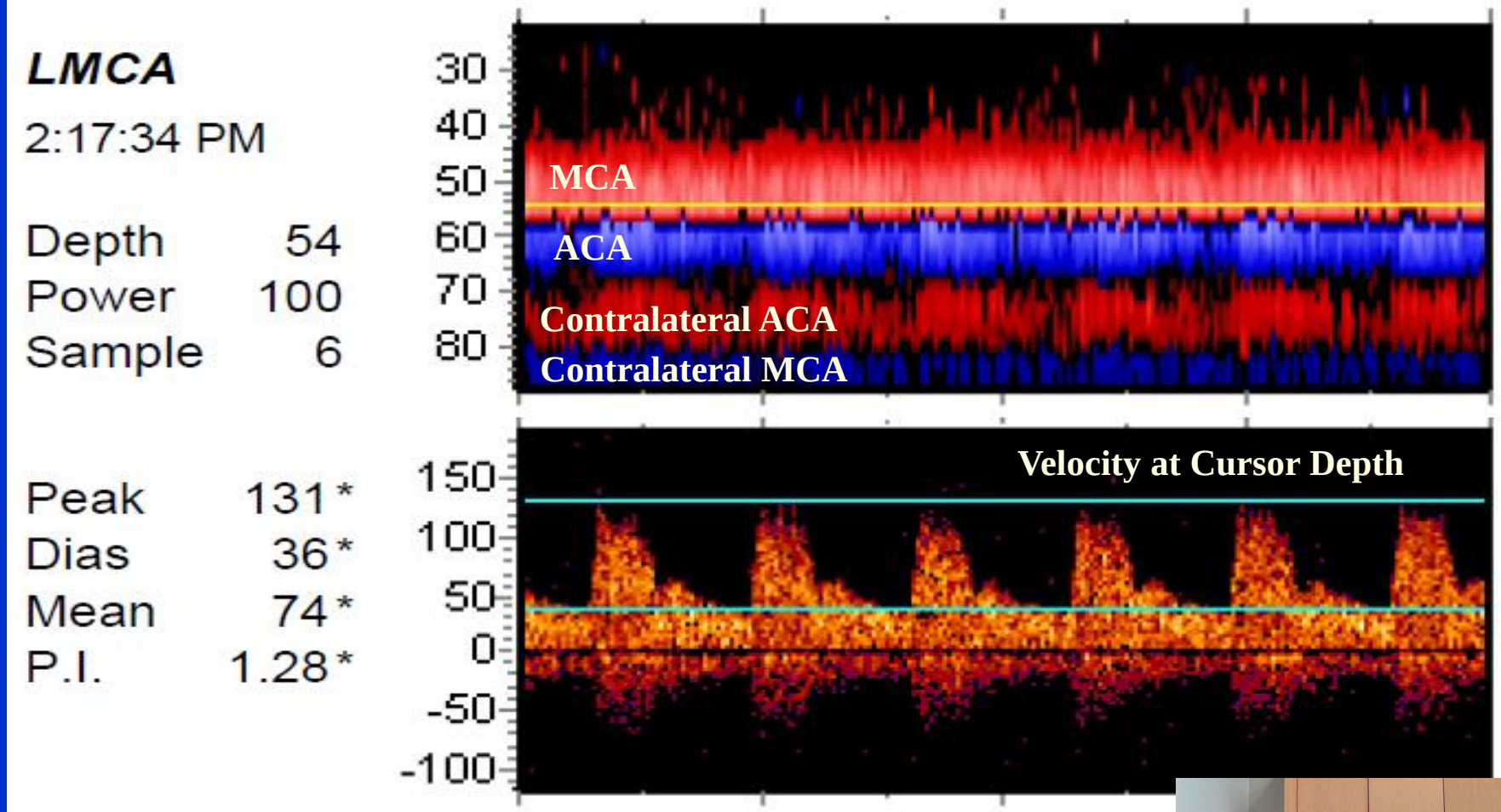
M-Mode

1. Bands of color (red & blue): representing flow direction across the Anterior or Posterior circulations

2. Easier to comprehend: Provides an overview of where the flow can be found: and what depth

3. M-mode does not:
   - -represent velocity or pulsatility
   - -describe a disease process
   - -provide a thorough/complete TCD examination

4. M-Mode represents reflected power (intensit



Red, Blue, Red, Blue

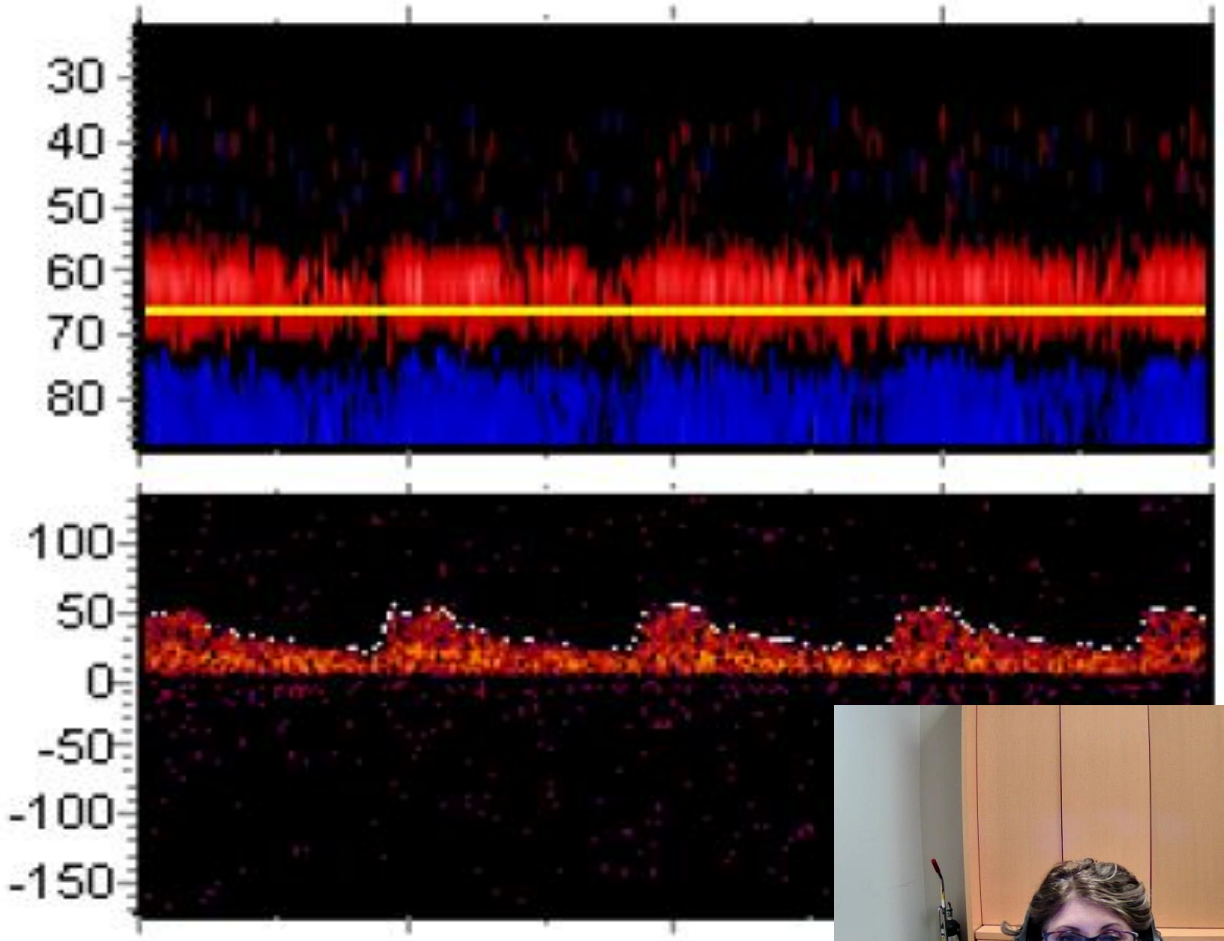
Signature M-Mode Presentation of the Anterior

MCA vs. PCA

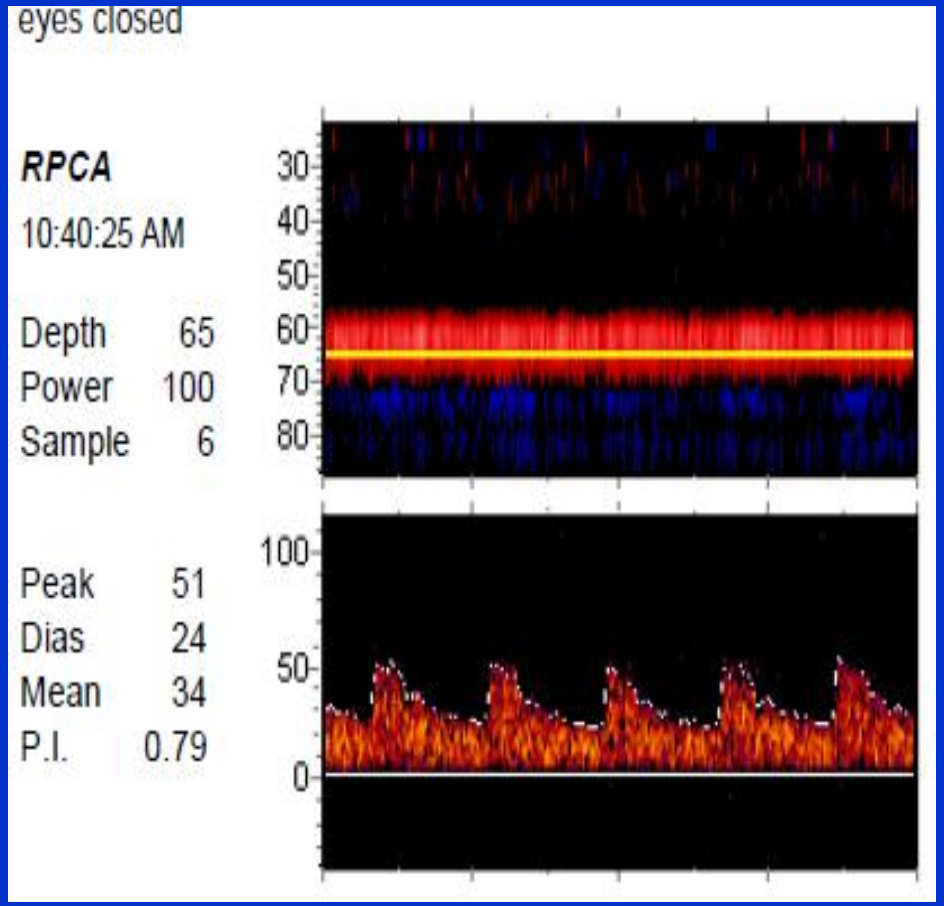
P1 Portion of PCA is shallow, it ends at 54-55mm of Depth – "RED"

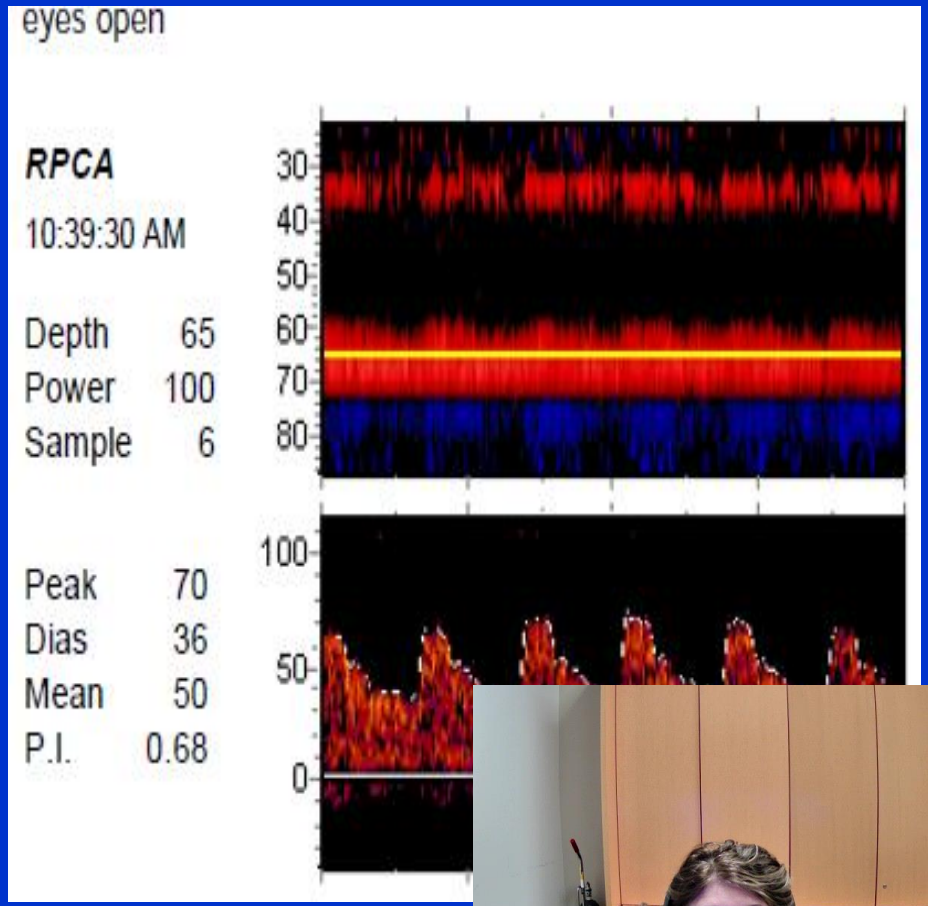
Top of Basilar (TOB) at Bifur. – "BLACK"

Deeper than Bifur. is the Contralateral P1 PCA – "BLUE"

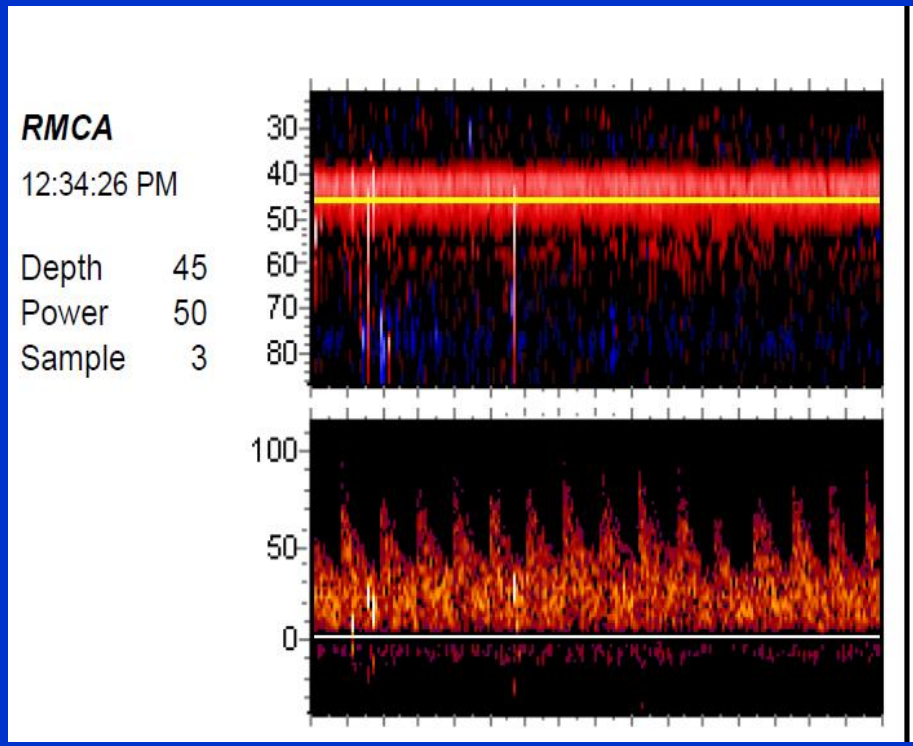


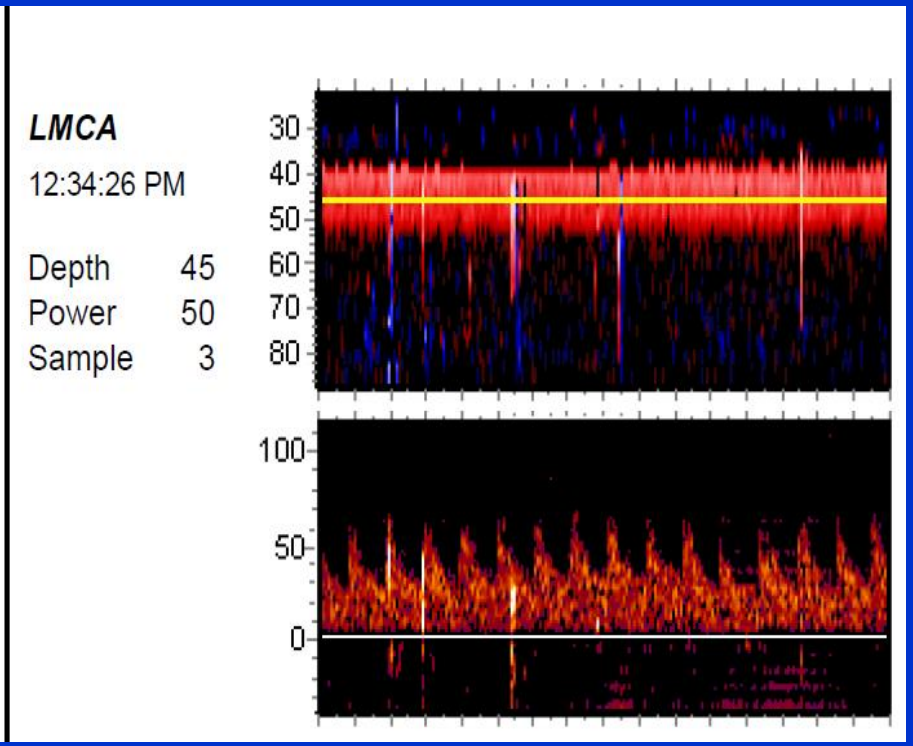
PCA- Light Reactivity

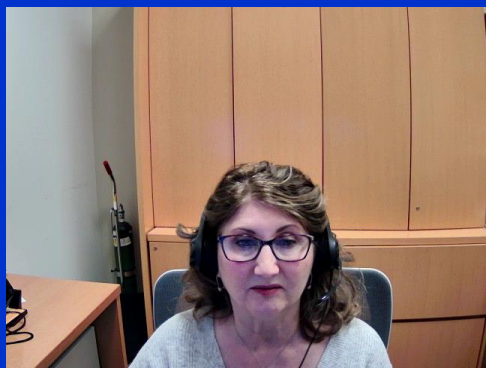




Advantage of Dual Monitoring: Identifies Asymmetry, Emboli and Bubbles







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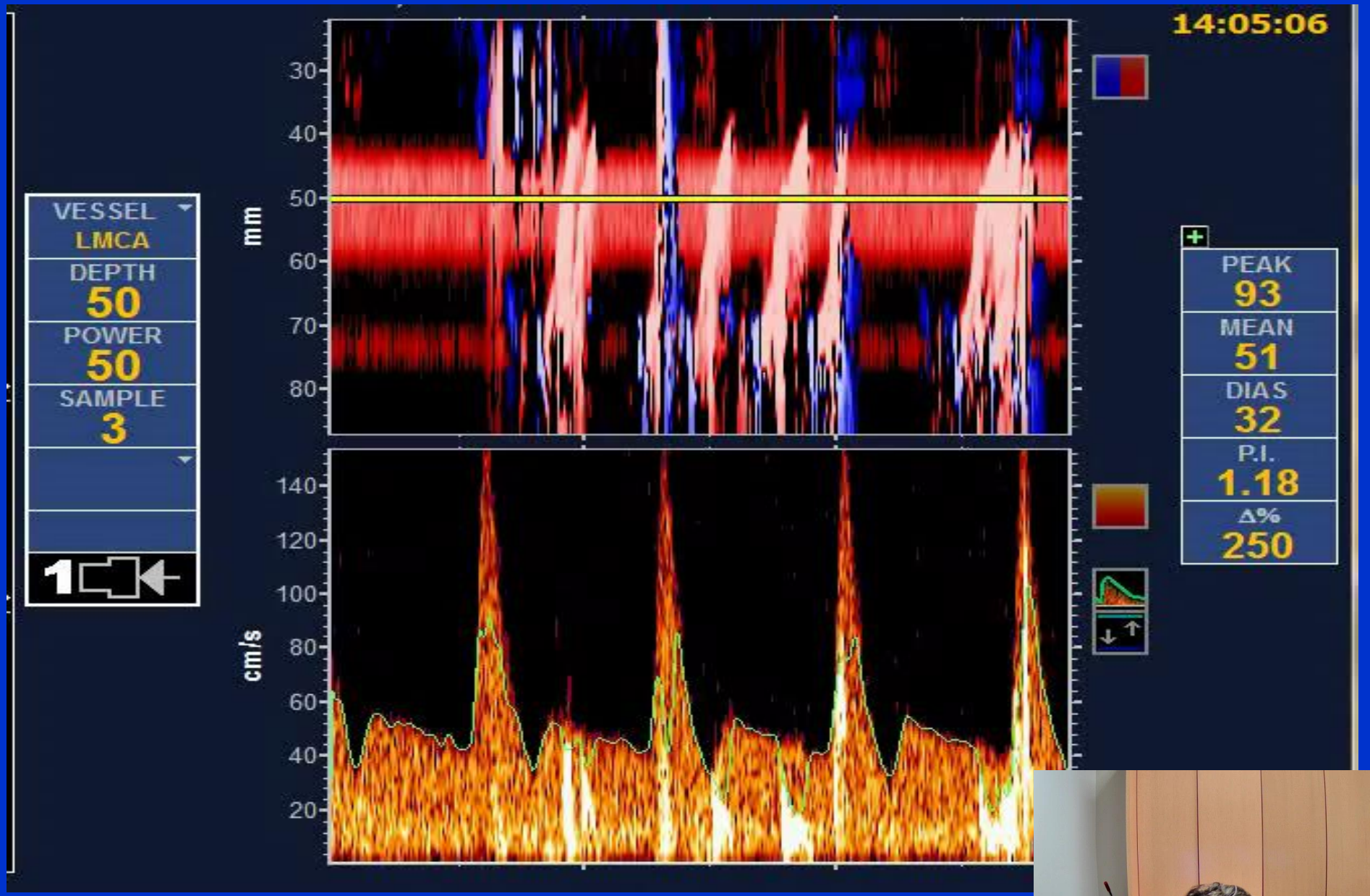

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Technical Difficulties

- **80%** of the Population: Incomplete Circle of Willis
- **5-10%** of the Population have acoustically insufficient Temporal windows due to increased bone density
- Missing or Hypoplastic vessels: ACA, P1 PCA, ACoM
- Persistent Fetal Circulation: Change in PCA normal flow direction
  *** Best identified with imaging**
- "Narrow" windows, or finding the "best" window

Thank You for Your Kind Attention!