Case #1

- 40 y/o woman presents to your office for ER follow-up one week after bike accident.
- Went over handle bars traveling on city streets.
- No loss of consciousness.
- Taken by ambulance to ER.
- Had trauma work-up including head CT (-).
- Diagnosed with clavicle fracture, nonoperative tx by orthopaedic surgeon, discharged home.
- Has headache, fatigue, dizziness, light sensitivity. Trouble staying focused at work, sleeping more than usual.
- Normal neurologic exam.

Diagnosis: Concussion

- H/o trauma
- Headache
- Fatigue
- Dizziness
- Light sensitivity
- Trouble staying focused at work
- Sleeping more than usual.
How would you treat the concussion?

1. Order urgent MRI brain to rule out subtle post traumatic bleed, return to clinic after MRI.
2. Rest from work and biking, return to clinic 1 week.
3. Return to work but rest from biking, return to clinic in a month.
4. Return to work and biking (assuming cleared by orthopaedic surgeon for clavicle fracture).

Concussion definition

- Blow to head, neck, body → force to head
- Rapid onset of neurologic impairment
- Symptoms usually short-lived and resolve spontaneously but in some cases can be prolonged
- Symptoms represent functional or metabolic change in CNS, not structural injury
- Graded set of clinical syndromes that may or may not include loss of consciousness
- Symptom resolution is sequential
- Standard neuroimaging is normal

Concussion symptoms

- Physical
- Sleep
- Cognitive
- Emotional

Concussion clinic evaluation

- History keys
  - Mechanism of injury
  - Symptoms initially and currently
  - If sports
    - Did they play through the symptoms?
    - Did they have a second hit (might make sx set last longer)
  - Loss of consciousness (if many minutes then would expect transport and head CT)
  - PMH – associated with prolonged symptoms
    - ADHD, learning d/o
    - Depression, anxiety
    - Concussion


- Worsening headache
- Seizure
- Increasing drowsiness
- Focal neuro deficit
- Repeated vomiting
- Slurred speech
- Does not recognize people/places
- Increasing confusion/irritability
- Weakness/numbness arms or legs
- Neck pain
- Loss of consciousness >30 seconds


Concussion treatment
- Cognitive rest
- Physical rest
- Medication
  - Avoid aspirin and ibuprofen
  - Tylenol OK
- Avoid alcohol
- Avoid driving

Symptom resolution after sport concussion
- Majority 7-10 days
- High school athletes shown to take longer to recover based on neuropsychologic testing compared to college athletes (Field et al., J Pediatr, 2003.)
- Prolonged symptoms: > 4 weeks. Consider neurology or neuropsychology consult.

Return to work/play

- Asymptomatic
- Normal neurologic exam (SCAT2)
  - Cognitive
  - Balance
- Computerized neuropsychologic testing


Step-wise activity progression

Asymptomatic

Clinician clearance

Light aerobic activity

Sport specific activity

Non-contact training

Full contact practice

Game play


Case #2

- 19 y/o female collegiate cross country runner home for spring break comes to clinic
- Complains of increasing fatigue, decreased appetite, trouble recovering from work-outs, worsening performance in meets, difficulty concentrating in class.
- No abnormalities in GI hx or gyn hx
- Exam: Height 5’3”, weight 125#. Tearful when discussing symptoms, but physical exam otherwise normal.

Causes of fatigue in a runner

1. Cardiac
   - Coronary artery dz
   - Hypertrophic cardiomyopathy
2. Endocrine
   - Hyperthyroid
   - Hypothyroid
   - Diabetes
3. Hematologic
   - Iron deficiency
   - Iron deficiency anemia
4. Malignancy
5. Infection
6. Depression, stress
7. Pregnancy
8. Nutritional
   - Disordered eating
   - Drugs, alcohol
   - Celiac dz
9. Overtraining syndrome
Labs/Studies
- White blood cell count and differential normal
- Hematocrit 36.2 (normal)
- Thyroid stimulating hormone: normal
- Fasting blood sugar: normal
- Pregnancy test negative
- EKG normal

What do you do now?
1. Screen for depression
2. Screen for eating disorder
3. Order serum iron and ferritin
4. Order stress echocardiogram
5. Diagnose overtraining and recommend rest
6. 1 and 2
7. 1, 2, and 3

Work-up, continued
- Depression screen (PHQ-9) = 5 (normal < 5)
- Eating disorder screen
  - No restrictive eating
  - No binge/purge behavior
  - No h/o dieting
- Ferritin 9 (low)
- Iron 111 (normal)

Importance of iron in athletes: VO2

The Fick principle

\[ \text{VO2} = \text{cardiac output} \times (\text{arterial O2} - \text{venous O2}) \]

- **Increasing hemoglobin** → **increased arterial O2** → **increased VO2**
- **Decreasing hemoglobin (anemia)** → **decreased arterial O2** → **decreased VO2**
Iron deficiency anemia is common in athletes

- Iron deficiency anemia
  - Athletes same incidence as general population
  - 2.9% women, 0.2% men
- Iron deficiency without anemia (low ferritin)
  - 37% female athletes and 23% female non-athletes have ferritin <20 (Rodenberg, 2007)
  - 10% male athletes (Hinton 2007)
  - Recreational athletes: 29% female, 4% male subjects with ferritin <16 (Sinclair 2005)
  - 35% female, 15% of male elite basketball players with ferritin <20 (Dubnov 2004)

Why are athletes iron-deficient?

- Low dietary intake
  - Vegetarians eat more nonheme than heme iron
- Decreased iron absorption
  - Celiac sprue
  - Chronic diarrhea
  - Gastrectomy
- Increased iron loss
  - Blood loss
  - Menstruation if younger woman
  - GI malignancy if older adult
  - Runners may have increased GI bleeding in stomach + large intestine (Pfitzinger 2003)
- Sweat
- Urine
- Hemolysis; foot strike → RBC breakdown
- Increased iron utilization
- Pregnancy

Iron deficiency anemia impairs performance

- Low hemoglobin + low ferritin = iron deficiency anemia
- Decreased VO2max
- Decreased transport of oxygen to tissues
Treating iron deficiency anemia improves performance

- Higher hemoglobin
- Increases work capacity
- Decreases heart rate with exercise
- Decreases lactate concentration
- Extreme example: blood doping


Does treating iron deficiency without anemia improve performance?

- Low ferritin may indicate relative anemia. Iron supplement → ↑ ferritin → ↑ hemoglobin → improved performance.
- Low ferritin may lead to mitochondrial dysfunction. Iron supplement may improve endurance performance due to improved mitochondrial function.

Case #3

- 18 y/o freshman cross-country runner
- “heart beat stays fast”
- “hard to stop sweating”
- “tired all the time”
- Times worse than when in high school
Differential diagnosis

- Cardiac
  - Arrhythmia
- Metabolic
  - Hyperthyroid
  - Anemia
  - Diabetes
  - Malnutrition/eating disorder
- Pulmonary
  - Exertional bronchoconstriction
- Malignancy
- Infection
- Depression
- Pregnancy
- Overtraining syndrome

Work-up

- Physical exam: VS normal, exam normal
- CBC with differential: normal
- Fasting BG: normal
- TSH: normal
- Pregnancy: negative
- Iron studies and ferritin: normal
- EKG: normal
- Depression screen: mildly positive
- Eating disorder screen: negative
- Cardiopulmonary exercise test with echo: no exertional bronchoconstriction, no arrhythmia, no structural heart disease

What is the diagnosis?

1. Parasite
2. Depression
3. **Overtraining syndrome**
4. Arrhythmia
5. Lupus
6. Occult malignancy

Overtraining syndrome

- Increased perceived exertion
- Decreased performance
- Decreased energy and mood
- Symptoms must last > 2 weeks
- No diagnostic test
- Diagnosis of exclusion
Overtraining syndrome model

- Overreaching
- Supercompensation
- Overtrained

Overtraining syndrome treatment

- Rest x 2-3 weeks
  - Decrease training volume by 50%
- If symptoms continue
  - More rest
  - Track symptoms
  - Track mood scores
  - Sports psychology
  - Nutrition

Consequences of overtraining syndrome

- Overuse injuries
- Recurrent illnesses
- Missed events
- Depression
- Premature retirement

Case #4

- 20 y/o collegiate cross country athlete
- Presents to clinic with right groin pain
- Started a few weeks ago, getting worse gradually
- Still able to run but pain gets worse the more she runs, hard to lift her leg due to pain


http://www.genucare.com/archives/496.html
Differential diagnosis

Groin pain in runner
- Intraarticular hip problem
  - Impingement
  - Labral tear
  - Femoral neck stress fracture
- Extraarticular hip problem
  - Hip flexor strain
  - Sports hernia
- GI/gyn problems


5 questions for every athlete with hip pain
1. Training: increased mileage?
2. Nutrition: Calories in versus calories out? History of eating d/o? Dietary restrictions?
3. History of stress fractures?
4. Family history of osteoporosis?
5. Menstrual history?

Our patient
- Increased mileage from 30 to 60 miles/week in last month without increased caloric intake
- No dietary restrictions or h/o eating d/o
- (+) h/o tibial stress fracture in high school
- No family history osteoporosis
- Menses regular until college but none since freshman year (18 months)
- Exam
  - Walking with right-sided limp
  - Tender right inguinal region
  - Pain with passive ROM: flexion, internal, and external rotation of hip
  - Neurologically intact lower extremities but pain with active hip flexion

What’s your leading diagnosis?
1. Hip flexor strain
2. Hip impingement or hip labral tear
3. GI/gyn problems
4. Sports hernia
5. Femoral neck stress fracture

11% 33% 53%
Healthy energy status

Healthy menstrual cycles

Healthy bones

Low energy availability with or without eating d/o Osteoporosis Amenorrhea

Low bone density

Irregular menses

OPTIMAL HEALTH

PATHOLOGY


• Best treatment = prevention
  • Screen for risk factors
  • Finding 1 risk factor should prompt eval for others
  • Increase energy availability
    • Increase dietary intake
    • Decrease exercise
    • Has been shown to restore menses
    • Has been shown to increase bone density
  • Estrogen: does not improve BMD as much as if menses are restored with increased energy availability
  • Multidisciplinary approach: primary care doctor, nutritionist, psychologist, eating d/o specialist, athletic trainer


• 55 y/o woman presents for routine annual exam. No complaints but shocked that she gained 10# since she saw you last year. Takes no medications.
  • BP 140/80, HR 80, Height: 5’3”, weight 170# (BMI 30)
  • Labs:
    • HgA1c 6.3%
    • Fasting glucose 104
    • Total cholesterol 192, TG 119, HDL 50, LDL 118
What treatment would most benefit this patient now and in the long run?

**Exercise**

Strong evidence that physical activity associated with lower risk of

- Coronary artery disease
- Stroke
- High blood pressure
- High cholesterol
- Type 2 diabetes
- Colon cancer
- Breast cancer
- Falls


The exercise prescription: What’s the right dose of activity?

Physical activity recommendations: 4 types of activities

- CV fitness
- Balance
- Flexibility
- Strength
Physical activity recommendations: components of each activity

- **Frequency**
- **Intensity**
- **Time**
- **Type**

Estimating exercise intensity

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Moderate</th>
<th>Vigorous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>&lt;50% max</td>
<td>50-70% max</td>
<td>&gt;70% max</td>
</tr>
<tr>
<td>Talk test</td>
<td>Can talk and sing</td>
<td>Can talk but not sing</td>
<td>Can only say a few words before pause for breath</td>
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</table>

Exercise prescription: Combine activity with components

- **Frequency**
- **Intensity**
- **Time**
- **Type**

CV fitness recommendations

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Intensity</th>
<th>Time</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>5x/week</td>
<td>Moderate</td>
<td>30 minutes</td>
<td>Major muscle groups</td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3x/week</td>
<td>Vigorous</td>
<td>20 minutes</td>
<td>Major muscle groups</td>
</tr>
</tbody>
</table>

**Balance recommendations**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Intensity</th>
<th>Time</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3d/week</td>
<td>Unknown</td>
<td>20 minutes</td>
<td>Tai Chi, tennis, yoga, surfing</td>
</tr>
</tbody>
</table>


**Strength recommendations**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Intensity</th>
<th>Time</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3d/week</td>
<td>Novice: 40-50%</td>
<td>Unknown</td>
<td>All major muscle groups</td>
</tr>
<tr>
<td></td>
<td>Experienced: 80%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


**Flexibility recommendations**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Intensity</th>
<th>Time</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3d/week</td>
<td>Stretch to feeling of tightness</td>
<td>Hold 10-30 seconds</td>
<td>All major muscle-tendon units</td>
</tr>
</tbody>
</table>


**Action plan: Exercise is Medicine**

1. Identify potential health benefits of exercise.
2. Is the patient healthy enough to begin exercise?
3. Assess patient’s stage of change.
   1. Precontemplation
   2. Contemplation
   3. Preparation
   4. Action and maintenance
4. Write the exercise prescription.

What makes a successful exercise program?

- Program characteristics
  - Moderate intensity
  - Supervised activity by experienced leader
  - Group support
- Individually tailored program
  - Goal-setting
  - Reinforcement: social support for behavioral change
  - Problem-solving

Choose an activity that fits your style.

Would You Like a Cocktail With That Workout?

Pedometers

- Popular and effective for promoting physical activity
- 10,000 steps/day was old recommendation

Update for 2011:

- Pedometers don’t measure speed
- May need <10,000 steps/day for sig health benefit
- 100 steps/minute is rough estimate of moderate intensity exercise
- Recommend using steps/minute and the number of minutes/session

ACS M Position Stand on Prescribing Exercise, Medicine & Science in Sports & Exercise, 2011.

Case

- 55 y/o woman presents for routine annual exam. No complaints but shocked that she gained 10# since she saw you last year. Takes no medications.
- BP 140/80, HR 80, Height: 5’3”, weight 170# (BMI 30)
- Labs:
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  - FPG 104
  - Total cholesterol 192, TG 119, HDL 50, LDL 118
Write the exercise prescription

- Frequency
- Intensity
- Time
- Type

Exercise prescription resources

http://bleacherreport.com/articles/1189176-bay-to-breakers-2012-changes-the-race-must-make

“All parts of the body if used in moderation and exercised in labors to which each is accustomed, become thereby healthy and well developed, and age slowly; but if unused and left idle, they become liable to disease, defective in growth, and age quickly.”

Hippocrates
Thank you!

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UCSF Internal Medicine and Orthopaedics

http://www.cdc.gov/physicalactivity/everyone/guidelines/index.html

http://go4life.niapublications.org/

http://go4life.niapublications.org/try-these-exercises#strength-exercises