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# A REVIEW PAPER ON DRUGS FOR BREAST CANCER TREATMENT

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***Abstract***

*One of the most common causes of death for women worldwide is breast cancer. While chemotherapy is a treatment choice for most cancers, the three primary clinical methods for breast cancer treatment are surgery, chemotherapy, and radiotherapy. Nanotechnology apps for cancer therapies have gained a lot of interest in recent years. This analysis focuses on the different forms of nanoparticles and their applications for the treatment of breast cancer, such as liposomes, micelles, polymeric nanoparticles, solid lipid nanoparticles, and gold nanoparticles. Nanotechnology has grown and been applied to cancer therapies in recent decades. Nanotechnology currently plays an important role in the selective delivery of drugs for the treatment of cancer, including breast cancer. Nanoparticles can target tumors and monitor drug release to specific locations, thus increasing drug therapeutic efficacy and minimizing toxicity to normal tissues or organs. In addition, nanoparticles can also activate anti-tumor immune cells. Nanoparticles, therefore, are a promising method for potential study and treatment of cancer.*

***Keywords:*** *Cancer, Drug, Disease, Nanoparticles, Nanotechnology.*

## I. INTRODUCTION

Cancer is one of the leading causes of death worldwide and is defined as a disease that begins when cells grow uncontrollably and crowd out normal cells. Cancer can develop anywhere in the body, such as in the lungs, breasts, or liver. The World Health Organization predicted that the burden of cancer will increase to 23.6 million new cases annually by 2030 (World Health Organization 2014). Thus, cancer treatment has become a prominent issue over the past several decades[1].

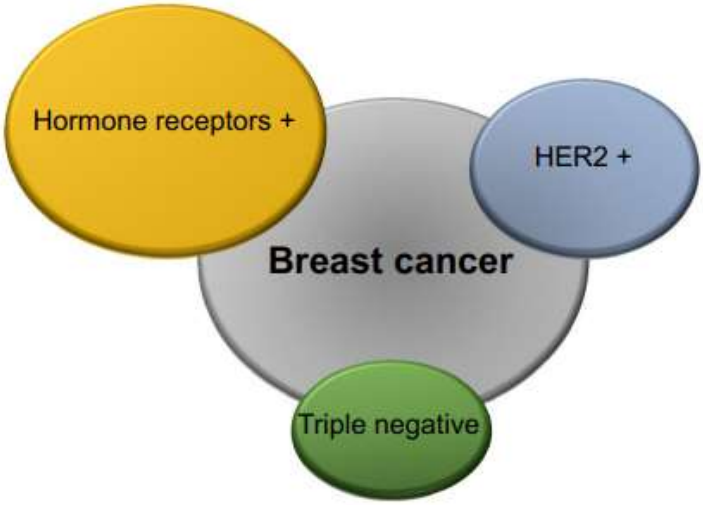


Fig. 1 Illustrates receptor-based breast cancer classification[2].

For women, breast cancer is one of the most commonly diagnosed cancers globally. In 2018, approximately 266,120 new cases of invasive breast cancer were estimated in women constituting 30% of all cancer cases (878,980 total cases); in addition, 40,920 of these breast cancer cases were estimated to be fatal. Breast cancer is usually classified on the basis of the type of receptor overexpression present on the cancer cell membrane (Fig. 1), including progesterone (PR) and estrogen (ER) hormone receptors and HER2 receptors, with HER2 being a member of the human epidermal growth factor receptor family[3].

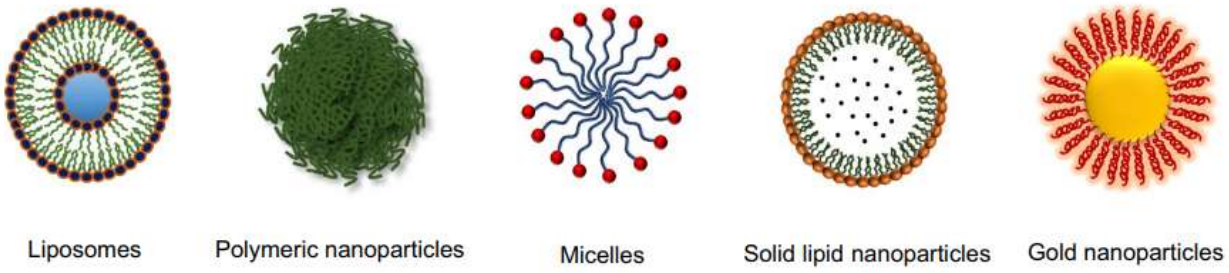


Fig. 2 Illustrates the nanoparticle types commonly used in the treatment of breast cancer[4].

In fact, different combinations of vectors and active ingredients will allow a wide range of personalization possibilities, depending on particular diseases and patients[5]. The routes used to administer and transmit active substances to their target tissue are a relevant factor when treating a disease[6]. These routes may have different effects, depending on how they are implemented. The administration is usually systematic. Occasionally, because of the nature of the condition or the toxicity present in the medication, it has to be administered directly to the affected organ[7].

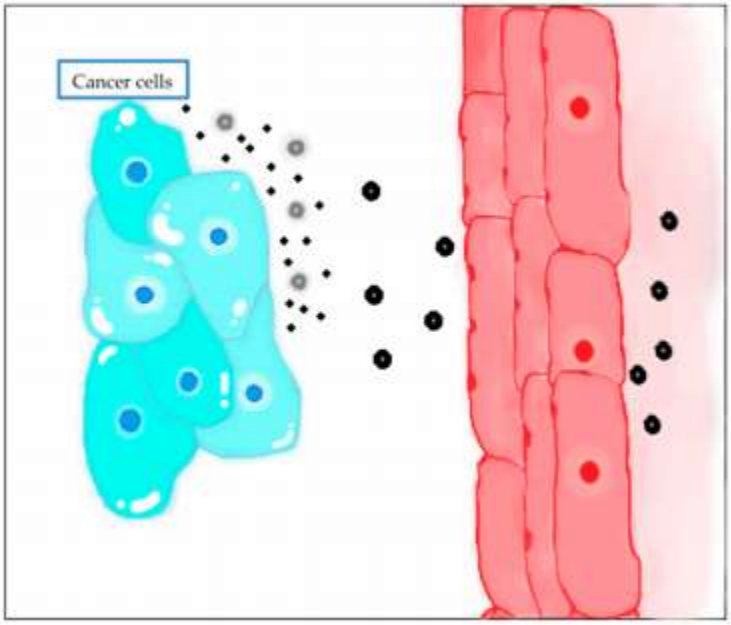


Fig. 3 Illustrates the diagram of the EPR consequence[8].

## II. DISCUSSION

| Anticancer drug | Results |
|---|---|
| Paclitaxel | The cytotoxic effect of nanoliposomal paclitaxel (86.25 μg/mL) on the MCF-7 cell line was more than that of the standard form (142 μg/mL) |
| Doxorubicin | The liposome nanoparticle of doxorubicin provided 1500-fold higher plasma and 20-fold higher intracranial tumor sum total doxorubicin AUC compared with free drug |
| Docetaxel | After the IV administration of liposome formulations, the half-life was 10 times longer than that of docetaxel alone. The AUC increased 1.728-fold. $IC_{50}$ value was found to be $20.3 \pm 1.95$ for free drug and $0.08 \pm 0.4$ μg/mL for liposome formulation |
| Paclitaxel/rapamycin | Liposomes were more cytotoxic to the 4T1 breast cancer cell line than the free drugs (approximately twofold at lowest concentration). In addition, liposomes were better able to control tumor growth than the solution |
| Paclitaxel/doxorubicin | The liposome tumor inhibition ratios were observed for the treatments with free and co-encapsulated of two drugs in liposomes (66.87% and 66.52%, respectively) as compared to the control |
| Quercetin/vincristine | Liposome formulations were physically stable and enhanced quercetin solubility 8.6-fold. In vitro MTT assays showed significant synergism, with a combination index of 0.113 and a dose-reduction index value of 115 at $ED_{50}$ for vincristine |

Table 1 Illustrates anticancer drug delivery by liposomes to breast cancer cells[9].

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| Anticancer drug | Results |
|---|---|
| Docetaxel | The therapeutic effects of docetaxel could be enhanced by micelle formulation, which were 205.6- and 223.8-fold higher than those of the commercial reference (Taxotere®) for MDA-MB-468 and MDA-MB-231 cell lines, respectively |
| Dasatinib | Dasatibib micelles exhibited 1.35-fold increase in the in vitro cytotoxicity against triple-negative human breast cancer cell line (MDA-MB-231) |
| Teniposide | Teniposide micelles inhibited the growth of MCF-7 more than commercial formulation (VM-26). $IC_{50}$ of VM-26 and micelles were 5.342 μg/mL and 3.248 μg/mL, respectively. The cellular uptake of micelles group was significantly higher than that of VM-26 group (1 h: $0.529 \pm 0.044$ mg vs. $0.126 \pm 0.017$ mg; 4 h: $1.829 \pm 0.163$ mg vs. $0.858 \pm 0.160$ mg) |
| Paclitaxel/cisplatin | Paclitaxel/cisplatin micelles showed more active than either of the single drugs. $IC_{50}$ of paclitaxel/cisplatin micelles was about 0.25 μg/mL while $IC_{50}$ of paclitaxel and cisplatin were about 45 and 20 μg/mL, respectively |
| Paclitaxel | The cell viability of paclitaxel micelles in MCF-7 cells showed significantly decreased from ~75% to ~30% when paclitaxel concentration increased from 0.01 μM to 0.25 μM. The tumor growth were significantly inhibited by super-antiresistant paclitaxel micelles for both intravenous (TIR = $45.90 \pm 10.47\%$) and oral ($44.62 \pm 11.15\%$) administration routes |
| Doxorubicin | The $IC_{50}$ values were found to be 0.13 μg/mL for free doxorubicin and 0.15 μg/mL for encapsulated doxorubicin |

Table 2 Illustrates anticancer drug delivery by micelles to breast cancer cells[10].

Usually, the three primary cancer treatment methods are surgery (in which the whole breast is removed, called a mastectomy, or in which only the tumor and underlying tissues are removed, called a breast-conserving lumpectomy), chemotherapy (in which medications are used to destroy cancer cells), and radiotherapy (in which high-energy waves are used to kill cancer cells). Chemotherapy is most widely used to treat most forms of cancer, among others. To date, nanotechnology has progressed rapidly to develop some of the most effective therapeutic methods for cancer. Among the different types of nanoparticles, liposomes, micelles, polymeric nanoparticles, solid lipid nanoparticles and gold nanoparticles are the most common nanoparticles used in breast cancer treatments[11].

## III. CONCLUSION

Currently, nanoparticle studies for breast cancer care have grown rapidly and have concentrated mainly on the use of targeting ligands to achieve high tumor accumulation. HER2 is one of the most common cell surface receptors in breast cancer cells, and this receptor is used to target conventional anticancer drugs such as paclitaxel, docetaxel, and doxorubicin effectively. Treatment efficiency is improved by the use of targeting ligands in the preparation of nanoparticles and toxicity is avoided in normal cells compared to nanoparticles without targeting ligands. Nanoparticles, therefore, are a promising method for the potential treatment of breast cancer and other cancers.

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