Anemia In Athletes
See also Anemia

Background
1. Anemia = hemoglobin (Hgb) or hematocrit (Hct) < 2 SD below mean
   - Normal values vary w/ age, sex, altitude
     - Normal Hgb for males: 14-16 gm/dL
     - Normal Hgb for females: 12-15.5 gm/dL
     - "Sports anemia": anemia in an athlete
2. General information:
   - Anemia in athletes should be worked up & tx as in non-athletes:
     - Iron studies
     - Vit B12 & Folate
     - GI evaluation
     - Referral as indicated

Pathophysiology
1. Anemia is a lack of RBCs due to a number of causes:
   - Vitamin deficiencies
   - Iron deficiency
   - Hemoglobinopathies
   - Bone marrow failure or dysfunction
2. Symptoms of anemia related to relative tissue hypoxia due to low oxygen carrying capacity of blood
3. Sports anemia is a dilutional pseudoanemia
   - Research indicates it may be a beneficial adaptation
     - Plasma vol incr 10-20% as a response to endurance training
     - Incr plasma vol causes Hgb levels to decr while incr blood fluidity
     - Not felt to be pathologic
     - Usually returns to normal within 3-5 days of activity cessation
4. Footstrike hemolysis or Exertional hemolysis, also "heel strike hemolysis" and "march hemoglobinuria"
   - Result of intravascular hemolysis d/t RBC trauma at sole of foot on impact
   - Primarily seen in long distance runners d/t repeated forceful, high impact heel strikes
   - Can also occur when recreational runner incr distance
   - "March hemoglobinuria" described in 1861 in military personnel after strenuous field marches
     - Affected men had dark urine that cleared w/rest
   - Can also be seen in swimming, wt lifting, and rowing
     - Thought to be d/t RBC exposure to continuous high oxygen-flux causing oxidative damage
     - Which may lead to a shorter life-span of RBC
     - Normal life-span: 120 days
5. Iron deficiency in athletes
   - Long-distance endurance sports
     - GI loss of heme due to reversible bowel ischemia, GI bleeding, gastric ulcers
     - Poor dietary intake of iron
- Menstruation
- Ferritin can be decreased in training athletes
  - Loss in sweat
  - Rapid turnover of iron in aerobic oxidative muscle metabolism
  - Iron shift from tissue storage to RBCs

6. Incidence/prevalence
- Athletes are no more likely to develop anemia than non-athletes
- Footstrike hemolysis found in up to 20% of long-distance endurance runners
  - Occurs equally in male and female runners
- Iron deficiency anemia is more common in female athletes and young athletes
  - Insufficient dietary intake of iron
  - Higher iron demands during growth
  - Menstruation
  - Low iron stores in ~18% of strenuously trained adolescent athletes

Diagnostics
1. History:
- Often no or mild symptoms
- General fatigue
- Weakness
- Dyspnea w/long, strenuous exertion
- Decr in exercise performance
  - Most common reason for athlete to seek care
- Hx should incl
  - Dietary intake
  - Possible hemoglobinopathies
    - Sickle cell anemia/trait
    - Thalassemias
  - Occult malignancy
  - GI or GU pathology
  - Hx of blood transfusions
  - Oral supplements
  - Prescription meds
  - Recent training hx
    - If incr mileage eval for footstrike hemolysis
2. Physical examination:
- See: Anemia
- Often mild or no findings
- May see glossitis, angular stomatitis, spooning of nails
3. Diagnostic testing
- Sports anemia
  - Mild decr in Hgb in euvoletic pt
  - Orthostatic VS normal
  - Normal
    - MCV
    - Iron studies
    - Vit B12 level
    - Folate
Footstrike hemolysis
- Incr reticulocyte count
- Echinocytes/reticulocytes on peripheral smear
- UA for hemoglobin, hemoglobin casts, hemosiderin
- CBC w/mild decr in Hgb, mild incr in MCV
- Iron studies normal w/ferritin normal or slightly low

Iron deficiency anemia
- Normal to low Hgb
- Low serum ferritin
- Decr MCV
- Soluble transferrin receptor (sTfR)
  - Incr sTfR: upregulation of receptor indicates iron deficiency
  - Not standard testing at this time, may be helpful
- Consider GI workup
  - Occult blood loss in stool incr w/long duration athletic events
    - Usually minimal loss
    - If anemic, work-up
- Iron malabsorption
  - Check serum iron before and 2 hrs after oral iron supplementation
  - If no serum iron rise, malabsorption syndrome likely
    - Parenteral iron tx

Differential Diagnosis
1. Rule out other causes of anemia/symptoms mimicking anemia
   - Acute infectious illness
   - Life threatening cardiac abnormalities
     - Congenital heart defects
     - HCM/ IHSS
   - If acute SOB
     - Pulmonary embolism (PE)
     - Asthma exacerbations
2. Decr exercise performance may be d/t deconditioning and overtraining w/o anemia
3. Supplements, herbal therapies, prescription drugs can cause bone marrow suppression
4. HIV may present w/anemia

Therapeutics
1. Sports anemia
   - Pseudoanemia
     - No tx required
2. Footstrike/Exertional hemolysis
   - Temporary
     - Will improve w/decr training vol and/or runner adaptation
       - Biomechanical eval to change stride
       - Soft, padded shoe inserts
       - Training on soft surfaces
       - Appropriate hydration to prevent secondary renal insufficiency from hemolysis
3. Iron deficiency anemia
   - Iron supplementation
     - 200 mg of elemental iron per day
     - Vit C incr bioavailability of oral iron
     - Severe iron deficiency requires further eval
     - May require parenteral therapy w/ IV iron supplementation and transfusion
       - IV iron max 100 mg of elemental iron per day once weekly for 4 wks
       - Followed by monthly therapy if required
         - IV iron dextran may cause anaphylaxis during tx
         - Less chance of reaction w/IV iron sucrose products
   - Gastric ulcers
     - Tx w/histamine H2 antagonists

Follow-Up
1. For iron deficiency
   - Repeat CBC, serum iron and ferritin to eval response to oral iron
   - Severe iron deficiency requires GI eval
     - Occult GI malignancy
     - Hemorrhagic ulceration
     - Arteriovenous malformation
     - Other GI sources of blood loss
     - Iron malabsorption
2. Women w/severe menorrhagia
   - Need eval and referral to gynecology when appropriate

Prevention/Screening
1. Screening for anemia in athlete is controversial
   - Consider in
     - Menstruating, tired female athletes
     - Elite male athletes
2. CBC and iron studies:
   - Iron
   - Ferritin
   - TIBC
   - Transferrin saturation
3. Consider soluble transferrin receptor assay if previous iron studies are indeterminant
4. If iron supplementation results in incr Hgb concentration, exercise performance improves

References

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