Cardiovascular risk associated with long-term anabolic-androgenic steroid abuse: an observational study from Norway

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Background: The use of anabolic-androgenic steroids (AAS) has become highly prevalent among recreational weightlifters. Numerous case reports have suggested an association between AAS use and a vast range of different cardiovascular diseases, including sudden cardiac death (SCD) and coronary artery disease (CAD). Few clinical studies have evaluated the risk of SCD and the prevalence of CAD in individuals with long-term AAS use.
Purpose: To evaluate the risk of ventricular arrhythmias and the prevalence of CAD among men with long-term AAS use.
Methods: Strength-trained men with at least three years of cumulative AAS use were recruited from recreational gyms. The control group consisted of strength-trained competing athletes who self-reported never using any performance enhancing drugs (non-users). AAS use was verified by sophisticated blood and urine analyses. Study participants went through a comprehensive cardiovascular evaluation including exercise ECG, 24 h ECG, heart rate variability (HRV) measures, signal averaged ECG (SAECG) and QT dispersion (QTd). Coronary computed tomography angiography (CCTA) was performed in AAS users. Not all participants had all tests.

Results: We included 51 AAS users and 21 non-users. Median age (25th-75th percentile) was 33 (29–37) years in the user group and 33 (29–42) years in the non-user group. Forty-eight (94%) of the users had been using AAS for five years or more. Characteristics are presented in the table. AAS users had significantly lower HDL values compared to non-users (p<0.001). No signs of ischemia or arrhythmias were detected during exercise ECG, however maximal exercise capacity was lower than in the control group and also compared to age-standardized values. A considerable, but statistically non-significant reduction was seen in overall HRV estimated as the standard deviation of the RR intervals for normal sinus beats (SDNN) (p=0.05). No difference was seen regarding left ventricular late potentials or QTd (table). Eight (19%) of the forty-two AAS users undergoing CCTA had at least a mild degree of CAD, and four of them three-vessel disease.
Conclusion: No ECG-findings indicated an increased risk of ventricular arrhythmias among the long-term AAS users. However, their maximal exercise capacity was lower than in controls, and one fifth of the long-term AAS users had verified CAD on CT coronary angiography.

	AAS users (n=51)	Non-users (n=21)	P value
Clinical characteristics			
Age (years)	33 (29-37)	33 (29-42)	0.664
Systolic blood pressure (mmHg)	129 (117-136)	123 (116-130)[a]	0.383
Diastolic blood pressure (mmHg)	78 (72-87)	70 (68-79)[a]	0.018
BMI (kg/m^2)	31.5 (29.4-33.7)	29.3 (26.6-35.3)	0.218
Laboratory analyses			
Hemoglobin (g/dL)	16.8 (15.9-17.3)	15.0 (14.4-15.6)	<0.001
HDL (mmol/L)	0.73 (0.39-1.18)	1.25 (1.13-1.40)	<0.001
FSH (U/L)	<1.0 (<1.0-<1.0)	3.4 (2.6-3.9)	<0.001
LH (U/L)	<0.6 (<0.6-<0.6)	3.1 (2.8-3.8)	<0.001
Free androgen index (FAI)	306 (66-786)	56 (38-64)	<0.001
Maximal exercise capacity	*n=43*	*n=12*	
Watt	270 (230-290)	280 (260-350)	0.033
Metabolic equivalents (METs)	9.6 (8.6-10.8)	11.2 (8.6-13.6)	0.131
Heart rate variability	*n=29*	*n=9*	
SDNN (ms)	124 (110-136)	160 (140-176)	0.053
Late potentials	*n=31*	*n=20*	
Late potentials* (n, %)	2 (6)	2 (10)	0.640
fQRS > 114 ms (n, %)	6 (19)	3 (15)	1.000
RMS voltage < 20 μV (n, %)	1 (3)	2 (10)	0.553
LAS duration > 38 ms (n, %)	2 (6)	1 (5)	1.000
QT dispersion	*n=29*	*n=10*	
Maximal difference (ms)	58 (42-66)	59 (44-72)	0.640

Data are presented as median (25th-75th-percentile) unless otherwise specified. P values were obtained from a Wilcoxon Rank sum test or Fisher's exact test. [a] n=19. BMI, body mass index.
*) Characteristics of late potentials include ≥ 2 of the following: 1) fQRS>114 ms; 2) RMS voltage<20 μV; 3) LAS>38 ms.

Table 1