

Exploring the potential of Self-healing hydrogels for breast cancer management

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Abstract

Introduction: Globally, breast cancer (BC) is the most common cancer among women (~30 % of all new cancer cases annually) and will be the second leading cause of death among women (~42,170) in the United States, 2025 (<https://www.breastcancer.org/facts-statistics>). It is conventionally treated by surgery, radio-, hormone-, chemo-, and targeted therapies, and its treatment depends upon its subtype, stage, and degree of metastasis. Self-healing hydrogels (SHHs) are an innovative approach for the management of BC owing to their distinct properties like self-healability, shear-thinning property, injectability, and stimuli responsiveness and can be used as a multimodal platform for synergistic cancer therapy.

Methods: The literature (research and review articles) was retrieved from various search engines like Google Scholar, Scopus, Science Direct, and PubMed, using keywords such as self-healing hydrogels, breast cancer, and chemotherapy from 2013 to Feb 2025.

Results: SHHs are used as a multimodal platform for managing BC using diverse approaches like stimuli-responsive release of chemotherapeutics, co-delivery of drugs, phototherapy, chemodynamic therapy, starvation therapy, and sonodynamic therapies or combination therapies. Moreover, these hydrogels are durable, reusable, and fatigue-resistant and can restore their structural integrity even after multiple destructions within a few seconds/hours. Additionally, SHHs can also adjust their pore structure because of persistent break-healing cycles leading to higher encapsulation of chemotherapeutics with uniform distribution.

Conclusion: Owing to their distinct properties, SHHs can be used as a promising carrier for the delivery of chemotherapeutics with synergistic anticancer activity on BC cells even at minimal adverse effects, either alone or in combination with other novel strategies.

Keywords: Self-healing hydrogel, breast cancer, Chemotherapy