

Cyclotronic Ion Resonance Therapy and Arthralgia

DOTT. SSA ANNANTONIA CIAFALONI

Ciafaloni Immobiliare SAS, Teramo, Italy

A total of 143 patients suffering various musculoskeletal disorders including rheumatoid arthritis, arthritis, osteoporosis, and post-surgical discomfort were subjected to ELF magnetic treatments using the Seqex device. A clear trend in pain reduction was observed over the 10 treatment regimen as well as a stabilization of relevant lab tests, including cholesterol level and blood pressure. Improvements were also noted in posturometric footboard tests. An additional 20 patients with various neuromuscular difficulties were treated with Seqex as well as magnetic “concentrators” for periods ranging from 3 to 10 treatments. Similar improvements in pain reduction were observed in this smaller group.

Keywords Arthritis; Ion resonance therapy; Pain reduction; Posturometric footboard.

Introduction

Cyclotronic Ion Resonance (ICR) allows us to adopt an electromagnetic therapy using complex and different electromagnetic signals. Alternating magnetic fields with an intensity range between 0.1 and 100 microT and a frequency range between 1 and 80 Hz, applied along with the earth’s magnetic field allow us to reach a normalization of cellular functions. We use different application methods in administering the ICR Therapy. We illustrate our experience with patients subjected to the Seqex® therapy with an automatically pre-programmed card, or through a method known as “SIwMEF Method” for the Seqex® therapy (Sequential Induction with Magneto Electric Field). This method consists in administering, through the Seqex® therapy, a series of specific electromagnetic sequences, hopefully to modify the pathologic condition of the biological human system.

These frequencies have been related to studies regarding the application of electromagnetic fields in medicine, studies that have generated a great variety of documentation. The administration instructions and sequences are the result of previous studies conducted by Dr. F. Crescentini.

The aim of this therapy is to normalize biologic function. One of the appliances adopted for the “SIwMEF Method” is the Q-PT (Quantum-Pain Therapy), a recent

Address correspondence to Dott. SSA A. Ciafaloni, Ciafaloni Immobiliare SAS, Teramo, Italy; E-mail: aciafaloni@tin.it

device for pain relief therapy. It consists of 6 different programs in order to treat neurologic, fascial, muscular, osteoarticular pain, as well as the neuro-psychic endocrine system and edema. The Q-PT device is made up of a Seqex[®] field generator, a punctiform concentrator (pointer-bundle), an electronic concentrator for the local applications, a mat which produces magnetic fields for the systemic treatment, and a group of “amplifying” magnets useful for mat treatments and for specific local treatments. The software stores a sequence of complex electromagnetic codes, specifically studied for pain relief and to allow medicines to be transmitted through an electromagnetic way.

Methods

During 2006, 143 patients with different musculoskeletal dysfunctions: pathogenesis: rheumatic, arthritic, osteoporotic, traumatic, post-chirurgical, were subjected to the Seqex therapy using the automatic form associated to the kinesiotherapy functional rehabilitation treatment. We have gathered information on each patient, examined the laboratory and radiologic test results, in particular the X-rays of the rachis in orthostatism in double projection, TAC, RMN, EMG together with all their clinical appraisals.

The clinical morphologic-structural test followed, as dynamic, active and passive together with the conducting functions test: as vestibular, ophthalmic and occlusive elements. All patients underwent a posturometric and stabilometric analysis using a computerized footboard that pointed out how the general barycentre and the barycentre of each foot was placed on the ground, how the load was balanced on the foot pillar supports and the dynamics of the general barycentre.

We have then done the cyclotronic ionic resonance (ICR) test using the automatic mode that stored the results on the smart card. After this we have subjected our patients to a series of ten cyclotronic ionic resonance and kinesiotherapy functional rehabilitation sessions. During the sixth treatment session ICR treatment using the automatic form was repeated. The result appraisals were obtained analysing the symptomatology, by clinical examination and posturometric (footboard) test results.

During the first three months of the year 2007 we have adopted the Q-PT therapy on 20 patients afflicted by various kinds of strong neuro-musculoskeletal dysfunctions: lombosciatalgia, acute shoulder ache, rachialgia, algescic coxarthrosis, cervical sprain posthumous, knee arthrosynovitis, etc. A range between a minimum of 3 and a maximum of 10 treatment sessions were carried out.

Results

The 143 patients treated with Seqex[®] therapy using the automatic mode associated to kinesiotherapy were 48 males and 95 females, aged between 25 and 92 years old. The patients pain middle average appraisals treated with Seqex[®] and kinesiotherapy are described in Figure 1. The vertical axis shows pain evaluation and the horizontal axis corresponds to the number of treatment sessions.

The strength, the active and passive arthral mobility and the muscular tone improvements, registered by a manual muscular test, have helped the kinesiotherapy to obtain better and more lasting results compared to previous protocols. Some laboratory tests, such as glycaemia, cholesterolemia and blood pressure were normalized in different patients resulting in a reduction of medical therapy.

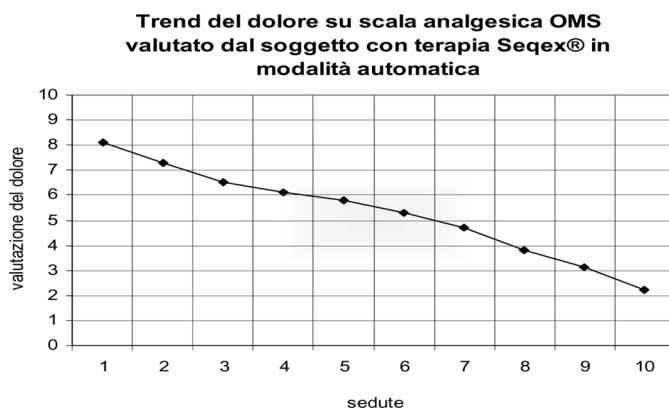


Figure 1. Pain trend on the analgesic OMS scale of a patient treated with Seqex® therapy in the automatic mode.

No undesired side effects occurred. We noticed variations regarding psychological attitudes, the quality of life and the aesthetic facial appearance. Sometimes, there was an improvement of the results simply combining an Omega3 and Magnesium Chloride treatment and prescribing the patient to drink a lot of water. Since the first treatment session we interrupted the administration of medical treatments based on FANS and cortisone which the patients had been previously subjected to prior to being under our observation.

The 20 patients treated with Q-PT were 7 males and 13 females aged between 32 and 87 years old. The patients pain middle average appraisals treated with Q-PT are described in Figure 2. Pain evaluation is plotted vertically and the number of sessions is plotted horizontally.

Beginning with the first treatment session we have noticed an immediate everyday autonomous improvement together with very satisfying verbal expression as well as evident clinical results regarding the active and passive arthral mobility and muscular strength. In four patients affected by a strong lombosciatalgia with areflexia of the affected limb we noticed after the first Q-PT treatment session an immediate reappearance of the osteotendinous reflexes. No undesired side effects nor unimproved cases were noticed.

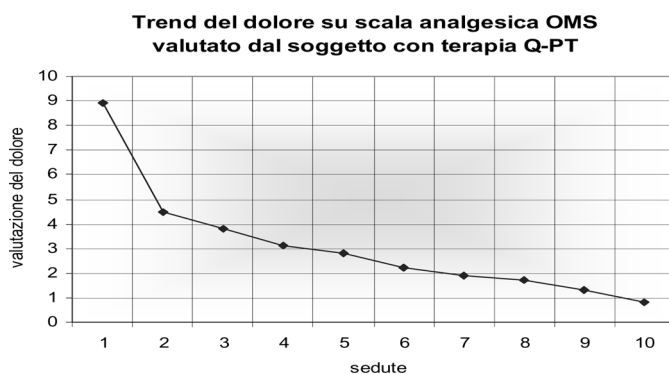


Figure 2. Pain trend on analgesic OMS scale of a patient treated with Q-PT therapy.

The results of the posturometric and stabilometric footboard tests, and in particular the data concerning the pressure centres and the rotation index, show a more significant decrease both in the overload and in the disorders, when the Seqex[®] therapy is applied with kinesiotherapy (Fig. 3).

The posturometric and stabilometric footboard test allows us to possibly analyze two different functions of the human body which are integrated, postural strategy and the local balance.

For postural strategies, one analyzes how the load is balanced on the foot pillar supports (posturometry).

For local balance conditions, one analyzes how the general barycentre of each foot sticks to the ground and estimates the strength and timing of each movement (stabilometry).

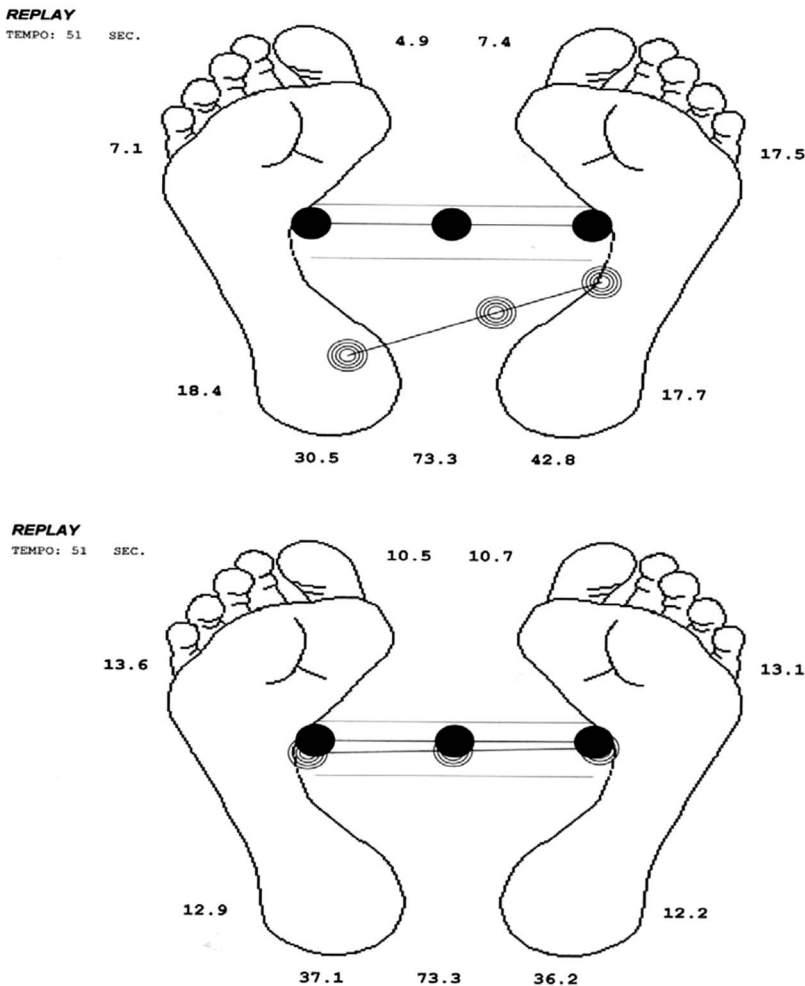


Figure 3. (a) Posturometric test before the treatment sessions; (b) Posturometric test after the cyclotron ionic resonance and kinesiotherapy sessions.

Table 1
Ground decentralization of the general Barycentre

	Median distance x before	Median distance x after	Median distance y before	Median distance y after
1° group	8,3	4,3	21	7,8
2° group	8,4	1,2	22	3,3

The Posturometric test offers us data about the ways, the static and dynamic adjustment strategies, the postural tensions, the load balancing gives the body alignment and internal force and data concerning the intrinsic pathologies affecting the feet.

With the use of Seqex® and Kinesiotherapy treatments, together with a correct harmonization between the internal and the earth's forces, the foot pillar supports improves obtaining a significant decrease in the overloading and in the disorders much more than with solely kinesiotherapy alone.

We have compared the posturometric test results referred to 2 groups of 10 patients each considering that each patient has been chosen having the same kind of ground decentralization of the general barycentre starting parameters. The first group was treated with 10 kinesiotherapy treatment sessions, whilst the second was treated with a therapy that consisted of both kinesiotherapy and ICR.

In Table 1, we report the comparative middle average appraisals before and after the therapy.

The distance x represents the change of the general barycentre towards right or towards left. The distance y represents the forward or backward change of the general barycentre.

A symmetric load balance indicates a correct posture, a correct structural alignment and an harmonic tension adjustment too.

Conclusions

The use of cyclotronic ionic resonance adopting the automatic or manual personalized Seqex® program or adopting the Q-PT, results in positive effects immediately perceived by the patient, by the doctor and by the instrumental measurements on the musculoskeletal system. During the following days and months improvements become more evident favouring rehabilitation, optimizing the results, thereby increasing the human beings potentiality and adding vitality in later years.

References

- Bricot, B. (1996). *La Riprogrammazione Posturale Globale*. Sauramps Med.
- Gagey, P.-M., Weber, B. (1997). *Posturologia*. Edizioni Marrapese.
- Lazzari Enzo (2006). *La Postura I fondamenti*. Edizioni Martina.
- Liboff, A. R., McLeod, B. R., Smith, S. D. (1999). Explaining magnetic field interactions with NGF-primed cells. *Bioelectromagnetics* 16:272–273.
- Polk, C. (1992). Counter-Ion polarization and low frequency, low electric field intensity biological effects. *Bioelectrochemistry and Bioenergetics* 28:279–289.

ELF Magnetic Therapy and Oxidative Balance

FRANCESCO RAGGI¹, GIUSEPPE VALLESI¹,
STEFANO RUFINI², STEFANIA GIZZI², ENRICO
ERCOLANI², AND RUGGERO ROSSI³

¹Department of Medical-Surgical Speciality and Public Health, Section of Hygiene and Preventive Medicine, University of Perugia, Terni, Italy

²Department of Clinical and Sperimental Medicine, Section of Farmacology, Chemiotherapy and Tossicology, University of Perugia, Terni, Italy

³Manager of School for Specialisation in Sport Medicine, University of Perugia, Terni, Italy

Knowledge about the relationship between exposure to extremely low-frequency (ELF) EMF and formation (or neutralization) of free radicals in the living cells is limited. Studies performed on animals and plants have shown conflicting effects on the relation between EMF and oxidative stress. Very few experiments have been performed on humans. The present study reports on the effects of an ELF magnetic therapy device (Seqex) on oxidative scale in humans. This device supplies complex magnetic signals with specific choices of frequency, intensity, and shape that are based on Liboff's ion cyclotron resonance hypothesis. Thirty-two healthy volunteers were treated using the Seqex cycle. A quantitative determination of oxidative stress was obtained at three time points by measuring Malondialdehyde (MDA) concentrations in peripheral blood before and after the cycle and one month following completion of the cycle. A highly significant reduction in mean MDA (53.8%, $p = 0.0002$) was found at the end of the treatment. One month later the mean MDA had again risen, but there was still a significant overall reduction of 15.6% ($p = 0.010$) compared to original values.

Keywords Oxidative stress; Free radicals; ELF magnetic therapy; Bioimpedance; Ion cyclotron resonance; Malondialdehyde; Healthy humans.

Introduction

In the last few years, after the introduction of new technologies with significant economic interests at stake, more and more attention has been focused on electromagnetic fields (EMF) effects on biological organisms. One cannot discuss EMF effects only in negative terms: instead, it is now realized that different mechanisms, which use low- and high-frequency EMF to obtain interesting therapeutic or diagnostic effects, are

Address correspondence to Giuseppe Vallesi, Department of Medical-Surgical Speciality and Public Health, Section of Hygiene and Preventive Medicine, University of Perugia, Via Lazio 8, 05100 Terni, Italy; E-mail: gipovallesi@hotmail.com

coming on the scene (Lappin et al., 2003; Bjordal et al., 2007; Mont et al., 2007; Pieber et al., 2007; Markov, 2007). These have progressed ahead since the work of Basset and Pawluk (1974) and Chiabrera et al. (1985), showing positive effect of EMF stimulation on fracture repair.

The knowledge about the relationship between exposure to extremely low-frequency (ELF) EMF and formation (or neutralization) of free radicals in the living cells, is still limited.

Oxidative stress, universally known as a dangerous factor in different pathologies and disorders (cardiovascular, neurologic and oncologic illness, premature aging, diabetes; Klaunig and Kamendulis, 2004; Spector, 2000; Robertson, 2004), is the biological expression of certain damage that occurs when pro-oxidant factors (drugs, active toxic, radiation, variation of O₂ tension, flogosis) overtake the anti-oxidant defence (Superoxid-Dismutase "SOD", catalase, Glutation Peroxidase "GSH-P", A,C, E vitamins, glutathione, carotenoids).

Studies on animals and crops have shown conflicting effects on the relation between EMF and oxidative stress (Harakawa et al., 2005; Lopucki et al., 2005; Tofani et al., 2003; Balcer-Kubiczek et al., 1999; Cantoni et al., 1995; Regoli et al., 2005; Fernie and Bird, 2001; Yoshikawa et al., 2000; Jeong et al., 2006). Very little experimentation has involved humans (Robertson et al., 2007). The "SEQEX[®]" (Seqex) medical apparatus (licence CE 355/MDD) applies complex waves, varying in frequency, intensity, and shape. These waves have been experimentally optimized through the observation of their biological effects. In clinical practice, they are individually selected by the doctor for each patient, on the basis of a bioimpedance analysis: the doctor tests specific complex waves on the patient and interprets the details of the impedance electric output. The device is based scientifically on the hypothesis of Ion Cyclotronic Resonance (ICR), as originally proposed by Liboff (1985, 1997, 2004), Liboff and Jenrow (2002), Liboff and Parkinson (1991), Liboff and McLeod (1988), Smith et al. (1987), McLeod and Liboff (1986), and more recently expanded by Del Giudice et al. (2002).

The purpose of the present study was to measure the possible effect on oxidative stress in healthy humans, following a cycle of treatment with the Seqex medical device.

Methods and Materials

Oxidative stress determination was carried out by measuring Malondialdehyde (MDA) dosage in peripheral blood samples. MDA is a marker of the peroxidated status in biological tissues, caused by endogenous or exogenous stress after exposition to hydrogen peroxide (Karatas et al., 2002; Del Rio et al., 2005).

As lipids are prone to oxidation of unsaturated bonds, it is perhaps reasonable to advocate lipid peroxidation as a significant event in the development of membrane damage. Lipid peroxidation is a complex radical chain reaction leading to the formation of various products including lipid hydroperoxides and conjugated dienes, with pathologic consequences like atherosclerosis, cell aging, cancer, cardiovascular, and hepatic illnesses.

With the breakdown of such hydroperoxides a great variety of aldehydes can be formed: these aldehydes are relatively stable and, at the same time, biologically active. Therefore, they can be considered as "cytotoxic second messengers" (Droge, 2002; Ushio-Fukai, 2006; Ushio-Fukai and Alexander, 2004; Maulik, 2006; Gutierrez et al.,

2006; Droge and Schipper, 2007). Among numerous analytical approaches for the estimation of oxygen radical-mediated damage in biological systems, the determination of MDA as one major aldehyde species, has been frequently employed (Karatas et al., 2002; Del Rio et al., 2005).

In assessing MDA, the most common methods of detection are insufficiently sensitive and disturbed by interference coming from related species or overestimation derived from stressing analysis conditions. For this reason, we used one of the new and more reliable methods, in which plasma MDA levels are determined by a highly sensitive and simple high-performance liquid chromatography (HPLC) method that is applicable to numerous clinical samples without any extraction procedures. This method consists of a rapid isocratic reversed-phase HPLC separation of MDA in samples of human plasma after 2-thiobarbituric acid (TBA) derivatization.

The MDA-2-thiobarbituric acid complex was analyzed and the separation was performed using a mobile phase composed of 35% methanol and 65% 50 mM sodium phosphate buffer, pH 7.0. in a C18 reversed phase column (150 mm × 4.6 mm i.d.).

Samples were prepared by adding to 50 μ l of plasma:

- 10 μ l of tiobarbituric acid (TBA) at 0.2% in 0.1 M Na-acetate buffer having 1mM of ditilentriamminopentacetic acid (DTPA) pH 3.5;
- 10 μ l of 2,6 ter-butyl 4 metilphenol (BHT) at 5% in ethanol 96% (BHT and DTPA are important stabilizers for the formation of the MDA-TBA complex).

All components were combined in vortex and incubated at 95°C for 45 min in a shaking water bath system. The samples then were cooled at room temperature and centrifuged at 10,000 r.p.m. for 5 min. The MDA-TBA complex were injected into an HLPC apparatus with a 1 ml/min flux, and checked in fluorescence at 515 nm excitation and 553 nm emission length.

The Seqex electromedical apparatus is a computerized system connected to coils contained within a mat on which the patient lies, normally dressed. An impedometric test preceding the treatment allows the doctor to personalize the therapy, choosing different ELF waves at proper intensities, frequencies, and shapes. The apparatus can supply one of 30 different kinds of electromagnetic wave shapes with intensities ranging from 1–100 μ Tesla and frequencies from 1–100 Hz. In the present study, each person was subjected to a cycle of 10 treatments, each lasting 27 min, every other day. Tests were carried out twice for each person, at the first and sixth session. The mean treatment duration was 36.2 days (SD: \pm 9.3).

The study was carried out on 32 people, aged 17–77 (Table 1). Mean age was 38.3 years (SD: \pm 16.4). People were all healthy volunteers, 16 of them young semi-pro athletes, and 16 sedentary subjects.

A “healthy volunteer” was considered a person who was not under the care of a clinician, not taking any medications, or undergoing any other kind of therapy for any medical conditions, during the period of the study.

In the sub-group of semi-pro athletes there were 14 males and 2 females with mean age of 26.8 years (SD: \pm 11.1), and in the sedentary sub-group there were 11 males and 5 females with mean age of 49.0 (SD: \pm 13.1). The analysis was carried out also on sub-groups represented by subjects with initial value of MDA exceeding 0.30 μ M/l (n = 19; mean age: 38.2; SD: \pm 15.7) and by subjects with initial MDA value less or equal to 0.30 μ M/l (n = 9; mean age: 32.9; SD: \pm 17.6) (regarding the last two sub-groups, only the subjects related to all the 3 measurements in the protocol were taken into consideration).

Table 1
Sample distribution

	Number	Mean age (\pm SD)	Mean (\pm SD) initial MDA (μ M/l)
Whole sample	32	38.3 (\pm 16.4)	0.41 (\pm 0.25)
Athletes	16	26.8 (\pm 11.1)	0.29 (\pm 0.23)
Sedentary subjects	16	49 (\pm 13.1)	0.55 (\pm 0.22)
Male	25	37.7 (\pm 17.4)	0.41 (\pm 0.25)
Female	7	40 (\pm 9.3)	0.44 (\pm 0.30)
Subjects with initial value of MDA > 0.30 μ M/l	19	38.2 (\pm 15.7)	0.57 (\pm 0.17)
Subjects with initial value of MDA <= 0.30 μ M/l	9	32.8 (\pm 17.6)	0.09 (\pm 0.04)

MDA measurements consisted of taking a fasting blood sample from each person in three different consequential times:

- immediately before the cycle of treatment (T1);
- immediately after the cycle of treatment (T2);
- one month after the last treatment session (T3).

For each person the blood sample was carried out in the morning, between 8 and 8.30 am. In T2, the treatment session was performed just before the blood sample withdrawal.

Statistical processing was carried out using the SPSS v. 8.0 statistical package. The analysis was carried out on the entire sample of 32 subjects as well as the subgroups. For the initial value of MDA in the subgroups, a cut off of 0.30 μ M/l was chosen, for the following reasons:

- In the literature, application of new and more reliable methods for MDA determination has been limited, probably because they are too expensive, or perhaps because their application requires the employment of specialized personnel. So, few nutritional or medical trials carried out in recent years report the use of these new and improved methods. Most of them found healthy plasma MDA values approximately in the range 0–1 mmol/L (Templar et al., 1999; Chirico, 1994; Agarwal and Chase, 2002), but several studies still report higher values (Sim et al., 2003; Cighetti et al., 1999, 2002), raising at least some doubts about the true biological significance of data.
- Since there are no precise reference values in literature, we used the following threshold: mean MDA value in the athletes group before treatment (T1); this choice is based on the hypothesis that, in this group, enzymatic systems that regulate free radicals concentration, are working properly (Gunduz et al., 2004; Metin et al., 2003; Senturk et al., 2005; Schneider et al., 2005; Urso and Clarkson, 2003; Pialoux et al., 2005).

For each examined group and for each of the three observations, the following was carried out: calculation of the mean, mode and median of the concentration of MDA (mode and median are not reported), including other statistical indexes like variance,

standard deviation, kurtosis, peak value, minimum value, and range. With regards to each analyzed group and each of the three observations, statistical significance was verified using F test (relation between the variances) and Wilcoxon test (mean comparison).

All results were reported. The interpretation of the results was carried out as follows:

- difference between the mean values—the condition of distribution normality was checked through evaluation of mean, mode, median, kurtosis, frequency bar charts, and Kolmogorov-Smirnov test (evaluation not reported); normality condition was not satisfied in our samples, so a nonparametric test was used for mean comparison (Wilcoxon Test);
- difference between the variances—the one-tail F-Test was adopted with the purpose of checking the significance of the difference between variances, since the analysis included the examination of the variations recorded in the groups' distribution profile during the three stages of observation.

Results

For each subject, results in the three time observations with absolute and percentage variation values, interval length values between the observations, central tendency indexes (mean), and variability indexes (variance, standard deviation, kurtosis, range, max., and min.) are shown in Table 2.

The treatment cycle (T1–T2 interval) results in a large decrease (–53.81%) of the mean MDA value ($p = 0.0002$). In the period following treatment (T2–T3), the mean MDA value tends to increase and this difference is also significant ($p = 0.0104$). What appears not to be significant is the comparison between the mean MDA values measured at the start and at the end of the analysis (T1–T3; $p = 0.3175$). Table 2 also introduces distribution variability indexes. Between T1 and T2, there is a decrease in the variability of the sample: variance decreases ($p < 0.0001$), the distribution turns from platykurtic towards normal (kurtosis ranging from -1.28 to -0.27) and the range is reduced (0.81 to 0.33). Figure 1 shows MDA values in the 32 subjects, before and after the treatment cycle. Variance increases between T2 and T3 ($p < 0.0001$, F Test), kurtosis shifts from -0.27 to -0.49 and the range from 0.33 to 0.83.

Upon analysis of the 16 semi-pro athletes sub-group (Table 3), we were able to highlight a reduction (–37.58%; $p = 0.0569$) measured immediately after treatment (T1–T2).

An increase in the MDA value was recorded during the successive observation interval (T2–T3), that is, 47 (SD: ± 7.2) days after the end of treatment ($p = 0.0054$). Finally, no significance was recorded with regards to comparison between the mean values of MDA measured at the start and end of the analysis (T1–T3; $p = 0.1808$). T1–T3 differences were not significant for the 16 athletes either ($p = 0.7712$). Variability analysis highlights the reduction of variance ($p = 0.0006$) immediately after treatment (T1–T2) followed by increased kurtosis (from -0.95 to 0.67) and reduction of range (0.68 to 0.28). After 47 d from the end of treatment, (T2–T3), variance increased ($p = 0.0003$), kurtosis decreased (from 0.67 to -0.81) and range increased (0.28 to 0.73).

For sedentary subjects (Table 4), the MDA reduction of the treatment was large, both for the T1–T2 interval (–62.81%) and the T1–T3 interval (–47.21%) and there

Table 2

Central tendency and dispersion indices, mean observation periods, absolute and % MDA variations. Whole sample

Observations	T1	T2	T3
Mean (\pm SD) MDA (μ M/l)	0.41 (\pm 0.25)	0.19 (\pm 0.10)	0.35 (\pm 0.23)
Variance	0.06	0.01	0.05
Kurtosis	-1.28	-0.27	-0.49
Max	0.84	0.42	0.84
Min	0.03	0.09	0.01
Range	0.81	0.33	0.83
Variations	T2-T1	T3-T2	T3-T1
Days (Mean \pm SD)	36.2 (\pm 9.43)	46.2 (\pm 6.35)	83.2 (\pm 5.95)
Mean MDA difference (μ M/l)	-0.22*	0.16*	-0.06
% Mean MDA difference	-53.8	82.7	-15.6
Variance difference	-0.05*	0.04*	-0.01

T1 = immediately before “SEQEX[®]” cycle.

T2 = immediately after “SEQEX[®]” cycle.

T3 = some days after “SEQEX[®]” cycle.

* $p < 0.05$ (for Mean MDA and Variance differences).

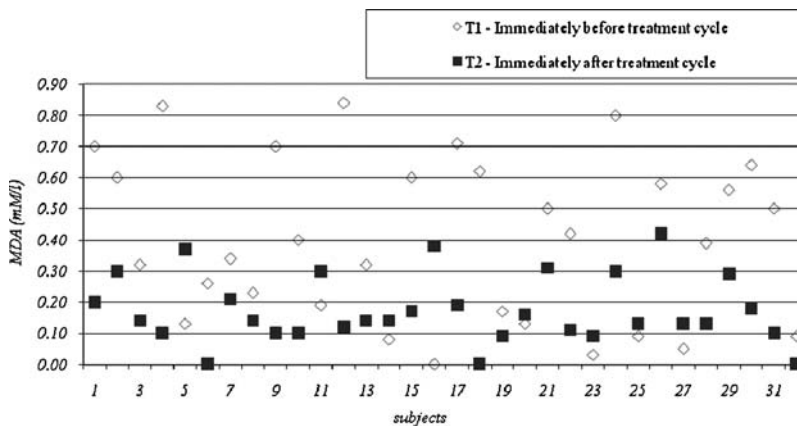


Figure 1. MDA blood concentrations (μ M/l) before and after “SEQEX[®]” treatment (T1-T2) in the whole sample (32 subjects).

were significant differences between both intervals ($p = 0.0024$ and $p = 0.0041$, respectively).

Table 3

Central tendency and dispersion indices, mean observation periods, absolute and % MDA variations. Athletes sub-group

Observations	T1	T2	T3
Mean (\pm SD) MDA ($\mu\text{M/l}$)	0.29 (\pm 0.23)	0.18 (\pm 0.08)	0.41 (\pm 0.24)
Variance	0.05	0.01	0.06
Kurtosis	-0.95	0.67	-0.81
Max	0.71	0.37	0.84
Min	0.03	0.09	0.11
Range	0.68	0.28	0.73
Variations	T2-T1	T3-T2	T3-T1
Days (Mean \pm SD)	39.0 (\pm 7.15)	47.0 (\pm 7.15)	86.0 (\pm 0.00)
Mean MDA difference ($\mu\text{M/l}$)	-0.11*	0.23*	0.12
% Mean MDA difference	-37.6	128	42.6
Variance difference	-0.04*	0.05*	0.01

T1 = immediately before "SEQEX[®]" cycle.

T2 = immediately after "SEQEX[®]" cycle.

T3 = some days after "SEQEX[®]" cycle.

* $p < 0.05$ (for Mean MDA and Variance differences).

We cannot exclude the random variability effect in the increase of mean MDA concentration between T2 and T3 ($p = 0.5097$). In relation to the evaluation of distribution profile of the sedentary subjects, range, and variance, as described for the whole sample and for the athletes sub-group, decreased in T1-T2 interval and increased in T2-T3 interval. Kurtosis improved in the 3 stages, reaching -0.68.

The possibility of restoring the oxidative stress via "SEQEX[®]" was further examined by a separate analysis carried out for subjects with MDA initial values (T1) exceeding $0.30 \mu\text{M/l}$. Only those subjects having all 3 measures in the protocol (28 subjects) were taken into consideration.

Figure 2 indicates the sub-group of 19 subjects who had MDA initial values (T1) exceeding $0.30 \mu\text{M/l}$ (normal value). It clearly shows the antioxidant effect of "SEQEX[®]" treatment (T1-T2) with proof of high reduction of the mean value (Table 5; $p = 0.0001$).

The figure highlights homogeneity of values in T2; in fact, the variance ($p = 0.0131$) and the range decreased and kurtosis increased. In the successive stage, (T2-T3), the mean value ($p = 0.0242$) and the variance ($p = 0.0002$) increased. With regards to the entire study period (T1-T3), data show significance for the difference between mean values ($p = 0.0382$), but not for the difference between the variances ($p = 0.1771$).

With regards to the group composed of subjects having MDA initial value in $T1 \leq 0.30 \mu\text{M/l}$ (Figure 3), the only significant difference is related to the entire

Table 4
Sedentary subjects sub-group. Central tendency and dispersion indices, mean observation periods, absolute and % MDA variations

Observations	T1	T2	T3
Mean (\pm SD) MDA (μ M/l)	0.55 (\pm 0.22)	0.20 (\pm 0.11)	0.29 (\pm 0.20)
Variance	0.05	0.01	0.04
Kurtosis	-1.02	-0.89	-0.68
Max	0.84	0.42	0.66
Min	0.19	0.10	0.01
Range	0.65	0.32	0.65
Variations	T2-T1	T3-T2	T3-T1
Days (Mean \pm SD)	32.9 (\pm 10.7)	45.4 (\pm 6.1)	80.3 (\pm 7.3)
Mean MDA difference (μ M/l)	-0.35*	0.09	-0.26*
% Mean MDA difference	-62.81	41.96	-47.21
Variance difference	-0.04*	0.03*	-0.01

T1 = immediately before “SEQEX[®]” cycle.

T2 = immediately after “SEQEX[®]” cycle.

T3 = some days after “SEQEX[®]” cycle.

* $p < 0.05$ (for Mean MDA and Variance differences).

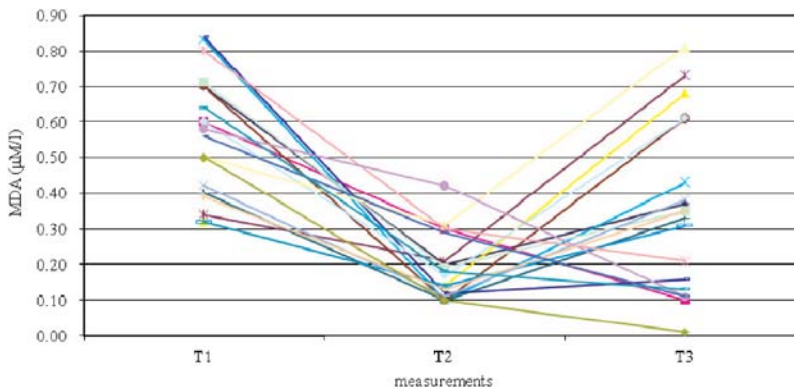


Figure 2. MDA blood concentration (μ M/l) in the three observations. Subjects with MDA initial value (T1) $> 0.30 \mu$ M/l.

period of observation which highlights increasing mean values ($p = 0.0382$) of MDA and increasing variance ($p = 0.0017$) (Table 6).

Table 5

Central tendency and dispersion indices, mean observation periods, absolute and % MDA variations. Sub-group of 19 subjects with initial values (T1) of MDA > 0.30 μM/l

Observations	T1	T2	T3
Mean (± SD) MDA (μM/l)	0.57 (± 0.17)	0.19 (± 0.09)	0.36 (± 0.24)
Variance	0.03	0.01	0.06
Kurtosis	-1.13	0.36	-0.81
Max	0.84	0.42	0.81
Min	0.32	0.10	0.01
Range	0.52	0.32	0.80
Variations	T2-T1	T3-T2	T3-T1
Days (Mean ± SD)	35.2 (± 10.5)	46.1 (± 6.3)	81.3 (± 7.2)
Mean MDA difference (μM/l)	-0.38*	0.17*	-0.21*
% Mean MDA difference	-66.4	88.9	-36.8
Variance difference	0.01*	0.05*	0.03*

T1 = immediately before “SEQEX®” cycle.

T2 = immediately after “SEQEX®” cycle.

T3 = some days after “SEQEX®” cycle.

**p* < 0.05 (for Mean MDA and Variance differences).

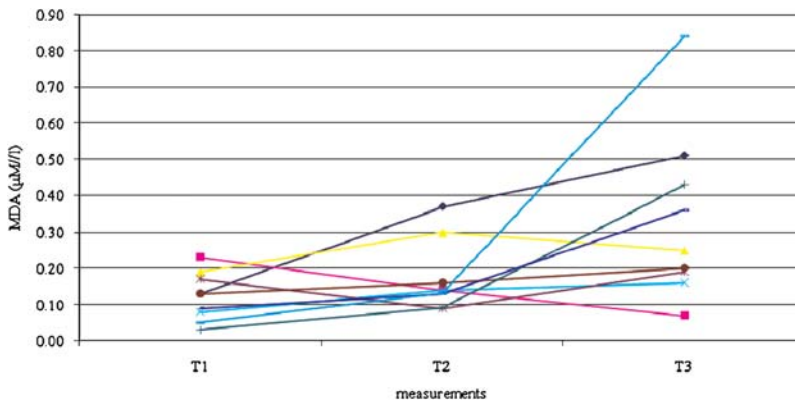


Figure 3. MDA blood concentration (μM/l) in the three observations. Subjects with MDA initial value (T1) ≤ 0.30 μM/l.

It is interesting to note, in Figure 3, the increasing trend in the interval after treatment (T2-T3), but, probably due to the scarce run length of the sample, a level of minimum significance is not reached.

Table 6
Central tendency and dispersion indices, mean observation periods, absolute and % MDA variations. Sub-group of 9 subjects with initial values (T1) of MDA < 0.30 $\mu\text{M/l}$

Observations	T1	T2	T3
Mean (\pm SD) MDA ($\mu\text{M/l}$)	0.12 (\pm 0.07)	0.17 (\pm 0.10)	0.33 (\pm 0.24)
Variance	0.00	0.01	0.06
Kurtosis	-0.90	1.25	1.82
Max	0.23	0.37	0.84
Min	0.03	0.09	0.07
Range	0.20	0.28	0.77
Variations	T2-T1	T3-T2	T3-T1
Days (Mean \pm SD)	38.3 (\pm 6.6)	47.7 (\pm 6.6)	86.0 (\pm 0.0)
Mean MDA difference ($\mu\text{M/l}$)	0.05	0.16	0.21*
% Mean MDA difference	40.9	94.2	173.6
Variance difference	0.01	0.05*	0.06*

T1 = immediately before "SEQEX[®]" cycle.

T2 = immediately after "SEQEX[®]" cycle.

T3 = some days after "SEQEX[®]" cycle.

* $p < 0.05$ (for Mean MDA and Variance differences).

Discussion

First, our study highlights an antioxidant effect following a cycle of treatment with the Seqex electromedical device. The effect is shown by the reduction of MDA during treatment and the increase of this value following interruption of the treatment. There is no international agreement on what exactly the biological effects are, especially the ones on oxidative stress, connected to ELF field exposure. Some studies (Harakawa et al., 2005; Lopucki et al., 2005; Tofani et al., 2003; Cantoni et al., 1995) enhance the possibility of antioxidant action while others (Balcer-Kubiczek et al., 1999; Regoli et al., 2005; Fernie and Bird, 2001; Yoshikawa et al., 2000; Jeong et al., 2006) report contrary conclusions. In order to better understand the effect produced by the Seqex treatment, we analyzed the results by sub-dividing the sample into two sub-groups, sedentary and semi-pro, because physical activity tends to increase the production of free radicals.

Both groups confirmed MDA reduction during treatment where overlapping MDA levels were reached: 0.18 in athletes and 0.20 in sedentary subjects, the difference being that the latter (starting from higher levels) (0.29 athletes-0.55 sedentary) had a higher percentage variation.

After about one month from the end of "SEQEX[®]" treatment, the athletes returned to initial MDA levels or higher (0.18-0.41) while the sedentary subjects were affected by a slight increase (0.20-0.29), remaining at low oxidative stress levels.

With regards to the athletes, we could state that increase of MDA values was due to constant physical activity (Senturk et al., 2005; Schneider et al., 2005; Urso and Clarkson, 2003; Pialoux et al., 2006), while for the non trained subjects, we could state that treatment activated the organism's enzymatic free radical management processes, which are fully active in trained subjects (Gunduz et al., 2004; Metin et al., 2003; Schneider et al., 2005).

This interpretation is supported by observing the significance of data: for the athletes, the T2–T3 difference is significant (and not T1–T3); for the sedentary subjects, it is the T1–T3 difference (and not T2–T3).

The second data highlighted by our study is sample variability; after treatment, the following occurs: “densification” of values near a mean level indicated by variance, range, and kurtosis. In the period following treatment, the tendency is to return to the initial situation. This indicates probable “restoring” action, and not simply antioxidant, on the oxidative equilibrium where the excessively high and low MDA values are confined within the physiological range.

The results here discussed could be contradicted because the numerous oxidative stress measure methods used to date need to be definitely validated, due to limitations of the same. Although the common methods of MDA measure are considered as being less sensitive (Karatas et al., 2002; Del Rio et al., 2005), this study adopts a very innovative and reliable technique, which is highly sensitive (0.012 $\mu\text{mol/L}$) and having good linearity (Karatas et al., 2002; Del Rio et al., 2005).

Other factors that could affect the results of MDA measure are:

- *The time blood samples were taken.* MDA blood concentration varies during the day, depending on the type and level of physical activity, eating, drinking, etc. Higher evening values are reported (Gunaydin et al., 2007). In our study, blood samples were all taken in the same days and at the same time of the day.
- *Within-subject variations.* MDA value cannot be considered stable, since it can slightly differ, in the same patient, from day to day, even though withdrawal time is constant. Probably, MDA cannot be used as a biomarker or a diagnostic test on an individual basis. However, on a group basis, the small day-to-day variability seems more promising.
- *Inter-group variations.* Since different studies have reported different mean values, it is very difficult to identify a “normal range”. Other studies reporting total plasma MDA collected in EDTA sample tubes and measured as a TBA adduct by HPLC do, however, report a group mean of 0.6 $\mu\text{mol/L}$ (Wong et al., 1987; Knight et al., 1987; Young and Trimble, 1991). Jiun and Hsien (1994) reported a mean of 0.9 $\mu\text{mol/L}$. Carbonneau et al. (1991) reported a group mean for healthy controls of 0.43 $\mu\text{mol/L}$.
- *Dietary habits and supplementary antioxidant substances intake.* Oxidative stress is variably related to dietary consumption of nutrients. For example, vegetable intake is known to reduce oxidative stress (Smolková et al., 2004), as is moderate red wine use (Lasheras et al., 2003) and fish oil fatty acids (Foulon et al., 1999). Oppositely, saturated fatty acids and potatoes are considered to increase MDA (Fang et al., 1996). The participants were requested not to change their dietary habits and to absolutely avoid adopting supplementary/antioxidant substances.
- *Physical exercise.* Its role was investigated above.
- *Smoking habits.* There is a positive correlation between plasma MDA and the exposure to cigarette smoke (Nielsen et al., 1997).

- *Consumption of alcohol.* Current hypotheses include the direct impact of the free radicals derived by ethanol; ethanol's ability to generate formation of oxygen-free radical species, which are able to start lipid peroxidation either directly or by exhausting antioxidative defense substances; and acetaldehyde's ability to stimulate lipid peroxidation either directly through free-radical formation or through depletion of the concentration of antioxidative substances (Dianzani, 1985; Vendemiale et al., 1989).

Data regarding smoking habits and alcohol intake were not collected from subjects, but it is likely that changes did not occur during the period studied.

In conclusion, this study has found an antioxidant effect due to treatment with the Seqex device. In addition, we highlighted a more complex restoring property of the apparatus (oxidative equilibrium). Recent studies (Droge, 2002) showed that Reactive Oxygen Species (ROS) have different effects according to cellular concentration: high levels are dangerous for living organisms, but at the right concentration, they act as cellular signaling mediators being involved in physiological processes like Vascular Endothelial Growth Factor (VEGF) regulation (Ushio-Fukai, 2006; Ushio-Fukai and Alexander, 2005; Maulik, 2006), mitochondrial activity (Gutierrez et al., 2006), monitoring of oxygen tension in the control of ventilation, erythropoietin production (Droge, 2002), angiogenesis, vascular tone regulation (Ushio-Fukai, 2006; Ushio-Fukai and Alexander, 2005), etc.

Gutierrez et al. (2006) states "these redox active second messengers are formed through regulated enzymatic pathways, including those in the mitochondrion, and result in the posttranslational modification of mitochondrial proteins and DNA. In some cases, the signaling pathways lead to cytotoxicity. Under physiological conditions, the same mediators at low concentrations activate the cytoprotective signaling pathways that increase cellular antioxidants."

Both effects shown in this study (antioxidant and balancing) last for a long period of time (about 40 d) even after treatment, to the point where sedentary and trained subjects had similar oxidative stress values.

We note the importance of this data, keeping in mind that most of today's pathologies are related to oxidative imbalance. We believe, however, that further studies should be carried out in order to fully understand how ELF waves effect the human organism.

References

- Agarwal, R., Chase, S. D. (2002). Rapid, fluorimetric-liquid chromatographic determination of malondialdehyde in biological samples. *J. Chromatogr. B Analyt. Technol. Biomed. Life Sci.* 775(1):121–126.
- Balcer-Kubiczek, E. K., Zhang, X. F., et al. (1999). Stress action on biological tissue and tissue models detected by the Py value. *Ann. N. Y. Acad. Sci.* 20(873):227–238.
- Basset, C. A. L., Pawluk, R. J. (1974). Acceleration of fracture repair by electromagnetic fields. A surgically non invasive method. *Ann. N. Y. Acad. Sci.* 238:2442–2461.
- Bjordal, J. M., Johnson, M. I., et al. (2007). Short-term efficacy of physical interventions in osteoarthritic knee pain. A systematic review and meta-analysis of randomised placebo-controlled trials. *BMC Musculoskelet. Disord.* 22(8):51.
- Cantoni, O., Sestili, P., et al. (1995). The effect of 50 Hz sinusoidal electric and/or magnetic fields on the rate of repair of DNA single/double strand breaks in oxidatively injured cells. *Biochem. Mol. Biol. Int.* 37(4):681–689.

- Carbonneau, M. A., Peuchant, E., et al. (1991). Free and bound malondialdehyde measured as thiobarbituric acid adduct by HPLC in serum and plasma. *Clin. Chem.* 37:1423–1429.
- Chiabrera, A., Nicolini, C., Schwann, H. P. (1985). *Interactions between Magnetic Fields and Cells*. London, Plenum Press.
- Chirico, S. (1994). High-performance liquid chromatography-based thiobarbituric acid tests. *Meth. Enzymol.* 233:314–318.
- Cighetti, G., Allevi, P., et al. (2002). Use of methyl malondialdehyde as an internal standard for malondialdehyde detection: validation by isotope-dilution gas chromatography-mass spectrometry. *Clin. Chem.* 48:2266–2269.
- Cighetti, G., Debiassi, S., et al. (1999). Free and total malondialdehyde assessment in biological matrices by gas chromatography-mass spectrometry: what is needed for an accurate detection. *Anal. Biochem.* 266:222–229.
- Del Giudice, E., Fleischmann, M., et al. (2002). On the “unreasonable” effects of ELF magnetic fields upon a system of ions. *Bioelectromagnetics* 23:522–530.
- Del Rio, D., Stewart, A. J., Pellegrini, N. (2005). A review of recent studies on malondialdehyde as a toxic molecule and biological marker of oxidative stress. *Nutr. Metabol. Cardiovasc. Dis.* 15:316–328.
- Dianzani, M. U. (1985). Lipid peroxidation in ethanol poisoning: a critical reconsideration. *Alcohol Alcohol.* 20:161–173.
- Droge, W. (2002). Free radicals in the physiological control of cell function. *Physiol. Rev.* 82(1):47–95.
- Droge, W., Schipper, H. M. (2007). Oxidative stress and aberrant signaling in aging and cognitive decline. *Aging Cell* 6(3):361–370.
- Fang, J. L., Vaca, C. E., et al. (1996). Determination of DNA adducts of malonaldehyde in humans: effects of dietary fatty acid composition. *Carcinogenesis* 17(5):1035–1040.
- Fernie, K. J., Bird, D. M. (2001). Evidence of oxidative stress in American kestrels exposed to electromagnetic fields. *Environ. Res.* 86(2):198–207.
- Foulon, T., Richard, M. J., et al. (1999). Effects of fish oil fatty acids on plasma lipids and lipoproteins and oxidant-antioxidant imbalance in healthy subjects. *Clin. Lab. Invest.* 59(4):239–248.
- Gunaydin, B., Sancak, B., et al. (2007). Temporal variation of oxidant stress in critically ill patients. *Minerva Anesthesiol.* 73(5):261–266.
- Gunduz, F., Senturk, U. K., et al. (2004). The effect of one year’s swimming exercise on oxidant stress and antioxidant capacity in aged rats. *Physiol. Res.* 53(2):171–176.
- Gutierrez, J., Ballinger, S. W., et al. (2006). Free radicals, mitochondria, and oxidized lipids: the emerging role in signal transduction in vascular cells. *Circ. Res.* 99(9):924–932.
- Harakawa, S., et al. (2005). Effects of a 50 Hz electric field on plasma lipid peroxide level and antioxidant activity in rats. *Bioelectromagnetics* 26(7):589–594.
- Jeong, Jh., Kum, C., et al. (2006). Extremely low frequency magnetic field induces hyperalgesia in mice modulated by nitric oxide synthesis. *Life Sci.* 78(13):1407–1412.
- Jiun, Y. S., Hsien, L. T. (1994). Lipid peroxidation in workers exposed to lead. *Arch. Environ. Health* 49:256–259.
- Karatas, F., Karatepe, M., Baysar, A. (2002). Determination of free malondialdehyde in human serum by high-performance liquid chromatography. *Anal. Biochem.* 311:76–79.
- Klaunig, J. E., Kamendulis, L. M. (2004). The role of oxidative stress in carcinogenesis. *Ann. Rev. Pharmacol. Toxicol.* 44:239–267.
- Knight, J. A., Smith, S. E., et al. (1987). Reference intervals for plasma lipoperoxides: age-, sex-, and specimen-related variations. *Clin. Chem.* 33:2289–2291.
- Lappin, M. S., Lawrie, F. W., et al. (2003). Effects of a pulsed electromagnetic therapy on multiple sclerosis fatigue and quality of life: a double-blind, placebo controlled trial. *Altern. Ther. Health Med.* 9(4):38–48.
- Lasheras, C., Gonzalez, S., et al. (2003). Food habits are associated with lipid peroxidation in an elderly population. *Scand. J. Amer. Diet. Assoc.* 103(11):1480–1487.

- Liboff, A. R. (1985). Cyclotron resonance in membrane transport. In: Camberra, A., et al., eds. *Interactions between Electromagnetic Fields and Cells*. New York, Plenum Press, pp. 281–296.
- Liboff, A. R. (1997). Electric-field ion cyclotron resonance. *Bioelectromagnetics* 18(1):85–87.
- Liboff, A. R. (2004). Toward an electromagnetic paradigm for biology and medicine. *J. Altern. Complement. Med.* 10(1):41–47.
- Liboff, A. R., Jenrow, K. A. (2002). Physical mechanisms in neuroelectromagnetic therapies. *NeuroRehabilitation* 17(1):9–22.
- Liboff, A. R., McLeod, B. R. (1988). Kinetics of channelized membrane ions in magnetic fields. *Bioelectromagnetics* 9(1):39–51.
- Liboff, A. R., Parkinson, W. C. (1991). Search for ion-cyclotron resonance in an Na(+)-transport system. *Bioelectromagnetics* 12(2):77–83.
- Lopucki, M., Schmerold, I., et al. (2005). Low dose magnetic fields do not cause oxidative DNA damage in human placental cotyledons in vitro. *Virchows Arch.* 446(6):634–639.
- Markov, M. S. (2007). Magnetic field therapy: a review. *Electromagn. Biol. Med.* 26(1):1–23.
- Maulik, N. (2006). Reactive oxygen species drives myocardial angiogenesis?. *Antioxid. Redox Signal* 8(11–12):2161–2168.
- McLeod, B. R., Liboff, A. R. (1986). Dynamic characteristics of membrane ions in multifield configurations of low-frequency electromagnetic radiation. *Bioelectromagnetics* 7(2):177–189.
- Metin, G., Gumustas, M. K., et al. (2003). Effect of regular training on plasma thiols, malondialdehyde and carnitine concentrations in young soccer players. *Chin. J. Physiol.* 46(1):35–39.
- Mont, M. A., Jones, L. C., et al. (2007). New treatment approaches for osteonecrosis of the femoral head: an overview. *Instr. Course Lect.* 56:197–212.
- Nielsen, F., Mikkelsen, B. B., et al. (1997). Plasma malondialdehyde as biomarker for oxidative stress: reference interval and effects of life-style factors. *Clin. Chem.* 43:1209–1214.
- Pialoux, V., Mounier, R., et al. (2006). Effects of exercise and training in hypoxia on antioxidant/pro-oxidant balance. *Eur. J. Clin. Nutr.* 60(12):1345–1354. Epub 2006 Jun 21.
- Pieber, K., Schuhfried, O., Fialka-Moser, V. (2007). Pulsed electromagnetic fields (PEMF)—results in evidence based medicine. *Wien. Med. Wochenschr.* 157(1–2):34–36.
- Regoli, F., Gorb, S., et al. (2005). Pro-oxidant effects of extremely low frequency electromagnetic fields in the land snail *Helix aspersa*. *Free Radic. Biol. Med.* 15;39(12):1620–1628.
- Robach, P., Schmitt, L., et al. (2006). Living high, training low: effect on erythropoiesis and aerobic performance in highly-trained swimmers. *Eur. J. Appl. Physiol.* 96(4):423–433.
- Robertson, J. A., Thomas, A. W., et al. (2007). The influence of extremely low frequency magnetic fields on cytoprotection and repair. *Bioelectromagnetics* 28(1):16–30.
- Robertson, R. P. (2004). Chronic oxidative stress as a central mechanism for glucose toxicity in pancreatic islet beta cells in diabetes. *J. Biol. Chem.* 279(41):42351–42354.
- Senturk, U. K., Gunduz, F., et al. (2005). Exercise-induced oxidative stress leads hemolysis in sedentary but not trained humans. *J. Appl. Physiol.* 99(4):1434–1441.
- Schneider, C. D., Barp, J., et al. (2005). Oxidative stress after three different intensities of running. *Canad. J. Appl. Physiol.* 30(6):723–734.
- Sim, A. S., Salonikas, C., et al. (2003). Improved method for plasma malondialdehyde measurement by high-performance liquid chromatography using methyl malondialdehyde as an internal standard. *J. Chromatogr. B Analyt. Technol. Biomed. Life Sci.* 785:337–344.
- Smith, S. D., McLeod, B. R., et al. (1987). Calcium cyclotron resonance and diatom mobility. *Bioelectromagnetics* 8(3):215–227.
- Smolková, B., Dusinská, M., et al. (2004). Seasonal changes in markers of oxidative damage to lipids and DNA; correlations with seasonal variation in diet. *Mutat. Res.* 551(1–2):135–144.
- Spector, A. (2000). Review: oxidative stress and disease. *J. Ocul. Pharmacol. Ther.* 16(2):193–201.
- Templar, J., Kon, S. P., et al. (1999). Increased plasma malondialdehyde levels in glomerular disease as determined by a fully validated HPLC method. *Nephrol. Dial. Transplant.* 14(4):946–951.

- Tofani, S., Barone, D., et al. (2003). Static and ELF magnetic fields enhance the in vivo antitumor efficacy of cis-platin against lewis lung carcinoma, but not of cyclophosphamide against b16 melanotic melanoma. *Pharmacol. Res.* 48(1):83–90.
- Urso, M. L., Clarkson, P. M. (2003). Oxidative stress, exercise, and antioxidant supplementation. *Toxicology* 189:41–54.
- Ushio-Fukai, M. (2006). Redox signaling in angiogenesis: role of NADPH oxidase. *Cardiovasc. Res.* 71(2):226–235.
- Ushio-Fukai, M., Alexander, R. W. (2004). Reactive oxygen species as mediators of angiogenesis signaling: role of NAD(P)H oxidase. *Mol. Cell. Biochem.* 264(1–2):85–97.
- Vendemiale, G., Altomare, E., et al. (1989). Increased plasma levels of glutathione and malondialdehyde after acute ethanol ingestion in humans. *J. Hepatol.* 9:359–365.
- Wong, S. H. Y., Knight, J. A., et al. (1987). Lipoperoxides in plasma as measured by liquid-chromatographic separation of malondialdehyde–thiobarbituric acid adduct. *Clin. Chem.* 33:214–220.
- Yoshikawa, T., Tanigawa, M., et al. (2000). Enhancement of nitric oxide generation by low frequency electromagnetic field. *Pathophysiology* 7(2):131–135.
- Young, I. S., Trimble, E. R. (1991). Measurement of malondialdehyde in plasma by high performance liquid chromatography with fluorimetric detection. *Ann. Clin. Biochem.* 28:504–508.

Extremely Low Frequency Electromagnetic Fields Prevents Chemotherapy Induced Myelotoxicity

EDOARDO ROSSI¹, MARIA TERESA CORSETTI¹,
SAMIR SUKKAR², AND CLAUDIO POGGI³

¹Department of Haematology, University-Hospital San Martino, Genoa, Italy

²Department of Nutrition, University-Hospital San Martino, Genoa, Italy

³Studio Poggi, Taggia, Italy

Side effects of chemo-radiotherapy reduce the quality and also the survivability of patients. The consequent fatigue and infections, related to myelodepression, act to reduce the dose-intensity of the protocol. Late side effects of chemo-radiotherapy include secondary tumors, acute myeloid leukemias and cardiotoxicity. Side effects of chemotherapy are related to oxidative stress produced by the treatment. Oxidative stress also reduces the efficacy of the treatment. Antioxidative treatment with natural (dietetic) or chemical agents has been reported to reduce the toxicity of chemo-radiotherapy and improve the efficacy of treatment. We here report our experience with SEQEX, an electromedical device that generates Extremely Low Frequency ElectroMagnetic Fields (ELF-EMF) to produce endogenic cyclotron ionic resonance, to reduce myelotoxicity consequent to ABVD protocol in patients with Hodgkin's lymphoma.

Keywords Antioxidative treatment; Chemo-radiotherapy; Hodgkin's lymphoma; Ion cyclotron resonance; Myelotoxicity.

Introduction

In Hodgkin's and non-Hodgkin's Lymphoma chemotherapy may cure a high number of patients. Improvement of survival reveal tardive toxicity related to chemotherapy and radiotherapy which may appear also within a few decades after conclusion of treatment. Recently Dutch researchers (Aleman et al., 2003) compared the causes of death of over 1,200 patients with Hodgkin's lymphoma with the normal population. They concluded that patients with Hodgkin's lymphoma were at risk of excess deaths from secondary cancers and cardiovascular disease throughout

Address correspondence to Edoardo Rossi, Department of Haematology, University-Hospital San Martino, Genoa, Italy; E-mail: edoardo.rossi@hsanmartino.it

more than 30 years of follow-up. They estimated that the rate of death from all causes other than HD was 6.8 times that of the general population.

Chemotherapy also induces a transient toxicity which may present during the treatment and results in fatigue, impairment of the quality of life and myelodepression. In particular myelodepression may reduce the dose-intensity schedule, which may compromise the results of the treatment, requiring supportive treatment with hematological growth-factors. It has been reported (Conklin, 2000; Myers, 1998) that the “oxidative stress” consequent to treatment with chemotherapy and radiotherapy is one of the factors responsible for chemo-radiotherapy-related-toxicity. Oxidative stress is the condition where “reactive oxygen species” (ROS) that are created exceed the capacity of the anti-oxidant system to reduce them. The consequence is an excess of ROS in cells and tissues. Toxicity of chemotherapy is, at least in part, consequent to the production of ROS. ROS are responsible of the mutagenesis induced by chemotherapy, which is one of its late side effects (secondary tumor) (Martingale et al., 2002). Exposure of cellular DNA to ROS induce accumulation of mutations whose end product is tumor production. Anti-oxidative drugs such as amiphostine, dexraroaxane and trimetazidina are used to reduce the toxicity of chemotherapy in particular cardio toxicity (Mantovani et al., 2002; Pascale et al., 2002; Sparano, 1998).

Oxidative stress reduces the efficacy of many chemotherapeutic drugs because it inhibits apoptosis, which is the therapeutic pathway of cell death of tumor cells induced by chemotherapy (Kagan et al., 2002; Shacter et al., 2000). Anti-oxidants on the other hand may improve the efficacy of chemotherapy. Multiple dietary antioxidants and glutamine are efficacious not only to reduce the toxicity of chemotherapy but also to improve its efficacy (Prasad, 2004; Savarese et al., 2003).

SEQEX is an electromedical apparatus which is able to produce 30 different shapes of electromagnetic waves with intensities between 1 to 100 μ T and a frequency between 1 to 100 Hz (Extremely Low frequency ElectroMagnetic Fields [ELF-EMF]). The shape, intensity and frequency of waves are selected by SEQEX on the basis of the measurement of the impedance measured in the body of the subject under treatment. In fact the body of the subject responds to every singular wave received with a cellular ionic movement (endogenous cyclotron ion resonance) measured by changes in body impedance, and the waves which produces better ionic movement are selected and saved in a memory card. Subsequently the waves selected, stored digitally on this card, are used to treat the patient.

Recently Raggi et al. (in press) in work yet to be published reported experimental data, conducted with SEQEX at Perugia University, clearly demonstrating that this treatment is able to reduce oxidative stress in a population of normal people.

These results prompted us: (1) to confirm the data about the potential for SEQEX to reduce oxidative stress and (2) to investigate this property to reduce the toxicity of ABVD chemotherapy. Typical dosages for one 28-day cycle of ABVD are as follows

Adriamycin 25 mg/m² IV on days 1 and 15

Bleomycin 10 mg/m² IV on days 1 and 15

Vinblastine 6 mg/m² IV on days 1 and 15

Dacarbazine 375 mg/m² IV on days 1 and 15

The total number of cycles given depends upon the stage of the disease.

Our experimental design followed 18 patients receiving chemotherapy. Included were nine patients in Group 1 receiving ELF-EMF therapy, and nine patients in Group 2 not receiving ELF-EMF therapy.

Results

(1) We evaluated oxidative stress before and after 27 minutes of 38 SEQEX treatments using the FRAS-3 technique (Cornelli et al., 2001). Overall, the mean oxidative stress was 208.6 at the beginning of treatment and 168.5 at the end, as shown in Fig. 1. We also observed reductions of oxidative stress during the treatment in the majority of tests.

(2) An appropriate dose-intensity of drugs, in accordance with protocol, consists of obtaining maximal efficacy of treatment, measured in terms of percentage and duration of complete remission. In ABVD protocol the major obstacle to prescribing the administration of a correct dose-intensity of drugs is myelotoxicity. The administration of G-CSF attempts to overcome this possible complication. We calculated the dose of G-CSF to administer to patients on the basis of number of neutrophil count checked weekly during chemotherapy.

The median total dose of G-CSF administered during the first four courses of therapy to the patients of Group 1 receiving ELF-EMF treatment was 1200mcg (range: 900–3900mcg) while it was 5100mcg (range: 1200–7500mcg) for the patients of Group 2, the difference is statistically significant ($p = 0.0002$). Usually patients during treatment with ABVD complain of “fatigue”. Fatigue is related to the reduction of haemoglobin levels during chemotherapy and it is one of the causes responsible for the poor quality of life of such patients. We studied the difference between the haemoglobin value (Hb) at the beginning of therapy and the lower value during the four courses of chemotherapy. The median value of Hb reduction in Group 1 was 0.3g/dl (range: 0–1.8g/dl) while in Group 2 it was 1.4g/dl (range: 0–3.2g/dl) (not statistically significant, $p = 0.1$). These clinical data for the 18 patients, the G-CSF administered to each patient and the maximal reduction of Hb levels are reported in Table 1.

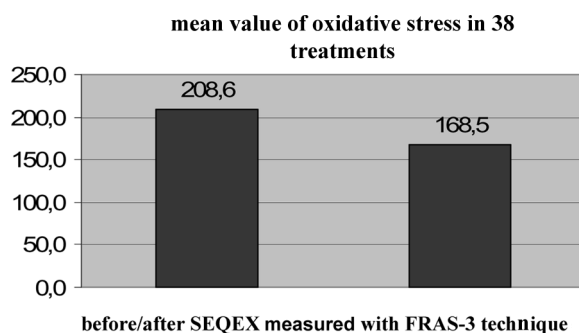


Figure 1. Evaluation of oxidative stress before and after 27 minutes of 38 SEQEX treatments as measured using the FRAS-3 technique.

Table 1

Patients 1 to 9 had supportive therapy with Seqex. Patients 10 to 18 in the second group did not. Age and stage are similar in the two groups. The G-CSF administered in the two groups is statistically different and is greater for those who did not receive the Seqex treatment. The group of patients not receiving the supportive treatment tended to have a larger decrease of haemoglobin, but this decrease was not statistically significant

Group	Age	Sex	Stage	G-CSF (μg) administered	Major Hb reduction (g/dl)
N° 1	42	F	II A	1200	0.9
N° 2	44	M	III A	1500	1.8
N° 3	45	M	II A	900	0
N° 4	69	M	I A	3900	0
N° 5	38	M	III A	1200	1.5
N° 6	35	F	II A	1200	0.5
N° 7	26	F	II A	1200	0.1
N° 8	39	F	III A	1200	0
N° 9	40	F	IV A	2400	0.6
Mean	40			1200	0.3
N° 10	47	F	III A	5100	3.2
N° 11	26	F	II A	5700	0.4
N° 12	20	M	III A	3600	0
N° 13	27	F	II A	1200	1.2
N° 14	78	F	II A	7500	2.7
N° 15	26	M	III A	4800	1.4
N° 16	40	M	II A	6600	1.6
N° 17	23	F	II A	5100	0
N° 18	43	M	I A	4500	1.6
Mean	27			5100	1.4

Conclusion

SEQEX through its production of selective ELF-EMF signals is able to reduce the oxidative stress. This may reduce the side effects of chemotherapy, specifically myelodepression. We know that oxidative stress may be, at least in part, responsible for secondary malignancies and cardiovascular diseases consequent to radio-chemotherapy, so we conclude that this medical device which reduces oxidative stress induced by treatment with chemo-radiotherapy may reduce the risk of these late toxicities.

We also conclude that the use of SEQEX in combination with a diet rich in anti-oxidant agents may further improve these results. We are involved in ongoing studies to find a protocol to prove the efficacy of such association as a supportive treatment for patients with Hodgkin and non-Hodgkin disease who are candidates for chemotherapy.

References

- Aleman, B. M. P., van den Belt-Dusebout, A. W., Klokman, W. J., van't Veer, M. B., Bartelink, H., van Leeuwen, F. E. (2003). Long-term cause-specific mortality of patients treated for Hodgkin's disease. *J. Clin. Oncology* 21:3431–3439.
- Conklin, K. A. (2000). Dietary antioxidants during cancer chemotherapy: impact on chemotherapeutic effectiveness and development of side effects. *Nutr. Cancer* 37:1–18.
- Cornelli, U., Terranova, R., Luca, S., Cornelli, M., Alberti, A. (2001). Bioavailability and antioxidant activity of some food supplements in men and women using the D-Roms test as a marker of oxidative stress. *J. Nutrition* 131:3208–3211.
- Kagan, V. E., Gleiss, B., Tyurina, Y. Y. et al. (2002). The role for oxidative stress in apoptosis: Oxidation and externalization of phosphatidylserine is required for macrophages clearance of cells undergoing Fas-mediated apoptosis. *J. Immunol.* 169:487–499.
- Mantovani, G., Macciò, A., Madeddu, C., Mura, L., Massa, E., Gramignano, G., Lusso, M. R., Murgia, V., Camboni, P., Ferreli, L. (2002). Reactive oxygen species, antioxidant mechanisms and serum cytokine levels in cancer patients: impact of an antioxidant treatment. *J. Cell. Mol. Med.* 4:570–582.
- Martingale, J. L. et al. (2002). Cellular response to oxidative stress: signaling for suicide and survival. *J. Cell. Physiol.* 192:1–15.
- Myers, C. (1998). The role of iron in Doxorubicin-induced cardiomyopathy. *Semin. Oncol.* 25:10–14.
- Pascale, C., Formengo, P., Epifani, G., Bosio, F., Giacometto, F. (2002). Cardioprotection of trimetazidine and anthracycline-induced acute cardiotoxic effects. *Lancet* 359:1153–1154.
- Prasad, K. N. (2004). Multiple dietary antioxidants enhances the efficacy of standard and experimental cancer therapies and decrease their toxicity. *Integrative Cancer Ther.* 3:310–322.
- Raggi, F., Vallesi, G., Ruffini, F. et al. Medical care with “SEQEX®” apparatus balances the oxidative scale in healthy volunteers: a clinical investigation of medical device. (*In press*).
- Savarese, D. M., Savy, G., Vahdat, L. et al. (2003). Prevention of chemotherapy and radiation toxicity with glutamine. *Cancer Treat. Rev.* 29:501–513.
- Shacter, E., Williams, J. A., Hinson, R. M., Senturker, S., Lee, Y. (2000). Oxidative stress interferes with cancer chemotherapy: inhibition of lymphoma cell apoptosis and phagocytosis. *Blood* 96:307–313.
- Sparano, J. A. (1998). Use of Dexrazoxane and other strategies to prevent cardiomyopathy associated with doxorubicin-taxane combinations. *Sem. Oncol.* 25:66–71.

The Autistic Syndrome and Endogenous Ion Cyclotron Resonance: State of the Art

FRANCESCO CRESCENTINI

Department of Bioelectromagnetic Research, I.R.P. L'Aquila,
Pescara, Italy

The autistic syndrome is a multigenic disease whose expression is different according to the level of involvement of different structures in the central nervous system. The pathogenesis is unknown. No completely effective medical therapy has yet been demonstrated.

Accepting the request of the families of eight autistic children in Lomazzo, Milan and Naples, we used ion cyclotron resonance (Seqex® therapy) therapeutic support after many other therapies had been already carried out on these patients.

After regimens consisting of 20–30 treatments with ICR, improvements were noted in all cases.

Keywords Autism; Electromagnetic therapy; Ion cyclotron resonance.

Introduction

What is autism? The following criteria are given by

1. Diagnostic and Statistical Manual of Mental Disorders: DSM IV and
2. International Statistical Classification of Diseases and Related Health Problems (ICD-10):
 - Serious alteration in social reciprocity.
 - Important compromise of the communication (verbal and non verbal).
 - Narrow behavioural repertoire, with poverty of fantasy, stereotypes, and repetitiveness of actions.
 - Frequent presence of hyper/hypo sensibility to sensory stimuli.
 - Cognitive and learning deficit and lack of attention.

Address correspondence to Dott. Francesco Crescentini, Department of Bioelectromagnetic Research, I.R.P. L'Aquila, Via B. Buozzi 53, Pescara 65122, Italy; E-mail: crs767fr@yahoo.it

Materials and Methods

Seqex[®] therapy (Endogenous Ion Cyclotron Resonance) was employed, with automatic and manual programming. Following a self-learning test, the main fields of disturbance were documented, and based on the outcome, in terms of frequency, intensity and geometry of deployment of magnetic field, therapeutic “smart cards” were manually programmed.

Therapy was dosed as follows:

20–30 applications each lasting 9–12 minutes with multifrequential sequences, using 9 codes in the smart card for a single applied therapy. Reprogramming of the smart card every 5–10–15 therapies. The first 5 treatments were applied on alternate days, the following treatments every three days until the tenth treatment, and the remaining treatments once a week until there were 20–30 total treatments. Following a set of 20–30 therapies, an interruption of at least 45 days.

There were 8 patients, 5 males and 3 females, ages 4 to 12. They were homogeneous as per ICD-10 diagnostic criteria for autism syndrome. The disease had been diagnosed for all the children before they were three years of age. In 7 patients the pathology set in after vaccinations. All were affected by intestinal disease and parasitism. Seven patients presented self-aggressiveness and aggressiveness towards school friend and relatives. All the children were already in therapy with allopathic and homotoxicological drugs.

We eliminated from this study some children that were affected by serious cerebral lesions.

Results

Within the first 5 treatments, the children had accentuated the stereotypes, and showed internal hyperstimulation with elimination of great amounts of parasites. Parents reported finding in the feces something like “colorful leaves”. All the children produced smelly feces, urines of darker color, also very smelly. But nearly all seemed to demonstrate more attention and interested in their surroundings. Within 10 therapies, and re-programming the therapeutic cards, the children substantially changed the relationship with their relatives. At school, the teachers said that the children were unrecognizable. The physical therapist, the speech pathologist, and the doctors who aided with psycho-linguistic rehabilitation found many changes. Three of the 8 began to relate with their school friends and, to go to the toilet by themselves. The stereotypes had diminished and the children demonstrated interest for games differently from the obsessive way they had done before.

All the children showed less opposition to their parents and followed orders with little or no difficulty. One key indicator were the comments by mothers. They told of the improvements obtained with phrases such as: “now my son is a child, I did not know what he was before” or “my son has reawakened, now he begins to have contacts with the world”, etc.

The greatest surprise was tied to a series of contemporary events: Three children had therapy scheduled in the same day. All had had a complete stop of language from the time they were 3 or 4 years old. All had begun the ion cyclotron resonance therapy at the same time as they were being treated at a speech rehabilitation center. All three children began to speak at the same time, expressing some words in the

same day after an identical number of therapies (five). Two of them constructed some phrases following the 15th treatment. This observation concerning an apparent synchronous response in these three patients suggests that the dose dependence and/or timing of the treatments is quite critical.

The children were followed for 6 month and improvements were evident for all the 8 children in different ways, but with constant incremental improvements over the course of the 20–30 therapies.

Conclusions

The therapeutic objectives were:

- To clean the extracellular matrix of heavy metals, chemical-pharmacological excess and toxins.
- To control oxidative stress
- To modulate internal peptide function
- To obtain immunomodulation
- To stimulate the central nervous system and to modulate the peripheral nervous system.
- To operate on the corticothalamic circuit
- To operate on serotonin receptors
- To operate on cell interconnection systems

We will use the DSM-4 criteria to indicate the targets. We will signal with the symbol ■ the targets for which there is evidence of obvious improvement.

(I) A total of six (or more) items from (A), (B), and (C), with at least two from (A), and one each from (B) and (C)

(A) qualitative impairment in social interaction, as manifested by at least two of the following:

- 1. marked impairments in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body posture, and gestures to regulate social interaction
- 2. failure to develop peer relationships appropriate to developmental level
- 3. a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest to other people)
- 4. lack of social or emotional reciprocity

(B) qualitative impairments in communication as manifested by at least one of the following:

- 1. delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)
- 2. in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
- 3. stereotyped and repetitive use of language or idiosyncratic language
- 4. lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level

(C) restricted repetitive and stereotyped patterns of behavior, interests and activities, as manifested by at least two of the following:

- 1. encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
- 2. apparently inflexible adherence to specific, nonfunctional routines or rituals
- 3. stereotyped and repetitive motor mannerisms (e.g hand or finger flapping or twisting, or complex whole-body movements)
- 4. persistent preoccupation with parts of objects

(II) Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years:

- (A) social interaction
- (B) language as used in social communication
- (C) symbolic or imaginative play

(III) The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder

Bibliography

- Agadjanian, N. A., Vlasova, I. G. (1992). Influence of infralow-frequency magnetic field on the nervous cells rhythm and their tolerance to hypoxia. *Biofizika* 37:681–689.
- Amassian, V. E., Somasunderinn, M., Rothswell, J. C., Crocco, J. B., Macabee, P. J., Day, B. L. (1991). Parasthesias are elicited by single pulse magnetic coil stimulation of motorcortex in susceptible humans. *Brain* 114:2505–2520.
- Amitai, Y., Gibson, J. R., Beierlein, M., Patrick, S. L., Ho, A. M., Connors, B. W., Golomb, D. (2002). The spatial dimensions of electrically coupled networks of interneurons in the neocortex. *The Journal of Neuroscience* 22(10):4142–4152.
- Amzica, F., Nunez, A., Steriade, M. (1992). Delta frequency (1–4 Hz) oscillations of perigeniculate thalamic neurons and their modulation by light. *Neuroscience* 51:285–294.
- Andrieux, A., Salin, P. A., Vernet, et al. (2002). The suppression of brain cold-stable microtubules in mice induces synaptic defects associated with neuroleptic-sensitive behavioral disorders. *Genes and Development* 16:2350–2364.
- Aschner, M., Aschner, J. L. (1990). Mercury neurotoxicity: mechanisms of blood-brain barrier transport. *Neuroscience & Behavioral Reviews* 14:169–176.
- Atema, J. (1973). Microtubule theory of sensory transduction. *Journal of Theoretical Biology* 38:181–190.
- Atchison, W. D., Joshi, U., Thornburg, J. E. (1986). Irreversible suppression of calcium entry into nerve terminals by methylmercury. *The Journal of Pharmacology and Experimental Therapeutics* 238:618–624.
- Buhl, D. L., Harris, K. D., Hormuzdi, S. G., Monyer, H., Buzsaki, G. (2003). Selective impairment of hippocampal gamma oscillations in connexin-36 knock-out mouse in vivo. *Journal of Neuroscience* 23:1013–1018.
- Chalmers, D. J. (1996). *The Conscious Mind – In Search of a Fundamental Theory*. New York: Oxford University Press.
- Changeux, J.-P., Dehaene, S. (1989). Neuronal models of cognitive function. *Cognition* 33:63–109.
- Dayhoff, J., Hameroff, S., Lahoz-Beltra, R., Swenberg, C. E. (1994). Cytoskeletal involvement in neuronal learning: a review. *Europe Biophysics Journal* 23:79–83.
- Dehaene, S., Naccache, L. (2001). Towards a cognitive neuroscience of consciousness: basic evidence and a workspace framework. *Cognition* 79:1–37.

- Dennett, D. C., Kinsbourne, M. (1992). Time and the observer: the where and when of consciousness. *Behavioral and Brain Sciences* 15:183–247.
- Dermietzel, R. (1998). Gap junction wiring: a ‘new’ principle in cell-to-cell communication in the nervous system? *Brain Research Reviews* 26:176–183.
- Desmedt, J. D., Tomberg, C. (1994). Transient phase-locking of 40 Hz electrical oscillations in prefrontal and parietal human cortex reflects the process of conscious somatic perception. *Neuroscience Letters* 168:126–129.
- Diagnostic and Statistical Manual of Mental Disorders: DSM IV <http://www.psychiatryonline.com/resourceTOC.aspx?resourceID=1>.
- Duda, D., Grzesik, J., Pawlicki, K. (1991). Changes in liver and kidney concentration of copper, manganese, cobalt and iron in rats exposed to static and low-frequency (50 Hz) magnetic fields. *Journal of Trace Elements and Electrolytes in Health and Disease* 5:181–186.
- Fukuda, T., Kosaka, T. (2000). The dual network of GABAergic interneurons linked by both chemical and electrical synapses: a possible infrastructure of the cerebral cortex. *Neuroscience Research* 38:123–130.
- Hameroff, S. R., Penrose, R. (1996). Conscious events as orchestrated spacetime selections. *Journal of Consciousness Studies* 3:36–53. <http://www.u.arizona.edu/~hameroff/penrose2>.
- International Statistical Classification of Diseases and Related Health Problems (ICD-10: <http://www.who.int/classifications/apps/icd/icd10online/>).
- James, S. J., et al. (2004). Metabolic biomarkers of increased oxidative stress and impaired methylation capacity in children with autism. *Am J. Clin Nutr* 80:1611–1617.
- Jibu, M., Pribram, K. H., Yasue, K. (1996). From conscious experience to memory storage and retrieval: the role of quantum brain dynamics and boson condensation of evanescent photons. *International Journal of Modern Physics B* 10:1735–1754.
- John, E. R., Tang, Y., Brill, A. B., Young, R., Ono, K. (1986). Double layered metabolic maps of memory. *Science* 233:1167–1175.
- Liboff, A. R. (1996). Evolution and the change in electromagnetic state. *Electro- and Magnetobiology* 15:245–252.
- Liboff, A. R., McLeod, B. R. (1995). Power lines and the geomagnetic field. *Bioelectromagnetics* 16:227–230.
- Liboff, A. R., McLeod, B. R., Smith, S. D. (1995). Explaining magnetic field interactions with NGF-primed cell. *Bioelectromagnetics* 16:272–273.
- Lyskov, E. B., Juutilainen, J., Jousmäki, V., Partanen, J., Medvedev, S., Hänninen, O. (1993). Effects of 45-Hz magnetic fields on the functional state of the human brain. *Bioelectromagnetics* 14:87–95.
- Parracho, H. M., et al. (2005). Difference between the gut microflora of children with autistic spectrum disorder and that of healthy children. *J. Med Microbiol.* 54:987–991.

Utilization of Extremely Low Frequency (ELF) Magnetic Fields in Chronic Disease; Five Years Experience: Three Case Reports

M. MANCUSO, V. GHEZZI, AND G. DI FEDE

Institute of Biological Medicine, Milano, Italy

We present three examples of the use of ELF magnetic therapy, two cases of multiple sclerosis and one of chronic pulmonary disease. In each of the two MS cases the Seqex device was applied as an adjunct to antioxidant medication two times a week for six weeks. Radiological and MRI examination indicated improvement in the two MS patients and stabilization in the patient with obstructive pulmonary disease following merely five treatments.

Keywords COPD; Dyspnoea; ICR; Low frequency electromagnetic therapy; Multiple sclerosis.

Magnetic field therapy has traditionally been used for orthopedic pathologies. In the last few years a number of studies have demonstrated utility in other diseases, particularly in neurology.

Starting in 2001 electromagnetic field therapy using high and low frequencies have been used in our Institute, either alone or more often associated with pharmacologic therapies, for various pathologies. We describe three cases of diseases in which ELF (extremely low frequency) therapy is associated with good results. The specific method is that of ion cyclotronic resonance, applied using the Seqex device. In all three cases therapy consisted of 2 applications per week, a total of 12 applications, with every application 30 minutes long.

First Case

41 year old man with radiologic diagnosis of multiple sclerosis (brain and spinal cord lesions); Examination revealed high values of oxidative stress. His symptoms

Address correspondence to G. Di Fede, Director, Institute of Biological Medicine, via Molino Delle Armi, 3/5, 20123 Milano (MI), Italy; E-mail: giuseppe.difede@imbio.it

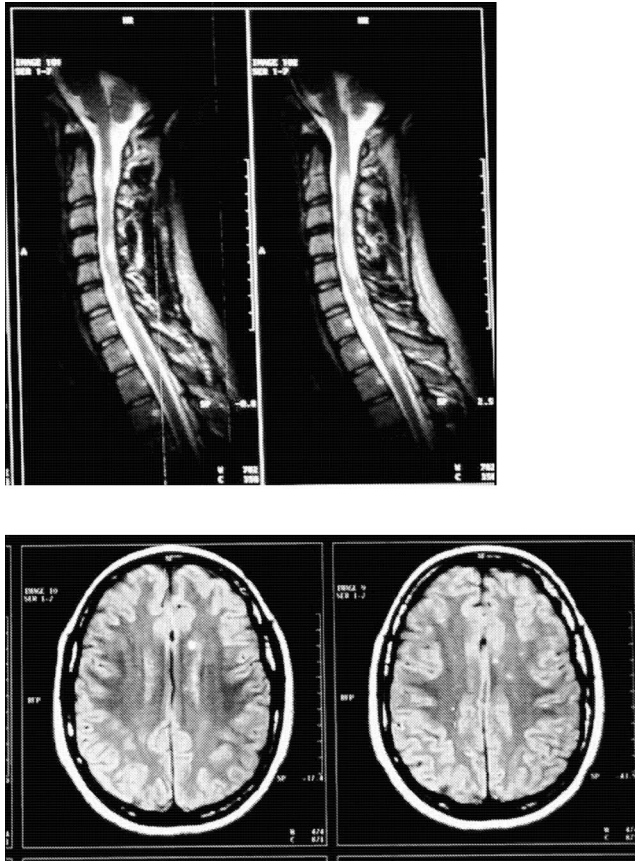


Figure 1. Radiological and MRI Exams, respectively, before and after treatment.

were cervical and lumbar pain associated with right leg mild functional impotence. Therapy consisted of supportive care with antioxidative products and ELF therapy; range of frequency was 10–30 Hz and range of intensity was 10–25 microTesla.

At the end of treatment there was a significant improvement of symptoms, with the last MRI revealing significant reductions in dimensional and activity of lesions.

Second Case

23 year old woman with radiologic diagnosis of multiple sclerosis (brain and spinal cord lesions, Fig. 1) with strong neurological deficits. Examination showed very high values of oxidative stress. For the past year she had been treated with interferon and the disease was stable.

Therapy consisted of energetic antioxidative treatment and ELF therapy with frequency range 10–20 Hz and intensity 20–30 microTesla.

The last MRI showed very significant reduction of dimension and activity lesions, particularly cervical ones (Fig. 2).

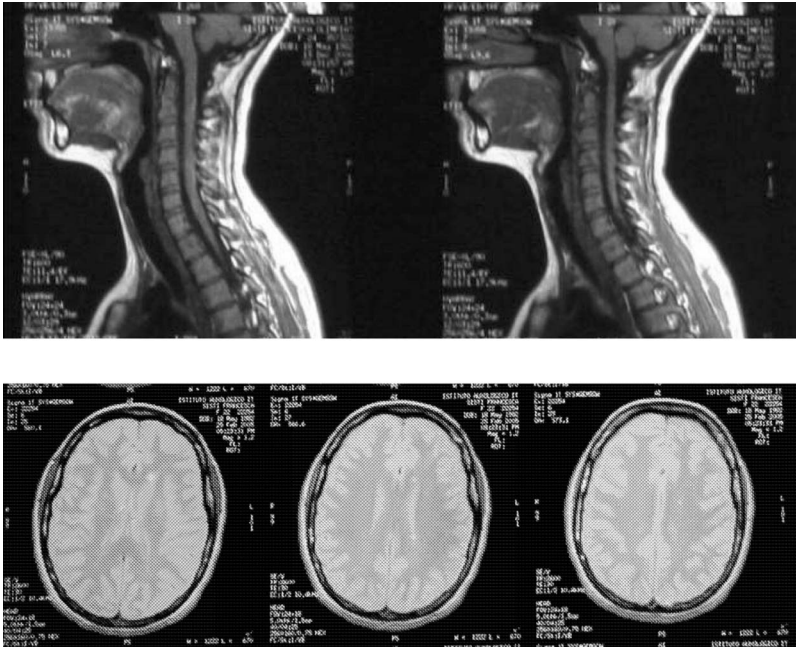


Figure 2. Radiological and MRI Exams, respectively, before and after treatment.

Third Case

70 years old man affected by chronic obstructive pulmonary disease contained with bronchodilators and corticoid therapy over several years. His major problems were dyspnoea and night breath loss.

After five applications the patient showed an improvement in sleep quality and quantity (more sleeping hours and a reduction in night breath loss). Dyspnoea was reduced.

Therapy involved the frequency range of 40–45 Hz and the intensity range of 70–90 microTesla.

At the end of the treatment cycle there was improvement of breathing parameters and quality of life. Disease was radiologically stable.

Summary

In all three cases adding ELF therapy to pharmacological treatment improved quality of life. Radiologic improvement was noted in the first 2 cases and stability in the third case.

We consider these as very good results, as measured in terms of prognosis, emotional aspects, and the social cost attached to these degenerative chronic diseases. Furthermore, treatment was well tolerated and without collateral effects.

We believe that ELF therapy can be a valid therapeutic option in integrated therapeutic strategies. The possibility for adding treatments at home makes this option more interesting.

In every case it is important to thoroughly study aspects concerning synergism, biologic tissue interaction and parameters standardization. We hope that these studies will be continued in a controlled trial.