The Therapeutic Applications of Pulsed and Static Magnetic Fields

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Abstract: This paper is to report on pilot clinical research projects executed to (i) obtain an understanding of how such projects should be carried out within the Australian system of medical research; and (ii) replicate findings of other scientists reporting on therapeutic benefits of static magnets (medical magnets) and Pulsating Electromagnetic Fields (PEMF). Our research studies indicate promising results from the application of medical magnets and PEMF in the cases reported here.

INTRODUCTION:
The application of magnetic fields for therapeutic purposes has gained in popularity over recent years. The First World Congress in Magnetotherapy held at The Royal Society of Medicine in London on 7-8 May 1996, indicates an acceptance of the practice by medical practitioners. In Australia, Swinburne University of Technology, Monash University and University of NSW perform experimental studies on the biological effects of EMF at an academic level.

With the entrepreneurial efforts of people who started manufacturing magnetic therapy products in Australia we see most pharmacies market some type of treatment device designed based on the application of bioelectromagnetics. Application of Transcranial Magnetic Stimulation (TMS) in some hospitals in Australia assists neurological patient assessment; such diagnostic tools utilise a large EMF generated from a circular or figure 8 coil on a patient’s cortex, and time delay between an excitation and the patient’s physical reaction indicates the condition of the connecting nerve path.

LITERATURE REVIEW:
There has been a worldwide increase of interest in the biological effects of magnetic fields. The general public however need to be informed that a biological effect reported may not necessarily entail health implications. Whether a biological effect due to EMF translates to a beneficial or harmful health effect need to be studied on a case-by-case basis followed by replication studies.

There are three approaches to identification of biological effects of medical magnets and PEMF:
(1) Laboratory investigations and biomedical research experimentation;
(2) Animal experimentation; and,
(3) Clinical case studies and research on human subjects.

Laboratory investigations at the cellular level expose single cells, groups of cells, or individual organs to magnetic fields under a variety of conditions and look for effects. Animals make good models for medical research as they eliminate the possibility of the placebo effect. Veterinary practitioners are also using magnetic field clinically for the treatment of musculoskeletal disorders. Animal studies however must be backed up by laboratory experiments performed on human subjects followed by clinical research.

There are a number of wide ranging successful applications of magnetic field therapy reported in medical journals and publications including the treatment of neurological conditions as well as various kinds of joint and muscular disorders [1,2,3].

Research into magnetic fields are subject to many methodological problems arising from the complexity of the human biology; and insufficient technological development in sensory instrumentation in the area of static magnetic fields at the biomagnetism flux levels. An EMF effect research protocol program has to cover effects on subatomic particles (eg. proton, neutron, electron), atomic particles, compounds or molecules, large molecules, macromolecules, organelles, cells, mitosis, cell maturation (blood, neuron, fat, muscle, bone and epithelial cells), tissues, organs, organ systems, and finally the human being organism as a whole. Thus this field must involve multiple disciplines including biochemistry, biophysics, physiology and psychology. This may be an expensive and arduous task but will hopefully provide rigorous results.

It is reported that, static magnets may affect action potential conduction or impulse generation in sensory ganglia. In principle this is precisely what is needed for a peripheral nerve block [4,5]. There is also published material on the use of static magnetic field for treating depression [6,7]. PEMF has been extensively used in the treatment of neurological and brain disorders [8,9,10].

Professor Zhang from Shenzhen University used rotating 6000 gauss magnetic fields for pain relief as well as treating many other diseases including drug withdraw symptoms. The mechanism claimed was that beta-endorphin was increased after treatment [11]. Some theoretical and experimental investigations have proposed biological mechanisms for magnetotherapy such as modulation of the K/Na pump/potential across cell membranes [12].

MATERIALS AND METHOD:
A number of research projects were carried out to investigate the human biological effects of medical magnets and PEMF. These were:
(1) use of magnet for treatment of
   (a) bone, joint and musculoskeletal disorders
   (b) depression
(2) application of PEMF for treatment of
   (a) motor-neuron disease
   (b) memory disorders
(3) effect of PEMF on the heart rate.

RESULTS:

(1a) Seven out of night patients reported reduction of
their arthritic pain by applying static magnets located
on the relevant acupunctures points.

(1b) Two patients participated in a study of applying the
south pole of a magnet to their forehead for
et treatment of their depression. The experiments were
carried out once a week. Self assessment identified
improvements in their mood resulting in better
sleeping and diet. The effect, however, lasted for
only 36 hours. Conclusions can not be drawn before
(1) provision of data from a larger sample
population; and, (2) increase in frequency of the
treatment; ie. in planning future experiments the
mid-exposure period have to be shortened.

(2a) A pilot study was performed on one patient with
Parkinson’s disease whereby he was exposed to
16Hz, 100mG transcranial PEMF, three times a
week (3[1] p. 22). Analysis of the pilot run indicated
a minute but certainly noticeable improvement of the
patient’s muscle control. The test rig instrumentation
is under development in order to extend the experiment to replicate Sandyk’s [13].

(2b) Research on the application of PEMF for treatment
of dementia is another area currently in progress.
The results recorded was 18% improvement in
memory performance achieved after six months of
treatment with 17Hz, 500mG transcranial PEMF,
twice a week.

(3) An experiment on the effects of 8Hz 400mG PEMF
on the heart rate was performed on six human
volunteers. A specially designed suit was made to
enable a localisation of the PEMF on the various
human organs. Mumetal barriers were made to suit
the insertion pockets of the clothes to enable isolated
exposure to the main organs of the human body. The
leak across the barriers was measured to be 25%.
This can be reduced by an improved design. Data
obtained indicated that isolating the brain from the
rest of the body and then exposing the brain only to
PEMF resulted in a decrease in heart rate. Therefore
it would seem that the variation in the heart rate of a
person subjected to PEMF is most likely related to
the brain sensing the PEMF and less likely to other
organs of the human body suggesting that the
vagus nerve is possibly affected by the field.
Further research will involve developing an
experimental rig in order to concentrate the PEMF
on the vagus nerve whilst avoiding exposure of
other sections of the head.

DISCUSSION AND CONCLUSION:

In conclusion while magnetic fields do affect the
human body, far more studies are necessary to determine
how these effects may best be used in therapy. Also to
convince our medical scientists of the usefulness of the
application of static magnets for medical treatment we
must identify the mechanism of interaction between the
static magnetic field and human biology via replicable
laboratory experiments.

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REFERENCES:
Callahan, T.A. Ketet, P. Bassler, M. Hallett and R.M.
Post, “Daily repetitive transcranial magnetic
stimulation (tTMS) improves mood in depression,”
Stimulation of the Human Brain,” pp. 733-735 in
Magneto-Therapy”, Proc. of the First World Congress in Magnetotherapy, pp. 5-78, London,
May, 1996.
Pickett and A.V. Cavopol, “Blockade of sensory
neuron potential by a static magnetic field in the 10mT
“Measurement and analysis of static magnetic field
that block action potentials in cultured neurons,”
[7] Magnetic hope for the mentally ill. The West
Australian, January 1996.
Randoll, “The variable magnetic fields in the complex
treatment of neurological diseases,” The XXVth
General Assembly of the International Union of Radio
Science, Lille, France, 28 Aug - 5 Sep 1996.
with magnetic fields,” Int. J. Neurosci, 66(3-4):237-50,
potentials by pico-Tesla range magnetic fields in
chronic progressive multiple sclerosis,” Int. J.
[12] F. Ayrapatian, “Theoretical aspects of magnetic
therapy,” J. of Advances in Physiological Sciences,
performance in Parkinson’s disease by administration