IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

A REVIEW ON FORMULATION SCENARIO OF CURRENT OPTHALMIC PRODUCT

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Abstract

The global elderly population is increasing, leading to challenges for healthcare systems in adapting to demographic shifts .Ocular drug-delivery technologies have advanced in the last two decades to treat chronic ocular illnesses effectively .Various novel ocular drug-delivery systems like nanomicelles, nanoparticles, and drug-eluting contact lenses aim to enhance drug bioavailability and overcome ocular absorption limitations .Lifestyle changes like healthy diet, exercise, and avoiding smoking can benefit eye health .Age-Related Macular Degeneration (AMD) is a common cause of blindness in adults over 50, affecting central vision .Vision loss due to ocular tissue injury impacts independence and quality of life, with aging being a significant factor .Glaucoma, characterized by optic nerve damage and increased intraocular pressure, is a leading cause of blindness globally .Intravitreal injection of VEGF inhibitors is an effective treatment for neovascularization in exudative AMD, preserving vision .

Index Terms : Ocular Drug-Delivery Technologies, Age-Related Macular Degeneration (AMD) Glaucoma, Nanomicelles , Lifestyle Changes for Eye Health

Introduction :

More individuals than ever before are living into old age due to a huge increase in the elderly population caused by a shifting global population structure. As a result, between 2015 and 2050, the share of the global population over 60 will almost double, from 12 to 22 percent. Health care systems face significant challenges in adapting to these demographic shifts. This is especially true for emerging nations, where it is predicted that 80 percent of the elderly will live in low-socioeconomic nations by 2050.Worldwide, 4% of adults over 60 are blind and 65% have visual impairments[1]

Newer treatment strategies for chronic ocular illnesses have been made possible by the dynamic advancement of ocular drug-delivery technologies over the last two decades. Any ocular drug-delivery system's major goals are to overcome different dynamic and static ocular barriers, lower dosage frequency,

and maintain therapeutic drug concentrations at the target location. Above all, the drug-delivery method should try to maximize drug bioavailability while avoiding any negative ocular effects. Anterior segment and posterior segment diseases are the common terms used to characterize ocular pathologic conditions. Practitioners use topical eye drops to treat anterior segment conditions such allergic conjunctivitis, cataracts, and dry eye disease. Relatively limited ocular absorption is the main drawback of ophthalmic medications administered topically. High nasolacrimal drainage and high tear-fluid turnover rates are the causes of this. Nanomicelles, nanoparticles, drug-eluting contact lenses, ocular inserts, and ocular implants that permit improved peroneal residency and increase the bioavailability of the therapeutic agents are examples of novel ocular drug-delivery systems[2].

The complex and fragile human eye is protected from infections and inflammation by a multitude of barriers that act as a barrier to the visual axis. One could categorize the anterior and posterior segments of the ocular anatomy into two general categories. The vitreous humor, retina, choroid, sclera, and optic nerve are found in the latter, whereas the cornea, conjunctiva, iris, ciliary body, and lens are found in the former. The distinct compositions of every stratum pose notable challenges to the delivery of ophthalmic drugs. Precise dosage maintenance is additionally hampered by dynamic barriers such choroidal and conjunctival blood flow, lymphatic drainage, tear dilution, and efflux pumps. Topical, systemic, intraocular, and periocular administration are all part of the traditional drug delivery pathway. Administering drugs via topical eye drops and ointments is the most popular and practical approach. Still[3]

Ocular Diseases :

The human eye's active operation involves multiple ocular tissues. A person's ability to maintain their independence is significantly impacted by vision loss, which also lowers their quality of life. Ocular tissue injury results in visual impairment. The main factors leading to vision loss include aging and injury to the retina and optic nerve. Vision impairment is currently causing serious problems for the healthcare system. Ocular abnormalities are associated with a lower quality of life, a higher chance of death, and less opportunities for higher education and work when compared to healthy individuals. In 2015, it was projected that 252.6 million people would be blind or have moderate to severe visual impairment[4].

1) Age-Related Macular Degeneration (AMD)

2) Cataracts

3) Diabetic Retinopathy

4) Dry Eye

5) Glaucoma

4) Intraocular Pressure (IOP)

1)Age-Related Macular Degeneration (AMD):

AMD is a condition that can cause permanent loss of central vision in elderly individuals. AMD, which is characterized by a progressive degeneration of the retina, choriocapillaris, and retinal pigment epithelium (RPE), is the most common cause of blindness in adults over 50. The retinal pigment epithelium exhibits abnormalities, which are clinical markers of early-stage AMD. The loss of central visual acuity brought on by late AMD results in severe, permanent vision impairment and, eventually, legal blindness, which has a negative impact on the life of the affected person. AMD is a common eye condition that can lead to vision loss, especially in older adults above 60 years[5].It is characterized by drusen (yellow deposits) and pigment changes in the retin[6].The prevalence of AMD is expected to increase due to the aging population, with an estimated 288 million cases by 2040[5].Research on AMD has been growing significantly, with a focus on understanding its mechanisms, treatment options, features, and classification[6].Technologies like optical coherence tomography (OCT) and OCT angiography play crucial roles in diagnosing and managing AMD[5].

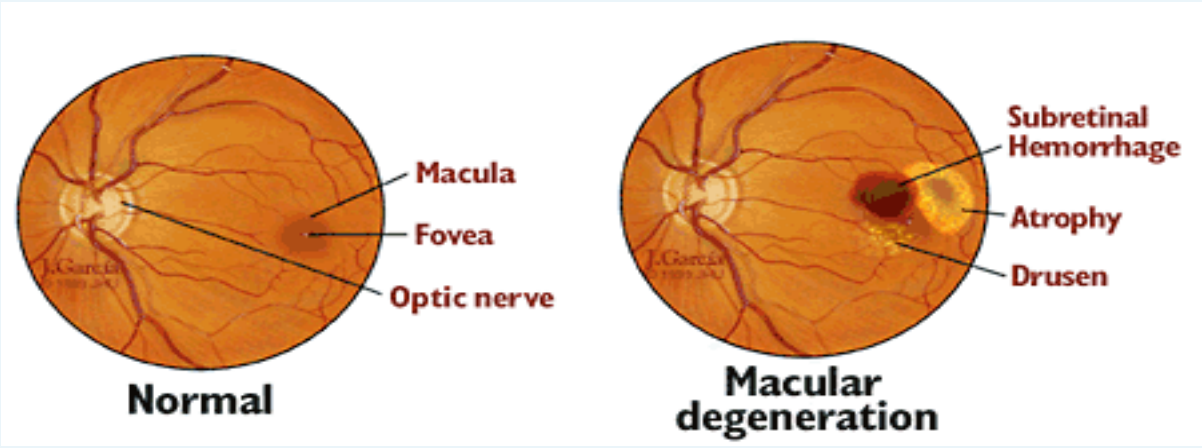


Fig.1

Vascular endothelial growth factor, or VEGF, is primarily responsible for the neovascularization of the human eye, despite the fact that angiogenesis involves many different growth factor pathways. According to the results of several studies, intravitreal injection of VEGF inhibitors can prevent neovascularization and be a successful therapeutic method for exudative AMD[4].

Symptoms

• First, central vision gets hazy, possibly leading to a complete loss of vision

• Lines appear "wavy" •

Colors, especially pastels, become increasingly difficult to distinguish from one another

• Difficulty seeing increases Reasons AMD in the family history • Age: mostly affects people over 65

• Race: AMD is more common in CaucasiansWomen are more likely to be harmed than men in the following areas: sex; lightcolored eyes; smoking; high blood pressure; high cholesterol; obesity; excessive sun exposur e; poor nutrition

Treatment:

Lead a healthy lifestyle by abstaining from smoking, exercising frequently, controlling blood pressure and cholesterol, shielding yourself from UV rays, eating a well-balanced diet rich i

fish and leafy greens, and staying away from processed foods. Before making any dietary or lifestyle changes, it is best to consult your doctor.

Addenda:

Ask your doctor if an AREDS-type supplement would be beneficial for you. A large study called the Age Related Eye Disease Study (AREDS and AREDS II) found that a combination of vitamins and minerals (lutein, zeaxanthin, zinc, copper, and vitamins C and E) can slow down the progression of Dry AMD in SOME patients.

Injections: A frequent treatment for wet AMD is the direct injection of anti-vascular endothelial growth factor (anti-VEGF) medications into the eye. By delaying the growth of new blood vessels in the retina, these injections lessen additional scarring and visual loss.

Lasers: In order to block the new, rogue blood vessels from leaking into the retina and cure wet AMD, lasers are sometimes utilized[1]

2)Cataracts

One of the main causes of eye blindness worldwide is cataracts, which are characterized by vision clouding and blindness. Many different kinds of damage can affect the crystalline lens, increasing the risk of protein misfolding and aggregation, which in turn can cause cataracts. The clinical equivalent of lens opacity, a cataract arises when the refractive index of the lens changes noticeably over the transmitted light's wavelength .Cataract is a significant global health issue, accounting for over 50% of blindness worldwide[6].It is considered a multifactorial disease influenced by both environmental factors and cell biology factors[6]

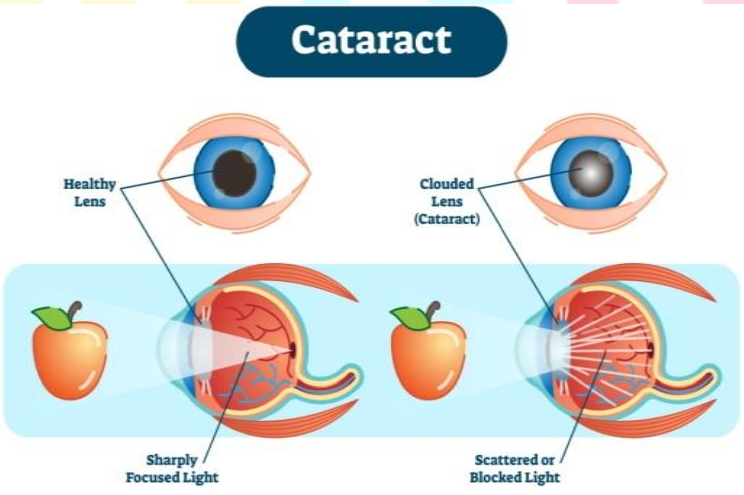


Fig.2

Enzymatic and non-enzymatic antioxidants are combined to enhance the lens's protective properties by actively scavenging reactive oxygen species. Cataracts arise from damage to the lenticular molecules caused by disruption or inhibition of their action[3].

• Signs and symptoms

double vision in the affected eye; trouble with glasses or contact lenses not working properly; cloudy, blurry, foggy, or filmy vision; nearsightedness (in older people); changes in color perception; problems driving at night (glare from oncoming headlights, for example); problems with glare during the day[2].

Treatment for Cataract :

Cataracts are commonly treated through surgical intervention, as it is the most effective way to restore vision impaired by clouding of the lens[8].Nanotechnology has enhanced drug delivery methods, but further research is needed to confirm the therapeutic effects of these compounds on cataracts and improve their delivery to the lens[7]

3)Retinopathy due to Diabetes

Diabetic retinopathy (DR) is the most common complication of diabetes mellitus (DM).It is essential to control risk factors to prevent DR effectively[10]. Diabetic retinopathy (DR) is mostly caused by diabetes or an unregulated blood sugar level. Microaneurysms, tiny intraretinal hemorrhages, capillary closures, and hard exudates are characteristics of diabetic retinal microvessel damage that occurs gradually[8].

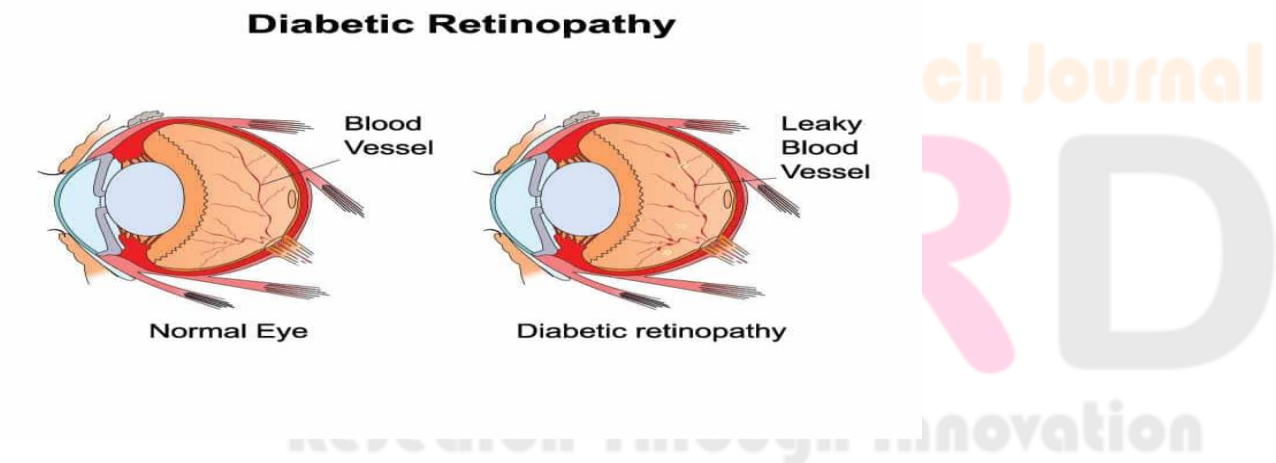


Fig.3

This primary cause of blindness is associated with angiogenesis excessiva, the process by which new blood vessels grow out of old ones. Blood vessels are damaged by an increase in blood sugar, which leads to their fast enlargement, leaking, and expansion. This hastens the process of neovascularization and causes diabetic retinopathy to arise[8].

4)Glaucoma(Xerostomia)

Glaucoma is a progressive eye disease that leads to optic nerve damage, resulting in visual impairment if left untreated [9]. Dry eye, also known as kerato conjunctivitis sicca, is caused by a malfunction

or deficiency of the tear film. The smoothness of the corneal surface reduces as the corneal epithelium starts to pit. This causes eyesight to become foggy or fuzzy. Aqueous tear-deficient dry eye and evaporative dry eye are the two types of dry eye. Dry eye is caused by vascular diseases of the collagen, conjunctival scarring from a vitamin A deficiency, or negative medication reactions[10] .

Glaucoma

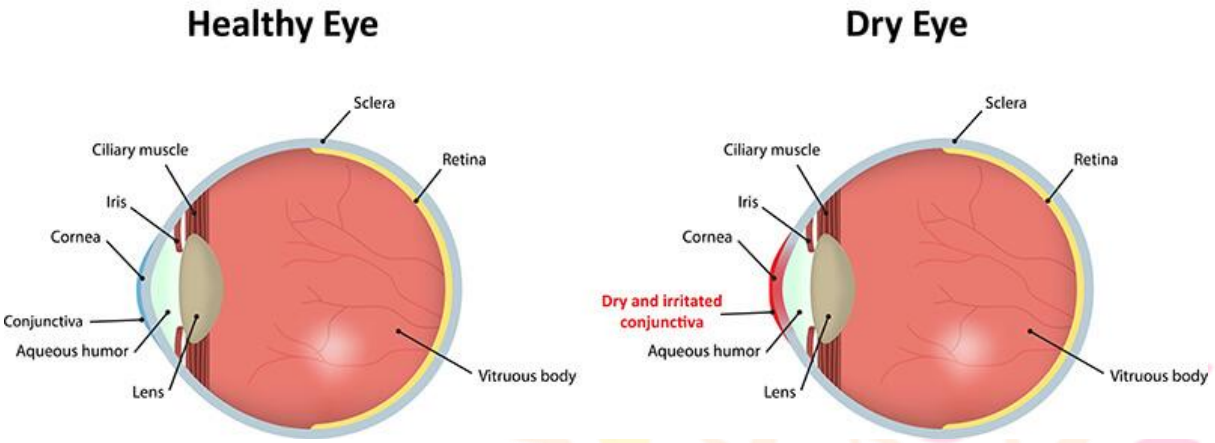


Fig.4

Sign And Symptoms:

Glaucoma can present with ocular pain, blurred vision, headache, nausea, and vomiting, which are indicative of acute angle closure glaucoma .Patients with glaucoma may experience symptoms such as eye fatigue, trouble focusing, dizziness, headache, eye discomfort, pain, nausea, and vomiting [11].

Treatment for glaucoma:

Timely diagnosis of glaucoma is crucial for effective treatment, with methods like measuring intraocular pressure, gonioscopy, and visual field monitoring.

Early combination therapy is recommended for advanced glaucoma, high progression rate, high IOP, severe visual field impairment, and younger patients[12].

5)Ocular hypertension

A collection of eye conditions together referred to as glaucoma are defined by damage to the optic nerves, which leads to a progressive loss of vision. The primary indicator of this condition is a continuous increase in intraocular pressure (IOP) [The primary cause of blindness in the world's population is glaucoma. Retinal ganglion cells (RGCs) are lost and optic nerve injury is brought on by elevated intraocular pressure. There

are three different stages of glaucoma: advanced, extreme, and early. There are currently 64.3 million glaucoma sufferers worldwide, and by 2040, that number is expected to rise to 112 million. Therefore, it is crucial to diagnose and monitor glaucoma, which can be done by taking an IOP reading. In those who are impacted, both retinal ganglion High IOP and oxidative stress cause damage to cells and retinal axons[5].

Ocular **hypertension**

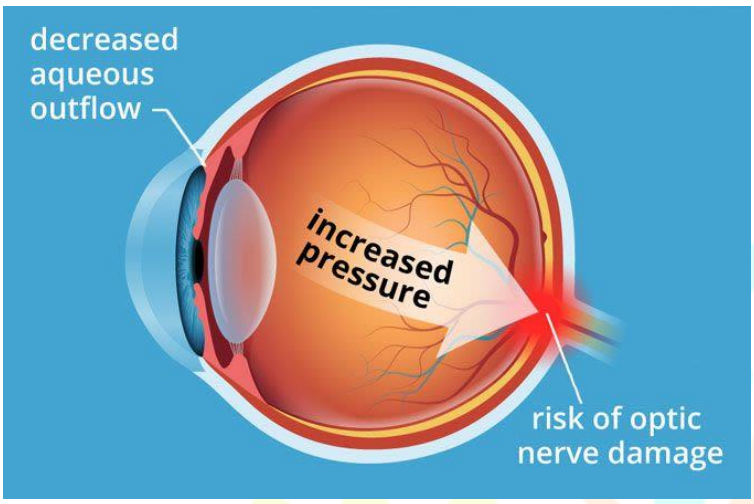


Fig.5

both traditional and cutting-edge topical ocular medication delivery methods These days, the market is filled with many ocular drug delivery systems, among which are the widely utilized ophthalmic eye drops. The manufacture of polymeric gels, ointments, suspensions, and emulsions are some others.

Factors to consider in choice of TreatmentMedication, lasers, or surgery (alone or in combination) can all be used to decrease IOP.

It is crucial that the patient and treating physician thoroughly discuss the advantages and disadvantages of the proposed course of treatment before beginning any kind of treatment to ensure the patient is completely informed. When evaluating possible treatment choices, a number of things must be taken into account[13].

Ophthalmic formulations :

1. Eyedrops
2. Emulsion
3. Suspension
4. Ointment
5. Gel composed of polymers

1) Eyedrops:

Among topical eye therapies, eye drops are the most practical, non-invasive, and patient-compliant. According to the study, a significant portion of patients had trouble injecting the drops. In addition, the solution may be lost or diluted due to tear drainage, which rises with the amount of eye drops used. Even if you have a perforated eardrum, you can still use antibiotic ear drops .However, there is a little chance that

some drugs, including neomycin, could cause ototoxicity. The recommended fluoroquinolone ear drop for those with perforation is ofloxacin[14].

Apart from that, the eye pocket's small capacity makes it impossible to determine the amount of medicine absorbed into the ocular tissue[7].

2)Emulsion:

When it comes to ocular formulation, emulsion-based formulations can improve precorneal residence duration, improve corneal drug penetration, boost bioavailability, and provide sustained-release qualities. Emulsion containing chitosan as a surface coating can potentially increase precorneal residence duration. The pharmacokinetic investigation

conducted by Yamaguchi et al. (2009) on the eyes of male albino rabbits comparing chitosan-coated emulsion to non-coated emulsion serves as the basis for this. When compared to non-coated emulsion, the emulsion mean residence time (1.5 times) and half-life (1.8 times) of the medication showed improvement[7].

In ophthalmic treatments, the emulsion is essential for distributing the active components uniformly and enab ling them to properly target the eye problem being treated[15].

3**) Suspension:** The primary advantage is that the insoluble suspension, which stays in the precorneal pocket rather than being washed or diluted by the tear, can lengthen the drug's duration of action and improve its contact time.

The varied particle sizes of the suspended particles also contribute to the enhancement in the duration of the drug's action. While the larger particles will be held in the precorneal pocket and slowly dissolve, the smaller particles will refill the medication that has been absorbed[8]. Ophthalmic suspensions are solutions for eye drops that have medication particles distributed throughout a li quid medium.Because of their propensity to administer poorly soluble medications, they are frequently utilise d to treat a variety of eye disorders[16]

4) Ointment:

A number of characteristics, such as being uniform, easily fabricated, non-irritating to the eye, and not producing undue blurring of vision, should be included in the formulation of an ointment. Ophthalmic ointment has a significant disadvantage that may lessen its effectiveness, despite the fact that it can improve and extend medication absorption[7]. It is applied directly to the eye to provide a prolonged release of medication, which can be more effective than oral medications or eye drops[17].

5) Polymeric Gel:

Due to its presence as a gel component at room temperature, ophthalmic premade gel is a less preferred dosing form. Because of the low accuracy and reproducibility of drug administration, which frequently results in hazy vision, crusty eyelids, and lachrymation, this feature has limited application in ocular drug delivery. Polymeric gels play a significant role in ophthalmic drug delivery systems due to their ability to improve ocular retention time, bioavailability, and therapeutic efficacy[18].

As a result, in situ gels gain attention in gelling systems since they offer the benefits of both gel and solution[7].

A new approach to topical ocular drug delivery

6) Nanoparticles:

Using the technology of nanoparticles, numerous other strategies have been devised. Solid lipid nanoparticles are one of them. Solid lipid nanoparticles have a number of benefits, including the ability to increase corneal ocular bioavailability for both hydrophilic and lipophilic drugs, improve corneal absorption, enable autoclave sterilisation, and show no signs of biotoxicity because physiological lipids are used in the preparation process[8].One method that shows promise for enhancing the transport of medicinal drugs to the eye is the use of ophthalmic nanoparticles.These nanoparticles are intended to get past obstacles like the tear film, ocular surface epithelium, and internal blood-aqueous and blood retina barriers that prevent medications from being delivered to the eye effectively[19].

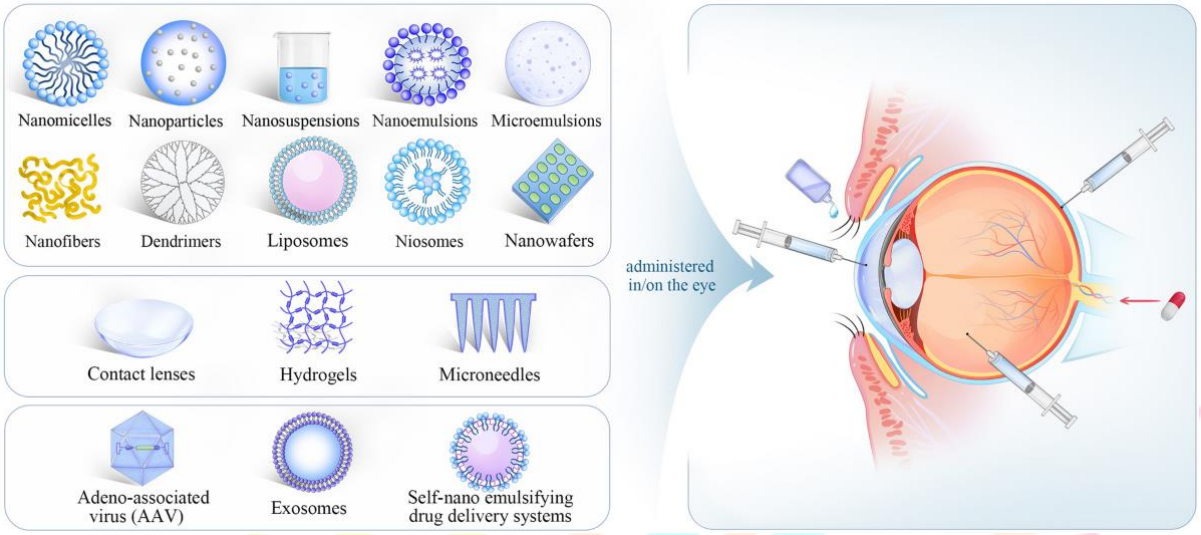
7) Nanomicelles:

Using nanomicelles as a medicine delivery mechanism has a number of benefits. The most popular carrier technology for delivering therapeutic medicines into transparent aqueous solutions is nanomicelles. It has the potential to boost tissue penetration with well-targeted delivery capabilities, decrease toxicity, improve drug solubility, and increase circulation time with only a minimal amount of preparation[7]Nanomicelles can enhance the bioavailability of medications by facilitating superior corneal penetration and intraocular absorption[20].

8) Liposomes:

Liposomes can be used for topical delivery to the eye, focusing on improving corneal adhesion and permeation.[21] Capable of encasing both hydrophobic and hydrophilic drugs, liposome divided into three

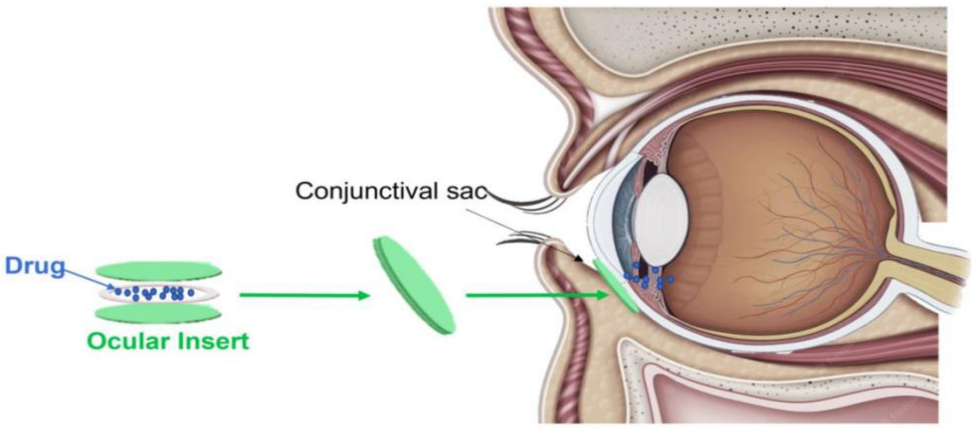
types: small unilamellar vesicles (10–100 nm), large unilamellar vesicles(100–300 nm), and multilamellar vesicles (contain more than one bilayer). Liposomes have an aqueous core containing drug that is enclosed by one or more phospholipid bilayers. Because these liposomes include naturally occurring phospholipids, they offer promise as a vehicle for the delivery of ophthalmic drugs. membranes that resemble cells and exceptional biocompatibility[7].



9) Ocular Inserts:

The primary goal of the ocular inserts is to increase the amount of time that the conjunctival tissue and the delivery system are in touch, resulting in a prolonged release that is appropriate for systemic or topical therapy. ocular insertion as being more continuous, regulated, and persistent. By doing this, it reduces the number of applications while maintaining an effective medication concentration in the target tissue. Based on the review, they discovered that patients' reluctance to give up their conventional liquid and semisolid medications is one physiological reason why the adoption of this administration method is less common among users.

A cutting-edge controlled drug delivery technology called ocular inserts is intended to treat a range of eye conditions[22]. Ocular inserts provide a controlled release of medication, ensuring accurate dosing and reducing the need for frequent applications[23].



[7].

Conclusion :

Ocular drug delivery systems present a variety of options for treating eye conditions, with topical eye drops being the most commonly used due to their ease of administration .However, challenges such as reduced patient compliance, low corneal permeability, and loss of active agents hinder the efficacy of eye drop formulations, leading to the development of alternative delivery systems .Suspension formulations like TobraDex ST have shown improved characteristics, pharmacokinetics, and patient compliance compared to traditional high-viscosity formulations, highlighting the importance of formulation optimization .Studies have demonstrated the effectiveness of suspension formulations in treating conditions like corneal inflammation and dry eye, with higher concentrations showing enhanced efficacy compared to lower concentrations .

References :

1) Owen Banda 1, Thokozani Mzumara 1,2 & Grace Ogbonna 1* Establishing the profile of eye diseases among elderly patients attending a tertiary hospital in Northern Malawi.

2) Vrinda Gote, Sadia Sikder, Jeff Sicotte, and Dhananjay Pal Ocular Drug Delivery: Present Innovations and Future Challenges

3) Li-Ching Liu, Yi-Hao Chen and Da-Wen Lu * Overviewof Recent Advances inNano-BasedOcularDrugDelivery

1) https://lhblind.org/what-is-age-related-macular-degeneration-2.https://www.webmd.com/eye-health/cataracts/what-are-cataracts

amd/?gad_source=1&gclid=EAIaIQobChMIlsej1Zb2hQMV4h6DAx3roAhLEAAYASAAEgLjePD_BwE

4) Wong, W. L.; Su, X.; Li, X.; Cheung, C. M.; Klein, R.; Cheng, C. Y.; Wong, T. Y., Global prevalence of agerelated macular degeneration and disease burden projection for 2020 and 2040: a systematic review and meta-analysis. The Lancet. Global health 2014, 2 (2), e106-16.

5) Friedman, D. S.; O'Colmain, B. J.; Munoz, B.; Tomany, S. C.; McCarty, C.; de Jong, P. T.; Nemesure, B.; Mitchell, P.; Kempen, J.; Eye Diseases Prevalence Research, G., Prevalence of age-related macular degeneration in the United States. Archives of ophthalmology 2004, 122 (4), 564-72.5)

6). Wong, W. L.; Su, X.; Li, X.; Cheung, C. M.; Klein, R.; Cheng, C. Y.; Wong, T. Y., Global prevalence of agerelated macular degeneration and disease burden projection for 2020 and 2040: a systematic review and meta-analysis. The Lancet. Global health 2014, 2 (2), e106-16.

5)Friedman, D. S.; O'Colmain, B. J.; Munoz, B.; Tomany, S. C.; McCarty, C.; de Jong, P. T.; Nemesure, B.; Mitchell, P.; Kempen, J.; Eye Diseases Prevalence Research, G., Prevalence of age-related macular degeneration in the United States. Archives of ophthalmology 2004, 122 (4), 564-72.5)

6) Wong, W. L.; Su, X.; Li, X.; Cheung, C. M.; Klein, R.; Cheng, C. Y.; Wong, T. Y., Global prevalence of agerelated macular degeneration and disease burden projection for 2020 and 2040: a systematic review and meta-analysis. The Lancet. Global health 2014, 2 (2), e106-16.

7) Harshal Wasnik,Rishi Gandhi,Niraj Patil,Rajendra Behera,Anand Golait,Tushar Patel,Tirthajit Baruah(Vandana Publications)- Vol. 8, Iss: 2, pp 11-20 A Comprehensive Review of Molecular Biology and Genetics of Cataract

8)Mohamad Faeznudin Rozi1, Awis Sukarni Mohmad Sabere1*A review on conventional and novel topical ocular drug delivery system.

9) M. Bikbov,G.Z. Isragilova,T. Gilmanshin- Vol. 19, Iss: 1, pp 15-21 Surgical Treatment of Age-Related Cataracts: Milestones and Challenges. Literature Review.

10)Nurul Athirah Naserrudin,Mohammad Saffree Jeffree,Nirmal Kaur,Syed Sharizman Syed Abdul Rahim,Mohd Yusof Ibrahim29 Sep 2022 - International Journal of Environmental R...- Vol. 19, Iss: 19, pp 12426-12426 Study on the Development of a Conceptual Framework to Identify the Risk Factors of Diabetic Retinopathy among Diabetic Patients: A Concept Pa

11) Jonathan A. Batten14 Nov 2022 - Current Opinion in Ophthalmology(Current Opinion inOphthalmology)- Vol. 34, Iss: 1, pp 3-8 Advances in drug therapy and delivery for cataract treatment

12) Shashilata Rawat,Uma Shankar Kurmi(Trans Tech Publications Ltd)- Vol. 37, pp 25-35 A Study on Glaucoma Disease Detection with Image Processing Methods.

11) Ingeborg Stalmans,Hans G Lemij,Jonathan Clarke,Christophe BaudouinKatholieke Universiteit Leuven,UCL Institute of Ophthalmology,University of Paris30 Oct 2020 - Clinical Ophthalmology(Dove Press)- Vol. 14, pp 3675-3680

13) Strahil Gazepov,Marija Hubreva,Radmila Zendelska,Elena Lichkova,Verica Stojmenova(Institute of Knowledge Management)- Vol. 28, Iss: 2, pp 613-618 Fixed combinations in the treatment of glaucoma

14)Pediatric Clinical Advisor (Second Edition)instant Diagnosis and Treatment2007, Page 418.

15) Zhi-Jian Yu Therapeutic opthalmic emulsions

16) H Nourry[1], C Viard, C Cambourieu, J-M Warnet [A relevant choice for corticoid eye drops: solution or suspension?]

17) J S Robin, P P Ellis Ophthalmic ointments

18) Yumei Wu,[a,b] Yuanyuan Liu,[a,b] Xinyue Li,[a,b] Dereje Kebebe,[a,b,e] Bing Zhang,[a,b] Jing Ren,[a,b] Jun Lu,[f] Jiawei Li,[a,b,c] Shouying Du,[d,*] and Zhidong Liu[a,b,**] Research progress of in-situ gelling ophthalmic drug delivery system

19) Hong-Yan Zhou,[1] Ji-Long Hao,[1] Shuang Wang,[1] Yu Zheng,[1] and Wen-Song Zhang[2]Nanoparticles in the ocular drug delivery.

20)Ruijun Cai, [1] Ling Zhang, [1] and Hao Chi [2,*] Recent development of polymer nanomicelles in the treatment of eye diseases

21) Gyan P Mishra [1], Mahuya Bagui, Viral Tamboli, Ashim K MitraRecent applications of liposomes in ophthalmic drug delivery

22) Anita Kumari, Pramod K. Sharma, Vipin K. Garg, and Garima Garg Ocular inserts — Advancement in therapy of eye diseases.

23) Anita Kumari [1], Pramod K Sharma, Vipin K Garg, Garima Garg Ocular inserts - Advancement in therapy of eye diseases.