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ANALYSIS ON APPLCATIONS OF NANO DRUG DELIVERY SYSTEMS ON CARDIOVASCULAR DISEAS TREATEMENT

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ABSTRACT

Nanomedicine and nano-delivery systems is a new but rapidly developing science in which nanomedicine materials are used as diagnostic tools or in a controlled manner to provide therapeutic compounds in specific target areas. In the treatment of chronic human disease via location-specific and targeted administration of accurate medications, nanotechnology has many advantages. In recent times a lot of excellent applications of nanomedicine in the treatment of various diseases have been made (chemotherapy agents, biological agents, immunotherapy agents etc.). The hazard to human life and health has been seriously impacted by cardiovascular diseases (CVDs). Although several medicines operating under multiple action mechanisms are available on the market as conventional CVD formulations, their low water solubility and limited biological activity, non-targeting, and drug resistance still make them far from adequate. New methods of delivery of CVDs through the creation of nanotechnology for drug delivery systems (NDDS) demonstrate considerable benefits in the resolution of the foregoing challenges. Nano-drug delivery systems major aim is to study the recent progress in cardiovascular medication carriers based on nanoparticles. In this work, the problems of the conventional treatment methods compared with the nanomedicine of CVDs are summarised.

Key words: Nanotechnology, drug, cardiovascular diseases.

1. INTRODUCTION

Human beings have employed natural plant products as medications for numerous diseases since ancient times. Modern medicinal products are generated mostly from herbs on a traditional foundation. Far from being obtained from natural resources, around 25% of the principal pharmacological agents and their derivatives now available [1, 2]. The discovery of innovative medications is based on natural molecules with varied molecular origins. The goal in generating synthetically viable lead compounds that resemble their counterpart' s chemistry has been a new trend in the natural drugs discovery [3]. Natural products have outstanding features, such as exceptional chemicals diversity, macromolecular and less poisonous chemical and biological capabilities

The area of cardiovascular disease was also expanded by nanotechnology. In the case of hypertriglyceridemia, currently available fenofibrate nanoformation is employed to solve issues related to pharmacological solubility and absorption. Many approaches for the therapeutic targeting of vascular diseases are being developed (Figure 1). In addition, theranostic nanoparticles are multifunctional and are promised to deliver therapeutic and imaging agents together.

This makes the discovery of new medications beneficial[4]. In addition computational research have contributed to anticipation of molecular drug interactions and to the development of next-generation technologies such as the discovery of target therapies and medicines. Despite a number of advantages, pharmaceutical firms hesitate to invest more in discovering and delivering natural medicinal products[5] and instead study the chemical compounds libraries that are accessible to develop innovative medications. However, natural chemicals, including cancer, diabetes, cardiovascular, inflammatory and microbial disorders, are currently being examined in order to treat various important diseases. It is mainly because natural medicines have distinct benefits, including decreased toxicity and adverse effects, low cost and strong therapeutic potential. However, biocompatibility and toxicity of natural chemicals are more challenging to take them as drug product.

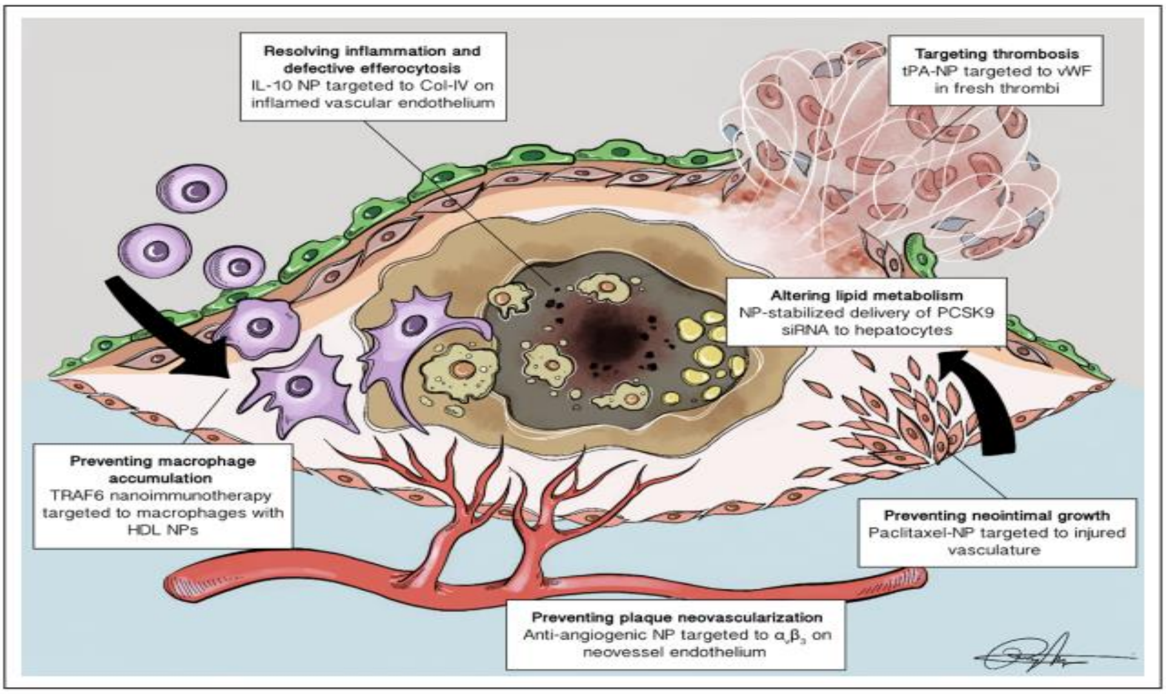

Figure 1. Targeted therapeutic strategies enabled by nanoparticles.

Cardiovascular diseases (CVD) have become a world-wide major public health problem and world-leading health concerns include mortality rate. The development of medications for treating CVDs has become a major priority in the face of such a terrible condition. Nanotechnology is a new approach for overcoming the bottleneck of cardiovascular disease because Nanoscience has rapidly grown and nanomaterials have been exceptionally successful. Substances that can increase drug stability and water solution, extend cycle life, enhance tissue or cell target absorption, reduce enzyme degradation and, thus, enhance drug' safety and/or efficacy are Nano-Drug Delivery Systems (NDDSs). NDDSs, including inhalation, oral administration or intravenous injection, can be delivered through many methods that have remaining improved bioavailability. In recent years, several academics have begun developing the CVD diagnosis and therapy nano-drug carrier system.

2. LITERATURE REVIEW

Rajasekharreddy Pala, 2020, The world's main causes of high morbidity and death are cardio-vascular diseases (CVDs). Preventive strategies, diagnostic measurements and treatment of CVDs, which require promising alternative technologies, are not particularly useful. Nanoscience and nanotechnology have opened a new window in the field of CVDs with the chance of effective therapy, improved predictions and less harmful effects on non-target tissues. Due to the qualities of passive and active targeted at the heart tissues, better target specificity and sensitivity, the application in cardiology of nanoparticles and nanocarriers has been highly attentive. More than 50% of CVDs may be treated efficiently using nanotechnology, it has been revealed. The major aim is to study the recent progress in cardiovascular medication carriers based on nanoparticles. This paper also describes the limitations in comparing nanomedicine for CVDs to traditional therapeutic methods.

Jayanta Kumar Patra, 2018, Nanomedicine and nanotechnology are a relatively new, but fast emerging scientific field where materials are used as diagnostic instruments or as therapeutic substances for the controlled determination of specified locations. Nanotechnology offers many advantages for the treatment and targeting of specific medical devices for chronic human ailments. There have recently been a lot of excellent nanomedicinal cations in the treatment of many diseases (chemotherapeutics, biologic agents, immunotherapy etc.). The current study provides a complete examination of development and application of nanomaterials, which will help to improve efficacy of both new and old treatments (e.g., natural products) and the selective identification of disease marker molecules.

Bruna Vidal Bonifácio, 20201, Since ancient times herbal treatments have been widely used all throughout the world. The progression of phytochemical and phytopharmaceutical sciences has allowed us to clarify various herbal items' composition and biological activity. The efficacy of many therapeutic plant species depends on their provision of active ingredients. The majority of biologically active constituents of extracts, such as flavonoids, tannins and terpenes have high water solubility but are low in absorption due to their failure to cross lipid cell membranes, their excessive molecular size or their poor absorptive capacity, leading to a loss of bioavailability and effectiveness. Because of these limitations, some extracts are not used clinically. The combination of herbal medicine and nanotechnology have been widely recommended because nanostructured systems may enhance the action of plant extracts, reduce the necessary dose and side effects and improve activity.

Alyssa M. Flores, 2021, Nanoparticles promise to promote vascular disease strategies. Nanoparticles have been applied to cardiovascular illness, since they are harnessed by the area of cancer for safe and more effective chemotherapeutics. Systemic exposures and interactions with drugs remain an issue for almost all cardiovascular therapy, including statins, antithrombotics and thrombolytics. Moreover, the development of entirely novel techniques to treating VED have been hindered by off-target effects and inadequate bioavailability. Nanoparticle delivery systems allow a medicine through logical design of nanoparticles to be administered more effectively or directly to its therapeutic purpose. It can overcome biological obstacles and improve the therapeutic index.

3. TYPES OF THE NDDSs

Liposomes

Liposomes are generally lipid vesicles generated from organised cell-like phospholipid bilayer. As a sort of pharmaceutical carrier, liposomes have various advantages, such as nontoxicity, non-immunogenicity, drug release prolongation, change in live medication distribution, enhanced drug treatment index, reduced adverse effects of pharmaceuticals, etc. Liposomes can be compatible with hydrophobic drug and not only easily created for the trapping of hydrophilic and ionic substances. Hydrophobic medication, especially those which contain genes, could be connected to the hydrophilic portion of the liposomes and can be enclosed by the bimolecular structure of the phospholipids. By modifying different lipid materials the particle size, potential and surface chemistry can be altered. Cationic liposomes are positively charged among various types of liposome, indicating they can lead to dependent cytotoxicity and inflammatory reactions and interact non-specifically with negatively charged serum proteins as complex.

Polymer Micellar Co-delivery System

Polymer nanoparticles can also be divided into non-biodegradables and drug delivery biodegradables. All of these are synthetic polymers, most of them poly(lactic co-glycolic acid) (PLGA), polyvinyl imines (PEI), polycaprolactones (PCL) or PVA. These polymers are biocompatible, non-toxic and teratogenic. Its products for degradation, including oligomerization and final products, are not hazardous to cells and can co-exist stably with most of the drugs. Natural polymers are usually classified as complexes of inclusion of polysaccharides, peptides, Chol and cyclodextrin. Nanoparticular polymers commonly made from the Amphiphilic block automatic copolymers are stable in the core and can be employed to intercept insoluble medical drugs.

Dendritic Macromolecules

Macromolecules are manmade, in different forms and normally branching. Scale-formed macromolecules can be placed in monodisperse space and most of them used for the management of and dissolving of insoluble targeted drugs as nano-carriers. Dendritic macromolecules are likewise monodispersively and have a single branch structure and can be adjusted by their molecular weight. In addition, the packaging includes a high number of prepared functional surface areas and a hydrophobic environment that make the products a great drug supply. Dendritic macromolecules are commonly utilised in biomedical and pharmaceutical industries because of their good biological characteristics, but their clinical use is limited by the presence of surface cationic charges.

Metal Nanomaterials

Structured in different shapes, gold and silver nanomaterials can be classified into/similar to nanoparticles, nanomatodes, nanocapsules, and nanoparticles. Metal nanomaterials were the most commonly used. In addition to using CT as nano-contrast agents and improved surface rhumatoid spectroscopy, golden nanomaterials are used for photo therapy of malignancies and rheumatoid arthritis. As several studies have revealed, the use of silver nanoparticles mainly involved antibacterial, anti-infective and anti-tumor areas. In addition, certain therapeutics may be charged for hollow or silver nanostructures physically or for targeted drug delivery on the surface of nanoparticles. However, the elimination of gold nanoparticles is too low in the human body, and silver ions toxicity in vivo restricts the application in the treatment of chronic diseases of these metal nanomaterials.

4. METHODOLOGY

In order to reduce the health care load, nanotechnology assists in the early detection and efficient treatment for CVDs. In a nutshell, improved medical imaging, targeted drug provision and a target provision of nanoparticle for killing ill cells are the significant responsibilities of nanoparticles in CVDs. Nanoparticles can also be efficiently removed from drugs by blood and tissue. Rapid nanotechnological breakthroughs enhance the imagery of CVDs through the development of nanotechnology-based, tailored cardiomedicine, cardio-capacity molecular imaging samples. Figure 2 presents unique characteristics of nanoparticles that enable them to become a viable agent for cardiovascular imaging.

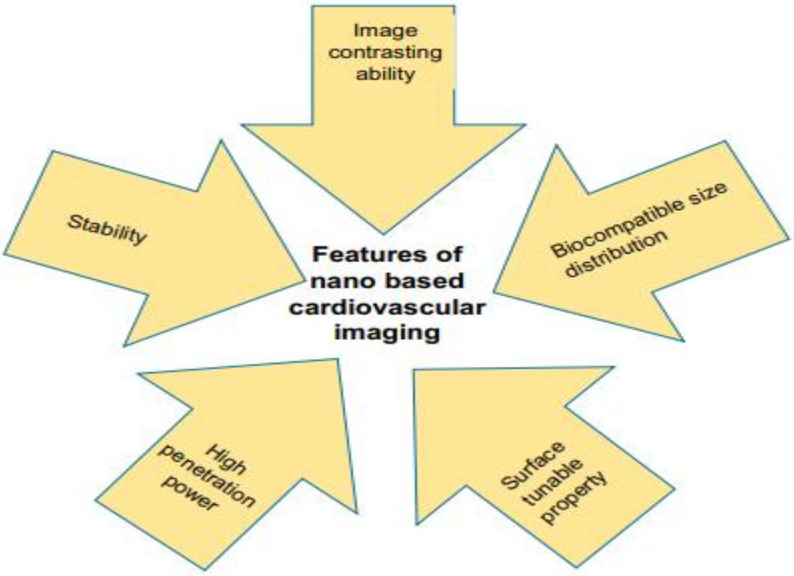

Figure 2 Special features of nanoparticles that made nanomaterials as indispensable in the cardiovascular imaging

The promising uses of such imaging samples in CVD treatment are because nanoparticles have the capacity to pass biological barriers and accumulate on the target site. Cardiac nanoimaging is an integrative strategy for diagnosis and real-time monitoring during operations and treatment. Cardiovascular nano-based imaging is linked to various sectors of diagnosis, surgery and therapy. Nanoparticular cardiovascular imaging has therefore been classified into wide fields such as thrombus imaging, stem cell, grease and theranosis depending on the site of the detection or mechanism mode. Figure 3 has demonstrated several imaging methods and strategies for cardiology.

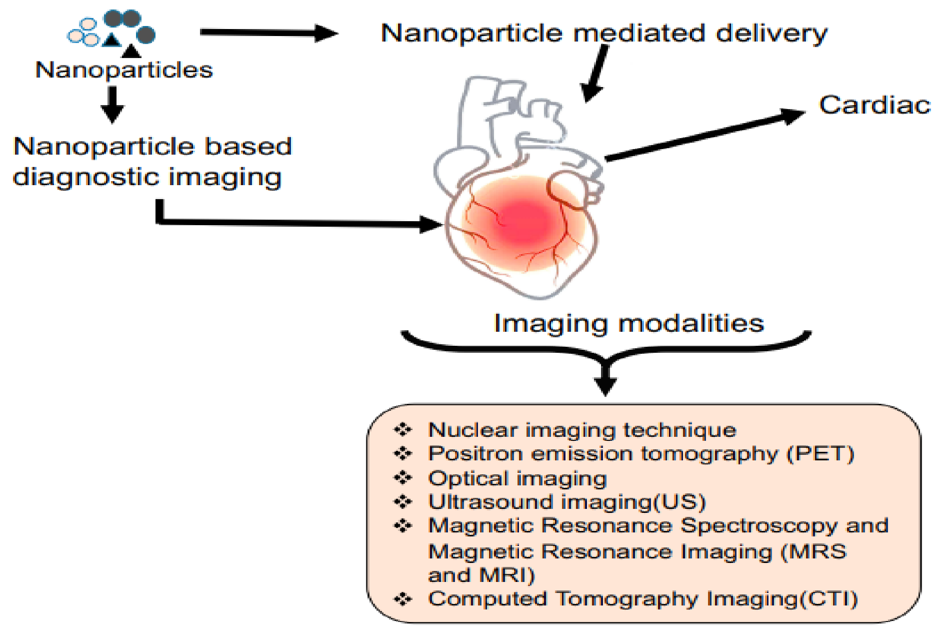

Figure 3 Nanoparticle-mediated diagnosis and imaging of CVDs.

Nanoparticles in CVDs decrease gap between test findings and large-scale clinical trials by theranostic use. Cardiology theranostics blends imagery and therapeutics using imaging-based methods of therapeutic drug delivery. Several nanoparticles are used for imaging diagnosis, drug delivery and additional drug effectiveness assessments. Light, external magnetic field or ultrasound controlled the delivery and action of Nanoparticles on the target region, which minimises local and systemic impacts; Magnetic resonance imaging has been used in a site-specific way for vascular intervention.

4.1 Application of the nddss in the diagnosis of cvds

For effective prevention and treatment of CVDs, early, fast and precise detection is critical. In recent years, increasing focus has been made to the application of molecular imagery in the diagnosis of CVDs. New contrast agents are crucial to real-time, quick, highly sensitive and high-resolution diagnostics in addition to the continual invention of different imaging methods.

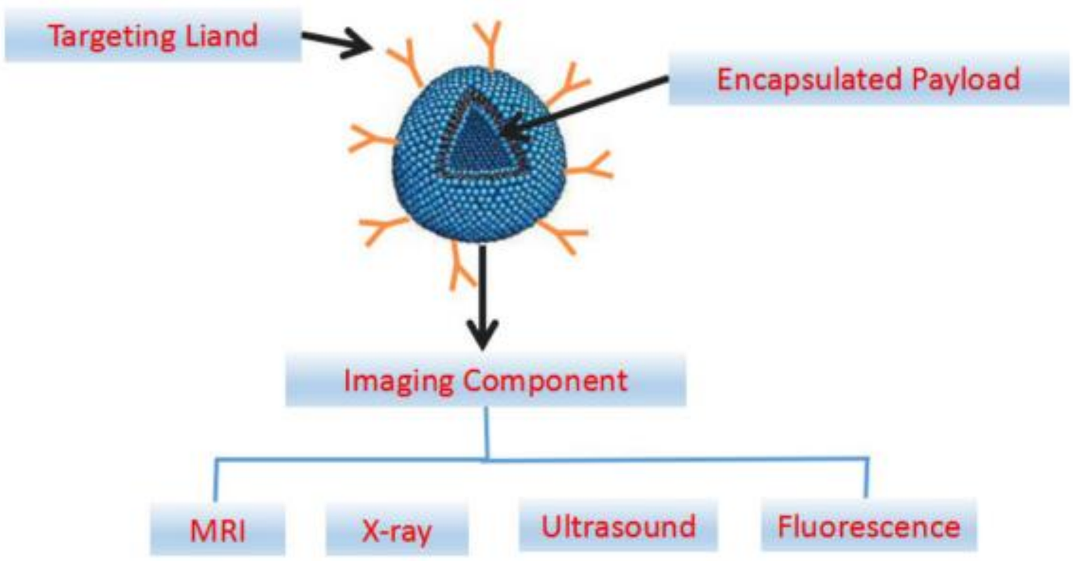

FIGURE 4 Abridged general view map of targeted nanoparticles engineered for imaging and drug delivery.

Nanocontrast agents provide the following advantages compared to traditional contrast agents: (2) physical and chemical attributes controlled (e.g., chemical composition, size) and performance of imaging; (3) the particular identification of certain biomolecules; (4) the ability to execute imagery multimodal, (5) values for individual diagnosis and therapy are predicted to be achieved. The contrast agent can be used in the initial stages of disease lesion fields by designing nano specials with unique chemical signals molecule of ill-founded tissues, X-rays, fluorescence imaging, and contrast improved ultrasosonic (US) imagery (Figure 4).

CONCLUSION

Nanotechnology and nanomedicine are therapeutic tools for diagnosis and therapy of cardiovascular disorders. Nano-sized particles serve as nanodevices or nanocarriers to transport medicines to a damaged site successfully. Nanocarriers have tremendous potential to deliver medications and genes in an efficient, targeted manner to remove solutions, bioavailability and other pharmacokinetic features. Finally, the nano-carrier has demonstrated distinct advantages in diagnosing and treating CVDs as an efficient, specific and regulated intracellular drug delivery mechanism. It can handle difficulties of targeting, the delivery of local drugs, controlled releases, prolonged release, and toxicity reduction successfully as it develops towards a multifunctional and integrated diagnosis and therapeutic direction. The use of NDDSs will be fostered and new procedures and methods for the clinical diagnosis and treatment will be developed by the innovation of the nanotechnologies and the further studying of the molecular pathologic mechanism of CVDs.

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