### Laboratory and Hemodynamic References with Therapy Implications

#### Reference Values

<table>
<thead>
<tr>
<th>Sodium</th>
<th>Chloride</th>
<th>Blood Urea Nitrogen (BUN)</th>
<th>Glucose</th>
<th>White count</th>
<th>Hemoglobin</th>
<th>Platelets</th>
</tr>
</thead>
<tbody>
<tr>
<td>[135-145]</td>
<td>[100-108]</td>
<td>[6.0 - 21.0]</td>
<td>70-100</td>
<td>4,000-11,000</td>
<td>12.0-18 g/dL</td>
<td>150k – 350k</td>
</tr>
<tr>
<td>Potassium</td>
<td>CO₂</td>
<td>Creatinine</td>
<td>0.6 – 1.2</td>
<td>0.6 - 1.2</td>
<td>[9.0]</td>
<td>&lt;150k</td>
</tr>
<tr>
<td>[3.8-5.3]</td>
<td>[22-29]</td>
<td></td>
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</tr>
</tbody>
</table>

#### Reference Values Implications

- **Sodium**: Mental status changes, cognitive issues.
- **Potassium**: Guarded treatment, Justify and/or document benefits to offset risk for dysrhythmia or tetany.
- **Glucose**: Pt needs carbohydrates before exercise.
- **HbA1c (A1c)**: Average glycol-hemoglobin over several months.
- **WBC (ANC)**: Initiate neutropenic precautions, however pt may ambulate in hall.
- **Hemoglobin**: Male 13-18 g/dL, Female 12-16 g/dL.
- **Hematocrit**: Male 42-52%, Female 37-48%.
- **Platelets**: 150k-450k.
- **BUN**: 6.0-21.0 mg/dL.
- **Creatinine**: Any renal or metabolic impairment Not influenced by dietary intake.
- **Magnesium**: MgD (deficiency) lethargy, dysrhythmias, confusion, constipation, potential nystagmus.
- **Digoxin**: Range 1.0 to 2.5 nmol/l (0.5-2.0 ng/mL).

#### Hepatic Specific Tests

- **ALP**: Enzyme produced in Liver and bone. ↑’s with normal or abnormal bone growth/puberty, liver damage. IV Albumen can ↑ 5-10 X normal.
- **AST**: 8-12 hours after infection w/peak 12-24 hours. ↑ 24-48 hours after MI Normalizes after 3-8 days ↑ seen in impaired hepatocytes, myocardial cells, erythrocytes, or skeletal muscle cells.
- **ALT**: ↑ seen in impaired hepatocytes, myocardial cells, erythrocytes, or skeletal muscle cells.
- **Bilirubin**: Total (Conjugated) Water soluble excreted in Bile. Non-specific ↑ seen in impaired hepatocellular damage and extra-hepatic biliary tract obstructions. > 1.2 Total Bilirubin – Jaundice noted ↑ unconjugated – likely obstructive, common bile duct, CA. May lead to ↑ Total/Conjugated
- **Ammonia**: Increased levels may cause encephalopathy, hyper-reflexic muscle action, rigidity
- **Serum Albumin**: Impaired by malnutrition, malabsorption, liver or kidney disease and other chronic diseases.
- **Serum Pre-albumin**: Impaired by malnutrition, malabsorption, liver or kidney disease and other chronic diseases.

#### Visceral Protein Levels (Nutrition)

- **Serum Albumin**: 3.5-5.0 g/dL
- **Serum Pre-albumin**: 16-30 g/dL

#### Tacrolimus/Prograf FK-506

- **Transplant immunosuppressant**: N = 6-15ng/ml severe liver toxicity as levels ↑

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Cardiac Specific Measurements

- **Troponin-I**: N < 0.03 ng/mL
  - > 0.10 ng/mL ~ Abnormal and very specific for cardiac ischemia, noted after 6 hours of insult elevated up to 3 days
- **Troponin-T**: N < 0.03 ng/mL affected by renal compromise
- **C-Reactive Protein (hs-CRP)**: cardiovascular risk
  - < 1.0 mg/L – low risk
  - 1.0-3.0 mg/L – moderate risk
  - > 3.0 mg/L – High risk, poor outcomes

- **BNP**: B type Natriuretic Peptide (NYHA scale)
  - BNP levels < 100 pg/mL: No heart failure
  - BNP levels 100-300 pg/mL: Heart failure present
  - BNP levels 300-600 pg/mL: Mild heart failure
  - BNP levels 600-900 pg/mL: Moderate heart failure
  - BNP levels > 900 pg/mL: Severe heart failure

- **CK**: Creatinine Phosphokinase
  - N=30-170 IU/L
  - Different substrates of CK found in heart, skeletal and brain tissues.
- **CK1 - BB**: Brain Tissue
  - ↑ with Anoxia, CVA, SAH, Brain CA, TBI
- **CK2 - MB**: Cardiac Muscle
  - *May ↑ 6x normal following MI, peak 18-24 hours
- **CK3 - MM**: Skeletal Muscle
  - *Can ↑ with IM injection or rigorous exercise

- **P1GF**: Placental Growth Factor
  - >27.0 ng/L indicates marked ↑ risk

- **CD-40 Ligand**: Associated with ↑ risk CVD

- **Serum amyloid A** levels > 0.3 mg/dL
  - Indicative of poorer outcome

- **Homocysteine**: N= 0-9 ug/g creatinine

- **Fibrinogen**: N= 220-400 mg/dL

Bleeding Ratio/Viscosity

<table>
<thead>
<tr>
<th>INR (Coumadin)</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Normalized Ratio</td>
<td>INR &gt; 4 Utilize caution, justify benefits vs. risks. Consider contacting MD for approved tx plan.</td>
</tr>
<tr>
<td>INR ~ 1.0</td>
<td>Normal</td>
</tr>
<tr>
<td>INR ~ 2.0-3.0</td>
<td>Therapeutic range for pts at risk for DVT/clots</td>
</tr>
<tr>
<td>INR ~ 2.5-3.5</td>
<td>Therapeutic for pts w/mechanical heart valves</td>
</tr>
</tbody>
</table>

- **PT**: Prothrombin Time (Coumadin)
  - N= 11.8-14.2 sec
  - (Sensitive to specific reagents)

- **aPTT**: activated Partial Thromboplastin Time (Heparin)
  - N= 24-34 seconds

- **D-Dimer**: > 400-500 ng/ml (+ DVT)
  - Sensitive to thrombosis if no anti-coagulant present.

Cardiopulmonary and ICU Specific Measurements

<table>
<thead>
<tr>
<th>paO2 75-105mmHg</th>
<th>FiO2 – fraction of inspired air (n=air @ sea level ~21%)</th>
</tr>
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<tbody>
<tr>
<td>paCO2 33-44 mmHg</td>
<td>PaO2/FiO2 (P/F) &lt;300 mmHg (40 kPa) = ALI</td>
</tr>
<tr>
<td>pH 7.35-7.45 (&lt; 7.25 acidosis)</td>
<td>PaO2/FiO2 (P/F) &lt;200 mmHg (26.7 kPa) = ARDS</td>
</tr>
</tbody>
</table>

- **Arterial Pressure**
  - 120/80 mmHg

- **PEEP** initial 5cm H20, increased by 2-3cm increments

- **Cardiac Index**: 3.5L/Min/m²

- **PA**: 15-25/6-12mmHg

- **CO**: 5L

- **MAP**: 100 mmHg

- **PAWP**: 4-12 mmHg

- **CVP**: 6-12 mmHg

- **Ejection Fraction (EF)** (N= 55-70%)

- **Intracranial Pressure (ICP)**: Normal: 5-13 mmHg

- **SVO2**: 60-80%

- **ICP**: 
  - > 20 mmHg (GCS 13-15) Drowsy and confused
  - > 30 mmHg (GCS < 8) Severe brain swelling

- **Double Product (mVO2)**: HRxSBP

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- **Homocysteine**: N= 0-9 ug/g creatinine

- **Fibrinogen**: N= 220-400 mg/dL

Acute Stroke Outcome Measures

| NIHSS Score (0-42, Normal = 0) Maximum for aphasic, hemianopsia, and hemiplegic patients is 31 |
| Poor Outcomes > 17 + A-Fib in 1st 3 hours; > 22 @ 24 hours; > 16 @ 7-10 days |
| Rankin Score (0-6 point Scale ~ Normal = 0) > 3 = poor outcome |

- **Barthel Index – morbidity prediction**
  - Mildly Disabled: Barthel Index > 60
  - Moderately Disabled: Barthel Index 41-60
  - Severely Disabled: Barthel Index < 41

Precautions with Therapy and/or Exercise

<table>
<thead>
<tr>
<th>Sustained SpO2 oximetry &lt; 88% (hypoxia)</th>
<th>Respiratory rate &gt; 40 breaths/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR &gt; 75% age predicted max (APM) at rest</td>
<td>Cardiac index &lt; 2 L/min/m²</td>
</tr>
<tr>
<td>Exercise induced hypotension (SBP or DBP) drop 10-20mmHg</td>
<td>CVP &lt; 10 mmHg or &gt; 20 mmHg (VAD Patients)</td>
</tr>
<tr>
<td>Systolic blood pressure &gt; 200 mmHg or MAP &gt;115mmHg</td>
<td>New onset of atrial fibrillation</td>
</tr>
<tr>
<td>Diastolic blood pressure &gt; 115 mmHg</td>
<td>Copious drainage from incision site</td>
</tr>
<tr>
<td>Hypotension: SBP &lt; 90 mmHg or MAP &lt; 60 mmHg</td>
<td>Frequent PVC’s (&gt; 6 per minute)</td>
</tr>
<tr>
<td>D-Dimer &gt; 400-500 ng/ml (+ DVT)</td>
<td>Diaphoresis, pallor or acute confusion</td>
</tr>
</tbody>
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<tr>
<th>Sustained SpO2 oximetry</th>
<th>Ventricular tachycardia</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR &gt; 75% age predicted max (APM) at rest</td>
<td>Acute headache</td>
</tr>
<tr>
<td>Exercise induced hypotension (SBP or DBP) drop 10-20mmHg</td>
<td>Visual disturbances or changes</td>
</tr>
<tr>
<td>Systolic blood pressure &gt; 200 mmHg or MAP &gt;115mmHg</td>
<td>Unstable cardiac arrhythmias</td>
</tr>
<tr>
<td>Diastolic blood pressure &gt; 115 mmHg</td>
<td>Marked dyspnea or fatigue</td>
</tr>
</tbody>
</table>