Research & Reviews: Drug Delivery

Nanocarriers for Ocular Bioavailability Enhancement

Snehanth Mitra*

Department of Pharmaceutical Sciences, University of Missouri-Kansas City, Kansas City, USA

Commentary

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***For Correspondence:**
Snehanth Mitra, Department of Pharmaceutical Sciences, University of Missouri-Kansas City, Kansas City, USA

E-mail: smitra7@gmail.com

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ABOUT THE STUDY

Many different methods have been employed recently to treat eye issues. One of the strategies being studied for both anterior and posterior segment drug delivery is nanotechnology-based ophthalmic formulations. Systems based on nanotechnology featuring the right particle size can be created to ensure reduced irritancy, sufficient bioavailability, and compatibility with ocular tissue. For ocular medication administration, a number of nanocarriers have been created, including nanoparticles, nanosuspensions, liposomes, nanomicelles, and dendrimers. Some of them have produced findings that are encouraging for increasing ocular bioavailability.

Nanoparticles

Colloidal carriers known as nanoparticles range in size from 10 nm to 1000 nm. Lipids, proteins, natural or synthetic polymers, such as albumin, sodium alginate, chitosan, poly (lactide-co-glycolide), Polylactic Acid (PLA), and polycaprolactone are the main components of nanoparticles used for ocular administration. The development of drug-loaded nanoparticles for distribution to both anterior and posterior ocular tissues has been the focus of

numerous researchers over the past few years as interest in ocular medication administration has grown. Due to their small size, which results in minimal discomfort, and their sustained release feature, which prevents repeated administration, nanoparticles constitute a promising choice for ocular medication delivery. Another effective method for long-term drug delivery to the tissues of the posterior portion of the eye is the use of nanoparticles. Nanoparticle placement for posterior segment administration depends on size and surface characteristics. Following intravitreal injection, nanoparticles move across the layers of the retina and have a propensity to assemble in the RPE cells, facilitating sustained drug administration in situations like the treatment of disorders of the posterior segment of the eye. Nanoparticles' surface characteristics play a significant role in how they are distributed from the vitreous humour to the retinal layers.

Nanosuspensions

Nanosuspensions are colloidal dispersions containing submicron sized medication particles stabilized by surfactants or polymers. It has shown promise in terms of hydrophobic medication delivery. It has a number of benefits, including sterilization, convenience in making eye drops, less discomfort, longer precorneal residence duration, and improved ocular bioavailability of medications that aren't soluble in tear fluid. Additionally, nanosuspension can be used in hydrogels or ocular implants to achieve continuous drug release for a predetermined amount of time.

Liposomes

Liposomes are lipid vesicles that range in size from 0.08 m to 10.00 m and have an aqueous core surrounded by one or more phospholipid bilayers. Since they have a cell membrane-like structure, good biocompatibility, and the capacity to encapsulate both hydrophilic and hydrophobic medicines, liposomes are the ideal delivery mechanism for ocular applications. In numerous investigations, liposomes have shown to be highly effective for delivering drug to the anterior and posterior segments of the eye. In order to improve precorneal residence time for drug administration to the anterior part of the eye, liposomes are sometimes combined with positively charged lipids or mucoadhesive polymers.

Dendrimers

Dendrimers are described as nanosized, highly branching, star-shaped polymeric structures that are available in a range of molecular weights and have functional groups at the terminal ends of the amine, hydroxyl, or carboxyl atoms. Using the terminal functional group, targeted moieties could be conjugated. To distribute medications, it is essential to choose the right molecular weight, size, surface charge, molecule shape, and functional group. Dendrimers' highly branching structure enables for the inclusion of a wide variety of medicines, both hydrophilic and hydrophobic. Polyamidoamine (PAMAM) dendrimers are frequently used in the delivery of drugs to the eyes.