International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May-June 2025, pp: 2194-2196 www.ijprajournal.com ISSN: 2456-4494

Liposomes as Nano Carriers in Cancer Therapy: A Comprehensive Review

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Date of Submission: 28-06-2025 Date of Acceptance: 08-07-2025

ABSTRACT
Liposomes are artificial vesicles composed of a phospholipid bilayer that can encapsulate both hydrophilic and lipophilic drugs, protecting them from degradation. Since their discovery in the mid-1960s, liposomes have revolutionized research and studies. Their biocompatibility and flexibility enable targeted drug delivery at tumor sites, reducing the harm associated with traditional chemotherapy. By delivering high concentrations of drugs directly to tumors, liposomes minimize damage to healthy tissues. A significant advantage of liposomes in cancer treatment is their ability to entrap a variety of hydrophilic anticancer drugs, antifungal agents, and gene therapy derivatives. This property makes liposomes an attractive platform for targeted and efficient drug delivery**.** This comprehensive review aims to provide an in-depth analysis of the current state of liposome-based anti-cancer therapy, highlighting recent advances, challenges, and future perspectives.

Keywords:liposomes, anti-cancer therapy, targeted drug delivery, chemotherapy, biocompatibility.

I. INTRODUCTION

Cancer is the second leading cause of death and a significant burden on public health worldwide. In the United States, it is estimated that one in three women and one in two men will be diagnosed with cancer in their lifetime. Breast cancer is the most prevalent type globally. Cancer classification is based on staging, which assesses the tumor's extent. The TNM staging system, referring to tumor, node, and metastasis, is the most clinically useful. Liposomes have emerged as effective drug delivery systems for treating various cancers. They offer several advantages, including improved pharmacokinetic properties, reduced toxicity, extended systemic circulation, and targeted disposition in tumor sites due to the enhanced permeability and retention (EPR) mechanism. Liposomes can encapsulate anticancer drugs, facilitating their delivery to tumor sites. However, liposomes also have potential limitations, including toxicity and lack of specific targeting and disposition. This introduction provides an overview of liposome properties, their current status in cancer treatment, and limitations, highlighting the need for further research and development.(3,5,8)

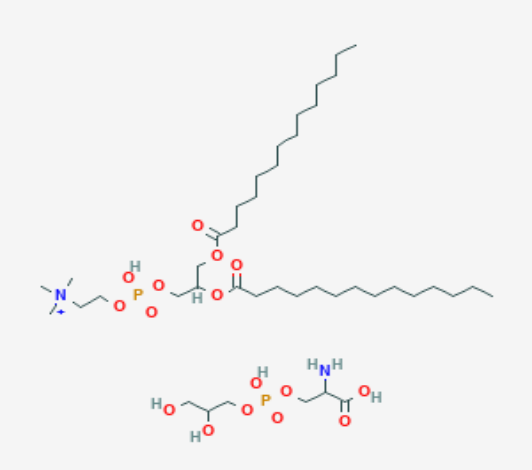

Fig:1. liposome.

Mechanism of formation of liposomes

The basic part of Liposome is formed by Phospholipids. Which are amphiphilicmolecules. Liposomes are formed when the thin films are hydrated and stacks of liquid crystalline bilayers become fluid and swells. However, in aqueous mixture these molecules are able to form various phase, some of them are stable and other remains meta stable. Hydrophilic Part: This part mainly consists of Phosphoric acid bound to a water-solublemolecule. Hydrophobicpart: This part consists of 2 fatty acid chains with 10-24 carbon atoms and 0-6 double bonds in each chain.(1,2,4,7)

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History

Liposomes are artificially engineered vesicles comprising a phospholipid bilayer, capable of encapsulating both hydrophilic and lipophilic drugs. This encapsulation protects drugs from degradation, thereby enhancing their efficacy. Since their discovery in the 1960s, liposomes have transformed the landscape of pharmaceutical research and drug delivery. The inherent biocompatibility and flexibility of liposomes enable precise targeting and controlled release of therapeutic agents at tumor sites. This targeted approach minimizes collateral damage to healthy tissues, mitigating the adverse effects associated with conventional chemotherapy. A key advantage of liposomal formulations in cancer treatment lies in their ability to encapsulate a broad spectrum of hydrophilic anticancer agents, antifungal drugs, and gene therapy derivatives. This versatility renders liposomes an attractive platform for efficient, targeted, and personalized drug delivery.(6)

Uses

- Liposomes are used as artificial blood surrogate.
- Liposomes are used as models for artificial cells.
- Liposomes are used as radio-Pharmaceutical and Radio diagnostic carrier.
- Anti- cancer agent.
- Anti-fungal agent.
- Anti-viral therapy.
- Gene therapy.
- Analgesic
- Ophthalmic drug delivery.
- Photodynamic therapy.(9,10)

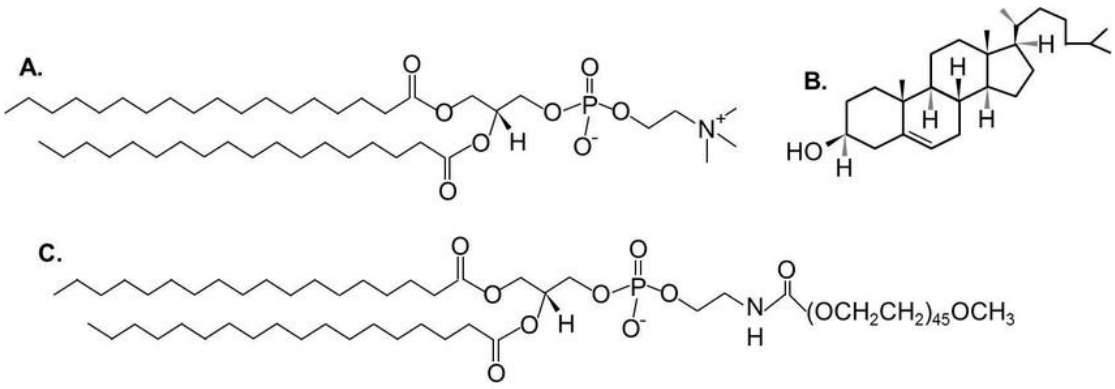

Fig no: 2. Chemical structures of common liposomes components.

Drugs

- Doxorubicin.
- Cytarabine.
- Mifamurtide.
- incristine.
- Irinotecan.
- Daunorubicin.
- Verteporphin.
- Paclitaxel.

II. CONCLUSION

The synergy between liposomes and anti-cancer therapeutics has revolutionized the landscape of oncology research. By leveraging the versatility of liposomal formulations, researchers have made significant strides in enhancing drug delivery, reducing toxicity, and improving treatment outcomes. As we continue to unravel the complexities of cancer biology, liposomes are poised to play an increasingly vital role in the development of personalized, precision medicine approaches.Moving forward, further investigations into the optimization of liposomal formulations, combination therapies, and targeted delivery strategies will be crucial in unlocking the full potential of liposomes in anti-cancer therapy. Moreover, interdisciplinary collaborations between researchers, clinicians, and industry experts will be essential in translating these advances into tangible benefits for patients.

ACKNOWLEDGMENT

First of all, we would like to thank our guide **Mrs. Ayesha Siddiqua**, who was a constant source of inspiration. She encouraged us to think creatively and motivated us to work on this review article. We are thankful to our principal **Dr. Arifa Begum SK** for giving us this opportunity to present our article. The authors would like to express their sincere gratitude to the numerous researchers, scientists, and clinicians who have contributed to

the advancement of liposome technology and anti-cancer therapy. Your tireless efforts to push the boundaries of human knowledge and improve patient outcomes are truly inspiring.

We would also like to acknowledge the support and resources provided by our institutions, without which this review would not have been possible.

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