



Editorial

Overview of polymeric nanocarriers to improve the drug delivery towards brain cancer

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1. Introduction

It is very important to use new brain cancer treatments in real life because primary brain tumors kill more than 200,000 people every year. A lot of research has been done over the years to try to improve survival rates, but the outlook for people with glioblastoma or other primary brain tumors is still challenging. The most difficult part of treating brain cancer is probably getting chemotherapy drugs and other anti-cancer drugs to tumor cells without going through the blood-brain barrier.¹ Polymeric nanoparticles (NPs), which are strong and flexible carrier systems, might be able to get around those problems. Several studies have shown that polymeric nanoparticles that have been made correctly can cross the blood-brain barrier, make medicines more available, lower toxicity throughout the body, and specifically target cancer cells in the central nervous system. Even though there aren't any clinical trials right now that look at how polymeric NPs might help treat brain cancer, there is a lot of preclinical data that suggests they could be helpful. This review intensifies different polymeric nanoparticles and analyzes how their composition, surface alterations, and delivery systems affect their capacity to improve brain tumor therapy.^{2,3}

2. Methodology, Current Challenges and Future Scope

Poly (β -amino ester) (PBAE) is a cationic polymer that is easy to make, breaks down naturally, and is safe for living things. It is often used to make nanoparticles that can carry polynucleotides and other chemicals that break down in acid. NPs can be taken up by monocytes, neutrophils, and stem cells and sent to brain tumor tissue.⁴ Using immune cells like monocytes and neutrophils to carry NPs to places where there is damage, inflammation, or tumor growth is very appealing because these cells can easily cross the blood-brain barrier.⁵ The nose-to-brain technique provides a minimally invasive and comparatively convenient method for NP delivery. Drugs that are given through the nose to the CNS go straight to the brain through the olfactory and trigeminal pathways, avoiding the blood-brain barrier.⁵ They can also have good pharmacokinetics and pharmacodynamics.^{6,7} Chitosan is a biodegradable polymer that is formed by taking the acetyl group off of chitin, which is a typical polymer that happens naturally.⁸ Nanoparticles made of chitosan and its derivatives usually have mucoid and cationic properties, which help them stick to mucous membranes and release drugs over a longer period of time.⁹ Chitosan's ability to stick to things makes it easier for it to move through the endothelium and epithelium. This makes it an ideal option for crossing the blood-brain barrier and for nose-to-brain delivery using chitosan-based polymeric nanoparticles.¹⁰ Other techniques include incorporation of Polyethylene glycol (PEG) is a polymer that

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adores water and can be covalently linked to NPs and other drugs to make them stay in the body longer or for time required in systemic circulation. According to the FDA, PEGylation of NPs has not been shown to make them more toxic.^{8,9} It is also one of the most prevalent modifications made to nanotherapeutics to make them work more effectively.¹⁰ Carboxylic acid polymerization with anhydride linkages makes polyanhydride. It is a very well-known and tested biocompatible and biodegradable polymer for combating cancer.¹¹ Hydrogels are hydrophilic gel polymer networks that are three-dimensional in nature and offer the advantages of reduced toxicity, targeted and stimuli-responsive drug delivery, and drug release that is passively regulated.¹² Other promising mechanisms of delivery includes Focused ultrasound (FUS) method that uses a minimally invasive approach to treat a number of illnesses, including brain-related illnesses.¹³

3. Conclusion

Although many studies employing polymer-based nanoparticles for brain tumor therapy have yielded encouraging results, only a limited number of approaches have progressed to clinical trials, and none have demonstrated efficacy as replacements or enhancements to existing therapeutic regimens. Challenges such as inadequate therapeutic delivery and variable study outcomes must be addressed for polymeric nanoparticle-based therapies to be effectively utilized in brain cancer treatment. PLGA is the predominant polymeric platform utilized in nanocarrier applications for neurological disease treatment; however, there is no contract on the optimal polymer for brain cancer treatment. This lack of consensus arises from the variable composition of polymers, which affects targeting ligands, content, delivery mechanisms, tumor characteristics, and other factors pertinent to each study. The optimal NP size and shape are influenced by these factors, and comparable studies have yielded inconsistent results regarding BBB and tumor localization. Polymeric nanoparticles are still a viable way to treat diseases, but more research is needed. Ongoing clinical trials and future studies will hopefully help us figure out the best way to use polymeric NPs to treat brain cancer.

4. Conflict of Interest

None.

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