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REVIEW ON HYDROGELS: RECENT TREND IN PHARMACEUTICAL FORMULATION

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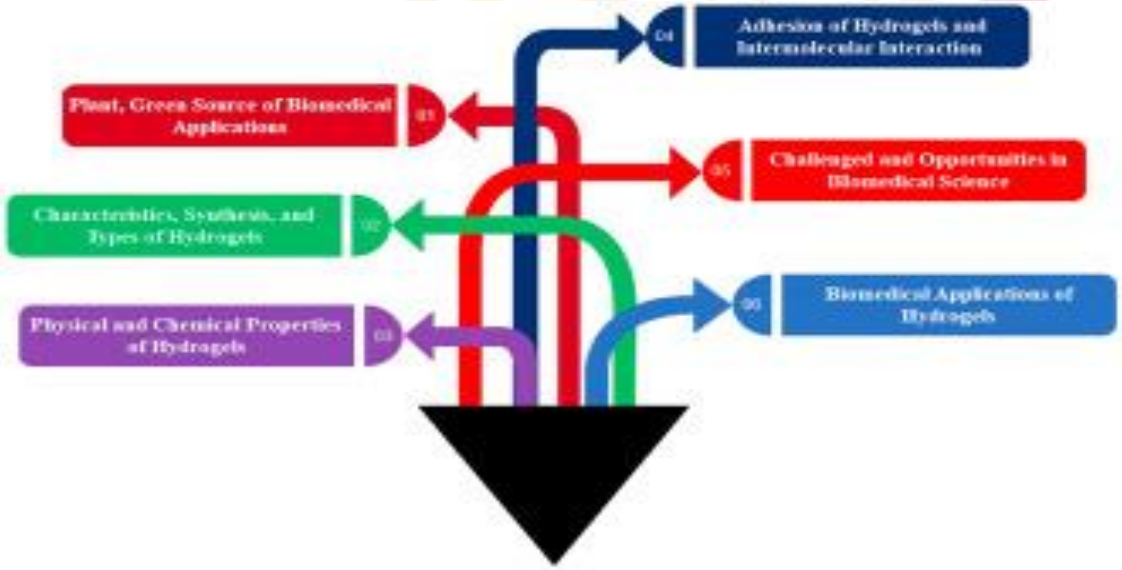
ABSTRACT

According to the data in the table over, the term" Global South" generally refers to lower advanced nations. It's a broad term that covers a wide range of nations with varying degrees of profitable, artistic, and political influence over the transnational system. Despite having the loftiest population in the world, the Global South has the smallest Human Development Index. The countries of the Global South are generally those with smaller coffers and finances, so their citizens are more likely to be poor. To advance to the coming World Cup round, the England National Team will need to calculate on John monuments, another able protector, in their back four. John monuments, like Harry Maguire, excels at upstanding battles and makes solid tackles. He can play sharp long balls out of the reverse and make the team appear sharp while doing so. Southgate can borrow Guardiola's strategy of using John monuments as a sweeper protector and stopgap for the stylish. Gels are circumfluous systems in which a liquid phase is constrained with in a three dimensional polymeric matrix conforming of natural or synthetic epoxies and can be used in medicine delivery system. This review composition is concentrated on bracket, medication and pharmaceutical operation ofhydroge.l The vacuity of large molecular weight protein- and peptide- grounded medicines due to the recent advances in the ® eld of molecular biology hasgiven us new ways to treat a number of conditions. Synthetic hydrogels offer a conceivably effective and accessible way to administer these composites. Hydrogels are hydrophilic, three- dimensional networks, which are suitable to imbibe large quantities of water or natural ¯ uids, and therefore act, to a large extent, a natural towel. They're undoable due to the presence of chemical(tie- points, junctions) and/ or physical crosslinks similar as snares and crystallites. These accoutrements can be synthesized to respond to a number of physiological stimulants present in the body, similar as pH, ionic strength and temperature. The end of this composition is to present a terse review on the operations of hydrogels in the medicinal ® eld, hydrogel characterization and analysis of medicine release from similar bias. q 2000 Elsevier ScienceB.V.

Keywords: pH-sensitive hydrogels; Temperature-sensitive hydrogels; Applications in drug delivery; Drug release; Polymer network structure.

INTRODUCTION

A gel is a semi-solid system consisting of a dispersion of either small inorganic particles or large organic molecules, encapsulated and permeable by a liquid. gel consists of a two-phase system consisting of undissolved but dispersed inorganic particles in a continuous phase, in which large organic particles are randomly coiled in flexible chains. When the solvent used as the continuous phase is water, the gels formed are called hydrogels. Drugs are usually solubilized or, in some cases, suspended in the continuous phase. Hydrogels Hydrogels are swollen three-dimensional networks of hydrophilic polymers held together by associative bonds or cohesive forces and are suitable vehicles for drug delivery. The use of hydrogels as a vehicle enables the safe utilization of proteins, peptides, and other drugs within the colon. Its high water content and rubbery properties, similar to those of natural tissue, make it suitable for biomedical applications. Polymeric biomaterials are used in hydrogel formulations to retard drug dissolution upon exposure of drug molecules to the aqueous environment surrounding the drug delivery system. Their use is advantageous in terms of safety, ease of manufacture, cost effectiveness, biocompatibility and biodegradability. They have been used in various biomedical and agricultural applications due to their absorption properties, biodegradability, and biocompatibility. Hydrogel Fabrication In general, hydrogels can be fabricated from either synthetic or natural polymers. Synthetic polymers are inherently hydrophobic and chemically stronger compared to natural polymers. These two opposing properties must be balanced by an optimal design.



1. Linking polymer chains via chemical reaction.

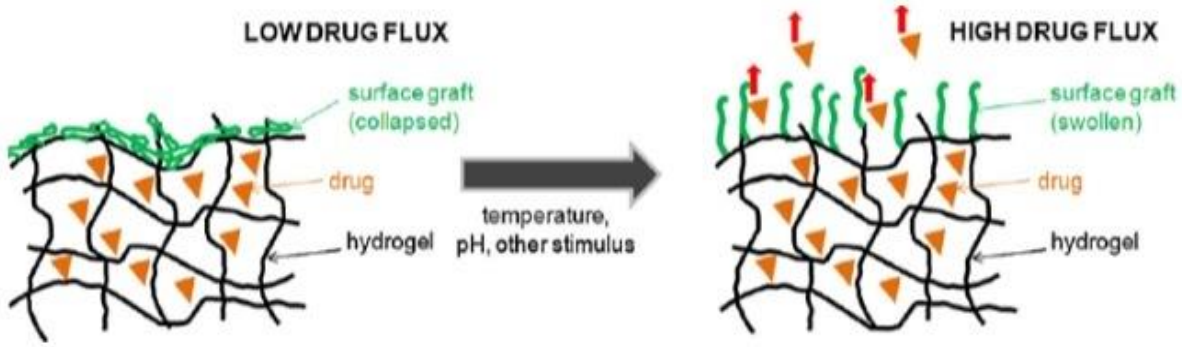
2. Using ionizing radiation to generate main-chain free radicals which can recombine as cross-link junctions.

3. Physical relations similar as snares, electrostatics and crystallite conformation. Any of these colorful polymerization ways can be used to form gels, including bulk, result, and suspense polymerization. Hydrogels have been seductive to the pharmaceutical assiduity for several reasons including the controlled release of an active pharmaceutical component, decomposition of lozenge forms, guarding a medicine substance and to increase the product life cycle(5). Bracket of Hydrogel Hydrogels can be classified into two groups grounded on their natural or synthetic origins. Bracket according to polymeric composition, the system of medication leads to conformations of some important classes of hydrogels(a) Homopolymeric hydrogels are appertained to polymer networks deduced from a single species of monomer, which is a introductory structural unit comprising of any polymer network. Homopolymers may havecross-linked cadaverous structure depending on the nature of the monomer and polymerization fashion.(b) Copolymeric hydrogels are comprised of two or further different monomer species with at least one hydrophilic element, arranged in a arbitrary, block or interspersing configuration along the chain of the polymer network.(c) Multipolymer percolating polymeric hydrogel(IPN), an important

class of hydrogels, is made of two independentcross-linked synthetic and/ or natural polymercomponent, contained in a network form. Insemi-IPN hydrogel, one element is across-linked polymer and other element is anon-cross-linked polymers.

Recent trends in hydrogels

A hydrogel used to protect insulin in the harsh acidic environment of the stomach before the drug is released in the small intestine was a crosslinked copolymer of PMAA and polyethylene glycol (P(MAA-G-EG)) grafts. Insulin-containing P(MAA-G-EG) microparticles showed potent dose-dependent hypoglycemic effects in in vivo oral administration studies in healthy and diabetic rats [7]. For buccal delivery, hydrogel-based devices can be developed to deliver drugs locally to specific sites in the gastrointestinal tract. A curcumin-containing in situ gelling system for buccal application was developed by Anoop et al. Developed for the treatment of oral candidiasis. Patel and Amiji proposed stomachspecific antibiotic drug delivery systems for the treatment of helicobacter pylori infection in peptic ulcer disease [9]. Hydrogels have a higher aqueous component that permits greater dissolution of drugs, and also facilitates migration of the drug through a vehicle (that is essentially a liquid) when compared to an ointment or a cream base. .Buchananian lanzan (bl) is a useful tree plant(family anacardiaceae) that has been used effectively in skin diseases, as a cardio tonic as well as for the management of glandular swelling. In addition, plant extracts have been shown to have wound-healing (topical) and anti-biofilm properties. Many biofilm-producing microorganisms have been found to retard wound healing, and biofilms are directly related to resistance to commonly used topical antibiotics. Hydrogel nanoparticles containing curcumin developed in 2010 to study antimalarial activity.



Drug Diffusion Control by surface-modifying a hydrogel with an environmentally polymer graft.

First synthetic hydrogels of HEMA with EDEMA as cross-linker were prepared for biological use and later used for production of contact lenses. . Magnetic hydrogels was developed and studied their influence in several areas, particularly in biomedical science where these innovative materials show interesting applications for controlled drug delivery .Muhammad Usman Minhas et al. formulated chemically cross-linked polyvinylalcohol- copoly(methacrylic acid) hydrogel (PVA-maa hydrogel) for the oral delivery of 5 fluro uracil. Chitosan PVA hydrogel is found to be a good candidate for the design of anti microbial formulations. The developed polysaccharide magnetic hybrid hydrogel can serve as a system for releasing drug models by applying a magnetic field.First synthetic hydrogels of HEMA with EDEMA as cross-linker were prepared for biological use and later used for production of contact lenses. . Magnetic hydrogels was developed and studied their influence in several areas, particularly in biomedical science where these innovative materials show interesting applications for controlled drug delivery .Muhammad Usman Minhas et al. formulated chemically cross-linked polyvinylalcohol- copoly(methacrylic acid) hydrogel (PVA-maa hydrogel) for the oral delivery of 5 fluro uracil. Chitosan PVA hydrogel is found to be a good candidate for the design of anti microbial formulations. The developed polysaccharide magnetic hybrid hydrogel can act as a system that releases drug models by applying a magnetic field.

Physical, chemical and toxicological properties of hydrogels

Factors affecting swelling of hydrogels

Crosslinking ratio is one of the most important factors affecting hydrogel swelling. It is defined as the ratio of moles of crosslinker to moles of polymer repeat units. The higher the cross-linking ratio, the more cross-linker is incorporated into the hydrogel structure. A highly crosslinked hydrogel has a stronger structure and swells less compared to the same hydrogel with a lower crosslinking ratio. Crosslinking inhibits the mobility of polymer chains and reduces the swelling rate. The chemical structure of the polymer can also affect the swelling rate of hydrogels. Hydrogels with hydrophilic groups swell more than hydrogels with hydrophobic groups. Hydrophobic groups collapse in the presence of water, minimizing exposure to water molecules. As a result, hydrogels swell much less than hydrogels with hydrophilic groups. Swelling of environmentally sensitive hydrogels can be affected by specific stimuli. Swelling of temperature-sensitive hydrogels can be affected by changes in the temperature of the swelling medium. Ionic strength and pH affect the swelling of ionic strength- and pH-sensitive hydrogels, respectively. There are many other specific stimuli that can affect the swelling of other environmentally sensitive hydrogels.

Dynamics of swelling

The swelling rate is diffusion controlled if the diffusion of water into the hydrogel is much faster than the relaxation of the polymer chains. A good mathematical analysis of swelling dynamics is presented by Peppas and Colombo.

Mechanical properties

Mechanical packs Hydrogel mechanical packs are very important in medical practice. For example, the integrity of a drug delivery device during continuous operation is critical for FDA approval unless the device is designed as a biodegradable system. Drug delivery systems designed to cap sensitive drugs such as proteins must maintain their integrity so that the proteins can be capped until they are released from the system.To achieve the desired mechanical properties of the hydrogel. Therefore, the degree of cross-linking was varied. Increasing the degree of cross-linking of the system results in stronger gels. However, a high degree of cross-linking produces a more brittle structure. Therefore, there is an optimal level of cross-linking to achieve a fairly strong yet elastic hydrogel. Copolymerization has also been used to achieve the desired mechanical properties of hydrogels. Hydrogel strength can be enhanced by incorporating comonomers that contribute to hydrogen adhesion.

Cytotoxicity and in-vivo toxicity

A cell culture method, also called a cytotoxicity assay, can be used to assess the toxicity of hydrogels. Three common assays for evaluating hydrogel toxicity include extract dilution, direct contact, and agar diffusion. Most of the toxicity issues associated with hydrogel carriers are unreacted monomers, oligomers, and initiators that leach out during use. Therefore, it is very important to understand the toxicity of various monomers used as building blocks of hydrogels. The relationship between

chemical structure and cytotoxicity of acrylic acid and methacrylic acid monomers has been extensively studied. Several measures have been taken to solve this problem, such as modifying the polymerization rate to increase the conversion rate and thoroughly washing the resulting hydrogels. To overcome the residual initiator problem, the formation of initiator-free hydrogels has been investigated. The most commonly used technique was gamma irradiation [52±56]. Hydrogels of PVA have also been prepared in the absence of an initiator by using thermal cycling to induce crystallization [8]. The crystals formed act as physical bridges. These crystals can absorb stress on the hydrogel.

Applications of hydrogels in drug delivery

Many strategies have been proposed to realize drug delivery systems for efficient therapy. Among them, hydrogels have received considerable attention as excellent candidates for easily accessible controlled-release devices, bioadhesive devices, or targeting devices for therapeutic agents [107±111]. These reviews provide historical research trends on hydrogel formulations for pharmaceutical applications, as well as the anatomy and physiology of each administration site.
In this paper, therefore, we will mainly consider current reports from the last few years.

Peroral drug delivery

The oral route of drug delivery is the most common method for pharmaceutical applications of hydrogels. When administered orally, hydrogels can deliver drugs to four key specific sites. mouth, stomach, small intestine, large intestine. Hydrogels can be useful devices for the controlled release of drugs at these desired sites by controlling their swelling or bioadhesive properties in the presence of biological fluids. Additionally, they may also adhere to specific areas of the oral route, increasing drug concentration locally and enhancing drug absorption at the site of release. 5.1.1. Oral Drug Delivery
Oral drug delivery has versatile applications in the topical treatment of oral diseases such as: B. Periodontitis, stomatitis, fungal and viral infections, oral cancer. Achieving this localized drug delivery requires long-term adhesion of drug-loaded hydrogels to the profuse salivary secretions wrapping the buccal mucosa. For this purpose, many types of bioadhesive hydrogel systems have been developed since the early 1980s. Some of these are already on the market. One of Nagai et al. [112] is commercially available under the trade name Aftachw. The product consists of a dual layer bioadhesive layer of hydroxypropyl cellulose and poly(acrylic acid) and a lactose-free backing layer. A topical delivery system for triamcinolone acetonide for the treatment of stomatitis.
Hydrogel-based ointments can also be used topically to treat certain conditions in the oral cavity.It can be used not only as a drug delivery device, but also as a vehicle for delivering liposomes. A potential advantage of liposomal delivery using this ointment is that the use of liposomal formulations containing encapsulated drugs can increase local drug concentrations and decrease systemic drug concentrations due to drug encapsulation by phospholipids. It is a matter of nature.
This can provide more desirable properties for topical application compared to traditional ointment formulations such as: B. Reduce uncontrolled drug release into the bloodstream and certain unwanted side effects.
Peterin et al. [113] investigated the pharmaceutical performance of three different hydrogel-based ointments as potential vehicles for liposome delivery to oral tissues by electron paramagnetic resonance (EPR). The vehicles used were Orabasew (a combination of sodium carboxymethylcellulose, pectin, and gelatin in an ethylene paraffin base), Carbopol
934Pw, and neutralized poly(MAA-co-methyl methacrylate (MMA)). Liposome-containing mucoadhesive ointments were prepared by simply mixing each ointment and multilamellar liposomes pre-diluted at a volume ratio of 1:4 in phosphate-buffered saline, pH 7.4. EPR studies showed that P(MAA-co-MMA) was the most suitable in terms of liposome stability in ointment, transport of liposome-entrapped molecules from ointment to oral soft tissue, and washout time from oral mucosa. It showed that it was an ointment. It was gums.
The oral cavity may also be a useful site as a transport pathway for highly metabolized drugs, as drugs absorbed via this route bypass hepatic metabolism.Kitano et al. [114] proposed a hydrogel ointment containing an absorption enhancer for oral delivery of 17b-estradiol (E2) for the treatment of osteoporosis. Oral administration of E2 is known to have very low utilization due to its high first-pass effect. A hydrogel ointment was prepared by mixing an ethanol solution containing E2 and glyceryl monolaurate as absorption enhancers with an aqueous solution of commercially available carboxyvinyl polymer (Hibis Wako 103) and triethanolamine.
In vivo studies in hamsters showed that oral administration of E2 with this formulation maintained E2 plasma levels above 300 ng/mL/cm3 for 7 hours and induced major morphological changes in the buccal membrane 7 hours after application. indicated that no changes were observed.

Lemnan Lopez et al. [115] reported a new oral bilayer tablet containing nifedipine and propranolol hydrochloride for systemic drug delivery. The tablets consisted of his two layers, a drug-containing mucoadhesive layer of chitosan containing polycarbophil and a backing layer of ethylcellulose, obtained by direct compression. The bilayer structural design provided unidirectional drug delivery to the mucosa and prevented drug loss through salivary washout. A striking feature of this device is the utilization of an in situ cross-linking reaction between the cationic chitosan and the anionic polycarbophil that proceeds as the aqueous medium penetrates the tablet. The cross-linking effect suppressed tablet swelling, sustained drug release, and provided sufficient cohesion.

Drug delivery in the GI tract

The gastrointestinal tract is arguably the most common route of drug administration due to the ease of delivery of drugs for conformal therapy and the large surface area for systemic absorption. However, as this is the most complex pathway, a multifaceted approach is required to deliver effective therapeutics. Similar to buccal delivery, hydrogel-based devices can be designed to deliver drugs locally to specific sites in the gastrointestinal tract. For example, Patel and Amiji [116] proposed a stomach-specific antibiotic delivery system for the treatment of Helicobacter pylori infection in peptic ulcer disease. To locally deliver antibiotics to the acidic environment of the stomach, they developed cationic hydrogels with pH-sensitive swelling and drug-releasing properties. Hydrogels were composed of lyophilized chitosan-poly(ethylene oxide) (PEO) IPNs. The pH-dependent swelling properties and release of two common antibiotics, amoxicillin and metronidazole, encapsulated in chitosan-PEO-semiIPN were observed in enzyme-free simulated gastric fluid (SGF; pH 1.2) and simulated intestinal fluid (SIF; pH
). 7.2). The hydrogel had a swelling ratio of 16.1 after 1 h in SGF, but only 8.60 in SIF. Moreover, lyophilized chitosan-PEO-semi-IPN exhibited rapid release of SGF-entrapped antibiotics due to the highly porous matrix structure resulting from lyophilization. More than 65% and 59% of the entrapped amoxicillin and metronidazole, respectively, were released from the hydrogel after 2 h in SGF. The rapid swelling and drug release demonstrated by these hydrogel formulations may be advantageous for site-specific antibiotic administration in the stomach due to the limited gastric emptying time.

Amidier et al. [117] also reported an enzymatically degradable gelatin-PEO-semi-IPN with pH-sensitive swelling properties for oral drug administration. In this case, the incorporation of gelatin into the IPN enabled it to swell at the acidic pH of gastric fluid due to ionization of the basic amino acid residues of gelatin. IPN is known to be degraded by proteolytic enzymes such as pepsin and pancreatin. Undoubtedly, oral delivery of peptides and proteins to the gastrointestinal tract is one of the most challenging problems and is therefore intensively studied. However, there are many hurdles, such as protein inactivation by digestive enzymes in the gastrointestinal tract and poor epithelial permeability of these drugs. However, certain hydrogels can overcome some of these problems with proper molecular design or formulation approaches. Akiyama et al. [118] Carbopolw (C934P), a poly(acrylic acid) product that has been shown to have an inhibitory effect on the hydrolytic activity of trypsin, and its neutralized lyophilized modification (FNaC934P), were used to inhibit protease inhibition. reported a new oral dosage form of an active hydrogel formulation). They showed that a biphasic formulation consisting of his FNaC934P, which gels rapidly, and C934P, which efficiently inhibits the enzyme but swells slowly, has the greatest impact on inhibiting trypsin activity. Recently, Lowman et al. [119] A hydrogel used to protect insulin in the harsh acidic environment of the stomach before the drug is released in the small intestine was a crosslinked copolymer of PMAA and polyethylene glycol (P(MAA-g-EG)) grafts. Insulin-loaded P(MAA-g-EG) microparticles showed potent dose-dependent hypoglycemic effects in in vivo oral administration studies in healthy and diabetic rats. Blood glucose levels in these animals were significantly reduced for at least 8 hours due to absorption of insulin in the gastrointestinal tract.The gastrointestinal tract is arguably the most common route of drug administration due to the ease of delivery of drugs for conformal therapy and the large surface area for systemic absorption. However, as this is the most complex pathway, a multifaceted approach is required to deliver effective therapeutics. Similar to buccal delivery, hydrogel-based devices can be designed to deliver drugs locally to specific sites in the gastrointestinal tract. For example, Patel and Amiji [116] proposed a stomach-specific antibiotic delivery system for the treatment of Helicobacter pylori infection in peptic ulcer disease. To locally deliver antibiotics to the acidic environment of the stomach, they developed cationic hydrogels with pH-sensitive swelling and drug-releasing properties. Hydrogels were composed of lyophilized chitosan-poly(ethylene oxide) (PEO) IPNs. The pH-dependent swelling properties and release of two common antibiotics, amoxicillin and metronidazole, encapsulated in chitosan-PEO-semiIPN were observed in enzyme-free simulated gastric fluid (SGF; pH 1.2) and simulated intestinal fluid (SIF; pH

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Rectal delivery

The rectal route has been used to administer many types of drugs, but patient acceptance is variable due to discomfort caused by the dosage form administered. Its primary use was in the topical treatment of rectal-related ailments such as hemorrhoids. Moreover, it is known that drugs absorbed from the lower part of the rectum are directly discharged into the systemic circulation. The rectal route is therefore a useful route of administration for drugs that suffer from severe first-pass metabolism. Conventional suppositories hitherto adapted as dosage forms for rectal administration are solid at room temperature and melt or soften at body temperature. A problem with rectal administration using conventional suppositories is that drug that diffuses uncontrollably from the suppository is not well retained in a specific location in the rectum and sometimes migrates to the large intestine. This often results in variability in the bioavailability of certain drugs. This is especially true for drugs that undergo large first-pass excretion. In this context, hydrogels, if designed to have sufficient bioadhesiveness after rectal administration, could offer a valuable way to overcome the problems of traditional suppositories. Ryu et al. [129] reported that by adding specific mucoadhesive macromolecular compounds to poloxamer-based thermogel suppositories, an increase in the bioavailability of propranolol, which is dependent on extensive rstpass metabolism, was observed. Among the mucoadhesive macromolecules tested, polycarbophil and sodium alginate produced the greatest mucoadhesion and the least rectal migration to suppositories, resulting in the greatest bioavailability of propranolol (82.3 and
84.7%). Miyazaki et al. [130] explored the potential application of xyloglucan gels with thermogelling properties as vehicles for rectal drug delivery.

Ocular delivery

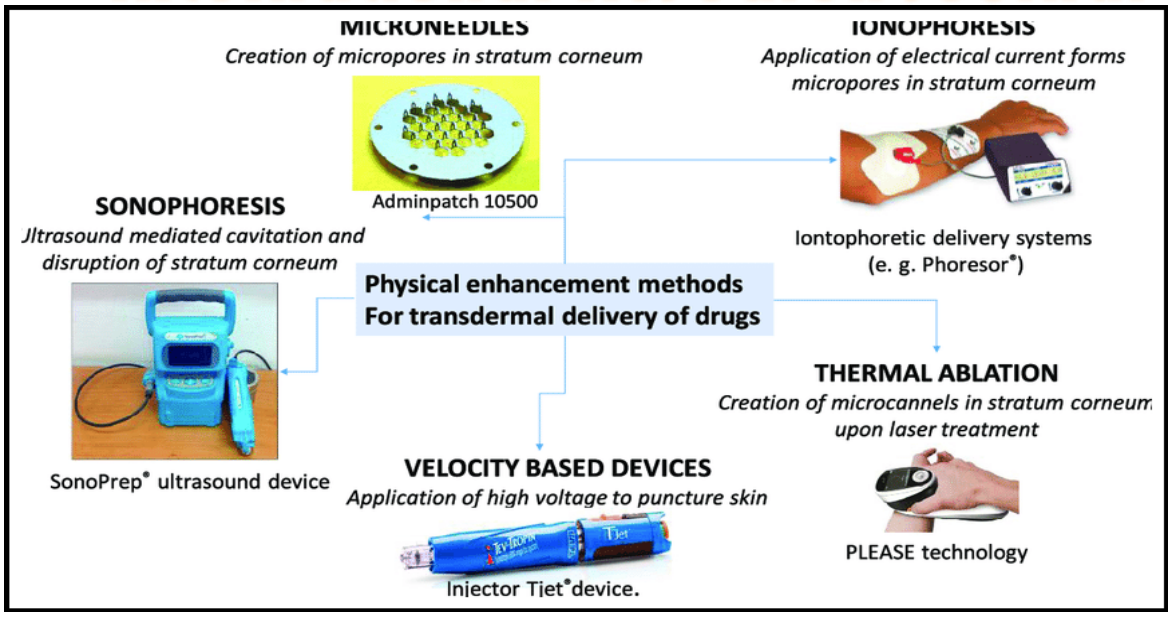
In ocular drug delivery, many physiological limitations hinder successful ocular drug delivery through protective mechanisms, including: B. Effective tear drainage, blinking, and reduced corneal permeability. Therefore, conventional eye drops containing drug solutions tend to be rapidly cleared from the eye, limiting absorption of the administered drug and resulting in poor ophthalmic bioavailability. Furthermore, their short-term maintenance often leads to frequent dosing regimens to achieve therapeutic effect over a sufficiently long period of time. came to develop drug delivery systems. Certain dosage forms such as suspensions and ointments can leave a residue on the eye, and these patients may experience discomfort due to their solid or semi-solid properties. can also provide drainage resistance devices. Additionally, they may provide a better feel to the patient and reduce grittiness. In particular, in situ-forming hydrogels are attractive as ocular drug delivery systems because they can be easily administered as liquids and retained as gels for long periods of time after administration. Cohen et al. [132] developed

an in situ gelation system from guluronic acid-rich alginate for ophthalmic administration of pilocarpine. This system significantly extended the duration of pilocarpine's antihypertensive effect to his 10 hours compared to his 3 hours when pilocarpine nitrate was administered as a solution. A rheological evaluation of Gelritew, a deacetylated gellan gum that gels when instilled into the eye due to the presence of cations, was performed by Carlfors et al. [133]. Their study showed that the high sol/gel transition rate of the Gelritew in situ gel resulted in longer precorneal contact times. Chetni et al.

Transdermal delivery

Drug delivery to the skin has traditionally been performed for the topical application of dermatological agents to treat skin disorders or to disinfect the skin itself. In recent years, the transdermal route has been considered as a possible site for systemic drug delivery. Potential advantages of transdermal drug delivery include the ability to administer drugs at a constant rate over an extended period of time, the ability to interrupt drug delivery if necessary by simply removing the device, and the ability for drugs to bypass hepatic first-pass metabolism. It is included. In addition, swollen hydrogels feel better on the skin compared to traditional ointments and patches due to their high water content. A versatile hydrogel-based device has been proposed for transdermal delivery. Sun Set has developed a composite membrane consisting of cross-linked PHEMA and a non-woven polyester backing. Depending on the manufacturing conditions, the composite membrane can be adjusted to give permeation fluxes for nitroglycerin from 4 to 68 mg/cm2 per hour. A Carbopol 934w-based formulation containing phosphatidylcholine liposomes (liposome gel) was proposed by Kim et al.

Their study examined the skin absorption behavior of hydrocortisone-containing liposomal gels. Gayet and Fortier reported hydrogels obtained by copolymerization of bovine serum albumin (BSA) and PEG. A potential application of BSA±PEG hydrogels has been proposed as controlled-release devices in the field of wound dressings due to their high water content of over 96%, which enables the release of hydrophilic and hydrophobic drugs. increase.



An extensive study on in situ photopolymerizable hydrogels of terminal diacrylate ABA block copolymers of lactic acid oligomers (A) and PEG (B) for barrier and local drug delivery in the control of wound healing was carried out by Hubbell [138] Research trends in transdermal applications focus iontophoresis and electrically assisted delivery using electroporation [139]. Several hydrogel-based formulations as vehicles for transdermal iontophoresis to enhance penetration of luteinizing hormone-

releasing hormone [140], sodium nonivamide acetate [141], nicotine [142], and enoxacin [143]. is being studied. On the other hand, a methylcellulose-based hydrogel was used as a viscous ultrasound coupling medium for AC-assisted transdermal sonophoresis to facilitate the penetration of insulin and vasopressin through human skin in vitro.

Subcutaneous delivery

As explained in sections 1-4, hydrogels have various potential pharmaceutical applications. Among them, their essential application is found in implantable therapies. Exogenous substances introduced subcutaneously can, to a greater or lesser extent, cause potentially unwanted body reactions such as inflammation, carcinogenicity, and immunogenicity.Biocompatibility, therefore, makes the material implantable. is a requirement for Due to their high water content, hydrogels are generally considered biocompatible materials. They also offer some promising properties. the low interfacial tension between water and hydrogel prevents protein adsorption and cell adhesion; ,single drugs with different hydrophilicity and molecular size are widely accepted; a unique opportunity to manipulate the release of incorporated drugs (crosslinking density and swelling) . Some of these may offer advantages in the delivery of certain sensitive drugs such as peptides and proteins.Giammona et al. developed a novel hydrogel resulting from the chemical cross-linking of a,b-polyaspart hydrazide (PAHy) with glutaraldehyde. PAHy is a new water-soluble polymer synthesized from polysuccinimide by reaction with hydrazine. Histological analysis showed that this hydrogel was inactive when subcutaneously implanted in rats. Several hydrogel formulations have also been proposed for subcutaneous administration of anticancer drugs. For example, cross-linked PHEMA has been applied to cystabine (Ara-C) and methotrexate with good biocompatibility. Poly(AAm-co-monomethyl-or-monopropylitaconate) developed by Blanco's group was used to control the release of Ara-C and 5-fluorouracil. Current research on implantable hydrogels aims to develop biodegradable systems that do not require subsequent surgical removal after the drug supply has been exhausted.

Cho et al. developed a bioerodible hydrogel based on a semi-IPN structure from poly(1-caprolactone) and a PEG macromer with terminal acrylate groups. In vivo, a constant sustained release of clonazepam encapsulated in semi-IPNs over 45 days was achieved. Recently, his two new degradable PEG hydrogels for controlled release of proteins were developed by Zhao and Harris . One type is made by a polycondensation reaction between a difunctional PEG acid and a branched PEG polyol. These gels degrade only to PEG and PEG derivatives when the resulting ester bonds are hydrolyzed. The other is a PEG-based hydrogel with functional groups that can covalently attach protein drugs to the gel network via ester linkages. Thus, release of immobilized protein drugs is achieved by hydrolysis of the ester bonds between the gel and proteins, followed by diffusion of the proteins out of the gel and degradation of the gel into controllable degradable dextran hydrogels. . colleague [154±158]. These hydrogels are based on acrylate derivatives of dextran. Their study thoroughly explored the application of hydrogels for the controlled release of proteins. A biodegradable crosslinked dextran hydrogel with PEG (PEG-Dex) was reported by Moriyama and Yui [159]. Insulin release from these hydrogels was modulated by surface degradation of the microdomain-patterned PEG-Dex.

CONCLUSION

Hydrogels are crosslinked polymer networks that absorb substantial amounts of aqueous solutions.Because of its high water content, this gel more closely resembles natural living tissue than any other type of synthetic biomaterial. Hydrogels have a unique combination of characteristics that make them useful in drug delivery applications. Due to their hydrophilicity, hydrogels can imbibe large amounts of water. Therefore, the molecule release mechanisms from hydrogels are very different from hydrophobic polymers. Hydrogels have been used to deliver active component like Desonide which is a synthetic corticosteroid usually used as an anti-inflammatory. Instead of conventional creams, the hydrogels have been formulated for better patient compliance. These hydrogels have moisturizing properties therefore scaling and dryness is not expected with this drug delivery system.

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