DEFINITION
Clinical condition caused by arterial insufficiency distal to a hemodialysis A-V fistula or graft due to diversion of blood into the fistula or graft

- usually associated with reversal of distal flow without adequate collateral circulation
- incidence conservatively estimated at 3-5%
- ischemia a spectrum with only altered sensation at one end & Steal Syndrome or IMN at the other
- can progress to irreversible neuropathy, loss of function (claw hand), gangrene, digit loss, limb loss.

Dialysis Access-Induced Ischemia /Steal Syndrome

Steal Syndrome is characterized by:
- Hand pain
- Diminished/altered sensation (numbness, paresthesias)
- Pale, cold hand
- Diminished or absent pulses
- Poor capillary filling
- Weakness

Ischemia /Steal: Prevention & Peri-operative Considerations

Pre-op assessment:
1. History/Risk factors: Diabetes, PVD, other
2. Physical Exam: Pulses, bilateral BP, Allen’s test, Doppler

Intra-operative:
1. Location & size of arterial anastomosis
2. Attention to pre-op and intra-op. pulses
3. In high-risk pts., consider intra-op. flow measurement, digital pressures, pulse oximetry

Post-op (acute cases):
1. Immediate attention to symptoms/signs of ischemia
2. Confirm ischemia due to “steal” vs. acute occlusion by compressing fistula--if questionable arteriogram/PTA prn
3. If significant steal/IMN → immediate surgical intervention
**Dialysis Access-Induced Ischemia / Steal Syndrome**

**Treatment Options:** Challenge of preserving the access while reversing the ischemia

1. Sacrifice of access (for severe ischemia, failed remedial surgery or IMN)
2. Distal radial artery ligation (not recommended)
3. Revision to PRA or other branch artery
4. PTA of arterial stenosis

5. Access flow-reduction procedure, i.e. "banding"

6. Distal re-vascularization of extremity (DRIL)

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**Surgical Approach** should be based on:
- Patient’s clinical condition
- Confirmation of “steal”
- Existing Access Flow

**Surgical Option** chosen should be based on maintaining adequate access flow while reversing the ischemia

**How much access flow is needed?** Enough to:
- Meet the prescribed dialysis pump flow rate (400-500 ml/min)
- Maintain access patency (grafts require >600-800 ml/min to remain patent / AVFs remain patent at very low flows)

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**Surgical Approach: One Surgeon’s Perspective**

In acute case of clear limb threat/IMN: sacrifice fistula—in less severe acute or chronic cases: may need arterial study to rule out anatomic occlusion, then attempt to measure access flow before choosing surgical option. Access flow should dictate surgical option:

1. If low-normal access flow: re-vascularization procedure (DRIL)
2. If high access flow: flow-limiting ("banding") revision first
3. If cannot ascertain flow and no immediate limb threat: consider flow-limiting procedure first, with re-vascularization and sacrifice as remaining options.

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**Hand ischemia / steal related to high-flow fistula**

(confirmed by indicator dilution flow study during dialysis or Doppler exam when not dialyzing)

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**Hand ischemia / steal related to high-flow fistula**

(assessed using ultrasound saline dilution technique [Transonic Systems, Ithaca NY])

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**Recommended initial treatment** is a simple flow-limiting revision to restore flow to extremity by limiting fistula flow

Clamp & sterile stethoscope (or flow probe) used to identify maximum reduction in size of anastomosis while maintaining adequate access flow—followed by placement of running suture
Hand ischemia / Steal in patient with upper arm fistula: failure to treat promptly and effectively resulted in amputation of digit and loss of hand function. Flow study revealed low access flow.

Hand ischemia related to low-flow fistula

Access flow measured by Indicator dilution technique (ultrasound saline dilution) [Transonic Systems, Ithaca NY]

Distal Revascularization-Interval Ligation (DRIL) Procedure
- to restore distal extremity flow without reducing access flow

1. Vein bypass of arterial anastomosis of access
2. Ligation of artery distal to arterial anastomosis of access

Dialysis Access-Induced Ischemia

Ischemic Monomelic Neuropathy (IMN)
- Devastating, usually irreversible ischemic injury confined to nerves of forearm following access placement
- Neurologic dysfunction/injury out of proportion to any ischemia that might be present
- Immediate onset, soft tissues spared, usually good perfusion
- Usually in diabetics, most with longstanding neuropathy
- Reported cases associated with brachial artery constructions

Ischemic Monomelic Neuropathy (IMN)—Cont’d
- Severe distal pain & sensory loss, weakness/paralysis of muscles innervated by all 3 forearm nerves
- Diagnosis usually missed/delayed
- Requires immediate recognition and treatment. If question, arteriogram to r/o acute occlusion; nerve conduction studies; EMG
- Treatment: Immediate sacrifice of access

Ischemic injury confined to the forearm nerves; no ischemic tissue loss or compromise; perfusion usually good.
Dialysis Access-Induced Ischemia /Steal Syndrome

SUMMARY I

- Pay special attention to the diabetic with neuropathy
- Immediate evaluation if post-op hand pain / other evidence of significant ischemia
- Recognition of symptoms & signs of steal syndrome and IMN
- Diagnosis almost always can be made on clinical features & non-invasive studies
- Consider arterial stenosis as common contributing factor to ischemia

SUMMARY II

- Consideration of surgical treatment options for ischemia should take into account providing adequate access flow for a functional access
- Main treatment options for steal syndrome/ ischemia are 1) flow-reduction procedure, or 2) distal re-vascularization (DRIL)—depending on level of pre-op access flow
- Immediate sacrifice of access for IMN
- Following remedial surgery, aggressive physical therapy for sequelae of severe ischemia & IMN

Dialysis Access-Induced Ischemia

Ischemic Monomelic Neuropathy (IMN)

A single-center, retrospective study by Raheb et al:

- 12 IMN patients: elderly, diabetic, female, most with neuropathy
- all had Brachial artery constructions
- symptoms & signs presented immediately post-op in all 12
- all 12 had severe pain, paresthesias, poor wrist flexion & extension, poor movement of intrinsic hand muscles

- only 4/12 had evidence of mild-to-moderate steal with diminished radial pulse
- no tissue compromise or loss
- delayed diagnosis & treatment in all 12 (4 d.-4 mos.)/ only 1 recovery
- diagnosis made on clinical grounds alone in 8/12; remaining 4 had additional tests to confirm nerve injury

Don’t let the sun set on a steal syndrome