Your Pre-season Heart Check-up List

Sudden cardiac death (SCD) in athletes is a rare but devastating event, often affecting apparently healthy competitors with previously undiagnosed cardiovascular disease. The typical victim has no suspicion that they are at risk, and prior to the event may have even felt that they were in peak form. Sports medical screening programs are designed to attempt to identify potential cardiac risks in individuals who exhibit no outward symptoms of heart problems. The goal of such screening is to encourage participation in sports but to do it with a reasonable level of caution so as to ensure the safety of the participant. Certain individuals, who may be at higher risk, can be identified, and specific treatment plans can usually be recommended to allow their safe participation in athletics. But unfortunately, the screening will also identify a small number of cases where competitive activity must be restricted to minimize the risk of SCD.

Many school-aged athletes participating in organized programs are required to take part in at least a rudimentary “sports physical” before taking the field. On the other hand, UCI Pro Tour cyclists are required to undergo comprehensive annual cardiovascular screening in order to maintain their racing licenses. But what about the rest of us? Most cyclists ride and compete outside any kind of formal structure, and hence probably do not have access to screening services to ensure that it is actually safe for them to compete.

At first glance, there would not appear to be much of a downside to these types of pre-participation screening. However, as we will see, sometimes these programs can lead to expensive, burdensome and often unnecessary downstream testing — especially when the initial screening is performed by inexperienced providers. Some cardiologists oppose carte blanche screening of all athletes — especially younger competitors since data are lacking in terms of its ultimate ability to reduce SCD events in this population — and there are differences between North American and European approaches to this sometimes controversial process. Nevertheless, most medical professional societies are in agreement regarding the basic approach to screening athletes of various age groups and abilities.

Below, we will examine the different medical screening and risk assessment methodologies, their similarities and differences, and why they can be controversial, from both the individual as well as the broader social perspective. Given these differing points of view, we will then suggest a reasonable pre-season heart Tune-Up Checklist to follow based on your age, gender, and ability.

Comprehensive Medical History

The first and most basic assessment of potential cardiac risk involves a detailed medical history and “old-school” physical examination. As the 19th Century Canadian physician Sir William Osler said, “Just listen to your patient; he is telling you the diagnosis!” Most cardiologists employ a 14-point personal and family medical historywhich should be completed prior to intensive training and/or competition. This survey includes personal history questions regarding symptoms such as chest pain, palpitations, shortness of breath, unexplained fatigue, and passing out — all of which are concerning and may indicate significant underlying heart problems. Questions regarding prior history of a heart murmur, previous restriction from participation in sports, cardiac testing ordered by other clinicians, or difficulties with high blood pressure (hypertension, or HTN) can provide additional clues. Family history questions that may raise red flags include premature or unexplained death or heart disease in a close relative under the age of 50 and family knowledge of cardiac conditions such as hypertrophic cardiomyopathy (HCM — abnormal thickening of the heart muscle which may lead to SCD) or serious heart rhythm problems. Doctors will also look for Marfan syndrome — a hereditary disorder of connective tissue associated with significant cardiovascular defects including aortic rupture — which is often indicated by a tall/slender build, and disproportionately long arms, legs, and fingers. (Michael Phelps, in his book “Beneath the Surface,” describes ongoing surveillance at Johns Hopkins University, since he exhibits the classic physique of a Marfan patient). If any of these symptoms or historical elements sound familiar, you should consult with your physician prior to competing.

Physical exam

Following an understanding of the individual's medical history, the next step is a focused physical examination, which includes listening to the heart with a stethoscope to detect murmurs which could potentially indicate the presence of significant structural heart diseases, like HCM. The upper and lower extremity pulses are compared to diagnose aortic coarctation (narrowing of the main artery arising from the heart often manifest as a pulse difference between the arms and legs). Aortic coarctation, commonly associated with other congenital heart problems, can result in severe HTN, heart failure, and even death. If the physician finds any of these abnormalities, the patient should be referred to a cardiologist before competing.

Resting Electrocardiogram (EKG)

An EKG may be necessary if there are worrisome findings in the medical history or physical examination. But here is where things start to get trickier and where a veritable Pandora's Box of spin-off effects starts to muddy the medical decision-making process. In particular, the appropriate role of a routine EKG in pre-participation screening of younger athletes is an area of considerable debate. The EKG does provide clues to underlying structural heart problems such as HCM, but more importantly, it also has the ability to screen for other conditions which cannot be detected by just the physical exam — problems which increase the risk of developing serious heart arrhythmias that can result in SCD. Routinely screening athletes with an EKG has been shown to be significantly more effective than history or physical examination alone in detecting these problems.

However, interpreting EKGs in athletes can be challenging, because normal physiologic adaptations caused by serious training may result in changes to the EKG. Inexperienced screeners, in particular, may interpret such an EKG as being "abnormal," resulting in unnecessary downstream testing. This "false positive" effect occurs with higher frequency in younger athletes, where the majority are healthy and statistically unlikely to have cardiovascular disease. A false-positive refers to a test result that indicates a disease is present when in reality the patient is healthy. And false-positives typically lead to additional testing, to figure out who truly has a disease, versus those who have been misdiagnosed and are actually healthy. (As an example, if there was a program to screen for a disease that affects 1 in every 1,000 patients, using a diagnostic test with a false-positive rate of 5%, this would generate an additional 50 follow-up studies — all on healthy individuals — in addition to the single patient who actually has the disease.) Although most medical tests are accurate, the minor but unavoidable frequency of false-positive results has fueled on on-going controversy within the medical profession about the cost and effectiveness of EKG screening. Clearly, the economic cost and social implications inherent in such medical programs can quickly become problematic.

Experts have formulated various guidelines to improve EKG interpretation in athletes and to attempt to reduce the proportion of false-positive results. Most notably, EKG analysis using the so-called Seattle Criteria has been shown to decrease the false-positive EKG rate from 17% to 4% in a group of 1,078 elite Australian athletes. If the results of this study were applied to the testing of all of the approximately four million high school athletes in the United States, the result would be the elimination of over 500,000 unnecessary follow-up studies such as echocardiograms (Echo) or exercise treadmill tests (ETT) — simply by adhering to these criteria. Considering that the cost of an individual echocardiogram can be as much as $2,000, the economic impact of such a change is staggering — an annual savings of as much as $1 billion depending on the tests ordered.

The costs and implications of false-positive EKG results is a significant factor which has led to different schools of thought about pre-athletic screening programs. For example, while both American and European groups recognize the need for pre-participation screening, most American groups endorse a comprehensive history and physical examination alone, without a routine EKG. European groups, on the

other hand (including the UCI and International Olympic Committee) typically do include a resting EKG. The European approach is based primarily upon the Italian experience where a mandatory screening program has been in effect since 1982. This national program showed an 89% reduction in SCD amongst athletes from 1979 to 2004. This appears to be an impressive victory, but a closer look at the data shows that the absolute number of athletes impacted is rather small (3.6/100,000 person-years in 1979 to 0.4/100,000 person-years in 2004). Critics of carte blanche screening point to this data, claiming that national screening is highly cost ineffective and an inefficient use of resources — that the cost-benefit ratio of such programs is wildly out-of-whack. Others, of course, would argue that such statistics are irrelevant, particularly if one of those three identified SCD risks happened to be you, your spouse or your child — and he or she wasn't screened.

Although there is continued interest in broader screening in the U.S., there are a number of unique obstacles preventing national screening like in Italy. Due to the large number of athletes in the U.S., the impact of downstream testing to rectify false-positive findings would be a significant financial issue. In an already strained healthcare system, who would foot the bill? In addition, it is important to remember that screening is a process, and not a one-time expenditure. Repeat exams at periodic intervals are necessary since a single evaluation — especially in adolescence — does not guarantee life-long freedom from SCD. For example, in one study of over 11,000 comprehensively screened adolescent English soccer players (including history, exam, EKG and Echo) five athletes died from subsequent cardiomyopathy approximately seven years after passing their initial testing. And there is still some medical uncertainty about whether restricting physical activity in some cardiac problems actually translates directly into improved outcomes anyway. In this context, the inference may be that participation in sports actually helps to address the underlying problem, or that some budding athletes might have been better served by an "ostrich approach." In fact, some athletes with conditions previously felt to be absolute contraindications to competition may now be allowed to play, assuming thoroughly shared decision-making between the patient, family members, and cardiologist along with a clearly delineated "Emergency Plan" in the event disaster strikes.

The logistics of organizing a national program de novo are certainly not trivial and would be very expensive. If such a program were developed, it would need to ensure equal opportunity for all athletes to access screening. There are also important legal ramifications to consider beyond obvious malpractice concerns. Is it appropriate for schools or athletic associations to mandate screening of athletes prior to competition, in essence forcing medical testing on a potentially unconsenting individual? How would sensitive information obtained during a pre-participation screening be handled? What are the long term consequences of abnormal test results as they relate to scholarships, grants or future job opportunities? And what about the potential legal repercussions involved when an athlete claims the legal right to compete contrary to a team physician's recommendation, because a scholarship (Knapp v. Northwestern University) or even a professional sports career (Mobley v. Madison Square Garden LP) may hang in the balance.

Despite all of these concerns, the current American guidelines do allow some "wiggle room" for smaller-scale programs to include an EKG during screening, provided the program is "well designed and prudently implemented." (One such example is the central-Pennsylvania-based Peyton Walker Foundation where using the European model, approximately 2% of screened high school students are identified with heart abnormalities requiring further follow-up, and about 1% are identified with potentially life-threatening conditions. These results are similar to what was found in the Italian program.)

So, given these differing approaches, along with their inherent uncertainties and technological imperfections, and given the individual economic as well as broader social costs of such uncertainties, what is a reasonable and cautious recommendation for cardiac assessment and testing for different types of cyclists?

1.) Suggested checklist for the developing cyclist (age 13-35)

SCD in athletes under age 35 is typically related to congenital/ structural heart problems. History and physical exam are endorsed by both North American and European societies, and an ECG may add increased sensitivity in appropriate hands. Stress testing is generally not part of the initial screening protocol.

- 14 point personal/ family medical questionnaire
- Focused exam by a trained provider
- Routine EKG not recommended in the U.S.; recommended in Europe
- Routine EKG may be acceptable in well designed, small scale programs
- Subsequent evaluation every 2 years

2.) Suggested checklist for the seasoned rouleur (age 35+):

Sudden cardiac death in athletes above age 35 is often associated with acquired coronary artery disease (CAD). Hence, the approach taken for older, master's athletes often includes a resting EKG, and may include a stress test.

- 14 point personal/ family medical questionnaire
- Focused exam by a trained provider
- Routine EKG is reasonable above age 35; recommended above age 40
- ETT is recommended for moderate-high risk patients or patients with documented CAD. Moderate-high risk patients are defined as men > age 40, women > age 50, or postmenopausal women, any of whom having one or more of the following independent risk factors: high cholesterol; HTN; tobacco use; diabetes; first-degree relative with heart disease
- ETT is reasonable if engaging in very intense sports (such as competitive bike racing)
- ETT is recommended when beginning a new exercise program, particularly if the athlete was previously relatively sedentary
- ETT is recommended for all athletes > age 65 even in the absence of symptoms/ risk factors
- ETT is recommended for all athletes > age 35 in Europe
- Subsequent evaluation every 1 to 4 years

Compare these screening recommendations to the requirements for elite UCI Pro Tour and Continental Pro cyclists, required by the UCI to undergo a Programme des Examens Obligatoires which includes yearly cardiovascular screening. The UCI has been accepting of scientific evidence suggesting that SCD can be minimized, although not completely eliminated by cardiovascular screening. In fact, their recommendations are by far the most comprehensive of all the approaches outlined.

- 14 point personal/ family medical questionnaire (yearly)
- Focused exam by a trained physician (yearly)
- Routine EKG required (yearly)
- Echocardiogram (alternating years with ETT)
- Exercise treadmill test (alternating years with Echo)

In the end, pre-participation cardiac screening comes down to a personal choice based on an individual's risk profile. Regular maintenance health visits to your doctor for an updated history and physical exam are a great place to start, and in fact are the cornerstones for appropriate risk assessment. Consult with your physician and use these visits as a platform to discuss other screening options — including an EKG or perhaps even a stress test — in accordance with the guidelines presented above. If available, take advantage of small-scale, prudently implemented screening programs in your area. Again, these are suggested guidelines, and individual cases vary, so an ongoing dialogue is important to appropriately tailor

any screening program. Lastly, never ignore concerning symptoms or significant family history since either could be a critical clue to significant health issues putting you at risk for SCD.

Dr. William Apollo, March 20, 2019