DECEMBER 11-12,2025
۲۱ و ۲۰ آذر ماه ۱۴۰۴
دومین کنگره پلاسما پزشکی ایران
The 2nd Congress on Plasma Medicine
دبیرخانه دائمی کنگره پلاسما پزشکی ایران
www.plasmamedsym.ir

Integrative Modulation of Angiogenesis and Oxidative Stress by Cold Atmospheric Plasma Combined with Anti-PD-1 Therapy in a Mouse Model of Melanoma

Forouzan Bousaeedi, Alireza Rafiei*, Zeinab Rostami

Department of Immunology, School of Medicine, Mazandaran University of Medical Sciences, Sari, Iran

OPEN ACCESS

Citation:
Bousaeedi F, Rafiei A, Rostami Z. Integrative Modulation of Angiogenesis and Oxidative Stress by cold atmospheric plasma Combined with Anti-PD-1 Therapy in Mouse Model of Melanoma. *Iran Biomed J.* Supplementary (2-2026): 1.

ABSTRACT

Introduction: Melanoma is a highly aggressive form of skin cancer. While immune checkpoint inhibitors, such as anti-PD-1, are effective, the responses among patients vary significantly. Therefore, complementary therapeutic strategies are needed. Cold atmospheric plasma (CAP), which generates reactive species, can influence the tumor microenvironment, oxidative stress, and angiogenesis. This study examined the effects of CAP, alone and in combination with anti-PD-1, on the expression of *EGFR* and *GJA1* in a murine melanoma model.

Materials and Methods: B16-F10 melanoma cells were injected subcutaneously into female C57BL/6 mice. After tumor formation, the animals were divided into five treatment groups: control, CAP, anti-PD-1, CAP + anti-PD-1, and dacarbazine. At the endpoint, tumor tissues were collected, and the mRNA levels of *EGFR* and *GJA1* were quantified using RT-qPCR.

Results and Discussion: The CAP + anti-PD-1 combination resulted in a significantly greater downregulation of *EGFR* and *GJA1* expression compared to the monotherapies, indicating a synergistic effect between the two treatments. Considering that *EGFR* promotes angiogenesis and *GJA1* modulates cellular redox signaling and intercellular communication, the combination therapy appears to exert a strong inhibitory effect on these pathways.

Conclusion: Our findings suggest that CAP-based combination therapy could serve as a promising strategy for enhancing the efficacy of immunotherapy in melanoma.

Keywords: Angiogenesis, Anti-PD-1, Cold atmospheric plasma, Melanoma, Oxidative stress

Corresponding Author: Alireza Rafiei
Department of Immunology, School of Medicine, Mazandaran University of Medical Sciences, Sari, Iran; E-mail: rafiei1710@gmail.com