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Adverse Cardiovascular Function Secondary to Inappropriate Exogenous Androgenic Anabolic Steroid Usage in Young Adult Males

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Abstract

- In today's society body image and athletic performance are emphasized and influenced by peers' perception. The inappropriate use of AAS in young males has steadily increased over the past few decades. The purpose of this study is to determine the long-term effects AAS have upon the cardiovascular system. The review of literature will explore studies that identify long-term abuse of injected AAS, which are used by adult male athletes' ages 18-40 compared to those equivalent male athletes who have never used any form of drugs or steroids and their effects on the cardiovascular system. The researcher plans to analyze the data of these studies to better determine how to diagnosis, detect and educate those patients who are susceptible to injury due to AAS usage. The research findings indicated that there is a direct correlation between AAS and young athletic males. Several research studies found a direct correlation between the usage of exogenous steroids and severe cardiovascular effects within the same age group of athletes. The data indicated that providers need to be aware of the increase in AAS users among the younger generation. With a strong emphasize on an athletic males ability to perform one sport to the highest level along with displaying an ideal body image that society demands has been found to have an increase in AAS abuse among this population. The identification and education of patients at risk for or who are abusing AAS is crucial to prevent irreversible cardiovascular events and/or dysfunctions from occurring secondary to abuse.

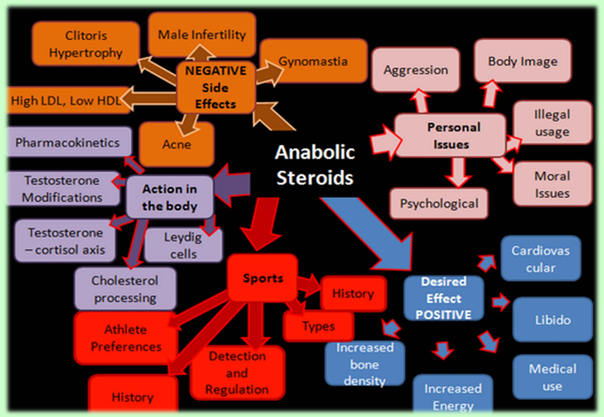
Introduction

According to surveys and media reports, the legal and illegal inappropriate use of anabolic-androgenic steroids (AAS) in the young adult male is gaining popularity. Anabolic androgenic steroids are synthesized from testosterone, which is responsible for development of primary and secondary sexual characteristics (See Figure 3). A recent survey indicated that there are as many as 3 million AAS users in the United States alone, and of those 3 million, 2.7%-2.9% are American adolescents who have experimented at least once during their lifetime (Evans, 2004). Evans (2004) found that only 15%-30% inappropriate use of AAS in the young adult male in the community attend gyms, and health clubs, and are weight-based trainers or athletes. However two/thirds of those individuals are noncompetitive recreational body builders or non-athletes who have strictly utilized AAS for cosmetics and to obtain the perfect body image and increase libido, see figure 1(Evans, 2004). In a society where athletic prowess is exemplified of an individual, one's future career and financial income, is based upon this prowess. This pressure directly correlated with the increase in the utilization of AAS in young male athletes Sachtleben,1993.

Statement of the Problem

- In young adult male athletes what effects does the long-term use of anabolic androgenic steroids have upon the cardiovascular system?

Figure 1: Anabolic Steroids (Evans, 2004)



Research Question

- What are the long-term effects of anabolic androgenic steroids on cardiac function?
- Inappropriate abuse of anabolic-androgenic steroids in the United States is a growing problem and concern, what are the multiple comorbidities that can develop from the chronic abuse?

Literature Review

- Angel and John Moores University (2013) conducted a study to investigate the effects of AAS on the cardiac structure and function and cardiovascular risk factors. Strength-trained participants underwent cardiovascular magnetic resonance imaging (CMR). The data analysis determined that participants who inappropriately used AAS had:
  - Higher absolute left ventricular (LV) mass (220 ± 45 g) compared to non-anabolic androgenic steroid participants (NAAS).
  - Reduced right ventricular (RV) ejection fraction (AAS 51 ± 4 % vs. NAAS 59 ± 5 %; $p < 0.05$)
  - Significantly lower left ventricular E':A' myocardial tissue velocity ratio [AAS 0.99(0.54) vs. NAAS 1.78(0.46) $p < 0.05$]
  - Peak LV longitudinal strain was lower in AS users (AS -14.2 ± 2.7 % vs. NAAS -16.6 ± 1.9 %; $p < 0.05$)
- Kaiskcioglu (2007) conducted a study to investigate the effects AAS usage had upon remodeling in the right atrium and ventricle. Results of the study were as follows:
  - Systolic, diastolic and pulse pressures were significantly higher in user athletes compared with non-user athletes
  - Aortic strain percent value in user athletes was significantly less than that of the non-user group ($p = 0.02$)
  - Aortic stiffness index in AAS users was significantly higher than that of NAAS (2.1 ± 1.1 vs. 3.8 ± 1.4 $cm^2\ dyn^{-1}\ 10^{-6}$, $p = 0.01$; 9.3 ± 3.7 vs. 5.9 ± 2.5, $p = 0.003$, respectively)
- Grace and Lane (2006) conducted a study to assess vascular stiffness and cardiac risk factors in bodybuilders using AAS. The researchers found:
  - Endothelial independent dilation was significantly impaired in the AAS group (A) compared to control groups [A (5.6 ± 3.24%) vs B (11.10 + 4.91%) vs C (17.88 + 9.2%), p=0.005
- Sader (2001) conducted a cross-sectional study to examine the arterial and cardiac structure and functions in bodybuilders who were administering AAS to those non-steroid bodybuilders. Results of the study were as follows:
  - AAS users self-reported significant increased strength (150 ±16vs 109 ±29kg, p=0.4)
  - The LV mass was significantly greater compared to those non AAS bodybuilder users, along with the arterial DMD and impaired endothelial function (See table 1)
  - LV hypertrophy, increased LV mass, cardiomyopathy and sudden death are correlated with inappropriate AAS use

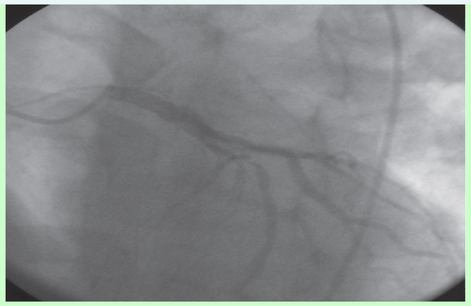
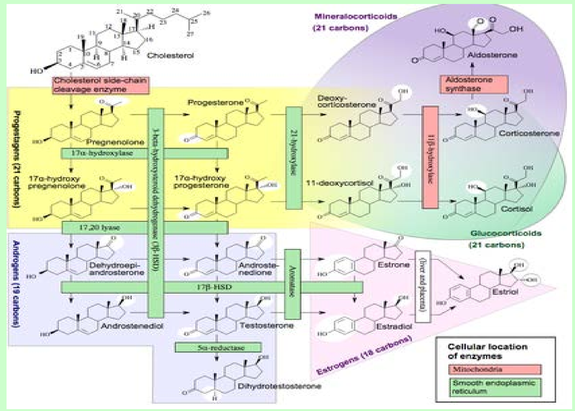


Fig 2 :An anterior-posterior view of the left coronary system. The left anterior artery demonstrates a 95% stenosis after the first septal branch (Sader,2001)

Figure 3. Pathway of Human Steroidogenesis (Walters,2003)



Discussion

- Kaiskcioglu discovered in 2007 that there was an increased in depressed diastolic functions of both the right and left ventricles, resulting in left ventricular hypertrophy. As did Angel (2013) whose data correlated with Kaiskcioglu.
- Angel determined with his cross-sectional cohort design, participants who had abused AAS, had higher LDL, higher resting heart rates and left ventricular hypertrophy and overall mass thickening.
- Another cross-sectional study conducted by Sader et al. (2001) support the findings of left ventricular hypertrophy, increased LV mass, cardiomyopathy and sudden death.

Table 1 : Structural and Functional Data for the LV and Lipid Profiles in Anabolic Androgenic Steroid Users (Sader, 2001)

	AS ($n = 28$)	NAS ($n = 19$)	*P* Value
IVSd (mm)	13 ± 2	12 ± 2	0.01
LVPWd (mm)	12 ± 2	11 ± 1	0.01
LVIDd (mm)	53 ± 5	52 ± 4	0.49
LV mass (g)	280 ± 60	231 ± 44	0.01
LVMI ($g{\cdot}ht^{-2.7}$)	59 ± 13	49 ± 11	0.01
LVMI ($g{\cdot}ffm^{-1.0}$)	3.57 ± 0.53 ($n = 22$)	3.27 ± 0.66 ($n = 15$)	0.13
EF (%)	59 ± 8	63 ± 6	0.04
E ($cm{\cdot}s^{-1}$)	72 ± 14	77 ± 15	0.27
A ($cm{\cdot}s^{-1}$)	54 ± 11	39 ± 12	0.01
E/*A*	1.36 ± 0.29	2.04 ± 0.59	0.01
E' ($cm{\cdot}s^{-1}$)	10 ± 2	12 ± 2	0.01
A' ($cm{\cdot}s^{-1}$)	9 ± 2	7 ± 2	0.01
E'/*A'*	1.16 ± 0.35	1.91 ± 0.56	0.01
E/*E'*	7.44 ± 1.67	6.05 ± 1.20	0.01
Total cholesterol (TC)	4.78 ± 1.53 ($n = 19$)	4.04 ± 0.69 ($n = 10$)	0.18
LDL	3.68 ± 0.47 ($n = 6$)	2.41 ± 0.49 ($n = 4$)	0.01
HDL	0.69 ± 0.26 ($n = 20$)	1.21 ± 0.31 ($n = 12$)	0.01
TC/HDL	8.21 ± 4.72 ($n = 19$)	3.11 ± 0.47 ($n = 8$)	0.01

LV, left ventricle; LVMI, left ventricular mass index ($g{\cdot}ht^{-2.7}$); LVMi, left ventricular mass index ($g{\cdot}ffm^{-1.0}$); *E*, early diastolic flow; *A*, late diastolic flow; *E'*, early diastolic tissue velocity; *A'*, late diastolic tissue velocity.

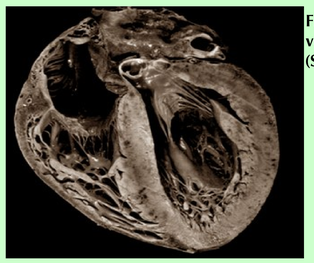


Figure 4: Bodybuilders autopsy heart left ventricular hypertrophy (Sader, 2001)

Applicability to Clinical Practice

- Pathological AAS induced left ventricular hypertrophy, impaired diastolic filling and arrhythmia may lead to an increased risk of myocardial infarction and sudden death. The risk of mortality among chronic individuals who inappropriately used AAS is reported to be 4.6 times higher than non-AAS participants who have utilized in an inappropriate mannerism (Evans, 2004).
- Physical examination can confirm a suspicion, by observing the patient closely during examination. In a well-muscled athlete, keep an eye open for acne, gynecomastia and cutaneous striae in the delto-pectoral area specifically in males with small testes, low sperm counts, high hematocrit and hemoglobin values

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