

A REVIEW OF THE USES OF ELECTRIC AND MAGNETIC  
FIELDS FOR THERAPY

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Electric and magnetic fields are finding increasing uses in medicine. In this paper we will review some of the areas electric and magnetic fields have been shown to be of significant value and some areas where the results are more speculative. Radio frequencies are used to provide localized hyperthermia in the treatment of some cancers in conjunction with X-rays and have been shown to increase the cure rate over X-rays alone. RF fields are also being used in electro-surgery, MRI and microwave imaging. Lower frequency fields have been shown to help with the repair of broken bones some of which had not healed with other treatments for as long as five years. Both pulses and sine waves tuned to values of  $(q/m)B$  for specific ions have been used successfully and a signal to noise ratio model has been developed that seems to explain why some signals work and others do not. Recent work indicates that electric fields may be useful in the repair of spinal cord injuries, other nerves and wound healing. Additional results indicate that magnetic fields can be used to reduce pain and that electric fields can both inhibit and enhance growth.

At the present time considerable effort is going into understanding the mechanism by which electric and magnetic fields effect biological processes. Biological complexity leads to a long chain of events to get from electric or magnetic field forces on charged particle through changes in chemical reaction rates to biological or health effects. Some of this work will be reviewed along with some of our recent results on the effects of these fields on white blood cells (neutrophils). In this work we have shown that DC and low frequency electric and magnetic field can change the speed and direction that neutrophils move in a concentration gradient of a chemo attractant. For RF field exposures we measure increases in speed that exceed those that can be obtained by increasing the temperature alone. This implies that something other than heating is being sensed by these cells that form an important part of our immune system.

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