Laboratory Values: Acute Care and Beyond – Preparing for Direct Access

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Objectives

- Identify lab values pertinent throughout the continuum of PT care
- Recognize normal and abnormal values
- Identify disease processes that may cause abnormal values
- Identify symptoms that may accompany abnormal values
- Identify PT implications and considerations
- Answer content questions and discuss case studies
Before we begin.....

- Do not attempt to memorize any of these normal values! That is simply not practical.
- Realize that many different sources and labs will utilize different numbers for “Normal Values”.
- Consider what makes up “Normal”.
- Please feel free to interrupt me with questions, comments, and discussion. We will all learn from each other!
Why are lab values important?

- “In order to provide best plan of care and intervention for today’s health care recipients, the therapist must understand test values, their variations, interpretations, and implications for therapy.”

  Goodman and Fuller

- “It is the professional responsibility of the physical therapist to interpret available laboratory values as a component of the examination and evaluation of a patient/client, to suggest laboratory testing when indicated, and to use lab values to guide the determination of safe and effective interventions for the patient/client. We, as physical therapists, act as consultants in the rendering of our professional opinion and bear the responsibility to advise the referring practitioner about the indications for physical therapy intervention.”

  Lab Values Interpretation Resources, 2013
Why are lab values important?

- APTA Vision

  Transforming society by optimizing movement to improve the human experience

- Identity

  “The physical therapist will be responsible for evaluating and managing an individual’s movement system across the lifespan to promote optimal development; diagnose impairments, activity limitations, and participation restrictions”

- Quality:

  “As independent practitioners, doctors of physical therapy in clinical practice will embrace best practice standards in examination, diagnosis/classification, intervention, and outcome measurement.”

  “…..striving to prevent adverse events related to patient care….“

- Collaboration:

  In clinical practice, doctors of physical therapy, who collaborate across the continuum of care, will ensure that services are coordinated, of value, and consumer-centered by referring, co-managing, engaging consultants, and directing and supervising care.
Why are lab values important?

- **Value**
  - “Accountability will be a core characteristic of the profession and will be essential to demonstrating value.”

- **Advocacy**
  - “The physical therapy profession will advocate for patients/clients/consumers both as individuals and as a population”

- **Entry level knowledge**
  - Minimum Required Skills for Physical Therapist Graduates at Entry Level
    - 10/1/13
Complete Blood Count: CBC
What is it?
- Evaluation of components in a sample of venous blood.
- Includes:
  - White Blood Cell Count (WBC)
  - Red Blood Cell Count (RBC)
    - Hemoglobin
    - Hematocrit
  - Platelets
White Blood Cells

- Immune System: Function to fight infection
- Normal Values:
  - Adult Male: 4,500-11,000 /mm$^3$
  - Adult Female: 3,900-10,700/mm$^3$
- Abnormalities:
  - Leukocytosis: Increase in WBC > 11,000
  - Leukopenia: Decrease in WBC < 4,000
Leukocytosis:
- Tolerance may be limited secondary to infection (especially with fever present)
- Bottom Line: You may make them feel worse instead of better! Consider risk versus benefit!

Leukocytopenia:
- Highly susceptible to infection
- Protective isolation or reverse isolation if treatment must occur out of room
- Strict hand washing is essential
- Bottom Line: Protecting the patient from potential harm you could expose them to is of the most importance.
Red Blood Cells

- Hematocrit: Percentage of total blood volume made up of RBC’s.
- Hemoglobin: Contains iron and transports oxygen; It is a measure of the total hemoglobin level in the blood.
- Normal Values:
  - Adult Male: Hematocrit 41-51%  Hemoglobin 14-17g/dL
  - Adult Female: Hematocrit 36-47%  Hemoglobin 12-16g/dL
Red Blood Cells

- Abnormalities
  - Elevated Hematocrit: Polycythemia, erythrocytosis, dehydration, high altitude acclimatization, tobacco use, lung disease, congenital heart defects, certain meds
    - Results in increased blood viscosity: Limits blood flow to the brain and allows blood to clot more easily.
  - Decreased Hematocrit: anemia, hemodilution, acute or chronic blood loss
Red Blood Cells

- Abnormalities:
  - Elevated Hemoglobin: Chronic hypoxemia, elevated altitude, polycythemia vera, dehydration
  - Decreased Hemoglobin: Anemia, hemolysis, cancer, blood loss
Red Blood Cells: PT Implications

- Low H/H: Patients may exhibit the following
  - Weakness and fatigue
  - Decreased exercise tolerance
  - Dyspnea on exertion
  - Heart palpitations
  - Tachycardia

- Considerations
  - Modifying treatment
  - Increased monitoring of vital signs
  - Frequent rest breaks
  - H/H < 25% and 8g/dL
    - Essential ADL’s with assistance for safety
Red Blood Cells: PT Implications

- Polycythemia: May exhibit the following
  - Headache
  - Dizziness
  - Blurred Vision
  - Decreased Mental Acuity
  - Sensory Changes in Distal Extremities

- Considerations:
  - Increased risk of stroke and thrombosis
  - Modifying treatment
  - Increased monitoring of vital signs
  - Frequent rest breaks
Platelets

- Clotting process by which platelet plugs are formed and wound healing begins

- Normal Values:
  - 150,000-350,000/microliter

- Abnormal Values:
  - Thrombocytosis - Increased platelet count secondary to iron deficiency, polycythemia vera, neoplasm, inflammation, renal failure, or acute infection
  - Thrombocytopenia - Decreased platelet count secondary to infection, nutritional deficiency, drugs, radiation/chemo, aplastic anemia, HIV, liver disease
Platelets: PT Implications

- Thrombocytopenia: Can result in increased bleeding
  - Bleeding often from mucosal surfaces: nose, GI, uterus, respiratory tract, delayed clotting
  - Spontaneous bleeding occurs with < 20,000
  - Prolonged bleeding after surgery or trauma with < 40,000

- Considerations:
  - > 20,000: Continue with ther-ex w/ or w/o resistance
  - 10,000-20,000: Ther-ex w/o resistance
  - < 10,000 and/or temp > 100.5: Consider holding treatment
Basic Metabolic Panel
What is it?
- Gives indicators of current electrolytes, glucose, and renal functioning.

Includes:
- Sodium
- Potassium
- Chloride
- Carbon Dioxide
- Blood Urea Nitrogen (BUN)
- Creatinine
- Glucose
Sodium (Na+)

- Important electrolyte for nerve conduction, contraction of muscles, and functioning of cells
- Normal Values: Adult 135-145 mEq/L
- Abnormal Values: Changes can cause cells to shrink or swell
  - Hypernatremia: Increased Na+ > 160
    - Excessive water lost from the body with profuse sweating or decreased anti-diuretic hormone resulting in increased Na+ concentration
  - Hyponatremia: Decreased Na+ < 120
    - Excessive infusion/ingestion of water or excessive ADH production resulting in dilution of the blood and low Na+ concentration
- Patients commonly affected: CHF, kidney failure, liver failure, pneumonia, athletes
- Considerations: Mental status changes, weakness, thirst, neurologic dysfunction
Potassium (K+)

- Impacts neuromuscular function; particularly muscle function. The heart muscle is most susceptible!
- Normal Values$^{1,2}$:
  - 3.5-5.0 mEq/L
- Abnormal Values: PT may be contraindicated
  - Hyperkalemia: Increased K+ >5.1
    - Caused by- renal insufficiency/failure, excess vit. D, bone disease, healing fractures, Addison’s Disease
  - Hypokalemia: Decreased K+ <3.2
    - Caused by- diuretics, diarrhea, chronic pyelonephritis, NG suction, metabolic alkalosis (Cushing’s Syndrome)
Potassium: PT Implications

- Considerations: Patients may not be able to participate!
  - Hyperkalemia - Patients may exhibit the following:
    - Early ECG changes
    - Flaccid paralysis
    - Nausea
    - Diarrhea
  - Hypokalemia - Patients may exhibit the following:
    - Decreased muscle strength -> paralysis
    - Abdominal distention
    - Disorientation
    - Respiratory Failure secondary to hypoventilation
    - Muscle twitches and tetany
    - ECG changes – Ventricular Arrhythmias
    - Dizziness
    - Hypotension
Potassium: PT Implications

- Monitor vitals!
  - Take radial pulse for full minute to detect rhythm disturbances
- Pending Discharge?
  - Challenge patient while in safe environment
Chloride

- Electrolyte controlled by the kidneys which indicates hydration and acid/base balance
- Normal Values\(^1\):
  - 98-105 mEq/L
- Abnormal Values:
  - Levels will fluctuate with fluid status
- PT Considerations:
  - Increased: Vomiting
  - Decreased: Anxiety, Dehydration
Carbon Dioxide

- Evaluation of electrolyte and pH status
- Indirect measurement of HCO3 regulated by kidneys
- Normal Ranges:
  - Adult 20-30 mEq/L
- Abnormal Values:
  - May produce alkalosis or acidosis
Carbon Dioxide : PT Implications

- CO2 Retention (Respiratory acidosis)- Your patients may exhibit some of the following:
  - Diaphoresis
  - Headache
  - Tachycardia
  - Disorientation
  - Agitation
  - Cyanosis
  - Lethargy
  - Ventricular Fibrillation
- Example: CO2 retainers- COPD patients
- PT Strategies: Deep breathing activities, upright positioning
Carbon Dioxide: PT Implications

- CO2 Excretion (Respiratory Alkalosis)- your patients may exhibit some of the following:
  - Rapid deep respirations
  - Lightheadedness
  - Muscle twitching
  - Anxiety and Fear
  - Paresthesias
  - Cardiac Arrhythmias

- PT Strategies: Pursed lip breathing, diaphragmatic breathing, relaxation techniques
Blood Urea Nitrogen (BUN)

- Indicates kidney functioning
- Normal Ranges: 8-20 mg/dL
- Abnormalities:
  - Increases indicate renal impairment
  - Patient may need dialysis
- PT Considerations:
  - If the kidneys are not functioning properly to rid the body of waste, your patient may feel like waste!
  - Elevated levels associated with decrease in wound healing.
Creatinine

- A by-product of normal muscle metabolism which is regulated and excreted by the kidneys.

- Normal Range: 0.8-1.2 mg/dL

- Abnormalities:
  - Levels rise with kidney impairment, so the patient may need dialysis
  - Malnutrition decreases creatinine levels

- PT Considerations: If the kidneys are not functioning properly to rid the body of waste, your patient may feel like waste!
Glucose

- Blood sugar level
- Normal Ranges\(^1,4\):
  - 70-110 mg/dL for a fasting test
  - HbA1c test: 4-6%
- Abnormalities
  - Hypoglycemia: Decreased glucose level- insulinoma, starvation, insulin overdose
  - Hyperglycemia: Increased glucose level- DM, acute stress
Glucose: PT Implications

- Considerations:
  - Be sure to consider the time and type of test and the activity surrounding the test
  - < 60: Patients may have low activity tolerance and over-exertion may cause hypoglycemic reaction
    -> shock. It may be advisable for patient to eat something prior to PT.
  - >300: Increased risk of diabetic ketoacidosis -> coma. It may be advisable to hold PT until levels are decreased.
  - Increased blood glucose= Increased risk of ulceration, infection, and impaired wound healing
Nutrition
Serum Albumin

- What is it?
  - Plasma protein produced by the liver
- Normal Values:\(^4\):
  - 3.5-5.5 g/dL
- Abnormal Serum Albumin:
  - Levels fall with protein deficiency and malnutrition
  - Associated w/ longer hospitalization and complications
Serum Albumin: PT Implications

- Positive correlation b/w low serum albumin and pressure ulcer sensitivity. Consider teaching your patient pressure relief techniques and educate!
- Delayed or difficult wound healing
- Does not respond to short term changes in nutritional status, therefore no change will be seen in the value after initiating education or supplementation
Prealbumin

- What is it?
  - Major transport protein
  - Marker for nutritional status
- Normal Value: 16-40 mg/dL
- Abnormal Values
  - Mildly Low 13.6-17.9 mg/dL
  - Moderately Low 10-13.5 mg/dL
  - Severe depletion < 8 mg/dL
Prealbumin: Considerations

- It is a better indicator of the effect of nutritional interventions
- Mortality risk increases as levels drop
Clotting Profiles
Clotting Profiles

- What are they?
  - Test used to determine the ability of initiation of the clotting sequence, to diagnose clotting disorders, and to monitor anti-coagulation therapy.

- Common Tests:
  - Prothrombin Time (PT)
  - Partial Thromboplastin Time (PTT)
  - International Normalized Ratio (INR)
Prothrombin Time

- Screens for bleeding disorder and measures effectiveness of oral anti-coagulant warfarin (Coumadin) oral therapy.
- Reference Range (varies depending on lab)
  - 11-12.5 seconds
- Therapeutic Range
  - 1.5-2 x normal reference range
- Critical Range
  - 3x the control value or greater
International Normalized Ratio

- Ratio of prothrombin time to the reference range of prothrombin time. (Warafin/Coumadin)
- Establishes uniform results between labs
- Normal Reference Range:
  - 0.9-1.1
- Therapeutic Range:
  - 2-3
- Abnormal Range:
  - >3.5
Partial Thromboplastin Time

- Screen for bleeding disorders and measures effectiveness of heparin therapy. (IV or subq)
- Reference Range (Varies depending on lab)
  - 30-40 seconds
- Therapeutic Range
  - 1.5-2.5x the normal reference range
- Critical Range
  - 3x the control value or greater
Coagulation Profiles: PT Implications

- Increased values may indicate increased risk of bleeding or hemorrhaging
  - Modify Treatment
  - Hold Treatment
- Bottom Line: Weigh the risk of treatment with the complications of bed rest. Is there a way to alter treatment to achieve or work towards therapeutic goals while minimizing risk?
Others
Erythrocyte Sedimentation Rate

- **What is it?**
  - Measurement of how fast RBC’s fall in a sample of anticoagulated blood. Non-specific screening tool used to determine the presence or stage of inflammation

- **Normal Values**:  
  - Men: 1-20 mm per hour  
  - Women: 1-15 mm per hour
Sedimentation Rate Considerations

- Elevated levels shown to be sensitive to osteomyelitis and its response to treatment
- Consider for wound healing
Cardiac Enzymes: CPK

- **What is it?**
  - Creatine phosphokinase (CPK-MB): cardiac enzyme that is released into circulation when the myocardium is damaged.
  - Significant for diagnosing MI
- **Normal Values**: 0-5.9 micro liters/liter
- **Abnormal Values**: Enzyme rises 4-6 hours post MI and peaks 12-24 hours post MI. Returns to normal within 48-72 hours
CPK-MB: PT Implications

- Notation of CPK-MB+: indicates acute MI has occurred.
- Acute PT should continue with careful assessment
- Increased monitoring of vital signs
- Consult with MD regarding patient’s cardiac status to allow improved ability to determine patient’s exercise tolerance
Numbers are very objective and clear, however patients and the current and past medical history are not!

Physical Therapists must find a way to keep their patients safe yet help them achieve their goals given the circumstances.

Bottom Line: Assess, Assess, Assess! Use your professional knowledge and judgment!
References/Resources

References
1. Pathology Implication for the Physical Therapist, Goodman and Fuller
2. Lab Values Interpretation Resources 2013 Update- Acute Care Section, APTA
3. Apta Website: http://www.apta.org/Vision/

Resources
- www.labtestsonline.org
- The Merck Manual of Diagnosis and Therapy 19th Edition
Thank you!
Please be sure to fill out your survey!
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