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酸化ストレスからみたプラズマ医療科学への期待

Future of Plasma Medicine From the Standpoint of Oxidative Stress

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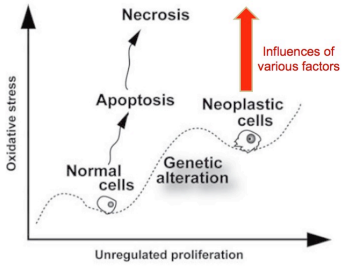
Thermal plasmas and lasers have been used in medicine to cut or ablate tissues and for coagulation. Non-equilibrium atmospheric pressure plasma (NEAPP; non-thermal plasma) is a recently developed, non-thermal technique with possible biomedical applications. Although NEAPP reportedly generates reactive oxygen/nitrogen species, electrons, positive ions, and ultraviolet radiation, research has not been performed into the use of this technique from the viewpoint of conventional free radical biology. Recently, Prof. Masaru Hori's Group (Plasma Nanotechnology Research Center, Nagoya University) developed several NEAPP devices with high electron density. Electron spin resonance revealed hydroxyl radicals as a major product. To obtain evidence of NEAPP-induced oxidative modifications in biomolecules and standardize them, we evaluated lipid peroxidation and DNA modifications in various *in vitro* and *ex vivo* measurements. Conjugated dienes increased after exposure to linoleic and α-linolenic acids. An increase in 2-thiobarbituric acid-reactive substances was also observed after exposure to phosphatidylcholine, liposomes or liver homogenate. Direct exposure to rat liver in medium produced immunohistochemical stainings of 4-hydroxy-2-nonenal- and acrolein-modified proteins. Exposure to plasmid DNA induced dose-dependent single/double strand breaks and increased the amounts of 8-hydroxy-2′-deoxyguanosine and cyclobutane pyrimidine dimers. These results indicate that oxidative biomolecular damage by NEAPP is dose-dependent and thus can be managed in a site-specific manner. Therefore, NEAPP confers local controllable oxidative stress and may be useful for a variety of medical purposes. Other recent advancements will also be discussed.



References: Okazaki Y et al. J Clin Biochem Nutr 55: 207, 2014; Toyokuni S. Adv Drug Deliv Rev 65: 2098, 2013; Akatsuka *et al.* PLoS One 7: e43403, 2012; Toyokuni S. Cancer Sci 100: 9, 2009; Toyokuni. Pathol Int 49: 91, 1999; Toyokuni S *et al.* FEBS Lett 358: 1, 1995