Preparticipation Sports Physical

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1. Description

The preparticipation sports physical:

- Is a gross overview of a patient's suitability for athletic competition
- Is an administrative requirement for organized sports activities but has not been rigorously validated as a screening tool
- Differs from other "screening" interventions in that it is a global assessment of health and not a single targeted intervention
- Assesses for conditions that put the athlete at risk for serious harm or even death
- Has traditionally focused on cardiopulmonary disease that predisposes to sudden cardiac death
- Surveys for other conditions that can predispose to injury or death
- Differs from interventions in adults in that the subject is often a minor and decision-making must include the interests of the parents or guardians as well as the athlete
- Provides an opportunity to educate athletes, parents, and guardians about the risks and benefits of sports participation
- Is the only exposure many adolescents have to medical care, and, therefore, an objective of the preparticipation visit should be to provide general medical care and lifestyle advice to adolescents who are not receiving regular medical care
- Depending on the legal climate of an area, may transfer liability for sports-related injury or death from the school to the care provider
2. Indications and Use

2.1 Use the preparticipation physical to screen for latent medical conditions and to evaluate for preexisting medical conditions.

Recommendations

- Use the preparticipation physical in three categories of patients:
  - Asymptomatic persons with occult conditions that predispose to serious morbidity or mortality
  - Symptomatic persons or persons with known medical conditions that may qualify for restricted participation in sports, including:
    - Uncorrected vision
    - Musculoskeletal abnormalities
    - Asthma
    - Obesity
    - Cardiac abnormalities
    - Hernia
    - Many genetic syndromes, such as Down syndrome, Marfan syndrome, achondroplasia, and Klippel-Feil syndrome
    - History of concussion
    - History of loss of a paired organ (e.g., kidney, eye, testicle)
    - Bleeding disorders
    - Eating disorders
    - Cancer
  - Symptomatic persons or persons with known medical conditions that might require exclusion from participation, including:
    - Severe musculoskeletal abnormalities
    - Cardiac abnormalities

- See the following from the 2008 AAP Council on Sports Medicine and Fitness's policy report, Medical Conditions Affecting Sports Participation:
  - Table 1: Classification of Sports According to Contact
  - Table 2: Medical Conditions and Sports Participation
  - Figure 1: Classification of Sports According to Cardiovascular Demands

Evidence

- A 1998 retrospective study of 2739 preparticipation sports physical exams found that 1.9% (53) of athletes were either partially or completely disqualified from participation. Musculoskeletal abnormalities accounted for 43% of complete disqualifications. Significant cardiac abnormalities accounted for 18.9% of complete exclusions; however, the prevalence of cardiac causes for exclusion was low (10 athletes, 0.37%). Twelve percent of patients were given qualified clearance. Abnormal visual findings were present in 54% of patients given qualified clearance; asthma was present in 3% of this group (1).

- A prospective study of 2670 preparticipation sports physicals in a suburban high school setting found that 1% of athletes were disqualified from participation. Musculoskeletal abnormalities accounted for 67% of contraindications to sports participation. Cardiac “risk factors” were identified in 15% of this population. Eleven percent of patients were given qualified clearance (2).

- A 1995 retrospective study of 2574 sports physicals performed over a 7-year study investigated disqualifying criteria for participation. A history of asthma was identified as the most frequent medical reason for initial restriction from participation (1.2% of athletes screened) (3).
• At the high school level, a prospective epidemiologic study showed that collision sports such as football and soccer have the highest injury rates. In younger participants (ages 7 to 13), a prospective epidemiologic study of 1659 athletes did not show an excess of injuries in collision sports; football, soccer, and baseball had equivalent injury rates (4).

• An observational study in Italy measured the impact of a new policy to perform screening ECGs in athletes aged 12 to 35. The overall risk of sudden cardiac death was lower during the late screening period (RR, 0.21 [CI, 0.09 to 0.48]) with a trend toward a reduction in the early screening period (RR, 0.56 [CI, 0.21 to 1.15]) (5). A 2010 cost-effectiveness analysis using the data from the Italian study estimated screening ECGs in athletes to be cost-effective, with an incremental cost-effectiveness ratio of $42,900 (CI, $21,200 to $71,300) in the base-case analysis. The relative risk of nonparticipation after a positive screen and the cost of screening were important in sensitivity analysis (6).

• A 2008 consensus guideline for sports participation was issued by the AAP. These guidelines classify sports as contact/collision, limited contact, and noncontact and discuss the benefits and risks of sport as well as appropriateness of sports participation associated with a number of medical conditions (7; 8; 9).

• A 2007 guideline from the American Heart Association recommends asking potential athletes about hypertension, history of syncope, exercise-induced symptoms, heart murmurs, and family history of sudden death or other cardiac conditions, as well as performing a physical exam to look for hypertension, heart murmurs, unequal femoral pulses, and Marfan syndrome. The guideline does not recommend routine ECG or echocardiography (10).

• The 2008 Bethesda Conference #36 provided recommendations regarding disqualifications of athletes with cardiovascular abnormalities (11).

• A 2006 MMWR report summarized rates of injury in a variety of youth sports (12).

Comments

• See the Preparticipation Physical Evaluation Form developed by the AAFP, AAP, ACSM, AMSSM, AOSSM, and AOASM.

• No studies in the U.S. have shown a significant reduction in morbidity or mortality as a result of preparticipation physical exam.

• Many experts believe that the causes of sudden cardiac death in Italy are too different from those in the U.S. for the Italian experience to be relevant to the care of American athletes. The most common cause of sudden cardiac death in the U.S. is hypertrophic cardiomyopathy, whereas in Italy it is arrhythmogenic right ventricular cardiomyopathy (13).

• Approximately 11% of athletes will have conditions that require follow-up before participation is allowed. Only 1% to 2% of athletes will have risk factors that may prevent unrestricted clearance (2). If ECG were added to the preparticipation physical exam, the rate of required follow-ups could increase up to 20-fold. In one study, 40% of 1005 highly trained athletes had ECG patterns suspicious for cardiac disease (14).

• Injury patterns vary by the types of demands that a sport requires. Sports can be classified by the amount and type of contact as “contact,” “limited contact,” or “noncontact.” Contact sports such as football, hockey, and soccer predispose athletes to strain, strains, and acute fractures. Noncontact sports such as cross-country predispose athletes to overuse injuries such as stress fractures and tendonitis.

• Sports can also be classified based on the static and dynamic demands placed on the athlete, with different injury patterns associated with different types of stresses (7).

• In 1997, a study showed that ECG is more sensitive for identifying cardiac abnormalities than history and physical exam alone (15). However, most sports medicine physicians and cardiologists
believe that such an approach is cost prohibitive and too nonspecific to be beneficial in the U.S. (10).
3. Accuracy/Efficacy

3.1 Carry out a directed history and physical exam in the asymptomatic athlete to identify conditions that contraindicate or restrict participation.

**Recommendations**

- Perform careful history and physical exam, focusing on high-yield elements such as:
  - Dizziness, syncope/near-syncope, seizures, or chest pain with exercise
  - Asthma or shortness of breath
  - Elevated BMI/obesity
  - History of concussion
  - Hypertension
  - Changes in visual acuity
  - Heart murmur
  - Musculoskeletal abnormalities
- See table General Screening Examination for Musculoskeletal Abnormalities.

**Evidence**

- A retrospective study of 2574 athletes undergoing preparticipation sports physicals identified certain physical exam elements as having the highest predictive value in multivariate logistic regression modeling to identify those athletes with potential contraindications to sports participation. Elevated BMI did not disqualify athletes from participation, but obese athletes were provided additional guidance with regard to conditioning (3).
- A 2004 systematic review evaluated the accuracy of the preparticipation sports physical in U.S. student athletes and included 25 articles. Overall, the articles reflected a lack of standardization and likely insensitivity of the approach (16).

**Comments**

- The screening musculoskeletal exam is quite insensitive (sensitivity as low as 50.8%) for the detection of significant orthopedic injuries (17) and should be done in conjunction with a detailed orthopedic history.

3.2 Expand the exam in athletes with history of syncope, chest pain, hypertension, or seizures.

**Recommendations**

- Screen athletes for conditions that predispose to syncope and sudden cardiac death.
- Ask about:
  - Exertional chest pain or tightness
  - Dyspnea on exertion
  - Syncope/near-syncope or feeling lightheaded
  - Exceptional fatigue
  - Palpitations
  - Known heart murmur, systemic hypertension, or heart problem
  - Unexplained seizure
  - Family history of premature death or significant early cardiovascular disease in close relatives or knowledge of certain conditions such as Marfan syndrome, hypertrophic cardiomyopathy, long QT syndrome
- Look for:
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- Elevated blood pressure
- Heart murmurs, by:
  - Performing auscultation with the patient supine, standing, squatting, and with the Valsalva maneuver
  - Knowing that heart murmurs consistent with dynamic outflow tract obstruction will typically be louder with the patient upright or with the Valsalva maneuver
- Delayed femoral pulses suggesting coarctation of the aorta, by:
  - Feeling for the femoral pulses with the patient supine
  - Palpating the radial and femoral pulses simultaneously
- Stigmata of Marfan syndrome or other connective tissue diseases
- Expect to hear benign flow murmurs and bradycardia in a large percentage of competitive athletes.
- Refer patients with possible cardiac anomalies to a cardiologist with expertise in pediatric and adolescent echocardiography.
- Be aware that the use of diagnostic cardiovascular tests (e.g., echocardiogram, ECG, exercise testing) to screen asymptomatic athletes is controversial and generally not recommended in the U.S.
- See table Causes of Sudden Death in 387 Young Athletes.

Evidence

- An analysis of 1866 deaths of young competitive athletes in the U.S. between 1980 and 2006 found an increase in the rate of sudden cardiac death in these young athletes (18).
- A systematic evaluation of 158 sudden deaths in trained athletes determined that sudden cardiac death is usually precipitated by physical activity (19).
- Sudden cardiac death is rare in high school and college athletes. Based on several studies, the estimated prevalence of sudden cardiac death is 1 in 200,000 to 1 in 250,000 athletes per year, or an average of 12 deaths per year. This incidence is less than that reported in apparently healthy adult athletes participating in jogging or marathon running where the prevalence is 1 in 15,000 to 1 in 50,000 per year (20; 21; 22; 23).
- More adolescent athletes die from sports-related injuries than from sudden cardiac death each year. The National Center for Catastrophic Sport Injury Research compiles data on catastrophic sports injuries from 17 sports.
- A prospective study screened 501 collegiate athletes using a combination of history, physical exam, and ECG. Confirmatory testing was obtained in 90 athletes with positive findings. No serious cardiovascular abnormalities were detected in this sample. The authors acknowledged the low yield and inefficiency of cardiovascular screening and questioned the value of standard screening interventions (24).
- A 2011 study prospectively evaluated 964 college athletes with history, physical exam, ECG, and echocardiography. ECGs were distinctly abnormal in 10% of athletes; follow-up evaluation resulted in the exclusion of 2 athletes from competition. Black participants were more likely to have a distinctly abnormal ECG, with adjusted RR of 1.772 (CI, 1.14 to 2.58). Screening with history and physical exam alone had a sensitivity of 44.4% and a specificity of 76.4%. Addition of ECG resulted in a sensitivity of 88.9% but a lower specificity of 69.5% (25).
- A 2007 guideline from the American Heart Association recommends asking potential athletes about hypertension, history of syncope, exercise-induced symptoms, heart murmurs, family history of sudden death or other cardiac conditions, and performing a physical exam to look for hypertension, heart murmurs, unequal femoral pulses, and Marfan syndrome. The guideline does not recommend routine ECG or echocardiography (10).
• Although no studies in the U.S. have shown a significant reduction in morbidity or mortality as a result of preparticipation physical exam, data from the Veneto region of Italy showed a large reduction in sudden cardiac death among athletes after institution of preparticipation ECG (5).

• A 2010 guideline from the AAP on the evaluation and management of hypertension in competitive athletes classifies blood pressure as prehypertension (>90th but <95th percentile for age), stage I hypertension (>95th up to 5 mm Hg above 99th percentile for age), and stage II hypertension (>5 mm Hg above 99th percentile for age). The guideline suggests that participation not be limited for those with prehypertension or stage I hypertension who have no evidence of end-organ damage, but that athletes with stage II hypertension be restricted from athletics until the blood pressure is controlled (26).

• The International Olympic Committee (27) and the European Society of Cardiology (28) recommend ECG as part of routine preparticipation screening of athletes.

Comments
• The interval for cardiovascular screening of athletes has been the source of some controversy. Guidelines in 1996 for collegiate athletes advised comprehensive screening every 2 years; however, a consensus statement in 1998 acknowledged that there was no evidence to support screening at this frequency and recommended instead that comprehensive screening should occur before beginning collegiate competition, complemented by interval history and blood pressure measurements before each season in the following years (29).

• National surveys of preparticipation cardiovascular screening document substantial variation in screening procedures and nonadherence to guidelines at high school and college levels, suggesting that current screening practices are inadequate and flawed. Much of the variation and nonadherence results from disparate state-approved preparticipation forms and examiners with a wide range of expertise in performing preparticipation physicals (30; 31).

• A survey of 500 high schools showed that only 17.2% used preparticipation forms containing all elements of the recommended cardiac screening questions or exam (32).

• Systemic hypertension is the most common cardiovascular abnormality in competitive athletes. Although the most common cause is essential (or idiopathic) hypertension, other causes, such as obesity, renal vascular disease, hyperthyroidism, and other endocrinologic abnormalities or coarctation, should not be overlooked. Essential hypertension has not been implicated in sudden cardiac death (33).

• Because of the low prevalence of sudden cardiac death in athletes and the low yield of current evaluation strategies, arguments for preparticipation screening for sudden cardiac death are largely based on ethical issues and legal requirements.

• Because sudden cardiac death is rare in young athletes, the design of clinical trials to establish an effective approach to cardiovascular screening is challenging.

• According to one authoritative review, hypertrophic cardiomyopathy (26%), commotio cordis (20%), coronary artery abnormalities (14%), idiopathic left ventricular hypertrophy (8%), myocarditis (5%), and ruptured aortic aneurysm secondary to Marfan syndrome are the most common causes of sudden cardiac death in North America. Wolff-Parkinson-White syndrome, long QT syndrome, Kawasaki disease, and drugs are less common causes of sudden cardiac death (34).

3.3 Elicit a history of sports-related concussion as part of the preparticipation physical exam.

Recommendations
• Elicit a history of sports-related concussion or history of head injury that resulted in interruption in participation (i.e., undiagnosed but probable concussion):
  • Loss of consciousness after head trauma
• Confusion after head trauma
• Amnesia after head trauma
• Seizure-like activity after head trauma
• Counsel athletes and families about the long-term effects of repeated concussions.
• Strongly encourage athletes with more than three concussions in one season, or with postconcussion symptoms lasting longer than 3 months, to take time away from sports.

Evidence
• Collision sports have the greatest incidence of concussion, with football's being the highest. Twenty percent of high school football players and 40% of college football players will suffer a concussion during their careers (35).
• In a 2012 survey of U.S. high schools, girls had a higher rate of concussion than boys (RR, 1.7 [CI, 1.4 to 2.0]) in gender-comparable sports. The survey reported 1936 concussions, the majority of which were from football (47%, n=912), followed by girls' soccer (8.2%, n=159), boys' wrestling (5.8%, n=112), and girls' basketball (5.5%, n=107) (36).
• A prospective study from 1997 to 2008 looked at the incidence of concussion in 12 high school boys' and girls' sports played at 25 schools in one large public school system. The study reported an incidence of 0.24 concussions per 1000 athlete exposures. Concussion rates increased 4.2-fold over the 11 years (15.5% annual increase) in all 12 sports, possibly due in part to improved recognition and reporting (37).
• Slower neurocognitive recovery has been documented in a prospective cohort of 2905 collegiate football players at 25 institutions who had repeated concussions (38).
• A prospective cohort of 1631 collegiate football players at 15 institutions showed that athletes require several days to recover cognitive function and postural stability after concussion (39).
• A 2-year prospective study of high school and college football players showed that players with a history of concussions are six times more likely to suffer a concussion in the future. The study had a denominator of 15,304 player-seasons (40).
• A retrospective study of 240 athletes found no association between heading in soccer or soccer-related concussions and impaired neurocognitive performance (41).

Comments
• Neurocognitive testing, such as ImPACT™ and CogState Sport and individualized evaluation should be used for making return-to-play decisions (42).
• The 2010 Clinical Report on Sport-Related Concussion from the AAP Council on Sports Medicine and Fitness proposed that athletes with three concussions in a season, or postconcussion symptoms lasting longer than 3 months, should be strongly encouraged to have a prolonged period of time away from sports (43).
• Postconcussion syndrome is defined as 3 months' duration of three or more symptoms (fatigue, disordered sleep, irritability, aggressiveness, anxiety, depression, or personality changes) (43).
• Up to 30% of concussions may go unrecognized, so many athletes may unknowingly continue to compete despite previous brain injury. Although studies have not documented long-term neurocognitive impairment associated with repeated concussions, it has not been possible to longitudinally follow concussed athletes for years after their injuries. Experience with dementia pugilistica in boxers and other research suggests that repeated brain trauma is not a benign process and can entail negative neurocognitive sequelae (44; 45; 46).

3.4 Use the preparticipation sports physical to optimize management in patients with asthma or EIB.\[4]
Recommendations

- Diagnose athletes with asthma or EIB:
  - Recognize that EIB is a transient narrowing of the airway with increasing airway resistance after exercise that may exist in patients with no history of asthma. It is distinct from asthma with exercise as a trigger.
  - Determine whether the patient has underlying chronic asthma in which exercise is a trigger or only EIB by pulmonary testing:
    - Do pulmonary function tests (with pre- and postbronchodilator and flow volume loops) to identify if underlying asthma present.
    - Next, do specific provocative testing, which might include eucapnic voluntary hyperventilation, field exercise challenge test, or treadmill testing.
- Treat patients with asthma or EIB:
  - Recommend prophylactic inhaled β-agonists 5 to 20 minutes before exercise:
    - Short-acting β-agonists are effective for 2 to 4 hours when used intermittently
    - Long-acting β-agonists given 30 minutes before exercise are usually effective for up to 12 hours
  - Be aware that tachyphylaxis can occur with β-agonists if used on a daily basis, and reserve their use for patients with intermittent need or symptoms.
  - Consider recommending leukotriene inhibitors, such as montelukast, which can be used daily without developing tolerance and last for 24 hours.
  - Recognize that patients with underlying asthma may require chronic therapy with inhaled corticosteroids if symptoms are not controlled with intermittent therapy.
  - For persistent symptoms, initiate combinations of the above medications and consider adding ipratropium.
- Recommend that patients do a pre-exercise warm-up to help reduce the severity of EIB.
- Recommend that patients cover their mouths during training exercises to reduce effect of cold air.
- Be sure that athletes, parents, and supervisory personnel know how to administer medications for bronchospasm.
- Recognize that elite athletes require objective testing to confirm the diagnosis of asthma and that special rules apply to these athletes:
  - Elite athletes requiring the use of certain proscribed inhaled long-acting β-agonists (terbutaline and formoterol) need to receive a therapeutic use exemption from their sport’s regulatory agency and the World Anti-Doping Agency.
  - Systemic corticosteroids are prohibited within 2 weeks of competition.
  - Systemic corticosteroids can be used outside of competition but require a therapeutic use exemption.
  - Systemic β2-agonist use is strictly prohibited.

Evidence

- Several epidemiologic studies have shown that EIB is a common condition. In a sample of military recruits without a history of asthma, the prevalence of EIB was determined to be 7%; in a group of Nairobi school children the prevalence of EIB was 11%; in elite figure skaters the prevalence was 35% (47; 48; 49).
- An epidemiologic study of inner-city children showed that EIB occurred more frequently in African American children than in European American children (13% vs. 2%) (50).
- A review of EIB cites epidemiologic research from the 1960s documenting a 40% to 90% prevalence of EIB in patients with intrinsic asthma (51).
- Inhaled, short-acting β-agonists are the drugs of choice for EIB. A placebo-controlled trial of inhaled albuterol in 27 asthmatic patients with EIB showed the superiority of albuterol over placebo and established the equivalence of aerosolized (i.e., metered-dose inhalers) and dry powder formulations (i.e., Diskus®) of albuterol (52).
• A European study of 25 patients with EIB established similar efficacy in the duration of protection from bronchospasm between two long-acting β-agonists (salmeterol and formoterol) and the short-acting β-agonist terbutaline (53).

• A 2003 Cochrane review evaluated the effect of mast cell stabilizing agents (nedocromil or sodium cromoglycate) in patients with EIB and included 24 trials with 518 participants. Mast-cell stabilizing agents were superior to anticholinergic agents at preventing bronchospasm (OR, 2.2 [CI, 1.3 to 3.7]) and reducing declines in FEV1. Mast cell stabilizers were less effective than short-acting β-agonists at preventing bronchospasm (OR, 0.3 [CI, 0.2 to 0.5]) and reducing FEV1 declines. The combination of mast cell stabilizers plus β-agonists was not superior to β-agonists alone (54).

• A 2007 Cochrane review evaluated the effect of inhaled corticosteroids (compared to placebo) in patients with EIB, and included six randomized, controlled trials with 123 participants. Overall, inhaled corticosteroids reduced declines in FEV1 with exercise (55).

• Two randomized, controlled trials in 37 and 57 children showed the efficacy of inhaled corticosteroids as adjunctive therapy in stabilizing EIB and potentiating responsiveness to prophylactic agents (56; 57).

• The antileukotriene agent montelukast was superior to placebo and the long-acting β-agonist salmeterol in attenuating EIB in three randomized, controlled trials of 110, 27, and 191 patients, respectively. No clinical trials are available comparing montelukast to short-acting β-agonists or cromoglycates. Antileukotriene agents are not first-line therapy for the management of EIB (58; 59; 60).

• The AAP published guidelines for metered-dose inhaler use in athletes with EIB in 1994 (61).

Comments

• A review article outlines important aspects of the diagnosis and treatment of asthma in elite athletes (62).

• The diagnosis of EIB is suggested by history, but should be confirmed by broncho-provocation testing. Testing should document a decrease in FEV1 of 15% to 20% after exercise.

• EIB usually can be controlled and is not a contraindication to participation in sports.

• A comprehensive practice parameter published in 2010 summarizes pathogenesis, diagnostic algorithm, and treatment recommendations for EIB (63).

• Tachyphylaxis can occur with β-agonists if used on a daily basis, and it can take up to 72 hours off the medication for β-receptors to be available again.

• Cromolyn and nedocromil have been shown to be effective but are not available in the U.S.

3.5 Use the preparticipation sports physical to evaluate athletes with other conditions that may be influenced by sports activities.

Recommendations

• In advising athletes with certain conditions, consider:
  • Excluding patients with acute diseases which cause enlargement of the spleen, such as infectious mononucleosis, from sports participation
    o Athletes with mononucleosis should be excluded from participation for 3 weeks
    o Light, noncontact sports can commence after 3 weeks and normal activity generally after 4 to 7 weeks, depending on the athlete and the sport
  • The risk for spinal cord injury in patients with Down syndrome
  • Appropriate exam, radiographic evaluation, and consultation for orthopedic problems involving the knee, ankle, shoulder, or cervical spine
Mandatory eye protection and exclusion from boxing and wrestling for athletes with functionality in only one eye

Individual assessment for those with a solitary kidney before engaging in collision or contact activities

Advising obese athletes of their higher risk of heat-related injuries such as heatstroke and need for careful acclimatization and hydration

Advising athletes with sickle cell trait of possible increased risk of heat-related injuries such as rhabdomyolysis and the need for acclimatization and attention to hydration

Assessing bone density and need for estrogen replacement in female athletes with evidence of eating disorders, anorexia, amenorrhea, and osteoporosis

Evidence

A 1986 study measured spleen size in 29 patients hospitalized with mononucleosis and 8 patients with other illnesses. All patients with mononucleosis had enlarged spleens by ultrasound at presentation; return to normal size paralleled normalization of hepatic enzymes and occurred by 28 days (64).

A study used ultrasound to measure spleen size in 631 normal college athletes and found wide variation, ranging from 5.59 cm to 17.06 cm (65).

A 2008 narrative evidence-based review of mononucleosis and athletic participation concluded that patients with mononucleosis can commence light, noncontact sports at 3 weeks as long as the athlete is afebrile, has a good energy level, and exhibits no significant associated abnormalities. Safe return to contact activity was found to be less well-defined, with the authors recommending return at 4 to 7 weeks, depending on the athlete and sport (66).

The AAP advises that the participation of children with Down syndrome in some contact sports, such as football, soccer, and gymnastics, places children at increased risk of spinal cord injury (67).

The Special Olympics mandates radiographic evaluation, including MRI in certain instances, for athletes with suspected cervical stenosis or atlantoaxial instability. The AAP concludes that there is insufficient evidence of the benefit of screening for cervical stenosis and calls for more prospective research (68; 69; 70).

A case series of nine heat-related deaths in Australia identified obesity as a significant contributor to mortality (71). Reviews of heat-related deaths in athletes have identified obesity as a major contributing factor (72; 73).

The AAP has guidelines for heat-related exertional illness.

The National Athletic Trainers' Association sponsors a Web page with information on heat-related illnesses.

A study of 425 female college athletes found that 15% to 32% were at risk for eating disorders based on validated questionnaires; 3.3% reported a diagnosis of anorexia nervosa and 2.3% reported a diagnosis of bulimia. Menstrual abnormalities were present in 315 of participants; 65.9% reported musculan injuries and 34.3% reported bone injuries during their college career (74).

The AAP Committee on Sports Medicine and Fitness presented its consensus on the “female athlete triad” in its 2000 publication Medical Concerns in the Female Athlete (75).

The AAP and the American Academy of Ophthalmology summarized consensus indications for eye protection in 2004 (76).

Comments

The NCAA formally recommends that sickle cell screening be mandatory for all NCAA Division I athletes. This is the result of a lawsuit on behalf of an athlete with sickle cell trait. This recommendation may be expanded to NCAA Division II athletes. Although there is no firm medical
evidence to support this recommendation, it is a legal requirement. It is not recommended by other U.S. organizations and is felt to have the potential for discrimination (77).

- Three case reports describe young athletes or military recruits with sickle cell trait who died from metabolic complications of exercise-induced rhabdomyolysis (78; 79; 80).
4. Complications

4.1 Understand that the standard preparticipation sports physical is insensitive and may miss latent medical conditions with consequence for both the athlete and the physician.

Recommendations

- Carry out the exam in a manner that conforms to reasonable, customary medical practice.
- Do not clear athletes with known or suspected serious underlying medical conditions or previous serious injury without appropriate testing and specialty consultation.
- Inform athletes and parents about the low sensitivity of the evaluation to detect latent abnormalities, and that “clearance” to participate does not imply absence of risk.
- Recognize the risk of overdiagnosis (e.g., failing to differentiate between hypertrophic cardiomyopathy and “athlete's heart”) and the risks inherent in specialized testing itself.
- Be sure that athletes with serious underlying conditions and their families understand that negotiating participation with an institution can be problematic and that signing a waiver of responsibility (a “prospective exculatory release”) may not suffice to permit participation.
- Understand that the AHA cardiac screening recommendations may change the likelihood of successful litigation in cases of sudden cardiac death in athletes; specifically, a physician who follows the recommendations may have greater protection than one who does not.

Evidence

- Medicolegal guidance with regard to the preparticipation sports physical is derived from case law rather than a systematic evidence base. There have been several high-profile cases involving elite athletes that have received extensive coverage in the popular press, media, and in the medical literature. In one case, a basketball player was improperly cleared to return to play after a syncopal episode and experienced sudden death while playing (81).
- In another case, a high school basketball player was barred from playing because of hypertrophic cardiomyopathy and syncope due to ventricular tachycardia while playing. Despite having an automated defibrillator implanted and citing the Americans with Disabilities Act as basis for justifying returning to play, the court ruled that neither the waivers of responsibility nor the Act ensures the right to participate if medically unfit (82).
- Reviews of consensus development conferences discuss other areas of legal uncertainty regarding the clearance of athletes and several medical and legal disputes that have occurred surrounding the evaluation of elite athletes with potentially lethal underlying medical disorders (83; 84).
- The 26th Bethesda Conference outlines criteria for distinguishing hypertrophic cardiomyopathy from “athlete's heart” and makes recommendations that those with unequivocal hypertrophic cardiomyopathy should not compete in most competitive sports (85).
- A 2007 AHA guideline addressed cardiac screening recommendations related to preparticipation screening for cardiovascular abnormalities in competitive athletes (10).

Comments

- The evaluation of elite amateur or professional athletes with potentially life-threatening cardiovascular conditions is a special challenge, and there are medicolegal ramifications to recommendations of clearance or exclusion.
- The evaluation of elite athletes with serious underlying medical disorders involves balancing several interests, including the athlete's interest in sport as an essential life activity, an institution's interest in promoting a safe environment, and the physician's interest in promoting the overall
well-being of the athlete, and involves balancing patient autonomy with a duty to safeguard a patient from harm.

- Considerable legal uncertainty persists over issues of clearance of elite athletes with serious underlying diseases.

- Some states have “Samaritan” statutes that protect physicians from liability if they perform preparticipation evaluations free of charge; physicians should familiarize themselves with the applicable statutes in their states.

- Note that the legal issues are complex and vary by state.
5. Patient Counseling

5.1 Advise athletes and their families about the limitations of the preparticipation sports physical and provide information about safe sports participation.

Recommendations

- Advise patients that:
  - A "normal" evaluation does not imply absence of risk
  - Sudden death is rare among young athletes and that the social and physical benefits of participation outweigh the risks
  - Injury, not underlying medical disease, is the most common cause of morbidity and mortality in young athletes and that attention to safety by complying with safe play rules and wearing protective equipment is of paramount importance
  - The use of illicit drugs or banned substances may jeopardize athletes' competitive status as well as their general health

Evidence

- A 2004 survey of 128 college hockey players documented that 58% had used the metabolic stimulants such as ephedrine, pseudoephedrine, and amphetamines to enhance performance (86).

- A survey of substance use and substance abuse in almost 14,000 NCAA athletes determined a 1-year prevalence of alcohol use at 81%, marijuana use at 28%, and anabolic steroid use at 1.1%. Athletes reported obtaining steroid prescriptions from a physician in 40% of cases (87).

- A 2007 survey of college-aged men assessed trends in the use of anabolic steroids. Reported use of anabolic steroids in the past year increased from 0.36% in 1993 to 0.9% in 2001, but rates of lifetime use or use in the past month did not increase (88).

- A 2007 survey of middle- and high school students found that anabolic steroid use remained stable over time, and decreased with student age (89).

Comments

- Comprehensive and up-to-date information on drug testing and banned substances is available from the NCAA.

- The U.S. Anti-Doping Agency and World Anti-Doping Agency provide comprehensive information on banned drugs.

- Individual sports organizations may have their own regulations regarding banned substances and doping.
6. Periprocurement Management

6.1 Ensure appropriate follow-up for patients with medical disorders identified as part of the preparticipation sports physical.

Recommendations
- Encourage patients to schedule preparticipation evaluations several months before their sports season so that any conditions requiring follow-up can be fully evaluated before the start of practice and competition.
- Manage underlying medical disorders such as hypertension and asthma according to accepted guidelines.
- Obtain required studies to evaluate disorders identified on clinical evaluation, such as radiologic studies, echocardiograms, and pulmonary function tests.
- Refer athletes with:
  - Cardiovascular conditions to a cardiologist
  - Serious or recurrent orthopedic injuries to an orthopedist or sports medicine physician
  - Uncontrolled asthma, EIB, or both to a pulmonologist or allergist
  - Multiple concussions to a neurologist
  - Eating disorders and their complications to an endocrinologist or nutritionist

Evidence
- Consensus.

Comments
- In general, the specific issue identified and the treatment plan will determine the appropriate interval for follow-up and reevaluation.
Preparticipation Sports Physical

References


45. McKeag DB. Understanding sports-related concussion: coming into focus but still fuzzy [Editorial]. JAMA. 2003;290:2604-5. (PMID: 14625338)

Preparticipation Sports Physical


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Preparticipation Sports Physical


78. Makaryus JN, Catanzaro JN, Katona KC. Exertional rhabdomyolysis and renal failure in patients with sickle cell trait: is it time to change our approach? Hematology. 2007;12:349-52. (PMID: 17654064)


Glossary

BMI
body mass index

CAD
coronary artery disease

CI
confidence interval

ECG
electrocardiography

EIB
exercise-induced bronchospasm

FEV1
forced expiratory volume in 1 second

MRI
magnetic resonance imaging

OR
odds ratio

RR
risk ratio

Acronyms

AAFP
American Academy of Family Physicians

AAP
American Academy of Pediatrics

ACSM
American College of Sports Medicine

AHA
American Heart Association

AMSSM
American Medical Society for Sports Medicine

AOASM
American Osteopathic Academy of Sports Medicine

AOSSM
American Orthopaedic Society for Sports Medicine

NATA
National Athletic Trainer’s Association

NCAA
National Collegiate Athlete Association

WADA
World Anti-Doping Agency
### Age-Related Injury Rates for Selected Amateur Sports

<table>
<thead>
<tr>
<th>Sport</th>
<th>Injury Rate Per 10^5 Practice or Game Exposures*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Youth (Ages 7 to 13)</td>
</tr>
<tr>
<td>Football (boys)</td>
<td>1500</td>
</tr>
<tr>
<td>Boys soccer</td>
<td>1700</td>
</tr>
<tr>
<td>Girls soccer</td>
<td>2300</td>
</tr>
<tr>
<td>Baseball (boys)</td>
<td>1700</td>
</tr>
<tr>
<td>Softball (girls)</td>
<td>1000</td>
</tr>
<tr>
<td>Boys basketball</td>
<td>NA</td>
</tr>
<tr>
<td>Girls basketball</td>
<td>NA</td>
</tr>
</tbody>
</table>

* Data gathered from two separate prospective surveys of sports injuries. Higher injury rate in youth sports probably reflects different definitions of injury used in studies (lower threshold for defining injury in youth sport study) (4; 90).
### General Screening Examination for Musculoskeletal Abnormalities

<table>
<thead>
<tr>
<th>Procedure Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection of athlete while standing, facing toward and away from the examiner</td>
</tr>
<tr>
<td>Complete range of motion exam of neck</td>
</tr>
<tr>
<td>Trapezius muscle testing</td>
</tr>
<tr>
<td>Resisted shoulder abduction</td>
</tr>
<tr>
<td>Range of motion of shoulder</td>
</tr>
<tr>
<td>Range of motion of elbow, wrist, and hand</td>
</tr>
<tr>
<td>Back flexion and extension inspection with knees straight</td>
</tr>
<tr>
<td>Inspections of quadriceps symmetry</td>
</tr>
<tr>
<td>&quot;Duck walk&quot; for four steps to assess balance, motion, and strength of lower extremities</td>
</tr>
<tr>
<td>Standing on heels and toes to assess strength, balance, and calf symmetry</td>
</tr>
</tbody>
</table>

Data from [21].
## Causes of Sudden Death in 387 Young Athletes

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of Athletes</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophic cardiomyopathy</td>
<td>102</td>
<td>26.4</td>
</tr>
<tr>
<td>Commotio cordis</td>
<td>77</td>
<td>19.9</td>
</tr>
<tr>
<td>Coronary artery anomalies</td>
<td>53</td>
<td>13.7</td>
</tr>
<tr>
<td>Left ventricular hypertrophy of indeterminate causation*</td>
<td>29</td>
<td>7.5</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>20</td>
<td>5.2</td>
</tr>
<tr>
<td>Ruptured aortic aneurysm (Marfan syndrome)</td>
<td>12</td>
<td>3.1</td>
</tr>
<tr>
<td>Arrhythmogenic right ventricular cardiomyopathy</td>
<td>11</td>
<td>2.8</td>
</tr>
<tr>
<td>Tunneled (bridged) coronary artery†</td>
<td>11</td>
<td>2.8</td>
</tr>
<tr>
<td>Aortic valve stenosis</td>
<td>10</td>
<td>2.6</td>
</tr>
<tr>
<td>Atherosclerotic CAD</td>
<td>10</td>
<td>2.6</td>
</tr>
<tr>
<td>Dilated cardiomyopathy</td>
<td>9</td>
<td>2.3</td>
</tr>
<tr>
<td>Myxomatous mitral valve degeneration</td>
<td>9</td>
<td>2.3</td>
</tr>
<tr>
<td>Asthma (or other pulmonary condition)</td>
<td>8</td>
<td>2.1</td>
</tr>
<tr>
<td>Heat stroke</td>
<td>6</td>
<td>1.6</td>
</tr>
<tr>
<td>Drug abuse</td>
<td>4</td>
<td>1.0</td>
</tr>
<tr>
<td>Other cardiovascular cause</td>
<td>4</td>
<td>1.0</td>
</tr>
<tr>
<td>Long QT syndromes‡</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Cardiac sarcoidosis</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Trauma involving structural cardiac injury</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Ruptured cerebral artery</td>
<td>3</td>
<td>0.8</td>
</tr>
</tbody>
</table>

* Findings at autopsy suggested hypertrophic cardiomyopathy but were insufficient to be diagnostic.
† Tunneled coronary artery was deemed the cause in the absence of any other cardiac abnormality.
‡ The long QT syndrome was documented on clinical evaluation.

CAD = coronary artery disease.

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Figures

Treatment of Exercise-induced Bronchospasm

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Proper inhaler technique should be reviewed at each visit with the patient; a spacer should be used with metered-dose inhalers.