内容

近年、室温で適用可能な低温大気圧プラズマが殺菌、細胞増殖、止血などの効果があることが知られており、生体への応用が期待されている。医学を含む、さまざまな医療分野で高い期待がある。

低温大気圧プラズマの効果は、その活性種の特性により、細菌の殺菌、細胞の増殖、止血などの作用を示す。特に、細菌の殺菌効果は、低温大気圧プラズマが細菌を破壊することで、感染症の治療に有用である。

1. Introduction

In the past few years the research topic of using cold atmospheric plasmas in medicine and hygiene has been investigated intensively. This is due to the fact that plasmas provide many species, e.g. reactive species, charged particles, UV photons, etc., which are relevant for diverse biomedical effects(1). In 2005 a clinical study on patients was started in a joint effort between the Max-Planck Institute for Extraterrestrial Physics and the Department of Dermatology, Allergology and Environmental Medicine in Hospital Munich Schwabing.

2. Plasma device

The plasma device used in this study-called MicroPlaSter-was developed and tested (fig. 1) in cooperation with the company Adtec Co. Ltd. This device contains a microwave plasma torch as shown in fig. 2(2). The plasma discharge is generated in the plasma torch by applying microwave power of approximately 85 W with an argon gas flow of 2 slm. The torch is placed at the end of a flexible arm and can be moved to the desired area. Due to the arrangement of six electrodes (fig. 2b) large areas of approximately 5cm in diameter can be treated with the plasma torch below the threshold of thermal damage. The produced agents by the plasma are delivered from the plasma torch to the desired region following the argon gas flow.

3. Clinical study

Bacterial colonization of chronic wounds can impair healing. Furthermore the treatment of chronic wounds has become more challenging due to the rapid increase of resistance to antibiotics and allergic reactions. The objective of this study was to examine the safety and efficiency of the cold atmospheric argon plasma device by decreasing the bacterial load as a new medical treatment.

Before starting a phase II study (clinical study on patients), a phase I study was carried out to show safety parameters and the optimum bactericidal dose for the relevant bacteria in wounds. Having this information the clinical study on patients was approved by the Bavarian State Association for Medical Issues.

More than 150 patients with chronic infected wounds were treated in a randomized phase II study. In addition to the standard wound care, the patients received a 5-min cold argon plasma treatment as an add-on therapy. The analysis of 291 treatments demonstrated, that there was a highly significant (~34%, P< 10^-4) higher reduction in bacterial count in plasma-treated wounds compared to the controls (non-treated) (fig. 3).

No side-effects or allergic reactions were reported and the treatment was very well tolerated.

4. Summary

We showed that cold atmospheric argon plasma provides a safe and painless treatment option for chronic infected wounds regardless of the bacterial species and the resistance level. We believe that cold atmospheric plasma will play an important role in many areas of health care.

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References