Magneto Therapy

Magneto therapy is one of the basic physiotherapeutic procedures. The basic form, application of static magnetic field (the permanent magnet), has been used since time immemorial as one of the natural healing sources. However, only the coming of electronics and powerful switching elements enables rapid development of low-frequency pulse magnet therapy. The effects of which is several times higher than those of the static magnetic field. The recently performed studies, imply that therapy performed by means of pulse electromagnetic field is up to 100 times more effective than the application of stationary magnetic field. That is why the pulse magneto therapy is nowadays becoming widely used physiotherapeutic method. With some conditions (e.g. chronic pains in degenerative articular diseases) this method has proven successful as therapy with long-lasting therapeutic effect even when other therapeutical methods failed. Pulse magneto therapy can be very effective in case of correct indication and application. It can also be recommended for use in combination with other therapy methods such as pharmacotherapy, the effects of which are usually supported by magneto therapy. That is why magneto therapy should neither be left out in case of comprehensive approach to treatment, nor given as preference of monotherapy. The latest findings about physiological response of the organism to the electromagnetic field imply the following effects of magneto-therapy: • analgesic effect • antiedematous effect • antiphlogistic effect • trophic effect (acceleration of healing and growth) • myorelaxation and spasmolytic effect • vasodilation. The following chapters contain brief explanation of physical background of magneto therapy and physiological mechanisms of its effect with emphasis on application in individual fields of medicine.

7.4.1. PHYSICAL BACKGROUND OF MAGNETO THERAPY

Magnetic field Magnetic field is an integral part of electromagnetic field which consists of both electric and the magnetic components. Both components of the electromagnetic field are mutually closely connected and cannot exist without each other, except in the following two special cases: • electrostatic field in which the magnetic component of the field is zero • stationary magnetic field in which the electric component is zero.

Owing to the used frequencies up to 150 Hz and owing to the design of the BTL applicators, the magnetic component of the field predominates over the electric. For short we will call the field by the commonly used term “magnetic field” here on after. The presence of a magnetic field is sensed primarily through its force effects by which it affects magnetically conductive things, moving charges and conductors with electric current flowing through them. The force effects are not very important for our theory, because biological objects are diamagnetic. However, it is necessary to take these force effects into account in case of metal implants, especially those which are fixed in soft tissues and are not made of antimagnetic materials.

Another interaction between the magnetic field and the matter occurs at the moment when the matter is exposed to the magnetic field. At that moment, individual free molecules are orientated in a way to minimize the energy inside the field. In case of biological objects, these forces act against the bonds between the atoms, molecules and ions in the tissues. This consequently influences also cellular processes. The effects important for physiotherapy are based on electrodynamics’ induction discovered by the physicist M. Faraday in the 19th. century. In practice, if you are moving the electric conductor in the magnetic field, voltage appears on it. If you make a closed loop of the moving conductor, electric current will flow through it. As Faraday discovered, this phenomenon also works the other way around – if the magnetic field moves or changes in the course of time (instead of the conductor), a similar effect occurs. These discoveries were only a short «remove??» from the application of alternating magnetic fields in therapy. In case of living organisms, the moving charges (the conductor moving in the magnetic field) are represented by the circulating body fluids (blood, lymph). In case of exposition to alternating magnetic field it refers to its individual more electrically conductive parts – the vascular bed (including circulating fluids), peripheral nerves, CNS neural paths and, last but not least, individual ions and charges on cellular membranes.

Stationary magnetic field Stationary magnetic field arises around permanent magnets but also around moving electric charges which move at a constant speed (direct current). Electric charge may be carried e.g. by ions (electric current flowing in liquids) and electrons (electric current flowing in conductors). In the latter case, a magnetic field similar to that around the permanent magnet arises around the electric conductor with constant direct electric current flowing through it .

Alternating magnetic field Time behaviour of this field is usually derived from the sinusoidal main voltage. In common practice, devices most often generate the fields of a frequency of 50 Hz and the sinusoidal waveform. The magnetic fields of these devices change their polarity in the course of time. These fields, even though with much lower intensity, exist in the surrounding of each electric conductor, transformers and motors supplied from the AC mains.

Pulse magnetic field This field is characterized by fast changes of electromagnetic field with rectangular pulses, their edges are very steep. That is why the pulse magnetic field and the electric component is higher and is permanently present beside the magnetic component. Some studies, which deal with comparison of individual magnetic field types, points out the very high efficiency of the pulse magnetic field in comparison with the stationary magnetic field. Therefore the question arises whether the positive results of the pulse magnetic field are not caused by the more intensive electric component of the field. Out of all possible pulse types, the BTL – 5000 device has been equipped with the following ones. These pulses cover the entire spectrum of required applications, from acute to chronic states.

7.4.2. THERAPEUTIC EFFECTS OF MAGNETO THERAPY

Magneto therapy is one of the commonly used physiotherapeutic procedures. This method has proved successful in some diseases which require long-lasting therapeutic effects (e.g. chronic pain of vertebral aetiology or degenerative joint diseases) even when other therapy methods have proven unsuccessful. However, it is also necessary to consider that like every therapeutic procedure, magneto therapy also has a certain failure rate. It has been proved that for treatment of patients in acute stages it is better to use static magnetic field at the beginning while in chronic diseases it is better to use pulse magnetotherapy. Application of magneto therapy must always be based on thorough medical history and detailed examination of the patient. The latest findings about physiological response of the organism to the electromagnetic field imply the following effects of magneto therapy: • Analgesic effect, • Antiphlogistic effect, • Trophic effect (acceleration of healing and growth), • Myorelaxation and spasmolytic effect, • Vasodilation. • Antiedematous effect,

Analgesic effect The analgesic effect of magneto therapy applies in most painful states of muscular as well as articular aetiology. Detailed description of this effect is quite complicated; its physiological effects have been specified in recent years. According to these findings, the analgesic effect of magneto therapy is accounted for by increased secretion of endogenous opioids caused by myorelaxation, antiphlogistic and antiedematous effects and maybe also the impact on presynaptic inhibition of nociceptive signals at the level of the medullary dorsal horns. The treatment should be combined with aimed pharmacotherapy, manual treatment and relaxation therapy, at least in the initial stage.

Antiphlogistic effect

This effect has not been convincingly explained so far, but recent studies agree on the following principle: The antiphlogistic effect is induced by increased phagocytosis of neutrophils and increased production of superoxide. This is followed by induction of superoxide dismutase bound to endothelium, which probably leads to higher concentration of hydrogen peroxide in the exposed area. Owing to the fact that superoxide inhibits the activity of catalase, the hydrogen peroxide is not degraded and thus it is able to destroy leukotrienes, which belong to the strongest activators of phagocytosis. This mechanism also explains the initial controversial action of the magnetic field in sterile inflammations as well as in the microbially induced inflammations. This effect also accounts for temporary impairment of rheumatic conditions during the first two or three expositions, when the inflammatory symptoms are intensified by increased produced superoxide. Simultaneous medication and physical therapy is necessary; the patient must be monitored during the therapy and in case of longer negative reaction the therapy must be stopped.

Trophic effect The magnetic field accelerates healing of the skeleton and soft tissues. It is caused by better blood circulation in the exposed area and by irritation of cytoplasmic membranes. This activates a metabolic pathway, the key point of which is the change of the cAMP/cGMP ratio.

Myorelaxation and spasmolytic effect Increased blood circulation in the area improves washing away acidic metabolites which cause painful irritation. In the muscles exposed to the magnetic field it is also induced increased activity of LDH (lactate dehydrogenase) and efflux of Ca^{2+} ions from muscle cells.

Vasodilation effect This effect is caused by the efflux of Ca^{2+} ions which causes relaxation of the vascular musculature and precapillary sphincters. Probably the n. vagus is also directly influenced and the increased metabolic activity of cells in the exposed area results in creation of EDRF and prostacyclins.

Antiedematous effect This effect results from the two above described effects - antiphlogistic effect of the magnet and acceleration of healing and improved blood circulation.

7.3.4. N/A

7.3.5. N/A