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Original Research Article

Helical Hyperbolic Magnetic Field in Nerves, when they Act as Current Conductors

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Abstract: Knowledge of the magnetic field of a nerve is of interest for the application of external electromagnetic therapy to regenerate injured nerves. The aim of this work is to the theoretical study of the magnetic field generated in the nerves when they act as current conductors and thus determine how their hyperbolic curves are, within the concept of hyperbolic medicine. Using Internet search engines and various databases (Medline, Google Scholar, Researchgate, Scielo), a bibliographic review of scientific papers related to the electromagnetic field generated in the nerves, when they act as current conductors, has been carried out. For this work we use, theoretically, the right-hand rule in electromagnetism. So, we apply it to a model nerve, to determine what its hyperbolic magnetic field is like. The conclusions are: a) Hyperbolic curves are very common in nature and human physiology. The lines of force of an electromagnetic field act on human physiology through hyperbolic curves. b) Human physiology and a nerve can be divided into smaller fragments like a magnet do and maintain their same characteristics. c) A nerve fragment is a conducting wire of electric current that generates a transversal magnetic field, according to the right-hand rule in electromagnetism. That magnetic field has hyperbolic lines of force that follow a counterclockwise helical path.

Keywords: Nerves, medicine, curves, hyperbolic, field, magnetic, helical, electromagnetism.

INTRODUCTION

A nerve has a electromagnetic field, which can be modified when another external electromagnetic field is applied in therapy. Numerous studies have been done to see if an electromagnetic pulse could regenerate injured peripheral nerves [1-11]. The results indicate that electromagnetic therapy increases the number of motor neurons to restore proper connections in the injured peripheral nerve [1, 10]. This determines a significant increase in regeneration [2, 4, 5, 9, 11].

In a simple magnet and the Earth's magnetic field, there are lines of force that follow a hyperbolic pattern [12-14]. Hyperbolic lines of force from electromagnetic fields are known to have effects on human physiology [12, 15-19] (Table 1). In addition, these hyperbolic curves are very frequent in human physiology [12,20-38] (table 2) and biological rhythms can be synchronized with them [39, 40].

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Table 1: Effects of electromagnetic fields on human physiology

- There are effects on nerves, heart tissue, skeletal muscle, sleep electrophysiology, melatonin secretion, and other body tissues.
- Some cells move toward the cathode (fibroblasts, keratinocytes, chondrocytes, epithelial cells) and others towards the anode (corneal endothelial cells, granulocytes, vascular endothelial cells), but this depends on the animal species.
- Some molecules produce permanent dipoles that align with the applied electric field.
- In the cell membrane, ionic channels and receptors can be altered by modifying the kinetics of activation.
- Electromagnetic fields can regulate the speed and amount of products of biochemical reactions, act on free radicals and modulate neurotransmitters in the brain.
- Earth's magnetic field also influences the geomagnetic orientation and navigation of some fish, migratory birds, butterflies, and bees.

Table 2: Hyperbolic curves in physiology

- Oxygen saturation for hemoglobin and myoglobin concerning partial oxygen pressure [24-27].
- Sometimes dose-effect relationship curves [28].
- Glucokinase and fructokinase saturation curves [29].
- Aspartate saturation curves [30].
- Insulin sensitivity in oral glucose tolerance test [31, 32].
- Heart rate responses during exercise [33].
- Strength-speed ratio of myocardial myosin isoenzymes [34].
- Force-speed ratio of shortening of skeletal muscle fibers [35].
- In aviation, periods of incapacitation in extreme gravitational stress [36].
- Descriptions of the perception of odors in an olfactory space [37].
- The human eye perceives a hyperbolic image of reality [38].

The concept of "hyperbolic medicine" covers several aspects. Its main feature is that hyperbolic space-time curves found in nature are related to and influence human physiology [12, 20-23, 39-54]. Electromagnetic therapy can use this feature to make treatment more effective.

As described in numerous works, if we divide hyperbolic human physiology or divide a magnet into several fragments, we get similar patterns. In both cases, they repeat their hyperbolic characteristics as if they were fractals [12, 22, 41, 46-54]. It has also been indicated that when a human organ, acting as a current conductor, moves away from an observer, it follows hyperbolic lines of force that enter through the south pole S of a magnet. If that organ approaches him, it follows the hyperbolic lines of force coming out of the north pole N of a magnet [12, 22, 41, 46-54] (fig.1).

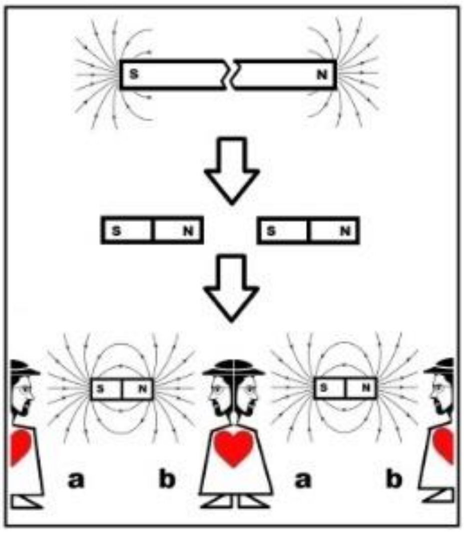

Figure 1: Human physiology can be divided like a magnet into smaller ones, preserving the same hyperbolic characteristics. When a human organ moves away from an observer it follows hyperbolic lines of force entering the south pole S of a magnet ("hyperbola moving away") (a). When it approaches the observer, it follows hyperbolic lines of force that come out of the north pole N of a magnet ("hyperbola approaching") (b).

It is known that the nerves of the human body are conductive wires of electric current, whose magnetic field is perpendicular to the nerve [6]. This is defined in electromagnetism according to the right-hand rule [13, 14, 54] (fig.2).

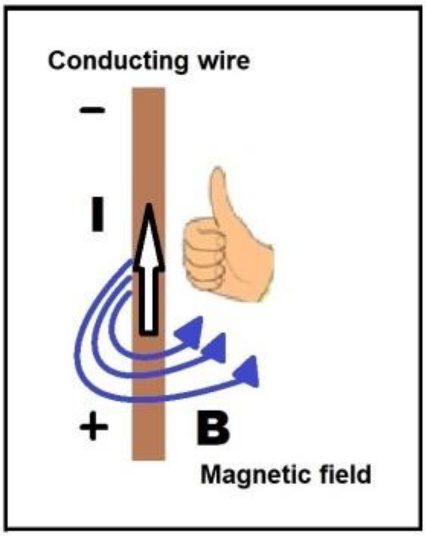

Figure 2: "Rule of the right hand, Ampère's rule or corkscrew rule": whenever an electric current (I) flows through a conducting wire, a magnetic field (B) is established, whose lines of force are circumferences located at the plane perpendicular to that conductor. When the thumb points in the direction of conventional current (from positive to negative), the other bent fingers will point in the direction of the magnetic flux lines around the conductor, rotating counterclockwise.

It has been described that neurons can generate electromagnetic waves and information between neurons can be transmitted through electromagnetic waves. These waves are the result of cations exchange on the inner surface of the cell membrane of neurons, especially Na+ and K+ [55,56].

Knowledge of the magnetic field of a nerve is of interest for the application of external electromagnetic therapy to regenerate injured nerves. The aim of this work is to the theoretical study of the magnetic field generated in the nerves when they act as current conductors and thus determine how their hyperbolic curves are, within the concept of hyperbolic medicine.

MATERIAL AND METHODS

Using Internet search engines and various databases (Medline, Google Scholar, Researchgate, Scielo), a bibliographic review of scientific papers related to the electromagnetic field generated in the nerves, when they act as current conductors, has been carried out. For this work we use, theoretically, the right-hand rule in electromagnetism. So, we apply it to a model nerve, to determine what its hyperbolic magnetic field is like.

RESULTS

a) The results of the bibliographic review indicate that images in nature are hyperbolas of space-time and exist independently of the longitude and latitude of the Earth where they are observed [12, 20-23, 39-54]. The lines of force of the Earth's magnetic field are hyperbolas [41], which can vary with time and even reverse their polarity [57]. Hyperbolic curves are very common in human physiology [12, 20-38]. The lines of force of an electromagnetic field act on human physiology [12, 15-19], and according to recent works they do so through hyperbolic curves [41]. Human circadian rhythms may be synchronized with these hyperbolic curves [39, 40].
b) The theoretical results of this study indicate that hyperbolic human physiology can be fragmented into smaller elements like a magnet does and maintain its same characteristics at smaller scales [12, 22, 41]. A nerve fragment is a conducting wire of electrical current that generates a transverse magnetic field in the shape of a corkscrew, according to the right-hand rule. The hyperbolic lines of force of this magnetic field follow a helical path rotating counterclockwise (fig.3A).

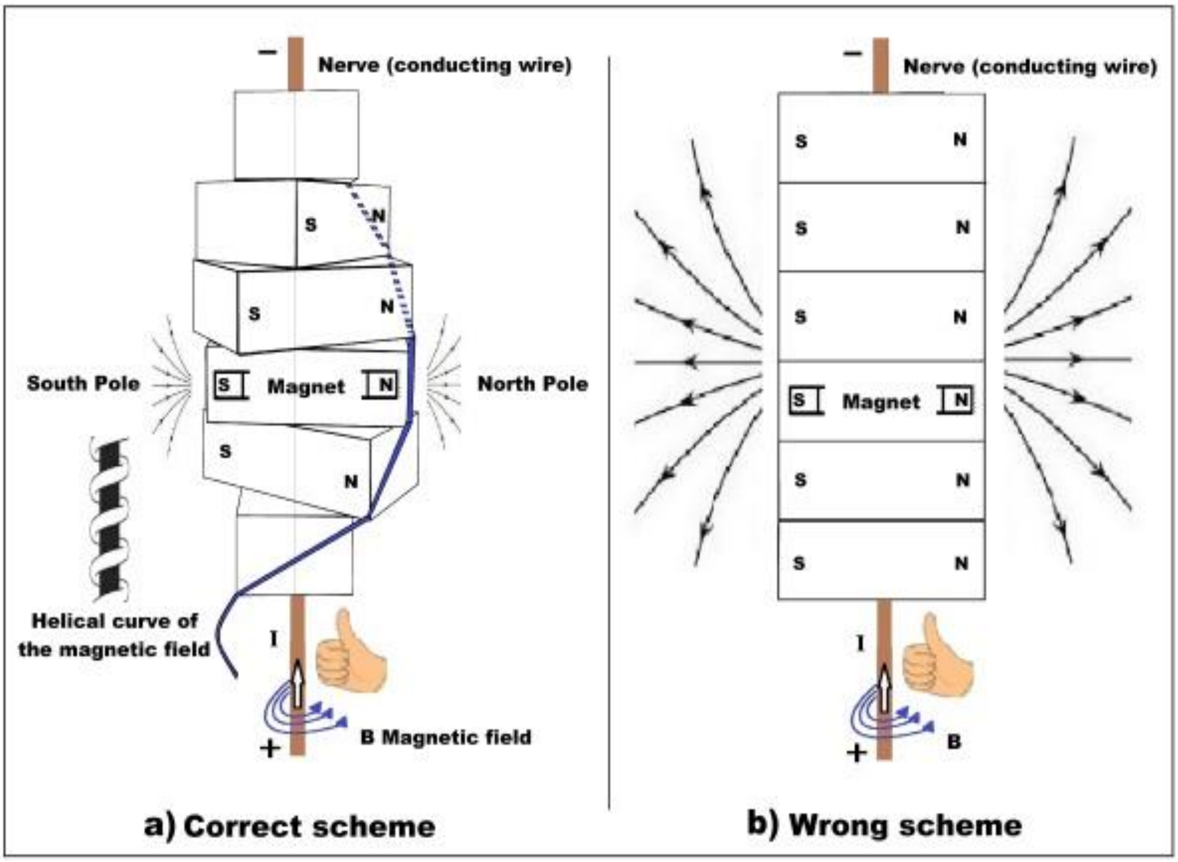

Figure 3: The physiology of a nerve can be divided into fragments like a magnet. When the nerve acts as a current conductor (I) a transverse magnetic field (B) is generated, whose hyperbolic lines of force follow a helical path rotating counterclockwise. a) Correct scheme, and b) Incorrect scheme.

DISCUSSION

If we observe the lines of force of a magnet and the Earth´s magnetic field, we perceive that they are hyperbolic images [13, 14, 45]. The results of the literature review indicate that hyperbolic curves are very common in medicine and are found in many human physiological processes [24-38]. It is possible to think that there is an adaptation of this human physiology to the hyperbolic deformation of the space in which we live. We know from previous work that electromagnetic fields have effects on human physiology [12, 15-19] through their hyperbolic lines of force [41]. It is reasonable to think that the cells of the human body synchronize their physiological processes to create hyperbolic curves similar to those that occur in nature. In this way, cellular physiological processes are subject to permanent synchronization [40].

It has been indicated that electromagnetic stimulation acts on a nerve by hyperpolarizing or depolarizing the membrane [3]. An axon can be activated when a parallel electromagnetic field is applied and if it is applied transversally to the axon it is also activated, inducing transmembrane potentials [7]. Axon polarization is dependent on the properties of the magnetic field (i.e., orientation to the axon, magnitude, and frequency), its geometry (i.e., axon radius, membrane thickness), and its electrical properties (i.e., conductivity, dielectric permittivity) [7]. The distance between the nerve and the coil plays a crucial role [8]. All of the above also depends on the characteristics of the magnetic field of the nerve itself, knowledge of which is the objective of this work.

In theory, both hyperbolic human physiology and the hyperbolic lines of force of a magnet can be divided into fragments. Each of them retains its same hyperbolic characteristics. If we fragment the nerve, we will also observe fragmented magnetic fields, in the same way as when we divide a magnet to create smaller ones. Each fragment retains its same characteristics. According to the "right-hand rule" in electromagnetism, we know that an electric current flowing through a conductor generates a transverse magnetic field, rotating counterclockwise. The same thing happens on a nerve. A nerve is a structure that behaves as a conducting wire and information is transmitted through it employing an electric current. When the current passes through the nerve, a transverse magnetic field is generated in each fragment (B). If the magnetic fields of these fragments had the same orientation as their south S and north N poles, the entire nerve would be a magnet. The generated magnetic field (B) can't be oriented as in figure 3B, since when the current passes through the entire nerve would be a single magnet. That is, the sum of all the nerve fragments would be a single magnet. Taking into account the above, the hyperbolic lines of force of the magnetic field generated in a nerve when the current passes must have a helical trajectory, as indicated in figure 3A. We believe that the hyperbolic lines of force exiting the north pole N in each nerve fragment rotate counterclockwise like a helix. And then they enter through the south pole S of the next nerve fragment. In this way, these hyperbolic lines of force follow a helical trajectory, counterclockwise.

CONCLUSION

- Hyperbolic curves are very common in nature and human physiology. The lines of force of an electromagnetic field act on human physiology through hyperbolic curves.
- Human physiology and a nerve can be divided into smaller fragments like a magnet do and maintain their same characteristics.
- A nerve fragment is a conducting wire of electric current that generates a transversal magnetic field, according to the right-hand rule in electromagnetism. That magnetic field has hyperbolic lines of force that follow a counterclockwise helical path.

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