

Cannulation and Vascular Access Survival

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Disclosures

None to report

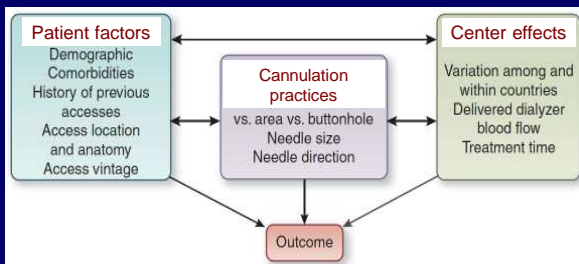
Case study of AVF hematoma

- 40 year old AA male with ESRD 2/2 HTN
- AVF placed, cannulation attempted 2 mos later
- Developed large hematoma at 1st cannulation
- No thrombosis
- AVF rested until hematoma resolved
- AVF used successfully for HD for next 5 yrs
- Multiple episodes of stenosis & thrombosis requiring intervention procedures

Outline

- Why is cannulation important to access survival?
- Is AVF ready to cannulate?
- Cannulation Methods
- Improving buttonhole cannulation
- Hemodynamic consequences of hematomas
- Application of ultrasound to cannulation

Factors that affect AVF survival



Besarab Kidney Int 2014

Outcomes associated with poor cannulation technique

- Loss of AVF
- Further hospitalization
- Central venous catheters
- Inconvenience
- Disruption of regular treatment
- Higher costs

Outline

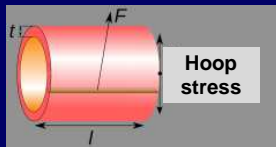
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Factors that that yield adequate remodeling

Shear stress: Force necessary to move fluid across vessel wall



Hoop stress: Force acting perpendicular to longitudinal axis of access



Is AVF ready to cannulate?

- Fluid mechanics definition
 - Shear stress has adequately dilated access
 - Hoop stress has adequately thickened wall
- Operational definition
 - AVF provides adequate blood flow
 - Vessel wall tolerates repeated cannulation
- Rule of 6's
 - Evaluate for maturation after 6 wks
 - Minimum 6 mm diameter with tourniquet
 - Less than 6 mm deep
 - AVF blood flow > 600 ml/min



Staff competency in cannulation is key

- Need program of training & competency assessment
- Cannulator rating system
 - Level 1: New employee with no experience
 - Level 2: New employee with experience
 - Level 3: Current employee improving competency
 - Level 4: Most experienced, competent cannulator
- Level 4 only for cannulation of new AVF

The Fistula First Catheter
Last Workgroup Coalition

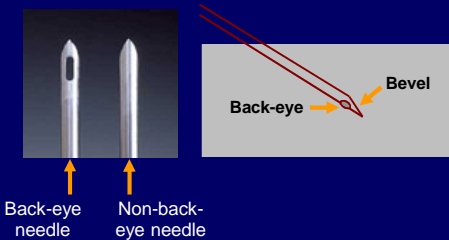
Need cannulation protocol for new AVF's

- 1st cannulation - single arterial needle
 - Prime needle with 10 ml saline filled syringe
 - Check for blood return & flush carefully
 - Advance to 2nd needle when single needle is problem free
- Advance 17 to 16 to 15 g needles



Back-Eye Needle

Back-eye opening allows blood flow from both sides of needle



Limits of blood pump speed

Negative arterial dialysis pressure
 > -200 to -250 mmHg may cause hemolysis

Needle Gauge	Maximum Qb
17	< 300 ml/min
16	300-350
15	350-450
14	> 450

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Rope ladder (site-rotation) cannulation

Area cannulation



Poor rope ladder technique
can yield AVF aneurysms



Buttonhole Technique

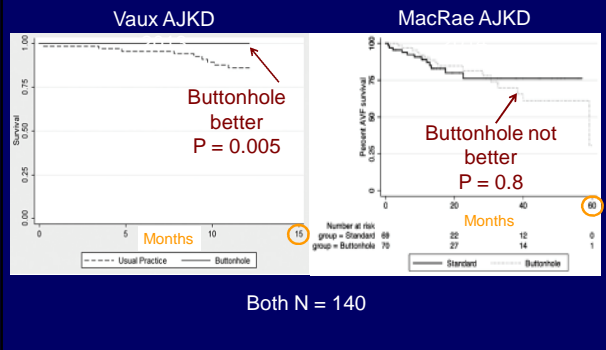


- Developed by Twardowski in Poland yrs ago
- AVF cannulated in same spot, angle, & depth
- Fibrous tunnel tract develops
- Need same cannulator
- Best for AVF with limited cannulation sites or home dialysis

Sharp vs. blunt needle



**Buttonhole vs. Rope ladder
AVF survival in RCTs**



Button hole cannulation – why promoted?

- Prolong AVF lifespan, improve quality of life
- Reduce pain, hematoma, infection, aneurysms
- Avoid missed cannulations

Reality

- Prolonged AVF life not confirmed
- May reduce hematomas
- Increased risk of local & systemic infection
- Reduction in missed cannulations & pain not consistently achieved

Bottom Line:
Optimal cannulation method not yet established

My opinion:
Buttonhole method requires careful attention to detail that may not be compatible with realities in hemodialysis units

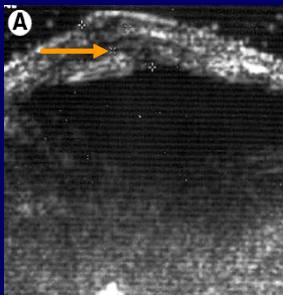
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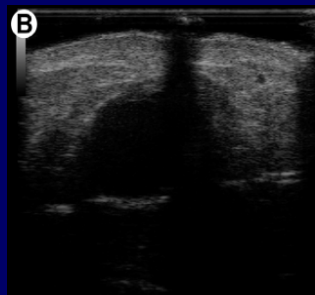
Buttonhole tunnel created by BioHole polycarbonate peg inserted into needle track



Buttonhole tunnel by sharp needle



Buttonhole tunnel by polycarbonate peg



Donnelly Semin Neph 2012

Dialysis through Supercath for 10 days followed by buttonhole cannulation



Donnelly Semin Neph 2012

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Hematoma without thrombosis
Does it matter?



Case study of AVF hematoma

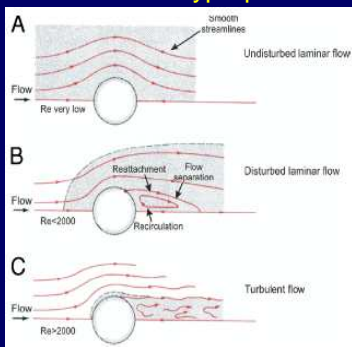
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Shear stress

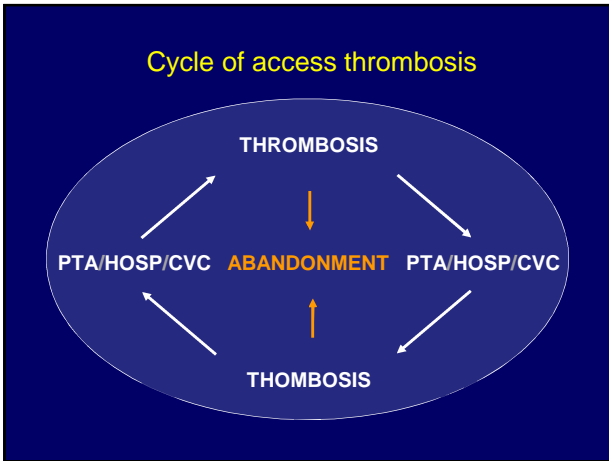
Force/Area necessary to move layer of fluid across vessel wall



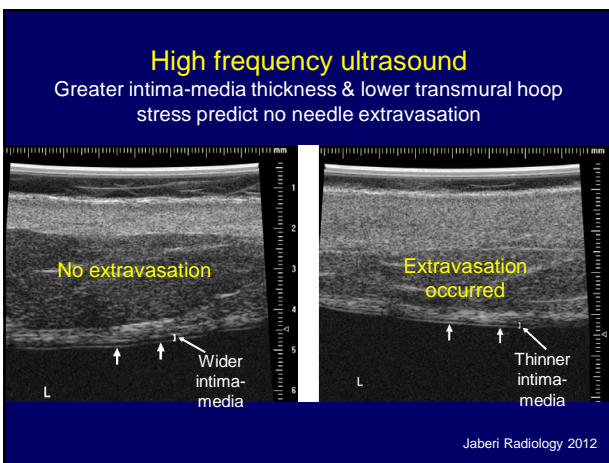
Low or oscillatory shear stress promotes neointimal hyperplasia



Chatzizisis JACC 2008

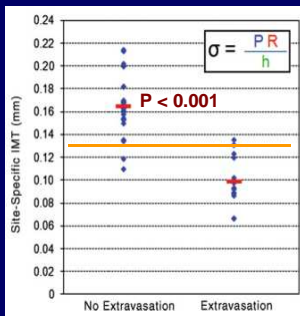


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Recommended minimum intima-media thickness 0.13 mm

Reliable enough for general use?



Jaberi Radiology 2012

Ultrasound guided cannulation is standard of care in central vein cannulation

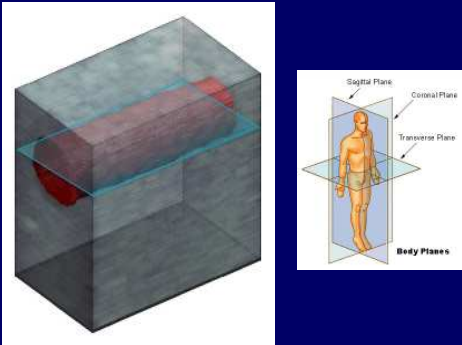
- Improved 1st pass success & fewer complications
- Helpful in difficult peripheral vein cannulation – may reduce need for central vein cannulation

Does access cannulation without ultrasound make sense?

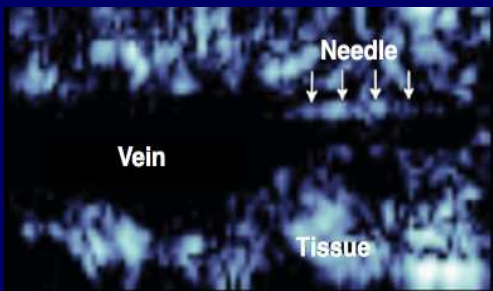
Sonic Window assisted cannulation



Sonic Window provides coronal view



Sonic Window provides view parallel to access & needle



Potential Advantages

- **Assessing access**
 - Assess AVF maturation – is diameter increasing?
 - Evaluate low blood flow, or high negative arterial or positive venous dialysis pressure
- **Assisting cannulation**
 - Assess depth & diameter, selection of needle gauge
 - Aid in difficult cannulation
 - Help avoid infiltration & cannulation failure
 - Identify alternative cannulation sites

Disadvantages

- Takes extra time – may require several minutes
- Patients do not tolerate delays
- Staff & patients may be reluctant to accept new technologies

Summary

- Optimal cannulation method not yet known
- Buttonhole should generally be reserved for limited cannulation sites or home dialysis
- Higher risk of infection with buttonhole is major disadvantage
- Are new cannulation methods practical in busy dialysis units where cost must be contained?
