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Academic Medicine
improving patients' lives

Patient selection and Technique for endoAVF creation

A/Prof Tan Chieh Suai, 陈确帅
Head and Senior Consultant, Department of Renal Medicine, Singapore General Hospital
Clinical Associate Professor, Duke- NUS School of Medicine
Clinical Senior Lecturer, NUS YLL School of Medicine

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Introduction – Surgical AVF

Michael J. Brescia, M.D.[†], James E. Cimino, M.D.[‡], Kenneth Appel, M.D.[§], and Baruch J. Hurwich, M.D.
N Engl J Med 1966; 275:1089-1092

Joining a superficial vein to an artery (side to side anastomosis)

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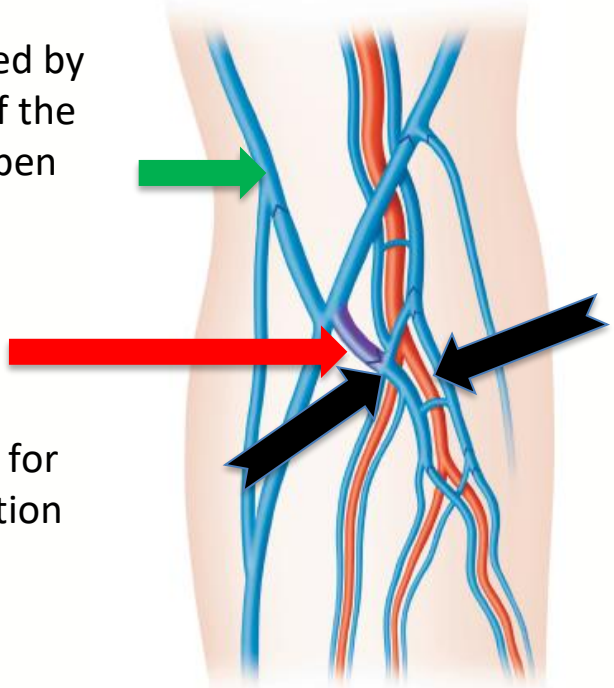
Surgical AVF vs Endovascular AVF

- Traditional AVF are created by joining superficial veins of the arm to the artery using open surgical technique

- Superficial veins are used for cannulation after maturation



- EndoAVF are created by joining deep veins to the artery using minimally invasive technique

- Arteries are closely accompanied by veins in deep venous system

- Perforating vein joins the deep venous system to superficial venous system

- Superficial veins are used for cannulation after maturation

Cardiovasc Intervent Radiol. 2019 Jan;42(1):1-9

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Surgical AVF vs Endovascular AVF

Right EndoAVF

Left EndoAVF

Left EndoAVF

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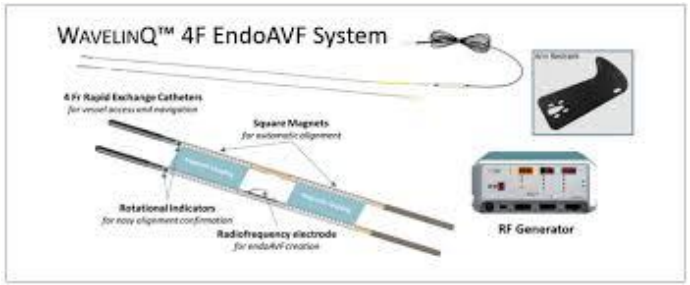
EndoAVF creation: Singapore experience

- EndoAVF creation started in 2021 in Singapore
  - Started as small pilot studies in Public Healthcare institutions
  - More than 100 creations to date

- Both endoAVF creation systems are available in Singapore



BD WavelinQ System

Medtronic Ellipsys System

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EndoAVF program: Team work matters

Finding the right patient	Creating the endoAVF	Using the endoAVF	Maintaining the endoAVF
Nephrologists	Nephrologists	Nephrologists	Nephrologists
Vascular Surgeon	Vascular Surgeon	Dialysis nurses	Vascular Surgeon
Sonographers	Interventional Radiologist	Sonographers	Interventional Radiologist
	Procedure nurses		Procedure nurses
	Radiographers		Radiographers

- A successful endoAVF program requires a team based approach

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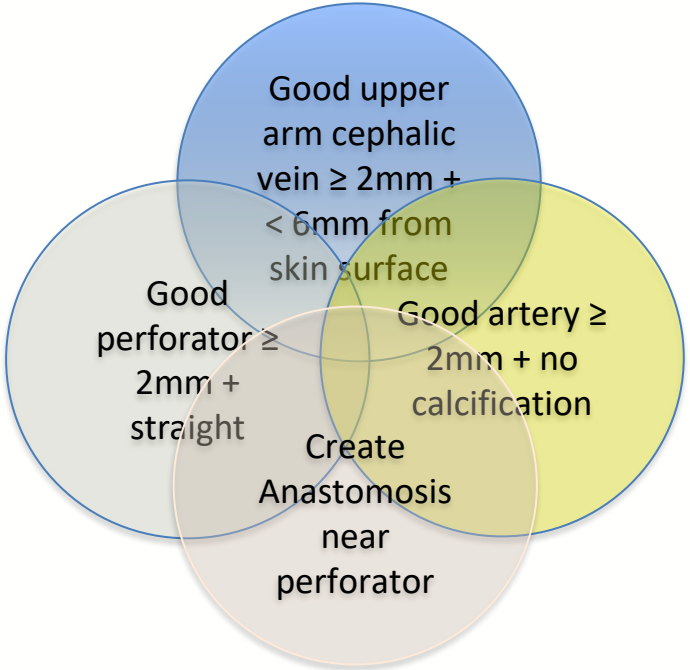
Principles of suitability for EndoAVF creation



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Finding the right patients for wavelinq endoAVF

- Dedicated ultrasonographer who is familiar with endoAVF vein mapping
  - Rules of twos +:
    - 2mm cephalic vein + less than 6mm below the skin surface
    - 2mm perforator:
    - 2mm artery and vein at site of anastomosis
    - 2 mm artery and vein at where you are planning to place the 5F slender sheaths (5F sheath = 5/π = 1.59mm inner diameter)
  - Which deep vein does the perforator join to?
    - to radial vein or ulnar vein? or both

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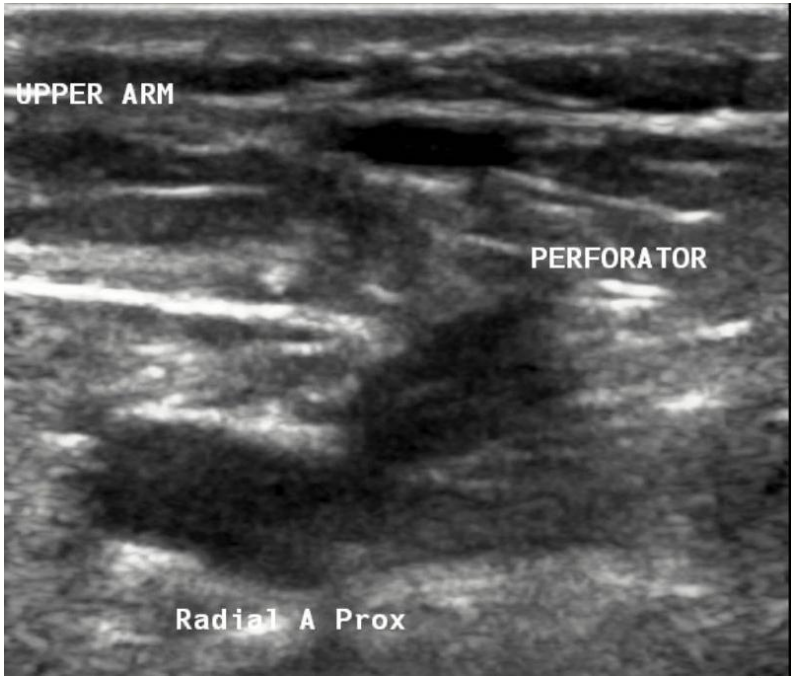
Ultrasound images of the anatomy of perforator to radial vein

Longitudinal view of perforator to Radial vein



Transverse view of perforator to Radial vein

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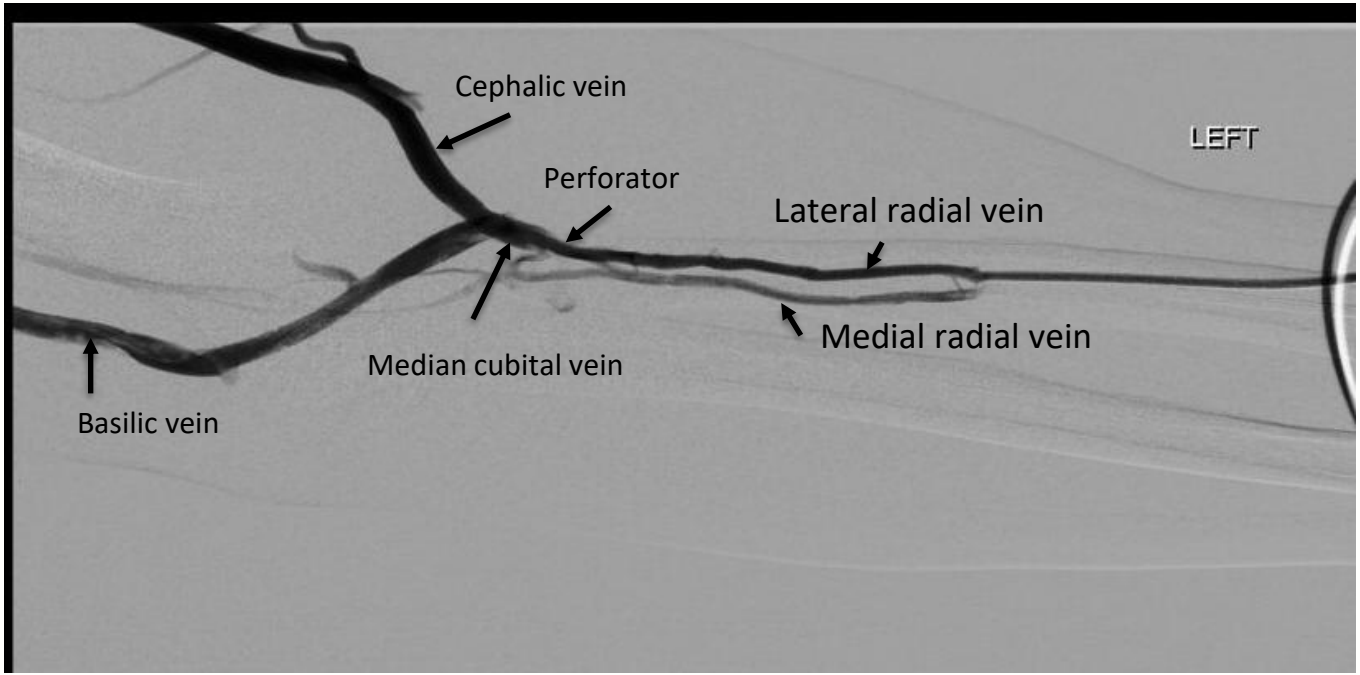
Angiographic images of perforator to radial vein



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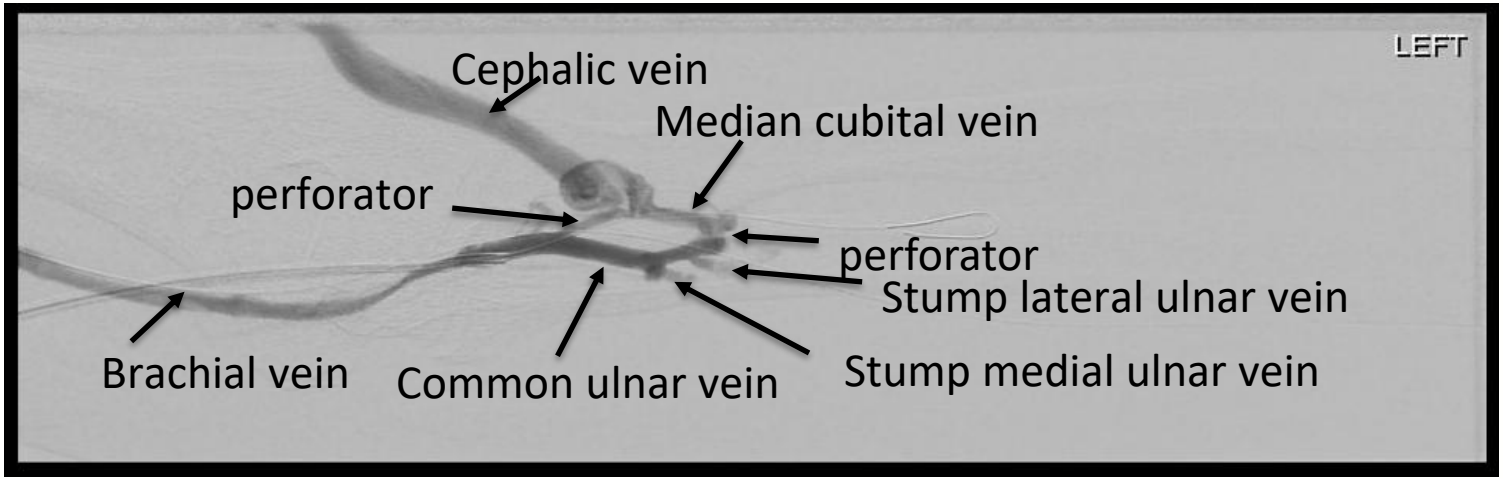
Ultrasound images of the anatomy of perforator from ulnar vein

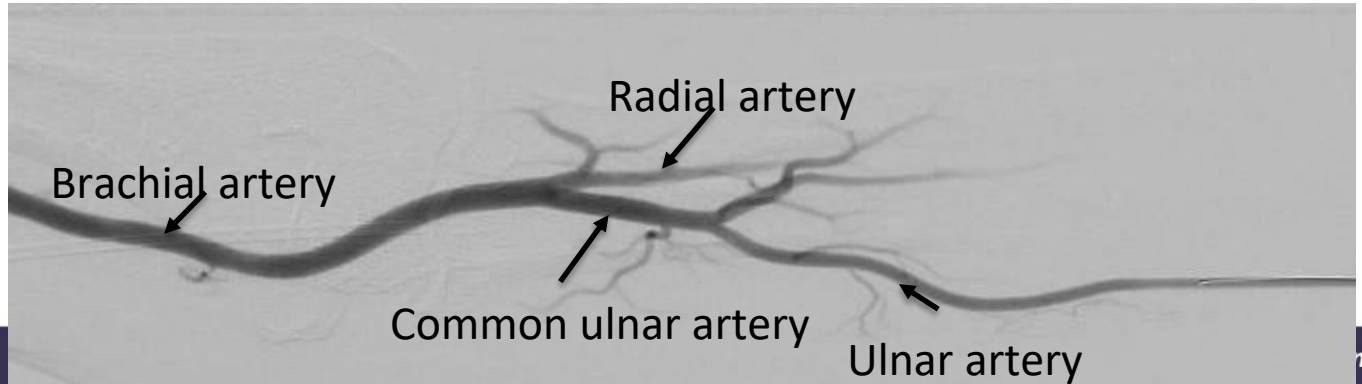
- Left arm

Medial

Lateral

Angiographic images of perforator to ulnar vein





Current vein mapping form for endoAVF creation

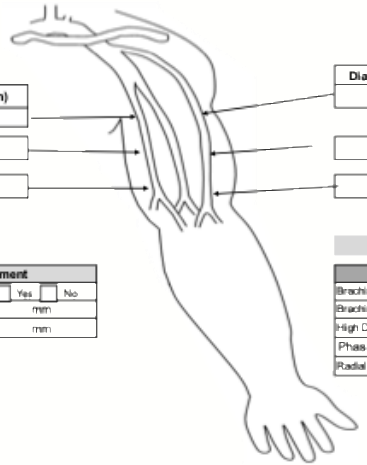
Singapore General Hospital
SingHealth

Vascular Studies Unit

Restricted, Sensitive (Normal)

Doc No. 71100-FM-001
Rev No.1

VSU Pre-EndoAVF Vein Mapping (Left)



Diameter (mm)	Depth (mm)

Diameter (mm)	Depth (mm)

Perforator Measurement		
Patent Perforator	☐ Yes ☐ No	
Perforator Vein Diameter	mm	
Distance from Radial Artery	mm	

For Ellipsys Only

Arterial Measurements		
Brachial Artery (Distal Upper Arm)		mm
Brachial Artery Flow Rate (Long Axis)		ml/min
High Division of Brachial Artery	☐ Yes ☐ No	
Phasicity (Brachial A)	☐ Triphasic ☐ Biphasic ☐ Monophasic	
Radial Artery (Proximal Forearm)		mm

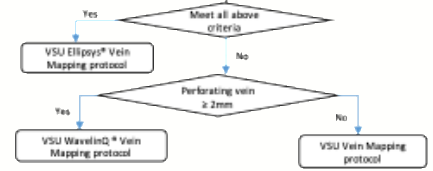
For WavelinQ Only

Target Radial AVF Site		
Radial Artery Diameter		mm
Lateral Radial Vein Diameter		mm
Medial Radial Vein Diameter		mm
Distal Radial Measurements		
Radial Artery Diameter		mm
Lateral Radial Vein Diameter		mm
Medial Radial Vein Diameter		mm
Phasicity ☐ Triphasic ☐ Biphasic ☐ Monophasic		

Brachial Measurements		
Brachial Artery Diameter		mm
Lateral Brachial Vein Diameter		mm
Medial Brachial Vein Diameter		mm
Mean Brachial Artery Baseline Flow Rate		ml/min
Brachial Artery Bifurcation		Elbow
Phasicity ☐ Triphasic ☐ Biphasic ☐ Monophasic		

VSU Pre-EndoAVF Vein Mapping Selection Protocol

Perforating vein ≥ 2mm
Proximal radial artery ≥ 2mm in diameter
Distance from perforating vein to proximal radial artery ≤ 1.5mm
No high division of brachial artery/No extremely tortuous perforating vein



Target Ulnar AVF Site		
Ulnar Artery Diameter		mm
Lateral Ulnar Vein Diameter		mm
Medial Ulnar Vein Diameter		mm
Distal Ulnar Measurements		
Ulnar Artery Diameter		mm
Lateral Ulnar Vein Diameter		mm
Medial Ulnar Vein Diameter		mm
Phasicity ☐ Triphasic ☐ Biphasic ☐ Monophasic		

Further evaluation by the attending physician may be required if results do not concur with clinical findings.

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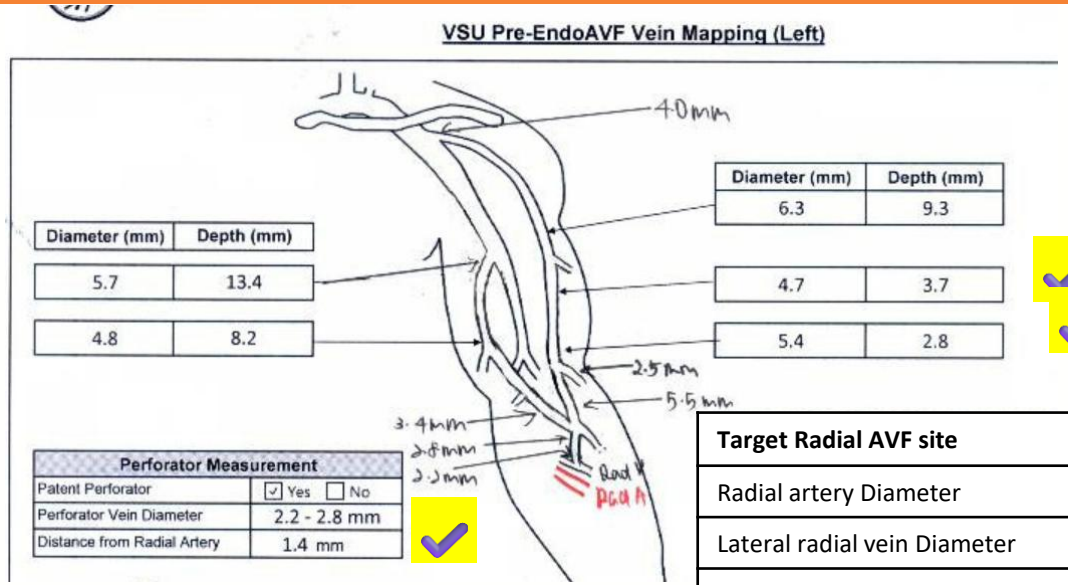
Finding the right patient



Target Radial AVF site	
Radial artery Diameter	2.6mm
Lateral radial vein Diameter	2.8 mm
Medial radial vein Diameter	2.2 mm

Distal Radial measurement	
Radial artery Diameter	2.1mm
Lateral radial vein Diameter	2.7 mm
Medial radial vein Diameter	1.8 mm

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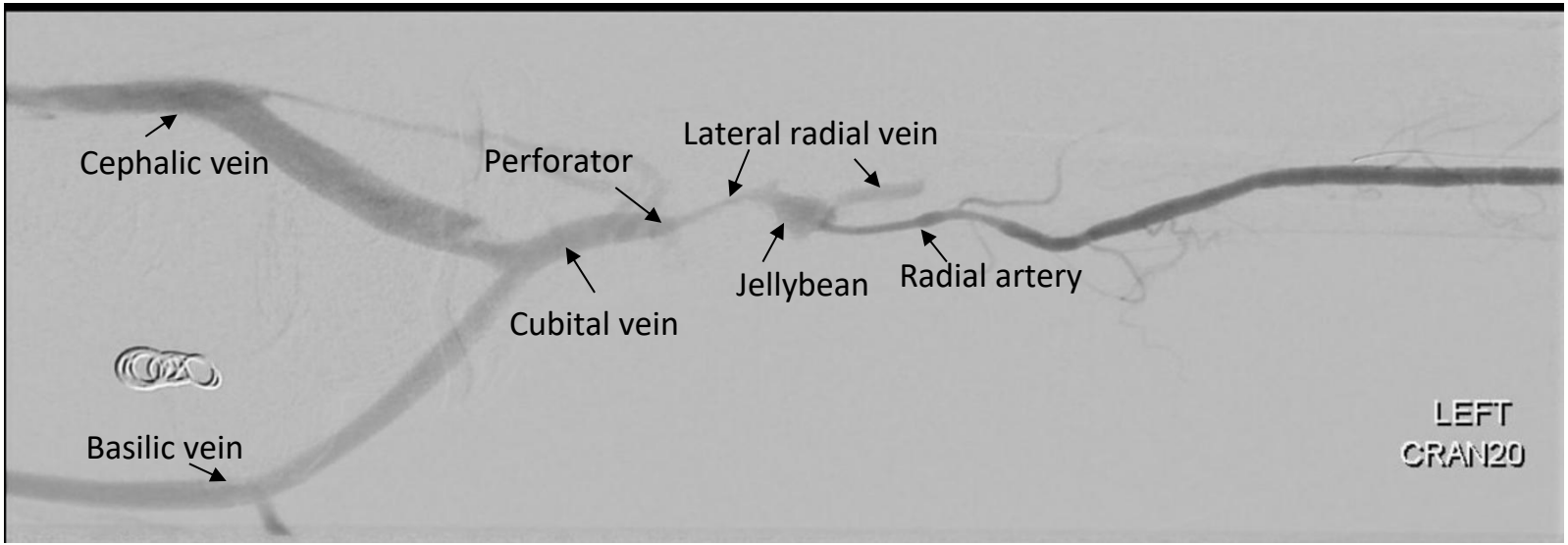
Finding the right patient



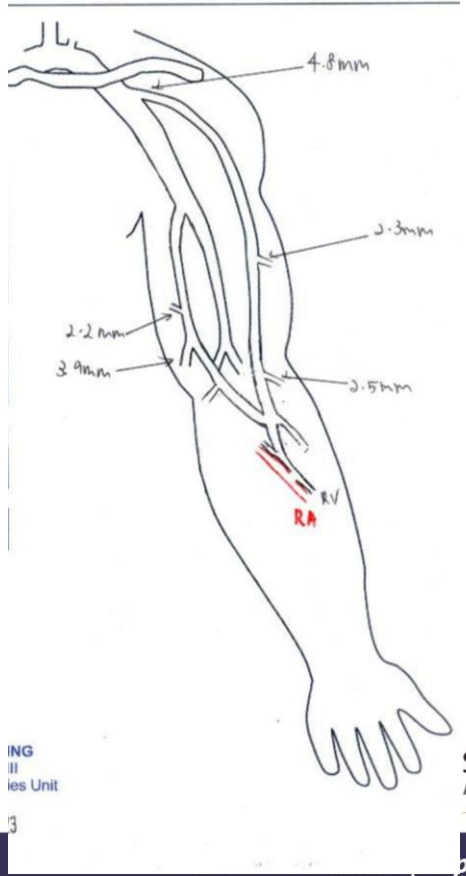
Finding the right patient

Outflow Vein Measurements		
	Cephalic	Basilic
Proximal Upper Arm	6.3 mm	7.1 mm
Mid Upper Arm	6.2 mm	6.7 mm
Distal Upper Arm	6.8 mm	5.9 mm
Antecubital	5.9 mm	5.4 mm
Volume Flow	438 **ml/min**	516 **ml/min**

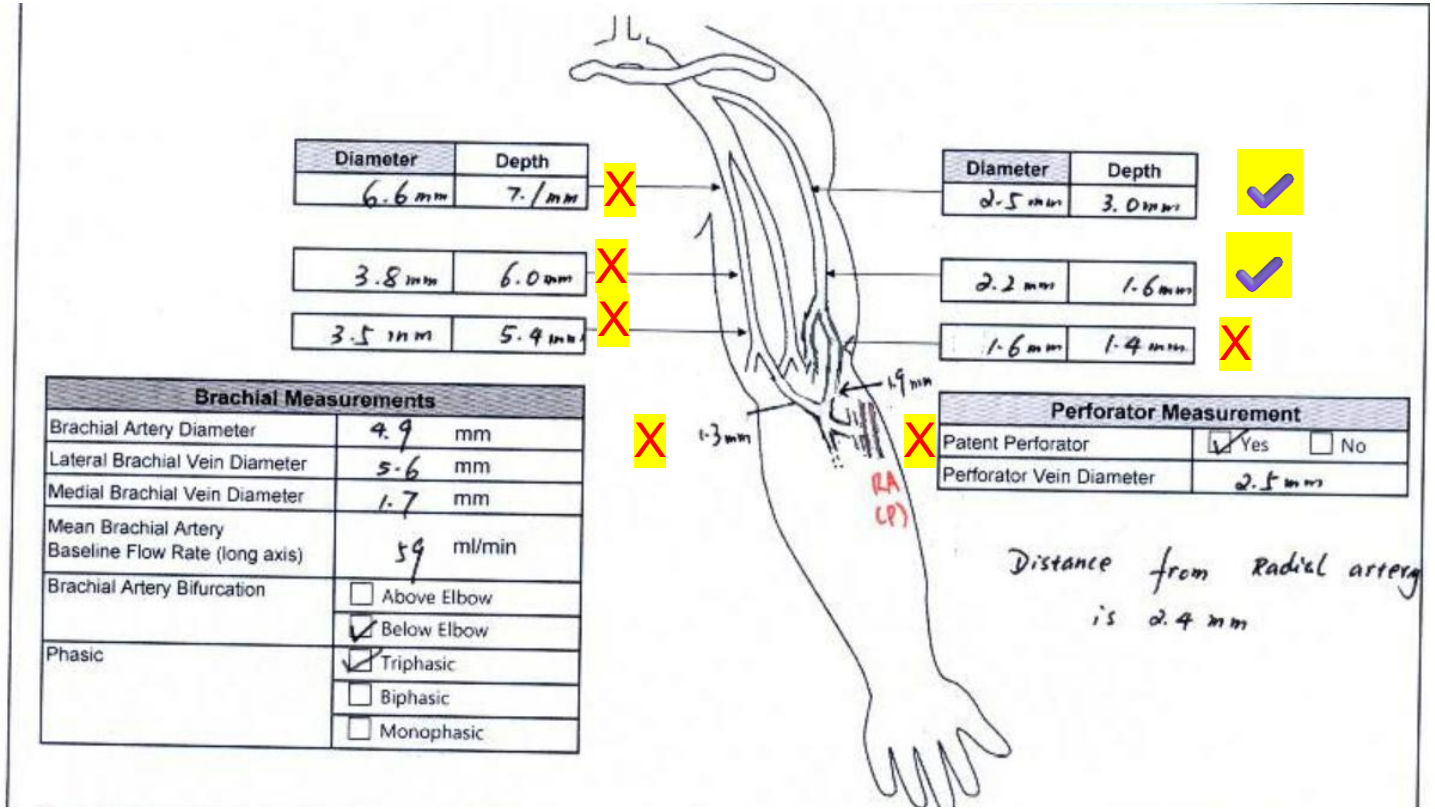
Arterial Measurements	
Brachial Artery (Distal Upper Arm)	5.6 mm
Brachial Artery Flow Rate (Long Axis)	1175 ml/min
Radial Artery (Proximal Forearm)	4.3 mm

Perforating Vein Measurements		
Patent Perforator	☑ Yes	☐ No
Perforator Vein Diameter	6.0 mm	

Anastomosis Site	
Measurement (AP Diameter)	4.4 mm



Finding the right patient



Diameter	Depth
6.6 mm	7.1 mm
3.8 mm	6.0 mm
3.5 mm	5.4 mm

Diameter	Depth
2.5 mm	3.0 mm
2.2 mm	1.6 mm
1.6 mm	1.4 mm

Brachial Measurements		
Brachial Artery Diameter	4.9	mm
Lateral Brachial Vein Diameter	5.6	mm
Medial Brachial Vein Diameter	1.7	mm
Mean Brachial Artery Baseline Flow Rate (long axis)	59	ml/min
Brachial Artery Bifurcation	☐ Above Elbow	
	☑ Below Elbow	
Phasic	☑ Triphasic	
	☐ Biphasic	
	☐ Monophasic	

Perforator Measurement	
Patent Perforator	☑ Yes ☐ No
Perforator Vein Diameter	2.5 mm

1.9 mm

1.3 mm

RA (P)

Distance from Radial artery is 2.4 mm

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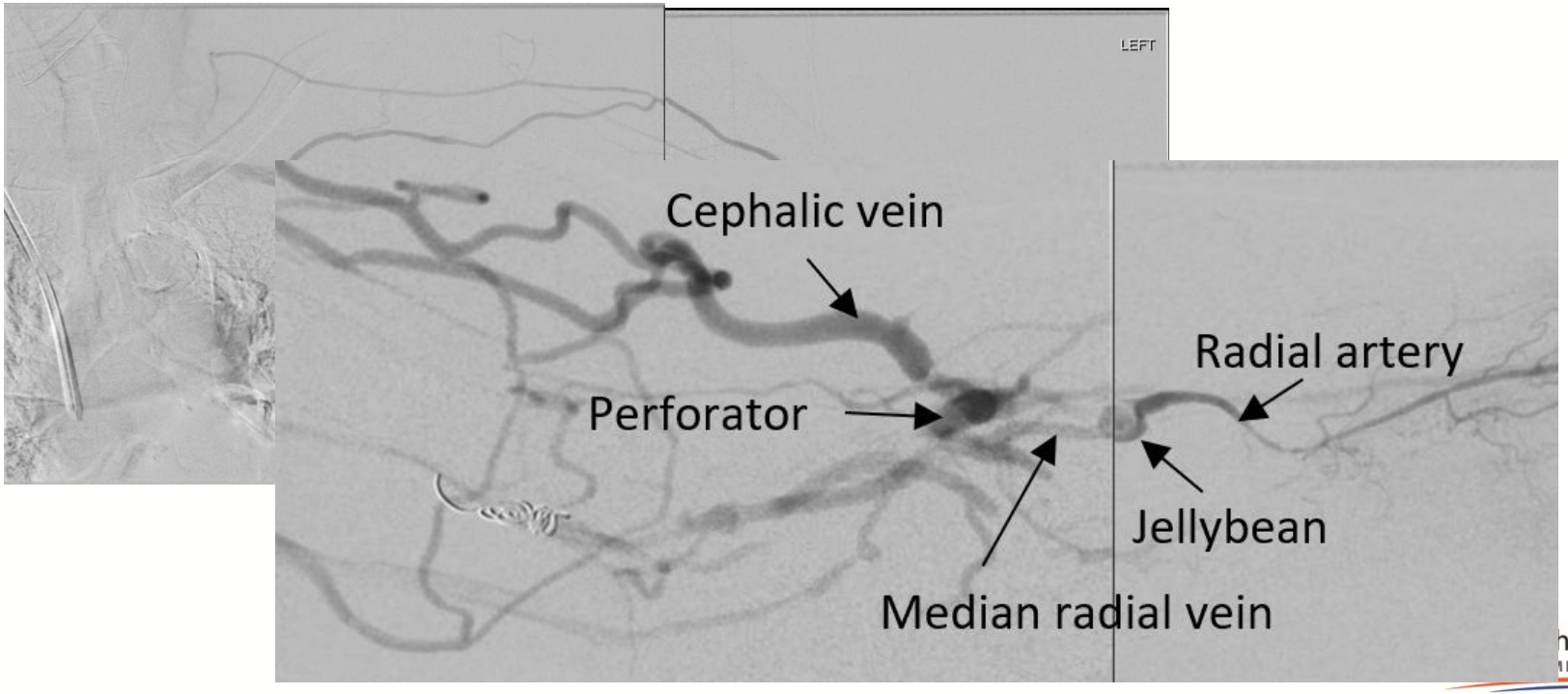
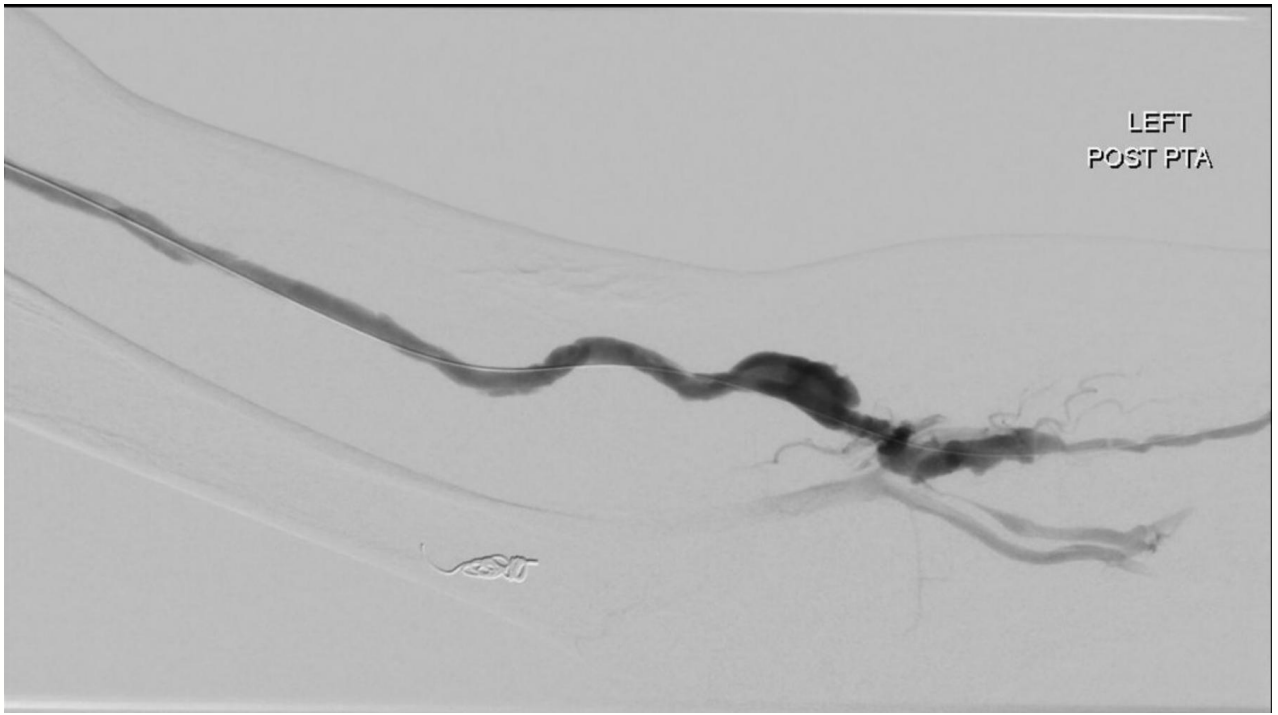
Finding the right patient



Finding the right patient



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EndoAVF program: Team work matters

Finding the right patient	Creating the endoAVF	Using the endoAVF	Maintaining the endoAVF
Nephrologists	Nephrologists	Nephrologists	Nephrologists
Vascular Surgeon	Vascular Surgeon	Dialysis nurses	Vascular Surgeon
Sonographers	Interventional Radiologist	Sonographers	Interventional Radiologist
	Procedure nurses		Procedure nurses
	Radiographers		Radiographers

- A successful endoAVF program requires a team based approach

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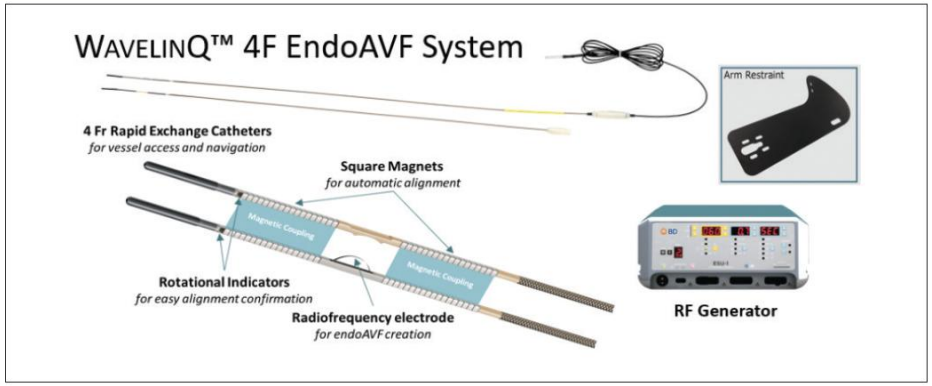
Creating the endoAVF



- Vascular sheath in artery
  - Insertion of the Arterial catheter
- Vascular sheath in deep vein
  - Insertion of the Venous catheter

- Activation to bring both catheter together to create an anastomosis in the deep system as close as possible to the perforator

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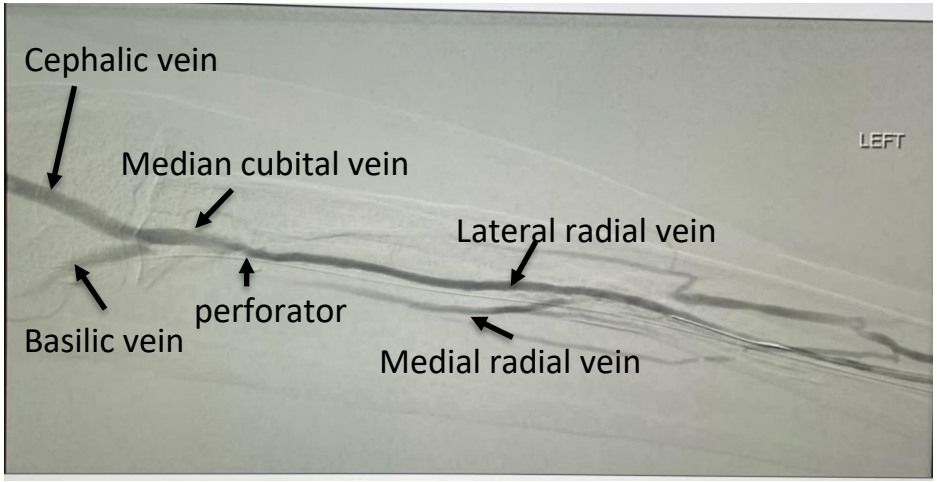
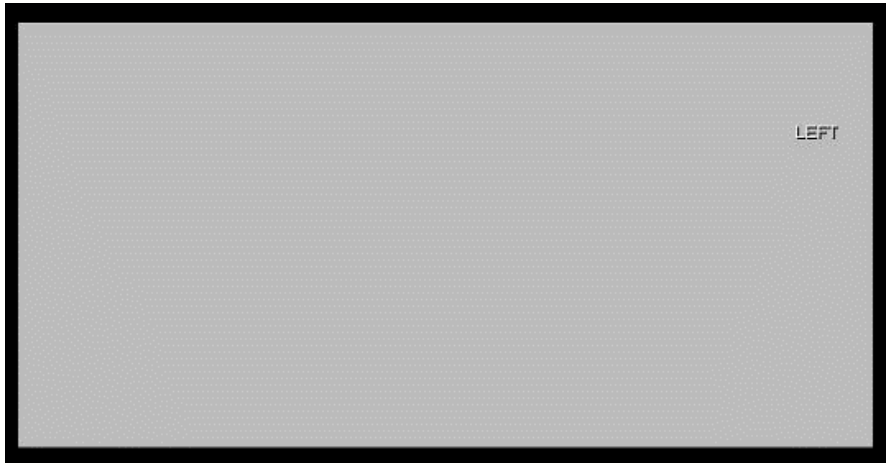
Accessing the deep vein





5F sheath in lateral radial vein

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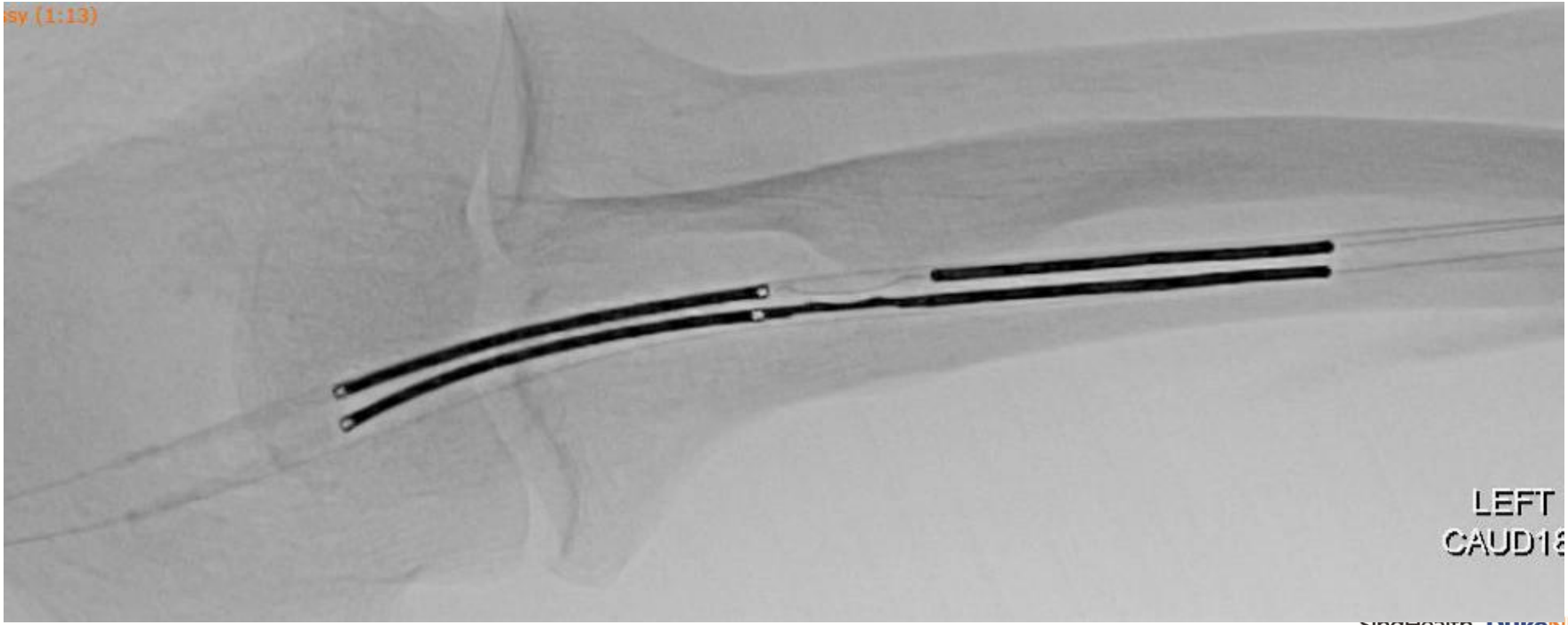
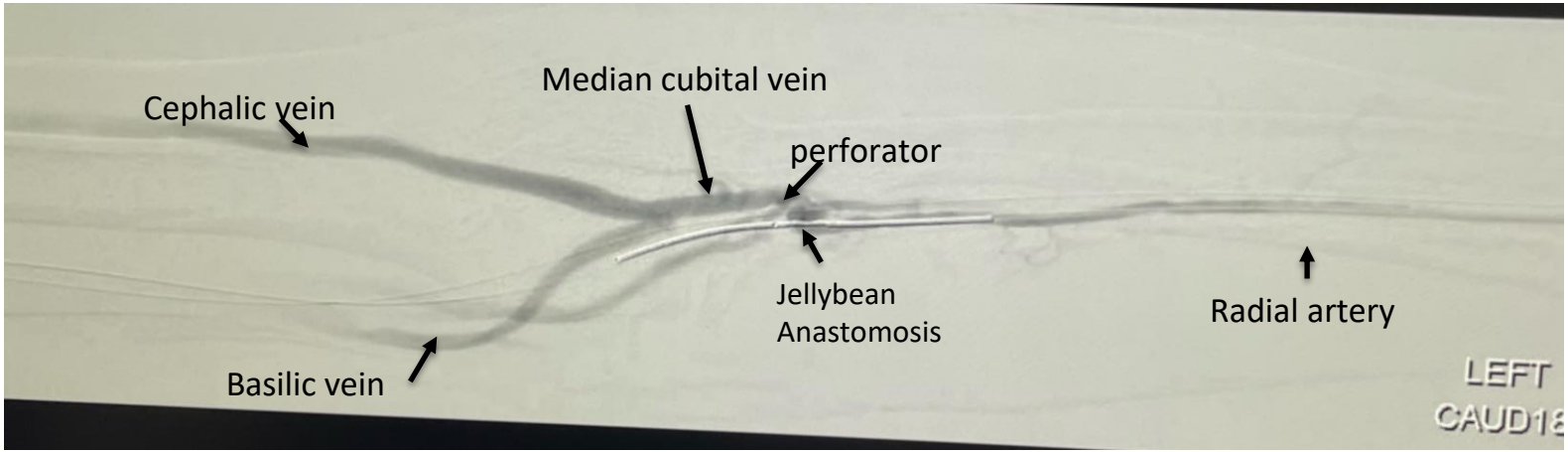
Accessing the artery and aligning the catheters

Creating the anastomosis



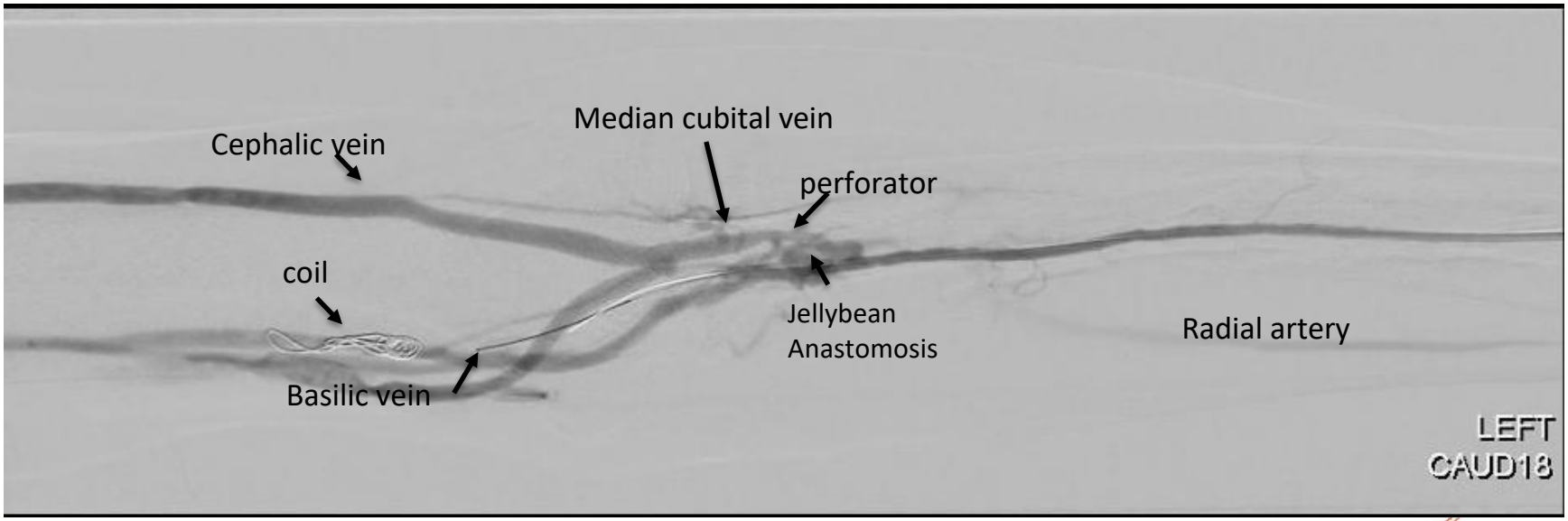
Typical appearance of the endoAVF on DSA



WavelinQ ”A” catheter in situ post creation
Contrast injection via radial artery sheath

Coiling of the deep vein

Final appearance



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Flow measurement 1 month post creation

terio Venous Fistula/Graft
rterio Venous Fistula/Graft

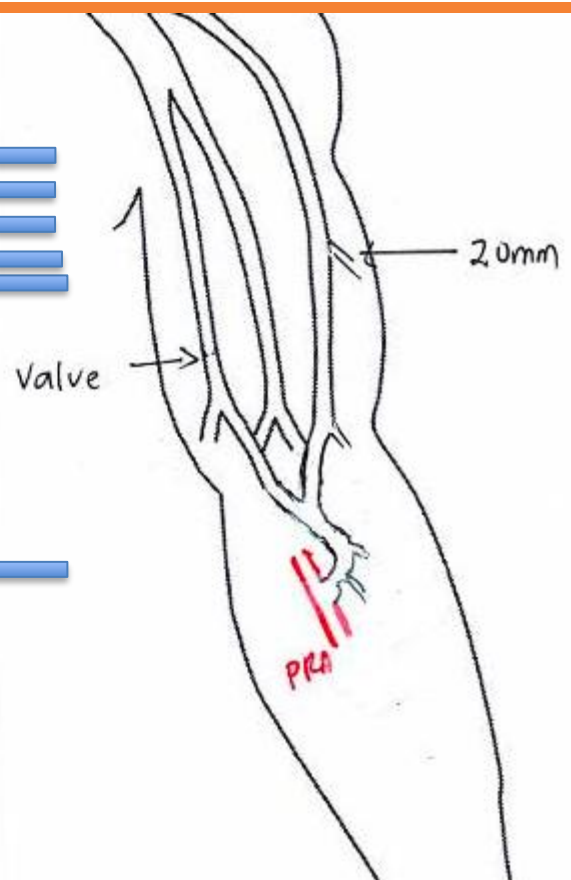
Outflow Vein Measurements		
	Basilic	Cephalic
Proximal Upper Arm	6.2 mm	4.3 mm
Mid Upper Arm	5.1 mm	4.6 mm
Distal Upper Arm	5.0 mm	5.2 mm
Antecubital	4.3 mm	4.8 mm
Volume Flow	408 **ml/min**	517 **ml/min**

Brachial Vein Measurements		
Brachial vein	Medial Vein	Lateral Vein
Diameter	Coiled	2.5 mm
Volume flow rate		22 ml/min

Arterial Measurements		
Brachial Artery (Distal Upper Arm)	6	mm
Brachial Artery Flow Rate (Long Axis)	1026	ml/min
Radial Artery (Proximal Forearm)	3.2	mm

Perforating Vein Measurements	
Perforator Vein Diameter	3.7

Anastomosis Site	
Measurement (AP Diameter)	3.5



EndoAVF program: Team work matters

Finding the right patient	Creating the endoAVF	Using the endoAVF	Maintaining the endoAVF
Nephrologists Vascular Surgeon Sonographers	Nephrologists Vascular Surgeon Interventional Radiologist Procedure nurses Radiographers	Nephrologists Dialysis nurses Sonographers	Nephrologists Vascular Surgeon Interventional Radiologist Procedure nurses Radiographers

- A successful endoAVF program requires a team based approach

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EndoAVF cannulation is an art

- EndoAVF can have dual outflows in basilic and cephalic veins
- Successful creation ≠ useable

EndoAVF

Support community dialysis nurses

- Repeated training workshops
  - Tips and tricks of needling
- Community centre (e.g. NKF & FMC) sent champion to attend training
- Ultrasound guided cannulation

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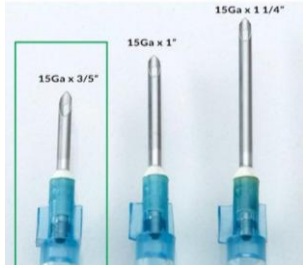
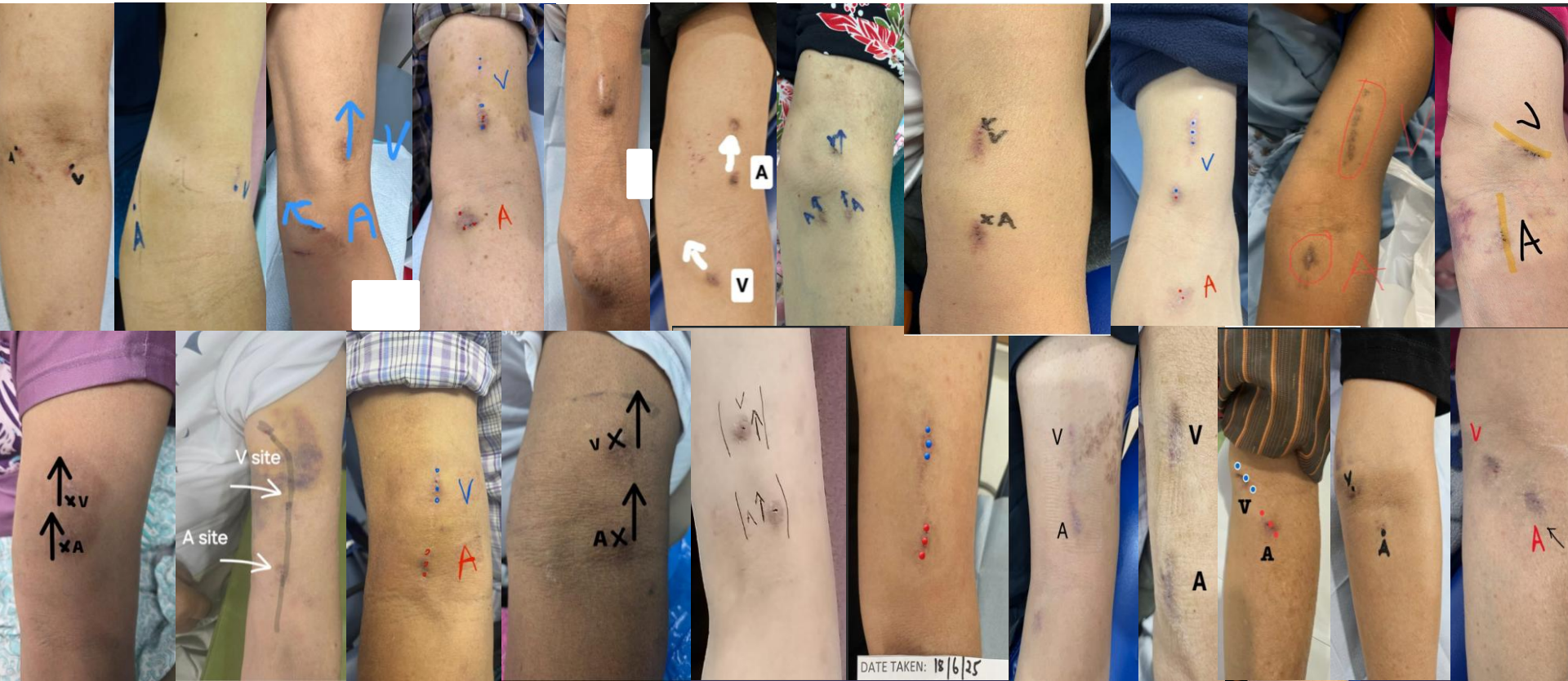
Improving patients' lives

Support community dialysis nurses

- Ultrasound marking
- New needle length
- Plastic cannula



Successful cannulation by community nurses



History of Laparoscopy Cholecystectomy

The audience was skeptical of Mühe's claims.[15] Most surgeons thought that operating through a small incision was dangerous. Mühe later had to deal with derogatory remarks such as "Mickey Mouse surgery" and "small brain—small incision."

Erich Mühe, Performed the first Laparoscopic Cholecystectomy in 1985

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Conclusion

- EndoAVF can be successfully created in our Asian population
- Cannulation can be challenging
- Good teammates matter!
- Practice and Pray hard

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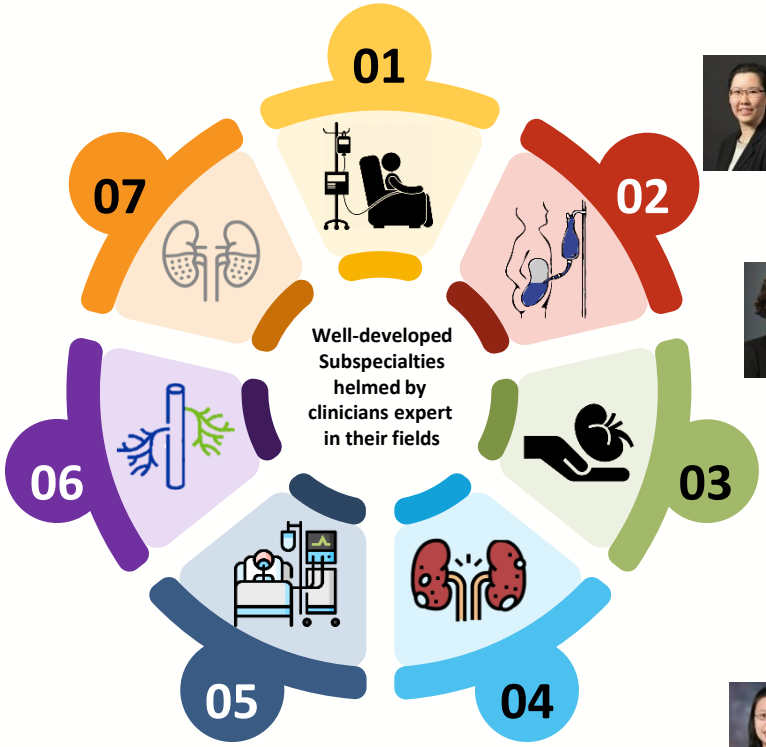
Department of Renal Medicine, Singapore General Hospital

Established 1973

Chronic Kidney Disease

Interventional Nephrology

Critical Care Nephrology



Hemodialysis

Peritoneal Dialysis

Transplant

Glomerulonephritis

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"Coming together is a beginning. Keeping together is progress. Working together is success." --Henry Ford

Thank You

Tan.chieh.suai@singhealth.com.sg

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