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Research Article

SURVEY ON: NANOTECHNOLOGY A NEED OVER EXISTING CONVENTIONAL ISCHEMIC HEART DISEASE THERAPY

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ABSTRACT

Ischemic heart disease causes coronary artery obstruction leading to almost 80% deaths from cardiovascular disease. The regenerative capacity of an adult tissue is insufficient to repair the massive loss of heart tissue. particularlycardiomyocynate (CMs) following ischemia or other catastrophic myocardial injuries. The delivery method of therapeutics agents such as small molecules, growth factor, exosomes, cells and engineered tissues have significantly advanced in medical science. Nanotechnology has opened new windows in areas of CVDs with an opportunity to achieve effective treatment, better prognosis and less adverse effects on non target tissue. The application of nanoparticles and nanocarriers in the area of cardiology has proved more effectiveness now due to the properties such as passive and active targeting to the cardiac tissue, improved target specificity and sensitivity. These properties of the improvement of the bioavailability of drugs,can reduce the dosage and frequency of administration, and may solve the problem of non-compliance of patient to the prescribed therapy. The main objective of this study is to interpret the problems related to ischemic heart disease treatment and to utilize the nanoparticles as a drug delivery system against the problem of conventional therapy. To collect information related to nanotechnology in the existing conventional system of IHD therapy the methodology of survey was conducted. So survey was performed of the doctors, patients and pharmacist since pharmacists dispense the IHD drugs prescribed by doctors to various patients. By survey it can be concluded that problems with conventional therapy can be overcome by nanotechnology based drug delivery system.

INTRODUCTION

Ischemic heart disease represents a group of pathophysiologically related syndromes resulting from myocardial ischemia - an imbalance between myocardial perfusion and cardiac demand for oxygenated blood. Ischemic limits tissue oxygenation (and therefore ATP generation) as well as availability of nutrients and removal of metabolic wastes.>90% myocardial ischemia results from reduced blood flow due to obstructive atherosclerotic lesions in the epicardial coronary artery .IHD usually is synonymous with coronary artery disease (CAD).

Causes of IHD -
10% causes -

1. Coronary emboli
2. myocardial vessel inflammation
3. vascular spasm

Conditions where otherwise modest vascular occulsions may become consequential –

1. Myocardial hypertrophy
2. Tachycardia
3. Hypoxemia
4. Systemic hypotension (e.gshock).

90% causes

The syndrome of IHD are the late manifestation of coronary atherosclerosis (beginning even in childhood or adolescence).

Types of IHD

1. Stable angina - no plaque disruption.
2. Unstable angina- plaque disruption, Thrombosis

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3. Myocardial infarction - acute plaque change, abrupt thrombotic occlusion, myocardial necrosis.

Pathophysiology

Sudden cardiac death- regional myocardial ischemia, fatal ventricular arrhythmia. Ischemic heart disease is a pathophysiological condition caused by the disproportion between the myocardial oxygen demand and its supply. The myocardium nutrition depends on the oxygen capacity of the blood and amount of coronary flow . Hence Ischemia is caused by the myocardial oxygen demand at the time of the provision of coronary artery spasm or intravascular blood clotting at the site of ruptured atherosclerotic plaque. This further gives results in limiting the coronary flow. The pathology to the large coronary arteries in which the stenosis reduc-es the coronary reserve in proportion to the degree of vasoconstriction. Stenosis may be accompanied by spasm amplify the size of it. In the ruptured atherosclerotic plaque often becomes a substrate for intravascular clotting which lead to the acute coronary events . During the acute ischemia oxygen deficiency impairs oxidation of glucose and free fatty acids (FFA), so the main source of energy becomes enzymatic cytoplasmic glycolysis. Secreted catecholamines (norepinephrine and epinephrine) intensify the hydrolysis of fats, which can reach to the heart. Hence as a result of the reduced supply of glucose promotes the oxidation of free fatty acids while becoming the only source of energy during which the oxygen consumption is increased, and the reserve decreases rapidly, it forces the cell to move to the anaerobic glycolysis. This causes the accumulation of hydrogen ions and lactate. Several seconds of ischemia impairs the relaxation and contractility of the myo-cardium.

Nanoparticles

Organic nanoparticles

Lipid nanoparticles

Typical lipid-based NP formulations include solid- lipid NPs, lipid carriers, lipid-drug conjugates, and nanoemulsions; all are primarily comprised of physiological lipid analogs with surfactants as stabilizers. According to the size, they are named as micelles (15 nm), liposomes (100 nm) or polymeric NPs. Micelles consist of lipids and other amphiphilic artificial molecules that self-assemble in aqueous solution and form a monolayer with the hydrophobic phase inside, that incorporates hydrophobic therapeutic agents. Liposomes are heavily investigated in nanomedicine and are the first to get FDA approval. Liposomes mainly consist of phospholipids that form bilayers with the aqueous phase inside, conferring superior biocompatibility to liposomes. PolymericNPs such as polylactic acid (PLA), polyglycolic acid (PGA), and poly lactic- co-glycolic acid (PLGA) are FDA-approved polymers.PLG Aisacopolymer of PLA and PGA and is being tested for drug delivery systems for intractable diseases, including cardiovascular diseases.

Dendrimers

Dendrimers are in the category of polymer NPs. However, they have a very different structure from classical polymers, which makes them unique. They consist of globular molecules made out of branched layers (generations). Such a precise synthesis leads to obtaining monodisperse molecules.

Inorganic Nanoparticles

Carbon-Based Nanoparticles

Carbon nanotubes (CNT)are a subfamily of fullerenes and are composed of graphite sheets that are rolled up into tubular forms. As nano-carriers, they incorporate drugs in their inner space and present chemically modified external surfaces with biological molecules, suchas nucleotides and proteins, to provide selective targeting .Based on their number of layers, CNTs are categorized as either single or multi-walled. The poor solubility of drugs, faster deactivation, and limited bioavailability can be addressed by using these CNTs. However, one of the major disadvantages of the CNT is the chance for their dissociation in biological fluids. Nevertheless, carbon nanotube is a well- suited drug carrier for enhanced penetration in the cells and also for offering privileged drug actions. Other investigations have suggested that scaffold consisting of col-hydrogel and CNT could be promising injectable biomaterial to deliver drugs and cells for cardiac tissue regeneration in the infarcted myocardialtissue.

Graphene

Graphene has great potential to be used for low-cost, flexible, and highly efficient photovoltaic devices due to its excellent electron- transport properties and extremely high carrier mobility."Recently, several graphene-based solar cells have been reported, in which graphene serves as different parts of the cell.

Metal nanoparticles

Nanogold, also called gold nanoparticles (GNPs) or colloidal gold has been actively investigated in a wide variety of biomedical applications. The unique physical and chemical properties, such as ease of bio- conjugation, excellent stability, superior security, and strong biocompatibility of many GNPs make them promising candidates in nanomedicine .Silver nanoparticles (AgNPs) have been developed as potent anti-microbial agents. After oral exposure, it is shown that about 18% of silver could be absorbed inhuman. Organic- inorganic hybrid nanoparticles (NPs) combine features of organic and inorganic building blocks and generate NPs with improved physicochemical properties, such as particle size and surface charge. Hybrid NPs hold great promise in overcoming the pitfalls being faced by existing inorganic materials, such as unwanted interactions with serum proteins (particularly opsonins) and consequential removal from the circulation by macrophages, rapid renal clearance, prolonged body accumulation, and lack of targetability. Magnetoliposomes (MLs) are composed of liposomes and magnetic NPs and are the first efficient hybrid liposome/NP systems produced for the drug delivery. Potential scope of magnetic NPs to leverage the delivery of growth factors, cytokines, and biomolecules to the degenerating cardiac cells and tissues to enhance their regeneration.

Artificial Nanoparticles

DNA nanostructures, owing to their precise control over chemistry, size, and shape, provide vast opportunity to unfold the information relating to nanoparticle-biological interactions. Drug delivery and therapeutics is considered as one of the most promising applications of the structural DNA nanotechnology. Artificial nucleic acid nano-devices could be utilized to provide

targeted drug delivery in the tissues upon sensing their environment. Moreover, several studies have proposed various DNA nanostructures and strategies to load, deliver, and release biomolecular drugs for cardiac therapy.

RESULT

For Doctor

In order to get the data related to need of nanotechnology in the present day treatment of existing convectional system of IHD therapy the methodology of survey was adopted. Survey was performed of the doctors who have the IHD patient under their treatment and also of the pharmacist who dispenses the IHD drugs prescribed by doctors. Most of Patients were adult and were the aged person under the treatment and least number was children. 15% patients complete their course and 70% Patients leave their course incomplete. The missing reason found that poor patients compliance was large side effects then comes to problem long term therapy , increased dose frequency and conventional drug delivery system.

For Patients

In order to get the data related to need of nanotechnology in the present day treatment of existing convectional system of IHD therapy the methodology of survey was adopted. Survey was performed of the doctors who have the IHDpatient under their treatment and also of the pharmacist who dispenses the IHD drugs prescribed by doctors. Most of patients are adult and suffering from angina Pectoris. 50% Patients following homeopathy treatment. 66. 7% patients feel adverse effects and 33.3% patients don't feel adverse effects. In future 86.4% Patients would like to take novel drug delivery system.

For Pharmacist

From the survey conducted for pharmacist on IHD medications, we got average percentage of medications sold on monthly basis. From the survey collected data the following results were achieved. Mostly sold drugs in market for IHD therapy are Amlodipine (more than 50% drug sold in market), Isosorbidemononitrate Aspirin + Atorvastatin (which is most preferred combination of Antiplateletes and statins) Telmisartan, & so on. According to the data collected in correspondence to class of drugs, bar graph was prepared, from that the most preferred class of drugs for treatment of IHD, such as Antiplateletes followed by statins then Angiotensin ll converting enzymes, nitrates, calciumchannel blockers etc were found to be used. From the survey it was also found that, cost of the product is one of the factor which affects treatment, dose compliance etc. According to the survey conducted it can be concluded that Many pharmacies till date do not keep Nano-particulate novel drugs in their Pharmacy, which is a current need to combat with increasing risks and minimising stress or burden on day to day increasing need of treatment. Nano-particulate system is definitely patient friendly approach which should be followed in our country as early as possible.

CONCLUSION

From the above survey on Ischemic heart disease we can conclude that most of the treatment method and drugs available in the market gives the symptomatic relief. The evidence presented within these survey demonstrate that nanotechnology does hold potential for application in the treatment of Ischemic heart disease. As the future in therapeutic is becoming more geared toward the personalized medicine, nanotechnology may be the best place to achieve these intended goal to individuals disease status. However their is substantial evidence to support the concept that nanotechnology is yet to make its full impact to revolutionize the medicine.

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