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Effect of BEMER physical vascular therapy on body surface temperature changes in racehorses: a pilot study

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Summary

Vascular physical therapy (BEMER) is a technology employing low-frequency pulsed electromagnetic fields to enhance microcirculation. The objective of this pilot study was to evaluate the effects of BEMER therapy on body surface temperature changes in the upper limb and dorsal regions of racehorses. The study involved 14 horses divided into an active BEMER group (n = 7) and a sham group (n = 7). Body surface temperature measurements were taken bilaterally from the lateral aspect at three time points: just before therapy, just after therapy, and 15 minutes after therapy. In each thermographic image, measurement regions were designated for the following muscles: the triceps brachii, the longissimus thoracis, and the quadriceps femoris, from which the average temperature was calculated. The findings revealed no increase in body surface temperature immediately after therapy in either group. However, 15 minutes after therapy the body surface temperature in the active BEMER group was significantly higher compared to that in the sham group, in which temperature decreased. BEMER therapy maintained a stable surface body temperature for up to 15 minutes after therapy, despite exposure to a lower ambient temperature (24°C).

Keywords: physical vascular therapy, thermography, racehorse, body surface temperature, vascularization

BEMER is a form of vascular physical therapy that utilizes low-frequency pulsed electromagnetic fields with a magnetic induction range of 10 to 100 µT, characterized by half-sinusoidal intensity modulations at frequencies of 8-11 Hz and 28-31 Hz. This therapy effectively stimulates rhythmic contractions of capillaries (3, 18). Consequently, it leads to a significant increase in the diameter of small blood vessels, the number of open capillaries, and the blood flow volume in arteries and veins (13, 14). When applied as a comprehensive or complementary approach, BEMER enhances fundamental physiological processes, including angiogenesis in microcirculation, the delivery of nutrients and oxygen to muscle cells, and the removal of metabolic byproducts. Through specific biorhythmic modulation, it also exerts a synergistic effect on larger blood vessels.

The application of BEMER therapy in human medicine has been documented in numerous scientific studies and clinical case reports (15) addressing conditions such as pain in patients with musculoskeletal disorders (8), myofascial dysfunction (11), complex regional pain syndrome (1), multiple sclerosis (17), joint degeneration (27), and post-exercise recovery (24). Despite extensive research, there is no definitive confirmation of the biological mechanism underlying the effects of BEMER therapy (27), and the available findings remain inconclusive regarding its efficacy (9).

Similarly, conclusions from the limited studies conducted on horses indicate that the efficacy of BEMER therapy remains a topic of debate. Research presented by Dai et al. (4) assessed the impact of BEMER therapy on post-exercise recovery and stress reduction in sport horses on the basis of blood parameters as well as physiological and behavioral indicators. However, significant progress in post-exercise recovery was not confirmed.

Other studies evaluated the effectiveness of BEMER therapy in reducing muscle pain in the thoracolumbar region on the basis of blood parameters, muscle tone, pain perception thresholds, and the evaluation of the horse's movement. No significant therapeutic effect of BEMER was demonstrated on the basis of those parameters (12). The most recent studies conducted on healthy racehorses indicated that BEMER therapy led to an increase in the diameter of blood vessels without increasing the body surface temperature in the distal parts of the limbs (16). Similar results were obtained in studies on healthy human participants, which demonstrated an increase in blood flow in the blood vessels of the lower limbs, specifically in the thigh area (2). Given the results of previous studies conducted on humans, the aim of this pilot study was to evaluate the effects of BEMER therapy on body surface temperature changes in the upper limb and dorsal regions of racehorses. It was hypothesized that the application of BEMER therapy to the upper body regions would result in an increase in body surface temperature.

Fig. 1. BEMER blanket designed for horses

Material and methods

The Animal Welfare Advisory Team at Wrocław University of Environmental and Life Sciences approved the study design in compliance with Polish and European Union legislation on animal experimentation (no. 20/2024). The procedures used in this study were deemed not to cause pain, suffering, distress, or lasting harm equivalent to or greater than that caused by the introduction of a needle (Article 1.5 of EU Directive 2010/63/EU).

Animals and data collection. A randomized, blinded, placebo-controlled study was conducted at the Wrocław Partynice Horse Racing Track in June 2024. The study involved 14 clinically healthy Thoroughbred racehorses aged 2-6 years, all engaged in regular race training. Prior to the experiment, all horses were examined by a veterinarian to rule out clinical signs of inflammation in the locomotor system (23). The animals were not subjected to any medical treatments other than routine vaccinations and antiparasitic prophylaxis. The horses were housed in the same stable under the same conditions, each in individual boxes (3.5 m × 3.5 m) with straw bedding. They were fed hay and concentrate feed according to their individual energy requirements. All horses followed a similar training regimen consisting of a warm-up in a walker (walking and trotting for 20 minutes), followed by saddle training: approximately 5 minutes of walking, then trotting and galloping for 10 to 20 minutes.

The horses were randomly divided into two groups: an active BEMER group (n = 7) including one 4-year-old, three 3-year-olds, and three 2-year-olds and a sham group (n = 7) including one 6-year-old, one 5-year-old, two 3-year-olds, and three 2-year-olds). The active BEMER group had a BEMER blanket covering the upper limbs (forelimbs and hindlimbs), chest and thoraco-lumbar region, whereas the sham group had a blanket applied in the same regions without activation.

Thermographic assessments were performed for both groups at three stages of therapy to determine changes in body surface temperature in the following areas: the upper part of the forelimb, the upper part of the hindlimb, and the thoraco-lumbar region. The stages of measurement were as follows: before therapy (BT), just after therapy (JAT), and 15 minutes after therapy (15AT).

BEMER vascular physical therapy. The study was conducted using a commercially available BEMER® blanket set (BEMER Int. AG, Triesen, Liechtenstein) (Fig. 1). The blanket consisted of 16 coils designed to generate a variable electromagnetic field, specifically tailored and arranged to meet the anatomical needs of horses. The coils emitted a pulsed sinusoidal signal. The blanket was always applied in the same manner by the same individual. The therapy involved a 15-minute program that delivered an electromagnetic signal with a flux density ranging from 30 to 100 μTesla (highest-level program). The control group underwent the same procedure with the device turned off.

Thermographic examination. The thermographic examination procedure adhered to established standards for thermographic measurements in veterinary medicine

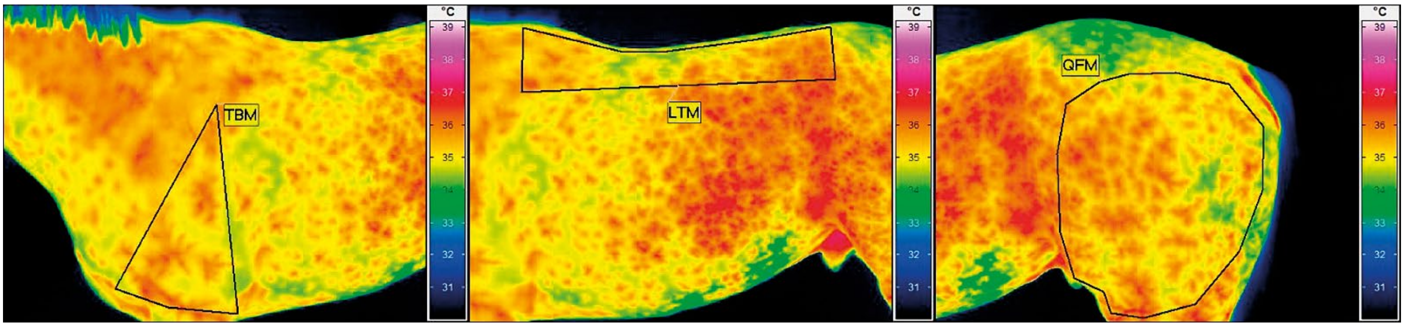


Fig. 2. Thermographic image of the upper part of the forelimb region (measurement region: TBM – indicating triceps brachii muscle), the chest and the thoraco-lumbar region (measurement region: LTM – indicating longissimus thoracis muscle), and the upper part of the hindlimb region (measurement region: QFM – indicating quadriceps femoris muscle), from the left lateral side, taken just after BEMER therapy

(20, 22). During the study, the stable doors and windows were kept closed to prevent drafts and exposure to direct sunlight. On the day of the examination, the horses were at rest, before training, brushed an hour before the study, and without the application of ointments or blankets on the day prior to the procedure (7, 28). The examination procedure for each horse was conducted in its box, allowing a 20-minute acclimatization period (25). A Vario-Cam HR® thermal imaging camera (InfraTec, Dresden, Germany) with a resolution of 640 × 480 was used for the study. Thermographic images were captured of three specific body regions: the upper forelimb region, the upper hindlimb region, and the chest with thoraco-lumbar region, with separate views taken from the right (R) and left (L) sides of the body. The images were taken from a fixed distance of 1.5 m with an emissivity coefficient of 1. The ambient temperature during the study was approximately 24°C.

The analysis of the thermograms was performed using the licensed IRBIS software, version 3 Professional, from InfraTec. For each thermogram, a region of interest (ROI) was used to measure the average temperatures of the primary muscle groups in the specified areas: the triceps brachii muscle (TBM) for the upper forelimb region, the longissimus thoracis muscle (LTM) for the chest and thoraco-lumbar region, and the quadriceps femoris muscle (QFM) for the upper hindlimb region (Fig. 2).

Tab. 1. Analysis of symmetry (right/left side of the body) of body surface temperature distribution in three measurement regions (ROI): triceps brachii muscle (TBM), longissimus thoracis muscle (LTM), and quadriceps femoris muscle (QFM) in 7 horses from the active BEMER group and 7 horses from the sham group at three stages of therapy (BT – before therapy, JAT – just after therapy, and 15AT – 15 minutes after therapy), and results of comparisons using the paired t-test

ROI/group	Stage of theraphy	Mean temperature ± SD (°C)		
		Right side	Left side	p
TBM/active BEMER group	BT	35.25 ± 0.24	35.25 ± 0.27	0.939
LTM/active BEMER group		35.55 ± 0.21	35.54 ± 0.31	0.954
QFM/active BEMER group		35.38 ± 0.34	35.47 ± 0.30	0.203
TBM/sham group		34.93 ± 0.50	35.04 ± 0.32	0.176
LTM/sham group		35.24 ± 0.41	35.25 ± 0.42	0.933
QFM/sham group		34.93 ± 0.53	35.07 ± 0.38	0.352
TBM/active BEMER group	JAT	35.23 ± 0.55	35.37 ± 0.40	0.261
LTM/active BEMER group		35.28 ± 0.44	35.68 ± 0.27	0.008
QFM/active BEMER group		35.21 ± 0.44	35.46 ± 0.31	0.140
TBM/sham group		35.00 ± 0.23	35.00 ± 0.20	0.985
LTM/sham group		35.21 ± 0.24	35.34 ± 0.35	0.398
QFM/sham group		34.82 ± 0.46	35.15 ± 0.48	0.066
TBM/active BEMER group	15AT	35.72 ± 0.17	35.70 ± 0.31	0.731
LTM/active BEMER group		35.48 ± 0.40	35.48 ± 0.43	0.905
QFM/active BEMER group		35.40 ± 0.50	35.36 ± 0.44	0.435
TBM/sham group		34.69 ± 0.38	34.75 ± 0.28	0.232
LTM/sham group		34.73 ± 0.45	34.75 ± 0.41	0.802
QFM/sham group		34.86 ± 0.54	34.90 ± 0.38	0.776

Statistical analysis. The normality of the distribution of surface body temperature was assessed using the Shapiro-Wilk test. The absence of asymmetry in body surface temperature between the right and left sides was verified using the paired t-test. To examine the effect of two or more factors (independent variables: active BEMER group vs sham group, ROI location: TBM vs LTM vs QFM, therapy stage: BT vs JAT vs 15AT) on the dependent variable (change in body surface temperature: ΔT), a factorial analysis of variance (Factorial ANOVA) was applied. This made it possible to simultaneously examine the effects of individual factors and their interactions on the dependent variable. Descriptive statistics for temperature were presented as means and standard deviations in the tables and figures. A significance level of $p < 0.05$ was adopted for all statistical tests. Statistical analysis was performed using Statistica version 14 (TIBCO Software Inc., Palo Alto, CA, USA).

Results and discussion

The results of the symmetry assessment of temperature in the three regions are presented in Table 1. The temperatures measured on the right and left sides did not differ significantly (except for the LTM in the active BEMER group). Therefore, for further analysis, the average temperature

Tab. 2. Analysis of temperature distribution in the active BEMER group vs sham group in three regions of interest (ROI): triceps brachii muscle (TBM), longissimus thoracis muscle (LTM), and quadriceps femoris muscle (QFM) at three stages of therapy (BT – before therapy, JAT – just after therapy, and 15AT – 15 minutes after therapy), and results of comparisons using the independent t-test

Stage	ROI: TBM			ROI: LTM			ROI:QFM		
	Active BEMER group	Sham group	p	Active BEMER group	Sham group	p	Active BEMER group	Sham group	p
BT	35.25 ± 0.25	34.99 ± 0.41	0.173	35.55 ± 0.19	35.24 ± 0.41	0.101	35.52 ± 0.30	35.00 ± 0.42	0.020
JAT	35.30 ± 0.46	35.00 ± 0.19	0.133	35.48 ± 0.34	35.27 ± 0.23	0.211	35.34 ± 0.33	34.99 ± 0.43	0.111
15AT	35.71 ± 0.23	34.72 ± 0.33	< 0.001	35.48 ± 0.41	34.74 ± 0.42	0.006	35.38 ± 0.47	34.88 ± 0.44	0.059

from measurements on both sides of the body was used.

Fifteen minutes after BEMER therapy (15AT), the body surface temperature in the TBM and LTM regions was significantly higher in the active BEMR group compared to the sham group (Tab. 2).

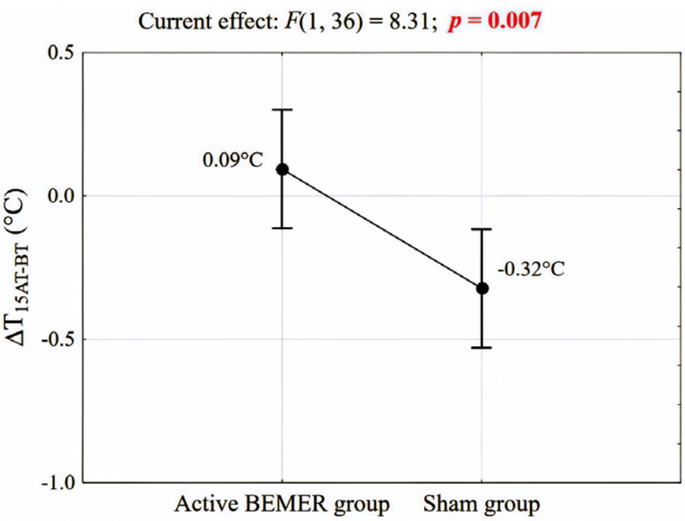
To assess the effect of two factors (independent variables: group and ROI) on the dependent variable (ΔT), as well as to examine the interaction between these factors, a factorial analysis of variance (Factorial ANOVA) was applied (Tab. 3).

The change in body surface temperature (ΔT) in the three ROIs, measured immediately after the BEMER therapy (ΔTIAT-AT), was not significantly influenced by any factor ($p > 0.05$). The body surface temperature 15 minutes after the therapy (ΔT15AT-AT) remained at the same level (+0.09°C) in the active BEMER group, while in the sham group it significantly decreased by 0.32°C. The change in temperature 15 minutes after the therapy (ΔTAT-15AT) was influenced by both the application of the BEMER therapy (active BEMER group vs sham group) and the ROI (TBM vs LTM vs QFM). Fifteen minutes after the therapy, in the active BEMER group, the temperature remained at the same

Tab. 3. Results of the analysis of variance in body surface temperature changes between therapy stages

Therapy stage	Effect	SS	df	MS	F	p
JAT-BT	Constant	0.160	1	0.160	1.382	0.247
	Group	0.021	1	0.021	0.178	0.675
	ROI	0.054	2	0.027	0.233	0.793
	Group × ROI	0.098	2	0.049	0.426	0.657
	Error	4.161	36	0.116	×	×
15AT-BT	Constant	0.551	1	0.551	2.522	0.121
	Group	1.815	1	1.815	8.307	0.007**
	ROI	0.930	2	0.465	2.130	0.134
	Group × ROI	0.754	2	0.377	1.726	0.192
	Error	7.864	36	0.218	×	×
15AT-JAT	Constant	1.304	1	1.304	7.794	0.008**
	Group	1.449	1	1.449	8.660	0.006**
	ROI	1.316	2	0.658	3.933	0.029*
	Group × ROI	0.308	2	0.154	0.922	0.407
	Error	6.022	36	0.167	×	×

Explanations: SS – sum square; df – degree of freedom; MS – mean square; F – test statatistics; p – test significance level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



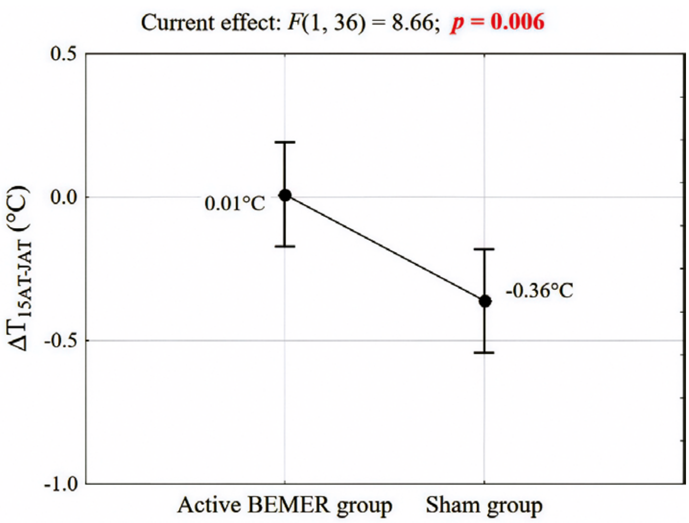


Fig. 3. Expected average marginal temperature changes 15 minutes after therapy (15AT) compared to temperatures before therapy (BT) ($\Delta T_{15AT-BT}$) and just after therapy (JAT) ($\Delta TT_{15AT-JAT}$) in the active BEMER group and the sham group

level ($\Delta T = 0.01°C$), while in sham group it decreased ($\Delta T = –0.36°C$) (Fig. 3). In the TBM region, the temperature did not change significantly ($\Delta T = 0.04°C$), but it decreased significantly in the LTM region ($\Delta TLTM = –0.39°C$) and slightly in the QFM region ($\Delta TQFM = –0.18°C$).

The study did not confirm the research hypothesis, as the BEMER therapy did not increase body surface temperature in the upper body regions. Similar results were obtained in previous studies using BEMER on distal parts of the limbs, which are considerably less vascularized (16). The upper body regions, due to the well-developed muscle tissue and richly vascularized skin, are naturally well-perfused. Studies indicate that the circulatory system in these areas effectively delivers oxygen and nutrients, especially during physical activity (6). Additionally, regular training increases plasma volume and blood flow in muscles, which confirms the effectiveness of blood supply to these areas (10). Therefore, this body region should be susceptible to increased perfusion following therapy. This is supported by earlier studies evaluating the effects of magnetic fields, which showed a significant increase in body surface temperature on the backs of horses after therapy, both in the experimental and placebo groups (5, 26).

It was shown that the body surface temperature in the area of the TBM and the LTM 15AT was significantly higher in the active BEMER group compared to the sham group, where a significant decrease in body surface temperature was noted compared to BT and JAT measurements. This suggests that the body surface temperature remains stable for at least 15 minutes after the BEMER therapy, at the same level as before the therapy and immediately after its completion. These results suggest that the BEMER therapy contributes to the improvement of microcirculation in the upper body regions. Similar findings were observed in a study using BEMER on distal parts of the limbs, where the study group showed significantly higher body surface temperatures in the limbs compared to the sham group immediately after the therapy. Additionally, 15 minutes after therapy, a significant decrease in limb body surface temperature was noted in the sham group compared to pre-therapy measurements, while in the study group, the temperature remained the same as before therapy (16). Similarly, in the current study, the body surface temperature of the upper body regions remained stable in the active BEMER group, but decreased in the sham group. This suggests that the BEMER therapy plays a role in maintaining a constant body surface temperature level for up to 15 minutes after the therapy.

The results of this study are consistent with previous findings (16, 19, 21), indicating a symmetrical distribution of body surface temperature between the right and left sides of the body. Furthermore, the studies were conducted under controlled environmental conditions according to recommendations for performing thermographic measurements (22). During the study, there was no draft or direct sunlight exposure of the horses, and the ambient temperature was stabilized at 24°C. Additionally, horses in both groups were not sweaty after the BEMER blanket was removed. However, the study had several important limitations. The main research limitation was the small number of horses, which may have influenced the statistical outcome. Moreover, differences between individual horses in both groups (age, training history, or training activity) could have affected the results of the body surface temperature distribution after therapy. The study should also include a control group with the same protocol as the active BEMER group and the sham group, but without the BEMER blanket application.

Although there are studies suggesting benefits of the BEMER therapy in both humans and animals, many experts believe that the evidence is insufficient to consider it a standard treatment and rehabilitation method. The exact biophysical and cellular mechanisms through which bioelectromagnetic energy regulation therapy influences tissue responses remain under investigation. However, numerous studies have shown that exposure to electromagnetic fields increases microcirculation in the body (13, 14). Since this study was a pilot one, further research with a larger number of horses and a longer duration is needed to describe the long-term effects.

BEMER therapy maintains body surface temperature at the same level for up to 15 minutes after the therapy, even when the horse is exposed to a lower ambient temperature (24°C). The results highlight the need for further research on the potential benefits of BEMER therapy in relation to changes in body surface temperature in healthy horses. Further studies involving larger groups of horses and longer durations of therapy are essential.

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