

Effect of cold atmospheric pressure plasma on the control and reduction of cell growth in breast cancer

Introduction: Breast cancer has become the most prevalent cancer in the world since 2021. The out-of-control growth of breast cells results in breast cancer. The type of breast cancer depends on which cell in the breast becomes cancerous. Due to the high incidence and limitations of surgery, chemotherapy, and radiotherapy including non-selective and incomplete tumor ablation, Non-thermal plasma (NTP) technology has been reported as a novel therapeutic way in different fields of medical science such as oncology and dermatology. In vitro and in vivo studies have reported that NTP has anticancer effects and can selectively inhibit the growth of cancer cell lines. The combination of physical and chemical factors in the interaction between NTP and cells is the base of the anti-cancer effect [1-3]. Plasma can affect target cells and tumors in two ways, direct and indirect. In direct treatment, plasma directly interacts with cells and tumors while in indirect treatment, first a solution or medium is activated by a plasma device then the activated solution or medium is added to the cell culture medium or injected to the tumor. In this study, atmospheric pressure argon and helium plasma jet was used to investigate and compare the effect of cold plasma on the control and reduction of cell growth in breast cancer in in-vitro and in-vivo studies.

Material and method: The configuration of argon and helium plasma jet is shown in Fig1.a. 4T1 mammary carcinoma cell were purchased from Iranian Biological Resource Center and were cultured in DMEM medium. The culture medium containing cells (expect control) was exposed to He or Ar plasma in direct treatment and, the plasma activated culture medium (PAM) was added to the cells in indirect treatment. The cell cycle and apoptotic rate were inspected using flow cytometry. Twenty-four female BalbC mice were randomly divided into 4 groups: breast tumor without treatment (control), breast tumor + direct He plasma, breast tumor + indirect He plasma, breast tumor + direct Ar plasma, breast tumor + indirect Ar plasma, and breast tumor + Temozolomide. The treatment time was adjusted to 3 minutes. The variation of weight and H&E staining was investigated.

Conclusion: The rate of apoptosis increased compared to the control group, and the presence of cells in the S phase of the cell cycle decreased in all groups except the control group (Fig1.b). The pathology images of tumors indicated that cell proliferation and angiogenesis were controlled by direct and indirect plasma treatment (Fig1.c). The results of this research provide doctors with a clear perspective on the treatment of breast cancer.

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References

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