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Plasma medicine: immunotherapeutic cancer treatment

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The newest results obtained by researchers of A.J. Drexel Plasma Institute on direct application of non-thermal plasma for direct treatment of different types of cancer by means of specific stimulation of immune system in the frameworks of the so-called onco-immunotherapy are reviewed in the presentation.

Especial attention is paid to fundamental analysis of depth of penetration of different plasma-medical effects, from ROS, RNS, and ions to special biological signaling and immune system related processes. General aspects of the plasma-stimulation of immune system are discussed, pointing out specific medical applications.

Most of experiments have been carried out using nanosecond pulsed DBD at low power and relatively low level of treatment doses, guaranteeing non-damage no-toxicity treatment regime. The nanosecond pulsed DBD physics is discussed mostly regarding its space uniformity and control of plasma parameters relevant to plasma medical treatment, and especially relevant to depth of penetration of different plasma medical effects.

Detailed mechanism of the plasma-induced onco-immunotherapy has been suggested based upon preliminary in-vitro experiments with DBD treatment of different cancer cells. Sub-elements of this mechanism related to activation of macrophages and dendritic cells, specific stressing of cancer cells and the immunogenic cell death (ICD) are to be discussed based on results of corresponding in-vitro experiments.

In-vivo experiments focused on the plasma-induced onco-immunotherapy were carried out in collaboration with medical doctors from Jefferson University hospital of Philadelphia. Today's achievements and nearest future prospective of clinical test focused on plasma-controlled cancer treatment are discussed in conclusion as well as practically important challenges in plasma medical dosimetry.