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Mechanisms of Plasma Therapeutics

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In this talk, I address research directed towards biomedical applications of atmospheric pressure plasma such as sterilization, surgery, wound healing and anti-cancer therapy. The field has seen remarkable growth in the last 3-5 years, but the mechanisms responsible for the biomedical effects have remained mysterious. It is known that plasmas readily create reactive oxygen species (ROS) and reactive nitrogen species (RNS). ROS and RNS (or RONS), in addition to a suite of other radical and non-radical reactive species, are essential actors in an important sub-field of aerobic biology termed "redox" (or oxidation-reduction) biology. It is postulated that cold atmospheric plasma (CAP) can trigger a therapeutic shielding response in tissue in part by creating a time- and space-localized, burst-like form of oxy-nitrosative stress on near-surface exposed cells through the flux of plasma-generated RONS. RONS-exposed surface layers of cells communicate to the deeper levels of tissue via a form of the "bystander effect," similar to responses to other forms of cell stress. In this proposed model of CAP therapeutics, the plasma stimulates a cellular survival mechanism through which aerobic organisms shield themselves from infection and other challenges.