The Benefits of the Low Intensity Training

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This presentation addressed the researches concerning the effects of the low intensity training on health promotion done in our laboratory. Supervised physical training performed at 50 % \( \dot{V}O_2 \text{max} \) or lactate threshold for 60 minutes, 3 or 5 times a week for 30 sessions could induce the improvement in \( \dot{V}O_2 \text{max} \), lipid profiles, and augment in cardio-pulmonary baroreflex. This training was also applied for patients in ischemic heart disease, hypertension, and obesity. These patients could improve their aerobic work capacity. Hypertensive patients could reduce their blood pressure in association with modulating in humoral factors without changes in body weight and diet. The obese patients succeeded in significant body reduction with mild food reduction. We also found the existence of break-point of double product (BPDP) during graded exercise test corresponding to lactate threshold. BPDP will be able to use for estimating lactate threshold. This low intensity training, which is easier and safer, can be recommended to the wide-variety of persons including older person to promote health.


Key words: Training, 50 % \( \dot{V}O_2 \text{max} \), Lactate threshold, Health

Physical exercise may play a major role in health promotion, and the prevention and treatment of various diseases. It is generally agreed that there is a threshold of intensity to attain these goals. Low intensity training has many benefits, especially for sedentary persons and patients, being easier, safer, and less likely to injure ligaments. Further it is easy to consume much energy, if one continues exercise for longer durations. We thus examined the effects of training at low intensity and longer duration on aerobic capacity and major risk factors of coronary heart disease. The results are discussed in the following.

**Effects of training at 50 % \( \dot{V}O_2 \text{max} \) on \( \dot{V}O_2 \text{max} \)**

When we started this project in early 1970s, it was known that training with at least 70-80 % of maximum aerobic power (\% \( \dot{V}O_2 \text{max} \)) results in increased \( \dot{V}O_2 \text{max} \), but little study had been made on the effect of training at lower intensity (see WHO 1969).

We were much interested to see whether intensity of 50 % \( \dot{V}O_2 \text{max} \), above which blood lactate and catecholamine begin to accumulate and maximal stroke volume can be reached, improves \( \dot{V}O_2 \text{max} \). Studies were made on 42 men and 22 women aged 16-60, who performed exercise on a cycle ergometer for 1 hr, 3 times a week for 10 weeks under the supervision by a exercise physiologist (Shindo et al. 1974, 1975, 1976, 1977, 1987). Almost all subjects showed improved \( \dot{V}O_2 \text{max} \), except young active subjects whose initial \( \dot{V}O_2 \text{max} \) were relatively higher than the other subjects. However, when they performed the same exercise for 5 times a week, \( \dot{V}O_2 \text{max} \) increased.

Physical aerobic capacity in visually handicapped boys and young male adults is extremely low, this being particularly influenced by eyesight (Shindo et
al. 1987). Training intensity at 50% \( \dot{V}O_2 \text{max} \) in blind people was equal to 4.4 mets on the average, this corresponding to walking at 3.75-4 miles/h. In spite of such low intensity, \( \dot{V}O_2 \text{max} \) increased much more than the healthy subjects. Training effects would appear to show significant negative correlation between initial \( \dot{V}O_2 \text{max} \) and improved \( \dot{V}O_2 \text{max} \). It is thus concluded that training at 50% \( \dot{V}O_2 \text{max} \) is effective, especially in sedentary people.

**Effects of the low intensity training to reduce risk factors**

In our epidemiological studies on Japanese, who eat less animal fat than European and American, the incidence of hypertension (Tanaka et al. 1990b) and appearance of hypercholesterolemia, hypertriglyceridemia, and hypo HDL-cholesterolemia (Tanaka et al. 1989) were found higher in the lower fitness level evaluated by estimated \( \dot{V}O_2 \text{max} \), as also suggested by studies in American and European cohorts. From these results, low intensity training at 50% \( \dot{V}O_2 \text{max} \) should be effective for decreasing major risk factors of ischemic heart disease.

Since 1980, lactate threshold (LT) has been used as the training intensity especially in patients and middle and older person instead of 50% \( \dot{V}O_2 \text{max} \) for the following reasons. LT, at around 50% \( \dot{V}O_2 \text{max} \) in sedentary persons, can be determined without forcing severe exercise in subjects. Exercise tests can thus be easily conducted even in patients. LT is strong determinant of endurance capacity and highly related to \( \dot{V}O_2 \text{max} \) and muscle oxidative capacity.

The training improved plasma profiles in obese (Sasaki et al. 1987) and hypertensive patients (Sasaki et al. 1989). With mild diet such as 1300 kcal per day and exercise at LT for 300 kcal, obese patients could lost 4.9±1.3 kg of body weight after 1 month without reducing lean body mass (unpublished). By this training, much energy can be consumed by exercise of long duration, since patients can initially do several hours of exercise without complaint.

Controversial results have been reported for antihypertensive effects of exercise. Interestingly, the effectiveness of exercise therapy involving strenuous intensity were not observed, while positive effects were observed in the case of mild intensity. A interesting study was made by Tipton et al. (1983), who compared the effects at different intensities on blood pressure in SHR rats. Only the lowest intensity training at about 40-60% \( \dot{V}O_2 \text{max} \) was found effective for reducing blood pressure.

We confirmed the efficacy of the prescription at LT intensity for treatment of hypertension repeatedly. This training induced to modulate multifactorial factors of regulating blood pressure such as reduction in blood volume (Urata et al. 1987), plasma norepinephrine (Kiyonaga et al. 1985, Urata et al. 1987) and endogenous digitalis like substance (Koga et al. 1992), and increase in urine dopamine (Kinoshita et al. 1991), plasma prostaglandin E (Kiyonaga et al. 1985) and taurine (Tanabe et al. 1989). Exercise at the training intensity was also found to cause significant increase in the plasma atrial natriuretic factor, which might act antihypertensively by reducing blood volume and/or peripheral resistance, in contrast to less increase in plasma catecholamine, arginin vassopressin and renin activity (Tanaka et al. 1986). Further, this training may augment inhibitory influence of the cardiopulmonary baroreceptors on forearm vascular resistance in middle-aged subjects with slightly higher resting blood pressure (Jingu et al. 1988).

Very recently, we have shown this exercise prescription is effective to increase HDL-c even in older patient with hypertension and ischemic heart disease aged 65-82 years old (unpublished).

**New noninvasive technique as an index of lactate threshold**

As mentioned above, training at LT is effective to improve health. But disadvantage of LT is to take blood sample frequently.

The ventilatory threshold developed by Wasser-
man et al. (1964) is widely used as a noninvasive method to evaluate LT. However it needs special expensive apparatus to determine ventilatory threshold. We recently found that break point of rate-pressure double-product (BPDP) during graded exercise was observed in all of the young healthy subjects and cardiac patients and the regression line for estimating LT from BPDP was nearly coincident with the identity line (Tanaka et al. 1990a). The possibility of the existence of BPDP may be explained by the following findings. The onset of the abrupt increase in plasma catecholamines coincided with LT (Mazzeo & Marshall 1989). In animal studies (Gregory et al. 1987, Rotto et al. 1989, Thimm et al. 1984), injection of lactic acid into the arterial supply in muscle has shown to induce reflex increases in arterial BP and HR. Therefore, the steeper increase in DP could be explained by the influence of the abrupt increase in sympathetic nerve activity above LT combined with the gradual decrease in parasympathetic nerve activity. The correlation between BPDP and LT was as strong as that between the ventilatory threshold and LT in young healthy subjects. The proposed method, which is simple and easy to measure, may be clinically useful for estimating LT.

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