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Opinion Article

Inferred Bacteria and Biomaterials during Leukaemia Radiotherapy

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DESCRIPTION

Due to the natural tumor-targeting ability and specific immune-activation characteristics, bacteria-mediated anti-tumor therapy has received widespread attention. It has made significant progress in breaking through the limitations of monotherapy and effectively eradicating tumours, particularly when combined with traditional therapies such as radiotherapy. Bacteria and their derivatives, due to their diverse biological properties, can not only improve the sensitivity of tumour radiotherapy but also protect normal tissues. Furthermore, genetically engineered bacteria and bacteria-based biomaterials have broadened the scope of their radiotherapy applications. In this review, we summarized recent studies on the use of bacteria and its derivatives in radiotherapy, demonstrating that bacteria, bacterial derivatives, and bacteria-based biomaterials can not only improve radiotherapy but also anti-tumor efficacy.

The Tumour Micro Environment (TME) and immune effects are improved. Furthermore, some probiotics can protect normal tissues and organs from radiation by inhibiting inflammation, anti-oxidation, and apoptosis. To summarise, the use of bacteria in radiotherapy has a bright future, but its biological safety and mechanism must be thoroughly evaluated and researched. Bacteria, as one of the most abundant microorganisms on the planet, have a significant impact on the ecosystem, particularly on human activities. On the one hand, bacteria like *Salmonella, Clostridium, Streptococcus, Listeria,* and *Bifidobacterium* exist to maintain the balance of living tissue. Bacteria, on the other hand, are the cause of many diseases and can be passed from person to person in a variety of ways. Few methods, such as the skin, respiratory tract, and digestive tract, among others bacterial diseases are highly contagious. Because of the backwardness of medicine in ancient times, they could cause significant harm to human society.

People have gradually eliminated the risk as health-care services have improved. However, over the last century, the threat of other diseases (such as cancer, AIDS, and so on) has outweighed the threat of bacterial infectious diseases. Interestingly, many studies have shown that certain types of bacteria have a high potential for cancer therapy, despite the fact that some of them may be carcinogenic1. It all started in 1813, when Vautier noticed spontaneous tumour regression in a patient with gas gangrene infected with *C. perfringens*. Busch, a German doctor, was the first to use bacteria to treat cancer on purpose. He successfully shrunk the tumour by inoculating *Streptococcus pyogenes* infected erysipelas. Following that, in 1891, Coley Toxin, which contained inactivated Streptococci and *Serratia* extract, successfully inhibited the growth of cervical sarcoma to some extent and aided in the development of immunology and bacterial tumour therapy. The rapid growth of this field began in 1976, when Morales, Eidinger, and Bruce reported successful bladder cancer treatment with Bacillus Calmette Guerin (BCG), a live attenuated vaccine form of Mycobacterium bovis, sparking a large number of studies since then.

Bacteria have always been a double-edged sword in the occurrence and progression of tumours. On the one hand, some strains of bacteria have been found to be capable of causing detrimental changes to their hosts normal physiological processes by (1) promoting chronic inflammation in the body, (2) inducing hormones to increase epithelial cell proliferation, (3) directly affecting tumour cell proliferation by changing cell transformation, and (4) producing carcinogenic metabolites or toxic substances to regulate cellular signalling and interfere with cell transformation. However, as research into bacteria and cancer advances, the antitumor potential of bacteria will not be overlooked. Furthermore, in recent decades, due to the uniqueness of Tumour Micro Environment (TME) and pathological characteristics, as well as the limitations of traditional treatment options such as surgery, radiotherapy, chemotherapy, and immunotherapy.

The research of using natural or genetically modified strains or strain metabolites to treat cancer is rapidly developing, including increased drug resistance of cancer cells, systemic toxicity, and immune suppression. To date, various biological components such as bacteria, viruses, and mammalian cells have been developed as drug carriers for tumour targeting. Because of their unique properties as an essential component of ecosystems, bacteria have shown great potential as a delivery vehicle for drugs and genes to target tumour sites. Overall, bacteria hold a lot of promise in cancer treatment. It has the potential to significantly improve the TME and boost anti-cancer immune response. Bacteria-based biomaterials have also been used for tumour

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theranostics as synthetic biology has advanced.

Despite the fact that most bacteria used in cancer therapy have been attenuated, several challenges remain in clinical applications, namely (i) Intrinsic bacterial infections and toxicity, (ii) Difficulty in bacterial drug production, (iii) Single functionality and (iv) Genetic instability.

CONCLUSION

Researchers have developed coating bacteria with erythrocyte membranes or tumour cell derived membranes to improve their biosafety, tumour distribution, or antitumor immune response to address the aforementioned dilemmas. Furthermore, bacterial-mediated combinatorial strategies, as well as the modification of aptamers, antibodies, or tumor-specific antigens on bacterial surfaces *via* synthetic biology and interfacial chemistry, can improve colonization at tumour sites, reduce side effects, and improve immune responses. Radiotherapy has a high therapeutic impact on a wide range of tumours as a first-line clinical cancer treatment. Ionizing radiation produced by high-energy rays could cause cancer cell DNA damage and death. According to statistics, 50%-70% of cancer patients receive radiotherapy during treatment, and radiotherapy can cure 40% of cancers. However, it has limitations in terms of safety and efficacy. Radiation, for example, can harm normal healthy tissues and cause acute or chronic toxic side effects. Meanwhile, the TME's reduced vascular density, hypoxia, inflammatory cell infiltration, and host immune changes will render the tumour tissue radiotherapy resistant. All of these factors can eventually lead to a decrease in therapeutic efficiency of radiotherapy.