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

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.
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

Anatomy of the Nerves, Arteries and Veins of the Arm (Upper Extremity)

- Cephalic v.
- Brachial a.
- Musculocutaneous n.
- Brachial v.
- Basilic v.
- Ulnar collateral a.
- Radial collateral a.
- Median n.
- Interosseous a.
- Interosseous v.
- Ulnar n.
- Ulnar a.
- Ulnar v.
- Radial n.
- Radial a.
- Radial v.

Artery (a.)
Vein (v.)
Nerve (n.)
Native Fistula

Radiocephalic fistula
Brachiocephalic fistula
Brachiobasilic fistula
Brachiocephalic Fistula

- Brachial artery
- Cephalic vein
- Fistula body

100% flow (from brachial artery)
25% flow (from brachial artery)
75% flow (into fistula body)
Brachiobasilic Fistula
Catheter
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

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)

- **ANZ**: 466 - 465
- **UK**: 432 - 524 - 349
- **Belgium**: 521 - 460
- **Sweden**: 533 - 534
- **Canada**: 572 - 512
- **US**: 3757 - 2157 - 1715

- **Catheters**
- **Grafts**
- **AVF**
**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)
### Table 11.1.1: Vascular Access on Haemodialysis, 2001-2010

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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

© 2009 Mosby, Inc. All rights reserved. doi:10.1016/j.surg.2008.11.003
### Table III. Main complications observed after construction of the 4 most common vascular access procedures

<table>
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<tr>
<th>Complication</th>
<th>RCAVF</th>
<th>BCAVF</th>
<th>BBAVF</th>
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<td>0.01</td>
<td>0.01</td>
<td>0.15</td>
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</table>

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 AV fistulae with fever and/or bacteraemia should be treated by appropriate antibiotics given intravenously for 2 weeks.
Infected graft AVFs should be treated by appropriate antibiotics given intravenously for 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.

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.
Mechanism of access thrombosis

Signs to pick up secondary failure

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