



# EFFECTS OF ANABOLIC STEROIDS IN ATHLETES: INCREASED RISK FACTORS FOR MYOCARDIAL INFARCTION

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**Abstract:** Anabolic androgenic steroids (AAS) have a number of adverse effects on the cardiovascular system that can lead to sudden cardiac death. Long-term abuse of anabolic steroids by athletes has been reported by many researchers to result in a low cardiac ejection fraction. Anabolic androgenic steroid abuse has been associated with acute myocardial infarction and fatal ventricular arrhythmias. Anabolic steroids are not only present in professional sports but also affect amateur athletes who are making increased use of performance-enhancing drugs. The primary objective of the article is to improve awareness of the risk factors and consequences of adverse effects of anabolic steroids by athletes and to save the lives of athletes due to heart attack (myocardial infarction). Anabolic androgenic steroids are the most commonly used substances. To improve an athlete's exercise performance and body image. Heart attack is scientifically also known as acute myocardial infarction, which occurs when the blood supply to the heart is cut off or a clot forms. Heart disease is still the leading cause of death in India. Common risk factors and causes of heart attack are diabetes, high blood pressure, obesity, family history of heart disease, sedentary lifestyle, smoking, occupational and academic stress, drinking too much alcohol, poor dietary habits, HIV, high cholesterol level and old age etc. Excessive use of anabolic steroids has been associated with the development of a reversible dilated cardiomyopathy and potentially severe heart failure and cardiac arrest.

**Key Words:** Myocardial infarction, cholesterol, sudden cardiac, Lipids, Left ventricular hypertrophy, Athletes

## I. INTRODUCTION

A myocardial infarction (MI), commonly known as a heart attack, is caused by a reduction or complete cessation of blood flow to a portion of the myocardium. Myocardial infarction may be "silent," and go undetected, or it could be a catastrophic event leading to hemodynamic deterioration and sudden death [1]. Common symptoms of a heart attack are severe pain in the center of the chest, pain in the left upper back, pain in the left arm, shoulder and jaw, shortness of breath, sweating or sweating even in cold environments, unusual difficulty in climbing stairs or difficulty walking, feeling unwell, fainting, and vomiting. Common risk factors and causes of heart attack are diabetes, high blood pressure, obesity, family history of heart disease, sedentary lifestyle, smoking, occupational and academic stress, drinking too much alcohol, poor dietary habits, HIV, high cholesterol level and old age. etc. Anabolic steroid use by athletes has been associated with a large number of cardiovascular disorders. Anabolic steroids also increase muscle mass and physical strength, and are therefore used in sports and bodybuilding to increase strength or physique. Excessive use of anabolic steroids has been associated with the development of a reversible dilated cardiomyopathy and potentially severe heart failure and cardiac arrest. Anabolic steroids cause lipid profile abnormalities, such as increases in total cholesterol, triglyceride, and LDL, and decreases in HDL levels. High total cholesterol, high triglyceride levels and high low-density lipoprotein are associated with hardening of the coronary arteries and plaque build-up in the arteries.

### **Anabolic androgenic steroids**

Anabolic androgenic steroids (AAS) abuse can increase the risk of cardiovascular complications, including acute myocardial infarction. Anabolic steroids increase muscle mass and physical strength, and are therefore used in sports and bodybuilding to increase strength or physique.

Abuse of Anabolic androgenic steroids may increase the risk of cardiovascular complications, including acute myocardial infarction. Anabolic steroids increase muscle mass and physical strength, and are therefore used in sports and bodybuilding to enhance strength or physique [1,3,8,5,9]. Anabolic androgenic steroids are the most commonly used substances to improve an athlete's exercise performance and body image. Anabolic androgenic steroids (AAS) abuse has been reported in 11% of

adult gym users, 39% of bodybuilders and a staggering 67% of powerlifters [7,8,9,10]. Post-mortem studies of athletes using AAS have found infiltration of eosinophils into myocardial cells as well as destruction of myofibrils [22,23,34,39], endothelial dysfunction was also observed (Cunha et.al.2005). Several studies have described cases of acute myocardial infarction and thromboembolic vascular episodes in athletes using Anabolic androgenic steroids [18,19,20,21]. Anabolic androgenic steroids abuse has been associated with acute myocardial infarction and fatal ventricular arrhythmias [7,8,18,19]. Many Anabolic androgenic steroids users also abuse growth hormone (GH), the effect on myocardial hypertrophy being potentiated by concomitant use of GH [22,23,24,25].

### **Cardiac Risk factors and Anabolic steroids**

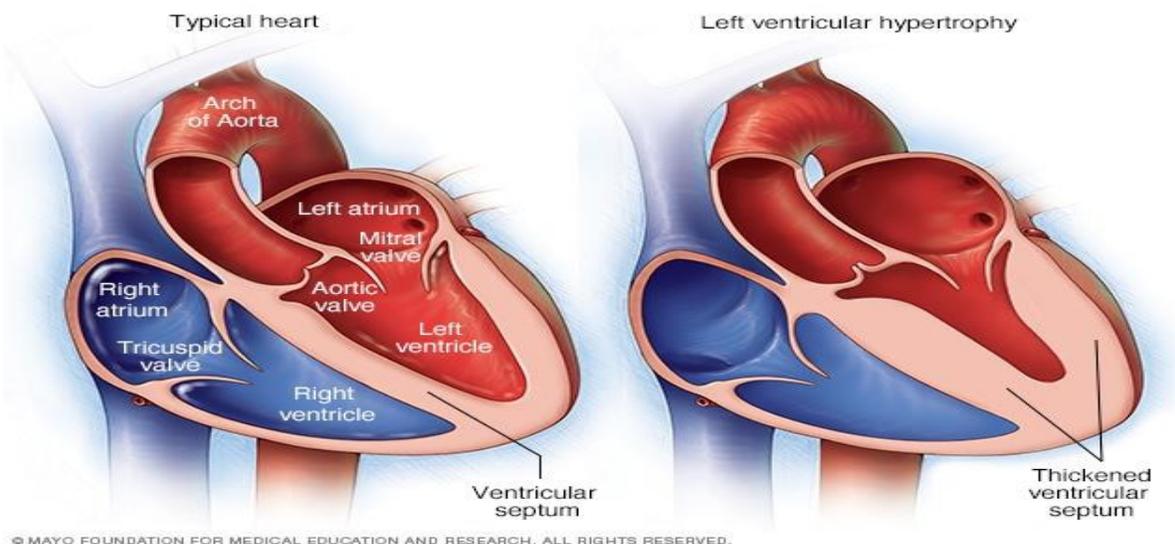
Several adverse effects of anabolic steroids are as follows :

#### **1. Deterioration of cardiac ejection fraction**

Ejection fraction is an indicator of how well your heart is working. Ejection fraction refers to how well your heart pumps blood [7,8,9]. This is the amount of blood pumped out of heart's lower chambers (ventricles) each time it contracts. A low ejection fraction usually means you have or are at risk for heart failure[23,34,43,]. The cardiac ejection fraction is the mass of fluid ejected from a chamber with each contraction. It may refer to the cardiac atrium, ventricle, pectoral or leg veins, although if unspecified it usually refers to the left ventricle of the heart[13,14,15]. The ejection fraction in a healthy heart ranges from 50% to 70%. With each heartbeat, your left ventricle pumps 50% to 70% of your blood to your body. The several research indicates the low cardiac ejection fraction due to long term misuses of Anabolic steroids by the athletes [2,10,11,12].

#### **2. Left ventricular hypertrophy :**

Left ventricular hypertrophy is a thickening of the wall of the main pumping chamber of the heart. This thickening can result in increased pressure within the heart and sometimes poor pumping action [3,29,30,31] . In the condition of left ventricular hypertrophy, the thickened heart wall may become rigid. The blood pressure in the heart increases. The changes make it harder for the heart to pump blood effectively. Eventually the heart may fail to pump with as much force as is needed High blood pressure is the most common cause of left ventricular hypertrophy. Long-term high blood pressure puts stress on the left side of the heart, causing it to become enlarged. According to the new research report. Anabolic androgenic steroid (AAS) abuse is associated with severe blood pressure (BP) elevation[33,34,35]. Long-term use of anabolic androgenic steroids (AAS) by athletes results in an increase in both systolic and diastolic blood pressure. Anabolic androgenic steroid (AAS) abuse is prevalent among competitive athletes and adverse effects on blood pressure (BP) and arterial stiffness can be substantial[36,38,39].



The above Figure prepared by the Mayo Foundation of Medical Education and Research shows a comparison of a normal heart and a heart with left ventricular hypertrophy

### **Lipid profile abnormalities**

Lipids are fatty compounds in the blood that perform a variety of functions in the human body. Lipids help move and store energy, absorb vitamins and make hormones. Excess of some lipids is harmful. [4,5,40,42]. Cholesterol is a lipid in blood. Cholesterol has two components, high-density lipoprotein (HDL) and low-density lipoprotein (LDL). High levels of low-density lipoprotein (LDL) cholesterol, triglycerides, and low levels of HDL cholesterol are associated with heart disease (5). Elevated levels of LDL cholesterol, often referred to as "bad" cholesterol, are associated with heart disease. LDL cholesterol can stick to the walls of the arteries, causing blockages or plaques [4,5,40,41,42]. As plaques build up, they reduce or block blood flow to the heart, which can result in a heart attack. In addition, high levels of triglycerides are also linked to heart disease as they can also lead to the formation of plaques in the arteries of the heart. Furthermore, Low levels of HDL cholesterol, commonly known as "good" or "healthy" cholesterol, can also increase the risk of heart disease. HDL cholesterol is involved in removing "bad" LDL cholesterol from the body [5,6,22,24,35,22]. Anabolic steroids have been shown to **increase the level of LDL cholesterol** and decrease the level of HDL cholesterol. The several research report indicates that , the misuse of Anabolic steroids by the athletes , have been shown to increase LDL cholesterol levels and reduce HDL cholesterol levels may increase the formation of plaques in coronary arteries in the heart , which responsible for heart attack or sudden death. Many research reports suggest that, abuse of anabolic steroids by athletes can increase the formation of plaques in the coronary arteries in the heart by raising the level of LDL cholesterol and lowering the level of HDL cholesterol, which can lead to heart attack or sudden cardiac death [5,6,22,24,35,22,23,25,27,28,29].

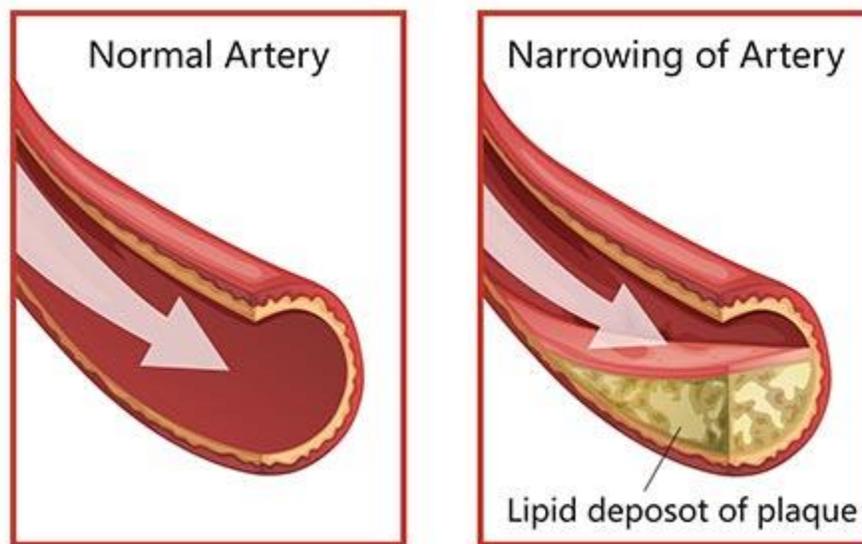


Figure 1. Drawing of how the coronary arteries get clogged up with plaque  
This diagram is derived from Wikipedia.

### **Sudden cardiac arrest**

Sudden cardiac arrest is the sudden stoppage of all activity of the heart due to an irregular heart rhythm. The person becomes unconscious. Sudden cardiac arrest can lead to death. Anabolic androgenic steroids (AAS) used by athletes to improve physical performance have been implicated in acute myocardial infarction and sudden cardiac death [3,4,5,6,7,9].

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