

Flow-assisted Surgical Techniques and Notes*

AVM Resection Protocol

*Flow-Assisted Surgical Techniques ("F•A•S•T") and Protocols are drawn from surgical experiences by transit-time flow measurement users and passed along by Transonic for educational purposes. They are not intended to be used as sole basis for diagnosis. Clinical interpretation of each patient's individual case is required.

Introduction^{1,3-4}

During a microsurgical resection/obliteration of an arteriovenous malformation (AVM), a cerebrovascular surgeon may elect to use a Charbel Micro-Flowprobe® (Fig. 1) as a quantitative tool to directly measure volume blood flow in cerebral vessels to help inform surgical decision making.

Measurements Steps¹⁻³

Pre-resection:

1. Identify Vessels to be Measured

Expose and identify afferent vessels and venous outflow vessels of an AVM.

2. Select Flowprobe Size

Measure the diameter of the vessels before opening the Flowprobe package. Select a Flowprobe size so that the vessel will fill 75% - 100% of the Flowprobe's ultrasonic sensing window.

3. Apply Flowprobe

Determine the optimal position for applying the Flowprobe on the vessel by selecting a site wide enough to accommodate the Flowprobe's acoustic reflector without compromising perforating arteries. Apply the Flowprobe so that the entire circumference of the vessel lies within the ultrasonic sensing window of the Flowprobe and aligns with the Probe body without distorting the vessel's natural shape (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 flowing around the vessel. The Signal Quality Indicator on the Flowmeter or Monitor indicates acoustic contact. If acoustic contact falls below the minimum threshold, an acoustic error message will be displayed.

4. Measure Baseline Flows before Resection

Following burst suppression, but before AVM resection, measure baseline flows in all afferent, transit and venous vessels. Record baseline flow measurements and the patient's blood pressure.

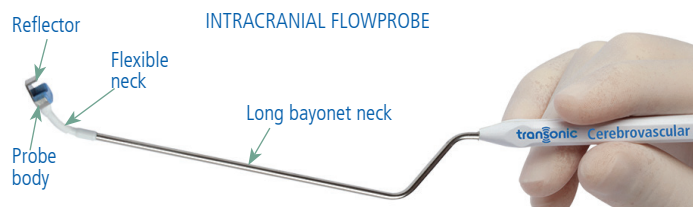


Fig. 1: The Charbel Micro-Flowprobe® is designed for deep intracranial surgery. Their long bayonet handle permits use under a surgical microscope. A flexible neck segment permits the Flowprobe neck to be bent, as needed, to optimally position the probe around a vessel.

5. Measure Flows During and Post Resection

During resection, measure flows as needed in each of the vessels. In possible transit 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

Waiting 10-15 seconds after applying the Flowprobe for mean readings to stabilize, and then document phasic flow patterns for the case record. If a negative flow is displayed, press the INVERT button to change the polarity before printing the waveform.



Fig. 2



Fig. 3: Measuring flow in AVM feeder vessel.

References:

1. Cerebrovascular Surgery Handbook NS-59-hb, Rev G, 2023
2. Measuring PeriFlowprobe(CV-180-mn) RevA 2018 USltr
3. Della Puppa A et al, "Intraoperative Flow Measurement by Microflow Probe During Surgery for Brain Arteriovenous Malformations," Neurosurg 2015; Jun; 11 Suppl 2:268-73. (Transonic Reference # 10288AH)
4. Kirk HJ et al, "Intra-operative transit time flowmetry reduces the risk of ischemic neurological deficits in neurosurgery." Br J Neurosurg. 2009; 23(1): 40-7. (Transonic Reference # 7744AH)

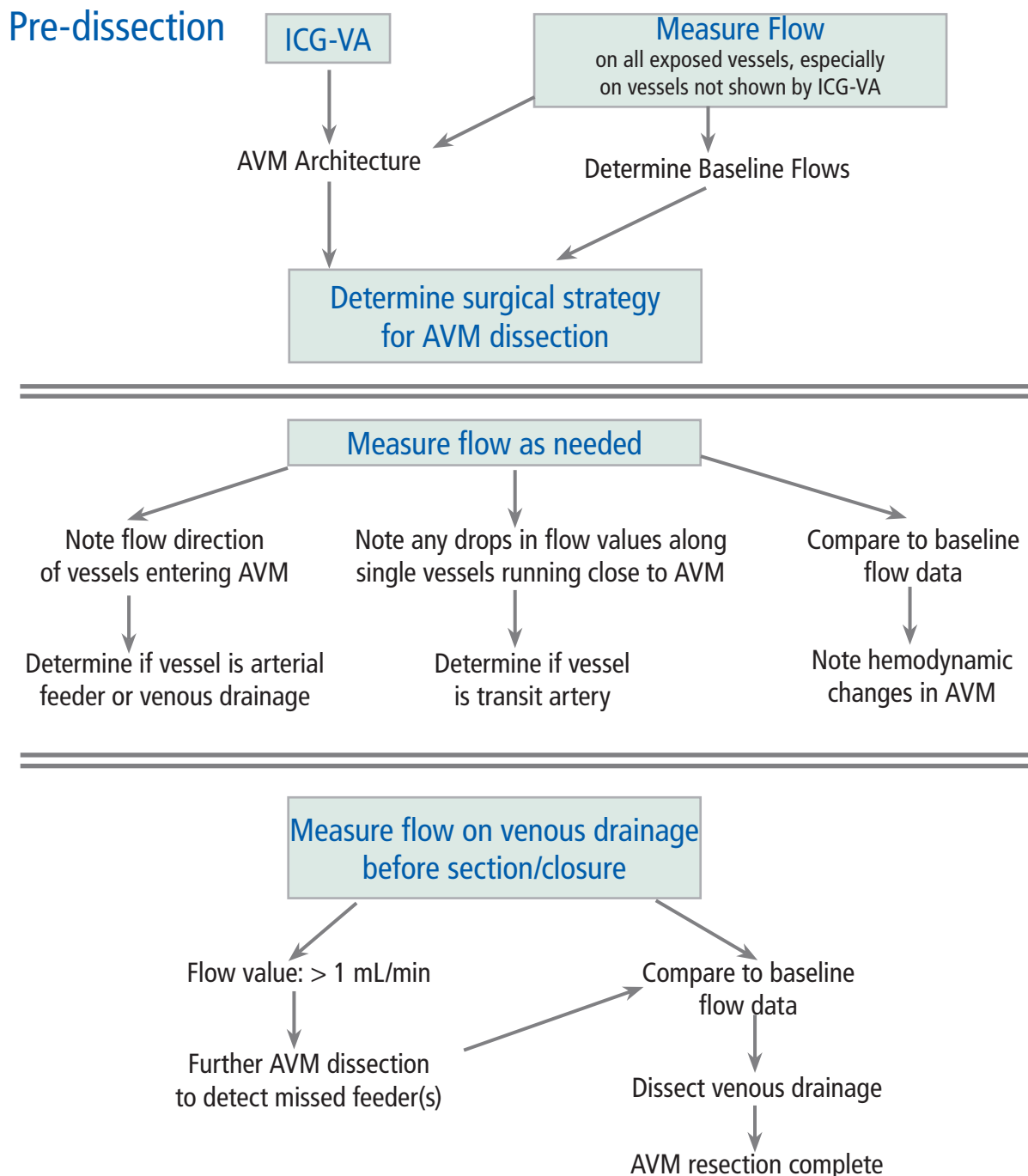
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Flow-assisted Surgical Techniques and Notes*

AVM Resection Protocol cont.

Flow-Guided AVM Resection³



³ Modified from Fig. 3, page 273 of Della Puppa A, Rustemi O, Scienza R, "Intraoperative Flow Measurement by Microflow Probe During Surgery for Brain Arteriovenous Malformations," Neurosurg 2015; Jun;11 Suppl 2:268-73. (Transonic Reference # 10288AH)