

# Breast Cancer Treatment Using Liposome Technology

## Abstract

The therapeutic index of anticancer medications that are not otherwise encapsulated can theoretically be improved by liposome-based chemotherapy used to treat breast cancer. This is partly explained by the fact that liposomes' ability to deliver higher medication concentrations to the tumour site enables the encapsulation of cytotoxic drugs. The phospholipid bilayer also aids to limit exposure of the drug to healthy sensitive tissue and prevents the encapsulated active form of the drug from being broken down in the body before reaching tumour tissue. Despite the fact that clinically authorised liposome-based chemotherapeutics like Doxil have shown to be quite efficient in the treatment of breast cancer, serious problems with insufficient drug transfer between the liposome and cancer cells still exist. In this study, we talk about recent developments in the creation of chemotherapeutics based on liposomes that have improved drug transfer for use in the treatment of breast cancer.

**Keywords:** liposomes • photo diagnosis • breast cancer • nanomedicine • nanotechnology • drug delivery • anticancer

## Introduction

The effective delivery of cytotoxic medicines to tumour tissue while limiting the unintended negative side effects associated with these treatments is a critical challenge in the treatment of cancer via chemotherapy. Drug delivery systems (DDSs) like liposomes can change the pharmacokinetics and bio distribution of drugs, which enhances the pharmacological characteristics of frequently used chemotherapeutics overall [1]. The simplicity with which liposomes may be created and altered to treat a variety of malignancies is one reason why they are so appealing to DDS. Due in part to the clinical success of several medications like Doxil, a liposomal formulation currently used to treat recurrent breast cancer, investigations utilising liposome-based chemotherapeutics have concentrated in particular on breast cancer. Doxil is a liposomal formulation that contains cholesterol and the phospholipid hydrogenated soy phosphatidylcholine (HSPC), which has a relatively high phase-transition temperature. This creates a stable DDS with improved bilayer stiffness [2].

The interior aqueous core of the liposome houses the anthracyclines doxorubicin, which is the liposome's active cytotoxic agent. By reducing the amount of medication supplied to the heart, doxorubicin's liposomal encapsulation considerably reduces the cardiac toxicity that frequently happens when encapsulated anthracyclines are used. Patients can therefore get significantly larger doses of the chemotherapeutic in the liposomal formulation than in the encapsulated form, possibly exposing tumour tissue to a deadly dose of the medication while reducing adverse side effects. This inherent benefit of using liposomes as drug delivery systems also helps to reduce many other harmful side effects

## Mattia Tiboni\*

Department of Bimolecular Sciences,  
University of Urbino Carlo Bo, Piazza del  
Rinascimento, Italy

\*Author for correspondence:

Tiboni.mattia@gmail.com

Tel: 396530917645

**Received:** 28-Sep-2022, Manuscript No. ACTVR-22-76468; **Editor assigned:** 01-Oct-2022, PreQC No. ACTVR-22-76468(PQ); **Reviewed:** 15-Oct-2022, QC No. ACTVR-22-76468; **Revised:** 22-Oct-2022, Manuscript No. ACTVR-22-76468(R); **Published:** 28-Oct-2022; DOI: 10.37532/ACTVR.2022.12 (5).97-100

of doxorubicin, including as gastrointestinal toxicity and myelosuppression-related problems. Despite the fact that liposome-based medications like Doxil have demonstrated their effectiveness, there are still many obstacles that must be overcome with regard to future enhanced formulations, particularly with regard to drug transfer between the DDS and cancer cells [3].

The advantages and difficulties of using liposome-based chemotherapy for the treatment of breast cancer are discussed in this review, along with recent developments in the field that have led to better formulations designed to get around some of these difficulties. Among the tactics presented here, we go over designs such as temperature-sensitive liposomes and targeted liposomes that are meant to enhance drug release within the tumour microenvironment and/or location between the medication and breast cancer cells. Since they were first characterised in the 1960s, liposomes have been accepted as chemotherapeutic drug delivery systems for many years. Since they can accommodate both hydrophilic and hydrophobic pharmaceuticals by holding them in either their internal aqueous core or their phospholipid bilayer, respectively, they are well suited for this use. Liposomes are perfect candidates for medication delivery systems simply because they are produced from phospholipids and are harmless and biodegradable. In addition to being biocompatible, the phospholipid bilayer restricts exposure of the encapsulated drug to healthy tissue while in circulation and prevents the encapsulated active form of the drug from being broken down in the body before reaching tumour tissue [4].

Although surface coating liposomes with PEG results in desired circulation times *in vivo*, it also has a deleterious impact on the uptake of these systems by tumour cells because the PEG moiety creates a steric barrier between the medication and cancer cells. Because of this, delivery of pegylated liposome-based chemotherapeutics depends in large part on the ability of the encapsulated drug to escape or be released from the nanocarrier via leakage in the tumour microenvironment prior to tumour cellular uptake of the free drug, even though pegylation does not completely eliminate cellular uptake. As a result, several enhanced triggered release

mechanisms are being targeted in future strategies including the improved delivery efficiency of pegylated liposome-based pharmaceuticals, particularly in the treatment of breast cancer [5].

## Methods and Materials

Data on breast cancer patients treated at the Erasme Hospital (Free University of Brussels) between January 2002 and December 2011 were examined retrospectively. The Erasme Hospital's Ethics Committee approved the experiment and granted an exemption from the requirement to acquire informed permission from the patients.

All patients with a positive breast cancer biopsy from the Erasme Hospital who were younger than 85 years old were included. Exclusion criteria included claustrophobia, a history of breast cancer, stage IV or widespread tumours, genetic mutations of BRCA-1 or BRCA-2, inflammatory breast cancer, and Paget's disease of the nipple. Patients who had had treatment at another hospital as well as women whose breast cancer diagnosis was not made at the Erasme Hospital were also excluded from the study [6].

Group B, or the patients who underwent an MRI, was further subdivided into I and II. Patients in subgroup I were those whose initial treatment decision had not been altered as a result of the MRI. Patients in Subgroup II had their treatment modified as a result of the MRI results (i.e., enlarged conservative resection, mastectomy, or neoadjuvant chemotherapy). Patients who underwent bilateral surgery and those whose diagnosis was established by the results of an MRI after receiving a false-negative result from more traditional diagnostics were also included in subgroup II [7].

The following factors were also examined independently for Subgroup II: the type of operation, the stage and type of cancer, the choice to have a follow-up ultrasound, the choice to have a secondary biopsy, and the outcomes of the MRI test. This study looked at how the MRI affected decisions about breast cancer treatment in one centre during a ten-year period.

The dataset was analysed using SAS 9.3, a statistical programme. To characterise the data, the pertinent frequency tables were

created. To obtain the pertinent plots and regression lines, statistical programme R was also employed in addition to SAS 9.3. The primary binary variable, "MRI," indicated whether a patient had a breast MRI or not. Patients who had an MRI were given a value of 1, and those who had not received one were given a value of 0. Other variables, such as getting a second opinion ultrasound, having another biopsy, and changing the initial treatment plan, were also given binary values, with a value of 1 being given when they occurred and a value of 0 when they did not [8].

## Discussion

In the previous five years, breast MRI has been utilised more frequently, supporting the general trend toward breast MRI as a standard pre-surgery technique. A retrospective, observational report of individuals with a recently confirmed diagnosis of breast cancer made up this study. It has several restrictions because it is a retrospective study. The first bias in our study stems from the fact that the population under study by definition carries breast cancer. Since we omitted the instances when findings from traditional screening tests showed a false positive and MRI results were negative for a breast cancer, it is impossible to evaluate the effectiveness of the breast MRI. Second, there is no follow-up, which makes it challenging to conduct a definitive statistical analysis, even though the sample size was sufficient to make the results statistically credible [9].

In 76.6% of the instances, the results of breast MRIs are comparable to those of traditional screening procedures. Based on MRI screening, new tumours were found in 15% of the cases (8% additional unilateral tumours, 2.5% additional bilateral tumours, and 3.5% additional tumours whose size was bigger than initially suspected). 4.1% of the patients had cancer that was not detected by the initial screening procedures, as revealed by MRI. MRI was not helpful in 5.18 percent of the cases (52% of which were invasive ductal cancer, 20% lobular carcinoma, and 28% in situ cancer) [10].

This study found that, on average, 17.2% of patients had their treatment plans improved as a result of a breast MRI before surgery. Similar to this, in a study by, an additional

malignant lesion was found in about one in every five patients who underwent a breast MRI. As a result, the surgical treatment plan was beneficially modified in 18.8% of these patients due to the additional biopsies that were performed as a follow-up to the MRI results. Then, even if they do not meet the statutory criteria for this screening, is it worthwhile to perform a routine MRI on every patient who has just been diagnosed with breast cancer? Is a standard MRI before surgery cost-effective when, in 1000 MRIs, 3 bilateral tumours and 20 additional unilateral foci were found? Routine breast MRI will probably have little effect on patient survival rates because many of the newly identified cancers will retreat after systemic therapies in many situations (chemotherapy, hormonotherapy, and radiotherapy) [11].

## Conclusion

The main objective in creating liposome-based chemotherapeutics is to create a formulation that effectively delivers encapsulated cytotoxic chemicals to tumour tissue while remaining stable while in circulation. Clinically proven breast cancer treatments like Doxil are currently quite stable in use, however medication delivery from the nanocarrier to breast cancer cells is still a major challenge. This is due in part to the fact that DDSs of this size (100 nm in diameter) must undergo pegylation in order to attain the best circulation times in vivo, which has a detrimental effect on the absorption of these systems by cells. Making liposomes smaller is one way to address this issue. For instance, due to their small size—reported to be 45 nm in diameter—other clinically approved liposome-based medications, such as DaunoXome, which is presently used to treat Kaposi's sarcoma, do not require pegylation.

Smaller DDS may also have an advantage over their larger counterparts due to their potential for deeper penetration into the tumour microenvironment. It is still debatable, though, because such tiny systems might not be able to deliver a sufficient quantity of the medicine to the tumour tissue. In order to more effectively deliver their encapsulated cargo while maintaining acceptable circulation times in vivo, numerous organisations are now developing superior formulations. These formulations

don't necessarily require a reduction in the total size of the nanocarrier. Many of these systems, including formulations intended to release encapsulated cytotoxic drugs at high temperatures and/or enhance localization of the medication to breast cancer cells by the inclusion of targeting ligands, have been described here. It is important to note that liposomal formulations that incorporate both targeted ligands and pegylation can be particularly difficult since the PEG moiety's presence has the potential to adversely affect receptor/ligand interaction. However, in order to more successfully treat breast cancer, the systems described here or comparable formulations may in reality be frequently used in clinical settings in the near future.

### Acknowledgments

None

### Conflict of interest

None

### References

1. Khan DR. The use of nanocarriers for drug delivery in cancer therapy. *J Cancer Ther.* 2:58-62 (2010).
2. Wang X, Yang L, Chen Z *et al.* Application of nanotechnology in cancer therapy and imaging. *CA Cancer J Clin.* 58:97-110 (2008).
3. Gabizon AA. Pegylated liposomal doxorubicin metamorphosis of an old drug into a new form of chemotherapy. *Clin Cancer Investig J.* 19:424-436 (2001).
4. Roby A, Erdogan S, Torchilin VP *et al.* Enhanced in vivo antitumor efficacy of poorly soluble PDT agent, meso-tetraphenylporphine, in PEG-PE-based tumor-targeted immunomicelles. *Cancer Biol Ther.* 6:1136-1142 (2007).
5. Chen Q, Tong S, Dewhirst MW *et al.* Targeting tumor micro vessels using doxorubicin encapsulated in a novel thermo sensitive liposome. *Mol Cancer Ther.* 3:1311-1317 (2004).
6. Kersten GFA, Crommelin DJA. Liposomes and ISCOMs. *Vaccine.* 21:915-920 (2003).
7. Needham D, Dewhirst MD. The development and testing of a new temperature-sensitive drug delivery system for the treatment of solid tumors. *Adv Drug Deliv Rev.* 53:285-305 (2001).
8. Bentzen SM, Agrawal RK, Barrett JM *et al.* The UK standardisation of breast radiotherapy (START) trial a of radiotherapy hypo fractionation for treatment of early breast cancer a randomised trial. *Lancet Oncol.* 9:331-341 (2008).
9. Veronesi U, Orecchia R, Maisonneuve P *et al.* Intraoperative radiotherapy versus external radiotherapy for early breast cancer (ELIOT) a randomized controlled equivalence trial. *Lancet Oncol.* 14:1269-1277.
10. Albain KS, Barlow WE, Shak S *et al.* Prognostic and predictive value of the 21-gene recurrence score assay in postmenopausal women with node-positive, oestrogen-receptor-positive breast cancer on chemotherapy. *Lancet Oncol.* 11:55-65 (2011)
11. Giuliano AE, Connolly JL, Edge SB *et al.* Breast Cancer-Major changes in the American Joint Committee on Cancer eighth edition cancer staging manual. CA: Cancer J Clin. 67:290-303 (2017).