WELCOME *To the*

2026 SYMPOSIUM

Flow Volume Measurement

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Disclosures

- None

Overview

- Why measure flow?
- How we measure?
  - Brachial artery flows
  - Technique
- Flow volumes guide interventions
- When to measure?
  - Clinic, OR, and IR



Why measure flow?

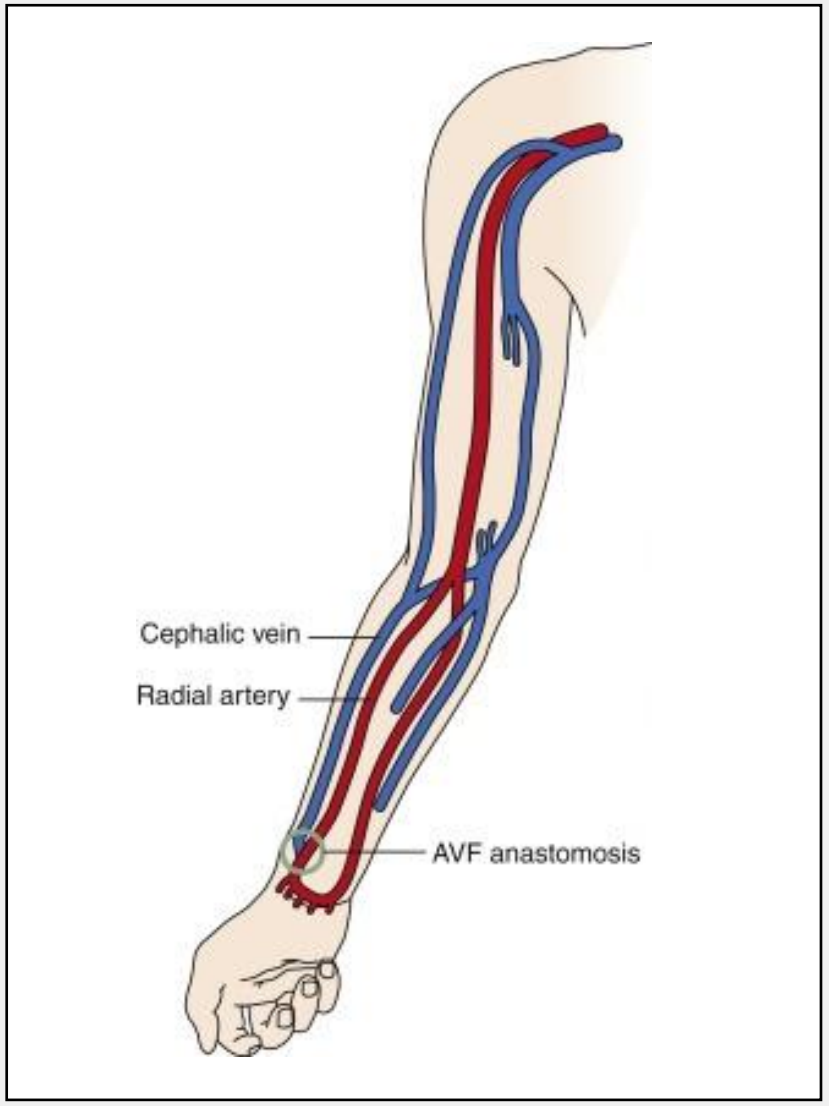
Flow tells us what physical exam can't

- Maturation
  - Flow predicts whether a new AVF will support dialysis [1,9]
- Surveillance
  - A falling flow flags stenosis before clinical failure [2]
- Symptoms
  - High flow may contribute to pain, steal, edema, and aneurysm development [6]
  - May contribute to early high-output cardiac strain [6]
- Procedure
  - Post-angioplasty flow predicts time to next intervention [5]

How we measure flow?

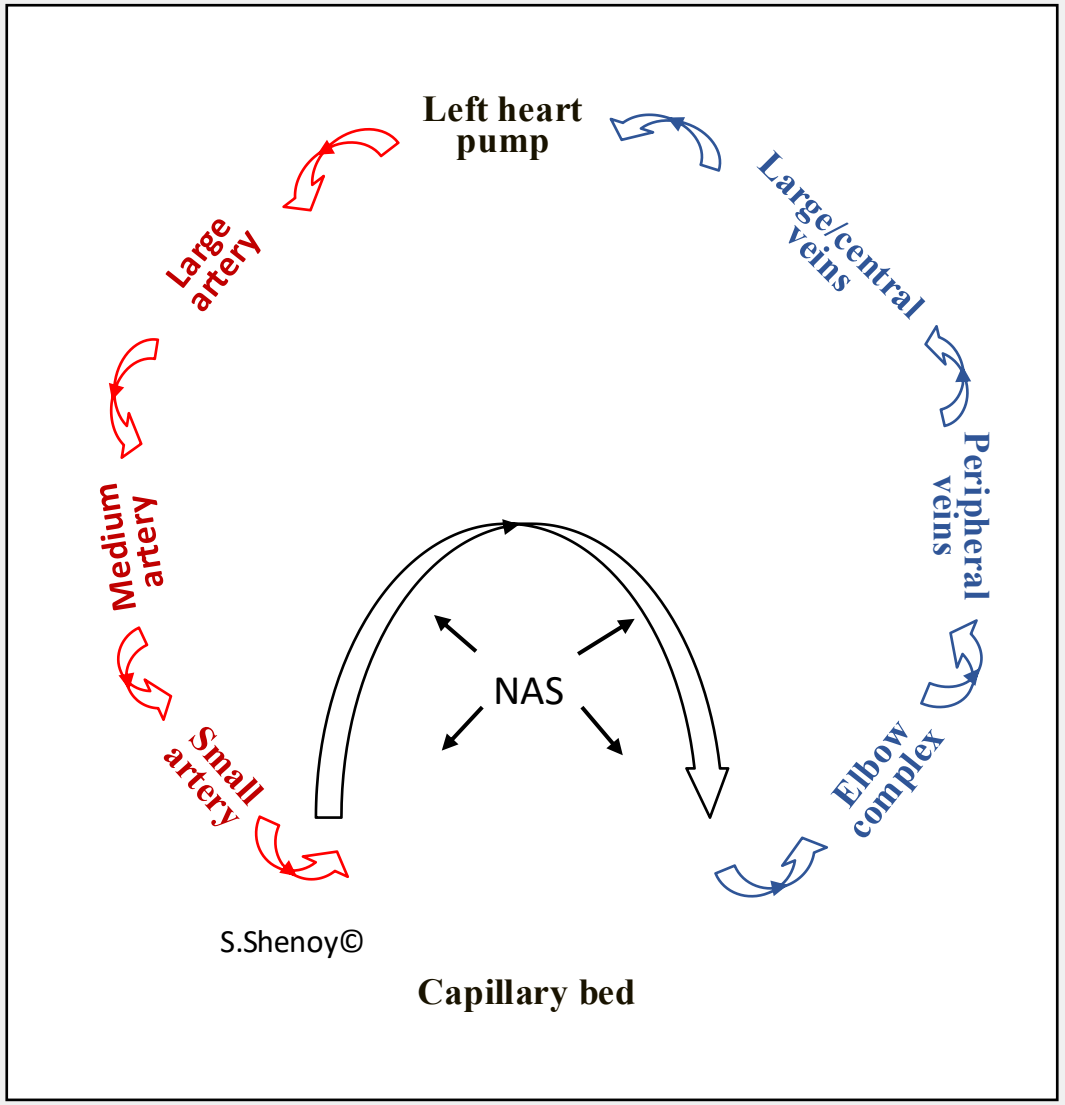
Brachial Artery Flow

- Over 90% of brachial artery flow is diverted into a low-resistance AV access [1]
- In radiocephalic AVFs, the ulnar artery contributes flow in most patients via the palmar arch [1,3]
- Measuring only the radial artery underestimates true access flow [1]
- Brachial artery captures total inflow for both radiocephalic and upper-arm AVFs [1,3]



Expected flows

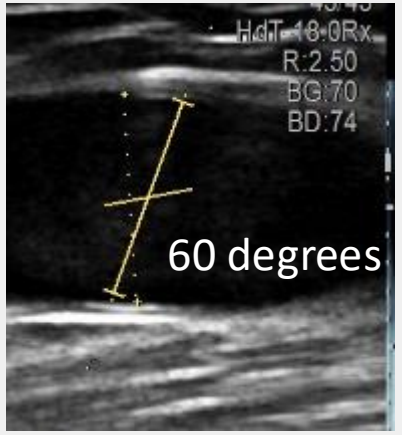
- Dialysis needs 150-450 ml/min
- Vascular access flow 400-100 ml/min
  - Bachial/Axillary
    - 750-2000 ml/min
  - Radial / Ulnar
    - 350-1000 ml/min
- Low flow: <400 ml/min
  - Inadequate dialysis / thrombosis
- High flow: > 1500 ml/min
  - Aneurysms, HAIDI, CHF

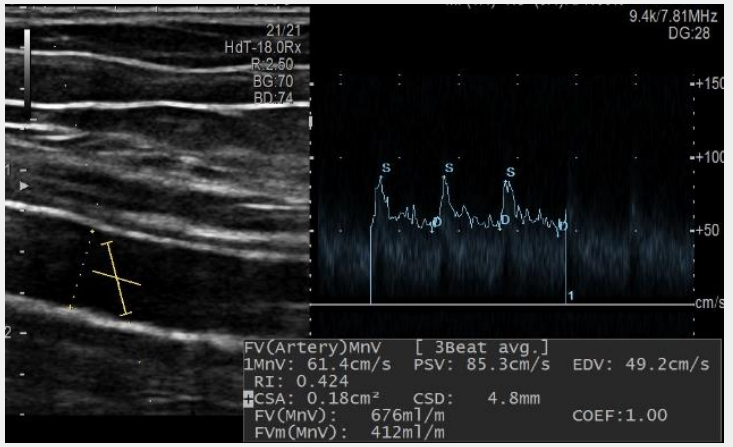


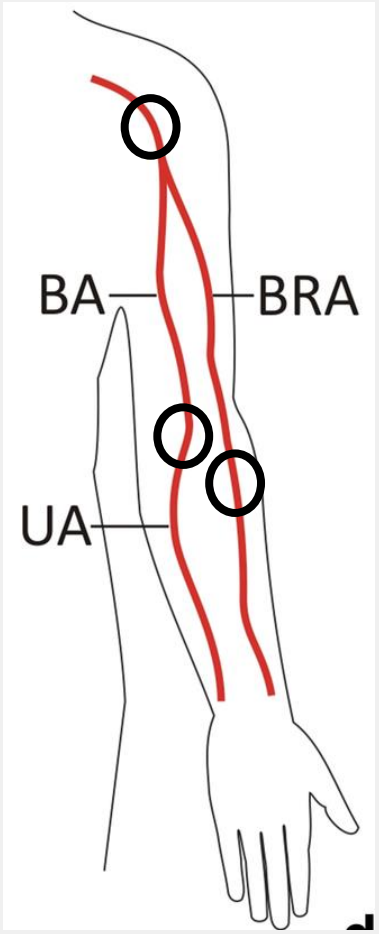
Duplex Doppler technique

Setup and Image Acquisition

- Insonation angle 60 degrees, Sample volume spans the full lumen correct angle to vessel wall [3,4]
- Average 3 stable cycles; reposition probe between measurements [3]
- Repeat measurement twice for concordance
- Common challenges and errors:
  - High brachial radial bifurcation
  - Arrythmia

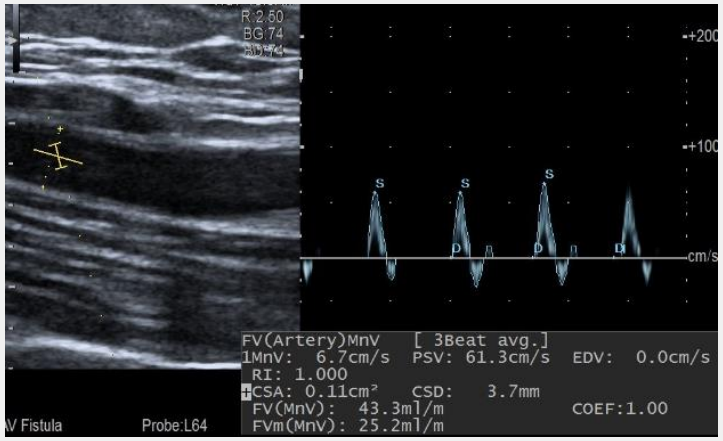


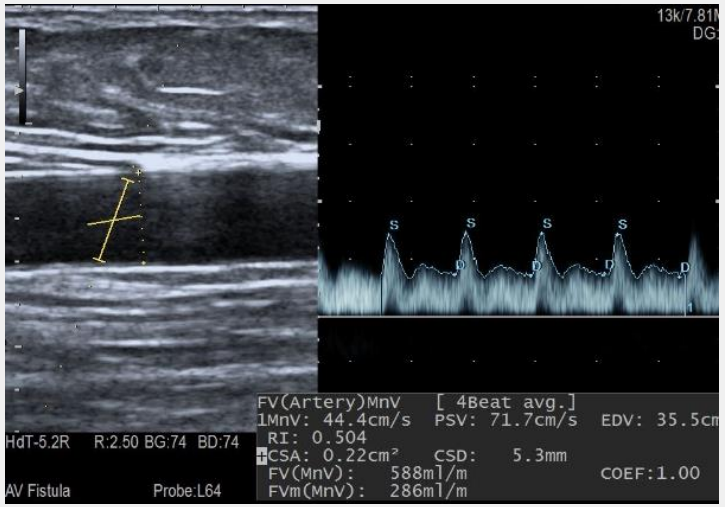




Haładaj, R., Wysiadecki, G., Polguj, M. *et al.* Hypoplastic superficial brachioradial artery coexisting with atypical formation of the median and musculocutaneous nerves: a rare combination of unusual topographical relationships. *Surg Radiol Anat* **41**, 441–446 (2019)

Why the brachial artery?





Normal vs. AV-fistla physiology

- Native brachial artery: triphasic, high-resistance waveform
  - Flow ~20-150 mL/min
- Post-anastomosis: biphasic, low-resistance waveform;
  - Flow rises immediately OR (~2x-10x)
- Continued dilation drives further increases over weeks

Salvage the non-maturing access

When flow is too low

- Low brachial-artery flow at 4-6 weeks suggests failure-to-mature [2,3]
- Flow 100-200 mL/min
  - High likelihood of juxta-anastomotic stenosis (JAS)
  - Most common culprit: JAS within 2 cm of the anastomosis [11]

Interventions

- Balloon angioplasty (PTA)
  - First-line
  - Mean post-PTA flow ~637 vs. ~151 mL/min in radiocephalic AVFs [11]
- Consider drug-coated balloon in difficult cases
  - May improve patency vs. plain balloon in selected lesions

High flow access

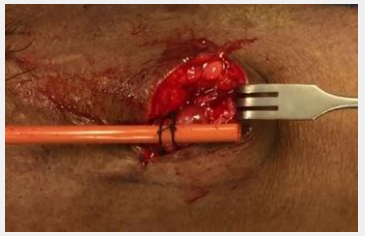
When flow is too high

- Access flow >1,500-2,000 mL/min
- Risks
  - High-output cardiac strain,
  - LV remodeling
  - Steal syndrome
  - Aneurysmal dilation



Interventions

- Precision banding
  - Targeted reduction to ~500-800 mL/min
- Intraoperative duplex titrates banding diameter in real time, avoiding under- or over-restriction [6,7,8]





- Ligation reserved for refractory high-output failure when access is no longer needed [6]

Three opportunities for measurement

Clinic

- Point-of-care duplex at the bedside, performed by the surgeon or trained APP
- Use:
  - Maturation check at 2-6 weeks
  - Surveillance, triage to intervention

Operating Room

- Intraoperative duplex at AVF creation and at banding/revision
- Use
  - Confirm patency after closure
  - Titrate banding
  - Document baseline flow

Interventional Radiology

- Pre- and post-angioplasty duplex flow
- Use
  - Define the functional endpoint of the procedure
  - Reestablish new baselines

References

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Thank you