Female Athletic Triad
See also Eating Disorders

Background
- Eating disorders
- Amenorrhea
- Osteoporosis

2. Combination of 3 medical conditions
- Disordered eating
- Amenorrhea
- Osteoporosis
- Not all pts have all 3 components of triad
  - Even having 1 or 2 elements has been shown to greatly incr long term morbidity

3. General information
- Criteria for disordered eating
  - Anorexia nervosa
    - Restrictive eating
      - Unwillingness or inability to take in enough calories to maintain a minimally normal wt for age and ht
      - Leading to body wt <85% of expected
  - Bulimia nervosa
    - Recurrent episodes of binge eating then purging by vomiting or laxatives
  - Eating disorder not otherwise specified
    - Disorders of eating that do not meet criteria for any specific eating disorder
    - Still considered part of Female Athlete Triad
    - Can incl athletes:
      - Not taking in enough food to offset energy expenditure
      - Preoccupation with eating and becoming too heavy

- Amenorrhea
  - Decr level of estrogen 2° to change in hypothalamus
  - Related to athletic training and wt fluctuation
  - Amenorrhea may be 1° or 2°
    - Primary amenorrhea: no spontaneous uterine bleeding by age 14 without development of 2° sexual characteristics or by age 16 with normal development
    - Secondary amenorrhea: absence of menstrual cycles for greater than 3-6 mos

- Osteoporosis
  - Loss of bone mineral density and inadequate bone formation
    - Can lead to bone fragility / incr fx risk
  - Athletes with premature osteoporosis are at higher risk for stress fx and fragility fx (hip/vertebral fx)
Pathophysiology

1. Pathology of dz
   o Disordered eating leads to disruption of hypothalamic, pituitary, ovarian axis
     ▪ Decr GnRH levels
     ▪ Decr LH/FSH levels
     ▪ Decr estrogen production
   o In women, estrogen necessary to maintain normal bone mineralization
     ▪ Hypo-estrogenic states may affect bone density
     ▪ BMD in amenorrheic athletes is 10-20% lower than in normally menstruating athletes
     ▪ Decr bone density linked to incr fx risk
     ▪ Similar to menopause - rate of bone loss escalates
   o Peak bone mass attained at 18-25 yrs of age
     ▪ After this both men and women lose bone at rate of 0.3-0.5% per yr
   o Secondary amenorrhea: loss of bone density can be up to 4% per yr
   o Factors involved in development of secondary amenorrhea
     ▪ Physical stress
     ▪ Emotional stress
     ▪ Wt loss
   o Usual sequenc
     ▪ Disordered eating > amenorrhea > osteoporosis

2. Incidence/ prevalence
   o Incidence: Unknown
   o Prevalence: studies have reported
     ▪ Disordered eating behavior in 15 to 62% of female college athletes
     ▪ Amenorrhea in 3.4 to 66% percent of female athletes
       ▪ 2-5% in general population

3. Risk Factors
   o Female athlete
     ▪ Highly competitive elite female athletes
     ▪ Women participating in sports or other activities that emphasize
       ▪ Endurance
         o Long distance running
         o Swimming
         o Rowing
       ▪ Or a particular physical appearance
         o Gymnastics
         o Diving
         o Figure skating
         o Ballet

4. Morbidity/ mortality
   o Each part of triad has potential complications
     ▪ Disordered eating (incl anorexia, bulimia, or eating disorder not otherwise specified)
       ▪ Malnutrition leads to fatigue, decr immune fxn, difficulty w/concentration
Female Athletic Triad

- Depression
- Severe disordered eating can develop
  - Fatal arrhythmias
  - Seizures
  - Suicide
- Amenorrhea
  - Lack of estrogen leads to osteoporosis
- Osteoporosis
  -Fx of hip, spine, or wrist most common
  - Can lead to impaired mobility/chronic pain

**Diagnostics**

1. **History**
   - Optimal time to screen a female athlete for Female Athletic Triad is during pre-participation sports physical
   - Hx should incl
     - Past medical hx
       - Thyroid disorders
       - Diabetes mellitus
       - Hx of stress fx
     - Menstrual hx
       - Age of menarche
       - Freq & duration of menses
       - Last menstrual period
       - Hx of amenorrhea/ how long
       - Changes of menstrual pattern during season when athlete exercising most
       - Hormonal therapy currently/ previously
     - Psychosocial hx
       - Use of tobacco, alcohol or anabolic steroids
       - Depression
       - Disordered eating hx: anorexia/ bulimia
       - Psychological stressors
     - Nutritional assessment and exercise hx
     - Use of restrictive or binge/ purge diets
     - Daily caloric intake
     - Exercise patterns/ intensity
     - Hx of previous fx
     - Medications
       - Laxatives
       - Diuretics or diet pills
       - Anabolic steroids
       - Antidepressants
       - Hormone therapy

2. **Physical exam**
   - Body Mass Index (BMI)
• Body fat composition (if available)
• Thyroid exam
• Breast/ gynecological
  ▪ If primary amenorrhea
• Musculoskeletal exam
• Signs of bulimia
  ▪ Scleral petechiae
  ▪ Dental caries / erosion of tooth enamel
  ▪ Scarred knuckles from biting
  ▪ Parotid gland hypertrophy
  ▪ Sore throat
• Signs of anorexia
  ▪ Cachectic appearance
  ▪ Bradycardia
  ▪ Hypotension
  ▪ Alopecia
  ▪ Skin with lanugo or dry / yellow color

3. Diagnostic testing
• Laboratory eval
  ▪ Urine/ serum Beta HCG-pregnancy
  ▪ CBC
    • Anemia
  ▪ Complete metabolic panel
    • Electrolyte levels, liver & kidney fxn
  ▪ Nutrition panel
    • Phosphorus, magnesium, albumin levels
  ▪ Thyroid panel
    • Hyper or hypothyroidism
  ▪ FSH/ LH to eval pituitary fxn, premature ovarian failure
  ▪ Prolactin level: pituitary fxn
  ▪ Direct estradiol, testosterone, DHEA levels
    • Evaluate estrogen level / androgen excess
    • Rule out 2° causes of amenorrhea

4. Diagnostic imaging
• Plain radiographic film to eval for stress fx/ fragility fx
• If plain x-ray negative but suspicion high: bone scan/ MRI
• Baseline dual-emission x-ray absorptiometry (DEXA)
• In athlete w/primary amenorrhea: U/S pelvis to eval if uterus present

5. Other studies
• Resting EKG
  ▪ Especially if heart rate <50 bpm
• Screen for Depression

6. Diagnostic criteria
• Clinical dx
• No single test allows for definitive dx
**Differential Diagnosis**

1. Pregnancy
2. Hypothyroidism / hyperthyroidism
3. Androgen excess
   - Hyperandrogenism
   - Cushing's Syndrome
4. Pituitary disorders
   - Pituitary neoplasm
   - Hypopituitarism
   - Sheehan's syndrome
   - Prolactinoma
   - Empty sella syndrome
5. Hypothalamic disorders
   - Adrenal insufficiency
   - Absence of Gonadotropin releasing hormone (GnRH)
6. Nutritional deficiencies secondary to eating disorder
7. Polycystic ovarian dz
8. Premature ovarian failure
9. Menopause
10. Ovarian defect
    - Gonadal dysgenesis
    - Turner Syndrome
11. Depression
12. Anxiety disorder

**Therapeutics**

1. Acute treatment
   - Treat stress fx s
   - Assess for cardiac arrhythmias
     - Especially if anorexic
   - Treat electrolyte abnormalities/ nutritional deficiencies
2. Further mgmt (24 hrs)
   - Psychiatric eval/ tx
3. Long-term care
   - Lifestyle changes
     - Dietary
       - Dietician to educate / monitor pt for adequate nutrition
       - Wt gain of 0.5 - 1 lb per wk acceptable if pt under weight
     - Exercise
       - Reduce exercise by 10-20%
         - Do not stop if pt compliant in other areas
       - Stop exercise if pt non-compliant
       - Stop exercise if possible, severe complications if exercise is continued
         - Stress fx
         - Arrhythmias
         - Severe electrolyte disturbances
Female Athletic Triad

Hormone replacement therapy (HRT)
- To treat 2° amenorrhea
- To improve bone mineral density
  - Combination estrogen/progesterone oral contraceptive
  - Cyclical estrogen/progesterone

Other pharmacotherapy
- Calcium supplementation 1200-1500 mg qD
- Vitamin D supplementation 400-800 IU qD
- Consider tx for osteoporosis
  - Bone mineral density (DEXA) >2.5 SD below age-specified norms
    - Bisphosphonates or calcitonin may be of some benefit, but no studies on young females
    - Should be stopped if pt desires to become pregnant or during pregnancy (class C drugs)
  - SSRIs
    - For severe eating disorders or depression/ anxiety

Follow-Up
1. Return to office
   - Weekly follow-up once dx then monthly once improves
     - Follow up lab work/nutrition status as needed
   - Can request assistance from athletic trainer or coach for monitoring of irregularities in eating behaviors or exercise regimen
2. Refer to specialist
   - Psychologist or psychiatrist familiar w/eating disorders
   - Initial consult w/dietician (especially if familiar w/sports nutrition)
     - Long term follow up to follow eating behaviors
     - Encourage proper caloric intake and modification
   - Cardiology consult if cardiac arrhythmias
   - Orthopedic surgery consult if fx or stress fx requires surgical intervention
3. Admit to hospital
   - May be required at any time during tx if pt is
     - Continuing to harm herself
     - Show signs of multi-organ dysfunction 2° to severe weight issues/malnutrition
   - May need long term inpt tx for severe eating disorders

Prognosis
1. Long term prognosis is good if amenorrhea or disordered eating is detected early
   - Helpful to screen in pre-participation evaluation
2. Mild to moderate cases of osteoporosis may improve
   - Lost bone mineral density may be permanent
Prevention
1. Educate athletes, coaches, trainers, and parents for earlier detection of female athletic triad

References

Evidence-Based Inquiry
1. What's the best way to manage athletes with amenorrhea?

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