

Flow Reduction What Works and When?

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Department of Surgery

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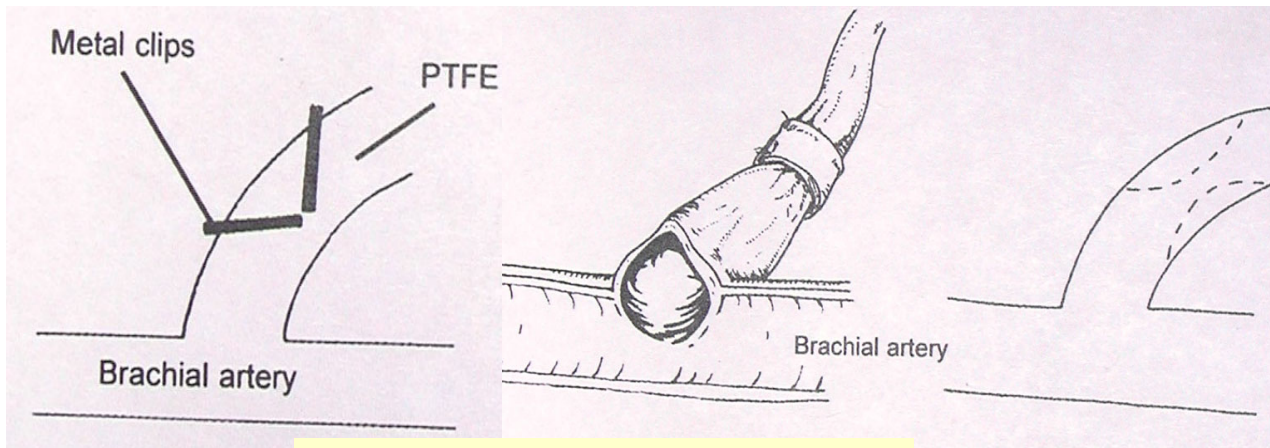
St. John Medical Center



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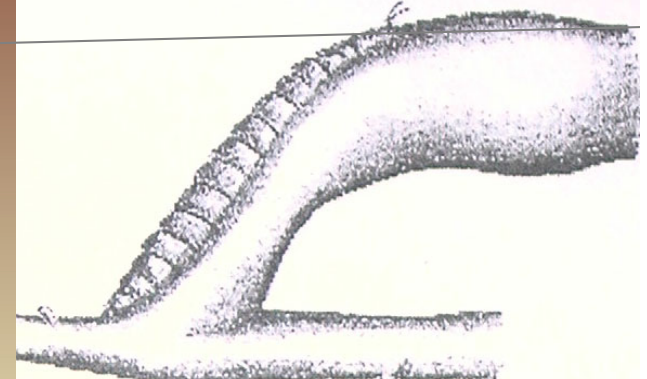
Indications for flow reduction

- High flow steal syndrome
- High access flow with unimpaired cardiac status
- Moderate flow with impaired cardiac status
- Transplantation with high flow AVF
- Symptomatic central venous stenosis or obstruction
- High flow or elevated AVF outflow pressure associated with aneurysm formation, cannulation site prolonged bleeding, other symptoms



Henriksson AE. Journal Vasc Access 2004; 5: 13-15

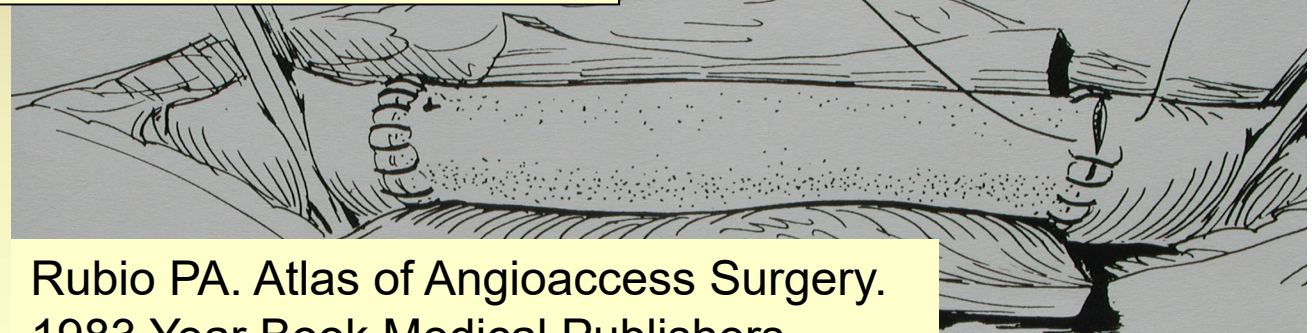
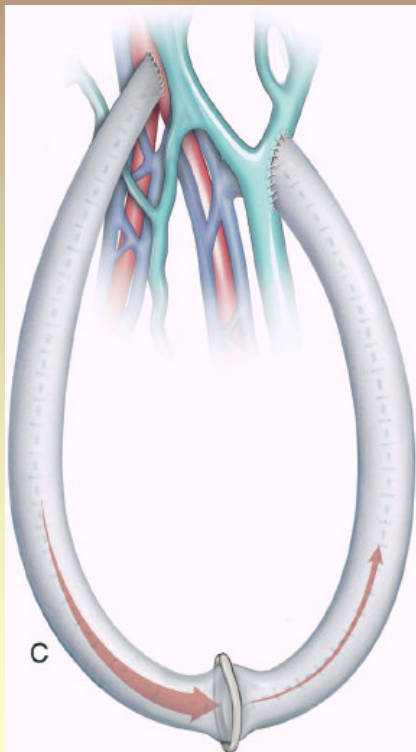
Interponated ePTFE graft



Bakran A. in Vascular Access Simplified. 2003 Trinity Press

Just a few of so many options.....!

Zanow J. in Vascular Access for HD VII. 2001 Precent Press



Rubio PA. Atlas of Angioaccess Surgery. 1983 Year Book Medical Publishers

Malik J, Davidson I. J of Vasc Access 2008;9:155-1666

Slide courtesy: Sidney Glazer M.D.

Access banding in the past just seemed to “never work”!

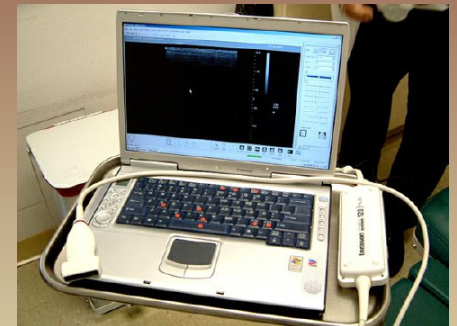
- Too tight = AVF thrombosis!
- Too loose = No benefit!
- Difficult to get it “Just Right”!

Why so difficult? Why so many failures in the past?

- ➔ **1) At restriction site: Only a ½ mm increment in diameter reduction makes large changes in flow volume!**
- ➔ **2) No clear operative evaluation of flow restriction success!**

Ultrasound: A Critical Role in ***ALL*** aspects of Vascular Access

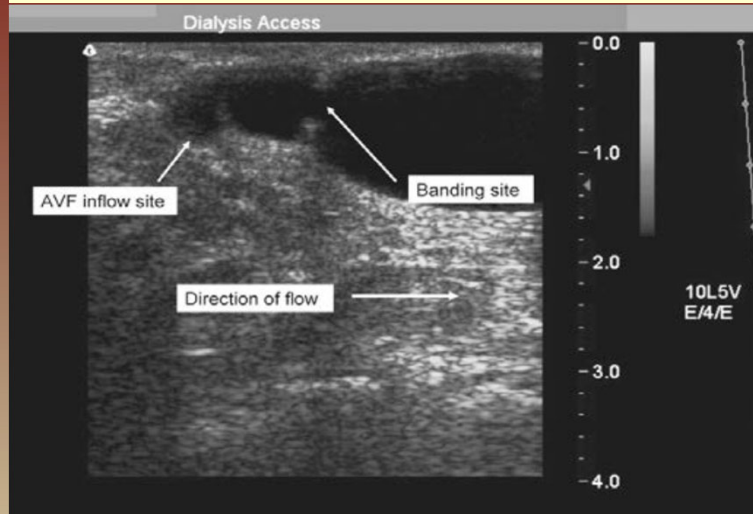
- Prior to fistula creation
- Follow-up before initial access cannulation.
- Evaluating access dysfunction
- **Real-time flow measurement during flow reduction (banding).**



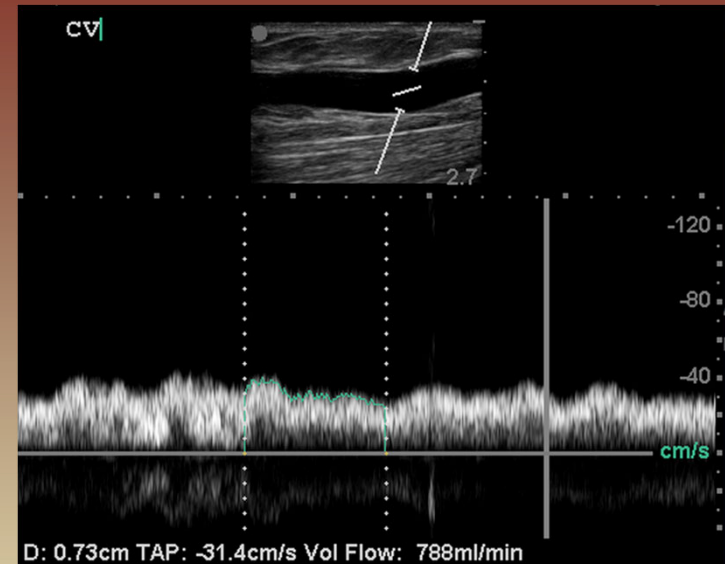
Gkotsis G, Jennings WC, Malik J, Mallios A, Taubman K. Treatment of high flow arteriovenous fistulas after successful renal transplant using a simple precision banding technique. Ann Vas Surg. 2016, Feb;31:85-90.

Jennings WC, Miller GA, Coburn MZ, Howard CA, Lawless MA. Vascular access flow reduction for arteriovenous fistula salvage in symptomatic patients with central venous occlusion. J Vasc Access 2012;13(2):157-162.

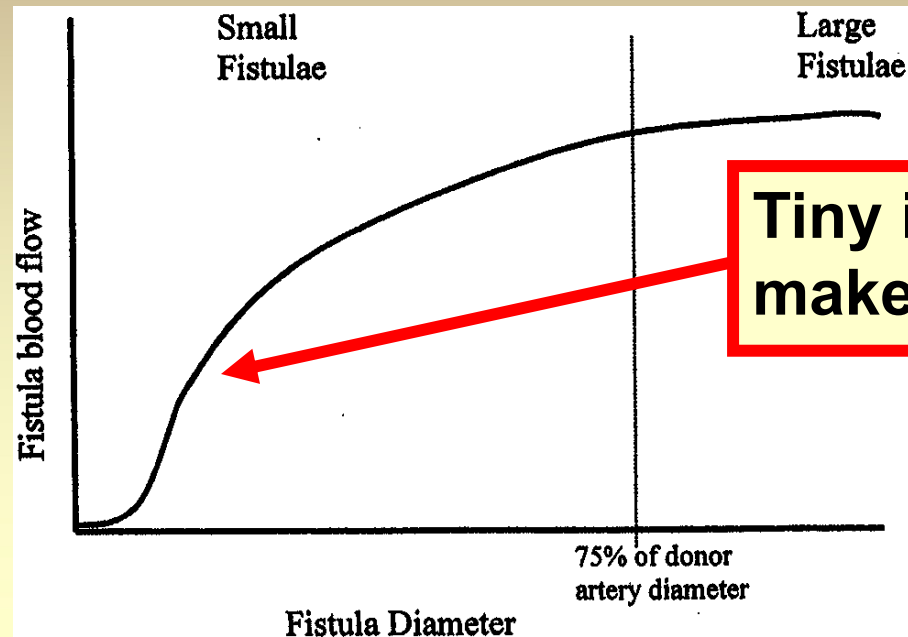
Real time ultrasound flow replaces guesswork



Precision banding in 1/2mm increments



Operative flow measurements



Tiny increments in AVF diameter make *major* changes in flow.

Wixon CL, Hughes JD, Mills JL. Understanding strategies for the treatment of ischemic steal syndromes after hemodialysis access. J Am Coll Surg. 2000 Sep;191(3):301-310.

Predicting success in banding for steal syndrome (banding is not for all patients!)

- Simple digital occlusion of the AVF with restoration of distal pulses and appearance of normal capillary perfusion in the hand.
- High brachial artery flow measurement.
- Other objective measurements may include correction of brachial/digital index or transcutaneous O₂ with and without temporary AVF occlusion.
- Resolution of both tachycardia and flow murmur may also be noted after digital AVF occlusion.

Dialysis Associated Steal Syndrome (DASS)

Mild symptoms: Occasional numbness but without motor deficit, rest pain, ulceration or threatened tissue loss.

Observation

All others

Access flow measurements, segmental blood pressures pulse volume recordings, finger pressures, digital/brachial indices, pulse oximetry, and arteriography with fistulagram.

Inflow lesion
↓
Angioplasty

Proximal Inflow Normal

Radiocephalic AVF*

Hand viable

Flow > 1200 ml/min

- **Precision banding**
- Distalization

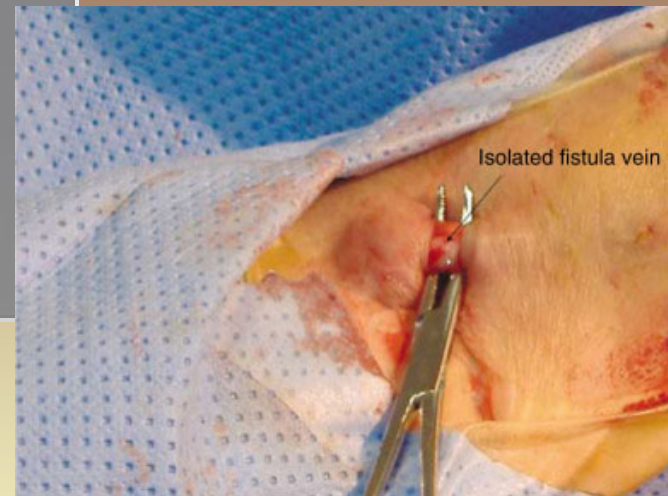
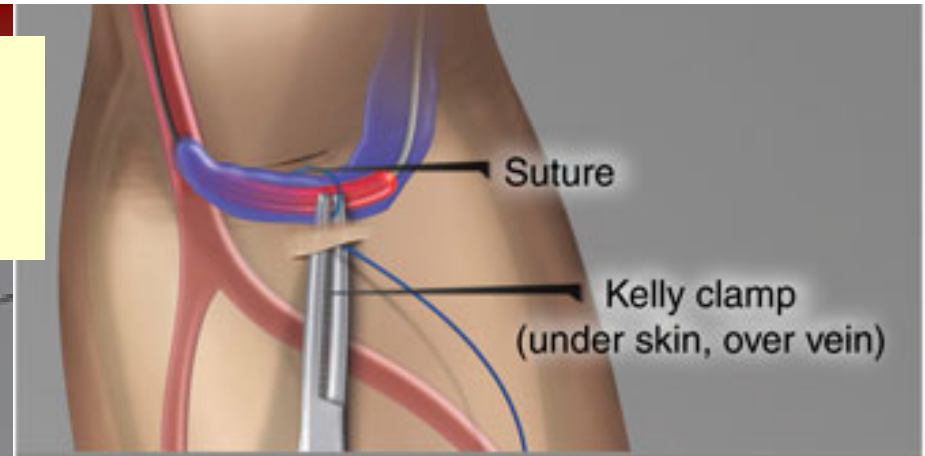
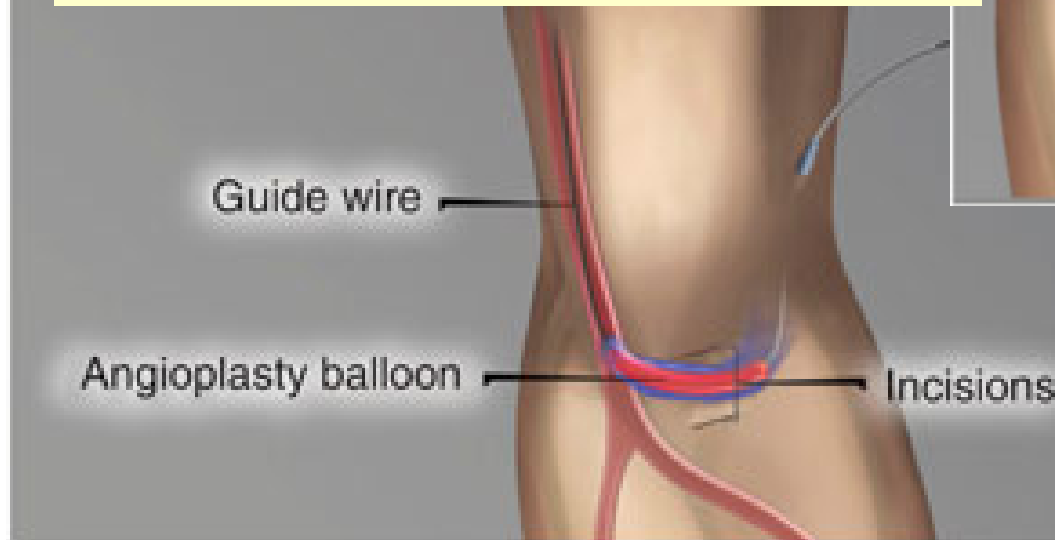
Threatened hand:
- Ligation
- Vein harvest
with translocation
to other site.

Hand viable

Flow < 750 ml/min

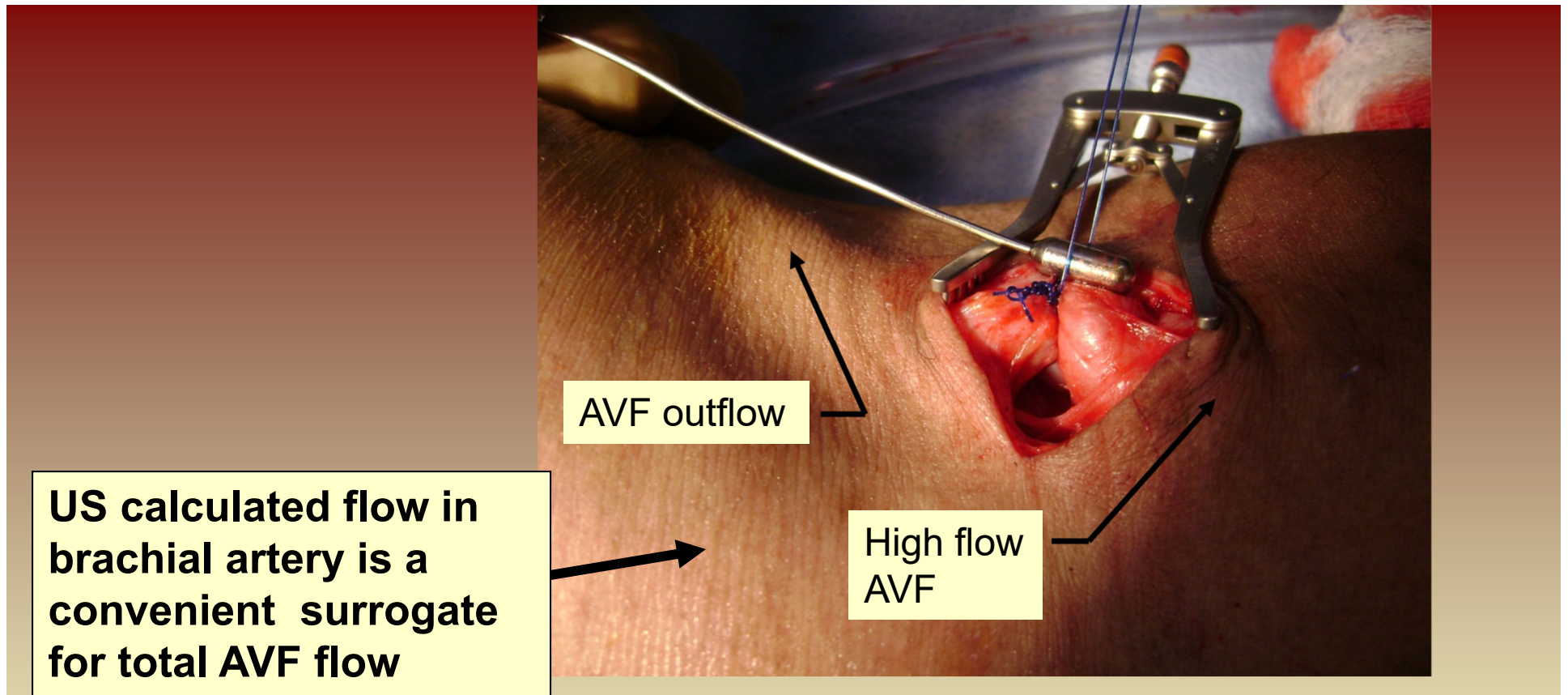
- Proximalization
or DRIL

Banding over an angioplasty balloon



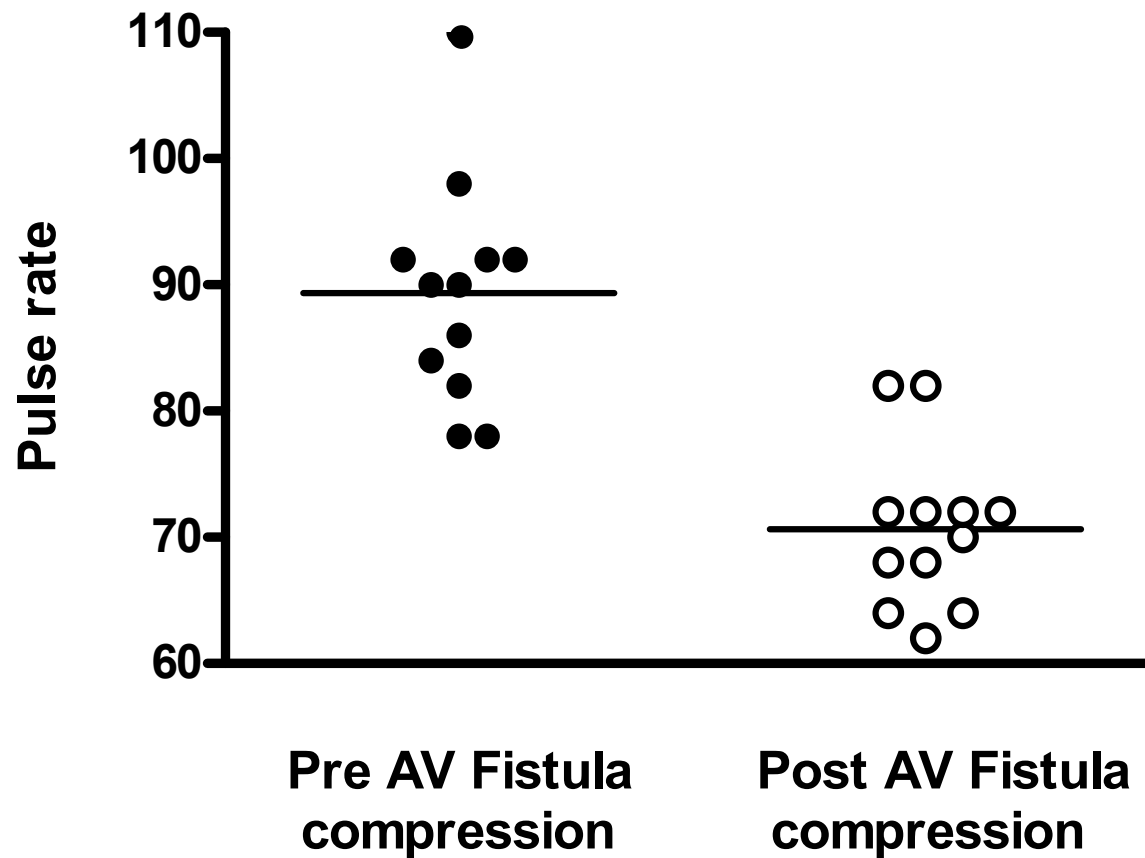
- Miller GA, Goel N, Friedman A, et al. The MILLER banding procedure is an effective method for treating dialysis associated steal syndrome. *Kidney Int* 2010;77:359.
- Jennings WC, Miller GA, Coburn MZ, et al. Vascular access flow reduction for arteriovenous fistula salvage in symptomatic patients with central venous occlusion. *J Vasc Access* 2012;13:157.

Images....https://www.google.com/search?q=Miller+access+banding&biw=1366&bih=662&source=lnms&tbn=isch&sa=X&ved=0ahUKEwjWrcXPpvfQAhVCw1QKHTpqA4wQ_AUIBygC&dpr=1#imgsrc=qrRJSXIYoOEwBM%3A



- Precision banding using a **vessel dilator as a dowel**.
- Flow restriction is created adjacent to the AVF anastomosis, using polypropylene suture and **sized in 0.5 mm diameter increments**.
- AVF flow rates are re-measured** until the target access flow is achieved (500-800ml/min). A second suture was placed at the same site for security.
- Local / sedation.... Maintain baseline blood pressure.

Gkotsis G, Jennings WC, Malik J, Mallios A, Taubman K. Treatment of high flow arteriovenous fistulas after successful renal transplant using a simple precision banding technique. Ann Vas Surg. 2016, Feb;31:85-90.



Temporary digital AVF occlusion decreased the mean pulse rate from 90/min to 72/min (range 110-78), $p < 0.05$.
(Nicoladoni-Branham sign)

Gkotsis G, Jennings WC, Malik J, Mallios A, Taubman K. Treatment of high flow arteriovenous fistulas after successful renal transplant using a simple precision banding technique. Ann Vas Surg. 2016, Feb;31:85-90.

OPTIONS FOR TREATMENT OF CENTRAL VENOUS STENOSIS OR OCCLUSION IN VASCULAR ACCESS PATIENTS

- Observation for asymptomatic patients with modest or no physical findings or symptoms
- Central venous angioplasty → **Precision Banding**
- Central venous angioplasty with stenting
- Angioplasty of collateral veins.
- HERO catheter
- Surgical bypass to unobstructed venous outflow
 - Surgical bypass to ipsilateral unobstructed central venous outflow such as external or internal jugular, or basilic vein
 - Surgical bypass to contralateral venous outflow such as subclavian or internal jugular vein
 - Surgical bypass to lower extremity venous outflow such as femoral or popliteal vein
 - Surgical bypass to intrathoracic or intraabdominal vena cava or right atrium
- Sacrifice of the access with ligation of the AV fistula or graft

Some considerations and limitations

- 1) ***The degree of vessel restriction that yields the targeted flow reduction in real-time is the key factor in banding success.***

Therefore, real-time flow measurements are a must.

- 2) Local anesthetic with minimal sedation.
- 4) Flow should be reduced to ≤ 800 ml/min
- 5) Is banding durable?
- 6) Banding may not be the best option for all high flow AVFs, particularly those with very large outflow veins.

Is banding durable? The Dutch study

- All surgical banding patients during an 8-year period were retrospectively studied (N=50). 12-month postoperative observation period was analyzed.
- 96% were brachial artery-based fistulas. 56% were hypertensive.
- 5mm woven polyester band placed at surgery.
- The **planned diameter reduction** was guided by a sufficient reduction of access flow in which a **palpable thrill was maintained, along with targeted flow reduction calculated beforehand based on preoperative access flow.** “We generally strived to attain a postoperative access flow between **600 and 1000 mL/min.**”

Roel H, Vaes D, Wouda R, van Loon M, van Hoek F, Tordoir JH, Scheltinga MR. Effectiveness of surgical banding for high flow in brachial artery-based hemodialysis vascular access. J Vasc Surg 2015;61:762-6.

Is banding durable?

Results: Initial banding flow reduction was 49%
(mean **3070 to 1490 mL/min**, $P < .001$).

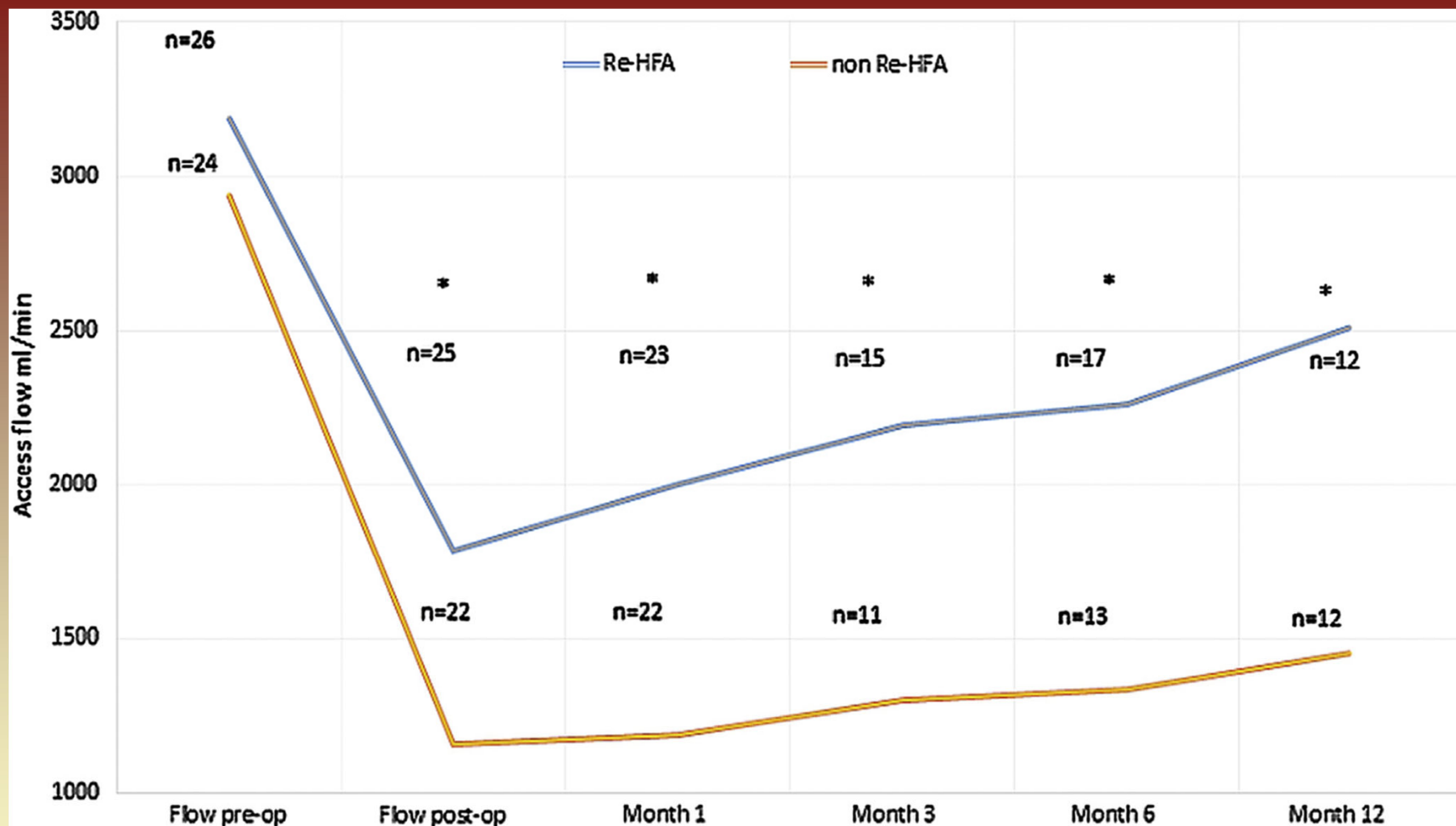
Only 15/50(30%) patients had initial flow reduction of the target (<1000ml/min)

Overall, recurrent high flow (>2 L/min)
developed in 52% of the patients over one year.

However, when initial banding reduced flow to
<1000 ml/min recurrent high flow was dramatically lower.

Mechanism of failure?...

Roel H, Vaes D, Wouda R, van Loon M, van Hoek F, Tordoir JH, Scheltinga MR. Effectiveness of surgical banding for high flow in brachial artery-based hemodialysis vascular access. J Vasc Surg 2015;61:762-6.

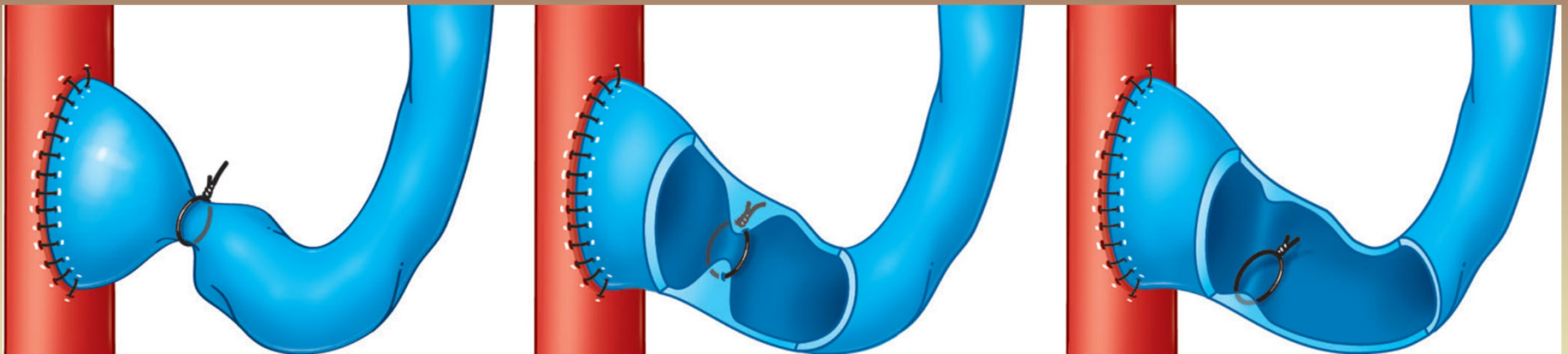


-The upper curve reflects patients developing recurrent high-flow access (HFA; >2000 mL/min).

-The lower curve illustrates patients with access flow that remained <2000 mL/min. *P < .05.

Roel H, et al. Effectiveness of surgical banding.....

Banding large AVFs?



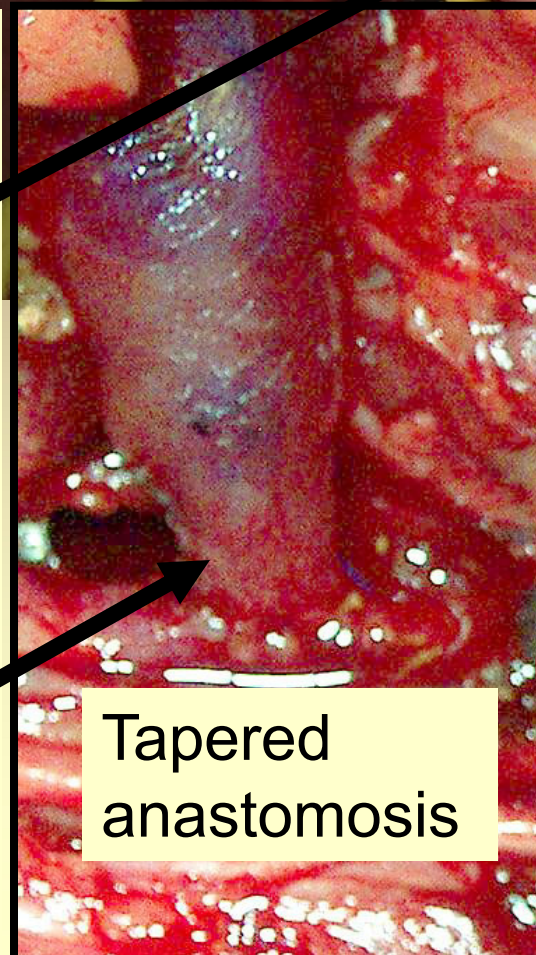
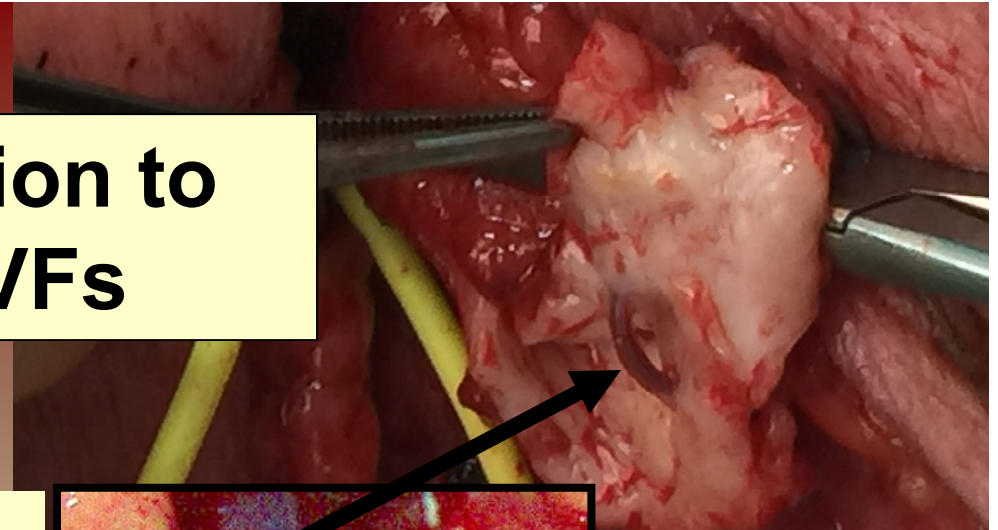
Banding postoperatively (n=4)

Gradual erosion of suture into lumen

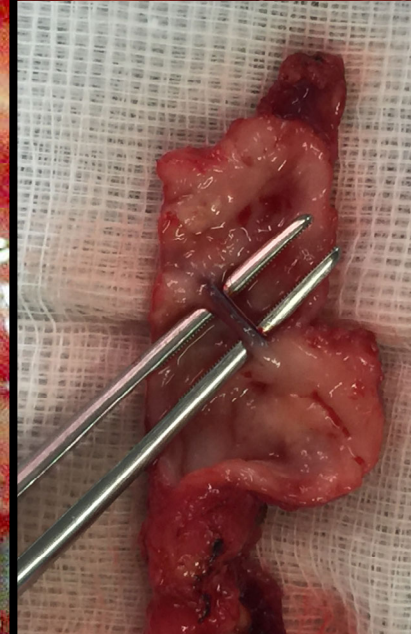
Mallios A. Lucas J, Jennings WC. A mechanism of banding failure in mega-fistulas. J Vasc Access 2018 Jan;19(1):98-100.

Consider an exception to banding for large AVFs

- **Mega-fistula** are often high flow with elevated pressure... Over time, **erosion of suture** into the lumen with resumption of high flow symptoms has been reported (**No bleeding or thrombosis**)
- **For large AVFs**, we recommend surgical revision with tapering or creation of a new anastomosis using real-time ultrasound flow.



Tapered
anastomosis



Conclusions

- Flow restriction by banding is a simple and useful tool for maintaining a functional and safe AVF in most patients.
- Real-time flow measurements before and after banding are critical elements for success.
- Brachial artery targeted flow volume should be 500-800 ml/min at completion.
- Avoid banding in large diameter AVFs.
- Extended follow-up with access flow volume measurements seems warranted.

2020 VASCULAR ACCESS FOR HEMODIALYSIS SYMPOSIUM



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