PARADIGM SHIFT FOR EXERCISE

by M. Doug McGuff, M.D.

For the past three decades the medical community has largely recommended aerobic exercise to patients as a means of improving their health. This emphasis on steady-state activity was largely based on the work of Kenneth Cooper, M.D. and a multitude of studies showing positive cardiovascular outcomes when performing aerobic exercise. Running, Jogging, and aerobic dance became national fads. Thirty years later, many of us are finding that the exercise rage that we helped create may have done more to destroy America's knees than it did to save America's hearts.

We must understand that aerobics is a word made up to describe a particular exercise philosophy. The word *aerobic* describes the subsegment of metabolism that involves the Krebs cycle and respiratory chain, which requires oxygen to function. During low level physical exertion, energy demands are met primarily by this metabolic pathway. At higher levels of exertion, other metabolic pathways predominate. The research that has been performed in the past has operated on the assumption that exercising to produce aerobic metabolic adaptations is most desirable. Measuring how *aerobic* a particular exercise is largely determined through V02max testing (maximal oxygen uptake). When exercise showed improvement in cardiovascular outcomes the link between aerobic metabolic conditioning and cardiovascular health was established. It then became a forgone conclusion that exercise that did not rely predominantly on the aerobic metabolic system would have no effect on cardiovascular health. Thirty years later, the literature is suggesting that we were wrong.

The Best Kind of Exercise

A review of the more recent literature seems to suggest that resistance training may be the best way to train the cardiovascular system. If you think about it, this makes sense. The only way we can get at the cardiac or vascular system is by performing mechanical work with the muscles. It only makes sense that the higher the intensity and quality of the muscular work, the greater will be the effect on those systems that must support the muscular work. If you think of exercise in biological terms, you will note that exercise is simply an irritative stimulus which acts upon the body (an organism); if the stimulus intensity is high enough, and the organism has the resources available (nutrition, rest) it will produce an adaptive response. By raising the stimulus intensity we can produce a more pronounced and well-preserved adaptive response.

How do we know that resistance training produces a strong cardiovascular effect? Most of us have been told that high muscular tension increases peripheral vascular resistance and traps venous blood, which inhibits venous return. These supposed effects act to decrease cardiac output (or so we were told). If you think about it, these arguments make little sense. Venous return is largely dependent on muscle contraction to move blood centrally. Forceful muscle contractions should enhance, not inhibit cardiac return. Furthermore, the release of catecholamines during intense exercise causes gut vasoconstriction, but stimulates vasodilatation in the muscles, the net effect of which should be to decrease peripheral resistance. Decreased peripheral resistance combined with enhanced venous return should enhance cardiac output. Increased end-diastolic pressure should enhance coronary artery perfusion, making permissible meaningful exercise to even those with coronary artery narrowing. The argument seems logical, but until recently it has not been measured directly. An article from the June 1999 issue of the *American Journal of Cardiology* actually used right heart catheterization to measure hemodynamic changes during high intensity leg press exercise in patients with stable congestive heart failure. The measurements taken noted significant increases in heart rate, mean arterial blood pressure, diastolic pulmonary artery pressure and cardiac index. Furthermore, there was a significant

decrease in peripheral vascular resistance, an increased cardiac work index and left ventricular stroke work index, suggesting enhanced left ventricular function.(1).
The profound effect of resistance training on the cardiovascular system might make one worry that the demands are too great and resistance training may actually be dangerous to those with know or lurking cardiovascular disease. A review of the literature shows that we need not worry too much. A recent article in the March-April *Journal of Cardiopulmonary Rehabilitation* examined circuit weight training at varying levels of intensity in patients with CAD. They actually noted a lower rate-pressure product when compared to treadmill walking and no subject displayed any ST-segment depression or angina during circuit weight training.(2). This parallels my experience training patients with known CAD. Despite training these subjects at very high intensity, taking every set to muscular failure, we have never had a subject experience angina. This is even true for subjects who have angina climbing steps or walking uphill. I believe that the augmented venous return improves coronary perfusion and permits a more meaningful level of exertion in these patients. Resistance training has even been shown to be safe early after myocardial infarction (again, I believe for similar reasons). An article from the March-April *Journal of Cardiopulmonary Rehabilitation* looked at resistance training as early as 6 weeks post MI and compared it to more traditional aerobic-based rehab protocols. Amazingly, they noted "...30 of 42 subjects had one or more cardiovascular complication (arrhythmia, angina, ischemia, hypertension, hypotension) during the aerobic exercises as compared to only 1 subject with complications during resistive exercises". (3). Furthermore, it appears that we need not worry too much about the blood pressure response from resistance training. A meta-analysis from the March issue of *Hypertension* concluded that "progressive resistive exercise is efficacious for reducing resting systolic and diastolic
blood pressure in adults." (4). Another article confirms that resistance training does not exacerbate exercise blood pressure. (5).

Peripheral Effects
Despite its profound effects on the cardiovascular system resistance training still has its major impacts through peripheral adaptations, mainly in terms of increased muscle strength. We have all told our patients that just performing activities of daily life (walking, taking the stairs, yard work) can preserve our cardiovascular health. Unfortunately, the age-related loss of muscle (sarcopenia) can undermine our ability to carry out those activities. Resistance training can prevent and even reverse sarcopenia.(6). Furthermore, as a muscle becomes stronger, fewer motor units will have to be recruited to perform a given task, thus reducing the demand on the cardiovascular system. Clearly, the best kind of exercise is the kind that will tax the musculature the most, this will create a powerful cardiovascular stimulus, while producing hemodynamic changes that minimize the risk of cardiac ischemia and also produce the most profound peripheral changes in the form of muscle strengthening.

The Best Resistance Training
The best resistance training would be high intensity but of low force so that the beneficial effects can be obtained without the risk of injury. Heightened intensity would also be helpful because the duration of the workout could be shortened and the recovery interval between sessions prolonged. A brief and infrequent exercise protocol would go a long way toward improving long-term compliance with an exercise program.
At my facility we use the SuperSlow™ protocol which involves lifting the resistance over a 10 second time span and lowering the resistance over a 10 second time span. The very slow lifting speed provides two beneficial effects. First, by moving so slowly the weight cannot get moving under its own momentum and this enhances muscular loading and intensifies the exercise. Secondly, the slow movement eliminates acceleration. Since force=mass x acceleration, we can greatly reduce the amount of force that the exercising subject will encounter. The SuperSlow™ protocol was originally devised for use with osteoporosis

patients.(7). The protocol is so effective at raising intensity that we find workouts of about 12 minutes to be optimal and a recovery interval of 7 days to be optimal for most subjects. We have been able to double subjects strength in about 12-20 weeks. Recent research performed by Dr. Wayne Wescott compared the SuperSlow™ protocol to standard repetition speed resistance training and noted a 50% better strength gain in the SuperSlow™ group.(8). The researchers were so astounded that they later repeated the study and were able to reproduce the results.(9).

So, it appears that exercise will make a paradigm shift in the new millennium. Aerobic exercise will fall into the background while resistance training takes center stage. If you want more information on these changes, consult your medline (http://www.ncbi.nlm.nih.gov) or feel free to contact me.

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Biography

M. Doug McGuff, MD is a graduate of the University of Texas Medical School at San Antonio. Dr. McGuff completed his emergency medicine residency at the University of Arkansas for Medical Sciences where he served as Cheif Resident. Dr. McGuff is currently a partner in Blue Ridge Emergency Physicians, P.A. in Seneca, South Carolina. Dr. McGuff also owns Ultimate Exercise, a licensed SuperSlow(tm) facility that provides one-on-one exercise instruction in a clinically controlled environment.