Collecting Blood from Patients with Vascular Lines

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Outline

• Vascular lines

• Sample contamination

• Options for collecting blood in patients with lines

• Investigating contamination
Vascular Lines

Commonly used in medical practice

- Infuse range of simple (0.9% NaCl) or complex (TPN) fluids
- Provide access for frequent blood collections

Infusions in, blood out

- Central venous catheter (CVC)
- Peripheral intravenous (IV) line
- Arterial line
- Venipuncture
Options for Blood Collection: What Does the Evidence Say?

Central and peripheral lines are generally acceptable
  - Most studies included limited tests – basic chemistries, CBC
  - Few report interference data, e.g., hemolysis

Common techniques for collection
  - Most collections: Pause infusion for at least 2 min
  - Line draw: Waste blood – at least 2x dead volume
  - Venipuncture: Opposite arm or distal (below IV)

Most studies fairly old
  - Reviews in Mohler et al., Himberger & Himberger
Risk of Sample Contamination

Infusate contamination presents the greatest risk when collecting blood from lines
  • Non-equilibrated mixture of blood and other fluid/compound

Basic mechanisms
  • Fluid in line dilutes blood collected
    - Fluid components $\rightarrow$ falsely high or normal
    - Other blood components are diluted $\rightarrow$ falsely low
  • Infused materials, e.g. some drugs, adsorb to line
    - Release into blood during collection $\rightarrow$ falsely high
  • Infusion is not fully equilibrated in bloodstream
Equilibration

Mixing

• Healthy heart circulates full blood volume roughly 1X/min
• 2 min wait = 2 body volumes, generally adequate circulation to equilibrate infused material throughout the bloodstream
• Pausing 2 min can greatly improve specimen collection

Some exceptions to the rule

• Some substances (Mg, Ca, PO$_4$, TPN) may take longer
• Likely delay from distribution into cellular compartment
• No conclusive study, mostly anecdotal
• No evidence-based standard for how long to wait
Options for Blood Collection: Line Draws

Preferred by patients and care team

Proper procedure is key to avoid contamination

• Turn off infusions for at least 2 min
• Flush the line with saline
• Waste blood: 2 times catheter dead-space volume (non-coagulation testing); 5 mL or 6 times dead-space volume for coagulation studies

Other considerations

• Order of draw, inverting to mix, etc.
• Minimize hemolysis
Options for Blood Collection: Peripheral IVs

Convenient but higher rates of hemolysis

- Collecting blood at IV start common in emergency rooms
- CDC LMBP strongly support venipuncture as a best practice

Evidence suggests technique can reduce hemolysis risk

- Large-bore needles, at least 21-gauge
- Place IV in antecubital fossa rather than distal
- Partial-vacuum tubes rather than full-vacuum or syringe
Peripheral IVs: Hemolysis at IV start

An example of hemolysis (H-index) at IV start:

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<th>Venipuncture</th>
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Options for Blood Collection: Venipuncture

Some advantages over line collections

- Less risk of hemolysis
- May be best for specific samples, e.g., TDM
- Less frequently contaminated

Avoiding contamination:

- Use the opposite arm if IV is running fluids
  - Caution with glucose, lipids
- Distal (below IV) after pausing a minimum of 2 minutes
- Proximal (above IV) only as last resort
Investigating Potential Specimen Contamination

Suspect specimen contamination if:

- Na & Cl normal, other basic tests (e.g., K, Hgb) very low
- Absurd/critical results that do not fit patient’s status
- Unexpectedly high drug levels without dose change

Questions to think about when investigating:

- How was the specimen collected? Does the patient have a line?
- What (if anything) was being infused before collection?
- Was the infusion paused, and if so, for how long?
- Could wrong order of draw explain the results?
Conclusions

Vascular lines present opportunities and risks
  • Possibility to collect blood without venipuncture
  • Higher likelihood of hemolysis, peripheral > central
  • Potential for contamination of line draws and venipunctures

Proper procedure is key
  • Line draws: Pause, Flush, Waste
  • Venipuncture: Pause(?), Opposite>Distal>>>Proximal


8. Ong YY, Boykin SF, Barnett RN. You can draw blood from the “IV arm” below the intravenous needle if you put a tourniquet in between. Am J Clin Pathol 1979;72:101-2

Disclosures/Potential Conflicts of Interest

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