Deconstructing the Complete Blood Count (CBC)

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Outline

- Introduction
- Defining components of the CBC with differential
- Interpreting the CBC with differential
- Cases
- References
Blood

Plasma composition
- Water: 92%
- Plasma proteins: 7%
- Other solutes: 1%

Plasma proteins
- Albumins: 60%
- Globulins: 35%
- Fibrinogen: 4%
- Regulatory proteins: <1%
- Enzymes, hormones, clotting proteins

Other solutes
- Electrolytes
- Organic nutrients
- Organic wastes

Blood clot formation and tissue repair

Platelets
- Neutrophils (50-70%)
- Eosinophils (2-4%)
- Lymphocytes (20-30%)
- Basophils (<1%)
Why check?

- Monitor overall health
- Screen for some diseases
- Confirm or make a diagnosis based on a patient’s symptoms
- Monitor an existing condition
- Monitor body’s response to medical treatment
- Most informative *single* test
- Relatively inexpensive
What’s “normal?”

- Normal ranges from lab to lab (reference ranges should be included)
- Normal depends on age, sex, pregnancy status, altitude
Defining the Components of CBC
White blood cells (WBC)

- Also known as leukocytes
- Protect body against infection and fight foreign material
- Use WBC to:
  - help identify if an infection is present
  - differentiate between different types of infection
  - See how body is responding to medical treatment (leukemia)
WBC Differential

- Breaks down WBC into their types
  - Neutrophils
    - Bands (immature) and segs (mature)
  - Monocytes
  - Lymphocytes
  - Eosinophils
  - Basophils
<table>
<thead>
<tr>
<th>Types of WBC</th>
<th>Function</th>
<th>Increased in...</th>
<th>Decreased in...</th>
</tr>
</thead>
</table>
| Neutrophil (31-68%)       | • 1st line of defense  
  • Phagocytosis of bacteria and cell debris                                | • Infection  
  • Stress/Inflammation  
  • Tissue damage  
  • Malignancies of bone marrow  
  • Steroid therapy                                                  | • Some viral conditions  
  • Cancer treatment  
  • Newborns with sepsis  
  • Some hereditary disorders  
  • Medications                                              |
| Lymphocytes (31-61%)      | • B cells: make antibodies  
  • T- and NK cells: fight viral infection                                   | • Viral infection                                                               | • Steroid therapy  
  • Adrenocortical hyperfunction  
  • Stress / Shock |
| Eosinophils (2-4%)        | Granules have a toxic protein receptor that binds to IgE to help kill parasites | • Parasitic infection  
  • Asthma  
  • Allergic reaction  
  • Hay Fever  
  • Drug reaction | • Steroid therapy  
  • Adrenocortical hyperfunction  
  • Stress/ shock |
| Monocytes                 | • Phagocytosis  
  • Present pieces of pathogens to T cells to mount an Ab response           | • Viral infection  
  • TB  
  • Parasitic disease  
  • Monocytic leukemia                                                    | • Bone marrow failure or suppression  
  • Steroid therapy  
  • Adrenocortical hyperfunction  
  • Stress/ shock |
| Aka macrophage (once out of blood stream) (4-9%) |                                                                       |                                                                                 |                                                      |
| Basophils (0-1%)           | Release histamine and prostaglandins                                        | • Chronic inflammatory and hypersensitivity reactions                           | • Steroid therapy  
  • Adrenocortical hyperfunction  
  • Stress/ shock |

*Historical Note: The table was created with information from the guidelines provided by Children's Mercy Hospital Kansas City.*
Table 1. Normal Blood Leukocyte Counts*

<table>
<thead>
<tr>
<th>Age</th>
<th>Total Leukocytes</th>
<th>Neutrophils</th>
<th>Lymphocytes</th>
<th>Monocytes</th>
<th>Eosinophils</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (Range)</td>
<td>Mean (Range)</td>
<td>Mean (Range)</td>
<td>Mean %</td>
<td>Mean %</td>
</tr>
<tr>
<td>Birth</td>
<td>18.1 (9.0 to 30.0)</td>
<td>11.0 (6.0 to 26.0)</td>
<td>5.5 (2.0 to 11.0)</td>
<td>1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>12 h</td>
<td>22.8 (13.0 to 38.0)</td>
<td>15.5 (6.0 to 28.0)</td>
<td>5.5 (2.0 to 11.0)</td>
<td>1.2</td>
<td>0.5</td>
</tr>
<tr>
<td>24 h</td>
<td>18.9 (9.4 to 34.0)</td>
<td>11.5 (5.0 to 21.0)</td>
<td>5.8 (2.0 to 11.0)</td>
<td>1.1</td>
<td>0.5</td>
</tr>
<tr>
<td>1 wk</td>
<td>12.2 (5.0 to 21.0)</td>
<td>5.5 (1.0 to 10.0)</td>
<td>5.0 (2.0 to 17.0)</td>
<td>1.1</td>
<td>0.5</td>
</tr>
<tr>
<td>2 wk</td>
<td>11.4 (5.0 to 20.0)</td>
<td>4.5 (1.0 to 9.5)</td>
<td>5.5 (2.0 to 17.0)</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>1 mo</td>
<td>10.8 (5.0 to 19.5)</td>
<td>3.8 (1.0 to 9.0)</td>
<td>6.0 (2.5 to 16.5)</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>6 mo</td>
<td>11.9 (6.0 to 17.5)</td>
<td>3.8 (1.0 to 8.5)</td>
<td>7.3 (4.0 to 13.5)</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>1 y</td>
<td>11.4 (6.0 to 17.5)</td>
<td>3.5 (1.5 to 8.5)</td>
<td>7.0 (4.0 to 10.5)</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>2 y</td>
<td>10.6 (6.0 to 17.0)</td>
<td>3.5 (1.5 to 8.5)</td>
<td>6.3 (3.0 to 9.5)</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>4 y</td>
<td>9.1 (5.5 to 15.5)</td>
<td>3.8 (1.5 to 8.5)</td>
<td>4.5 (2.0 to 8.0)</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>6 y</td>
<td>8.5 (5.0 to 14.5)</td>
<td>4.3 (1.5 to 8.0)</td>
<td>3.5 (1.5 to 7.0)</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>8 y</td>
<td>8.3 (4.5 to 13.5)</td>
<td>4.4 (1.5 to 8.0)</td>
<td>3.3 (1.5 to 6.8)</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>10 y</td>
<td>8.1 (4.5 to 13.5)</td>
<td>4.4 (1.8 to 8.0)</td>
<td>3.1 (1.5 to 6.5)</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>16 y</td>
<td>7.8 (4.5 to 13.0)</td>
<td>4.4 (1.8 to 8.0)</td>
<td>2.8 (1.2 to 5.2)</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>21 y</td>
<td>7.4 (4.5 to 11.0)</td>
<td>4.4 (1.8 to 7.7)</td>
<td>2.5 (1.0 to 4.8)</td>
<td>0.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>

*Numbers of leukocytes are in thousands/mcL ($\times 10^9/L$), ranges are estimates of 95% confidence limits, and percentages refer to differential counts.

Neutrophils include band cells at all ages and a small number of metamyelocytes and myelocytes in the first few postnatal days.

RBC (aka Erythrocyte)

- RBCs carry oxygen (O2) from lungs to the body, and also carbon dioxide (CO2) back to lungs to exhalation

- # of RBCs: Reported as an absolute number per liter of blood
Hemoglobin (Hgb)

- Hgb is the protein in RBCs that binds O2 and carries it to tissues of the body
- Hgb gives blood its red color
- Good measure of the blood’s ability to carry O2
- Too few (anemia) may indicate the body is not getting enough O2
- With too many (polycythemia), RBCs may clump and block capillaries
Hematocrit (Hct)

- Aka packed cell volume (PCV)
- Measures the amount of space RBCs take up in the blood
- Value is given as a % of RBCs in a volume of blood
  - Hematocrit of 36% = 36% of blood’s volume is made up of RBCs
  - Aka percentage of volume of whole blood that is made up of RBCs
- Measurement depends on the # and size of RBCs
Normal Values

- RBC x 3 = Hemoglobin
- Hgb x 3 = Hematocrit
## Normal Values

### Normal blood count values from birth to 18 years

<table>
<thead>
<tr>
<th>Age</th>
<th>Hb  g/dl</th>
<th>RBC $\times 10^{12}$/l</th>
<th>HCT</th>
<th>MCV  fl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth (term infants)</td>
<td>14.9–23.7</td>
<td>3.7–6.5</td>
<td>0.47–0.75</td>
<td>100–125</td>
</tr>
<tr>
<td>2 weeks</td>
<td>13.4–19.8</td>
<td>3.9–5.9</td>
<td>0.41–0.65</td>
<td>88–110</td>
</tr>
<tr>
<td>2 months</td>
<td>9.4–13.0</td>
<td>3.1–4.3</td>
<td>0.28–0.42</td>
<td>84–98</td>
</tr>
<tr>
<td>6 months</td>
<td>10.0–13.0</td>
<td>3.8–4.9</td>
<td>0.30–0.38</td>
<td>73–84</td>
</tr>
<tr>
<td>1 year</td>
<td>10.1–13.0</td>
<td>3.9–5.1</td>
<td>0.30–0.38</td>
<td>70–82</td>
</tr>
<tr>
<td>2–6 years</td>
<td>11.0–13.8</td>
<td>3.9–5.0</td>
<td>0.32–0.40</td>
<td>72–87</td>
</tr>
<tr>
<td>6–12 years</td>
<td>11.1–14.7</td>
<td>3.9–5.2</td>
<td>0.32–0.43</td>
<td>76–90</td>
</tr>
<tr>
<td>12–18 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>12.1–15.1</td>
<td>4.1–5.1</td>
<td>0.35–0.44</td>
<td>77–94</td>
</tr>
<tr>
<td>Male</td>
<td>12.1–16.6</td>
<td>4.2–5.6</td>
<td>0.35–0.49</td>
<td>77–92</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indices</th>
<th>Meaning</th>
<th>Definition</th>
<th>Normal Values</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCV</td>
<td>Mean corpuscular volume</td>
<td>Average size (volume) of RBCs</td>
<td>75-108 (fL)</td>
<td>Help differentiate between types of anemia</td>
</tr>
<tr>
<td>MCH</td>
<td>Mean corpuscular hemoglobin</td>
<td>Average weight of Hgb per RBC</td>
<td>25-44 picograms</td>
<td>Clinical implications are the same as for MCV</td>
</tr>
<tr>
<td>MCHC</td>
<td>Mean corpuscular hemoglobin concentration</td>
<td>Average concentration of Hgb per RBC</td>
<td>33-36 (g/dL RBC) (normochromic)</td>
<td>Hyperchromic vs hypochromic</td>
</tr>
<tr>
<td>RDW</td>
<td>Red cell distribution width</td>
<td>Measures uniformity of RBC size</td>
<td>11.5-14.5</td>
<td>&gt; 14.5 indicates greater cell size variability</td>
</tr>
<tr>
<td>Reticulocytes</td>
<td># of immature RBCs</td>
<td></td>
<td>0.5-1.5%</td>
<td>Indicates active RBC production from BM</td>
</tr>
</tbody>
</table>
Platelet Count

- Measures how many platelets you have in your blood
- Platelets are smallest type of cell
- Important in clotting
- Too few → uncontrolled bleeding
- Too many → risk of clot
- Normal value: 150,000-350,000 / mL
Mean Platelet Volume (MPV)

- Measures average size of platelets
- Even if platelet count is normal, MPV can be too high or too low
- Normal range: 7.5-11.5 fL
Interpreting the CBC
Anemia

- Low RBC, Hgb, Hct (less than 5 th percentile for age) → blood has low O2 carrying capacity

- Can be due to:
  - Blood loss
  - Nutritional deficiency
  - Destruction of RBCs (hemolysis)
  - Decreased production (defects in bone marrow, low EPO)

- Most children with mild anemia have no signs or symptoms
## Screening

<table>
<thead>
<tr>
<th>ORG</th>
<th>RECOMMENDATIONS</th>
<th>High-Risk Groups</th>
</tr>
</thead>
</table>
| AAP | • Screen at 9-12 months  
     • Again 6 months later in high risk groups | • Premature infants  
     • LBW infants  
     • Infants fed with low-iron formula  
     • Breastfed infants > 6 months who are not receiving iron supplement |
| CDC | • Screen kids from low-income families or newly immigrated families between 9-12 months, then 6 months later, then annually from 2-5 years  
     • Consider screening for pre-term and LBW infants < 6 months of age if not fed with iron-fortified formula  
     • Infants with RF should be assessed at 9-12 months and again 6 months later  
     • Non-pregnant adolescents should be screened q 5-10 years | • Infants fed non-iron-fortified formula / cows milk before 12 months  
     • Breastfed infants > 6 months without supplementation  
     • Children who consume > 24 oz of cow’s milk /day  
     • Children with special health care needs |

Anemia

1) Acute vs chronic
   - hemodynamic stability
   - Previous CBC
   - Active bleeding?

2) History/Exam: pallor, glossitis, jaundice, lymphadenopathy, hepatosplenomegaly, tachycardia, acute bleeding, pica, tachypnea

3) MCV
   - microcytic (<80 μm³)
   - normocytic (80-100 μm³)
   - macrocytic (>100 μm³)

4) Reticulocyte count
   >2%: hemolytic process
   <2%: hypoproliferative

5) Smear: look for size/shape of RBCs, color, inclusions
### Differential based on age

<table>
<thead>
<tr>
<th>Neonatal</th>
<th>Infancy to Toddlerhood</th>
<th>Late Childhood and Adolescence</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Blood loss</td>
<td>• Iron deficiency</td>
<td>• Iron deficiency</td>
</tr>
<tr>
<td>• Isoimmunization</td>
<td>• Concurrent infection</td>
<td>• Chronic disease</td>
</tr>
<tr>
<td>• Congenital hemolytic anemia (spherocytosis, G6PD def)</td>
<td>• Blood loss</td>
<td>• Blood loss</td>
</tr>
<tr>
<td>• Congenital Infection (parvo, HIV, TORCH)</td>
<td>• Disorder of Hgb structure of synthesis (thalassemia, SCD)</td>
<td>• Rest same as infancy to toddlerhood</td>
</tr>
<tr>
<td>• Diamond Blackfan Syndrome</td>
<td>• RBC enzyme defects (G6PD def, PK def)</td>
<td></td>
</tr>
<tr>
<td>• Fanconi Anemia</td>
<td>• RBC membrane defects (spherocytosis, elliptocytosis)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Acquired hemolytic anemias (antibody-mediated, drug, HUS, DIC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Transient Erythroblastopenia of childhood</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Leukemia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lead poisoning</td>
<td></td>
</tr>
</tbody>
</table>

Microcytic Anemia

- Most common causes in children:
  - Iron deficiency
  - Thalassemias
  - Lead poisoning
  - Anemia of chronic disease
- Check ferritin, zinc protoporphyrin, CRP
- Look at peripheral smear
Iron Deficiency

- Microcytosis with elevated RDW
- Toddlers and Adolescents
  - Milk consumption, diet, blood loss
- Treat with 4-6 mg/kg/day of elemental iron divided BID or TID
  - Avoid dairy products when administering
  - Better absorbed with citrus juice
- Reticulocyte count should increase within 1 week
- Hemoglobin should normalized in 1 month
- Treat for at least 3 months to replenish iron stores
Iron Deficiency

- Most likely reason for failure of anemia to correct is non-adherence
- Trial a different oral formulation which is better tasting
  - NovaFerrum
- If adherence not in question and still refractory, refer to Hematology
Differentiate IDA and Thalassemia

- Mentzer Index (MCV / RBC count)

- Example:

<table>
<thead>
<tr>
<th>Patient</th>
<th>MCV (fl)</th>
<th>RBC (x10^6 per mm^3)</th>
<th>Mentzer Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 y/o AA child</td>
<td>64</td>
<td>5.3</td>
<td>12</td>
</tr>
<tr>
<td>2 y/o child who drinks 30 oz of cow’s milk daily</td>
<td>72</td>
<td>4.8</td>
<td>15</td>
</tr>
</tbody>
</table>

- < 13 suggests thalassemia; > 13 suggests iron deficiency
- Can request newborn screen if born in United States or get hemoglobin electrophoresis
Normocytic Anemia

- Work-up is based on bone marrow function as determined by the reticulocyte count
  - If elevated, evaluate for blood loss or hemolysis
    - Check a DAT and evaluate the peripheral smear for spherocytes
  - If low, consider aplasia or bone marrow disorder
Normocytic anemia

Evaluate clinical and laboratory evidence of blood loss
- Reticulocytes
- Indirect bilirubin
- Blood smear
- NI Reticulocytes
- NI Indirect bilirubin
- NI Blood loss

Clinical evaluation
- Smear: no PMN hypersegmentation or macro-ovalocytosis
- Hemoglobin <9 g/dL
- BUN or creatinine
- Bone marrow aspirate/biopsy
- Trial of Fe

Hematology
- Microcytic hypochromia
- Iron deficiency
- Fe/TIBC, ferritin

Macro-ovalocytosis
- Dimorphic population
- Serum Fe - RBC folate

Recent/ongoing hemorrhage
- Ensure patient stable
- No further evaluation
- Further Dx and Rx

Protein-calorie malnutrition
- Anemia of infection
- Anemia of chronic disease
- IDA

Anemia of pregnancy
- Anemia of infection
- Anemia of chronic disease
- IDA

Macrocytic Anemia

- Rare in children
- Initial work up is a peripheral smear
  - Presence of hypersegmented neutrophils indicates a megaloblastic anemia (B12 or folate deficiency)
  - Nonmegaloblastic causes of macrocytosis include
    - Alcoholism
    - Hemolysis
    - Hemorrhage
    - Hepatic disease
    - Bone marrow disorders (aplastic anemia, myelodysplasia, sideroblastic anemia)
    - Hypothyroidism
Macrocytic Anemia

- Check vitamin B12, folate
- Check medication list
- Check MMA and homocysteine
  - **B12 deficiency**: elevated homocysteine and MMA
    - Vegan diet
  - **Folate deficiency**: increased homocysteine, NORMAL MMA
    - Goat’s milk
Special Considerations

- **Volume Depletion**
  - Severely dehydrated patients may not show anemia until after rehydration

- **Acute blood loss**
  - Although patient may be hypotensive, lab values may not reflect anemia until 36-48 hours after acute bleed
Leukocytosis

- Causes
  - Infection
  - Chronic inflammation
  - Medications (steroids, WBC growth factors)
  - Malignancy (leukemia)
    - Will likely have blasts on the differential
Leukopenia

- May indicate:
  - Infection, bacterial or viral
  - Effect of chemotherapy
  - Medications (AEDs, antibiotics, immunosuppressants)
  - Malignancy
  - Aplastic anemia
  - Hypersplenism
  - Autoimmune disorders

- African Americans can have lower WBC at baseline
Neutropenia

- Normal ANC varies by age, particularly during infancy
  - Lower limit of normal:
    - First 24 hours of life: 6,000/μL
    - First week of life: 5,000/μL
    - Second week of life: 1,500/μL
    - Week 2-1 year of life: 1,000/μL
    - Age 1 year and on: 1,500/μL
      - 1,200/μL for African Americans
Neutropenia

- Beyond 1 year of life
  - Mild: ANC 1,000-1,500
  - Moderate: 500-1,000
  - Severe: < 500
Initial Evaluation of Neutopenia

- **History:**
  - Underlying disease, congenital anomalies, medication exposure
  - Infection (systemic bacterial such as sepsis, meningitis; serious respiratory such as pneumonia; multiple bacterial such as cellulitis, otitis media, lymphadenitis; unusual such as liver or brain abscesses; unusual pathogens)
  - Viral symptoms

- **Physical Examination**
  - Short stature, poor growth, congenital anomalies such as skeletal
  - Eczema, abnormal skin pigmentation, adenopathy, organomegaly
  - Recurrent gingivitis or oral ulcers
<table>
<thead>
<tr>
<th>Cause</th>
<th>Etiologic Factors/Age</th>
<th>Associated Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection</td>
<td>Viruses, bacteria, protozoa, rickettsia, fungi</td>
<td>Redistribution from circulating to marginating pools, impaired production, accelerated destruction</td>
</tr>
<tr>
<td>Drug-induced</td>
<td>Phenothiazines, sulfonamides, anticonvulsants, penicillins, aminopyrine</td>
<td>Hypersensitivity reaction (fever, lymphadenopathy, rash, hepatitis, nephritis, pneumonitis, aplastic anemia), antineutrophil antibodies</td>
</tr>
<tr>
<td>Immune neutropenia</td>
<td>Alloimmune, autoimmune</td>
<td>Variable arrest from metamyelocyte to segmented neutrophils in bone marrow</td>
</tr>
<tr>
<td>Reticuloendothelial sequestration</td>
<td>Hypersplenism</td>
<td>Anemia, thrombocytopenia, neutropenia</td>
</tr>
<tr>
<td>Bone marrow replacement</td>
<td>Malignancy (e.g., lymphoma, metastatic solid tumor)</td>
<td>Presence of immature myeloid and erythroid precursors in peripheral blood</td>
</tr>
<tr>
<td>Cancer chemotherapy or radiation therapy to bone marrow</td>
<td>Suppression of myeloid cell production</td>
<td>Bone marrow hypoplasia, anemia, thrombocytosis</td>
</tr>
<tr>
<td>Aplastic anemia</td>
<td>Stem cell destruction and depression</td>
<td>Panmyelopenia</td>
</tr>
<tr>
<td>Vitamin B12 or folate deficiency</td>
<td>Malnutrition; congenital deficiency of vitamin B12 absorption, transport, and storage; vitamin avoidance</td>
<td>Megaloblastic anemia, hypersegmented neutrophils</td>
</tr>
<tr>
<td>Acute leukemia, chronic myelogenous leukemia</td>
<td>Bone marrow replacement with malignant cells</td>
<td>Panmyelopenia, leukocytosis</td>
</tr>
<tr>
<td>Myelodysplasia</td>
<td>Dysplastic maturation of stem cells</td>
<td>Bone marrow hypoplasia with megaloblastoid red cell precursors, thrombocytopenia</td>
</tr>
<tr>
<td>Prematurity with birthweight &lt; 2 kg</td>
<td>Impaired regulation of myeloid proliferation and reduced size of postmitotic pool</td>
<td>Maternal preeclampsia</td>
</tr>
<tr>
<td>Chronic idiopathic neutropenia</td>
<td>Impaired myeloid proliferation and/or maturation</td>
<td>None</td>
</tr>
<tr>
<td>Paroxysmal nocturnal hemoglobinuria</td>
<td>Acquired stem cell defect to secondary to mutation of PIG-A gene</td>
<td>Panmyelopenia, thrombosis</td>
</tr>
</tbody>
</table>

Thrombocytosis

- **Mild** (450-700,000/mm³)
- **Moderate** (700-900,000/mm³)
- **Severe** (900,000-1 million/mm³)
- **Extreme** (>1 million/mm³)
Thrombocytosis in Children

- Relatively common in young children
- Usually transient, benign finding secondary to infection/inflammation
  - Repeat in 1-2 months and will likely resolve
- Platelets are acute phase reactants
- Reactive thrombocytosis
  - Iron deficiency
  - Major trauma
  - Surgery
  - Postsplenectomy
Thrombocytopenia

- Defined as platelet count <150,000/mm³
- Clinical features:
  - Petechiae, purpura, gingival bleeding, epistaxis, menorrhagia, hematuria
- History and exam will guide your differential!

Table 3. Relationship Between Platelet Count and Bleeding

<table>
<thead>
<tr>
<th>Platelet Count (×10³/mcL [×10³/L])</th>
<th>Signs and Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;100</td>
<td>None</td>
</tr>
<tr>
<td>50 to 100</td>
<td>Minimal (after major trauma and surgery)</td>
</tr>
<tr>
<td>20 to 50</td>
<td>Mild (cutaneous)</td>
</tr>
<tr>
<td>5 to 20</td>
<td>Moderate (cutaneous and mucosal)</td>
</tr>
<tr>
<td>&lt;5</td>
<td>Severe (mucosal and central nervous system)</td>
</tr>
</tbody>
</table>

Other variables: function of platelets, anatomic defect, associated coagulopathy

Buchanan GR, Pediatrics in Review. 2005
Thrombocytopenia

Can watch and repeat platelet count

• Infection
  – EBV, CMV, HIV, Hantavirus, Parvovirus, Dengue Hemorrhagic Fever, Malaria
  – Evaluate for infection, repeat platelet count 4-6 weeks after resolution of symptoms

• Medications
  – Discontinue medication and repeat platelet count in 4-6 weeks

Refer to Hematology

• Malignancy: leukemia, lymphoma, neuroblastoma

• Bone marrow failure
  ▪ Aplastic anemia, Fanconi Anemia, Amegakaryocytic thrombocytopenia

• ITP

• Inherited thrombocytopenia

• DIC
Case #1

15 month old male presents for well child check. Mom reports he appears pale and drinks 40 ounces of milk per day. On your exam, you note pallor. Which lab values would be most consistent with iron deficiency anemia?

- A. Hgb 8 gm/dL, MCV 60 fL, RDW 17% (11.5-14.5), rbc 4.5x10(6)mcL (3.9-5.3)
- B. Hgb 8 gm/dL, MCV 80 fL, RDW 14%, rbc 5x10(6)mcL
- C. Hgb 8 gm/dL, MCV 60 fL, RDW 14%, rbc 6x10(6)mcL
- D. Hgb 11 gm/dL, MCV 70 fL, RDW 12%, rbc 5x10(6)mcL
Case #2

- A 6 year old male with past medical history of asthma develops shortness of breath, cough, and wheezing consistent with an acute asthma exacerbation. He is afebrile without rhinorrhea or congestion. His exam is notable for diffuse end-expiratory wheezing. He is started on schedule albuterol and a prednisone burst. Five days later, he returns to your clinic for follow-up. He remains afebrile and symptoms have greatly improved. You order a cbc with differential. His white blood cell count is elevated at 25x10^3 mcL. What is the most likely cause for his leukocytosis?
  - A. Leukemia
  - B. Bacterial pneumonia
  - C. Prednisone
  - D. Lymphoma
Case #3

- A previously healthy 14 year old male presents to your clinic for evaluation of fever, pharyngitis, and fatigue. His exam is significant for bilateral cervical adenopathy and splenomegaly. You decide to obtain labs. His cbc with differential is significant for a platelet count of 20,000/mm³ and atypical lymphocytes. What is the most likely etiology for his thrombocytopenia?
  - A. Alcohol abuse
  - B. EBV infection
  - C. Leukemia
  - D. ITP
References


