CLINICAL VIGNETTE

Anabolic Steroid Induced Myocardial Infarction

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Introduction

Myocardial infarctions in young men without a personal or family history of hyperlipidemia, diabetes, or coagulopathies should be evaluated for other causes of hyperlipidemia and hypercoagulability, including anabolic-androgenic steroids (AAS). AAS are commonly used to treat hypogonadism, and they are also used illicitly at supraphysiologic doses by young men and athletes for performance and muscle strength. At supratherapeutic doses, AAS can predispose patients to erythrocytosis. Data also suggests use of AAS can predispose patients to hyperlipidemia, hypercoagulability, and myocardial infarctions (MIs). A few published reports characterize the effect of supraphysiologic doses AAS on myocardial events.

Case

A 41-year-old man presented with five hours of mid-sternal, non-radiating, squeezing chest pain associated with lightheadedness and nausea that began while the patient was jogging. His past medical history included pre-diabetes, prior cocaine and tobacco use, anxiety, depression, and post-traumatic stress disorder (PTSD).

In the emergency room, he was hypertensive with normal heart rate. Electrocardiogram (ECG) showed elevated ST segments, high sensitivity troponin was elevated at 1,386 (<57 ng/L), and he was diagnosed with an inferior ST segment elevation myocardial infarction (STEMI). He was treated with aspirin, ticagrelor, nitroglycerin, metoprolol, unfractionated heparin, and sent for cardiac catheterization. He was found to have a 100% occlusion of his left anterior descending artery, and received a balloon angioplasty.

He later reported to the medical team that he was actively using intramuscular injections of testosterone cypionate 200 mg/mL twice a week for six to eight months preceding his myocardial infarction, prescribed to him for low testosterone levels. He was also using selective androgen receptor modulators (SARMs), clomiphene, and HCG for three weeks preceding his myocardial infarction. The last dose of testosterone was one week before his myocardial infarction.

Labs on presentation were significant for a total cholesterol of 133 (<200 mg/dL), LDL of 96 (<99 mg/dL), aspartate aminotransferase (AST) 25 (13-35 U/L), alanine aminotransferase (ALT) 27 (7-45 U/L), Hemoglobin (Hb) 16.9 (13.3-17.7 g/dL), Hematocrit (Hct) 49.4 (39-52%), creatinine 1.34 (0.52-1.28 mg/dL). Urine toxicology was negative for cocaine. Serum testosterone was not tested on arrival, as use was not initially disclosed.

After discharge, patient was seen in endocrinology and his total testosterone nadir was 400 ng/dL. As he did not meet criteria for hypogonadism and given his previous myocardial infarction, he was advised to abstain from all forms of anabolic steroids to prevent a future cardiovascular or thromboembolic event.

Discussion

This patient represents a major adverse cardiovascular event in a young man taking anabolic steroids with no cardiovascular risk factors or family history of cardiovascular disease. Anabolic-androgenic steroids (AAS) are testosterone derivatives used by young athletes to increase performance and development. These derivatives are often administered at supraphysiological doses to attain the desired benefit. Supraphysiological dosing may lead to various adverse events, including erythrocytosis, cardiovascular events, hyperlipidemia, and gonadal suppression.

Pinto et al. reported a young man with no cardiovascular risk factors co-administering high doses of anabolic steroids and human growth hormone (hGH) who suffered a myocardial infarction.[1] Baloch et al. reported another young man with no cardiovascular risk factors with a myocardial infarction after using anabolic steroids.[2] The literature on young men taking supraphysiological doses of AAS developing MACE is sparse, which may be due to patients under-reporting use of AAS.

Some studies attribute anabolic steroids' thrombotic effect by increasing the synthesis of thromboxane A2, leading to increased platelet aggregation. AAS also stimulate thrombin, activating the coagulation cascade leading to a hypercoagulable state.[3]

In addition to activating platelets and the coagulation cascade, use of anabolic steroids is associated with erythrocytosis, which can theoretically lead to hypercoagulability.[4,5] However, the exact level of hemoglobin or hematocrit needed to contribute to a hypercoagulable state is unknown. Additionally, there is no consistent relationship between testosterone therapy and venous thromboemboli.[6,7] Few testosterone-associated VTE events are reported with no RCTs to conclusively ascribe causation. However, the FDA has required testosterone manufacturers to include a label about the risk for VTE events.

Another possible explanation for increased cardiovascular risk is testosterone's impact on established cardiovascular risk factors, including hyperlipidemia and various dyslipidemias. AAS are known to increase LDL and decrease HDL,[8] which was echoed by Hsiao in a case report.[9]

Multiple possible mechanisms could contribute to AAS' effect on cardiovascular events. However, there are few randomized controlled trials (RCTs) with adequate size or duration to provide conclusive evidence of anabolic steroids' effects on major adverse cardiovascular events (MACE).[4,10] Although the FDA issued a black box warning regarding testosterone's potential adverse cardiovascular effects, they concluded there was weak evidence to confirm a causal relationship between testosterone and adverse cardiovascular outcomes.[11] Regardless, they have mandated pharmaceutical companies to add labels regarding a "possible" risk of cardiovascular events with the use of testosterone.

Given the uncertainty of testosterone's effect on MACE and the paucity of RCTs on this relationship, future studies that are adequately powered need to be directed toward this topic. Given multiple theoretical mechanisms which testosterone can lead to cardiovascular events and likely underreporting of testosterone use, it is advisable to ask all young men who present with a myocardial infarction about substance use history and to ensure they abstain from testosterone therapy.

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