Vascular Access Options in Therapeutic Apheresis:

An Eye Towards the Future

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DISCLOSURES

None

BACKGROUND

- RN at TOH for 20 years with varied experience in hematology, medicine, GI, acute monitoring area, rehab nursing. Experience outside of the hospital in long term care, home health care, QCH, & clinical teaching for UofO.

- Last 8 years in CVAD service at TOH. Newly cross-trained in Apheresis program

- Member of CVAA (national and local chapter) and INS
OBJECTIVES

➤ TO PROVIDE COMPREHENSIVE INFORMATION AROUND VASCULAR ACCESS AS IT RELATES TO THERAPEUTIC APHERESIS INCLUDING:

1) Principles of flow

2) Review of best practice guidelines as they relate to vessel preservation

3) Exploration of some newer technologies relating to vascular access
3 Types of Veins:

1) **Superficial** – lie in connective tissue under skin. Most suited for venipuncture

2) **Deep** – usually accompany arteries of the same name. Enclosed in a protective sheath of connective tissue with arteries and nerves

3) **Perforating** – connect deep and superficial veins
Mechanics of Flow

Types of Flow

Poiseuille equation for laminar flow of a fluid through a straight tube is:

\[
\text{velocity} = \frac{\pi \ p \ r^4}{8 \ l \ \eta} = = \frac{\pi \ (\text{pressure}) \ (\text{radius of the tube})^4}{8 \ (\text{length of tube}) \ (\text{viscosity})}
\]
What Does This Really Mean??

A relationship exists:

1) **Tube radius** ↓ by half = ↑ resistance to flow 16 fold

2) **Length** ↑ x 2 = ↓ flow by \( \frac{1}{2} \)

3) **Viscosity** (how sticky or as related to Hct)
   
   ↑ viscosity = ↓ flow
Vessel Diameter and Blood Flow

16 mm  150-350 ml/min
8 mm  250 ml/min
6 mm  250 ml/min
20-40 ml/min
95 ml/min
10 ml/min

Antecubital veins ~50-80 ml/min (ASFA)
### Catheter Diameter Size & Flow

<table>
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<th>Gauge</th>
<th>French</th>
<th>Approximate Outer diameter (mm)</th>
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**Gauge**
1800’s arbitrary system of measuring the diameter of an iron wire. ↑ gauge = ↓ catheter

**French**
developed by a maker of surgical instruments in the 1800’s. More predictable. Equal to the outer diameter of the line multiplied by 3.

Most important for Apheresis....
Inner diameter → determines flow
**most accurate, refer to manufacturer info**
Virchow’s Triad

• Principles related to the formation of venous thrombosis

1) Vessel wall damage or injury
2) Alterations in blood flow
   - venous stasis (related to?)
3) Hypercoagulability of blood
Significance??

• Why some devices work and others don’t

• PICC??

- Structured approach and comprehensive assessment prior to initiation of therapy
- Smallest gauge catheter, in the largest vessel, for the shortest length of time possible

CDC recommendations (2011)

- Promptly remove any intravascular catheter that is no longer essential. Select catheters on the basis of the intended purpose and duration of use, known infectious and non-infectious complications (e.g., phlebitis and infiltration), and experience of individual catheter operators [33–35]. Category IB

ASFA (2014)

- Risks and benefits should be tailored to each particular patient in the context of the constraints of a particular system’s resources
Emerging Approaches to Access

- **PIVs** – consider as first option (ASFA)
  - Frequency, duration, type of procedure, can the patient squeeze?
  - Evaluate! Plan ahead!
  - Promote vessel health
  - Remember direction of flow
  - “Rule of 1/3 or 1/2”
  - Do we have to bleed through a 16-18 gauge steel needle??
Trans-illuminator Vein Finders

**Advantages**
- Increases the visibility of veins eligible for cannulation
- Does not require a significant investment of time to learn technology

**Disadvantages**
- Many studies show no significant difference in the rate of successful IV placement
- Does not show depth of vessel
U/S - guided PIV

Advantages
• Allows for visualization of deep veins
• Distinguishes veins from arteries
• Can be used for both peripheral access and return
• Shown to improve vascular access success in black patients

Disadvantages
• Equipment is expensive
• Traditional apheresis needles may not be long enough
• Learning curve can be long and steep
The Display

- Allows visualization of the “echos”
- Sound waves are converted back into electrical signals
- Amplified by the receiver and turned into grey dots
Considerations:

Vein Depth | Stick Angle | Catheter Length

Depth and Angle 45 degree rule & 50% rule
Terms used by permission
Dr. Robert Dawson DNP
Vortex Ports

• Single or double lumen?? Is bigger always better??

A round chamber design + a tilted outlet allow for efficient flushing action to hyper-cleanse the entire chamber, resist sludge build up, and reduce occlusions.
Accessed Vortex Port

- Consider intradermal 1% buffered lidocaine for comfort
- 16 gauge straight, non-coring, high-flow needle
- Can accommodate flows at approximately 70ml/min (our experience)
- Have patient “puff out” chest when accessing
- If dual lumen, consider a 19 gauge Huber point non-coring needle for return
Considerations for all Ports
Summary

• Placement and maintenance of CVCs represents one of the greatest risks to patients undergoing T.A. (ASFA 5th Ed. 2014)

• Vessel preservation needs to be a priority → play the “long game”

• Always obtain a vascular history prior to start of tx

• Always include patient in the development of an individualized plan of care

• Consider inserting “return” with the option of becoming “access”
References

- Swedlow, P., Red Cell Exchange in Sickle Cell Disease, 2006, American Society of Hematology
- Weinstein, Sharon M., “Plumer's Principles and Practice of Intravenous Therapy, 8th Edition”, 2007, Lipincott Williams & Wilkins
Questions??