

Production of Portable Atmospheric Plasma Generator and Evaluation of its Antibacterial Effect for Treatment of Bacterial Keratitis

Hossein Aghamollaei*, Khosrow Jadidi, , Abolfazl Mazandarani, Mohsen Ghiasi, Majid kakdkhodaie

Chemical Injuries Research Center, Systems Biology and Poisonings Institute, Baqiyatallah University of Medical Sciences, Tehran, Iran

Introduction:

Eye infections are one of the most important complications after trauma and ocular chemical burns. Important keratitis-causing bacteria include *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The use of antibiotics has limitations, such as antibiotic resistance, the difficulty of using antibiotic drops for the patient for a long time, and eventually the scarring in some cases. In the case of military injuries, the use of chemical antibiotics is further restricted due to unfavorable environmental conditions. Cold atmospheric plasma contains highly energetic species such as free radicals, electrons, positive and negative ions, atoms, and excited molecules, which can inactivate microorganisms. The present study introduced cold atmospheric plasma as a new technique with high safety and effectiveness for the treatment of bacterial keratitis.

Methods

A portable cold atmospheric plasma generator was designed and produced. (Figure 1).

Pseudomonas aeruginosa and *Staphylococcus aureus* were first cultured on LB agar medium and then treated with cold atmospheric plasma for 5, 7, and 10 minutes. For in vivo study 10⁶ CFU of *Pseudomonas aeruginosa* was injected into the corneal stroma of 9 New Zealand male rabbits. In the plasma group, rabbits were treated with cold plasma for 7 minutes in 2 days and the other group was treated with antibiotics. The rabbits were examined and photographed daily.

Results:

After 7 min exposure to plasma, all bacteria were killed in the culture medium. The rabbits' eyes which were treated with plasma were clear without any significant complications.(figure2) The mean CFU in rabbit's cornea was significantly reduced in plasma-treated and antibiotics groups than in non-treated rabbits. (P<0.05).

Conclusion:

The potential of this type of plasma for the treatment of bacterial keratitis was approved in an animal model. After more clinical trials, this portable device can be used in various environmental conditions for the treatment of bacterial infection after trauma or chemical burns patients.