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Apoptosis by Direct Current Treatment in Tumor Cells and Tumor Tissues

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Electric field induces cell fusion, electroporation on biological cells, including apoptosis. Apoptosis is expressed in a series of natural enzymatic reactions for the natural elimination of unhealthy, genetically damaged, or otherwise aberrant cels that are not needed or not advantageous to the well-being of the organism. Its markers involve cell shringkage, activation of intracellular caspase proteases, externalization of phosphatidylserine at the plasma membrane, and fragmentation of DNA.

Direct electric fields using direct current have been exploited recently to investigate its effects on tumor cells and tissues, but the mechanism of direct electric fields has not been exhibited clearly other than by electroosmosis or pH changes. Direct electric field induces apoptosis in tumor cells cultured and tumor tissues as indicated by cell shrinkage, DNA fragmentation and tumor suppression. In our experiment that direct electric field was applied to tumor tissues via two needle electrodes inserted into tumor tissue 5mm at distance in parallel, pH changes resulted from electrochemical reaction, exhibiting about pH 9.0, 1.83, 2.0 in the vicinity of cathodic and anodic electrode and between electrodes in maximum, respectively. DNA fragmentation of tumor tissues destructed by direct electric field was analyzed by Tunel assay by ApopTag technology. As a result of this analysis, it showed that apoptosis in tumor tissue destructed was increased up to 59.1% in tissues between electrodes than 4.1% in normal(control) tissues, showing 41.1, 31.1% in anodic and cathodic tissues. *In vitro* cell survival was exhibited that it was decreased with enhancing electric current intensity in the same condition of electrical charge 5C having different time applied. We will show a results of apoptosis analyzed by flow cytometry *in vitro*.