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Nanosensors Success in Cardiovascular Diseases

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ABSTRACT

Nanotechnology is modest representation of tiny in meaning, but nanometer is one-billionth of a meter. A solitary walled carbon nanotube with a distance across of 1 nanometer is 100,000 times littler than a strand of hair. In examination, a strand of hair is 100,000 times littler than a house 10 meters wide. Nanotechnology is the future technology with immense scope for various applications, such as nanomedicine, nanoelectronics, nanaosensors, etc. Nanosensors are natural, synthetic, or surgical sensory point's used to transfer information about nanoparticles to the macroscopic arena.

For the most part utilized as a part of different therapeutic purposes and as passages to building different nanoproducts, for example, PC chips that work at the nanoscale and nanorobots. A typical notion that individuals have with nanotechnology inside the human body is whether the materials utilized are lethal. The sensors, developed from carbon nanotubes, are fit for detecting whether cells joining to the insert are bone cells (as would be trusted), microscopic organisms or provocative cells.

INTRODUCTION

Cardiovascular Diseases

Cardiovascular diseases (CVD) are rapidly witnessed all over the world with a huge number of individuals and are expected to be continued as one of the top most indorsers to healthcare expenditure. According to WHO, approximately 17 million people's lives have been snatched away by CVD each year throughout the world [1-7].

Generally six types of cardiovascular diseases are common & they are listed below:

- Ischemic heart disease
- Cerebrovascular disease (Stroke)
- Peripheral vascular disease
- Heart failure
- Rheumatic heart disease
- Congenital heart disease

Challenges of CVD include

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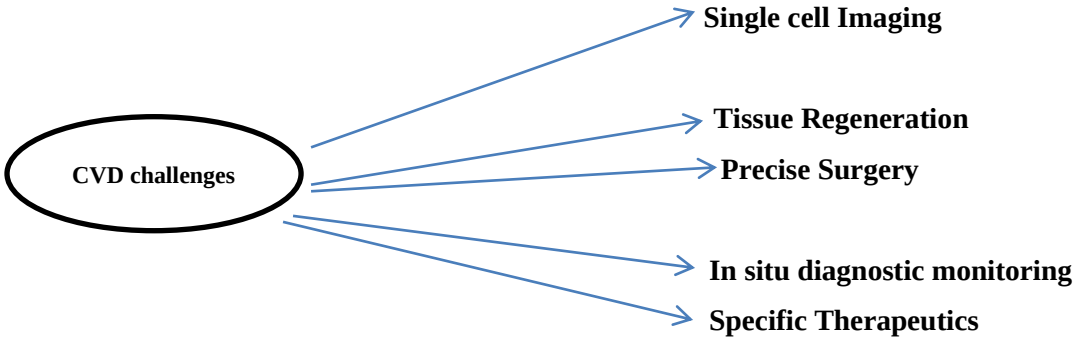

Nanosensors in Cardiovascular Diseases

Nanosensors in medicinal research are fast emerging, and particularly in heart ailments. Poor dietary examples and less dynamic lifestyles are the basic reasons for expanding Heart diseases & disorders. Cardiovascular diseases are sudden and needs rapid consideration and fast treatment. Nano sensors are designed such a way as to detect a heart attack by calculating the stress reaction in the heart and converting it into an ECG signal [8-10]. Nanosensors are able to wirelessly covey the signal to physicians for rapid diagnosis and treatment. These sensors are less cost and can be used by individuals with cardiac disease at all times.

Severe stress in the heart, leads to excess release of enzymes (protein molecules), thereby putting pressure and exertion on blood vessels; which leads to chest pain or cardiac arrest [11-35].

Nanosensors

Devices with nano arranged materials are used for both prior processing and sensing analysis. Two or three chips are being elaborated for use in medical monitoring or diagnostics. First chip is associated with analyte preliminary processing and sensing structures, it will be made by the nanofab created. Rest of the chips would be with standard microcontrollers. Nanosensors have a silicon or polymeric filters with nano sized sieving structures; micro liquid systems for bio-object sorting; a micro PCR; single chip electrophoresis system; a single chip (with outward light source) SPR system with microscale substance and catalytic sensors with deep submicron structures for better functionality and response time [36-40].

Various Projects of Successful Nanosensor in Cardiovascular Disease around the World

Approaches of Cardiovascular detection may be different, but ultimate goal is for proper diagnosis & better treatment of diseased individuals.

Testing C-reactive protein (CRP) levels in the blood

C-reactive protein is one of the critical phase proteins that elevate during inflammation. Increased levels of CRP continuously suggest recurrent coronary episodes in patients with unsteady angina and acute myocardial infarction (heart attack). Elevated CRP levels also are linked with lower survival rates in cardiac patients [41-47].

Portugal researcher's developed a novel approach for treatment of CV disease based on a transducer array made of carbon nanotubes for the selective and sensitive assessing of C-reactive protein in blood and saliva. This non-invasive approach is a very less time taking and does not need any sample prior treatment analysis, it can provide immediate results in situ and therefore it will elevate the capacity of diagnostics in real time and as a result it will lead to improve the quality of health care systems [48-56].

Project is started firstly with assembling of nanosensor, tested and optimised for standard solutions. Nanosensor included by a transducer array made of single-wall carbon nanotubes on compatible oxides of metallic semiconductor with silicon substrate and chemical recognition layers or coatings that elevate the transducer´s sensitivity and selectivity to the specific analytes. The nanosensor will be used to the detection of C-reactive protein in artificial samples and the results estimated with the ones obtained with ELISA assay [57-76].

Second step of project include, application of nanosensor to actual clinical samples (human blood and saliva) and the results will also be demonsrated using ELISA assay. Samples taken from human would be blood and saliva either from healthy individuals or individuals suffering from different diseases associated with C-reactive protein. Results acquired for saliva will be tested alongside blood in order to identify if C-reactive protein in saliva gave important result for cardiovascular risk disease and to check the nanosensor as a non-invasive technique.

Third step of project includes the nanosensor adjusted to a prototype and tested with real samples.

Measuring the stress symptom (myocardial infarction) in the heart

IIT Mumbai, Department of Electrical Engineering has developed a cantilever in the sensor using tiny or nano-particles of the polymer to measure the stress symptom (myocardial infarction) in the heart and change it into an electrical signal. Nano-particles, in a polymer produce electrical current through biochemical procedure of the enzymes produced in the heart. As the heart experiences intense stress or strain, it immediately releases enzymes (protein molecules) in bulk, exerting pressure on its blood vessels, which outcome as chest pain, perspiration or even a cardiac arrest.
Silicon Nanosensor technology depending on electrical impedance measurements was constructed for identification of proteins. The nanosensor miniaturizes the high-density, low-volume multiwell plate concept. Estimation of two cardiac proteomic biomarkers has been established through this technology. Ttwo proteins, C-reactive protein and NT-pro-brain natriuretic peptide (BNP), are associated with adverse cardiac consequence in clinical samples when analysed in the pg/mL concentration. Occurrence of the antibody-antigen binding complex in individual wells is noticed. This technology has the capability to achieve near real-time detection with improved sensitivity at 1 ag/mL for BNP and 1 fg/mL for CRP from human serum.

Rapid multi-channel serum profiling for cardiac disease

Rapid Multi-Channel Serum Profiling for Cardiovascular disease was performed by researchers from USA.
Fluorescent Nanosensors fastens the diagnosis of cardiac aliments in individuals with CV Diseases, minimizing economic impact. Proposed research uses nanoparticle-based sensor arrays to quickly profile serum, highlighting on the creation of effective sensor elements that use supramolecular "hairpin" motifs to provide a turn-on fluorescence response. Covalent bonding of the nanoparticle recognition element and fluorescent reporter will permit their use in flow systems.

CONCLUSION

Expansion and current understanding of various sectors in molecular biology [77-79], material science, genetics, cellular biology, bioengineering [80-85] and proteomics [86-97] develop nanobiotechnology. Nanobiotechnology [98-100] acts as a bridge between interactions on the microscopic and molecular levels, leading a path for outstanding and inclusive platform from where it can become the important prospective towards the progress of CVD diagnosis and treatment.

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