

Investigation of the efficacy of dielectric barrier discharge jets (DBD-Jet) and plasma activated water (PAW) in wound treatment: an in-vivo study

Introduction: The effects of cold plasma, such as antimicrobial, anti-inflammatory, tissue regeneration, cell proliferation, and angiogenesis, have made this technology a therapeutic option for wound healing [1]. These effects are not only related to the treatment duration and type of tissue, but also depend on the plasma configuration, working gas, and plasma distance.

The dielectric barrier discharge jet (DBD-Jet) is a special type of plasma jet that guarantees the safety of the treatment. While using a ring electrode in this configuration weakens the discharge inside the dielectric tube [2], It led us to investigate the effectiveness of DBD-Jet on wound healing in direct and indirect methods.

Material and method: DBD-Jet was developed by the Plasma Technology Development Company (Tehran, Iran). In this study, the electrode is connected to an AC power supply ($V_{pp}=12$ kV, $f=55$ kHz), the helium gas rate flow is kept at 5 l/min. The plasma-activated water is prepared by applying the plasma jet on the surface of 2ml distilled water for 2 to 4 minutes.

The rats were randomly divided into 4 groups ($n = 6$): a wound without treatment (control), a wound treated with DBD-Jet plasma for 2 min (wound + DBD-Jet plasma), a wound treated with 2 min plasma-activated water (wound + 2 min PAW), and a wound treated with water 4 min plasma- activated (wound + 4 min PAW). The protocol is summarized in Fig.1. A thermal camera (Testo 881) was used to measure the wound temperature during the plasmatherapy. The appearance of wounds was recorded using a Canon camera and pictures were analyzed with Image J (version 1.8.0). The variation of wound microbial load and histopathology was investigated.

Conclusion: We found that DBD-Jet plasma and washing of wounds by PAW can support wound healing and tissue regeneration. Interestingly, our results showed that the 2 minute PAW has more effectiveness in wound healing than the 4 minute one.

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References

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Session Classification: Poster Session

Track Classification: Atmospheric and Medical Plasmas