Catheter Blood Collection Practices: Can A High Quality Sample for Laboratory Diagnostics be Obtained?

Stephen Church
Expert Member
EFLM WG_PRE

Zorica Sumarac
Corresponding Member
EFLM WG_PRE

EFLM: E-learning Webinar

Webinar Objectives

- Why is IV Therapy Used?
- Overview Types of Vascular Access Devices (VAD).
- Current Guidelines
- Nursing Prospective
- Laboratory Prospective
- Key Considerations
- Recommendations

- Questions throughout the webinar

- Catheter, also known as cannula, cannulation
- Focus of the webinar is IV catheters, no discussion on urinary catheters
Why Intravenous Therapy?

- To restore and maintain fluid and electrolyte balance
- To administer medications:
  - Anti-infective drugs (antiviral/antibiotic)
  - Pain management
  - Chemotherapy
- To infuse total parenteral nutrition (TPN)
- To administer a blood transfusion/blood products

Why Vascular Access?

- Direct route to the bloodstream
- Rapid drug action
- Accurate and precise drug administration
- Drug therapy may be irritating or cannot be given via another route
- Required for patients who cannot tolerate and/or absorb from the gastrointestinal tract
Intravenous Therapy

Central role in patient care

60%–90% of patients receive IV therapy

One of the most common, yet complex invasive procedures


Types Of Vascular Access Devices

Peripheral
- Catheter tip is outside the superior vena cava

Central Venous
- Catheter tip is within the lower one-third of the superior vena cava

Arterial
- Catheter tip is usually placed in the radial artery

Peripheral
- Catheter tip is placed in cephalic veins of the forearm or back of the hand
Peripherally Inserted Venous Cannulas (PIVCs)

Most common type of VAD often routinely used in emergency departments.
A single lumen catheter is inserted either into the back of the hand, cephalic or metacarpal vein or in the forearm cephalic or antecubital veins
Often used for blood collection
Length 14 mm—75 mm
Short Term: Typically indicated for 3 days, some devices 7 days

Peripheral: Midline Catheters

A single lumen catheter is inserted under ultrasound guidance into the basilic, brachial or cephalic vein
The tip of the catheter lies in the axillary vein outside of the chest and is therefore considered peripheral rather than central access
Length 76 mm—203 mm
Typically indicated for 1—4 week dwell time
**Peripherally Inserted Central Catheters (PICC)**

- Inserted in upper arm: basilic/brachial /cephalic veins
- Longer length 400+ mm, smaller diameter
- Dwell time up to a year
- Multiple lumens
- Select devices may be indicated for power injection
- Some have internal valves to minimise reflux into the catheter lumen

**Long-Term Central Venous Catheters (CVC)**

- Implemented in the jugular or subclavian
- Multiple lumens: cuffed, tunneled, implanted
- Placed under anaesthesia
- Long dwell time
Implantable Port/Vascular Access Port (VAP)

- Implanted devices with a reservoir underneath the skin and a portion of the catheter resting in either the superior vena cava or the right atrium — requires specialist skill to insert and remove
- Requires external access needle
- Dwell time multiple years
- Sites: Jugular/subclavian/axillary

Current Guidelines - CLSI


**Avoid collecting through a VAD or during an IV start**

- Section 5.3 Vascular Access Devices and Infusions:
  - 5.3.1 Intravenous Fluids
  - 5.3.2 Blood Sampling form Vascular Access Devices
Current Guidelines – UK RCN

• Royal College of Nursing (RCN)-Standards for infusing therapy, 4th edition, 2016:

  *Peripheral cannulae should not be used* routinely for blood sampling due to haemolysis of the sample which may give false results (WHO, 2010). *Samples can be taken at initial placement* of the peripheral cannula (Dietrich, 2014; Hambleton et al., 2014).

• Section 8.7 Blood Sampling:
  – Blood Sampling Via Access Devices

Current Guidelines – US INS

• Infusion Nursing Society (INS)-Infusion Therapy Standards of practice, 2016 Standard:

  *When sampling via a vascular access device, carefully analyse the risks vs benefits* before deciding to use a VAD for obtaining blood sample.

• Section 6 Vascular Access Device Management:
  – 43 Phlebotomy
  – III Blood Sampling Via a Vascular Access Device
Current Guidelines – Others

- WHO Guidelines on drawing blood-Best practices in phlebotomy, 2010: Provides no guidance
- EFLM...

This document only applies to the use of a closed blood collection system (i.e., blood collection systems where the tube cap is not removed throughout the blood sampling process) and does not provide guidance for the blood collection with an open needle and syringe. Also, it is restricted to blood collection using needles and therefore does not cover collection from a catheter. We discourage blood sampling from an intravenous catheter, as it has been shown by many studies that catheter blood collection increases the risk of hemolysis [2-4]. In cases where catheter blood collection is the only option, care must be taken to minimize the risk of hemolysis and contamination of the sample caused by admixtures of intravenous (i.e., fluids or flushing solutions; these steps are outside the scope of this document). The EFLM is currently working on the recommendations for catheter blood collection, to address this important issue.

Nursing Prospective

- VAD have blood collected from them, higher in emergency can be nearer 90%
- It is carried out approximately 16 times a day in some units
- Not aware of any issues, 54% describe impact as being infection, contamination and poor results
- Retake blood samples due to quality issues
- On average, there is issues with blood samples 13% of the time.
Laboratory Prospective - Interference

- Haemolysis
- Contamination (Blood Cultures)
- Contamination (IV Fluids)
- Impact on Clotting Results

Laboratory Prospective - Haemolysis

leading factors associated with hemolysis were classified as (i) anatomic and physiological: right hand, forearm, or antecubital space, smaller distal veins, discharge diagnoses (respiratory, gastrointestinal, reproductive, dermatological, endocrine disease); (ii) equipment: plastic, smaller, and new IV catheters; partial catheter obstructions, laboratory tube of larger size; and (iii) technical: difficult catheter placements, difficulty collecting blood, multiple or unsuccessful attempts to place IV catheters, partial filling of the primary vacuum tubes and excessive force when aspirating blood or filling tubes with a syringe.


**Blood cultures** from indwelling intravascular access devices (VAD) such as intravenous catheters and ports are associated with greater contamination rates than from blood cultures obtained by venipuncture.


### Recommendations:
- **DO NOT** collect blood cultures through VAD

---

**Laboratory Prospective – Sample Contamination IV Fluids**

**IV Infusions:**
- Water, Electrolytes, Glucose, Vitamins, Protein
- Total Parenteral Nutrition (TPN):
  - Amino Acids
  - Carbohydrate
  - Electrolytes, Vitamins and Trace Elements

**Most Common IV Fluids:**
- 9% Normal Saline (also known as NS, 0.9NaCl, Saline, or NSS)
- 5% Dextrose in Water (also known as D5 or D5W)
- Lactated Ringers (also known as LR, Ringers Lactate, or RL)
  - Solution contains sodium chloride, potassium chloride, calcium chloride, and sodium lactate in sterile water

**Often Including many key laboratory parameters!!**
Laboratory Prospective – Sample Contamination
IV Fluids

• How?
• Sample drawn from lines with ongoing infusions
• Samples drawn from flushed lines without a volume discarded
• Venipuncture directly above the site of infusion

Recommendations:
• Stop any infusion and discard volume

Laboratory Prospective – Clotting Results

Several studies show equivalent results for routine parameters with peripheral VAD discard

Hinds et al: Did not support obtaining blood samples via a TVAD even after 12 mL of blood was discarded using heparinised CVAD

When Should You Collect from a VAD?

- **Peripheral cannulae should not be used routinely** for blood sampling (RCN)
- **When sampling via a vascular access device, carefully analyse the risks vs benefits** before deciding to use a VAD for obtaining blood sample. (INS)
- **Avoid collecting through a VAD or during an IV start** (CLSI)

**Recommendations:**
- Consider the patient needs pain & inconvenience of blood collection vs impact of erroneous results
- Only do when clinically necessary

---

What about an Ongoing Infusion?

- **Remember collecting from an infusion can lead to sample dilution and/or erroneous results.**
- **Peripheral VAD:**
  - Infusing solutions should be stopped for at least 2 minutes prior to obtaining the blood sample (INS)
- **Central VAD:**
  - Stop all infusions,
  - Flush the lumen with preservative-free 0.9% sodium chloride (USP) prior to blood sampling from a CVAD.
  - Research has not established the length of time for stopping fluid flow or the amount of flush solution. One study suggests a wait time of 10 minutes after stopping the infusion before drawing the sample. (INS)

**Recommendation:**
- Stop all infusions, minimum 2 minutes before collection
- Flush lumen with sodium chloride (saline) before collection NOT heparin or citrate
- Calculate the required discard volume
How MUCH Blood Should I Discard?

- **Definitions:**
  - **Discard Volume:** This is the volume of blood that you should collect into a syringe or blood collection tube which is then disposed off and not used for analysis
  - **Dead Space:** The internal volume of the catheter lumen or tubing

0.2 mL 2 mL

- **BUT what about the connectors?**

---

How MUCH Blood Should I Discard?

- **CLSI GP41-A6**
  - 2 * the dead-space volume is recommended for non-coagulation testing
  - 5 mL, 6 * the dead-space volume for coagulation tests.
- **INS 2016 Standard**
  - Central VAD:
    - 3–5 mL for pediatric patients, with the exception of coagulation studies obtained from a CVAD exposed to heparin
    - 6 mL from non-tunneled catheters
    - 9 mL from tunneled cuffed catheters
  - Discard volume for implanted ports could not be established.

**Recommendation:**
- Understand what type of VAD is in place
- Obtain the internal volume for the VAD and any connections
- Calculate appropriate volume, as a guide
  - Peripheral: 2 mL, unless coagulation 5 mL
  - Central: 5mL+
How Should I Connect to VAD?

- Connecting and using the correct devices have been shown to have a significant impact on reducing haemolysis.
- The strategy is to reduce the mechanically induced shear stress on the red blood cells.

Conclusions: Sample collection through intravenous catheters is associated with significant higher risk of spurious hemolysis as compared with standard blood drawn by straight needle, and this risk is further amplified when intravenous catheter are associated with primary evacuated blood tubes as compared with manual aspiration.

Conclusions: If IV catheters are used for blood collection, hemolysis rates directly correlate with the vacuum within the tubes and can be estimated by the proposed formula. By the use of partial-draw vacuum blood collection tubes, hemolysis rates in IV catheter collections can be reduced to levels comparable with collections performed by aspiration systems.
How Should I Connect to VAD?

- Note if you collect using a syringe
- Sample should be transferred through a specific device into the sample tube used by the laboratory

Recommendation:
- Use a Luer-Lok device to create a secure connection to the VAD
- Use a blood collection tube holder
- Use blood collection devices or techniques that reduce the mechanical shear stress eg controlled aspiration collection or partial draw tubes
- Always transfer from a syringe into the laboratory sample tube with the transfer device

Recommendations

- Only when clinically necessary
- Ideally on insertion of the VAD, stabilise VAD before any collection
- If indwelling, ensure all infusions are stopped for minimum 2 minutes
- Disinfect the needle free connector and allow to dry
- Flush device with 10 mL Sodium chloride
- Ensure appropriate connection, use a luer lok connector and holder
- Reduce shear stress on cells with partial draw tubes, controlled aspiration
- Always use a discard, consider the required discard volume
- Continue collection in accordance with EFLM blood collection guidelines
- Flush device with 10 mL Sodium chloride
- Once complete disinfect the needle free connector and allow to dry
Conclusion: Can A High Quality Sample for Laboratory Diagnostics be Obtained?

- **Education** is required to ensure blood collectors are aware the potential impacts of blood collection from VAD.
- Ensure that there is **appropriate equipment** to connect to and collect the sample from the VAD.
- Create a specific protocol for blood collection from VAD.

EFLM Working Group: Catheter Collection

- Create awareness & initial recommendation - webinar
- Conduct a survey of blood collection practice from VAD:
  - 35 Questions to enable the laboratory to audit a blood collection from a VAD
- Survey to be conducted across member organisation
- Publication of results
- Publication of recommendations
Standardisation in the Preanalytical Phase Are We there Yet?

KEEP WORKING!!

EFLM – E-learning Webinar
Catheter Blood Collection Practices,
18th September 2018