Internet Journal of Medical Update

Journal home page: http://www.akspublication.com/ijmu

Editorial

Introduction to Polymeric Drug Delivery

Dr. Vicky V. Mody, PhD

Assistant Professor of Medicinal Chemistry, Department of Pharmaceutical Sciences, Appalachian College of Pharmacy, 1060 Dragon Road, Oakwood, Virginia, USA 24614

Dr. Robert Langer a professor of chemical and biomedical engineering at Massachusetts Institute of Technology once stated that the need for novel material can generally be broken into two categories, the creation of new materials and manipulation of the existing materials. In both cases the current needs of the novel therapeutics include reducing the toxicity of materials, optimizing the pharmacokinetic parameters, and finally increasing their concentration at the desired target. These physiochemical properties are considered ideal for any pharmaceuticals. Even though the task is daunting, researchers across the world have accepted this challenge and seek to develop ideal pharmaceuticals by excavating nature and developing new materials. Polymers are one such class of materials that has been developed in the search of better pharmaceuticals. The application of the polymeric materials for medical purposes is growing fast. Polymers have found applications in diverse biomedical fields such as drug delivering systems, developing scaffolds in tissue engineering, implantation of medical devices and artificial organs, prosthesis, ophthalmology, dentistry, bone repair, and many other medical fields.

For almost four decades, both natural and synthetic polymers have been investigated for use as carriers for controlling drug dosage. This coalition of polymeric science with the pharmaceutical science led to the innovation in the design and the development of novel drug delivering systems. The purpose of the polymers in such system is to deliver drugs to target pathological cells in order to increase the effectiveness of drugs thus reducing their undesirable side effects. Besides, the polymer core also protects the drugs from the physiological environment in vivo and thus increases the bioavailability of the drug to the patients. Hence, the polymeric drug delivering systems offer some unambiguous advantages such as localized and sustained delivery of the drug. This becomes especially important for toxic drugs which are related to various systemic side effects. In addition, for polymers to be used as drug carriers, they should have a well defined structure, should be biocompatible and non toxic. This led to invention of novel polymers with desired physiochemical properties to exploit them in drug delivery systems. Due to these superlative properties of polymers various drug delivering systems such as biodegradable drug delivery systems, diffusion controlled drug delivering systems, and responsive drug delivery systems have been developed over the period of years. These unique polymeric delivering systems are differentiated on the basis of the mechanism controlling release of the drug from the polymers.

Amongst, these novel classes of the polymeric delivering systems the biodegradable delivering system is most commonly favored to target specific areas of the body such as inflammation or tumors. In fact, the synthetic conjugates of biodegradable poly-3-hydroxybutrate are currently been investigated for the delivery of non steroidal anti-inflammatory agents such as aspirin, ibuprofen, ketoprofen, naproxen, and diclofenac for treating inflammations. These biodegradable polymers disintegrate into biocompatible compounds when exposed to chemicals (water), enzymes, or microbial which subsequently leave their incorporated medications behind. The drug molecule present in the system is released due to this process of erosion either in bulk or at the polymer’s surface. The degradation process basically involves the breakdown of polymers which are then further reduced by the Kreb’s cycle to carbon dioxide and water. Furthermore, the biodegradability of these polymers can be easily manipulated by incorporating a variety of labile groups such as ester, orthoester, anhydride, carbonate, amide, urea, and urethane in their backbone. Examples of such polymers include polyanhydrides, polyesters, polyacrylic acids, poly (methyl methacrylates), and polyurethanes.

Correspondingly, diffusion controlled drug delivering systems involve the dispersion of therapeutic agent within a polymer shell such as macromolecules. The sustained release of therapeutic agents by this system is driven by diffusion and the drug is released either by passing through the pores or between polymer chains. These are the processes that control the release rate. The ease of preparation and the commercial success of intra-uterine contraceptives such as Progestasert®, Norplant®, and various transdermal patches such as Nicoderm®, and Transderm Nitro® have triggered intense research in this field.

Responsive drug delivery systems are another class of delivery systems where the rate of drug released can be controlled by its surrounding such as, temperature, solvent, pH, or concentration. Poly (N-isopropylacrylamide) is a well-known example of a thermo-responsive polymer which exhibits lower critical solution temperature or phase separation at about 32^{o}C. This polymer is soluble in water; but, as temperature is increased, the polymer precipitates and phase separates. Similarly, copolymers of poly (ethylene glycol) and poly (propylene glycol) and the copolymers of poly (lactic acid) and poly (glycolic acid) copolymers also exhibit thermo-responsiveness. These copolymers are useful in developing thermogelling systems which are liquid at low temperature and gel at human body temperature (37°C) which eventually degrades and releases the drug molecules. The gels such as Atridox® are injected or applied to specific local sites and offer therapeutic properties for the local repair of damaged tissue such as cartilage, bone and chronic wounds. The unique ability of these responsive systems to gel at body temperature offers the key benefit.

Thus, cosmic advances have been made in the field of polymeric drug delivery and the delivery systems described here represents a mere latent image of what has been developed so far. Even though, few of these delivery systems even extend beyond the domain of laboratory and has found applications in other processes including aerosol inhalation devices, forced-pressure injectables, and gene therapies. The research into drug delivery systems extends beyond traditional pharmaceuticals to achieve therapeutic effects in humans so that the safety and efficacy of current treatments may be improved. Moreover, this novel therapeutics can be easily managed if their delivery rate, biodegradation, and site-specific targeting can be predicted, monitored, and controlled. This will not only be beneficial from a global health care perspective, but also play a constructive role in reducing cost of traditional time consuming long term treatments.

Dr. Vicky Mody,
Associate Editor,
Email: vmody@acpharm.org