# Vascular Access for Haemodialysis

Mike Stephens

# Overview

- Learning Objectives
- History and development of vascular access
- Standards in vascular access surgery
- Types of vascular access
- Complications

# Objectives of the Session

- Understand the different types of vascular access available for haemodialysis patients
- Know how to assess a patient for vascular access surgery
- Know how to consent a patient for vascular access procedures

# Development of Vascular Access Surgery

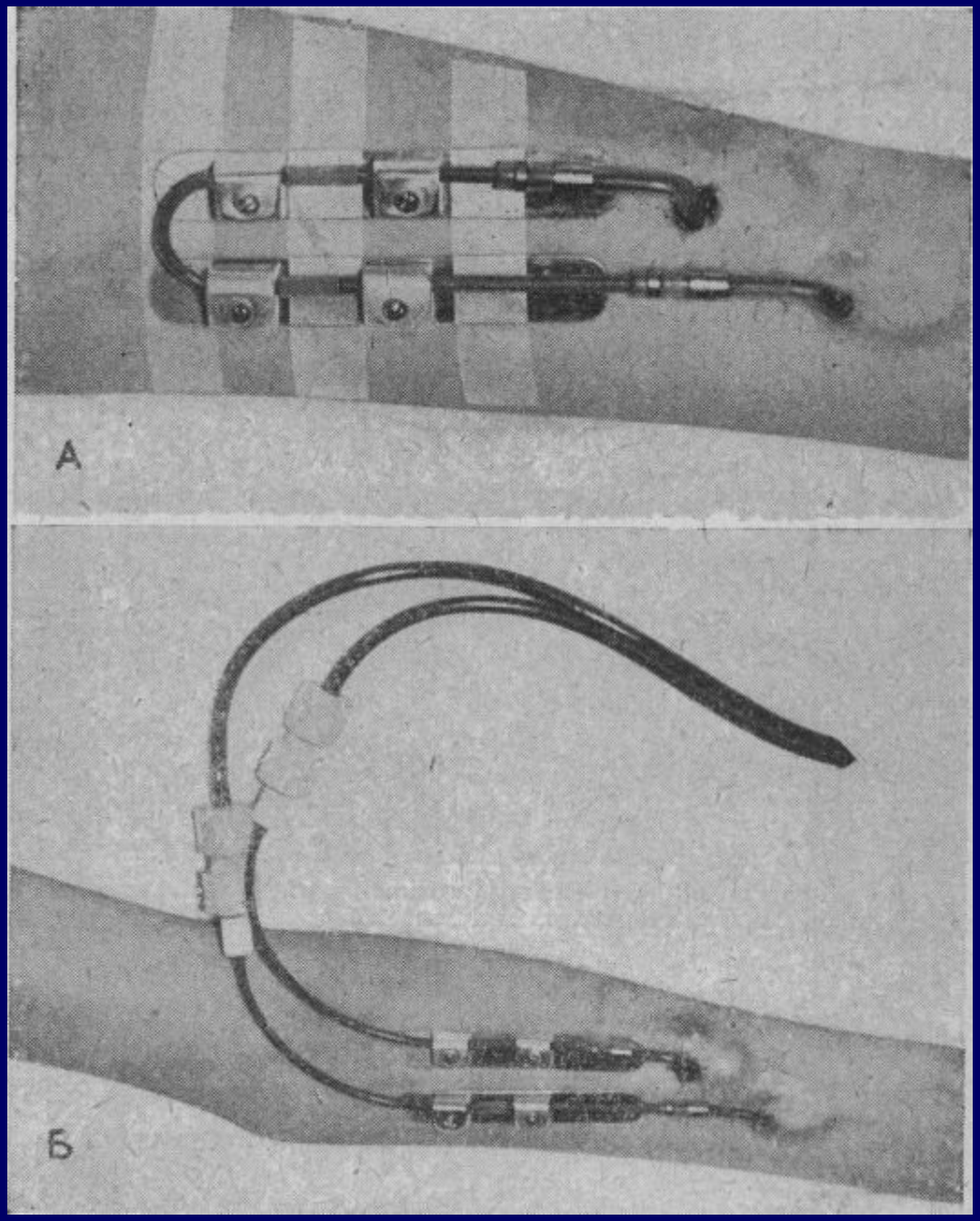
1657 Sir Christopher Wren invented an instrument for IV injections
1665 Lower reported the first transfusion between dogs
1667 Jean Denys performed the first successful transfusion into humans
1818 James Blundell performed the first trabsfusion of human blood
1901 Karl Landsteiner discovered ABO blood groups
1914 Richard Lewisohn introduced sodium citrate as anticoagulant
1937 Landsteiner and Weiner discovered the Rh factor
1913 Abel, Rowntree and Turner created an *artificial kidney*
1943 Kolff developed the first practical model for humans
1955 Kolff revised model (including 7 beer cans and a fruit juice can)
1960 Scribner, Dillard, Quinton devised a Teflon-Silastic AV shunt
1966 Brescia, Cimino, Appel and Hurwich described a subcutaneous AVF
1973 Indwelling right atrial catheter developed for TPN
1979 Hickman and colleagues reported their modification
1984 Bothe and colleagues described their *Port-a-Cath*

“…promptly jumped down from the table, and apparently oblivious of its hurts, soon began to fondle its master…..”

Lower, 1665

# Development of Vascular Access Surgery

1657 Sir Christopher Wren invented an instrument for IV injections
1665 Lower reported the first transfusion between dogs
1667 Jean Denys performed the first successful transfusion into humans
1818 James Blundell performed the first trabsfusion of human blood
1901 Karl Landsteiner discovered ABO blood groups
1914 Richard Lewisohn introduced sodium citrate as anticoagulant
1937 Landsteiner and Weiner discovered the Rh factor
1913 Abel, Rowntree and Turner created an *artificial kidney*
1943 Kolff developed the first practical model for humans
1955 Kolff revised model (including 7 beer cans and a fruit juice can)
1960 Scribner, Dillard, Quinton devised a Teflon-Silastic AV shunt
1966 Brescia, Cimino, Appel and Hurwich described a subcutaneous AVF
1973 Indwelling right atrial catheter developed for TPN
1979 Hickman and colleagues reported their modification
1984 Bothe and colleagues described their *Port-a-Cath*


А
Б

# Development of Vascular Access Surgery

1657 Sir Christopher Wren invented an instrument for IV injections
1665 Lower reported the first transfusion between dogs
1667 Jean Denys performed the first successful transfusion into humans
1818 James Blundell performed the first trabsfusion of human blood
1901 Karl Landsteiner discovered ABO blood groups
1914 Richard Lewisohn introduced sodium citrate as anticoagulant
1937 Landsteiner and Weiner discovered the Rh factor
1913 Abel, Rowntree and Turner created an *artificial kidney*
1943 Kolff developed the first practical model for humans
1955 Kolff revised model (including 7 beer cans and a fruit juice can)
1960 Scribner, Dillard, Quinton devised a Teflon-Silastic AV shunt
1966 Brescia, Cimino, Appel and Hurwich described a subcutaneous AVF
1973 Indwelling right atrial catheter developed for TPN
1979 Hickman and colleagues reported their modification
1984 Bothe and colleagues described their *Port-a-Cath*

# The Ideal Vascular Access

- Provide safe and effective therapy by enabling the removal and return of blood via an extracorporeal circuit
- Easy to use
- Reliable
- Minimal risk to the individual

# Options

# Options

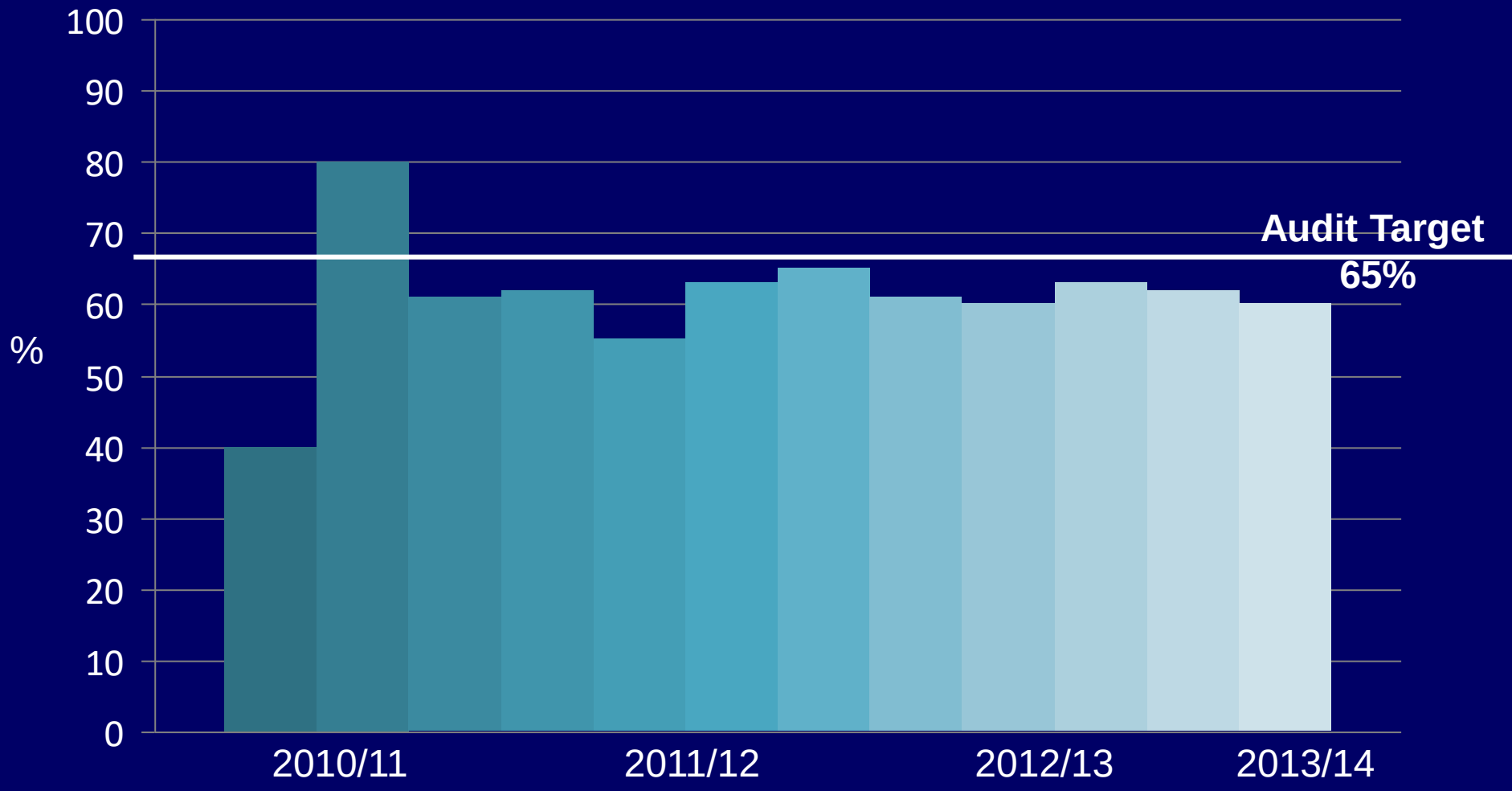
- Arteriovenous fistula
- Arteriovenous graft
- Tunnelled venous catheter
- Non-tunnelled venous catheter

# UK Renal Association Guidelines

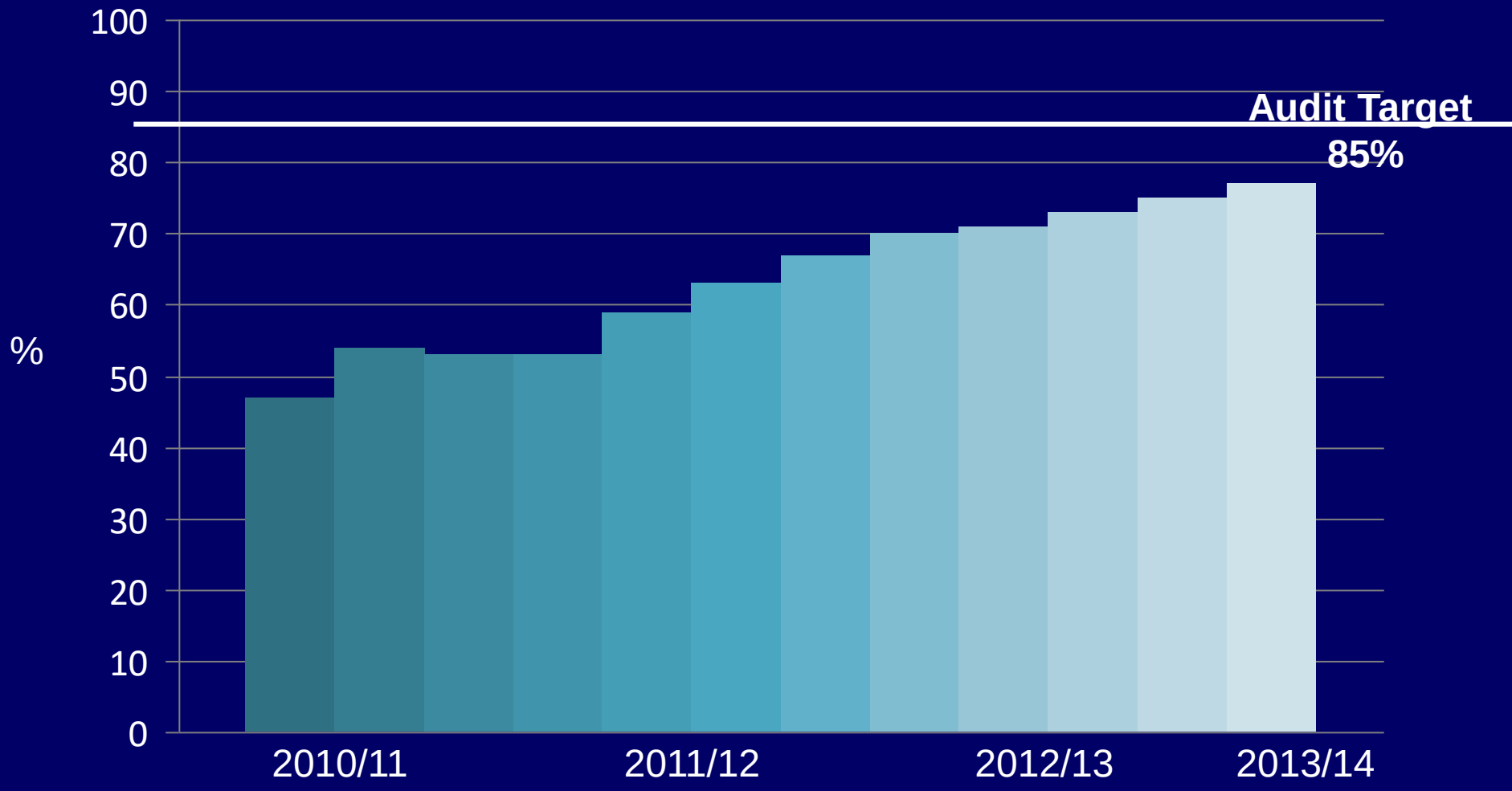
- 65% of incident HD patients should commence dialysis with an AV fistula
- 85% of prevalent HD patients should receive dialysis via a functioning fistula

Clinical Practice Guidelines 2011

# Incident patients Cardiff



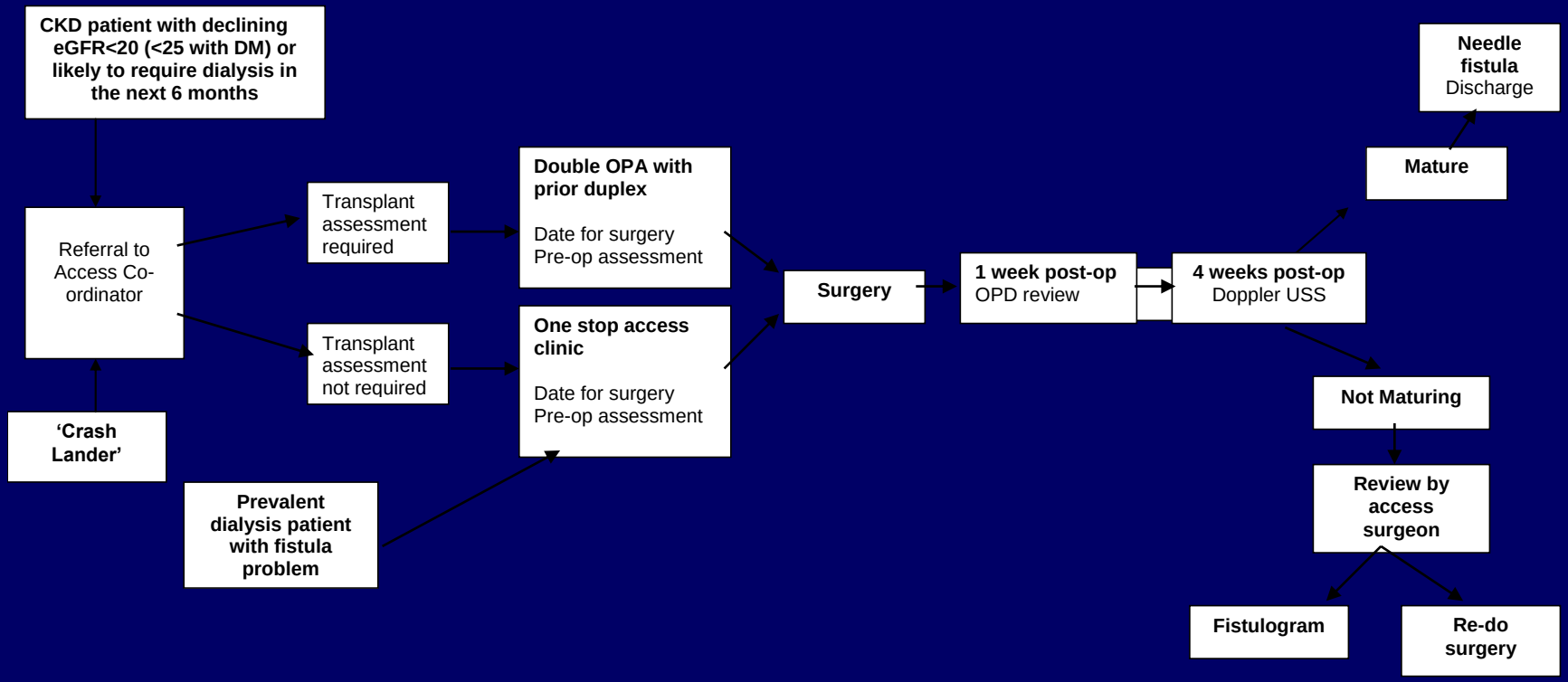
# Prevalent patients Cardiff



# When to start planning for Vascular Access

# When to start planning for Vascular Access

- When patients enter CKD stage 4
- Exact timing of placement will depend on rate of decline, co-morbidities, transplant options and type of access planned


CKD patient with declining eGFR<20 (<25 with DM) or likely to require dialysis in the next 6 months
Referral to Access Co-ordinator
'Crash Lander'
Transplant assessment required
Transplant assessment not required
Double OPA with prior duplex
Date for surgery
Pre-op assessment
One stop access clinic
Date for surgery
Pre-op assessment
Prevalent dialysis patient with fistula problem
Surgery
1 week post-op
OPD review
4 weeks post-op
Doppler USS
Mature
Needle fistula
Discharge
Not Maturing
Review by access surgeon
Fistulogram
Re-do surgery

# Vascular Access Clinic

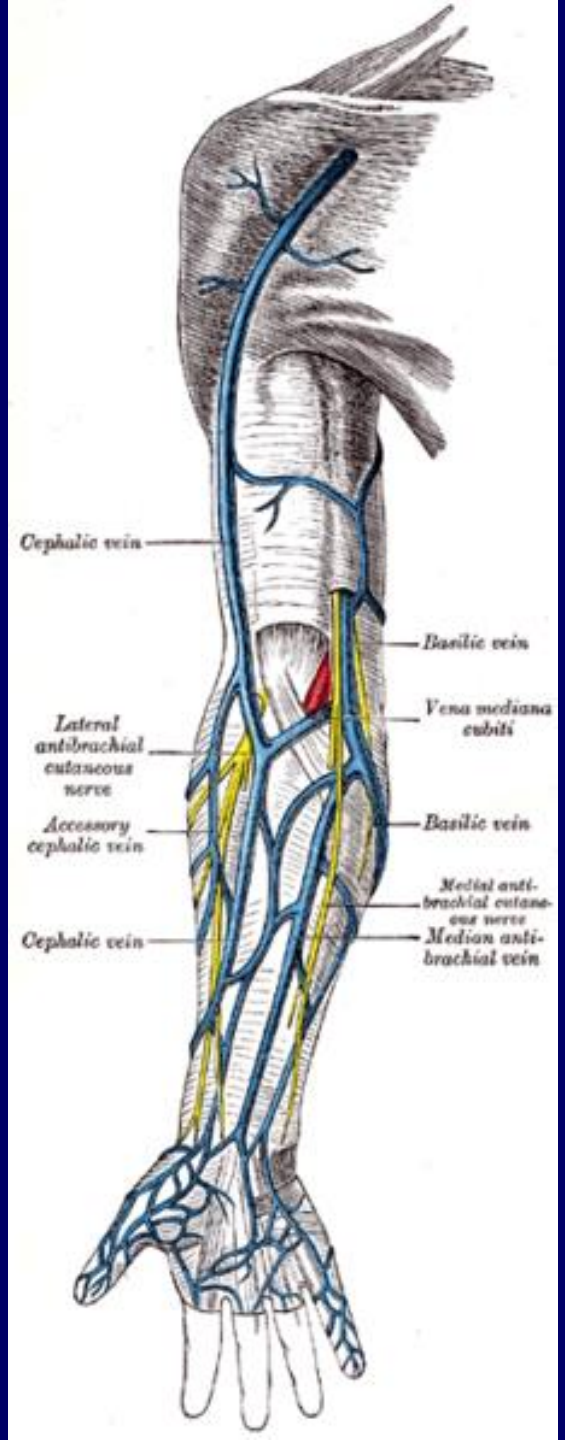
# Vascular Access Clinic

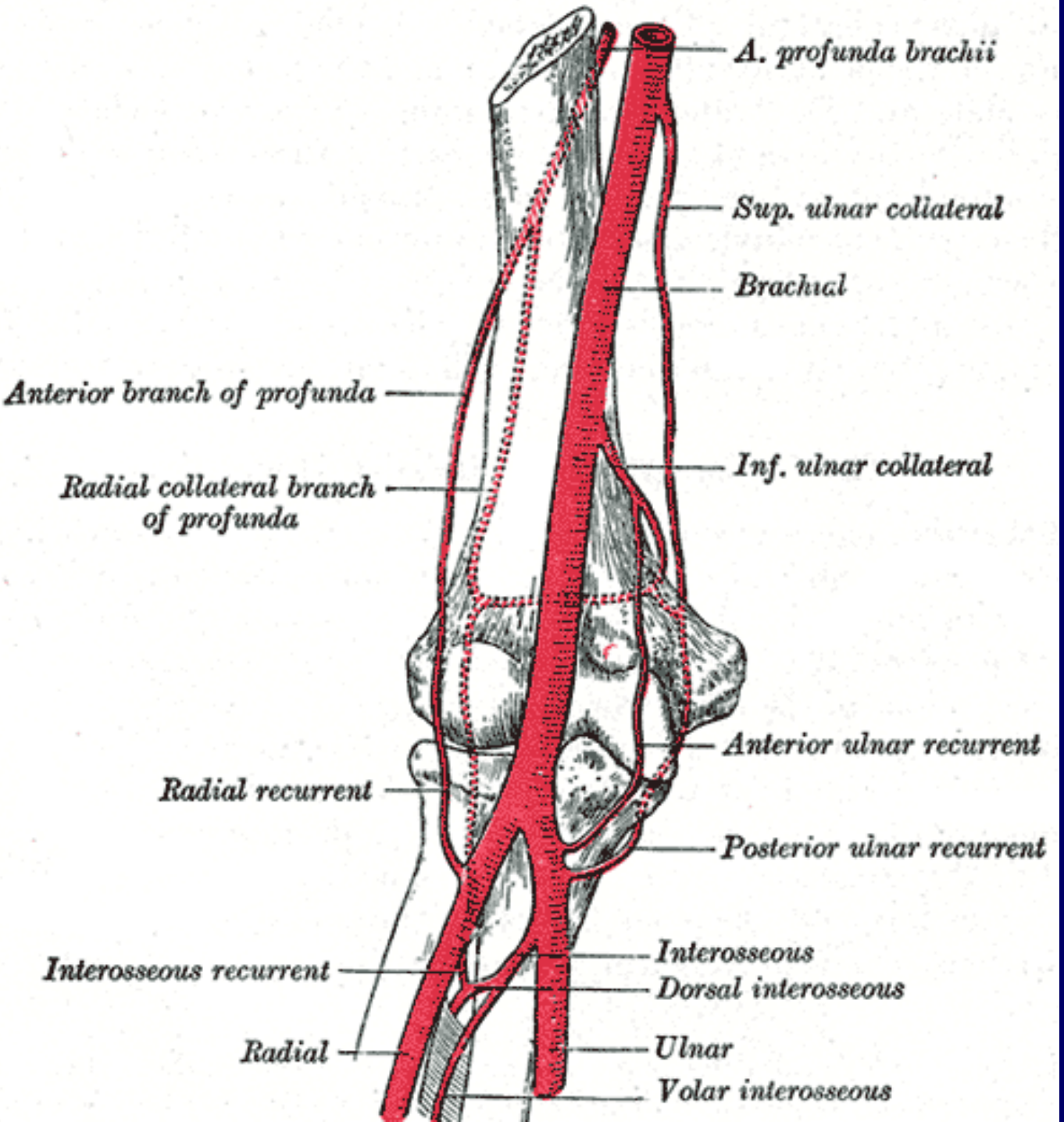
- General Health (DM/CVD/PVD)
- Medication history (anticoagulants/antiplatelets)
- Occupation
- Dominant Arm
- Superficial veins
- Allen’s test
- Doppler Ultrasound Scan
- Date for Surgery
- Pre-operative Assessment

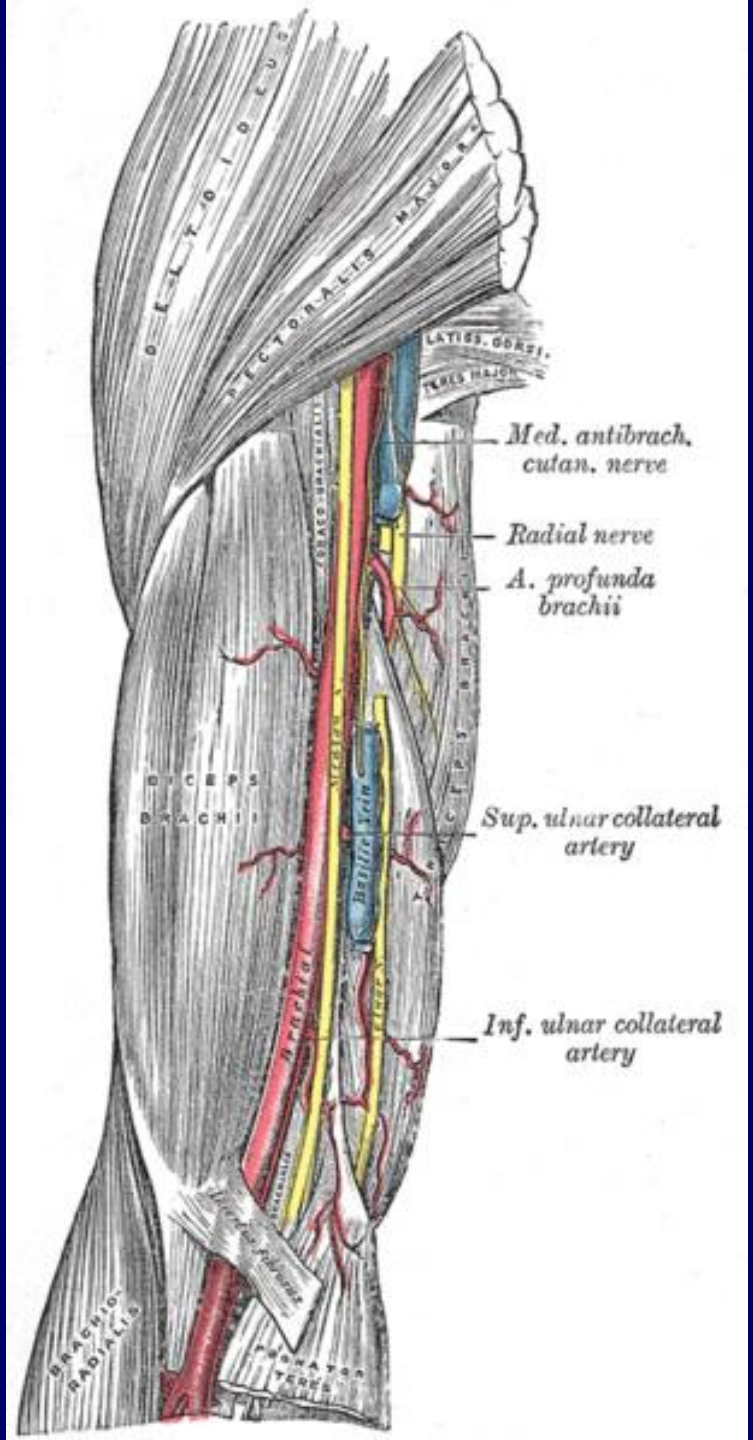
# Options for AV fistulae

# Options for AV fistulae

- Snuff-box fistula
- Radiocephalic fistula (wrist or forearm)
- Brachiocubital fistula
- Brachiocephalic fistula
- Brachiobasilic fistula
- Saphenous vein fistula


Cephalic vein
Basilic vein
Vena mediana cubiti
Lateral antibrachial cutaneous nerve
Accessory cephalic vein
Basilic vein
Medial antibrachial cutaneous nerve
Cephalic vein
Median antibrachial vein


A. profunda brachii
Sup. ulnar collateral
Brachial
Anterior branch of profunda
Inf. ulnar collateral
Radial collateral branch of profunda
Anterior ulnar recurrent
Radial recurrent
Posterior ulnar recurrent
Interosseous
Interosseous recurrent
Dorsal interosseous
Ulnar
Radial
Volar interosseous


DELTOIDEUS
PECTORALIS MAJOR
LATISS. DORSI.
TERES MAJOR
Med. antibrach. cutan. nerve
Radial nerve
A. profunda brachii
BICEPS BRACHII
Basilic vein
Sup. ulnar collateral artery
Brachial
Inf. ulnar collateral artery
BRACHIO-RADIALIS
PRONATOR TERES

# AV graft options

- Forearm straight graft
- Forearm loop graft
- Brachio-axillary graft
- Femoro-saphenous loop graft
- Femero-femoral loop graft
- Axillo-axillary graft

# Assessing maturation

- Clinical
- Doppler Ultrasound
  - Flow >600ml/min
  - Cannulation segment >10cm long or two 4cm segments
  - Outflow vein diameter >6mm
  - Cannulation segment <6mm from skin surface

# Complications of Vascular Access

# Thrombosis

- 1 year patency AVFs approx. 65%
- Many factors
  - small vessels
  - dehydration
  - hypotension
  - venous outflow obstruction
- Primary patency at 2 years:-
  - AVF 43%  AVG 31%
- Secondary patency at 2 years:-
  - AVF 64%  AVG 60%

# High Output Heart Failure

- Rapid flow changes immediately after construction
  - RC AVF 250ml/min
  - BC AVF 600ml/min
- Heart Failure relatively uncommon (surprisingly)
- Probably need 25%-50% cardiac output through fistula to result in failure
- Revision possible

# Venous Hypertension

- Rapid if central stenosis
- May be due to retrograde flow
- Treatment depends on exact cause
    - May get better
    - May need to ligate fistula
    - Consider venogram

# Aneurysms

- Pseudo-aneurysms
  - Needling sites
  - Infection
- True aneurysms
  - If skin threatened may bleed
  - Management depends on size/symptoms/skin

# Ischaemic Steal Syndrome

- Prevalence 10-20% (symptomatic), 4% requiring intervention
- More likely and more rapid with AVG
- Diagnosis clinical plus Doppler assessment
- Difficult to predict
- Operative treatments:-
  - Ligation
  - Banding
  - DRIL
  - RUDI

# Neuropathy

- Carpal tunnel syndrome-like symptoms
- Ischaemic Monomelic Neuropathy (Vascular Access Neuropathic Syndrome)

# Summary

- Vascular Access takes careful planning
- High failure rates but successful outcomes achievable
- Complications are common but usually manageable