Chapter 9: Preanalytical Considerations

Objectives

1. Define the key terms and abbreviations listed at the beginning of this chapter.
2. List and describe the physiological variables that influence laboratory test results and identify the tests most affected by each one.
3. List problem areas to avoid in site selection, identify causes for concern, and describe procedures to follow when encountering each.
4. Identify and describe the various vascular access sites and devices and explain what to do when they are encountered.

Objectives (cont’d)

5. Identify, describe, and explain how to handle patient complications associated with blood collection.
6. Identify, describe, and explain how to avoid or handle procedural error risks, specimen quality concerns, and reasons for failure to draw blood.

Overview

- Preanalytical Phase of Testing
- Begins when test is ordered
- Ends when testing begins
- Skills Needed in Phlebotomist
- Technical skills to perform blood draw
- Ability to recognize preanalytical factors & address them
Overview (cont’d)

• Topics Presented in Chapter 9
  - Physiological variables
  - Problem venipuncture sites
  - Types of vascular access devices
  - Patient complications & conditions
  - Procedural errors
  - Specimen quality issues
  - Troubleshooting failed venipuncture

Reference Ranges/Intervals

• Tests confirm health or screen, diagnose, & monitor disease
• Test results are compared with specimens of healthy people
• Consist of range of values with high & low limits
• Most often based on healthy, fasting people

Basal State

• Definition: resting state of body early in morning after fasting 12 hours
• Basal-state specimen
  - Ideal for establishing reference ranges on inpatients
  - Effects of diet, exercise, etc. on test result are minimized
• Basal state is influenced by:
  - Age
  - Gender
  - Conditions of body
  - Diurnal: Happening daily
  - Circadian: Having a 24 hour cycle

Physiological Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Has Effect on</th>
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<tbody>
<tr>
<td>Age</td>
<td>RBC, WBC, creatinine clearance</td>
</tr>
<tr>
<td>Altitude</td>
<td>RBC</td>
</tr>
<tr>
<td>Dehydration</td>
<td>Hemoconcentration, RBC, enzymes, Fe, Ca, Na</td>
</tr>
<tr>
<td>Diet</td>
<td>Glucose, lipids, electrolytes</td>
</tr>
<tr>
<td>Diurnal variation</td>
<td>TSH, cortisol, Fe</td>
</tr>
<tr>
<td>Drug therapy</td>
<td>Enzymes, hormones</td>
</tr>
<tr>
<td>Exercise/IM injection</td>
<td>pH, PCO₂, CK, LDH, glucose</td>
</tr>
<tr>
<td>Fever</td>
<td>Hormones, cortisol</td>
</tr>
<tr>
<td>Gender</td>
<td>RBC, Hgb, HtZ</td>
</tr>
<tr>
<td>Jaundice</td>
<td>Yellow color interferes</td>
</tr>
<tr>
<td>Position</td>
<td>Protein, K</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>RBC</td>
</tr>
<tr>
<td>Smoking</td>
<td>Chol, cortisol, glucose, OH, triglyceride, WBC</td>
</tr>
<tr>
<td>Stress</td>
<td>WBC, Fe, ACTH, catecholamine, cortisol</td>
</tr>
<tr>
<td>Temperature and humidity</td>
<td>Hemoconcentration</td>
</tr>
</tbody>
</table>
Problem Sites

• Burns, Scars, & Tattoos
  - Veins are difficult to palpate here
  - May have impaired circulation
  - New burns are painful
  - Tattoos may be more susceptible to infection; dyes may interfere

• Damaged Veins
  - Sclerosed: hardened
  - Thrombosed: clotted
  - Difficult to puncture & yield erroneous results

Problem Sites (cont’d)

• Edema
  - Swelling caused by abnormal accumulation of fluid in tissues
  - Results when fluid from IV infiltrates surrounding tissues
  - Contaminates blood with tissue fluid
  - Veins are harder to locate, & tissue is fragile

• Hematoma
  - A swelling or mass of blood
  - Caused by blood leaking from vessel during venipuncture
  - Can be painful, contaminate blood sample, obstruct blood flow

Hematoma

(Photograph courtesy Sue Kucera.)

Problem Sites (cont’d)

• Mastectomy (5 yr rule)
  - Surgical breast removal
  - Lymph flow is obstructed with removal of lymph nodes
  - Lymphostasis: obstruction/stoppage of normal lymph flow
  - Swelling & infection may be present
  - Applying tourniquet here can cause injury
  - Can change blood composition

• Obesity
  - Veins may be deep & hard to find
  - Use longer tourniquet & try cephalic vein (best choice)
**Vascular Access Devices and Sites**

- **Arterial Line**
  - A catheter placed in an artery (usually radial)
  - Provides accurate & continuous measurement of blood pressure
  - No tourniquet or venipuncture on an arm with an arterial line

- **Arteriovenous Shunt or Fistula**
  - The permanent, surgical fusion of an artery & a vein
  - Created to provide access for dialysis
  - Located on back of arm above wrist

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**Blood Sampling Device**

- Connected to arterial or central venous catheter to collect blood
- Reduces chance of infection
- Prevents needlesticks
- Minimizes waste from line draws

(Courtesy of Edwards Lifesciences, Irvine, CA.)

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**Heparin or Saline Lock**

- A catheter or cannula connected to a stopcock/cap w. diaphragm
- Provides access for administering medicine or drawing blood
- Placed in vein in lower arm above wrist for up to 48 hrs
- Flushed w. heparin or saline to prevent clogging

(Courtesy of Edwards Lifesciences, Irvine, CA.)
• Intravenous (IV) Sites
  - **IV line**: a catheter inserted in a vein to administer fluids
  - Avoid collecting blood from arm w. IV
  - Blood may be contaminated w. IV fluid
  - If necessary, collect below IV

• Previously Active IV Sites
  - Avoid collecting from known previous IV sites for 24 to 48 hrs

• Central Vascular Access Devices (CVADs)
  - Known as indwelling lines
  - Consist of tubing inserted into a main vein or artery
  - Used for:
    - Administering fluids & medications
    - Monitoring pressures
    - Drawing blood

• Types of CVADs
  - Central venous catheter or line
    - Inserted into large vein (subclavian)
    - Advanced into superior vena cava
  - Implanted port
    - A small chamber attached to indwelling line
    - Surgically implanted under skin (upper chest or arm)
  - Peripherally inserted central catheter
    - Inserted in veins of extremities & threaded into central veins

• Allergies to Equipment and Supplies
  - **Adhesive allergy**
    - Place gauze square over site; have patient remove in 15 min
  - **Antiseptic allergy**
    - Use alternate antiseptic
  - **Latex allergy**
    - Look for sign indicating latex allergy on patient’s door
    - Use nonlatex equipment (e.g. gloves, tourniquet, & bandages)
Patient Complications and Conditions (cont’d)

- Excessive Bleeding
  - Patients on aspirin or anticoagulant may bleed longer
  - Maintain pressure until bleeding stops
  - If bleeding continues >5 min, notify appropriate personnel

- Fainting (syncope)
  - A loss of consciousness & postural tone
  - Caused by insufficient blood flow to brain
  - Have patients w. history of fainting lie down during venipuncture
  - Vasovagal: loss of consciousness due to nervous system response to abrupt pain, stress, or trauma

- Nausea and Vomiting
  - Discontinue blood draw until feeling subsides
  - Give patient emesis basin or wastebasket
  - Apply cold, damp washcloth to forehead

- Pain
  - DIGGING IS NEVER OK!!!!!!!
  - Warn patient before needle insertion
  - Avoid excessive, deep, blind, or lateral redirection of needle
  - Extreme pain or numbness indicates nerve involvement; remove needle immediately, apply ice, document incident if pain persists

- Petechiae
  - Tiny, nonraised red spots
  - Appear on arm when tourniquet is applied
  - Indication that site may bleed excessively

- Seizures/Convulsion
  - Discontinue draw immediately
  - Hold pressure over site without restricting patient’s movement
  - Do not put anything in patient’s mouth
  - Protect patient from self-injury
  - Notify first-aid personnel
Procedural Error Risks

- **Hematoma Formation**
  - Discontinue draw immediately & hold pressure over site 2 min
  - Offer cold compress or ice pack if it is large & swollen
- **Iatrogenic Anemia**
  - Iatrogenic means: adverse reaction brought on by effects of treatment.
  - Example: Removing blood on a regular basis or in large quantities can lead to iatrogenic anemia.
  - Life is threatened if >10% of blood volume is removed at once
  - Collect only minimum required specimen volumes
- **Inadvertent Arterial Puncture**
  - Signs: rapidly forming hematoma, blood filling tube quickly

Procedural Error Risks (cont’d)

- **Infection**
  - Avoid by doing the following:
    - Don’t open tape or bandages ahead of time
    - Don’t preload needles onto tube holders ahead of time
    - Don’t touch needle insertion site after sterilizing it
    - Minimize time between needle cap removal & venipuncture
    - Remind patient to keep bandage on at least 15 min

- **Nerve Injury**
  - Caused by:
    - Improper site or vein selection
    - Inserting needle too deeply or quickly
    - Excessive lateral redirection of needle
    - Blind probing
  - If initial vein entry is unsuccessful:
    - Use slight forward or backward redirection of needle
    - Remove needle & try an alternate site

- **Reflux of Anticoagulant**
  - Blood flows back into vein from collection tube
  - Tube additives (e.g. EDTA) may cause adverse reaction
  - Keep arm in downward position & tube below venipuncture site

- **Vein Damage**
  - Never ever...“poke and hope”
    - Avoid numerous venipunctures in the same area over time
    - Avoid blind probing & improper technique
Specimen Quality Concerns

- Hemoconcentration
  - A decrease in fluid content of blood
  - An increase in nonfilterable large molecules
  - Caused by stagnation of normal venous flow due to tourniquet

- Hemolysis: Video (Preventing hemolysis during venipuncture)
  - Damage to or destruction of RBCs
  - Hemoglobin escapes into fluid part of specimen

- Partially Filled Tubes (short draw)
  - Blood-to-additive ratio may be incorrect

Specimen Quality Concerns (cont’d)

- Specimen Contamination
  - Allowing alcohol residue, fingerprints, glove powder, baby powder, urine on newborn screening samples
  - Getting glove powder on blood films or capillary specimens
  - Dripping perspiration into capillary specimens
  - Following improper antiseptic procedure
  - Using wrong antiseptic

- Wrong or Expired Collection Tube: always check date before putting tubes out for use.

Troubleshooting Failed Venipuncture

- Tube Position
  - Improper seating
  - Needle fails to penetrate stopper

- Needle Position
  - Needle not inserted far enough
  - Bevel partially out of skin
  - Bevel partially into vein
  - Bevel partially through vein
  - Bevel completely through vein
  - Bevel against vein wall
  - Needle beside vein
  - Undetermined position

A. Correct needle position; blood can flow freely into the needle.
**Needle Position**

**B.** Needle not inserted far enough; needle does not enter vein.

**C.** Needle bevel partially out of the skin; tube vacuum will be lost.

**D.** Needle bevel partially into the vein; causes blood leakage into tissue.

**E.** Needle bevel partially through the vein; causes blood leakage into tissue.
Needle Position

F. Needle bevel completely through the vein; no blood flow obtained.

Needle Position

G. Needle bevel against the upper vein wall prevents blood flow.

Needle Position

H. Needle bevel against the lower vein wall prevents blood flow.

Needle Position

I. Needle beside the vein; caused when a vein rolls to the side.
Troubleshooting Failed Venipuncture (cont’d)

• Collapsed Vein
  - Vein walls draw together temporarily, shutting off blood flow
  - Caused by:
    • Vacuum of tube or plunger pressure is too strong for vein
    • Tourniquet is too tight or too close to site
    • Tourniquet is removed during draw (esp. w. elderly)
    • VEINS DO NOT ROLL!!
  • Tube Vacuum
    - Loss of vacuum due to bevel partially out of skin
    - Loss of vacuum due to damage of tube

Chapter 8/9 test info:

• Matching:
  - AV shunt
  - Hematoma
  - Edema
  - Diurnal
  - Lipemia
  - Palpate
  - Age, attitude, dehydration
  - Hemoconcentration
  - 70% isopropyl alcohol
  - Reference ranges
  - Basal state
    - basal state
    - preanalytical
    - venipuncture
    - requisition
    - STAT
    - fasting
    - timed
    - cortisol
    - CVC
    - allow tube to fill stopper end first

Additional matching

• Hemolysis
• Reflux
• Geriatric
• Needle phobia
• Patency
• Concentric circles
• Site may bleed excessively
• Flash
• EMLA
• Syncope
• Petechiae
  - vasovagal
  - end stage renal failure
  - tourniquet on longer than 1 minute
  - excessive fluid
  - glucose & triglycerides
  - sclerosed
  - tube lost vaccum
  - circadian
  - jaundiced
  - arterial line

J. Collapsed vein prevents blood flow despite correct needle position.
Additional test info

- 39 multiple choice questions
- Know:
  - Preanalytical-Analytical-Post Analytical chart in study guide