

RENAL ACCESS A Surgeon's Perspective

STEPHAN MOSTOWY
BSc, MD, FRCS (C)
Endovascular/Vascular Surgeon



MAGNITUDE OF RENAL FAILURE

- > 300,000 dialysis patients
- Dialysis population increasing 4.6%/yr
- Dialysis access is the most common vascular surgery procedure performed
- Dialysis access problems are the #1 reason for hospital admission

IMPORTANCE OF ACCESS

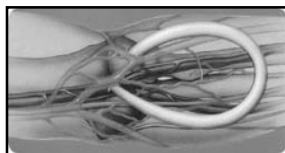
- **USRDS 2002:**
 - Number of HD VA procedures ↑ by 4X between 1991-2000
 - VA services inpatient → outpatient arena
 - VA procedures and complications
 - 20% of dialysis pt hospitalizations in US
 - Cost ~ 1 billion USD annually
 - Single greatest categorical expense for dialysis pt care

OBJECTIVES

- To understand the advantages/disadvantages of different types of AV access
- To highlight the importance of the preoperative assessment
- Outline an algorithm for the selection of access creation
- To discuss common complications of vascular access and their management
- Highlight the importance of the Vascular Access Coordinator
- To empower dialysis personnel to become 'access advocates'

VASCULAR ACCESS TYPES

- Central venous catheter
- Arteriovenous graft
- Native arteriovenous fistula



DIFFERENT ACCESS TYPES

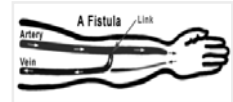
Method	Advantages	Disadvantages
Dialysis catheter	<ul style="list-style-type: none"> • Easily inserted and removed • Immediately available for use • Hemodynamic effects of AV shunt (heart failure, steal) do not occur • Placement possible in nearly all patients 	<ul style="list-style-type: none"> • Highest risk for infection • Incites central venous thrombosis or stenosis that may preclude use of extremities for AV access • Inconsistently provides blood flow rates adequate for optimum dialysis
Autogenous AV access	<ul style="list-style-type: none"> • Fewer secondary procedures required to maintain equivalent patency • Resistant to infection 	<ul style="list-style-type: none"> • More difficult to cannulate • Early failure rate higher compared with bridge grafts • Requires prolonged maturation period • Hemodynamic effects (heart failure, steal) may occur • Anatomy may preclude procedure in some patients
Non-autogenous (prosthetic) AV access	<ul style="list-style-type: none"> • Available for use in 2-3 weeks • Easy to cannulate • Superior early technical success in patients with small or diseased vasculature • Placement possible in most patients 	<ul style="list-style-type: none"> • Infection often requires removal • Hemodynamic effects (heart failure, steal) may occur • Multiple secondary procedures usually required to maintain patency

VA type, Patient Morbidity and Mortality

GOAL → AVF FIRST

- Among HD pts, the cost of VA-related care was 5X lower in pts who began with an AVF c/w CVL or AVG
- AVF creation at least 4 months before starting HD associated with lowest risk of sepsis and death (RR 0.57) by reducing use of CVLs

Advantages of AVFs



- Higher patency
- Less expensive
- Less likely to become infected
- Less likely to erode through overlying skin
- Less likely to be associated with distal steal syndromes
- Less likely to require
 - Thrombectomy
 - Secondary revision
 - Replacement to maintain function

DOQI

Goals of Access Placement -
Maximizing Primary AV Fistulae

Ultimately,
40% of prevalent patients
should have a
native AV fistula

Significant Differences in VA Practice Patterns

- Japan
 - >80% use of autogenous AVF
- Europe
 - 67-93% use of autogenous AVF
- US
 - 24% AVF
 - 58% synthetic AVG
 - 1998-2002 ↑ autogenous AVF (24-28%)
 - Substantial geographic variations w/i US regarding use of AVF in new HD pts

Central Venous Catheter Use Among New ESRD Pts



- 60% US patients
- 31% European patients start dialysis with CVL
 - ? late referral for access creation
 - ? Suboptimal access planning during pre-ESRD period



BRITISH COLUMBIA

- 2105 PATIENTS ON DIALYSIS WITH 2252 ACCESSSES
- FISTULA 1129 50.1%
- GRAFT 177 7.9%
- CATHETERS 946 42.0%



• 305 PATIENTS ON HEMODIALYSIS WITH 324 ACCESSSES

- AV ACCESS 190 (58.6%)
 - 158 FISTULAS (48.7%)
 - 32 GRAFTS (9.9%)



- CATHETERS 134 (41.4%)

Predictors of Type of VA Placed at Start of HD

- Gender
- Age
- Race
- Diabetes
- PVD
- Duration of predialysis care
- Type of physician placing vascular access
- *Preoperative sonographic mapping*

PREOPERATIVE VEIN MAPPING



- Increased number of autogenous accesses placed (85% vs 35% first time procedures)
- Autogenous dialysis accesses placed were less likely to need secondary revision
- Reduced # of exploratory incisions

GENERAL PRINCIPLES

- Strategy for *sequential longterm* access placement
- Autogenous preferred
- Upper extremity over lower extremity
- Non-dominant arm over dominant arm
- Distal over proximal
- Evaluation of arterial inflow and venous outflow
- CVL's discouraged

Which Procedure for Which Pt?

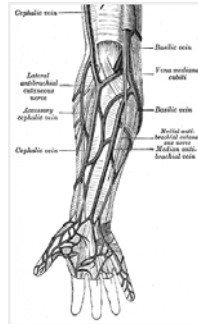
- Clinical factors: History
 - Previous AV access procedures
 - previous central venous catheter use
 - Indwelling devices
 - ICD/pacemaker
 - Consequences of a primary failure in an individual pt
 - Age of pt
 - Pt already on dialysis?
 - Early predialysis pt?
 - 6 months
 - How well will the pt tolerate a GA if more than a 'simple fistula' required?
 - Will pt require saphenous veins for other procedures?
 - L/E bypass
 - CABG

Which Procedure for which Pt?

- Clinical Factors: physical exam
 - Upper extremity pulse exam
 - Clinically evident superficial veins with tourniquet?
 - Size of arm
 - Quality of skin
 - Previous AV access procedures

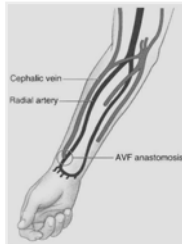
How Big a Vein do I Need?

- It depends....
 - Generally > 2.5 mm diameter for native fistula
 - Will use smaller for radiocephalic AVFs
 - Usually require vein \geq 4 mm for graft to vein anastomosis



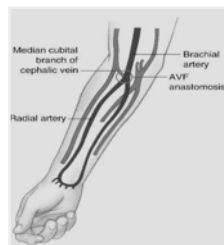
MY TOOLBOX

- Choice of AVF:
 - Radiocephalic
 - Wrist
 - Mid-forearm
 - Brachiocephalic
 - Brachiobasilic
 - Staged procedure
 - Need for general anesthesia
 - Formal transposition
 - superficialization

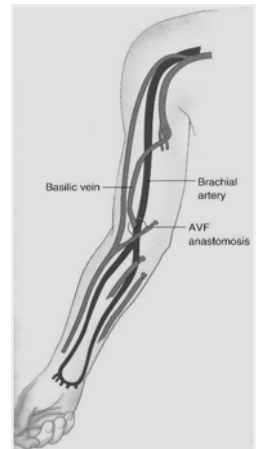


← Radiocephalic AVF

Brachiocephalic AVF →



Transposed Brachiobasilic AVF



Basilic Vein Transposition

- Higher operative complication rate compared with 'simple fistulae' or AVGs
- Increased anesthetic risk
 - Size and depth of dissection often exceed limitations of local/regional blocks
- Technical variations
 - Staged procedures
 - Partial transposition/elevation
 - Minimally invasive vein harvest techniques

MY PERSPECTIVE ON AV GRAFTs

- REVISIONAL PROCEDURES
- AFTER FAILED BASILIC VEIN TRANSPOSITION
- NO UPPER ARM VEINS FOR AV ACCESS CREATION
- PTS WHO REQUIRE MORE URGENT DIALYSIS

AVG Configurations

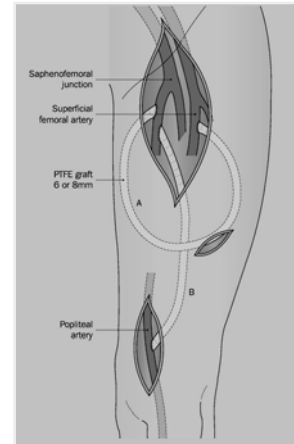


Loop forearm

Straight forearm

Straight upper arm

Lower Extremity AV Access



Factors Affecting Fistula Patency

- Vessel size
- Access surveillance
- Prior temporary access or as emergency
- Access position
- Prosthetic AV grafts
- ?diabetes ?women
- Vasculitis, athrombotic tendencies
- Smoking
- Surgical expertise
- Drugs - antiplt agents, fish oil, Ca+ channel blockers

Management of AV Fistula

- Avoid venepuncture and ivs pre/postop
- Avoid external compression
- Cannulation >6 weeks to allow maturation
- Needling puncturing strategies
- Fistula surveillance

VASCULAR ACCESS STRATEGY

- Develop strategies to:
 - Maximize AVF use
 - Decrease incidence of thrombosis
 - Develop quality assurance program
 - Detect the 'at risk' access
 - Track complications
 - Implement procedures to ↑ longevity

Barriers to Improvement

- Inadequate preoperative planning
- Unfamiliarity with techniques of transposition procedures
- Bias among some access surgeons against advocating for all autogenous approach based on limitations of life expectancy in chronic hemodialysis pts

FISTULOGRAMS

- HELPS PLAN FISTULA
- ASSESS VENOUS DRAINAGE

- R/O CENTRAL STENOSIS

- LOCATES PROBLEM AREAS
- STENOSIS
- OCCLUSION

AV ACCESS COMPLICATIONS

- PRIMARY NON-FUNCTION AND FAILURE TO MATURE
- ISCHAEMIA
- VENOUS STENOSIS
- THROMBOSIS
- ANEURYSM FORMATION
- INFECTION

Primary Non-Function

- Frustrating for pt and surgeon
- Why did access fail?
 - Inadequate vein
 - Repeated episodes hypotension
 - Inflow disease
 - Failure of preoperative planning
 - AVF too deep?
- Re-evaluate preoperative duplex studies
- What was my 'backup plan'?

Maturation Failure

- Multiple collateral outflow veins
- U/S guidance for marking of collaterals for ligation
- Attempt to improve fistula development by ligating side branches

Cannulation Problems

- U/S guided cannulation

- 2nd stage procedure
 - Diameter of fistula
 - Depth of fistula
 - Flow assessment

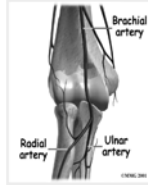
- SUPERFICIALIZE

Steal Syndrome

- Risk factors:
 - Proximal, upper arm av access
 - Prosthetic av graft
 - Diabetic
 - Distal atherosclerosis
- U/S findings:
 - Reversal of flow in forearm vessels
 - Large diameter, high flow proximal access

'Steal Syndrome' Treatment

- Conservative
- Move anastomosis distally to the Proximal Radial Artery (PRA)
- Ligate access
- Banding/clipping
- DRIL



Failing AV Access

- High venous pressures
 - Transonic flow monitoring
- Fistulography and PTA
 - ? Surgical revision
 - Frequent need for PTA
 - Inadequate response to PTA

Thrombosed AV Access

- Fistula or graft?
- Often not possible to salvage clotted fistula
 - ?role for urgent thrombolysis/surgical thrombectomy
- Thrombosed graft
 - Thrombectomy alone vs. concurrent revision
 - Thrombolysis and graftogram

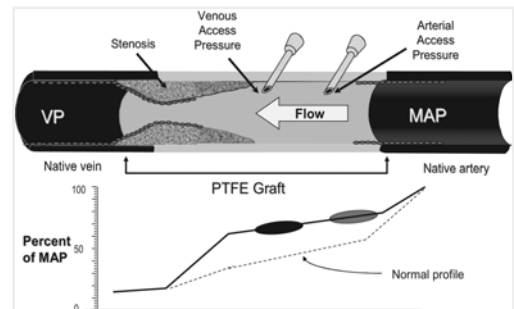
PERM- CATH COMPLICATIONS

- INFECTION
- PULLED OUT
- CENTRAL OCCLUSIONS / STENOSIS
 - VENOUS HYPERTENSION
 - SWOLLEN ARMS / FACE

Venous Outflow Stenosis

- Not as common as with AVG
- When it occurs in AVF → worse than in AVG
- Most common site → adjacent to anastomosis
- Screening test: venous pressure and flow- poor
- Tx success: poor
- AVF will stay open even with very low flow

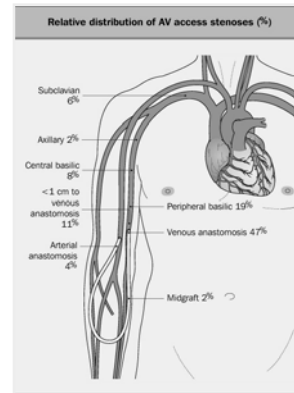
A-V GRAFTS



- STENOSIS OFTEN OCCURS AT VENOUS OUTFLOW

Screening For Venous Stenosis

- ◆ **Primary techniques**
 - Dynamic venous pressure
 - Static venous pressure
 - Intra-access flow
- ◆ **Supplemental**
 - Physical examination
 - Clinical parameters
 - Recirculation
 - Unexplained decreases in Kt/V and URR
 - Doppler ultrasound imaging

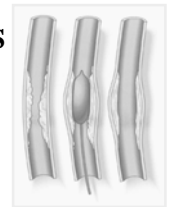
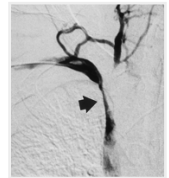


Treatment Of Venous Stenosis

- ◆ **Two choices**
 - Surgery
 - Percutaneous transluminal venous angioplasty
- ◆ **Choice depends on local expertise**
- ◆ **Abnormal parameters must return to normal post - treatment**

Central Venous Stenosis

- **LIGATE ACCESS**
- **REPEATED PERCUTANEOUS BALLOON VENOPLASTY**
- **VENOUS BYPASS**



BUTTON HOLE COMPLICATIONS

PSEUDOANEURYSM →

STENOSIS



EROSION →



METHODS OF REPAIR

- **ANGIOPLASTY** – for stenosis
- **REVISE WITH PATCH** – for stenosis, pseudoaneurysm, and erosion
- **INTERPOSITION GRAFT** – for stenosis, pseudoaneurysm, and erosion
- **LIGATE FISTULA**

AV Access Aneurysms



Access Aneurysms

- 'One site-itis'
- Graft
 - False aneurysm
 - Associated infection?
- Fistula
 - Older accesses
 - Bleeding
 - Loss of needle sites
 - Associated venous outflow obstruction



AVF - Aneurysm Formation

- ◆ Blood flow increases with time
 - Fistula dilates
- ◆ "One siteitis"
- ◆ Repair if:
 - Thinning of skin
 - Ulceration of skin
 - Spontaneous bleeding
 - Limits potential needle sites
 - Cosmetic appearance

AV Access Aneurysm Repair

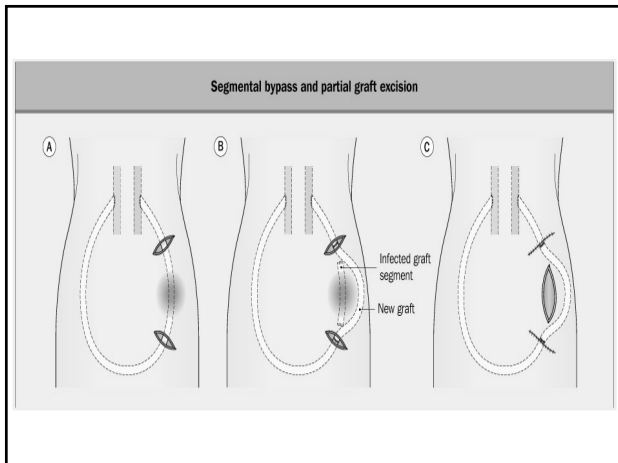
- Abandon access
- Primary anastomosis
- Interposition graft

AV GRAFT INFECTION



PBG Infection

- ◆ Very serious complication
- ◆ Frequency - 1.3 episodes/100 dialysis mo.
- ◆ Staphylococcus aureus most common
- ◆ Must be treated aggressively
 - Antibiotics
 - Surgery
 - localized resection
 - removal



Aneurysm + Erosion = BIG problem



Improve AV Access Survival



VASCULAR ACCESS COORDINATOR

- **Critical to program**
- **Increased fistula prevalence**
- **Monitoring access flows**
 - Earlier recognition of problems
- **Liason between surgeon and dialysis staff**
 - Tracking studies, OR bookings, and interventions
- **Resource to pts, RNs, and surgeon**
 - Often the best judge as to whether av access is usable
 - Pt education
 - Assistance with difficult cannulations
- **Access clinic in predialysis centre**

Being an 'ACCESS ADVOCATE'

- **Educating pts on the merits of AVFs**
 - Pts learning to accept CVLs as 'temporary access'
 - Discontinue CVLs as early as possible
- **Early referral for AVF placement**
 - 6 month lead time
- **Recognizing failing accesses, complications**
- **Protecting venous geography**
- **New fistulas accessed by senior RNs only**
- **Get help after second unsuccessful cannulation attempt**
- **Prophylactic placement of new access**

CONCLUSIONS

- **AV access is an important area for quality improvement efforts in dialysis**
- **Careful preoperative planning is essential to achieving good outcomes**
- **Proper planning and education will allow for increased autogenous fistula prevalence**
- **Early recognition and proper management of access complications will increase access survival and minimize pt morbidity**
- **A team approach in a dedicated access program will lead to improved overall outcomes**