DOCTORAL THESIS

急性和長期運動對血清瘦素的影響及內分泌和免疫機理之研究

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Date of Award:
2002

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Effects of Acute and Chronic Exercise on Serum Leptin and the Regulation Mechanism of Endocrine and Immune Functions

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哲學博士學位課程

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二零零二年八月

中文提要

瘦素——肥胖的基因產物，在能量代謝中扮演著多功能角色，受到人們普遍的關注。本文的主要目的在於 1、觀察急性和長期運動對血清瘦素分泌的影響；2、運動是否是決定血清瘦素多少的獨立因素；3、血清瘦素變化的相關內分泌及免疫機制。

實驗設計：研究包含人體及動物兩個部分，人體試驗通過比較青春期前的運動員與非運動員血清瘦素的區別，探討長期規律運動對瘦素分泌的影響；動物實驗爲 2×5 的設計，旨在觀察兩種強度 (力竭性及 40 分鐘的適量) 的不同周期 (0、一次急性以及 6、8 及 12 週) 的游泳訓練，對大鼠血清瘦素的影響及瘦素變化的內分泌和免疫機制。

研究方法：人體試驗：受試者爲 36 名 (21 男，15 女) 處於青春期前，活動水平不同的運動員與非運動員，測試包括血清生化指標，體適能參數及身體成分等參數；動物實驗：100 只 5 週齡的雄性 Sprague-Dawley 大鼠，分別比較急性運動鼠和長期運動鼠與不運動的對照鼠的血清瘦素的區別，測量指標包括血清瘦素，胰島素，葡萄糖，黃體生成素，睾酮，淋巴細胞 CD_4^+/CD_8^+比例，血細胞因子，身體成分，食物攝入量等項。

研究結果：身體成分相似的兒童運動員與非運動員，血清瘦素濃度無顯著差異；皮下脂肪是預測瘦素濃度的一個良好指標；急性力竭性游泳後大鼠血清瘦素明顯升高，適量運動鼠沒有這種變化，兩種強度的運動鼠血清胰島素、葡萄糖及 CD_4^+/CD_8^+比例明顯降低，CD_8^+% 明顯升高；長期運動鼠出現攝食量減少，體重降低、腎周脂肪墊、皮下脂肪減少及瘦素降低，但是與不運動的對照組相比，6 週及 12 週運動鼠血清瘦素/脂肪重量及瘦素/皮下脂肪相對量之比值不變，同時血清胰島素、葡萄糖、睾酮、黃體生成素、CD_4^+/CD_8^+比例及白細胞介素-1α、白細胞介素-6、腫瘤壞死因子-α沒有變化，兩種強度的 8 週游泳訓練有顯著降低瘦素/脂肪重量之比值、瘦素/皮下脂肪相對量之比值、及 CD_4^+/CD_8^+比例，明顯升高 CD_8^+%的作用，但是兩種負荷強度的 8 週運動，淋巴 T 細胞組成沒有差異，大鼠內臟脂肪墊可解釋 58~85%血清瘦素水平的方差，是預測的較佳指標。

結論：禁食狀態下的血清瘦素水平與機體脂肪重量高度相關；急性力竭性運動大鼠的血清瘦素水平升高；長期游泳的動物瘦素明顯降低，瘦素在運動中可能擔當了抗肥胖及抗饑餓的雙重角色；內分泌及免疫機能不變時，血清瘦素/脂肪重量及瘦素/皮下脂肪之比值保持不變，免疫機能變化時 (8 週大負荷運動訓練鼠 CD_4^+/CD_8^+比例降低，CD_8^+% 升高)，瘦素的相對值(8 週)的波動，提示血清瘦素的變化可能與運動引起的免疫機能變化有關聯；運動是改變瘦素的獨立因素；血清瘦素變化的原因有待進一步研究。

Abstract

Leptin, the product of the ob gene, plays a multifunctional role on energy intake and expenditure. The aims of this study were to investigate the effects of acute and chronic exercise on serum leptin, the changes of leptin secretion with or without fat loss, and the regulating mechanism of endocrine and immune function on leptin in vitro.

STUDY DESIGN: The present investigation consists of two parts. Part 1, a preliminary study to show whether chronic and regular exercise is an independent variable to affect the levels of leptin by comparison of young athletes and non-athletes; and Part 2, an animal study which observed the effects of acute and chronic (6, 8 and 12-week) exercise with exhaustive and moderate swimming on serum leptin concentrations and the regulation of endocrine and immune functions in rats. Thirty-six prepuberty children (21 boys and 15 girls) participated in Part 1, and 100 Sprague-Dawley male rats were studied in Part 2. RESULTS: there were no significant gender and physical activity differences on leptin levels in children with similar body composition. The thickness of subcutaneous adipose tissue is a good predictor of serum leptin levels. In animals, acute exhaustive swimming increased leptin significantly while moderate exercise had no effects. The concentrations of serum insulin, glucose and the ratio of CD_4^+/CD_8^+ decreased, and CD_8^+% increased significantly in both exercised groups. Lower weight, retroperitoneal fat mass (RFM) and subcutaneous adipose tissue (SAT) were found in rats exercised for 6 and 12-weeks but not in sedentary controls, and the values of leptin/RFM and leptin/SAT were significant differences compared with their controls. Six weeks of high intensity exercise led to lower serum testosterone (T) compared with moderate exercise. In addition, the rats with 8 weeks of high intensity training had lower leptin/RFM, leptin/SAT and higher CD_8^+% than the controls, and the ratios of CD_4^+/CD_8^+ decreased in all exercised rats. Retroperitoneal fat mass may explain 58~85% variance of serum leptin levels. CONCLUSION: The fasting leptin concentrations were highly correlated with the fat weight. Acute exhaustive exercise increased the serum leptin concentrations and chronic high intensity exercise decreased it in rats regardless of fat content changes. It is suggested that serum leptin might play the dual roles of anti-obesity and anti-starvation during energy metabolism. The values of leptin/RFM and leptin/SAT decreased in rats after 8 weeks of high intensity swim training while the ratio of CD_4^+/CD_8^+ decreased, and CD_8^+% increased significantly. Exercise, independent of its effects on weight loss, influenced on leptin secretion in rats. However, the reasons that lead to serum leptin changes are still unclear.

正文目錄