Cardiac Concerns in the Athletic Preparticipation Exam

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Athletic Preparticipation Exam

Ensure the safety of patients who desire to participate in athletic activity.
Give recommendations for old/new injuries and chronic disease states for successful athletic activity.
Look for risks that could lead to permanent injury or death during athletic activity.

Athletic Preparticipation Exam

The state of the PPE in the US despite multiple groups evaluating, culling information and reevaluating has not changed the sudden death rate in high school and collegiate athletics.
Who is at Risk for Sudden Cardiac Death (SCD)

This is US data and does not apply to other countries.
Black males have the highest risk.
Males have greater risk than females.
Older estimates from 1:160,000 to 1:300,000 athlete deaths per year are likely underestimating the incidence.

Who is at Risk for Sudden Cardiac Death (SCD)

More recent studies in 11 US and Canadian cities show a SCA incidence of 1:27,000 in the 14-24 yr age group.
US military recruits aged 18-35 have exercise related SCA incidence of 1:9000.

What are the Causes of US Athletic SCD in High School and College?

Hypertrophic cardiomyopathy (HCM) is the most common cause at 36%.
Coronary artery anomalies- 17%.
Myocarditis- 6%.
Arrhythmogenic right ventricular cardiomyopathy (ARVC)- 4%.
How Do we Screen for These Risks?

Lets put 300 athletes in a room.
Add 6 doctors, CRNP’s, PA’s.
Add a few nurses, ATC’s, PT’s.
Add somebody who knows how to use a scale.
Ask lots of good questions.
Do a quick exam.
Simmer for 4-5 hours and serve.

AHA Recommended 12 Points for Screening Cardiac Risk

Personal history
Family history
Physical exam
AHA: Personal History
Exertional chest pain or discomfort.
Unexplained syncope or near syncope with exercise.
Excessive exertional and unexplained dyspnea/fatigue with exercise.
Prior recognition of a heart murmur.
Elevated systemic blood pressure.

AHA: Family History
Premature death (sudden, unexpected or otherwise) before age 50 due to HD in one or more relatives.
Disability from HD in close relative <50 years old.
Specific cardiac conditions HCM, dilated CM, long QT syndrome, Marfan syndrome, ion channelopathies, clinically important arrhythmias in family members.

AHA: Physical Exam
Heart murmur including provocative maneuvers.
Femoral pulses to exclude aortic coarctation.
Physical stigmata of Marfan syndrome.
Brachial artery blood pressure in sitting position.
Heart Murmurs

Flow murmur is the most common murmur in high school and college athletes.
Provocative testing should show a louder murmur with increasing preload.
Flow murmurs greater than 3/6 should be evaluated further.

Heart Murmurs

All diastolic murmurs, holosystolic murmurs and continuous murmurs should have further evaluation.
Murmurs louder with standing than sitting should have further testing.
Murmurs associated with any other positive history or physical findings should have further testing.

Hypertrophic Cardiomyopathy

Outflow to the aorta is obstructed by thickening of the left ventricular wall.
The thickening is asymmetric in HCM and often greater than 16mm.
This is not athletic heart syndrome where the thickening is usually less than 12mm and is symmetric.
Cardiac Exam Clues for HCM
Black males at highest risk.
Exertional syncope.
Family history because of autosomal dominant inheritance.
Systolic murmur that gets louder with decreased preload.

Congenital Coronary Artery Anomalies
Second leading cause of SCD in young athletes.
No physical exam findings.
Most common is left main coronary artery originating from right sinus of Valsalva and RCA originating from the left coronary sinus.
50-66% of these deaths have no previous cardiac history.

Myocarditis
Third leading cause of SCD in US. Not found at PPE because most of these athletes have illness symptoms.
Never allow an athlete to play with fever. It adds to the temperature rise produced by athletic activity and you do not know if the illness is affecting the myocardium.
Marfan Syndrome
Genetic defect at FBN1
Autosomal dominant inheritance with variable expression
Family history is negative in 25-33% of Marfan patients and likely from new mutation.
Incidence is about 1:5000
Males=females=races=ethnic groups

Marfan Syndrome
Diagnosis requires presence of major and minor criteria.
With no family history, major criteria in 2 organ systems and a minor in a third system.
With positive family history, major criteria in 1 organ system and a minor in a second system.

Physical Clues for Marfan Syndrome: Major criteria
Arm span greater than 1.05 times the height.
Severe pectus excavatum.
Scoliosis> 20 degrees or spondylolisthesis.
Hyperlaxity of the elbows or wrists.
Pes planus.
Ectopic lens of the eyes.
Physical Clues for Marfan Syndrome: Major criteria

- Ascending aorta dilatation or dissection.
- Lumbosacral dural ectasia.
- Positive family history
- Documented abnormal FBN1

Cardiac Exam Clues for Marfan Syndrome

- Mitral valve prolapse with or without regurgitation.
- Aortic insufficiency
- Both of these findings are considered minor criteria.

Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC)

- Most common cause of SCD in northern Italy.
- No cardiac exam findings.
- Found by EKG screening in Italy.
- May have history of exertional palpitations, syncope or near syncope.
Inherited Arrhythmia Syndromes

Congenital Long QT syndrome
Brugada Syndrome
Catecholaminergic polymorphic VT
These are often grouped as ion channelopathies.

Congenital Long QT Syndrome

Long QTc of > 470 msec in men.
Long QTc of > 480 msec in women.
Ion channel mutations are linked to LQTS.
LQTS 1, 2 and 3 account for 90% of congenital LQTS.
LQTS 1 causes arrhythmic events at 4 times the rates of LQTS 2 and 3.

Cardiac Exam Clues to Congenital LQTS

No cardiac exam findings.
History of exertional or nonexertional syncope or near syncope.
Family history.
**Brugada Syndrome**
Arrhythmic events usually occur between the ages of 22 and 65. Events are more common at night than in the day. Events are not usually associated with exercise. No cardiac exam findings.

**Catecholaminergic Polymorphic VT**
Typically begins in childhood and adolescence. May have family history of juvenile SCD. May have history of stress induced syncope. No cardiac exam findings.

**Bethesda Conference**
Now in its 36th edition from 2005. Contains all of the recommendations for athletic participation for athletes with cardiac problems. We just have to find the problems. It is available free on-line.
Now Feel Good About Doing PPE
About half of athletes with HCM will not have a murmur on exam.
Congenital coronary artery anomalies have no findings on exam.
Myocarditis usually does not happen at the PPE.
Marfan characteristics are easy to find at the PPE.
Inherited arrhythmias have no findings on exam.

You have the possibility to find that 1:200,000 US high school and college athletes who will have SCD.

The Milan Study
In northern Italy where the rate of SCD was 1:28,000 athletes, they started doing EKG’s with their PPE’s. ARVC has distinct EKG findings. Anyone with positive history or positive EKG received further work up.
They had a 89% drop in SCD over the next 5 years.
The Milan Study

In doing this they also removed 2% of all athletes from athletic activity. Just imagine what the ACLU would do with that!

Now We Can Fix the PPE in the US

First do everything we are doing now in the PPE.
Do EKG’s yearly on all school age and college athletes (10-20 million people plus or minus).
The false positive rate of young EKG’s is anywhere from 10 to 40% so they will all need to see a cardiologist for athletic clearance.

EKG findings considered normal in well trained athletes.

EKG findings seen in diagnoses causing SCD.
Now We Can Fix the PPE in the US

But that is OK because we will find the 4% of athletes with ARVC and some of the 3% of athletes with ion channelopathies in the total of the SCD group.
We can already identify the 4% with Marfan Syndrome in the SCD group.

Now We Can Fix the PPE in the US

But we will still miss the half of the HCM athletes without a murmur (18%). (Of course we will find all of the ones with murmurs!)
We will miss all of the coronary artery anomalies (7%).
A completely normal EKG is very reassuring. (Really, in this situation it is.)

Now We Can Fix the PPE in the US

Since all of are athletes are not from northern Italy, we can do limited ECHO’s to catch the rest of the HCM patients. (The number is mind boggling.)
The last estimate for this was about 2 billion dollars a year.
What Have We Done Recently to the PPE?

The only new addition to the PPE has been the testing for sickle cell trait in all division 1 college athletes. A positive sickle cell trait finding however does not preclude an athlete from sports activity.

The Future of the PPE

Expect EKG’s to become a mandatory part of the PPE in the next 10 years. Abnormal EKG’s will mandate further cardiac work up to participate in athletics. Expect sickle cell trait testing to come down to the middle school and high school level. (At least this only has to be done once per athlete and the test costs about $7.)

The Noble Goal of the PPE

The most important thing to remember with the PPE is to identify and advise not only about SCD but everything else like injuries, chronic disease, nutrition and healthy behaviors so your athletes can have the safest season available.
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