Adult CCRN/CCRN-E/CCRN-K Certification Review Course: Hematology/Immunology

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Disclosures
- Nothing to disclose
Hematology and Immunology: Physiology and Pathophysiology

Hematopoietic System
- Purpose
- Location
- Composition
- Components
- Function and assessment

Bleeding Disorders
- Vessel integrity disruption
- Platelet disorders
- Coagulation disorders
Disseminated Intravascular Coagulation (DIC): Definition

- Secondary disorder
- Overstimulation of bleeding and thrombosis
- Life-threatening
- Acute and chronic syndromes

Risk Factors

- Tissue damage
- Obstetric complications
- Shock states
- Massive blood or volume resuscitation
- Cancers
- Hematologic disorders
- Specific system dysfunction

Common Response

- Tissue damage
- Platelet damage
- Endothelial damage
Pathophysiology
- Tissue damage
- Healing stimulated (clotting)
- Initial microvascular thrombi
- Fibrinolytic mediators released
- Hemopoietic chaos

Pathophysiology (cont)
- Lyse all clots
- Ability to clot is lost
- Bleeding state
- Consumptive coagulopathy

Laboratory Values

<table>
<thead>
<tr>
<th>Test</th>
<th>Elevated</th>
<th>Decreased</th>
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<tbody>
<tr>
<td>Hemoglobin</td>
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<td>Hematocrit</td>
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<td>Platelets</td>
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<td>Prothrombin time (PT)</td>
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<td>Partial thromboplastin time</td>
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<td>Fibrinogen</td>
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<td>Fibrin degradation products fibrin split products (FSP)</td>
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<td>D-dimer</td>
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Treatment
- Support/treat primary problem
- Early recognition
- Decrease bleeding risk
- Treat pain
- Transfusion

Treatment (cont)
- Vitamin K
- Heparin
- General management

Review Questions
**Question 1**

A patient with traumatic brain injury is suspected to be going into DIC. Laboratory results consistent with this diagnosis would be:

A. Low PT and activated partial thromboplastin time (aPTT), high platelet count, high fibrinogen
B. Low bleeding time (BT), low hemoglobin, high PT, high aPTT
C. Low platelet count, low fibrinogen, high PT, high aPTT
D. Low fibrinogen, low FSP, high platelet count, high hemoglobin

**Question 1—Rationale**

A patient with traumatic brain injury is suspected to be going into DIC. Laboratory results consistent with this diagnosis would be:

C. Low platelet count, low fibrinogen, high PT, high aPTT
   - Platelets, fibrinogen, clotting factors have been used to make clots
   - Low PT and aPTT, high platelet count, high fibrinogen—DIC would present with low platelet and fibrinogen
   - Low BT, low hemoglobin, high PT, high aPTT—DIC would present with low BT
   - Low fibrinogen, low FSP, high platelet count, high hemoglobin—DIC would present with high FSP and low PCT and Hgb

**HELLP**

- Hemolysis
- Elevated
- Liver enzymes
- Low
- Platelets
HELPP: Pathophysiology

- Preeclampsia
- Spastic vasoconstriction
- Fibrin deposits in capillaries

HELPP: Treatment

- Prevent seizures
- Fluids and electrolytes
- Blood products if needed
- Control blood pressure
- Dexamethasone

HELPP: Treatment (cont)

- Deliver the baby
- Monitor liver and renal function
- Plasma exchange?
- Liver transplantation?
- Risk for future pregnancies?
Heparin-induced Thrombocytopenia (HIT)

- Acquired allergy to heparin
- Antibodies to heparin are produced
- When heparin is administered, the antibodies “attack” heparin and thrombocytes

Heparin-induced Thrombocytopenia (HIT) (cont)

- Decreased platelet count
- Treatment:
  - Stop heparin
  - Administer nonheparin anticoagulant
  - Administer platelets if needed

Thrombotic Thrombocytopenic Purpura

- Decreased platelet count
- Hemolytic anemia
- Classically presents with neurologic symptoms or renal dysfunction and fever
Thrombotic Thrombocytopenic Purpura (cont)

- Difficult diagnosis
- Causes
- Treatment
  - Stop cause
  - Administer platelets, oprelvekin (Neumega)
  - Plasmapheresis

Idiopathic Thrombocytopenic Purpura

- Thrombocytopenia <150,000
- Unable to determine cause

Anemia - Etiologies

- Blood Loss
- Under Production
  - Malnutrition
  - Chronic Illness
  - Medications
  - RBC Destruction
Anemia Presentation
- Tachycardia
- Rapid Respiratory Rate
- Weak Pulses
- Orthostatic Hypotension
- Decreased UO
- Decreased LOC
- Hypovolemic Shock

Anemia Tx Options
- Tx the Underlining Cause
- Packed Red Blood Cells
- Recombinant Human Erythropoietin
- Supplemental Vitamins and Minerals
- Blood Conservation
- Maintain Hgb 7-9 (non bleeding pt)

Thrombocytopenia
- < 150,000
- Causes: Autoimmune Dis, AIDS, Depressed Bone Marrow, DIC, HIT, Bleeding, Meds, Hemodilution
- Treatment: Administer Platelets, Oprelvekin (Neumega)
**WBC Differential**

- Polymorphonuclear (PMN) or Granulocyte Leukocytes
  - Neutrophils: 45%-75% 2,000 – 7,000
  - Eosinophils: 0%-4% 0 – 400
  - Basophils: 0%-3% 0 - 200

- Defense Against
  - Infection
  - Hypersensitivity
  - Disease Processes

**NEUTROPHILS**

- Most Abundant WBC Type
- First Line of Defense
- Initiate Phagocytosis
- The Mature Nucleus has Segments (segs)
- Immature Nucleus has Bands
- Bands = < 5% of WBC count
- “Shift to the Left”

**Neutropenia**

- Neutropenia < #
  - Viral Diseases
  - Few Bacterial Infections
  - Iron and Aplastic Anemia
  - Overwhelming Infection
  - Bone Marrow Depression
  - Agranulocytosis
    - # < 500
Immunosuppression: Etiology

- Primary NEUTROPENIA
- Immunosuppressive Agents (chemo, anti-rejection)
- Radiation Therapy
- Autoimmune Disorders
- Viral Infections (HIV/AIDS)
- Genetic Disorders
- Diseases/Disorders (DM, ETOH abuse)
- Chronically Critically Ill and Septic

Immunology/Oncology

- Goals of Therapy
  - Safety
  - Prevention of Opportunistic Infection
  - Monitoring and Treatment of Infection
  - General Support

Review Questions
Question 2

Thrombocytopenia may develop as the result of:
A. A drug reaction
B. A congenital problem
C. An allergic reaction
D. All of the above

Question 2—Rationale

Thrombocytopenia may develop as the result of:
D. All of the above
- A drug reaction (eg, HIT)
- A congenital problem (eg, TTP)
- An allergic reaction (eg, HIT)

Question 3

Which of the following assessment information would be consistent with a low platelet count from HIT?
A. The presence of metabolic acidosis
B. The presence of acute thrombosis development
C. Elevation in ALT and AST
D. Decrease in neutrophils
Question 3—Rationale

Which of the following assessment information would be consistent with a low platelet count from HIT?

B. The presence of acute thrombosis development
   - In HIT, there is a low platelet count and thrombosis development due to the antibody to the heparin antigen (protein) destroying platelets
   - The presence of metabolic acidosis—Met acidosis could cause a low platelet count, but not thrombosis development
   - Elevation in ALT and AST—Liver dysfunction/failure typically also presents with low platelets, but not thrombosis
   - Decrease in neutrophils—Thrombocytopenia and neutropenia frequently present with bone marrow suppression, not with HIT

Summary