Some Examples of Applications for Electroporation

APPLICATIONS IN VIVO

Electro Gene Therapy

In an attempt to achieve immunoreactions against implanted brain tumours, rats with N29 glioma tumours were delivered with electric pulses followed by injections of IL-18 and IFN-gamma secreting cells. Tumours were inoculated subcutaneous on both thighs of the rats.
The results were evaluated by measuring the growth of untreated contralateral tumours. There were no difference in contralateral tumours between animals given no treatment, electric pulse only or secreting cells only. A significantly inhibited growth was observed only in tumours given electroporation in combination with secreting cells (Persson et. al. 2002).

Electro Chemo Therapy

In vivo electropermeabilization used to augment the chemotherapeutic efficiency in cancer treatment has been termed electro chemotherapy. This novel mode of tumour treatment has been employed mostly for subcutaneous cutaneous malignancies but treatment of orthotopic tumours, e.g. of the brain (Salford et. al. 1993), the liver (Chazal et. al. 1998; Jaroszeski et. al. 1997; Ramirez et. al. 1998) and the pancreas (Jaroszeski et. al. 1999) has shown promising results. The first clinical trial with electro chemotherapy was performed on head and neck tumours by Mir and colleagues in France, 1991 (Mir et. al. 1991).

Electro Immuno Therapy

Studies have suggested that the host immune system is activated after tumour treatment with electropermeabilization. In a study by Mir et.al. 1991, immunogenic fibrocarcinoma was treated with electro chemo therapy in immunocompetent mice and immunodeficient (nude) mice. The treatment was effective on the immunocompetent mice but only a temporary delay in tumour growth was observed in the nude immuno deficient mice group. A stimulated immune response, through increased monocyte and T-lymphocyte was confirmed by Serca et.al. 1996 in a similar study, but using cisplatin instead of bleomycin.

Electro Radio Therapy

Treatment of tumours with Pulsed Electric Fields (PEF) has been found to enhance the therapeutic effect of radiation therapy in male rats of the Fischer-344 strain with glioma N32 tumours implanted subcutaneously on the thigh of the hind leg. The total absorbed radiation dose given to the tumours was 20 Gy, in 4 fractions of 5 Gy each day in four consecutive days. Exponentially decaying pulsed electric fields of 1400 V/cm and t1/e= 1 ms were applied to the tumours with 16 pulses in the 4 consecutive days. There were no significant differences in number of cures for PEF (1/4) vs. controls (0/8) or PEF vs. Radiation Therapy (0/5). For the PEF + Radiation-therapy group, however, the number of cures (6/9) was significantly larger compared to both the controls (p=0.009) and the Radiation Therapy group (p=0.03).
After 36 hours post treatment with either PEF or PEF+Radiation, the major vessels in the tumour appear fragmentarily stained with a fluorescent antibody to the von Willebrand Factor, indicating a commenced breakdown of the vasculature, while tumours treated with radiation only exhibit clearly demarcated endothelial walls of apparently unaffected blood vessels (Persson et al. 1999, 2002).

APPLICATIONS IN VITRO

In Vitro Examples

A variety of in vitro procedures that capitalizes on the effects of electroporation have been developed.

- Loading genetic material into cells
- Drug delivery into cells
- Monoclonal antibody production
- Cell-cell fusion
- Cell-tissue fusion
- Membrane protein insertion