

## 運動影響睪固酮激素變化之因素

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### 摘 要

激素檢測法發明而使得研究人員有機會觀察到體能活動對內分泌腺體之效應。運動研究顯示體能活動刺激性腺分泌睪固酮並非受到腦垂體之調控。許多研究發現運動後睪固酮濃度急性上升3%—37%。運動強度是影響睪丸分泌睪固酮之重要因素。訓練動機高之運動員自選訓練強度較接近能刺激睪丸分泌睪固酮之強度。有關現象也許意謂有引發睪固酮分泌之運動刺激閾值。研究顯示實施不同型態運動也會影響睪固酮分泌。未受訓者實施高強度訓練導致睪固酮下降與初期訓練過度所引發泌乳素分泌有關。此外，訓練初期之訓練過度現象造成睪固酮下降是否也與可體醇分泌增加所導致游離睪固酮／可體醇比率下降有關，則有待進一步之研究。睪固酮與運動能力關係密切，若能以適當之運動訓練方式增加內生性睪固酮則可幫助競技員提升運動能力並避免類固醇藥物使用。

## Factors Influencing Testosterone Response to Exercise

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### Abstract

Hormonal responses to exercise conditioning could be observed by researchers upon the development of the assay techniques. Many studies have been shown an acute increase in testosterone levels from 3%-37% following exercise. Exercise intensity has been considered an important factor to elevate testosterone while exercising. Athletes who were higher motive and freely selected training intensity stimulated testes to secrete testosterone. This evidence has been related to an existence of an exercise intensity threshold to stimulate a mass elevation of testosterone. It has been demonstrated that mode of exercise varies testosterone releases. An over-training periods during the beginning of intense training decreases the testosterone level of untrained that have been linked to a prolactin secretion. Furthermore, an elevated cortisol level during over-training period causes a reduction of free testosterone / cortisol ratio remain unclear and further study is warranted. Testosterone and exercise performance has been closely related. An optimal training procedure can stimulate endogenous testosterone, improve athletic performance, and avoid the use of synthesize steroids.

## 壹、緒 言

近年來，由於發展出激素檢測法而使得研究人員有機會觀察到體能活動對內分泌腺體之效應。雖然動物之活體及離體實驗結果顯示性腺激素經由下視丘—腦垂體—性腺軸線迴饋機制所調控，但是運動研究顯示體能活動刺激性腺分泌睪固酮並非受到腦垂體之調控（15）。此外，許多研究利用不同方式之體能活動引發睪丸分泌睪固酮，結果都不儘相同顯示運動引發血睪固酮變化十分複雜而會受到如許多因素之影響。本文針對運動實驗內容之差異對結果之影響做進一步探討。

## 貳、影響運動睪固 之因素

### 一、運動強度

睪固酮是最重要之雄性素（Androgen）。研究顯示睪固酮可使肌肉中蛋白質合成率上升與分解率下降。其中之機轉，一般以為與刺激細胞中DNA之轉錄（Transcription）使得肌肉蛋白合成率增加（9），而肌力則雖隨著肌肉橫斷面積之增加而上升。一般而言，安靜時成年男子血液睪固酮含量約為10.2至42.2nmol/l（2.94-12.15 ng/ml），而成年女子也可經由腎上腺皮質之網狀帶（zona reticularis）分泌0.49至3.39 nmol/l（0.14-0.98 ng/ml）之睪固酮（9），而當受測者進行45及90分鐘高強度（3.3 min/km）與中強度（4.3min/km）運動後，血漿睪固酮分別上升7%及21%（14）。Deschenes等人（4）收集相關資料後發現運動後睪固酮濃度急性上升3%—37%。Busso等人（1）以80%最大自主收縮進行15及51週之重量訓練後檢測血清睪固酮發現上升分別52%及15%。Haakinen等人（7）則發現運動員以自選運動強度方式

進行重量訓練每週3-5天持續24個月血清睪固酮發現上升27%而Wheeler等人(22)利用非運動員自選運動強度方示進行每週64公里跑步運動發現血清睪固酮下降17%，而Seidman(18)等人也發現非運動員每週進行5次有氧活動12週後血清睪固酮下降21%。這差異或許與訓練動機高之運動員自選訓練強度較接近能刺激睪丸分泌睪固酮之強度有關。這現象也許意謂有引發睪固酮分泌之運動刺激閾值。

## 二、運動時間及運動量

運動時間方面，Cumming等人(3)發現短時間運動可引發睪固酮上升，而超過2小時之運動則造成睪固酮下降。此外，Kraemer等人(12)發現抗阻運動訓練組間休息時間長短也是影響運動後激素濃度之因素。

運動強度、持續時間、及實施組數之乘積為所謂運動量。Kraemer等人(12)認為運動量是引發激素反應之重要因素。Guezennec等人(6)以70%一次最大反覆強度進行一項7組之運動訓練結果發現睪固酮並未上升，而Weiss等人(21)則以80%一次反覆最大強度實施4項運動，每項進行3組之訓練後發現血清睪固酮顯著上升。Tremblay(20)觀察激素對相等運動量之重量訓練與跑步訓練之反應，結果發現重量訓練後睪固酮濃度顯著上升。根據實驗結果顯示運動強度應該是影響睪丸分泌睪固酮之重要因素。

## 三、運動型態

研究發現運動型態影響激素分泌。有別於重量訓練(3, 6, 12)、跑步機跑步(19, 23)、路跑(13, 14)及腳踏車測力器(5, 16)後血漿睪固酮濃度增加等實驗結果，先前實驗觀察到高強度游泳導致睪固酮下降現象。Cumming等人(3)認為人類以水平姿勢運動改變肝臟血流或是因游泳時浸水造成血容比上升(血液稀釋)造成雄性素下降原因。Wilkerson et al.(23)也認為運動後睪固酮濃度上升與運動時血液容

積變化所造成。Keizer等人(11)則認為運動引起睪固酮代謝清除率(metabolic clearance rate)下降是導致男性受測者睪固酮濃度變化之因素。然而Kraemer等人(12)實驗發現抗阻運動後男性受測者血清睪固酮濃度顯著增加而女性受測者則無變化。實驗結果顯示血液容積及清除率並非影響運動後血液睪固酮變化之主要因素(2, 12)。此外, Tremblay(19)比較8至10反覆之重量訓練與50%至55%最大耗氧量之跑步訓練對性腺分泌反應之影響, 結果發現睪固酮濃度在重量訓練後顯著上升。

#### 四、體能狀態

一般而言, 與運動員相比較, 非運動員受以絕對運動強度進行訓練產生較複雜之激素反應。Hackney等人(8)發現睪固酮隨著4至6週之高強度體能訓練而下降而在訓練開始八週後睪固酮濃度回到接近訓練前水準。Remes等人(17)研究顯示雄性素分泌因體能狀態之起伏而有變化。Hackney等人(8)認為非運動員實施高強度訓練導致睪固酮下降與初期訓練過度所引發泌乳素(Prolactin)分泌有關。此外, 訓練初期之訓練過度現象造成睪固酮下降是否也與可體醇(Cortisol)分泌增加所導致游離睪固酮/可體醇比率下降(10)有關, 則有待進一步之研究。

### 參、總 結

睪固酮不但與動物生殖成長有關, 也和運動能力關係密切。目前國內外許多競技員濫用合成類固醇而造成傷害。若能以適當之運動訓練方式增加內生性睪固酮則可幫助競技員提升運動能力並避免類固醇藥物使用。體能活動之強度(intensity)、持續時間(duration)及方式(mode)是影響這些性類固醇分泌之因素。而以那一種運動方式及強度閾值以增加內生性睪固酮之合成則有待進一步研究。

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