

Recognizing and Treating Heart Problems in Athletes

Sam Aznaurov, MD

Molly Ware, MD

Boulder Heart

303-720-7918

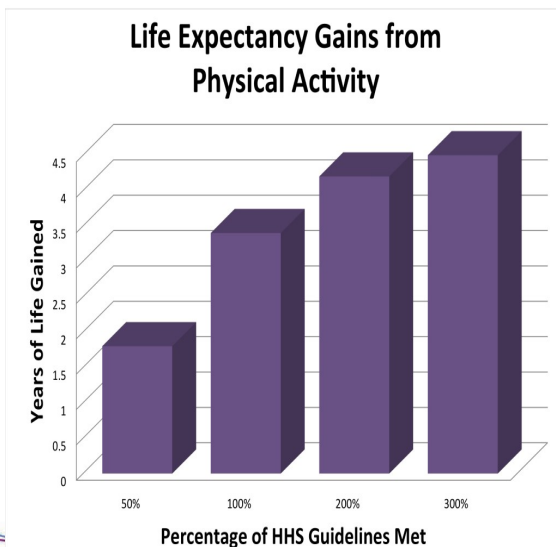


Benefits of Exercise

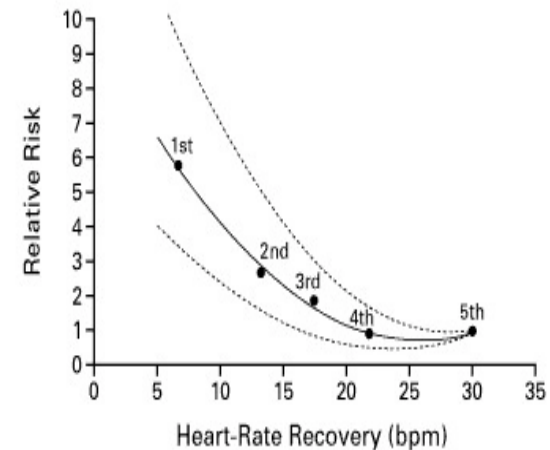
- Cardiovascular health
- Musculoskeletal health
- Weight maintenance/reduced risk of diabetes and high blood pressure/improved cholesterol profile
- Decreased inflammation
- Reduced risk of cancer
- Psychological benefits
- Longevity
 - One study of >250,000 middle aged people demonstrated 50% decreased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



Benefits of Exercise



Heart Rate Recovery

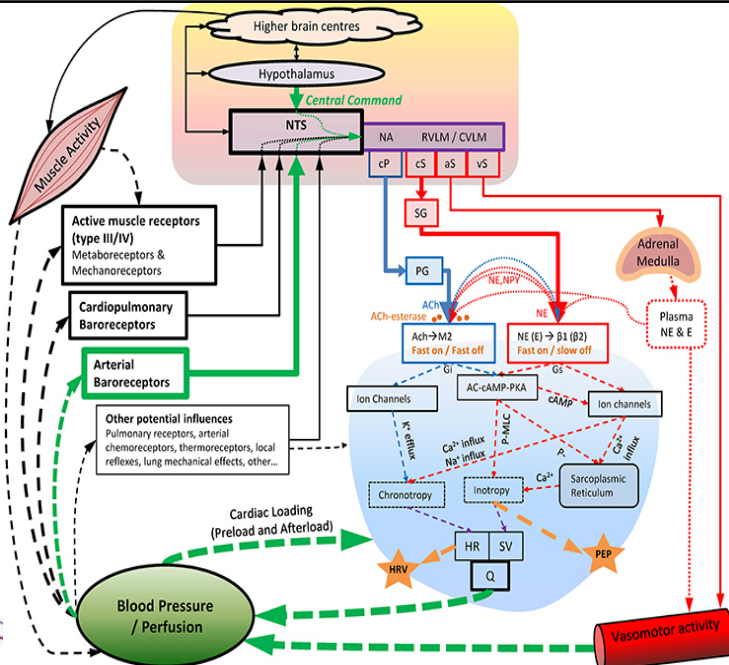


Physiological Changes with Exercise

- 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

Physiological Changes with Exercise

- Increased lung ventilation
- Increased oxygen uptake by muscles (VO_2 mL/kg/min)
- Good warm up is important to activate metabolic pathways (eg, anaerobic and aerobic glycolysis)
- A definite stress test . . .
- Complex, efficient system



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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 Boulder Boulder 10 k 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

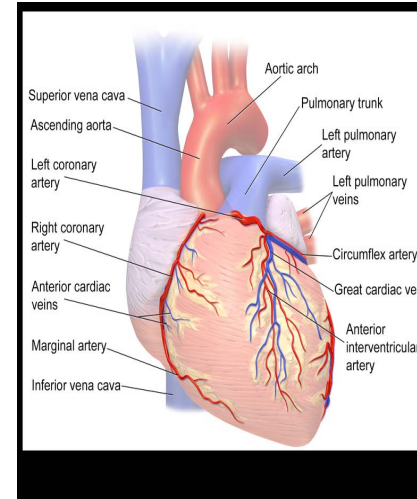
- Boulder Community Health and CU Sports Medicine and Performance Center
 - <https://cusportsmedcenter.com>



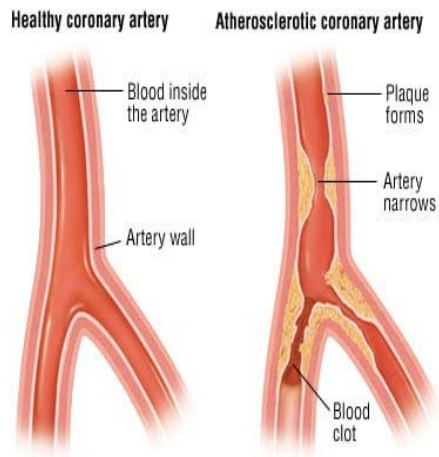
Athletes Are Not Immune

<https://www.youtube.com/watch?v=6vxs9U9wjeI>

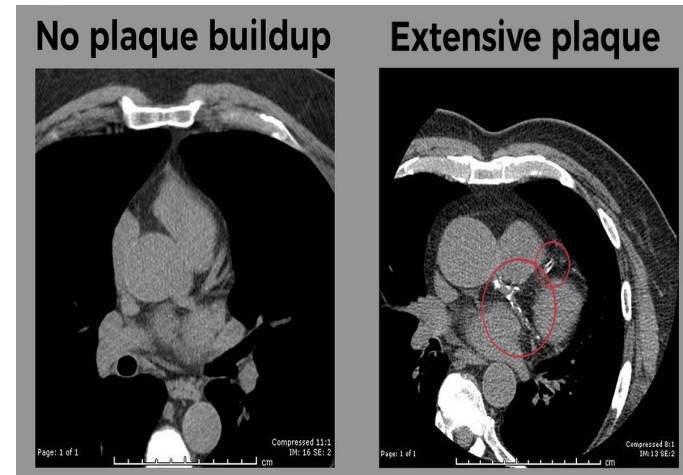
Coronary Artery Disease in the Masters Athlete



Coronary Artery Disease



Coronary Artery Disease



Coronary Artery Disease

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

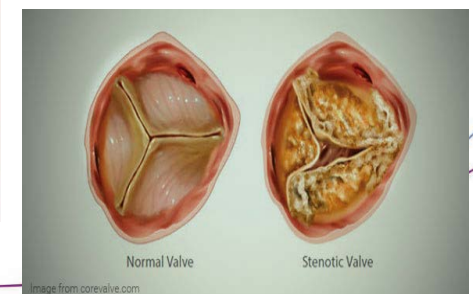
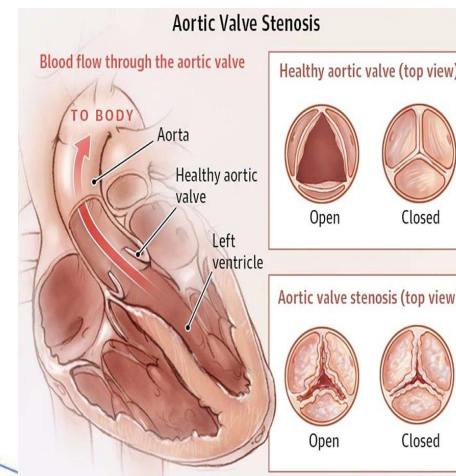
Coronary Artery Disease in the Masters Athlete

- 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

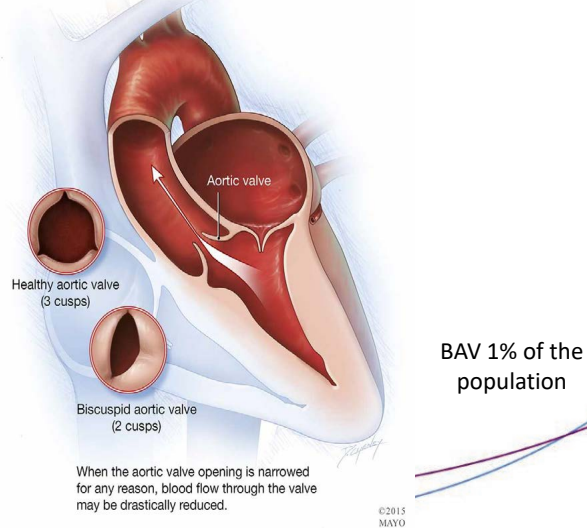
- The benefits of exercise may plateau above 100 minutes/day
- Sweet spot for mortality benefit seems to be 22-40 MET hours/week
 - **Examples:**
 - Brisk walking is 3 METS/hr . . . 8 hours of walking per week
 - Running at 8 mph is 13 METS/hr . . . 3 hours of fast running per week
 - Cycling at 10-16 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

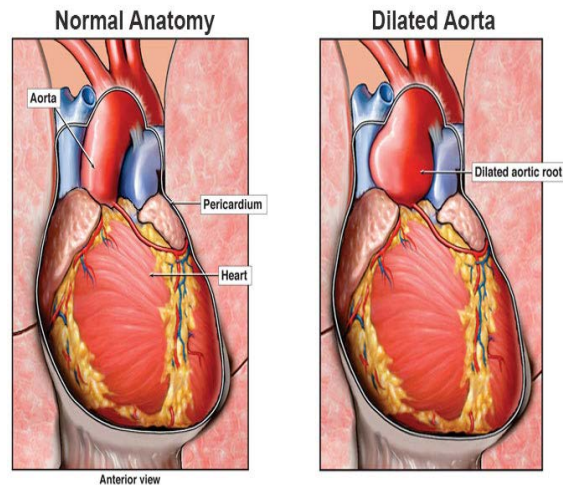
Bicuspid aortic valve



Heart Valve Problems

- Can lead to heart failure . . .
 - Shortness of breath
 - Leg swelling
 - Decreased performance
 - Fainting

Aortic Problems



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 $\dot{V}O_2$ for every 100 m above 1500 m
 - An $\dot{V}O_2$ of 50 mL/kg/min at sea level equates to an $\dot{V}O_2$ of 14 mL/kg/min at Everest base camp!

Arrhythmias and Syncope in Athletes

Sam Aznaurov, MD, FACC, FHRS
Cardiac Electrophysiologist
Boulder Heart

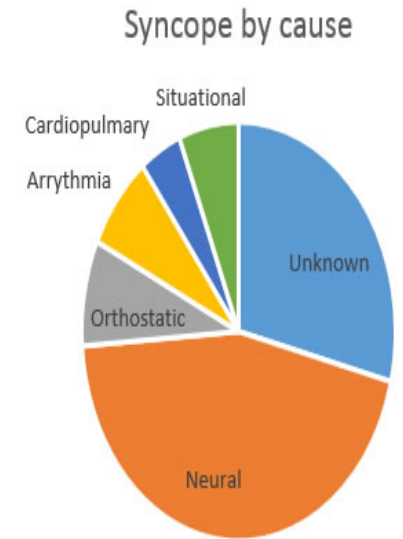
Syncope - definitions

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



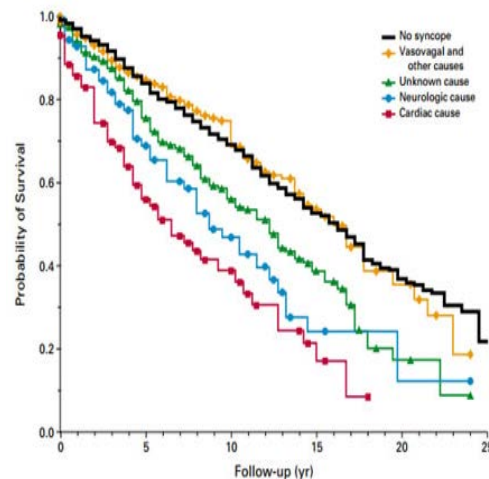
Syncope – natural history

- 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



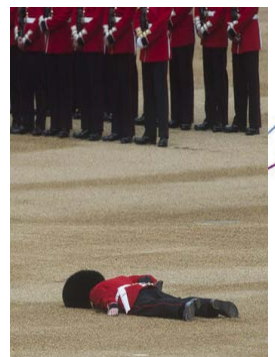
Syncope – benign vs malignant

- Benign syncope
 - Vasovagal / Neurocardiogenic / Orthostatic / Situational
- Malignant syncope
 - Cardiac
 - Arrhythmias
 - Neurologic
 - Seizure



Orthostasis and vasovagal :

- 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)



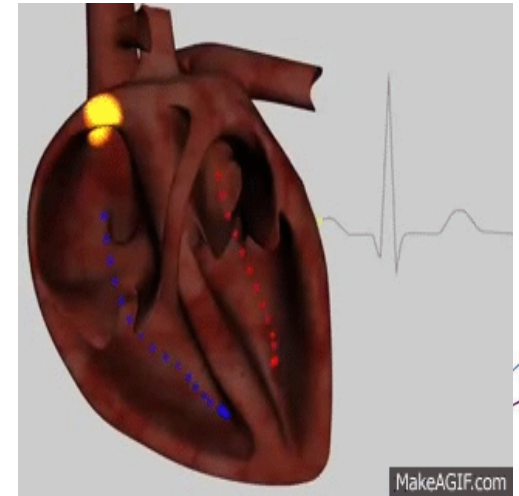
Syncope – features of malignant syncope

- 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??

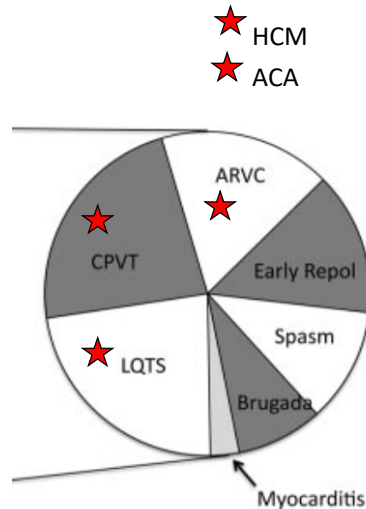
Cardiac rhythm

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



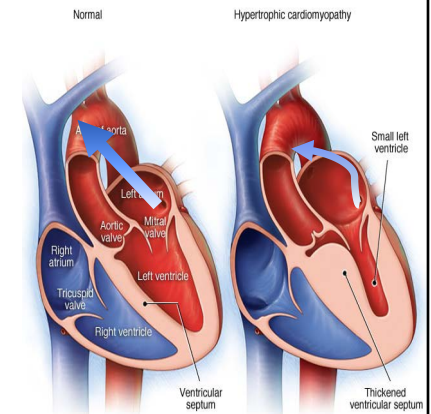
Congenital arrhythmic syndromes

- 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!



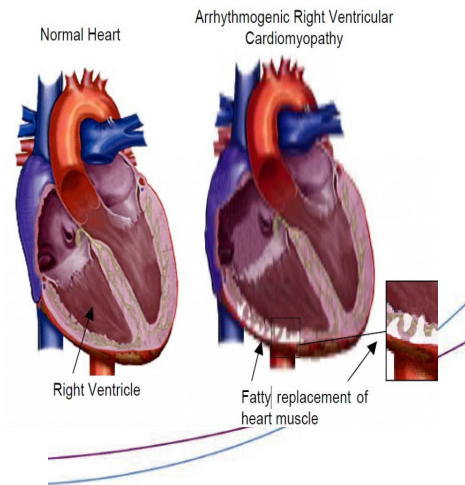
Hypertrophic cardiomyopathy

- 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



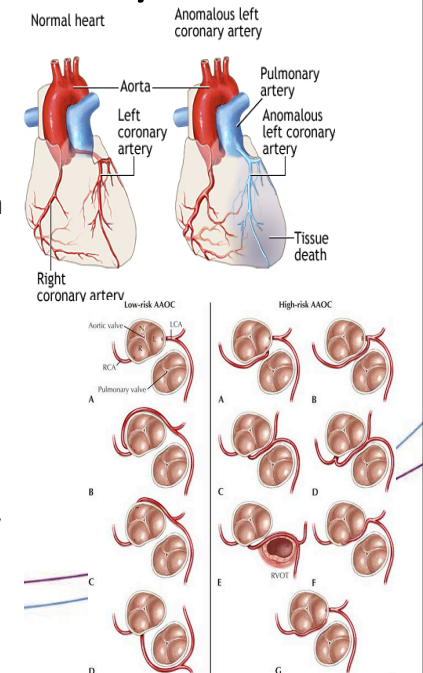
Arrhythmogenic (right) ventricular cardiomyopathy

- 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



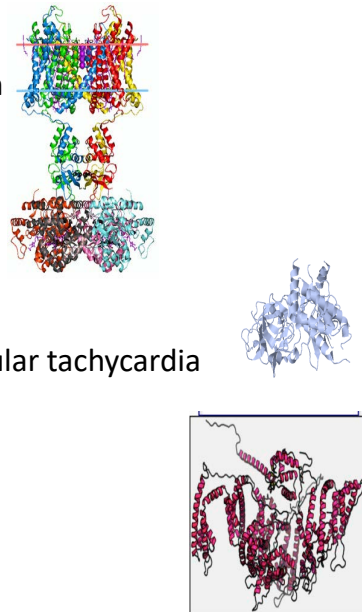
Anomalous coronary artery

- 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

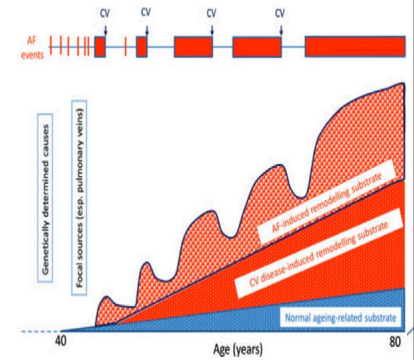
- Disorganized rhythm in the *atria* (non-pumping chambers)
- NOT immediately unstable
- Short-term effects
 - Elevated heart rate
 - Palpitations / fatigue / lightheadedness
 - Exacerbation of underlying heart/lung conditions
- Long-term consequences
 - Stroke
 - Heart failure

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 >10year strenuous exercise history are highest risk group

Atrial fibrillation timeline

- Progressive disease
- Risk factors accumulate over time
- Burden of disease *accelerates*
 - “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

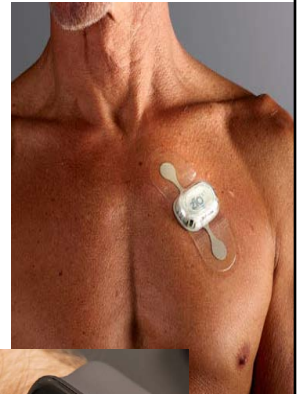


Conclusions – symptoms of concern

- 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

Conclusions – getting help

- 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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