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Revolutionary Advances in Cancer Treatment

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Introduction

Surgical resection stands as the primary approach for patients grappling with a breast cancer diagnosis. Notably, over 90% of individuals in the early stages of breast cancer clinically necessitate surgery as part of their treatment regimen. While significant progress has been made in improving the five-year survival rates for breast cancer patients, a formidable challenge persists in the form of postoperative recurrence and distant metastases, which continue to be leading causes of death in breast cancer cases. In clinical practice, adjuvant radiotherapy (RT) following breast-conserving surgery represents the gold standard for surgical patients, delivering a substantial reduction in local recurrence rates and mortality.

Description

However, it is imperative to acknowledge the considerable adverse effects associated with RT, particularly the adverse impact on the skin. Alarmingly, over 90% of patients who undergo RT experience skin radiation damage, leading to severe, often intolerable consequences. Such skin radiation injuries are frequently incapable of self-healing and are highly susceptible to infection, adding to the complexities of managing these cases, not to mention the complications related to immunocompromised surgical wounds. Regrettably, to date, effective solutions that reconcile the conflict between controlling tumor recurrence and mitigating radiation-induced skin injuries in postoperative RT remain elusive [1].

In the relentless quest for innovative cancer treatments, the development of a biodegradable hydrogel and a stretchable bioadhesive is shining a bright light on the path to improved therapy outcomes. This groundbreaking combination, capable of releasing oxygen, anticancer drugs (DOX), and possessing antioxidant and photothermal properties, represents a leap forward in cancer care. In this article, we delve into the exciting development of these cutting-edge medical technologies and their potential to concurrently prevent tumor recurrence and mitigate skin radiation damage. The biodegradable hydrogel, a product of cutting-edge research and development, holds immense promise in the realm of cancer therapy [2].

This remarkable substance is engineered to release oxygen (O2) and the anticancer drug doxorubicin (DOX) in a controlled and sustained manner. This dual function serves a vital role in inhibiting tumor growth and improving treatment efficacy. Radiation-induced skin injuries, encompassing issues such as dyspigmentation, ulceration, and erythema, present a far more intricate and refractory challenge when compared to regular wounds. What's more, these injuries can worsen due to the potential for infection and uncontrolled bleeding in the surgical wound. The interplay between radiation and moisture gives rise to a continuous generation of reactive oxygen species, which inflict damage on DNA and provoke cell apoptosis. Over time, radiation-induced damage becomes notably harder to heal in comparison to ordinary skin damage, profoundly impacting the patients' quality of life [3].

In light of these complications, the processes of wound closure and the clearance of reactive oxygen species (ROS) after surgery and adjuvant radiotherapy (RT) are indispensable elements of treating radiation-induced surgical trauma. Remarkably, skin injuries often manifest several weeks or longer after RT, while postoperative treatments for potential tumor recurrence typically take place shortly after surgery. This disparity has sparked the pursuit of a novel two-step postoperative treatment strategy, one that integrates on-demand radiosensitization and ROS elimination properties. Oxygen, often in short supply in the tumor microenvironment, is essential for the function of radiation therapy. The hydrogel's ability to release oxygen helps create an oxygen-rich environment, making cancer cells more susceptible to radiation treatment.

Moreover, the controlled release of DOX ensures targeted drug delivery, minimizing damage to healthy tissues and maximizing its effectiveness against cancer cells. Accompanying the biodegradable hydrogel is the stretchable bioadhesive, a true wonder in the field of cancer care. This innovative adhesive not only attaches securely to the skin but also possesses antioxidant and photothermal properties. These attributes significantly broaden its utility in cancer therapy. The antioxidant properties of the bioadhesive play a pivotal role in protecting healthy tissues from oxidative damage caused by radiation therapy. Radiation therapy, while effective against cancer, can unintentionally harm surrounding skin and tissues. The bioadhesive's ability to scavenge harmful free radicals helps safeguard the skin from radiation-induced damage [4].

Furthermore, the bioadhesive exhibits photothermal properties, which means it can absorb and convert light into heat. This property can be harnessed to enhance the delivery of anticancer agents or in the treatment of superficial tumors, offering a versatile and effective therapeutic option. One of the most exciting aspects of this innovative duo is their synergistic effect when used in combination. When applied together, the biodegradable hydrogel and stretchable bioadhesive can achieve two critical goals simultaneously. First, they prevent tumor recurrence by delivering targeted chemotherapy and enhancing the effectiveness of radiation therapy. The oxygen-rich environment created by the hydrogel makes the tumor more susceptible to radiation, while the controlled release of DOX attacks cancer cells directly [5].

Conclusion

Second, they effectively attenuate skin radiation damage. The bioadhesive's antioxidant properties protect the skin, reducing radiation-induced skin damage, which is often a side effect of cancer treatment. The development of a biodegradable hydrogel and stretchable bioadhesive is a remarkable advancement in the field of cancer therapy. These innovations demonstrate the potential to revolutionize the way we treat cancer, providing a more targeted, effective, and less damaging approach to therapy. As these technologies continue to be refined and integrated into clinical practice, we can anticipate a future where cancer treatment is not only more effective but also less debilitating for patients. This remarkable combination offers hope to cancer patients, simultaneously addressing the challenge of tumor recurrence and the unwelcome side effects of radiation therapy, heralding a new era in cancer care.

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Conflict of Interest

None.

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