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EFFECT OF VO_{2MAX} ON LEFT VENTRICULAR EJECTION FRACTION IN ATHLETE

Physiology

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ABSTRACT

The main goal of this study was to show how VO_{2max} affect left ventricular function when an athlete does moderate to maximum treadmill which can help to evaluate cardiovascular fitness. As an athlete start doing treadmill, depending on the need of oxygen to tissues, cardiac output, stroke volume, left ventricular ejection fraction and myocardial activity along with increased Vo2max,

Data collection was done at D Y Patil Hospital, Navi Mumbai after taking permission from medical ethic committee. After asking to do treadmill, systolic time interval were estimated for finding Vo2max and left ventricular ejection fraction, taking into consideration duration. For proper results, athletes were asked to do treadmill for 2 weeks

As an athlete perform treadmill, VO_{2max} was found to be increased with a gradual increase in left ventricular ejection fraction was somewhat increased ($P<0.005$) Thus in athletes, VO_{2max} was to be much more correlated with left ventricular ejection fraction ($P<0.005$).

KEYWORDS

Treadmill, VO_{2max}, left ventricular ejection fraction, athlete.

INTRODUCTION

The ability of the body to make oxygen-rich blood available for working muscles is the biggest factor affecting aerobic performance. The more blood that the heart can eject per heart beat, the more work an individual will be able to do. Stroke volume which is nothing but left ventricular ejection fraction can be defined as the amount of blood ejected from the left ventricle of the heart during a contraction. It is measured in mL/beat.

The principal features of the cardiovascular responses to endurance training in normal subjects were well documented by the late 1960s. They include an increase in maximal oxygen uptake, stroke volume, and cardiac output, left ventricular ejection fraction with no change or a small decrease in maximal heart rate. Endurance training, which delivers an acute volume load to the heart during exercise, may alter the compliance characteristics of the left ventricle. Such an adaptation may be very beneficial during exercise, allowing for increased diastolic reserve and therefore increased stroke volume and cardiac output in response to increased filling pressures.

For athletes, systolic function is often characterized by the ejection fraction, fractional shortening or stroke volume but these measures are also very complex ones determined not only by myocardial characteristics but by several other factors, as preload, afterload and autonomous regulation.

VO_{2max} is the best indicator of cardiorespiratory endurance and aerobic fitness while cardiorespiratory fitness is a limitation for VO_{2max}. Exercise training at a variety of intensities increases maximal oxygen uptake (Vo_{2max}), the strongest predictor of cardiovascular and all-cause mortality and thus represents a potentially important preventative approach to reduce the risk of disease development in currently healthy adults.

METHODOLOGY –

After getting approval from medical ethics committee, this study was carried at D Y Patil Hospital, Navi Mumbai. In this study, 40 athletes were asked to do treadmill through Bruce protocol for 3 times a week. (Till to get 90% of maximal, age-predicted heart-rate). Treadmill – intensity – 10mm/mv, frequency – 50 hertz, speed – 25 m/sec. Each athlete was asked to sign informed consent form. In this study, parameters chosen were blood pressure, pulse and systolic time intervals from which VO_{2max} and left ventricular ejection fraction was calculated.

3D echocardiography is done by Doppler's method, which is a standard method to record systolic time intervals; transducer used is of frequency 21HZ, velocity – 2 to 2.5 megavolt.

Calculation of Vo_{2max} –

Vo_{2max} (ml/kg/min) = 3.62 x T + 3.91 (Treadmill)

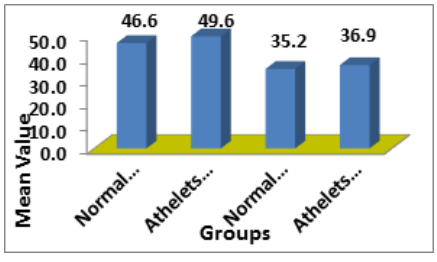
Calculation of Left ventricular ejection fraction –

Left ventricular ejection fraction = Pre-ejection phase / Left ventricular ejection phase

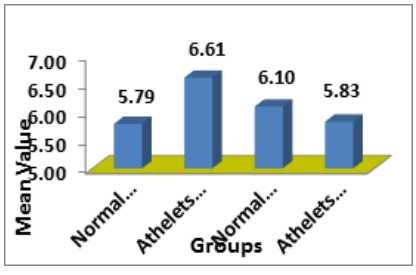
RESULTS –

Parameters	N	Mean	Stdev	Unpaired T Test	P-value	Significant at 5% level
Duration	21	12.6352	1.0720	2.052*	0.048	Yes
VO_{2max}	21	49.6471	3.8824	2.168*	0.037	Yes
Left ventricular ejection fraction	21	6.6129	.9559	2.380*	0.023	Yes

Mean value of $\dot{V}O_{2max}$



Mean value of Left ventricular Ejection fraction



Above table along with graphs shows a strong correlation between VO_{2max} and left ventricular ejection fraction, concluding that as an athlete performs treadmill from mild to moderate as left ventricular ejection fraction increases with increase in $Vo_{2max.}$ ($P< 0.005$)

DISCUSSION

Cardiac adaptations in athletes are characterized by enhancement of left ventricular systolic performance at peak exercise which

contributes to enhanced stroke volume at peak exercise. We found a higher left ventricular ejection fraction in athletes at the end of treadmill greater increase in VO_{2max} in athletes. At a given exercise intensity, left ventricular ejection fraction was higher in athletes than in non-athletes even though the magnitude of adrenergic stimulation is expected to be lower at any given work rate.

VO_{2max} in athletes appears to be mediated primarily by central adaptations as reflected by enhancement of left ventricular systolic performance and larger stroke volume .i.e. by left ventricular ejection fraction at peak treadmill. However, the smaller increase in heart rate during the sub maximal exercise at a given exercise intensity observed in the trained state is also compatible with concomitant peripheral adaptations in our subjects.

Stroke volume rises during exercise as a result of increases in ventricular end-diastolic volume and, to a lesser degree, sympathetically mediated reduction in end-systolic volume (particularly during upright exercise). Left ventricular end-diastolic volume is determined by diastolic filling, a complex process that is affected by a variety of variables, including heart rate, intrinsic myocardial relaxation, ventricular compliance, ventricular filling pressures, atrial contraction, and extra cardiac mechanical factors to match with $VO_{2max.}$

In athletes, increase in O_2 uptake capacity after training is generally attributed to both enhanced left ventricular performance resulting in augmented maximal cardiac output (central adaptations) and increased 02 extraction by working skeletal muscle reflected in widening of the arteriovenous O_2 difference (peripheral adaptations).

The enhanced left ventricular systolic performance in response to training is reflected by a larger increase in left ventricular ejection fraction at similar changes in end-diastolic volume during exercise..

Thus endurance training impacts myocardial function 1) at rest, 2) during submaximal exercise, and 3) during maximal exercise.

CONCLUSION

From above study it was concluded that VO_{2max} strongly affect left ventricular ejection fraction as an athlete does treadmill from moderate to maximum, depending on the need of oxygen,

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