

# Medical Note

## MILLER Banding: Minimally Invasive Limited Ligation Endoluminal-assisted Revision

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Two conditions create the need to increase venous outflow resistance in an arteriovenous fistula (AVF) used to deliver hemodialysis.

**STEAL SYNDROME:** Peripheral ischemic symptoms from hypoperfusion distal to the hemodialysis access due to the access diverting flow from the periphery.

**HIGH FLOW ACCESS:** As an AV fistula ages, high flow (~>2 L/min) can develop which can lead to high flow access problems including:

- Post-dialysis bleeding
- Elevated venous pressures
- Pathologically accelerated access growth
- Cardiac overload

### FISTULA BANDING

A high resistance band is used in both instances to correct steal or high flow in pathological accesses by restoration of sufficient distal flow and perfusion. With accesses that have induced symptoms of steal, it is critical to balance the demands of the access with restoration of sufficient flow to alleviate the steal symptoms. For a high flow access, the diameter of the band must also be precisely controlled as not to induce thrombosis.

### MILLER BANDING

The MILLER procedure uses an inflated angioplasty balloon as a sizing dowel inside an access as a ligature is tightened around the outside of an access. The band restricts flow through the access to improve distal perfusion and alleviate symptoms.

**PRE-INTERVENTION:** Patients are examined and categorized as "Steal" or "High Flow" according to their symptoms and the physical examination.

#### 1. ANGIOGRAPHIC/PRE-BANDING INTERVENTIONS

A 21-g microaccess needle and catheter with intravenous contrast are introduced into the access to identify any outflow obstruction. A 5F vascular sheath, guide wire and Bernstein catheter are used to access the inflow artery for arterial imaging. With the catheter in the feeding artery, extremity imaging is performed. A pre-procedure flow measurement with a Transonic® Endovascular Flowmeter and ReoCath® Flow Catheter measures access flow. Steal patients also undergo an upper arm extremity arteriogram.

#### 2. BANDING SITE IDENTIFIED

The arm is palpated to locate a banding site as close to the AV anastomosis as possible (1-3 cm), yet superficial enough to allow for easy dissection.

#### 3. DISSECTION

Under local anesthesia, two parallel lateral 0.5 cm incisions are made. A peri-access tunnel is dissected subcutaneously under the access, using Kelly clamp blunt dissection.

#### 4. BANDING

A 2-0 mono filament Prolene ligature is pulled under the access. The suture is then looped over the access (under the skin) using a Kelly clamp. An angioplasty balloon is inflated to 18 atmospheres of pressure in the area encircled by the suture loop.

**Note:** Balloon sizing is critical to the procedure's success. In steal patients, the band should be equal or smaller than the size of the downstream artery to ensure that access resistance is significantly increased with respect to the resistance of the downstream artery. In high flow patients, the diameter of the access lumen must be reduced by 60-80% in order to significantly affect flow, (per Murray).

The ligature is then tightened around the balloon until there is no flow in the access. The ligature is secured, the balloon is deflated and removed, and flow is restored in the access.

#### 5. PROCEDURE COMPLETION/MODIFICATIONS

Immediately after banding, flow measurements are performed to quantify the flow reduction. The access is palpated to assess flow. If flow is too sluggish, a balloon with a diameter 1 mm larger is used to stretch the band. If a patient reports no symptomatic improvement and angiographic evidence of steal persists, the procedure is repeated with a second ligature (using a balloon with a diameter 1 mm less than the first).

# Flow-guided MILLER Banding Cont.

## FLOW MEASUREMENT PROTOCOL

### Pre-procedure:

- Patients have physical examination and designated "Steal" or "High Flow"
- Inflow artery imaged
- Extremity imaged; Steal: upper arm imaged
- Intra-access ReoCath® flow measurement
- Banding site identified through palpation

1. Dissection: two parallel lateral 0.5 cm incisions are made; a peri-access tunnel is dissected subcutaneously under the access.

2. 2-0 mono filament Prolene ligature pulled under the access. The suture is then looped over the access (under the skin).

3. An angioplasty balloon is inflated to 18 atmospheres of pressure in the area encircled by the suture loop.

4. Band tightened & secured.

5. Balloon deflated & removed. Flow restored.

6. Intra-access Flow measured and quantified with ReoCath®.

7. Post-banding: access palpated to assess flow.

- If flow sluggish, a larger balloon is used to stretch the band.
- If no alleviation of symptoms, and steal persists, the procedure is repeated with a smaller second ligature.

## EQUIPMENT



HVT100 Endovascular Flowmeter, extension cable and ReoCath® 6 F Antegrade Flow Catheter.

### REOCATH® FLOW MEASUREMENT TIPS

- Once the stopcock is opened, perform injection immediately. Do not let blood flow into the injection lumen.
- After the injection, close the stopcock to avoid blood from entering the injection lumen.
- Do not stop the injection or change rate of injection when the display changes from "READY" to "INJ. 03". Make sure the injection is complete by the time the countdown reads "INJ. 00". Variability or disruptions in the injection will invalidate the flow measurements and cause the display to read "REPEAT".
- The full 10 mL syringe must be injected. Variability in injection volume or time will cause errors and variability in measurements.

### References:

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Murray BM, Rajczak S, Herman A, Leary D., "Effect of surgical banding of a high-flow fistula on access flow and cardiac output: intraoperative and long-term measurements," *Am J Kidney Dis.* 2004 Dec;44(6):1090-6. (Transonic Reference # HD415A)

Miller GA, A, Friedman A, Khariton A, Preddie DC, Savransky Y., "Access flow reduction and recurrent symptomatic cephalic arch stenosis in brachiocephalic hemodialysis arteriovenous fistulas," *J Vasc Access.* 2011 Oct 4: 2010 Oct-Dec;11(4):281-7. (Transonic Reference # 9642AHR)

Miller GA, Hwang W, Preddie D, Khariton A, Savransky Y, "Percutaneous salvage of thrombosed immature arteriovenous fistulas," *Semin Dial.* 2011;24(1):107-14. (Transonic Reference # 9599AHR)