Can Resistance Training Reset Your Baroreflex?

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The ability to reset the baroreflex set point during exercise was discussed in a recent review article by Raven et al. (4). The authors presented some convincing evidence that central command center controls can be modified during steady-state exercise. Although this area of research is relatively new, the concept is based on sound physiological principles that govern blood pressure control. I can accept the argument that these adjustments are possible with aerobic exercise, but I question whether or not resistance training could induce the same adaptation. Before I give you my opinion on that subject I need to briefly review the basic control factors involved in blood pressure control and the cardiovascular difference between steady-state aerobic exercise and the on-and-off nature of an anaerobic exercise like resistance training.

Your blood pressure is always shown as systolic pressure (cardiac contraction) and diastolic pressure (cardiac relaxation) and is given as systolic over diastolic pressure. It is easier to deal with a single number, so these measurements are normally converted into a single number termed your mean arterial pressure (MAP). MAP is defined as follows: MAP = pulse pressure/3 + diastolic pressure, pulse pressure being the difference between systolic and diastolic pressure. Two factors are involved in controlling MAP. The first is cardiac output or the amount of blood pushed into the arteries each minute. The amount of blood moved depends on heart rate (beats/minute) and the volume of blood expelled from the heart. The amount pushed per beat is your stoke volume (SV), and it is influenced by the size of the ventricles of the heart and the volume of blood returning to the heart. The second control factor of MAP is peripheral vascular resistance, which represents the amount of resistance to blood flow that is exerted in the arteries at any given time. The resistance is greater when the artery diameter is reduced (vasoconstriction) and less when the vessel is open (vasodilatation). All of these components of MAP are altered during exercise via central (cardiovascular centers in the brain) and peripheral (muscle activity) control mechanisms. The cardiovascular centers of the medulla oblongata (enlarged end of the spinal cord) contain specific neuronal pools that can increase the heart rate (cardioexcitatory), decrease the heart rate (cardioinhibitory), and adjust the diameter of arteries. These control centers respond to exercise (increased muscle activity) and/or shifts in plasma pH, carbon dioxide, and oxygen. Basically the system is very simple: as tissue demands go up so does the heart rate and vasoconstriction (decreased vessel diameter).

Pressure receptors called baroreceptors are located in blood sinuses in the aorta and carotid artery and respond to increases in MAP. These receptors function as a protective mechanism and help maintain cerebral blood pressure at a reasonable level, and they prevent you from breaking cerebral blood vessels during exercise. Any increase in MAP stimulates the baroreceptors, and they in turn activate the cardioinhibitory area of the cardiovascular center in the medulla. When active the cardioinhibitory area decreases...
the heart rate and inhibits vaso-
motor activity (vasodilatation). The
end result is a drop in MAP. Nor-
mally this response would be ben-
eficial, but during exercise it could
limit the ability to supply the mus-
cle with enough oxygen or nutri-
ents. Of course this response
could be overridden at the tissue
level through localized mecha-
nisms (1).

The resetting of the barorecep-
tors as described by Raven et al.
(4) would explain how we could
maintain control over MAP during
exercise and still have a barore-
cceptor response. Studies of hyper-
tension (elevated blood pressure)
have shown that baroreceptors
can adjust to an increase in MAP
if the pressure is maintained at
the elevated level for a prolonged
length of time. The receptors are
similar to an elastic band around
the artery and when stretched can
adapt. Their adaptation to the
stretching decreases neural activ-
ity back to normal but does ele-
vate blood pressure. It is conceiv-
able that this same type of adap-
tation could occur with steady-
state forms of exercise if they were prolonged enough. I
would define steady-state exercise
as any form of activity that main-
tains an increased heart rate for
long periods of time. This would
include walking, running, cycling,
or swimming activities in which
the intensity remains relatively
constant over time. Under these
conditions an adjustment of the
baroreceptor would occur.

If we accept the fact that this
could be accomplished during
steady-state exercise, the question
becomes: what about during non-
steady-state activities, such as re-
sistance training? Of course to an-
swer this question we need to clar-
ify what we mean by resis-
tance training. If we characterize it
as weight lifting, and then restrict
it to higher-intensity lifting, 70%
of the 1 repetition maximum
(1RM) or above, I feel the answer is
no! During the concentric part of a
lift the heart rate and vasocon-
striction would increase and drive
the MAP upward, then would tend
to drop somewhat during the ec-
centric component of the lift. Dur-
ing a multiple-repetition routine,
the heart rate and MAP would un-
dergo a constant up-and-down
pattern. The rest period between
sets would then allow the heart
rate and MAP to drop back toward
normal. How close they get to rest-
ing levels would depend on the
length of the rest period between
sets. In my opinion this type of on-
and-off stimulation would make it
extremely difficult for the barore-
cceptors to adapt to the elevated
pressure. However, it is possible
that a prolonged routine with a
high number of sets and low rest
periods carried out over years of
training could readjust the barore-
cceptor settings.

Research dealing with the
control of baroreceptor activity
during exercise is relatively limit-
ed at this point and has been
conducted with aerobic forms of
activity (2, 3). Although I do not
feel that lifting can reset barore-
cceptor responses on a short-term
basis, it would be interesting to
measure these effects after pro-
longed exposure to resistance
training. Is anyone out there in-
terested in conducting this type
of research? ▲

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