Electroporation of cell membranes by rotating electric fields.

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Abstract: *We monitored the entry of the fluorescence dye, propidium iodide, into murine myeloma cells after poration of the cytoplasmic membrane by application of a rotating electric field for 100ms. The dye becomes strongly fluorescent only by binding to DNA after entering the cell. The poration field was generated between four electrodes driven by four 90°-phase-shifted square-topped signals.1 Field strength and frequency were about 77 kV/m and 25 kHz, respectively. Various results for the fluorescence increase of the cytoplasm after the pulse were obtained. Spherical cells showed either a ring-shaped fluorescence increase or an increase starting at one or more points. For ellipsoidal cells, the increase started from membrane points close to their long axis. These experiments confirm the advantages of rotating fields for biotechnological applications. Gentler field conditions can be used because these fields scan the cell surface. Scanning increases the probability of a poration of randomly oriented nonspherical cells or of the weakest membrane points of electrically inhomogeneous cells.*