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Research Article

A Prospective Combination of Nanotechnology and Medicine: Nanomedicine

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ABSTRACT:

Development of nanomedicine approaches achieved the unprecedented progresses of biomedical nanotechnology. It has the potentiality to diagnosis and treatment of life threading diseases. Nanoparticles used as medicine for their significant, beneficial response to specific internal and external trigger, as well as low toxicity properties with reduce side effects. Nanomedicine strategies have become progressively implemented to control the drug release kinetics and nanoanalytical contrast reagents are useful in nanopharmaceutical research. This paper is documenting many nanomedicine products for therapeutic and diagnostic related applications which are highlighted to modern trend of medicine.

Keywords: Nanomedicine, Drug delivery system, Biomaterials, Bio films.

INTRODUCTION:

In early days, it was thought that the small particles which were used to make wide-motors, robot arms, whole computer is known as nanoparticles and the technology which was used on that domain known as Nanotechnology. The actual definition of Nanotechnology is the projected ability to construct any material from bottom up.

In 1986, Drexler was first coined the term 'Nanotechnology' [1]. In 1959, Richard Feynman observed that a nanoscale atom can be generated by manipulating molecules and atoms using some sophisticated instrument or biological system [2]. Nanoparticles are small in sizes; overall dimension of nanoparticle is under 100nm. So there are several advantages to use them as nanomedicine. In present time, transition metals, silicon, carbon, and metal oxides are used to obtain nanoparticles. [3]. as we all know that, our modern civilization is getting absolute profit from nanotechnology, like-

A) Large scale of energy including economic solar cells.
B) Long lasting battery.
C) Some electronic devices which have ultra high density data storage.
D) Single atom transistor.
E) Most interesting and popular benefit of nanotechnology in medical science. By the help of nanotechnology the medical imaging, pharmaceutical drugs, tissue regeneration, are developing day by day. Not only that, multifunctional platforms are combined in a fraction size. [4-15]

The domain where Nanotechnology combined with biology known as Nanobiotechnology. Based on the usage of nanoparticles in biological field they are classified into three groups, those are organic, inorganic and mixed.

[16] Nanodevices are used as carrier or transporter to target specific infections or diseases by delivering drug or molecules as well as it can protect against the attachment including bio film formation.[16-18]

NANOPARTICLES USED IN DRUG DELIVERY

Smart or stimuli responsive polymers are those polymers which have the ability to respond to both physical and chemical stimulus. Exogenous and endogenous stimuli were generated to delivered the molecule into system for various purpose such as hydrolytic cleavages named as Supra, also conformational changes of stimuli with nanoparticles enhance the reaction in between drug against target molecule.[19] Conformational changes or off-on of a polymer chain can be triggered by using various exogenous stimuli like, electric pulses, ionic strength, US intensity, magnetic field, temperature and microwave.[20]. Apart from this, some endogenous stimulating factors like enzyme concentration, hormone level, small bio molecules, redox gradient etc. [21]. These exogenous and endogenous stimuli can utilize to design the functional motif as well as the side chain of the polymer to deliver the drug into the target system. [22-23] by changing or utilizing the pH variations are most popular stimuli among the researchers it already applied to target slidely acidic tumour sides. [24-28].A new nanobullet was designed by Wilson and his co-workers termed as ‘thioketal nanoparticles’ (TKNs). These delivery vehicles were configured poly-1, 4-phenylacetone dimethylene thioketal (PPADT) for siRNA which was further able to denature selectively in response ROS of intentional inflammation after oral delivery. [29]. In 1965, Alec Bangham and his co-workers first described the swollen phospholipids system. [30] From that time, the enclosed phospholipids bilayer structure consisting of single bilayers which are known as liposomes. [31]. In drug delivery system, liposomes were firstly used in 1971 by Gregoriadis et.al. [32]. The large Uni Lamellar Liposomes (LUV) is designed by using polycarbonate filters which is nowadays a very popular carrier to delivered molecules into target sites. Last few decades mesoporous silicamaterials are very popular nanoagents, used as a drug delivery system.[33-34] Gold nanoparticles such as nanorods, nanocages, nanoshells, were used to design or promote for the formation of liposomes under some isotonic conditions generated through polyethyleneglycol(PEG) and others. The isotonic dendrimers were also used as a coating agent for AuNPs e.g., these complexes act as a strong cytotoxic material against human cervical cancer. Magnetic nanoparticles were embedded into the surface of micro bubbles to apply as a drug and gene delivery system for diagnostic and therapeutic purposes. This super paramagnetic iron oxide with Fe3O4 and L-arginine can be smartly controlled by external ultrasonic radiation including magnetic force. [35] To respond the endogenous or exogenous stimuli some nano sized membrane vesicles are secreted by special cells known as exosomes. Exosomes are suggested as noble drug delivery vehicles for their beneficial features due to the lowest cytotoxicity. Exosomes are attached with specific drugs and use as a transporter for personalized medicines. Exosomes are very popular due to their accuracy and specificity. To produce exosomes Nie’s group has taken account the mouse’s immature dendritic cell.to design this exosome the have utilized exosomal membrane protein lamp to be which is fused with alpha-v integreen specific iRG peptide. Mixture was loaded with with doxorubicin into exosome which is highly efficient exosome for targeting tumour cells. [36]

NANOPARTICLES FOR DISEASE DETECTION AND MEDICAL IMAGING

Gadolinium and iron oxide used as paramagnetic nanoparticles that can alter the relaxation time of selected sites. Nano Gadolinium have been successfully utilized as a contrast agent for resolving such areas as kidney and brain as well as iron oxide is used to resolve as well as imaging of the liver, lymph nodes and bone marrow. [37] For physical and chemical properties of nanoparticles it is used for preventing infectious diseases as well as antibody based diagnosis. For example,

florescent silica nanoparticles can able to detect *Mycobacterium tuberculosis* complex with four hours. Another nanoparticle europium has been successfully used for the detection of anthrax antibodies by using fluorescence ELISA. Silica fluorescence nanoparticle also can be used to detect *Salmonella typhimurium* based on a single stranded DNA aptamer. [38-41] In 2010, Zhang and Hu developed a quantum dot based nanosensor to assay for the detection of HIV- 1 and HIV-2 which is very popular due to low sample which is very popular due to low sample high sensitivity and short analysis time. [42]. During the past few years scientists have been observed that the nanoparticles of 4-100nm, which are more than thousand times smaller than the normal cells due to their size they exhibit strong interaction with bio molecules, present both on the outside and inside the cell. The nanoparticle used as a bio conjugated moieties for selective detection of disease and treatment. [43-47]. Plasmatic noble metal gold nanoparticles exhibit some unique and versatile optical properties due to this is used for cell optical imaging including molecular disease detection and targeting.[48-52].

NANOPARTICLES IN DRUG AND GENE DELIVERY

Drug delivery is one of the most effective applications of nanoparticles in different nanoparticle application areas. Polymer and liposome based drug delivery system is the large part of clinical use of nanoparticles nowadays. Polymer based drug delivery system is easily classified under some specific subdivisions like, polymeric micelles, polymer protein conjugates, polymeric drugs and polymeric drug conjugates. [53]

Cancer

Nanoparticles achieved a legendary success in the treatment of various cancers especially nanomedicines and nanoparticles based drug delivery system. For example, various polymer based drugs and liposomes are presented as therapeutic agents. [53-54]For the treatment of several cancer diseases Paclitaxel is the remarkable anticancer agent for the treatment of various types of cancer like lung, ovarian, esophegal, and skin.

Neurodegenerative Diseases

To produce the medicines or drug delivery system for the treatment of neurodegenerative diseases was the most challenging aspect for scientists, because the drug transport was resisted by natural tendency of blood brain barrier. This blood brain barrier was removed by all those drugs which were made by polyhexaadecyl cyanocrylate. [55-56]

Sex Transmitted Diseases

The delivery of an HIV- 1 protease inhibition CGP-70726, using pH sensitive nanoparticle made from a copolymer of methacrylic acid and ethyl acrylate was investigated by De Jaeghere and colleagues. Eudragit L100-55 is the commercial name of this copolymer. It has pH dependent solbulity so for this reason it was chosen. [57]

Ocular Diseases

Goblet cells secret the diffusion barrier layer in the conjunctiva and protects the cornea. In several cases, eye drops and drug solutions are used to treat the ocular diseases. These medicines are usually high concentrated for these reason frequent applications are required to ensure the prevention of rapid pre corneal loss caused by the mucus during blinking. Commercially available Eudragit polymers were used to deliver non-steroidal and anti inflammatory drug to eyes by Pignatello and colleagues. [58]

CONCLUSION

Nanoparticles offer multiple solutions including prevention of diagnostic and treatment purpose in the area of medical imaging and gene/drug delivery. Over the last few decades nanoparticles have been screened and examined in respect of their properties, shape and size to fulfil some guidelines as per market request. Nanomedicine has become today applied in progressive evolutionary manner to improve the property of therapeutic, diagnostic as well as some health care products.

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