

# Flow Mediated Dilation (FMD)

**Dr. Widlansky / Cardiovascular  
Academic Initiative (CAI)'s Protocol**

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# What is FMD?

- A non-invasive measurement of endothelial function using ultrasound
- FMD is endothelium dependent nitric oxide mediated dilation of the arteries in response to an imposed increase in blood flow & shear stress
- FMD
  - Inflation using a cuff
  - 3 minutes of images post inflation
  - Baseline and hyperemic flow measured
  - Can be done Brachial (upper arm) or Femoral (upper thigh)



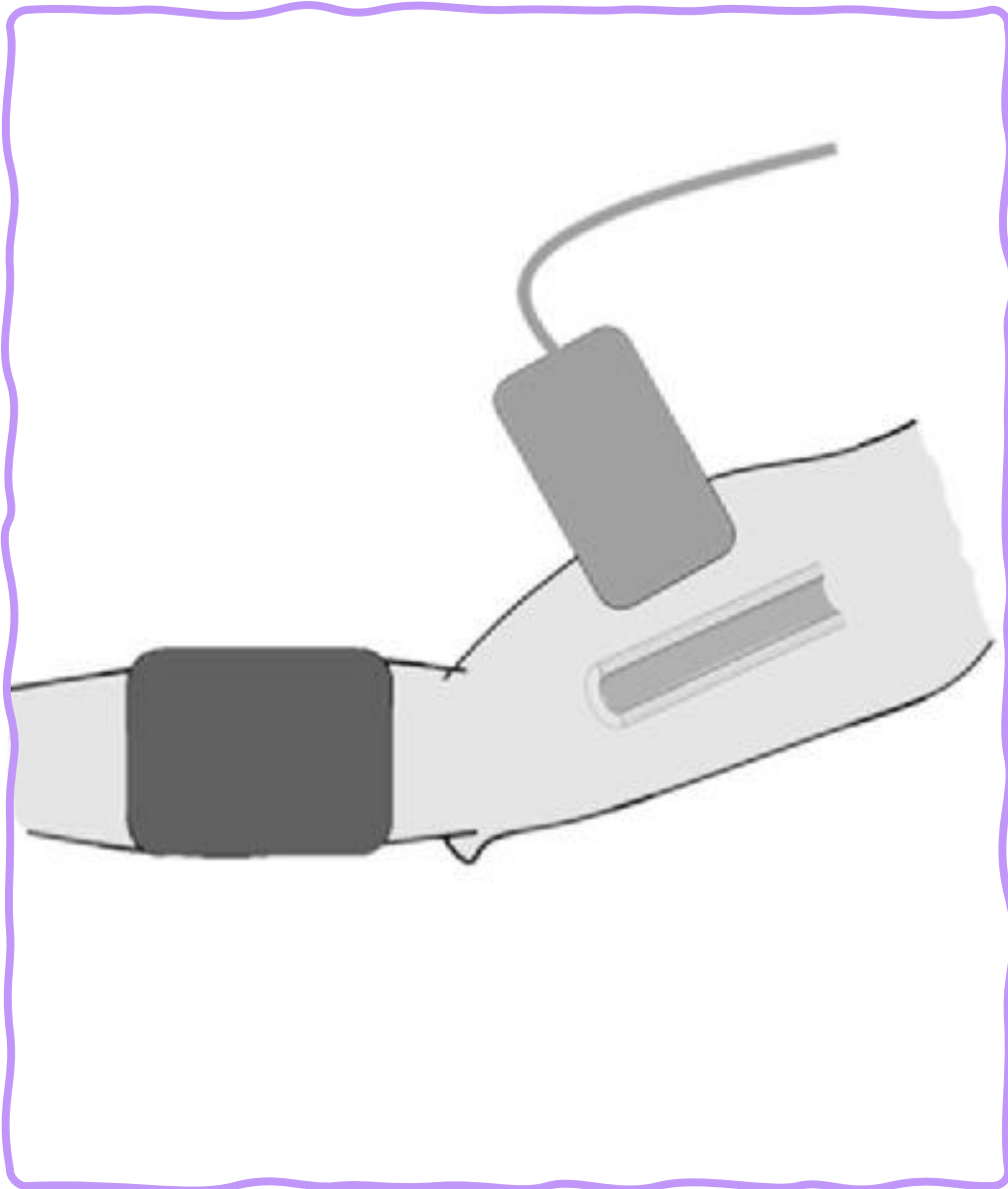
# Equipment Needed

- Cuff for inflation
  - Hokanson SC10
  - Hokanson SC5
  - [Cuff examples](#)
- Aneroid sphygmomanometer
  - [Example](#)
- Measuring tape
- Skin marker if desired
- Bedside table or flat height adjustable surface for patient's arm
- Towels/sheets/washcloths for support of arm



# FMD Protocol Basics

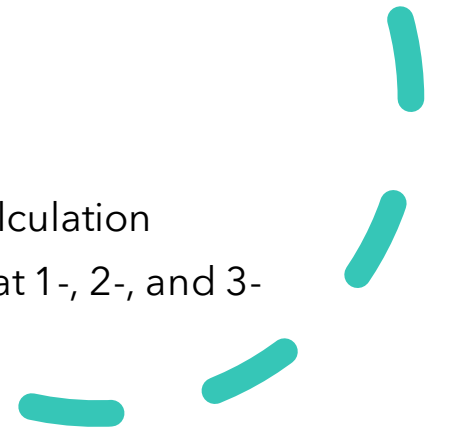
- Below cubital fossa protocol
- 5-minute cuff inflation
- 10 second clips (not continuous capture)
  - Baseline(s)
  - RH1
  - RH2
  - RH3



# Brachial FMD Protocol

## Step by Step

- Patient supine in bed
  - Try to limit to one pillow if possible
  - One arm out on a table supported by towels
  - Patient to be resting for ~10 minutes
- Take three blood pressure measurements
  - Preferably on the opposite arm FMD will be performed
- Place cuff snug on patient's arm just below elbow
- Locate a clean open spot on the brachial artery
- Take a baseline flow image/calculation
- Take 3-5 baseline (BSL) clips
- 5-minute cuff inflation
  - 200mmHg
- Take hyperemic flow image/calculation
- Reactive hyperemia (RH) clips at 1-, 2-, and 3-minutes cuff deflation



# Nitro-Mediated Dilation (NMD)

## Step by Step

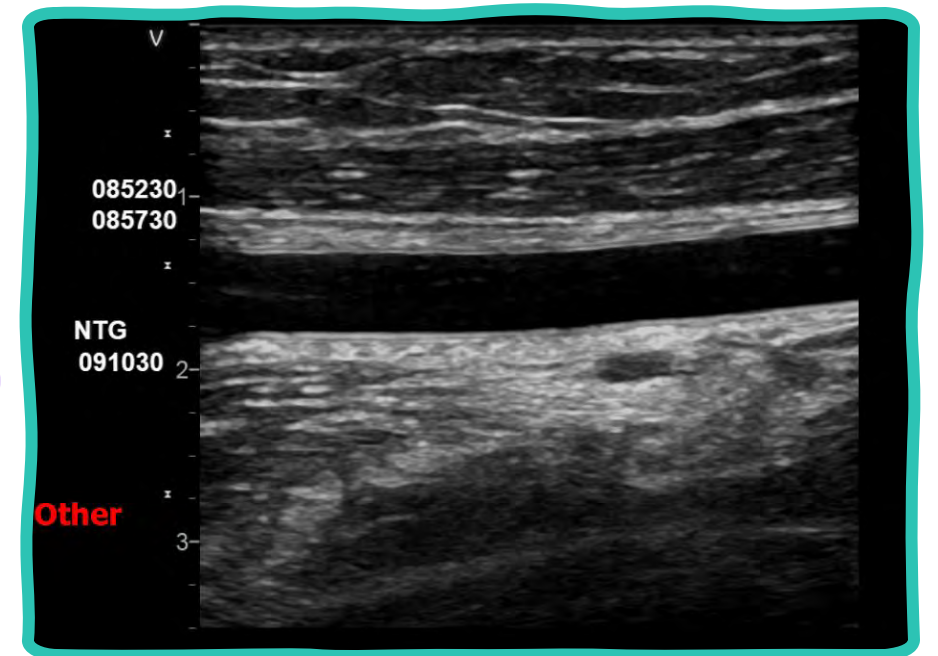
Always done on brachial artery, and at last FMD of visit

Patient in same position as for brachial FMD

- Locate a clean open spot on the brachial artery
- Take a baseline flow image/calculation
- Take at least 3 baseline (BSL) clips
- Have RN give NTG and note time on ultrasound screen
- Reactive hyperemia (RH) clips at 2-, 3- 4- and 5-minutes post NTG administration

### NTG Contraindications:

1. Systolic Blood Pressure too low (less than 110mmHg)
2. Previous adverse reaction to nitroglycerin (headaches, fainting etc.)
3. Used Viagra, Levitra, or Cialis within the past 7 days
4. History or migraine or chronic headaches
5. Current headache at time of visit



# Femoral FMD Protocol

## Step by Step

- Patient in Bed (head of bed elevated)
  - In a semi reclined sitting position
  - Can use a pillow under leg (under the knee) to help position
  - Leg slightly bent and knee and flexed outward, the PT's other leg can be covered by a blanket
  - Patient to be resting for ~ 10 minutes
- Take three blood pressure measurements
- Place cuff snug on patient's leg just ABOVE the knee
- Locate a clean open spot on the femoral artery
- Take a baseline flow image/calculation
- Take 3-5 Baseline (BSL) clips
- 5-minute cuff inflation
  - 200mmHg
- Take hyperemic flow image/calculation
- Reactive hyperemia (RH) clips at 1-, 2-, and 3-minutes cuff deflation

# Control Conditions

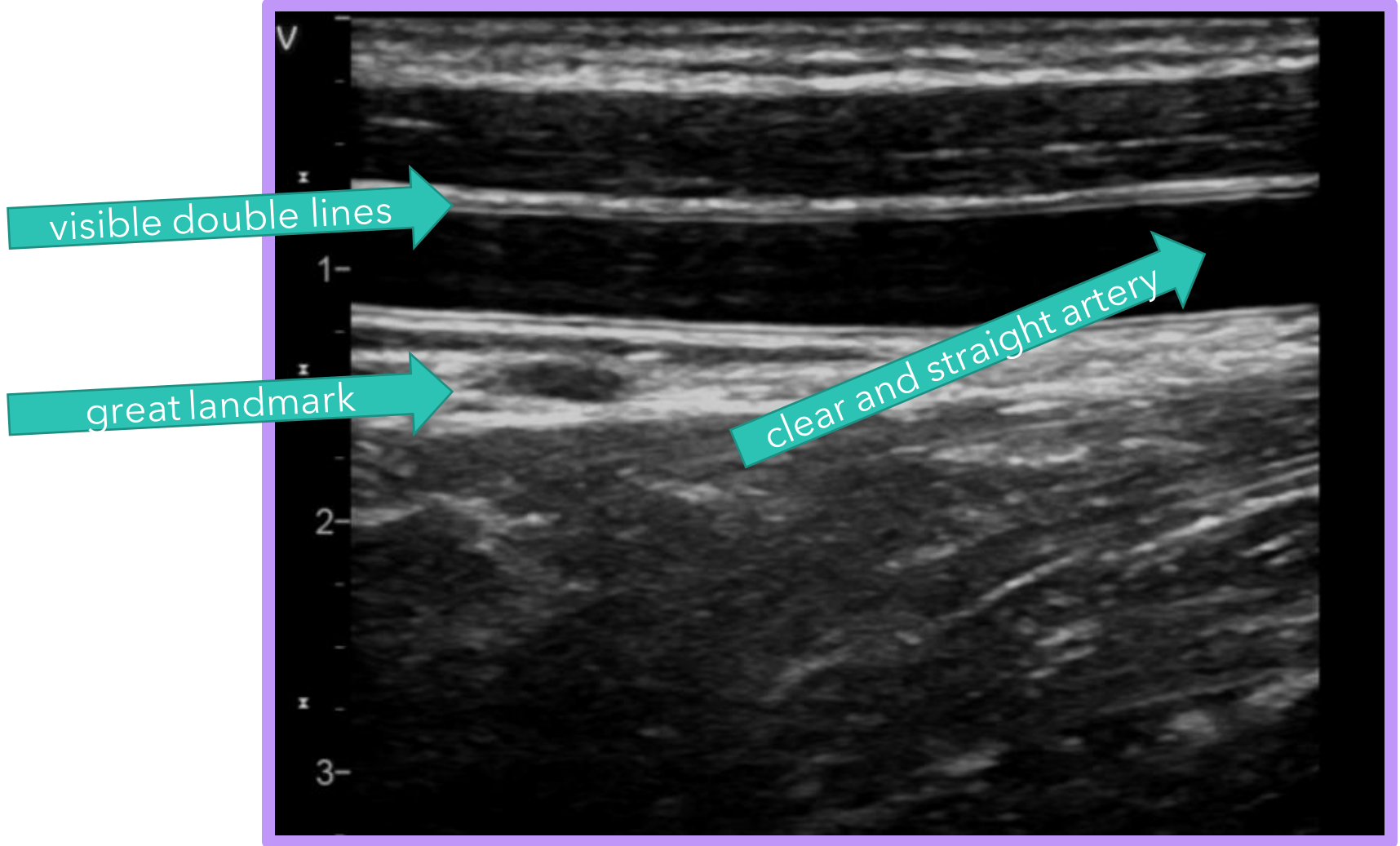
## Most Common

- 8 hour fast from food/drink
- Withhold morning medications (vasoactive)
- Abstain from smoking for at least 6 hours
- No changes in vasoactive medications for past 6 weeks
- If multiple FMDs done - try to stick to same time of day

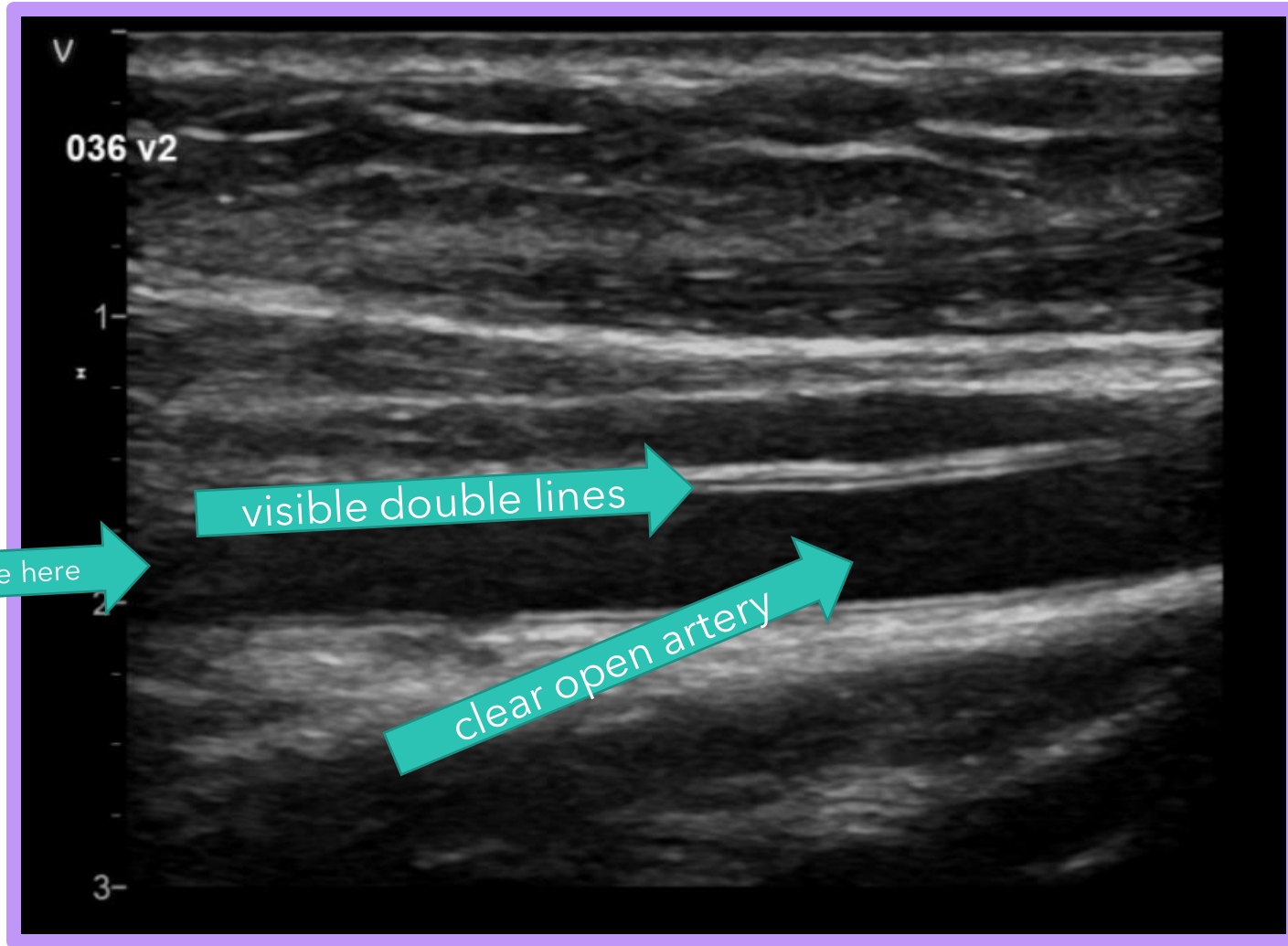
## Other Important Considerations

- No vigorous physical activity for 24 hours
- FMD should be performed in a quiet, temperature-controlled room (72-74 degrees if possible)
- FMD should be performed by the same trained operator, when possible, for multiple/follow up FMDs on same subject
- Premenopausal women should be assessed in a standardized part of their menstrual cycle if possible
- Use the same arm for repeat FMD measurements where possible

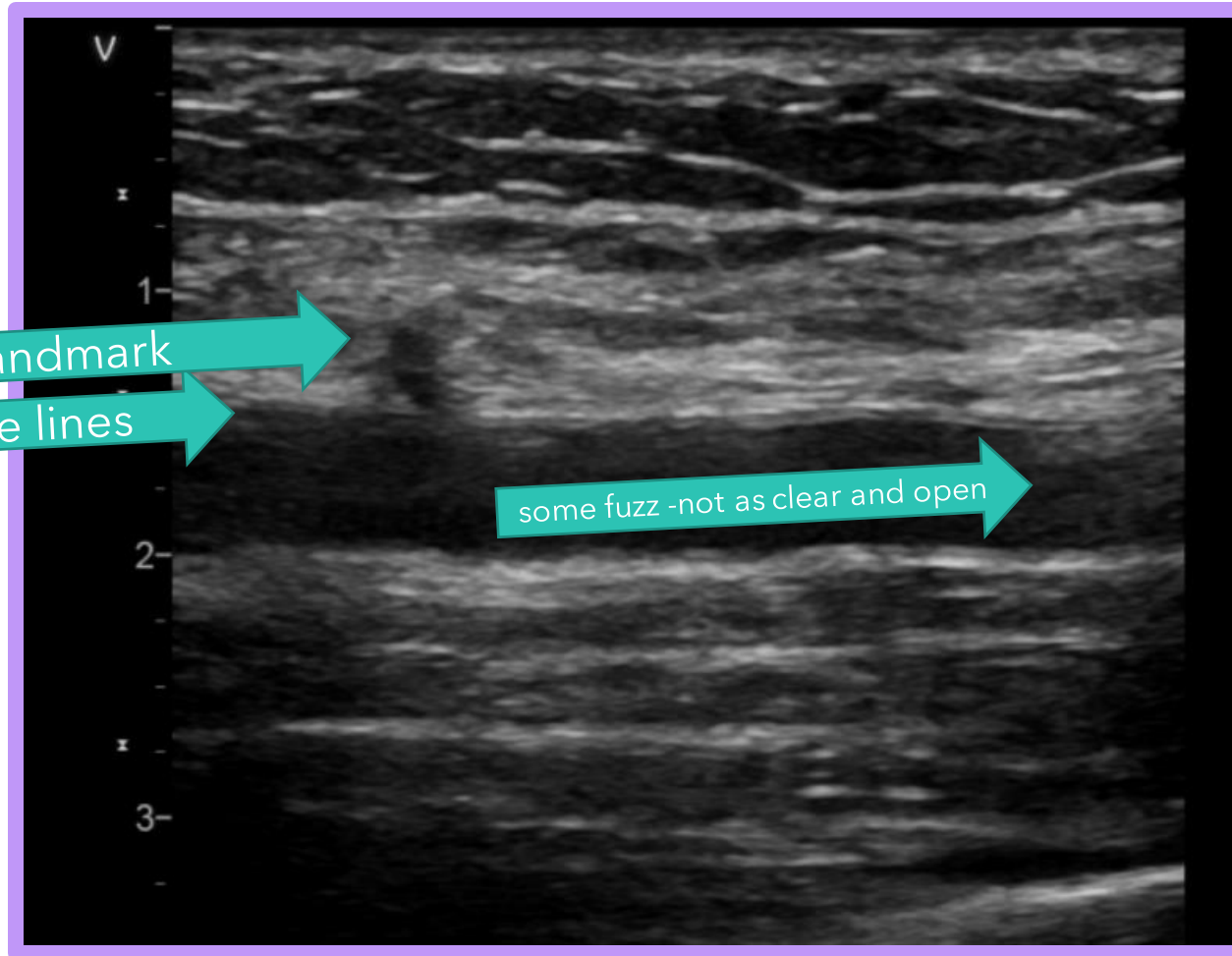




# Analyzable Image Example

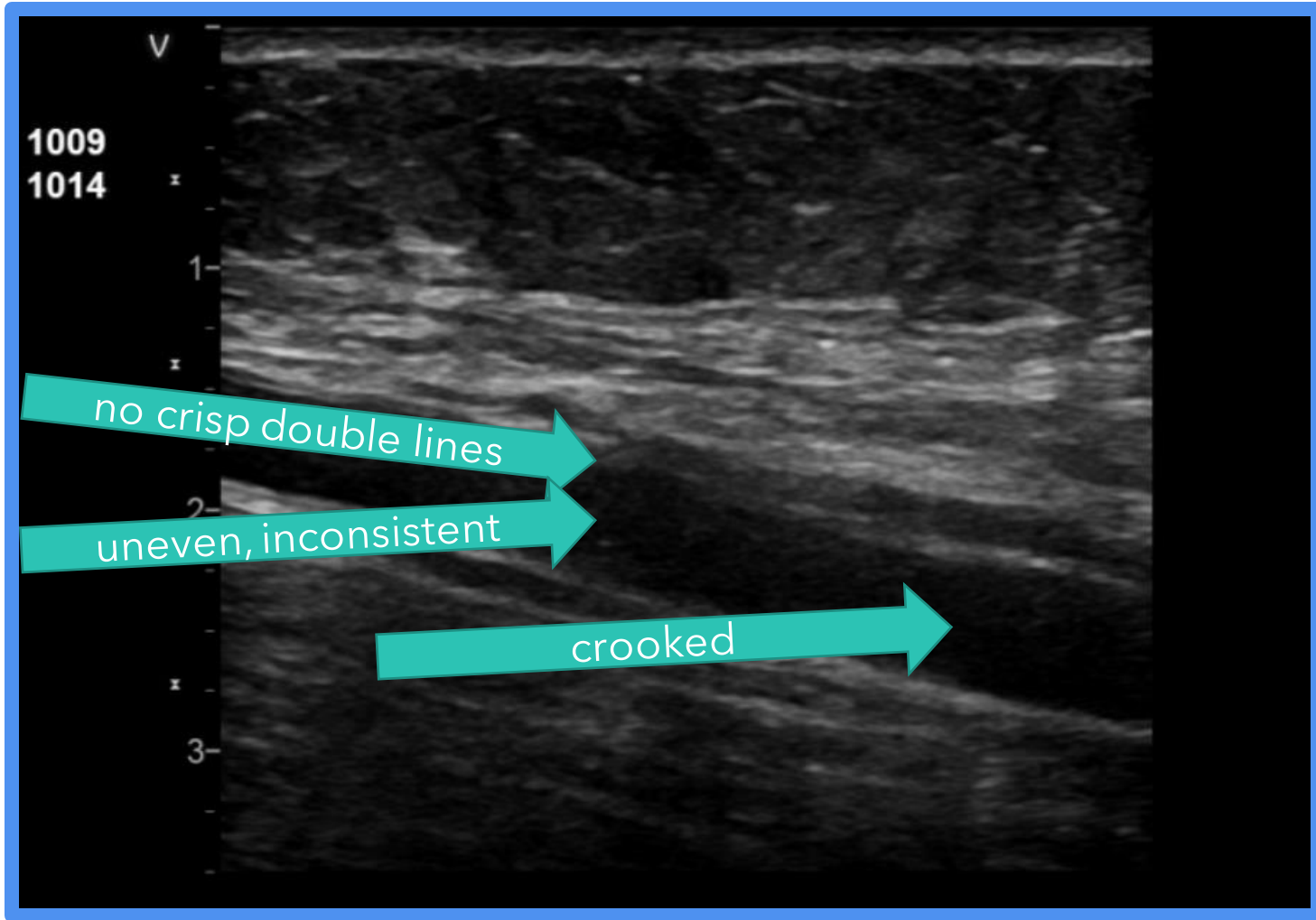


# Analyzable Image Example



**This is an example of a scan that is still workable but not ideal**

# Analyzable Image Example



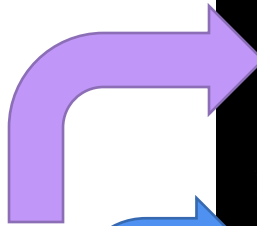
**If we were able to play this clip, we would see lots of movement as well**

# Unanalyzable Image Example

# Documentation

## During Scan

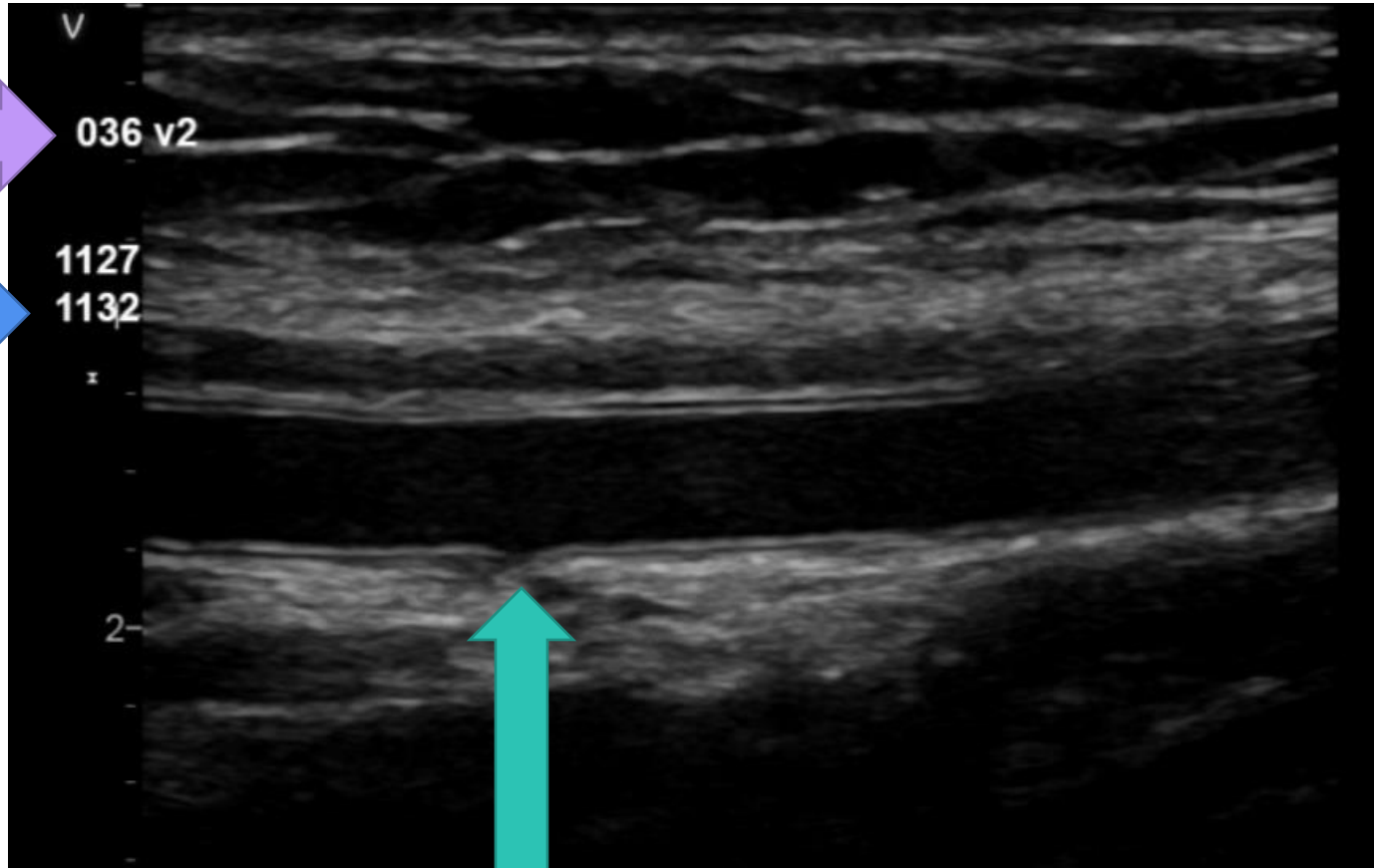
Visit  
date/notes  
(optional)



1127  
1132

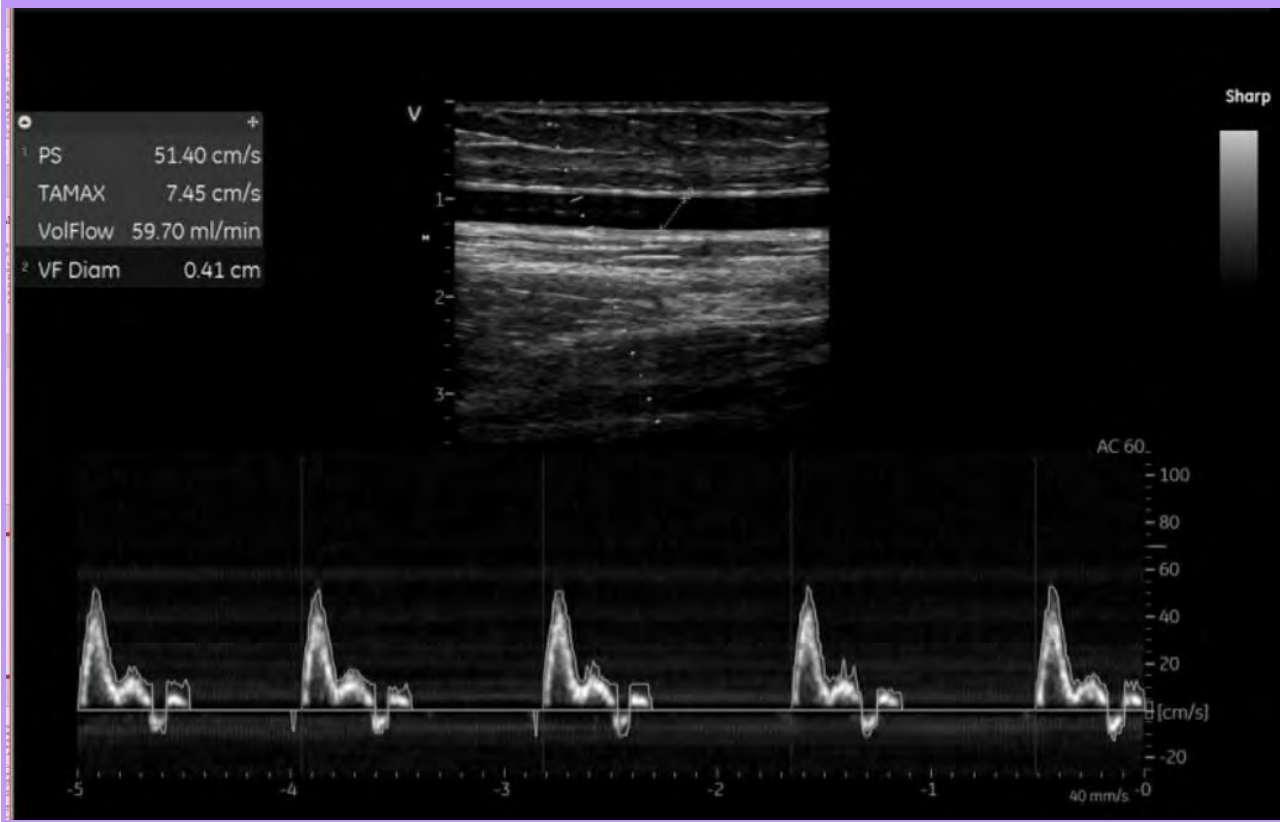


Inflation time  
Deflation time  
(5 minutes)

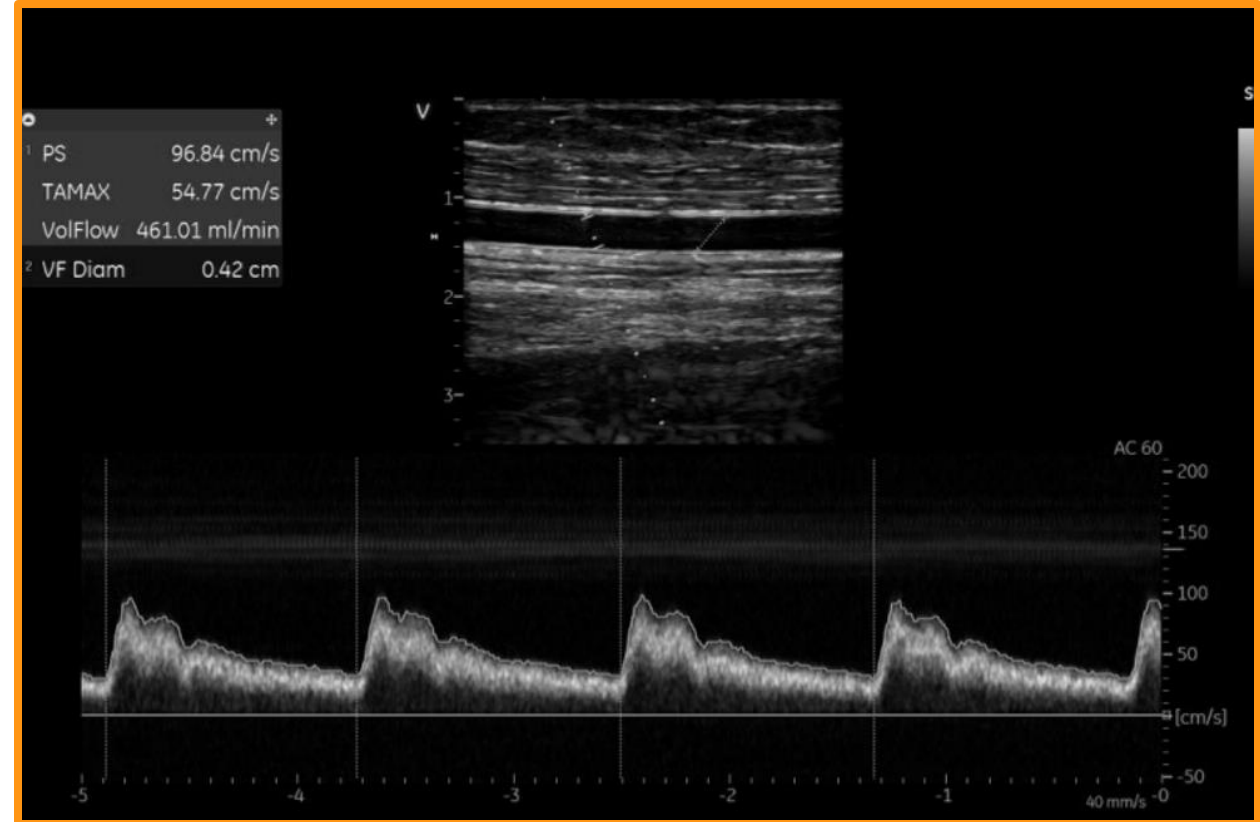


Landmarks can also be marked on  
screen if that is helpful to prevent drifting

# Flow Images



Baseline



Hyperemic

# Documentation

## Before / After Scan

- Confirm fasting
- Confirm medication changes
- Time of FMD is time cuff inflation began
- Location of measurement is L/R arm
- Notes about location can include:
  - Angle
  - Pressure
  - Position of patient's arm

Subject Study ID #: \_\_\_\_\_

Date (MM/DD/YY): \_\_/\_\_/\_\_

Visit # (if applicable): \_\_\_\_\_

Patient fasted food/drink for 8 hours? YES / NO

Patient refrained from smoking for 6 hours? YES / NO

Patient withheld any vasoactive medications? YES / NO

Any changes in medication since last visit? YES / NO

### FMD:

Performed by (initials): \_\_\_\_\_

Room Temperature: \_\_\_\_\_ Celsius

Time of FMD: \_\_: \_\_ AM/PM

Location of measurement: \_\_\_\_\_

Inches from AC: \_\_\_\_\_ Additional notes about location: \_\_\_\_\_

### FMD BP/HR

SBP 1: \_\_\_\_\_ SBP 2: \_\_\_\_\_ SBP 3: \_\_\_\_\_ : \_\_ AM/PM

DBP 1: \_\_\_\_\_ DBP 2: \_\_\_\_\_ DBP 3: \_\_\_\_\_ : \_\_ AM/PM

HR 1: \_\_\_\_\_ HR2: \_\_\_\_\_ HR3: \_\_\_\_\_ : \_\_ AM/PM

# Analyzing an FMD (brief overview)



Program: Brachial  
Analyzer



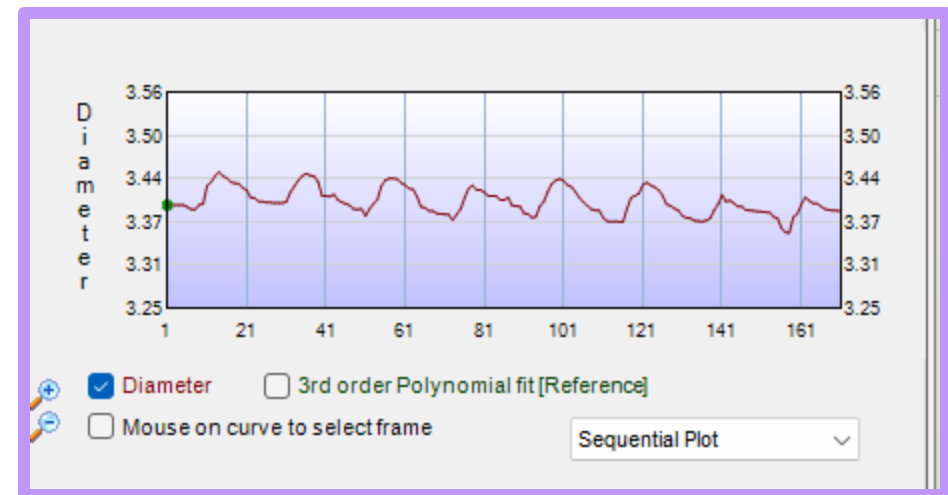
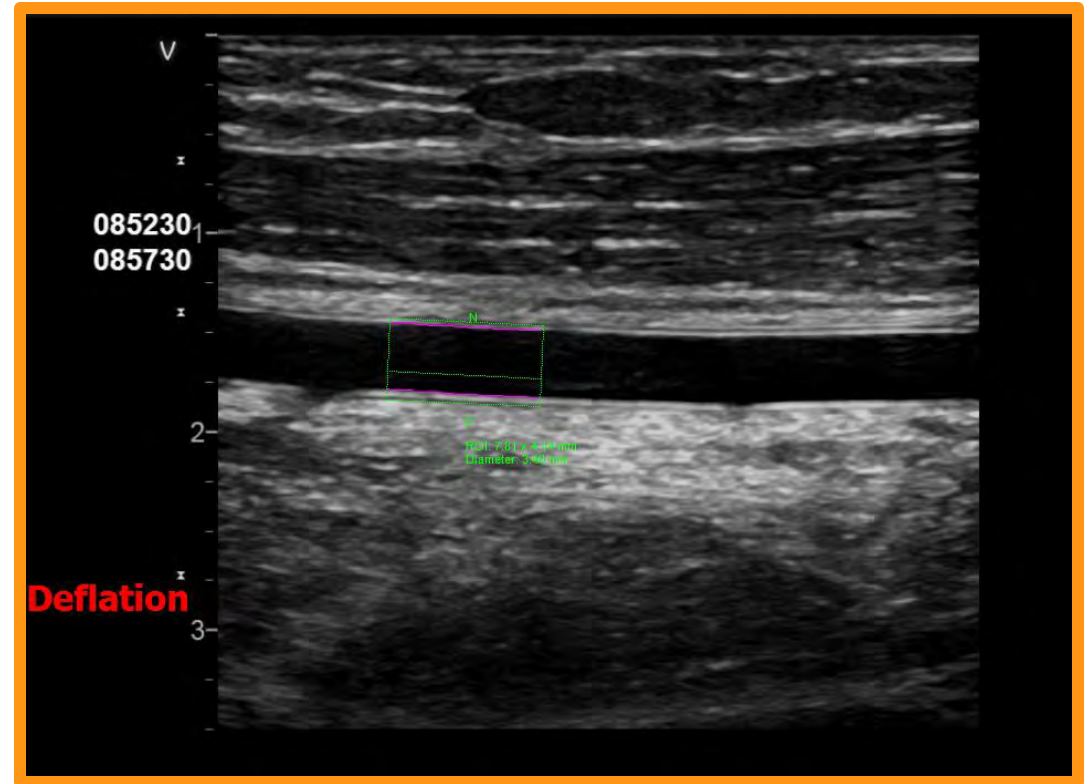
Find a clean open  
location



Note landmarks



Keep consistent spot  
through entire FMD



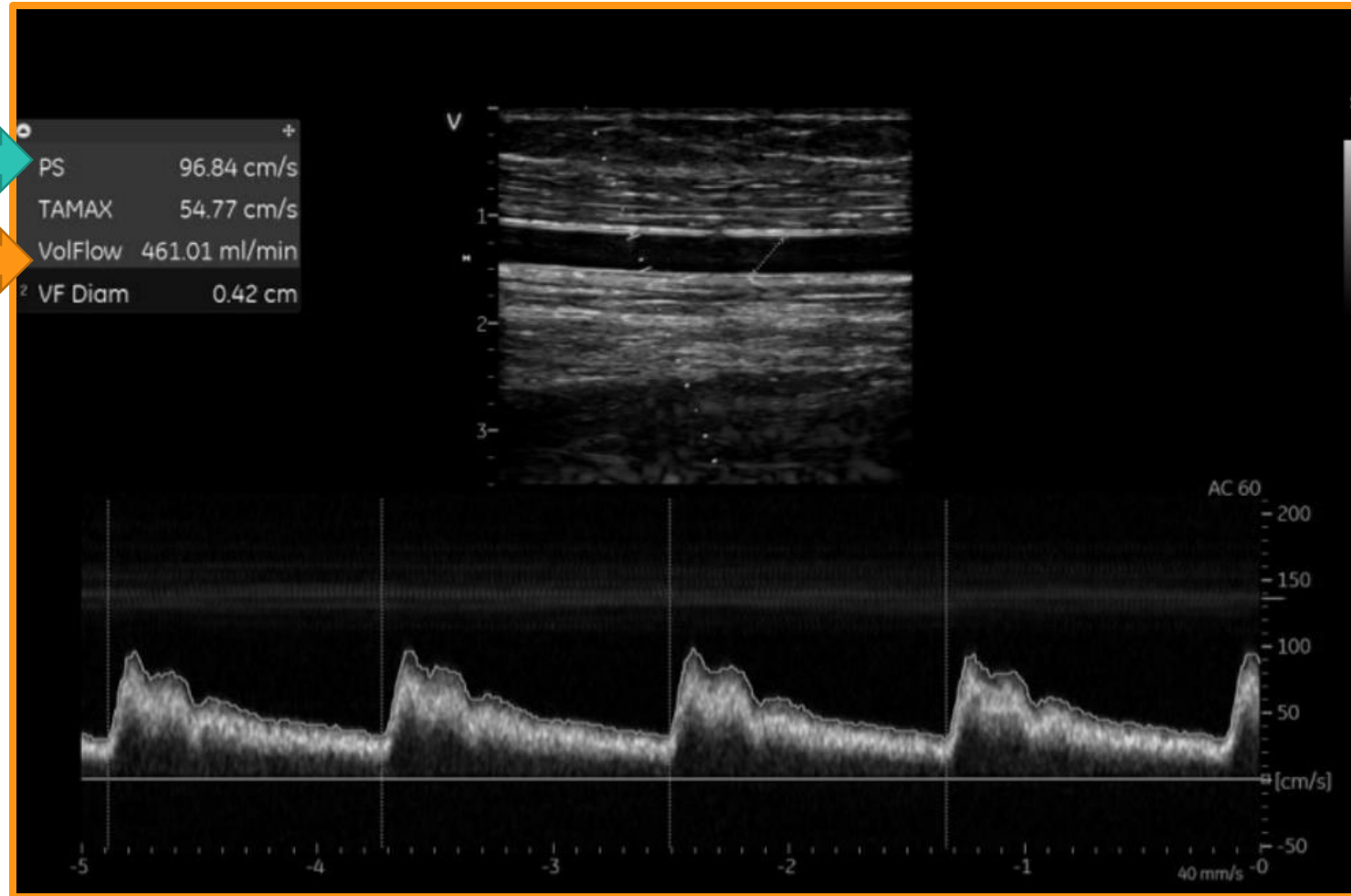


# Flow Calculations

Flow Velocity



Flow





Questions?

Now, lets go practice!