CRUNCH TIME

BLOOD n' STUFF

Allergies & Anaphylaxis

Jennifer Farah, MD, and Mel Herbert, MD

Background

- Immunoglobulin E (IgE)-mediated immediate-type hypersensitivity reaction (type 1)

Clinical Findings

- Wide-ranging symptoms and signs
    - Starts with skin symptoms
        - Generalized warmth
        - Pruritus
        - Flushing
        - Urticaria
    - Other symptoms
        - Angioedema
        - Wheezing
        - Abdominal distress
        - Gastrointestinal bleeding
    - Might have nausea/vomiting with no respiratory symptoms
- Signs
    - Tachycardia
    - Hypotension
    - Tachypnea
    - Stridor

Management

- Aggressive airway management
- Oxygen
- Fluids
- H_1 and H_2 blockers
- Steroids
- Epinephrine for moderate to severe symptoms

How You Will Be Tested

- Remember the type of hypersensitivity reaction this is (type 1)

Angioedema

Jennifer Farah, MD, and Mel Herbert, MD

Background

- Three main etiologies:
    - Allergic
    - Hereditary angioedema (HAE)
    - Medication induced (typically angiotensin-converting enzyme [ACE]-inhibitor)

Clinical Findings

- Edema of the face, airway, extremities

Management

- Airway protection is the biggest concern
- C1-INH (inhibitor) concentrate: for HAE
- Fresh frozen plasma (FFP): some evidence for use in HAE and medication-induced angioedema
    - Contains enzyme that degrades bradykinin but also contains bradykinin
- Icatibant: for HAE, controversial for medication-induced angioedema
    - Bradykinin 2 receptor inhibitor
- Ecallantide: for HAE; controversial for medication-induced angioedema
    - Inhibits kallikrein (the enzyme that converts high-molecular-weight kininogen to bradykinin)
- Treatments for anaphylaxis are typically given in case there is an allergic component
    - Epinephrine, steroids, antihistamines

How You Will Be Tested

- Know the most classic drugs associated with this (ACE-inhibitors)

Aplastic Anemia

Gita Pensa, MD; Jessica Mason, MD; and Jessie Werner, MD

Background

- Bone marrow failure - body does not produce red blood cells
- Causes
    - Medications/toxins
        - Chloramphenicol classic
    - Radiation
    - Leukemia/marrow infiltration
    - HIV
    - Parvovirus B19
        - Classic in patients with sickle cell disease
    - Idiopathic

Clinical Findings

- Reticulocyte count will be low or zero
- Haptoglobin will be normal because this is not a hemolytic issue

How You Will Be Tested

- Remember that Parvovirus B19 can cause aplastic anemia in sickle cell disease

Blood Products Part 1 (Cryoprecipitate & Recombinant Factor VIIa)

Mel Herbert, MD, and Stuart Swadron, MD

Cryoprecipitate

Background

- Frozen blood product from blood plasma
- Fresh frozen plasma (FFP) is centrifuged and the precipitate collected
- Transfused as 4-6 unit pool (pooled from multiple units of FFP)
- High levels of factor VIII
- ABO testing is needed
    - Full crossmatch is not
- Current uses
    - Back-up in hemophilia if factor concentrates unavailable
    - Disseminated intravascular coagulation
    - Von Willebrand disease
    - Uremic bleeding
    - Fibrinogen disorders
    - Bleeding related to liver disease

How You Will Be Tested

- Know when to use it

Recombinant Factor VIIa

Background

- Activated form of factor VII

How You Will Be Tested

- Side effect profile → Causes arterial thrombosis

Blood Products Part 2 (PRBCs & Platelets)

Gita Pensa, MD, and Jessica Mason, MD

Packed Red Blood Cells (PRBCs)

Background

- 1 unit ↑ hemoglobin (Hgb) 1 g/dL (adults)
- Transfusing 10-15 mL/kg should increase Hgb by 2-3 g/dL (pediatrics)
- Must crossmatch pretransfusion
- ↓ transfusion reaction rate in type-specific blood

Clinical Findings

- Give O RhD negative PRBCs to
    - Patients with O negative blood
    - Women who might be/are pregnant
    - Emergency cases if blood-group testing cannot be done
- Can give O RhD positive PRBCs to
    - Men
    - Post-menopausal women

How You Will Be Tested

- Know who gets RhD positive

Platelets

Background

- Crossmatch pretransfusion
- Each unit contains platelets from up to 8 donors

Clinical Findings

- 1 unit ↑ platelet count by 50,000
- Apheresis from single donor
    - ↓ transfusion reaction
    - ↓ infection

How You Will Be Tested

- When to transfuse based on platelet counts:

- If no bleeding and <10,000
- If need invasive procedure and <20,000
- If bleeding and <50,000
- If need cardiac or neuro surgery and <100,000

Blood Products Part 3 (Prothrombin Complex Concentrate)

Gita Pensa, MD, and Jessica Mason, MD

Background

- Concentrated forms of vitamin K–dependent clotting factors
    - II, VII, IX, X
- Two formats
    - 4-factor PCC = factors II, VII, IX, X
    - 3-factor PCC = II, IX, X
- Preferred over fresh frozen plasma (FFP) in warfarin-related bleeding (4-factor PCC preferred)

Clinical Findings

- Reverses international normalized ratio (INR) in 15 to 30 min
- Not shown to significantly increase risk of thrombosis
- PCC is preferred to FFP because it isn't frozen (does not require thawing), no ABO incompatibility issues (no cross-matching), lower volume

How You Will Be Tested

- Know which factors it contains and when to use it

Blood Transfusion Reactions

Jennifer Farah, MD; Mel Herbert, MD; and Jessie Werner, MD

Background

- There are several types of reactions that vary in symptoms and time of onset
- Febrile transfusion reaction (least concerning) to transfusion-related acute lung injury/transfusion-associated circulatory overload (TRALI/TACO) (more concerning)

Management

- Stopping the transfusion is generally the right treatment

How You Will Be Tested

- Know the specifics of the various reaction types

Febrile Reaction

Background

- Recipient antibodies react to the donor leukocytes
- Usually benign
- Most COMMON transfusion reaction

Clinical Findings

- Fevers and chills within 1 h
- Non-hemolytic

Management

- Treat with antipyretics
- Stop the transfusion until you rule out an acute hemolytic reaction
- Can use leukocyte-reduced red cells

IgA-Mediated Transfusion Reaction

Background

- Allergic-type reaction

Clinical Findings

- May progress to anaphylaxis

Management

- Stop Transfusion
- Treat allergic reaction
- Require washed packed red blood cells (PRBCs) in the future

Delayed Extravascular Transfusion Reaction

Background

- Delayed - Days to weeks post-transfusion

Clinical Findings

- Anemia
- Jaundice
- Fevers

Management

- Most don't require specific treatment
- If significant anemia → Ag-negative transfusions in the future

Acute Intravascular Hemolytic Reaction

Background

- ABO incompatibility (mismatched blood)
- Can progress to disseminated intravascular coagulation (DIC) and shock

Clinical Findings

- Immediate onset of
    - Fever
    - Nausea and vomiting
    - Diffuse pain

Management

- Stop the transfusion
- Replace IV tubing (contains blood)
- IV fluids
- Diuretics
- Corticosteroids

Transfusion-Related Acute Lung Injury (TRALI)

Background

- Within 6 h of transfusion
- Multifactorial; neutrophil-mediated process

Clinical Findings

- Clinical presentation similar to acute respiratory distress syndrome (ARDS)
- Hypotension
- Fever
- Diffuse infiltrates on chest X-ray (CXR), not volume overload

Management

- Treat with oxygen, airway, and pressor support
- Avoid diuretics

Transfusion-Associated Circulatory Overload (TACO)

Background

- Due to volume overload

Clinical Findings

- Respiratory distress due to acute pulmonary edema
- Hypertension (as opposed to hypotension in TRALI)
- Leukopenia
- Pulmonary edema on CXR
- Elevated jugular vein distension

Management

- Stop the transfusion

- Supportive care
- Consider diuretics

Transfusion-Associated Graft-Versus-Host Disease

Background

- Associated with Immunocompromised states
- Prevent by using irradiated blood products

Management

- Stop the transfusion
- Supportive care

Disseminated Intravascular Coagulation (DIC)

Vanessa Cardy, MD, and Gita Pensa, MD

Background

- Acquired life-threatening bleeding disorder with
    - Bleeding
    - Clotting
- Causes
    - Infection (most common)
    - Trauma
    - Crush injuries
    - Burns
    - Acute respiratory distress syndrome
    - Transfusions
    - Pregnancy
    - Envenomation
    - Post-op
    - Heat stroke

Clinical Findings

- Purpura and petechiae
- Mucosal bleeding
- Bleeding from venipuncture sites
- Clots in end-circulatory regions (nose, genitals, extremities) and central nervous system
- Labs
    - ⬆ prothrombin time and activated partial thromboplastin time
    - ⬆ thrombin time
    - ⬇ fibrinogen and platelets if bleeding
    - ⬆ D-dimer if clotting

Management

- Airway, breathing, circulation
- Supportive care
- Fresh frozen plasma/cryoprecipitate/vitamin K/folate

How You Will Be Tested

- Be able to recognize this from labs

Dyshemoglobinemias Overview

Gita Pensa, MD, and Jessica Mason, MD

Background

- Three main types
    - Carboxyhemoglobinemia (CO)
    - Methemoglobinemia (Met)
    - Sulfhemoglobinemia (Sulf)
- Functional alteration of hemoglobin (Hgb) molecule ➔ cannot carry oxygen properly

Clinical Findings

- Similarities
    - Hgb can't bind oxygen
    - Co-oximetry for diagnosis
    - Pulse oximetry is unreliable
    - Skin changes color
        - Blue = Met
        - Cherry red = CO
        - Sulf-blue/gray (and blood is green!) = Sulf
- How they differ
    - Etiology
        - CO ➔ binds to Hgb more strongly than O_2
        - Met ➔ ferric instead of ferrous, can't carry oxygen
        - Sulf ➔ sulfur binds to Hgb, permanently oxidizes the iron

Management

- CO ➔ oxygen
- Met ➔ methylene blue
- Sulf ➔ no specific antidote, resolves with red blood cell turnover, transfuse if severe

How You Will Be Tested

- Know the findings for diagnosis and the antidotes

Hemolytic Anemia Overview

Gita Pensa, MD, and Jessica Mason, MD

Background

- Consider if anemia **and** jaundice
- Microangiopathic hemolytic anemia (MAHA) occurs with
    - Thrombotic thrombocytopenic purpura
    - Hemolytic uremic syndrome
    - Disseminated intravascular coagulation
    - HELLP syndrome (hemolysis, elevated liver enzymes, low platelet count)
- Transfusion reaction can lead to
    - Severe hemolysis
    - Multi-organ failure

Clinical Findings

- Complete blood count findings:
    - Schistocytes (intravascular hemolysis)
    - Spherocytes (extravascular hemolysis)

How You Will Be Tested

- This may be a second-order question:
    - Know how to diagnose hemolytic anemia based on labs
    - Then, remembering which illnesses are associated with a hemolytic anemia can help lead you to a diagnosis on the test

Specific Hemolytic Anemias (G6PD Deficiency, PNH, Malaria, Babesiosis, Sickle Cell, Thalassemia)

Gita Pensa, MD, and Jessica Mason, MD

Other conditions that lead to hemolytic anemia:

Glucose-6-phosphate dehydrogenase (G6PD) deficiency hemolytic crisis

Background

- Can be triggered by
    - Infection
    - Oxidant drugs (sulfa, nitrofurantoin, pyridium, quinolones)
    - Metabolic acidosis
    - Fava beans

Paroxysmal nocturnal hemoglobinuria

Background

- Blood cells are too sensitive to complement

Clinical Findings

- Hemolysis

Management

- Prevent this by giving washed packed red blood cells

Malaria (mosquitoes, travelers) and Babesia (ticks)

Background

- Leads to Red cell destruction and splenic sequestration

Clinical Findings

- May see Intravascular and extravascular hemolysis

Hemoglobinopathies (sickle cell, thalassemia)

How You Will Be Tested

- Likely a question on G6PD deficiency. Know the triggers

Hemophilias

Vanessa Cardy, MD, and Gita Pensa, MD

Background

- X-linked recessive coagulation factor deficiencies
- Factor VIII (A)
- Factor IX (B)

Clinical Findings

- Easy bruising
- Bleeding into joints
- Muscle hematomas
- Slow, severe bleeds after minor events
- Labs
    - Assume factor VIII level is zero if it cannot be measured

Management

- Airway, breathing, circulation
- Replace factors
- Control bleeding
- Can develop inhibitors (antibodies) to the deficient factor
    - Factor replacement → anaphylaxis

How You Will Be Tested

- Know which factor is missing in each type and how to manage

Henoch-Schonlein Purpura (HSP) / IgA Vasculitis

Gita Pensa, MD; Jessica Mason, MD; and Jessie Werner, MD

Background

- Immunoglobulin A vasculitis (current name)
- Children aged 3-15 y = 90% of cases
- Adults = 10% of cases
- One-third of patients can have a recurrence, most often within 6 mo

Clinical Findings

- Classic tetrad:
    - Palpable purpura
    - Arthritis/arthralgias
    - Renal disease
        - Hematuria
        - Proteinuria
        - More severe in adults
    - Abdominal pain (can cause intussusception, kids > adults)
    - Normal platelets

Management

- Generally resolves on its own, need close follow-up of
    - Hydration status
    - Analgesia
- Admit if patient in severe pain or is sick

How You Will Be Tested

- Recognize the classic tetrad

Hypercalcemia of Malignancy

Vanessa Cardy, MD, and Gita Pensa, MD

Background

- May be from
    - Secretion of parathyroid hormone-related protein (PTHrP)
    - Destruction of bone
    - 1,25-Dihydroxy vitamin D (calcitriol)

Clinical Findings

- Depends on acute vs chronic rise in calcium levels
- Classically
    - Stones
    - Bones
    - Abdominal groans
    - Psychiatric moans
- Tests
    - Calcium level
        - Calculate total serum calcium
            - Corrected calcium = [0.8 × (4 − Albumin g/dL)] + serum Ca mg/dL
- ECG changes
    - Shortened QT
    - ST depression
    - Atrioventricular (AV) blocks

Management

- IV normal saline (NS)
- IV bisphosphonate
- Calcitonin subcutaneous or intramuscular
- Consider hemodialysis if
    - Renal failure
    - Altered mental status change
    - Cannot tolerate NS infusion

How You Will Be Tested

- Know the causes and management

Hyperviscosity Syndrome

Vanessa Cardy, MD; Gita Pensa, MD; and Jessie Werner, MD

Background

- Hyperviscosity syndrome is caused by microvascular sludging due to excess cells; it leads to stasis, impaired microcirculation, and impaired tissue hypoperfusion
- Can be a sign of underlying malignancy (multiple myeloma, leukemia, polycythemia vera, Waldenström's macroglobulinemia)
- Most common cause is Waldenström's macroglobulinemia

Clinical Findings

- Mucosal bleeding
- Visual changes
    - On fundoscopic exam, you may see retinal hemorrhages, exudates, and "sausage-link vessels"
- Neuro findings (headache, dizziness)
- Labs
    - Complete blood count
    - Blood smear
        - See Rouleaux formation (aggregation of cells like a stack of coins)
    - Serum protein electrophoresis (SPEP)

Management

- Phlebotomy → 2 units
- IV hydration if low Glasgow coma score
- Plasmapheresis or leukapheresis
- Chemo

How You Will Be Tested

- Know that Waldenström's macroglobulinemia is the most common cause

Iron Deficiency

Gita Pensa, MD, and Jessica Mason, MD

Background

- Most common anemia in women aged 15-50 y
- Microcytic anemia differential diagnosis
    - Thalassemias
    - Sideroblastic anemias
    - Anemia of chronic disease

Clinical Findings

- Depletion of iron stores ➔ low mean cell volume (MCV)

Management

- Minor-moderate
    - Outpatient iron therapy
- Severe
    - Order labs from ED
    - Consider transfusion

How You Will Be Tested

- Differentiate iron deficiency anemia from other forms of anemia (eg, hemolytic)

Idiopathic Thrombocytopenic Purpura (ITP)

Vanessa Cardy, MD; Gita Pensa, MD; and Jessie Werner, MD

Background

- Immune-related REMOVAL of platelets, normal platelet FUNCTION
- Diagnosis of exclusion
- Self-limited in kids
    - Peaks at age 2-6 y
    - Most common hemorrhagic condition
- Chronic in adults
    - Peaks at age 20-50 y

Clinical Findings

- Petechiae
- Gingival bleeds
- Epistaxis
- Genitourinary/gastrointestinal bleeding
- Consider obtaining head CT for intracranial hemorrhage if platelets <10,000

Management

- Treat
    - If platelets <10,000 and no bleeding
    - If platelets <50,000 and signs of bleeding
- Pediatric cases
    - Generally don't need active treatment
- Adults
    - Prednisone
    - IV immunoglobulin (IVIG; second line)
    - Referral if refractory

How You Will Be Tested

- Recognize this as a diagnosis and know how to treat it

Leukemia

Vanessa Cardy, MD; Gita Pensa, MD; and Jessie Werner, MD

Background

- Acute myeloid leukemia (AML) and chronic lymphocytic leukemia (CLL) are most common types in adults

Clinical Findings

- B symptoms (fever, weight loss, drenching night sweats)
- Petechiae
- Easy bleeding
- Complete blood count to assess
    - White blood cell count
    - Blasts
    - Anemia
    - Thrombocytopenia

Management

- May need bone marrow biopsy to confirm diagnosis
- Refer to hematology/oncology

How You Will Be Tested

- Know the most common types

Leukopenia

Vanessa Cardy, MD; Gita Pensa, MD; and Jessie Werner, MD

Background

- Low white blood cell count caused by decrease in either
    - Neutrophils or
    - Lymphocytes
- Causes
    - Medications
    - Viruses
    - Leukemia
    - Chemotherapy
    - Radiation

Clinical Findings

- Key fact is the absolute neutrophil count (ANC number)
    - Mild: 1,000-1,500
    - Moderate: 500-1,000
    - Severe: <500
- ↑ Risk of infection

Management

- Supportive care
- Isolation as needed

How You Will Be Tested

- Know how to calculate an ANC

Lymphoma

Vanessa Cardy, MD; Gita Pensa, MD; and Jessie Werner, MD

Hodgkin Lymphoma (less common than non-Hodgkin Lymphoma)

Background

- Lymphoid malignancies
- Peaks
    - Young adults
    - Adults >50 y

Clinical Findings

- B symptoms (fever, weight loss, drenching night sweats)
- Painless lymphadenopathy (neck/supraclavicular)
- Tests
    - Chest X-ray (CXR) → mediastinal nodes on CXR
    - Basic labs
    - Lymph node biopsy
    - Look for **Reed-Sternberg cells** (owl eye cells)

Management

- Highly curable disease
- Radiation/oncology consults

Non-Hodgkin Lymphoma (NHL)

Background

- Usually elderly
- Lymphoid malignancies
- ↑ Rates extranodal disease

Management

- Aggressive NHL → highly curable with aggressive treatment
- Steroids if mass effect

How You Will Be Tested

- Know non-Hodgkin is more common

- Reed-Sternberg cells = Hodgkin

Megaloblastic Anemia

Gita Pensa, MD, and Jessica Mason, MD

Background

- B_{12}/folate deficiency → classic cause
- Folate takes months to use up, B_{12} takes years
- Alcoholism/liver disease also cause macrocytosis

Clinical Findings

- Macrocytic red cells
- Neurologic symptoms with anemia

Management

- Vitamin supplementation

Methemoglobinemia

Vanessa Cardy, MD, and Jessica Mason, MD

Background

- Ferrous iron converted to ferric iron
    - Ferric form cannot bind O_2

Clinical Findings

- Vague neuro symptoms
- Tachypnea
- Tachycardia
- Anxiety
- Blue skin (cyanosis)
- O_2 saturation → 80%-85%
    - Unaffected by O_2 therapy
    - Actual O_2 level could be even lower

Management

- Treat “Blue with Blue”
    - Methylene blue 1-2 mg/kg IV

How You Will Be Tested

- A patient who is hypoxic and does not improve with oxygen

Multiple Myeloma

Vanessa Cardy, MD, and Jessica Mason, MD

Background

- Plasma cell cancer

Clinical Findings

- Back/bony pain
- Anemia
- Renal insufficiency
- Tests
    - Complete blood count
        - Anemia
    - Renal function (they get failure)
        - Light chain casts and nephropathy
- Protein and albumin ratio increased
    - Serum protein electrophoresis (SPEP)
        - Abnormal spikes
    - Bone survey
        - Lesions
- Bence-Jones protein in urine
- Hypercalcemia

Management

- Hematopoietic cell transplant
- Bisphosphonates
- Physical activity for bone health
- Bone health promotion

Neutropenic Fever

Vanessa Cardy, MD, and Jessica Mason, MD

Background

- Suspect in cancer patients undergoing treatment
- This is an emergency
- Neutrophils nadir → 5-10 d after chemo
    - Start to recover 5 d later
- Risk of occult infections
    - Fully examine body, lines, catheters
    - Avoid rectal exam, temperature, or medications until antibiotics onboard

Clinical Findings

- Diagnosis
    - Temperature >38°C for 1 h or
    - Single temperature >38.3°C with absolute neutrophil count <500

Management

- Empiric antibiotics (should cover *Pseudomonas*)
- Broad work-up looking for source
    - Urinalysis
    - Blood cultures
    - Thorough exam looking for source
    - +/- Chest X-ray
- Admit
- Add vancomycin if
    - Line infection
    - Methicillin-resistant *Staphylococcus aureus* (MRSA) risk
    - Hypotension
        - Severe mucositis

How You Will Be Tested

- This may be a multi-part question. You need to know how to calculate the absolute neutrophil count (ANC), then recognize it is neutropenic fever from the description (remember the definition), and know the management.

Non-Immune Thrombocytopenia

Vanessa Cardy, MD, and Jessica Mason, MD

Background

- Platelets <100,000 due to
    - Decreased production
    - Increased consumption/destruction
    - Splenic sequestration

Clinical Findings

- Petechiae
- Ecchymosis
- Gingival bleeds
- Epistaxis
- Genitourinary and gastrointestinal bleeds
- Tests
    - Complete blood count (platelets)
    - Assess bleeding status/risk

Management

- Depends on platelet levels, +/- acute bleed
- Transfuse platelets as needed

Pancytopenia

Vanessa Cardy, MD, and Jessica Mason, MD

Background

- Multifactorial, often idiopathic
- Causes
    - Autoimmune
    - Post-viral
    - Vitamin B_{12}/folic acid deficiency
    - Chemicals

Clinical Findings

- Anemia
- Thrombocytopenia
- Leukopenia
- Low reticulocyte count indicating bone marrow failure

Management

- Address underlying cause and treat
- Antibiotics or transfusions as needed

How You Will Be Tested

- Be able to identify based on labs

Polycythemia

Vanessa Cardy, MD, and Jessica Mason, MD

Background

- Caused by
    - Heart/lung disease
    - Tumors
    - High altitude
    - Smoking
- Risk of
    - Thrombosis
    - Bleeding

Clinical Findings

- Primary → polycythemia vera
    - ↓ Erythropoietin
    - ↑ Hemoglobin levels
- Hyperviscous blood causes
    - Sluggish flow
    - Platelet dysfunction

Management

- Phlebotomy
- Goal → Hematocrit 55%

Transplants Overview

Mel Herbert, MD, and Stuart Swadron, MD

Background

- Transplanted organ lacks innervation ➔ pain is not a reliable sign
- Patients are immunosuppressed ➔ may not show inflammatory symptoms
- Acute or chronic rejection
- Complications of immunosuppression (eg, diabetes mellitus, obesity)

Clinical Findings

- Infections, rejection, graft-vs-host disease, medication side-effects
- Usual postoperative complications
    - Hematomas
    - Hernias
    - Post-operative infections
- Vascular problems include
    - Thrombosis - hepatic artery or portal vein
        - ↑ Risk in kids
        - Can cause organ failure
        - Doppler ultrasound or magnetic resonance angiography of hepatic artery
    - Portal vein thrombosis
        - Graft ischemia
        - Increased portal pressure
        - Ascites
    - Pseudoaneurysm formation ➔ vessel rupture, hemorrhagic shock
- Recurrence of primary liver disease

Management

- Consult transplant team

How You Will Be Tested

- Medications and side effects used in transplant medicine
    - Heart transplants are sensitive to adenosine
    - Cyclosporine is used in kidney transplant and is nephrotoxic

Post-Transplant Infections

Vanessa Cardy, MD, and Jessica Mason, MD

Background

- Patients on immunosuppressant medications
- Infections are divided into timelines:
    - 1 mo
        - Usually from donor - herpes simplex virus, West Nile, human immunodeficiency virus
        - Wound infections, procedure-related
        - Hospital-associated - *Clostridioides difficile* (Cdiff), methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococcus (VRE)
        - Reactivation of latent host-diseases (*Pseudomonas*, *Aspergillus*)
    - 1-6 mo
        - Opportunistic infections
        - Reactivation of diseases in the recipient
            - Cytomegalovirus (CMV)
            - Epstein-Barr virus (EBV)
            - Varicella
    - >6 mo
        - From chronic immunosuppression
            - Opportunistic infections
            - Common infections
                - *Streptococcus pneumoniae*
- Live vaccines (MMR [measles, mumps, rubella], varicella, rotavirus)
    - Contraindicated in transplant patients
    - If have disease, give immunoglobulin

Clinical Findings

- Complete physical exam
    - Inspect skin for occult infections
- Labs may be dictated from history, physical and transplant team

Management

- Admit

How You Will Be Tested

- Know the timeline of when certain diseases are most common

Post-Transplant Rejection

Vanessa Cardy, MD, and Jessica Mason, MD

Background

- Three forms:
    - Hyperacute (minutes to hours)
        - From preformed antibodies
    - Acute (weeks - 3 mo)
        - humoral/T-cell-mediated
    - Chronic (3 mo - years)
        - Fibrotic changes, slowly failing organ
- May be able to reverse acute rejection

Clinical Findings

- Renal
    - Slowly ⬆ creatinine, tenderness, decreased urine output
- Lung
    - Cough, shortness of breath
    - Temperature ≥0.5°C over baseline
- Cardiac
    - No pain with myocardial infarction
    - Fatigue, heart failure
    - Atropine doesn't work on transplanted hearts (use isoproterenol)
        - Vagal nerve is cut (transplated hearts are de-enervated)

Management

- Usually steroids
- Workup for cause of failure
- Check level for any immunosuppressive medications
- Admit

How You Will Be Tested

- Know the timelines and causes of each kind of rejection

Raynaud's Phenomenon

Vanessa Cardy, MD, and Jessica Mason, MD

Background

- Digits undergo color change
    - White ➔ blue ➔ red

Clinical Findings

- Pain and paresthesias

Management

- Prevention
- Rewarming are key
- Low-dose calcium channel blockers

How You Will Be Tested

- You might get a description accompanied by a photograph

Reactive Arthritis

Vanessa Cardy, MD, and Jessica Mason, MD

Background

- Young men, 1-4 wk post-gastrointestinal/genitourinary (GI/GU) infection

Clinical Findings

- "Can't see, Can't pee, Can't climb a tree"
    - Don't need all 3 to diagnose
    - Can't see = uveitis
    - Can't pee = urethritis
    - Can't climb a tree = arthritis, typically multiple joints in lower extremities

Management

- Urethritis ➜ treat gonorrhea/chlamydia
- Eye symptoms ➜ immunosuppressants in consult with ophthalmology
- Arthritis ➜ nonsteroidal anti-inflammatory drugs or steroids

How You Will Be Tested

- Recognize the triad in a description (will usually tell you it's after a GI/GU infection)

Sarcoidosis

Vanessa Cardy, MD, and Mel Herbert, MD

Background

- Multisystem granulomatous disease

Clinical Findings

- Wide range of symptoms
    - Respiratory (most common)
    - Central nervous system
    - Renal
    - Cardiac
    - Skin
        - Erythema nodosum
    - Eyes
    - Musculoskeletal
- Renal involvement may affect calcium metabolism
    - At risk for long QT/dysrhythmias
- Chest X-ray (CXR)
    - Hilar adenopathy

Management

- Corticosteroid therapy
- Specialist follow-up
- Check calcium level
    - Hypercalcemia may occur
- ECG

How You Will Be Tested

- Recognize this from a description +/- CXR with hilar adenopathy

Scleroderma

Vanessa Cardy, MD, and Mel Herbert, MD

Background

- Sclerosis can be
    - Systemic or
    - Limited
- Risk of renovascular crisis ➔ always check blood pressure

Clinical Findings

- CREST ➔ limited sclerosis
    - Calcinosis
    - Raynaud's
    - Esophageal dysmotility
    - Sclerodactyly
    - Telangiectasia

Management

- Renovascular crisis ➔ angiotensin-converting enzyme inhibitors
- Severe disease ➔ immunosuppression

How You Will Be Tested

- Know the features of CREST (be able to identify scleroderma via description)

Sickle Cell

Mel Herbert, MD, and Stuart Swadron, MD

Background

- Sickling of red blood cells (RBCs), particularly under physiologic stress
- Autosomal recessive

Clinical Findings

- Many clinical manifestations
    - Vaso-occlusive crisis
        - Pain, infarction
        - Consider complete blood count, reticulocyte count
    - Splenic sequestration crisis
        - Life-threatening
        - Classically <5 y old in shock, abdominal mass (splenomegaly)
    - Acute chest syndrome
        - High mortality, “pneumonia gone bad”
        - Findings on chest X-ray (CXR) + fever, chest pain, respiratory symptoms or hypoxia
    - Aplastic crisis
        - With Parvovirus B19 infection
        - Temporary shut-down of RBC production
        - Low reticulocyte count, low hemoglobin
    - Others
        - Stroke (especially in children)
        - Priapism
        - Infection
        - Gallstones
        - Renal failure

Management

- Vaso-occlusive crisis
    - Treat with analgesia (moving away from O_2), +/- IV fluids
- Splenic sequestration crisis
    - Treatment = resuscitation and transfusion
- Acute chest syndrome
    - Supportive care, antibiotics
- Aplastic crisis
        - Supportive care, transfusion

How You Will Be Tested

- Know the definition of acute chest syndrome and how to identify it
- Know that pain control often requires very high doses of opiates

See **EM:RAP 2018 April - Pediatric Pearls – Sickle Cell in Kids – An Update**

Spinal Cord Compression

Vanessa Cardy, MD, and Mel Herbert, MD

Background

- Thoracic spine → 70% cases

Clinical Findings

- Early symptoms → subtle
- Red flag
    - Previously well-controlled back pain suddenly requiring escalating analgesics
- Gastrointestinal and genitourinary symptoms (later findings)
    - Urinary retention
    - Urinary dribbling
    - ↑ Post-void residual (exact volume controversial)

Management

- Urgent steroids
- Treat pain
- Emergency radiation
- Neurosurgery consult

How You Will Be Tested

- Clinical findings

Superior Vena Cava Syndrome

Vanessa Cardy, MD, and Mel Herbert, MD

Background

- Usually from apical lung cancer, mass or thrombus compressing the superior vena cava

Clinical Findings

- Gradual cough
- Dyspnea
- Facial and arm swelling
- Distended neck veins
- May be worse in the morning
- Worse when hands are over head

Management

- Sit up
- Support breathing
- Dexamethasone IV
- Refer for definitive therapy

How You Will Be Tested

- They may show you a picture

Systemic Lupus Erythematosus

Vanessa Cardy, MD, and Mel Herbert, MD

Background

- Autoimmune disease
- Patients are immunocompromised
- ↑ Coronary artery disease risk
- Drugs that trigger systemic lupus erythematosus - “HIPPS”
    - Hydralazine
    - Isoniazid
    - Phenytoin
    - Procainamide
    - Sulfonamides

Clinical Findings

- “DOPAMINE RASH” (need 4/11 criteria for diagnosis)
    - Discoid rash
    - Oral ulcers
    - Photosensitive rash
    - Arthritis
    - Malar rash
    - Immunologic criteria
    - Neurologic/psych symptoms
    - Renal disease
    - Antinuclear antibody positive
    - Serositis
    - Hematologic disorders

Management

- Severe, life-threatening symptoms → steroids
- Rheumatology consult

Thalassemias

Vanessa Cardy, MD, and Mel Herbert, MD

Background

- ↑ risk if of Mediterranean, Indian, African, Middle Eastern, or Asian descent
- Alpha and beta forms

Clinical Findings

- Range of symptoms
    - Asymptomatic → hydrops fetalis
    - Beta major form → transfusions
- Signs/symptoms
    - Jaundice
    - Signs of anemia
    - Hepatosplenomegaly
    - Bony changes

Management

- Transfusions
- Iron chelation as needed

How You Will Be Tested

- They may try to confuse you with this versus sickle cell
- Know the dominance pattern

Thrombotic Thrombocytopenic Purpura (TTP)

Gita Pensa, MD, and Jessica Mason, MD

Background

- Often idiopathic
- Can be associated with medications, human immunodeficiency virus, chemo
- Autoantibody-mediated inhibition of enzyme ADAMTS13 (deficiency of ADAMTS13) so von Willebrand factor (vWf) is not cleaved, leading to platelet-fibrin thrombi deposits in vessels
- Differential includes
    - Hemolytic uremic syndrome, disseminated intravascular coagulation, idiopathic thrombocytopenic purpura

Clinical Findings

- Classic pentad → most do not have all 5 symptoms
    - Thrombocytopenia
    - Hemolytic anemia
    - Renal disease
    - Fever
    - Neuro symptoms
- Suspect if
    - Hemolysis
    - Low platelets
    - ADAMTS13 deficiency

Management

- Admission
- Massive plasma exchange
- +/- steroids
- No platelet transfusion

How You Will Be Tested

- Recognize the pentad

Tumor Lysis Syndrome

Vanessa Cardy, MD, and Mel Herbert, MD

Background

- At ↑ risk
    - 1-3 d after start of chemo
    - Rapidly growing cancers
    - History of chronic kidney disease

Clinical Findings

- Labs
    - Hyperkalemia
    - Hyperphosphatemia
    - Hypocalcemia
    - Hyperuricemia
    - Renal failure (from depositions in renal tubules)

Management

- IV hydration
- Allopurinol if hyperuricemic
- Treat hypocalcemia/hyperkalemia
- Dialysis as needed

How You Will Be Tested

- Recognize this and know how to treat

Vasculitis

Vanessa Cardy, MD, and Mel Herbert, MD

Background

- Vasculitides cause inflammation and necrosis of blood vessels
- Grouped by size of blood vessel affected; can be primary or secondary
- Secondary vasculitides can be due to infection, medications, cancer, or collagen vascular diseases
- Patients commonly have constitutional symptoms (eg, weakness, arthralgia, malaise)

Large-vessel vasculitides

Background

- May present with hypertension, bowel ischemia, myocardial ischemia, stroke

Giant cell arteritis (temporal arteritis)

Background

- Presents with headache, visual changes, temporal tenderness, and jaw claudication

Clinical Findings

- Erythrocyte sedimentation rate will be significantly elevated

Management

- Steroids should be started when this diagnosis is suspected to prevent vision loss
- Diagnosis is confirmed with temporal artery biopsy

Behçet's disease

Clinical Findings

- Oral and genital ulcers, and ocular findings (eg, uveitis)

Takayasu arteritis

Clinical Findings

- May initially present with vague constitutional symptoms and progress to anemia, chest pain, and limb claudication
- Can affect the aorta

Medium-vessel vasculitides

Background

- Polyarteritis nodosa and Berger's disease (also known as IgA nephropathy) are in this category

Clinical Findings

- Present with nodules, gangrene, livedo reticularis, hypertension, aneurysm, neuropathy, and constitutional symptoms

Small-vessel vasculitides

Background

- Hypersensitivity vasculitis, Henoch-Schonlein purpura, granulomatosis with polyangiitis (formerly Wegener's granulomatosis), and Goodpasture syndrome are in this category

Clinical Findings

- Present with urticaria, palpable purpura, splinter hemorrhages, scleritis, uveitis, episcleritis, microscopic polyangiitis

Management

- Work-up
  - Complete blood count, renal function, inflammatory markers, urinalysis
  - X-rays if pulmonary signs/symptoms
  - Biopsy may be needed
- Nonsteroidal anti-inflammatory drugs
- Glucocorticoids

How You Will Be Tested

- Know the specific vasculitides

Von Willebrand Disease

Vanessa Cardy, MD; Mel Herbert, MD; and Jessica Mason, MD

Background

- Von Willebrand disease is the most common bleeding disorder
- Von Willebrand factor (vWF) is present in plasma and endothelium
- vWF stabilizes factor VIII and plays a role in platelet adhesion and collagen fibril formation
- Three types of von Willebrand disease:
    - Type 1: decreased production - treat with desmopressin (DDAVP)
    - Type 2: dysfunctional vWF - treat with factor VIII for bleeding in type 2 and type 3
    - Type 3: almost no vWF - treat with factor VIII for bleeding in type 2 and type 3

Clinical Findings

- Bleeding from gums, nose, gastrointestinal tract, and menorrhagia
- Labs
    - Increased bleeding time
        - Platelet count, prothrombin time, and partial thromboplastin time might be normal
    - Abnormal vWF assay (Ristocetin cofactor assay)

Management

- DDAVP (IV/subcutaneous/intranasal)
- vWF concentrate
- Cryoprecipitate and fresh frozen plasma are no longer recommended due to low concentrations of vWF
    - Cryoprecipitate can be considered if other treatments are unavailable
- Antifibrinolytic agents including aminocaproic acid and tranexamic acid (TXA)
- Oral contraceptive pills for menorrhagia
- Prophylactic TXA for
    - Dental procedures
    - Minor procedures

How You Will Be Tested

- The Boards like this topic because there are a lot of details that are easily tested. Know the types of von Willebrand disease and how they vary. Know how to treat.
- Know that bleeding time increases while other coagulation studies may be normal.