

2018 Vascular Access for Hemodialysis Symposium

May 10-12, 2018
New Orleans, LA



Vascular Access Anatomy and Access Circuit

John F. Lucas III, MD, FACS



Practice Gap, Objectives & Expected Outcome

Practice Gap: Narrow focus on the vascular access cannulation zone

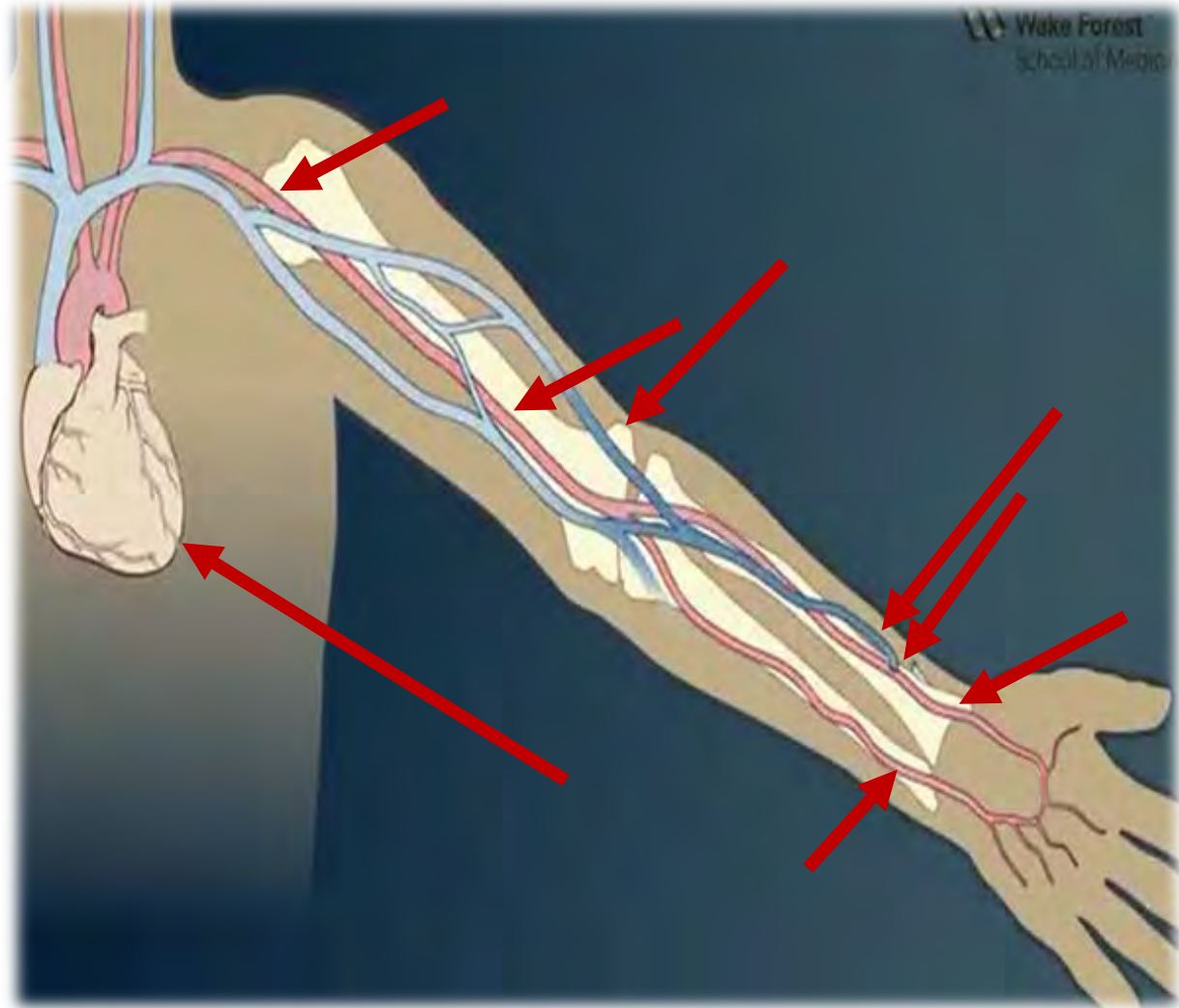
Educational Need: Identify all parts of the vascular access circuit

Objective: Describe the parts of the hemodialysis vascular access circuit

Expected Outcome: Identify the parts of the hemodialysis vascular access circuit including inflow, body and outflow components

The Vascular Access Circuit

- Heart- pump(inflow)
- Artery- feeding vessel (inflow)
- Anastomosis – connection between artery and vein (inflow)
- AVF – portion of enlarged vein used as cannulation zone (body)
- Outflow Veins- vessels that return blood back to the heart (outflow)



The Vascular Access Circuit - Problems

- Heart
- Artery
- Anastomosis
- AVF
- Outflow Veins

The Vascular Access Circuit - Problems

➤ **Heart**

➤ Artery

➤ Anastomosis

➤ AVF

➤ Outflow Veins

- Congestive heart failure
- Chronic low blood pressure
- Bradycardia
- Severe hypertension

The Vascular Access Circuit - Problems

➤ Heart

➤ **Artery**

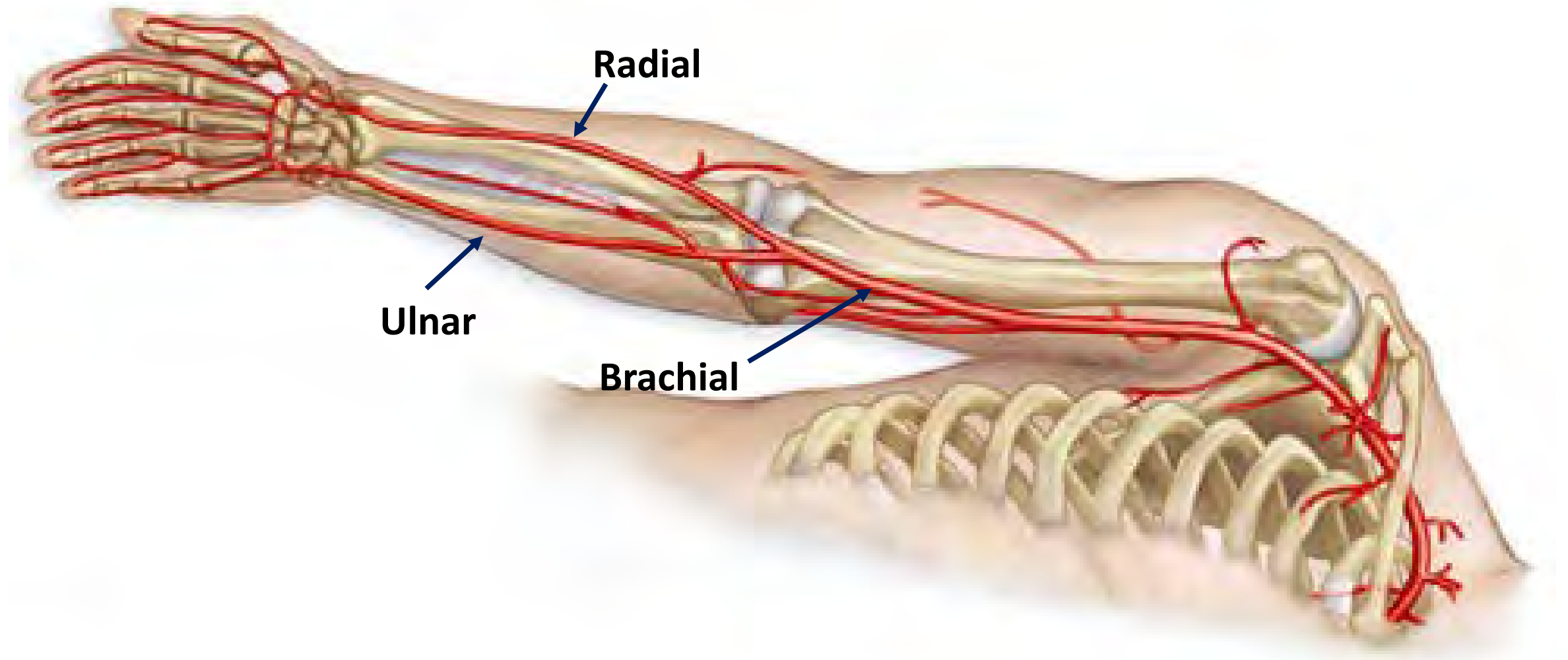
➤ Anastomosis

➤ AVF

➤ Outflow Veins

- Atherosclerosis
 - Narrowed and limits flow
 - Stiff and will not increase flow
- Occlusion
 - Limits flow
 - Promotes steal
- High bifurcation of brachial artery

Arterial Anatomy



The Vascular Access Circuit - Problems

- Heart
 - Stenosis
 - Aneurysm
- Artery
- **Anastomosis**
- AVF
- Outflow Veins

The Vascular Access Circuit - Problems

➤ Heart

➤ Artery

➤ Anastomosis

➤ **AVF**

➤ Outflow Veins

- Rule of 6s
 - 600 ml/min flow
 - 6 mm in diameter
 - 6 mm or less from the surface
 - 6 inches of available length for cannulation
- Stenosis
 - Anastomosis
 - Swing segment
 - Cannulation segment

The Vascular Access Circuit - Problems

➤ Heart

➤ Artery

➤ Anastomosis

➤ AVF

➤ **Outflow Veins**

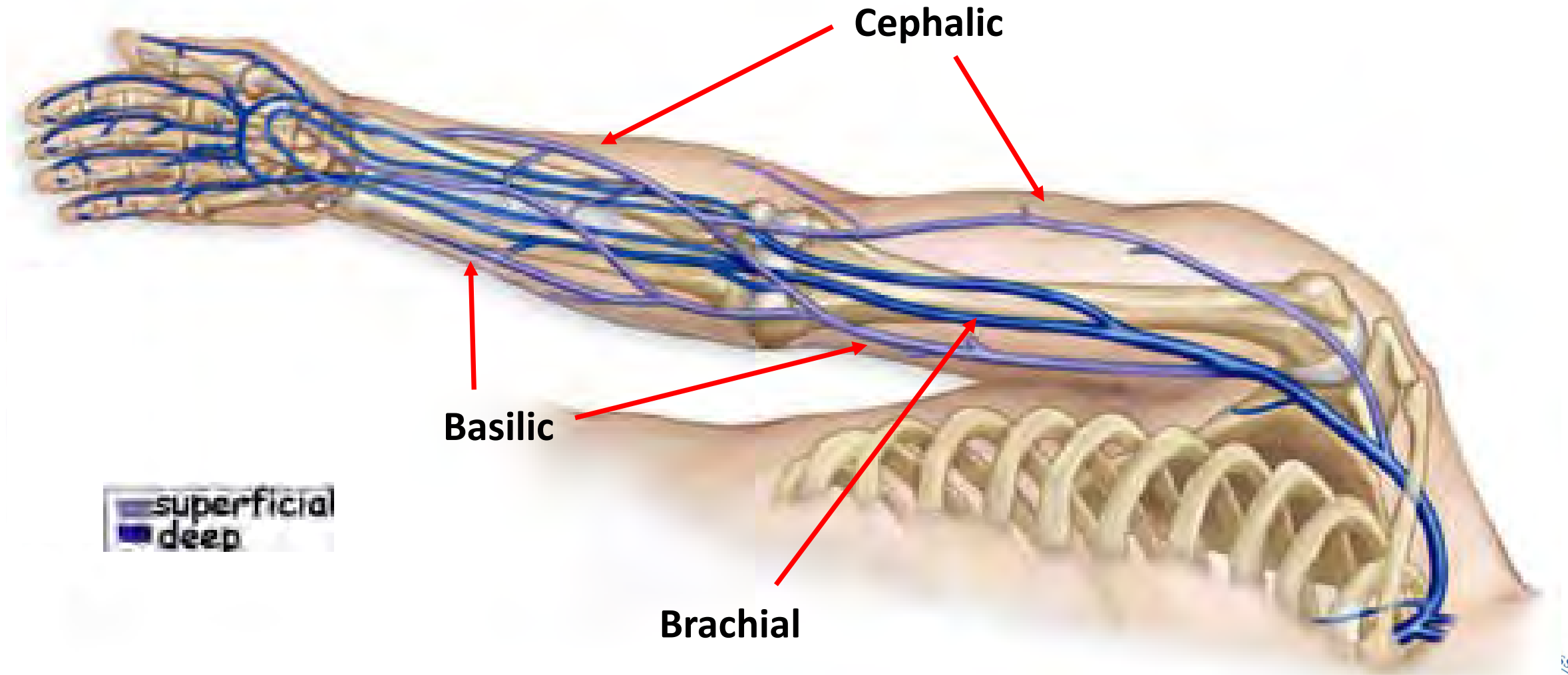
- Occlusion or Stenosis

- Pacemaker
- Port-a-cath
- Defibrillator
- Dialysis catheter
- PIC lines
- Cephalic arch

The Vascular Access Circuit

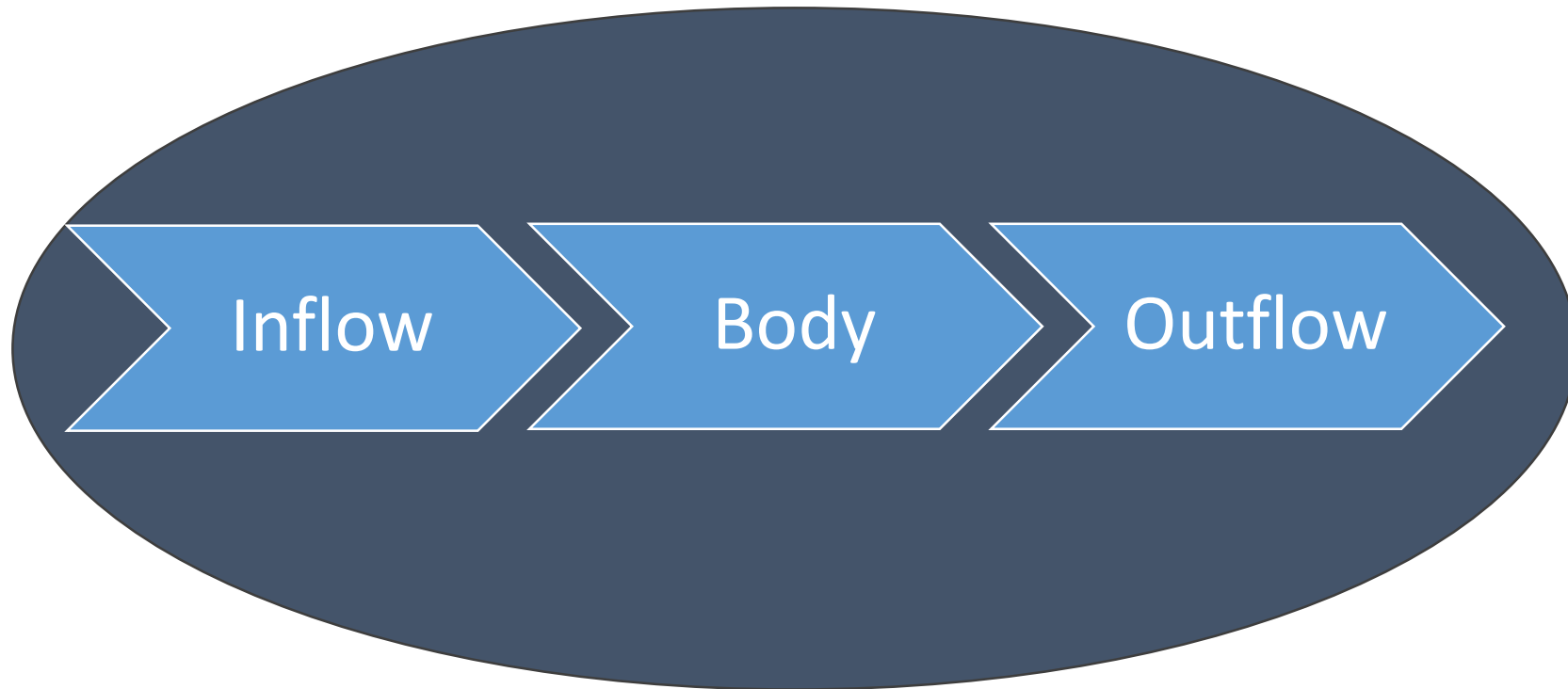
- Primary fistulas
- Primary transposed fistulas
- Grafts

Venous Anatomy



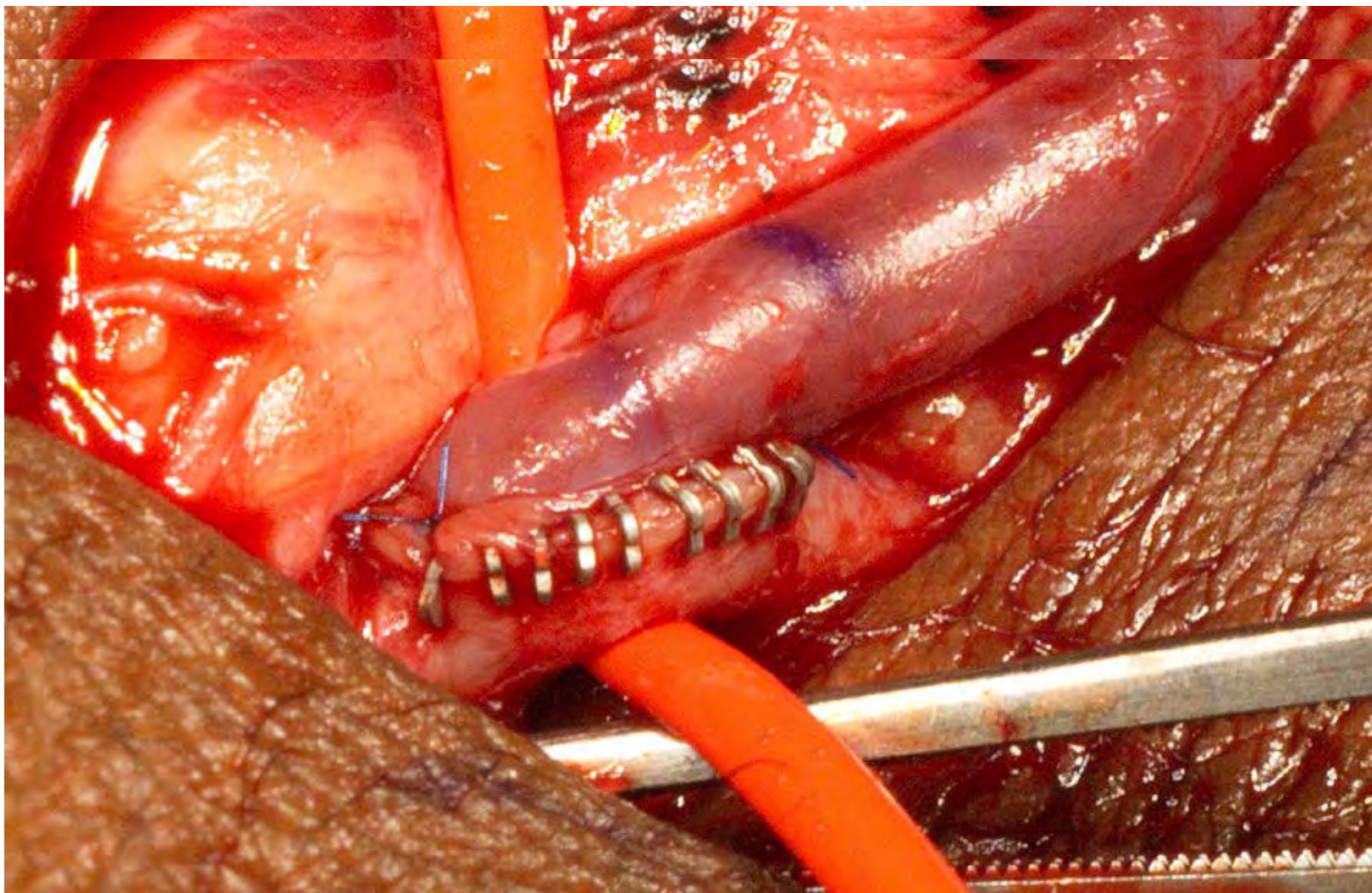
Vascular Access Circuit Simplified

Vascular Access Circuit



The Vascular Access Circuit -Types of Access

- **Primary fistulas**
- Primary transposed fistulas
- Grafts
- Cephalic vein
 - Wrist
 - Forearm
 - Elbow
 - Above
 - Below



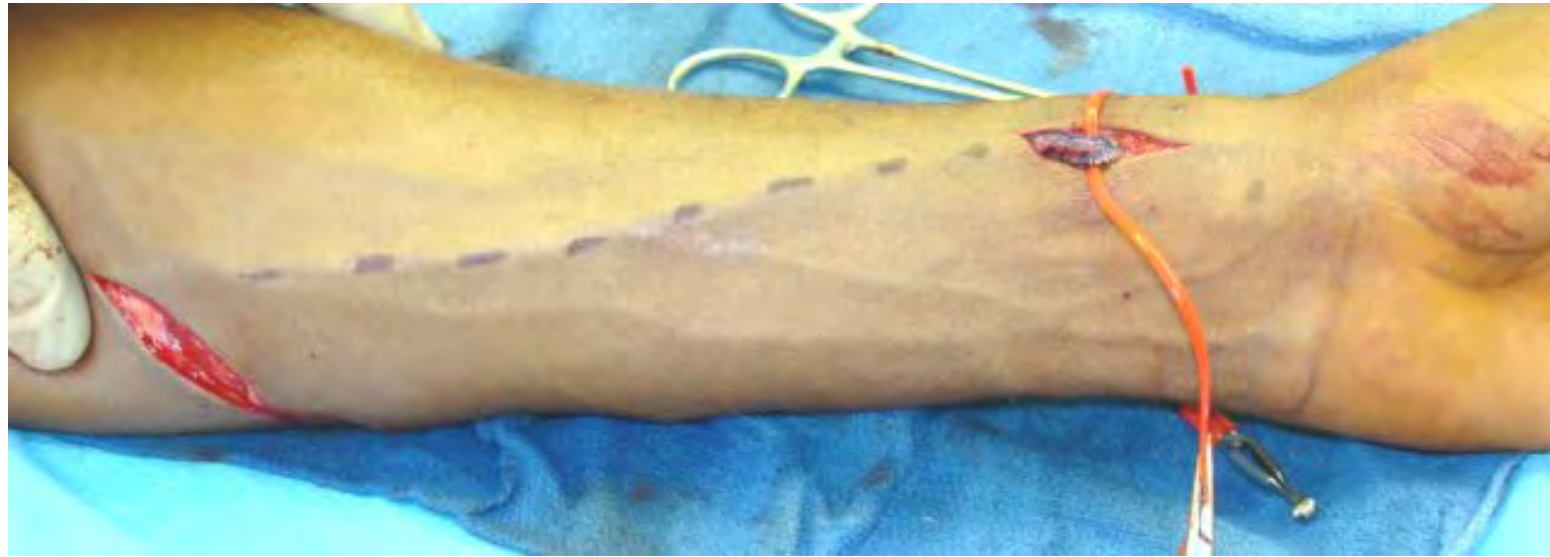
The Vascular Access Circuit -Types of Access

- Primary fistulas
- **Primary transposed fistulas**
- Grafts
- Cephalic vein if too deep
- Basilic vein
 - Forearm
 - Upper arm
- Brachial vein
- Femoral vein

Radiobasilic Transposition



Radiobasilic Transposition







The Vascular Access Circuit -Types of Access

- Primary fistulas
- Primary transposed fistulas
- **Grafts**
 - Forearm
 - Loop
 - Straight
 - Upper arm
 - Loop
 - Straight
 - Leg
 - Loop

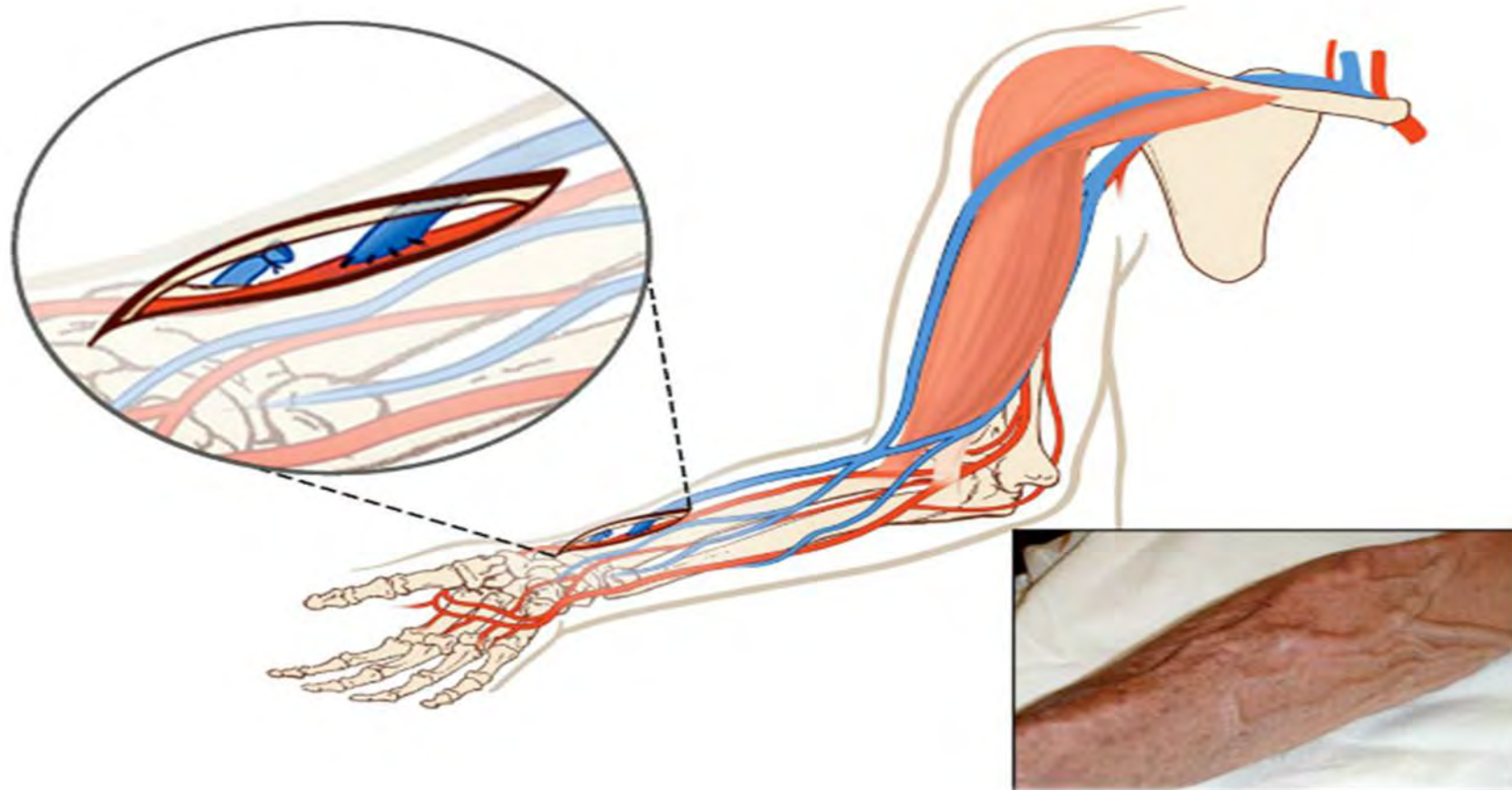
The Vascular Access Circuit -Types of Access

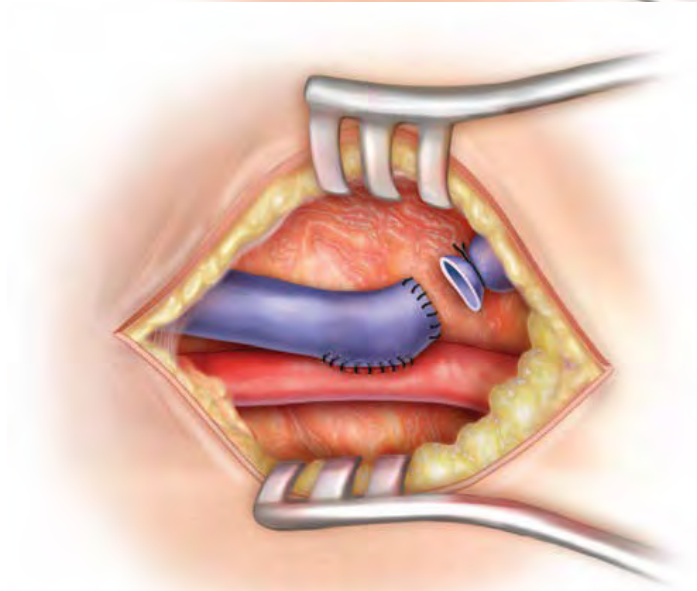
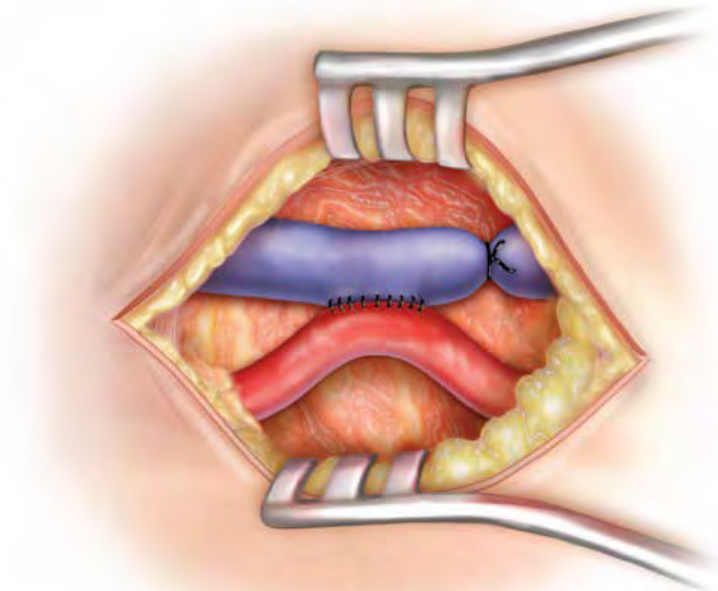
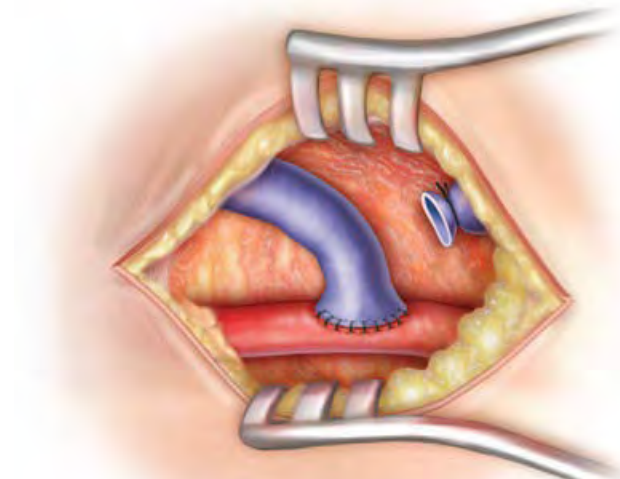
- Primary fistulas
- Primary transposed fistulas
- **Grafts**
 - PTFE
 - Atrium
 - Bard
 - Gore
 - Maquet
 - Biologic grafts
 - Artegraft
 - Procol
 - Cryopreserved vessels
 - Polyurethane
 - Vectra

Wrist Fistula

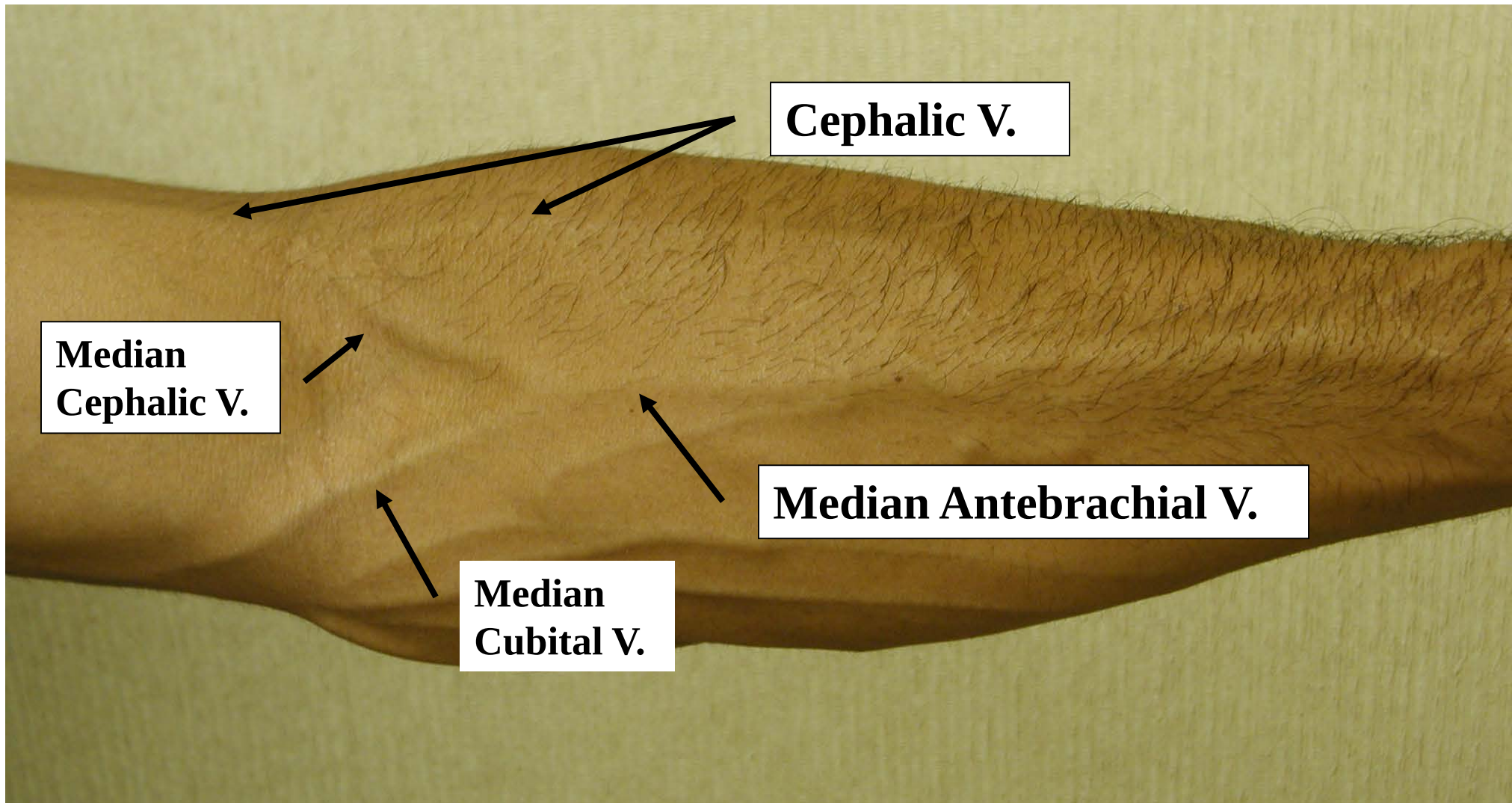
Radiocephalic Arteriovenous Fistula (Brescia-Cimino)

Note: lower arm can also have a Proximal Radial Artery (PRA) connected to AVF





Jennings WC, Mallios A, Blebea J. Upper Extremity Permanent Hemodialysis Access Placement. Darling RC, Ozaki CK, eds. Master Techniques in Surgery: Vascular Surgery: Hybrid, Venous, Dialysis Access, Thoracic Outlet, and Lower Extremity Procedures. Ch.16, p.151-163. Philadelphia: Wolters Kluwer; 2015.



**Median
Cephalic V.**

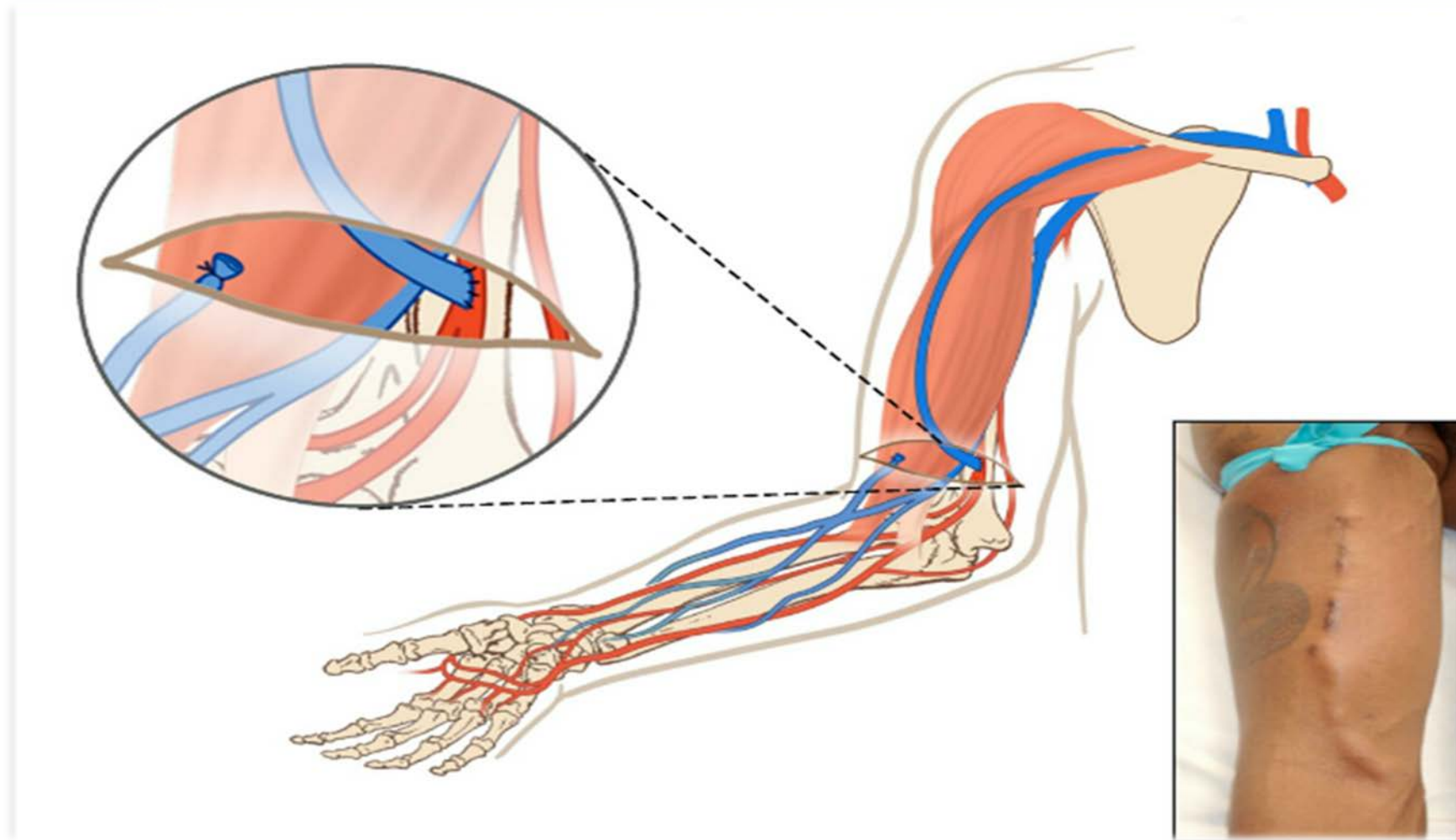
Cephalic V.

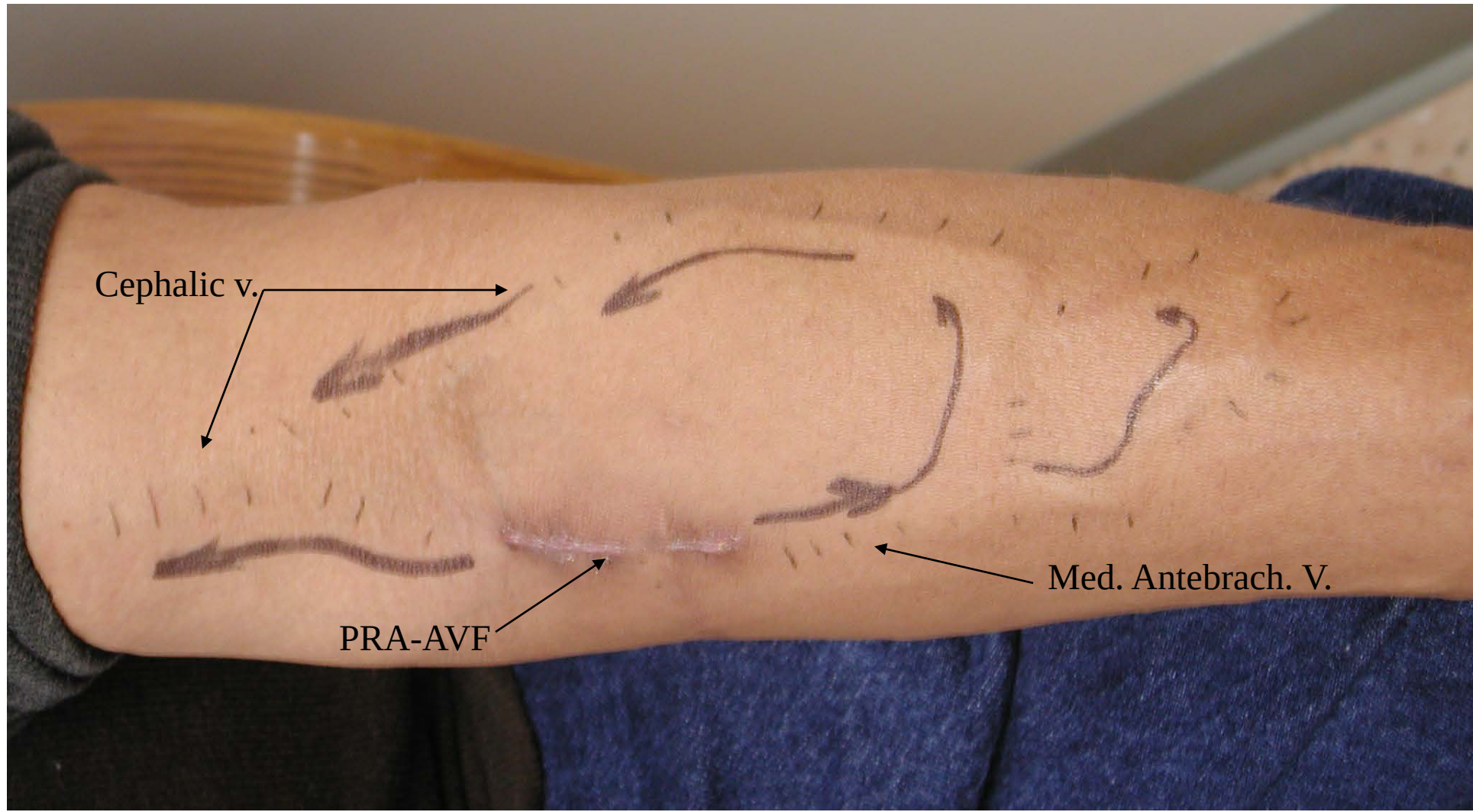
Median Antebrachial V.

**Median
Cubital V.**

Upper Arm Fistula

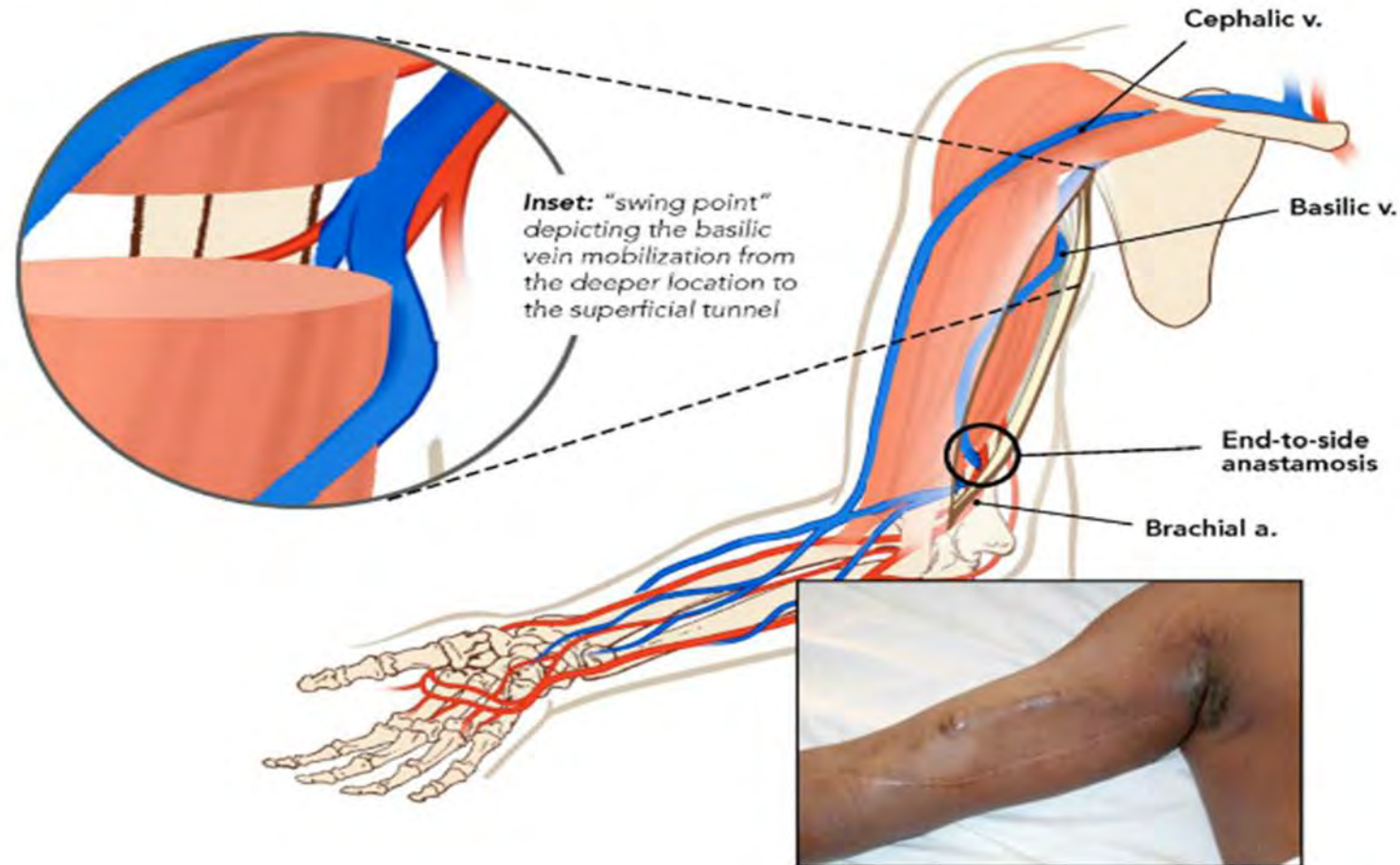
Brachiocephalic Arteriovenous Fistula

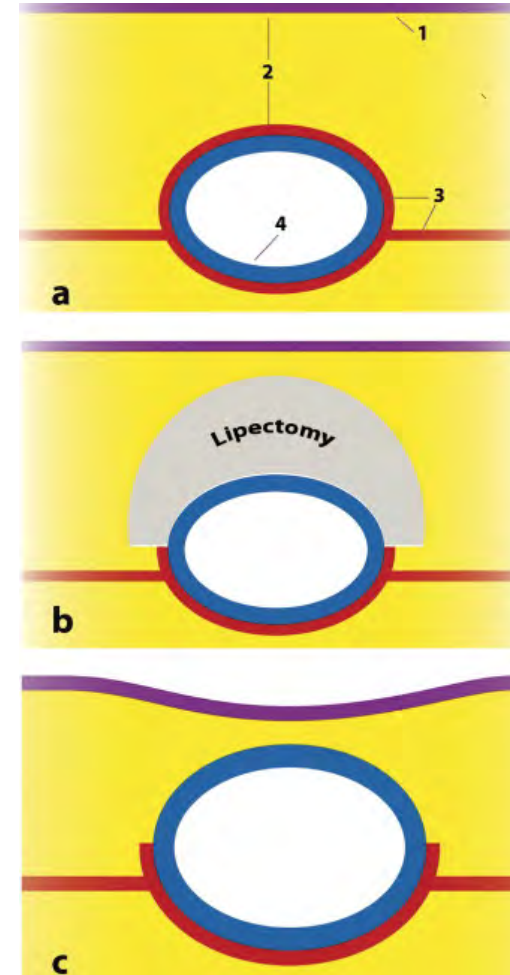
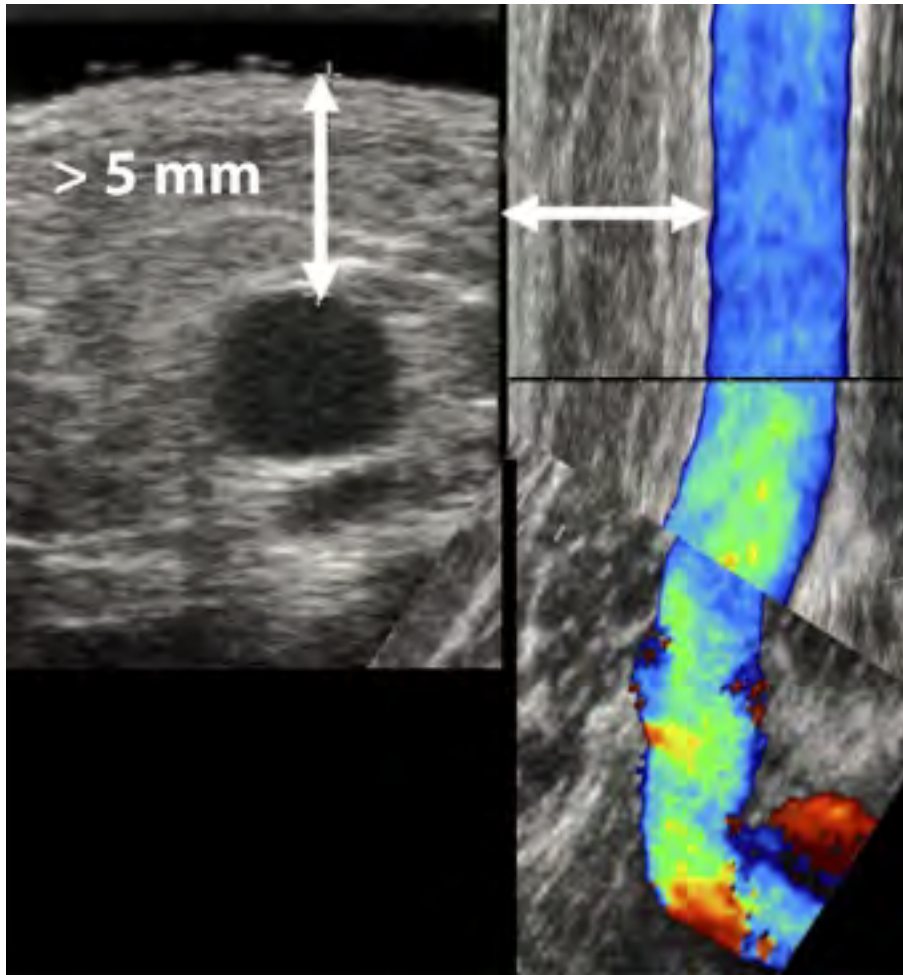




Transposed Fistula

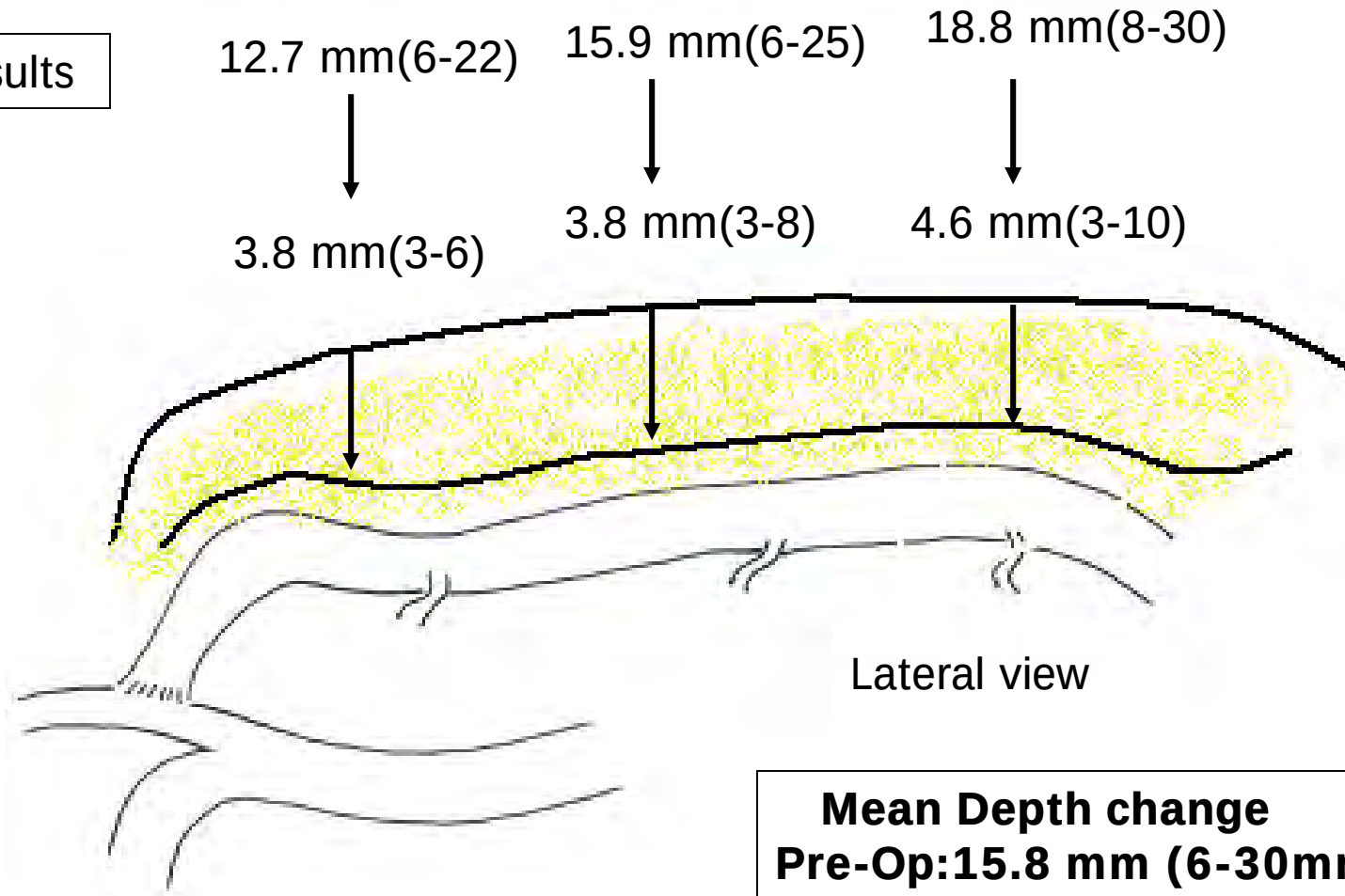
Transposed Basilic Vein Arteriovenous Fistula





Bourquelot, J. et al. Lipectomy as a new approach to secondary procedure superficialization of direct autogenous forearm radial-cephalic arteriovenous accesses for hemodialysis. *Journal of Vascular Surgery*. 2009 Aug;50(1):369-74.
[http://www.jvascsurg.org/article/S0741-5214\(09\)00662-4/fulltext](http://www.jvascsurg.org/article/S0741-5214(09)00662-4/fulltext)

Results



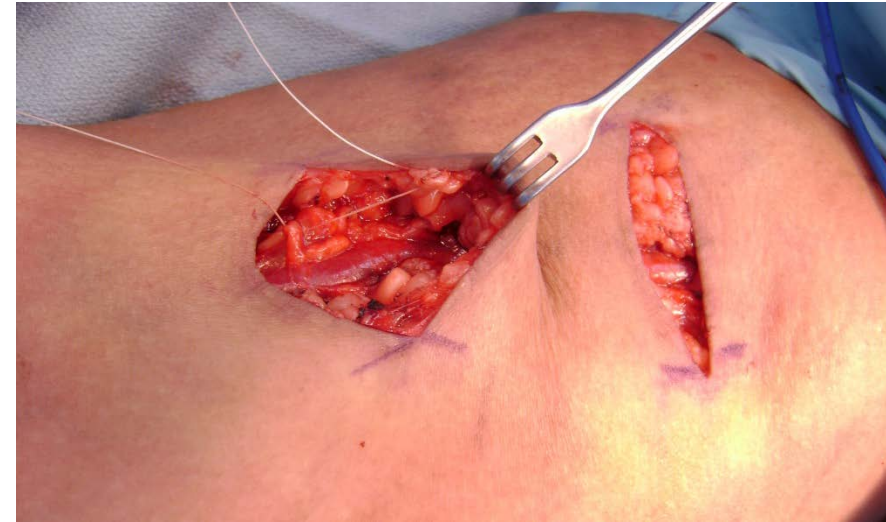
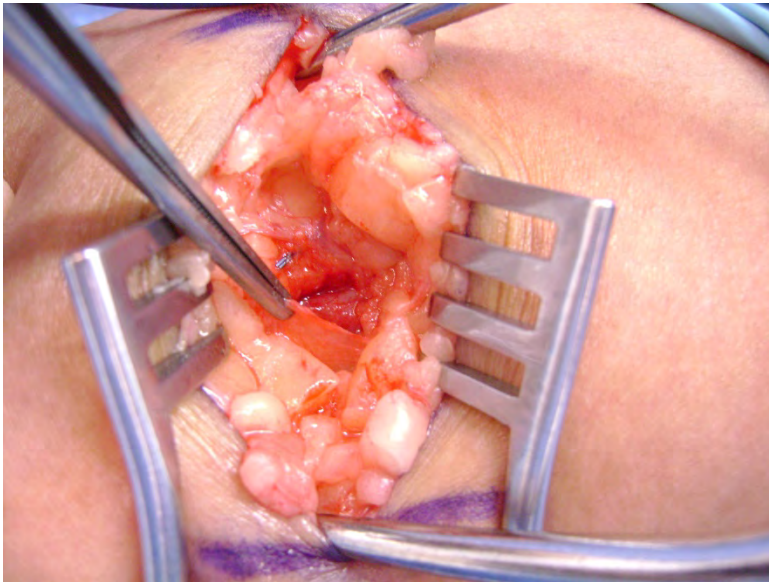
Mean Depth change
Pre-Op:15.8 mm (6-30mm)
Pos-Op:4.1 mm (3-8 mm)
(P ≤ 0.01)

Barnard KJ, Taubman KE, Jennings WC. Accessible autogenous vascular access for hemodialysis in obese individuals using lipectomy. Am J Surg. 2010 Dec;2010(6):798-802.

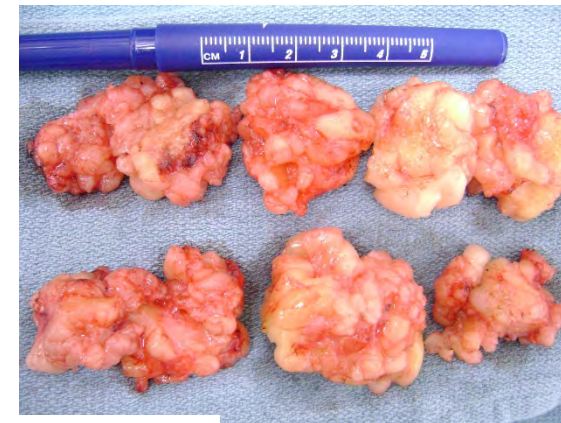
Lipectomy

First stage AVF

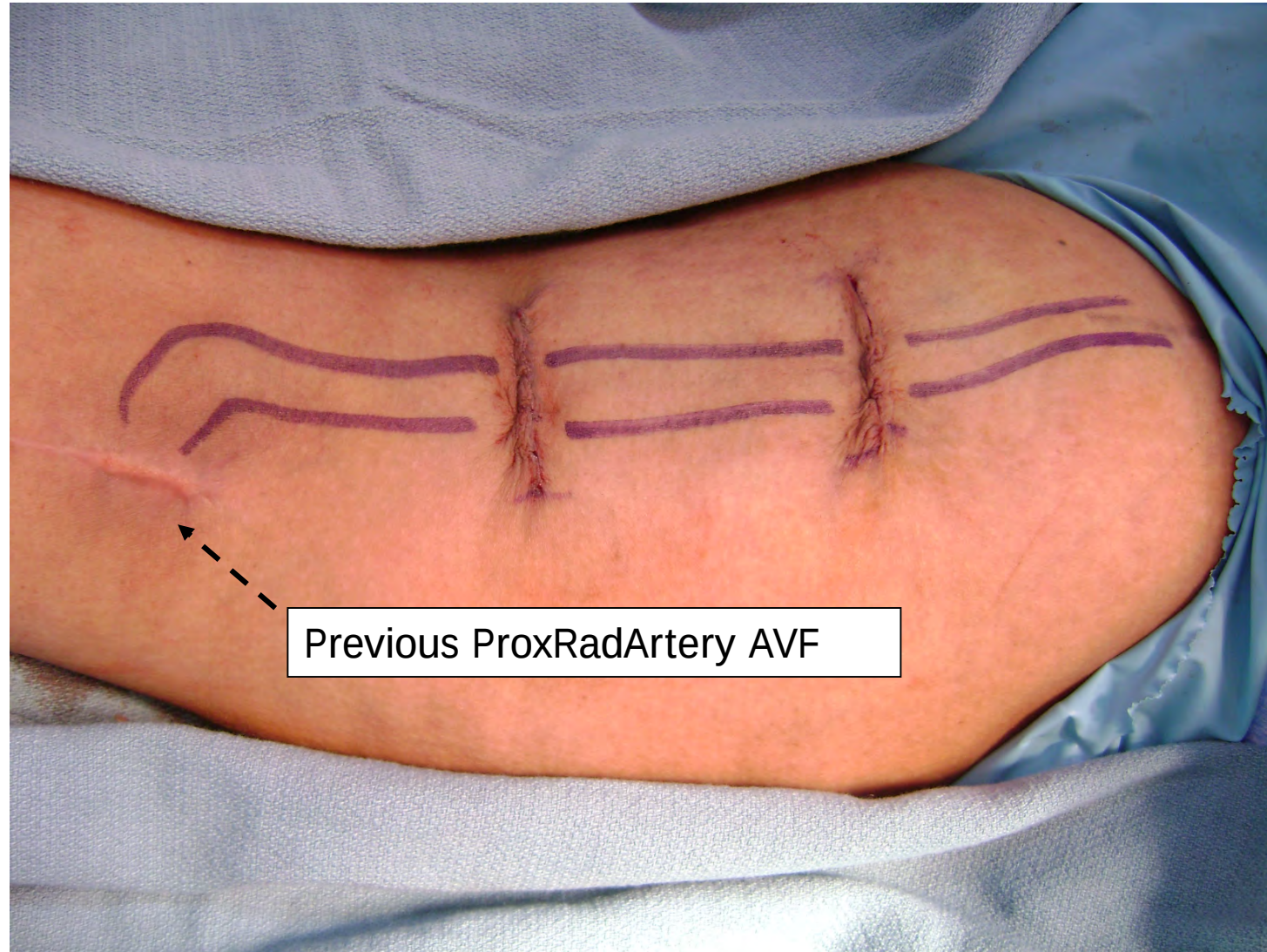
Jennings WC, Mallios A, Blebea J. Upper Extremity Permanent Hemodialysis Access Placement. Darling RC, Ozaki CK. Master Techniques in Surgery: Vascular Surgery: Hybrid, Venous, Dialysis Access, Thoracic Outlet, and Lower Extremity Procedures. Ch.16, p.151-163. Philadelphia: Wolters Kluwer; 2016.

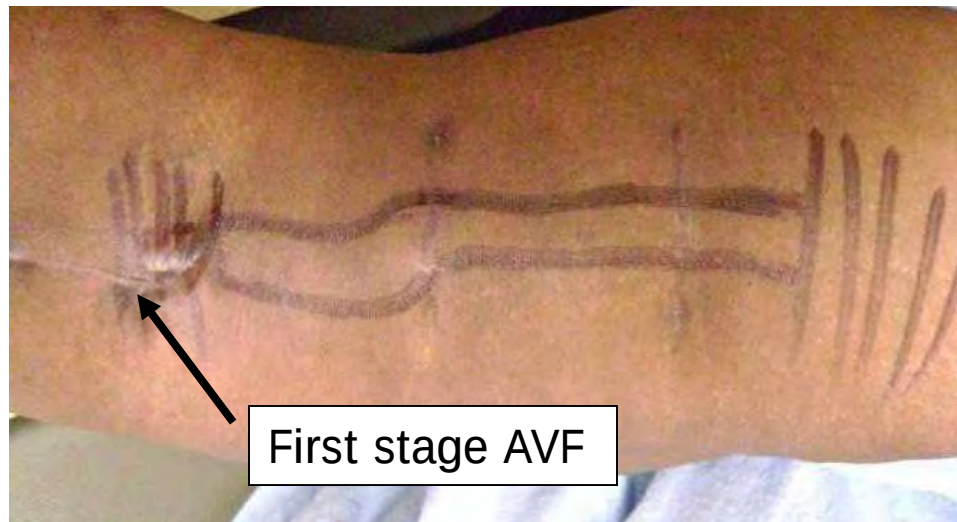


Barnard KJ, Taubman KE, Jennings WC. Accessible autogenous vascular access for hemodialysis in obese individuals using lipectomy. *Am J Surg*. 2010 Dec;2010(6):798-802.



Bourquelot, J. et al. Lipectomy as a new approach to secondary procedure superficialization of direct autogenous forearm radial-cephalic arteriovenous accesses for hemodialysis. *Journal of Vascular Surgery*. 2009 Aug;50(1):369-74.



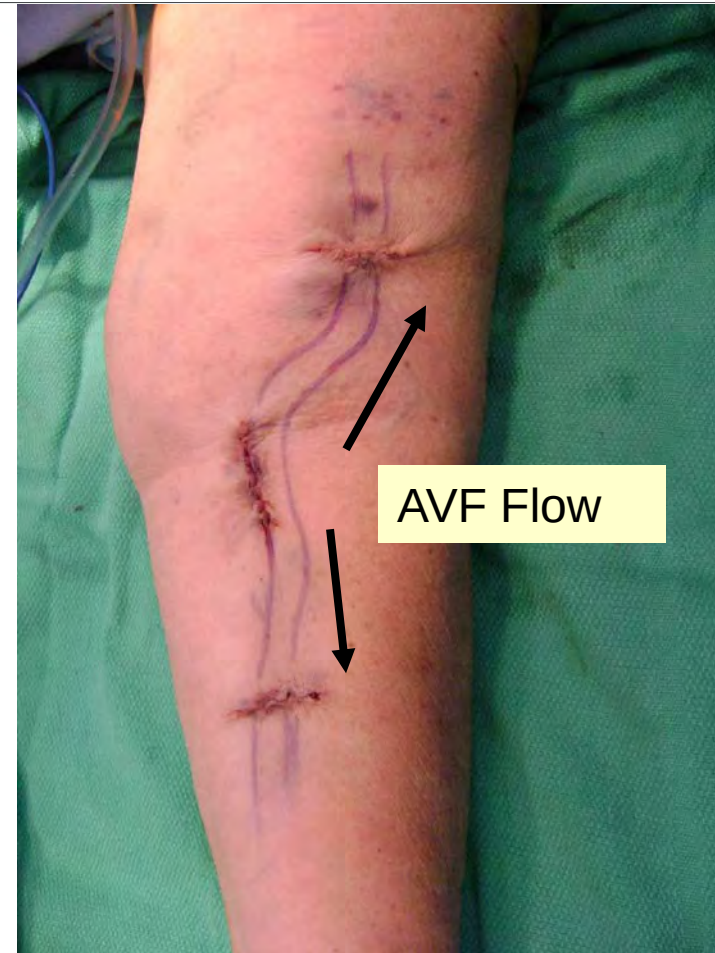
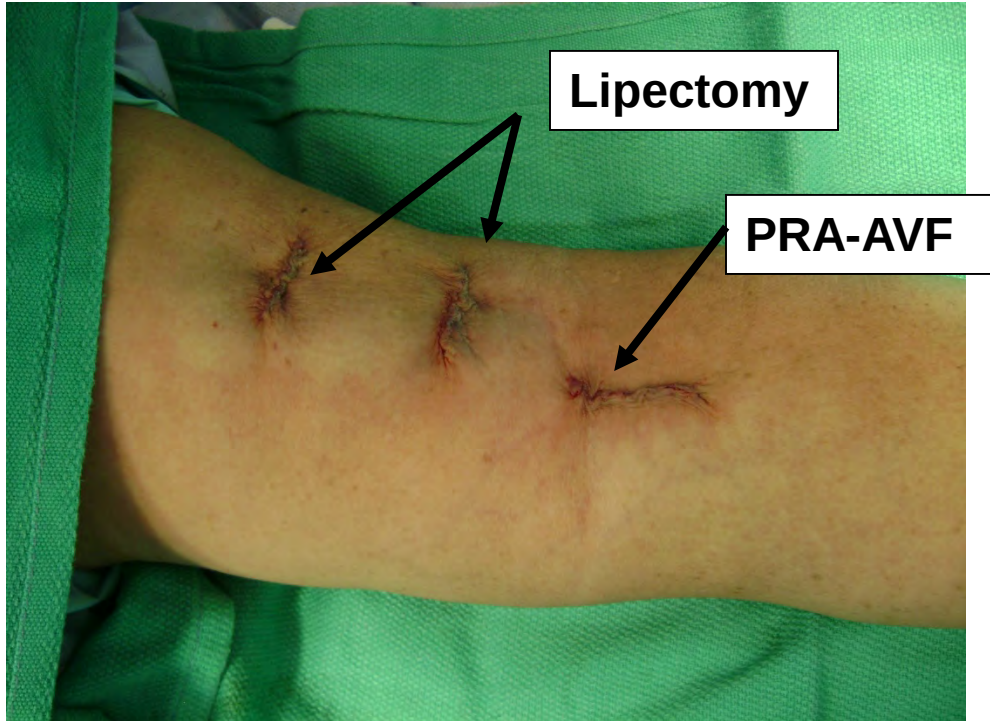


First stage AVF

-Mature AVFs after lipectomy and prior to first dialysis.
-AVFs marked for initial cannulation



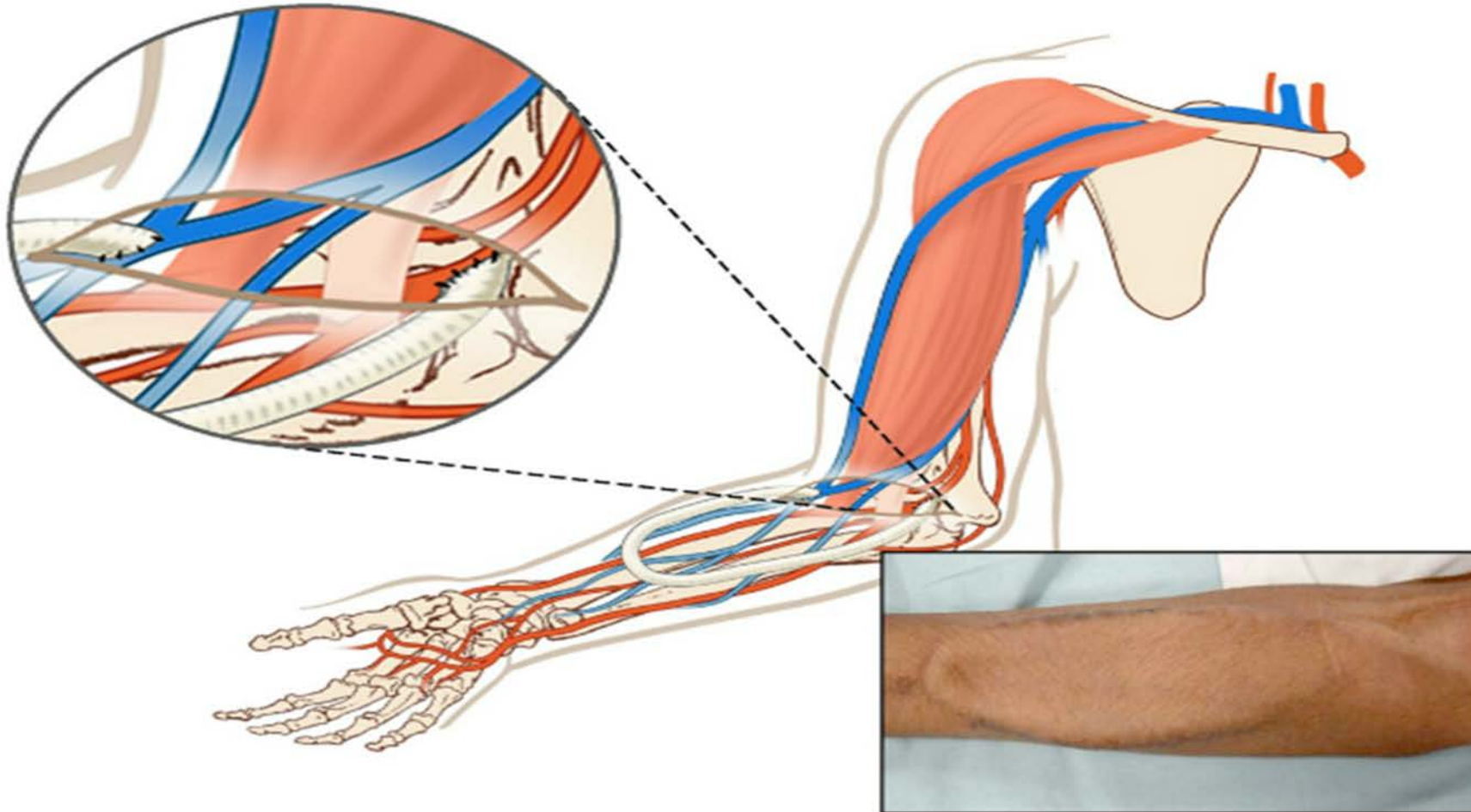
First stage AVF



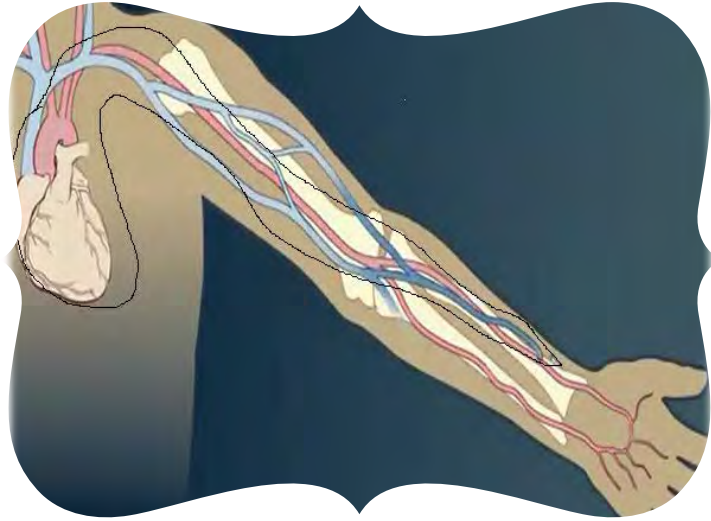
Lipectomy with PRA-AVFs as a single stage procedure.....
When the cephalic vein is $\geq 6\text{mm}$.

AV Graft

Forearm Loop Arteriovenous Graft



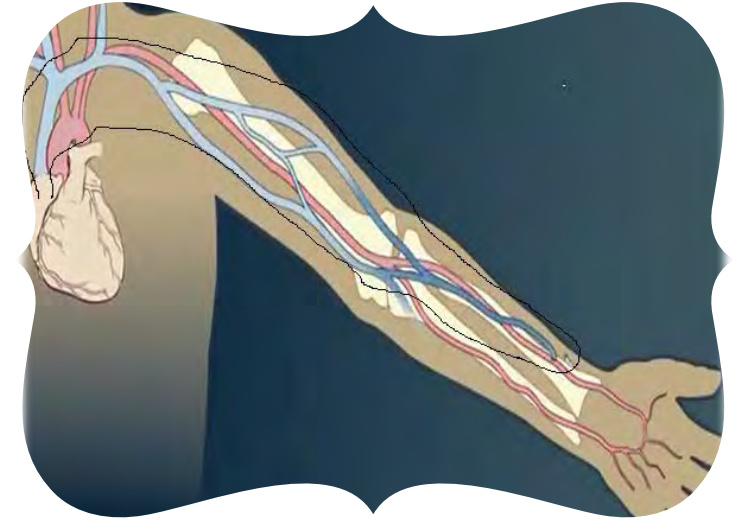
Vascular Access Circuit



Inflow= Heart as pump,
Arteries to the access location,
Artery connected to the vein
(AVF) or graft (AVG), Initial
portion of the AVF

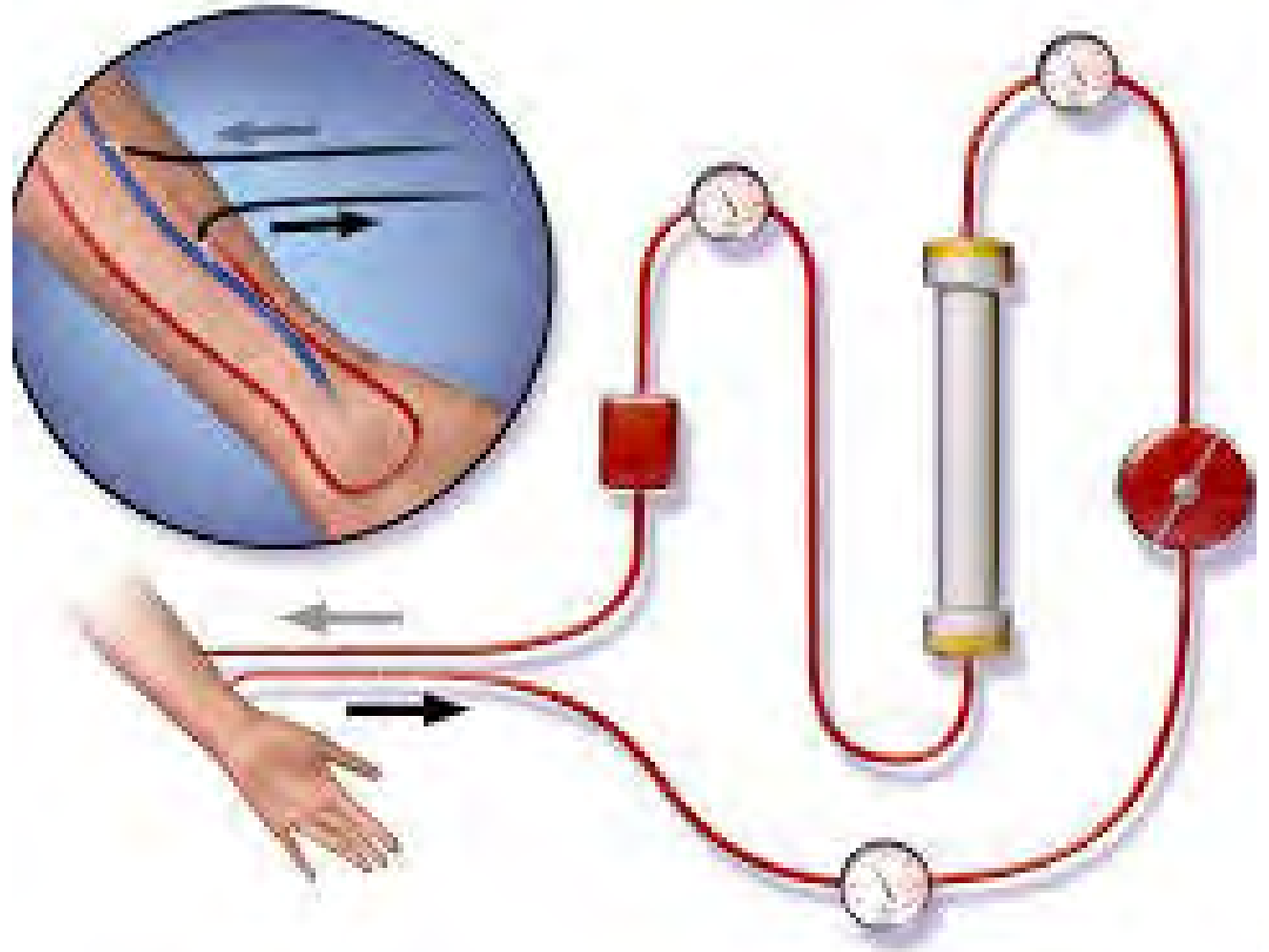
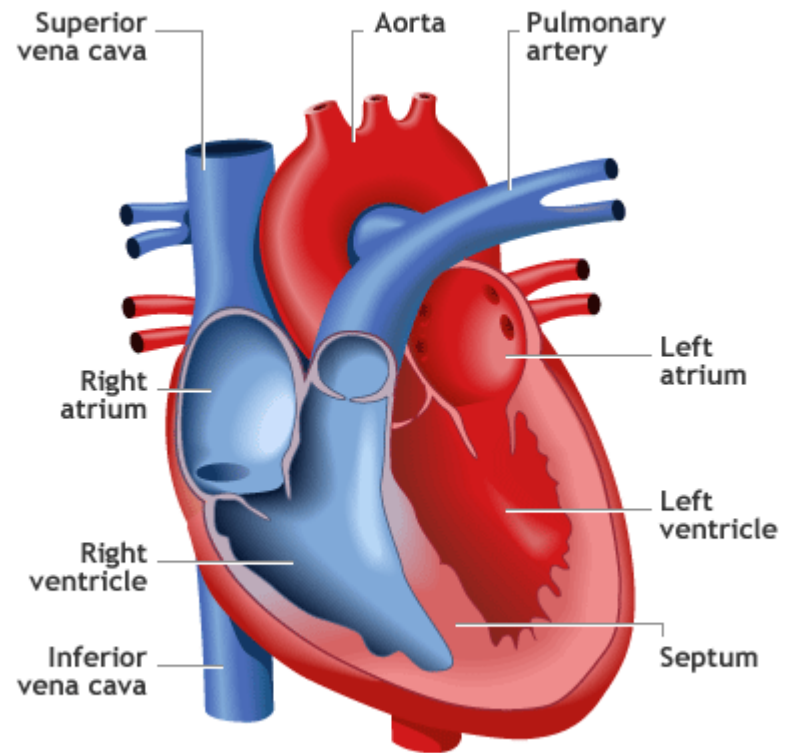


- Body=Cannulation
Zones



- Outflow= veins
leading from the
AVF/AVG back to
the heart

Questions?



2018 Vascular Access for Hemodialysis Symposium

May 10-12, 2018
New Orleans, LA



Vessel Mapping

What Are Key Elements, How Are They
Interpreted and Findings Shared with the
Dialysis Access Care Team

John F. Lucas III, MD, FACS



New Patient Evaluation For AV Access

New Patient Evaluation



New Patient Evaluation

Time	Ht (in)	Wt (lb)	BMI	BP	Position	Side	Site
4:12 PM				172/87	sitting	right	arm
4:03 PM		111.00	18.47	179/80	sitting	left	arm
						right	

Time	Ht (in)	Wt (lb)	BMI	BP	Position	Side	Site
3:32 PM				130/73	sitting	left	arm
3:30 PM		253.00	33.38	101/58	sitting	right	arm

New Patient Evaluation

- Why does the patient need vascular access
 - CKD
 - Backup for PD
 - ESRD on dialysis with catheter
- Cause of Renal Failure
 - DM – particularly long standing Type I
 - Autoimmune
 - Atherosclerosis

New Patient Evaluation



New Patient Evaluation - History

- Venous cannulation
 - IJ catheters for HD
 - Pacemaker/Defibrillator
 - Port-a-cath
 - Pic lines
- Previous access
 - AVF
 - AVG
- Dominant arm
- Trauma
- Surgery
 - Mastectomy
 - Axillary dissection

New Patient Evaluation

☐ IJ Catheter, Right	☐ IJ Catheter, Left
☐ PAC, Right	☐ PAC, Left
☐ Pacemaker	
Surgical Scarring:	

☒ IJ Catheter, Right	☐ IJ Catheter, Left
☐ PAC, Right	☒ PAC, Left
☒ Pacemaker	
Surgical Scarring: Base of both sides	

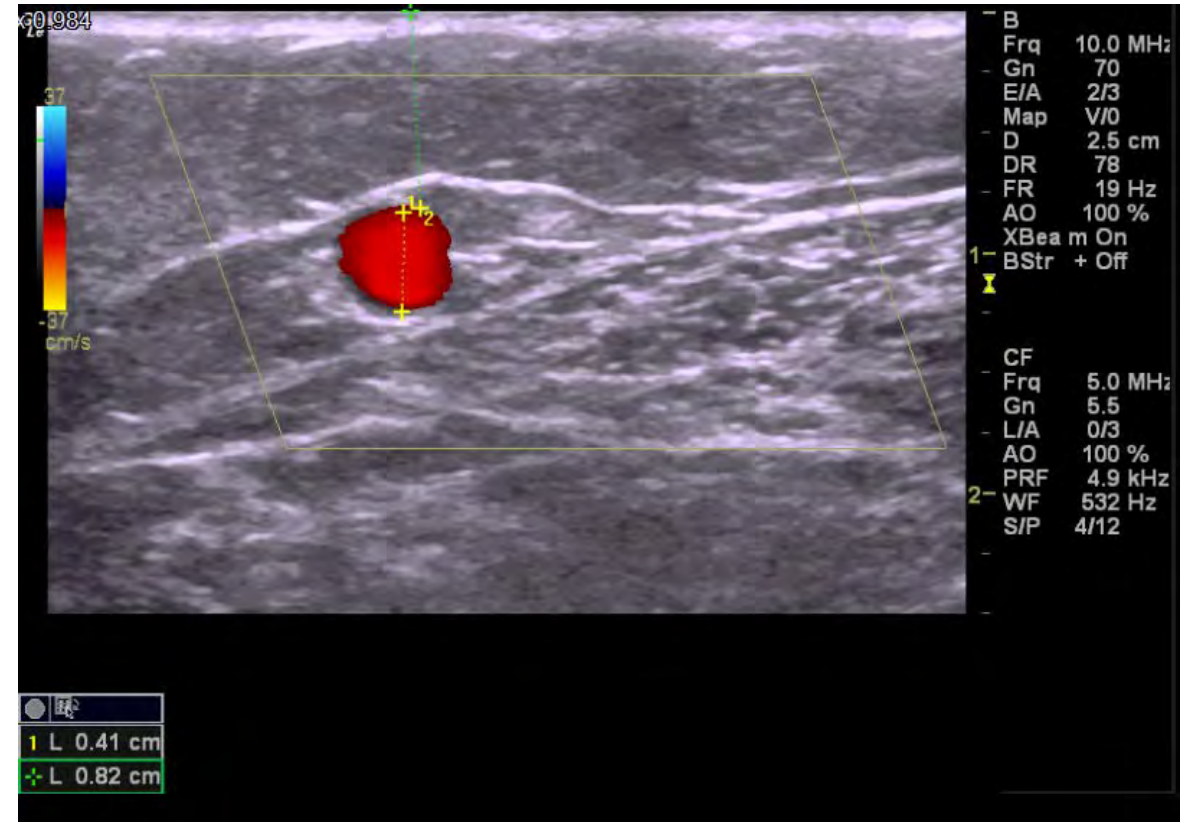
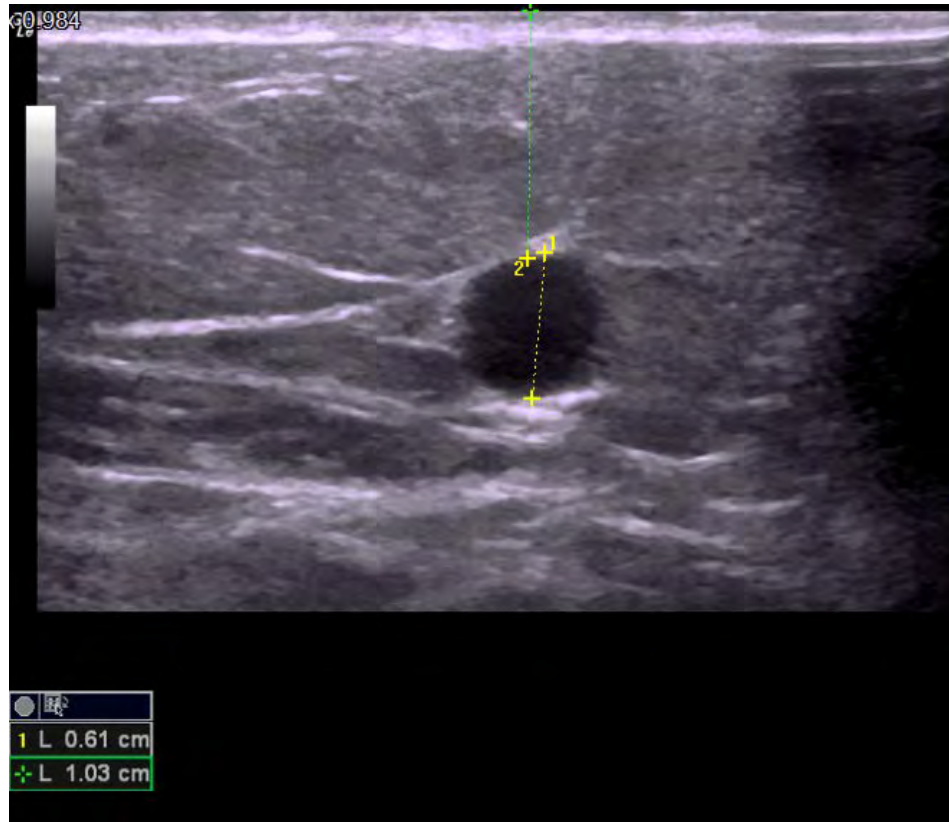
Pulses - Upper	Right	Left
Carotid Bruit:		
Brachial:	2+	2+
Radial:	2+	2+
Allens Test:	normal	normal

Pulses - Upper	Right	Left
Carotid Bruit:		
Brachial:	2+	2+
Radial:	1+	Non-Palp
Allens Test:	normal	abnormal

New Patient Evaluation



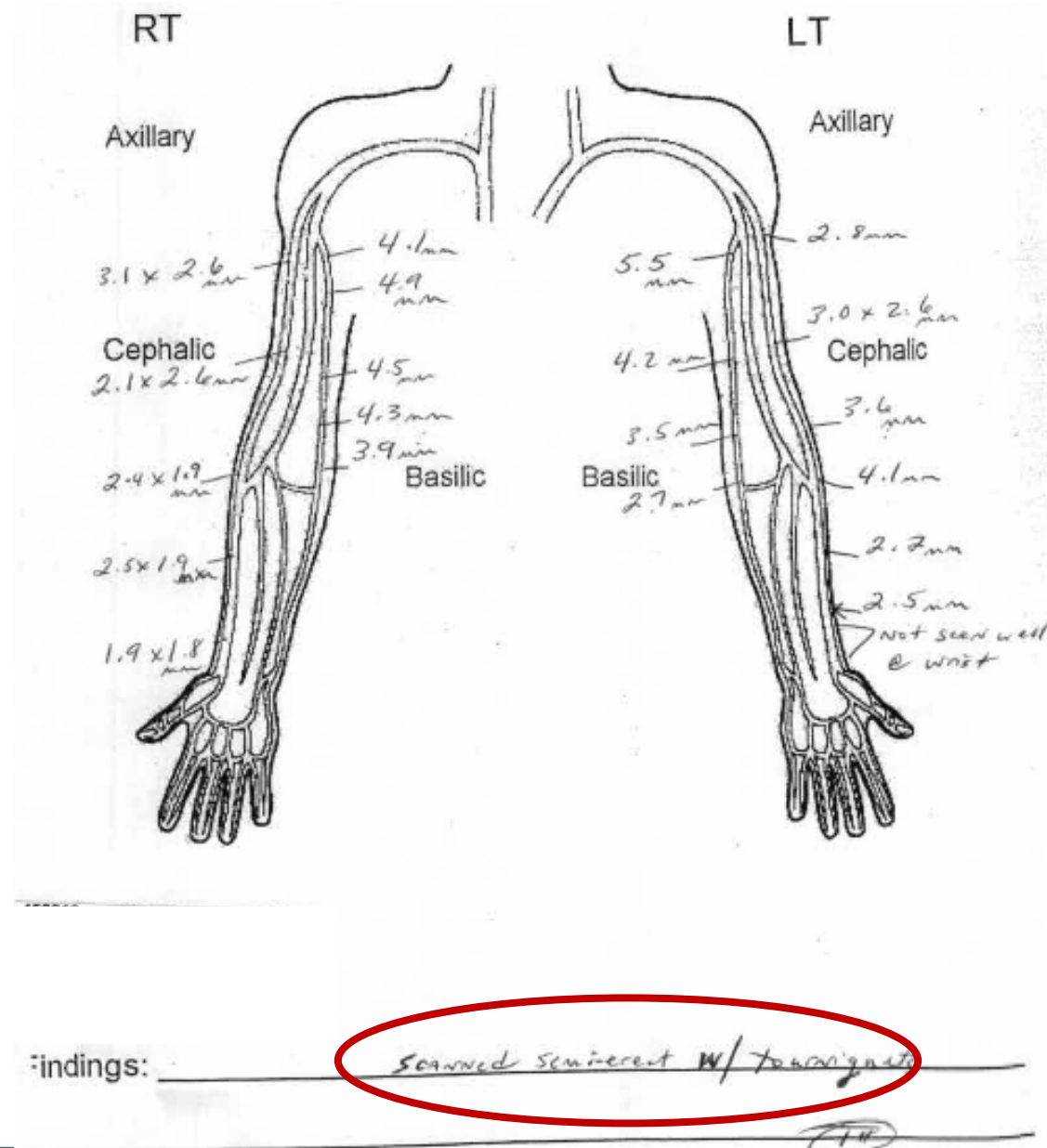
New Patient Evaluation



New Patient Evaluation

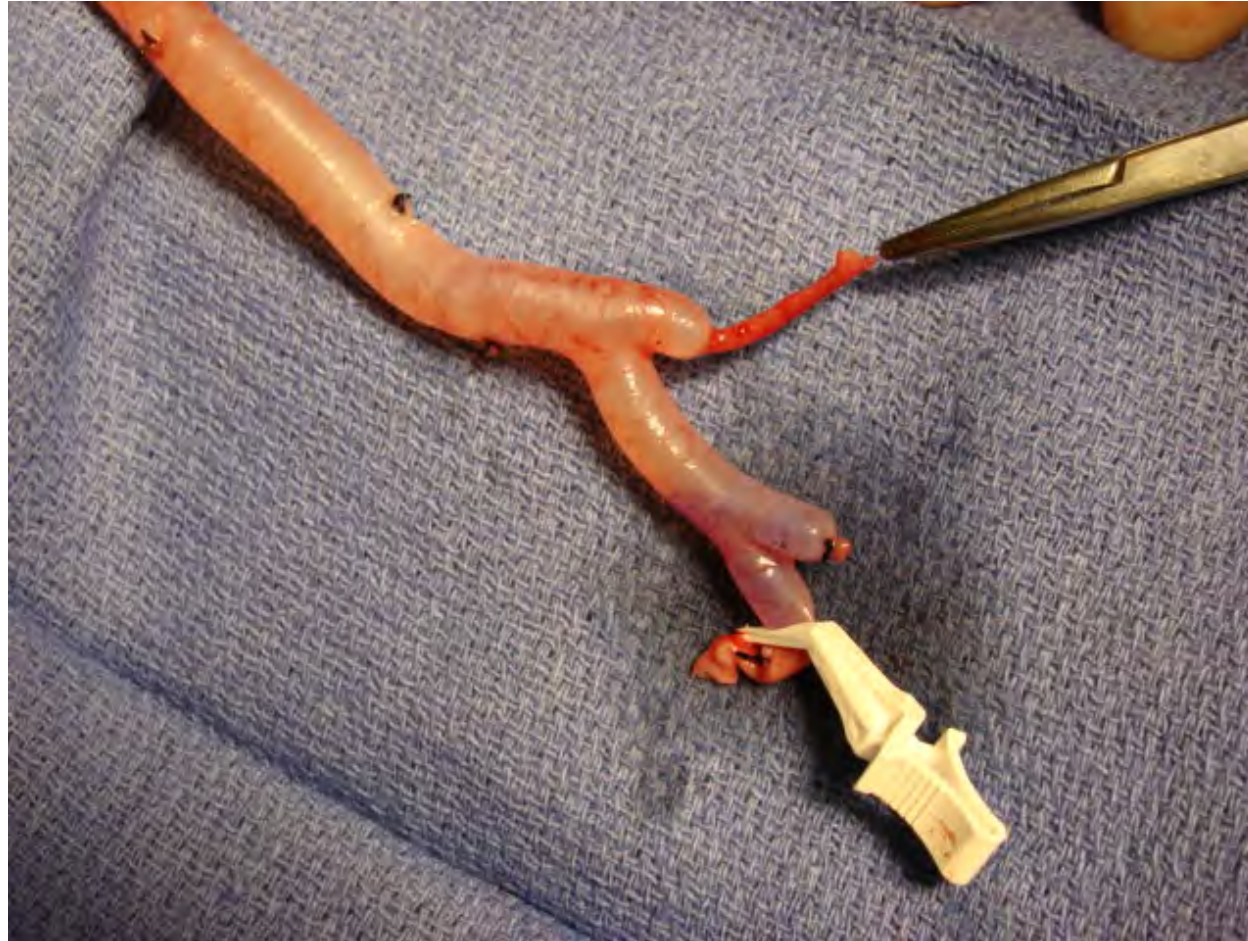


Ultrasound Mapping

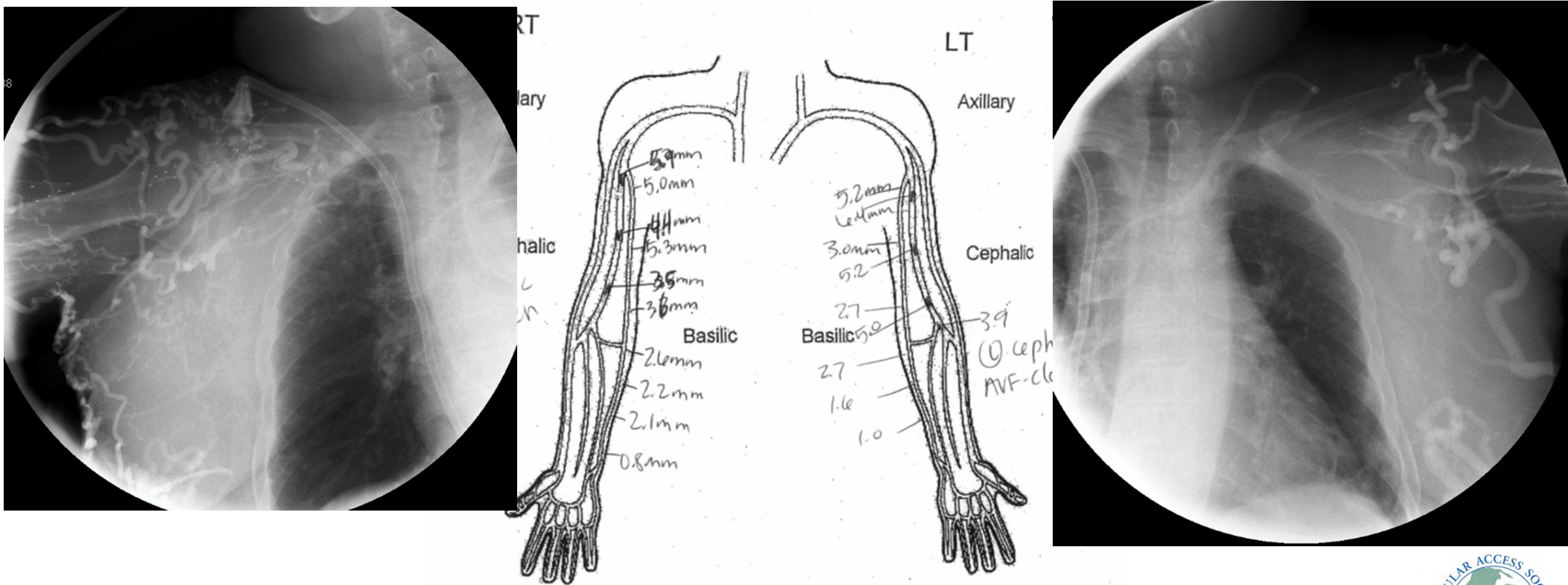


Venogram





New Patient Evaluation



Conclusion

- Mapping is critical to choosing proper access
- US is first choice for mapping
 - Warm room
 - Tourniquet
 - Arm dependent
- Venogram is study for patient already on dialysis with history of central vein instrumentation
 - Warm room
 - Tourniquet

Conclusion

- Not ESRD
 - US mapping by surgeon
 - US mapping in radiology
- ESRD
 - US mapping by surgeon
 - Venograms if history of central venous catheters or devices
- Repeat if poor vessels first time
 - Dehydrated
 - Cold
 - Scared