COMPARISON BETWEEN APPLICATION OF GIRDLE COIL AND SEVERAL LOCAL INDUCTORS IN MAGNETOTHERAPY

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Abstract

It's well known that the girdle coil and/or several local inductors are most used in magneto-therapy. In formal point of view there is not any difference between application of these two kind of inductors. There are only difference in constructions of these two kind inductors. Often the physicians prefers to use girdle coil because its application is more friendly for the patient. The nurse prefers to use girdle coil because its application is more easy than application of several local inductors. In principally the girdle coil can provide influence of electromagnetic field on more large area of the human body. Nevertheless in many cases the physicians prefers applications of local inductors. For instance in stomatology can be used only local inductors. Often in surgery physicians prefers application of local inductors, also. The comparison between properties of girdle coil and local inductors is the main goal of present investigation.

1. INTRODUCTION

Comparison between the two kind of inductors should consists not only comparison between two construction. More important is comparison between space configuration of magnetic field created by the two different inductors in patient's area. This space configuration of magnetic field can be obtained using appropriate computer visualisation of magnetic field of both local inductors and girdle coil. In the process of discussion on influence of magnetic field on the human body in the case of two kind of inductors it's necessary to take in account vector of velocity of ions of blood and ions of other kind of liquid of human body in the area of influence of magnetic field.

2. BASIC MATHEMATICAL DESCRIPTION OF INFLUENCE OF MAGNETIC FIELD ON THE MOVEMENT OF IONS IN LIVE TISSUES

It is known from electrotechnics the equation (1) for determination of the force $\vec{F}$ of influence of magnetic field with magnetic induction $\vec{B}$ on ion with electric charge q which moves in the magnetic field with velocity $\vec{V}$.

$$\vec{F} = q(\vec{V} \times \vec{B}) \qquad (1)$$

It follows from the equation (1) that this force $\vec{F}$ would be maximal when the vector of velocity $\vec{V}$ of the moving ion and the magnetic induction $\vec{B}$ are perpendicular. If the mass of the moving ion is m then the acceleration $\vec{a}$ given by the force $\vec{F}$ is:

$$\vec{a} = \frac{\vec{F}}{m} \qquad (2)$$

Thus, a new component $\vec{V}_n$ of the ion's velocity in the living tissue appears:

$$\vec{V}_n = \vec{a}t \qquad (3)$$

Where t is the time.

Formally, the effect of external magnetic field on the moving ion in living tissue is expressed by adding the new component to its initial velocity. Thus, the final value of velocity of ion movement in living tissue can be determined by the equation (4).

$$\vec{V}_R = \vec{V} + \vec{V}_n \qquad (4)$$

It's well known in medicine, that the physiological effect of the influence of external factors (in particular the influence of external low-frequency or permanent electric and magnetic fields) depends on the change in the rate of movement of the ions in the tissues due to these effects. In this case, the equation (4) illustrates the basic principle of magnetotherapy, namely that the physiological effect of the influence of the low-frequency magnetic field on the living tissue depends to the new component $\vec{V}_n$ of the speed of movement of ions. If the equation

(1) and (2) are replaced successively in the equation (3), the equation (5) can be obtained:

$$\vec{V}_n = \frac{q(\vec{V} \times \vec{B})}{m} t \qquad (5)$$

Basic remarks:

1. From the equation (5), it can be seen that the new component of the travel speed, resp. the physiological effect of magnetic field effects on living tissues depends on:

1.1. Electric charges q and mass m of specific ions.

1.2. The value of magnetic induction $\vec{B}$ and the value of the initial ionic velocity $\vec{V}$, which in turn depends on the temperature of the tissues.

1.3. Angle between the vectors of magnetic induction $\vec{B}$ and the initial velocity $\vec{V}$ of the ions.

1.4. If at least one of the two magnetic induction vectors $\vec{B}$ and / or the initial ionic velocity $\vec{V}$ changes, this results in a change in the new travel speed components, respectively. the physiological effect of magnetic field effects on living tissues.

3. COMPARISON BETWEEN BASIC PROPERTIES OF GIRDLE COIL AND SYSTEMS OF SOME LOCAL INDUCTORS

On Fig. 1 can be seen application of girdle coil in magneto-therapy. On Fig. 2 can be seen electronic unit of system for magneto-therapy together with local inductors.

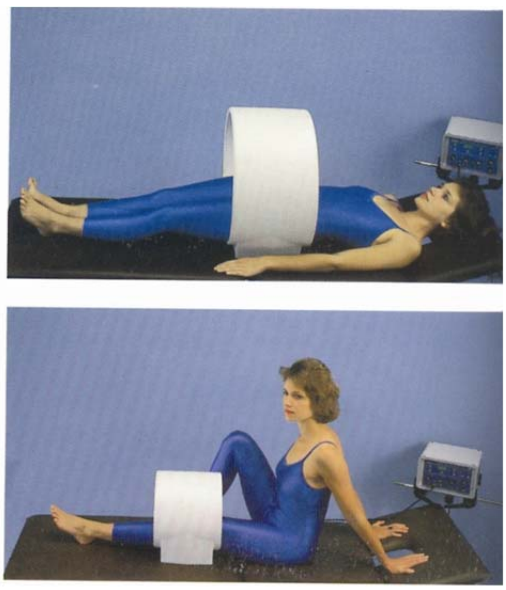

Fig.1. Magneto-therapy using girdle coil

Fig. 2. Electronic unit of system for magneto-therapy together with local inductors

3.1. Basic properties of girdle coil

1. It can be seen on Fig.1 that the application of a girdle coil provides a low frequency magnetic field effect on a relatively large area of the human body, but the therapy is of limited effectiveness due to the small angle values between the magnetic induction vector and vector of the initial ionic velocity of blood at most points of the impact area of the magnetic field [9].

2. Changing the space configuration of the magnetic field created by the girdle coil (the "moving" magnetic field mode) can only provide a simple "motion" of the magnetic field – only along the coil axis.

3.2. Basic properties of systems of some local inductors

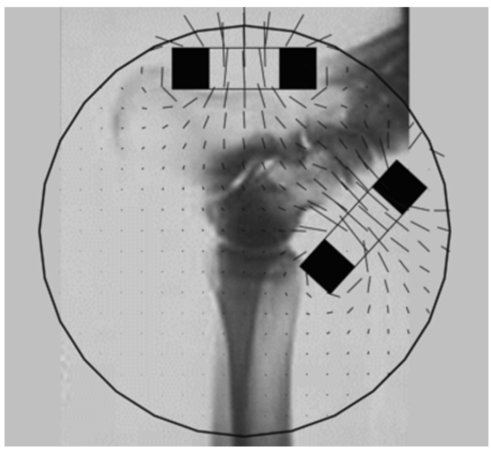

Fig. 3. A simple application of pair local inductors

1.The application of one or a pair of local inductors provides magnetic field impact on a small area of the body, but local inductors can easily be positioned such that the vectors of magnetic induction and initial ionic velocity are nearly perpendicular (Fig.3), providing an increased effectiveness of the therapeutic process [6,7].

2. The application of local inductors allows the use of a different number of inductors suitably located around the field of magnetic field action. This practically provides unlimited possibilities for forming the spatial configuration of the magnetic field in the patient area.

3. The use of a plurality of local inducers suitably located in the patient region allows a number of combinations to be formed by varying their number by switching with respect to the instantaneous spatial configuration of the magnetic field in the subject area including rotation and translation of the field. This allows a longer therapy process to be used without adaptation of the body to the influence of magnetic field.

4. Of course increasing the number of local inductors used complicates their management. However, this disadvantage can be easily avoided by using microprocessor control of the magnetotherapy system modes [8,10].

5. The microprocessor control of magnetic therapy systems allows not only changes in the spatial configuration of the magnetic field in the patient area but also changes in the parameters of excitation current in the inductors (amplitude, frequency, signal form). Practically, with the use of appropriate software, multiple modes of therapy can be provided [11,12].

4. SYSTEM FOR MAGNETOTHERAPY WITH “RUNNING” MAGNETIC FIELD

This system (Fig.4) can be an example about application of limited number of local inductors using microprocessor control of the magnetotherapy system.

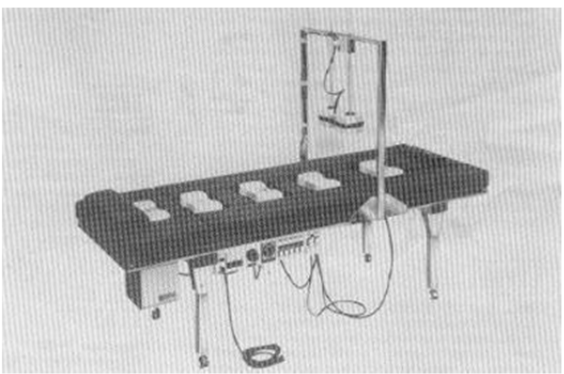

Fig. 4. System for magneto-therapy with “running” low frequency magnetic field

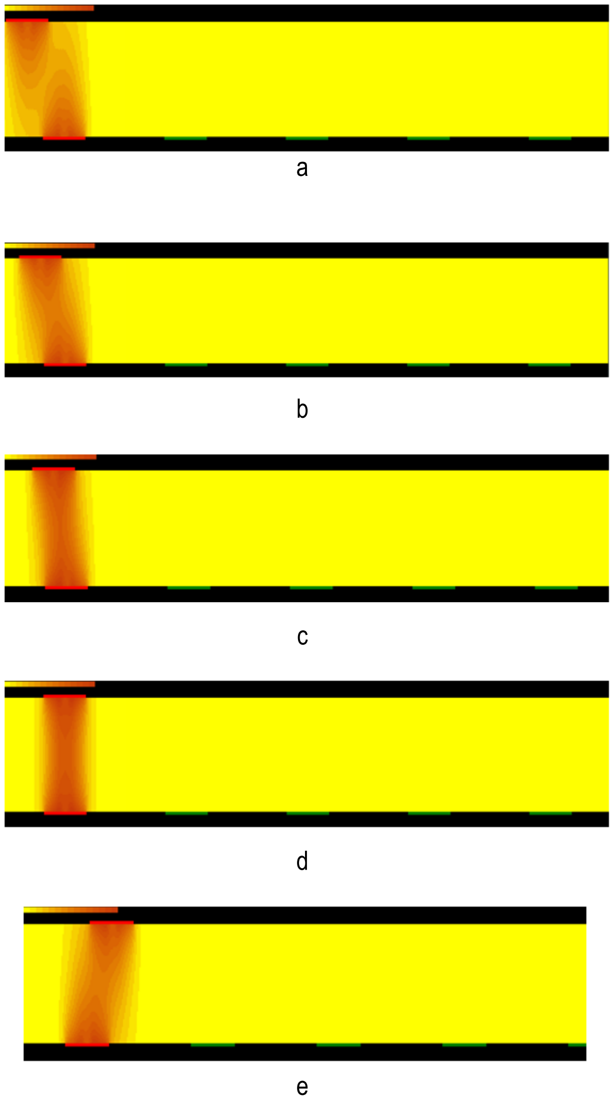

Fig. 5 (a,b,c,d,e). Visualisation of “running” low frequency magnetic field on the axis of bed

The spatial location of the local inductors in the patient area in the proposed random "running" magnetic field system is chosen considering the above mentioned in 3.2 properties of system build by local inductors [1,2,3,4,5]. The aim is to provide not only the possibility of rotating the magnetic induction vector in a plane perpendicular to the axis of the bed, but also moving said plane of rotation of the magnetic induction vector longitudinally along the axis of the bed. Thus, system application can be provided for multiple diseases, regardless of which part of the patient's body is concerned. At the same time, thanks to the microprocessor control of the system, there are quite a number of modifications of the spatial-time configuration of the magnetic field in the patient's body. The microprocessor control of spatial field configurations of the magnetic induction vector field implies the possibility of 3D pseudo-random changes in spatial field configurations of the magnetic induction vector field, resulting in improved therapeutic results and more severe cases of disease.

5. CONCLUSION

It's clear that the construction of system with "running" low frequency magnetic field is more complicated and more expensive than girdle coil. In addition this system need microprocessor control as advantage and as disadvantage.

The system with "running" low frequency magnetic field can provide not limited modes of programs for therapy on the base of appropriate software, which is impossible in the case of application of girdle coil.

The conclusions made above are of a general nature and should be taken into account at all in the study, comparison and synthesis of different systems of magnetotherapy. These conclusions are also important when interpreting trajectories of movement of various ions in living tissues, also.

6. ACKNOWLEDGMENTS

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