Plasma produces KO cocktail for MRSA

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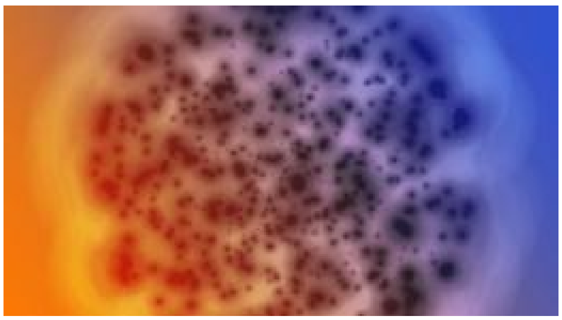

Bacteria

MRSA (methicillin-resistant *Staphylococcus Aureus*) and other drug-resistant bacteria could face annihilation as low-temperature plasma prototype devices have been developed to offer safe, quick, easy and unfailing bactericidal cocktails.

Two prototype devices have been developed: one for efficient disinfection of healthy skin (e.g. hands and feet) in hospitals and public spaces where bacteria can pose a lethal threat; and another to shoot bacteria-killing agents into infested chronic wounds and enable a quicker healing process.

Two papers published today, Thursday 26 November, as part of a selection of papers on Plasma Medicine in *New Journal of Physic*s (co-owned by the Institute of Physics and German Physical Society), demonstrate how far the design of equipment to harness the bacteria-killing power of low-temperature plasma has come.

Plasma, oft called the fourth state of matter after solid, liquid and gas, is defined by its ionized state. In space, stars are made up of high-energy plasma and, on Earth, it is researchers in high-energy plasma that are making significant strides towards limitless energy from nuclear fusion. The high energy of plasma stems from some atoms or molecules in a gas being stripped of their electrons, resulting in a mix of ionized and neutral species.

Also on Earth, scientists have been working on low-temperature and atmospheric-pressure plasma and have found applications in a range of industries, from plastic bag production to the manufacturing of streetlamps and semiconductor circuits.

In a low-temperature plasma, unlike its high-temperature counterparts, the temperature of ions and neutral particles stays low. The 'recipe' for producing such plasmas is simple: the fraction of atoms (molecules) that are ionized - and therefore are hot - is so low that collisions with cold neutral atoms (molecules) quickly reduce their temperature again. The analogy of adding a drop of hot water to a bucket of cold water gives a sense of how low-temperature plasma physicists are able to create plasmas without dramatically increasing the temperature of the overall molecules.

In medicine, low-temperature plasma is already used for the sterilization of surgical instruments as plasma works at the atomic level and is able to reach all surfaces, even the interior of hollow needle ends. Its ability to disinfect is due to the generation of biologically active bactericidal agents, such as free radicals and UV light, which can be delivered to specific locations. It is research into how and why these biologically active agents are generated that has led to the construction of medically invaluable devices.

One research group from the Max Planck Institute for Extraterrestrial Physics has built and trialed a device which is capable of disinfecting human skin safely and quickly (within seconds), annihilating drug-resistant kinds of bacteria that currently cause approximately 37 000 deaths from hospital induced infections every year in EU countries.

On the current disinfection challenge that medical staff face, and that their device will overcome, the researchers write, "The surgeons' disinfection procedure - hand rubbing (3 minutes) or hand scrubbing (5 minutes) - has to be repeated many times a day, with a number of negative side-effects arising from the mechanical irritation, chemical and, possibly, allergic stress for the skin. For the hospital staff, the issue of hand disinfection is equally daunting. Over a typical working day, some 60 to 100 disinfections (in principle) are necessary - each requiring 3 minutes - i.e. a total of 3 to 5 hours!"

The new plasma devices under development cut this down dramatically - to around ten minutes a day. In addition, only electricity is needed, no fluids or containers.

Another device, an 'argon plasma torch', was developed by this group, together with ADTEC Plasma Technology Ltd in Japan, specifically for disinfecting chronic non-healing wounds. One advantage of the 'argon plasma torch' comes from regulating densities of biologically-active agents which are designed to ensure that the plasma is deadly for bacteria but harmless for human cells.

Cell biological studies, conducted together with partners from the Institute of Pathology, Technical University of Munich, are reported and interpreted in terms of chemical reactions which work differently in bacterial and human cells - deadly to the bacteria and supporting cell regeneration in human cells.

After successful trials that show how plasma can be manipulated to very beneficial ends, these researchers write, "One can treat plasmas like a medical cocktail, which contains new and established agents that can be applied at the molecular level to cells in prescribed intensities and overall doses."

This work represents a first step in the direction of 'plasma pharmacology', a step along a path that will require considerable research efforts to harness the full potential of this new field of 'plasma medicine'.

Both research papers describe the mechanics of their trials, the safety concerns they endeavour to overcome, the remarkable bactericidal effect they have successfully achieved, and the positive cell regeneration effects that can be stimulated using plasmas.

More information:

• Nosocomial infections - a new approach towards preventive medicine using plasmas
• Designing plasmas for chronic wound disinfection

Source: Institute of Physics (news : web)