EFFECT OF ASCORBIC ACID ON THE RIGHT AND LEFT CORONARY ARTERIES OF MALE RABBITS FED WITH HIGH-CHOLESTEROL DIET

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Abstract

INTRODUCTION: Atherosclerosis and cardiovascular diseases are the most common causes of death in western countries. The beneficial effect of ascorbic acid on various organs has been reported. The present study was conducted to determine the effect of ascorbic acid on the right and left coronary arteries of male rabbits fed with high-cholesterol diet.

METHODS: Twenty white male rabbits (mean weight: 950 g) were weighed and randomly divided into two groups. For 40 days, group 1 (n=10) was given a high-cholesterol (1%) diet, group 2 (n=10) was fed with a high-cholesterol diet and ascorbic acid (100 mg/kg). Then both of the groups were weighed and the animals were sacrificed. The right and left coronary arteries were dissected and then fixation, tissue processing, histological sectioning and H & E staining were carried out and sections were studied by light microscopy. The results were analyzed by using the Mann Whitney test.

RESULTS: Group 2 which received ascorbic acid had no fatty streaks in their coronary arteries. Significant difference in mean weight was observed before and after the diet in both groups ($P<0.05$).

CONCLUSIONS: Histopathological study of the coronary arteries showed that the rabbits which received ascorbic acid diet did not develop fatty streaks. Thus ascorbic acid exerts an apparently inhibitory effect on fatty streak formation and may slow down or prevent atherosclerosis by countering the side effects of a high-fat meal.

Keywords: Ascorbic acid, cholesterol, coronary arteries.

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Introduction

Atherosclerosis is a pathologic condition that causes several disorders including cardiovascular diseases. The process of atherosclerosis is not of a degenerative nature; it is an active process that begins as lipids are deposited in the intima of the arteries. It involves the elements of chronic inflammation associated with those of repair in the arterial wall.[1]

Hypercholesterolemia is one of the major risk factors of atherosclerosis. Many prospective epidemiologic studies have found a continuous graded, direct relationship between total serum cholesterol level and the incidence of coronary heart disease.[2]

LDL is the primary transporter of cholesterol in the blood; consequently, total cholesterol levels and LDL cholesterol levels are highly correlated. LDL cholesterol is a risk factor for atherogenesis and coronary heart disease (CHD). When LDL is oxidized, it is taken up by endothelial cells and macrophages in the arterial wall, leading to the first stages of atherosclerosis (fatty streaks). Antioxidants such as vitamin C are now being investigated in clinical trials exploring prevention of CHD.[3]

The aim of this study was to evaluate the effect of ascorbic acid on coronary artery diseases in male rabbits fed with high cholesterol diet.

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Materials and methods

This experimental study was carried out in Isfahan University of Medical Sciences in 2005. Twenty white male rabbits were weighed (mean weight: 950 g) and after one week of adaptation, they were randomly divided into two groups and fed with cholesterol and ascorbic acid for forty days as follows:

Group 1 (n=10): High-cholesterol diet (1 percent).

Group 2 (n=10): High cholesterol diet + ascorbic acid (100 mg/kg).

At the end of the experiment, the animals were weighed and sacrificed. The right and left coronary arteries were dissected, then fixation and tissue processing were done and histological serial sections, five microns in thickness were obtained. One out of five sections was stained using the Hematoxylin and Eosin method.

The sections were studied by light microscopy. The presence of atherosclerotic plaques was scored between 1 and 4 and the presence of no fatty streaks was considered as 0.

The data were expressed as mean ± SD and analyzed by Student's t-test and P values less than 0.5 were considered as significant.

Results

The results indicated that group 2 which received ascorbic acid showed no development of fatty streaks in coronary arteries (mean ± SD = 0), but group 1 which received only a high-cholesterol diet showed signs of fatty streak formation (mean ± SD = 1.8±0.65).

The difference between the two groups was significant (P<0.5). Figures 1 and 2 show the coronary arteries in the rabbits' hearts.

Discussion

Studies have shown that both hypercholesterolemia and changes in plasma lipoproteins are effective in the development of atherosclerosis. The most important change is LDL oxidation. Oxidized LDL is phagocytized by macrophages and endothelial cells which are then converted to foam cells. It also adheres to the proteins of the extracellular matrix like collagen and glycosaminoglycans. Together, they make up fatty streaks and atherosclerotic plaques.[4,5] Many studies have shown that antioxidant vitamins like vitamin C and E can prevent atherosclerosis by preventing LDL oxidation.[6] Other studies show that vitamin C always forms the first line of antioxidant defense and is the only antioxidant in plasma that can completely prevent lipid peroxidation.[6] An in vitro study done by Suzanne et al. in 1994 showed that vitamin C has different effects in moderation of blood lipoproteins.[7] They suggested that some more in vivo studies should be done to clarify the antiatherosclerotic effects of vitamin C. The clinical trial of the EPIC (European Prospective Investigation of Cancer) studied the diet, lifestyle and physical activity of 500,000 volunteers.

A strong inverse relationship between plasma levels of vitamin C and cardiovascular and cancer mortality was observed.[6] Another study done on rabbits in 2005 showed that taking high doses of vitamin C causes a decrease in atherosclerotic plaques covering the vessels.[8] The results of this study are consistent with our study in terms of the amount of vitamin C consumed. Based on the results of this study and other studies, it can be concluded that vitamin C, especially in high doses, can prevent atherosclerosis by inhibiting LDL oxidation.

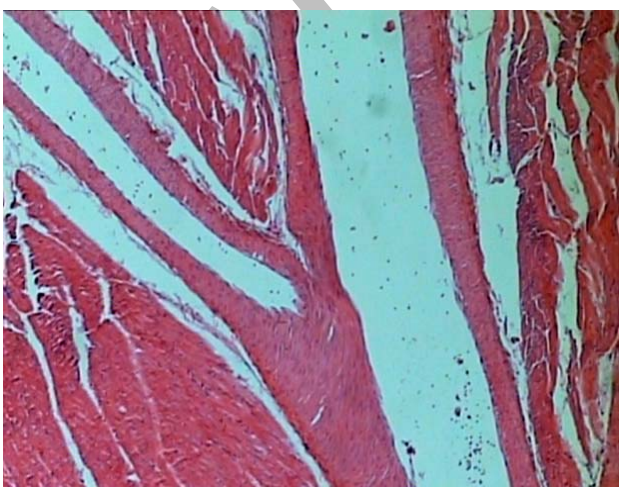

FIGURE 1. Normal left coronary artery. H & E stain (150×)

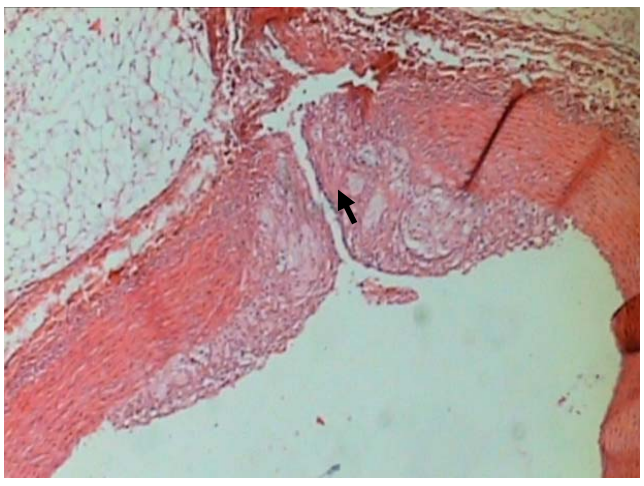

FIGURE 2. Arrow shows atherosclerotic plaque in the orifice of left coronary artery. H & E stain (200×)

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