

Article

Disulfide-Crosslinked mPEG-PLA-(LA)₄ Nanomicelles for Taxane Delivery in Breast Cancer Therapy

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Abstract

Taxanes represent a crucial class of chemotherapeutic agents clinically employed for the treatment of various malignancies, including breast cancer. Three commonly utilized taxanes—paclitaxel (Taxol), docetaxel (Taxotere), and cabazitaxel—are substantially limited by inherent drawbacks such as poor aqueous solubility, rapid clearance, and non-specific distribution. To enhance their anti-tumor efficacy against breast cancer, an mPEG-PLA-(LA)₄ nanomicelle carrier was designed and synthesized in this study for the loading of these three taxanes. These nanomicelles were designed to improve the aqueous compatibility and nanomicelle-mediated delivery of hydrophobic taxanes. In vivo animal experiments were conducted to evaluate the therapeutic effects of the three drug-loaded nanomicelles on subcutaneous human breast cancer MCF-7 xenografts in BALB/c nude mice. The results demonstrated that the injectable paclitaxel, docetaxel, and cabazitaxel micelles exhibited significant inhibitory effects on the MCF-7 xenograft tumors. These findings suggest that mPEG-PLA-(LA)₄ DS nanomicelles may serve as a structurally defined and versatile carrier platform for hydrophobic taxane delivery.

Keywords: paclitaxel; docetaxel; cabazitaxel; nanomicelles; breast cancer; disulfide-crosslinked

1. Introduction

According to the International Agency for Research on Cancer (IARC) of the World Health Organization (WHO), if current epidemiological trends continue, the global burden of breast cancer will exacerbate significantly by 2050. Over the next 25 years, the number of new breast cancer cases worldwide is projected to increase by approximately 38%, and mortality will rise by roughly 68%. By then, annual incident cases will exceed 3.2 million, with annual deaths approaching 1.1 million. Concurrently, the lifetime risk of developing breast cancer continues to escalate, with an estimated 1 in 20 women likely to be diagnosed with the disease during their lifetime. Notably, this growth is unevenly distributed geographically; Asia, with particularly populous nations such as China, will be the primary contributor to this future increase, demonstrating a remarkably pronounced upward trend in the disease burden [1]. Chemotherapy, encompassing both adjuvant and neoadjuvant approaches, can effectively mitigate the risk of recurrence in patients with early-stage cancer [2]. Taxanes constitute a vital class of chemotherapeutic agents utilized



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