Charbel Micro-Flowprobes® are designed to measure blood flow in cerebral vessels (Fig. 1). The bayonet-style Flowprobes, available in 1.5, 2 and 3mm sizes, use ultrasonic transit-time principles to directly measure volume blood flow, not velocity. Flow measurements can guide cerebrovascular surgical strategies including microsurgical resection/obliteration of AVMs.

**Measurements Steps:**

1. **Identify Vessels to be measured**
   - Expose and identify afferent vessels and venous outflow vessels of an AVM.

2. **Select Flowprobe Size**
   - Measure the vessel diameter of the vessels with a gauge before opening the Flowprobe package. Select a Flowprobe size so that the vessel will fill between 75% - 100% of the ultrasonic sensing window of the Flowprobe.

3. **Apply Flowprobe**
   - Determine the optimal position for applying the Probe on the vessel by selecting a site wide enough to accommodate the Flowprobe’s acoustic reflector without compromising perforating arteries coming off the vessel. Apply the Flowprobe so that the entire vessel lies within the ultrasonic sensing window of the Flowprobe and aligns with the Probe body (Fig. 2). Bend the Flowprobe’s flexible neck segment as needed (Fig. 1). As the Flowprobe is being applied to the vessel, listen to FlowSound®. The higher the pitch, the greater the flow. Sterile saline or cerebrospinal fluid may be used to flood the Flowprobe’s lumen and provide ultrasound coupling. Do not irrigate continuously because the Flowprobe will also measure saline flow. The Signal Quality Indicator on the Flowmeter or AureFlo indicates acoustic contact. If acoustic contact falls below an acceptable value, an acoustic error message will be displayed.

4. **Measure Baseline Flows before Resection**
   - Before AVM resection, and following burst suppression, measure baseline flows in all afferent, transint and venous vessels. Record the baseline flow measurements and the patient’s blood pressure on a Flow Record.

5. **Measure Flows during and Post Resection**
   - During resection, measure flows as needed in each of the vessels. In possible transint arteries measure at different sites along the vessel. A drop in flow between two points on the vessel might identify an additional feeder into the AVM. Compare flows with baseline flows to guide the surgical procedure. Measure flows post resection to ensure total obliteration of the AVM.

6. **Document Flows**
   - To document flow values, wait 10-15 seconds after applying the Flowprobe for mean readings to stabilize. Then press the PRINT button on the Flowmeter or take a snapshot on AureFlo to document the phasic flow patterns for the case record. If the Flowmeter displays a negative flow, press the INVERT button to change the polarity before printing the waveform.

**REFERENCES**


Flow-Guided AVM Resection¹

### Pre-dissection

**ICG-VA**

- AVM Architecture

**Measure Flow**
- on all exposed vessels, especially on vessels not shown by ICG-VA
- Baseline Flows

**Determine surgical strategy for AVM dissection**

### During-dissection

**Measure flow as needed**

- Note flow direction of vessels entering AVM
- Determine is vessel is arterial feeder or venous drainage

- Note any drops in flow values along single vessels running close to AVM
- Determine is vessel is transit artery

- Compare to baseline flow data
- Note hemodynamic changes in AVM

### Final-dissection

**Measure flow on venous drainage before section/closure**

- Flow value $> 1$ mL/min
- Further AVM dissection to detect missed feeder(s)

- Compare to baseline flow data
- Dissect venous drainage

- AVM resection complete