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A Review Paper on Polymeric Nanoparticles for Drug Delivery

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ABSTRACT: ***The difficulty of some diseases and the inherent toxicity of certain medications have led to a growing interest in designing and optimizing drug delivery systems. As a key tool to improve drug bioavailability or specific delivery at the site of action, polymeric nanoparticles stand out. Polymer flexibility makes them theoretically suitable for meeting the specifications of each complex method of drug delivery. An overview of the state-of-the-art panorama of polymeric nanoparticles as drug delivery systems was conducted in this study, focusing specifically on those applications in which the corresponding disease entails significant morbidity, a significant decrease in patient quality of life or even a high mortality rate. A revision of the use of polymeric nanoparticles for the delivery of ophthalmic drugs, for the diagnosis and treatment of cancer, and for the delivery of nutraceutical has been carried out, including a brief debate on the future prospects of these systems.***

KEYWORDS: ***Drug, Disease, Nanoparticles, Polymer, Systems, Toxicity, Flexibility.***

INTRODUCTION

Increasingly, the severity of some diseases and the toxicity associated with certain drugs involve novel drug delivery routes. A drug delivery system (DDS) is a formulation or device that allows the introduction of active ingredients into the body by monitoring the volume, time and release of the drug at the site of action, crossing the biological membranes to meet the therapeutic target, in order to increase not only their effectiveness but also their safety. This involves not only methods of therapeutic drug administration, but also the use of vectors to promote their application to the human body and their diffusion .

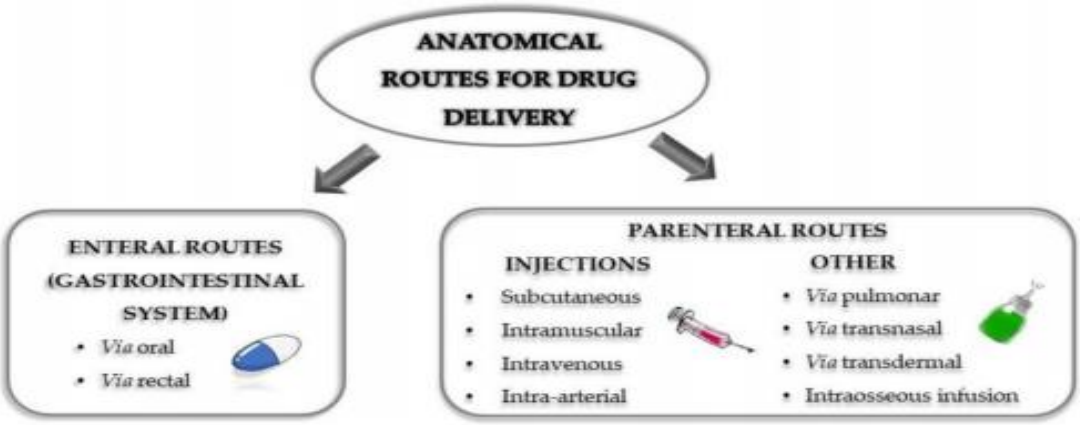

Figure 1: Illustrates classification of the different anatomic routes for the drug delivery

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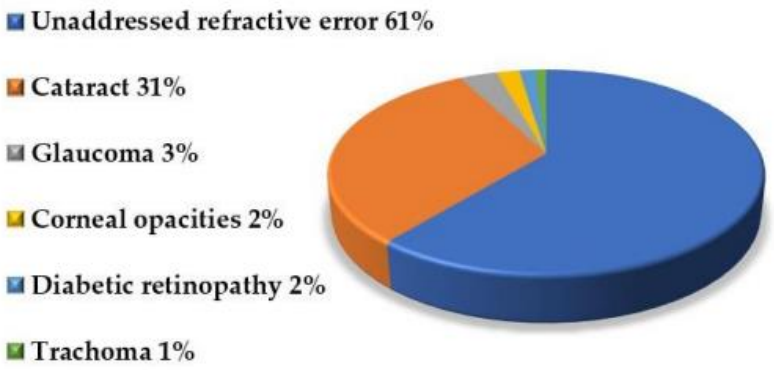

Figure 2: Illustrates the incidence rate of the most conventional eye diseases [1]

In reality, depending on specific diseases and patients, various combinations of vectors and active ingredients can allow a wide range of possibilities for personalization. When treating a disease, the routes used to administer and distribute active substances to their target tissue are a relevant factor. Depending on how they are applied, these routes can have various consequences. Normally, the administration is systemic. Occasionally, it needs to be administered directly to the affected organ due to the nature of the disease or the toxicity found in the drug. Figure 1 indicates the various anatomical routes of administration currently available for the delivery of medicines [2].

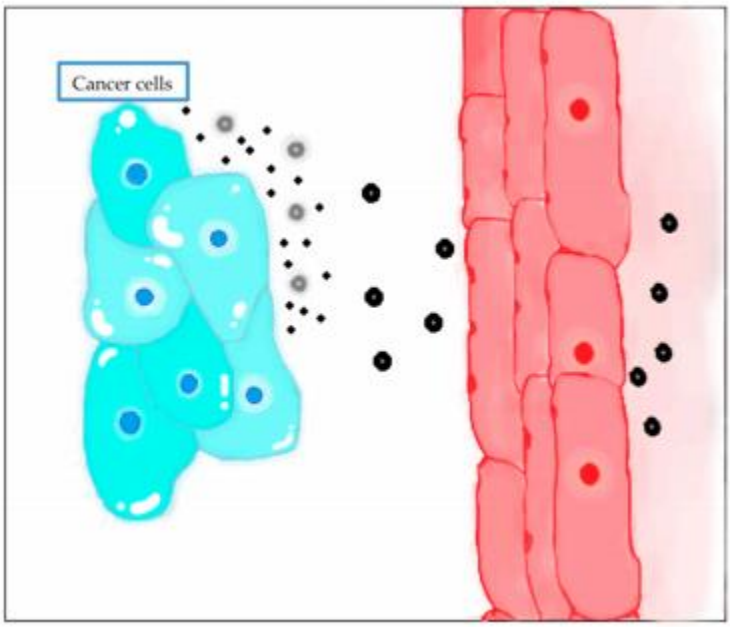

Figure 3: Illustrates the diagram of the EPR consequence

CONCEPT OF POLYMERIC NANOPARTICLES

Based on molecular recognition processes, this approach consists of changing the surface of the NPs with one or more moieties required to achieve their functionalization and, as a result, increasing the concentration of drugs in tumour tissues. Monoclonal antibodies and antibody fragments, antigen biding such as fragments and single chain variable fragments are the most frequent targeting elements (Figure 4). Transferrin, hormones, folic acid and other proteins or peptides are other molecules that can be used. In cancerous cells, certain compounds identify and bind receptors[3].

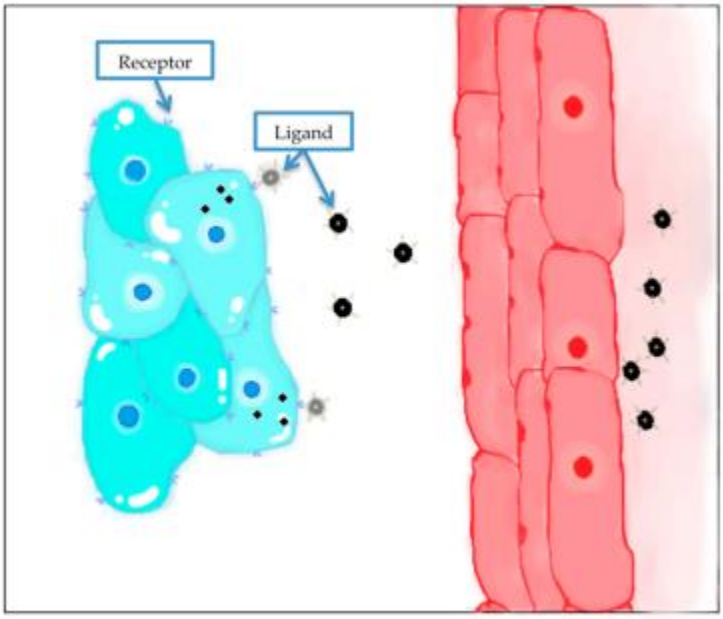

Figure 4: Illustrates the diagram of the active targeting procedure

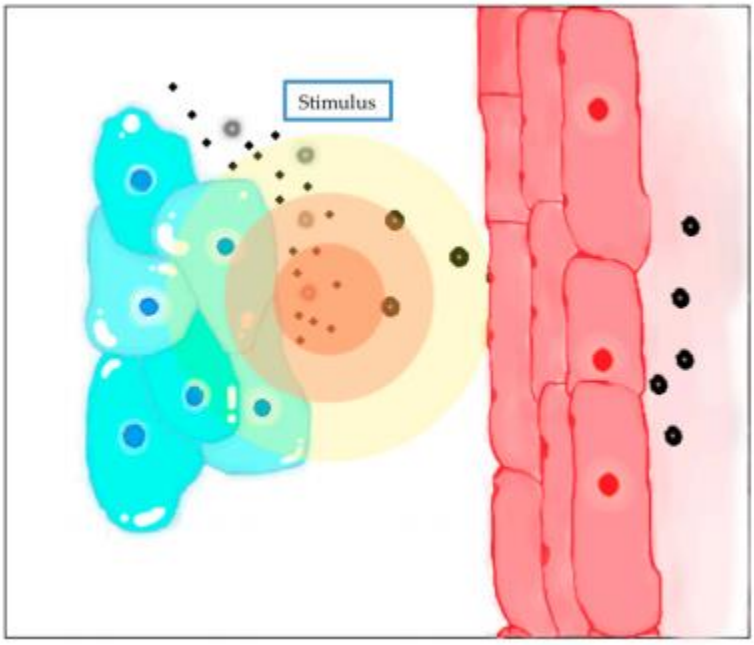

Figure 5: Illustrates the diagram of the active targeting procedure [4]

These ligands are typically selected based on which receptor is more over-expressed compared to normal tissues in tumour cells. If the selected receptors are internalized, a particular pathway can transport the nano carriers into the cancerous cells. Furthermore, to enhance the aggregation of nano carriers at the site of action, these ligands can be directed to the endothelial cells of solid tumour blood vessels. The goal of active targeting, therefore, is to enhance the penetration of nano carriers into cancer cells [5].

CONCLUSION

The creation of new alternatives such as DDS has been motivated by the toxicity associated with certain medications and classical formulations or by the difficulty of the treatment of certain diseases. Among these, due to the biocompatibility, biodegradability and flexibility they can offer, polymeric NPs attract high interest, opening up a wide range of materials that could possess the necessary characteristics for a particular application. The use of hyaluronic acid in the outer surface of the NP, for example, increases adhesion to mucosal tissue and thus the release time of the active ingredient, which is helpful for drug delivery to the eyes. Different cancer diagnosis methods are used with some drawbacks, such as the difficulty of early stage detection. Due to the various types of contrast agents, NPs (e.g., gadolinium-based materials or AuNPs) being a promising agent in medical applications due to their excellent biocompatibility, good water solubility and low toxicity, the optimization of these techniques is possible. NP defense with PEG improves the stability of magnetic nano materials and prevents macrophage detection, which increases circulation time, which is also a diagnostic prerequisite. At the same time, given that the key obstacle to successful cancer therapy is MDR mediated by ABC transporters, the use of PEG as a coating material for polymeric NPs has recently been identified as an effective tool to inhibit ABC

transporters. NPs are a possible theranosis due to the simultaneous use of a single NP for both cancer detection and drug delivery. Passive diffusion, active targeting and stimulus sensitive systems have been identified with regard to NP pathways for drug delivery.

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