Medical Note

Intraoperative Blood Flow Measurement during AV (Prosthetic) Graft Construction

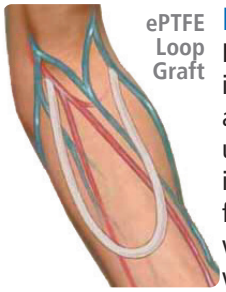

Fig. 1: Loop ePTFE graft from brachial artery to cephalic vein.

INTRODUCTION

Flow cannot be measured directly on newly inserted prosthetic ePTFE grafts (Fig. 1) because air within the synthetic graft walls attenuates ultrasound signal transmission. Graft outflow is therefore measured on the outflow vein following completion of both the arterial and venous anastomoses (Figs. 2, 3). If the distal vein has not been ligated, flow is still measured proximal to the anastomosis, while the distal unligated section of the vein is temporarily occluded (Fig. 4).

MEASUREMENT STEPS:

1. IDENTIFY VESSELS TO BE MEASURED

Identify the exposed segments of the venous outflow conduit for the graft. Determine the optimum site (wide enough to accommodate the Probe's acoustic reflector) for applying the Probe, and clean the vein at this site from fat and excess tissue.

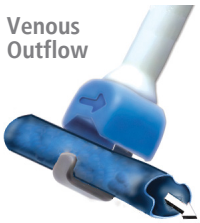

Fig. 5: Outflow vein filling 75- 100% of the Probe's sensing window.

2. SELECT FLOWPROBE SIZES

Estimate the diameter of the outflow vein with a gauge. Select a Probe size so that the vein will fill between 75% - 100% of the lumen of the Probe.

Nominal Probe Size	Acceptable Vessel Range
4 mm	3.0 - 5.0 mm
6 mm	4.0 - 7.3 mm

3. APPLY FLOWPROBE

Apply sterile gel to the Flowprobe to provide ultrasound coupling between the Probe body and Probe reflector. Apply the Flowprobe to the vein, proximal to the anastomosis, bend the Probe's flexible neck segment as necessary, so that the entire vein lies within the lumen of the Probe and aligns with the Probe body (Fig. 5). If desired, listen to the pitch of FlowSound® as the Flowprobe is applied to the vein. The higher the pitch, the greater the flow. Check the Signal Quality Indicator on the Flowmeter display for ultrasound acoustic contact. An acoustic error message will be displayed if ultrasound contact falls below an acceptable minimum.

4. MEASURE AND EVALUATE VENOUS OUTFLOW

With the Flowprobe positioned as under Step 3 (above), measure venous average flow as displayed on the Flowmeter. An initial venous outflow < 400 mL/min is associated with a higher rate of initial graft failure.[1] As the site recovers from surgery, flow will increase to levels preferred for hemodialysis (> 600 mL/min).

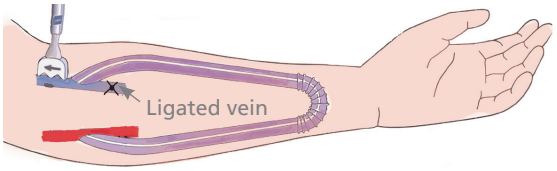

Fig. 2: Loop ePTFE Graft anastomosed to the side of an artery and end of ligated vein.

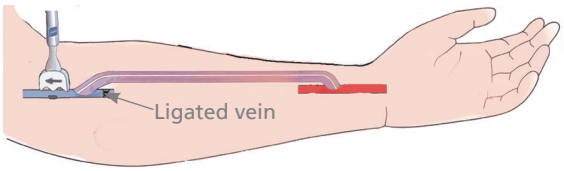

Fig. 3: Straight ePTFE Graft anastomosed to the side of an artery and end of a vein.

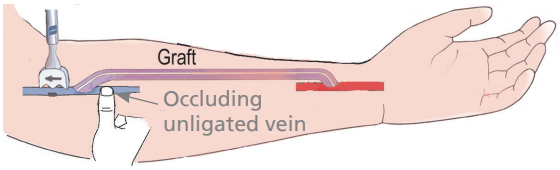

Fig. 4: In a graft anastomosed to an unligated vein, flow is measured while the distal portion of the vein is temporarily occluded.

Graft Type	Flow (mL/min)	Failure within 90 Days (Requiring Intervention)	p value
PTFE Grafts	< 400	65 %	.01
	> 400	40 %	

Table 1: In prosthetic grafts, initial flows of less than 400 mL/min foreshadowed failure within 90 days.[1]

ePTFE-Grafts [1,2]	
Flow Rate	Recommendation
≤ 250 mL/min	Abandon site immediately
250 - 400 mL/min	Consider prophylactic anti-coagulation

References

1 Johnson CP et al, "Prognostic Value of Intraoperative Blood Flow Measurements in Vascular Access Surgery," Surgery 1998; 124: 729-38.
2 Berman SS et al, "Predicting Arteriovenous Fistula Maturation with Intraoperative Blood Flow Measurements," J Vasc Access. 2008; 9(4): 241-7.

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Intraoperative Blood Flow Measurement during AV (Prosthetic) Graft Construction Cont.

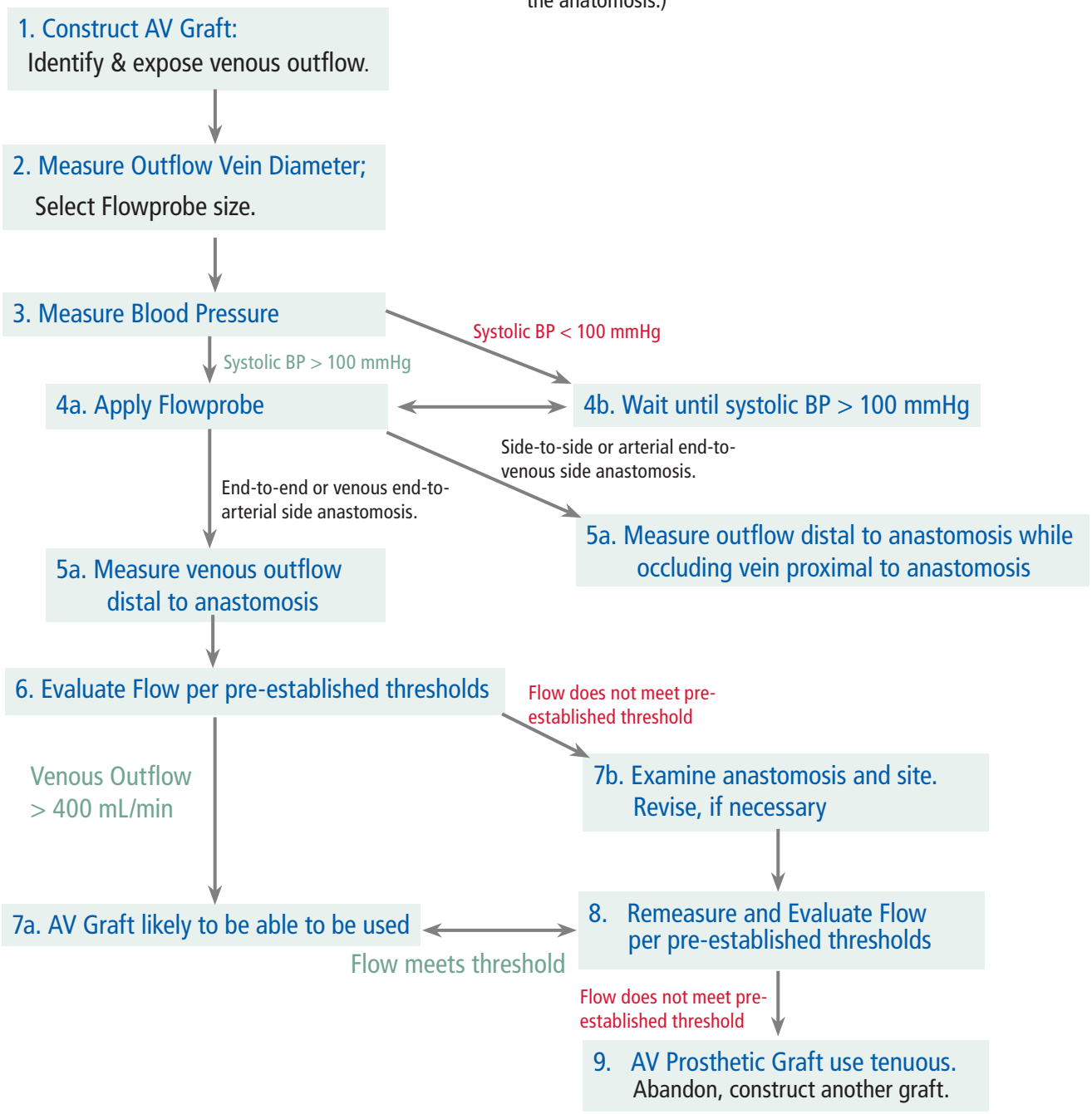
5. DOCUMENT FLOWS

After applying a Flowprobe to a vein, wait ~ 10-15 seconds. When flow readings are stable, flow data can be captured by recording or taking a snapshot on the Flowmeter or by pressing PRINT on Flowmeter equipped with that option. If the flow reading is negative on the LED, press INVERT to reverse the polarity of the flow reading from negative to positive before printing out the waveform.

6. MEASURE POTENTIAL FOR STEAL SYNDROME (OPTIONAL)

With the Flowprobe placed on the vein as previously, measure flow with, and without, occlusion of the artery distal to the arterial anastomosis. The difference between the two readings equals flow in the distal branch of the artery. When the flow reading without distal occlusion is higher than the reading with occlusion, blood in the distal branch is flowing retrograde to augment fistula flow and vascular steal may develop. (Note: Alternately, distal arterial flow can be measured directly by placing a Flowprobe on a properly cleaned arterial site distal to the anatomosis.)

PROTOCOL



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