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Selective Effects of Plasma Activated Medium (PAM) on Human Glioblastoma and Fibroblast Cells: A Novel Approach for Targeted Tumor Therapy

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ABSTRACT

Introduction: Non-thermal plasma and its derivative, plasma-activated medium (PAM), have attracted growing attention as promising agents for selective cancer therapy. Unlike direct plasma exposure, PAM enables indirect delivery of reactive oxygen and nitrogen species into the cellular environment, reducing thermal and electromagnetic stress. Glioblastoma, an aggressive and treatment-resistant brain tumor, presents a major interest in exploring PAM as an adjuvant tool for selective cytotoxicity.

Materials and Methods: Human glioblastoma (U87-MG) and fibroblast (IMR-32) cell lines were cultured under standard conditions and treated with PAM at four concentrations (100%, 50%, 25%, and 12.5%) for 72 hours. PAM was prepared by exposing deionized water to a cold atmospheric plasma jet for 5 minutes (200 V, using air as working gas). Cell viability was assessed using the MTT assay, and statistical analysis was performed using R version 4.2.2, which included normality testing, ANOVA, and post-hoc comparisons.

Results and Discussion: Treatment with 100% PAM significantly reduced the viability of U87 MG cells (OD = 0.394 ± 0.122; p = 0.038), revealing strong induction of apoptotic. In contrast, lower concentrations (50%, 25%, and 12.5%) had negligible impact (p > 0.5). For IMR-32 fibroblasts, significantly higher viability was observed at low-to-moderate concentrations—particularly with 50% PAM (OD = 0.797 ± 0.250; p = 0.0007) and 12.5% PAM (p = 0.0001)—suggesting protective or proliferative effects. These outcomes confirm the selective and dose-dependent nature of PAM on malignant versus normal cells, which is consistent with previous findings. Such differential sensitivity is likely due to variations in redox balance and antioxidant defense between cancerous and healthy cells.

Conclusion: PAM exhibits concentration-dependent selective cytotoxicity, effectively suppressing glioblastoma cell viability while promoting fibroblast survival. These findings highlight its potential as a safe and minimally invasive adjunctive strategy in glioblastoma therapy. Further in vivo evaluation is warranted to confirm safety and translational efficacy.

Keywords: Apoptosis, Fibroblast (IMR-32), Glioblastoma (U87-MG), Plasma-activated medium, Selective cancer therapy

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