Cycling with Coronary Artery Disease

Editor's Note: Coronary artery disease (CAD) or "blockage of the arteries," is surprisingly common, estimated to occur in as much as 50% of the population. It is often a "silent" or unrecognized condition or disease, and its prevalence increases significantly with age. For both serious recreational and more competitive cyclists, it is critically important to regularly assess your cardiac health – particularly as you age, and even if you have every reason to believe that you are pretty healthy. Below, we engage in a full discussion of cycling with CAD – at different competitive levels – with our associate Dr. Bill Apollo, a cardiologist and bike racer based in Harrisburg, Pennsylvania.

Monday morning … again. But today, Phil was particularly refreshed and rejuvenated after spending the previous week on his bike, exploring the smooth roads of central Oregon. He and his son enjoyed 400 miles of breathtaking vistas, which many would consider a small slice of heaven. They have become accustomed to such adventures, having experienced the glorious scenery of Idaho last year, and Washington the year before. And by the way, Phil completed all of these epic rides with nine stents in his heart. He has coronary artery disease (CAD) – a condition in which cholesterol plaques narrow the coronary arteries, thereby depriving the heart muscle of blood and oxygen.

Phil was diagnosed with premature CAD at age 38 when, like many, his primary focus was on his young family, a new home, and his career – not necessarily cycling. He began to notice intermittent discomfort in his upper chest, throat, and jaw. At first, he misinterpreted the initial signs of a serious problem, attributing the symptoms to indigestion, or perhaps life's stresses. Heart disease never crossed his mind. The episodes continued to worsen, so he saw his family physician who wisely ordered a treadmill stress test. He failed the stress test, and after being sent to a see cardiologist, ultimately required an angioplasty procedure (restoration of blood flow to a narrowed artery with a small balloon) to correct the blockage in his heart.

It wasn't until about 2 years later that he discovered cycling when his brother-in-law mentioned training for a "cool" ride called RAGBRAI. Shortly thereafter, Phil was logging significant mileage and like the rest of us, he became addicted to the bike. His story did not end with his first angioplasty procedure however. Over the next 15 years he had a total of nine stents placed in his heart (small expandable metal tubes placed inside a narrowed coronary artery). Phil is a great example of how a very common problem, if monitored carefully, does not necessarily mean an end to cycling – even at a competitive level.

Phil's story has important implications for all of us, as the miles and the years click by – even if we can still hang with the fast group during Tuesday's club ride. CAD is very common, and as we age, it becomes more important – especially when assessing the risk of continued competition for an *athlete-patient*. As we have previously explored, a young pro rider below the age of 35 would be more at risk from congenital coronary anomalies, structural heart problems, or lethal heart rhythm issues than from CAD. A recent study of U.S. military recruits (ages 18 to 35) showed that CAD occurs much less frequently in young people who experience sudden cardiac death (SCD). Of those who died of proven cardiac causes, like inflammation of the heart muscle or structural abnormalities, only 28% had any evidence at all of traditional CAD upon autopsy.

In sharp contrast however, American Heart Association statistics indicate that CAD accounts for one-third of *all deaths* in the U.S. in those *over* age 35, and is statistically the leading risk factor for SCD in athletes in this age group. Unfortunately, sometimes an athlete may ignore important warning signs, thinking that they are too young or too healthy to have CAD, failing to realize that anywhere from 4 - 10% of heart attacks in the U.S. occur before age 45.

Exercise definitely helps to fend off father time, and many cyclists ride well into their middle or later ages, enjoying the physical and psychological benefits of regular activity. In fact, market research indicates that most registrants in "average" cycling events such as Gran Fondos and recreational tours are just like Phil and his son: between 35 - 54 years old. At first glance, these statistics are encouraging. However, they can also sound the alarm bell, since many if not most such athletes – with no indication of a heart problem (or worse yet, misinterpreted symptoms like Phil) – compete outside any type of organized team structure, and hence may not have adequate screening services to determine if it is safe for them to participate in such events.

But what about athlete-patients like Phil, who have *already* been diagnosed with CAD, but who wish to continue training at a fairly intense or competitive level? ("Competitive" as used here does not just mean participation in sanctioned races, but also includes "recreational" riders who may train just as hard as or harder than their peers competing in Masters level races). To address this question, the European Association of Preventative Cardiology (EAPC) published guidelines in July 2018, which were subsequently adopted by the American College of Cardiology (ACC). The good news is that cyclists like Phil are actually encouraged to participate in all types of exercise programs – including competitive events – as long as certain criteria indicate a low risk for adverse cardiac events.

But what exactly does "low risk" mean, and how does a cardiologist make this determination? First, cardiologists agree that regular exercise reduces the risk of developing CAD. However, and conversely, it is also clear that intensive training may increase mortality risk in some patients who already have CAD. Therefore, the goal must be to encourage participation in sports such as cycling with a reasonable level of caution – to ensure the safety of the participant.

When assessing an athlete-patient's eligibility to compete, three key pieces of clinical information should be considered: (a) the number of critical coronary blockages; (b) the pumping function of the heart; and (c) performance on a standard stress test. Let's use these tools to think like a cardiologist.

Critical coronary blockages: Blocked or narrowed arteries carry major risk during intense exercise and need to be fixed if the athlete-patient wants to participate at a competitive level. Ideally these arteries should be "revascularized" – as in Phil's case – with angioplasty or stenting. After the blockages are repaired, competitive level events should be avoided for three months. A structured cardiac rehabilitation program should be developed, with emphasis on individualized advice to progressively increase training loads. Once back on the saddle, office visits are necessary at least yearly, and the patient should undergo periodic testing to be sure all is well.

Pumping function: Competitive cycling requires a big engine, and normal heart pumping function is necessary to ride at this level. Pumping function is commonly assessed by echocardiography (cardiac ultrasound or "Echo") and described by a metric known as ejection fraction (EF). Every patient with CAD should know their EF, or the percentage of blood ejected from the heart each time it beats. During systole (contraction phase) the heart never completely empties; normal, healthy adults typically have an EF ranging anywhere between 50% and 70%. EF directly impacts what cardiologists refer to as "cardiac output" – the amount of oxygen-containing blood a person can supply to their body each minute.

For example, a typical 70 kg athlete with an average heart size of about 150 cubic centimeters (cc), an average EF of 60%, and a typical heart rate of 60 beats per minute (bpm), produces a cardiac output of about 5.4 liters/ min (150 cc heart size x 60% EF = 90 cc x 60 bpm = 5400 cc, or 5.4 liters/ minute). As the athlete's heart beat increases during exercise, cardiac output naturally increases in a linear fashion. If the athlete described above was exercising at a heart rate of 150 bpm, this would produce a cardiac output of 13.5 liters per minute.

The repeated exercise of endurance training results in adaptive changes to the size, shape, and structure of the heart, all which combine to make it a more efficient engine. This normal response to consistent training – referred to as "physiologic remodeling" – causes an increase in both the heart's size and mass, allowing the EF of a highly-trained endurance athlete to drop closer to 50%. This small drop in EF is offset by the increased heart size so that the endurance athlete can actually achieve the same cardiac output at rest – total amount of blood delivered to the body – with a lower EF.

During exercise, and based on the equation above, a highly trained athlete will be able to produce a much larger cardiac output than an untrained individual. Fortunately, despite his multiple stents, Phil's EF has consistently been around 55%, and he has never exhibited any signs of pathologic remodeling. (Note: normal cardiac adaptation to endurance training should never be confused with "*pathologic* remodeling" – an abnormal decrease in EF which results from things like scar tissue from prior heart attacks. Pathologic remodeling is always detrimental to performance. In some cases where echocardiography may be inconclusive, magnetic resonance imaging (MRI) is used to more accurately assess EF as well as quantify the amount of scar tissue present – since both of these are significant risk factors for predicting cardiac events during competition.)

Stress test results: Athlete-patients interested in competitive cycling should be able to exhibit normal, age-adjusted exercise capacity at maximal effort during a standard treadmill stress test. This typically involves an electrocardiogram (EKG) test while walking on a treadmill or riding a stationary bike, to closely measure your heart rhythm, blood pressure and breathing. There is no better way to check "engine performance" than with an all-out stress test. This simple test is critical in determining the ability to perform at a competitive level, since during race-like situations, the athlete-patient must be able to achieve a very high intensity workload, without any restrictions.

This is where the ball is often dropped, since sometimes health care professionals unfamiliar with cycling – including some cardiologists – underestimate the physical demands involved in competitive efforts. The type and level of competition planned by the patient must therefore be clearly understood by the cardiologist performing the stress test. The athlete-patient should be stressed to maximum exertion on the treadmill, not just to the age-adjusted 85% Maximum Predicted Heart Rate (MPHR), as is often the custom for average patients. This distinction is vital; almost all competitive athletes occasionally exceed 85% MPHR, and may do so for prolonged periods of time. During the stress test, the athlete should be able to go "full-gas" without symptoms of chest pain, undo shortness of breath, dizziness or passing out.

The resultant EKG should indicate no evidence of insufficient coronary blood flow, and there should be no abnormal exercise- induced heart rhythms. The serious endurance athlete should "leave everything on the field" during this test – go "all out" – so that an accurate assessment of cardiac risk can actually be achieved. For more recreational riders, the age-adjusted 85% MPHR may be acceptable. Phil has not required routine maximum effort testing since he is no longer interested in competitive riding, and in that context, has become quite adept at regulating his heart rate and perceived level of exertion. Since his initial diagnosis, he has also developed a keen sense of symptom recognition and has been uniformly correct in recognizing new blockages when they developed.

Summary: Every athlete-patient is unique but in general, if the above three criteria are met (no critical blockages; normal pumping function; excellent stress test results) then most cyclists with CAD can safely participate – even in competitive level events – with low risk of a heart-related problem. On the other had, if these criteria are not met, the athlete-patient should be considered "higher risk" and should not try to participate in high-level competitive events. That said, "normal" cycling activities may still be possible in higher-risk patients, after having an appropriate discussion with their cardiologist about the intensity and duration of their planned exercise efforts. Based on stress test results, reasonable activity guidelines can be established with respect to maximum allowed heart rates while riding, as well perceived level of exertion, all to help minimize risk.

Caution is also suggested to athletes over 60 years old even if there are no obvious "red flags" because studies have shown an increased risk of SCD during endurance events in this population.

Data gathered over a 30-year period examining the rates of death and cardiac arrest among U.S. triathletes, indicate an approximately 10-fold risk of SCD in athletes over 60 years old. Of the 135 competition-related SCDs reported in one study, 44% were directly attributable to cardiac causes, with coronary artery disease found at autopsy in 67% of the cases.

Notably, in this sampling, most of the cardiac arrests actually occurred during the swimming portion of the triathlon; most of the cycling-related deaths were the result of trauma/crashes – not from cardiac issues. Several hypotheses have emerged to explain this phenomenon including: (a) high levels of adrenaline early in competition, putting an already vulnerable heart at risk; (b) unfamiliarity with the rigors of open water swimming; and (c) difficulty in identifying and treating SCD victims in the water. Nonetheless, these data are still very clinically relevant to a cardiologist performing a pre-competition evaluation. High-intensity swimming, cycling and running all produce similar demands on the heart, and result in similar types of physiologic remodeling; therefore, they are associated with similar competitive risks in a patient with known CAD.

By clearly understanding these guidelines, you and your cardiologist can have an educated discussion about your cycling activities after being diagnosed with CAD. Be certain to clearly communicate your cycling goals – whether that means cruising the boardwalk with an ice cream cone, conquering the weekly time trial series, or enjoying a week-long cycling adventure with your son, like Phil. Be proactive even if you have not been diagnosed with CAD, since as outlined above, certain athletes – especially those over age 60 – may still be at significant risk due to clinically silent cardiovascular disease. And most importantly, listen to your body and never ignore chest symptoms, as they could be the warning sign of a potentially avoidable disaster.

By Bill Apollo and Steve Maxwell, The Outer Line, December 19, 2018