Cold Atmospheric Plasma for Post-Surgical Cancer Therapy: A Scoping Review of Tumor Control and Tissue Regeneration

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ABSTRACT

Introduction: The presence of residual tumor cells after surgery presents a major risk for cancer recurrence, while effective tissue repair is crucial for post-operative recovery. Cold atmospheric plasma (CAP) has emerged as a promising modality with dual functions: selectively targeting tumor cells and promoting tissue regeneration. Despite the growing interest in CAP, there is a lack of comprehensive reviews focusing on its post-surgical applications.

Materials and Methods: We conducted a systematic search of PubMed using terms related to CAP, post-surgical cancer therapy, and tissue regeneration. Studies were included if they investigated the application of CAP in post-surgical models or clinical settings, with anti-tumor and/or regenerative outcomes. The screening and selection followed PRISMA-ScR methodology. Data were extracted on study type, tumor model, plasma device used, outcomes, and mechanistic insights.

Results and Discussion: The evidence indicated that CAP could selectively induce apoptosis in residual tumor cells while enhancing wound healing, activating stem cell and promoting angiogenesis. Mechanistic studies suggest the involvement of reactive oxygen and nitrogen species, extracellular matrix remodeling, and stem cell modulation. Additionally, CAP-treated biomaterials further support tissue repair, providing a translational pathway toward clinical application.

Conclusion: CAP demonstrates significant dual therapeutic potential in post-surgical cancer therapy by combining tumor control with regenerative benefits. The mechanistic insights support optimized application, and ongoing translational research is warranted to establish standardized protocols for clinical use.

Keywords: Cold atmospheric plasma, Postsurgical cancer therapy, ROS, Stem cells tumor control, Tissue regeneration

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