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A REVIEW ON NOVEL DRUG DELIVERY SYSTEM IN RECENT MOVEMENT

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ABSTRACT

Novel drug delivery systems gift a chance for formulation scientists to beat the various challenges related to medicinal drug medical aid, thereby improving the management of patients with various disease Some medication have an optimum concentration vary with within which most profit springs and concentrations higher than (or) below the vary will be harmful or turn out no therapeutic result. varied drug delivery and drug targeting systems area unit presently below development. the most goal for developing such delivery systems is to reduce drug degradation and loss, to stop harmful aspect effects and to extend bioavailability. Targeting is that the ability to direct the drug loaded system to the location of interest. Controlled drug carrier systems like micellar solutions, vescicles and liquid dispersions, as well as nanoparticle dispersions consisting of little particles of ten – four hundred nm show nice promise as drug delivery systems. Novel drug delivery systems in present as an opportunity for formulation of various dosage form to overcome the many challenges associated with drug delivery to the specific site of action. Through NDDS(novel drug delivery system) the disease can be treated with specific action in very low time duration. Now a days, There are various dosage forms used as novel for increase therapeutic effects in patients and it also improves patient compliance. better drug bioavailability is there. less risk of side effects. low dose can work as better drug delivery. this type of delivery system have been developed for achieving sustained drug release kinetic and for addressing formulation difficulties such as poor solubility, stability and drug entrapment. The physico-chemical properties and the *in vitro*/*in vivo* performaces of various systems. Nanoparticles, nanocontainers, liposomes, aspasomes, emulsomes, nanopowders, microemulsions etc included in novel drug delivery system.

KEYWORDS: Drug delivery system, bioavailability, Nanoparticles,microemulsion.

INTRODUCTION

The method by that a drug is delivered will have a major result on its efficaciousness. Some medication have an optimum concentration vary at intervals that most profit comes, and concentrations on top of or below this vary is cyano genetic or turn out no therapeutic profit in the least. On the opposite hand, the terribly slow progress within the efficaciousness of the treatment of severe diseases, has urged a growing would like for a multidisciplinary approach to the delivery of medicine to targets in tissues. From this, new concepts on dominant the pharmacological medicine, pharmacodynamics, non-specific toxicity, immunogenicity, biorecognition, and efficaciousness of medication were generated. These new methods, usually known as drug delivery systems (DDS), area unit supported knowledge domain approaches that mix compound science, medicine, bio-conjugate chemistry, and biological science. Dramatic changes have in introduced, with new technology and new devices currently on market. In some cases ancient capsules and ointments are replaced by diffusion pumps, wearable ambulant pumps, electrically assisted drug delivery and host of alternative delivery strategies supported variedcompound technologies. In some cases the new medication need new delivery systems as a result of the normal systems area unit inefficient and ineffective. Some therapies might become terribly website specific and need terribly high concentrations of medication in hand-picked sites of body, as a lot of controlled drug delivery systems are offered terribly close to future. New drug delivery system development is essentially supported promoting the therapeutic effects of a drug and minimizing its cyano genetic effects by increasing the number and persistence of a drug within the section of target cell and reducing the drug exposure of non target cells.[1,2,3&4]

The biopharmaceutical performance of associate existing drug molecule may be considerably improved through its evolution from a standard kind to a completely unique delivery system. except biopharmaceutical performances, the safety, effectualness and patient compliance also are improved for a drug molecule. gift day drug delivery firms area unit action conspicuously on development of multiple platform technologies for obtaining competitive deserves, expand patent span, and enhance market share of their merchandise. The quantum of novel drug delivery merchandise has considerably accumulated within the past few years, and this growth is anticipated to continue within the close to future. These days giant numbers of firms area unit busy developing super molecule and amide primarily based drug molecules

because of advancement within the field of genetics that successively accelerated analysis of biopharmaceuticals because of the distinctive nature of biopharmaceuticals it's trouble some to deliver them by typical routes and this presents challenges to the drug delivery scientists. Therefore, gift analysis is specializing in the delivery of those advanced molecules through completely different routes as well as oral, nasal, pulmonary, vaginal, rectal, buccal, colon specific, etc.[5]

Drug characteristics dissent dramatically, even those aimed to treat identical symptoms; chemical composition, size, hydrophilicity and efficiency establish molecules whose operate could also be specific or extremely complicated. AN increasing understanding of cellular biology at the molecular level, combined with the (decoding) of the human order, and a technological breakthrough within the field of genetics and deoxyribonucleic acid micro-arrays, has introduced even additional candidates, like peptides and nucleic acids (gene delivery).

Drug activity may be a results of molecular interaction (s) in bound cells; it's so simply deduced that it's necessary for the drug to succeed in somehow the location of action following administation (oral, endovenous, local, transcutaneous, etc.) at adequate concentrations. The scientific field addressing this issue is understood as drug delivery and has primarily the subsequent aim: to deliver the drug at the correct place, at the correct concentration for the correct amount of your time. once this can be not possible by merely choosing AN applicable administration route, or if such administration causes patient discomfort, methods supported the association of the drug with a carrier (a drug delivery system – DDS) or another.[6,7]

Design of floating pharmaceutical indefinite quantity forms with a bulk density but internal organ fluid is one in every of the thriving trends for enhancing drug residence within the abdomen. These systems would act free lance of the extremely variable nature of the internal organ voidance method leading to reduced fluctuations of drug bioavailabilities.

Apart from the commented advantages established by these floating systems, they may even have their limitations provided that they need a satisfactory level of fluid within the abdomen to float. Likewise, within thefed state a modification in body position to supine may have a right away result on the floating system. so as to style a a lot of systematic and intellectual floating system it's as vital as ever to check completely different aspects of those systems to

own a deeper insight to the buoyancy, drug un harness mechanisms, effectiveness associate degreed responsibleness of those floating systems as associate degree strategy for establishing an economical gastro retentive drug delivery system.[8]

Merits of novel drug delivery system

Due to increasing cost of successful drug discovery, the present pharmaceutical industry is under the stress of downward pressure on prices of pharmaceutical products. The costs as well as time for development of a new chemical entity are much higher than those required to develop a new drug delivery system. A novel drug delivery system gives new life to a drug molecule, thereby increases its market value and competitiveness and extending patent life. In past couple of years, there has been a significant increase in novel drug delivery approvals and this is expected to continue at an impressive rate in the near future.[9]

Demerits of navel drug delivery system

Novel drugs which are administered through the oral cavity should possess the risk of undergoing acid or enzymatic degradation or hydrolysis. Some medical devices like Nano shell, Nano tube, Nano pores are difficult to administered into body of some patient, baby, or old people. All type of drugs or medicine cannot be administered through the nanoparticles, carriers or devices because they cannot be incorporated in the polymer matric or they can be degraded. But the scientist and researchers are continuously try to overcome the drawbacks through their invention.

- Barriers to drug delivery in tumors
- Challenges and barriers of ocular drug delivery
- Formulation design of poorly soluble drugs
- Vegetative formulation
- Pharmaceutical equipment & drug release testing
- Academy & industry perspective.[10]

Drug Delivery Carriers

Colloidal drug carrier systems like micellar solutions, sac and liquid dispersions, in addition as nanoparticle dispersions consisting of little particles of 10–400 nm diameter show nice promise as drug delivery systems. oncedeveloping these formulations, the goal is to get systems with optimized drug loading and unharness properties, long shelf-life and low toxicity. The incorporated drug participates within the microstructure of the system, and

willeven influence it thanks to molecular interactions, particularly if the drug possesses amphiphilic and/or mesogenic properties.[11,12]

Liposomes

Tiny pouches made from lipids, or fat molecules encompassing a water core wide used for clinical cancer treatment. Many completely different forms of liposomes are wide used against infectious diseases and may deliver bound vaccines. Through out cancer treatment they encapsule medicine, shielding healthy cells from their toxicity, and stop their concentration in vulnerable tissues like those of patient kidneys and liver.

Liposomes also can scale back or eliminate bound common aspect effects of cancer treatment like nausea and hair loss.

They are kind of vesicles that consist either of the many, few or simply one lipid bilayers. The polar character of liposomal core permits polar drug molecules to be encapsulated. Amphiphilic and oleophilic molecules are solubilised among lipid bilayer per their affinity towards phospholipids.

Hydrogels

Hydrogels ar three-dimensional, hydrophilic, chemical compound networks capable of uptake massive amounts of water or biological fluids. The networks ar composed of homopolymers or copolymers, and ar insoluble because ofthe presence of chemical crosslinks (tie-points, junctions), or physical crosslinks, like entanglements or crystallites.

Hydrogels exhibit a physical science compatibility with water, that permits them to swell in liquid media. They're wont to regulate drug unleash in reservoir-based, controlled unleash systems or as carriers in swellable and swelling-controlled unleash devices. On the forefront of controlled drug delivery, hydrogels as enviro-intelligent and stimuli-sensitive gel systems modulate unleash in response to hydrogen ion concentration, temperature, ionic strength, field, or specific analyte concentration variations.

In these systems, unleash may be designed to occur among specific areas of the body (e.g., among a definite hydrogen ion concentration of the organic process tract) or conjointly via specific sites (adhesive or cell-receptor specific gels via bound chains from the colloidal gel surface). Hydrogels as drug delivery systems may be terribly promising materials if combined with the technique of molecular learning.[13]

Nanoparticles

Nanoparticles (including nanospheres and nanocapsules of size 10-200 nm) within the solid state and either amorphous or crystalline. they're able to take up and/or encapsulate a drug, so protective it against chemical and catalyst degradation. In recent years, perishable chemical compound nanoparticles have attracted right smartattention as potential drug delivery devices seeable of their applications within the controlled unharness of medicine, in targeting specific organs / tissues, as carriers of polymer in sequence medical care, and in their ability to deliver proteins, peptides and genes through the peroral route.[14,15]

Classification of nanomaterials

Nanotubes

They are hollow cylinders made of carbon atoms. They can also be filled and sealed, forming test tubes or potential drug delivery devices.

Nano wires

Glowing silica nano wire is wrapped around a single strand of human hair. It looks delicate. It is about five times smaller than virus applications for nano wires include the early sensing of breast and ovarian malignancies.

Nanocantilever

The honey comb mesh behind this tiny carbon cantilever is surface of fly‟s eye. Cantilevers are beams anchored at only one end. In nano world, they function as sensors ideal for detecting the presence of extremely small molecules in biological fluids.

Nanoshells

Nanoshells are hollow silica spheres covered with gold. Scientists can attach antibodies to their surfaces, enabling the shells to target certain shells such as cancer cells. Nano shells one day also are filled with drug containing polymers.

Quantum dots

Quantum dots are miniscule semiconductor particles that can serve as sign posts of certain types of cells or molecules in the body. They can do this because they emit different wavelengths of radiations depending upon the type of cadmium used in their cores. Cadmium

sulfide for ultra violet to blue, cadmium selinide for most of the visible spectrum and cadmium telluride for far – infra red and near infra red.

Nano pores

Nano pores have cancer research and treatment applications. Engineered into particles, they are holes that are so tiny that DNA molecules can pass through them one strand at a time, allowing for highly precise and efficient DNA sequencing. By engineering nanopores into surface of drug capsule that are only slightly larger than medicines molecular structure, drug manufacturers can also use nanopores to control rate of drug‟s diffusion in body.

Gold Nanoparticles

These nanoparticles, seen in transmission electron micrograph image, they have solid core. Researchers at north western university are using gold particles to develope ultra sensitive detection systems for DNA and protein markers associated with many forms of cancer, including breast prost rate cancer.

Bucky balls

Bucky ball is common name for a molecule called buckminsterfullerene, which is made of 60 carbon atoms formed in shape of hollow ball, discovered in 1985. Bucky balls and other fullerenes because of their chemistry and their unusual hollow, cage like shape extremely stable and can withstand high temperatures.[16,17,18]

Carbon nanotubes

Carbon nanotubes is changed to flow into well at intervals the body. Such modifications is accomplished with valence or non – valence bonding.

Modifications will increase or decrease circulation time with within the body.

Carbon nano tubes show no important toxicity once they have changed therefore on be soluble in liquid, somato type fluids. They enter without delay into the cells. Cancer cells in tumors area unit larger than traditional cells and conjointly exhibit discharge. massive molecules that flow into slowly will leak into and accumulate in cancer cells. Carbon nanotubes carrying active agents are incontestable in animal studies to try to to this. Researchers have conjointly used carbon tubes to deliver the precursors of active drug, that they decision a prodrug, eg : Cisplatin.[19,20,21]

Dendrimers

Dendrimers are exactly outlined, artificial nanoparticles that are close to 5–10 nm in diameter. they're created of layers of chemical compound encompassing a bearing core. The dendrimers surface contains many various sites to that medication could {also be is also} attach and also attachment sites for materials like PEG which may be wont to changed the method of dendrimer that interacts with body. PEG are often hooked up to dendrimer to „disguise‟ it and forestall the body‟s defense reaction for police work it, there by fastness the method of break down. This fascinating particle holds important promise for cancer treatment. Its several branches permit alternative molecules to simply attach to its surface.

Researchers have designed dendrimers into refined antitumor machines carrying 5 chemical tools – a molecule designed to bind to cancer cells, a second that light upon locating genetic mutations, a 3rd to help in imaging growth form victimization x – rays, a fourth carrying medication free on demand, and a fifth that will send an indication once cancerous cells are finally dead. The creators of those dendrimers had in tests with cancer cells in culture and conceive to strive them in living animals presently.[22,23,24]

Fast dissolving tablet

A novel tablet concept which offers ease of oral administration and benefits of increased patient compliance is fast dissolving tablet (FDT). This tablet format is designed to allow administration of oral solid dosage form in absence of water or fluid intake. Such tablets readily dissolve or disintegrate in saliva generally within less than 60 seconds. When put on tongue, this tablet disintegrate instantaneously, release in the drug. Good in chemical stability. Suitable during traveling where water is may not be available.[25,26,27,28,29,30]

Chronotherapeutics: Chrono therapeutics refers to a treatment method in which *in–vivo* drug availability, is timed to match rhythms of disease, in order to optimize therapeutic out comes and minimizes side effects. Controlled release formulation can be divided into subgroups such as rate controlled release, delayed release and pulse release formulations. Enteric coatings have traditionally been used as layer device in treatment of Parkinsonism patients using l–dopa / benzarazide.[31,32,33,34]

Drug loaded erythrocytes

Drug loaded erythrocytes is one of the growing and potential systems for delivery of drugs and enzymes. Erythrocytes are biocompatible, biodegradable, posse‟s long circulation half–

life and can be loaded with variety of biologically active substances. Carrier erythrocytes are prepared by collecting blood sample from the organism of interest and separating erythrocytes from the plasma. By using various physical and chemical methods cells are broken and drug is entrapped into erythrocytes, finally they are resealed and resultant carriers are then called as "resealed erythrocytes". Upon re injection the drug loaded erythrocytes serve as slow circulation depots, targets the drug to reticulo–endothelial system.

Miniaturized drug delivery system for intra – corporeal use

Modern diagnostic and therapeutic procedures address the quality of patient care and aimed at reducing pain and discomfort. Research in micro endoscopy is devoted to miniaturization of devices and to integration of micro systems into tip of endoscope in order to increase its functionalities. Endoscopic wireless devices usually refer to as endoscopic pills.[35,36]

Iontophoresis (IP)

Novel topical systems include iontophoresis and phonophoresis. It is an electro chemical method that enhances the transport of some solute molecule by creating a potential gradient through the skin with an applied electrical current or voltage. It induces increased migration of ionic drugs into skin by electrostatic repulsion at active electrode. Negative ions are delivered by cathode and positive ion by anode. Typical iontophoresis devices consist of battery, microprocessor controller, drug reservoir and electrodes.

Advantages of IP include

a) Control of delivery rates by variations of current density, pulse voltage, drug concentration and ionic strength.

b) Eliminating gastro intestinal incompatibility, erratic absorption and first pass metabolism.

c) Reducing side effects and variation among patients.

d) Avoiding risks of infections, inflammation, and fibrosis associated with continuous injection and infusion.

Phonophoresis

Phonophoresis (ultra sound, sonophoresis, immoderate sono phoresis, immoderate phono phoresis) is that the transport of medicine through the skin exploitation immoderate sound. it's the mix of immoderate sound medical care with topical drug medical care to realize therapeutic drug concentrations at elect sites within the skin. it's wide employed by

physiotherapists. Now a days that product is applied to the skin and a few time is allowed for drug to start absorption into the skin. Then immoderate unit is applied.

The immoderate sound emitted from the unit is really a wave outside the conventional human hearing vary.

Molecular imprinting technology

The molecular learning technology has a colossal potential for making satisfactory drug indefinite quantity forms.

Molecular learning involves forming a pre-polymerization complicated between the templet molecule and practical monomers or practical oligomers (or polymers) with specific chemical structures designed to act with the templet either by valence, non-covalent chemistry (self-assembly) or each. Once the prepolymerization complicated is made, the polymerisation reaction happens within the presence of a cross-linking chemical compound associate degreed an applicable solvent, that controls the general compound morphology and macroporous structure. Once the templet is removed, the merchandise could be a hetero polymer matrix with specific recognition parts for the templet molecule.

Examples of MIP-based drug delivery systems involve: (i) rate-programmed drug delivery, wherever drug diffusion from the system should follow a selected rate profile, (ii) activation-modulated drug delivery, wherever the discharge is activated by some physical, chemical or organic chemistry processes and (iii) feedback-regulated drug delivery, wherever the speed of drug unleash is regulated by the concentration of a triggering agent, like a organic chemistry substance, the concentration of that depends on the drug concentration within the body. Despite the already developed attention-grabbing applications of million instructions per second, the incorporation of the molecular learning approach for the event of DDS is simply at its inchoate stage. Not with standing, it may be foretold that, within the next few years, vital progress can occur during this field, taking advantage of the enhancements of this technology in alternative areas. Among the evolution lines that ought to contribute additional to boost the relevancy of learning for drug delivery, the applying of prognostic active tools for a rational style of imprinted systems and therefore the development of molecular learning in water could also be highlighted.[37,38,39]

ADMINISTRATION ROUTES

The choice of a delivery route is driven by patient acceptableness, the properties of the drug (such as its solubility), access to a illness location, or effectiveness in addressing the particular illness. the foremost vital drug delivery route is that the peroral route. Associate in Nursing increasing variety of medicine ar macromolecule and peptide- primarily based. they provide the best potential for simpler medicine, however they are doing not simply cross tissue layer surfaces and biological membranes; they're simply changed or degraded, susceptible to fast clearance within the liver and different body tissues and need precise dosing. At present, macromolecule medication are typically administered by injection, however this route is a smaller amount pleasant and conjointly poses issues of periodical blood drug concentrations. So, despite the barriers to undefeated drug delivery that exist within the duct (i.e., acid-induced chemical reaction within the abdomen, protein degradation throughout the duct by many chemical process enzymes, microorganism fermentation within the colon), the peroral route continues to be the foremost intensively investigated because it offers blessings of convenience and cheapness of administration, and potential producing price savings.

Pulmonary delivery is additionally vital and is settled in an exceedingly form of ways that - via aerosols, metered dose inhalator systems (MDIs), powders (dry powder inhalers, DPIs) and solutions (nebulizers), all of which cancontain nanostructures like liposomes, micelles, nanoparticles and dendrimers.

Aerosol product for pulmonic delivery comprise quite half-hour of the worldwide drug delivery market. analysis into respiratory organ delivery is driven by the potential for undefeated macromolecule and amide drug delivery, and by the promise of an efficient delivery mechanism for cistron medical care (for example, within the treatment of cystic fibrosis), additionally because the got to replace CFC propellants in MDIs. pulmonic drug delivery offers each native targeting for the treatment of metabolic process diseases and more and more seems to be a viable choice for the delivery of medicine systemically. However, the pulmonic delivery of proteins suffers by proteases within the respiratory organ, that cut back the general bioavailability, and by the barrier between capillary blood and alveolar air (air-blood barrier).

Transdermal drug delivery avoids issues like duct irritation, metabolism, variations in delivery rates and interference thanks to the presence of food. it's conjointly appropriate for

unconscious patients. The technique is mostly non-invasive and esthetically acceptable, and might be wont to give native delivery over many days. Limitations embrace slow penetration rates, lack of dose flexibility and / or exactness, and a restriction to comparatively low dose medication.[40]

Parenteral routes (intravenous, intramuscular, subcutaneous) are very important. The only nanosystems presently in the market (liposomes) are administered intravenously. Nanoscale drug carriers have a great potential for improving the delivery of drugs through nasal and sublingual routes, both of which avoid first-pass metabolism; and for difficult-access ocular, brain and intra-articular cavities. For example, it has been possible to deliver peptides and vaccines systemically, using the nasal route, thanks to the association of the active drug macromolecules with nanoparticles. In addition, there is the possibility of improving the occular bioavailability of drugs if administered in a colloidal drug carrier.[41]

Trans-tissue and native delivery systems need to be tightly mounted to resected tissues throughout surgery. The aim is to supply AN elevated medical specialty impact, whereas minimizing general, administration-associated toxicity. Trans-tissue systems include: drug-loaded gelatin like gels, that area unit shaped unchanged and cling to resected tissues, cathartic medication, proteins or gene-encoding adenoviruses; antibody-fixed gelatin like gels (cytokine barrier) that kind a barrier, which, on a target tissue may stop the permeation of cytokines into that tissue; cell-based delivery, that involves a gene- transduced oral membrane somatic cell (OMEC)-implanted sheet; devicedirected delivery - a chargeable drug infusion device which will be hooked up to the resected web site.

Gene delivery may be a difficult task within the treatment of genetic disorders. With in the case of sequence delivery, the inclusion desoxyribo nucleic acid should be introduced into the target cells, that ought to get transcribed and also the genetic info ought to ultimately be translated into the corresponding super molecule. to realize this goal, variety of hurdles area unit to be overcome by the sequence delivery system. Transfection is affected by: (a) targeting the delivery system to the target cell, (b) transport through the plasma membrane, (c) uptake and degradation within the endolyso somes and (d) animate thing trafficking of inclusion desoxyribonucleic acid to the nucleus.

Nanoparticles offer huge blessings relating to drug targeting, delivery and unharness and, with their further potential to mix diagnosing and medical aid, emerge joined of the key tools

in nano medicine. the most goals area unit to enhance their stability within the biological setting, to mediate the bio distribution of active compounds, improve drug loading, targeting, transport, release, and interaction with biological barriers. The toxicity of nano particles or their degradation product remains a serious downside, and enhancements in biocompatibility clearly area unit a main concern of future analysis.[42]

New drug delivery systems can provide improved or unique clinical benefits such as

• Improvement in patient‟s compliance.

• Improved out comes.

• Reduction of adverse impact.

• Avoidance of expensive interventions like laboratory services.

• Allowing patients to receive medications as out patients and probably.

• Reduction in overall use of healthful resources.

• Nano-drug delivery systems that deliver giant however extremely localized quantities of medication to specific areas to be free in controlled ways.

• Controllable unleash profiles, particularly for sensitive medicine.

• Materials for nanoparticles those square measure biocompatible and perishable.

• Technologies for self-assembly.

• Functions (active drug targeting, on-command delivery, intelligent drug unleash devices/ bioresponsive triggered systems, self-regulated delivery systems, systems interacting with the body, sensible delivery).

• Nanoparticles to enhance devices like implantable devices / nanochips for nanoparticle unleash, or multi reservoir drug delivery-chips.

• Nanoparticles for tissue engineering; e.g. for the delivery of cytokines to regulate cellular growth and differentiation, and stimulate regeneration; or for coating implants with nanoparticles in perishable chemical compound layers for sustained unleash.

• Universal formulation schemes that may be used as blood vessel, contractile organ or peroral medicine.

• Cell and cistron targeting systems.

• Devices for police investigation changes in magnetic or physical properties once specific binding of matters on magnet nanoparticles that may correlate with the quantity of ligand.

• Better unwellness markers in terms of sensitivity and specificity.

• Improvement in patient‟s compliance.

• Improved out comes.

• Reduction of adverse effect.

• Avoidance of costly interventions such as laboratory services.

• Allowing patients to receive medications as out patients and possibly.

• Reduction in overall use of medicinal resources.

• Nano-drug delivery systems that deliver large but highly localized quantities of drugs to specific areas to be released in controlled ways;

• Controllable release profiles, especially for sensitive drugs.

• Materials for nanoparticles those are biocompatible and biodegradable.

• Technologies for self-assembly.

• Functions (active drug targeting, on-command delivery, intelligent drug release devices/ bioresponsive triggered systems, self-regulated delivery systems, systems interacting with the body, smart delivery).

• Nanoparticles to improve devices such as implantable devices / nanochips for nanoparticle release, or multi reservoir drug delivery-chips.

• Nanoparticles for tissue engineering; e.g. for the delivery of cytokines to control cellular growth and differentiation, and stimulate regeneration; or for coating implants with nanoparticles in biodegradable polymer layers for sustained release.

• Universal formulation schemes that can be used as intravenous, intramuscular or peroral drugs.

• Cell and gene targeting systems.

• Devices for detecting changes in magnetic or physical properties after specific binding of ligands on paramagnetic nanoparticles that can correlate with the amount of ligand.

• Better disease markers in terms of sensitivity and specificity.[43,44,45,46]

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