

Clinical Outcomes and Safety Considerations of Electrochemotherapy in Oncology

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DESCRIPTION

Electrochemotherapy (ECT) has emerged as an innovative approach in the management of various cancers, combining traditional chemotherapy with localized electrical pulses to enhance drug delivery to tumor cells. This technique involves applying short, intense electric pulses to the tumor tissue after administration of cytotoxic drugs, such as bleomycin or cisplatin. The electric pulses temporarily increase cell membrane permeability, a phenomenon known as electroporation, allowing higher concentrations of chemotherapeutic agents to enter cancer cells. By improving drug uptake selectively in tumor tissue, ECT enhances cytotoxic efficacy while minimizing systemic side effects, making it a promising treatment modality for both superficial and deep-seated tumors.

Clinical studies have demonstrated that electrochemotherapy can achieve significant tumor control in multiple cancer types, including melanoma, head and neck squamous cell carcinoma, breast cancer and cutaneous metastases from various solid tumors. Reported overall response rates in cutaneous and subcutaneous metastases often exceed 70 percent, with complete response rates ranging from 40 to 60 percent in well-selected patient populations. In addition to tumor shrinkage, ECT has been shown to provide effective palliation of symptoms such as pain, bleeding and ulceration, thereby improving patients' quality of life. The rapid onset of response is particularly valuable in cases where traditional chemotherapy or radiotherapy is not feasible due to prior treatments, comorbidities, or tumor location.

Safety is a critical consideration in the clinical application of electrochemotherapy. One of the advantages of ECT is its localized action, which generally limits systemic toxicity associated with conventional chemotherapy. Most adverse effects are mild and transient, including localized pain during the procedure, muscle contractions due to electrical pulses, erythema, edema, or temporary skin ulceration at the treatment site. Serious complications are rare but can occur, particularly when treating tumors in proximity to vital structures or in patients with cardiac devices. Proper patient selection, careful

planning of electrode placement and adherence to established procedural protocols are essential to minimize risks. Additionally, the combination of ECT with general or local anesthesia allows for controlled delivery of electrical pulses while ensuring patient comfort and safety.

Electrochemotherapy also demonstrates favorable outcomes when integrated with other therapeutic modalities. Combining ECT with immunotherapy or radiotherapy has shown synergistic effects, as ECT can induce immunogenic cell death, releasing tumor antigens that stimulate anti-tumor immune responses. This property opens the potential for ECT to contribute not only to local tumor control but also to systemic anti-cancer effects. Furthermore, technological advancements in electrode design and pulse delivery systems have expanded the applicability of ECT to larger or irregularly shaped tumors, improving both efficacy and safety.

Despite these advantages, certain limitations and challenges remain. The effectiveness of ECT can be influenced by tumor type, size, vascularization and accessibility. Deep-seated tumors require careful planning and specialized electrodes and treatment efficacy may be lower in poorly perfused or highly fibrotic tissues. In addition, while ECT is effective for local tumor control, it is not a standalone solution for metastatic disease and must be considered as part of a comprehensive, multidisciplinary cancer management strategy. Long-term follow-up studies are still needed to better understand durability of response, recurrence rates and the potential benefits of repeated treatments.

CONCLUSION

In conclusion, electrochemotherapy represents a safe and effective modality for local tumor control in oncology. Clinical outcomes indicate high response rates, rapid symptom relief and minimal systemic toxicity, making it particularly suitable for patients with cutaneous, subcutaneous, or accessible tumors who have limited treatment options. Safety considerations are generally manageable, with most adverse events being mild and transient, though careful planning and patient selection remain

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essential. The integration of ECT with other cancer therapies and ongoing technological innovations further enhances its therapeutic potential. As research continues, electrochemotherapy is likely to play an increasingly important

role in modern oncology, offering a targeted, effective and well-tolerated approach to tumor management.