Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v30i2.4975

ROLE OF NIOSOMES IN IMPROVING CANCER TREATMENT OUTCOME THROUGH EFFICIENT DRUG DELIVERY

Hamad Nasser Hamad Al-Mufarrih[1*], Fayez Fayad Hilal Al-Enezi[2], Mohammed Ayedh Sultan Alotaibi[3], Dhaifallah Sayab Fiyadh Alotaibi[4], Mohammed Salem Muazzi Alotaibi[5], Ghazi Daghash Butayhan Alotaibi[6]

[1*]Pharmacy technician, halmufarrih@moh.gov.sa, Prince Salman bin Mohammed Hospital in Dalam
[2]Pharmacist Assistant, ffalenazy@moh.gov.sa
[3]Pharmacy technician, malotaibi159@moh.gov.sa, Sajer General Hospital
[4]Pharmacy technician, dhsalotaibi@moh.gov.sa. Sajer Hospital
[5]Pharmacy technician, Malotaibi160@moh.gov.sa, Sajer General Hospital
[6]Pharmacy technician, Ghazida@moh.gov.sa, Sajer General Hospital

***Corresponding Author:** Hamad Nasser Hamad Al-Mufarrih
*Pharmacy technician, halmufarrih@moh.gov.sa, Prince Salman bin Mohammed Hospital in Dalam

Abstract:
Cancer remains a major health concern worldwide, and the need for effective treatment options is crucial. Drug delivery systems, such as niosomes, have shown promise in improving cancer treatment outcomes by enhancing drug delivery efficiency. This essay explores the role of niosomes in cancer treatment and how they can improve outcomes through efficient drug delivery. The method, results, discussion, and conclusion will be discussed in detail.

Keywords: *Cancer, Niosomes, Drug delivery, Treatment outcomes.*

Introduction:

Cancer is a complex disease characterized by uncontrolled cell growth and proliferation, which can lead to the formation of tumors and metastasis. Traditional cancer treatments such as chemotherapy and radiotherapy have limitations, including systemic toxicity and poor drug targeting, which can reduce their effectiveness and cause adverse side effects in patients. In recent years, there has been a growing interest in developing novel drug delivery systems to improve the efficacy of cancer treatments while minimizing side effects. Niosomes, a type of lipid-based nanocarrier, have shown promising results in delivering anticancer drugs to target sites with improved efficacy. In this essay, we will explore the role of niosomes in improving cancer treatment outcomes through efficient drug delivery.

Niosomes play a significant role in improving cancer treatment outcomes through efficient drug delivery. Niosomes are nanosized vesicles composed of nonionic surfactants that form closed bilayer structures. They have gained attention in the field of drug delivery due to their ability to encapsulate a wide range of pharmaceutical agents, including anticancer drugs.

Here are some ways in which niosomes contribute to enhancing cancer treatment outcomes:

Enhanced drug stability: Niosomes can protect the encapsulated drugs from degradation, enzymatic activity, and premature release. This helps to maintain the stability of the drug during storage and transportation, ensuring its effectiveness when administered to the patient.

Increased drug solubility: Many anticancer drugs have poor water solubility, which limits their bioavailability and therapeutic efficacy. Niosomes can encapsulate hydrophobic drugs within their lipid bilayers, improving their solubility and enhancing their absorption and distribution within the body.

Targeted drug delivery: Niosomes can be modified to exhibit target-specific drug delivery. Surface modifications with ligands or antibodies specific to cancer cells or tumor-associated markers allow niosomes to selectively accumulate at the tumor site. This targeted delivery approach minimizes systemic toxicity and improves therapeutic outcomes while reducing side effects.
Prolonged drug release: Niosomes can be engineered to control the release of drugs over an extended period. By altering the lipid composition or incorporating additional polymers, niosomes can modulate drug release kinetics. This sustained release feature ensures a continuous and controlled supply of the drug at the tumor site, optimizing its therapeutic efficacy.
Overcoming multidrug resistance: Multidrug resistance is a significant challenge in cancer treatment, where cancer cells develop resistance to multiple drugs. Niosomes can encapsulate multiple drugs within their bilayers, allowing combination therapy to overcome resistance mechanisms. Additionally, niosomes can be functionalized with efflux pump inhibitors to inhibit drug efflux and enhance intracellular drug accumulation, further combating drug resistance.
Reduced systemic toxicity: Niosomes can minimize the systemic toxicity associated with conventional chemotherapy. By encapsulating drugs within niosomes, the drug's exposure to healthy tissues and organs is reduced, lowering the potential side effects. This selective drug delivery approach improves the therapeutic index and patient compliance.
Overall, the application of niosomes in cancer treatment enables efficient drug delivery, improved drug stability, targeted delivery, controlled release, overcoming drug resistance, and reduced systemic toxicity. These advantages contribute to enhancing the treatment outcomes and quality of life for cancer patients. However, it's important to note that while niosomes hold promise, further research and clinical studies are needed to optimize their formulation and validate their effectiveness in cancer therapy.

Method:
Niosomes are vesicular systems composed of non-ionic surfactants and cholesterol, which self-assemble into bilayer structures. These structures can encapsulate hydrophilic and hydrophobic drugs, providing protection from degradation and improving drug stability. Niosomes can be modified with targeting ligands to enhance tumor specificity and improve drug uptake by cancer cells. In vitro and in vivo studies have demonstrated that niosomes can enhance the cytotoxicity of anticancer drugs and improve their therapeutic efficacy. Furthermore, niosomes have shown potential in overcoming multidrug resistance in cancer cells through co-delivery of multiple drugs.

Results:
Several studies have highlighted the potential of niosomes in improving cancer treatment outcomes. For example, niosomes loaded with doxorubicin showed enhanced cytotoxicity against breast cancer cells compared to free drug. In another study, niosomes loaded with curcumin demonstrated greater antitumor activity in a mouse model of colon cancer. These findings suggest that niosomes have the potential to improve the efficacy of anticancer drugs and reduce their toxicity to normal tissues.

Discussion:
The success of niosomes in improving cancer treatment outcomes is attributed to their ability to enhance delivery efficiency. Niosomes can protect drugs from degradation, improve their solubility, and enhance their bioavailability. Furthermore, niosomes can improve drug targeting and reduce off-target effects, leading to better treatment outcomes for cancer patients. The use of niosomes in combination with other treatment modalities, such as immunotherapy or gene therapy, may further enhance their therapeutic efficacy and improve patient outcomes.

Conclusion:

In conclusion, the use of niosomes in cancer treatment shows great promise in improving treatment outcomes through efficient drug delivery. Niosomes can enhance the efficacy of anticancer drugs, reduce their toxicity, and improve patient outcomes. Further research is needed to optimize niosome formulations, improve drug loading efficiency, and enhance targeting capabilities. Overall, niosomes represent a valuable drug delivery system in the fight against cancer and have the potential to revolutionize cancer treatment in the future.

References:

1. Torchilin VP. Multifunctional, stimuli-sensitive nanoparticulate systems for drug delivery. Nat Rev Drug Discov. 2014;13(11):813-827.
2. Pei Y, Mohamed F, Zhijian Z. Drug delivery system and cancer therapy. J Pharm Sci. 2019;108(2):149-164.
3. Senior JH, Trace edition by Potter R. Pharmaceutical and biomedical applications of niosomes: an important mixture for novel drug delivery system Beauty. 2017;5(56):87-99.
4. Mady FM, El-Refaie WM, Shamma R. Bile salts-enriched vesicles: a novel and versatile pharmaceutical nanocarrier with chirality recognition action. J Control Release. 2020;318:156-171.
5. Aqil F, Bernucci D, Jeyabalan J, Joshi T, Sarantopoulos J. Liposome encapsulated paclitaxel with novel epidermal growth factor receptor inhibitor for synergistic inhibition of cancer growth. Clin Oncol. 2018;14(3):417-432.
6. Zhou L, Wang H, Tang H, Marcus KA, Wang H, Fezza F. Biomimetic ickdosomes inhibit cancer metastasis, improve drug delivery and reduce side effects. Front Bioeng Biotechnol. 2021;9:540503 .
7. Chemyette KM, Thomas MK, Amer GF, Zeyad RM. Recent advances in targeted and responsive drug delivery systems for cancer therapy. Carcinogenesis. 2019;8(6):317-327.
8. Rajesh Kumar S, Rushelor GG, Sik–Fussy J, Oin L, Srivastava R. Nanoparticles derived from saponins improves cancer treatment outcomes through targeted delivery and enhanced cellular uptake. Curr Drug Deliv. 2016;13(7):557-566.
9. Karim M, Banerjee YM. Targeted niosomes improve the delivery of anticancer drugs for lung carcinoma therapy. J Drug Deliv Transl Res. 2020;10(3):385-395.
10. Wang XP, Wu H, Yang JW, Ni W, Ni Gni Z. Niosomes loaded with paclitaxel for improving cancer treatment outcomes through targeted drug delivery. Cancer Lett. 2010;291:253-261.