CASE REPORT

Anabolic steroids abuse-induced cardiomyopathy and ischaemic stroke in a young male patient

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SUMMARY

We report a case of a 37-year-old man presented with acute stroke and hepatorenal impairment which were associated with anabolic-androgenic steroids (AAS) abuse over 2 years. Despite the absence of apparent symptoms and signs of congestive heart failure at presentation, an AAS-induced dilated cardiomyopathy with multiple thrombi in the left ventricle was attributed to be the underlying cause of his condition. Awareness of the complications of AAS led to the prompt treatment of the initially unrecognised dilated cardiomyopathy, and improved the liver and kidney functions. However, the patient was exposed to a second severe ischaemic event, which led to his death. This unique and complex presentation of AAS complications opens for better recognition and treatment of their potentially fatal effects.

BACKGROUND

The abuse of anabolic-androgenic steroids (AAS) has increased in recent years, being not confined only to bodybuilders or high-level sportsmen but also spread to casual fitness enthusiasts and subelite sportsmen and even women.¹ Supraphysiological doses and high-frequency usage of AAS may cause a wide spectrum of clinical manifestations which are usually ignored or at best unfollowed, though some may be life-threatening.² A literature search revealed few case reports that suggested an association of intracoronary thrombosis, sudden death, myocardial necrosis, cardiomyopathy and stroke as possible consequence of AAS overuse. We report a particular case with a clinical scenario which indicates a strong association between AAS abuse and fatal cerebrocardio manifestations. A hypothesis for the underlying causation of these fatal manifestations is further addressed.

CASE PRESENTATION

A patient presented to the neurocritical care unit at Kasr Al-Aini Hospital with an acute right-sided weakness associated with a confusional state which followed a first-ever experienced generalised tonic clonic seizure.

The patient had a history of anabolic steroid abuse over the past 2 years. The most frequently used anabolic steroids were: methandienone (active ingredient) and methenolone acetate as reported by the caregiver. There was no history of alcohol or other substance abuse. The medical and family histories were unremarkable.

On examination, the patient was lethargic and confused. General examination revealed normal blood pressure and temperature. The patient had sinus tachycardia (pulse rate was 120/min), mild bilateral lower limb pitting oedema, but with no evidence of jugular venous congestion or bilateral basal crepitation. Also the patient had an enlarged tender liver with no stigmata of chronic liver disease. Neurological examination revealed right-sided hemiparesis (grade 3) with right-sided facial weakness.

INVESTIGATIONS

Laboratory testing showed increased haemoglobin concentration (18 gm/dL), increased serum transaminases (aspartate aminotransferase, 280 IU/L; alanine aminotransferase, 310 IU/L), coagulopathy (International Normalised Ratio 1.6), hyperbilirubinaemia (total bilirubin 2 mg/dL), renal impairment (creatinine 3.03 mg/dL, urea 110 mg/dL), hyponatraemia (122 mmol/L) and hyperkalaemia (5.8 mmol/L). Virology, drug screen and immune profile were negative and thyroid functions were within normal range.

Initial brain CT scan revealed two lesions, one less hypodense than the other. A diagnosis of chronic infarction in the left frontal lobe and a sub-acute left temporoparietal infarction was proposed (figure 1). Further brain imaging with MRI confirmed such results. EEG did not elicit epileptiform activities and chest X-ray showed augmented cardiothoracic index. An abdominal ultrasound revealed hepatomegaly, mild ascitis and bilateral pleural effusion in addition to grade I nephropathy. During the performance of the abdominal ultrasound, the operator noticed intraventricular thrombus in the heart. Urgent echocardiography showed a dilated cardiomyopathy with an estimated ejection fraction of 13% and multiple thrombi in the left ventricle. Toxic cardiomyopathy secondary to AAS over use was suspected.

DIFFERENTIAL DIAGNOSIS

A diagnosis of severe toxic cardiomyopathy associated with anabolic steroids was made after ruling out other causes of non-ischaemic dilated cardiomyopathy, including infectious, autoimmune and metabolic causes.

TREATMENT

After initial correction of hyponatraemia with slow isotonic saline infusion, symptoms and signs of congestive heart failure became evident. The patient was transferred to the intensive care unit

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Figure 1 The chronic left frontal infarction (black arrow) and subacute left temporoparietal infarction (white arrow).

(ICU), where aggressive therapy with cardiac inotropes and intensive diuresis was rapidly initiated, on which the liver and kidney functions improved dramatically. Low-molecular-weight heparin therapy was started followed by oral anticoagulation. A follow-up echocardiogram (2 weeks from admission), by the same operator, showed the disappearance of one of the intra-ventricular thrombi and improvement in left ventricular function (EF 20%). Thus, the patient was discharged from the ICU to the normal ward.

OUTCOME AND FOLLOW-UP

Unfortunately few days later, the patient developed disturbed consciousness, gaze deviation to the right side and dense left hemiplegia and became hypotensive, tachycardiac, tachypnic and sweaty. An urgent CT of the brain was performed, which revealed no new insult. ECG showed acute massive inferior myocardial infarction (MI) (troponin I=8 ng/mL). The patient was immediately transferred to the ICU and died on the same day.

DISCUSSION

The present history of this case was significant for chronic self-administration of massive doses of anabolic steroids, of various natures. AAS are a family of hormones that include the natural male hormone testosterone, together with its many synthetic relatives, all of which exhibit *anabolic* ('muscle building') and *androgenic* ('masculinising') properties. Potential mechanisms of cardiovascular toxicity of AAS include direct myocardial injury, atherogenic, thrombotic, haemostasis and vasospastic effects.²

The direct myocardial injury has been proposed to result from increased fibrosis of the myocardium mediated by aldosterone-like effects.³ Several studies show that high doses of AAS, such as nandrolone, may lead to growth-promoting effects on cardiac tissue, as seen in hypertrophic cardiomyopathy, followed by apoptotic cell death that is mediated by membrane

receptor second messenger cascades that increase intracellular Ca^{2+} influx and mobilisation, leading to apoptosis and injury of the cardiac muscle.^{3,4}

The atherogenic effects of AAS abuse arise from their ability to decrease high-density lipoprotein cholesterol by 20% and increase low-density lipoprotein (LDL) cholesterol by 20% through modification of apolipoprotein A-I and B synthesis.⁵

In addition to its atherogenic effects, the excess LDL-C (caused by exogenous androgens) may oxidise at the arterial endothelium and consequently impair endothelium-dependent arterial relaxation by inhibiting nitric oxide production, predisposed the patient to coronary vasospasm.⁶ These lipoprotein abnormalities increase the risk for coronary artery disease by threefold to sixfold and may occur within 9 weeks of AAS self-administration.^{7,8}

Finally, the effect of AAS abuse on the haemostatic system may fluctuate from an antithrombotic to a prothrombotic profile, and this variation may be dose dependent. Using low doses decreases platelet threshold activation to collagen, whereas higher doses are associated with increased platelet aggregation and may influence the activity of vascular cyclooxygenase enzyme which may yield to a procoagulant state.⁹ The reversibility of such myocardial and vascular effects after discontinuation of the drugs is still controversial.¹⁰

The presenting symptoms were explained as a result of end-organ hypoperfusion due to the severe cardiomyopathy. The early rise in the liver enzymes and the renal impairment which rapidly improved with treatment suggests an ischaemic injury rather than toxic or viral cause. The CT and MRI which revealed brain infarctions and the Q wave in the first ECG indicate vascular insults. Possible mechanisms can be attributed to adverse effects of AAS on the cardiovascular system. The subsequent fatal event that presented with sudden disturbed consciousness level, right-sided weakness and ST segment elevation may have resulted from dislodgement of an intracardiac

thrombus leading to an embolic stroke with the development of an acute MI.

The literature contains very few reports of cardiovascular events associated with anabolic steroid abuse.^{11–13} This case is unique as the patient developed an embolic stroke in the absence of any risk factors for the disease, and not as a complication of dilated cardiomyopathy with left ventricle thrombus formation which were deduced to be the result of AAS abuse.

Learning points

- ▶ Disparity and lack of precise consistency of medical knowledge on the effects of these widely abused drugs requires detailed controlled studies to verify these effects.
- ▶ The quick and uncontrolled spread of anabolic-androgenic steroids (AAS) abuse among athletes and body builders mandate a worldwide collective endeavour to educate the public and physicians about these potentially fatal hazards and propose a battery of follow-up for the consumers.
- ▶ Prompt and proper management of hazards of AAS carries a high chance of reversal of their complications.

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article critically for important intellectual content and approved the final version to be published.

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