

ELECTRIC PULSE THERAPY

Bertil R.R. Persson

Introduction

The living cells constituting the human body are surrounded by the cell membrane that is an extremely thin (10 nm) double layer of phospholipids. Specific proteins embedded in the membrane allow passage of ions such as Sodium (Na^+), Potassium (K^+), Calcium (Ca^{2+}), Chlorine (Cl^-), and Carbonate (HCO_3^-). The cell membrane is very restrictive for the passage of most other exogenous molecules and ions. However, since a quarter of a century, electric pulses have been developed to an efficient tool to temporarily open the membrane barrier. The use of very brief, intense electric pulses opens the membrane barrier for transfer of specific molecules to the interior of the cell.

In 1974, Zimmermann *et al.* (1974) first published observations of breakdown of cell membranes by the use of electric pulses. They observed that red blood cells began to lose haemoglobin after exposure to a pulsed electric field. This occurred when the electric field strength exceeded a certain threshold value. The fraction of haemoglobin found in the supernatant was plotted against the external electric field strength and yielded the classical sigmoid curve that characterises the dielectric breakdown of mammalian cell membranes. It was discovered that very short, high-voltage pulses (<1 millisecond) could dramatically increase the permeability of cell membranes. This state of permeabilisation, induced by a pulsed electric field, is generally termed electroporation, or more accurately, electropermeabilization (EP).

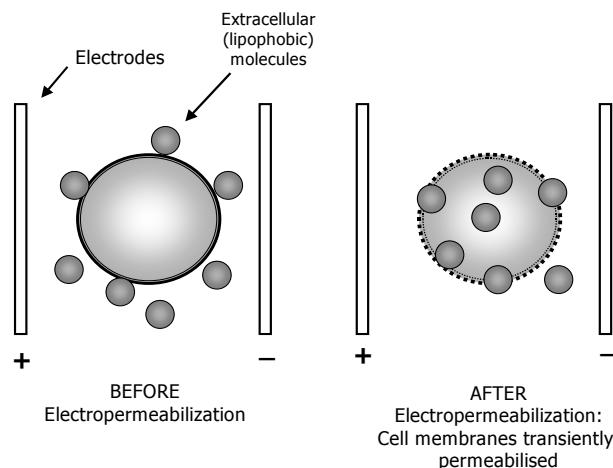


Figure 1.1 The principle of electropermeabilization.

Before electropermeabilization (EP), non-permeant lipophobic molecules cannot pass through the cell membrane. But after applying electric pulses EPT, extracellular molecules have free access to the cytoplasm and the nucleus.

Immediately following the exposure to EPT, molecules and other compounds present in the extracellular fluid access the cytoplasm and the nucleus during a short period of time. This permeabilised state is transient and the membrane normally regains its normal structure within minutes.

Electro pulse treatment is used in a variety of *in vitro* biomedical applications to internalise nonpermeant molecules such as antibodies, nucleic acids, restriction nucleases and particularly gene constructs into cells. This method has a great potential to develop into new therapeutic methods for cancer and other diseases. It can be used by itself or to enhance the effect of already established therapeutic regimes.

- *Electro chemo therapy (ECT)*
- *Electro Gene Therapy (EGT)*
- *Electro Immune Therapy (EIT)*
- *Electro Pulses and Radiation Therapy (ERT)*
- *Electro Pulses and Thermo therapy (Laserthermia/Hyperthermia)*

NUMBER OF PAGES: 11

For the full version of this paper, please visit our web site at:

<http://www.aditusmedical.com>

and go to the section called "Science and Technology".
You will be asked to register before the download can take place.

