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Immunocorrective Effects of Magnetostimulation Administered in Patients with Thermal Injury

Abstract. *The group of 40 patients with burn injuries (>20% body surface) was routinely treated. Twenty of them received additional treatment with magnetostimulation. This treatment improved the efficiency of immune system increasing activity of T regulatory cells and decreasing pro-inflammatory activity of different effector cells. The gained immunocorrection contributed for better clinical status of patients treated with magnetostimulation.*

Streszczenie. *Grupę 40 pacjentów z oparzeniami ponad 20% powierzchni ciała poddano rutynowemu leczeniu. Ponadto 20 pacjentów tej grupy otrzymało leczenie magnetostymulacyjne. Leczenie to poprawiło sprawność układu odpornościowego, pobudzając aktywność limfocytów T regulacyjnych i hamując pro-zapalną aktywność różnych komórek efektorowych. Uzyskana immunokorekcja przyczyniła się do poprawy stanu klinicznego pacjentów.* ***(Efekty immunokorekcyjne magnetostymulacji u pacjentów z oparzeniami termicznymi).***

Keywords : Thermal injury, magnetostimulation, immunocorrection.
Słowa kluczowe : Oparzenia termiczne, magnetostymulacja, immunokorekcja.

Introduction.

The severe thermal injuries comprising more than 20% of body surface lead to the generalized reaction of the organism described as a „systemic inflammatory reaction syndrome" (SIRS). This kind of injury represents a strong signal for the immune system. The way of immune response depends on the range and intensity of the injuring signal and on the potential reactive abilities of the system. If the both elements are reciprocally balanced and the intensity of signal does not exceed the potential defensive abilities of immune system, the healing of injury proceeds without severe complications and the health status of patient may gradually improve. The immunoregulatory activity of thymic-dependent Treg lymphocytes represents one of the most important mechanisms by which the immune system may supervise and control the intensity of posttraumatic inflammation [1 - 3].

The recent observations [4, 5] describing the immunocorrective influence of low-frequency magnetic field seem to indicate that the magnetostimulation can be considered as a potential valuable component in the treatment of severe burn injuries.

The study was aimed to determine the influence of magnetostimulation (Viofor JPS) on the immunoregulatory functions of immune system, including the activity of Treg lymphocytes, in patients suffering from burn injuries.

Material and methods.

The group of 40 patients (25 men and 15 women, age from 20 to 55 years with burn skin injuries in range from 20 to 50% of body surface) was enrolled to the study. 20 of them were treated on the conventional way and the remaining 20 received also magnetostimulation [4], (Viofor JPS magnetic field generator, 14 daily expositions, 15 min each, according to M1P2 programme, with the use of a large ring applicator. The induced homogenous magnetic field represented basic pulses frequency of 180 – 190 Hz and magnetic induction B = 3,2 μT, mean, and = 40 μT at the peak of pulse). The control group consisted of 20 healthy men.

The immunological tests performed before treatment and after 3 months of therapy were done on the mononuclear cells separated from the blood (PBMC) [5, 6]. The cells were functionally tested in the microculture system (response to PHA and to Con A, production of cytokines IL-1β, IL-1ra, IL-6, IL-10 and TGF-β) and qualitatively/quantitatively analysed by cytometry for the presence of TCD4 and TCD8 lymphocytes and the cells expressing Treg phenotypes $CD4^+CD25^{high}$ with co-expression of CD152 and CD62L molecules.

Results.

After magnetostimulation the reactivity of T lymphocytes to PHA and to ConA increased significantly (table 1) and production of pro-inflammatory cytokines IL-1β and IL-6 decreased (table 2). The production of anti-inflammatory and immunoregulatory cytokines (IL-1ra, IL-10 and TGFβ) increased considerably after magnetostimulation (table 3).

In addition, in this group of patients the percentage of T $CD4^+$ lymphocytes also increased. No such changes were observed in the group of patients treated routinely.

The mean percentage values of Treg lymphocytes ($CD4^+CD25^{high}$) in the both groups of patients were significantly lower before the treatment than in the healthy individuals. These values increased considerably after magnetostimulation (table 4). Similar changes were observed for the subpopulation of lymphocytes $CD4^+CD25^{high}$ with co-expression of CD152 and CD62L receptors which are characteristic for regulatory T lymphocytes (Treg).

Table 1. Response to mitogens in microcultures of PBMC from patients treated routinely or additionally treated with magnetostimulation

Group of patients		Tested parameter	
		PHA dpm x 10^3/cult.	Con A dpm x 10^3/cult.
Routinely treated N = 20	before treatment	39,8 ± 10,5	27,9 ± 10,0
	after treatment	32,1 ± 12,9	30,1 ± 12,3
Statistical significance		N.S.	N.S.
Treated with magneto-stimula-tion N = 20	before treatment	41,8 ± 13,4	29,9 ± 11,2
	after treatment	52,7 ± 14,8	37,6 ± 9,2
Statistical signuificance		$p < 0,05$	$p < 0,01$

Table 2. Concentration of pro-inflammatory cytokines in supernatants of microcultures of PBMC from patients treated routinely or additionally treated with magnetostimulation

Group of patients		Tested parameter	
		IL-1β (pg/ml)	IL- 6 (pg/ml)
Routinely treated N = 20	before treatment	598 ± 240	1200 ± 690
	after treatment	500 ± 190	980 ± 290
Statistical significance		N.S.	N.S.
Treated with magneto-stimula-tion N = 20	before treatment	664 ± 197	1210 ± 273
	after treatment	331 ± 60	726 ± 186
Statistical signuificance		p < 0,01	p < 0,05

Table 3. Concentration of anti-inflammatory cytokines in supernatants of microcultures of PBMC from patients treated routinely or additionally treated with magnetostimulation

Group of patients		Tested parameter		
		IL-1ra (pg/ml)	IL-10 (pg/ml)	TGFβ (pg/ml)
Routinely treated N = 20	before treatment	1600 ± 428	540 ± 280	1720 ± 580
	after treatment	1980 ± 430	620 ± 298	1800 ± 520
Statistical significance		N.S.	N.S.	N.S.
Treated with magneto-stimula-tion N = 20	before treatment	1686 ± 324	575 ± 311	1628 ± 504
	after treatment	3382 ± 366	939 ± 518	2051 ± 492
Statistical signuificance		p < 0,01	p < 0,01	p < 0,05

Discussion and conclusion.

The results of our study confirmed earlier observations that stress, pain, tissue necrosis, infection and inflammation, which are inherently connected with the burn injury, are agents exerting strong immunosuppressive influence on the thymic-dependent functions of immune system [7, 8]. Following the earlier findings, which describe immunocorrective effects of magnetostimulation administered in children with impaired immunity [5], this way of treatment was now added into the routine therapy of patients with severe burns. The administration of magnetostimulation in patients with severe burn injuries significantly improved immunoregulatory capacity of immune system. This improvement was reflected by an increase of Treg lymphocyte actrivity, increased production of immunoregulatory and anti-inflammatory cytokines (IL-1ra, IL-10 and TGFβ) and decreased production of pro-inflammatory cytokines (IL-1βand IL-6). All these changes are important elements on the way to attain the good progression of healing process after burn injury.

The magnetostimulation can be included into the immunocorrective therapeutic methods and can be safely administered in the treatment of patients with severe burns.

Table 4. Percentage of Treg lymphocytes and proportion of TregCD152 and TregCD62L in PBMC from patients treated routinely or additionally treated with magnetostimulation.

Group of patients		Tested parameter		
		Treg	CD152 in Treg	CD62L in Treg
Routinely treated N = 20	before treatment	2,7 ± 1,2	20,5 ± 7,9	59,7 ± 10,3
	after treatment	2,4 ± 1,1	23,6 ± 8,8	64,9 ± 10,8
Statistical significance		N.S.	N.S.	N.S.
Treated with magneto-stimula-tion N = 20	before treatment	2,3 ± 1,0	20,7 ± 9,3	53,5 ± 8,1
	after treatment	5,1 ± 1,3	29,8 ± 12,7	67,9 ± 11,0
Statistical signuificance		p < 0,01	p < 0,01	p < 0,01

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