Low temperature argon plasma as anticancer and stimulating regeneration agent

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Abstract

Recent studies have suggested that low temperature argon plasma (LTAP) is a strong sterilizing agent that can eliminate all known pathologic microorganisms, including multidrug-resistant ones. Our current study revealed that LTAP selectively suppressed cell proliferation and caused death of cancer cells of any in vitro or in vivo origin with no significant side effect on normal cells. Our study further showed that LTAP irradiation could stimulate proliferation and differentiation of fibroblasts and stem cells.

Key Words: low temperature argon plasma (LTAP); Cancer cells; Proliferation; Differentiation; Regeneration

Short research communication

Today the low temperature argon plasma (LTAP) is widely known as a strong sterilizing agent which able to eliminate all known microorganisms, including the multidrug-resistant ones [1-8]. The present studied indicated that LTAP can selectively suppress the cell proliferation and cause the death of the cancer cells of any origin in vitro and in vivo. Herewith it has no significant negative effect on normal cells; and in case of fibroblasts and stem cells, LTAP irradiation stimulated its proliferation and differentiation.

In our study, the device of MicroPlaSter β developed by “AD’TEK Plasma Technology Co.Ltd.” and “Plasma scalpel”...
made by «Plasma technology» (Russia) has been used for generation of the microwave LTAP (Figures 1 and 2).

Fig. 1. The microwave LTAP device of MicroPlaSter β developed by “AD’TEK Plasma Technology Co.Ltd.

图 1。微波 LTAP 装置的 MicroPlaSter β由“ADTEK”等离子体技术有限公司生产。

Fig 2. “Plasma scalpel” made by « Plasma technology» (Russia).

图 2。"等离子刀"由«等离子体技术» (俄罗斯) 生产
Using the model flatworm organism, the planarians, we investigated the impact of LTAP irradiation on regeneration processes. It has been found that the various modes of LTAP irradiation possessed the activating or the inhibiting actions on intact and regenerating planarians. The observable effects of LTAP have been specified as stimulation or suppression using the stem cells proliferation and the regenerative blastema growth as the morphogenetic models in planarian, as well as investigation of the wound-specific genes expression responsible for regenerative processes (Figure 3).

The research of LTAP effects on the cultivated human cancer cells has shown that the certain modes of irradiation were able to suppress its proliferation and caused an apoptosis. In that case the exposure with the cold plasma induced multiple effects, such as the alteration in the expression level of genes controlling the cell cycle and proliferation, the changes in cytoskeleton and dissection. In intact planarian, LTAP significantly accelerated the blastema growth and stimulated stem cells proliferation in planarian. In regenerating planarian, LTAP altered the expression levels of genes controlling the cell cycle and proliferation, the changes in cytoskeleton and surface adsorption, and the changes in cell morphology. In human cancer cells, LTAP induced multiple effects, such as the downregulation of genes involved in cell cycle control, the upregulation of genes involved in apoptosis, and the changes in cytoskeleton and cell morphology. These effects were further validated in vitro and in vivo experiments, demonstrating the potential of LTAP as a therapeutic agent for cancer and aging.
in cell adhesion, in the activation of the caspase pathway of apoptosis. Hereby, the same modes of LTAP action have not demonstrated the negative actions on fibroblasts and stem cells, and moreover, in some cases even stimulate its proliferation and differentiation. Similar results were obtained in our experiments using in vivo wound healing in rats. The sessions of LTAP exposure caused the acceleration of the wound healing in more that two times in irradiated animals compare to the untreated ones (Figure 4).
The obtained results of the study of the biological activity of LTAP allowed offering it as the principle new medical technology for anticancer therapy in oncology and for stimulation of wound healing. In EU countries the therapy on the basis of low temperature gas plasma is already used for sterilizing and treatment of the badly healing wounds and ulcers (Figure 5).

Fig 5. LTAP effect on wound healing in rats. A: control; B: LTAP, numbers showing the days after the exposure.

References


