ADVANCES IN IDIOPATHIC LOW BACK PAIN

edited by

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Can Local Heat Economize Muscle Activity?

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Introduction

In many cases low back pain (LBP) is thought to be caused by muscular tension in connection with an increased muscle tone (1, 2). A common form of treatment is the local application of heat (for instance via mud packs) (3–6). Although most patients experience this therapy as comforting, convincing evidence for a beneficial effect is lacking. The present study investigates the question, whether local heat application changes muscle activity measured by surface electromyography (SEMG). Previous investigations on relaxed muscles could not show effects, possibly because of the low activity of the SEMG at rest (7, 8). Therefore the protocol was modified and the investigation was done on muscles at light to medium strength isometric contraction.

Subjects and patients

20 young, healthy volunteers participated in a cross-over study, where one run was performed with heat application ("intervention") and one without ("control"). At the beginning of each run electrodes were placed in the lumbar region and remained there throughout all phases of the test. After an initial phase of 15 minutes' rest in prone position, the first test was carried out ("pre-test").
Lying still in prone position the volunteers had to rise their trunk 6 times (in intervals of 30 seconds each) submaximally. During each action a SEMG was recorded for 4 seconds. The mean frequency ("TURNS"), the mean amplitude (Mean Rectified Voltage, "MRV") and the integral of the mean amplitude ("Root Mean Square, "RMS") were recorded.
This was followed by either the application of heat to the lower thoracic and lumbar region (intervention with regular mud packs, temperature: 50 °C, thickness of the layer: 5 cm) for 20 minutes or by a 20 minutes' period of rest (control). The interval between both runs was one to 7 days. Thereafter a second test was carried out (post-test). Volunteers were asked to rise their trunk as before (each time for 5 seconds, with interval of 30 seconds), while again a SEMG was recorded. Post-test TURNS were compared with those from the pre-test. To be considered as "pairs" (set of data), TURNS of pre-test

Table 1 a. Intervention (heat application).

Parameter	I/II	Mean ± SD	SEM	p-value	
Turns	I	288.8 ± 20.3	4.5		
Turns	II	288.7 ± 20.4	4.6	0.733	n.s.
MRV	I	125.3 ± 38.8	8.7		
MRV	II	108.7 ± 20.4	4.6	0.031	*
RMS	I	166.2 ± 51.7	11.5		
RMS	II	143.2 ± 27.0	6.0	0.021	*

Table 1 b. Control (no heat application).

Parameter	I/II	Mean ± SD	SEM	p-value	
Turns	I	309.6 ± 20.8	5.2		
Turns	II	310.1 ± 21.2	5.3	0.362	n.s.
MRV	I	121.6 ± 25.4	6.3		
MRV	II	117.7 ± 40.5	10.1	0.585	n.s.
RMS	I	162.2 ± 34.1	8.5		
RMS	II	155.8 ± 50.9	12.7	0.469	n.s.

**Table 1: Longitudinal changes of electromyographic recordings.
MRV = Mean Rectified Voltage (≙mean amplitude), RMS = Root Mean Square (≙Integral of MRV); I = before, II = after intervention/control.**

and post-test had to differ by less than ± 3. If necessary, volunteers were asked to exercise more or less intensively in order to get 5 valid data sets from every volunteer.
Thus "frequency-standardized" changes of RMS and MRV between pre- and post-test were obtained for both runs and tested for significant differences applying the t-test for paired samples (two sided). The null-hypothesis was rejected when p was less than 0.05.

Results

In the control run RMS and MRV did not change significantly between pre- and post-test, while in the intervention run there was a statistically significant decrease of MRV ($p = 0.03$) and RMS ($p = 0.02$) of around 13% (see Tables 1 a and b). TURNS remained unchanged in both runs between pre- and post-test ($p = 0.73$ and $p = 0.36$).

Discussion

LBP is thought to be associated with an increase in muscle tone. Thermotherapy is believed to induce a decrease in tone (3, 4, 6). A valid method to quantify muscle tone is, however, lacking. The SEMG is based on an experimentally proven relation between static contraction force and myoelectric activity (9). Its relevance in this context is based on the hypothesis that changes in the respective sum potential manifest as an increase or decrease of one component, if the other is kept constant (frequency or amplitude). This would imply that amplitude (or RMS) would represent a proper indicator (at constant frequency) for eventual changes in the muscle tone caused by the application of heat in the presence of a sufficient number of contractions.

The present results show that at constant conditions and comparable arbitrary muscular activity no changes in the SEMG are to be expected in 2 consecutive measurements (Table 1 b). Obviously, the application of heat does induce changes in the SEMG (Table 1 a), which can be interpreted as a decrease of the muscular activity. The underlying mechanism remains unclear. This decrease in amplitude (or myoelectric activity) might be caused in principle by physical (due to the application of heat) as well as by physiological changes.

A merely physical cause, i.e. a change in electric conductivity at (at least 3) different sections on the way of the electric impulses from the place of generation (at the electrodes and distal ends of the wire, at the transition point from skin to the electrodes and/or at the tissue between skin and muscle) is unlikely because of the small difference in temperature between body surface (about 30 to 35 °C) and the mud packs (about 50 °C). The influence of temperature changes on the conductor (wires) can therefore be neglected. To avoid artifacts caused by movements and electromagnetic disturbances special emphasis has to be put on the conduct of the wires.

In the course of heat application a change in the electrophysiological properties of the tissue layers and the transition from the skin to the electrodes occurs; its influence on the SEMG can only be estimated. It is, however, quite unlikely that it is of quantitative relevance.

Thus the decrease in amplitude can be interpreted primarily as a consequence of physiological changes, i.e. a decrease in the muscle tone. One could suggest that the reduction in myoelectric activity confirms the results of former investigations where similar trends could be observed after heat application on the resting muscle (10). A decrease in amplitude indicating a decrease in the myoelectric activity or the muscle tone is reported also after other forms of physical therapy without heat application (11). Using the same technique as in the present study a decrease in amplitude could be observed after massage treatments. The same trend is seen with techniques to reduce the muscle tone, for instance with acupuncture (12).

A muscle tone reducing effect is further implied by changes in thermoregulation, an aspect well investigated, where an increase in muscle tone due to low temperatures (inducing low_temperature_creeping) decreased if heat was supplied (13).

A reduction in myoelectric activity is usually interpreted as a decrease in the muscle tone (2, 7, 8). A clear definition of the term "tone", however, is lacking, because the underlying neuro-muscular changes are poorly understood. In the present study the muscular tone is interpreted as the activity of different kinds of fibers (red, white, intermediate) representing the result of complex modes of recruitment. Thus the decrease in muscular tone can be interpreted as a change that leads to a quantitatively and qualitatively different state of activity via changes in the mode of recruitment. It is known that an increase in muscular strength and the compensation for fatigue are closely linked with a successive innervation of increasingly large motor units (besides an increase in frequency) and that changes in the state of activation of smaller motor units occur when strength decreases and recreation takes place (14–17). This indirectly implies that the same muscular work happened before and after heat application with a different recruitment of muscle fibers. After heat implication less muscle fibers might get activated, indicated an economizing of muscular work. Since a small amount of fibers defines smaller muscular units, the latter preferably innervating red muscle fibers, also a fiber-specific interpretation of these phenomena seems to be plausible.

Conclusion

Heat application results in a decrease of myoelectric activity. This is interpreted as a change in recruitment, which is in accordance with an economizing effect of muscular work.

References

(1) Struppler A: Pathophysiologie und Klinik des Skelettmuskeltonus. Arch Physik Ther 1958;10:276.
(2) Kirwan EOG: Back Pain, in Wall PD, Melzack R (eds): Textbook of Pain. Churchill Livingstone, 1989, p 335.
(3) Schmidt KL: Physikalische und balneologische Therapie rheumatischer Erkrankungen. Therapiewoche Schweiz 1982;2:148-156.
(4) Senn E: Physikalische Therapie, inn Fehr K, Miele W, Schattenkirchner M, Tillmann K (eds): Rheumatologie in Praxis und Klinik. Stuttgart, Thieme, 1989.
(5) Schmidt KL: Grundlagen und Wirkung länger applizierter Kälte- und Wärmeanwendungen in der Therapie, in Schmidt KL (ed): Kompendium der Balneologie und Kurortmedizin. Darmstadt, Steinkopf, 1989, p 325.
(6) Breithaupt H, Demuth F: Physiologische Grundlagen der Kalt- und Warmanwendungen, in Hildebrandt G (ed): Physikalische Medizin, Band 1. Hippokrates, 1990, p 81.
(7) Schmidt KL, Podzich M: Elektromyographische Untersuchungen bei entzündlichem und degenerativem Wirbelsäulenrheumatismus. Z Rheumaforsch 1967;26:376-382.
(8) Schmidt KL, Podzich M: Oberflächenelektromyographische Untersuchungen bei der ankylosierenden Spondylitis. Arch Physik Ther 1967;19:129-133.
(9) Laurig W, Rohmert W: Zeitliche Veränderungen von Oberflächen-Elektromyogrammen bei statischer und einseitiger Muskelarbeit, in Rohmert W (ed): Muskelarbeit und Muskeltraining. Stuttgart, Gentner, 1968, p 137.
(10) Schmidt KL: Personal communication.
(11) Zauner-Dungl A, Ebenbichler G, Uher E, Bochdansky T, Resch KL, Quittan M: Changes of the surface-EMG after a short duration massage. Eur J Phys Med Rehab 1992;2:168.
(12) Kitzinger E: Kommentar und Ergänzung zur Arbeit von Gaymans "Experimentelle Untersuchungen". Dtsch Z Akupunkt 1982;6:172.
(13) Koslowski L, Krause F: Kälte und Wärme, in Siegenthaler W (ed): Klinische Pathophysiologie. Stuttgart, Thieme, 1970, p 970.
(14) Hannerz J: Discharge properties of motor units in relation to recruitment order in voluntary contraction. Acta Physiol Scand 1974;91:374.
(15) Grimby L, Hannerz J: Disturbances in voluntary recruitment order of low and high frequency motor units on blockades of proprioceptive afferent activity. Acta Physiol Scand 1976;96:207.
(16) Stoboy H, Nüssgen W, Friedebold G: Das Verhalten der motorischen Einheiten unter den Bedingungen eines isometrischen Trainings. Int Z Angew Physiol 1959;17:391.
(17) Eccles JC, Sherrington CS: Numbers and contraction values of individual motor units examined in some muscles of the limb. Proc Roy Soc B 1930;106:326.