How Low Can You Go: Pediatric Anemia
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I don’t have any money, take any money, nor give any money to anyone. Except my kids.
Objectives

• Define anemia and related CBC indices in pediatric patients
• Learn to categorize anemias based on RBC size and mechanism
• Understand the presentation, workup, and treatment of the more common causes of pediatric anemia
Is the patient anemic?

3-year-old with cyanotic heart disease

Hemoglobin is 13 grams/dL
Is the patient anemic?

6 week old thriving premature infant

Hemoglobin is 7.9 grams/dL
Definition

Reduction of the hemoglobin concentration or red blood cell volume below the normal range
Factors Affecting Hemoglobin Levels

- Age
- Gender
- Race
- Sexual Maturation
- Altitude
- Heredity
- Disease Processes
Rule of Thumb

Lower limit of normal for hemoglobin:

Eleven Plus Point One Rule
$11 + 0.1 \times \text{Age in years}$

Lower limit of normal for MCV:

Seventy Plus One Rule
$70 + 1 \times \text{Age in years}$
Symptoms of Anemia

- Central
  - Fatigue
  - Dizziness
  - Fainting
- Blood vessel
  - Low blood pressure
- Skin
  - Paleness
  - Coldness
  - Yellowing
- Eyes
  - Yellowing
- Respiratory
  - Shortness of breath
- Muscular
  - Weakness
- Intestinal
  - Changed stool color
- Heart
  - Palpitations
  - Rapid heart rate
  - Chest pain
  - Angina
  - Heart attack
- Spleen
  - Enlargement
Classification based on MCV and Retic Count

Examination of CBC and peripheral blood smear

- MCV <80
  - Microcytic anemia
  - Serum iron studies
    - Low iron and ferritin with high TIBC
    - Iron deficiency anemia
    - Mentzer index (MCV/RBC) <13 Thalassemia

- MCV 80-100
  - Normocytic anemia
  - Reticulocyte count
    - <2% (hypoproliferative)
      - Leukemias
      - Aplastic anemia
      - Pure red cell aplasia
      - Other marrow failure syndromes
    - >2% (hyperproliferative)
      - Hemorrhage
      - Hemolytic anemias

- MCV >100
  - Macrocytic anemia
  - Megalocytes and segmented neutrophils on peripheral smear
    - Present: megaloblastic
    - Absent: non-megaloblastic
      - Vitamin B12 and/or Folate deficiency
      - Drug-induced
      - Alcohol abuse
      - Myelodysplastic syndrome
      - Liver disease
      - Congenital bone marrow failure syndromes
Pediatric Anemia

- Worldwide, anemia affects up to HALF of children <5 years of age.
- In the US, overall rate is as low as 6%, but as high as 18% in low income families.
- AAP recommends screening between 9 and 12 months of age.
- Also recommends selective screening at any age in children with risk factors such as feeding problems, poor growth, and inadequate dietary iron intake.
Common Causes of Anemia

- Iron Deficiency Anemia
- Hemolytic Anemia
- Hemoglobinopathy, specifically sickle cell disease
- Thalassemia
- Aplastic Anemia
Causes of Iron Deficiency Anemia

- Blood Loss
  - Occult or overt GI losses, surgery, trauma
- Increased Requirements
  - Menstruating females
  - Rapid growth in infancy and adolescence
  - Pregnancy
- Inadequate dietary intake
  - Diet low in heme iron
  - GI disease or surgery
  - Excessive cow’s milk intake
Treatment of Iron Deficiency Anemia

- Increase dietary iron content
- Reduce milk intake
- Ferrous sulfate 3-6 mg/kg/day in toddlers or 325 mg tablets QD/BID
- Multivitamin is NOT sufficient for replacement!!

Should see a rise of >1 g/dL of Hemoglobin in 4 weeks in those with mild anemia or within 2 weeks for those with severe anemia

Reticulocyte count can also be used to assess response: should see an increase in about a week

Once anemia has corrected, need to continue treatment for 2-3 months until iron stores are repleted (as evidenced by ferritin normalization)
Iron deficiency anemia that is not responsive to iron

• Non-compliance with oral therapy
• Not taking their oral therapy
• Seriously, you should check the bottle
• Could be alpha thalassemia
• Inadequate absorption due to GI disease
Thalassemias

**Beta Thalassemia**
- >1% in Mediterranean, northern Africa, SE Asia, India, Indonesia
- >20% in some villages in Greece
- Rare otherwise; not seen much in Mississippi

**Alpha Thalassemia**
- Most common single gene disorder in the world
- 5-10% in Mediterranean, 20-30% West Africa, 68% Pacific
- Commonly seen in African Americans
Alpha Thalassemia

- Four alpha genes, two from mom and two from dad
- Deletions take out the function of one of the genes
- Commonly see silent carriers and patients with trait
- Often confused with iron deficiency anemia as it causes a mild microcytic anemia
- Bart’s hemoglobin is seen on the newborn screen