To Screen or Not to Screen: Commentary and Review on Screening Laboratory Tests in Elite Athletes

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Introduction

In *Current Sports Medicine Reports*, we have had reviews in recent years suggesting the usefulness of screening blood tests for athletes. Sports physicians often are asked to screen elite athletes for metabolic problems that can inhibit performance. In addition, team physicians may be proactive and screen for correctable medical problems to help their patients reach maximal performance. Not all screening tests are measures of bodily fluids. In this issue, we published a review of available screening tests for female athletes for disordered eating (REF). Athletes with disordered eating have higher rates of abnormal laboratory test results such as anemia or iron deficiency (6). In this commentary, I will review the rationale, or lack thereof, for obtaining screening blood tests in general athletes.

A consensus statement on periodic examination of elite athletes in 2009 made certain the recommendations for screening elite athletes, such as testing ferritin levels in female athletes (25). A survey on National Collegiate Athletic Association (NCAA) Division 1 programs, published in 2003, found that 43% (standard deviation, ±8%) of schools screened for ferritin levels among female athletes. This was prior to the NCAA requiring sickle cell blood testing on all athletes (5). Talking to many physicians at Division 1 schools across the nation, the number of schools that conduct screening appears to be much higher, but further research is needed to confirm this finding. Despite the controversy of testing for sickle cell trait (1), the time when the sickle screening is done may be the optimal time to draw other blood test on athletes.

Hematologic and Ferritin Testing

Reduced ferritin levels are common in athletes. Iron depletion is much more common (2 to 5 times) in female athletes compared with male athletes (12,21). Correcting iron depletion has been reported to help endurance athletes' performance (7). The exact ferritin level when iron replacement should be started has been reported at various ferritin levels, but a current review on the topic recommends a value of below 20 $kg \cdot L^{-1}$ to be the level for beginning iron replacement (7).

Screening endurance athletes for ferritin and hemoglobin levels is recommended in female athletes and male endurance athletes (7,12,25). A study on both male and female basketball players from different countries found a higher rate of iron depletion and anemia and thereby recommended screening ferritin and hemoglobin levels in basketball players (9). In power athletes, like football, rugby, and similar sports, ferritin levels are rarely low and screening is not recommended (3).

It is difficult if you are going to screen athletes to decide how often the test should be done. When examining changes across a competitive season, multiple tests across a 10-month season are not necessary, as values do not change significantly (26). Annual screening of athletes and monitoring of athletes on replacement therapy would seem appropriate. Replacement with both intravenous and oral iron supplementation raises ferritin levels in athletes with iron depletion (15). It would be more logical to use the safer oral form at 20 mg of elemental iron than to subject the athletes to intravenous iron (7).

Vitamin D Testing

Vitamin D deficiency and insufficiency are common in athletes, with indoor athletes having an increased rate of low Vitamin D than that of outdoor athletes (23). Little is known about the direct impact of vitamin D deficiency on athletic performance (27). There are vitamin D receptors in muscle cells, and vitamin D can affect muscle type (16). Studies on Finnish military recruits showed that recruits with low Vitamin D levels had higher rates of stress fractures during basic training (27).

A meta-analysis by Stockton *et al.* (32) found that people with vitamin D levels <25 $ng \cdot mL^{-1}$, but not those with >25 $ng \cdot mL^{-1}$, had an increase in limb strength with supplementation. Contrary to these findings, a recent study in swimmers found no correlation between vitamin D levels

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and swimmer's times (10). Further double-blind studies are needed to determine whether vitamin D replacement is beneficial for athletic performance.

Current consensus opinion recommends vitamin D levels in athletes to be between 40 and 100 $ng \cdot mL^{-1}$ (23). Monitoring of vitamin D levels is needed when supplementing vitamin D in athletes since values above 125 nM can be found in athletes on replacement, raising concerns about adverse effects (27). From the review of the literature, vitamin D insufficiency is common and levels below 25 $ng \cdot mL^{-1}$ may benefit from replacement but this needs further testing through double-blind studies. The recommendation is to test biannually (late winter and late summer) in order to check laboratories at maximum and winter nadir (24). Replacement using vitamin D2 can be either 50,000 IU weekly or 5,000 IU daily, with proper monitoring of vitamin D levels (32).

Complete Metabolic Panel

Two comprehensive studies looked at biochemical screening in athletes (13,26). Both found a very high false-positive rate of about 80%. There were many insignificant elevated levels in these biochemical tests, which would cause many unnecessary tests without significant positive findings, except for hyperlipidemia. Fallon (13) found significant values for hyperlipidemia in 3% of his mixed-sport population, while Meyer and Meister (26) did not find hyperlipidemia problems in soccer players. In a study on football players in the National Football League, 7.2% (5.2 to 9.3) had an elevated low-density lipoprotein cholesterol ≥160. This was similar to an age-matched control population of non-football players (34). These elevated levels are concentrated overwhelmingly on the offensive and defensive lines (4,31). The U.S. Preventive Task Force (USPTF) makes no recommendation for or against routine screening for lipid disorders in younger adults in the absence of known risk factors for coronary heart disease (18). In summary, from the studies looking at abnormal values on metabolic panels, increased risk of metabolic syndrome in football linemen, and neutral USPTF recommendation, cholesterol screening in power sports, particularly obese football linemen, appears to be warranted.

The many elevated laboratory tests from screening chemistry test (13,26), which are actually normal for athletes, cause unnecessary concern and further unnecessary testing. A previous example of this inappropriate screening was seen in the recommended urinalysis for athletes during the preparticipation examination, which has stopped since being recommended due to the lack of significant positive testing (29,33). An illustrative example of abnormal blood test found in screening test is that in the study of Meyer and Meister (26) which found, as in many other studies (2,22,30), that the creatine kinase could be as high as 1,200 U/L in athletes. From the multiple large samples of elite athletes, routine chemistry panels should not be performed in asymptomatic athletes.

Thyroid Screening

Subclinical hypothyroid (SCH) has been associated with impaired functional and hemodynamic responses compared with people with euthyroid condition (35). This would lead sport physicians to consider testing for abnormal thyroid-stimulating hormone (TSH) levels in elite athletes. Screening for abnormal TSH levels in asymptomatic athletes did not produce positive results (26). Athletes with SCH would have one or more of the following symptoms: fatigue, dry skin, constipation, muscle cramps, or decreased exercise capacity (11). Yet when testing symptomatic patients, the yield of positive TSH test results is small, with only 1.6% of athletes with fatigue having elevated TSH levels (8). Screening asymptomatic athletes is not recommended (14,26), and in those with symptoms, the yield is low (8). Therefore in asymptomatic athletes, testing of TSH levels should be avoided.

Sexually Transmitted Infections — Chlamydia

If sports medicine physicians are going to do any screening test on athletes, then we should look at the whole athlete and follow USPTF recommendations. In high school and NCAA studies, male athletes are more sexually active than nonathletes (17) and male college athletes more often will have unprotected sex and multiple partners than female athletes (20). The USPTF strongly recommends that clinicians routinely screen all sexually active women aged 25 years and younger for chlamydial infection. The USPTF does not recommend for or against screening in the general male population, but male college athletes are a higher-risk population than the general population and at higher risk than female athletes are. Multiple studies have demonstrated that screening during preparticipation examination is fruitful (19,28). They found that sexually active athletes had about a 4% asymptomatic chlamydia infection rate. If sports physicians are going to screen athletes, they should include urine chlamydia screening in sexually active athletes.

Conclusions

Sports physicians play an active role in preventing illness and enhancing performance in athletes. This may involve screening electrocardiograms, exercise-induced bronchospasm testing, or eating disorder screening. Testing athletes' blood for abnormal values has mixed effectiveness. Testing hemoglobin and ferritin levels in certain athletes appears to be worthwhile. Vitamin D levels may be useful, but further studies are needed. In power sports, for example, football, cholesterol screening in football linemen appears to be warranted. Chemistry panels and TSH levels appear to be detrimental and should be avoided. Finally we need to remember that athletes are people too and in some cases have higher-risk behaviors than the general population; they should receive the appropriate recommended USPTF screening tests, as well.

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