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What need to be known about the therapy with static magnetic fields

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Abstract During the last three decades the interest toward clinical application of magnetic and electromagnetic stimulation increased worldwide. Numerous publications have discussed the possibility of exogenous magnetic fields to initiate beneficial effects on various biological processes, which are of critical importance for healing of different injuries and pathologies. Today, magnetic and electromagnetic fields are increasingly utilized for the treatment of numerous musculoskeletal injuries and pathologies. For example, selected magnetic fields were reported to be beneficial in the treatment of musculoskeletal injuries and post-surgical, post traumatic and chronic wounds, reduction of edema, in the acceleration of pain and stress relief, and thus contribute to healing processes. The application of this modality could be facilitated by establishing the exact dosimetry of application and by searching for biophysical mechanisms of action, as well. It should be remembered that "not all magnets are equal", therefore the specific medical problem requires a proper diagnostics, a selection of the magnetic field to be applied and a design of the appropriate protocol for treatment. The paper advised that every study and report should carefully explain both the medical problem and the parameters of the applied magnetic field and cautions against generalized statements like "Magnetic field does/does not cause biological response".

Keywords Static magnetic field · Permanent magnets · Therapy

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1 Introduction

The first decade of the twenty-first century is marked with significant increase of the cost paid by individuals and governmental institution for medical services. It is fair to say that today western medicine is based mainly on the achievements of chemistry, which have been further utilized and expanded by the pharmaceutical industry. Unfortunately nearly all pharmaceuticals affect not only the target tissues, but the entire organism and in many cases cause adverse effects. In contrast, magnetotherapy provides non-invasive, safe, and easily applied methods to directly treat the site of injury, the source of pain, and inflammation.

The magnetic field therapy is often a subject of publications that categorically affirm or reject the possibility of magnetic fields to cause health effects. The authors of many papers use the word "controversial" when they speak about magnetobiology and magnetotherapy. It should be understood that magnetotherapy is not a controversial issue. The problems occur when general claims are made by scientists or clinicians that the therapy works or does not work when only one magnetic field is applied for treatment of a specific problem. Looking in conventional drug therapy: not one medication is prescribed without serious consideration of dosage. Why the same approach is not applied for magnetotherapy?

This article is therefore designed to discuss the needs of proper terminology and exact protocol of any biological and clinical study. I should acknowledge that the particular reason for writing the paper was the publication "Static magnetic therapy does not decrease pain or opioid requirements: a randomized double-blind trial" which appeared in Anesth. Analg. V. 104: 290–294, 2007. Reading the title, one should wonder if the authors

(Cepeda, Car, Sarquis, Miranda, Garcia, and Zarate) have any knowledge of physics of magnetic fields (MFs). There is no "static magnetic therapy" recognized as therapeutic modality. If one separates "static magnetic" and "therapy"—the first term does not have any sense. In physics exists a term "static magnetic field", but this is not a synonym of "permanent magnet". Static magnetic field is the field that does not exhibit spatial and temporary changes. But such field might be created either by a permanent magnet or by a coil, supplied by direct current (DC).

As it has been shown (Markov 2004a) magnetotherapy includes at least six groups of electromagnetic fields, developed and utilized in different countries of the world during last 50 years: (1) static/permanent magnetic fields, (2) low frequency sine waves, (3) pulsed electromagnetic fields (PEMF), (4) pulsed radiofrequency fields (PRF), (5) transcranial magnetic stimulation, and (6) millimeter waves.

In each group, a variety of parameters of magnetic field are needed to properly characterize the applied modality. In general, as it has been shown (Markov 1994, 2004a) any study of MF action on a particular biological system has to consider the following parameters:

- Type of field
- Intensity or induction
- Spatial Gradient (dB/dx)
- Localization
- Time of exposure
- Depth of penetration
- Temporary change (dB/dt)
- Frequency
- Pulse shape
- Component (electric or magnetic)

In the particular case of use of permanent magnets the parameters that need to be explained and discussed are reduced to the first six of the list above. Unfortunately, in many studies these parameters are not reported when the protocol is described. For that reason it is difficult to exactly reproduce the study. Immediately, it becomes a reason to claim that this approach is "controversial". The problem actually is with the authors who generalize their finding. In most cases authors apply one only magnetic field and conclude: "Yes, magnetic field works" or "No, magnetic field does not work."

Recently we conducted a study that analyzes 56 published English papers reporting application of permanent magnets in clinical trials. (Colbert et al. 2007a, b; 2008) In addition to characteristics of physical properties of magnetic field, clinical indications were added to the 10 criteria used for evaluation of the MF effects. Interestingly enough, only 2 of the 56 studies received a perfect score that indicated the compliance with the criteria. In other words, >4% of the recently published clinical studies properly reported the protocol of the study(s).

2 Be careful

The above-mentioned paper of Cepeda et al. (2007) declares the goal to evaluate the effect of magnetic therapy on pain intensity. On 17 lines in the abstract there is no indication of the type of magnetic field the authors attempt to evaluate. Fast forward, in the methods section is said that the authors used MagnaBloc device, again without indicating what is the magnetic field they were going to investigate. There was no indication about what the magnetic field strength was, at the surface of the device and at the target site. Still in the abstract the text explained that devices were placed over the surgical incision for 2 h. This is phenomenal mistreatment of patients: one can wonder how medical professional expect to get substantial pain relief within 2 h after the surgery. What reason these authors have to claim that magnetic therapy lacks efficacy in controlling acute postoperative pain? There is no indication about the magnetic field strength applied in this trial. This study does not shed any light on the main goal of the authors—to show the lack of efficacy of magnetic field therapy.

Let me make clear right here: no magnet has therapeutic ability. Magnets are only tools for delivering magnetic fields to human body, when applied with therapeutic purpose. Therefore, any scientific/clinical study must explain the parameters of magnetic fields listed above.

Probably, here I should point that while the authors stated that real and sham devices were placed over the surgical incision, the Fig. 1 and the text related to the figure indicated that the devices were placed around the surgical wound. How close to the edge devices were located remained unknown.

It became evident that authors

- Don't know (or at least don't provide) the characteristics of MagnaBloc device
- They don't know that Magnabloc device has very complicated magnetic field distribution
- They took the liberty to claim that their 2-h trial showed "magnetic therapy lacks efficacy"

I want to point that any anesthesiologist will say "this agent does/does not cause effect when applied with this dose". Why the same approach should not be applied for magnetic field therapy?

There is one thing I would agree with the authors of this study: the availability of various permanent magnets in drug/department stores does not help in further development of this complimentary modality. Moreover—the

magnets are promoted by industry and accepted by general public as alternative to medical intervention. This practice is obviously wrong.

First, "not all magnets are equal". The manufacturers and distributors of magnets for human use pick, from the industry, the cheapest magnets without consideration of their physical parameters. The issue for them is how to wrap and impressively pack the magnets. In addition, the distributors are focused on making the most attractive wording of potential benefit from the magnet. In most cases, no interest, no motivation related to clinical knowledge and experience. If some words are said on the packaging—they are promising immediate relief of all your problems.

Second, the skyrocketing cost of health care and especially of medications turns people in search of alternative solutions for their health problems, especially, when one considers that most of medications have serious adverse effect. Most frequently, users of magnets are elderly people for whom both the cost and the potential adverse effects of combination of several drugs create additional problems.

Third, science and medicine did not and do not fulfill their duty to accurately inform population what is necessary to be known when one decided to buy a magnet instead of a drug.

It is not fair to blame people for their wrong decisions; it is better to guide them in making the right decision. What I would do to accomplish this goal:

- I would educate medical practitioners what today science knows about the potential benefit of magnetic field therapy
- I will try to explain to potential users that magnetic field therapy, as any therapy should be scientific based—the proper diagnostics and selection of the appropriate magnetic device is critically important for the success of therapy
- Everybody must understand that the success of therapy depends on the magnetic field received at the target tissue/organ
- In magnetic field therapy, the dosage is crucially important: "More does not mean better"
- Medical community must not be in a state of denial, but applying more efforts to educate itself and general public what is right and what is wrong in information for magnetic field therapy.

Shortly speaking, I am advocating for more involvement of science in this therapy. In that respect, any author of scientific/clinical paper, any editor must restrict himself/herself from title/statement like "magnet does/does not have medical benefit". The conclusion should be "This magnetic field do/does not cause the desired effect in treatment of this problem". Anything else does serve neither the medicine, nor the patients. It is sad that the editor of mainstream medical journal are very much willing to publish negative papers and when the positive effects are reported, in most cases papers are rejected for various reasons or at least declared "controversial".

For all these reasons a large part of medical community remains convinced that magnetic field therapy does not deserve their attention. One can only wonder if the negative papers that appeared so far in the medical journal were reviewed by experts from bioelectromagnetics (The Bioelectromagnetics society is the largest International society with members from more than 45 countries who work in engineering, analyzing and applying the magnetic field generating systems).

What is wrong with Cepeda et al. (2007) *paper*? These authors did not bother to review the substantial amount of papers that reported positive effects of use of magnetic field for therapeutic purposes. Instead, their introduction section concludes "Furthermore, findings in an acute postoperative pain model could be generalizable to pain syndromes that share "tissue injury" as the source of nociceptive input. Because of the widespread marketing and use of magnetic therapy, despite a near total lack of scientific evidence supporting its use for pain relief, we sought to evaluate the effect of magnetic therapy on pain intensity levels and opioid requirements in patients with postoperative pain."

It certainly does not help to publish a statement like "despite a near total lack of scientific evidence supporting its use for pain relief". It is simply not true—the world scientific and medical literature has more than 500 publications on the effects of permanent magnets on human health. In the same paragraph, these authors stated: "we sought to evaluate the effect of magnetic therapy on pain intensity levels and opioid requirements in patients with postoperative pain."

The magnetic field generating device is explained by authors in the following way: "The MagnaBloc® is a quadrapolar static magnetic device 3.5 cm in diameter with 4 permanent magnets arrayed with alternating polarity. It has a magnetic flux return ring that maximizes the flux to the treatment side. We chose this magnet because it has been reported to produce magnetic fields with the high tissue penetration, which, in theory, may augment pain alleviation." The authors did not tell the readers anything serious about MagnaBloc device, thereby from the very beginning compromising the science and the device itself. Neither the overall size of MagnaBloc nor the fact that there are four small magnets incorporated in the device provides valuable information for the device. No one would be able to repeat the study protocol.

I am confused with the overall design of this study: everybody who went through the general anesthesia knows

that immediately after he/she had been "woken up" there is no adequate reactions to environment. This status lasts for hours, different for different people. Therefore, the information received during the first 2 h more likely would be with little value to evaluate the effects of magnetic field in pain relief.

In addition, authors obviously forgot that MagnaBloc is comprised of four magnets which could not be separated. Let me also ask: what means "around incision"? How close or how far from the edge of incision were the devices located? How many MagnaBloc devices were used for each patient? How the MagnaBloc devices were fixed around the incision? The reader does not know the number of MagnaBloc devices, the exact location, and the distance from the body surface.

These questions should be linked to the fact that in 2002 I was a part of a team that established two important features of MagnaBloc: (1) the maximum effectiveness of MagnaBloc is at the edge between small magnets incorporated into MagnaBloc device, (2) the effect is better pronounced at 0.5 cm from the surface of Magnabloc and is smaller at the surface of the device and at distances larger than 0.5 cm (Engstrom et al. 2002).

From medical point of view, it is not clear what is the objectivity of application of morphine: when and how pain intensity of 4 was reached? What means "Nurse administered the initial loading dose of 2.5 mg morphine"? Why for children the dose was prescribed in milligrams per kilogram but not in adult patients? How patients were monitored for their needs of additional dose of morphine, what is the effect of this additional dosage?

Further, the paper said "The magnet group required 15.8 ± 9.0 mg of morphine, and the sham group required 14.6 ± 8.4 mg. The magnet group required 1.5 mg more morphine (95% CI, _1.8 to 4.0) than the sham group." Looking the values presented, some patients may receive 6 mg, some 25 mg of morphine.

From general point of view the conclusion to be drawn here is: magnetic field exposure does not overcome the effect of morphine. For every lay person this was to be expected: with such dose of morphine administered within 2 h, any other factor more likely will not have effect. Therefore the study of the effectiveness of magnetic field was designed to fail. Add the fact that nobody knows what was the magnetic field applied in the study, a little wonder why the authors made their claims.

Cepeda team states: "The scientific rigor of the study design and execution and the precision of the estimates permit us to confidently conclude that magnetic therapy should not be used for treatment of postoperative acute pain or other pain syndromes in which the source of nociception is tissue injury."

This study is light years far away from claimed "scientific rigor" for the reasons stated above. Yes, the studies that review a number of publications more likely will report that some magnetic fields cause beneficial effect for specific problem, some not. The reasons should be search into the designed of the studies, into improper choice of the magnetic field delivering device.

In a review paper Eccles (2005) concluded: "The weight of evidence from published, well-conducted controlled trials suggest that static magnetic fields are able to induce analgesia." Eccles also stated that "73% of the analyzed studies demonstrated a positive effect of static magnets in achieving analgesia across a broad range of different types of pain (neuropathic, musculoskeletal, fibromyalgic, rheumatic and postsurgical".

One of the papers cited by both Cepeda et al. (2007) and Eccles (2005) is the paper of Man et al., published in 1999. This pioneering study of application of permanent magnets in plastic and cosmetic surgery was designed by myself and I presented it at the Second World Congress of Electricity and Magnetism in Biology and Medicine, that took place in 1997 in Bologna, Italy. In this study, patches of permanent magnets were placed over the surgical wounds immediately after the surgery. It was shown that within first 24 h after surgery and immediate application of magnetic field with 400 Gauss at the site of surgery, pain, edema and coloration were reduced with 31–42%. Further in time, for both, exposure and placebo, groups' pain exponentially decreases within 2 weeks study period still maintaining favorite pain decrease for real versus placebo magnetic patches.

The study of Man et al. (1999) is no way study of chronic pain—it is par excellence application of static magnetic field for treatment of acute, postsurgical wounds. It was a study of the effect of magnetic field alone, not modified by morphine usage. Once again, the design of Cepeda et al. study was wrong and it was clear that 2-h period is absolutely inappropriate for obtaining post-analgesic pain relief.

I wish to invite the Cepeda team, as well as Dr. Flam (2007) and Dr. Shafer (2007) to read the scientific literature before they made their statements. Yes, I agree with Dr. Shafer that "we have a responsibility to our patients". But this responsibility requires an honest, not-biased review and analysis of scientific publications.

It is not fare to use acupuncture as evidence for magnetic field efficiency. It is not fare to refer to reviewer of the Cepeda paper "Magnets shouldn't work and this article says they don't. Why publish it?" Yes, I want to ask again "Why publish a paper which was wrong by design and by execution?" Why does the journal pick reviewers who know in advance that magnets should not work?" Where is the scientific integrity in the review process?

3 What magnetotherapy can do?

Whether some people want it or not, the magnetic field therapy has broad distribution all over the world. Contemporary use of magnetic fields in medicine has more than 60 years of development. Starting in 1945, immediately after the end of the World War II, in Japan, magnetic field therapy has been in use in various countries in Europe, Asia, North and South America. More than 2 million people received the benefit of magnetic field therapy worldwide.

Both static and time varying magnetic fields were successfully applied mainly to treat therapeutically resistant problems in the musculoskeletal system. Numerous publications suggest that exogenous magnetic fields can have profound effects on a large number of biological processes, most of which are of critical importance for diagnostics and therapy (Detlavs 1987; Bassett 1992; Shupak 2003; Adey 2004; Rosch and Markov 2004; Barnes and Greenebaum 2007).

Hundreds of papers published in the scientific and medical journals clearly demonstrated that selected magnetic fields provide a practical, exogenous method for inducing cell and tissue modifications which correct selected pathological states. A number of clinical studies, in vivo animal experiments and in vitro cellular and membrane research, all suggest that magnetic and electromagnetic field stimulation can accelerate the healing processes. These fields are also able to enhance such fundamental properties of the human organism as tissue repair and regeneration.

It is well accepted that many components of living systems communicate with each other via electromagnetic signals. In addition, endogenous electromagnetic and magnetic fields are associated with many basic physiological processes ranging from ion binding and molecular conformation in the cell membrane to the macroscopic mechanical properties of tissues. Cell membrane receptors and transducers also function by detecting, elaborating, and transmitting electrical charges, currents, and potentials as well as electromagnetic fields. If we look on these issues from the view point of physics, magnetic fields are capable of alterating many of these biological phenomena. It has been shown that magnetic fields may induce changes in living systems on the organism, tissue, cellular, membrane and subcellular levels. (Detlavs 1987; Bassett 1992; Markov and Pilla 1994; Sisken and Walker 1995; Lawrence et al. 1998; Shupak 2003; Rosch and Markov 2004; Adey 2004; Aryapetyan and Markov 2006; Barnes and Greenebaum 2007).

During the last two decades the world has witnessed the marked revival of methods of therapy that have their roots in old remedies which people used during the centuries before the aggressive development of pharmaceutical medicine took place. Why did this happen? Natural medicine that used herbs and other plant components was developed by trial and error during the millennia and natural remedies have been transferred from generation to generation. It was not only the combination of ingredients, but also the methods of "cooking" that kept the secrets of success.

Little by little, medical schools were initiating development of pharmaceutics. What was an easy substitution of natural "drugs" with their chemical equivalents manufactured in the ordinary pharmacy, today is multibillion pharmaceutical industry. This industry redesigned the whole education in medical schools and the entire health care system in the Western world.

The massive use of pharmaceutics leads to overdose patients causing significant, and often deadly side effects. Physicians prescribe dosage of medication based upon the body weight in consideration that the target of medication will receive the dosage needed. Well, what about the remaining 90–95% of the dose? It would be absorbed by other tissues and organs that definitely do not need such stimulation and this is an invitation for adverse responses.

People intuitively turned to alternative medicine, searching for methods of healing that have local application. Here, magnetic fields and permanent magnets come as plausible opportunity. Magnetotherapy, as many other methods of physical therapy provides excellent opportunity for local treatment. While pharmaceutics in most cases treat symptoms and the relief is only temporary, magnets placed over the appropriate area of the body are affecting the source. It is most demonstrated in pain relief At the X International Congress on Stress, that took place in Montreau, Switzerland in 1999, I first introduced the term "electroceutics" as alternative of "pharmaceutics" in a way to mark the possibility of using electromagnetic fields and modalities for therapeutic purposes.

MF have been proven to be clinically safe, and it is well accepted that MF provide a practical, non-invasive method for inducing cell and tissue modifications which can correct selected pathological states. Numerous publications suggest that exogenous magnetic and electromagnetic fields can have profound effects on a large number of biological processes, most of which are of critical importance for diagnostics and therapy (Todorov 1982; Detlavs 1987; Markov 1987; Bassett 1989, 1994; Pilla and Markov 1994; Markov and Pilla 1995; Sisken and Walker 1995; Lawrence et al. 1998; Shupak 2003; Rosch and Markov 2004).

The most effective clinical applications of these fields over the past 25 years relate to bone unification, pain reduction, and soft tissue edema. The treatment success rate for these patients approaches 80%, with virtually no reported complications after nearly three decades of use

(Bassett 1989; Markov 1994; Markov 2004a; Rosch and Markov 2004; Pilla 2007). While the success rate of magnetotherapy is comparable to surgical intervention for delayed and non-union fractures, the cost of non-invasive therapy is significantly less. Cost substantially decreases when appropriate permanent magnets are immediately applied directly to the site of injury. For many musculoskeletal injuries and post-surgical, posttraumatic, and chronic wounds, magnets and MF are recognized as a modality that contributes to reduction of edema. Edema reduction can be a major therapeutic factor in the acceleration of pain and stress relief, which in turn contributes toward the healing processes.

3.1 What should magnetotherapy be?

The medical community should be aware that magnetotherapy can not be successfully developed without the joint efforts of physicists, engineers, biologists and physicians. An important role will be played by medical practitioners, including physical and occupational therapists, who routinely use physical modalities, while scientists need to create dosimetry and methodology for magnetotherapy.

Saying that a patient was "magnetically stimulated" is about as nonspecific as saying a patient was given a drug. It should be emphasized again and again that magnetic field stimulation requires as precise dosage as any other therapy. However, "dosage" is more complicated because it requires taking into account a number of physical parameters, which characterize the magnetic field generating system. Space does not permit more than a superficial presentation of the relevant evidence here to support the statement that "different MF produce different effects in different biotargets under differing conditions of exposure."

Unfortunately, the advancement of magnetotherapy depends on funding provided mainly by manufacturers and distributors of magnetotherapeutic devices, including permanent magnets. This has lead to claims that reports sponsored by manufacturers are biased. Well, let us make it clear: World governments spend significant amount of money to support investigation of potential hazard of power lines and cell phones, but basically little, if any money was allocated for supporting research and application of magnetic field therapy. Thus, the circuit is closed: no money from funding agencies, no independent research.

If the money came from manufacturers-the studies were classified as biased by opponents of magnetotherapy. "Main stream" medicine rejects the possibility that magnetic fields might be even a complimentary tool for treatment of some medical conditions. Medical journals, such as JAMA, or British Medical Journal have thus far rejected papers that shows benefit, and are very fast to publish badly designed and executed studies that show no effects of applied fields. This way, the situation with the use of magnetic fields for therapeutic purposes remains very complicated.

3.2 What needs to be done?

Any therapy that utilizes magnetic fields should start with

- Evaluation of the clinical problem,
- Identification of the source of the problem (i.e. target organ/tissue) and
- Selection of the appropriate source of the magnetic field

More important is to identify the magnetic flux density that needs to be delivered to the desired target tissue. The ability of the MF to modulate biological processes is determined first by the physiological state of the injured tissue, which establishes whether or not a physiologically relevant response can be achieved and, secondly, by achieving effective dosimetry of the applied MF at the target site. It should be remembered that the therapeutic effect depends upon the spatial distribution of MF in the injured site. Therefore, the main question remains: what is the proper choice of the magnetic device.

A biologically and clinically relevant characteristic of the static magnetic field is the field strength at the target site. The three-dimensional dosimetry of the magnetic field is extremely important to analyze and further predict the biological effects at the given target. A number of studies of in vitro biological response to applied magnetic field suggest the existence of biological "windows". The "windows" represent combinations of amplitude, frequency and exposure duration within which the optimal response is observed, and once outside this range, the response is found to be significantly smaller. This demonstrates the principle that "more does not necessarily mean better". For static magnetic fields, several "windows" have been detected at 5–20, 150–200, and 450–500 G, respectively 0.5–2, 15–20, and 45–50 mT (Bawin et al. 1975; Markov et al. 1975; Zukov and Lazarovich 1989; Markov 2004b, c).

It should be emphasized once again that expected therapeutic results depends on the magnetic field strength at the target tissue. Therefore, "gauss rating" and even the field strength at the surface of the magnet are insufficient and irrelevant to predict expected therapeutic effects. The relevant physical parameter is the magnetic field at the target site in two studies of the effects of MagnaBloc device was shown that not only the field strength, but also the gradient of the field might be of importance for achieving the desired biological and clinical effects (McLean et al. 1995; Markov 2002).

Therefore, a basic science or clinical study of magnetic field therapy should include information about both

physical and biophysical parameters of applied magnetic fields, as well as precise clinical protocol of the therapy. (See the paper of Colbert et al. in this issue).

4 Conclusion

Despite years of well-documented experience elsewhere, the USA mainstream medicine does not recognize the potential of magnetotherapy. Some of the essential elements of the rapidly growing and expanding database on reproducible biological and clinical effects of magnetic fields are not well known or interpreted too narrowly by traditional medicine, and the regulatory, and public sectors of society.

More importantly, biophysics is needed to plan the therapy and to consider the potential cell/tissue component that more likely would be influenced by the magnetic field. Characterizing the potential of a magnetic field to alter existing biochemical and biophysical processes requires knowing the characteristics of the magnetic field, and the appropriate sequence is physics–biology-therapy, incorporating all three. Some confusion has appeared among medical practitioners with respect to the application of these modalities due to the variety of methods of stimulation, parameters of the applied fields and currents, and the lack of a defined biophysical mechanism capable of explaining the observed bioeffects.

It appears today that the therapy that utilizes permanent magnets needs a very careful attention of the medical community. To say "Magnets do not have therapeutic value because they can not have any effects" does not help. Even if the skepticism toward benefit of the use of magnets happened to prevail, there should be scientific arguments and clinical evidence against this modality. Everybody who decides to claim positive or negative effects of magnetic field therapy should be honest and non-biased. Everybody should avoid statements like "magnets do/does not work". The statement should be "This magnetic field does/does not work in resolving that medical problem". Apply the same approach to the use of magnets as to use of drugs—diagnosis, choice of treatment, dosage.

However, the advantages of using magnets with minimal clinical supervision can be a disadvantage for executing double-blind studies, since a patient can discover whether they are using it as active or placebo device, and this is a criticism of these studies. The goal of medicine is to resolve the problem, to heal the injury/disease, to alleviate pain. It is too much attention paid to double blind or crossover approach. I should remind that in the Ancient Greece medical schools, students learned that 70% of the success of therapy is patient belief in doctor and only 30% are due to therapy itself. I don't see any problem in the fact that patient will know that the treatment is real. Given the fact that in many cases magnetotherapy is applied when other methods failed, patients might serve as own control. I never received the answer of a simple, but very fundamental question "How ethical is to place a suffering person in the placebo group if I know that the therapy might improve his/her status?"

4.1 Give the chance for magnetic field therapy

An up to date reference discussing research in magnetic/electromagnetic therapy is "Bioelectromagnetic Medicine", co-edited by Paul J. Rosch and Marko Markov. Additional information might be found in the special issues of journal "The environmentalist", published in 2005 and 2007 which includes selected presentations from the 2004 Kos meeting "Biological Effects of Electromagnetic Fields" and in the NATO Research Workshop book: Bioelectromagnetics: current concepts", co-edited by S. Ayrapetyan and M. Markov. The most recent publication which is of basic importance is the third edition of "Handbook of Biological Effects of EMF", edited by F. Barnes and B. Greenebaum.

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