Applications of nanoparticles in ophthalmology

Mohammad Amin Kamaleddin
Department of Biotechnology, College of Science, University of Tehran, Tehran, Iran
amin.kamaleddin@ut.ac.ir

I. Abstract

This article provides an overview of novel applications of nanotechnology in the field of ophthalmology and its related disease such as Angiogenesis-Related Blindness, Neovascularization, Retinopathy of prematurity, Retinal Degeneration, and Uveitis. These applications have opened a new era in the understanding of unique properties of nanoparticles. Nanoparticles (NPs) are nanometer-scaled particles (1- 100* 10^{-9}m) used in the form of nanoconjugates, nanospheres, nanocapsules, or NPs themselves. NPs can be designed to improve penetration, drug targeting, and controlled release. After investigating the potential of NPs to Cross Blood-Retina Barrier, I refer to the applications of nanomedicine in cornea and retina therapies. Then, Neuronal Toxicity as the Main Disadvantages of NPs, is discussed and at the end of the script, I introduce novel diagnostic techniques and nanomedical tools in ophthalmology. Recent evidence point to the fact that development of an effective and non-toxic nano-scaled biomaterials and identifying the best mode of delivery system; could shine more light on the future applications of nanotechnology in ophthalmology.

II. Introduction

Nanoparticles (NPs) are nanometer-sized particles (1- 100* 10^{-9}m) used in the form of nanoconjugates, nanocapsules, or NPs themselves in order to treat the different disease in the field of ophthalmology such as retinopathy, retinal degenerations, and uveitis. Individual molecules are usually not referred to as nanoparticles, although the size of most molecules would fit into the above outline. Recent evidences put more emphasis on their ability to triumph over the constraints of current modalities and to improve their bioavailability in the retina and the permeability of therapeutic molecules across the barriers of the eye including the inner and outer blood-retinal barriers, aqueous barrier, and corneal barrier in response to the problematic accessibility of these areas to drugs since it is highly restricted by the presence of these barriers. NPs can be designed to improve penetration, drug targeting, and controlled release. The therapeutic efficacy of drugs in ocular diseases has been reported to be enhanced by the use of Nps in a wide variety of shapes such as liposomes, nanospheres, polymeric nanoparticles (1) ,dendrimers(2) ,hydrogels (3) ,and microemulsions.

III. Data Collection

A review was conducted to identify researches related to diagnosis and therapeutic roles of vesicles on human body. A systematic search of available literature in the
PubMed, Medline, and Scopus databases was performed.

IV. Results

In contrast to outstanding progress in the treatment of eye disease, the reliable tools for both early detection and accurate diagnosis of eye disease onset are lacking. Protein biomarkers that allow the discrimination of early and late stages of eye disease are instantly needed as they would enable monitoring pre-symptomatic aspects of the disease, disease progression, and the efficacy of intervention therapies.

V. Conclusion

Relentless efforts to develop more-effective, less-destructive therapy for eye disease have added a chapter called Nano-ophtalmology, which includes biopharmaceuticals, e.g. drug delivery systems , drug discovery, implantable materials like tissue regeneration scaffolds, implantable devices like intraocular pressure monitors, bioresorbable materials ,glaucoma drainage valves and diagnostic tools like genetic testing, imaging and intraocular pressure monitoring(24).The properties of NPs should be characterized sufficiently before studies with those NPs are performed. These parameters include chemical composition, size, and presence of coating, surface characteristics, and degree of aggregation, zeta potential, and water solubility.

VI. References

1.Nagarwal RC et al. Polymeric nanoparticulate system: a potential approach for ocular drug delivery. Journal of controlled release : official journal of the Controlled Release Society. 2009;136(1):2-13.