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FUTURE ASPECT OF NANOMEDICINE

Dhanashree B. Midgule, Sutaja L. Ingale, Sayali C. Dudhal, Geetanjali S. Mehetre

Department of Pharmaceutical Chemistry ,KasturiShikshanSanstha College of Pharmacy, Shikrapur, Pune-412208.
Department of Pharmaceutics, Kasturi Shikshan Sanstha College of Pharmacy, Shikrapur, Pune-412208.

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ABSTRACT

Nanotechnology is science which focused on the design, synthesis, characterization and application of materials on the nanoscale. The nanotechnologies nowadays are present in many areas of our life, and they will have much impact on the fields of medicine and health care. The world of medicine is very complex, so all of the benefits from nanoscience and nanotechnology to medicine will take time to become evident; however, other benefits will come immediately. Nanomedicine is the improvement and preservation of human health using molecular tools and molecular knowledge of the human body. Nanomedicines future applications will be based on the ability to repair specific diseased cells, functioning in a similar way to antibodies in our natural healing processes. Human health has always been determined on the nanometer scale; this is where the structure and properties of the machines of life work in every one of thecells in every living thing.

Corresponding author
Miss. Sayali C. Dudhal
Assistant Professor
Department of Pharmaceutical Chemistry,
KasturiShikshanSanstha College of Pharmacy,
Shikrapur, Pune-412208.
scd.ksscop@gmail.com
Tel: +91-9970526611

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INTRODUCTION

'Nanomedicine' is the field of science and technology of diagnosing, treating and preventing disease and traumatic injury, of relieving pain, and of preserving and improving human health, using molecular tools and molecular knowledge of the human body. It was perceived as embracing five main sub-disciplines that in many ways are overlapping and underpinned by the following common technical issues such asanalytical tools, nanoimaging,nanomaterials and nanodevices**,** novel therapeutics and drug delivery systems**,** clinical, regulatory and toxicological issues etc. for the diagnosis, prevention and treatment of disease and to gain increased understanding of the complex underlying patho-physiology of disease 'Nanomedicine is the best nano-size tool. The main purpose is to improve quality of life.[1]There are the three nanotechnology areas of diagnosis, imaging agents and drug delivery with nanoparticles in the 1–1000 nm range."

The main goal of 'Nanomedicine' as the comprehensive monitoring, control,construction, repair, defence and improvement of all human biological systems, working from the molecular level using engineered devices and nanostructures, ultimately to achieve medical benefit.Determination of active components or objects in the size range from one nanometre to hundreds of nanometres nanoscale should be use. They may be included in a micro-device (that might have a macro-interface) or a biological environment. The purpose is always on nanointeractions within a framework of a larger device or biologically, within a sub-cellular (or cellular) system.[2]

Physiological Principles for Nanomedicines:

Nanomaterials can be introduced as potential medicines for several decades. The major task is that how to exploit constructs of this size range in a beneficial way. . Nanomaterials was behave differently to low-molecular-weight drugs, the biological properties of nanomaterials was mainly dependent on relevant physiology and anatomy. 'Nanomedicine' have an grate impact on potential toxicity because biodistribution, movement of materials through tissues, phagocytosis, opsonization and endocytosis of nanosized materials are all likely different as other conventional medicine. [3]

OBJECTIVES OF NANOMEDICINE:

The main objective of nanomedicine drug delivery includes:

i. Nanomedicine systems that improve the solubility and bioavailability of hydrophobic drugs.
ii. Designing delivery vehicles that can improve the circulatory presence of drugs, e.g. of protein-based drugs which are difficult to administer orally due to their breakdown in the alimentary canal before they reach their therapeutic site.
iii. Reducing toxicity: much lower doses of highly targeted drugs means less systemic toxicity. It means it is help to reduce the drug toxicity.
iv. Designing mechanisms to target drugs to specific cells or tissues.
v. Increasing specificity: It will become possible to target individual pathogens or bio molecules.
vi. Developing delivery systems means the 'Nanomedicine' the drug delivary system used for slow release to maintain a level therapeutic dose. Developing novel nanostructures that can be used in specific applications, e.g. ocular, wound management, cancer therapy, neurology, and orthopedics.[3],[4]

Nanomedicine as a Drug Delivery:-

The primary application of nanomaterials is to optimise the target, site-specific drug delivery. The potential of eliminating a tumorous outgrowth without any collateral damage through nanomaterials-based drug delivery. It has significant interest on cancerous treatment. Nanoparticles are the basis on bio-nano-materials [5] and major efforts in designing drug delivery systems are based on functionalized nanoparticles. [1,2] Initially, they can be act as carriers for vaccines and anticancer drugs [5] and then the nanometer size ranges may significantly enhance the drug delivery by affecting the bio-distribution and toxicdynamics of drugs. [6, 7] This can make in vivo delivery of many types of drugs which pose serious delivery problems,a relatively easy task. [8] Modification and functionalism can be done on nanoparticles to deliver drugs through the blood brain barrier for targeting brain tumors can be regarded as a brilliant outcome of this nanotechnology. [9] For example,"Doxorubicin" does not cross the blood–brain barrier, but its integration with polysorbate 80 and modified polybutylcyanoacrylate nanoparticles can increase penetration on blood brain barrier is thesignificant extent. [10] Due to their size, shape and function, nanoparticle systems play a important role in creation of "DNA delivery vectors". [11] They can penetrate deep into tissues and are absorbed by the cells efficiently. Nano-sized colloidal carriers of drugs can be regarded as an advanced development in pharmacotherapy.[1]They can be act as potential carriers for several classes of drugs like anti-cancer, anti-hypertensive and hormones, etc.[12]Submicron colloidal particles have been used as nanoparticles for the purpose of drug delivery [2] and used for the diagnosis of diseases.[10]

Nanoparticles have major scope in pharmacokinetics for insoluble drugs. For example, the trans-retinoic acid nanoparticle coated by $CaCO_3$ was developed as a new drug delivery system, which based on spray drying they can easily formed aggregates. Then these aggregate is to re-disperse in water, which stimulated insulin secretion from islets. [7] Generally, nanoparticle may be composed of polymeric or inorganic materials. Some important examples from literature are reviewed in the following sections.

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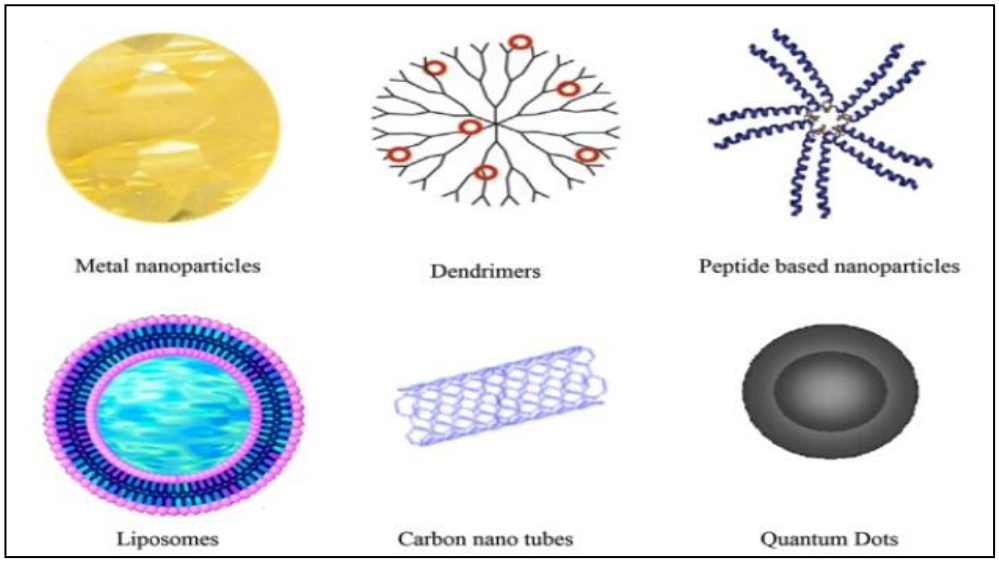

Fig.No.1: Example of Metal Nanoparticle, Dendrimers, polypeptide –based nanoparticle, liposomes, Carbon nano tube, Quantum Dots.

Principles of Drug Targeting:-

The concept of designing site specific drug delivery systems to achieve selective targeting is conceived by Paul Ehrlich. Paul Ehrlich who proposed a system that act as 'Magic bullet'. It is the first statement published on targeting describing targeted delivery is an incident where carriers conjugate and/or complex with drug and delivers it exclusively to preselect and/or target cells in a specific manner. Targeted drug delivery systems is defined as systems, which target the drug selectively and effectively at pre-identified and/or pre-selected target site in therapeutic concentration, while restricting the movement of drug to normal cells, thus minimizing undesirable effects and maximizing therapeutic concentration at target site.A targeted drug delivery system (TDDS) is a system that releases the drug at a pre-selected bio-site in a controlled way.[11],[12]

Objectives of Targeted Drug Delivery System:-

i. To prevent the drug from going into cells/tissues/organs where it is not needed.
ii. To prevent drug degradation and elimination that is done by the body defence system such as opsonins in blood, liver and kidney.
iii. To increase bioavailability and drug accumulation at the target site.[10]

Advantages of Drug Targeting System:-

i. Delivery of drugs to specific pre-identified compartments of the body.
ii. It is help to maximize the intrinsic activity of the drug.
iii. It is help to minimize the entry of drug to non-target cells.
iv. Targeted drug delivery system of Nano medicine help to previously in-accessible domains e.g., intracellular sites, virus, bacteria and parasites offers distinctive therapeutic benefits.
v. Delivery of the drug in controlled manner to pharmacological receptors and it is also help to its binding specifically with target cells.
vi. It is also help to offers protection of the drug inside the body.
vii. It is also help toenroot the drug to extra vascular site of drug action.
viii. It is also have major advantages to maximum drug concentration at the site of action and minimum concentration at non-target tissue and/or organ.[9],[11]

TYPES OF DRUG TARGETING TO TUMORS:-

Passive Targeting:-

The basic principle of passive targeting involves drug-carrier complex and/ or drug delivery vectors that can deliver the drug directly on tumor cells or tissues. In case of cancer nanotherapeutic the size of nanomedicines andthe behaviour of tumor tissue vasculature play an important role in passive targeting.These type of passive targatingaiso help to increased metabolic requirement of growing tumor cell as well as pre-existing blood vessels are exposed to pressure that leads to the development of new capillaries to the tumor by the process of angiogenesis. Accumulation of nanomedicines in tumor tissues is dependent of interstitial fluid pressure which is help elevated in tumor tissues than the normal tissues. In particular, interstitial pressure is higher at the centre and diminishing towards the periphery which is responsible for inducing drugs to outflow from the cells leading to redistribution of drug in the cancer tissues and/or cells. The accumulation of nanomedicinesas an important role in in proliferating tissues is also dependant of size, surface characters, and circulation half-life.[8],[10],[11]

Enhanced Permeability and Retention:-

Nanomedicine play an important role in cancer tissue because the vasculature found in cancerous tissue is extensively different from normal tissue with respect to their size, density, permeability and flexibility. It is mostly heterogeneous in distribution, larger in size, has high vascular density and is more permeable and leaky, unlike the tight endothelium of normal blood vessels. Due to this leaky and defective architecture of tumor vasculature could be due to elevated levels of vascular mediators such as bradykinins, nitric oxide, and vascular endothelial growth factor (VEGF), basic fibroblast growth factor(bFGF), prostaglandins, etc. The leaky vasculature mainlypermits diapedesis (extravasation) of circulating nanocarriers within the tumor interstitium. This phenomenon coupled with the impaired lymphatic drainage of macromolecules in solid tumors, allowsto an enhanced accumulation and retention of high molecular weight drugs in or around neoplastic tissue. This property of accumulation for macromolecular drugs in tumor tissue is much more than they execute in normal tissues is known as enhanced permeability and retention (EPR) effect. The EPR effect is predominantly used for passive targeting of drugs encapsulated in carriers.

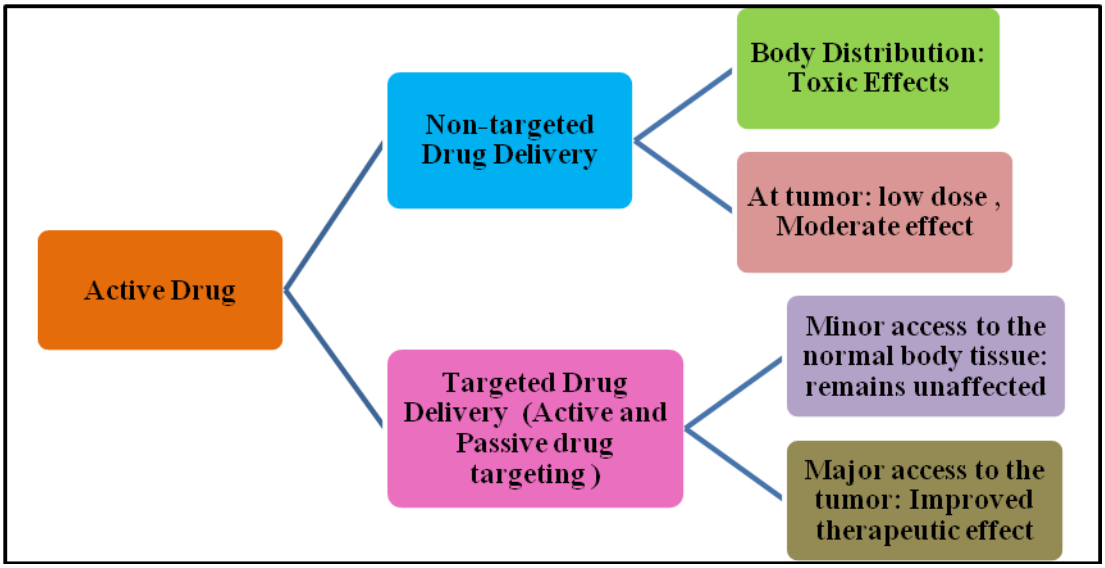

Fig.No. 2: Active Drug (non-targeted and targeted) drug delivery system.

Active Targeting:-

Drug delivery system of 'Nanomedicine ' plays an important role in Active targeting.These process involves conjugation of targeting molecules like antibodies, ligands, peptides, polymers, nucleic acids etc on the surface of nanocarriers with receptors. These receptor targating complex plays an important role in disease recovery. Tumortargeting molecules on the nanocarriers bind to tumor tissues via an endosome-dependent mechanism that bypasses the drug efflux pump leading to high intracellular concentration. The distribution pattern of the drug-carrier complex is can altered by physical, chemical and biological means, so that it is identified and reached only throughparticularised. The Nanotechnologies and possible nanobiotechnologyan application plays an important role in human medicine, as illustrated in the diagram (Figure 3).

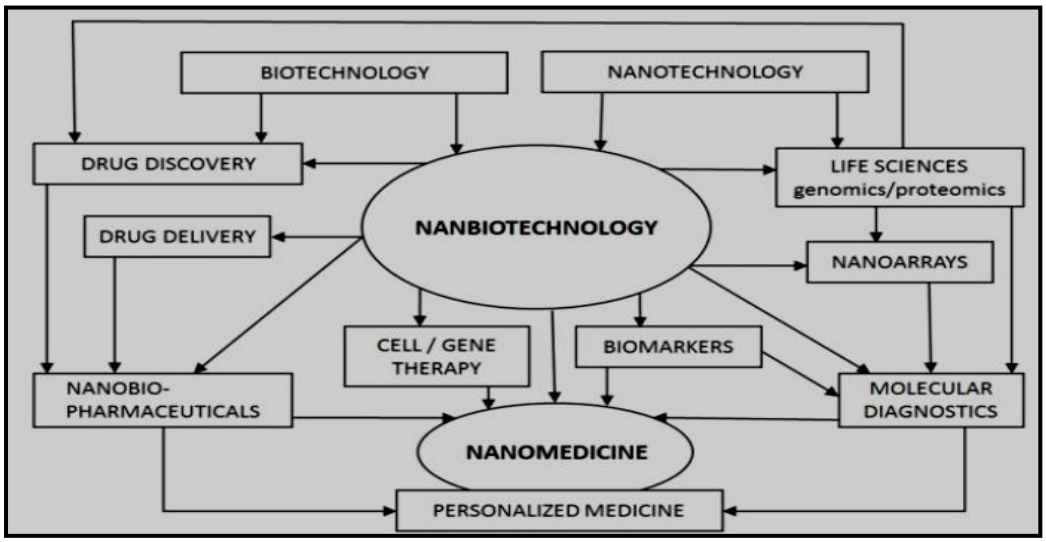

Fig. No. 3:Importance of Nanotechnology in Nanomedicine.

Nanomedicines for Tumor Targeting:

Nanotechnology baseddrug delivery systems plays an mportant role in tumar targeting treatment. Nanomedicines plays major role diagnosis and treatment of the tumor with great accuracy and effectiveness. Nanotechnology means nanoscale performed technology. The nanoscaleparticles/ nanoparticles are ultrafine particles in the nanometer size ranging from 1 nm to 1000 nm. Nanomedicine is an important area in nanotechnology which refers diagnosis, prevention and treatment of diseasesspecific medical intervention at the molecular level. [5]Polymers play an important role in the development of nanocarriers based cancer drug delivery. The word "polymer therapeutics" [9, 10] includes polymer-drug, [11-13] polymer–protein, [13, 14] and/or polymer-micelles [16] conjugates which are used in polymeric nanomedicines. Polymeric nanomedicines include different variety of architectures such as liposomes, niosomes, micelles, micro and nanospheres, nanogels, other vesicular systems, and dendrimers. Some important technological advantages of nanotherapeutic drug delivery systems (NDDS) are as follows:-[17, 18]

i. It has Prolonged half-life.
ii. It helps Improved biodistribution of anti-cancer drugs.
iii. They also have Versatilitynatueof route of administration (NDDS can be administrated through oral, nasal, parenteral, intraocular routes etc.)
iv. In whichBoth hydrophilic and lipophilic compounds can be delivered efficiently.
v. Due to optimized size and surface characteristics of nanopraticlulate carrier systems increase circulation time of the drug.
vi. Release of the drug in controlled and sustained manner during the transportation and at the site of drug action.
vii. Increased intercellular concentration of drug either bybetter permeability and retention effect or by endocytosis mechanism.For quick and successful clinical translation, the nanocarriers should exhibit following characteristics [19]:-

a) Made-up by biocompatible, well characterized and simple in use material;
b) Have high uptake in the proliferating tissues over normal tissues
c) Soluble and/or colloidal under aqueous condition with better efficiency;
d) Have a long shelf life and extensive circulating half-life, and Have a low aggregation rate.

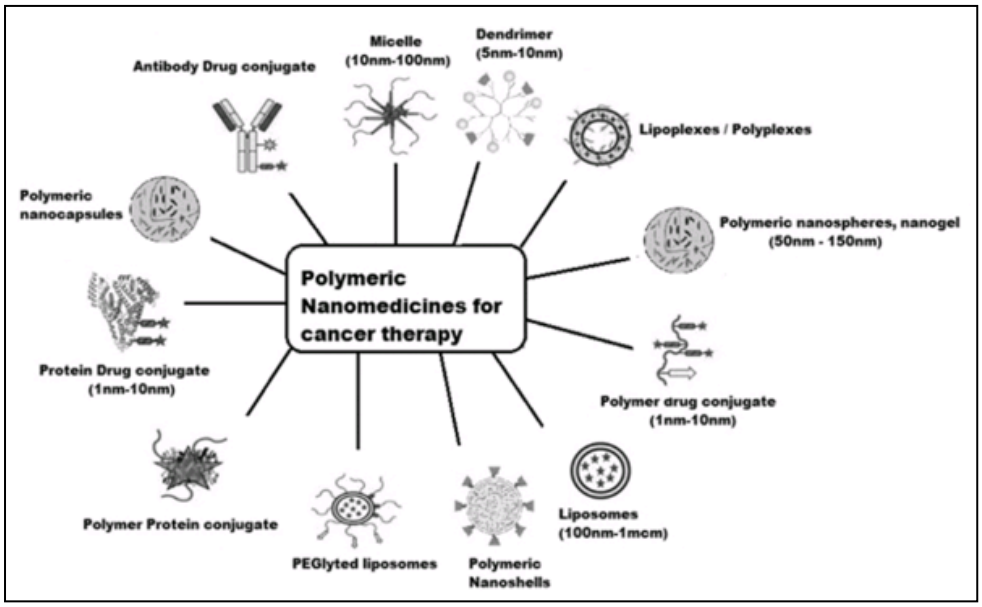

Fig. No. 4: Typesof Polymeric Nanomedicines for Cancer therapy.

TYPES AND PROPERTIES OF DRUG DELIVERY TOOLS USED IN NANOMEDICINE:-

On the basis research of nanotechnology and nanomedicine applications have been particularly prolific pertains to delivery of diagnostic and therapeutic agents. Drug deliverycarriers are macromolecular assemblies that can incorporate imaging and therapeutic compounds of distinct nature, such as small chemicals, fluorophores and biosensors,peptides and proteins, and oligonucleotides and genes. They can be designed for improvement the solubility of these cargo molecules and their increase the bioavailability, and also to control theircirculation, biodistribution in the body. It is also help to increase the release rate enhancing their efficacy. [20]

Nanocarrier design:-

A broad spectrum of materials like biological, synthetic and semi-synthetic are assembled in a variety of conformational arrays (from linear structures to branched and dendritic counterparts, micelles, hollow capsules, porous or solid particles, etc.) have been designed to help in diagnostic and therapeutic interventions.Such as these include carbon nanostructures, quantum dots, metal particles, liposomes,andformulations based on natural and/or synthetic polymers (Fig.no.5). The composition and architecture of these systems play an important role in determining their translational capabilities, including their ability to carry cargoes of different chemistries and their loading capacity,stabilitybiodegradability and overall biocompatibility, and various functional aspects.[20],[21]

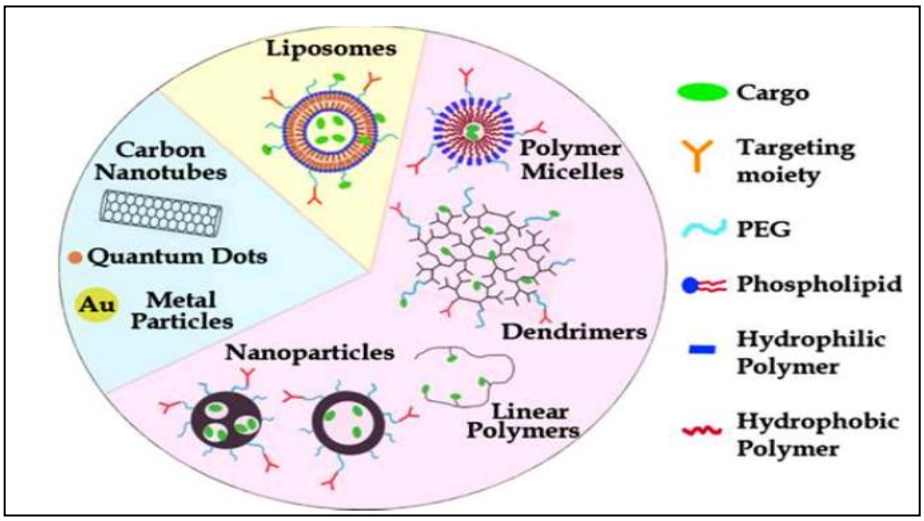

Fig.No.5: Nanocarrier Design.

Pharmacokinetics, targeting, and sub-cellular transport of nanocarriers:-

For the development of effective diagnostic techniques and therapeutic delivery methods carry a number of important challenges.The many of which may be overcome with the input of nanomedicine approaches. The size scale of nanomedicines and the degree of manipulationto which they can be subjected and make these endeavors seemingly tangible. Drug delivery carriers can be used to improve control of their circulation and biodistribution and solubility in the body at the tissue, cellular, and sub-cellular level. This is can be achieved by incorporating immune-evading moieties. The affinity molecules that favor adhesion to either general or specific biological markers, depending on the degree of selectivity required. In addition,when carriers are targeted to cellular receptors involved in endocytic transport or coupled to cell penetrating peptides. In case of if they are designed to modify the permeability of cellular barriers, they also provide delivery to a variety of intracellular compartments, such as the lysosome, cytosol, nuclei, etc., and can furthermore be transported at some extent across cellular layers, a requirement for a number of clinical goals.[22],[23]

Circulation and Clearance:-

When the drug are administered in vivo, therapeutic agents are often recognized as foreign substances are rapidly cleared from the body. This is a general obstacle of classical means of drug delivery. That also applies to chemicals used as palliative treatment of symptoms associated to genetic diseases. The more specific small molecules used to regulate affected metabolic pathways, inhibitorsand activators of the affected molecules, chaperones to improve folding and stability. Therecombinantproteins an enzymes used for replacement therapies. The clearance of foreign compounds in the body occurs mainly by the reticularendothelial system and other elements of the immune system, as well as by renal. Resident macrophages in the alveoli remove substances administered into the lungs through the respiratory tract,Kupffer's cells in the liver sinusoids remove materials that enter the portal circulation through the gastrointestinal epithelium.The materials administered in the systemic circulation are cleared mainly by the spleen and liver, and the lymph nodes remove substances that arrive to the tissue parenchyma by draining them through the lymphatics. [24]

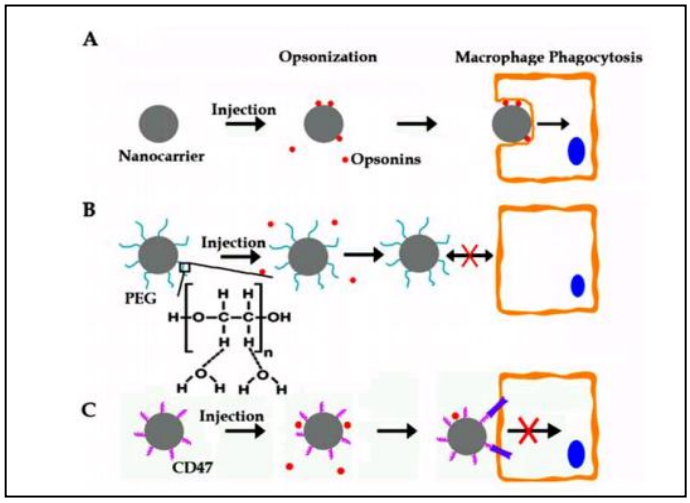

Fig.No.6: Strategies to minimize rapid clearance of nanocarriers.

Targeting:-

According to above information as describe previously, nanomedicines play an important role in improve the bioavailability and pharmacokinetics of diagnostic and therapeutic agents, also protecting them from rapid degradation. In per maximize their efficacy, carriers can be designed which leads to help maximize bioadhesion to areas in the body where their action is required, a strategy known as targeting (Fig. no.7). [21],[25]

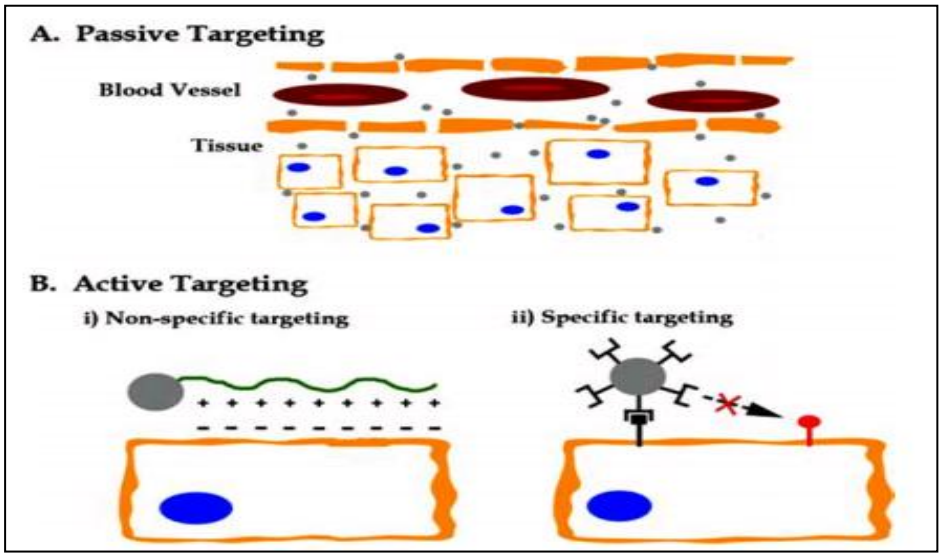

Fig.No.7: Passive and Active Targeting of a drug carrier.

In other cases enhanced the drug delivery throughout the body rather than specific delivery to particular organs, is preferred. Therefore due to this genetic conditions that affect multi-organ systems due to ubiquitous distribution of the molecular markers or functions may be affected, such as in many monogenic disorders with both peripheral nervous system and central nervous system components. Since the most therapeutics do not present intrinsic affinity to cells in the body. Due to the coupling to the respective carriers which gives the affinity property. This is the major advantages. Such specific targeting it may be help to may reduce potential side effects of the therapeutic in non-intended targets. For such an instance, carriers injected in the circulation are passively targeted to organs irrigated by the vascular bed and afterword they immediately downstream the area of administration (first pass phenomenon), such as in the case of pulmonary accumulation of carriers administered intravenously. Also the nanocarriers can gain preferential access to organs irrigated by discontinuous blood vessels (Figure 3A), which do not pose a barrier from free diffusion of substances between the circulation and tissue, such as in the liver, an organ considered a main therapeutic target for many monogenic diseases that affect metabolic pathways. However, delivery of therapeutics to most other sites in the body requires more complex and precise strategies of active targeting.

This can be achieved by coupling to affinitymoieties that recognize specific markers expressed by the cells which require intervention (Fig. 7Bii), including natural ligands of such markers, proteins and peptides, antibodies and their fragments, sugars, and aptamers. Also, targeting to markers that are expressed under certain pathological processes (as opposed to control physiological conditions) helps favouring delivery to disease sites. Whether it is due to targeting via positively-charged moieties or by specific affinity means, targeted delivery of drug carriers offers advantages over direct targeting of therapeutics. Apart from the described advantages posed by increased solubility, circulation time, and release control, carriers bearing multiple copies of an affinity moiety display greater affinity due to this multivalency, compared to drugs that are directly coupled to one copy of the same affinity molecule. As described below, multivalency of targeted carriers also provides tight binding to cell surface receptors, which can favour uptake with in the cell, a necessary requirement for many diagnostic and therapeutic applications. [26]

Sub-cellular transport:-

For most applications the molecular targets for intervention are intracellular. Therefore, targeting to selected cells and tissues is not sufficient to attain significant effects; the delivered cargoes must also gain access to intracellular compartments where their molecular targets are located. Interventions related to RNA interference or delivery of antisense oligonucleotides requires transport of these cargoes to the cytosol of the cell, where the target is accessible. This is also the case for delivery of some chaperones, inhibitors or activators, enzymes and other proteins located in the cytosol or sub-cellular organelles for such as in the moitochondria, peroxisomes, etc., which can be re-directed to these compartments by signal peptides if drug delivered previously to the cytosol. The Gene therapies also require drug delivery to the cytosol, with a subsequent transport to the cell nucleus according In all these cases, cytosolic delivery can be granted mainly by two routes: direct transport of the good carrier on cargoes and/or their carriers from the extracellular space to the cytosol of cells, or engulfment by the plasma membrane and In the uptake to vesicular compartments. (A) Endocytosis of carriers can lead to transport to endosomes and lysosomes, whereto acidic pH and hydrolases can be degrade the carrier components and release the therapeutic cargo.

Alternatively, pH-sensitive carriers can destabilize the endosome, releasing the cargo to the cytosol. (B) Transport across cellular layers can take place either via paracellular transport between adjacent cells or via transcytosis across the cell body (by on the vesicular mediated endocytosis and exocytosis).[27],[28]

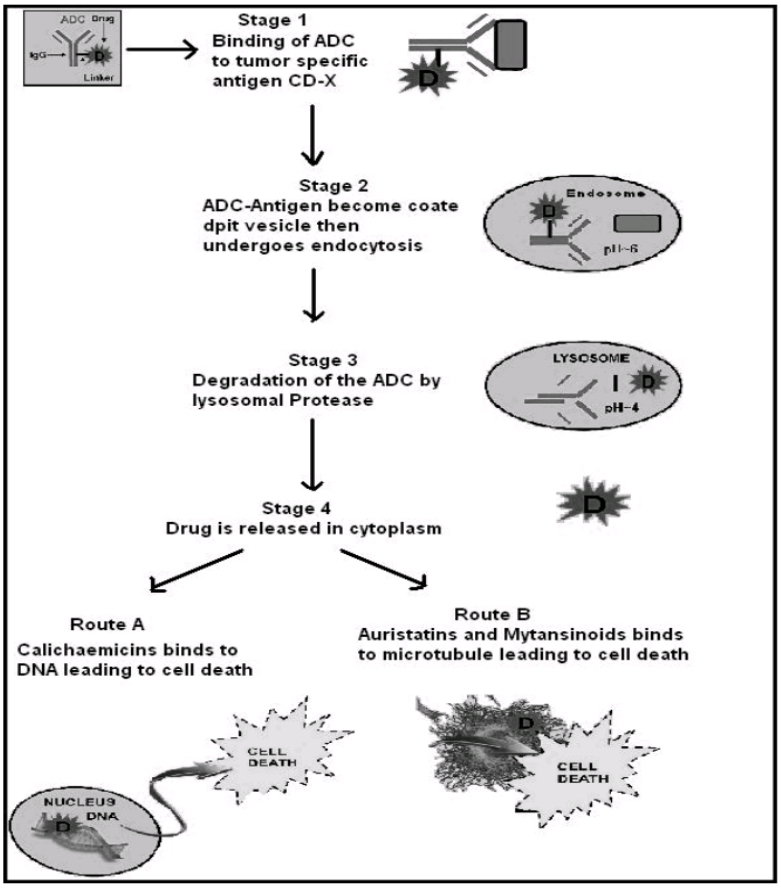

Fig. No. 8: Sub-cellular delivery of nanocarriers. A) Endocytosis of carrier can lead to transport.

MECHANISM OF ACTION OF ADCS:-

The mechanism of action of ADCs as illustrated in (Fig. no.9) consists of the following four Stages:-

Stage 1: Binding of ADC to tumor specific antigen.

Stage2: Catherin-mediated endocytosis of ADC-antigen complex Stage 3 Degradation of ADC-antigen complex by lysosomal protease

Stage 4: Release of drug in cytoplasm

Stage 3: Degradation of ADC-antigen complex by enzyme lysosomal protease

Stage 4: Release of drug in cytoplasm

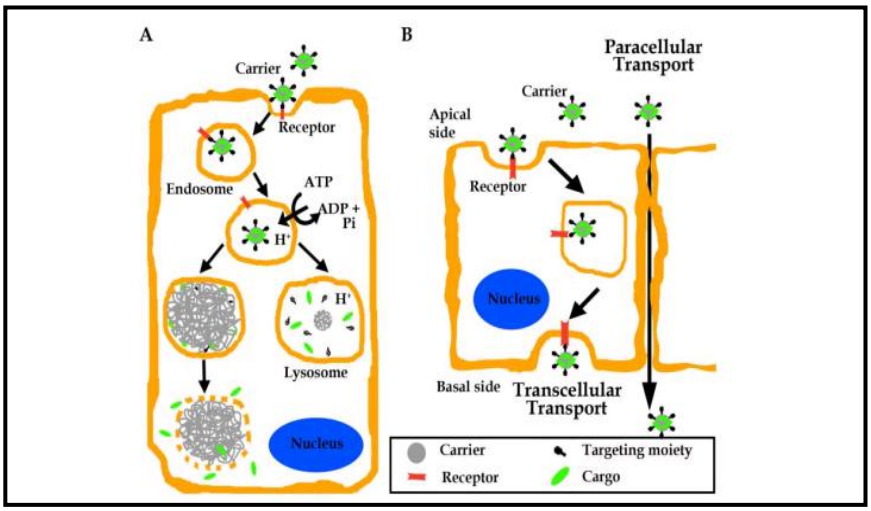

Fig. No. 9: Mechanism of action of ADCs.

Nanomedicine applications for treatment of genetic diseases:-

The various several properties of nanomedicine designs, or is mainly pertaining there are biocompatible size andhigh degree of manipulation that allow adaptation to different biomedical applications, have a caused this field to be considered a new technological revolution. Nanotechnology has opened new possibilities for ex vivo detection methods (e.g., applicable to mutation screening) as well as biomarkers of disease, with various several technologies being also applicable for in vivo imaging.These strategies are considerably more sensitive than the traditional methods, permitting detection in smaller samples and/or providing more accurate measurements and tracings of the parameters of interest. From the therapeutic perspective, nanomedicine strategies hold considerable promise to improve control parameters forsuch as the solubility, stability, clearance, biodistribution, sub-cellular transport, controlled release of therapeutic cargoes of diverse nature, improving their efficacy and minimizing potential side effects.For the most part use, these technologies are the still at the experimental stage, particularly those they require in vivo administration as opposed to those designed for ex vivo diagnosis and detection.[26]However, research as has shown a great potential of these platforms for clinical translation in the near future, with similar examples being also already available in the market, mostly in the case of cancer therapeutics. Although the relatively unexplored in the case of theirgenetic deficiencies, the use of nanomedicine principles and strategies for diagnosis and treatment of these conditions is a rapidly growing field with highly promising perspectives.[29]

Small molecule therapy:-

Small molecule therapy means typically encompasses chemicals used either or for palliative care of symptoms or more specifically designed to cope with a particular landmark that regulatedisease progression. In many cases of their small size and chemical properties are same as relativelypermissive of diffusion through the body and cells, with relatively good efficacy. Another important cellular barrier encountered by some cases of small molecule therapies is that of the blood-brain interface, which are the forces more invasive means of local delivery, including direct injection or implantation of the naked therapeutic agent or different scaffolds containing a said therapeutic into the brain, e.g., by on intracerebral or intraventricular, administration are used. In this regard, prolonged circulation and stability rendered by nanocarriers can be enhancing the chances of drug diffusion into the brain parenchyma. As carrier to target of particular transporters of the blood-brain barrier can also improve cross into the central nervous system. For Examples illustrating this are those that capitalize on targeting the transfer in receptor, which is provides trans-endothelial transport by a clathirn-mediated mechanism. This has been explored for drug delivery of nerve growth factor for Huntington's disease Nanocarriers have also been used as vehicles to assist in transporting chelating agents into the brain for iron capture and removal in Alzheimer's disease, also used with potential in Huntington's and Parkinson's diseases. Similar those nanomedicine strategies can improve drug delivery of other small molecule therapies for genetic diseases, including various hormones to control regulatory pathways, antibiotics, growth factors, cofactors, inhibitors or activators that act as upstream or downstream of affected pathways, chaperones that favor proper protein folding, and other chemicals. [29],[30]

Enzyme Therapy:-

The term enzyme therapy describes the administration of exogenous enzymes to replace their defective endogenous counterparts (enzyme replacement therapy or ERT) and cn also be extended beyond the treatment of various genetic diseases with a impaired enzyme production, for instance in cases where administration of additional enzymes that are not encountered endogenously in the human body can also be help alleviate phenotypic symptomsHowever, effective drug delivery of enzymes often suffers from the impediments stated above these small molecule therapies, with the added of that arise from using proteins as therapeutic agents: susceptibility to the proteases, high potential for immunogenicity, and In even more reduced penetration within tissues and cells in the body.

Therefore, these therapeutic strategies represent good targets for improvement by nanomedicine approaches. For example, several lysosomal ERTs are clinically available, providing a marked phenotypic improvement. However, in many cases are produced the production of antibodies against the administered recombinant enzymes hinders the efficacy of this treatment over time, which represents a major obstacle for treatment of these chronic conditions. This could be ameliorated by encapsulating or coupling said enzymes within immuno-evasive carriers or polymers,For such as those described in above section. Some cases preliminary attempts in this direction include the case of delivery of PEG-modified dextranase enzyme, which is achieved prolonged activity by bypassing immune recognition in a mouse model of LSD mimicked by lysosomal accumulation of dextran.Similar to strategies of PEGylation have been useful for delivery of uricase enzyme for gout in treatment of hyperourecemia.[30],[31]

Gene Therapy:-

The definition of gene therapy is broadly explain that encompasses the modulation of the expression of genes affected in genetic conditions, which can be achieved at the level of providing codifyinggene sequences that can enable the transcription and translation of functional proteins otherwise affected by these defects, or other regulatory sequences that can be up-regulate or down-regulate said expression at any stage during transcription the codifying sequence of the affected gene, or delivery of oligonucleotides for correction of mRNA transcripts by the mRNA insertion/deletion, small interference RNA (siRNA) for silencing, etc.[24] This strategy capitalizes on the viral vectors, by given that many viruses can actively bind to cell surface receptors, enter cells by the endocytosis, and gain of access to the cytosol and the nucleus, in certain cases, by escaping the endo-lysosomal vesicles in which they are contained. These viruses have evolved mechanisms capable of "sensing" the lowering pH within endosomes and lysosomes, e.g., by protonation of amphiphilic molecules, which can then destabilize and porate the endo-lysosomal membrane.Delivery of said nucleic acid-based therapeutics has been shown to be markedly effective when using viral vectors, which is attributable to their innate ability to effectively deliver double-stranded or single-stranded DNA or RNA molecules within cells. [30]

ADVANTAGES OF NANO MEDICINE:-[31]

i. Advanced therapies with reduced degree of invasiveness.
ii. Reduced negative effects of drugs and sur-gical procedures.
iii. Faster, smaller and highly sensitive diag-nostic tools.
iv. Cost effectiveness of medicines and disease management procedures as a whole.
v. Unsolved medical problems such as can-cer, benefiting from the Nano medical ap-proach.
vi. Reduced mortality and morbidity rates and increased longevity in return.

DISADVANTAGES OF NANO MEDICINE:-

i. The defect of proper knowledge about the effect of nanoparticles on biochemical pathways and processes of human body.
ii. Scientists are primarily concerned about the toxicity, characterization and exposure pathways associated with Nano medicine that might pose a serious threat to the human beings and environment.
iii. The society's ethical use of Nano medicine beyond the concerned safety issues, poses a serious question to the researchers.

FUTURE APPLICATIONS OF NANOMEDICINE:-

Nanomedicine refers to our future developments inmedicine that will be based on the ability to build nanorobots. In the future these nanorobots could be actually programmed to repair specific diseased cells, functioning in a similar way to antibodies in our natural healing processes. Nanotechnologies are set to increase rapidly over the coming years. Researchers are developing customized nanoparticles the size of molecules that can be deliver drugs directly to diseased cells in your body. When it is perfected, this method should be greatly reduce the damage treatment for such as the chemotherapy does to a patient's healthy cells.Nanomedicine refers to future developments inmedicine that will be based on the ability to build nanorobots. In the future use of these nanorobots could actually be programmed to repair specific diseased cells, functioning in a similar way to antibodies in our natural healing processes.[32]

i. The elimination of bacterial infections in a patient within minutes, instead of using treatment with antibiotics over a period of weeks.
ii. The ability to perform surgery at the cellular level,removing individual diseased cells and even repairing defective portions of individual cells.
iii. Significant lengthening of the human lifespan by repairing cellular level conditions that cause by the body to age.[33][35][36]
iv. To bring together regulatory experience with first-generation nanomedicines the European Medicines Agency's main Scientific Committee for Human Medicinal Products established a multidisciplinary expert group on nanomedicines in 2011. [34],[35]
v. The remit of the expert group is to provide scientific input for well-founded Scientific Advice, collate the current regulatory reflection for the safe approval of the nano similar nanomedicines, and to monitor the uptake of technical advances in the development and evaluation of upcoming new nanomedicines, for example, innovative block copolymer micelle products that are being also developed as an nanomedicines to assist targeted drug delivery and control drug release. [17]
vi. A chain of RPs has been drafted on principles for the development and evaluation of nanosimilars developed with reference to first-generation nanomedicines and the principles to be considered when generating supporting evidence to changes made by to the manufacture and control of these products [9,10], and principles for the development and evaluation of emerging nanomedicines (second-generation nanomedicines) progressing towards first-in-man studies. [11],[32]

FUTURE SCOPE OF NANOMEDICINE:-

i. In different away and areas of Nanomedicine, synthesis and use of novel nanomaterials and nanostructures (e.g., less antigenic)
ii. Biomimetic nanostructures (synthetic products developed from an understanding of nature or biologic systems);
iii. Nanoanalytic tools, methods, and instruments for studying single or multi-subunit biomolecules or individual diseased cells (e.g., combining biochemical techniques with advanced imaging and spectroscopy to provide insights to the behaviour of single diseased cells and their surrounding microenviroent, leading to personalized therapy)
iv. Devices and nanosensors for early point-of-care detection of diseases and pathogens (e.g., in vitro diagnostics like molecular pathology or reading highly-integrated ultra-sensitive biochips via devices that reply upon the polymerase chain reaction coupled with micro/nano fluidics)
v. Identification and quantification of novel or disease-related biologic biomarkers/targets/receptors/ligands for imaging, diagnosis and therapy (e.g., for advising patients the risks increased of certain cancer, neurodegenerative diseases, and cardiovascular diseases, thereby providing an avenue for personalized prevention regimen)etc.

CONCLUSION

Various problems of conventional medicine are circumvented with the use of nanomedicine in cancer detection and treatment. Nanomedicine potentially offers a means of earlier diagnosis; more effective, safer, and personalized treatments; as well as reduced health care costs. The work reviewed here also to demonstrates the design parameters that are critical to achieve favorable tumor penetration and distribution; and also various examples that have come into clinical practice. A number of FDA-approved therapeutics, medical devices, imaging agents, and diagnostic devices containing nanomaterial's have become available, advancing medicine and improving health care etc. The development and availability of nanomedical products, it is expected that research become a useful for medicine our in the future.

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CONFLICTS OF INTEREST

The author declares no conflict of interest.

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