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The Study and Risk of Coronary Artery Disease

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Review Article

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ABSTRACT

Coronary artery disease (CAD), also known as atherosclerotic heart disease, is the most common type of heart disease and cause of heart attacks. The plaque, is the blockage of arteries by fatty deposits in the inner walls of the arteries of the heart, narrows the arteries and restricts blood flow to the heart, which may leads to death. This condition can lead to chest pains (angina), heart attack, stroke or heart failure. Plaque is formed by the deposits of fatty substances; cholesterol, cellular waste products, calcium and other substances build up in the inner lining of an artery which usually affects large and medium-sized arteries.

INTRODUCTION

Coronary artery disease is the most common type of heart disease. This disease may give rise to several other diseases because of its progress; there may be complete obstruction of the lumen of the coronary artery, severely restricting the flow of oxygen-carrying blood to the myocardium. Individuals with this coronary artery disease will suffer from one or more myocardial infarction and may have signs and symptoms of chronic coronary ischemia, including symptoms of angina and flash pulmonary edema [1-10].

A distinction should be made between myocardial ischemia and myocardial infarction. Ischemia in simple terms means the amount of blood supplied to the tissue is inadequate. When the myocardium becomes ischemic, it does not function optimally [11-15]. When a large area of the myocardium becomes ischemic, there will be impairment in the relaxation and contraction of the myocardium. If the blood flow to the tissue is improved, myocardial ischemia can be reversed. The tissue has undergoes irreversible death due to lack of sufficient oxygen-rich blood [16-25].

A rupture of an atheromatous plaque may develop in an individual at any stage of the spectrum of coronary artery disease called as acute myocardial infarction. It is the most common form of heart problems in industrialized nations and far the leading cause of heart attacks [26-30]. Mortality data from the Registrar General of India shows that cardiovascular diseases are a major cause of death in India now [31-36]. The adult prevalence has increased in urban areas from about 2% in 1960 to 6.5% in 1970 and 10.5% in 2000; while in rural areas, it increased from 2% in 1970 and 4.5% in 2000. The disease occurs at a younger age in Indians when compared to those in North America and Europe [37-44].

PATHOPHYSIOLOGY

The arteries that supply blood to the heart muscle which is smooth, elastic lining inside a coronary artery develops atherosclerosis [45]. If this happens, the artery's lining becomes hardened, stiffened and swollen with all sorts of "grunge" including calcium deposits, fatty deposits and abnormal inflammatory cell- to form a plaque [46-50]. Deposits of calcium phosphates in the muscular layer of the blood vessel appear to play not only a significant role in stiffening arteries but also for the induction of an early phase of coronary arteriosclerosis. Mostly, these patients suffer from a kidney dysfunction [51,52]. Plaque can be of, as large "pimples" that protrude into the channel of an artery, causing a partial obstruction to blood flow. Some patients may report one or two plaques, or might have dozens distributed throughout their coronary arteries. However, there is a term in medicine called "Cardiac Syndrome X", which describes a chest pain (Angina pectoris) [53,60].

Rarely, women with "Cardiac Syndrome X" have typical angina syndromes that are not associated with the presence of atherosclerotic plaques; that is; the localized blockages are absent. Scientists have concluded that the blood vessels in these women are diffusing abnormal [61-70]. Some have falsely claimed that the lining of the artery becomes thickened, making the plaque flush within the wall of the artery. In general, female coronary arteries are somewhat smaller than in males [71,72].

CORONARY ANGIOGRAM

It is not completely clear why women are more likely than men to suffer from "Syndrome X"; however hormones and other risk factors unique to women may play a role [73-75]. Cardiac Syndrome X is also known as micro vascular angina, in which there will be micro vascular dysfunction [76]. In this syndrome there will be decreased blood flow to heart tissue, during regular menstrual cycle and after menopause estrogen levels decline with age and thus exposed to change the levels of estrogen through their lives. In women's blood vessels may be "programmed" for more changes than men's vessels, which increase the risk of problems in the lining of the arteries. Apart from this disorder in women, the other is preeclampsia (a problem associated with high blood pressure during pregnancy) and delivering a low-birth weight baby [77-80].

SYMPTOMS

In the early stages of coronary artery disease, there are generally no symptoms, but the disease can start when a patient is very young. The symptoms include:

1. Chest pain (angina), milder pressure, tightness, squeezing, burning, aching.
2. Shortness of breath, dizziness or a choking sensation, accompanying chest pain.
3. Irregular heartbeats.
4. A sudden increase in the severity of angina [81-86].

DIAGNOSIS OF CORONARY ARTERY DISEASE

The common characteristics for arteriosclerosis include age, Diabetes, Family history of Heart disease, High blood cholesterol, High blood pressure, Obesity, Smoking & Stress.

It is diagnosed through various tests including:

Coronary Angiography

It is also called cardiac catheterization, is a minimally invasive study which is performed under local anaesthesia and involves injecting X-ray dye into the coronary arteries via tubes called catheters. An X-ray films the blood flow to show the location and artery narrowing. It can identify the blood vessels in the heart have narrowed, pumping normally and flow of the blood [87].

Echocardiogram (ECHO)

It is a non-invasive test which translates sound waves from chest into pictures of the heart. It shows clear information about pumping of the heart, blood flows into the heart. It also gives the information regarding the size and shape of the heart, pumping capacity and the location and extent of any damage of the tissue. The main advantage of it is not invasive (does not enters into body cavities) [88].

Electrocardiogram (ECG)

It records the heart's electrical activity. Small patches called electrodes are placed on the Chest, arms & legs and are connected by wires to the ECG machine [89]. Electrical impulses of the heart are translated into a line on a strip of paper like waves. These electrodes detect the tiny electrical changes on the skin that arise from the heart muscles [90].

TREATMENT OF CORONARY ARTERY DISEASE

Plaque Removal: To remove plaque from arteries, the following procedures are performed.

Angioplasty

It is also called Trans luminal coronary angioplasty, inserting a long flexible tube called a catheter into a blood vessel through a small incision in your skin [91]. Once the catheter reaches the blocked vessel, the balloon is inflated and compresses the plaque against the sides of the blood vessel.

Coronary Artery Bypass Graft (CABG)

It is an open-heart operation in which an artery is taken from the leg is attached to the blood vessel to detour blood around the blockage. During the part of the operation, the heart will be stopped and a heart-lung machine will be used to pump the blood and help in breathing.

Coronary Stent

It is a small, latticed, high grade stainless steel tube that is used to hold the coronary artery open and minimize the chance of abrupt closure after angioplasty. The stent is positioned in such a way that it should be narrowed at the area of the artery. When the catheter's balloon is inflated, the stent expands and is pressed against the vessel wall. The balloon gets deflated and withdrawn, leaving the stent permanently in place. Some may perform "direct stenting" where the stent is threaded through the lesion and expanded [92].

Rotational Atherectomy

It widens narrowed arteries using a high-speed rotational device to "sand" away plaque.

Drugs Used in the Treatment of CAD: It is divided into three broad categories

1. Medication which reduce the Blood pressure
2. Medication which reduce Cholesterol
3. Medication which dilate the vessels

Blood Pressure Medications

The main factor for developing heart disease is Blood pressure. It is treated using one medication or a combination of medications.

Diuretics: Thiazide diuretics such as chlorthalidone and hydrochlorthalidone are the most commonly used. These are very effective in reducing high blood pressure. It can lower potassium levels, although potassium sparing diuretics are available.

Angiotensin-Converting Enzyme (ACE) Inhibitors

It works by blocking the body's production of protein called angiotensin, which constricts the blood vessels. They help to preserve heart function after heart attacks, protect the kidneys of diabetic people. Some of the commonly used ACE inhibitors are Benazepril, captopril, lisinopril.

Angiotensin-Receptor Blockers (ARBs)

It works by preventing the angiotensin from exerting its blood vessels constricting effects on the body. These are good alternatives for those who cannot take an ACE inhibitor. Medications are candesartan, valsartan, losartan.

Beta Blockers: These are the most commonly used for controlling cardiac ischemia and heart failure. Beta-blockers obstruct the working of epinephrine, a hormone that normally stimulates the heart to best faster and stronger. People with asthma, heart failure or diabetes should be extra careful while taking these medications. It includes atenolol, metoprolol [93].

Calcium-Channel Blockers (CCB)

These are vasodilators which dilate the coronary arteries, thereby increasing the blood flow to the heart and reducing its workload, by lowering the blood pressure and the force of the heart's contractions. People who do not get adequate relief from using beta blockers or nitrates can use calcium channel blockers.

Cholesterol Medications

There are various medications that can be used for lowering the blood cholesterol.

Statins

Medically known as HMG-CoA reductase inhibitors. It lowers the LDL levels and also improves the overall cholesterol profile by lowering total cholesterol. Statins work by preventing the liver from making cholesterol and forcing it to draw LDL cholesterol from the blood. Commonly used statins are Atorvastatin, fluvastatin, lovastatin, rosuvastatin.

Fibric Acid Derivatives

These are prescribed for people who have high levels of triglycerides in their blood. They reduce triglyceride levels by 20 to 50% and raise HDL levels by 10 to 15% and also have a minimal effect on LDL levels. These drugs block the production and activity of the protein that transports cholesterol in the blood. Gemfibrozil and fenofibrate are commonly used.

Niacin

It is an essential vitamin B found in many of the healthy food products such as fish, meat and dairy products. Niacin on its own can reduce LDL levels by 15% lower triglycerides and boost the levels of HDL by as much as 20%. It works by cutting the liver's production of VLDL, which is converted into LDL. It is unsafe for people with chronic liver disease, diabetes, peptic ulcer and certain other heart conditions [94].

Bile Acid Binders

These are synthetic resins. These resins bind themselves chemically to the cholesterol rich bile acids, preventing their reabsorption. These medications are capable of lowering the LDL cholesterol levels by 15 to 30%, depending on the daily dose. Cholestyramine, colesevelam and colestipol are commonly used.

Cardiovascular Medications

These medications function as anti-platelet drugs, preventing the formation of blood clots.

Aspirin

It is the most common inexpensive drug used to prevent subsequent heart attack and death in people. It reduces the inflammation that is common in coronary artery disease. It might have some serious side effects such as GIT bleeding and hemorrhagic stroke in both men and women. The risk of aspirin-induced bleeding is higher in men, in people who have a history of uncontrolled high blood pressure.

Nitrates

It helps to prevent ischemia by relaxing the muscles in the walls of the blood vessels, causing them to dilate and thereby increasing the supply of blood to the heart. They also reduce the heart's work by lowering the body's blood pressure within the heart chambers. The heart then requires less oxygen and does not put the coronary arteries under stress [95-97].

CONCLUSION

The effects of high blood cholesterol and lowering blood cholesterol in reducing morbidity and mortality from cardiovascular diseases are well established. Non pharmacological measures like dietary restriction and exercise may help in lowering blood cholesterol levels. When such therapy fails, and in patients with abnormally high blood cholesterol levels, drug therapy is indicated. Drugs like statins, nitrates, have a spectrum of adverse effects.

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