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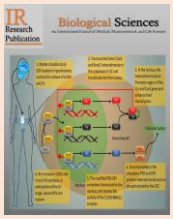

Role of nanotechnology in amplifying bioavailability

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ABSTRACT

Although nanotechnology and nanoscience methods for particle design and formulation are beginning to grow the market for many pharmaceuticals and are laying the groundwork for a lucrative niche within the business, some of the projected benefits have been exaggerated. This paper will discuss logical approaches to the nanoscale vehicle and entity design and surface engineering for site-specific drug delivery and medical imaging following parenteral administration. Nanomaterials help with targeted delivery, prolonged administration, and improved pharmacokinetics profiles, as well as medication diffusion into numerous organs by overcoming barriers such as the blood-brain barrier. Furthermore, these nanoparticles have a higher differential uptake efficiency in target cells (or tissue) compared to normal cells (or tissue) by preventing them from prematurely interacting with the biological environment, improving permeation and retention in disease tissues, and improving cellular uptake, resulting in lower toxicity. In this review, we discuss the most often utilized nanoparticles for increasing medication bioavailability.

Introduction

The rate and extent (amount) of unmodified medication absorption from its dose form is referred to as bioavailability. When a rapid commencement of action is required in the treatment of acute illnesses such as asthma attacks, pain, and so on, a fast absorption is desirable. When the goal is to extend the duration of action or counteract the bad effect and extent of absorption, which is also important in the treatment of chronic illnesses like hypertension and epilepsy, a slow rate of absorption is required. These can be accomplished by modifying the drug's physicochemical qualities as well as the dosage form's features [1]. Nanomedicine and nano delivery systems are a comparatively recent but quickly emerging field in which tiny materials are used as diagnostic tools or to administer therapeutic medicines to specific targets in a controlled manner. Nanotechnology provides a number of advantages in the treatment of chronic human diseases by allowing precise medicines to be delivered to specified locations [2]. Bioavailability refers to the degree and amount of drug that is completely available in the intended

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destination. Nanotechnology is on the verge of providing a wide range of innovations and ways to transform the pharmaceutical and medical fields. The application of nanotechnology for the treatment, detection, monitoring, and management of biological systems has recently been referred to as nanomedicine. Novels for various drug delivery systems such as liposomes, niosomes, and nanospheres have been reported to have the potential to deliver drugs. The inclusion of drugs in the delivery system also provides increased melting point, improved stability, protection against toxins, improved pharmacological activity, improved macrophage tissue distribution, retained delivery, and protection from physical and chemical damage [3].

The Nano technology used in drug delivery includes nano-scale molecules or particles that can improve drug availability. Molecular control is performed by devices such as nano-engineered robots to increase the availability of bioavailability in both specific and indirect areas [4]. Low bioavailability is usually caused by insufficient time inclusion in the GI. If the drug does not melt easily or can interact with the epithelial cover, time may be insufficient in the suction area (if the pattern is polar and ionized). In such cases, bioavailability may be low and highly variable. Drug bioavailability may be affected by pre-intestinal surgery (such as bariatric surgery), physical activity, age, genetic phenotype, sex, disorders (such as mal-absorption syndromes and achlorhydria), and depression. Chemical reactions that result in decreased absorption can reduce bioavailability. Hydrolysis with digestive enzymes or gastric acid (for example, penicillin and chloramphenicol palmitate hydrolysis), complex formation (for example, polyvalent metal ions and tetracycline), and drug absorption (e.g., cholestyramine and digoxin), metabolism by microflora in the lumen and junction in the intestinal wall are examples of such reactions (**Figure 1**).

It has also been concluded that phytomedicine has a high therapeutic efficacy that should be investigated further using nanotechnology. According to the literature, phytomedicine has great in-vitro bioactivity but poor aqueous solubility, increased molecular size, disintegration during stomach emptying, and extensive metabolism are all issues that restrict the in-vivo applicability of these plant extracts. [5] In the below-mentioned table 1, summary of some investigations on the nanotechnology of the drug is been shown.

Nanomedicine is changing the trend

Nanotechnology is on the verge of transforming medical and pharmaceutical fields by introducing a wide range of innovations and processes. A few medical fields are already benefiting from nanotechnology programs [6].

The application of nanotechnology to the treatment, diagnosis, monitoring, and management of biological systems is known as nanomedicine. Many bioactive molecules used in therapeutic procedures are hydrophobic and have low bioavailability. Nanotechnology-based delivery methods are being developed to improve the targeted distribution of such nutrients. Nanoparticles are also made from natural food ingredients like proteins, polysaccharides, lipids, and phospholipids, so they are safe. Nano-emulsions are made up of food-grade components such as a lipid core and a protein coating. There are a variety of phytomedicine benefits in herbal formulation studies, including nano-based formulations, such as improved solubility and bioavailability, toxicity, increased pharmacological activity, improved stability, macrophage tissue proliferation, continuous delivery, and chemicals, among others. As an outcome, nano phytomedicine has a bright future in terms of improving function and eradicating herbal-related issues [7]. Nanotechnology has a number of advantages in the treatment of chronic human diseases by delivering site-specific and targeted therapeutic strategies [8].

The beneficial efficacy of whichever medicine, for certain animals, plants, synthetic, or sea, is determined by the volume of the drug delivery form in its operating area and the amount required to achieve the desired therapeutic response. This dosage form structure is referred to as physiologic discovery, biological discovery, or simple bioavailability discovery [9]. Many drugs' reactions may be directly related to plasma levels. As a result, bioavailability is distinct as the speed and rate of assimilation of drugs whose dosage has not changed. Immediate absorption is sometimes required in the management of serious illnesses such as pain, asthma, and so on [10].

Nanobiotechnology can help to break down the human body's barriers to the administration of specific drugs to certain organs, such as entering the bloodstream and the brain entering the bloodstream. Nanomaterials have a wide range of implementations, including human wellbeing and food hygiene. Many enterprises, educational establishments, and businesses have recently adopted novels utilizing NPs in applied science. Nanotechnology has been recommended as a spark of hope in treating the current COVID-19

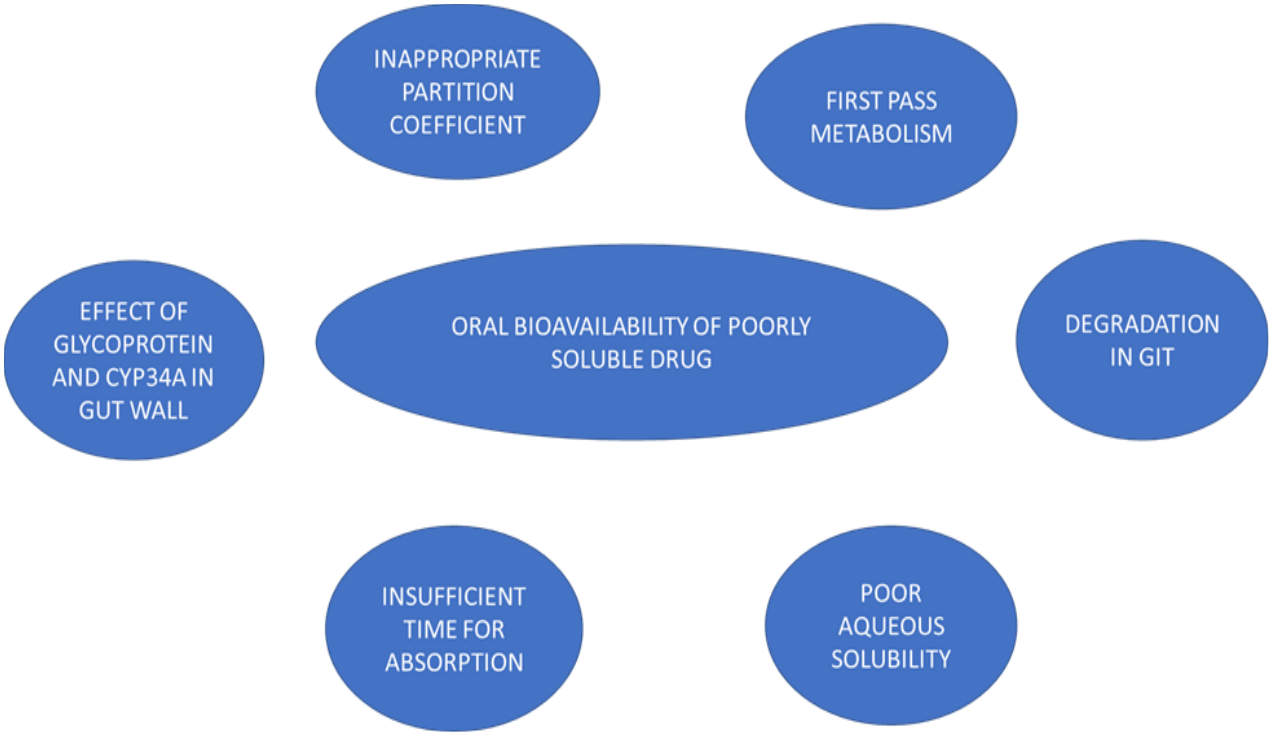

Figure 1. Reasons for poor oral bioavailability of poorly water-soluble drugs.

Table 1. Summary of investigations on nanotechnology

Recently drugs as nanomedicine	Mechanism used in formulation	Applications
Amphoterecin B	Dendrimers Polymeric micelles	Enhanced remedial usefulness and bioavailability
Nitrendipine	Solid Lipid Particles Nano-emulsion Nanocrystals	Enhanced therapeutic efficiency and bioavailability Enhancement in physical stability, *in vitro* drug release, and bioavailability
Tamoxifen	Polymeric nanoparticles	Improved therapeutic efficacy and bioavailability

epidemic [11]. **Figure 2** included the various advantages of nanoparticles for drug delivery.

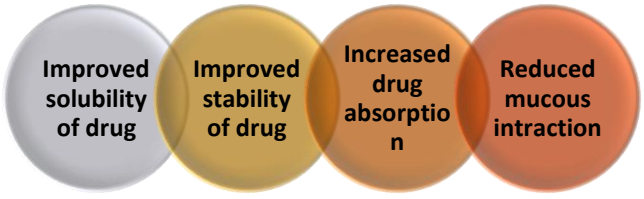

Figure 2. Advantages of nanoparticles

Nanotechnology is the study and application of different aspects of nanoscale materials. Nanotechnology is gaining traction in various fields because it has better-designed and smarter materials. Nanomedicine is the use of nanotechnology in the development of drugs and health care and has been used to fight many of the most common diseases, such as cancer and heart disease [12].

Physiological effect on the bioavailability of nanoparticles

Nanoparticulate system of drug delivery (NDDS) including nanoparticle development has developed into a popular research topic in recent years due to its unique benefits such as preventing drug degradation and environmental contact, increasing intracellular penetration, and improving drug absorption [18].

Size impact on oral bioavailability

The bioadhesion of solid lipid nanoparticles (SLNs) has been observed in the GI tract that it can be enhanced by reducing its size, allowing them to spend more time in the GI tract and thus contribute to better oral discovery. The proven fact is that particle size is important in the administration of oral medications Heretofore, it was discovered that particle size had a significant influence on particle movement in mucus [19]. Within a certain range, the size of the nanoparticle has a negative influence on the oral bioavailability of the drug, according to the hypothesis. However, researchers in oral drug delivery must continue to actively test the appropriate particle size [20].

Influence of advanced structures on oral biological acquisitions

The NDDS offers many benefits for drug delivery, such as increasing drug solubility and constancy. Even if the nanoparticle is released for a long time, it can be quickly removed from the body if it attaches to the mucous membranes, reducing the delivery of medication to the target tissue. Studies have found that the chemical composition of nanoparticles has a significant control on their interface with natural processes, which alters efficiency. Successful delivery of the drug delivery predicted in the NDDS requires overcoming the body's biological and biochemical deficits at the same time, requiring a very different, if not contradictory, physical texture for nanocarriers [21]. In general, a variety of materials or modifications of nanoparticles are needed to meet most therapeutic goals. Consequently, understanding the role of the further structures of nanoparticles in oral delivery is important [22].

Conclusion

The application of nanotechnology in medicine has the potential to significantly improve human health by increasing disease diagnosis, mitigation, and therapeutic interventions. Nanomedicines are composed primarily of restorative and/or scanning complexes encapsulated in submicrometric-sized carrier components. The application of nanomedicine for clinical purposes has received significant attention over the last several decades from academic circles, investigators, government, funding bodies, and regulatory agencies. In addition, nanoencapsulation can safeguard new treatments from deterioration in biological systems and provide dispersibility. Ever since the 1990s, the number of FDA-approved nanomaterials brands and clinical trials has grown dramatically, and now includes synthetic polymer granules, liposome compositions, micellar nanoparticles, nutrient nanoparticles, nanocrystals, and several others, frequently in pairing with drugs or biological drugs.

Contribution of authors

All authors have contributed equally to writing the article.

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None

Conflict of interest

None

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