Low-temperature Argon plasma for the sterilization of chronic wounds: from bench to bedside

Stolz W[1], Georgi M[1], Schmidt H-U[2], Ramrath K[1], Pompl R[3], Shimizu T[3], Steffes B[3], Bunk W[3], Peters B[1], Jamitzky F[3], Morfill G[3]

[1] Hospital Munich-Schwabing, Clinic for Dermatology, Allergology and Environmental Medicine, Germany
[2] Hospital Munich-Schwabing, Institute for Microbiology, Germany
[3] Max-Planck-Institute for Extraterrestrial Physics, Garching, Germany

Infectious skin diseases caused by bacteria are one of the main reasons for hospitalization of dermatological patients, causing costs of millions of Euro each year. Leading among them are infections of wounds like chronic ulcers of the lower leg, which are also a major reservoir for multiresistant bacterial strains. Standard treatment for these wounds include topical and systemic antibacterial regimens, but are often limited by the development of resistency of germs against antibiotics or of allergic reactions.
Low-temperature Argon plasma has been shown to be highly effective in vitro against different, even multiresistant bacteria and yeasts. Having a temperature just slightly above body temperature, it can be applied on wounds of the skin. Furthermore, because of the properties of a physical therapy, resistency of germs or allergic reactions due to plasma are not feasible.
Our study group therefore conducted a phase I study which examined the effects of low-temperature Argon plasma on normal human skin. On different levels of examination, no visible structural changes occurred. Subsequently we began a phase II study with the main goal of reviewing the efficiency of Argon-plasma treatment on different infectious skin diseases, mainly chronic wounds, compared to an non-Argon plasma treated area.
After well over 800 treatments in over 100 patients no side effects occurred until now, and the treatment is well tolerated in almost all cases. Testing the efficiency with different microbiological analysis systems, we see a slightly higher germ reduction in treated areas compared to the areas not treated with Argon plasma. This effect is higher with gram-negative germs.
As this effect still significantly differs from the excellent in vitro results we developed new methods of germ detection as well as improvements of the Argon plasma application itself. In addition, we investigated whether a special pretreatment of the in most cases uneven surface of the chronic wound by a high pressure water jet is helpful.
In our experience the low temperature Argon plasma technology offers a novel approach to infected chronic wounds without the usual side effects of both development of resistant germs and allergic reactions.