Recognizing and Treating Heart Problems in Athletes

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Benefits of Exercise

• Cardiovascular health
• Musculoskeletal health
• Weight maintenance/reduced risk of diabetes and high blood pressure/improved cholesterol profile
• Decreased inflammation
• Reduced risk of cancer
• Psychological benefits
• Longevity
  • One study of >250,000 middle aged people demonstrated 50% decreased mortality in those who engaged in combination vigorous and moderate exercise

Benefits of Exercise

Life Expectancy Gains from Physical Activity

Heart Rate Recovery

Physiological Changes with Exercise

- Nervous system: the control center
- Increased cardiac output (heart rate and stroke volume)
  - 5-6 L/minute at rest
  - Up to 35 L/minute in well trained athletes!
- Increased blood pressure

Different Types of Athletes

- Endurance (volume loading)
- Weight lifters (pressure loading)
- Mixed
- Different adaptations to training
The Fittest Community in the Nation

• Impressive number of professional athletes from all fields

  • University of Colorado
    • 28 National Championships
      • Two former CU runners won medals at the 2016 Rio Olympics — Jenny Simpson in the 1,500 meters and Emma Coburn in the steeplechase
    • GO BUFFS!

The Fittest Community in the Nation

• High school athletes: many students participate, often at the national/international level

  • Huge number of recreational athletes, many train and compete at an elite level

The Fittest Community in the Nation

• Active in general
  • 93,000 bikes around town
  • Countless youth programs
  • The annual Bolder Boulder 10k has been run for 41 years and is the 3rd largest running race in the United States and the 7th largest in the world.

Community Partnerships

• Boulder Community Health and CU Sports Medicine and Performance Center
  • https://cusportsmedcenter.com
Athletes Are Not Immune

https://www.youtube.com/watch?v=6vxs9U9wjel

Coronary Artery Disease in the Masters Athlete

Coronary Artery Disease

No plaque buildup

Extensive plaque
Coronary Artery Disease

• https://www.webmd.com/heart/video/inside-look-heart-attack

Coronary Artery Disease in the Masters Athlete

• Increased risk of heart attack during exercise compared with rest
  • 1-2/100,000 person years; majority 45-55 years old
  • Habitual exercise decreases the risk of exercised induced heart attack

• Underlying risk factors for heart disease
  • Age, genetics, cholesterol, high blood pressure, past smoking, diabetes, overweight

Coronary Artery Disease in the Masters Athlete

• The benefits of exercise may plateau above 100 minutes/day
• Sweet spot for mortality benefit seems to be 22-40 MET hours/week
  • Examples:
    • Brisk walking is 3 METS/hr . . . 8 hours of walking per week
    • Running at 8 mph is 13 METS/hr . . . 3 hours of fast running per week
    • Cycling at 10-16 mph is 6-10 METS/hr . . . 4 hours of moderate cycling per week
• Masters endurance athletes have higher prevalence and burden of coronary plaque than controls
  • Men more affected than women

Heart Valve Problems
Heart Valve Problems

- BAV 1% of the population
- Can lead to heart failure...
  - Shortness of breath
  - Leg swelling
  - Decreased performance
  - Fainting

Aortic Problems

- High blood pressure
- Other causes of aortic enlargement
  - Genetic syndrome/connective tissue disease
    - Marfan’s disease
      - 1/3000-5000 people
    - Bicuspid aortic valve
- Can lead to...
  - Rupture/dissection which is generally a very bad thing
  - Burst type exercise/heavy weight lifting can worsen dilation and increase risk of dissection
Performance Enhancers Are Not Worth the Risk

- Anabolic steroids
  - High blood pressure; cholesterol and glucose abnormalities; skin/muscle/joint damage; psychiatric and sexual side effects

- Erythropoietin
  - Stroke, heart attack, blood clots in the lungs

- Stimulants (high dose caffeine, amphetamines, ephedrine)
  - Stroke, heart attack, high blood pressure, arrhythmia, insomnia

Other Conditions

- Underlying medical issues can worsen cardiac symptoms

- Or underlying medical issues can present as cardiac symptoms
  - Anemia
  - Thyroid disease
  - Kidney disease

Other Conditions

- Electrolyte derangements during prolonged exercise

- Body temperature extremes (heat stroke/hypothermia)

- High altitude
  - 1% decrease in MV02 for every 100 m above 1500 m
  - An MVO2 of 50 mL/mg/min at sea level equates to an MVO2 of 14 mL/kg/m2 at Everest base camp!

Arrhythmias and Syncope in Athletes

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**Syncope - definitions**

- Sudden, temporary loss of consciousness
- Traumatic
- Nontraumatic
  - Loss of cerebral perfusion (blood supply to the brain) – 80%
  - Preserved cerebral perfusion – 20%
    - Seizure
    - Non-seizure

**Syncope – natural history**

- Most syncope has a defined cause (50-70%)
- 500,000 first-time cases of syncope every year
  - 2/3 never recur
  - 1/3 recurrent but benign
  - Very small percentage malignant

**Syncope – benign vs malignant**

- Benign syncope
  - Vasovagal / Neurocardiogenic / Orthostatic / Situational

- Malignant syncope
  - Cardiac
    - Arrhythmias
  - Neurologic
    - Seizure

**Orthostasis and vasovagal syncope**

- Inadequate blood return to the heart
  - Sudden change in posture
  - Prolonged standing
- Inappropriate feedback loop
  - Slowed heart rate
  - Decreased pump action
  - Dilation of blood vessels
- Exacerbated by:
  - Dehydration
  - Medications
  - Heat
  - Situational factors (blood, urination/defecation, abdominal/thoracic strain)
**Syncope – features of malignant syncope**
- Resulting in injury
  - Facial trauma
  - Laceration / fracture
- Exercise-mediated
- At rest, especially seated/reclined
- Pulseless/apneic
  - Requiring CPR or defibrillation
- Not immediately resolved
- No latent neurologic symptoms

Was there a cessation in heartbeat??

**Cardiac rhythm**
- Generates coordinated pump action of the heart
- Responsive to physiologic changes in the body
- Made possible by specialized electrical pathways in the heart

**Congenital arrhythmic syndromes**
- Associated with a family history of syncope or sudden death
- May present with syncope (+/- recurrent), or with sudden cardiac arrest
- Can cause arrest in an otherwise normal heart!

**Hypertrophic cardiomyopathy**
- Abnormally thickened heart muscle
- Multifactorial genetic disease
- 1:500-5000 (0.02-0.2%) in general adult population
- 30-40% of sudden death in young athletes!
- Ventricular fibrillation / sudden cardiac arrest
- Outflow tract obstruction
- Requires exercise restriction
Arrhythmogenic (right) ventricular cardiomyopathy

- Structurally abnormal heart muscle
  - Cell-cell binding elements
  - Accelerated “wear and tear”
- Multifactorial genetic disease
- LARGE lifestyle modifier – endurance exercise
- 1:5000 (0.02%) in general population
  - 3:1 male predominance
- 20% of sudden death in young athletes!
- Requires exercise restriction

Anomalous coronary artery

- Abnormal origin of coronary artery
- Variety of defects
  - Origin from pulmonary artery
  - Origin from incorrect aspect of aorta
  - Inter-arterial course
- 1-2% prevalence in general population!
  - ½ are benign
  - 10-15% of sudden death in young athletes
- May be treated with bypass surgery
- May require exercise restriction

Ion channel disorders in structurally normal heart

- Defect in regulation of cardiac activation
  - (mostly) single-gene disorders
- Long QT syndrome
  - 1:2000 (0.05%) in general population
- Catecholaminergic polymorphic ventricular tachycardia
  - 1:10000 (0.01%) in general population
- Brugada syndrome
  - 1:5000 (0.02%) in general population
  - 1:600 (0.15%) in Asian population
- Require exercise restriction

Atrial fibrillation

- Disorganized rhythm in the atria (non-pumping chambers)
- NOT immediately unstable
- Short-term effects
  - Elevated heart rate
  - Palpitations / fatigue / lightheadedness
  - Exacerbation of underlying heart/lung conditions
- Long-term consequences
  - Stroke
  - Heart failure
**Atrial fibrillation causes**
- “Wear and tear” disease of the heart
  - Age
  - Cardiac disease – hypertension, diabetes, heart failure, valvular disease
  - Non-cardiac disease – lung disease/sleep apnea, thyroid, anemia, alcohol/drug use, many many others
- Athletes are at 3-8x increased risk
  - AF present in 15% of veteran athletes
  - In young patients with no other AF risk factors, intense exercise history in 60%
    - Middle-aged men with >10 year strenuous exercise history are highest risk group

**Atrial fibrillation timeline**
- Progressive disease
- Risk factors accumulate over time
- Burden of disease accelerating
  - “AFib begets AFib”
- Later-stage disease more difficult to treat
- AFib is a very individual disease, and treatment decisions need to be made on an individual basis

**Conclusions – symptoms of concern**
- Fainting/syncope
- Chest pain or pressure
- Unusual shortness of breath
- Unusual heart racing/skipping
- Unexplained decline in exercise tolerance

**Conclusions – getting help**
- TALK to your doctor!
  - Primary care
  - Cardiologist
  - Other
- Workup (investigation)
  - ECG
    - Spot
    - Continuous
  - Wearable data
    - Pulse oxymetry vs electrocardiographic
Conclusions – getting help

- Workup (investigation)
  - Imaging
    - Echo/ultrasound
    - Cardiac CT
    - Cardiac MRI
    - Nuclear imaging
  - Stress testing

- Treatments
  - Exercise prescription
  - Medications
  - Procedures
    - Cath / stent / bypass surgery
    - EP study / ablation
    - Implantation of cardiac monitor / pacemaker / ICD
- All treatment decisions have to be made on an individual basis!

Thank you!

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