Vascular Access in dialysis- Common problems

Dr Goh Heong Keong

Outline of Lecture

- Introduction
- Types of vascular access
- History of dialysis/vascular access
- Ideal vascular access
- Prevalence of fistula use
- Complications of Fistula
- Picking up failing fistula
- When to refer?
- Conclusion

Introduction

- Vascular Access- the lifeline of haemodialysis patients
- Vascular access associated problems- major burden in any nephrology unit.
- It has been estimated that vascular access procedures and complications account for over 20% of hospitalizations of dialysis patients and cost over $1 billion annually in the United States

Allon M, Robbin ML. Increasing arteriovenous fistulas in hemodialysis patients: problems and solutions. Kidney Int 2002; 62: 1109-24.

Types of vascular access

Native Fistula

Graft

Catheter- permanent/ temporary

depending on site of insertion

MEDICAL HISTORY

First Clinical Experience with the Artificial Kidney

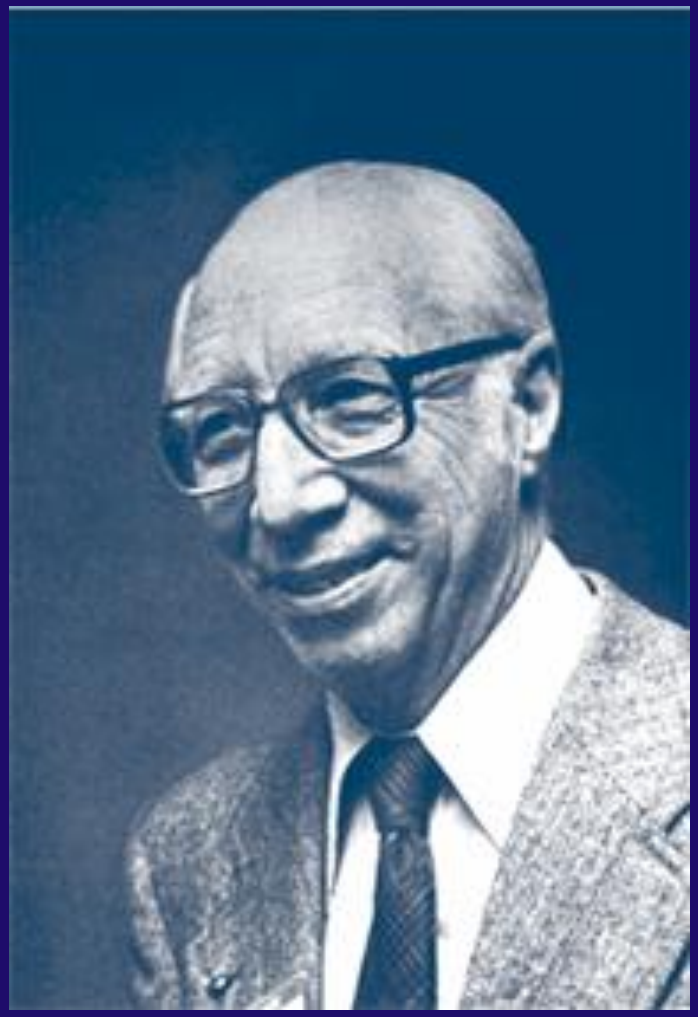
WILLEM J. KOLFF, M.D.

Cleveland, Ohio

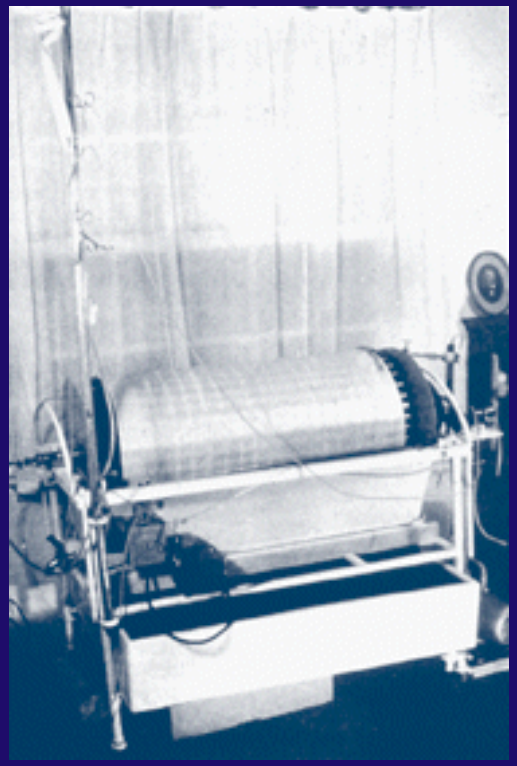
Received January 14, 1965; accepted for publication January 19, 1965.

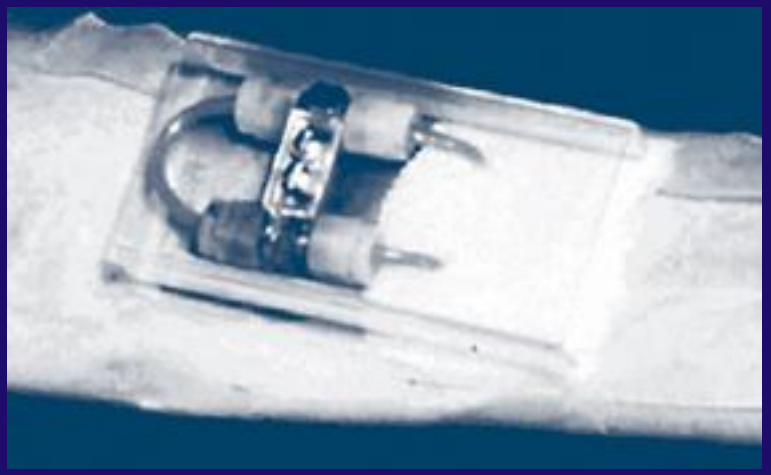
From the Cleveland Clinic, Cleveland, Ohio.

Requests for reprints should be addressed to Willem J. Kolff, M.D., Cleveland Clinic, 2020 East 93rd St., Cleveland, Ohio 44106.



Willem Kolff, of the Netherlands, in 1945 used a rotating drum kidney to treat a 67-year-old patient that had been admitted to the hospital with acute kidney failure.





Quinton, Dillard and Scribner’s vascular access

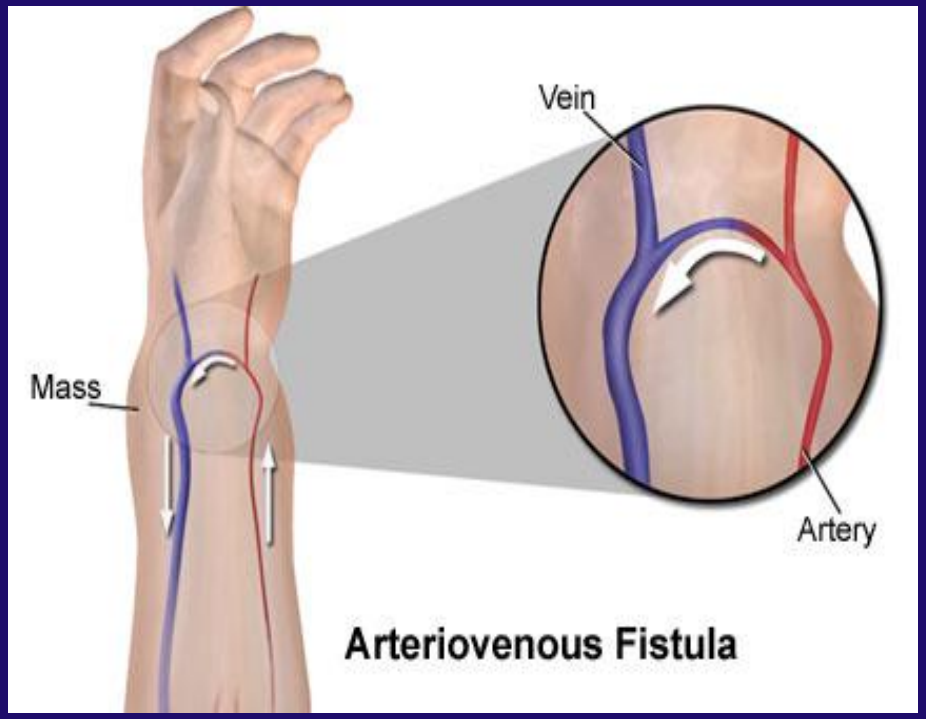
In 1949, Allwall tried to use a rubber tubing and glass cannula device to connect artery and vein, but he failed.
This idea of Alwall was later taken up by Quinton, Dillard and Scribner (Seattle, USA) who developed an arteriovenous (AV) Teflon shunt

James E. Cimino and Michael J. Brescia (New York, USA) described a ‘simple venipuncture for hemodialysis in 1962.

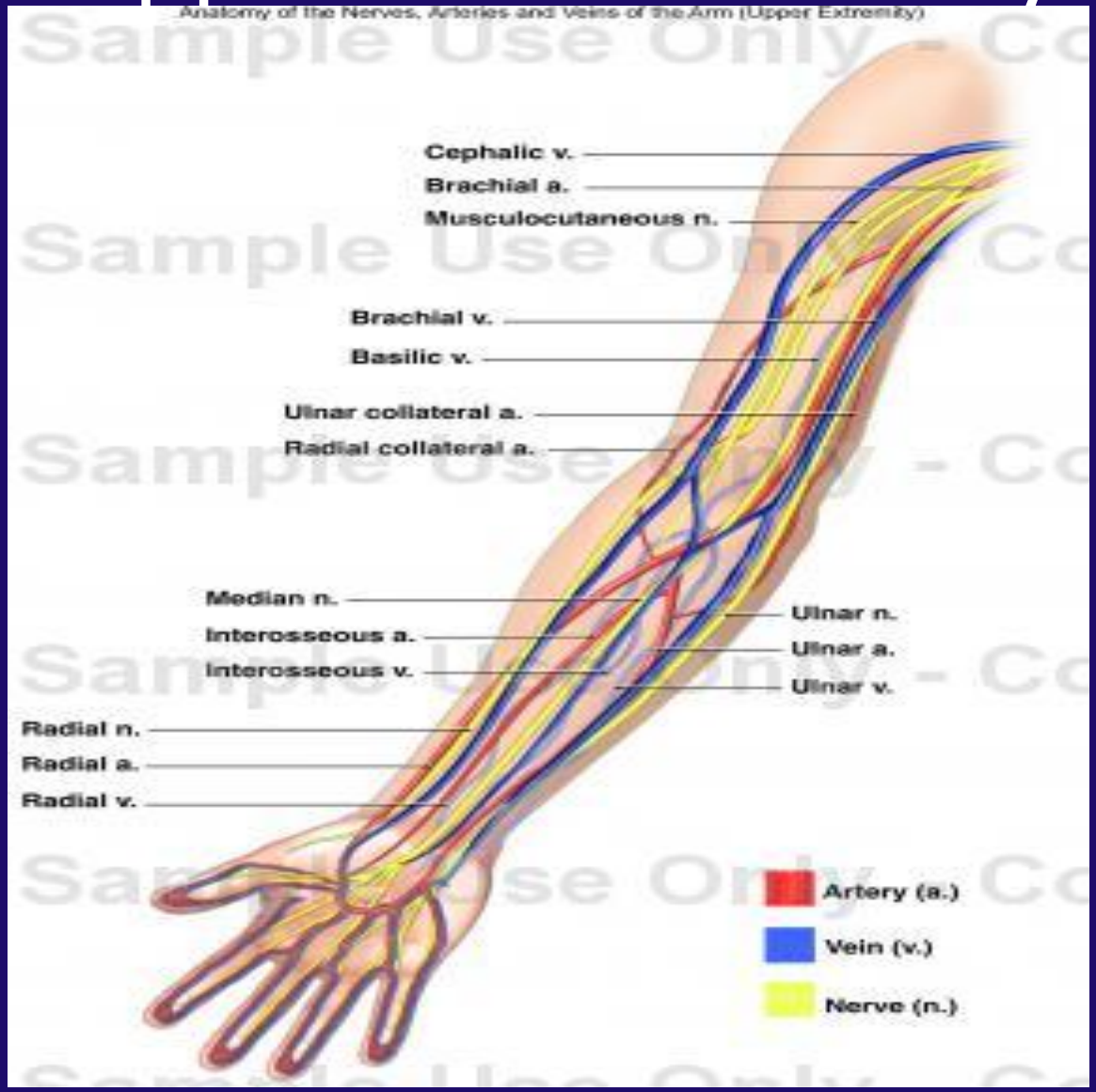
The legendary paper ‘Chronic hemodialysis using venipuncture and a surgically created arteriovenous fistula’ was published by Brescia, Cimino, Appell and Hurwich

Fistula Creation Terminology

An arteriovenous fistula ,also called AVF, is a surgical connection of an artery directly to a vein.



Upper Limbs Anatomy

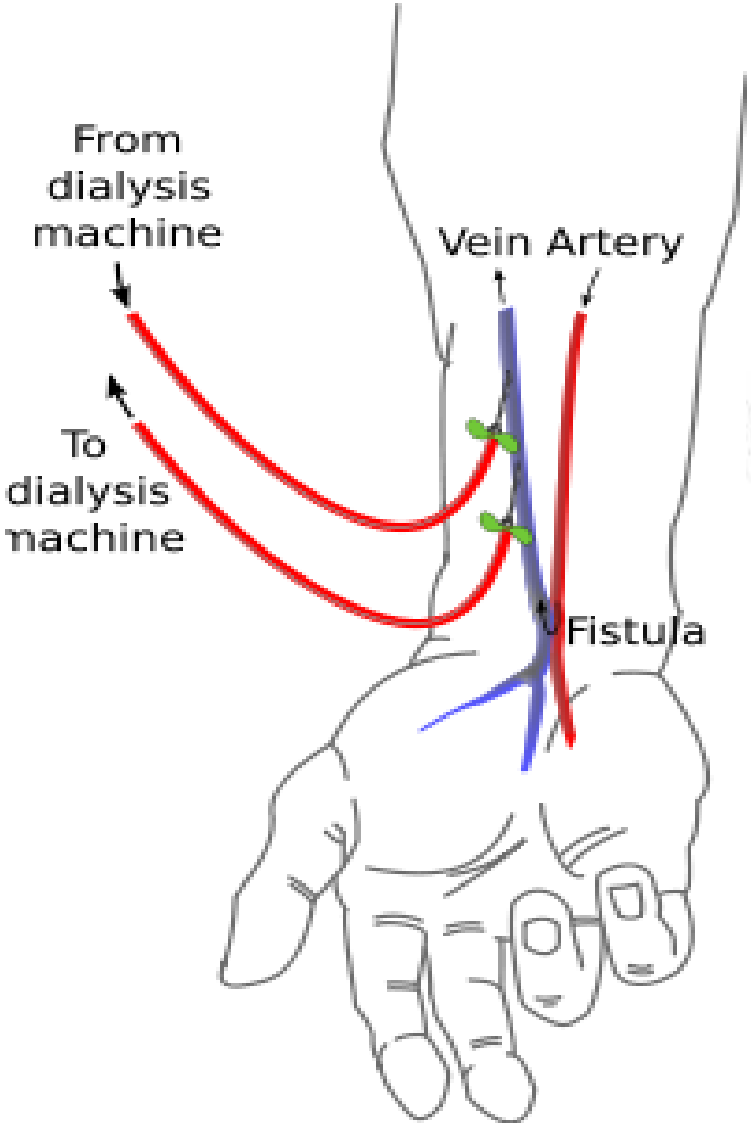


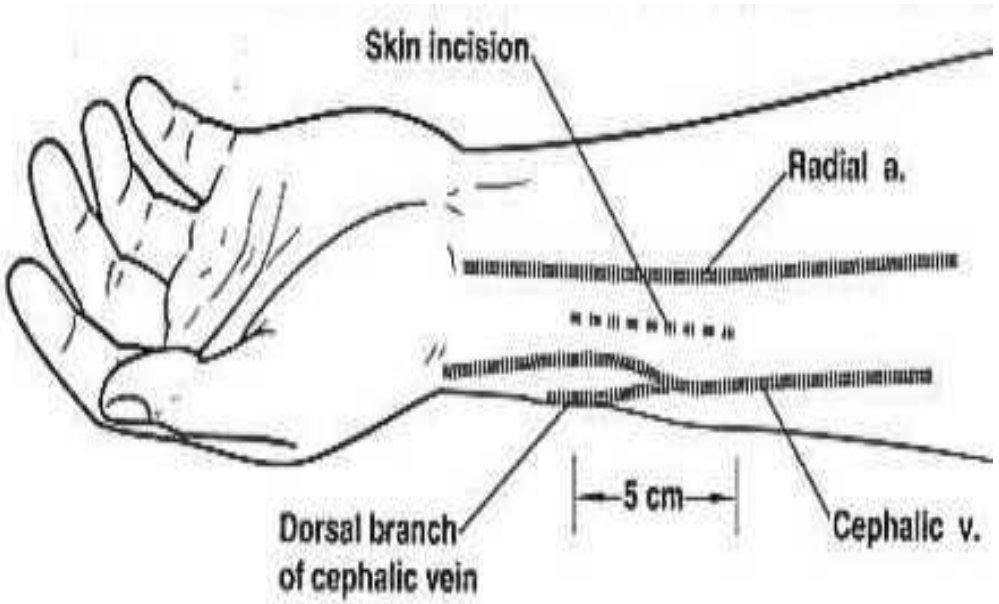
Native Fistula

Radiocephalic fistula

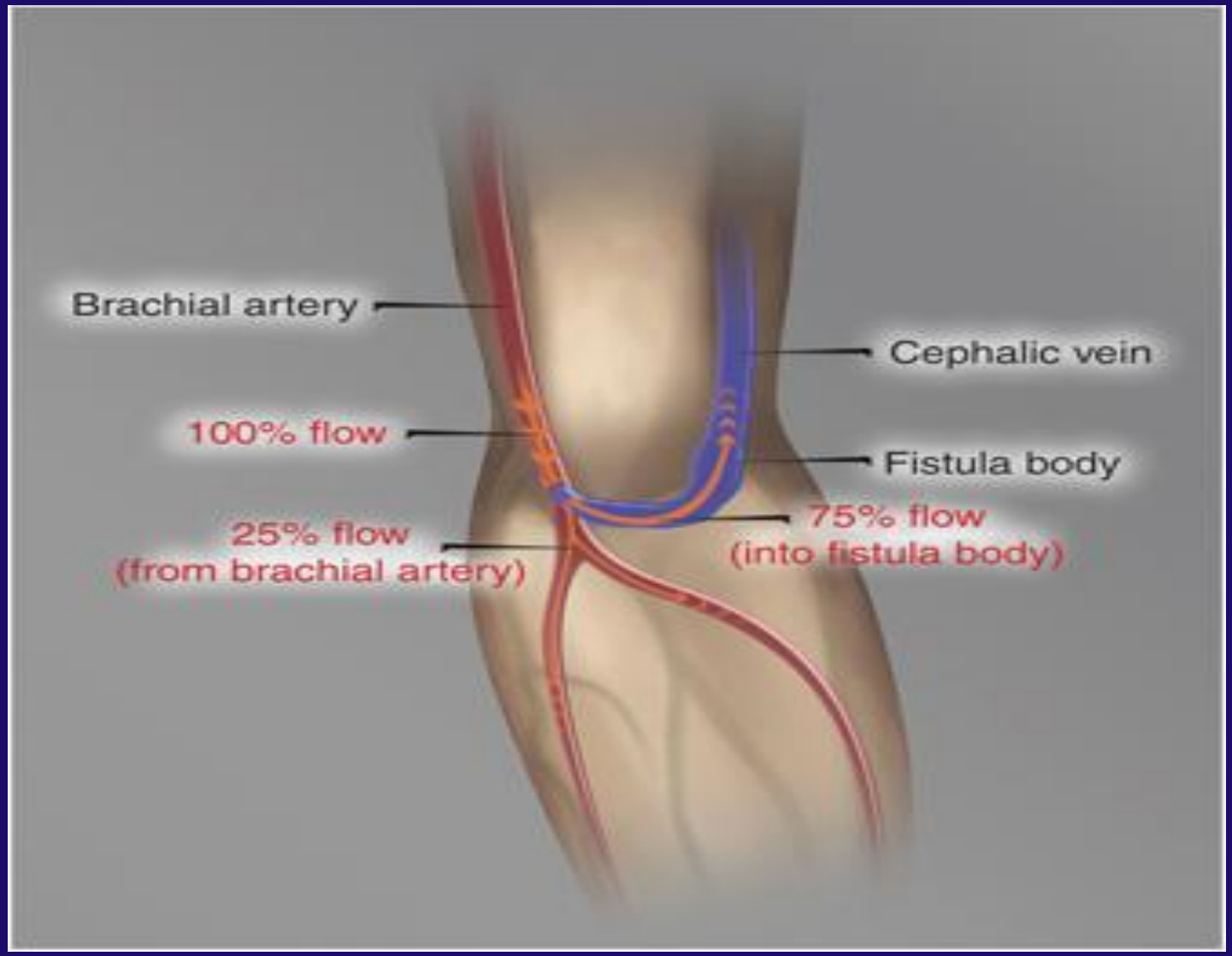
Brachiocephalic fistula

Brachiobasilic fistula

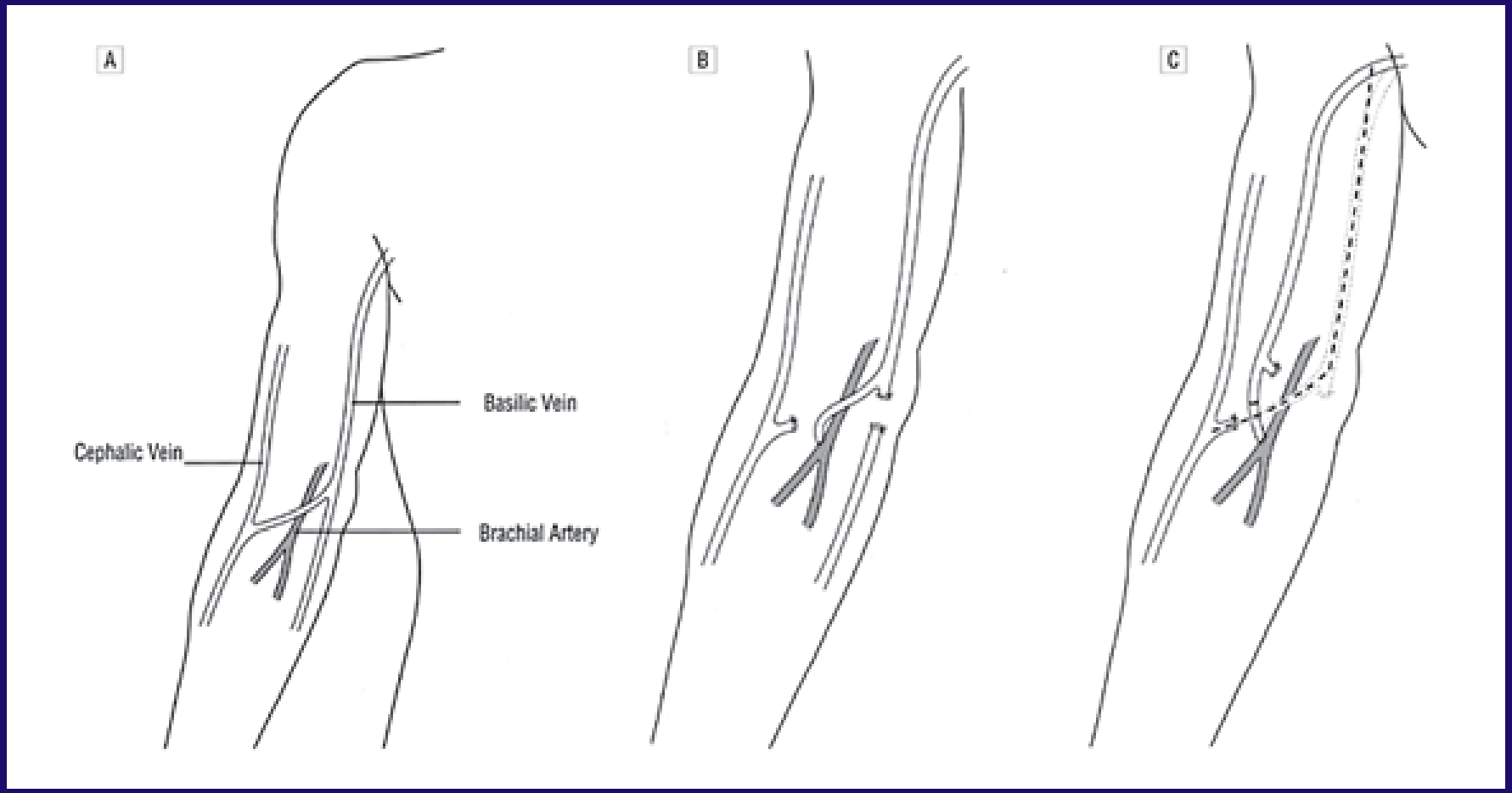

From
dialysis
machine
To
dialysis
machine
Vein
Artery
Fistula


Skin incision
Radial a.
5 cm
Dorsal branch
of cephalic vein
Cephalic v.

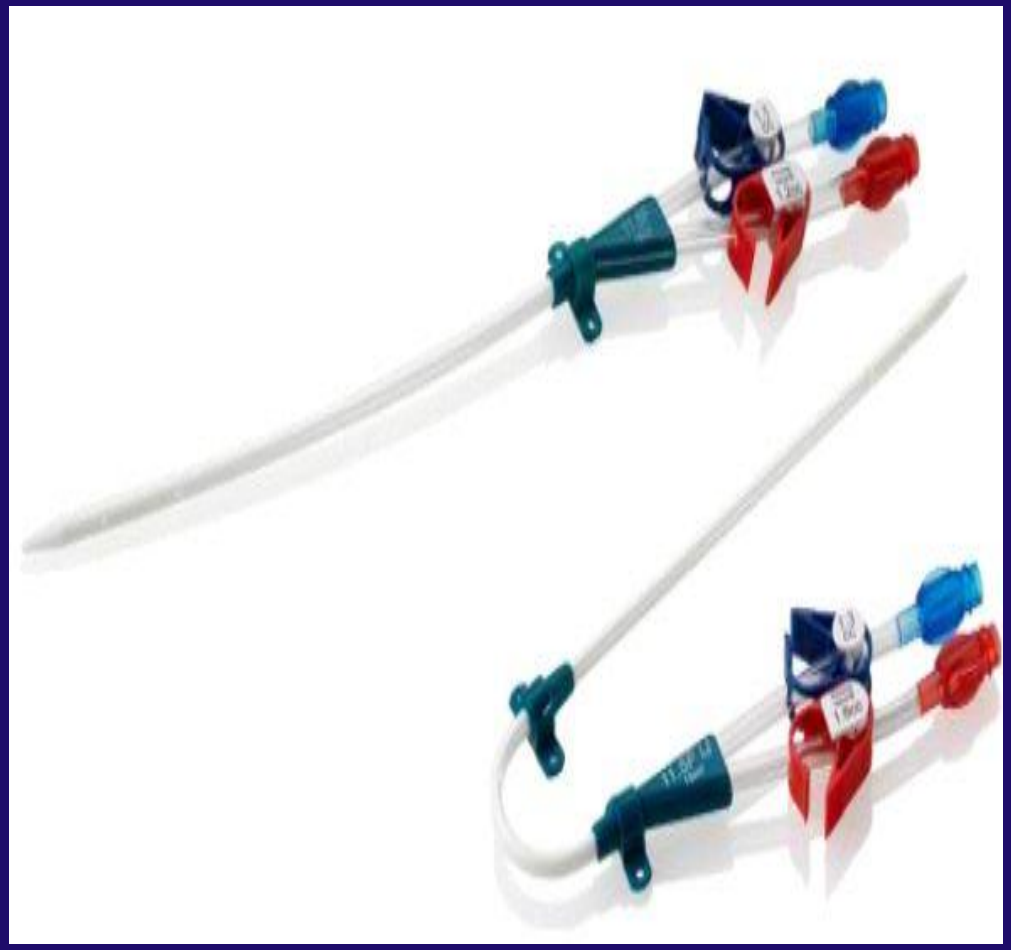
Brachiocephalic Fistula



Brachiobasilic Fistula



Catheter




17
19


20
19

Ideal Vascular Access

- 1) provide longevity of use with minimal complication rates from infection and thrombosis.
- 2) supply high blood flow rates to deliver the prescribed dialysis dose.
- 3) Minimal Intervention to maintain patency

Pietro Ravani et al, Clinical epidemiology of arteriovenous fistula in 2007, JNEPHROL 2007; 20: 141-149

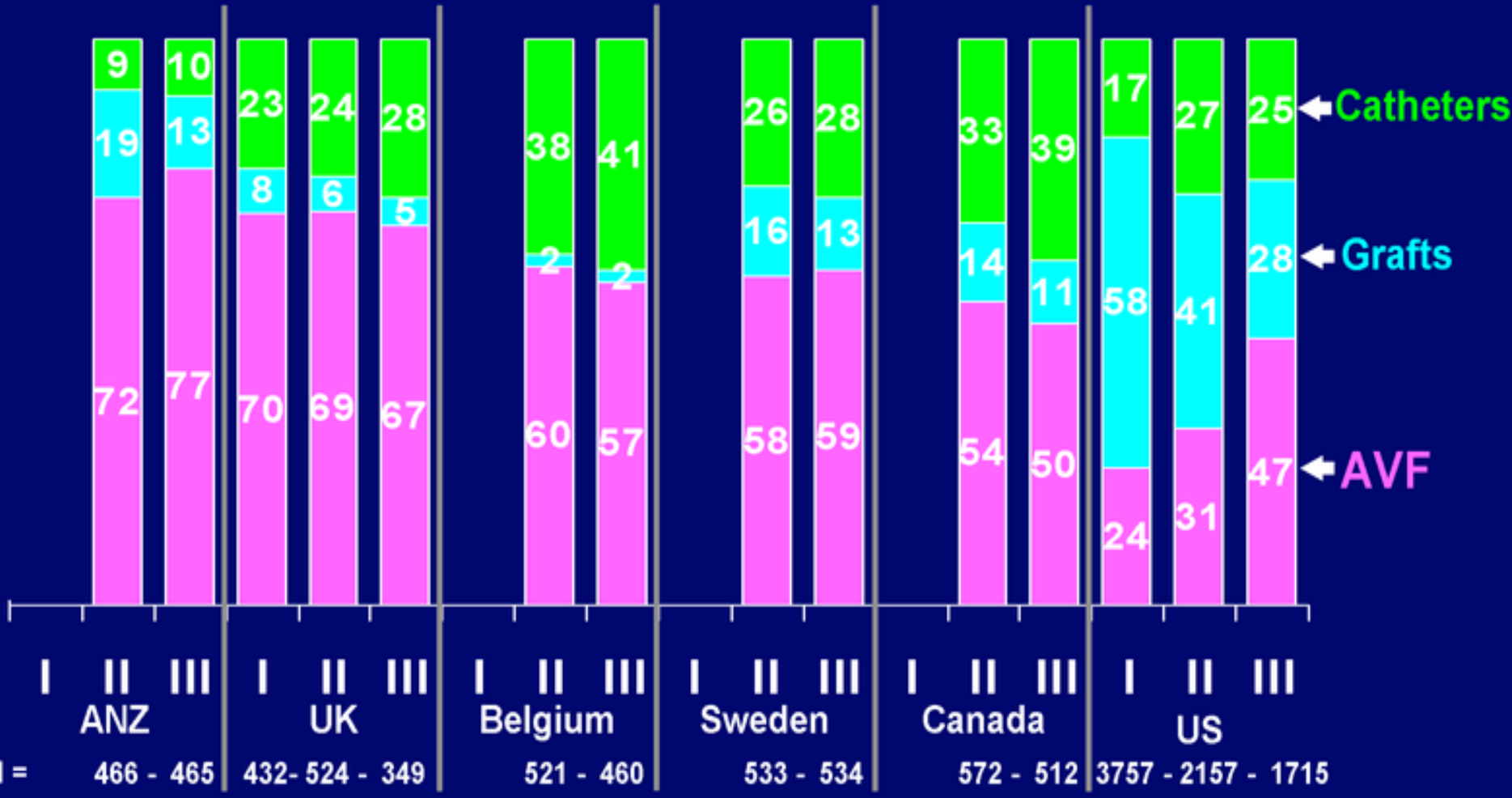
1) Fistulae are associated with increased survival and lower hospitalization
2) Fistulae have the lowest rate of thrombosis and longer survival of the access
3) Less intervention.
4) Cheaper to maintain

Creating Vascular Access

Vital importance to make sure fistula is created before initiation of dialysis.

Various possible challenges before successful fistula creation

Figure 1b: Trends in Vascular Access Use: DOPPS I, II and III (1996-2007)



DOPPS

Ethier et al. *Nephrol Dial Transplant 2008; 23(10):3219–3226*

Fistula First Policy- Challenges

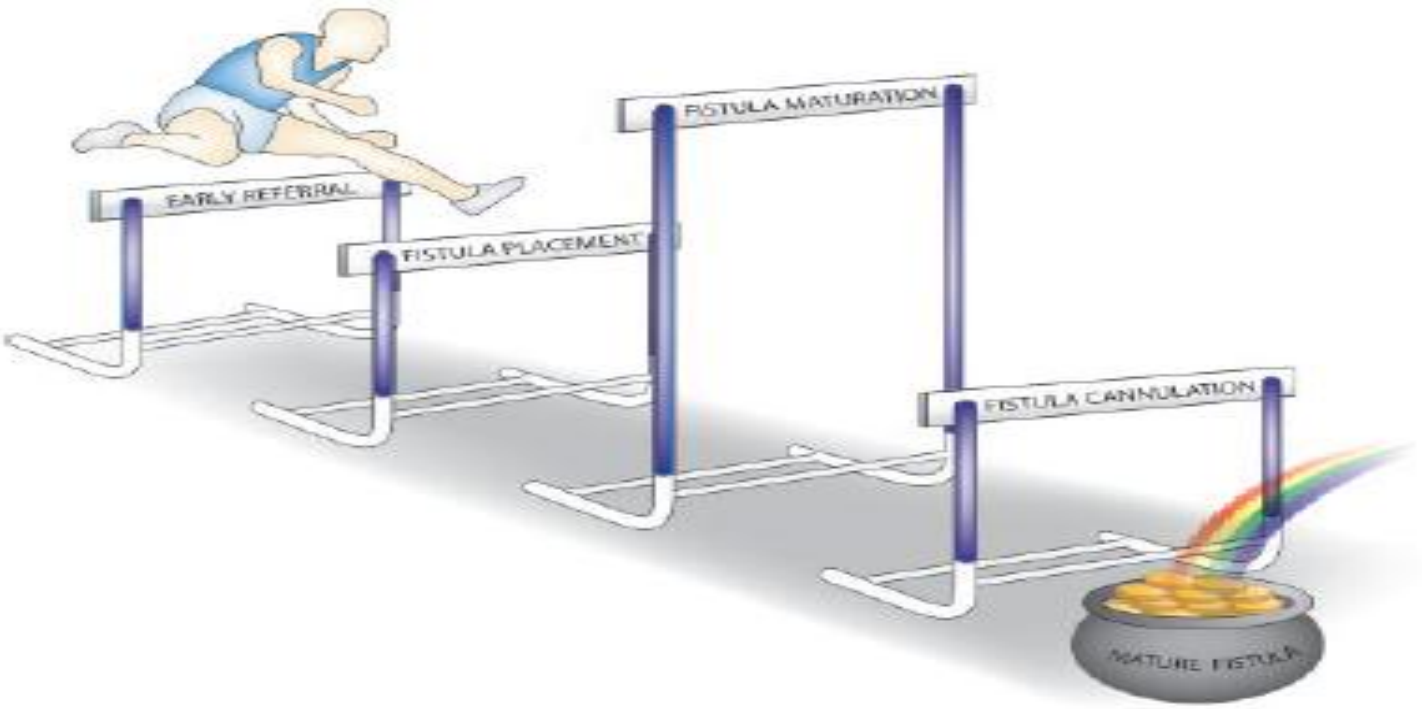
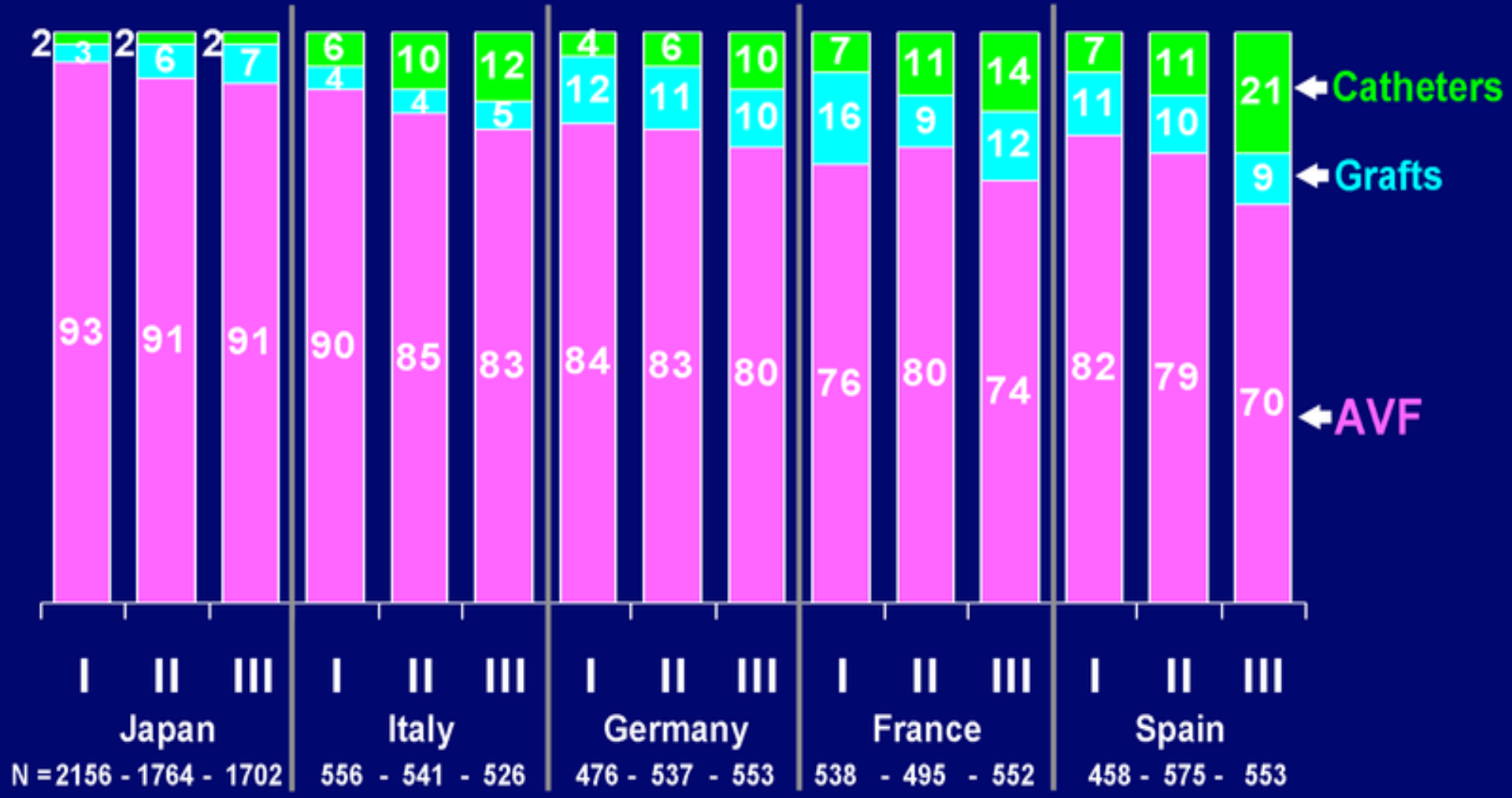


Figure 2. The "fistula hurdle." Several hurdles must be overcome successfully to ensure that a patient initiates dialysis with a mature fistula. These include early referral of patients with chronic kidney disease to a nephrologist, fistula placement well before reaching ESRD, adequate fistula maturation, and successful cannulation of the fistula by the dialysis staff. Failure to achieve any step results in a patient who initiates dialysis with a catheter.

Figure 1a: Trends in Vascular Access Use: DOPPS I, II and III (1996-2007)



DOPPS

Ethier et al. *Nephrol Dial Transplant 2008; 23(10):3219–3226*

Table 11.1.1: Vascular Access on Haemodialysis, 2001-2010

Access types	2001		2002		2003		2004		2005	
	n	%	n	%	n	%	n	%	n	%
Wrist AVF	4049	79	4680	78	5249	75	5891	73	6405	69
BCF*	897	17	1068	18	1359	20	1693	21	2169	23
Venous graft	19	0	14	0	23	0	41	1	30	0
Artificial graft	64	1	78	1	113	2	149	2	221	2
Permanent CVC	25	1	43	1	61	1	99	1	179	2
Temporary CVC*	90	2	138	2	179	3	233	3	266	3
Temporary FVC*	0	0	0	0	0	0	0	0	4	0
TOTAL	5144	100	6021	100	6984	100	8106	100	9274	100

Access types	2006		2007		2008		2009		2010	
	n	%	n	%	n	%	n	%	n	%
Wrist AVF	7798	68	8309	65	9491	62	10665	61	10985	58
BCF*	2856	25	3421	27	4403	29	5243	30	6016	32
Venous graft	22	0	37	0	19	0	32	0	49	0
Artificial graft	284	3	305	2	351	2	379	2	379	2
Permanent CVC	235	2	261	2	298	2	465	3	507	3
Temporary CVC*	298	3	424	3	579	4	770	4	803	4
Temporary FVC*	19	0	25	0	59	0	46	0	71	0
TOTAL	11512	100	12782	100	15200	100	17600	100	18810	100

18th MDTR report 2010, Malaysia

Fistula Complications

The natural history of vascular access for hemodialysis: A single center study of 2,422 patients

Vasilios Papanikolaou, MD, PhD, Andreas Papagiannis, MD, Dionisios Vrochides, MD, PhD, Georgios Imvrios, MD, PhD, Dimitrios Gakis, MD, Ioannis Fouzas, MD, PhD, Nikolaos Antoniadis, MD, PhD, *and* Dimitrios Takoudas, MD, PhD, *Thessaloniki, Greece*

doi:10.1016/j.surg.2008.11.003

Table III. Main complications observed after construction of the 4 most common vascular access procedures

Complication	*Number per patient-year*			
	RCAVF	*BCAVF*	*BBAVF*	*u-PTFE*
Vein stenosis/edema	0.20	0.42	0.28	0.30
Steal syndrome	0.01	0.10	0.01	0.12
Bleeding	0.03	0.04	0.03	0.04
Infection	0.01	0.01	0.01	0.15

Incidence is expressed in complication occurrence per patient-year.

How to pick up?

1) Vein stenosis- central vein stenosis

Increasing swelling over fistula hand with formation of collaterals especially over the neck.

Central Vein stenosis

1)Left side more than right
2)Duration of catheter
3)Age

However….

Slight hand swelling is expected post fistula creation

Usual management

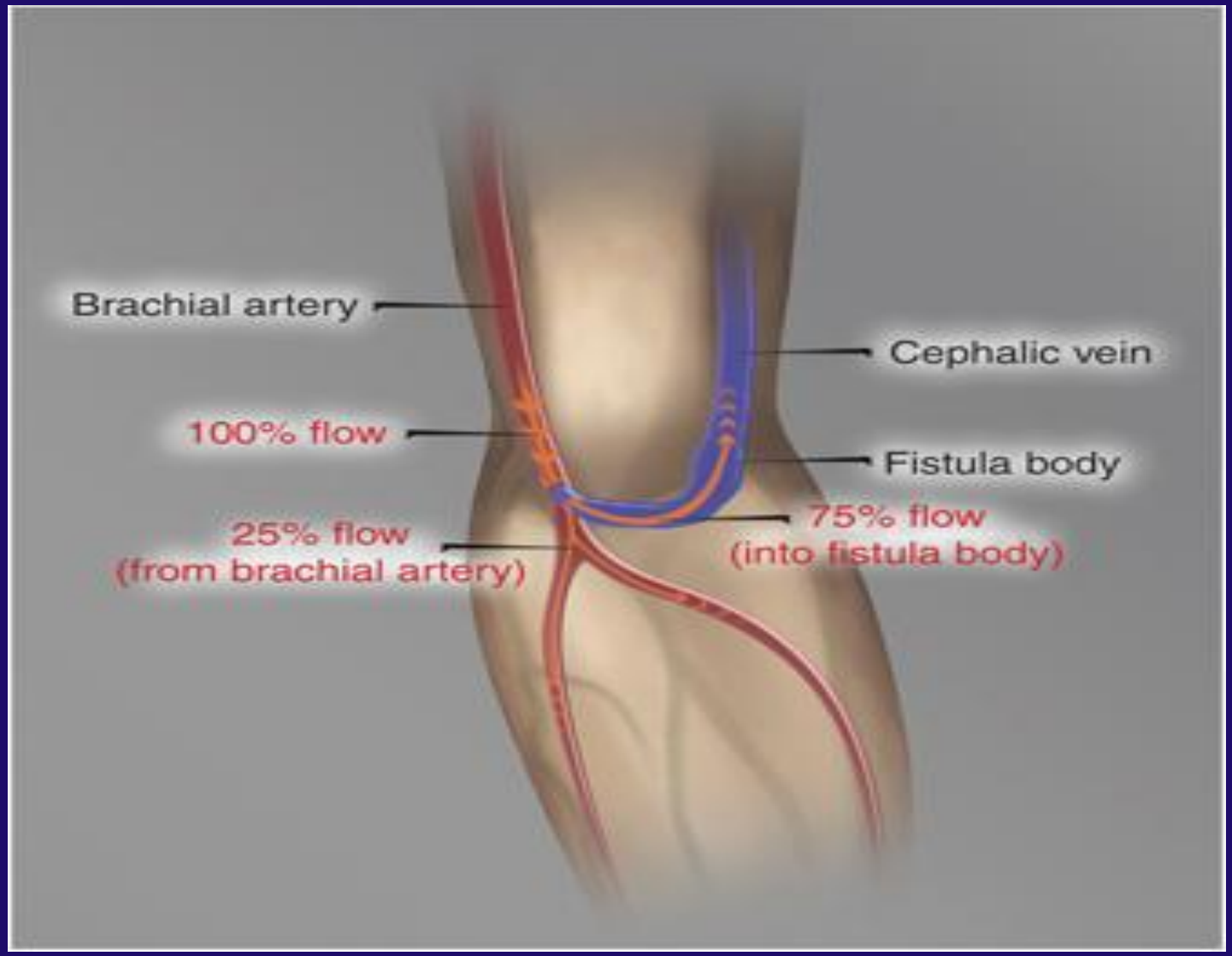
Elevate the hand

Refer if suspect central vein stenosis because plasty can be done

2) Steal syndrome

Elderly patients, diabetics and patients with peripheral and/or coronary arterial obstructive disease are more prone for the development of access-induced ischaemia

Steal Syndrome



These high-flow AVFs induce a steal phenomenon with lowering of distal perfusion pressures and, when collateral circulation is inadequate, symptoms may occur.

A grade 1–4 classification for access-induced ischaemia

(grade 1: pale/blue and/or cold hand without pain,

grade 2: pain during exercise and/or HD,

grade 3: ischaemic pain at rest and

grade 4: ulceration, necrosis and gangrene)

For grade 1 and 2 ischaemia a conservative treatment is indicated,

while with grade 3 and 4, interventional treatment is indicated

3) Bleeding from Fistula

Very common, usually longer compression is sufficient, however, prolonged bleeding should alert you that patient might have bleeding tendency or central vein stenosis

4) Vascular Access Infection

Native fistula

Catheter

Graft

Native Fistula/Graft

Infection of autogenous AV fistulae without fever or bacteraemia should be treated by appropriate antibiotics for at least 2 weeks (Evidence level III).

Infection of autogenous AVfistulae with fever and/or bacteraemia should betreated by appropriate antibiotics given intravenously for 2 weeks.

Infected graft AVFs should betreated by appropriate antibiotics given intravenouslyfor 2 weeks and continued orally for 4 weeks.

Catheter related infection

Diagnosis of catheter infection is relatively easy in symptomatic patients presenting with fever, pain, skin exit and/or track infection and bacteraemic episodes.

Should be treated with IV antibiotics 2 weeks +/- catheter removal.

Picking Up failing Fistula

- 1) Not maturing fistula (Primary Fistula failure)
- 2) Matured but failing fistula (Secondary failure)

1) Primary Failure

- A working fistula must have all the following characteristics: blood flow adequate to support dialysis, which usually equates to a blood flow greater than 600 mL/min; a diameter greater than 0.6 cm, with location accessible for cannulation and discernible margins to allow for repetitive cannulation; and a depth of approximately 0.6 cm

RULE OF SIXs

- Primary fistula failure, as a result of early thrombosis or failure to mature, is a major hurdle to increasing fistula prevalence.
- It is more common in women ,non-white patients, older patients, and those with vascular disease.

Miller CD, Robbin ML, Allon M: Gender differences in outcomes of arteriovenous fistulas in hemodialysis patients. *Kidney Int 63: 346–352, 2003*

Signs to suggest primary failure

- 1) Fails to mature for cannulation after 6 weeks.
- 2) Weak thrill/ no thrill after operation

2) Secondary Failure

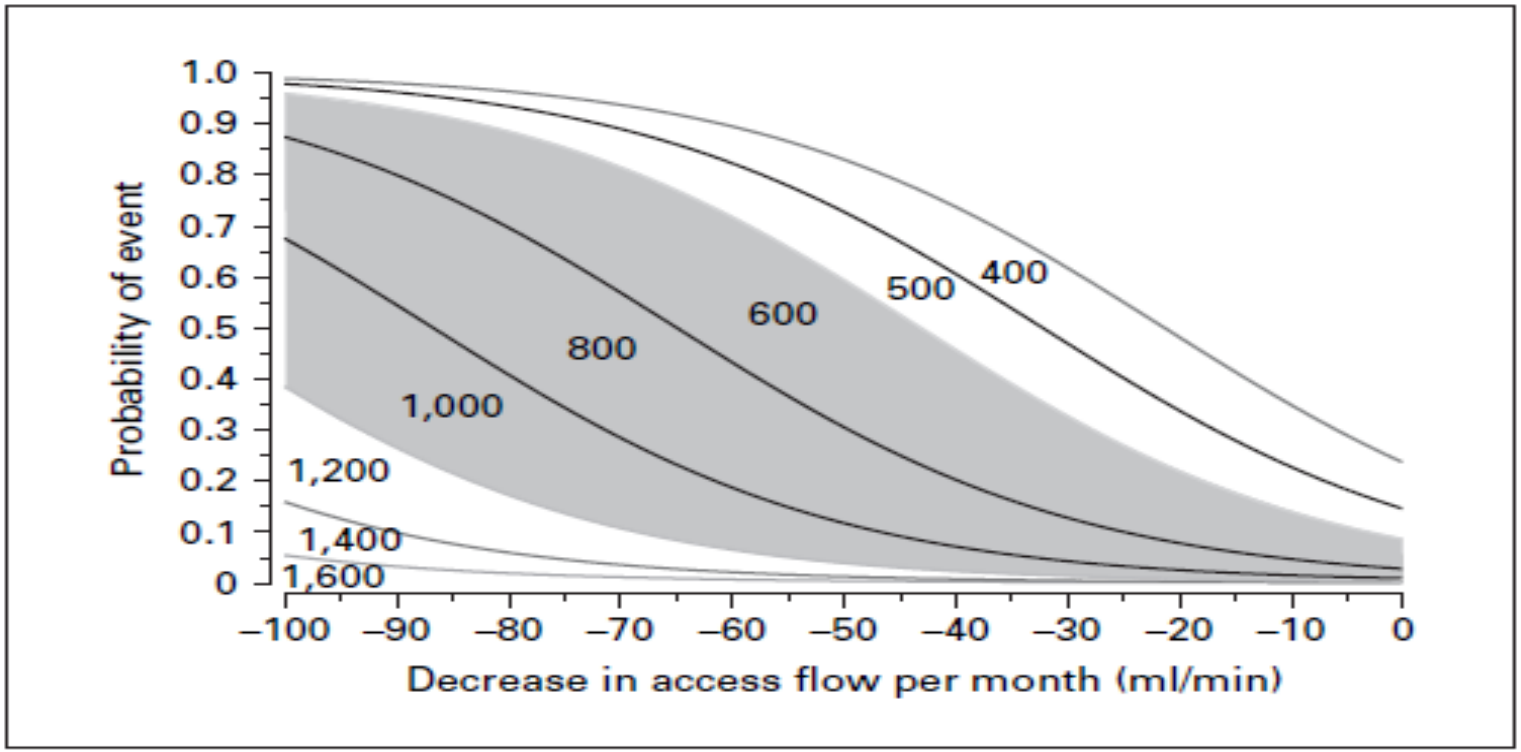


Fig. 7. Probability of a vascular access thrombosis occurring within a 3-month period is dependent not only on the absolute flow at any time but also on the rate if there is a change in flow.

Besarab Blood Purification 2006;24:77-89

Mechanism of access thrombosis

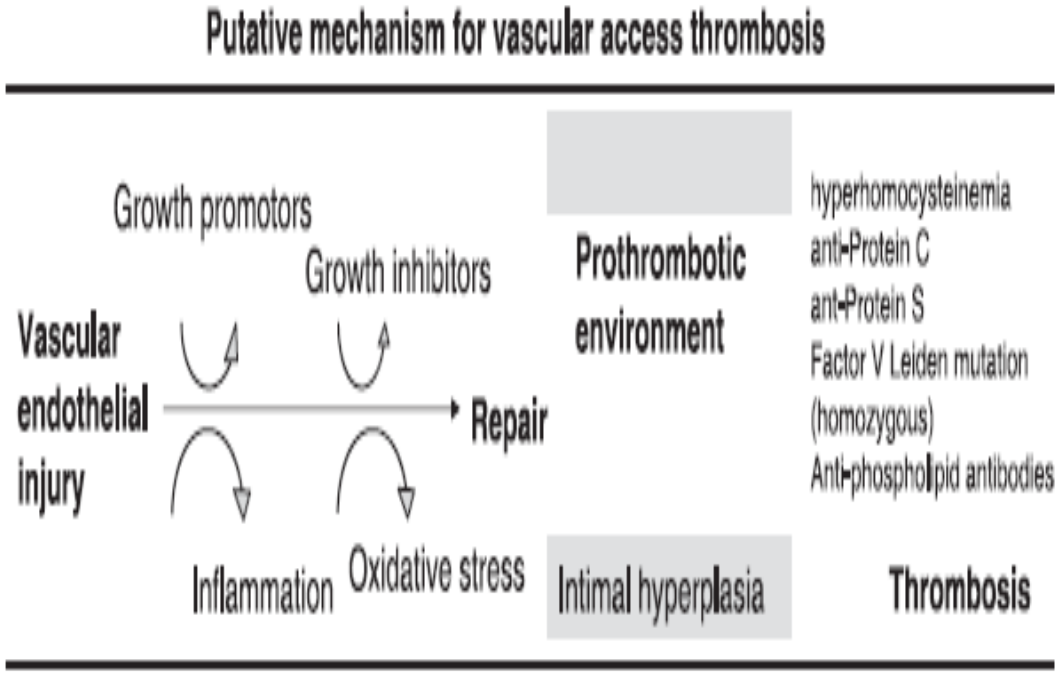


FIG. 1. Vascular endothelial injury incites growth promotors, growth inhibitors, inflammation, and oxidative stress during the process of repair and leads to vascular intimal hyperplasia. In the presence of thrombotic factors in patients with kidney failure, vascular access thrombosis can ensue.

Vascular Access Thrombosis prophylaxis , Choudhury, *Seminars in Dialysis*—Vol 19, No 4 (July–August) 2006 pp. 335–342

Signs to pick up secondary failure

- 1) Decreasing trend of blood flow
- 2) Increasing venous pressure

D Pagado et al “Surveillance policy for early detection of failing arteriovenous fistulae for haemodialysis” NDT 2002 Volume 9 , Issue 3

Ways to pick up early failing Fistula

- Periodical monitoring
  - Physical Examination- Look, Listen and Feel
  - Objective assessment- blood flow assessment- dilution method (Transonic)/ultrasonography.

When to refer??

- 1) Not maturing Fistula (Primary failure)– inflow/outflow problems
- 2) Suspected central vein stenosis
- 3) Failing fistula (getting more difficult to cannulate/ dropping Qb)- stenosis?

Primary Fistula Failure

Two Categories of problems

1) Inflow problems
2) Outflow problems

Poor Inflow Causing Early Failure

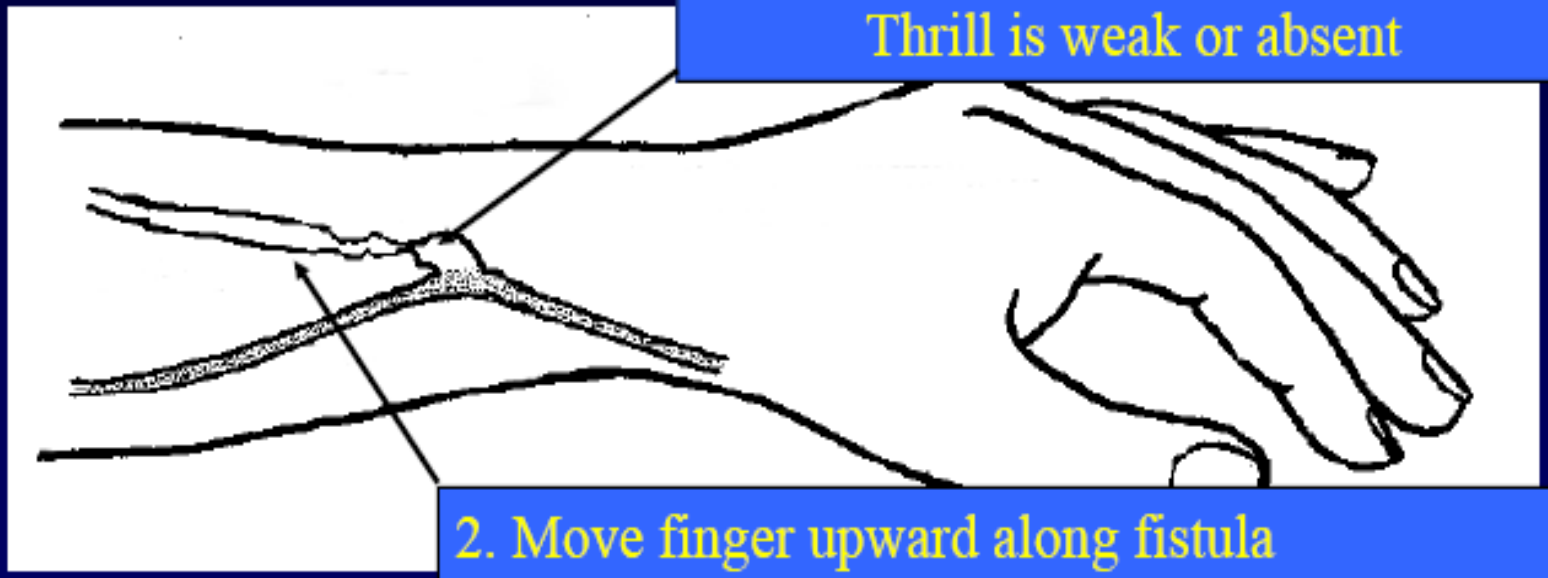
- Pre-existing arterial abnormalities
  - Anatomically small
  - Atherosclerotic
- Should be avoided by good pre-evaluation
- Frequent problem because pre-evaluation was not done

Poor Inflow Causing Early Failure

- Pre-existing arterial abnormalities
  - Anatomically small
  - Atherosclerotic
- **Acquired**
  - **Juxta-anastomotic stenosis**

Detection of Juxta-Anastomotic Stenosis

1. Palpate the arterial anastomosis
   - Pulse very forceful
   - Thrill is weak or absent



2. Move finger upward along fistula
   - Pulse disappears
   - Sudden decrease in caliber of vessel

Outflow Problems Causing Early Failure

- Small vein caliber
- Stenotic veins

- Should be avoided by pre-evaluation
- Frequent problem because pre-evaluation was not done

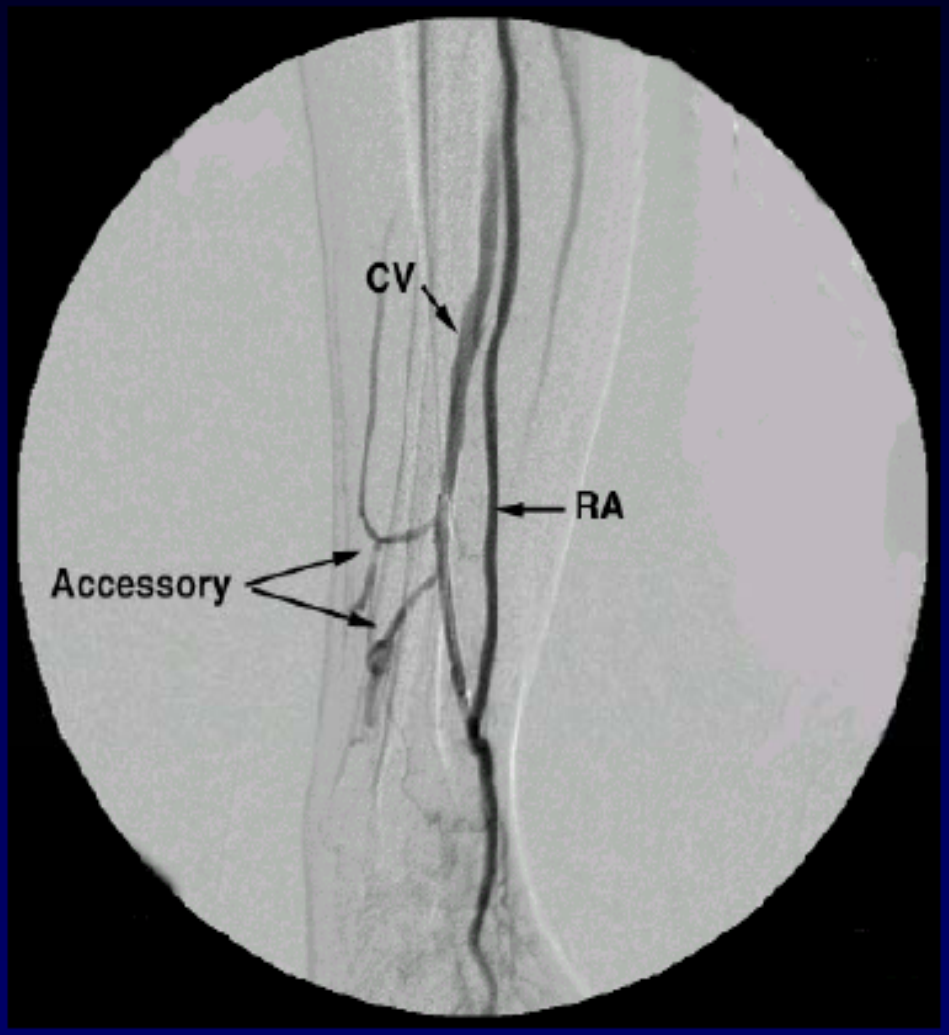
Outflow Problems Causing Early Failure

- Small vein caliber
- Fibrotic veins

Pre-evaluation

- **Accessory veins (side branches)**

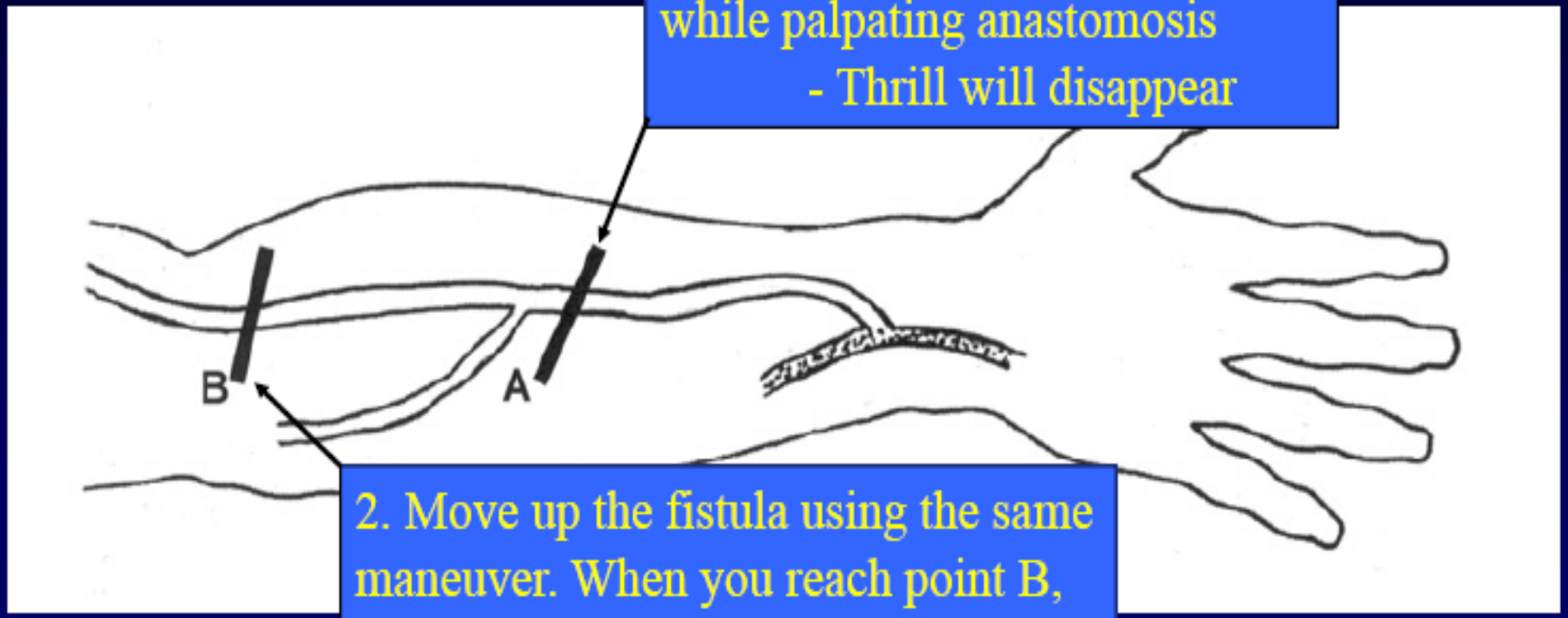
Accessory Veins



- Branches of cephalic
- Easily diagnosed by physical exam
- Often are not a problem
- Can cause development failure
  - Retarded maturation
  - Diversion of flow

Detection of Accessory Veins

1. Occlude fistula at point A while palpating anastomosis
   - Thrill will disappear



2. Move up the fistula using the same maneuver. When you reach point B, the thrill will return

Failing Fistula

- Assessment should be done.
- Likely to be due to stenotic lesion
- Intervene early to prevent thrombosis

THANK YOU

Resources

www.PassPACES.com/kidney.htm