CHAPTER 20

Mucoadhesive Polymers: Gateway to Innovative Drug Delivery

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1. INTRODUCTION

Drug molecules are associated with side effects, efficacy problems, and degradation. To overcome these shortcomings, new drug molecules with improved properties are developed constantly. However, the development of a new drug molecule is an expensive and time-consuming procedure. Many strategies have been adopted to improve the safety and efficacy of old drugs such as individualizing drug therapy, dose titration, and therapeutic drug monitoring. In addition, delivering drugs at a controlled rate via slow and targeted delivery is also helpful in overcoming the associated drawbacks of the already existing molecules. Increased understanding of pharmacokinetic and pharmacodynamics studies of drug molecules helps in predicting the incompatibility and fate of drugs considering different routes of administration. These studies suggest that mucosal delivery of drugs has numerous advantages, which are beneficial to overcome the associated drawbacks of drugs responsible for therapeutic insufficiency [1]. Mucous membrane forms a moist surface lining of the gastrointestinal tract, respiratory passages, eye, nasal, oral, and genital organs.

Among the various approaches for mucosal delivery, mucoadhesion is of prime importance in transporting drug molecules with increased bioavailability. Mucoadhesive drug delivery systems have a potential to optimize the delivery of therapeutics, both locally and systematically in a controlled manner [2]. In addition, these mucoadhesive systems have the ability to deliver various unstable bioactive including macromolecular drugs such as proteins and oligonucleotides via different routes of administration like ocular, nasal, vaginal, and buccal which otherwise difficult to deliver by oral route [3]. In order to develop these adhesive delivery systems, researchers explore natural and synthetic polymers, silk, silk-like proteins, and bacterial proteins. Such mucoadhesive polymers are continuously being developed and extensively investigated for promising biomedical application, out of which many of them translated into a potential clinical application. One of the first developed mucoadhesive formulations was orbase formulated from natural gums and represented the firstly purposely developed mucoadhesive drug delivery system [4]. The number of publications about mucoadhesive drug delivery systems each year reflects about the intensive investigations in this field, as illustrated in Fig. 1.

Advancement in the field of nanotechnology enhances the capability of the pharmaceutical technologist in reshaping the field of mucoadhesive systems likely micelles, self-emulsifying drug delivery system (SEDDS), nanoparticles, micro gels, and liquid crystals for specific and controlled delivery of therapeutics using these mucoadhesive materials. Since mucoadhesive formulations were extensively investigated using different techniques to interpret the interface between the mucosal membrane and formulations. The properties affecting this interaction have been investigated to explain complex phenomena and in order to interpret the involved mechanisms.

2. MECHANISM OF MUCOADHESION

The polymeric molecules attached to mucosal surfaces across the interface. Interpenetration and entanglement of mucoadhesive polymers with mucus and mucosal membrane results in mucoadhesion involving following the binding forces that can arise in the following way.

Ionic bonds: Such kind of bonding occurs in ionic polymers (anionic and cationic) that interact with mucus substructures via electrostatic interactions.

Hydrogen bonds: This kind of bonding occurs in polymers having a hydrogen atom to electronegative atoms such as oxygen, fluorine, or nitrogen, carries

Modeling and Control of Drug Delivery Systems. https://doi.org/10.1016/B978-0-12-821185-4.00020-8