# How to Measure the Flow (Qa) of a Dialysis Arteriovenous Fistula Using Ultrasound

## 1. Measurement Location

The flow of an arteriovenous fistula is measured in the **venous outflow segment**.
Choose a straight venous segment:

- at least **2 cm downstream from the anastomosis**
- not compressed by the probe
- without curves, turbulence, thrombus, or obvious stenosis

## 2. Doppler Settings

For a reliable calculation, the following parameters must be correct:

- **Sample gate (sample volume):** 2–4 mm
- **Insonation angle:** ≤ 60°, with proper angle correction parallel to the vessel wall
- **PRF:** adjusted to avoid aliasing
- **Wall filter:** low, to include low diastolic velocities
- **Gain:** sufficient to obtain a clear spectrum without noise or oversaturation

## 3. Diameter Measurement

Because flow is calculated from velocity and lumen cross-sectional area, accuracy is essential.

- Use **B-mode** (optionally aided by color) to clearly outline the lumen
- Measure the internal diameter **intima-to-intima** in a transverse view
- Ensure the vessel is not compressed and maintains a round shape
- If the lumen is oval, use the **shortest diameter** for a conservative calculation
- Ideally take **2–3 measurements** and use the average, especially if the lumen is irregular

## 4. Measurement of Mean Velocity (TAMEAN / TAMV)

In longitudinal view:

- place the sample volume in the center of the lumen
- record a stable, non-aliased Doppler spectrum
- allow the machine to calculate the time-averaged mean velocity over **3 to 5 cardiac cycles**

## 5. Flow Calculation

The machine generally calculates automatically:

$$Qa = \pi \times (\frac{d}{2})^2 \times \text{TAMV}$$

where:

- **d** = diameter (mm or cm)
- **TAMV / TAMEAN** = time-averaged mean velocity (cm/s)

If **d** is in cm and **TAMV** in cm/s:

- $cm^2 \times cm/s = cm^3/s = mL/s$
- $\times 60 = mL/min$

Final result: **mL/min**

## 6. Reference Values and Interpretation

- Normal AV fistula: ≈ **600–1200 mL/min**
- Possible abnormality/stenosis: **< 500–600 mL/min**
- Excessive flow: **> 1500–2000 mL/min** → risk of steal, cardiac overload, dilation

Flow must always be interpreted in **trend**, comparing with previous measurements.

## 7. Common Technical Errors

- Angle > 60° → inaccurate velocities
- Measuring diameter with color Doppler instead of B-mode
- Measuring too close to the anastomosis (turbulence)
- Unintentional compression of the vessel with the probe
- Accidentally measuring arterial inflow instead of venous outflow

## 8. Clinical Errors

- Not considering blood pressure: **hypotension = reduced flow**
- Measuring immediately after dialysis: **hypovolemia = lower flow**
- Not checking for accessory veins diverting part of the flow
- Using PSV (Peak Systolic Velocity) instead of **time-averaged mean velocity**

## 9. When Additional Measurements Are Useful

- Suspicion of stenosis: pre-/post-stenotic velocity ratios, turbulence, elevated PSV
- Steal syndrome: comparison of proximal and distal arterial flow
- AV grafts (AVG): measure flow in the body of the graft

## PS – What Does Qa Mean?

**Qa** means *Access Flow*, the volumetric flow of the dialysis access.
It is the **flow (Q)** passing through the vascular access (**a = access**), either an AV fistula or AV graft.
Expressed in **mL/min**.