

Why Exercise? Reversal of Coronary Artery Disease

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On August 2, 2013 I was exercising on a treadmill at my usual gym watching the television in front of me. Two relevant brief news announcements that came across the television's screen gave me food for thought.

The first news story flash across the television screen was as follows:

“Former president George W. Bush, an exercise enthusiast, had a coronary stent inserted today. He had no history of previous heart disease or chest pains and is doing well.”

The mention that he was an exercise enthusiast seemed to imply that his exercise had failed to prevent him from having the need for a stent. I also was a little surprised about the stent since I remember that George Bush had been a regular avid runner during his presidency. He ran regular 8-minute miles, which impressed me. I like to jog and am a couple of years younger than George Bush but there was no way that I could keep up his pace. Although I disagreed with most of his political policies, I could admire his personal dedication to exercise. It is always a bit of a shock to hear of someone who exercises regularly having heart troubles.

So, why exercise?

I know enough about atherosclerosis to know that it is an insidious disease often without symptoms. Most coronary atherosclerosis even when severely advanced often has few symptoms. It is often missed on routine screening treadmill stress tests and even with coronary angiography the extent of the disease can be underestimated. Also, there is a strong component of genetics in coronary atherosclerosis and it is definitely more common as we age. Is it inevitable if we live long enough?

The news flash about George Bush did make me think more about the role of exercise in prevention and treatment of coronary atherosclerosis. How worthwhile

is it? Can exercise truly prevent slow or even reverse atherosclerosis? Could all the running, swimming and cycling that I do be in vain? I quickly rationalized that George Bush is different from me. His problem was probably related to stress, perhaps falling away from a lifestyle program, or maybe even an overzealous diagnosis have having a stent put in for disease that is not that really all that harmful. After all even in the news story he had no chest pain. (It is questionable about using a stent when chest pain is absent.) I know that running is still good for the heart. And it was not going to deter me in my own exercise program. With a bit of determination and mild denial, I started to run a bit faster on my treadmill! I like the feeling that aerobic exercise gives me and just feel healthier and more alert when I do it.

So what are the known benefits of regular exercise in preventing a heart attack or even reversing atherosclerosis?

First, here is a standard definition of “exercise”: an activity requiring physical effort, especially when it pertains to sustaining or improving health and fitness.

This definition of “exercise” is the result of a modern phenomenon. It might also be said that “rich men exercise, while poor men work!”

Worldwide societies have significantly changed in the past 200 years from predominantly agricultural-based societies (more daily exercise as part of one's work) to industrial and technological societies (more sedentary). Therefore, scheduled exercise has become a tool to restore balance to our sedentary bodies. Most often exercise is promoted to lose weight, maintain fitness,

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maintain appearance and enhance mental wellness or just entertainment. People often exercise in structured classes. They often want formulas on how intense and how long to exercise.

Unfortunately, because of busy schedules people rationalize more and more that they just do not have time to exercise when it is probably their best daily preventive health medicine. These are the very people that frequently asked me “what is the minimum amount of exercise that I need to stay healthy.” The standard answer is 30 minutes of brisk walking 3–4 times per week. However, this is very minimal and in general most people need more to maintain optimal health. A study from Duke University Medical Center (1) in 2002 confirmed that moderate exercise (getting heart rate up to 75% maximum) is needed to lower weight and LDL-C levels and walking alone is insufficient. What we do know is that even small amounts of exercise are better than no exercise and that more vigorous exercise is better if you are trying to reverse weight, blood pressure, diabetes or cholesterol problems.

Also, exercise is merely part of a total potential healthy lifestyle that includes proper preventive medical evaluation and treatments, healthy nutrition and a healthy mental status.

Two physicians’ icons that had significant influence on the role of exercise and heart disease are worth mentioning here.

Dr. Paul Dudley White (1886–1973) was one of the best-known cardiologists during his lifetime and markedly changed people’s thoughts on the relationships between exercise and heart disease (2). I had the pleasure of meeting Dr. White many years ago when he was quite elderly but still teaching at Harvard Medical School. Common teaching 60 years ago was that coronary atherosclerosis was a result of aging and was inevitable. Today, as a result of Dr. White’s research we know that although advancing age is one of the risk factors for atherosclerosis its development is “not” inevitable!

Dr. White was one of the founders of the American Heart Association and stressed how taking care and controlling risk factors for coronary atherosclerosis could reduce the incidence of heart attacks and how regular exercise can improve the heart’s condition and improve the quality of life even after a heart attack. Dr. White was influential in changing our thinking of how much activity people should have after a heart attack. The main teaching prior to Dr. White was to treat heart

attacks with prolonged bed rest and markedly restricting the patient from exercising. Dr. White got people mobile soon after their heart attacks. He felt that this promoted more rapid recovery. His approach is standard today and has been proven by the test of time.

Dr. White was one of the physicians involved in starting the famous Framingham study. The Framingham study started in 1948. It is a long-term longitudinal study that continues today. It studied the relationship of daily health habits such as smoking, diet and exercise and how over time these factors impacted on health and longevity. Thousands of research papers have been published from this group. The Framingham study firmly established risk factors for coronary atherosclerosis. These included the “noncontrollable” risk factors of age, male sex and hereditary. But more importantly, the studies confirmed the “controllable” risk factors. The prominent ones are well known to all cardiologists and include smoking, elevated serum cholesterol, elevated blood pressure, diabetes and most importantly curbing a sedentary lifestyle. The central focus of the American Heart Association has been to educate the public about risk factors, identify them and try to modify them so as to reduce the risk of heart attack and stroke. It has been successful in helping reduce the overall incidence of cardiovascular disease.

Dr. White became nationally known in 1955 when he took care of President Dwight D. Eisenhower after he had his first heart attack. Rather than treating a heart attack as a disability with rest, Dr. White got the president to be active and back to playing golf. With one swing of a presidential golf club on early television, cardiac rehabilitation was born. Eisenhower served four more years as President.

Dr. White led by example. He was an avid walker and bicyclist. When he flew from Boston to Washington DC to consult with President Eisenhower, Dr. White would walk from the Washington National Airport to the White House. Also, Dr. White rode his bicycle almost every day in Boston on his way to work. He did this into his eighties and persisted even after he suffered his first stroke. Today, a bicycle trail along the Charles River in Boston is named after him and enjoyed by thousands of people every day. Dr. White was a living example of a lifestyle that he advocated. That is an important point for physicians to still remember today when educating our patients. In other words, we owe it to our patient to “walk our talk.”

The second physician to have a major impact on how we think about exercise is Dr. Kenneth Cooper who is now 83 years old and with his son Tyler run the Cooper Aerobics Fitness Center and Clinic in Dallas Texas.

Dr. Cooper also leads by example and has been a lifelong exercise enthusiast. He has been a personal health consultant to many presidents. I am privileged to have met with him and shared communications over many years. I have learned a lot from him.

Dr. Cooper rose to national attention in 1968 when he published his book simply called *Aerobics* (3). It became a bestseller (of which most of the profits did not go to Dr. Cooper). It was Dr. Cooper who coined the term “aerobic exercise.” This form of exercise stresses the concept of being active with movement so as to enhance the flow of oxygen through the body.

Dr. Cooper was a physician for the Air Force. He was involved in establishing fitness standards for pilots. He was also involved in evaluating the physical fitness of astronauts. He did extensive evaluations with treadmill stress tests and measured oxygen utilization with gas exchange masks in air force pilots and astronauts. Basically, he demonstrated that regular aerobic exercise improves oxygen utilization called VO_{2max} .

His results are published in over 16 books and thousands of research papers. He is “the icon” of physical fitness.

Common aerobic exercises include walking, jogging, cycling, swimming and dancing. These are all activities that have been enjoyed by people for thousands of years long before there were any exercise gyms or aerobic dance classes. It is just that in modern times with increased sedentary lifestyles from convenience and technology, we need to make an effort to get the aerobic activities that our bodies need. Dr. Cooper also now stresses to have some weight-bearing exercises to maintain bone and muscle mass and regular flexibility training, which are both important in optimal functioning into advanced age.

Dr. Cooper simplified the amount of aerobic activity that is needed to maintain good health and established a point system to measure it. Each aerobic activity was given a point that was multiplied by its duration. To maintain fitness it was recommended to get 30 points per week. I remember reading this in 1968 and have tried to maintain regular aerobic exercise during my lifetime. I still try to have a well-rounded aerobic program supplemented regular with weight training and stretching.

The benefits of regular aerobic exercise include not only improved oxygen consumption, but also control of weight management, improved respiratory vital capacity, decreased risk of diabetes mellitus, more optimal lipid profiles (raising protective HDL-C and lowering harmful triglyceride and LDL-C particles). Exercise also increases the size of LDL particles and makes them large and fluffy. When LDL particles are large and fluffy, they are less likely to penetrate the blood vessel walls and initiate atherosclerosis than when they are small and dense, which is common in sedentary individuals. Exercise also increases cardiac output and more efficient heart rate much the same way that β -blockers do, only better and without potential side-effects. The biggest benefit of regular exercise may just be increased mental alertness and sense of well-being. This is important at any age or condition. Here again Dr. Cooper has been a role model for exercise all of his life. He frequently exercises with his patients.

There is no debate now about the benefits of aerobic exercise after a heart attack or heart surgery. Cardiac rehabilitation programs are an integral part of any quality cardiac program. Doctors and patients are familiar with exercise prescriptions. Dr. Cooper was involved with the development of all these areas.

How aerobic exercise reduces the risk for diabetes deserves special emphasis. Type 2 diabetes mellitus is the fastest growing health epidemic worldwide. Its cause is mostly related to excessive caloric intake combined with a sedentary lifestyle. The end result of diabetes is enhanced atherosclerosis with resultant heart attacks and strokes, end-stage kidney disease and dementia just to mention a few of its complications.

Often the emphasis of the treatment and prevention of diabetes is diet and medication directed. Although diet and medications are important, regular aerobic exercise is the single-most important tool available to avoid and control diabetes today. This valuable tool is often not used to its full benefit. It is “only” aerobic exercise that will enhance insulin sensitivity and facilitate normal glucose metabolism at the cell membrane site. Medications can only partially and transiently accomplish this. Type 2 diabetes mellitus is mostly a disease of insulin not working correctly at the cellular level in the muscles. As the insulin does not work correctly at the receptor site, more and more insulin is secreted to overcome this problem. This is called insulin resistance. We know that excessive insulin, as a result of insulin insensitivity, is harmful to blood vessels. It promotes rapid progression

of atherosclerosis and may even have a direct toxic effect causing inflammation. We now know that inflammation within the vessel walls is the primary precipitant of most heart attacks and strokes. Only exercise lowers insulin levels. We are indebted to Dr. Cooper for getting us on the right track in using exercise as one of primary tools to fight diabetes and heart disease (4).

The second medical story to come across the television scene that same day that stimulated my thinking about exercise was as follows:

“Hawaiian Hula Dance class after heart attack and heart surgery reduces blood pressure and improves recovery and fitness.”

Being from Hawaii, I felt that it may be the more important and relevant news story than the story about George Bush. Native Hawaiians have twice the incidence of heart attacks when compared to the rest of the population. Once one of the healthiest people on earth now suffer the ravages of Western illnesses, including atherosclerosis. This is largely the result of changes in lifestyle and loss of cultural values with so-called “modernization.”

The television story was about a preliminary study from the Queens Hospital in Honolulu (5). Twenty-seven patients of Hawaiian background with heart attacks were enrolled in a post heart attack cardiac rehabilitation class to have Hula lesson twice per week for about an hour. Hawaiian hula is an ancient art expression. Hula is a slow and rhythmic dance with a swaying motion of the hips and arms. When activity is measured, it comes to 6.6 Met units, which is equivalent to moderate walking on an incline. This is similar to what most cardiac rehabilitation programs try to achieve. Hula was actually banned in Hawaii for many years by the Christian missionaries who thought it is too seductive! For many years now, the hula dance has had a strong resurgence in Hawaii. However, most people see it as an art form rather than a tool for healing.

What this preliminary study found was that compared to a control group, the group given hula all had better blood pressures (drop in 20 points systolic from baseline), heart rates and fitness. But here again one of the main benefits was relaxation and spiritual connectedness. This enhanced spiritual connectedness resulted in healthier patients taking less medications. There was also excellent compliance with cardiac rehabilitation classes, which correlated with a 53% reduction in recurrent heart attack. Although this is a small study, it is important to

review this to see where it can be culturally adapted.

I would like to add to the previous definition of exercise as follows: “Exercise is also *all* creative movement.”

I think that this is the next paradigm shift that we as physicians need to think about and encourage our patients in that direction. Like Drs. White and Cooper, we need to be role models for our patients in this form of exercising so as to motivate them.

Hula is a dance that has been in Hawaii for hundreds of years. There are many different types of hula today, but the type used for cardiac rehabilitation is slower flowing rhythmic style. The purpose of hula is nonverbal communication and expression. Hula is not a unique cultural expression. There are many cultural dances around the world that have similar nonverbal communication and expression. These dances could have the same effect on improving oxygen consumption, lowering blood pressure, improving optimal body mass index and most importantly improving mental well-being. The important thing with exercise is to do something that you like to do. That way it will be sustainable. I think that doing some exercise that is closer to your soul with a smile on your face is better than marching on a treadmill while watching the clock. Therefore, think of exercise as everything you do and make it fun.

So it is obvious that we need to exercise and we need to do it soulfully. We need to think of all of our movement as exercise and make it constructively creative. Some hula, yoga and/or local dance everyday would do us all good.

In cardiology we are in love with scientific studies to measure things. One of the unanswered questions is whether lifestyle changes can cause regression or reversal of coronary atherosclerosis. In 1990, lifestyle enthusiast Dr. Dean Ornish (6) published a small study using serial coronary angiograms to show improvement in coronary atherosclerosis with a lifestyle program that included a low-fat diet combined with regular exercise. The difficulty doing this study is that coronary angiography is an invasive test.

We now have noninvasive technology that can objectively measure atherosclerotic plaque with CT coronary angiography. This is a very useful research tool. I have been involved with this technology and the ability to actually see atherosclerotic plaque and measure it with a noninvasive test is truly amazing. A CT coronary angiogram is the best measure of total plaque

burden and can identify both hard (less harmful) and soft (potently more harmful) atherosclerotic plaques. CT coronary angiography is also helpful in assessing vessel remodeling, which is important to maintain blood flow in the presence of coronary atherosclerosis.

Preliminary studies and case studies have shown that modifying cardiac risk factors (particularly exercising and reducing cholesterol) can definitely decrease atherosclerotic plaques (particularly soft plaques). Atherosclerotic plaque is dynamic. Vessels are always changing in response to it with remodeling and development of collateral circulation. There may never be total regression or reversal of atherosclerosis, but modifying any of the cardiac risk factors can influence plaque evolution in a positive direction. The biggest beneficial decrease is seen in the patients with the most advanced atherosclerosis. These are often the patients who have the most prevalent cardiac risk factors. Obviously, if we limit and reverse the factors that lead up to plaque formation it is more likely to slow or reverse the disease process and promote health.

It is hard to separate out the importance of the role of exercise compared to diet, discontinuation of smoking, control of high blood pressure and diabetes, and medications. I think that it is probably unimportant to try to separate them out and rather look at total lifestyle management. Serial CT coronary angiography is a wonderful tool to follow atherosclerosis (7); however its downside is expense and potential radiation exposure. Because of that, it should be used with caution. Giving commonsense recommendations to exercise more and eat healthier has no side-effects.

Beneficial lifestyle programs need to be easy to follow, make sense and be sustainable. Physicians are the best teachers when they are role models. CT coronary angiography can be very helpful in identifying and following problems but should not replace prudent

thought, commonsense and advice. Also, medications can be very helpful as part of any lifestyle program but should not be our first and only choice for lifestyle improvement (8). As physicians, we should strive to have our patients on as few of medications as possible and only those that are absolutely necessary. We should always be encouraging our patients that with good exercise and diet programs, there is always a chance of reducing and eliminating medications.

Why exercise? There is no pill as good as exercise in improving and sustaining health. As Dr. Cooper says,

“Fitness cannot be stored. Fitness is a journey and not a destination.”

We need daily exercise to maintain our fitness. As we age, we need to modify our fitness to our physical abilities but at any age or any stage of health creative expression is always possible. Or in other common words,

“If you don’t use it, you lose it.”

References

1. Kraus W, Houmard JA, Duscha BD, *et al.* Effects of the amount and intensity of exercise on plasma lipoproteins. *N Engl J Med.* 2002;347:1483–92.
2. Hurst J. Paul Dudley White: the father of American cardiology. *Clin Cardiol.* 1991;14:622–6.
3. Cooper K. *Aerobics.* New York: Bantam Books; 1968.
4. Cooper K, Cooper T, Procter W. *Start Strong, Finish Strong: Prescriptions for a Lifetime of Great Health.* USA: Penguin Press; 2007.
5. HELA Study Hula Empowering Lifestyle Adaptation: Presented at American Psychological Society Honolulu, Hawaii. Honolulu Star Advertiser; August 2, 2013.
6. Ornish D, Brown SE, Scherwitz LW, *et al.* Can lifestyle changes reverse coronary artery disease? The Lifestyle Heart Trial. *Lancet.* 1990;336:129–33.
7. Inoue K, Motoyama S, Sarai M, *et al.* Serial coronary CT angiography-verified changes in plaque characteristics as an end-point: evaluation of effect of statin intervention. *J Am Coll Cardiol Img.* 2010;3:691–8.
8. White RL. *Soar: Achieving Your Best Possible Health Through Awareness.* USA: AuthorHouse; 2010.