

PULSED DISCHARGES FOR MEDICAL APPLICATIONS*

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We have investigated the possibility to instigate discharges in tissue and evaluated their potential for medical applications. With appropriate electrode configurations, we were able to generate either corona discharges or spark discharges in the tissue itself by applying nominal rectangular high voltage pulses of 30-ns and 380-ns duration, respectively. The shorter pulses were provided by a Blumlein line pulse generator, and the longer pulses were generated with a Blumlein pulse forming network. Sub-microsecond pulsed electric fields have demonstrated remarkable potential in the treatment of solid tumors¹. We assumed that the efficacy of the method can be improved by reactive species that are generated in a corona. Changing the polarity of the voltage-bias applied to the center needle of a coaxial delivery system, we were able to compare treatments with and without discharge. However, our experiments did not show any significant advantage of a corona discharge for our configuration and treatment parameters. With the longer pulse it is possible to generate a spark discharge between the tips of two needle electrodes, which are inserted into the tissue. Depending on tissue type (muscle, liver, fat) and pulse amplitude, several tissue-conditioning pulses had to be applied before breakdown could be achieved. When a spark was initiated, the breakdown voltage was lower than expected for liquids but higher than expected for air (at atmospheric pressure). The visual inspection of the tissue damage showed a highly localized incision, which runs between the tips of the needle electrodes. The preliminary histological analysis suggests that the damage is mostly caused by the shockwave associated with the spark.

1. Richard Nuccitelli, Xinhua Chen, Andrei Pakhomov, Wallace Baldwin, Saleh Sheikh, Jennifer Pomicter, Wei Ren, Christopher Osgood, R. James Swanson, Juergen F. Kolb, Stephen J. Beebe, Karl H. Schoenbach, "A New Pulsed Electric Field Therapy for Melanoma Disrupts the Tumor's Blood Supply and Causes Complete Remission without Recurrence," *Int. J. Cancer* 125 (2009) 438.

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