VASA 2026

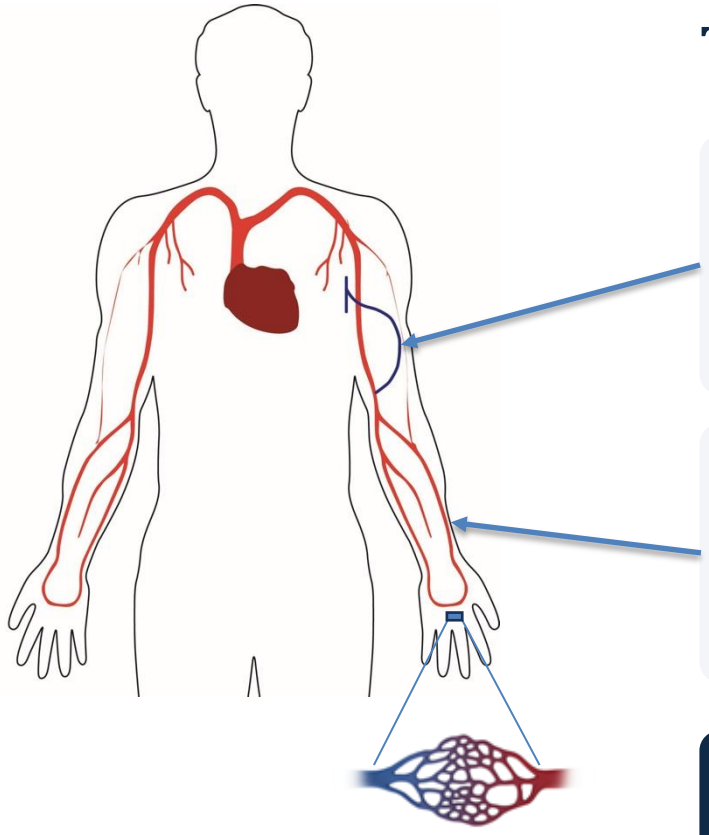
Management of Hemodialysis Access Induced Distal Ischemia (HAIDI)

Yael Vin, MD, MPH, FACS

MAY 21, 2026

Hemodynamic Effects of Access Creation

Local and systemic adaptations preserve perfusion in most patients



The proximal artery supports two systems

1 **High-flow, low-pressure system**

The arteriovenous access

2 **Low-flow, high-pressure system**

Distal arterial system → distal perfusion

Most patients remain asymptomatic

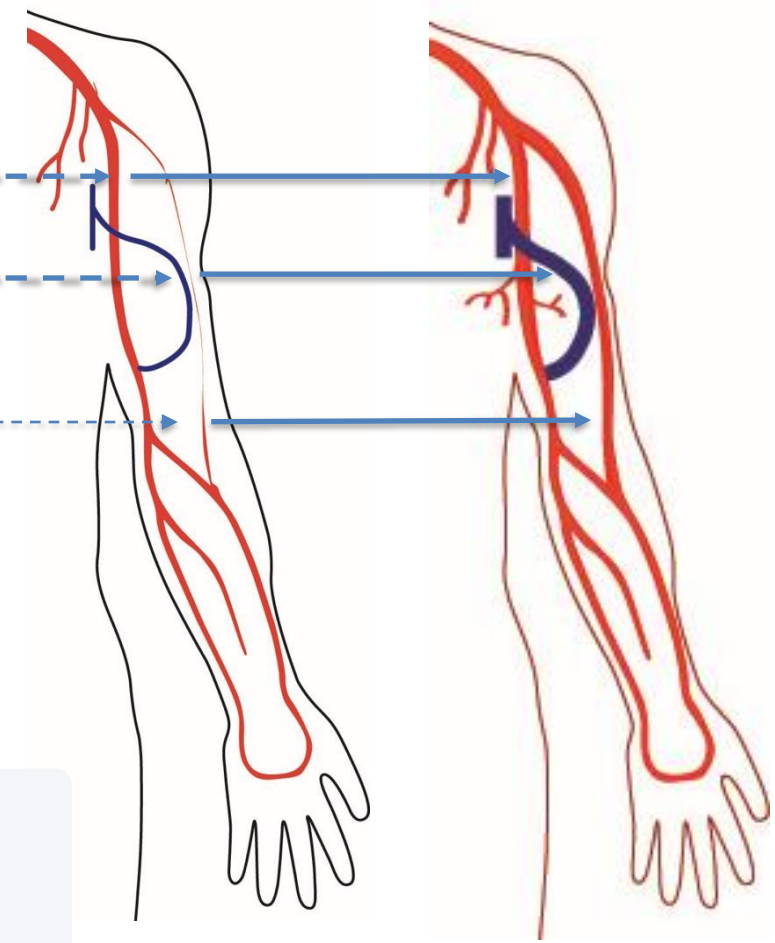
Between local and systemic adaptations, perfusion pressure is maintained.

Remodeling After Access Creation

Vascular adaptations that allow access maturation while preserving distal perfusion

Coordinated changes

- **Proximal artery**
  Increases in size and flow
- **Fistula**
  Increases in size and flow
  Walls thicken
- **Collaterals**
  Develop and increase in flow



GOAL

Allow access maturation while maintaining distal circulation

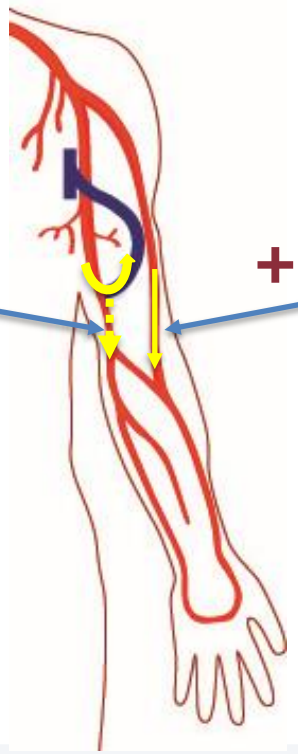
The Steal Phenomenon

Why ‘steal’ occurs

TERM 1

Low pressure distal to anastomosis

Access acts as a pressure sink



+

TERM 2

High pressure collaterals

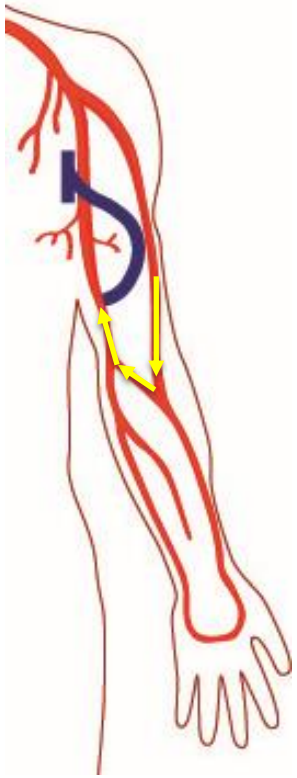
Compensatory recruitment

=

RESULT

Reversal of flow

(‘Steal’)



PREVALENCE

70–90% of accesses demonstrate

Partial (diastolic) or complete (systolic + diastolic) reversal of distal flow

HEMODYNAMICS

Steal Is Not Ischemia

Physiologic steal does not predict or indicate distal ischemia

DEMONSTRATE STEAL

70–90%

Of all accesses

Show partial or complete reversal of distal flow on imaging.

PRESENT WITH HAIDI

1–8%

Of all accesses

Develop clinical signs of ischemia —
Some without steal
Severity of steal does not correlate with symptoms

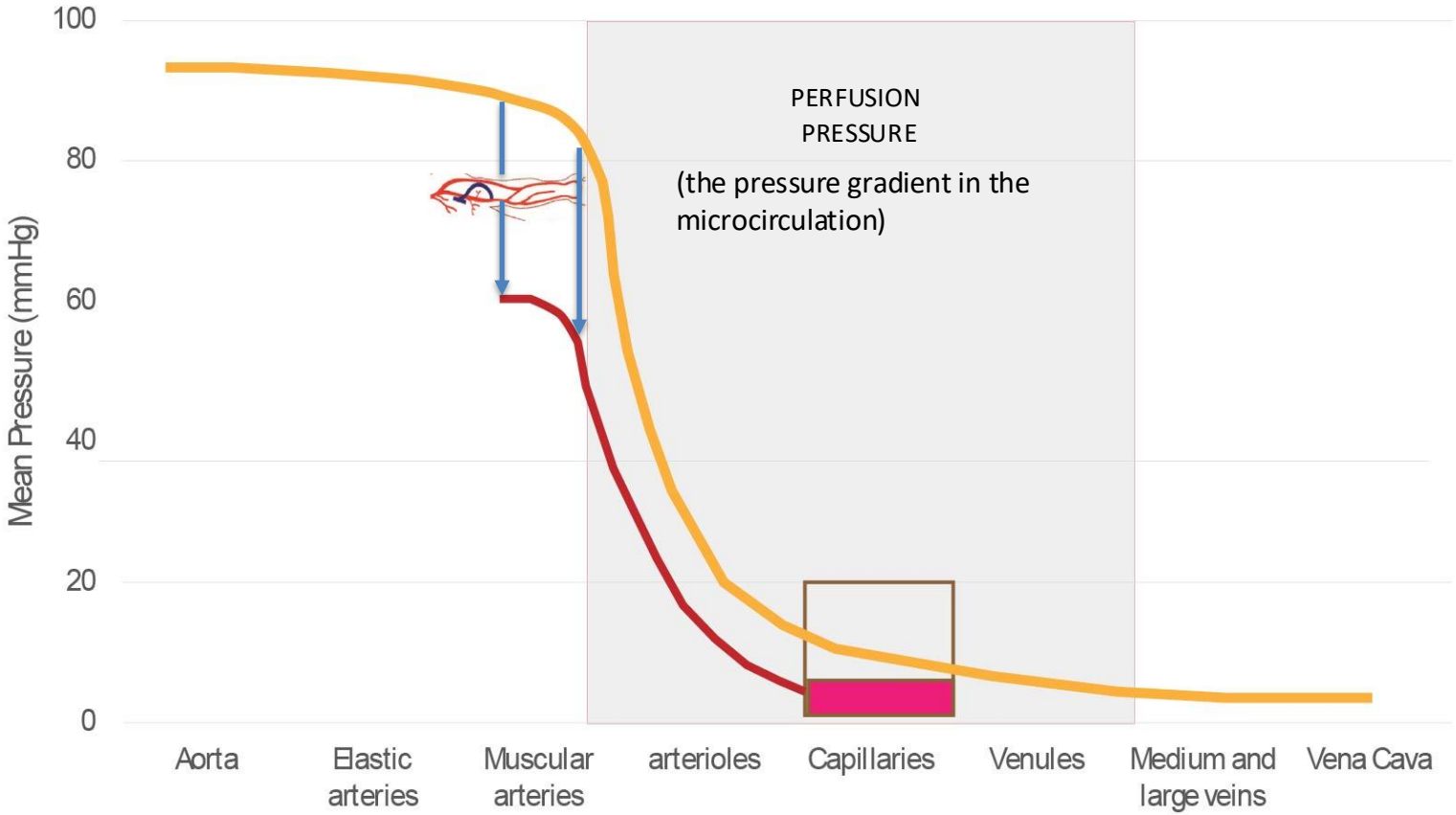
KEY INSIGHT

‘Steal’ itself is not the primary cause of ischemia

PATHOGENESIS

Distal Hypotension Drives Ischemia

Reduced perfusion pressure produces symptoms



The clinical question

What factors reduce flow / pressure distal to the access?

For simplification

Flow ↔ Pressure

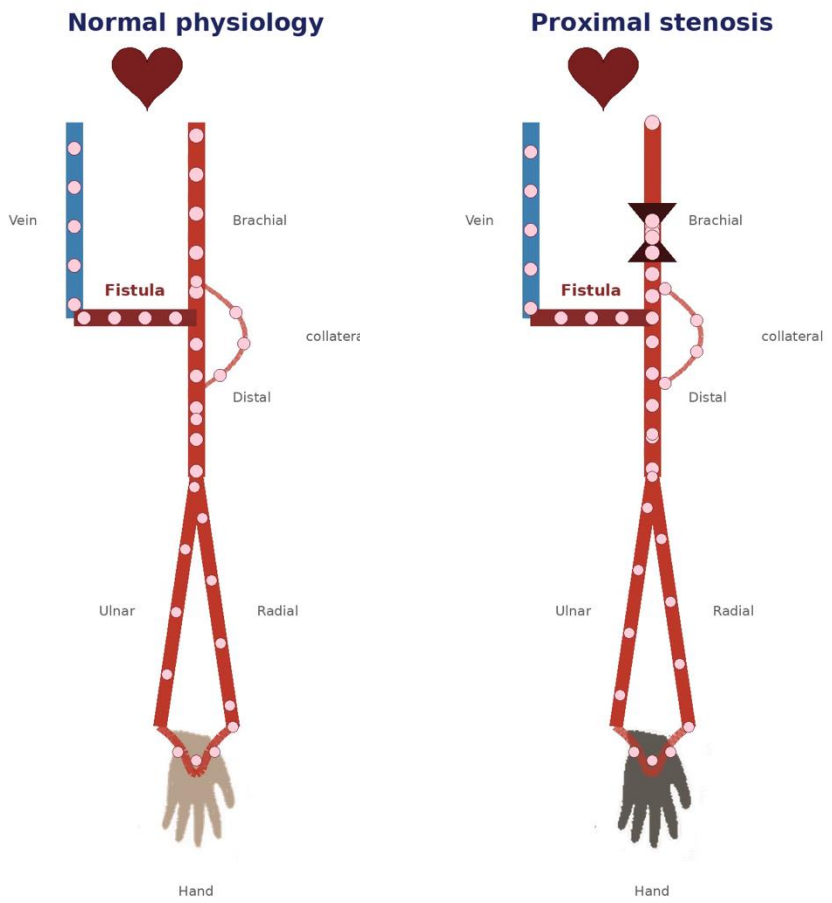
(assuming other systemic and local hemodynamic factors are constant)

DISTAL TO ACCESS

Mean pressure distal to the AV access — Inflow pressure feeding the microcirculation has been dragged down

Contributing Factor 1: Arterial Inflow Into the Distal System - PA Stenosis

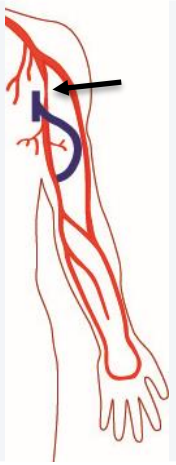
Reduced inflow from the proximal artery reduces distal flow



01

PA Stenosis

↓ Arterial Inflow into the distal system



02

Increased Resistance

Flow resistance ↑ in the distal arterial system

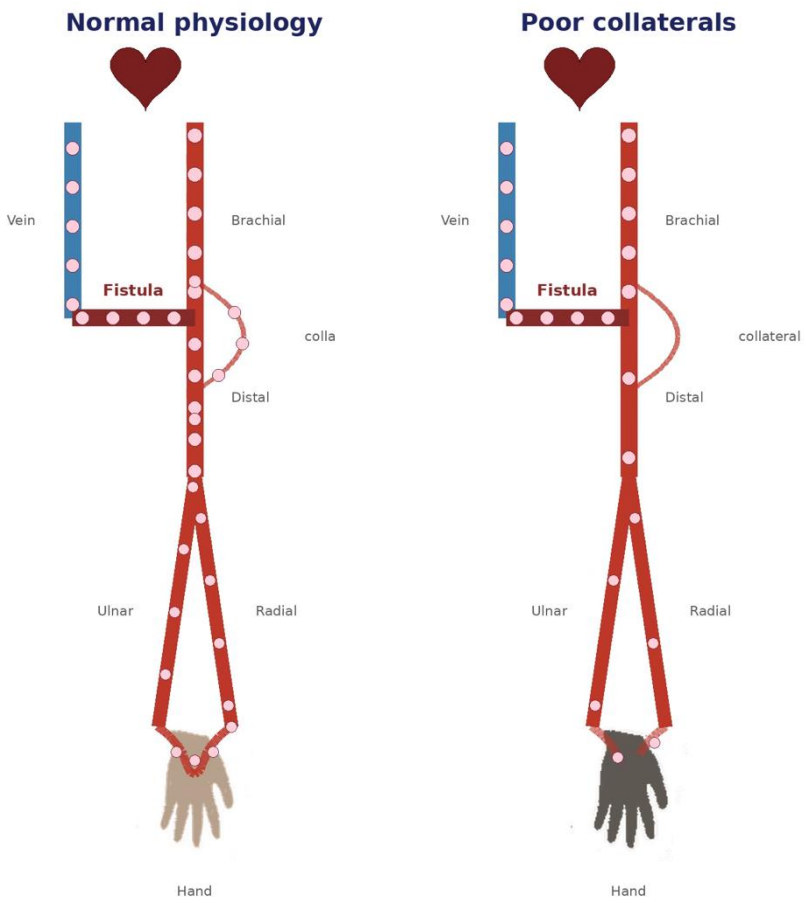
03

High Flows in Access

Diversion of flow from distal arterial system

Contributing Factor 1: Arterial Inflow Into the Distal System – Poor collaterals

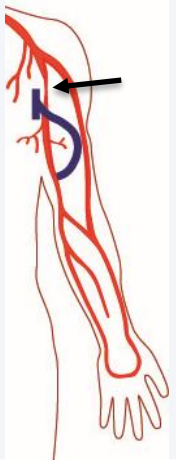
Reduced inflow from collaterals reduces distal flow



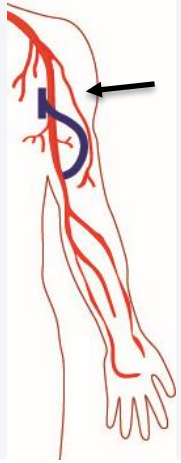
01

PA Stenosis

↓ Arterial Inflow into the distal system



Poor collaterals



02

Increased Resistance

Flow resistance ↑ in the distal arterial system

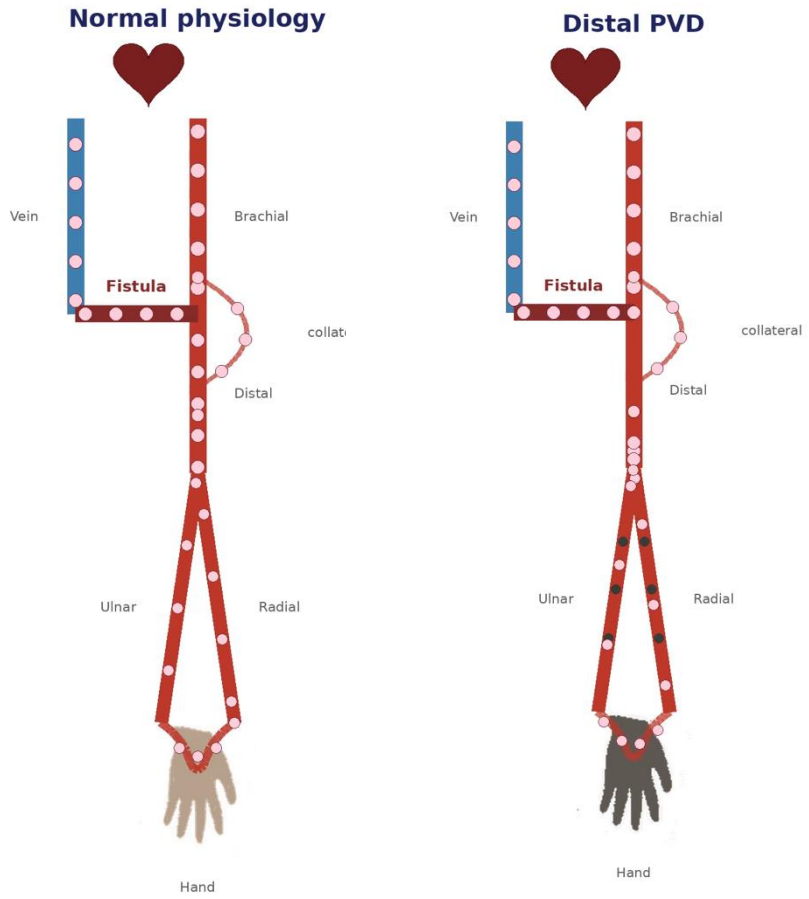
03

High Flows in Access

Diversion of flow from distal arterial system

Contributing Factor 2: Arterial ‘Outflow’ of the Distal System - Increased Resistance

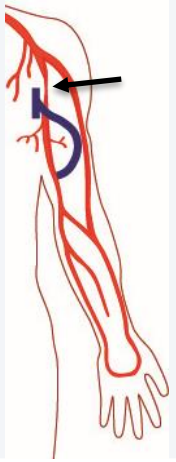
Medium and small artery disease increases resistance and reduces flow



01

PA Stenosis

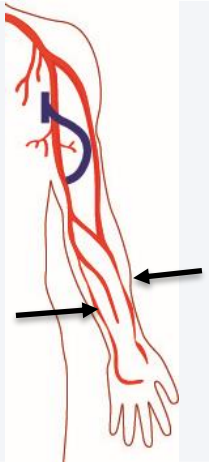
↓ Inflow into the distal Arterial system



02

Increased Resistance

Flow resistance ↑ in the distal arterial system



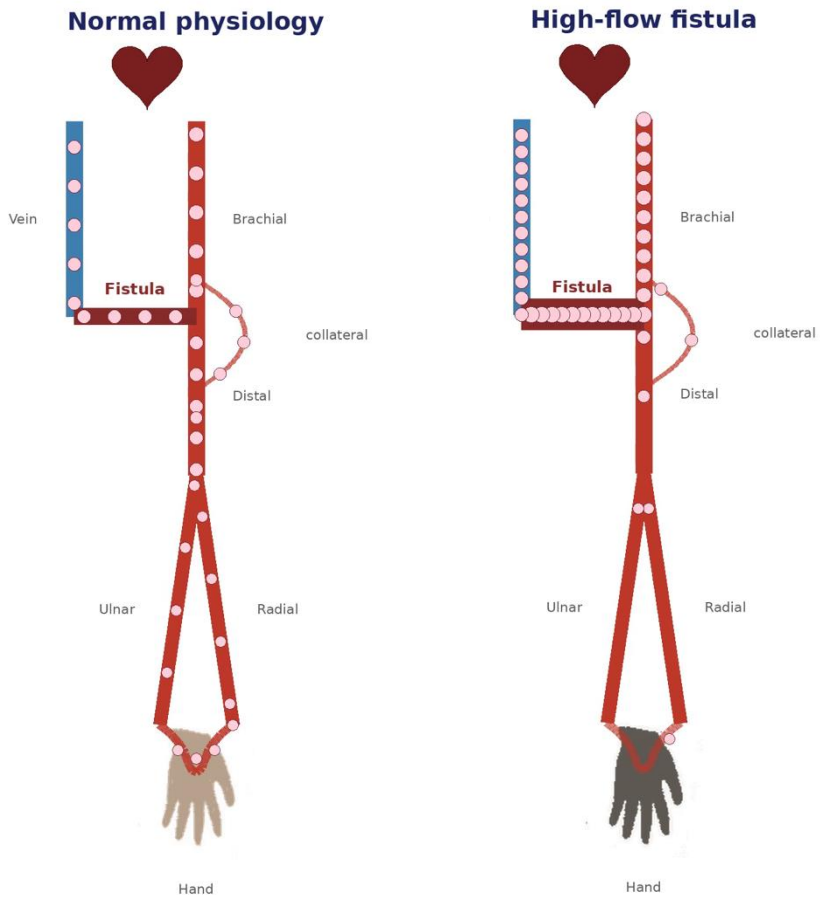
03

High Flows in Access

Diversion of flow from distal arterial system

Contributing Factor 3: Access Flows – High Flow Access

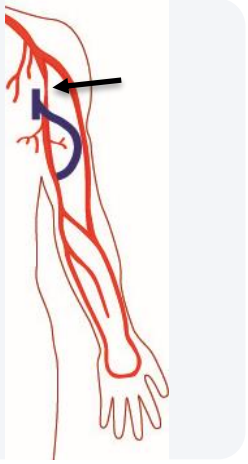
Flow diverted into access – reduces flow distally



01

PA Stenosis

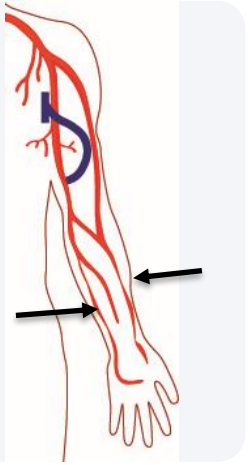
↓ Inflow into the distal arterial system



02

Increased Resistance

Flow resistance ↑ in the distal arterial system



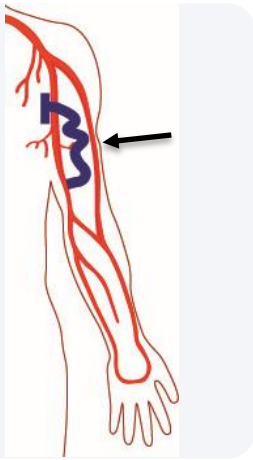
HAIDI= A Combination of Factors

Imbalance between access remodeling and arterial disease

03

High Flows in Access

Diversion of flow from distal arterial system



DIAGNOSIS

Recognizing HAIDI

History and detailed clinical exam are the cornerstones

Examine the patient **with and without occlusion of the access** — identify ischemic monomelic neuropathy (IMN) early.

RED FLAG

Acute motor or sensory loss

± pulse, one or all nerves involved

Suspect ischemic monomelic neuropathy (IMN)

ACTION

Ligate access urgently

EQUIVOCAL

Unclear history and clinical signs

WORK-UP

Non-invasive vascular testing

(with and without occlusion)

EMG when neuropathy suspected

EVIDENT

History and clinical signs of HAIDI

PROCEED

Clinical staging

Direct management to severity stage

Adapted from Beathard GA et al. ASDIN white paper: Assessment and management of HAIDI by interventional nephrologists.

CLINICAL STAGING

Severity Staging of HAIDI

Stage-based assessment guides management urgency

STAGE I	STAGE II	STAGE III	STAGE IV
Pale / cool hand	**Pain during exercise or HD**	**Rest pain or motor function loss**	**Tissue loss**
No symptoms	II a tolerable • II b intolerable	Continuous symptoms	IV a limited • IV b irreversible



Pallor on exam



Hand exercise / examination maneuver



Tissue loss — Stage IV

MANAGEMENT

Management by Stage I — IIa

Conservative measures for early/tolerable disease

STAGE I · IIa *Pale/cool hand or tolerable pain on exercise or HD*

Conservative measures

Hand warming

Maintain peripheral perfusion via vasodilation.

Hand exercise

Promotes collateral recruitment over time.

Reduce intradialytic hypotension

Hold antihypertensives pre-HD

Midodrine when appropriate

Optimize dialysis prescription — dry weight, length, flow

Continue to Monitor

Document baseline exam

Reassess

Escalate as needed

Management by Stage IIb — IV

Consider ligation

STAGE IVb *Irreversible tissue loss*

STAGE IVb

Irreversible tissue loss

Offer ligation

Consider amputation with access maintenance for select cases – offer ligation as an option, document the shared decision making and the rationale

HAIDI management does not adhere to strict criteria- use clinical judgement and tailor on a case-by-case basis.

Management by Stage IIb — IV

Workup and intervention for intolerable, rest, or tissue-loss disease

STAGE IIb · III · IVa — *Intolerable pain, rest pain, or limited tissue loss*

Duplex + Arteriogram

01 Arterial inflow
Into distal system

PROXIMAL ARTERY STENOSIS

02 Arterial outflow
Distal system

↑RESISTANCE
DISTAL ARTERIAL DISEASE

03 Access flow

HIGH FLOW

Management Decision Tree

Imaging findings determine the procedural approach

Duplex + Arteriogram

PROXIMAL ARTERY STENOSIS

Percutaneous treatment

Angioplasty

DISTAL ARTERIAL DISEASE
With normal / low flow

Inflow Procedures (increase inflow pressures)

PAI vs. DRIL · DRAL (radiocephalic)

HIGH ACCESS FLOW

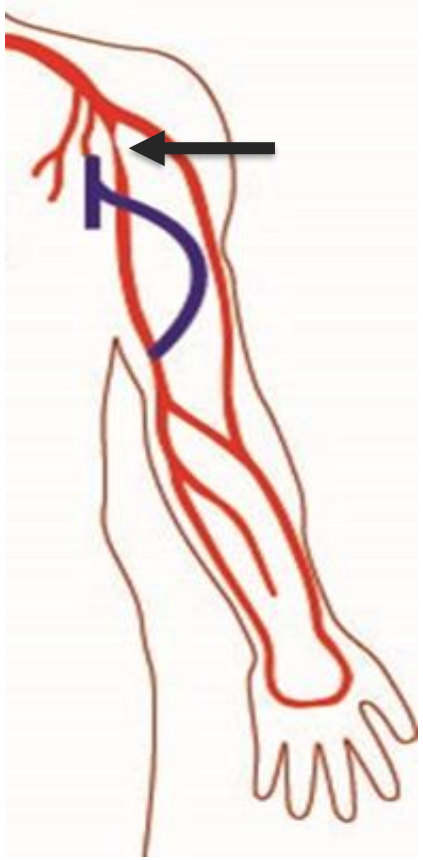
Flow reduction

Banding · RUDI

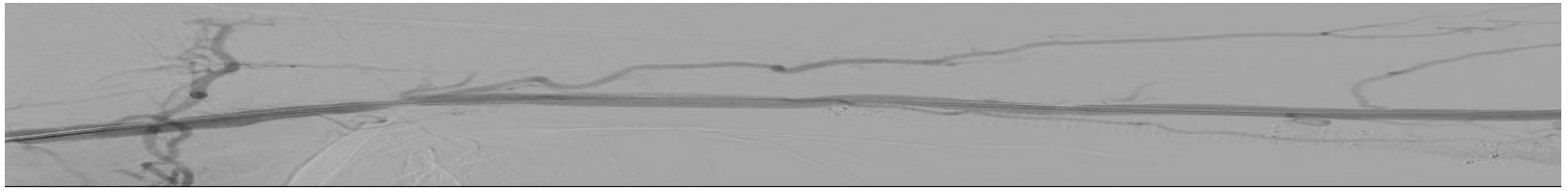
Each strategy targets a different element of the flow / pressure equation

HAIDI with Proximal Artery Stenosis

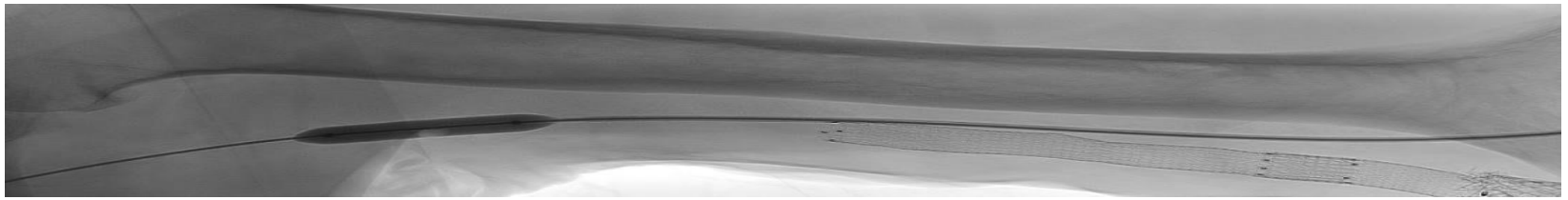
Management: angioplasty ± stent



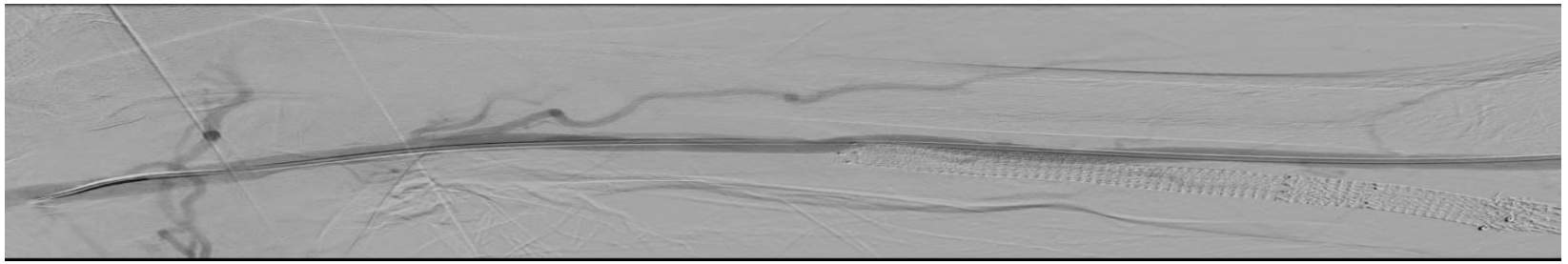
PRE-INTERVENTION



DURING ANGIOPLASTY



POST-INTERVENTION



Pre-existing critical stenosis would be recognized preop or would not allow access to mature →
Element of stenosis + Access remodeling at a rate higher than artery can adapt

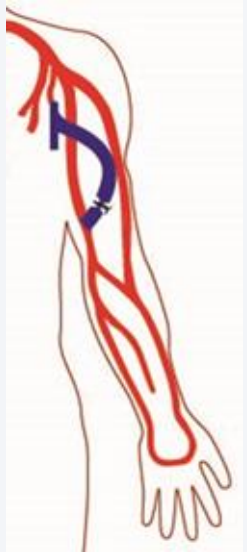
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HAIDI with a High-Flow Access

Management: flow reduction techniques

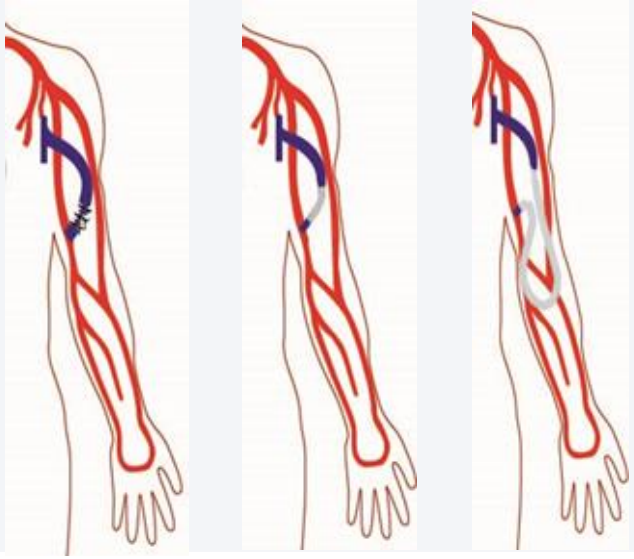
Simple Precision Banding

Targeted narrowing at a single point



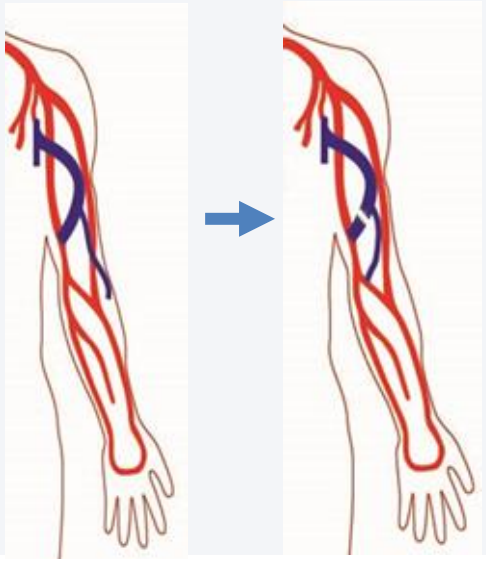
Long-Segment Banding

Longer narrow segment to increase resistance



Revision Using Distal Inflow (RUDI)

Inflow shifted distally

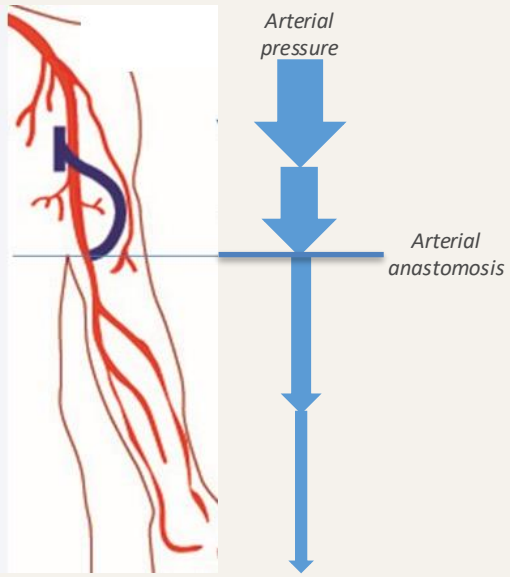


Less invasive ← → More durable

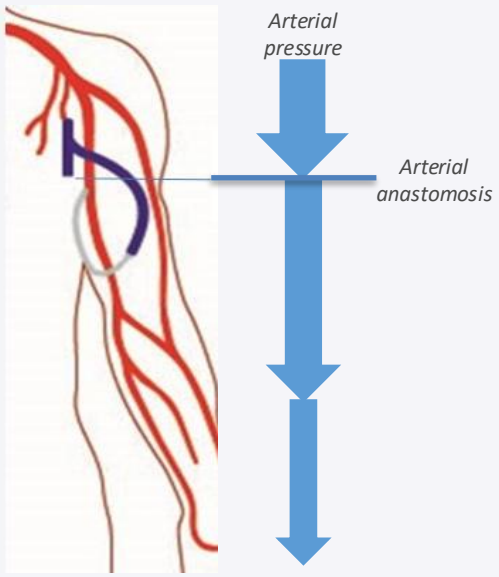
PAI vs. DRIL

Two strategies for HAIDI in a normal- or low-flow upper-arm access

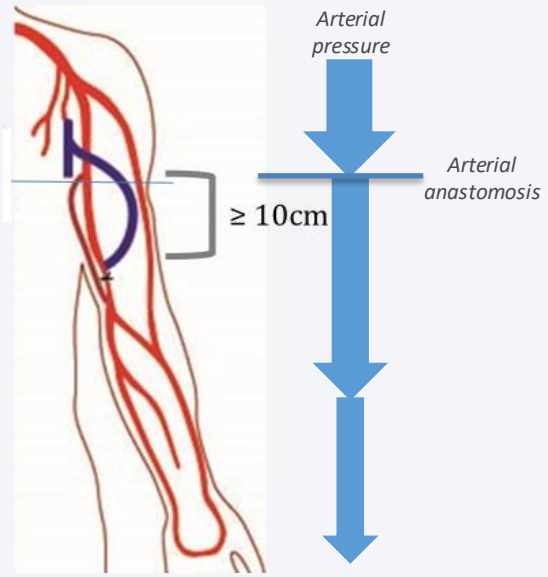
BASELINE



PROXIMALIZATION OF ARTERIAL INFLOW (PAI)

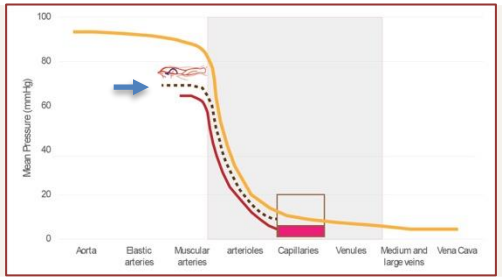


DISTAL REVASCULARIZATION & INTERVAL LIGATION (DRIL)



Mechanisms by which PAI and DRIL increase distal pressures:

Shifts arterial inflow to a larger, higher-pressure artery.
Added inflow segment to the access increases resistance
Distal arterial segment is larger with less resistance
Recruitment of collaterals at a higher point



PAI vs. DRIL: Why PAI is Often Preferred

Comparable hemodynamic effect with lower surgical burden

PAI

Preferred

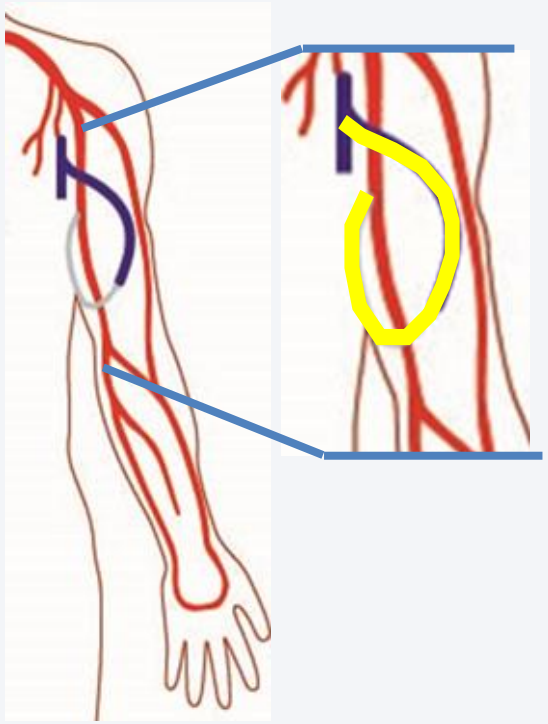
- **Less extensive**

  Procedure performed under regional or local

  Reduced procedure time, risks

- **Preserves native artery**

  No ligation → no risk of bypass failure



DRIL

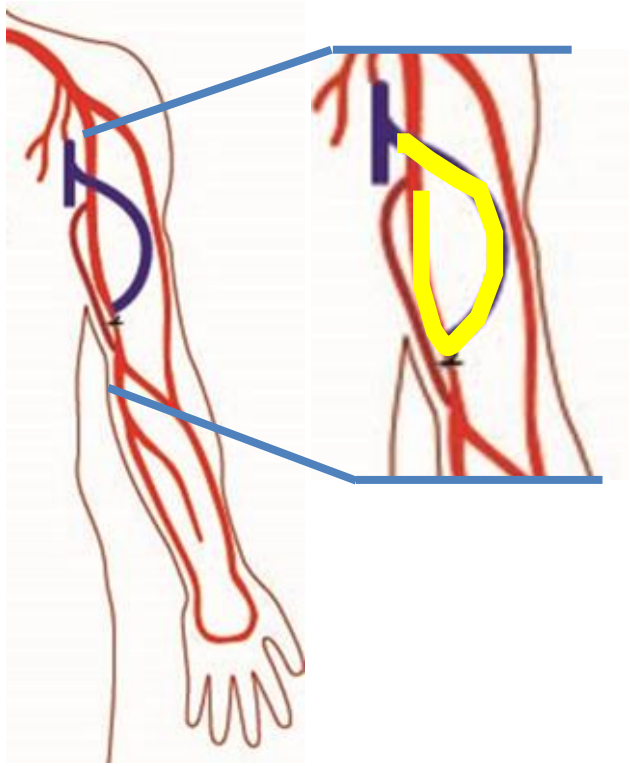
Reserved for select cases

- **Native artery ligation**

  Permanent, downstream-dependent on bypass

- **Bypass failure risk**

- **Extensive procedure**

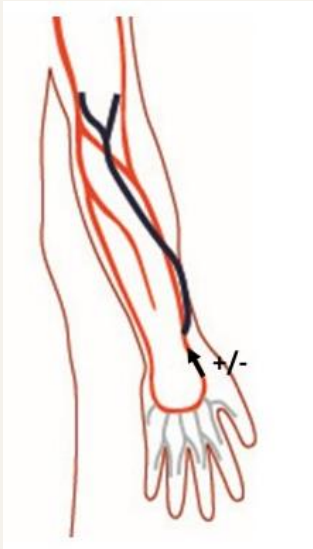


DRAL for Radiocephalic HAIDI

Distal Radial Artery Ligation — restoring palmar perfusion pressure

⚠ BEFORE LIGATION
Confirm radial and ulnar artery patency

PRE-DRAL



Baseline

Normal flow through radial artery, but distal arterial pressure is low

(+/–) steal

POST-DRAL



After distal radial ligation

Radial artery ligated distal to the access

EFFECT **Increased pressure in the palmar arch — improved perfusion to the hand**

Best Management: Avoid HAIDI

Recognize risk and design the access accordingly



Vascular access surgery as a minefield

Identify high-risk patients

Prior HAIDI	**Prior amputation**	**PVD**	**Diabetes**
Older age	**Female sex**	**Brachial-based inflow**	

Design accesses to prevent HAIDI

- **Avoid brachial inflow**
  When other targets are reasonable
- **Limit anastomosis size**
  Particularly at the brachial artery
- **Consider axillary inflow**
  Pre-emptive PAI in highest-risk patients
- **Don’t forget peritoneal dialysis**
  PD remains a viable alternative for some

KEY TAKEAWAYS

HAIDI — Summary

01

Diagnosis and staging

02

Management

Match strategy to:
1. Stage
2. Underlying hemodynamic factors (distal system inflow & outflow, access)

Decision making is on a case-by-case basis

03

Prevention is the best treatment

Thank you

Yael Vin, MD, MPH, FACS · VASA 2026