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The effect of the pulsatile electromagnetic field in children suffering from bronchial asthma

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From the bibliography it is well known that pulsatile electromagnetic field has an anti-inflammatory and analgesic effect. It causes vasodilatation, myorelaxation, hyper-production of connective tissue and activation of the cell membrane. Therefore our aim was to study the possible therapeutic effect of pulsatile electromagnetic field in asthmatic children.

Forty-two children participating in this study were divided in two groups.

The 1st group consisting of 21 children (11 females, 10 males, aged 11.8±0.4 yr) was treated by pulsatile electromagnetic field and pharmacologically.

The 2nd group served as control, consisting also of 21 children (11 females, 10 males, aged 11.7±0.3 yr) and was treated only pharmacologically.

Therapeutic effect of the pulsatile electromagnetic field was assessed on the basis of pulmonary tests performed by means of a Spirometer 100 Handi (Germany). The indexes FVC, IVC, ERV, IRV, FEV_1, FEV_1/FVC%, $MEF_{75,50,25}$, PEF, PIF and the changes of the flow-volume loop were also registered.

The pulsatile electromagnetic field was applied by means of the device MTU 500H, Therapy System (Brno, Czech Republic) for 5 days, two times daily for 30 minutes (magnetic induction: 3 mT, frequency: 4 Hz as recommended by the manufacturer).

The results in children of the 1st group showed an improvement of FVC of about 70 ml, IVC of about 110 ml, FEV_1 of about 80 ml, MEF_{75} of about 30 ml, PEF of about 480 ml, PIF of about 550 ml. The increases of ERV, IRV and FEV_1/FVC and decreases of $MEF_{25,50}$ were statistically insignificant. The results in the 2nd group were less clear. The flow-volume loop showed a mild improvement in 14 children. This improvement in the 2nd group was less significant. The clinical status of children and their mood became better. We believe that the pulsatile electro-magnetotherapy in children suffering from asthma is effective. On the basis of our results we can recommend it as a complementary therapy.

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Electromagnetic field therapy has an anti-inflammatory and analgesic effect on the biological structures of the human body. It causes vasodilatation, myorelaxation, and hyperproduction of connective tissue and activation of cell membranes which is well known from the literature (2, 7, 8, 12, 13, 26, 28).

On the basis of this potential favourable effect we explored the possibility of using electromagnetic field in treatment of inflammatory processes of the airways and lungs (17, 23).

In this study we were focused on the therapeutic effect of the electromagnetic field in asthmatic children (9, 11).

In our previous study we observed a favourable effect of this method of therapy in patients suffering from chronic obstructive pulmonary disease (COPD) and bronchial asthma (21).

We supposed that the effect of treatment in children would be more successful because structural changes of the airways and lung tissue in young organism are not yet established.

We did not find any data about the influence of the electromagnetic field therapy on the asthma in the literature.

Materials and methods

Subjects

It had been admitted 450 children who suffered from bronchial asthma already for several years and received sanatorium therapy at the Sanatorium Helios in High Tatras. The diagnosis of bronchial asthma was stated at homely Health Dispensaries and repeatedly at Sanatorium Helios according to the international consensus report on diagnosis and treatment of asthma (3, 4, 16, 24, 25). From these children we selected 42 patients. The main goal of the selection was to make a group of children with approximately equal degree of asthma. The children were on stable therapeutic regimen for at least 2 weeks before entering the study.

The selected children were divided randomly into two groups. The 1st group consisted of 21 children (11 females, 10 males, aged 11.8±0.4 yr) who were treated with electromagnetic field and also pharmacologically.

The 2nd group was the control group, which consisted likewise from 21 children (11 females, 10 males aged 11.7±0.3 yr) who were treated only pharmacologically, that means the electromagnetic exposure was omitted.

The pharmacological therapy was prescribed by the Health Dispensaries and could not be omitted according to the decision of the Medical Ethical Committee of the Sanatorium. All children had been on corticoids, with individual differences in bronchodilatators and antihistamines and other drugs generally being used for treatment

of bronchial asthma in children (Ventolin, Ventodisk, Intal, Bronchovaxom, Beclarone, respectively Zaditen, Zyrtec and Ditec). Therefore the children status was stabilised, without apparent asthma troubles.

Magnetotherapy

The pulsatile electromagnetic field was being applied by means of the device M 500H (Therapy System, Brno, Czech Republic) for 5 days, twice a day, for 10 min with a magnetic induction of 3 mT and a frequency of 4 Hz. This dose was recommended by the manufacturer (Biotrop parameters for MTU 500H).

Pulmonary function tests

The therapeutic effect of the pulsatile electromagnetic field was assessed on the basis of improvement of pulmonary function tests indices (1, 5, 18, 24, 25, 27) after therapy, performed by the means of a Spirometer 100 Handi (ZAN, Germany; the manufacturer declares the fault of volume and flow on ±2%) in accordance with standardized guidelines. It registered expiratory forced vital capacity (FVC_{ex} in l), inspiratory vital capacity (IVC in l), expiratory and inspiratory reserve volume (ERV, IRV in l) forced expiratory volume in 1 sec (FEV_1, percentage of $FEV_1/FVC_{ex,}$ maximal expiratory flow (MEF75, 50, 25 in $l \times s^{-1}$), peak inspiratory and expiratory flow (PIF, PEF in $l \times s^{7}$) these variables were measured before and after pulsatile electro-magnetotherapy.

In the 2nd control group without electromagnetic therapy, the indices were registered in the corresponding time as in the 1st group.

The flow-volume loop changes were also recorded.

Statistical analysis

Student's *t*-test for paired samples was used to analyse the effect of the pulsatile electro-magnetotherapy on pulmonary function tests. The normal distribution of the tested samples was verified by the Kolmogorov–Smirnov's test. A p-value less than 0.05 was taken to indicate statistical significance. In the tables we presented the standard error of mean (S.E.M.), differences of means (in l), found before and after pulsatile electro-magnetotherapy and in controls without pulsatile electro-magnetotherapy but in corresponding time.

Results

Children of the first group showed statistically significant increase in the following values: FVC_{ex} about 70 ml, IVC about 110 ml, FEV_1 about 80 ml, MEF_{75} about 30 ml, PEF 480 ml, PIF about 550 ml (Table I). Increases in ERV, IRV and FEV_1/FVC and decreases of MEF_{25}, MEF_{50} were not statistically significant.

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Table I

Pulmonary function test indices in children of the 1st group (1st GROUP – MAGNET) before treating (BEFORE) by magnet and medicaments and in children of the 2nd group (2nd GROUP – CONTROL) after (AFTER) treating only by medicaments

		FVC_{ex}	IVC	ERV	IRV	FEV_1	FEV_1/FVC %	MEF_{25}	MEF_{50}	MEF_{75}	PEF	PIF
1st GROUP – MAGNET												
BEFORE	x	2.40	2.32	0.70	1.02	2.19	91.5	2.08	3.32	4.18	4.59	2.57
	S.E.M.	0.16	0.14	0.09	0.13	0.16	2.3	0.18	0.25	0.33	0.35	0.27
AFTER	x	2.47	2.43	0.77	1.20	2.26	91.8	2.04	3.24	4.48	5.08	3.12
	S.E.M.	0.15	0.16	0.13	0.12	0.15	2.30	0.2	0.26	0.30	0.37	0.26
Diff. A–B	(l)	+0.07*	+0.11*	+0.05	+0.10	+0.08*	0.4%	–0.04	–0.09	+0.30*	+0.48**	+0.55**
2nd GROUP – CONTROL												
BEFORE	x	2.12	2.11	0.74	0.76	1.96	92.6	1.73	2.82	3.54	4.16	2.65
	S.E.M.	0.08	0.07	0.07	0.08	0.07	1.3	0.11	0.16	0.21	0.27	0.17
AFTER	x	2.22	2.15	0.63	1.04	2.02	92.0	1.89	2.89	3.92	4.32	2.66
	S.E.M.	0.10	0.08	0.07	0.12	0.09	1.9	0.13	0.18	0.25	0.23	0.17
Diff. A–B	(l)	+0.10	+0.04	–0.11	+0.24**	+0.06	–0.51%	+0.15	+0.07	+0.38*	+0.17	+0.01

Difference of means (x) after and before therapy (Diff. A–B) in litters (l). Standard errors of means (S.E.M.).
* = $P<0.05$, ** = $p<0.01$

The results of the 2nd control group were less clear. Statistically significant increases showed only in the indices IRV about 240 ml and MEF_{75} about 380 ml.

The flow-volume loop in children of the first group showed a mild improvement in 14 cases, which was responsible mainly for improving their PEF index. The improvement of the flow-volume loop was less frequent in children of the second group.

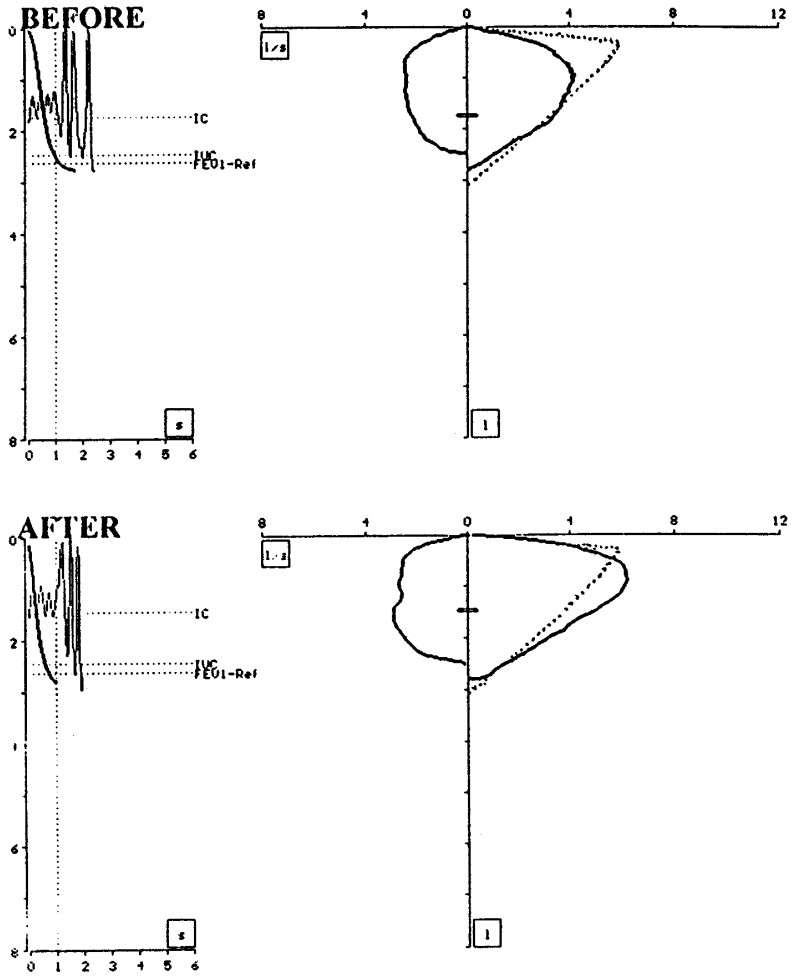

Fig. 1. Flow-volume loop represents an example of the improvement in one child from the 1st group

The breathing of children who suffered from laboured breathing, become effortless after 2–3 applications of the electro-magnetic therapy. If the classical asthma symptoms (1) like coughing, wheezing, and relative hyperinflation of the chest were present before the therapy they disappeared. For some children the magnetic therapy was so tranquillising, they got to sleep short after the treatment started. The children were placid, well tempered and could sleep well.

Discussion

Pulsatile electromagnetic field has a favourable therapeutic effect in patients suffering mainly from diseases of locomotion (20). The therapeutic effect on diseases of the respiratory tract is less established (10, 11). Despite the lack of these data we have obtained good effects in patients with chronic bronchitis. With adult asthmatics we have been less successful (21). We supposed that the electro-magnetotherapy could be more effective in children because in them the asthma induced structural alterations of the respiratory apparatus may be still not so stable. In fact we have seen, that the pulmonary function test indices were changed more in children than in adult bronchitics.

The effectivity of pulsatile magnetotherapy has been judged on the basis of pulmonary function tests (1, 5, 16, 19, 22). In asthma they have three main uses: first to confirm the diagnosis, second to assist in the assessment of the severity of the disease and third, to monitor the course and its modification by treatment (1, 4, 14, 15, 22). Despite some differences between pathology of adults and infants suffering from asthma (18) these differences do not support the use of pulmonary function tests for determining bronchial asthma in children (3). According to Peroni et al. (18) the lung function measurement is essential in monitoring asthmatic children.

The results of our study showed statistically significant improving of some pulmonary function test indices typical for airflow limitation as are FVC_{ex}, FEV_1 and PEF. Sometimes the differences between indices before and after magnetotherapy could be considered as mild (e.g. values of IVC, ERV IRV) but from clinical viewpoint improving of the airflow already about 20 ml (though non-significant in average) can increase the supply of tissue with oxygen. On the other hand in mild-to-moderate asthma in remission (or similarly after effective medication), the abnormalities of lung function are often discrete (1).

In the 2nd group we could see statistically significant differences only between values of IRV and MEF_{75}. Significant differences of indices indicate improving of the airflow and its limitation may have been absent. It seems that electro-magnetotherapy together with pharmacotherapy proved to be more effective in the therapy of asthma in children.

It is interesting that the values of $MEF_{25,50}$ after electro-magnetotherapy were negative (what means lower effect on these values) in comparison with results after pharmacotherapy. This difference is not statistically significant.

Changes in the flow-volume loop were in conformity with changes in the lung function tests.

Not only oxygenation but also the general status of children and their mood improved very well. They slept well and the typical coughing for asthma was absent during night.

Chvojka recommends (9, 11) the repetition of electromagnetic therapy to achieve a better therapeutic effect. We repeated the therapy three times in eleven asthmatic children and they were spending 10 month with normalized indices of lung function tests. We have not published these results so far because we intend to increase the number of our observations. In conclusion our experience on the effect of magnetotherapy in asthmatic children is very promising.

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REFERENCES

1. Bell ML, Chanez P: Diagnosis and assessment of asthma. Eur. Respir. Mon. 23, 180–194 (2003)
2. Borg MJ, Marcuccio AM, Poerio AM, Vangone A: Magnetic fields in physical therapy. Minerva Med. 87, 185–197 (1996)
3. British Thoracic Society, National Asthma Campain, Royal College of Physicians of London et al. The British guidelines on asthma management 1995 Review and position statement. Thorax 52, 1–21 (1997)
4. Cochrane GM (1990): Asthma pathophysiology. In: Respiratory Medicine. Eds. Gibson GJ, Geddes DM, Bailliere Tindall, Philadelphia, Toronto, Sydney, Tokyo, pp. 609–619.
5. Enright PL, Lebowitz MD, Cocroft DW: Physiologic measures: pulmonary function tests. Asthma outcome. Am. J. Respir. Crit. Care Med. 149, 9–18 (1994)
6. Fabbri LM, Romagnoli M, Richeldi R, Olivieri D: Asthma versus chronic obstructive pulmonary disease. Eur. Respir. Mon. 23, 195–210 (2003)
7. Grunner O: Contemporary views on the evaluation of the therapeutic action of magnetic fields. Cas. Lek. Ces. 12, 405–409 (1987)
8. Cholodov JA: Biological effects of magnetic fields. Prac. Lek. 33, 242–249 (1981)
9. Chvojka J (1987): Magnetoterapie její prednosti a úskalí. II (in Czech). Hradec Králové OUNZ
10. Chvojka J: Pulsní magnetické pole – jeho možnosti v detské neurologii (in Czech). Ces. Pediat. 42, 484–486 (1992)
11. Chvojka J (1993): Magnetotherapie v klinické praxi. (in Czech) Mestec Králové
12. Jerabek J: Pulsed Magnetotherapy in Czechoslovakia. Rev. Environ. Health 10, 127–134 (1994)
13. Kaldrovits J: Elektromagnetická povaha struktúry zivej hmoty (in Czech). Chemické zvesti 8, 457–470 (1994)
14. Laitinen LA, Laitinen A: Structural and cellular changes in asthma. Europ. Resp. Rev. 44, 348–351 (1994)
15. O'Byrne PM, Postma DS: The many faces of airway inflammation. Asthma and chronic obstructive pulmonary disease. Am. J. Crit. Care Med. 156, 541–566 (1999)

16. National Heart, Lung and Blood Institute, National Institute of Health, Bethesda, Maryland 20892. International consensus report on diagnosis and treatment of asthma. Eur. Respir. J. 5, 601–641 (1992)
17. Navrátil L, Hlavatý V, Landsingerova E: Možnosti léčebného využití pulzního magnetického pole (in Czech). Cas. Lek. Ces. 132, 590–593 (1993)
18. Peroni D, Piacentini G, Sabbion A, Boner A: Asthma in chidren. Eur. Resp. Mon. 23, 178–292 (2003)
19. Pride NB: Assessment of changes in airway calibre. I. Tests of forced expiration. Br. J. Clin Pharm. 8, 193–203 (1979)
20. Sadloňová J, Korpáš J: Experiences with the use of magnetotherapy in some diseases of musculoskeletal system (in Slovak). Bratisl. Lek. Listy 100, 678–681 (1976)
21. Sadloňová J, Korpáš J, Vrabec M, Salát D, Buchancová J, Kudlička J: The effect of the pulsatile electromagnetic field in patients suffering from chronic obstructive pulmonary disease and bronchial asthma. Bratisl. Lek. Listy 103, 260–265 (2002)
22. Saetta M: Airway pathology of COPD compared with asthma. Eur. Resp. Rev. 45, 211–215 (1997)
23. Shovkun VA, Chernov VN, Useinova NN, Nezhivenko MV, Nezhivenko NN, Gulkanian LA, Orlova LN: The use of magnetic fields in combined rehabilitation of children with a history of acute pneumonia (in Russian). Vopr. Kurortol. Fizioter. Lech. Fiz. Kult. 1, 40–41 (1996)
24. Standards for the diagnosis and care of patients with chronic obstructive pulmonary disease (COPD) and asthma. Am. Rev. Respir. Dis. 136, 225–244 (1987)
25. Stark JE (1990): Asthma. Clinical features and investigation. In: Respiratory Medicine. Eds. Brewis RAL, Gibson GJ, Geddes DM, Bailliere Tindall, London, Philadelphia, Toronto, Sydney, Tokyo, pp. 19–644.
26. Tenforde TS, Kaune WT: Interaction of extremely low frequency electric and magnetic fields with humans. Health Physics 53, 585–606 (1987)
27. Wilson LM (1992): Diagnostic procedures in respiratory disease. In: Pathophysiology. Eds. Price SA, Wilson LM. Mosby Baltimore, Boston, Chicago, Philadelphia, Sydney, Toronto, pp. 530–542.
28. Zagorskaja EA, Klinovitsky VA, Melnichenko VP, Rodina GP, Semyonov SN: The effect of low frequency electromagnetic fields on physiological systems. Kosm Biol Aviakosm Med. 24, 1–11 (1990)