THE PRE-PARTICIPATION PHYSICAL EXAMINATION

Saturday, April 25, 2015

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Disclosure

- CIC for ImPACT Applications, Inc
- Listed on ImPACT website as a “concussion management professional” in the Tucson area
- I don’t sit on the ImPACT board and receive no remuneration, financial or otherwise

Learning Objectives

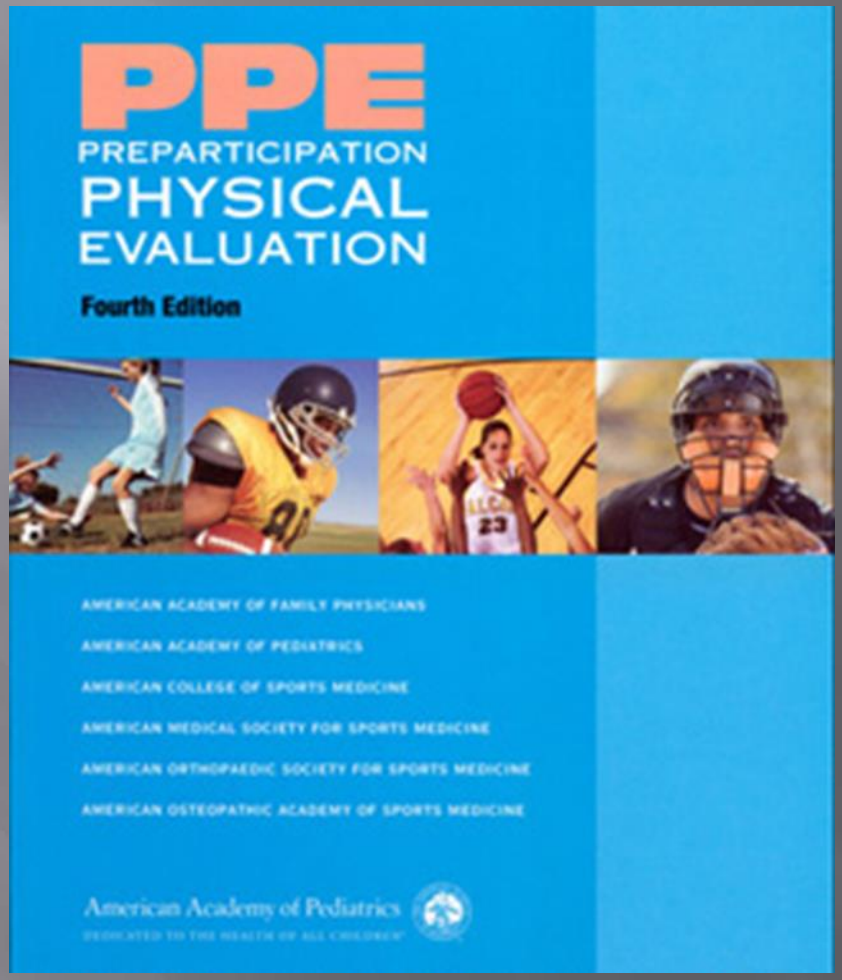
- Be aware of the recommended cardiovascular screening strategies for athletes during the PPE
- Interpret the significance of positive findings in the pre-participation history and physical
- Learn the most common causes of sudden cardiac death in athletes
- Be familiar with some of the issues of including the ECG as it pertains to athletes

Goals

- Primary
  - Prevent injury or illness
  - Detect life-threatening or disabling conditions
  - Meet legal and insurance requirements

Goals

- Secondary
  - Determine general health
  - Discuss ETOH, tobacco, other drugs, other issues
  - Assess fitness levels



American Academy of Family Physicians
American Academy of Pediatrics
ACSM
AMSSM
AOSSM
American Osteopathic Academy of Sports Medicine

Timing of PPE

- 4-6 weeks prior to reporting date
  - Time for rehab and evaluation
  - Time for follow-ups

History

- Most important part of PPE
- 78% musculoskeletal and medical problems leading to deferral or disqualification detected in history
- Parents should help fill out form since athletes often omit important information; only 39% of time did histories match

Bratton *Sports Med 1997:24(5)*

History

- Recent or chronic injury, illness or conditions
- Hospitalizations and surgeries
- Meds, supplements, medication allergies
- Allergies (pollen)
- Cardiovascular *
- MSK*
- Neurological
- Hyperthermia

History- Cont

- Pulmonary (including asthma, EIA)
- Protective devices
- Eyes (including vision)
- Skin
- Weight and eating disorders
- Psychosocial concerns
- Immunizations
- Menstrual history

AHA Cardiovascular Screening

- **Personal history***
  - Exertional chest pain/discomfort
  - Exertional syncope/near syncope
  - Excessive and otherwise unexplained, dyspnea/fatigue associated with exercise
  - Previous recognition of a precordial murmur
  - Elevated systemic blood pressure
  - Unexplained seizure, heart infection, Kawasaki's dz◆
  - Restricted from participation in sports in the past
  - Ever had prior testing for the heart

**Maron et al Circ v115(12) 2007, pp 1643-1655*

◆ PPE Monograph 4th Ed 2010

AHA Cardiovascular Screening

- **Family history***
  - Premature death (sudden or otherwise) before age 50 related to heart disease in 1° relatives
  - Disability from heart disease in a close relative aged < 50 yrs
  - Specific knowledge of certain cardiac conditions in family members: hypertrophic or dilated cardiomyopathy, long-QT syndrome, Marfan's syndrome, or clinically important arrhythmias
  - A family history of unexpected or unexplained sudden death, drowning or near drowning, unexplained motor vehicle accident, unexplained seizures, or SIDS◆

**Maron et al Circ v115(12) 2007, pp 1643-1655*

◆ PPE Monograph 4th Ed

PPE Quiz

- Which of the following is **not** a recommended component of the physical exam?
  A. Precordial auscultation in the supine and standing positions
  B. Palpation of brachial artery pulses
  C. Assessing for stigmata of Marfan's syndrome
  D. Brachial BP measurement
  E. Palpation of femoral pulses

AHA Cardiovascular Screening

- **Physical examination**
  - Heart murmur (supine and sitting)
  - Femoral pulses to exclude aortic coarctation
  - Physical stigmata of Marfan's syndrome
  - Brachial artery blood pressure (sitting position)

Maron et al Circ v115(12) 2007, pp 1643-1655

Prevalence of SCD

- The AHA prevalence of CV lesions that potentially predispose young athletes to SCD is 0.3% (1 in 300-500 athletes)*

*Maron B et al Cird 2007; 115:1643-55.

Incidence of SCD

- US
  - Adults (> 35 years of age), joggers or marathon racers 1:15,000 to 1:50,000*
  - High-school and college athletes < 1 in 100,000*
  - Military (18-35) 1:9000**
  - NCAA athletes 1:43,770 ***

*Corrado D et al *Herz 2009;34:259–66*

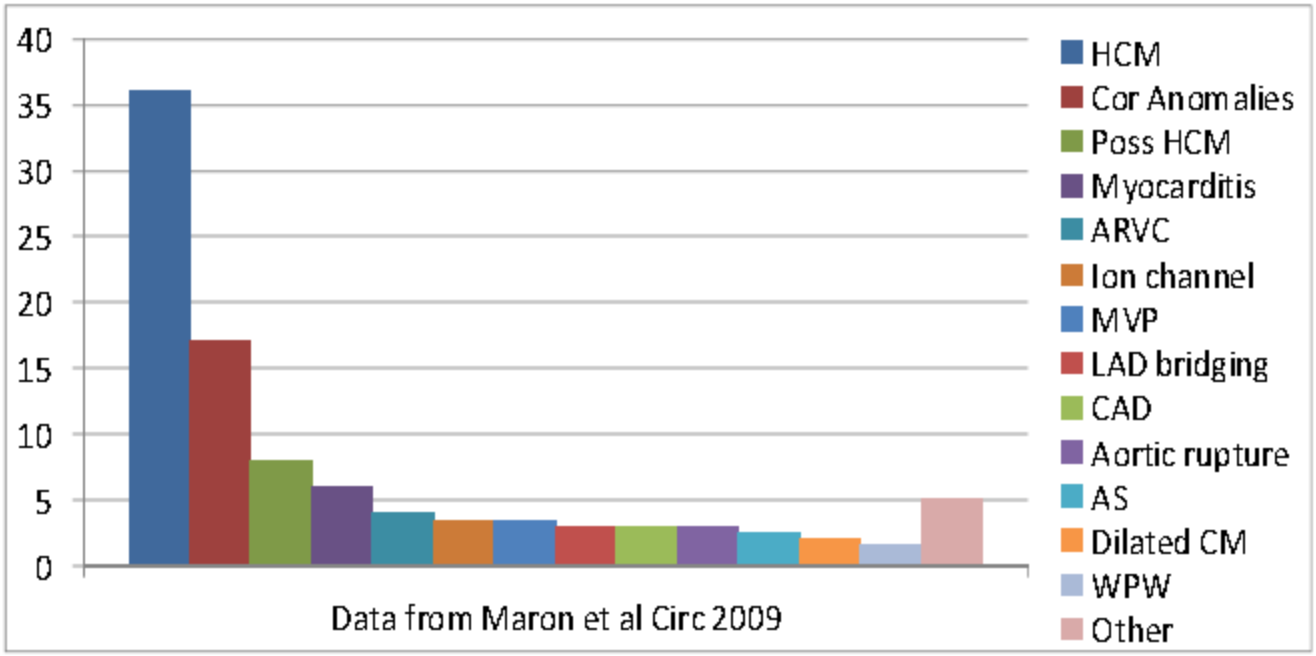
**Eckart RE, et al. *Ann Intern Med. 2004*

*** Harmon et al *Circ 2011 v 123*

Question

- The most common cause of sudden cardiac death in athletes younger than 35 years old is:
  - Premature coronary artery disease
  - Congenital coronary artery anomalies
  - Hypertrophic cardiomyopathy
  - Marfan's Syndrome

CV SCD Among US Athletes <40y 1980 -2006



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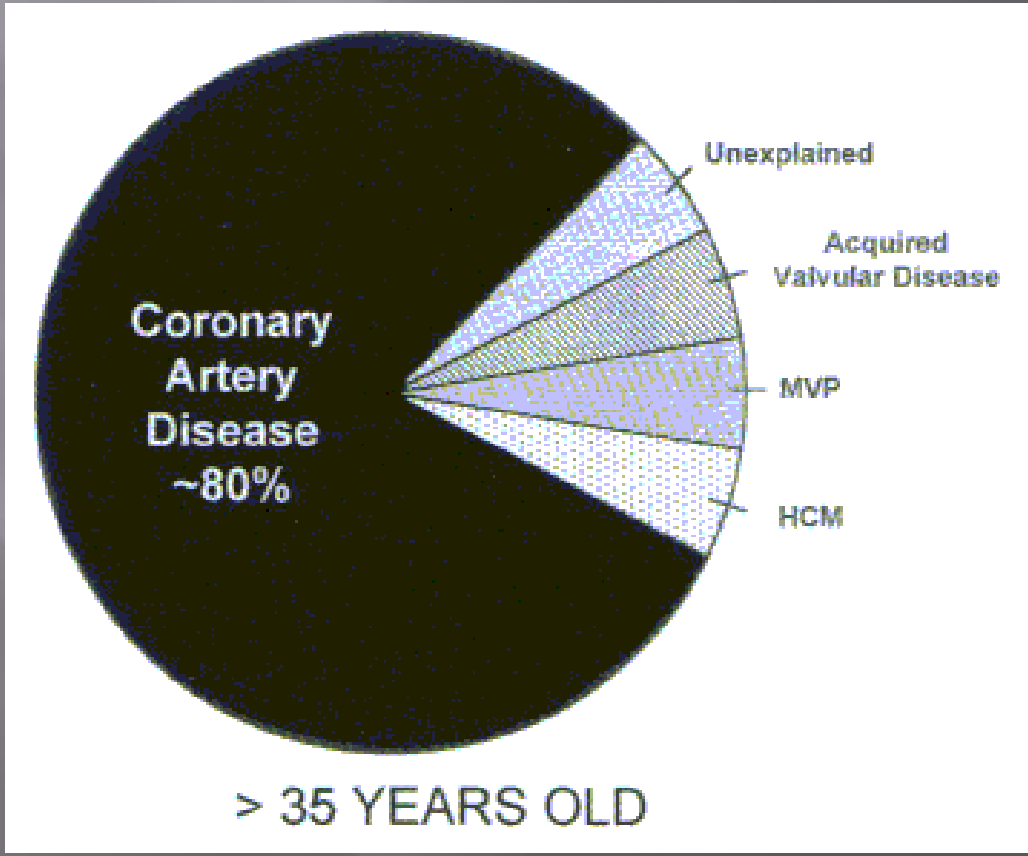
Courtesy of John Difiore and American Academy of Family Physicians

Question

- The most common cause of sudden cardiac death in athletes younger than 35 years old is:
  - Coronary artery disease
  - Congenital coronary artery anomalies
  - Hypertrophic cardiomyopathy
  - Ion channel pathology

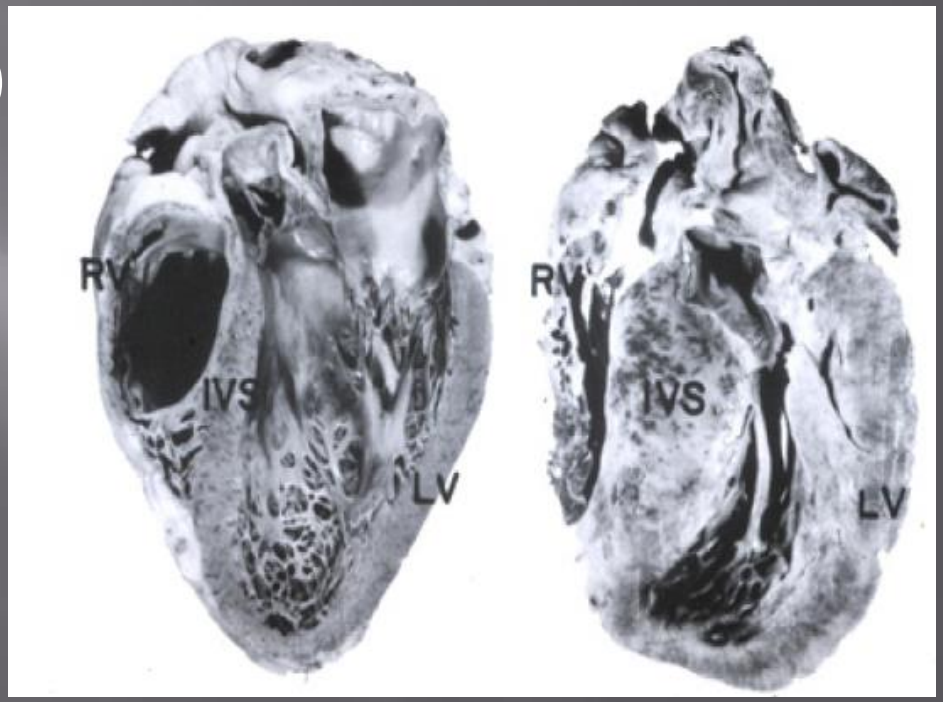
Causes of Sudden Death

- **Causes of SD (> 35 y.o.)-** Coronary artery disease



Causes of Sudden Death

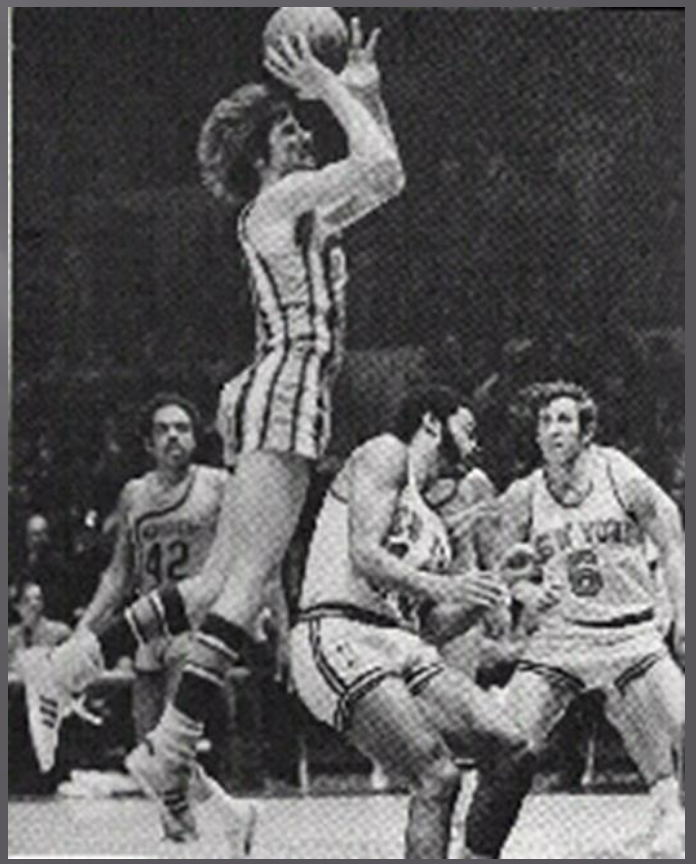
- **Hypertrophic Cardiomyopathy (HCM)**
  - Most common cause of SD 33% of cases*
  - Genetic disorder of cardiac proteins with hypertrophy usually of interventricular septum
  - Symptoms:
    - Asymptomatic
    - Exertional fatigue
    - Chest pain
    - Palpitations
    - Syncope
    - Sudden death



*Drezner et al *Curr Sp Med Rep 9(2) 2010*

Causes of Sudden Death

- **Congenital Anomalous Coronary arteries**
  - Normal anatomy: LCA from the left coronary sinus; RCA from right coronary sinus
  - Most common anomaly is origin of left main from right anterior sinus of Valsalva
  - 17% of causes of SCD in US*



*Maron BJ, et al Circ. 2009; 119:1085-92.

Causes of Sudden Death

- **Marfan's Syndrome**
  - Inherited disease of the fibrillin-1 gene affecting all systems of the body, but mainly
    - CV- murmur with mid-systolic click
    - MS- curves, pectus deformities, arm span>height, arachnodactly
    - Ocular- ectopic lens
  - Along with HCM, best reason to do a PPE since much is seen on PPE
  - Dx made by Ghent Criteria
  - 3% of SCD*

**Curr Sp Med Rep 9(2) 2010*

Channelopathies

- Autopsy-negative sudden unexplained death (SUD) are often due to primary cardiac electrical diseases, or ion channel disorders
- The prevalence of ion channel disorders is unknown
  - Reported 3% of autopsy-negative SUD in U.S. athletes
  - Australia, autopsy-negative SUD represents approximately 30% of SCD in individuals < 35 yo
  - U.S. military recruits, autopsy-negative SUD accounts for 35% of nontraumatic exercise-related SCD

*Schimpf R et al **Herz 2009;34:281–8**

Channelopathies

- Long QT Syndrome
- Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT)
- Short QT Syndrome
- Brugada Syndrome
  - Symptoms
    - Unexplained seizure, heart infection, Kawasaki's dz
    - A family history of unexpected or unexplained sudden death, drowning or near drowning, unexplained motor vehicle accident, unexplained seizures, or SIDS

*Pigozzi F et al *Clin Sports Med 27 (2008) 153–181*

Musculoskeletal History

- MS system at highest risk during activity
- Important to ask regarding fractures, joint dislocations, subluxations, instabilities, surgeries and muscle injuries
- Obtain old records

Physical Examination

- Check-in
- Height and Weight

Physical Examination

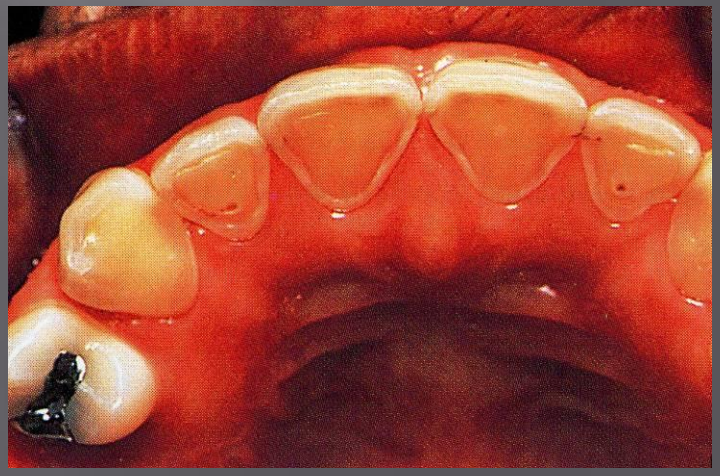
- **Blood Pressure in sitting position**
  - No caffeine, supplements, OTC's, within 30 minutes
  - Appropriate-sized cuff
  - If ↑, wait 10-15 minutes, then re-check
  - If still↑, re✓ @ another time
  - Bladder width should be 20% greater than diam. of limb; length should encompass 2/3 of limb circumference

Physical Examination

- **Vision**
  - Should be 20/40 or better
  - Anisocoria

Physical Examination

- **ENT**
  - Soft tissues
  - Check dentition



Physical Examination

- **Derm**
  - HSV
  - Impetigo
  - Tinea
  - Acne
  - Lanugo
  - Pigmented lesions- refer if any suspicious

Physical Examination

- Breast
  - Don't do
  - Discuss self breast exam
- Belly
  - Hernia
  - Organomegaly
  - Recent surgery
- Testicles
  - Discuss self testicular exam
  - Not routinely done
    - If performed, make sure present and descended
    - Check for masses and size

Physical Examination

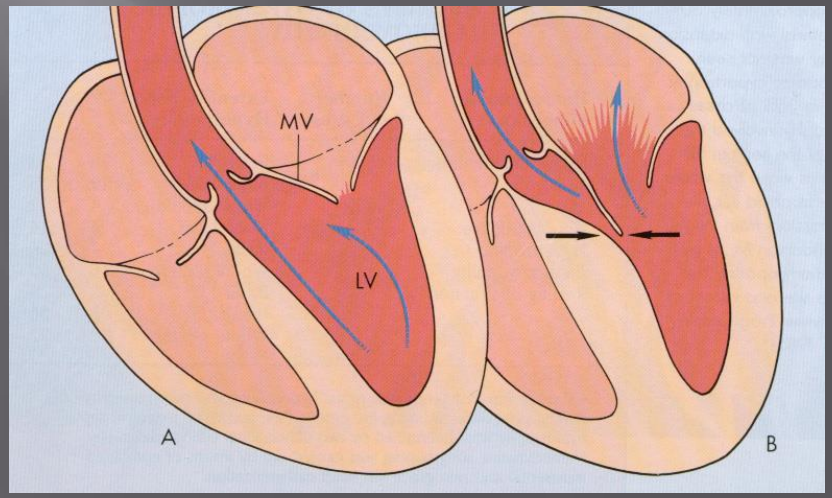
- **Lungs**
  - Wheezing

Physical Examination

- **Cardiovascular**
  - Sitting BP
  - Standing and supine heart exam
  - Femoral pulse delay?
  - Marfan's stigmata?

Physical Examination

- **Cardiovascular**
  - **Murmurs**
    - **HCM** : 75% don't have a murmur*
      - **Squatting** ↓ outflow obstruction & ↓ murmur
        Valsalva ↑ obstruction & ↑ murmur



Maron BJ *Lancet. 1997; 350:127-33*

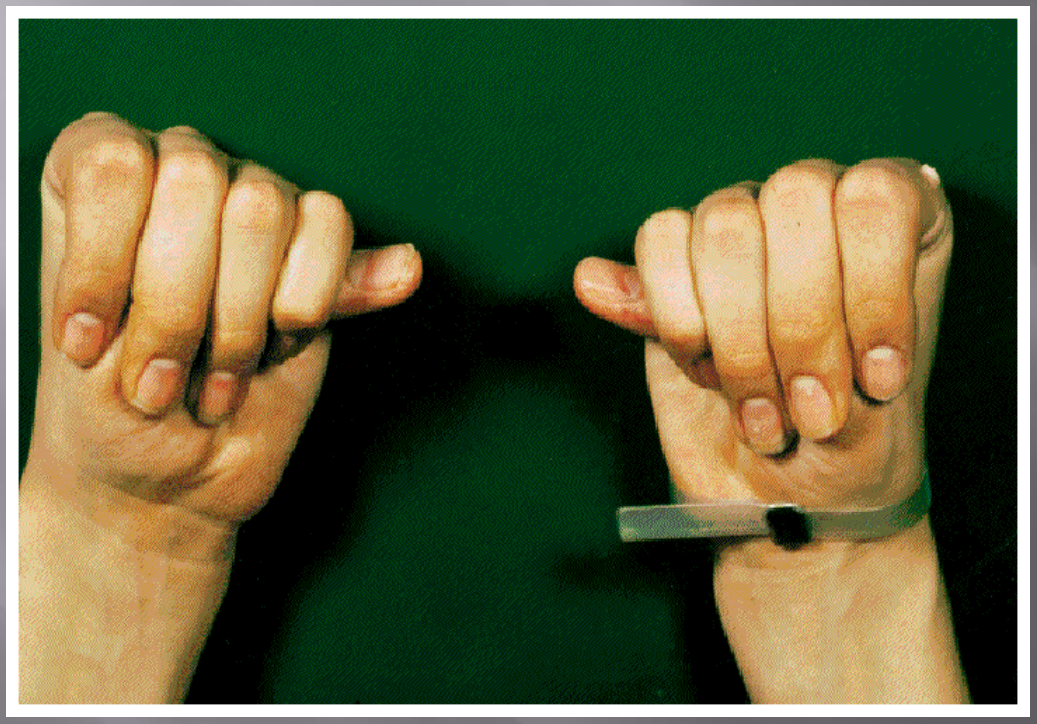
Physical Examination

- **Cardiovascular**
  - Murmurs- refer if:
    - Grade III or louder
    - **All** diastolic murmurs
    - Murmur which ↑ on Valsalva
    - Any murmur with which you feel uncomfortable
    - Marfanoid habitus
    - History of fatiguability, syncope, FH of SCD etc.

Marfan's Stigmata

- Tall stature
  - Arm span:ht > 1.05
  - Reduced US:LS <0.86
- Spinal curves
- Pectus deformities
- Arachnodactly
- Wrist and thumb sign
- Hypermobility of joints

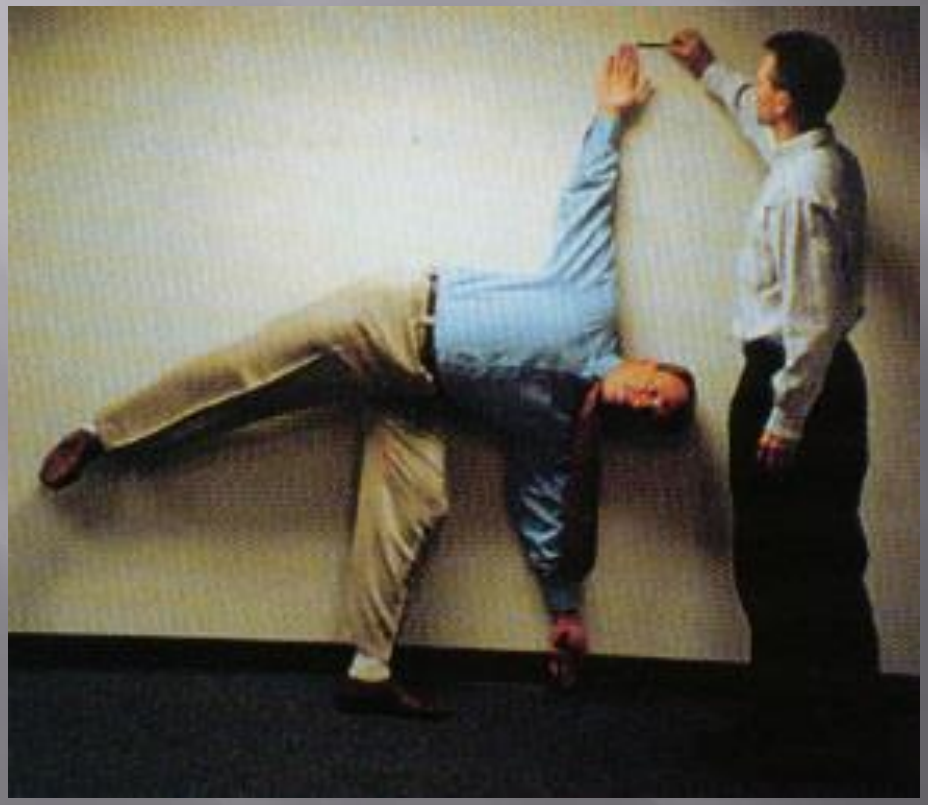
Marfan's Syndrome- Stigmata

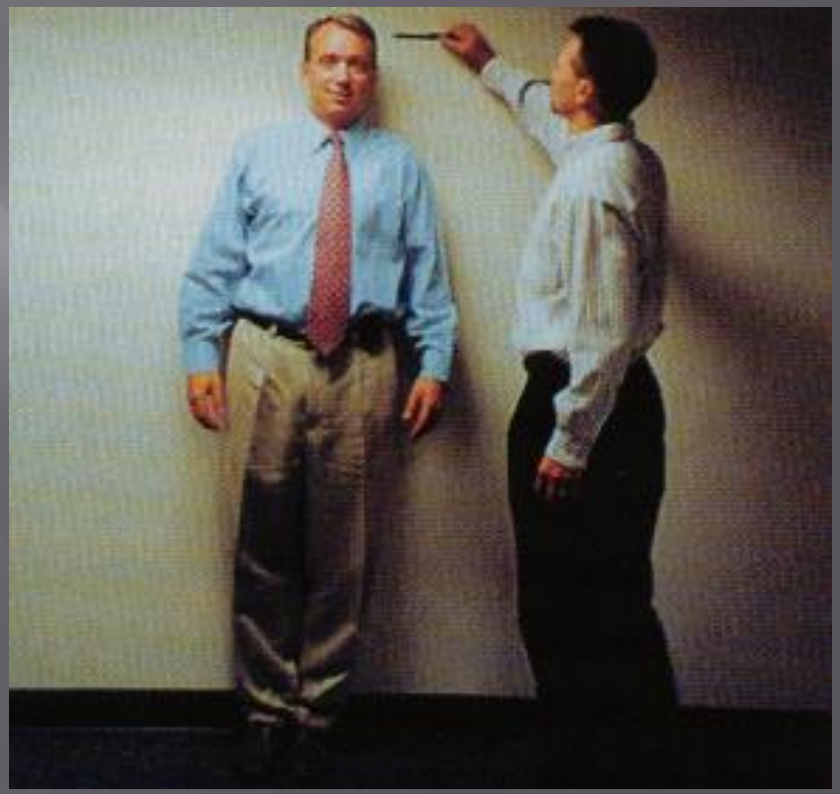


Steinberg Sign

Walker-Murdoch Sign

Marfan's Syndrome





Female athlete

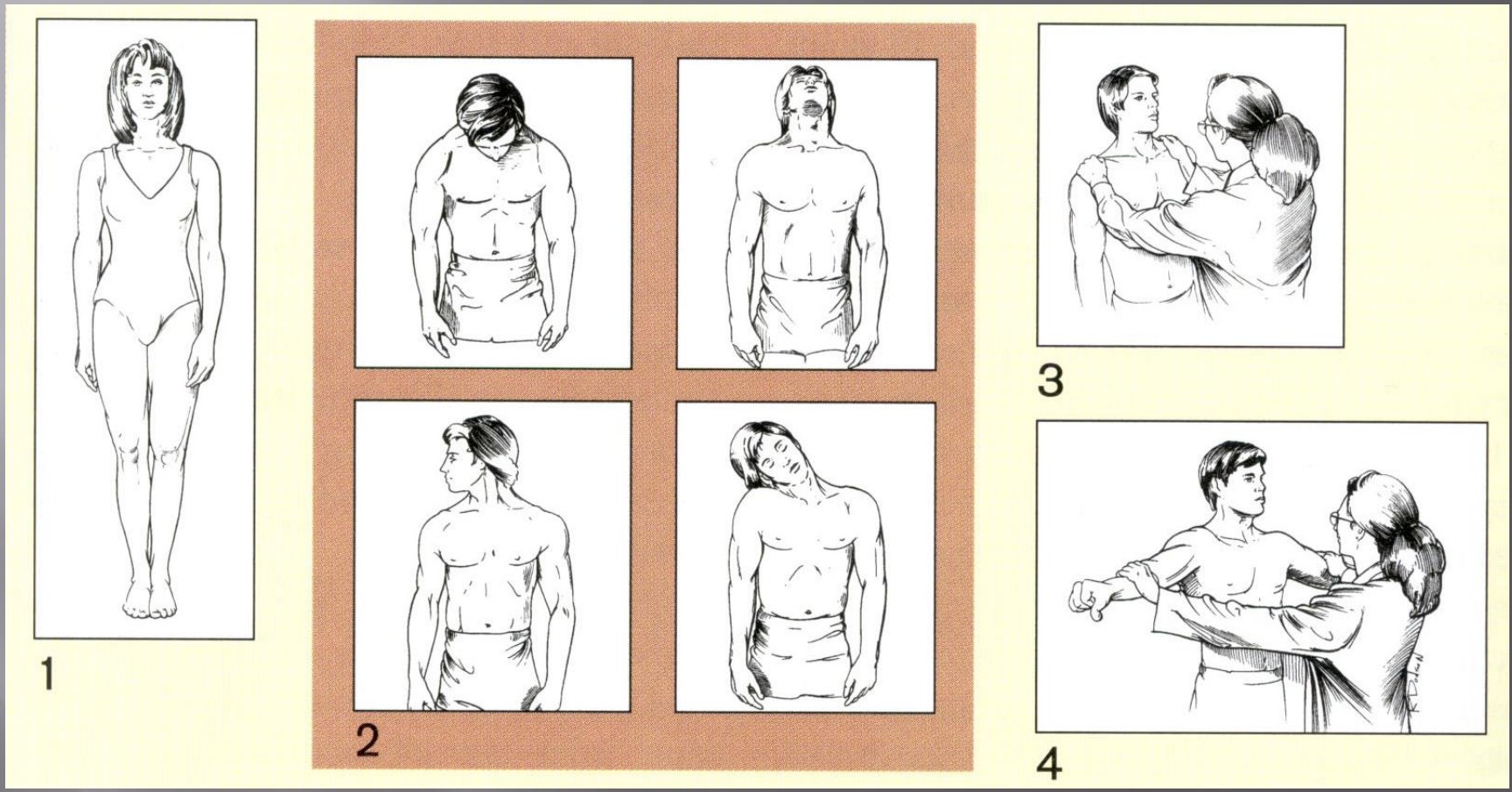
- Disordered eating more prevalent in females
  - Russell's sign on dorsa of hands
- Alignment issues
  - Valgus alignment

Musculoskeletal Examination

- SOR: A*
- History up to 92% sensitive for significant MS injury*
- If history is negative, do a 2 minute ortho screen for inspection of ROM, strength testing, and joint (in)stability
- If history or screen is positive, more focused joint exam or sport-specific exam for "stressed" joints

*__Gomez__ *Am J Dis Child 1993;147(10)1109-1113*

Musculoskeletal Examination



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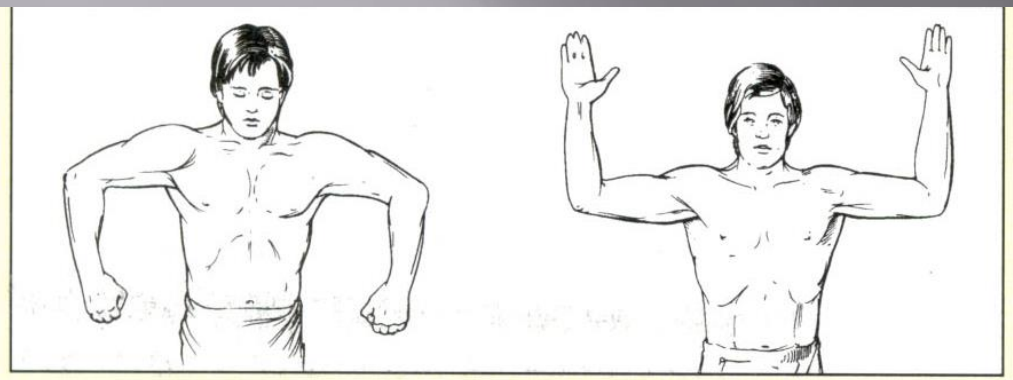
Musculoskeletal Examination



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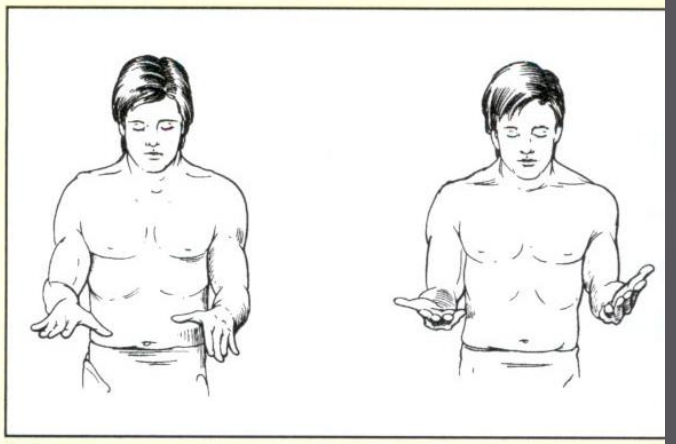

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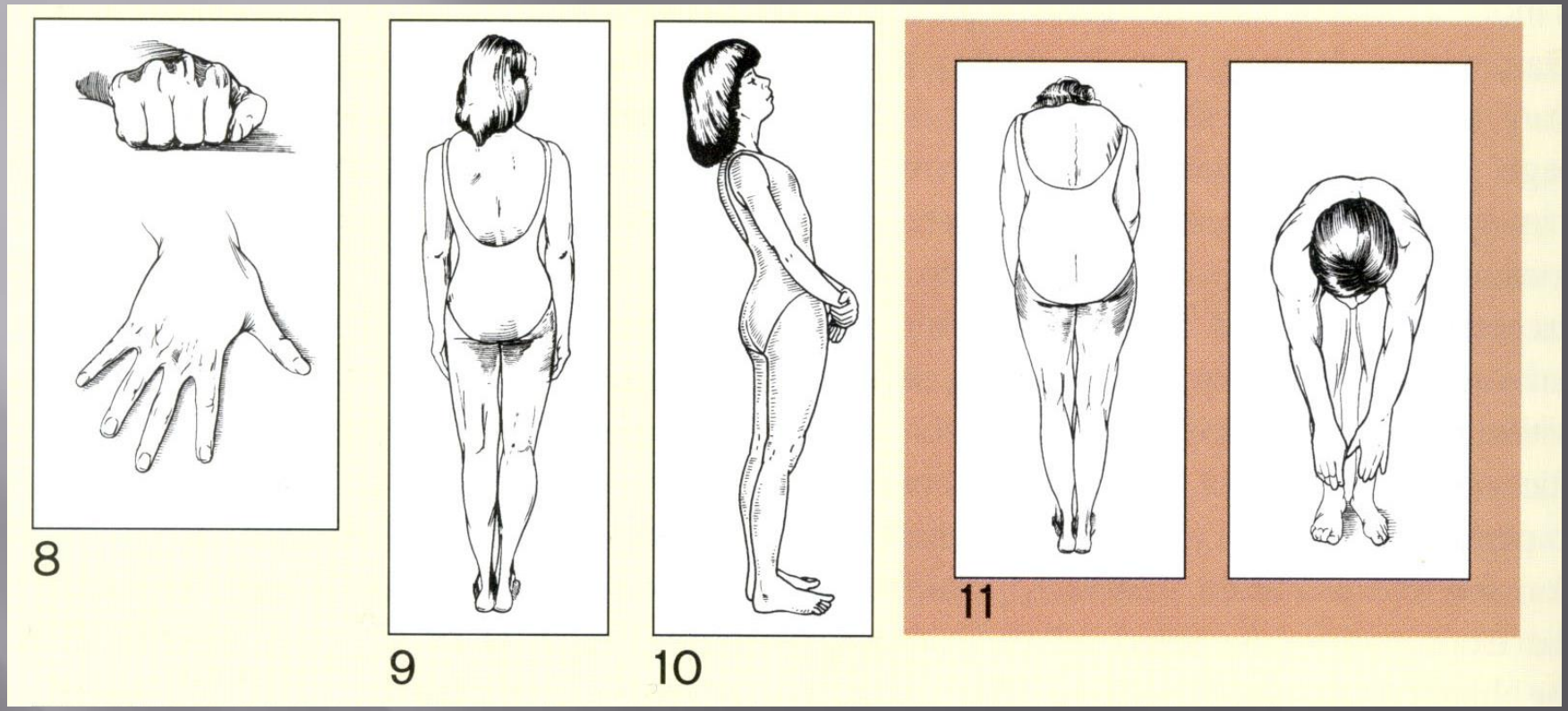
From: Preparticipation Evaluation Manual

Musculoskeletal Examination



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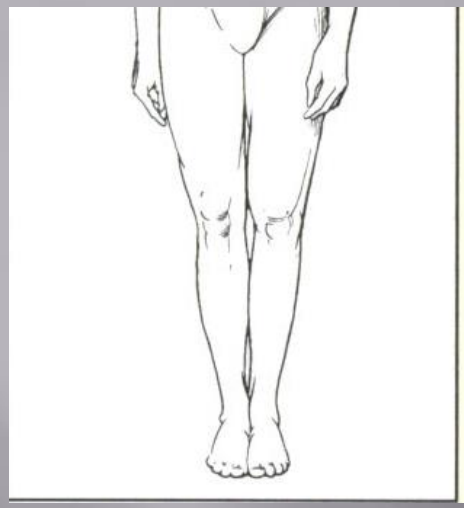
Musculoskeletal Examination



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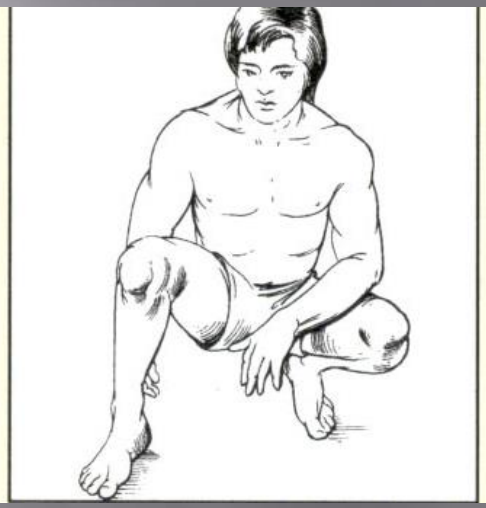

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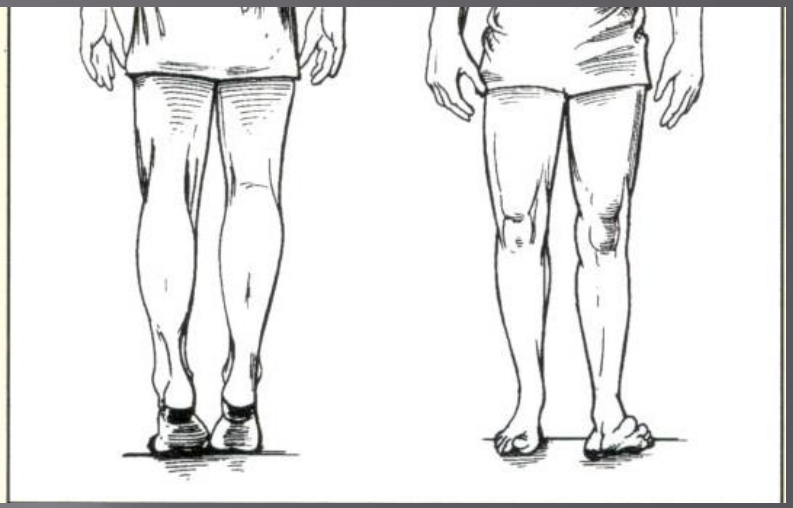

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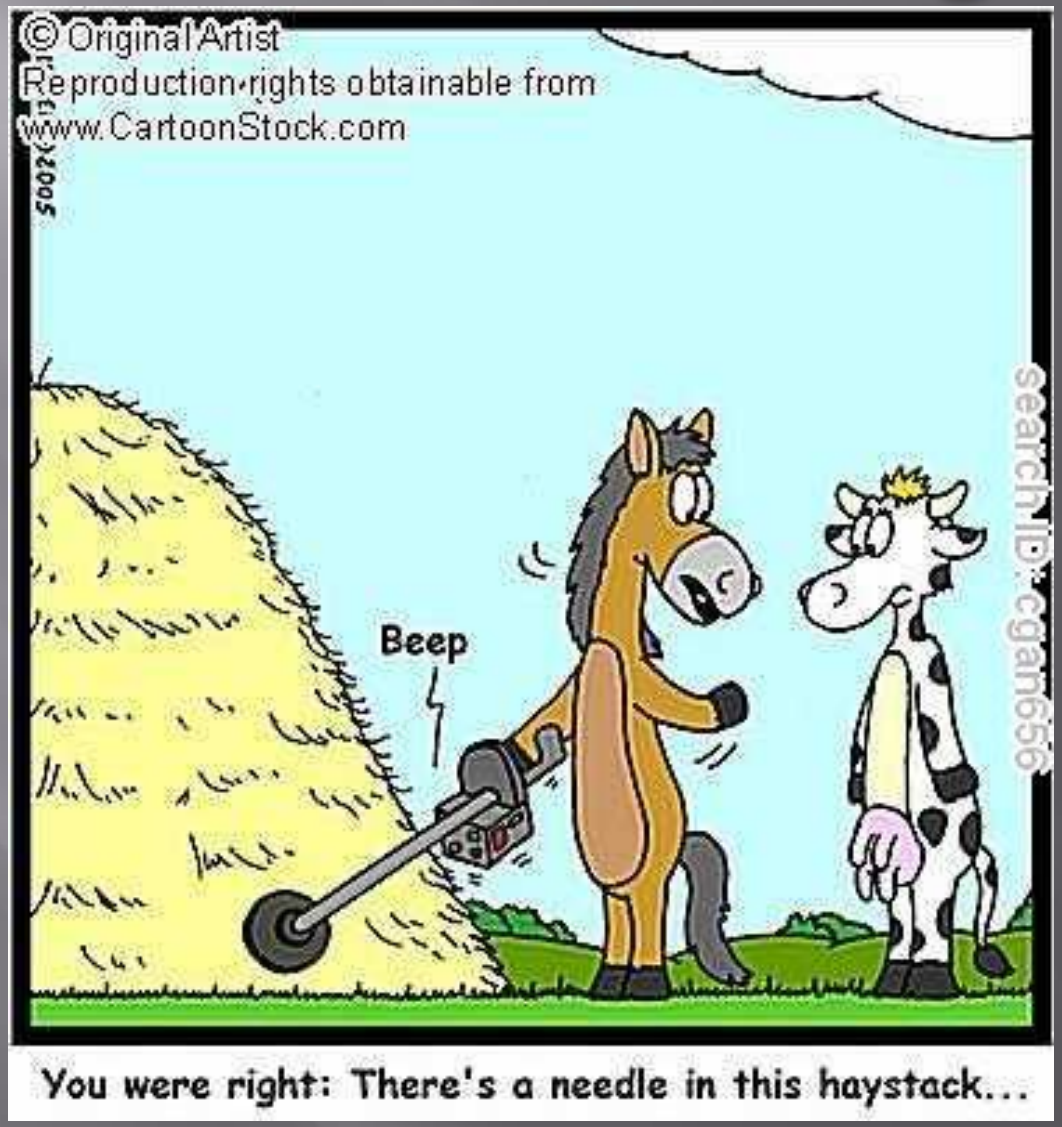
From: Preparticipation Evaluation Manual

Musculoskeletal Examination

- Neuro
  - Linked to MS portion of exam
  - If history of stingers or transient quadriplegia (CCN), evaluation of C-spine, upper extremity strength and DTR's
  - Evaluate history of multiple concussions with cranial nerves, cerebellar, and cognitive function testing

CARDIAC SCREENING ?

Cardiac Screening



ESC Position on CV Screening with ECG

- In 2004 and 2005 the International Olympic Committee, and the European Society of Cardiology both endorsed a standardized PPE CV screening program modeled after the Italian screening system
- The endorsement includes using a standard 12-lead ECG in addition to a detailed history and physical examination for screening all young competitive athletes

Italian Experience

- Corrado et al 2006 JAMA 2006:296; 1593-1601
  - 25 yr Italian experience with 42,386 athletes
  - 10 fold reduction of SCD
  - 89% reduction of SCD due to cardiomyopathy
  - 0.2% of athletes DQ'ed from competition for potentially lethal cardiovascular lesions
  - 9% abn ECG
  - 2% cardiac disorder
  - 7% false positive rate

Italian Experience

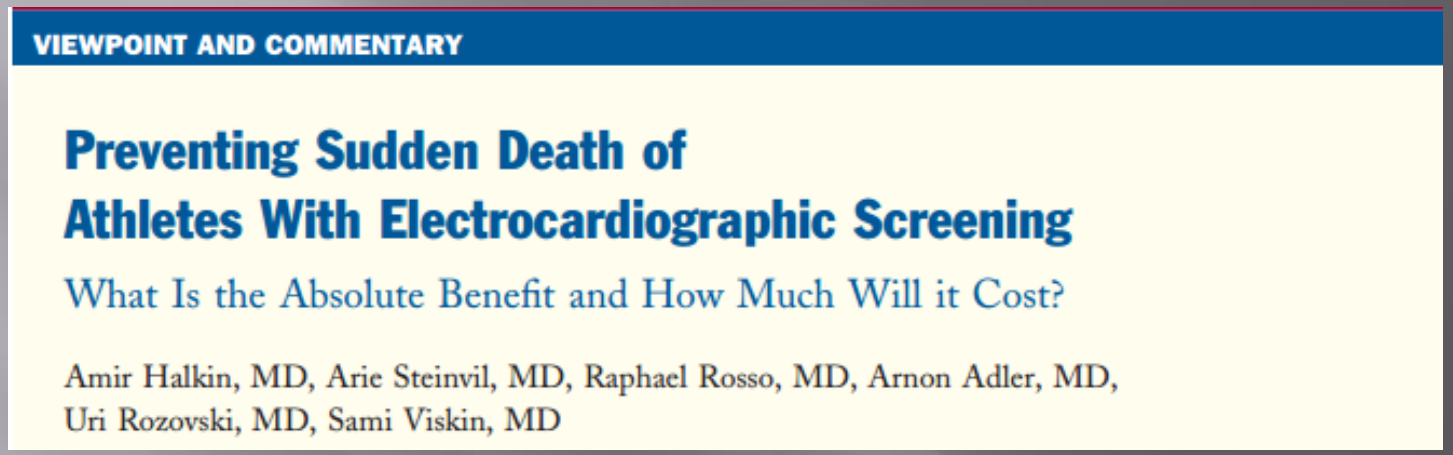
- Corrado D et al NEJM 1998; 339:364-9
  - 33,735 young athletes who underwent PPE screening in 1979 to 1996
  - ECG 77% greater power than H&P detect cardiomyopathy

AHA Position on Screening with ECG

- The AHA panel agreed that non-invasive testing such as the ECG can improve the diagnostic power of the H&P, but concluded that the addition of the ECG was not feasible or recommended in the context of mass, universal screening in the United States
  - Low prevalence of disease
  - Sensitivity?
  - High false positive rate
  - Poor cost-effectiveness
  - Lack of clinicians to interpret the results
  - Sheer size of cohort in US compared to Italy

Maron et al *Circ 2007; 115:1643-455*

J Am Coll Card;2012(60);22,2271- 6



VIEWPOINT AND COMMENTARY

Preventing Sudden Death of Athletes With Electrocardiographic Screening

What Is the Absolute Benefit and How Much Will it Cost?

Amir Halkin, MD, Arie Steinvil, MD, Raphael Rosso, MD, Arnon Adler, MD, Uri Rozovski, MD, Sami Viskin, MD

- 20 year program would cost between $51 and $69 billion
- Would save 4813 lives
- Cost per life saved is in range of $10.6 and $14.4 million

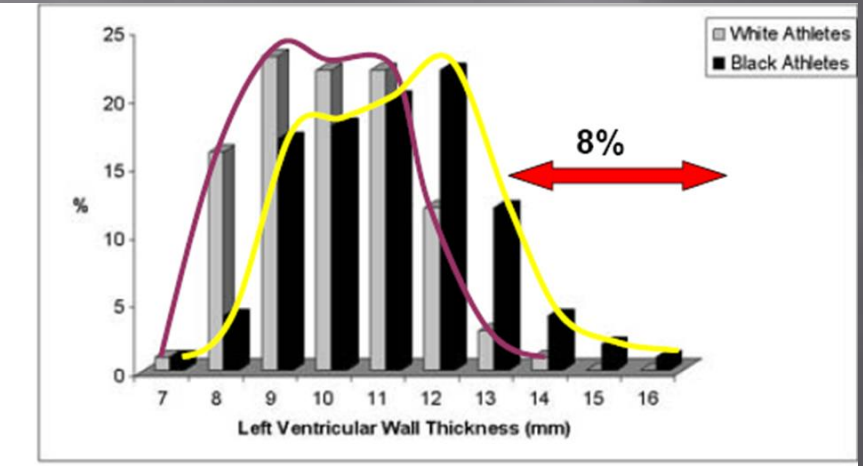
LIMITATIONS OF THE ECG

- Sensitivity of a negative ECG in the detection of HCM is limited by the 20% of individuals with HCM who have normal or only mildly abnormal ECG
- ECG cannot reliably detect coronary artery anomalies and disorders asso with aortic dissection
- Additionally, the ECG requires a skilled and experienced examiner for accurate interpretation

*Battle RW et al *Clin Sports Med 30 (2011) 503–524*

LIMITATIONS OF THE ECG

- African-Americans have thicker walls
- Different sports will have different physiological changes
- Males have more abnormalities than females



From Sharma JACC 2008

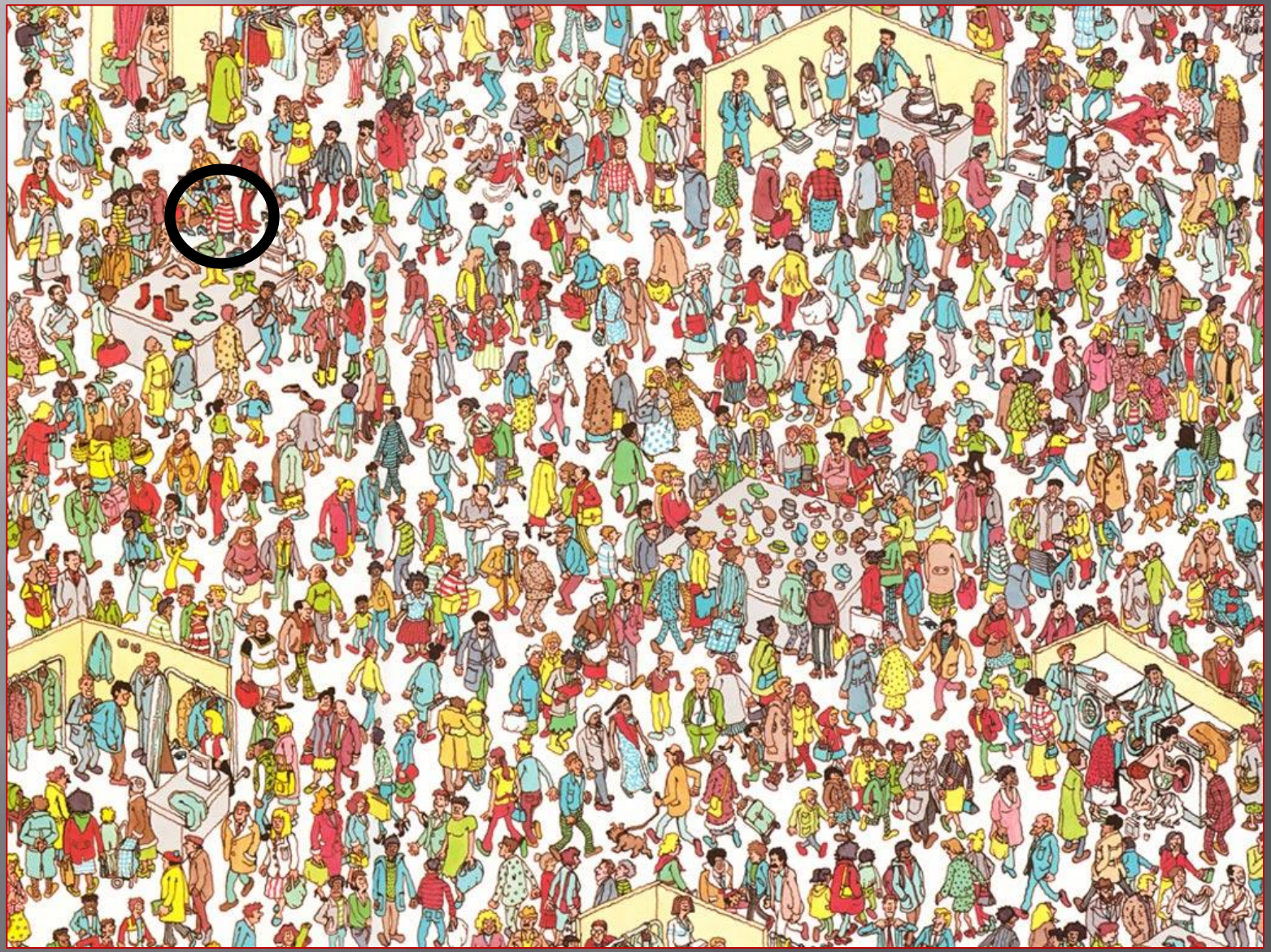
ECG Changes asso w/ Training

- Sinus bradycardia > 30 bpm
- Sinus arrhythmia
- Junctional escape rhythm
- Ectopic atrial rhythm or wandering atrial PM
- 1° AVB (PR interval > 200 ms)
- Mobitz type I (Wenkebach) 2°AVB
- Incomplete RBBB
- Early repolarization (ST elevation, J-point elevation, J-waves, or terminal QRS slurring)
- QRS voltage for LVH (Except QRS voltage for LVH **AND** any non-voltage criteria for LVH such as LAE, LAD, ST-segment depression, T-wave inversion, or pathologic Q waves

Not Training-Related ECG Changes

- T-wave inversion
- ST- segment depression
- Pathological Q-waves
- Left atrial enlargement
- LAD/Left anterior hemi-block
- RAD/ left posterior hemi-block
- RV hypertrophy
- Ventricular pre-excitation
- Complete LBBB or RBBB
- Long- or short QT interval
- Brugada-like early repolarization

Last Word On Screening



CLEARANCE

Determining Clearance

- Is athlete at increased risk of injury?
- Is another participant being placed at increased for injury?
- Can treatment permit safe participation?
- Can athlete safely participate in other sports?

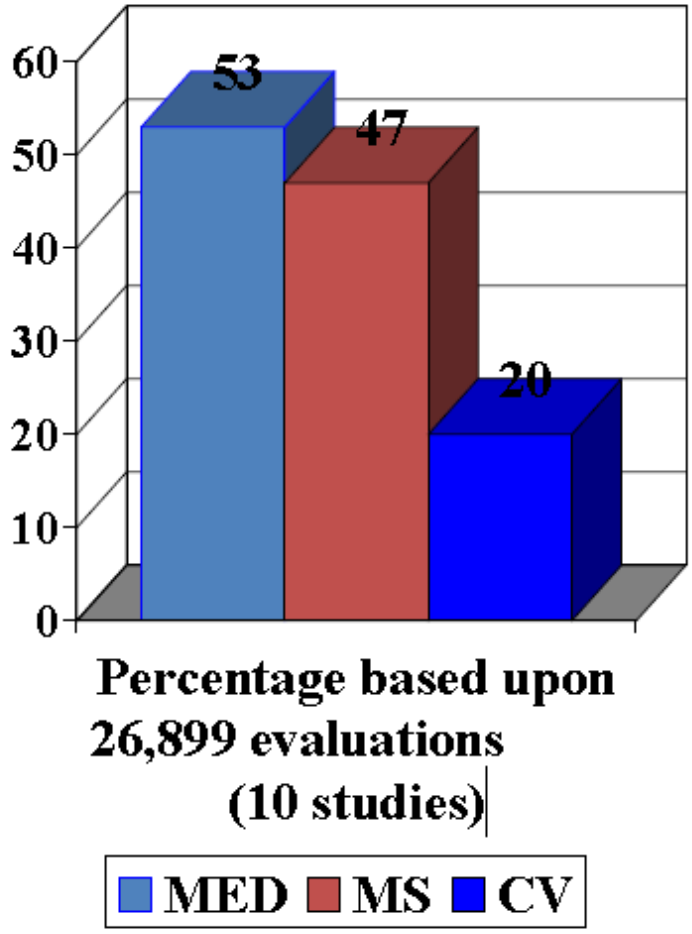
Clearance

- 3 types
  - Unrestricted
  - Clearance after further evaluation and/or rehab (deferred)
  - Not cleared for some or all sports (disqualified)

PPE Quiz

- Which conditions most frequently result in restriction from participation:
  - A Medical
  - B Musculoskeletal

Conditions Resulting in Restriction



Courtesy of John DiFiori, MD

Clearance

- Based in part on:
  - 36th Bethesda Conference Guidelines for Cardiovascular Abnormalities (Maron B, *Zipes D J Amer Coll Card 45(8) Apr 2005)*
  - PPE Monograph 4th Ed. (2010) ppesportsevaluation.org
  - Medical Conditions Affecting Sports Participation (AAP (2008) www.aap.org policy statements

Clearance

Classification of Sports by Contact

Contact/Collision

- Basketball
- Boxing*
- Diving
- Field hockey
- Football
  - Flag
  - Tackle
- Ice hockey
- Lacrosse
- Martial arts
- Rodeo
- Rugby
- Ski jumping
- Soccer
- Team handball
- Water polo
- Wrestling

Limited Contact

- Baseball
- Bicycling
- Cheerleading
- Canoeing/Kayaking (white water)
- Fencing
- Field
  - High jump
  - Pole vault
- Floor hockey
- Gymnastics
- Handball
- Horseback riding
- Racquetball
- Skating
  - Ice
  - In-line
  - Roller
- Skiing
  - Cross-country
  - Downhill
  - Water
- Softball
- Squash
- Ultimate Frisbee
- Volleyball
- Windsurfing/Surfing

Noncontact

- Archery
- Badminton
- Body building
- Canoeing/Kayaking (flat water)
- Crew/Rowing
- Curling
- Dancing
- Field
  - Discus
  - Javelin
  - Shot put
- Golf
- Orienteering
- Power lifting
- Race walking
- Riflery
- Rope jumping
- Running
- Sailing
- Scuba diving
- Strength training
- Swimming
- Table tennis
- Tennis
- Track
- Weight lifting

*Participation not recommended by the AAP. The AAFP, AMSSM, AOASM, and AOSSM have no stand against boxing.

Reprinted with permission from American Academy of Pediatrics Committee on Sports Medicine and Fitness: Medical conditions affecting sports participation. Pediatrics 1994;94(5):757-760

Clearance

Classification of Sports by Strenuousness

High-to-Moderate Intensity

High-to-Moderate Dynamic and Static Demands	High-to-Moderate Dynamic and Low Static Demands	High-to-Moderate Static and Low Dynamic Demands
Boxing*	Badminton	Archery
Crew/Rowing	Baseball	Auto racing
Cross-country skiing	Basketball	Diving
Cycling	Field hockey	Equestrian
Downhill skiing	Lacrosse	Field events (jumping)
Fencing	Orienteering	Field events (throwing)
Football	Ping-pong	Gymnastics
Ice Hockey	Race walking	Karate or judo
Rugby	Racquetball	Motorcycling
Running (sprint)	Soccer	Rodeoing
Speed skating	Squash	Sailing
Water polo	Swimming	Ski jumping
Wrestling	Tennis	Water skiing
	Volleyball	Weight lifting

Low Intensity

Low Dynamic and Low Static Demands
Bowling
Cricket
Curling
Golf
Riflery

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Specific Conditions

Specific Conditions- Cardiac

- Hypertension
  - Prehypertension or Stage 1
    - If no organ damage, OK to participate
    - Pursue work-up and monitor BP
  - Stage 2 or end-organ damage
    - No participation, including static sports
    - W/U and treat
    - May participate once pressure controlled

Specific Conditions- Cardiac

- **Blood Pressure, adult values**

Table 1. Classification and Management of Blood Pressure for Adults Aged 18 Years or Older

BP Classification	Systolic BP, mm Hg*		Diastolic BP, mm Hg*	Management*		
				Lifestyle Modification	Initial Drug Therapy	
					Without Compelling Indication	With Compelling Indications†
Normal	<120	and	<80	Encourage		
Prehypertension	120-139	or	80-89	Yes	No antihypertensive drug indicated	Drug(s) for the compelling indications‡
Stage 1 hypertension	140-159	or	90-99	Yes	Thiazide-type diuretics for most; may consider ACE inhibitor, ARB, β-blocker, CCB, or combination	Drug(s) for the compelling indications Other antihypertensive drugs (diuretics, ACE inhibitor, ARB, β-blocker, CCB) as needed
Stage 2 hypertension	≥160	or	≥100	Yes	2-Drug combination for most (usually thiazide-type diuretic and ACE inhibitor or ARB or β-blocker or CCB)§	Drug(s) for the compelling indications Other antihypertensive drugs (diuretics, ACE inhibitor, ARB, β-blocker, CCB) as needed

Abbreviations: ACE, angiotensin-converting enzyme; ARB, angiotensin-receptor blocker; BP, blood pressure; CCB, calcium channel blocker.
*Treatment determined by highest BP category.
†See Table 6.
‡Treat patients with chronic kidney disease or diabetes to BP goal of less than 130/80 mm Hg.
§Initial combined therapy should be used cautiously in those at risk for orthostatic hypotension.

Question

- A 15 year old male has a BP that is at the 95th percentile for his age. His PPE clearance should be deferred until his blood pressure is below the 90th percentile
  - True
  - False

Specific Conditions- Cardiac

- Hypertension
  - Peds
    - BP 90-99%'ile- OK to ppt while W/U, if no end organ involvement
    - BP > 99th %'ile- same as stage 2

Specific Conditions- Cardiac

- **Murmur**
  - Functional: OK to play during evaluation
- **Arrhythmia**
  - As per 36th Bethesda guidelines

Specific Conditions- Derm

- **Derm**
  - **HSV**
  - **Tinea**
  - **Impetigo**
  - **Carbuncles**
  - **MRSA**
- DQ above until lesions have been treated and resolved, especially in contact and mat sports

Specific Conditions- Eye

- **Paired Organs**
  - **Eye**
    - Functionally monocular if vision >20/40 in one eye
    - High risk sports OK with polycarbonate protection
    - Judge clearance individually

Specific Conditions- Paired Organs

- **Paired Organs (cont)**
  - **Kidneys**
    - Ribs help protect
    - Location and pathology determines clearance
    - Pelvic, multicystic, hydronephrotic or abnormal UPJ precludes contact or collision sports
    - Solitary kidney
    - Provide protection and sign waiver

Specific Conditions- Paired Organs

- **Paired Organs (cont)**
  - **Testicle**
    - Solitary testicle
      - Inform of risk to remaining testicle
      - Use protective cup
    - Undescended testicle
      - Explain risk of testicular cancer and refer

Specific Conditions- Pulmonary

- **EIA (EIB)**
  - May clear with proper meds and education

Specific Conditions- Diabetes

- **Diabetes**
  - Counsel re: proper nutrition, insulin use and risk of hypoglycemia

Specific Conditions- Sickle Cell Trait

- Sickle Cell trait
  - Sickle cell trait occurs in approximately 8% of black Americans and 0.01% to 0.05% of Caucasians. It is non-life threatening in normal circumstances; however, during strenuous activity, especially in hot humid environments or at altitude, there have been case reports of sudden death in athletes with sickle cell trait
  - The US military has reported a 20-fold increase in risk of sudden death in recruits with sickle cell trait. Death results from the complications of sickling, including rhabdomyolysis, profound acidosis, acute renal failure, and multi-organ system failure
  - Athletes with sickle cell trait should maintain adequate hydration and be advised to avoid strenuous exercise that leads to muscle pain during early season sprints

Specific Conditions- Obesity

- Obesity
  - May have asso conditions that put them at risk

Medicolegal Considerations

- Waiver
- Good Samaritan Statutes
- HIPPA
- Minors

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