Universidad de Alcalá

Doctoral Program in Medicine

BIOLOGICAL EFFECTS OF BIOMAGNETIC PAIR THERAPY

Doctoral Thesis presented by

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PREAMBLE

A few years ago I discovered by chance the action of permanent magnetic magnets in the everyday clinic. The clinical results, the low cost of therapy prompted me to investigate further in this regard. Since then, I have sought the relationship between permanent magnets and the human being.

This thesis is the beginning of a line of research within medical bioelectromagnetism, on the therapeutic and diagnostic technique of the Biomagnetic Pair.

I am confident that the fruits of this research will be seen throughout the future. With this, we intend to pass through the melting pot of scientific methodology to everything new observable and be a keystone for its consolidation and future research.

ACKNOWLEDGEMENTS

This thesis is the beginning of a unique and original line of research on the Biomagnetic Pair technique. I thank my wife Raquel for her support, for her understanding in such a long study. To Dr. Bardasano for teaching me to think before I act. To my family, especially my brother Tomás, for their collaboration in the format of this thesis. To my mother, recently deceased, who could not see with her eyes the end of this work. To Dr. Domingo Pérez León for the non-profit transfer of measuring devices. To the librarians of the Ilustre Colegio Oficial de Médicos de Madrid, for their help in all the search for scientific references. I would not want to leave aside the innovative spirit that has inspired me, among which I highlight; the illusion, to keep my spirit happy. To hope, for being in difficult times. Inspiration, without it, humanity would not react. To the difficulties, true masters of evolutionary change.

RECOGNITION AND CONSTANCY

The European Foundation for Bioelectromagnetism Health Sciences deserves special and separate mention for its logistical support for this thesis, as well as Dr. Goiz Durán Honorary Professor and researcher at the University of Alcalá de Henares since 2013 and creator of the Biomagnetic Pair system.

SUMMARY

This thesis is focused on verifying the effect of magnets according to the Biomagnetic Pair technique on the body, measuring the effect they have on neuromuscular excitability. For this purpose, the fundamentals of the technique will be briefly explained, as well as a historical overview of the physiological bases of neuromuscular excitability and the use of rheotome as a measure of it.
Finally, the effects of static magnetic fields on neuromuscular excitability are detailed in a clinical study.

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INTRODUCTION

In ancient cultures, the use of magnets for therapeutic purposes is described. The Egyptians mention the papyrus of Ebbers which is the first manuscript. The Chinese, the Hindus used magnets for these purposes.

In the Quixote of La Mancha:

> *"You will know, Sancho, that the Spaniards, and those who embark in Cadiz to go to the East Indies, one of the signs they have to understand that they have crossed the equinox line that I have told you is that all those who go on the ship die from lice, with none left, nor will they find him in all the bass, if they weigh him to gold; And so, you can, Sancho, walk a hand on a thigh, and if you find something alive, we will come out this doubt, and if not, we have passed."*

We see therefore, as in Quixote, the action of the passage of the equinox as a modulating agent of the presence of lice in the skin, since the polarity of the terrestrial axis is modified at this level. This implies a sensitivity on the part of the parasite towards the terrestrial poles, which are nothing more than magnetic poles.

During the sending of the first humans into space, Dr. R. Boeringmeyer describes the shortening of the right leg of all astronauts returning to earth. This non-contrasted observation is the origin of the Biomagnetic Pair technique, since Dr. Boeringmeyer describes that with the application of a static magnet of 0.1 T the right leg returned to its original state.

Thanks to the studies of Dr R. Boeringmeyer, Dr Goiz Duran created the Biomagnetic Pair technique ([1]). This technique uses pairs of static magnets placed at specific anatomical points in the body to rebalance the metabolism. The Biomagnetic Pair can tackle with partial or total success a great majority of diseases. It has great preventive value.

The objective of this thesis is to evaluate, measure and verify the Biomagnetic Pair technique by means of its effect on the neuromuscular excitability measured by the Reotomo.

1 THE PHENOMENON OF THE BIOMAGNETIC PAIR

We are faced with a new type of therapy, based on the application of permanent static magnetic pairs directly on the body at certain specific strategic anatomical points.

Dr. F. Mesmer (b. May 23, 1734, Iznang, Swabia, Germany - March 5, 1815, Meersburg, Germany), at the beginning of the 17th century, used permanent magnetic magnets with great repercussion in his time, finally criticized for his relationship with placebo.

According to Dr. Goiz's theory; "the biomagnetic pair is a physical aspect of magnetism applied to medicine. It is based on the ability to study, detect, classify, measure and correct functional alterations in the pH of living organs"([2]).

The idea of the Biomagnetic Pair arises when its discoverer, Dr. Goiz, attends a course on biomagnetism given by Dr. Richard Broeringhmeyer ([3]), a doctor who describes that a static magnetic field can detect alterations in the pH of internal organs in a direct and qualitative way.

On impacting a stable, static 0.1 T magnet on an area of the acidic body, a shortening of the right leg occurs. It is a process that depends on the state of neuromuscular excitability of the affected body area.

1.1 BIOMAGNETIC PAIR THEORY

1.1.1 Biomagnetic Pair Therapy

The **biomagnetic Pair** is based on a manual sensorial maneuver, rhythmic, combining magnets in various positions of the body and with a diagnostic objective and treatment in the same session.

How to proceed: for its execution it is essential to assess the environmental factors of the site with geomagnetic field measurement (days of calm and no geomagnetic storm) with high precision validated meters, Hall effect and proton magnetometer.

> *Sensory maneuvering*: The physician actively intervenes in the process of therapeutic diagnosis. The patient is placed in supine decubitus, the legs are held at the height of the lower third of both twins.
>
> *Rhythmic*: When taking both twin muscles of the legs, in the distal third, the doctor makes a rhythmic movement of oscillations between both legs, lifting each of them alternately.
>
> *Use of magnets*: Each time the doctor lifts both legs in a rhythmic way, he places a 0.1 T magnet of north polarity on the right side of the body (right hemisome), at certain anatomical points, waiting for a sensory response.

If there is an acidity due to alteration of the state of local electromagnetic disturbance, we will have a shortening of the lower right limb. Which gives us the *shortening point*.

Later, with a magnet of opposite polarity, south, the corresponding anatomical point is searched, waiting for the lower right limb to return to normal. When regulated, this point is called an *even point*. According to Dr Goiz "*every point where there is an acidic zone correlates with an alkaline zone, by a phenomenon of electromagnetic resonance* "([4]).

Goiz sign magnetopodal:

By definition, electricity or moving electric charges are magnetism. And whenever there is a mechanical stimulus, an electric current is produced.

The second law of thermodynamics refers to us that energy is neither created nor destroyed, it is only transformed. Therefore, the mechanical stimulus produced in the rhythmic movement of the operator, together with the placement of the static magnet, generate a current, and if the zone is excitable, the shortening reflex or magnetopodal sign would be produced.

1.1.2 Hypothesis of the principle of the Biomagnetic Pair: the "NEN" or neutral energy level.

Dr. Goiz's foundation ([5]) "*establishes that disease occurs when the balance of what he calls NEN or Neutral Energy Level is lost".*

The NEN defines "*the bioenergetic limits in which all cellular metabolic processes of human organisms take place*".

The NEN acts as a dielectric for the formation and stability of the organs, of the homeostasis.

> *"The alteration of the NEN obeys the law of all or nothing, similar to the muscular reobase. When an organ leaves its normal energetic level, it is altered, and independently of the cause, the phenomenon persists in imbalance"*.

In the positive pole of the NEN we will have phenomenon of acidosis, shortening of the matter, dysfunction, and finally degeneration of the matter.

In the negative pole of the NEN, we will have elongation of matter, distension, edema, dysfunction and degeneration of matter.

In both poles we find the same intensity, the same cell frequency, and the same number of altered particles.

Relationship of the NEN with the pH of the organism:

pH is a measure of the acidity or alkalinity of a solution.

It is called acidic dissolution when the pH scale is below 7 and alkaline when above 7.

In humans, blood ranges from 7.35 to 7.45. Its maintenance is vital to preserve life, in fact proteins, true pillars of our body, all have a specific isoelectric point and act optimally at a given pH.

There are numerous membrane transporters that regulate cytosolic pH.

Also at the intracellular level there is a proton pump that maintains the pH. Thanks to the existence of intracellular acid zones, which remain within the lysosomes, molecules can be purified and endocited in an autophagic way.

Maintaining a dynamic balance between intracellular pH and extracellular pH is fundamental to the equilibrium of life, so that the cell can continue to live.

Otto Warburg, Nobel Prize winner in medicine, describes the appearance of an alteration in the metabolism of cellular oxygenation as the cause of cancer. It also attributes a change in intracellular pH towards acidity as a result of this process. Since cells need to create ATP in an anaerobic medium. ([6])([7]).

Sodi Pallares, describes as cellular alteration the loss of the free energy of Gibbs, and therefore produces a phenomenon of intracellular acidity.

1.1.3 The theory of symbiotism according to Goiz: The pathogenic code

According to the theory of the Biomagnetic Pair, there is a relationship between viruses, bacteria, fungi and parasites.

> According to Dr. Goiz "*Microorganisms do not live isolated in the environment, but are in vibrational resonance with the rest of the body in a symbiotic way. Vibrational resonance is a phenomenon described by Goiz who attributes to microorganisms an ability to communicate*.

Establishing a true process of symbiosis within the body where there is an association of different species that take advantage of each other, being the human being the final carrier.

1.1.4 Mitochondrial evolutionary symbiosis

1.1.4.1 Bacteria and ATP synthesis.

The origin of life begins with the need to obtain energy and then be able to store it. In the body, energy is produced at the mitochondrial level. Phylogenetically, this cellular part comes from bacteria, true precursors to the maintenance of life on earth.

Energy produced at the mitochondrial level has several phases ([8]).

In phase 1 the high-energy electrons are transferred to the mitochondrial membrane and release energy used to pump hydrogenions into the cell interior. Generating an electrochemical gradient of protons.

In phase 2, thanks to this force created by the gradient, the ATP synthetase produces ATP through ADP and P.

Eukaryotic cells couple the gradient flow of hydrogeniones by transporting certain metabolites.

In bacteria, the gradient is used to generate ATP, and for transport processes, where there is a flagellum that carries out its rotation, allowing the movement of bacteria thanks to the hydrogenion pump. Therefore, the modifications of the extracellular pH modify the movement of this flagellum, changing its orientation ([9]).

1.1.5 Atopobiosis

Potgieter ([10]) defines a new paradigm of medicine: ATOPOBIOSIS. The latest studies are now beginning to doubt the sterility of blood. It is suggested the presence in blood of inactive or not immediately cultivable forms but that can survive in blood and inside the erythrocytes. A new microbiome has been discovered, but not in the gastrointestinal tract, but in the blood.

2 THE PLACEBO EFFECT

Hernandez Gracias ([11]) defines placebo as a therapy that has no medical efficacy, but can have curative or palliative effects if the patient believes that they are actually giving a real medicine. The placebo works as long as there is faith in it.

Mesmer ([12]) developed his theory of animal magnetism, which picked up a tradition ranging from Plato to Paracelsus. *"De InfluxuPlanetarum"*, in which he tries to demonstrate the attraction forces of celestial bodies that influence the human nervous system.

As a result of a treatment with magnets to a patient in 1774, and perceive a significant improvement from her, he is strengthened in the belief that all bodies have a universal fluid, a force related to terrestrial magnetism.

This fluid was emitted by the human being and generated spontaneous healings. Later, after the publication of The "Memory on the discovery of animal magnetism" was very successful in its application with magnets, which later removed to use only his hands.

He was rejected by the scientific community of the time, criticizing his methods of placebo and hypnosis. He is considered the father of both processes.

His follower James Braid developed hypnosis as a therapeutic element ([13]). Although primitive methods of hypnotic induction are already described in the ancestors of our history of humanity, concrete forms of religious magic manifestation are related to special mechanisms of suggestion, provoking trances capable of modifying the normal parameters of conduct or performance of a person ([14]).

3 JUSTIFICATION

The Biomagnetic Pair is a technique:

Creative: the originality of the proposal turns medicine into an art.

Novelty: there are no references in literature to the idea of associating magnets and looking for a reflection in the body with the intention of healing.

Useful: its ease of use, simplicity and clinical impact are a great contribution to medicine.

Medical application: the relevance of current studies in relation to permanent magnetic fields will lead to the Biomagnetic Pair to be a great medical proposal.

Social impact: its low cost, and its easy handling imply a great impact, which is already taking place throughout Latin America.

From all the above, the present thesis is focused on verifying the effect of magnets according to the Biomagnetic Pair technique on the body, measuring the effect they have on neuromuscular excitability. Leaving for future thesis or studies, the relation that has the biomagnetic pair with the symbiotism, as well as the verification of the magnetopodal reflex. To do this, we will use the Reotome as a meter of neuromuscular excitability, and check the changes produced by impacting a pair of static magnets on the body.

4 NEUROMUSCULAR EXCITABILITY

4.1 FUNDAMENTALS AND THEORETICAL BASIS

A chemical, electrical or physical stimulus is capable of inducing a response on the neuromuscular tissue, by modifying the membrane potential at rest, transforming the membrane potential into an action potential.

The objective symptoms of the patient, which can be appreciated with the help of our senses through inspection, palpation, percussion and auscultation ([15]): in short, observation and its involvement in tactile phenomena as the fundamental basis of the process to understand the functioning of the human being.

The state of neuromuscular excitability is related to the state of response of the cell membrane, which will allow us to know the state of adaptation of the cell to any stimulus.

4.2 HISTORY OF NEUROMUSCULAR EXCITABILITY

Krothschuh 1953, developed the history of neuromuscular excitability, and divided it into 3 parts. The first *pre-Galvanic* stage, from Thales of Miletus who observed the attraction of different elements when rubbing amber to Jean Jallabert (1712-1768) who demonstrated the therapeutic use of electrical stimulation on muscle. To pass later to the *galvanic* stage, where Galvani affirmed the existence of an inherent electricity to the animal and Volta that affirmed that the animal tissue only conducts the electricity, to finally arrive at Duchenne de Boulogne that reflected the motor points and the excitability of certain muscles that presented nervous degeneration. The electrical muscular diagnosis is now established.

And finally arriving at the chronaxic stage, where the time factor began to take on relevance, first with Du Bois Reymond's "general law of electric excitation" ([16]) stating that muscular and nervous excitation was produced only by variable states of electric current. Only the use of current switches was capable of causing muscle contraction. He measured the current associated with the muscle impulse.

Fick in (1864-1943) demonstrated in addition to these minimum intensity currents, an electrical pulse duration was necessary.

Erb in (1867-1931) formulated the "degeneration reaction or Erb reaction", where the galvanic and faradaric excitability at muscular level was lost after a variable time. Thanks to this principle, the concept of electrotherapy was structured, which is defined as the application of electricity, electromagnetic energy, as a therapeutic agent with the aim of provoking different biological and physiological reactions that will produce the recovery or improvement of the functioning of cells or tissues.

Engelman (1843-1909) verified the influence of the duration of the passage of constant current on the ability to produce a neuromuscular response. He noted the need for higher current values the shorter the duration of the current pulse applied. This space of time, Engelman called it physiological time.

Hoorweg (1866-1952) developed his research on the influence of time on the neuromuscular impulse. He demonstrated empirically that the intensity needed to achieve minimal muscle contraction increased as the duration of current impulses decreased.

4.3 MOLECULAR BASES OF NEUROMUSCULAR EXCITABILITY

Neuromuscular excitability depends on the metabolic adaptation of the muscle to its environment.

The propagation of the action potential when it reaches the neuromuscular plaque releases calcium from the reticulaarcoplasmic calcium. This calcium binds to troponin thanks to the presence of ATP and produces the interaction of crossed bridges between myosin and actin thus allowing muscle contraction. When calcium is released there is muscle contraction, when it is absorbed there is muscle relaxation. When an electrical stimulus of sufficient intensity is applied to the muscle, it responds with a contraction.

Depending on the state of excitability of the muscle we will have more or less excitability, which depends on the output of calcium and the exchange of other ions to generate ATP.

Depending on the excitability of the central nervous system we will have the faster or slower creation of the action potential that later activates the muscular plaque.

4.4 CODING OF SENSORY INFORMATION

Perception:

The organism is in permanent adaptation with the environment. Any stimulus generates a cascade of events, and the body reacts.

> Kandell ([17]) attributes "*the activation of an afferent fiber increases as the intensity of the stimulus increases. The membrane potential change produced by the sensory stimulus is transformed into a pulsation code in which the frequency of the action potentials reflects the amplitude of the receptor potential*".

Gustav Fechner, Helmhotz and Wundt, ([18]) fathers of experimental psychology studied the physiological phenomena that led to the sharing of the same principle in the reception of stimuli:

1. a physical stimulus

2. a set of phenomena that transform the stimulus into a nervous impulse

3. a response from this signal in the form of perception, conscious experience or motor response.

Therefore any stimulus on the body produces a sensory and receptive effect.

4.5 EXCITABILITY AND THE NERVOUS SYSTEM

4.5.1 The vegetative nervous system

"The nervous system of vegetative life is made up of the sympathetic and parasympathetic systems. Because both systems innervate the same viscera, they have been given antagonistic functions. From where it results that the increase of tone of one of them carries peculiar functional disorders for disturbing the visceral nervous balance" ([19]).

There are subjects in which the two antagonistic systems are hyperexcited by reactional defense action.

Each of them has antagonistic functions in each section, mainly the sympathetic tends to excitement, and the parasympathetic to relaxation.

There are some methods of exploration of the vegetative nervous system, where the imbalance of both systems will be manifested by the increase in tone of one of them over the other. Depending on the predominant sympathetic or parasympathetic.

The vegetative system responds to external stimuli.

The supposed functional antagonism of the sympathetic and parasympathetic systems, the imbalance of both systems will be manifested by the increase of tone or predominance of one of them over the other (state of sympathicotonia or parasympathicotonia) ([20]).

This fact is of relevance, since this state depends on the state of neuromuscular excitability. Any change in neuromuscular stability will result in a change of state.

The body constantly reacts to external stimuli. A review of the different stimuli described in the literature with respect to physical examination tests is performed. Each test is a demonstration of the body's reactivity to a stimulus.

Noguer and Molins ([21]) define the exploration of the neurovegetative system as a fundamental part of performing a medical act. Vegetative life is regulated by the sympathetic and parasympathetic systems.

The increase in tone of one of them leads to peculiar functional disorders by disturbing the nervous balance: vegetative lability.

The exploration of the vegetative nervous system is useful for the treatment of acute accidents, due to the rapid response to its stimuli of the vegetative tone.

4.5.2 Exploration methods

a. Oculocardial reflex: (Dagnini-Aschner), decrease pulsations when compressing eyeballs.

b. Pilomotor reflex: pilomotor erection when ice is applied to the body (by sympathetic excitation).

c. Ciliospinal reflex: dilation of the pupil by pinching or stinging the lateral and posterior neck on the same side.

d. Active standing test: the pulse is accelerated, then a reflex bradycardia occurs.

e. Valsalva test: forced exhalation against pressure and closure of the glottis usually produces a reflex bradycardia (disappearance of this phenomenon indicates vagal neuropathy and heart failure).

f. Symptom of Samoggi: pupil contraction in the exhalation of vagotonic individuals.

g. Hering's phenomenon: increased pulse rate and decreased tension during inspiration in vagotonic individuals (respiratory sinus arrhythmia).

h. Passive orthostatism test: lowers blood pressure in prolonged standing.

i. Sweat test: increase body temperature by 1 degree, sweating occurs that is highlighted by sprinkling the skin of the patient with starch.

j. Dermography.

k. Carotid sinus reflex: compression or massage at the carotid bifurcation level causes reflex bradycardia.

l. Coldpressure test: an increase in blood pressure after immersing the hand in cold water.

m. Kernig sign: when the patient is in supine decubitus, he is helped to sit down, then it is observed that the legs are flexed, and it is impossible for them to stretch (sign of meningeal irritation).

n. Sign of Brudzinski: sick supine decubitus, and when elevating the two lower limbs it is observed that they also bend in flexion at the level of the knees, without it being possible to carry out this stretched movement. Or when the patient's head is flexed, the knees are flexed. (sign of meningeal irritation).

o. Mingazzini's manoeuvre: search for defects in the motor ways, when the patient lying on the back, with the muscles flexed at right angles over the pelvis and the legs flexed over the knees, finds it more difficult to maintain this position at the paretic end.

p. Barré's manoeuvre: sick in prone position with the lower limbs bent at right angles at knee level, with the two legs vertical, oscillates and falls from the affectionate side.

q. Sign of Lasègue: exacerbation of the pain when lifting the limb of the sick side in complete extension. (due to the elongation of the nerve) and on the other hand it does not increase if the limb is bent in flexion.

r. Bragard's maneuver: when the foot is dorsiflexioned, it provokes or exaggerates even more the pain in the ciatalgias.

Each of these tests, used in clinical practice, validated by medical science, demonstrate that the body reacts to mechanical stimuli, with manual stress tests.

4.6 MAGNETO SYMPATHETIC REFLEX PODAL

In the exploration of the nervous system, we are going to focus on the part of the automatisms, medullary or of defense, that are phenomena of the shortening and extending muscles, producing crossed extension. These reflexes are complex coordinated movements that put into action synergistic but anatomically distant muscle groups, which are provoked by certain manoeuvres and nevertheless cannot be abolished by voluntary motility. They are usually more present in lesions of the pyramidal fascicule, they are observed in the lower limbs, where the most important is the phenomenon of the shorteners, which is caused by the forced flexion of the toes and is produced by the triple flexion of the tarsus, knee and hip. However, it can also be excited by punctures on the sole of the foot ([22]).

Electrical versus magnetic examination of the body:

An electrical scan of the motor nerves and muscles may also be done. Galvanic currents are applied to investigate the functional status of brain lesions. The galvanic excitation determines a contraction at the moment of closing and another at the moment of opening. The contraction is more intense in the negative pole than in the positive pole ([23]).

A magnet generates a state of permanent current, which when it comes into contact with the body, produces a reaction in it. If the excitatory state is broad, even a shortening of the right leg can be observed, because a muscular excitation is produced when applying a static magnet.

Therefore, we believe it would be appropriate to investigate the effect of the body when applying a static magnet with the consequent shortening of the leg, as described in the technique of the Biomagnetic Pair. What we will call: Goiz reflex or sympathetic reflex magneto podal.

4.7 MEASUREMENT OF NEUROMUSCULAR EXCITABILITY FROM BERNSTEIN TO DELONS: THE REOTOME

4.7.1 JuliusBernstein: The Reotomo

The measurement of neuromuscular excitability is referred to by the measuring apparatus called "*Differential Reotome*"([24]), a discovery made by Bernstein thanks to which he was able to determine the action potential of the membrane (1868), later the membrane theory (1902).

In the first electrophysiological instrument the galvanometer could not record the time course of the action potentials, but Julius Bernstein designed an ingenious device called the "*Differential Reotome*". A pin on a rotating wheel closes the stimulus circuit when it touches a copper wire, while two other pins on the opposite side of the wheel close the recording circuit (a galvanometer) when passing through a mercury surface.

By adjusting the position of the pins, Bernstein was able to test the electrical response at precise moments after the stimulus, and used his instrument to produce the first recording of an action potential in 1868.

He then developed an influential theory according to which the negative resting potential is due to the membrane permeable to potassium ions and the action potential to a non-selective increase in the permeability membrane (Bernstein, 1912).

For many years, the application of external electrodes was the only technique available for measurement potentials and Bernstein's hypothesis remained intact ([25]).

Later, Weiss (1905) introduced the so-called "*Ballistic Reotome*", a device that allowed stimulation with rectangular waves of direct current, and established Weiss' excitation law: "*to excite a nerve a constant amount of electricity must be required plus one proportional to the duration of time, which acts as if it were necessary to constantly combat the tendency to return to the primitive state of rest*.

Thanks to Dr. Weiss the determining factor for the excitation of a tissue is the relationship between the intensity and duration of the stimulus. Weiss coined the term reobase, as the minimum voltage necessary for a current to be effective (minimum intensity necessary to produce a threshold response using a rectangular, unidirectional pulse of 1 second duration)([26]).

Later Lapicque established in 1909, the measurement of physiological time, the only constant element in excitability, called chronaxia. What is the duration of the impulse necessary for a rectangular impulse to produce the minimum contraction using a double intensity of a reobase (i.e. the time necessary for the reobase to have a maximum effect).

Bourguignon (1876-1963) calculated the chronaxia measurements for nervous and muscular tissues, establishing the parameters between disease and health.

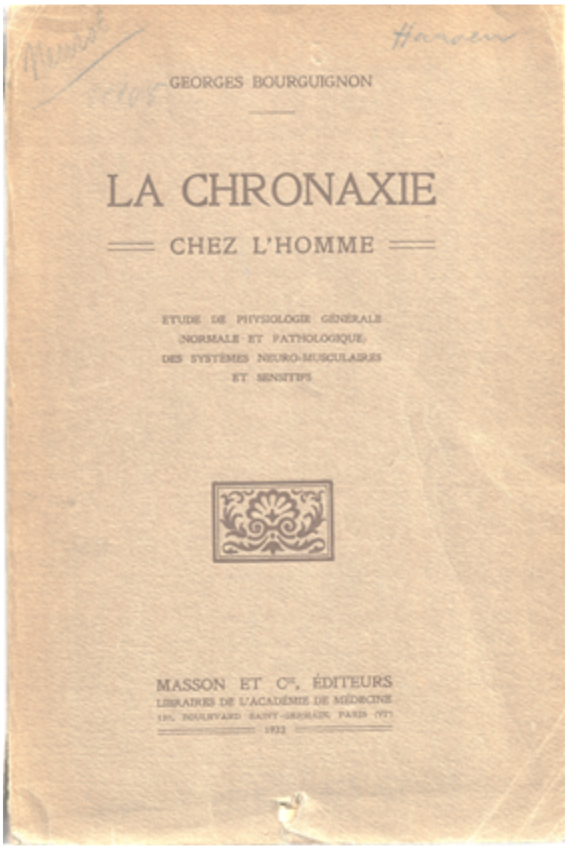


Figure 1 Cover of Bourguignon's book, "La chronaxie chez l'homme".

The values of reobase, chronaxia and useful time were applied in the modern electrodiagnostic field. The useful time being the minimum duration of a one-way rectangular impulse of reobasic intensity capable of producing a response.

With the contribution of Frenchman Lapicque and later Laborit's studies the Reotomo was optimised. The military doctor Georges Guiot ([27]) built the first electronic Reotome, where a measure of the muscular excitability could be established according to the time of duration of the impulse. Basis for the study of this thesis to demonstrate the effect on neuromuscular excitability of magnetic pairs.

Measurement of neuromuscular excitability as a function of impulse time: To make a tissue go from rest to excitation by means of an induced electrical stimulus two fundamental conditions are necessary, the amount of current sufficient to stimulate the target tissue, and the duration of the stimulus will have to be appropriate to the area to be stimulated.

4.7.2 Cronaxia and reobase

Lapicque

The relationship between the intensity of the stimulus (I) and its duration (T) is not linear, and was codified by Lapicque (year 1909) which graphically represented its development (figure 2)[28]( )([29]).

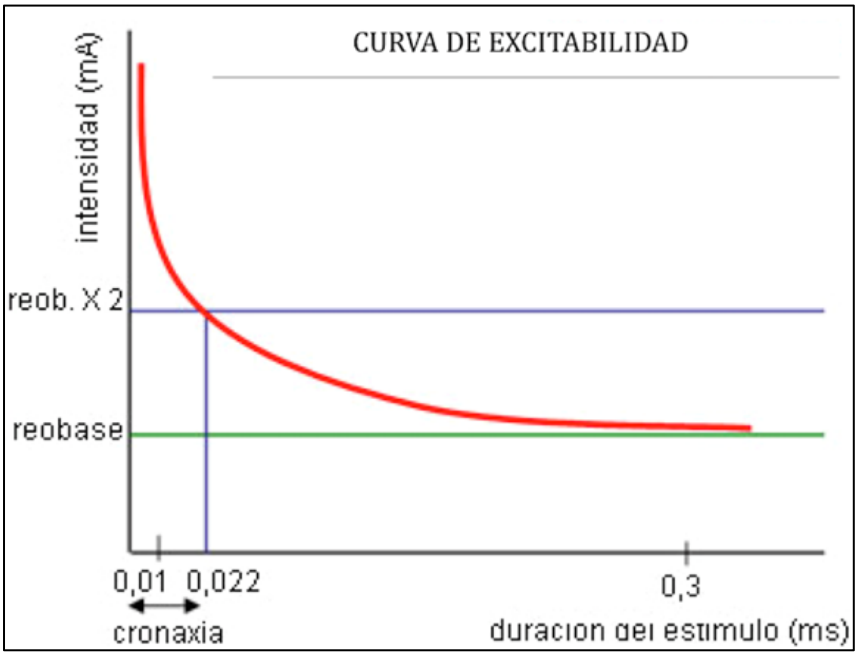


Figure 2 Neuromuscular excitability curve Intensity/time

The measurement of physiological time, the only constant element in excitability, is chronaxia. What is the duration of the impulse necessary for a rectangular impulse to produce the minimum contraction using a double intensity of a reobase (i.e. the time necessary for the reobase to have a maximum effect).

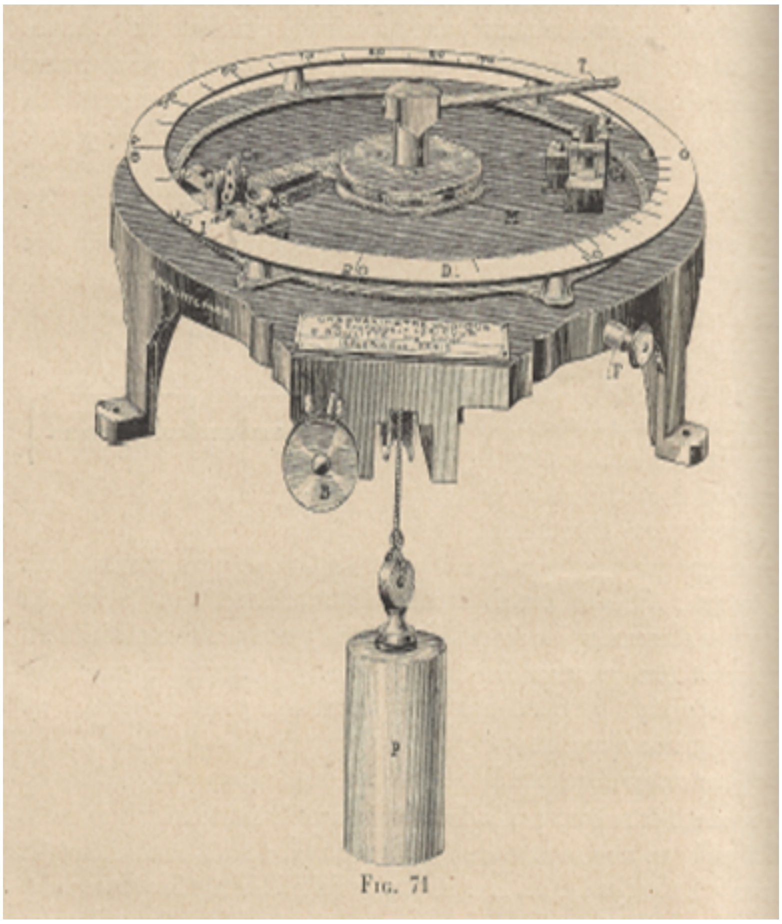


Figure 3 Reotome used by Lapicque

Mathematical demonstration of Lapicque to coin the term cronaxia

Hoorwerg in 1892 demonstrates the importance of the time factor in the excitation of muscle tissues ([30]).[31]If it is made to act on the same muscle the discharge of two capacitors of different capacities loaded with the same potential proved that the capacitor of greater capacity whose time of discharge is greater produced more excitation than the one of smaller discharge. And he established the excitation law according to which the voltage V necessary to obtain a capacitor response is inversely proportional to their capacity, and directly proportional to the constants a and b characteristic of each tissue and to the resistance of the circuit ([32]).

$$V=a*R+(b/c)$$

Weis used direct current by means of a ballistic Reotome that thanks to a carbine that emitted a bullet at a known speed cut two separate conductors at a variable distance at will.

Weis found that with short-duration currents more intensity was needed and vice versa. And he formulated the law of the excitation threshold which depends on two constants of tissue a and b and the time that the current lasts.

$$Q=a+b*t$$

Being:

Q the amount of electricity

a electricity, and the product $b*t$ electricity,

therefore b will be intensity as t is the measure of time.

To know the values of *a* and *b* of Weiss, it is enough to make two determinations on a neuromuscular preparation modifying intensity and currents obtaining

$$Q=a+ b*t$$

$$Q1 =a+b*t1$$

By modifying the experimental conditions the values of *a* and *b* are modified, with the constant *a/b* where *a* is the amount of electricity and *b* is an intensity. *And* his quotient is time.

Therefore it follows that the characteristic of the tissue depends on the relationship between *a* and *b*, and that Lapicque called CRONAXIA.

But Lapicque in an elegant mathematical way deduced the following:

If we express the Weiss law in function of the intensity of current we will have:

$$I = (a / t) + b$$

Dividing now by b will get:

$$(I / b) = [a / (b * t)] + 1$$

and I call to *Y=a/b* that corresponds to the chronaxia we will have

$$(I/b)=(y/t)+1$$

and that's the same thing

$$I=b*[(y/t)+1]$$

Called Lapicque formula where there are two constants:

And that is the time of excitement

B which is the intensity of the current

When in this formula we make the limit of time to infinity we will have

$$I=b$$

i.e. when the excitability time is infinite, the intensity is equal to *b*, i.e. the excitation threshold of the tissue for infinite times is *b*: the REOBASE.

But Lapicque went further in the study, if he passed a current whose duration was equal to the chronaxia i.e. *t=and* then we will have

$$I=b*[(y/t)+1]$$

But being *t=I* then it would be

$$I=b*(1+1)=2*b$$

So when the intensity needed to create a double contraction we will have that the time is the same as the chronaxia because we have decided that *t=I.*

That is, when we have that the intensity is twice the reobase (*b*) we find the time of chronaxia.

Chronaxia measures the excitability characteristic of tissue, the greater the excitability of a tissue, the less chronaxia.

The reobase is the intensity that must have a pulse of infinite duration to generate a contraction of the threshold and the chronaxy is the time that lasts a pulse of intensity equal to double the reobase, capable of generating a contraction of the threshold.

In order to stimulate an excitable tissue, the membrane potential must be raised to the excitation threshold, and very quickly for the Na and K channels to open and close.

The accommodation phenomenon occurs when your excitation threshold is raised, which would be the same as entering the catabolic phase, where more stimulation is needed to obtain a contraction ([33]).

Cronaxia of subordination

In terms of physiological study, it was proposed to study a constitution chronaxy, linked to the characteristic of the muscles or nerves studied. Bourguigon ([34]), a French doctor at the beginning of the last century who detailed one by one all the chronaxias of the muscles.

But Lapicque ([35]) and other researchers of his time decided to investigate the chronaxia of subordination, that variable chronaxia, influenced by metabolic states, as well as by drugs.

As a conclusion Lapicque called chronaxia as "*the notion of chronaxia is superior to a technical rule for excitation or for assessing pharmacodynamics. Chronaxia announces a profound modality, an essential property of each organization of living matter: this modality conditions the reactions of the cell with respect to the external world, of the external world with respect to the cell as well as the interactions between cells"([36]).*

4.7.3 Physiological principles and bases of the Reotomo

Delons ([37]) demonstrates the interest in the use of the Reotom on the basis that it is a measure of the basal metabolic situation of the individual. Where the sum of two catabolic effects produces hypoexcitability and the sum of two anabolic effects produces hyperexcitability. And he also refers to it as a necessary tool for the general practitioner, since he can avoid the side effects of medicines by knowing his metabolic situation thanks to neuromuscular excitability curves. Concept already advanced by its predecessor Lapicque, who demonstrated the variation of the chronaxia in function of the different metabolic states.

In muscle fatigue, the US military used the Reotomo as a reference test to evaluate fatigue and the effects of magnesium dosage in elite athletes ([38]).

Professor Guiot ([39]) postulates that Reotomo can be used to evaluate neuromuscular fatigue.

Nelson ([40]) also used Reotomo to evaluate the benefit of certain products such as aspartic acid in military exercise.

Nowalk ([41]) attributes chronaxia as a temporal parameter related to the membrane properties of neural elements.

Bostock and Guihéneuc ([42]) describe new techniques for evaluating neuromuscular excitability, investigating the relationship of excitability with passive ionic currents, Na K pump activity, and the behavior of the generated calcium gradient.

Ayaz ([43]) attributes chronaxia time to evaluate the reaction of coenzyme Q10 intake in diabetic rats and its action on diabetic neuropathy .

4.7.3.1 Action Potential

Kandell ([44]) The resting membrane potential is the result of separation of charges across the cell membrane. At rest, the cell has an excess of positive charges on the outside of the cell membrane and an excess of negative charges on the inside. Whenever there is a net flow of cations or anions into or out of the cell, the charge separation across the resting membrane is altered, altering the polarization of the cell.

Depolarization occurs when there is a charge separation, less negative action potential. Hyperpolarization induces a more negative membrane potential. When depolarization approaches a critical level (threshold), the cell responds by opening ion channels, producing the action potential.

Every action potential has an initial phase that we call DEPOLARIZATION, which is due to the entry of Na into the cell; a REPOLARIZATION phase that corresponds to the exit of K from inside the cell, and a REST phase; in this phase, the pump Na and K ATPasa rearranges again the normal concentrations of the cations on both sides of the membrane.

4.7.3.2 Neuromuscular plate

Neuromuscular plaque is the termination of the nerve fiber that forms a cleft in the plasma membrane of the muscle fiber. It is the terminal part of the axon and the membrane of the muscle fiber.

When an action potential reaches the nerve terminal, calcium channels are opened, which will allow the exit of acetylcholine vesicles into the synaptic space. In the post-synaptic membrane there are acetylcholine receptors that open to allow the passage of positive ions (sodium) generating a positive potential within the muscle fiber, called: terminal plate potential, which in turn initiates a potential for action on the muscle membrane causing muscle contraction, thanks to the release of calcium ions.

4.7.3.3 Physiological phenomenon of the catabolic terrain

In the interstitial tissue

In the interstitial tissue, the catabolic state produces the output of Potassium to the outside of the cell, as well as the output of amino acids, urea, glycogen and some lipids.

Sodium enters the cell, with an internal cellular hyperhydration since sodium is accompanied by water (which leads to a tendency to haemorrhage).

Therefore catabolism leads the interstitial tissue to a process that tends to alkalinity.

In the blood

Blood buffer systems prevent the appearance of catabolism phenomena in blood, the bicarbonate system, hemoglobin and phosphate control this situation. However, if there is an increase in protein destruction, there is an increase in urea, uric acid in urine, an increase in blood cholesterol, an increase in glucose, leukopenia and low hematocrit could suggest a blood catabolic terrain.

Delons ([45]) attributes the reduction in the amount of sodium as the best direct sign to evaluate the catabolic situation.

In the emunctoriums: DRAINING ORGANS

In the emunctoriums, the lung eliminates volatile acids, weak organic acids that come from the degradation of vegetable proteins transformed into $CO2$.

The renal system eliminates the mineral acids, which come from the degradation of animal proteins, where the amino acids promote the exit of uric acid, the sulphuric acid sulphuric amino acids, and the nucleic acids of phosphoric acid. Knowing that urinary density gives us the rate of urea directly.

The urinary pH does not provide exact knowledge about the global metabolic state, as it depends on numerous factors for its control, buffer solutions and the proper functioning of the kidney. It is the surface tension of urine that gives us the global metabolic imbalance, when it is below 64 dynes/cm it reflects the global catabolic state directly.

In the nervous system

Every catabolic system increases the sympathicotonic tone.

Increased adrenergic synaptic mediators, with vasoconstriction (hypertension, tachycardia, hyperthermia), bronchial dilation (hypoventilation) and intestinal atony.

Excitation of the anterohypophysis-acidophilus, with increased secretion of ACTH and cortisol, increased FSH and estrogens, and increased TSH.

CATABOLIC TERRAIN

MEMBRANE	DEPOLARIZED
INTERSTITIAL TISSUE	ALKALINITY
BLOOD	ACIDOSIS
SNV	HYPERSYMPATHOTONIA
CATABOLIC HORMONES	TSH, ACTH, ESTROGENS

Table 1 Catabolic terrain summary

4.7.3.4 The physiological phenomenon of the anabolic soil

At the level of the interstitial tissue

Proteins and Potassium are directed towards the cell, and hydrogen and sodium are directed towards the blood. The interstitial medium is in a process of dehydration, increased endothelial proliferation of capillaries that favors the increase of thrombosis.

At the blood level

Alkalosis cannot be measured directly at the blood level, but indirect signs may be observed such as a decrease in total proteins, a low lipid rate, hypoglycemias, but a slight increase in triglycerides (lipids of glycidic origin), a high hematocrit value, leukocytosis, and eosinophilia.

In the emunctoriums: DRAINING ORGANS

At the pulmonary level, the drop in blood CO2 produces a slight hypoventilation.

At the renal level, it is necessary to eliminate the ions that threaten homeostasis, increase diuresis and reabsorb as little sodium as possible. The urinary density is low, and the surface tension is high above 69.

Vegetative nervous system

All anabolism increases the parasympathicotonic tone, producing an increase in cholinergic mediators, vasodilatation, hypotension, bradycardia, hypothermia, bronchoconstriction, hyperventilation, intestinal hyperperistaltism.

At the level of the antero pituitary, increases the secretion of insulin, as well as testosterone.

ANABOLIC SOIL

MEMBRANE	REPOLARIZED
INTERSTITIAL TISSUE	ACIDITY
BLOOD	ALKALINITY
SNV	PARASYMPATHICOTONIA
ANABOLIC HORMONES	INSULIN AND TESTOSTERONE

Table 2 Summary of anabolic terrain

4.7.3.5 Neuromuscular excitability curves

CURVES OF EXCITABILITY and REOTOMO:

The reotome as an instrument to evaluate neuromuscular excitability curves.

Laborit, along with the support of his wife, and Dr. Guiot, used the Reotomo to accurately measure the condition of the patients' terrain.

The terrain of the patient is the relationship between the energy that is lost and the energy that is available for living. The balance between catabolism and anabolism is essential to maintaining life.

The catabolic state: HIPOEXCITABILITY

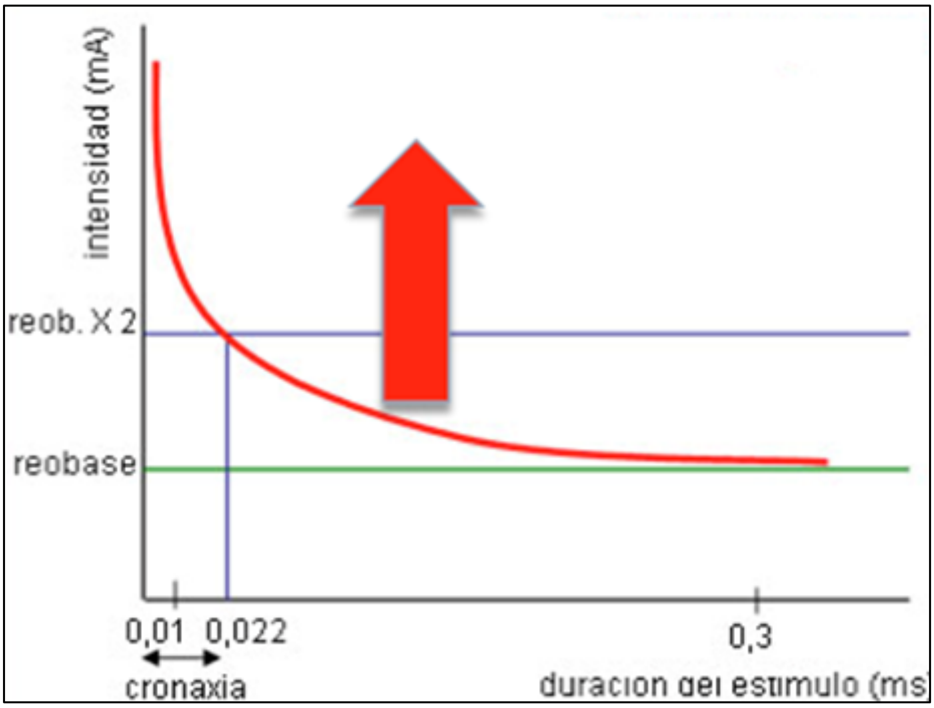


Figure 4 The catabolic state: HYPOEXCITABILITY

In catabolic processes, it is necessary to increase the intensity of the stimulus to obtain a stimulus, the cell membrane is hypoexcitable.

In this state the cell has consumed its energy reserves, it cannot depolarize, in order to repolarize and obtain energy it needs more energy, it is a state of HYPOEXCITABILITY.

If the excitability threshold is high, a higher intensity stimulus will be necessary to produce depolarization, we will have a hypoexcitability (it occurs in catabolic phenomena, the cell has consumed its resources and needs more stimulus to depolarize itself).

Figure: in catabolic terrain, the intensity of the stimulus must be increased in order to obtain stimuli; the cell membrane is hypoexcitable.

The anabolic state: HYPEREXCITABILITY

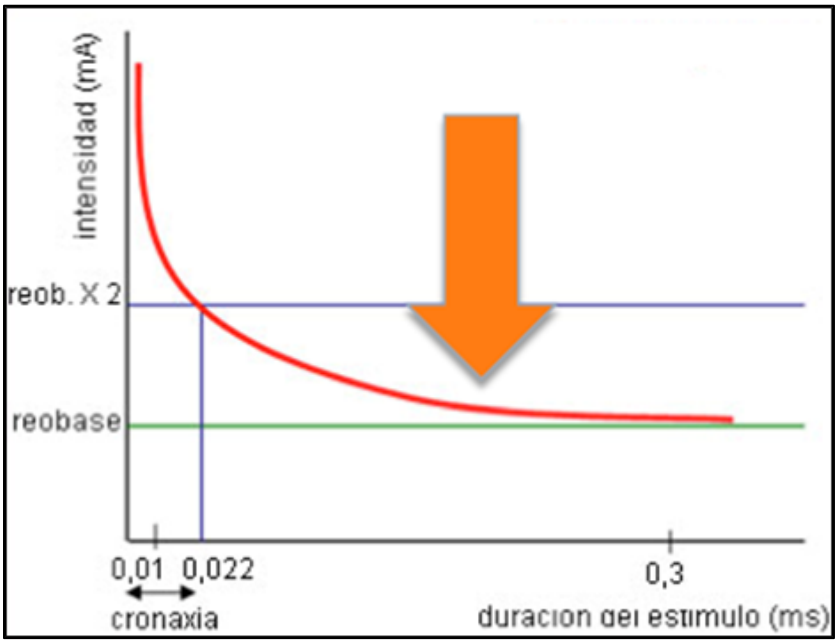


Figure 5 The anabolic state: HYPEREXCITABILITY

Anabolism leads the nervous system to a state of parasympathicotonia, increased vagotonia, in general terms, anabolism is related to the energy available for consumption during the day.

In the anabolic state, the cell is ready to be excited, with a low energy stimulus it will be more easily excited. The lower the intensity, the higher the state of hyperexcitability.

If the excitability threshold is low, any stimulus, no matter how mild, will produce depolarization, we will have hyperexcitability (it occurs in anabolic phenomena, where the cell tends to repolarization).

Any regulatory effect on excitability will improve cell depolarization and lower the excitability threshold.

Neuromuscular excitability curves:

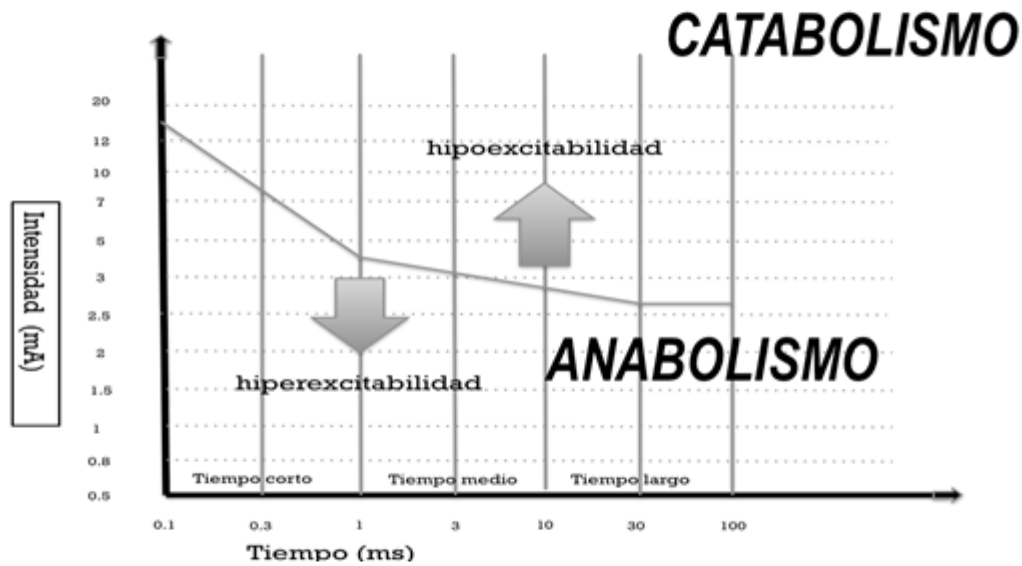


Figure 6 Excitability curve

Segmental impacts of the neuromuscular excitability curve.

Thanks to the work of Professor GUIOT in 1956 it was proved that the neuromuscular excitability curve is separated into 3 parts ([46]), for short time, medium time and long time. Each time it selects a specific fibre group with its own excitability. The practical interest of these segments is their relationship with the main ions involved in the neuromuscular junction.

We will have to each time corresponds to a specific metabolic situation:

- in short time (0.1 to 0.3 ms) relationship with calcium
- in average time (1 to 10ms) ratio with magnesium
- in long time (10 to 30ms) relation with the sodium/potassium pump.

Thanks to these works by Professor Guiot, Laborit discovers the oscillating reaction to aggression ([47]).

In fact, these studies were expanded by Professor Coirault (1902-1975), who demonstrated how the different phases of this confusional state are related to states of hyperexcitability in a first phase, where as Professor Laborit ([48]) mentions well, with nerve inversion with respect to muscle, which reaches a cellular surpolarization. In a second phase, a state of depolarization or hypoexcitability, with intense thirst.

5 BIOLOGICAL EFFECTS OF THE BIOMAGNETIC PAIR

At the BIEOM congresses in 2013 and 2014, in Thessaloniki and Cape Town respectively, the proposal for this study was defended, with the approval and reading of the attached poster:

5.1 OBJECTIVE

Assess changes in the state of excitability of two static magnets applied to the body.

Declaration of interest:

The authors of this study, Jose Luis Bardasano and Enrique de Juan declare the absence of conflicts of interest in relation to this research, as long as there are no personal or financial relationships that could bias their work or the conclusions presented here.

5.2 MATERIAL AND METHOD

- 2 magnets of 0,1 T lined and with the same geomagnetic field orientation.

Figure 7 Magnetic pairs used in the study

- Reotomo RH32 (manufactured in France, Suresne year 1984)

  It consists of two electrodes, a potentiometer, a display, a printer.

Figure 8 RH 32 Reotome

- Group: healthy people, without medication, between 25 and 65 years of age, in equal proportion men and women. Sample size 25 subjects for control and 30 subjects for cases.
- Time of study: all measurements were made between 10 and 13 hours, to avoid alteration of the cortisol cycle and in similar spatial and temporal conditions at the same temperature, and in a magnetic calm environment (assessed by the proton magnetic environment calibrator to avoid any effect of geomagnetic storm).
- Place: Madrid, same stretcher, same position for measurement both in cases and in controls.

5.3 METHOD

Location of the measurement point by the Reotomo:

the location for the present study of neuromuscular excitability was performed on the external popliteal sciatic nerve. (see figure 11)

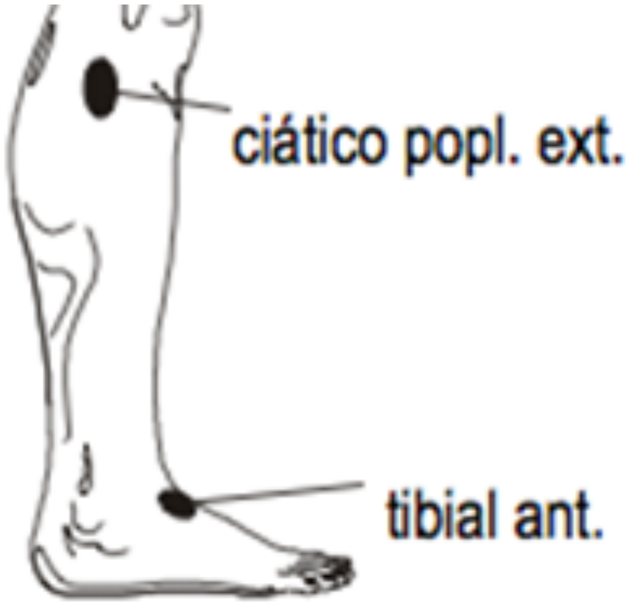


Figure 9 Stimulation in the external popliteal sciatic nerve

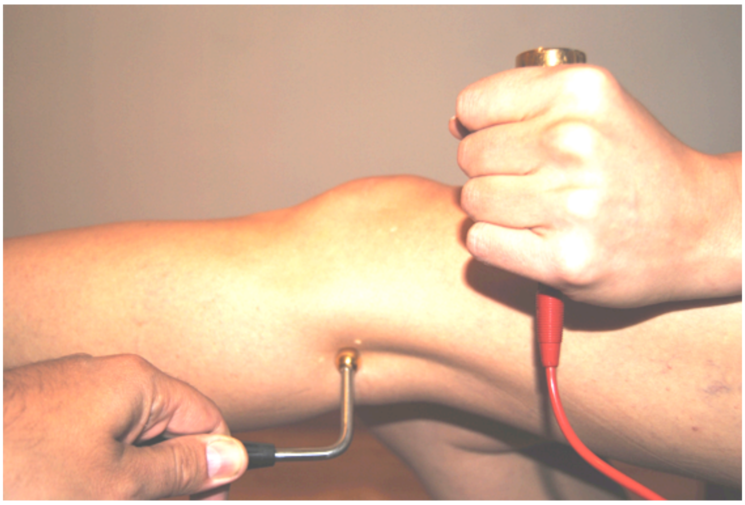


Figure 10 Placement of the stimulus point on the sciatic nerve

<u>In experimental cases, which carry magnets:</u>

The sequence of the investigation is as follows

i. Reotome measurement of neuromuscular excitability in the posterior popliteal nerve, of the left leg before and after magnet placement.

ii. The patient is placed on the supine decubitus stretcher. A north polarity magnet is placed in the stem zone and a south polarity magnet is placed in the lumbar zone. Wait 20 minutes.

Figure 11 Placement of static magnetic pairs in the described areas

<u>Controls that don't have magnets:</u>

The sequence is as follows :

i. Reotome measurement of neuromuscular excitability in the posterior popliteal nerve of the left leg before and after magnet placement.

ii. The patient is placed on the supine decubitus stretcher. No magnets are placed anywhere on the body. Wait 20 minutes.

Ethical considerations:

In this work the privacy of the participants has been guaranteed. All of them gave their free consent for the use of their information, which has been handled confidentially at all times. The work has been carried out at all times in accordance with ethical criteria and in compliance with the 1975 Helsinki Declaration, amended in 1983.

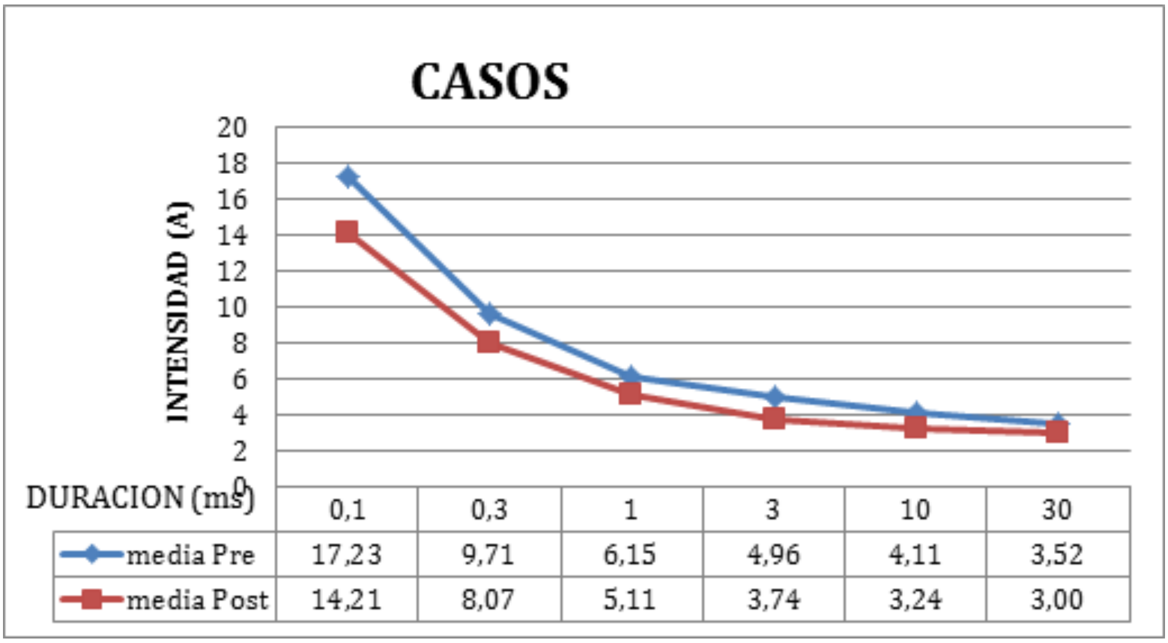
5.4 RESULTS

After the study, these results are obtained: the statistical analysis is carried out for quantitative data, two independent averages, t of Student.

Average pre: average of the results before the application of the magnetic pairs.

Mean post: mean of the results after the application of the magnetic pairs

i. Group of CASES with magnets (n=30):



Graph 1 Excitability curves in the cases

CASE

NERVIO	MEDIA pre	(ic95%)	MEDIA post	(ic95%)	t pareada
0,1	17,23	±2,48	14,21	±2,59	0,022
0,3	9,71	±1,74	8,07	±1,51	0,061
1	6,15	±1,01	5,11	±0,98	0,029
3	4,96	±0,76	3,74	±0,64	0,003
10	4,11	±0,62	3,24	±0,56	0,016
30	3,52	±0,57	3,00	±0,54	0,168

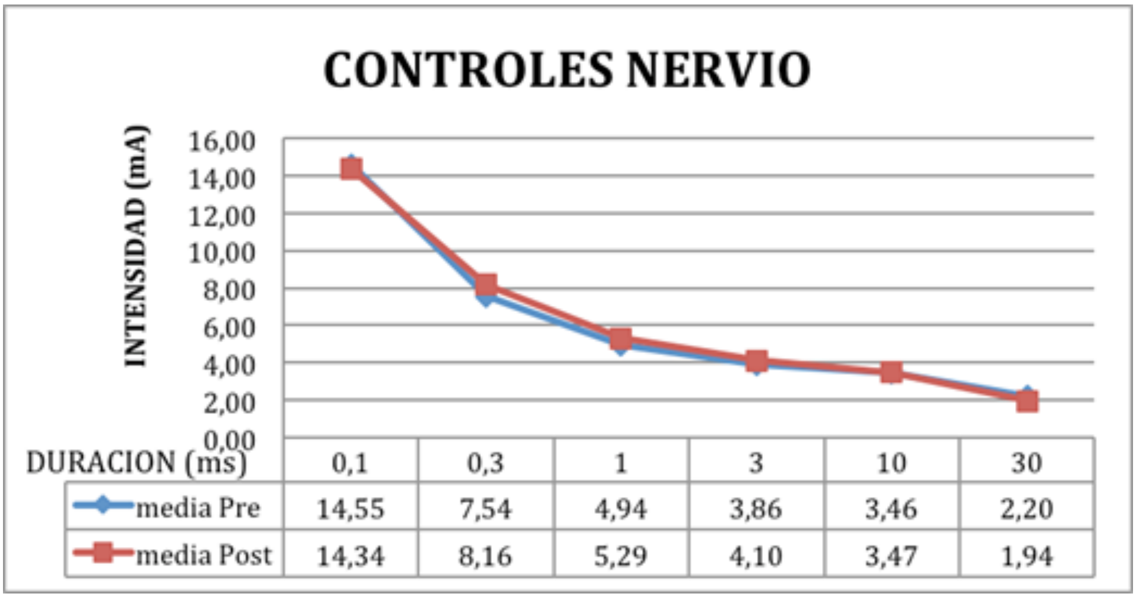
Table 3 95% Confidence Interval and Student t results for paired.

Statistically significant values

In all records there is a change in neuromuscular excitability but where a statistically significant difference is found it is for short (0.1ms), medium (1 and 3 ms), and long (10ms) times. For the times 0.3 ms and 30 ms no significant change is found.

In middle times, where the chronaxia is found, the change is statistically significant.

ii. CONTROL GROUP without magnets (n=25)



Graph 2 Excitability curve for controls

CASE					
NERVIO	**MEDIA pre**	**(ic95%)**	**MEDIA post**	**(ic95%)**	**t pareada**
0,1	14,55	±2,74	14,34	±5,62	0,884
0,3	7,54	±2,95	8,16	±3,20	0,444
1	4,94	±1,94	5,29	±2,07	0,438
3	3,86	±1,51	4,10	±1,60	0,536
10	3,46	±1,36	3,47	±1,36	0,992
30	2,20	±0,86	1,94	±0,76	0,282

Table 4 Means, 95% Confidence Interval and Student t results matched

In the control group there is no statistically significant difference at any time mathematically.

In the group of cases, when static magnetic fields are applied, there is a statistically significant difference for times of 0.1 ms

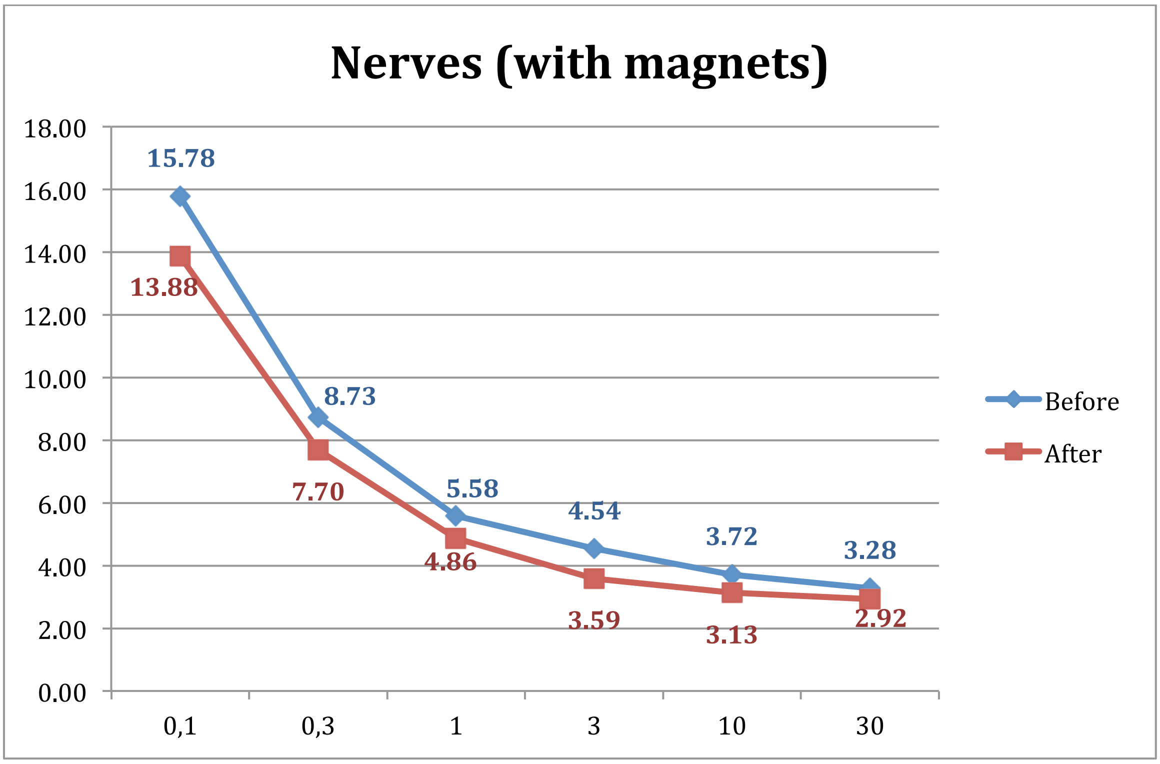
1ms 3 ms 10 ms between the neuromuscular excitability values.

Extension of the first study

Faced with the finding of the significance at certain times of cases with respect to controls, it was decided to expand the sample of cases (with magnets) to 42 and controls (with placebo) to 31, but this time the controls used a placebo.

Getting these results:

i. Graphs in CASES (n=42)



Graph 3 Excitability curve in cases (with magnets)

CASE

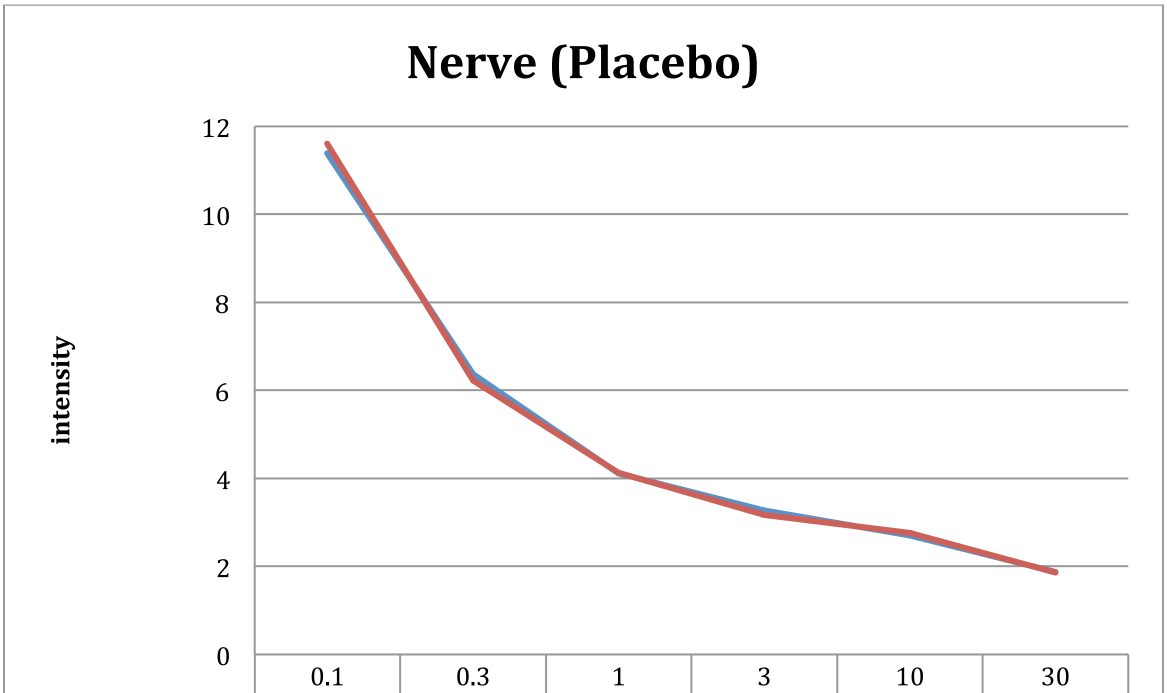
NERVIO	MEDIA pre	(ic95%)	MEDIA post	(ic95%)	t pareada
0,1	15,78	±2,07	13,88	±2,04	0,055
0,3	8,73	±1,36	7,70	±1,15	0,109
1	5,58	±0,79	4,86	±0,75	0,044
3	4,54	±0,60	3,59	±0,49	0,002
10	3,72	±0,51	3,13	±0,44	0,032
30	3,28	±0,47	2,92	±0,42	0,197

Table 5 Means, 95% Confidence Interval and Student t results for pairings

In all records there is a change in neuromuscular excitability but where a statistically significant difference is found it is for short (0.1ms), medium (1 and 3ms), and long (10ms) times. For the times 0.3ms and 30ms there is no significant change.

In middle times, where the chronaxia is found, the change is statistically significant.

ii. GRAPHIC IN CONTROLS (n=31) PLACEBO



	0.1	0.3	1	3	10	30
in the past	11.394	6.374	4.110	3.268	2.700	1.874
after	11.602	6.232	4.136	3.175	2.757	1.860

Graph 4 Control Excitability Curve

CASE					
NERVIO	**MEDIA pre**	**(ic95%)**	**MEDIA post**	**(ic95%)**	**t pareada**
0,1	11,39	±5,04	11,60	±5,51	0,652
0,3	6,37	±2,64	6,23	±3,27	0,791
1	4,11	±1,84	4,14	±2,13	0,820
3	3,27	±1,68	3,18	±1,67	0,660
10	2,70	±01,52	2,76	±1,88	0,697
30	1,87	±0,95	1,86	±1,03	0,965

Table 6 Means, 95% confidence interval and results for the Student t paired

In the controls (no magnets with placebo), we found no significant variation in the excitability curves.

By increasing the sample of controls, and applying a placebo instead of magnets, we find the same results as in the previous study.

5.5 INTERPRETATION OF THE RESULTS OBTAINED

These results support the working hypothesis and the existence of a biological effect associated with the application of magnetic pairs since the excitability curve decreases significantly at certain times. There is an increase in hyperexcitability, as the cell is more excitable with less stimulus intensity. It is a process that tends to parasympathicotonia.

Especially at the level of chronaxia time, already described by Lapicque, as the fundamental element of neuromuscular excitability.

In the first test, where cases are compared with magnets and controls without magnets, it is found that there is an increase in excitability when applying the magnetic pairs at the times indicated above, but not when they are not applied.

In view of the doubt that the fact of not applying magnets could suggest, it was decided to extend the sample and in addition to place a placebo in the controls instead of not putting anything.

In this second study, statistically significant modifications were found at the same times as in the previous study. And no change in placebo controls.

For times 0.1, 1, 3 and 10 ms there is statistically significant modification at these times for both trials regardless of whether placebo was used or not.

The presence of static magnets induces a relaxation response, as the curve tends to hyperexcitability, which allows a greater state of vagotonia. Therefore, the cell tends to recover its membrane potential earlier, repolarizes earlier and tends to higher alkalosis, as well as increased parasympathetic tone ([49]).

The application of magnetic pairs implies an improvement in function of the cell membrane that is more permeable to excitation.

In mean times, variation occurs for both 1 ms and 3ms, so we suggest that the effect of magnets has greater impact in mean time, which is related to the metabolism of magnesium. (between 1 and 3 ms, where the chronaxia is found) Further studies will allow finding a closer relationship between magnesium metabolism and magnetic pairs.

5.6 DISCUSSION

5.7 IN THE DEVELOPMENT OF THE THESIS

5.7.1 Biomagnetic Pair Definition: Goiz Sign

Static magnetic fields modify the state of the body's diamagnetic properties. There are references to this in the literature that support this definition of the biomagnetic pair, for example:

> Gmitrov ([50]) shows that the barometric sensitivity of the arteries is increased by the presence of static magnetic fields, describes an improvement in response, producing a direct stimulating effect on the carotid baro receptors. But there is a change in the response as a function of the earth's pressure.
>
> Iwasaka ([51]) analyses that under a strong magnetic field, the diamagnetic properties of biological cells modulate the behaviour of the cells themselves. The effects of the fields affect the morphology of the smooth muscles, and of the forms of colonies of cells extended along the direction of the magnetic flux. It is evidence that smooth muscle cells detect high-density magnetic flux and therefore change their cellular orientation. The mechanism proposed in this study is that there is a torsional force acting on the diamagnetic fibers of the cytoskeleton.
>
> Ichioka ([52]) delves into the biological effects of magnetic fields with respect to blood circulation and biochemical values: static magnets appear to modify microcirculation as well as the creatinine rate in urine and serum. Blood

flow had a rebound effect during exposure followed by a gradual decrease and a return to the control value.

The existence of studies demonstrating the action of static magnetic fields on the body contributes to support the discovery of the biomagnetic pair.

5.7.2 Neutral Energy Level or NEN

At the level of biomagnetism, we see how static magnets can influence body fluids, cell membrane, plasma proteins:

Aida ([53]) discovers that static magnetic fields can affect concentrations of Zn, Fe.

Takaeuchi ([54]) analyzes the effects of static magnetic fields with uric acid crystals and checks that static magnetic fields modify the orientation of uric acid crystals at room temperature.

Ayrepetyan ([55]) stresses that static magnetic fields influence the depolarization of the cell membrane and reduction of intracellular calcium, altering nucleotides in nodes and increasing the volume of cell bodies. Changing the hydration of calcium ions can be one of the consequences of exposure to static magnetic fields.

Kinouchi ([56]) verifies that static magnetic fields affect the diffusion of biological particles in solutions through Lorentz force and Maxwell stress. In fact the diffusion of charged particles as well as plasma proteins at low magnetic action thresholds at high thresholds is suppressed. In erythrocytes there is also a change in volume.

Nikolic [57] analyzes the action of static magnetic fields on the sodium and potassium pump and shows that it produces a significant increase in the alpha subunit of the sodium potassium pump in the brain of the snail.

Chionna [58] verifies how the static magnetic field modifies cell shape, plasma membrane and increases the level of intracellular calcium which plays an antiapoptotic role in certain types of cell growth. The magnetic field reduces the morphology of the cell, changing the distribution of glycans.

Capolov [59] investigates how the spatial variation of the magnetic field is the main cause of the blockage of the action potential in the dorsal root ganglia in vitro.

Rosend [60] demonstrates the effect of static magnetic fields affects the disposition of membrane phospholipids by their diamagnetic properties.

There is therefore a clear relationship between the action of static magnetic fields and everything that is related to the cell.

5.7.3 Sensitivity

All cells in the body contain mitochondria, which are descendants of prokaryotes:

> Pokorny ([61]) states that the production of ATP and mitochondrial GTP form a strong proton charge layer, strong static electric field. Its dysfunction leads to disturbances of the electromagnetic field.
>
> Pokorny ([62]) also references the longitudinal polar oscillations in microtubules in eukaryotic cells generate an endogenous electromagnetic field. The existence of the endogenous biological electromagnetic field, its generation by microtubules and the effects produced by the supporting mitochondria have a reasonable experimental basis to relate the existence of an endogenous magnetic field intra mitochondrial.

There is a phylogenetic relationship between our primary energy structure (mitochondria) and bacteria. In addition, the formation of energy itself generates a magnetic field.

5.7.4 Electromagnetic Resonance

Shin ([63]) checks the biological effect of communications between internalised bacterial magnetic nanoparticles and a static magnetic external field on a human cell line. The combination of both leads to alteration of cell structure and cell growth. This allowed us to think about the advantage of controlling the therapy of a target cell by magnetic stimulation.

5.7.5 Symbiotism

There are scientific publications demonstrating the effect of static magnets on bacteria:

Tessaro ([64]) shows that applying two intensity magnets against each other increases the bacterial growth rate in 3 species and slows the growth of one of them.

Bajpai ([65]) carries out a study to check the effect of the electromagnetic field on gram positive (*S. Epidermitis*) and gram negative (*E. Coli*) bacteria. Quantitative analysis of SEM images confirms the effect of electromagnetic field in suppressing bacterial growth. In addition, cell integrity and internal membrane permeation tests were performed to understand the origin of this effect. The results of these trials were statistically analyzed to reveal the bactericidal effect of the magnetic field, indicating cell membrane damage.

Binhi ([66]) studies the effect of magnetic fields on *Echerichia coli*, by the method of assessing the level of viscosity that surrounds it. Viscosity dependence is proportional to the effect of magnetic fields. And these in turn modify the circulation of Ca, Mg, Zn ions. It is therefore suggested that these ions together with proteins participate in the mechanism and can act on the DNA.

Zhang ([67]) verifies that magnetic fields induce mutations through the high production of intracellular superoxide radicals in the *echerichia coli.*

Hsieh ([68]) investigates the action of static magnetic fields on the inflammatory response of certain cells belonging to the dental pulp. It verifies that the inflammatory response of the cells of the dental pulp produced by lipolysaccharides that come from bacteria is attenuated by the action of these static magnetic fields being the mechanism of action through the modification of the cellular membrane.

Filipic ([69]) discovers that the static magnetic field negatively influences the growth of *echerichia coli and pseudomona*.

Piatti ([70]) verifies that exposure to magnetic fields results in inhibition of the growth of *serratia marcencens.*

The cellular phylogenetic evolution is related to the bacteria being the mitochondria the witness of this relation. The mitochondrial process generates electromagnetic fields around it. Static magnetic fields modify the bacterial state both at the cellular level, of its metabolism and of its growth.

The human body has a symbiotic state called atopobiosis. There are multiple publications that point out the existence of a latent state of microorganisms waiting to generate diseases in the body.

The biomagnetic pair attributes to microorganisms the main cause of most diseases.

Besides, there are publications that relate the effect of static magnetic fields on microorganisms.

For this reason, it would be interesting to test Dr. Goiz's ideas and his discovery on the action of the biomagnetic pair on microorganisms in further research.

5.7.6 The Placebo Effect

The biomagnetic Pair has a therapeutic action with static magnets, which are placed at certain anatomical points. The following publications demonstrate in scientific studies the effects of magnets on the body has effects on molecular level, fluids, cell membrane, microcirculation, and also on stem cell growth, chondrocyte formation and DNA.

5.7.6.1 Actions of static magnets on DNA conductivity

Wong ([71]) demonstrates the action of static external magnetic fields on the electronic conductivity of DNA producing positive improvements in the decomposition of guanine doubles.

5.7.6.2 Actions of static magnets on cell proliferation

Kim ([72]) attributes the osteoblastic proliferation of stem cells derived from human bone marrow to static magnetic fields of moderate intensity.

Jouni ([73]) investigates how static magnetic fields increase the differentiation potential of certain cell lines by intracellular activation of the MAPK pathway and the concentration of Ca 2+.

Stolfa ([74]) designs an experiment to study the effects of electromagnetic fields on the metabolic activity of chondrocytes in vitro. Experiments show that magnetic fields have a positive effect on the viability of human chondrocytes cultured in vitro.

Amin ([75]) examines the effects of magnetic fields of moderate static magnetic resistance on chondrogenic differentiation in stromal bone marrow-derived cells. Data show that magnetic fields of moderate intensity induce chondrogenesis in BMSCs via a TGF-β-dependent pathway. This finding has potentially important applications in cartilage tissue engineering strategies.

Temuzzo ([76]) investigates the action of static magnetic fields on cell apoptosis and their modulation with calcium channels. This study demonstrates that exposure to magnetic fields has a protective effect on chemically induced apoptosis, with aging cells being the most susceptible. Investigation of gene expression of bcl-2, bax, p53 and Hsp70 in culture age newly isolated human lymphocytes and indicates that these genes are modulated by SMF exposure under the experimental conditions used.

5.7.6.3 Actions of the static magnetic field on oxygen reactive species: ROS

Poniedzielak ([77]) investigates the effect of static magnetic field gradient on oxygen reactive species in blood neutrophil production. It verifies how the action of the field affects the species reactive to oxygen both in its formation and activation.

5.7.6.4 conclusion of the placebo effect and the biomagnetic pair:

As a result of these studies, while recognizing that the curative intent of the physician is basic to improving the health of the patient, the certainty that static magnets have an effect on the human body is evident. Therefore, the placebo effect would be reduced to the healing act itself, but magnets also have their effect without being placebo.

However, the realization of the biomagnetic Pair therapy implies an attitude too present by the doctor. In fact, the location of the points, as well as the affirmation of acidity and alkalinity as a function of shortening are too subjective aspects that lead to effects that are not valued in this thesis.

The interaction of the physician in impacting the magnet on the body can directly influence the development of the therapy itself. That is why there is a phenomenological part of the process, where the doctor's attitude actively intervenes in the therapy process. We enter into the magnitude of shamanism or curanderismo, however static magnets have their own action on the body.

The phenomenological part is inscribed within the historical development of medicine. Rescuing the soul and bringing it back to earth was the goal of shamans in the age-old ages.

The millenary cultures that remain alive allow this interaction. Currently, medicine is focused on cancelling the doctor's mission in order to exercise a more innocuous behavior. Which in itself is nothing more than the art of healing. For this reason, Goiz's genius lies in rescuing this millenary culture and putting it at the service of magnets, at the service of science, at the service of medicine. Assuming that yes, the limits in which all of us who dedicate ourselves to human suffering must work.

Using the crucible of science to demonstrate the effect of static magnets on the body is one of the objectives of this thesis. Without underestimating the culture and the history, the duty of the doctor is in helping and healing with the look set on a correct application of the technique.

The work of medicine is to rescue from these millenary cultures, from magnetism, what is really significant, observable, measurable and repeatable: that is, scientific. For this reason, the placebo effect could intervene in the action of the magnets, but with the study carried out, and in view of the number of publications described, it is demonstrated that the placebo does not statistically modify the excitability.

5.7.7 Reflex magneto podal

The diagnostic method of the biomagnetic Pair is established in a shortening of the right leg by applying a 0.1 T magnet.

Hongz CZ ([78]), in an attempt to understand the neural mechanism of the effects of static magnetic fields, measured the excitability index and nerve conduction velocity. There was no change in driving speed after exposure to static magnetic fields. On the other hand, at the level of excitability there was an increase in the motor nerve.

As well as research articles that refer to the action of static magnetic fields both on the modification of the cell membrane, in size sense and orientation, in the vascular endothelium as well as in the calcium channels.

Therefore, later studies could prove this effect of a static magnetic field on the body to demonstrate the existence of this shortening reflex, which in passing, could be called Goiz shortening sign.

5.7.8 Neuromuscular excitability

As the excitability curve decreases significantly at certain times, this implies a modification of the vegetative state of the metabolism, which would change to a more vagotonic situation as hyperreactivity increases.

This influences the whole metabolism, obtaining in a secondary way an improvement of the acidity state of the body, reducing the acidity to balance the body more.

This process directly corroborates the theory proposed by Goiz, where the application of static magnetic fields regulate the state of acidification of the body.

By regulating the state of acidity, the NEN would be rebalanced and we would have a better state of health.

In The Ionic Kinetics of the Neural Membrane, Dr. Azanza ([79]), observes that when high intensity static magnetic fields are applied, between 0.12 T, they modify the kinetics of extracellular calcium, increase the flow of calcium to the cytosol activating dependent calcium metabolic pathways. Allowing an increase in the state of excitability.

An increase in sodium output has been shown in erythrocytes exposed to magnetic fields, which means an increase in the potassium sodium pump.

The orientation of the cell membrane proteins depends on the presence of magnetic fields, which facilitates ionic movements across the cell membrane.

Oxygen accumulates where the intensity of the magnetic field is most intense.

5.7.9 Reotomo

The Reotomo is a great discovery from the beginning of the century, developed later and little expanded at present. Patient's vegetative state meter is a reliable test, easy to use and quick to measure. Above all at the level of drug use, with the simple fact of knowing the metabolic terrain, an endless number of side effects of drugs could be avoided.

It is proposed with this thesis, to rescue the knowledge of the terrain as base to evaluate the patient, we hope that later studies with the Reotomo grant him the place that he deserves in the medicine.

5.7.10 Other pairs

Only one pair has been studied, the Occipital Lumbar pair. We hope that later studies will extend the sample to other pairs described by Dr. Goiz and thus give more testimony of this easy and highly effective technique.

Everything that supports the technique of static magnetic pairs together with neuromuscular excitability is novel. There is no current scientific literature associating static magnetic fields and neuromuscular excitability.

This thesis brings some light into the great confusion about static magnetic fields and their involvement in human biology. It is a pioneering and original experiment, it is hoped that later studies will develop this idea further. The statistics support both the procedure and the results that are valid and of enormous interest for future studies.

These works were approved, read and defended at the international congresses of the Bioelectromagnetics society and European Bioelectromagnetics association, in 2013 (Thessaloniki) and 2014 (Cape Town).

6 CONCLUSIONS

1 The Biomagnetic Pair is a method of diagnosis and treatment that has a regulatory effect on neuromuscular excitability.

2 The Biomagnetic Pair discovers a new sign of excitability : the magnetopodal reflex.

3 Given the current situation of searching for low-cost techniques, with great clinical effectiveness, the Biomagnetic Pair is proposed as a technique of health interest.

4 The use of neuromuscular excitability provides knowledge about the state of the patient's vegetative nervous system, with all that it implies at the medical level.

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