Society for Endocrinology - Media Release

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New research provides clues as to why elite rowers have bigger, stronger hearts

Scientists have unravelled a potential mechanism for how top-level rowers develop enlarged strengthened hearts as a result of long-term intensive training. The research, published in the August edition of *Clinical Endocrinology* suggests a causal link between naturally occurring hormone levels and strengthening of the heart muscle in professional rowers. Elite rowers were found to have higher levels of insulin-like growth factor 1 (IGF-1) compared to healthy sedentary volunteers. In these athletes, IGF-1 values correlate with enlargement and strengthening of heart muscle cells.

Researchers, led by Dr Giovanni Vitale (University of Milan, Italian Auxologic Institute, Italy) and Professor Gaetano Lombardi (University of Naples Federico II, Italy), measured circulating IGF-1 levels in blood samples from 19 top-level male rowers and 19 age-matched healthy sedentary controls. IGF-1 is a hormone that is produced by the liver in response to growth hormone stimulation. Each subject had their cardiac structure and function measured using standard echocardiography and 'pulsed Tissue Doppler', a more effective way of accessing and recording activity, particularly from the right side of the heart. For the rowers, examinations took place during a period of intense physical training, but at least 24 hours following the last athletic activity.

The rowers had higher serum IGF-1 levels compared to controls, but in both groups IGF-1 levels were within the normal range. The rowers' hearts were also much larger, showing increased cavity dimensions, increased wall thickness, and enhanced muscle function, in both the left and right sides of the heart, compared to controls. In the rowers, IGF-1 levels correlated significantly with several echocardiographic parameters of myocardial contractility. Importantly, these associations remained significant when adjusted for age and heart rate. There were no significant differences in terms of height, weight and blood pressure between the two groups, although as expected, the rowers had significantly lower resting heart rates compared to the control group.

This is the first study to show an independent association between IGF-1 levels and remodelling of the right side of the heart in competitive rowers, and provides clues as to how the body responds and adapts to prolonged physical exercise. IGF-1 promotes muscle growth, and is known to be activated during exercise; IGF-1 levels often remain elevated following a training period[1]. This research provides a potential mechanism for cardiac

remodelling in rowers, whereby an increase in IGF-1 may activate biochemical pathways, which trigger heart muscle growth, resulting in increased cardiac strength and output.

Researcher Dr Giovanni Vitale said:

"Cardiac hypertrophy, or enlargement of the heart muscle cells, is a hallmark of top athletes, especially rowers, and is a physical adaptation to increased cardiac load during prolonged periods of exercise. Our results show both the left and right sides of the rowers' hearts are larger, and function at an enhanced capacity compared to those of the controls. The causes of this strengthening of athletes' heart muscle are not completely clear. It could be due to the production of growth factors (such as IGF-1) during training. In fact, physical exercise is associated with cardiac haemodynamic changes (pressure and volume overload) able to stimulate the production of growth factors by stretching myocardial fibers."

"To this end, we investigated levels of the hormone insulin-like growth factor-1 (IGF-1), and found significantly increased levels in the rowers compared to the control group, although in both groups IGF-1 levels were within the normal range. Furthermore, higher IGF-1 levels in the rowers' bloodstream correlated significantly with better heart performance. These results highlight a possible biochemical mechanism for cardiac hypertrophy in elite rowers and suggest a potentially beneficial role for IGF-1 in the remodelling of the heart muscle. This could mean that naturally increased production of IGF-1, occurring as an adaptation to prolonged training, influences biochemical processes that control contraction of the heart muscle in rowers. Further research is now needed to determine the exact relationship between higher production of IGF-1 and cardiac output in elite rowers."

General Information

IGF-1 is a hormone produced mainly by the liver in response to growth hormone, and plays an important role in muscle growth. The majority of circulating IGF-1 (98%) is found in conjunction with IGF-1 binding proteins. The hearts of athletes such as rowers, who take part in long-term intensive training, undergo a physical adaptation to cope with the increased cardiac load. Thickening of the heart wall muscle or myocardium, is known as hypertrophy, and is common among athletes.

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Notes for editors

References

1. Koziris, LP et al., 1999. Serum levels of total and free IGF-1 and IGFBP-3 are increased and maintained in long-term training. *J.Applied Physiology,* **86:** 1436-1442.

Contact information

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ABSTRACT

Circulating IGF-1 levels are associated with increased biventricular contractility in top-level rowers

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Background The intensive physical activity is often associated with cardiac changes.
Objectives (i) To evaluate the IGF-1 system and myocardial structure and function by standard Doppler echocardiography and Tissue Doppler in athletes and sedentary controls; and (ii) to determine any relationship between IGF-1 system and echocardiographic parameters.
Methods Nineteen male top-level rowers and 19 age-matched healthy sedentary male controls underwent blood determination of fasting serum IGF-1, IGFBP-3 and acid-labile subunit levels and standard Doppler echocardiography combined with pulsed Tissue Doppler of posterior septal wall, left ventricular (LV) lateral mitral annulus and right ventricular (RV) tricuspid annulus. Myocardial presystolic (PS_m), systolic (S_m), the ratio of early diastolic (E_m) to atrial (A_m) velocities as well as myocardial time intervals were calculated.
Results Rowers had higher serum IGF-1 levels ($P = 0{\cdot}04$), higher biventricular cavity dimensions and wall thicknesses compared to controls. They also had better LV and RV myocardial function than controls. In the rowers, IGF-1 was associated with LV ejection fraction ($r = 0{\cdot}50$, $P = 0{\cdot}03$), RV PS_m velocity ($r = 0{\cdot}55$, $P = 0{\cdot}01$) and with RV myocardial precontraction time ($r = -0{\cdot}57$, $P = 0{\cdot}01$). These associations remained significant after adjusting for age and heart rate.

Conclusions Top-level athletes showed higher IGF-1 levels and a better myocardial performance than controls, particularly for the RV systolic activity. The independent correlations between IGF-1 and systolic parameters of the left (ejection fraction) and right (PS_m velocity and precontraction time) ventricles may possibly indicate a role of IGF-1 system in the modulation of myocardial inotropism in athletes. Further studies are needed to confirm this hypothesis.