Chapter 8
Use of Lipids, Polymers, and Peptides for Drug Delivery and Targeting to Cancer Cells or Specific Organs

Sampan Attri
https://orcid.org/0000-0002-9906-9934
Department of Community Medicine and School of Public Heath, PGIMER, India

Shruti Sharma
Department of Experimental Medicine and Biotechnology, PGIMER, India

Ujjawal Sharma
Department of Community Medicine and School of Public Heath, PGIMER, India

Manjita Srivastava
National Institute of Virology (ICMR), India

Subash C. Sonkar
https://orcid.org/0000-0001-7929-3464
Multidisciplinary Research Unit, Department of Biochemistry, New Delhi, India

Meenakshi Singh
Transplant Immunology and Immunogenetics Lab (HLA), ACTREC, Tata Memorial Centre, India

Prudhvilal Bhukya
https://orcid.org/0000-0001-5657-9996
National Institute of Virology (ICMR), Pune, India

ABSTRACT

Cancer has been the most deleterious disease in recent times, and unfortunately its spread is increasing. Systemic treatment with chemotherapeutics remains the conventional way of treating many cancers, despite the serious damage long-term chemotherapy can cause in healthy tissues. Many therapeutic strategies have achieved popular practical applications, but drug delivery systems still face challenges associated with safety, and this has led to the development of safer drug delivery methods composed of biocompatible substances. In this respect, lipid-, polymer-, and peptide-based drug delivery systems have been proposed as safer candidates for cancer therapy. These delivery methods are expected to as biodegradable systems with low cytotoxicity for cancer therapy. Therefore, in this chapter, the authors discuss use of lipids, polymers, and peptides as delivery vehicles for chemotherapeutic agents and their structural characteristics.

DOI: 10.4018/978-1-7998-6530-8.ch008

INTRODUCTION

Cancer is a major cause of mortality in the most of countries across the earth. However, the ability of existing standard treatments for a range of cancers is suboptimal. Basically, utmost cancer treatments deficient specificity which signify that these treatments imitate both cancer cells and their regular counterparts. Furthermore, several anticancer agents are extremely toxic and therefore constraint their use in treatment. Also, a number of cytotoxic chemotherapeutics are greatly hydrophobic, which restricts their efficacy in cancer therapy (Snaebjornsson et al., 2020). Conclusively, many chemotherapeutic agents show short half lives that restrain their efficiency. Radiation therapy, surgical exclusion, and combinatorial approaches have been also suggested as treatment options, still, these modalities cannot be used to kill malignant cells that have already spread through a body. As a result of these insufficiencies, many existing treatments lead to the massive side effects, failure, and cancer patients inconvenience due to complications in administration. These situations has led to the development of new drug delivery systems that can help to overcome the limitations of conventional treatment approaches (Bandopadhyay et al., 2020).

Lipids, polymers, and peptides can be incorporated in drug delivery systems for effective cancer chemotherapy with lowers side effects such as low cytotoxicity, enhanced solubility of hydrophobic drugs and controlled release of drugs. Targeted delivery combined with controlled drug release has a critical role in the future of personalized medicine. The significant benefit of using lipids, polymers and peptides as a drug carrier noticeably increases organ or cell-specific drug accumulation and opens up the opportunity of controlled release of the delivered drug where the remedial effect is required. Selective activation in this manner could inhibit the drug's toxicity from affecting normal tissues and cells, eliminating whichever harmful side effects it might otherwise have which indicates the current achievements in the development of polymers nanoparticles in cancer therapy. The objective of targeting specific cell surface receptors through structural compatibility has revived the use of these biomolecules as enormously specific carriers as short peptides are typically non-antigenic, are structurally simple and synthetically distinct. In recent years, many developments in the field of lipid, polymers and peptide-based nanoparticles principally for cancer therapy, as their use can bypass the side-effects and can reduce the damage common to conventional chemotherapy (Maghrebi et al., 2019; Deb et al., 2019). In this chapter, we describe the progression of these biomolecules for targeted delivery of chemotherapeutics and discuss the latest innovations in the field that must lead in the near prospect to their clinical application.

LIPIDS

Over the past few years, lipids and liposomes have gained attention as a carrier system for therapeutically active agents. This is due to their unique characteristics, including biocompatibility, low toxicity, biodegradability, lack of immune system activation, and capability to incorporate both hydrophobic and hydrophilic drugs. Lipids have shown tremendous therapeutic potential as carriers for payloads and delivery to targeted sites, which has led to several liposomal formulations designed for the clinic and clinical trials for cancer therapy. There are several types of lipid-based carriers that stem from manufacturing methods and the main components used. For example, liposomes, micelles, emulsions, solid lipid nanoparticles, core-shell-type lipid-polymer hybrids and biomimetic vesicles have been widely investigated for lipid-based drug delivery (Markovic et al., 2020).