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MANAGEMENT OF ATHEROSCLEROSIS BY NANOMEDICINES(NANOPARTICLES)

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ABSTRACT

Atherosclerosis is the leading root of cardiovascular diseases (CVDs), which has a high mortality rate. There is no proper treatment for atherosclerosis as only present therapies are used which slow down the progression of AS. It is the inflammatory disease of arteries which is caused due to the building of a plaque inside endothelial cells. Nanomedicines are used for the treatment of many infectious diseases like CVDs. They have an ability to produce drugs that control the cellular processes by interacting with cellular receptors. Nanomedicines have an ability to cure several diseases by controlling different pathological pathway through nanoparticles. NPs are competent drug couriers. Nanoparticles are used for treatment of Atherosclerosis by targeting with various cellular receptors like integrins and other which act as atherogenesis. So these nanoparticles are used for treatment of Atherosclerosis.

Key words: Cardiovascular diseases, nanoparticles, endothelial cells, cellular receptors

Introduction

Cardiovascular diseases are the major causes of death throughout the world. These CVDs had high mortality and morbidity rate. Almost 17.6 million people die due to CVDs. There is a high diagnostic and treatment cost of CVDs due to which CVDs become a threat to economic burden worldwide. [1] Atherosclerosis(AS) is one of the most important cardiovascular diseases. It is characterized as a chronic inflammatory disease of the arteries. AS is identified by substantial modification in the inner layers of the arteries. The pathological damage of the endothelial cells is the initial phase of AS.[2] This AS is basically the stiffening or hardening of the arteries. AS is caused by the building of a plaque inside the sub-endothelial cells (the inner lining of an artery). In this condition the arteries become hard and narrow. AS restricts the blood flow and leads to the blood clot and myocardial infarction and stroke. A plaque is a sticky substance made of cholesterol,fat, calcium and other substances. The plaque is formed in three stages. First is fatty streak, second is plaque progression and third is plaque disruption. Mostly the deposition of lipoprotein particles is the firstly identified change toward the development of atherosclerotic lessons. [3] Atherosclerosis is a slow and ongoing disease. AS may start from childhood but they become chronic with age. The following causes of atherosclerosis are hypertension, high triglycerides, elevated cholesterol ,Diabetes due to insulin resistance , corpulence,high fat consumption, smoking, inflammation caused from arthritis and other diseases due to C-reactive protein, lack of healthy diet and the family history of AS.[4] The symptoms of atherosclerosis are inter plaque hemorrhage, bleeding, sudden numbness in legs, fatigue, Thrombosis
Stenosis.[5]
The pathogenesis of atherosclerosis is explained in figure 1

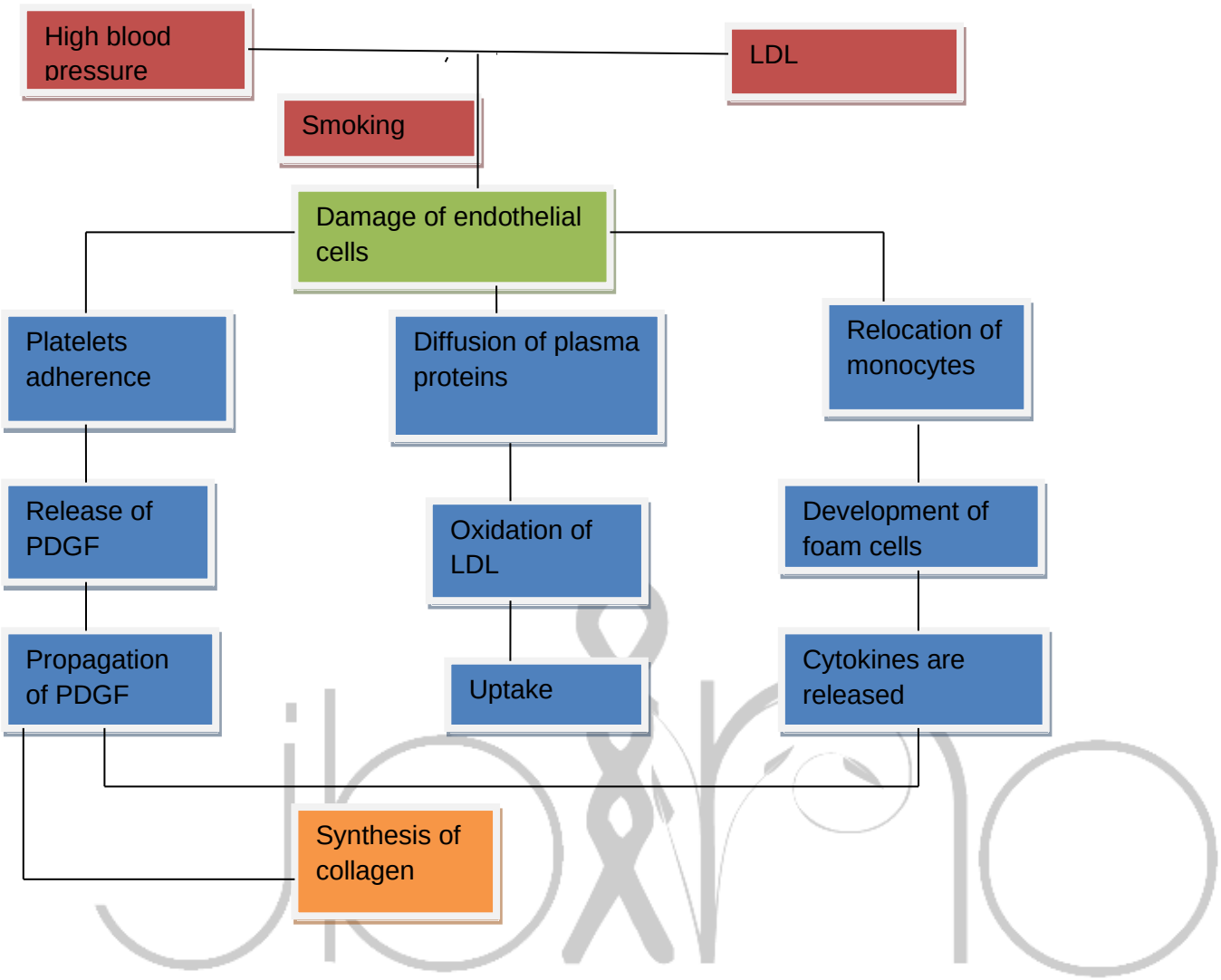

Figure 1: pathogenesis of atherosclerosis

People living with atherosclerosis

AS is the main pathological reaction of cardiovascular diseases. It can start early in life and remain quiescent and immunosuppressed for a long time period before developing into its new stages and becoming lethal.[6] The early diagnosis of atherosclerosis depends upon the peripheral and carotid arteries. People can lead a healthy life with atherosclerosis by proper management. A healthy lifestyle, medication like use of statin and other cholesterol lowering medicines, antioxidants, medical and other hospital medications are helpful for survival AS patients. However, this does not permanently treat the atherosclerosis but it can reduce the risk factor and save from further development of the atherosclerosis. And when AS comes to the stage of complications then the patient should be hospitalized for further treatment and sometimes for surgery. These diseases are more common in women than men. The risk of developing in women starts at the age of 55 while in men it is 45.[7] According

to the current data, there is a 30% chance of death at the chronic stage of AS.

Nanoparticles

Nanotechnology is the branch of science which uses compatible nanoparticles(NPs) for non-invasive imaging and treatment of many diseases. These NPs are characterized as the drug delivery barriers[8]. The research on nanoparticles shows that they are very important in medicine. These NPs have a small size and large surface. So the nanoparticles have more solubility and more ability to pass through the blood brain barrier. These NPs have high biocompatibility as well as enhance the efficiency of target cells. Low availability drugs could also reached to the target site directly through nanoparticles. [9] In recent studies, these nanoparticles are used for drug delivery in AS. Nanomedicines, the branch of Nanotechnology, are used for the treatment of many CVDs. These are able to interact with cellular receptors of the body and are involved in the control of cellular processes as well. Nano medicines actually used the nanoparticles which are only carriers of nucleic acid or proteins which are used for the controlling and treatment of many diseases.[10] There are many types of organic,inorganic and metallic nanoparticles used. The silica, silver, gold are inorganic nanoparticles used in CVDs. The gold nanoparticles are mostly used because macrophages can consume gold.[11] While iron oxides are one of the metallic nanoparticles mostly used. Organic nanoparticles like lipid liposomes, carbon nanotubes, dendrimers nanoparitcles and polymeric micelles are used.[12] Mostly the organic nanoparticles are used because inorganic nanoparticles are difficult to degrade. For AS, lipid based molecules like liposomes are used as a drug delivery system due to their high biocompatibility and low resistance. Glucocorticoids had an anti-inflammatory role in the treatment of atherosclerosis so this liposome is used as a nanocarriers. [13] The atherosclerosis is reduced in mice by the targeted CD40 which induces the TRAF6 signalling in macrophages. In this study,small inhibitor molecules which block the interaction between the tumor necrosis factor receptors-associated factor TRAF6 and high density lipid Rhd nanoparticles. The lipid nanoparticles have an advantage over other nanoparticles. This LPH have the greater storage capacity which can be preserved without fear of losing gene silencing efficiency.[14]

The phagocytic activity offers another strategy for the nanoparticles drug delivery into the atherosclerotic plaque. The atherosclerotic plaque is the most ample type of cell in which nanoparticles are used for drug delivery. The targeting cellular responses are involved in the drug delivery via nanoparticles. avβ3 integrins show an important part in angiogenesis which are also atherosclerotic related Processes. The cRGDfK peptides which are coated on NPs are delivered into atherosclerotic plaque. The allowance of entry into the cell is mediated when cRGDfK peptides bind specifically with the avβ3.[15]Hyaluronic acid (HA) is integrated into NPs and when it binds to macrophages and damaged endothelium then it can visualize the atherosclerotic plaque. This HA is binder to other receptors

like CF44 and this HA contains high biocompatible and biodegradability.[16] Targeted cellular response of NPs are used to target atherosclerosis regions and cure the AS. In atherosclerosis Nanoparticles coated with the withRapamycin produces the target cellular processes by decreasing vascular smooth muscle cells (vSMC) proliferation.[17] Targeting LDL with NPs is also known as important strategy for the treatment of nanoparticles. The clinical trials of the Nanomedicines have been performed to check their efficiency and safety. Nanomedicines has been widely used for drug delivery because these have high stability and high carrier capacity. So these are used fir diagnosis,imaging and treatment of CVDs, hepatitis B, and other diseases. [18]

Conclusion

This review concludes that nanoparticles are used as an efficient drug carrier for treatment of atherosclerosis.

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