Exposure to electric field (EF): Its palliative effect on some clinical symptoms in human patients

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ABSTRACT

The palliative effect of electric field (EF) at 50-60 Hz, which are frequency bands for commercial application was evaluated on 55 different clinical symptoms identified by users of Healthtron (Model HES-30, Hakuju Institute for Health Science Co., Ltd., Tokyo, Japan), a putative therapeutic device. During a period of approximately two years, there were 1,253 Healthtron users, and the 505 who had undergone exposure at least twice, and likewise accomplished the questionnaire, constituted the randomly selected pool of patients in this study. The patients age between 20 and 90 years old, with 85.3% comprising the>40 years age bracket, and there were 208 males and 297 females. Symptoms that were identified by at least 10 patients included cold feeling in the extremities, fatigue, headache, hypertension, insomnia, joint pain, low back pain, pain in the extremities, pruritus cutaneous, sensation of numbness in the extremities, shoulder/neck pain, and stiffness. The palliative effect of Healthtron therapy was evident with headache without accompanying fever (91.7%), joint pain (66.7%), lower back pain (57.3%), shoulder/neck pain and stiffness (56.0-57.8%), and in alleviating fatigue (55.0.%). Overall, the palliative effect on pain-related symptoms affecting locomotorial organs (head, joints, shoulder, neck, extremities and abdomen), non-ascribable to trauma, was recorded in 175 (58.5 %) of 299 cases. No patients claimed palliative effect of Healthtron immediately after a single exposure, suggesting that the alleviation of pain associated with specific symptoms necessitates long period of therapy. Since there were differences in the frequency (2-several), and interval of exposure among the patients, the potential correlation between the duration and interval of exposure with palliation could not be evaluated. In future related work, well-defined exposure conditions and other evaluation criteria, and sizable number of subjects limited to a targeted set of symptoms should be instituted.

Key word:commercial power frequency;extremely low frequency;electric field;pain.

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INTRODUCTION

Electric field (EF) exists whenever a positive or negative electrical charge is present, and it exerts force on other charges within the field. Any electrical wire that is charged will produce an associated EF even when there is no current flowing. The strength of the EF is measured in volts per meter (V/m). The higher the voltage, the stronger is the EF at a given distance from the wire. Magnetic field (MF), on the other hand, arises from the motion of electrical charges. The strength of the MF is measured in amperes per meter (A/m). Generally, however in researches on electromagnetic field (EMF), scientists specify a related quantity, known as flux density (in micro tesla, μT), instead. In contrast to EF, MF is only produced once a device is switched on and current flows. The higher the current, the greater is the strength of the MF. Like EF, MF is strongest close to its origin, and rapidly decreases at greater distances from the source.

Extremely low frequency (ELF<300 Hz) electrical stimulation has been used as a form of electrical treatment to promote callus formation (Hashimoto, 1975), heal inflammation (Lee, 1993), and in the palliation of acute lower back pain (Ghoname, 1999). The mechanism of action however has not been clarified, and its association either with EF and/or MF is unclear.

In 1972, the Ministry of Health and Welfare, Tokyo, Japan approved the manufacture of Hakuju AC High Voltage Electric Field Health Device (Trade name: Healthtron with Approval number 14700BZZ00904), an apparatus that utilizes ELF EF without generating MF, and supposedly a physical therapeutic instrument in the alleviation of pain related to shoulder stiffness, insomnia, chronic constipation, and headache. In this paper, we report the findings on the palliative effect of Healthtron pooled from inputs of patients by way of a questionnaire.

MATERIALS AND METHODS

Electric potential apparatus and method of exposure to EF

The electric field exposure apparatus, Healthtron (Model HES 30, Hakuju Institute for Health Science Co., Ltd. Tokyo, Japan) was used. Healthtron comprises a step-up transformer (a device for controlling the voltage in the circuit), a seat, and electrodes (Fig. 1). It applies high voltage to one of two opposing electrodes to make a constant potential difference and form an EF in the space between the two electrodes.

Figure 1. Electric field exposure system. Healthtron comprises a booster, a seat, and electrodes.

The users were comfortably seated and allowed to read a book or sleep during the duration of exposure. To prevent accidental electric

shocks due to formation of electric currents, the subjects were not allowed any form of bodily contact with the floor, as well as with anyone (operators and other persons exposed to electricity) during treatment. The insulator-covered electrodes were placed on the floor on which the feet were allowed to rest, and on the head of each patient. The initial power supply of 30,000-volts (ELF of 50 or 60 Hz), was applied to the electrode placed on the foot, generating an EF between the foot- and head-positioned electrodes. Exposure to electricity lasted for 30 min per session, and the frequency of exposure varied from once daily to once per week.

Administration and processing of questionnaire

The efficacy of Healthtron was assessed based on the results obtained from questionnaires administered from August 1, 1994 to June 30, 1997, at the Toranomon Clinic Minato-ku, Tokyo, Japan, under the direct supervision of Yuichi Ishikawa, MD. A total of 1,253 patients (489 males; 764 females) were administered the instrument, of which 505 (208 males; 297 females), visited the clinic and used the Healthtron device and accomplished the instrument at least twice. Others may have used the device more than twice. To reduce the extent of subjectivity of the entries in the questionnaire, the evaluation of the palliative effect of Healthtron was limited to these 505 patients.

Every Healthtron user was attended to by a physician, and interviewed on the palliative effect of the instrument during the previous visit. The instrument included questions on chief/major bodily complaints (=symptoms), past medical history and treatment, frequency of utilization of Healthtron and impressions after use, including its palliative effect, and the user's personal possession of Healthtron. The severity of symptoms at the first hospital visit was rated a 3, and the severity after Healthtron therapy was classified into 5 grades, namely: very good (5); good (4); unchanged (3); aggravated (2); highly aggravated (1). Very good and good were classified as "palliated", and the duration of palliation in days irrespectively of the frequency/interval of exposure, was likewise recorded.

RESULTS

The patients' ages ranged between 20 and 90 years old, with 85.3% comprising the>40 years age bracket (Table 1). There were 208 (41%) males and 297 (59%) females. Fifty-five different symptoms were identified, and the proportion of those patients that reported palliation per symptom with Healthtron therapy are summarized in Table 2. Symptoms that were identified by at least 10 patients included cold feeling in the extremities, fatigue, headache, hypertension, insomnia, joint pain, low back pain, pain in the extremities, pruritus cutaneous, sensation of numbness in the extremities, shoulder/neck pain, and stiffness. The palliative effect of Healthtron therapy was evident with headache without accompanying fever, organopathy such as subarachnoidal or cerebral hemorrhage, or inflammation (91.7%), joint

Table 1. Age range and sex distribution of Healthtron users.

Age range	Number of users	Male : Female
~20	2	2:0
21~30	38	15:23
31~40	34	10:24
41~50	81	29:52
51~60	147	59:88
61~70	143	69:74
71~80	50	20:30
81~90	10	4:6
Total	**505**	**208 (41%) : 297 (59 %)**

Table 2. Palliation rate in 55 identified clinical symptoms in 505 patients.

Symptoms	No. of patients	No. of patients with palliation (%)
abdominal fullness	1	0 (0)
abdominal pain	2	1 (50)
allergic constitution	7	3 (42.9)
alopecia	3	3 (100)
arrhythmia	2	1 (50)
back pain	5	3 (60)
blurred vision	5	2 (40)
chest pain	1	0 (0)
cold feeling in the extremities	14	6 (42.9)
constipation	5	3 (60)
cough	5	3 (60)
deafness	2	1 (50)
diarrhea	3	3 (100)
dizziness	5	3 (60)
ear ringing	7	1 (14.3)
enervation	4	3 (75)
exanthema	4	1 (25)
eyestrain	5	1 (20)
facial edema	1	1 (100)
facial numbness	2	0 (0)
facial paralysis	1	1 (100)
facial stiffness	1	0 (0)
fatigue	20	11 (55)
generalized muscle stiffness	1	0 (0)
gingival pain	1	0 (0)
glycosuria	7	4 (57.1)
headache	12	11 (91.7)
heavy feeling in the body	4	2 (50)
heavy feeling in the head	1	0 (0)
heavy feeling in the legs	1	1 (100)
heavy stomach feeling	1	0 (0)
hypertension	10	4 (40)
insomnia	17	8 (47.1)
jaundice	1	1 (100)
joint pain	45	30 (66.7)
loss of appetite	1	0 (0)
loss of grip	1	0 (0)
lower back pain	89	51 (57.3)
menstrual irregularity	1	0 (0)
pain in the extremities	31	10 (32.3)
palpitation	1	1 (100)
paralysis in the extremities	3	0 (0)
plantar edema	4	2 (50)
pollakiuria	1	1 (100)
pruritus cutaneous	10	4 (40)
rigidity of the arms	1	1 (100)
sensation of numbness in the extremities	29	11 (38.0)
separation of the calx epidermis	1	1 (100)
shoulder or neck pain	25	14 (56)
shoulder or neck stiffness	90	52 (57.8)
sore throat	2	1 (50)
stomachache	5	4 (80)
swelling of joints	2	2 (100)
trembling of the extremities	1	1 (100)
urinary incontinence	1	0 (0)
total	**505**	**268 (53.1)**

pain (66.7%), low back pain (57.3%), shoulder/-neck pain and stiffness (56.0-57.8%), and in alleviating fatigue (55.0.%). Interestingly, the palliative effect on pain-related symptoms affecting locomotorial organs (head, joints, shoulder, neck, extremities and abdomen) was recorded in 175 (58.5%) of 299 cases. These pain-related symptoms were not ascribable to traumas. Of the 10 patients with pruritus cutaneous, while 4 claimed to have been palliated, the clinical manifestations were aggravated in one patient after the first therapy.

Figure 2 shows mean duration of palliation per symptom irrespective of the frequency/interval of Healthtron therapy in 505 patients. Considering the small sample size in many of the symptoms identified, an inherent limitation in this study where the researchers were solely dependent on data generated from the questionnaire, we believe that the persistence of the palliative effect of therapy could be validly described only in those symptoms that were identified by at least 10 patients showing>50% palliation rate. Palliation of fatigue lasted for about 50 days; joint, lower back, and shoulder/neck pain were alleviated for 100 days or more; and headache and shoulder/neck stiffness were palliated for a little less than 100 days. The longer mean duration of palliation noted among many other symptoms could be a reflection of the sample size rather than the real effect of therapy.

DISCUSSION

In this study, the efficacy of Healthtron was merely evaluated on users' subjective answers to the questionnaire, and there were no objective evaluation criteria used. Palliation rate of>50% for a particular symptom is suggestive of the efficacy of Healthtron. Considering the insignificant number of patients who identified some specific symptoms relative to others, the evaluation as well as comparison of the effect of therapy on the 55 different symptoms is not statistically tenable. Since there were differences in the frequency (2-several) and interval

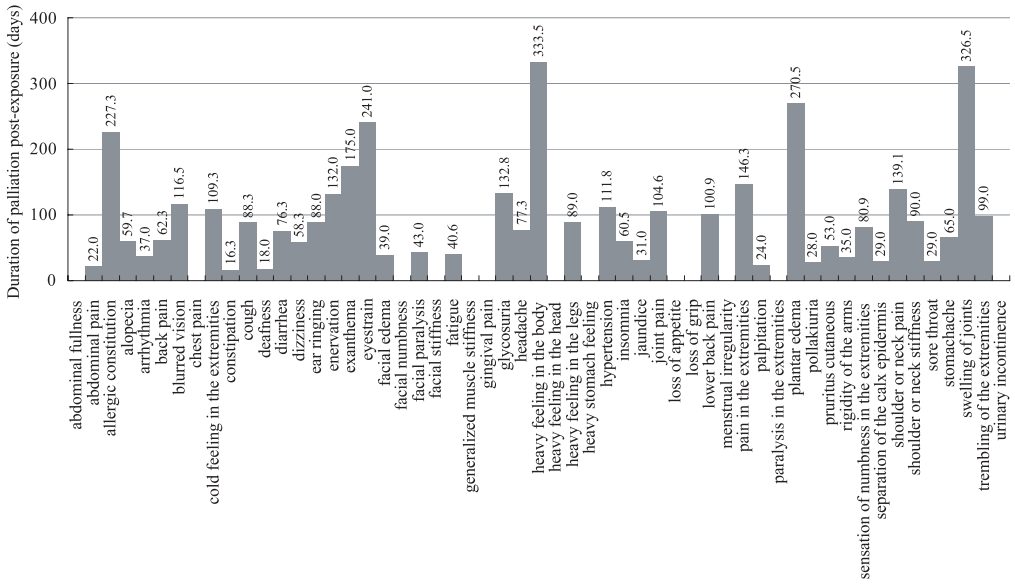

Figure 2. Mean duration of palliation of symptoms irrespective of the interval of treatment.

of exposure among the patients, the potential correlation between the duration and interval of exposure with palliation could not be evaluated, as well.

No patients claimed palliative effect of Healthtron immediately after a single exposure, suggesting that the alleviation of pain associated with specific symptoms necessitates long period of therapy. Fatigue, headache, joint, lower back and shoulder/neck pain and stiffness registered>50% palliative rate, with palliation lasting for approximately 150 days or shorter. Present data on palliation of headache and shoulder stiffness, as well as on constipation (6/14=43%), and insomnia (8/17=47%) collaborate earlier claims of the Healthtron manufacturer at the time of the product's approval.

One patient experienced exacerbation of pruritus cutaneous after initial exposure to Healthtron. It was unclear however, as to whether this was effected by exposure to EF. It would be interesting to do a follow-up observation on this phenomenon. In another patient, numbness in the extremities due to diabetic blood circulation impairment was palliated by EF exposure. Interestingly, in NOD mice, the onset of diabetes is inhibited by EF, implying the possibility that diabetes mellitus and its symptoms were palliated by EF exposure (Sakamoto et al., 1995). This cannot be similarly concluded in the present study, since the patient manifested other symptoms, as well.

Despite certain limitations, results of the present findings clearly point to Healthtron's palliative effect principally on pains associated with the head, neck, back, shoulder, joints and extremities. Considering, however, that majority of the patients in this study had received medications in institutions other than the Toranomon Clinic, and that the interval of therapy varied among the patients, it is interesting to find out as to how Healthtron effected palliation, and the role it plays in

palliation. The limitations identified in the procedural design of the present study somehow hindered drawing out of conclusions as to the usefulness of Healthtron therapy on symptoms under-represented in terms of sample size. To help clarify the role of EF on the body, in future related work, well-defined exposure conditions and other evaluation criteria, and sufficient number of subjects limited to a targeted set of symptoms should be instituted.

Many facts about the influence of MF have been reported to clarify the potential risk of MF used in power plants and electrical products on the body. There are however fewer studies on the effect of ELF EF, such as its influence on the intracellular calcium level of cultured cells (McLeod et al., 1987; Walleczek et al., 1990; Liburdy et al., 1992, 2000; Cho et al., 1994, 1999; Kim et al., 1998). ELF EF stimulates the body through the perception of EF by the body surface via hairs, and the formation of induced current in the body (Liburdy et al., 1992). Further studies however are needed to elucidate the possible association of these two mechanisms cited to the findings of the present study, and their potential role in the palliation of bodily symptoms post-exposure to an electric potential apparatus.

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電界曝露:ヒトにおける臨床的愁訴における緩解効果

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要　約

商用周波数（50/60Hz）の電界曝露による臨床症状に対する緩解効果を電位治療器“ヘルストロン”（白寿生科学研究所，HES-30A型）の利用者から得た55種類の症状について検討した。全利用者は2年間で1253名にのぼり，本研究の対象者には少なくとも 2回以上ヘルストロン治療を受け，同時に無作為的に実施するアンケートに2回以上回答するという基準を満たした505名とした。対象者の年齢範囲は10-90才で，40才以上が85.3%を占めた。また男性は208，女性は297名であった。対象者中少なくとも10人以上が主訴と答えた症状は：手足の冷え，疲れやすい，頭痛，高血圧，不眠,関節痛，腰痛，手足の痛み，皮膚のかゆみ，手足のしびれ，肩／首の痛みと肩／首のこりであった。ヘルストロン治療による緩解効果が顕著であった症状は：発熱を伴わない頭痛（91.7%），関節痛（66.7%），腰痛（57.3%），肩／首の痛みおよび凝り（56.0-57.8%）と疲れやすい（55.0%）であった。全体的な傾向から，運動器系に影響があり同時に外傷に起因していない疼痛症状に対する緩解効果が299例中175例（58.5%）を記録した。一回の治療で緩解した例は認められなかった，これは疼痛の緩解には長期の治療期間が必要である事を示している。本研究では，ヘルストロン治療の期間，頻度が利用者によって異なっていた為，期間や頻度と緩解効果との相関関係についての検討は加えることができなかった。将来的に関連する研究を行なう際は，目的症状に限定した多くの患者とよく吟味された電界条件と評価基準を設定しなければならない。

キーワード：商用周波数；超低周波数；電界；疼痛.