The hand becomes cold following a recent fistula creation

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Haemodialysis access-induced distal ischaemia (HAIDI):

- One of non-thrombotic hemodialysis access complication
- Storey et al was first described in 1969
  - Access-related hand ischemia or the steal syndrome
    - Creation of radial-cephalic autogenous access (i.e., Brescia-Cimino-Appel access)

Storey BG, et al. *Surgery* 1969.

Introduction

- Haemodialysis access-induced distal ischaemia (HAIDI):[1]
  - **Loss of access**
  - **Loss of limbs**
- 8% following creation of upper limb vascular access:[2,3]
  - **Cold painful hand** with neurological deficit to **distal gangrene** and **ulceration**

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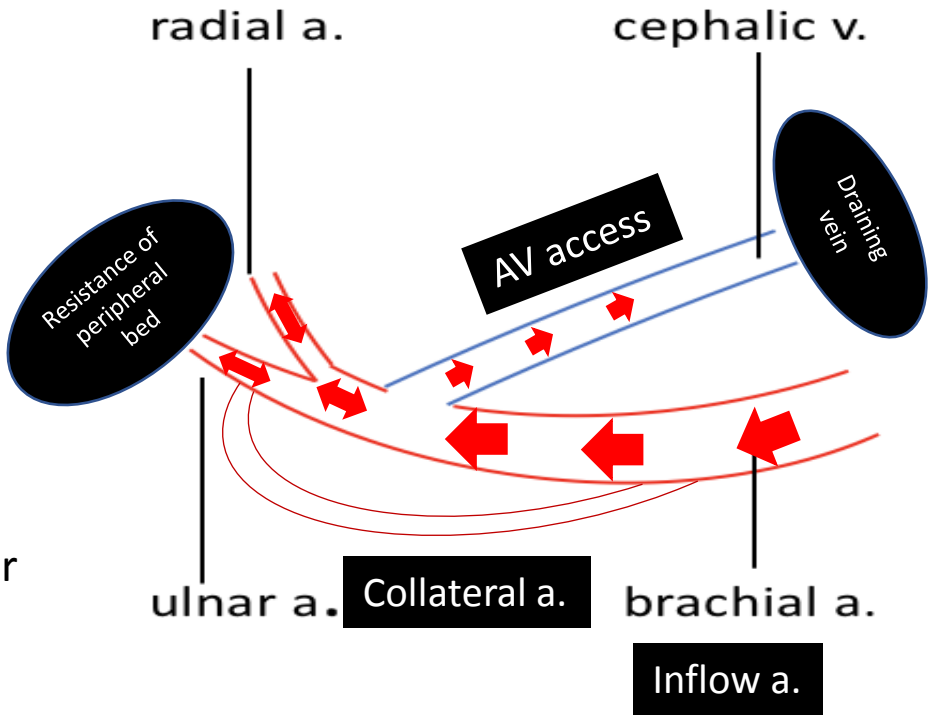
Physiologic changing of AV access

- Flow direction to anastomosis[1,2]
  - Proximal a. flow: antegrade flow
  - Distal a. flow: retrograde flow or bidirectional flow
  - Depend on
    1. Inflow artery
    2. Collateral arteries
    3. Arteriovenous access
    4. Draining vein
    5. Resistance of peripheral vascular bed (hand)
- Reversal of flow[2,3]
  - 73% autogenous A-V accesses
  - 91% of prosthetic A-V accesses



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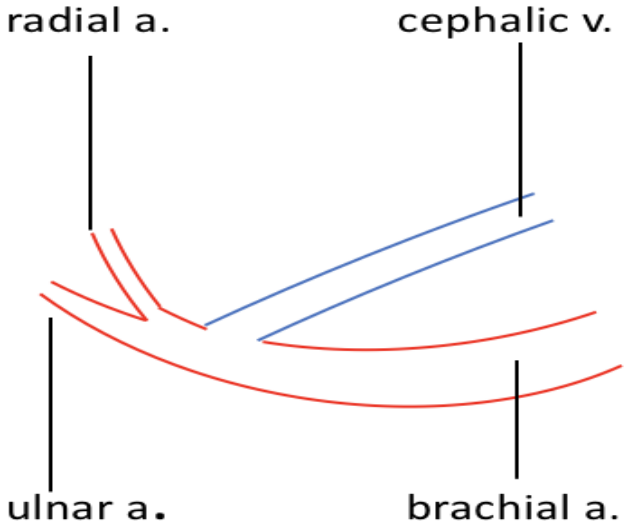
HAIDI

- Incidence is higher in **upper arm** arteriovenous fistulas and grafts than in **forearm** vascular access due to single arterial supply[1,2]

- Clinically significant steal syndrome[1-3]
  - 1% of wrist AVF
  - 3% of brachial a. base AVF
  - 9% of upper arm AVBG



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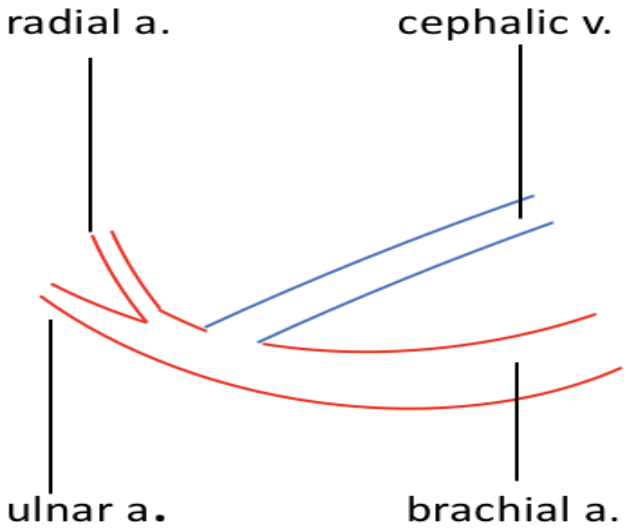
Classification

- Classification
  1. Low flow HAIDI
  2. High flow HAIDI



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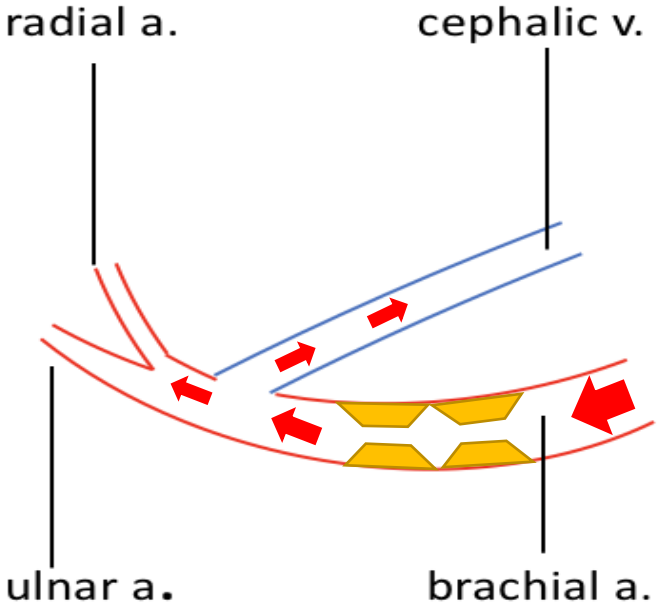
Etiology and Type

1. **Blood flow restriction** to the hand from ***arterial occlusive disease*** **proximal** or distal to the AV access anastomosis[1,2] **(Low flow HAIDI)**



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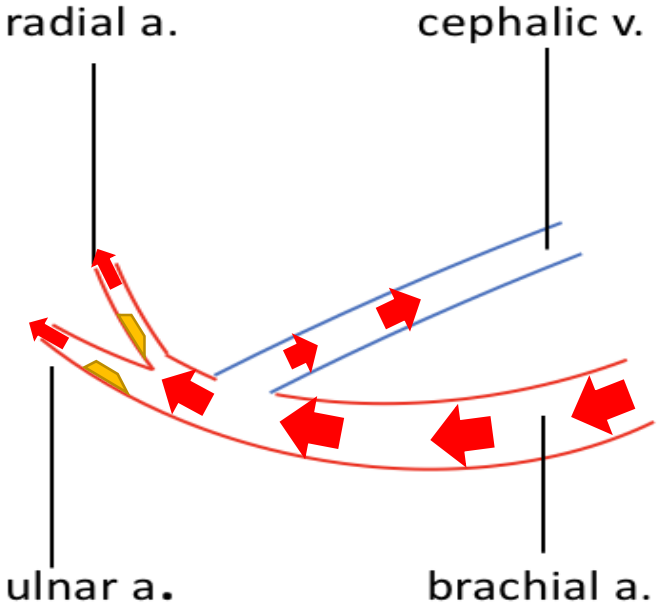

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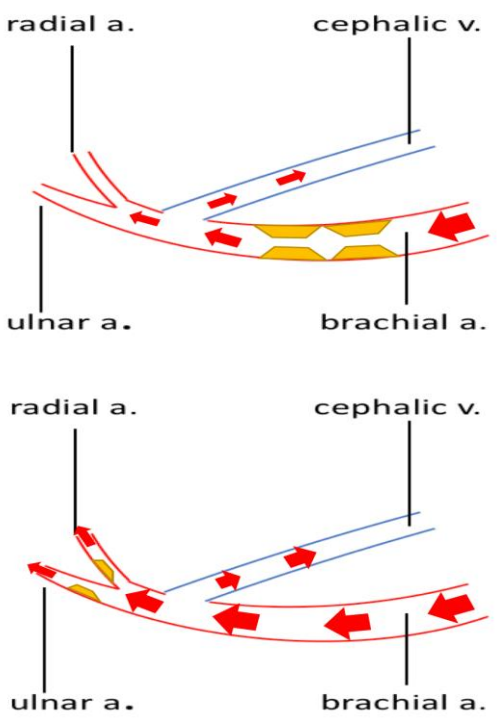

- With stenosis of inflow artery or distal artery, decreased flow to arm
  - Reduction of hand perfusion.

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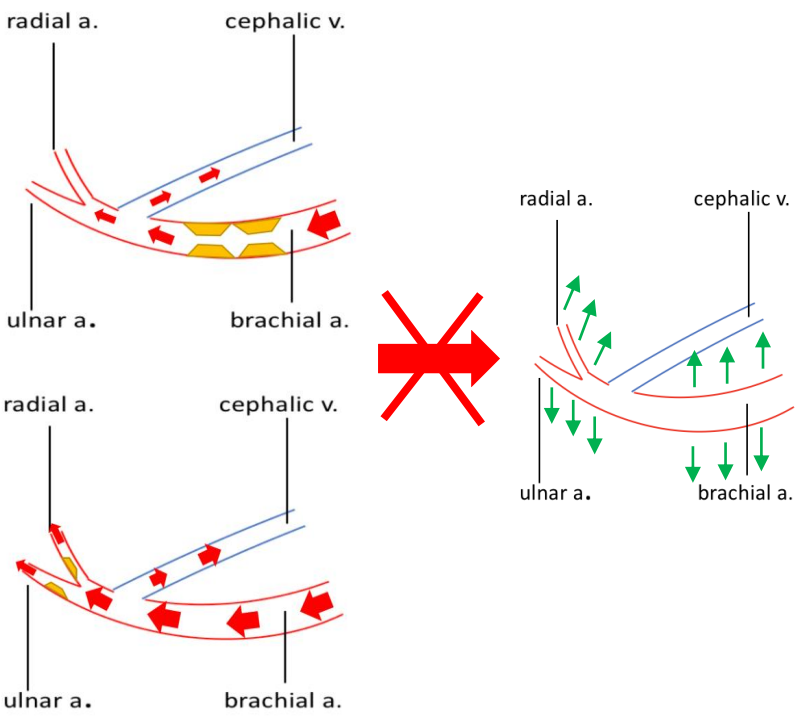
Etiology and Type

1. **Blood flow restriction** to the hand from ***arterial occlusive disease*** proximal or distal to the AV access anastomosis[1,2] **(Low flow)**

   - With diversion of blood from inflow artery, proximal stenosis prevent remodelling and adaptation of inflow
     - Reduction of hand perfusion.



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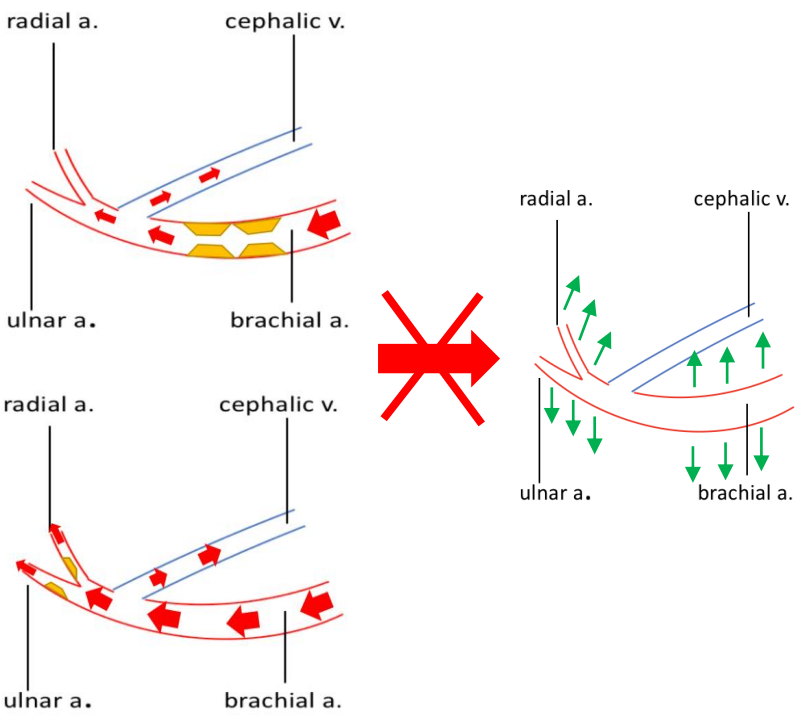
Etiology and Type

1. **Blood flow restriction** to the hand from ***arterial occlusive disease*** proximal or distal to the AV access anastomosis[1,2] **(Low flow)**

- **Lack of vascular (arterial) adaptation** or collateral flow reserve (i.e. atherosclerosis) to the increased flow demand from the AV access.



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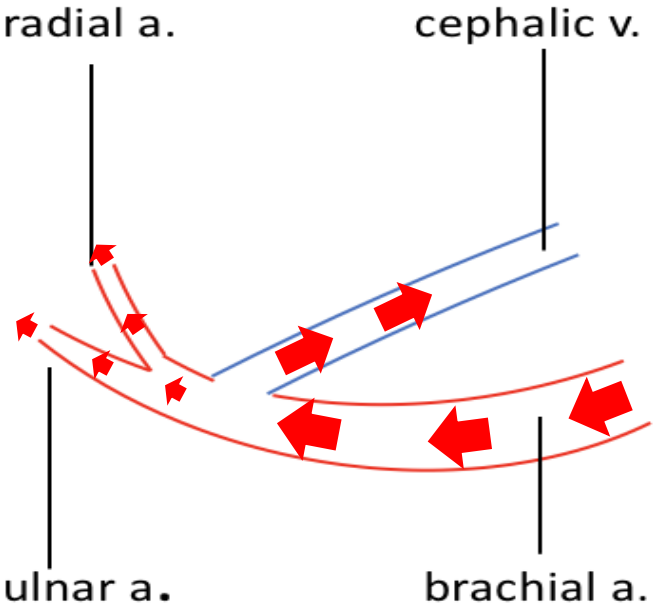
Etiology and Type

2. Excess blood flow through the AV fistula (true steal)[1-3]

(High flow HAIDI)

- Arterial inflow not compromised
  - Actually may be high (high flow)
- High volume of flow into low resistance system of dilated venous system results



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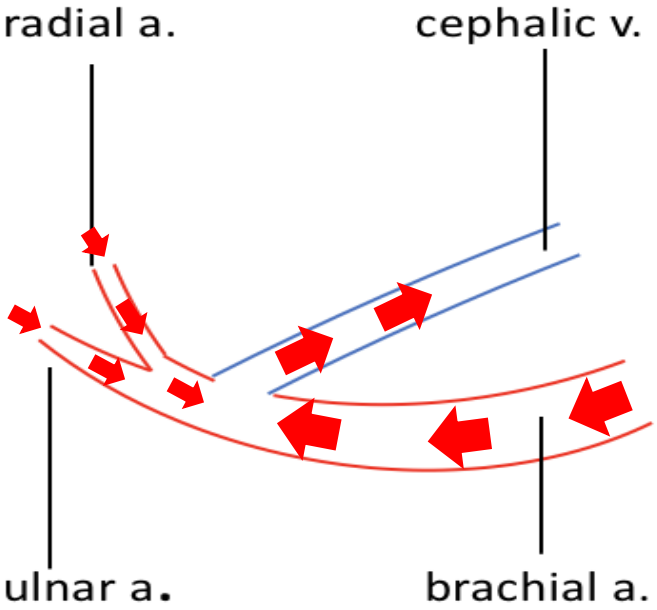
Etiology

2. Excess blood flow through the AV fistula (true steal)[1-3]

(High flow HAIDI)

- Reversal of flow direct on in distal arteries with subsequent negative pressure effects on tissue perfusion in the hand.[2,3]
- Relative hand ischemia



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Risk factor

- Old age (> 60 years old)
- Atherosclerosis
  - Smoking
  - Diabetes mellitus
- Female gender
- Cardiovascular comorbidity
- Anastomosis size > 4 mm

- Poor skin status
- Previous amputations
- Past hand ischemia

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Clinical presentation

- Extremity coolness
- Pale to whitish or cyanotic fingernail beds
- Rest pain
- Sensory and motor function deficit
  - Muscle weakness
  - Tingling and numbness in hand and fingers
- Nail changes
- Fingertip ulcerations
- Tissue loss

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Vascular examination

- Diminished or absent radial and ulnar pulses
- Alleviated symptom and sign by compressing AV access

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Onset of Steal syndrome

- **Acute steal symptoms**
  - pain, pallor, paresthesia, poikilothermia, paralysis
  - tingling and numbness

- **Chronic steal**
  - Sing and symptom of chronic ischemic change
    - nail changes
    - dry ulcerations
    - tissue loss

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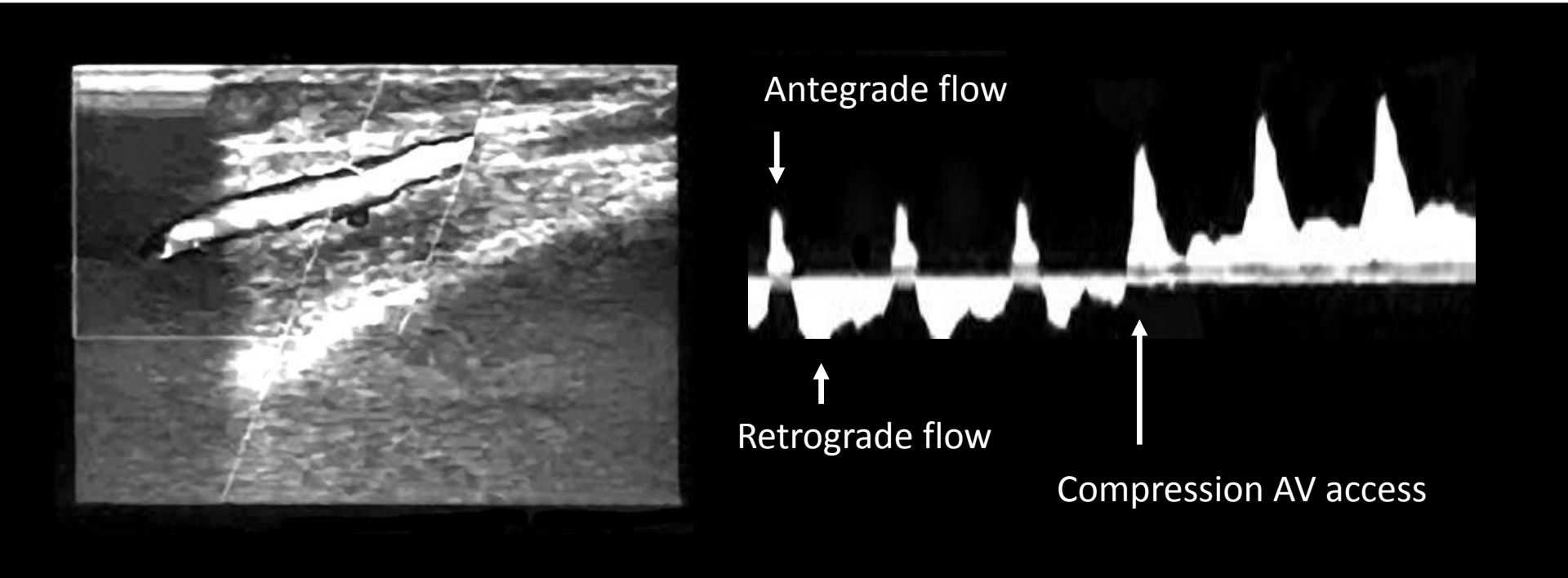
Diagnostic study

- **Duplex ultrasound (DUS)**
  - Diastolic retrograde blood flow in distal artery
    - Retrograde waveform with minimal antegrade waveform
    - Compression fistula: changes flow from retrograde to antegrade.



Diagnostic study

- Blood flow measurement by ultrasound
  - Straight segment
  - > 5 cm away from abnormal flow:
    - aneurysms, stenosis, anastomosis area

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Diagnostic study

- **Finger pressure**
  - Thumb systolic pressure < 50 mmHg
  - Digital/brachial artery index (DBI) of <0.60

- **Systolic pressure index**
  - Post AV access creation forearm systolic pressure / contralateral forearm pressure
  - Systolic pressure index < 0.5

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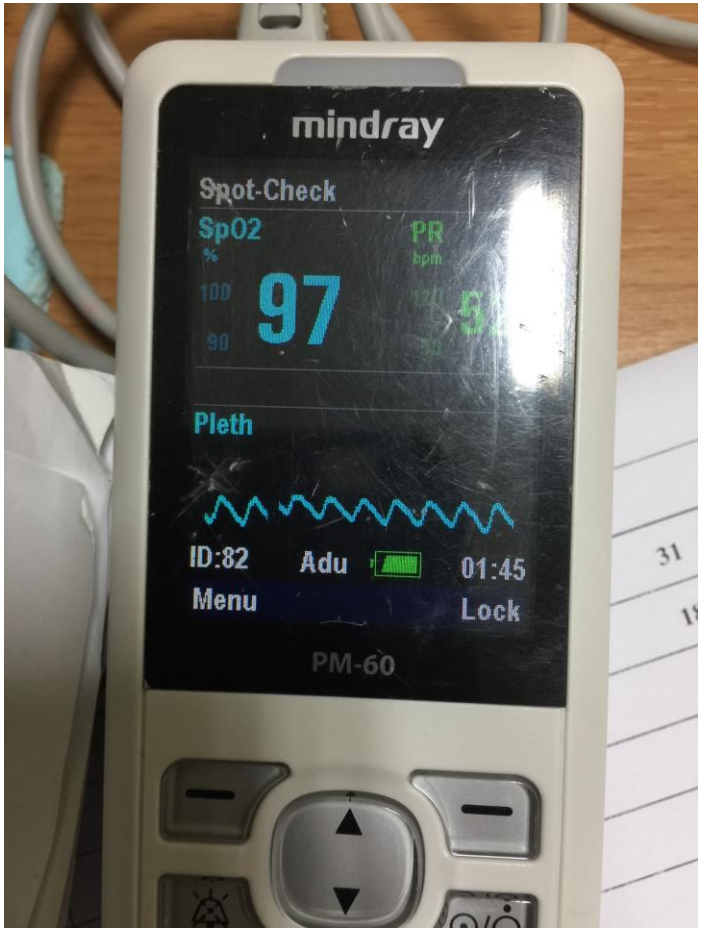
Diagnostic study

- **Pulse oximeter**
  - Finger pulse oximeter
    - Waveform
    - O_2 saturation



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Haemodialysis access-induced distal ischaemia (HAIDI) severity

- **Stage I:** Retrograde diastolic flow without complaints; steal phenomenon
  - **Conservative**
- **Stage II:** Pain on exertion and/or during haemodialysis

  IIa: tolerable during HD/Exercise: **Conservative**

  IIb: intolerable during HD/Exercise: **Surgery**: improve QoL

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Haemodialysis access-induced distal ischaemia (HAIDI) severity

- **Stage III:** Pain at rest
  - **Surgery**: Pain and Risk of tissue loss
- **Stage IV:**

  Ulceration/necrosis/gangrene

  IVa: limited tissue loss: potential for preservation of function

  IVb: irreversible tissue loss: significant loss of function
  - **Surgery**: Tissue loss and Risk of limb loss

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Management

- The goals for treating steal syndrome:
  1. Restoration of antegrade flow sufficient to maintain distal perfusion
  2. Maintenance of AV access for dialysis.

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Management

1. Non-operative management
   - Conservative management
2. Surgery
   - Ligation
   - Banding
   - DRAL (Distal Radial Artery Ligation)
   - DRIL (Distal Revascularization Interval Ligation)
   - PAI (Proximal Arterial Inflow)
   - RUDI (Revision Using Distal Inflow)

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Conservative management

- HAIDI: Stage I and II a
  - Watched with the expectation
  - The most resolve within a few weeks or at least not progress
  - Follow-up on a frequent basis
    - worsening of symptoms can occur quickly
    - result in permanent injury, such as muscle atrophy.
- **Exercise**
  - Steal exercise with hand fists over a softball
  - Lifting weights: 2.5-5 lbs.
- **Blood pressure medication modification** on dialysis day
  - (if pain on HD presented)
- **Lifestyle improvement**
  - Smoking cessation

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Surgery

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Management guideline and Surgical technique

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ORIGINAL ARTICLE

Surgical techniques for haemodialysis access-induced distal ischaemia

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THANK YOU

FOR YOUR ATTENTION

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