Skin Temperature during Cold Pressor Test in Fibromyalgia: an Evaluation of the Autonomic Nervous System?

G. Brussemans (*), H. Nogueira Carvalho (**), E. De Schamphelaere (***), J. Devulder (*), G. Crombez (****)

Abstract: Introduction: Fibromyalgia (FM) is a common chronic pain disorder characterized by whole-body pain and multiple symptoms. This study investigated potential dysfunctions of the Autonomic Nervous System (ANS) in FM patients through the measurement of the autonomic response during a cold-water test.

Methods: 23 female patients with FM and 15 healthy female controls were recruited. First, FM patients filled out the following questionnaires: PainDETECT, American College of Rheumatology (ACR) criteria of FM, and Profile of Mood States (POMS). Healthy controls only filled out the POMS. Subsequently, all participants immersed their forearm into 1°C cold water as long as they could tolerate for a maximum of 120 seconds. A thermographic camera recorded skin temperature and its recuperation process.

Results: The two groups differed significantly regarding central body temperature, forearm thermography, and peripheral (forearm)-central (ear) temperature ratio. FM patients showed less tolerance to cold water than control participants. Although total temperature decrease, cool-down rate, recuperation between 0 and 20 minutes after withdrawal showed significant intergroup differences, thermal recovery followed similar patterns in both groups.

Discussion: Peculiar ANS baseline characteristics are seen in FM patients. Although those patients have reduced ability to sustain low temperatures, therefore limiting extrapolation of inter-group analysis, their thermal-adaptive responses were found different as compared to controls.

Key words: Fibromyalgia; Autonomic Nervous System; Thermal response; Thermography.

INTRODUCTION

Fibromyalgia (FM) is a prevalent chronic pain disorder. It is estimated to affect approximately 2% of the European population, predominantly females. FM is one of the most commonly observed chronic widespread conditions by rheumatologists. A substantial amount of FM patients first present and seek ongoing care in the primary care setting (1). The syndrome is characterized by chronic widespread pain and multiple symptoms, ranging from fatigue, sleep disturbances, cognitive dysfunction, and depressive disorders, but may also include neurologic symptoms such as paresthesia, blurred vision, numbness, and weakness (2). FM is commonly associated to other disorders such as Chronic Fatigue Syndrome, Irritable Bowel Syndrome (IBS), Irritable Bladder Syndrome, Interstitial Cystitis, and Temporomandibular Disorder (TMD). Patients with FM primarily complain of pain. Investigations have revealed that FM is often characterized by hyperalgesia (increased pain response to normally painful stimuli) and/or allodynia (pain responses to normally non-painful stimuli), which has been observed during heat, cold, and mechanical or ischemic tests (2). These abnormal responses suggest that the aberrant functioning of pain/sensory processing in patients with FM is centrally located, rather than confined to the region of the body where pain is experienced (3).

The underlying mechanisms of such pathological responses are still unclear, and may involve multiple factors. It has been proposed that disruptions in the cascade of responses to stress, particularly at the level of the hypothalamic-pituitary-adrenocortical (HPA) axis, and at the level of the locus coeruleus/norepinephrine-sympathetic (LC-NE) systems, may be an important symptom-generating mechanism. However, studies of the HPA axis function in FM patients have revealed inconsistent results, with both HPA axis hypo- and hyperactivity being identified (6).

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Others have shown that patients with FM show abnormal concentrations of neurochemicals and receptors, a condition that is ultimately associated with increased signaling within pro-nociceptive (ascending) pathways, and decreased signaling in anti-nociceptive (descending) pathways (8). Whereas decreased activity of anti-nociceptive pathways is evidenced by low cerebrospinal fluid (CSF) concentrations of metabolites of neurotransmitters such as serotonin, norepinephrine and dopamine, an increased signaling in pro-nociceptive pathways is suggested by increased CSF levels of other neurotransmitters (1). These include substance P, nerve growth factor, brain-derived neurotrophic factor, glutamate, and other excitatory amino acids. Glutamate, through its N-methyl-D-aspartate receptor subtype, is known to produce increased central sensitization to pain. This is also known as the “wind-up” effect. After repeated painful stimulations, the “wind-up” phenomenon is responsible for a progressive central pain amplification, which results in greater hyperalgesia and allodynia.

Besides the above-mentioned CNS abnormalities in FM patients, dysfunctions of the Autonomic Nervous System (ANS) have also been described (2, 9). The ANS is the main regulator of involuntary functions such as blood pressure, heart rate, respiration, temperature, intestinal motility, urination, and sexual activity (10). ANS abnormalities have been documented in conditions such as irritable bowel syndrome, chronic fatigue syndrome, and migraine headache. Those conditions are often associated with FM, suggesting a similar pathophysiology (11). Studies examining the ANS in FM patients have reported increased autonomic activity as measured by elevated skin conductance, heart rate (12), and blood flow (13). Twenty-four hour Heart Rate Variability (HRV) analysis during a circadian-variation study has shown increased nocturnal predominance of low-frequency band oscillations in FM patients, suggesting exaggerated sympathetic modulation of the cardiac sinus node (14). Impaired sympathetic reactivity to orthostatic and tilt-table stress has also been reported (15, 17), along with hypo-reactivity to various sympathetic stimuli such as auditory stimulation and cold pressor test at 10 and 4°C (16). Dysfunction of the ANS is also presumed to play a role in diverse clinical manifestations of FM such as sleep disorders, anxiety, Raynaud’s-like phenomenon, Sicca symptoms and intestinal irritability (11). FM is therefore a condition in which autonomic dysfunction is apparently prominent.

Starting from a clinical point of view, we aimed at evaluating the potential of an easy-to-perform test (in this case, the Cold Pressor Test) as a tool to identify ANS alterations in FM patients, and, therefore, help to further clinically define FM. The goal was to set up a simple experiment that was able to trigger ANS reactivity in response to a stressor. Given that body-temperature is regulated by the ANS, our experiment consisted of a cold-water immersion test, in which body temperature was precisely monitored before and throughout the different temperature response stages using a thermographic camera, and thermometers at different body points. Cold-water immersion stimulates cutaneous nociceptors, and cold-sensitive receptors. Nociceptors evoke an axon reflex and/or a reflex through the central nervous system, which in turn increases skin sympathetic nerve activity within the ice-water immersed area. This increased sympathetic nerve activity causes, first, vasoconstriction of cutaneous blood vessels, followed by vasodilation (22). The local cold stimulation also causes a reflex effect on the skin vascular system of the whole body.

**Methods**

**Participants**

A total of 38 women (mean age: 43 years, range: 20-56 years) were included.

Twenty-three of them were recruited at the Multidisciplinary Pain Center (MPC) of the Ghent University Hospital, and diagnosed with FM using the American College of Rheumatology (ACR) criteria (5). After manual assessment of tender-points, pressure pain thresholds were determined using a pressure FPK 10 algometer (Wagner Instruments). The average duration of their pain had been 8.3 years (range: 1-35 years). Thirty-five % of the sample daily used antidepressive medications (25% amitriptyline, and 10% serotonin reuptake inhibitors), and 50 % took pain medication daily. In all cases, current medications were maintained throughout the study.

Fifteen female healthy controls were selected to match the age of patients on a group level. Their clinical history was evaluated and pain complaints excluded. Pregnant women were excluded. The average age was 40 years (range: 20-56 years).

The experiments were approved by Ghent University Hospital’s local Ethics Committee. All participants were carefully informed on the study procedures, and provided informed consent.
FIBROMYALGIA AND THERMAL REACTIVITY

Materials

Thermographic pictures were recorded by a computer-assisted infrared thermographic camera (Thermacam SC300, FLIR, Danderyd, Sweden). This camera produces a matrix (representing image points) of temperature values (Fig. 1). The thermal sensitivity of the thermograph is 0.05°C at 30°C.

Body temperature was measured by bilateral ear thermometers (Genius 2 IR Tympanic Thermometer), and an electronic thermometer at the right axilla (Hantmann Thermonal Basic). The average ear temperature was calculated using the following formula: \( \text{left + right)/2} \).

Blood pressure and pulse rate were measured using an automatic monitor (Propaq Encore Welch Allyn).

The cold water test was performed using a Techne TE-10D Tempette device with cooler Techne DipCooler RU-200.

Study protocol

The experiment took place during the autumn of 2012 at the MPC. During the experiment, room temperature was kept constant at 23°C. All procedures were performed by the same investigator.

Anthropometric data (weight and height) were recorded, and BMI calculated. Basal blood pressure and heart rate were also collected. Patients filled out three questionnaires: PainDETECT, Profile of Mood Scale (POMS) and the New 2010 American College of Rheumatology Criteria of Fibromyalgia (ACR) (5). Controls filled out POMS only.

The PainDETECT questionnaire, developed and validated in Germany, is a self-report questionnaire with 9 items. Seven items describe sensory characteristics of pain, and 2 items describe spatial and temporal characteristics of pain. Sensitivity and specificity of the PainDETECT compared to clinical diagnosis are 85% and 80%, respectively. PainDETECT is often used for screening of neuropathic pain components (23). For this purpose, a total PainDETECT score lower than 12 indicates that a neuropathic component of pain is unlikely, a score between 12 and 18 is defined as ambiguous, and a score higher than 18 is likely to correspond to the presence of a neuropathic pain component.

The Profile of Mood Scale (POMS) is a widely used instrument designed to assess current mood state. POMS consists of 65 adjectives selected to measure seven mood areas (anxiety, tension, depression/dejection, anger/hostility, confusion/bewilderment, vigor/activity, fatigue/inertia, and friendship). Responses to each item range between 0 and 4, with higher scores indicating more negative moods over the past week (0 indicates “not at all”, regarding the presence of an adverse mood, and 4 indicates “extremely”) (24). In this study, we used a modified POMS version. First, a shortened 32-item version was used, and second, negative emotions were given negative scores while positive emotions were given positive ones. Hence, the final score appeared to be representative of patient positivity or negativity, according to its absolute distance from zero.

Besides the presentation of widespread pain and symptoms for 3 months or more, the New 2010 ACR criteria consists of the Widespread Pain Index (WPI) that assesses the number of painful body areas, and the Symptom Severity Scale (SS) that assesses the severity of fatigue, waking unrefreshed, and cognitive symptoms, as well as the extent of other somatic symptoms. The presence of 3 major criteria is required for the diagnosis of FM: 1) WPI ≥ 7 and SS ≥ 5, or WPI 3-6 and SS ≥ 9; 2) Symptoms lasting at least three months at a similar level; 3) No other health problem that would explain the pain and other symptoms.

The experiment was based on a cold-water immersion test. The water temperature was kept at 1°C ± 0.5°C. Participants were instructed to merely wear light and thin single-layer clothing in order to avoid a clothing confounding effect. Immediately before the test (T), pain was assessed using a 0-10 Numerical Rating Scale (NRS ; 0 = No Pain and 10 = Excruciating Pain), and a thermographic recording of the forearm was made. Subsequently,
patients were instructed to immerse their right forearm into cold water for a maximum of 2 minutes, or to withdraw their hand from the water whenever their NRS score of pain would reach 9 or 10.

Immediately after withdrawal (T0), skin temperature was measured using the supra-stated infrared thermograph and a NRS score referring to the patient’s general pain experience was obtained. During the recuperation procedure, thermographic recordings were obtained at 1 (T1), 2 (T2), 5 (T5), 10 (T10) and 20 (T20) minutes after withdrawal. At T1, blood pressure and pulse were measured. At T20, an NRS score of pain was once again obtained. All measurements took place while participants were standing upright.

Temperature calculation from the thermographic measurements took place after the experiment by means of the thermographic camera software. SPSS 17 Statistics Package for Social Sciences was used for the statistical analyses. Two-tailed Students’ t-tests for independent samples were used for the between-group comparison of parametric variables, while the Mann-Whitney U test was used otherwise. When needed, two-way mixed design ANOVA was used to preform within and between group comparisons. A P value < 0.05 was considered significant.

RESULTS

Fibromyalgia patients had a significantly higher BMI than healthy controls (P = 0.011). More obese participants (BMI > 30 Kg/m²) were found within the FM group (35% vs 0%). The average total PainDETECT score was 22.35 (SD : 5.83). Almost 75% of the FM patients (n = 15) had total PainDETECT scores indicative of a neuropathic component of pain (score > 18). The remaining 8 patients had a total PainDETECT score between 12 and 18 (ambiguous range). Most endorsed items were “Do you have sudden pain attacks in the area of your pain, like electric shocks?”, “Is cold or heat (bath water) in this area occasionally painful?”, “Does slight pressure in this area, e.g., with a finger, trigger pain?” All FM patients had a high score for all stimuli.

The POMS score for FM patients (Mean : -49.39, SD : 25.02) was significantly lower than the POMS score for healthy controls (Mean : 0.33, SD : 9.42), indicating that patients were in a more depressive, anxious mood. In both groups, no significant correlation was found between POMS score and immersion times.

Pain measures

No FM patients were able to tolerate cold pressor pain during the entire maximal 120 second duration of the test, contrarily to 7 participants of the control group. As a consequence, the mean immersion duration was significantly shorter for FM patients (Mean : 17.61, SD : 14.58) than for healthy controls (Mean : 75.93, SD : 44.43) (t = -5.866, df = 36, P < 0.001). We performed a 2 Group (FM vs healthy controls) × 3 time (baseline, T0 and T20) ANOVA on the NRS pain scores. There was a main effect of Group, indicating that FM patients reported more pain than healthy controls overall (Basal : F1,36 = 37.5 ; T20 : F1,36 = 67.7 ; both with P < 0.001; for T0, lack of homogeneous variance indicated to a Mann-Whitney test : Z = -4.384, P < 0.001). There was also a main effect of pain, indicating that self-reported pain was higher immediately after the immersion, and returned back to baseline pain after 20 minutes (P < 0.001, t = -7.641, df = 37 and P = 0.838, t = -0.206, df = 37, respectively). There was no interaction between Group and Time, which would have indicated a differential pattern of pain in FM patients (FM : baseline = 6.00 ; T0 = 9.00 ; T20 = 6 ; healthy controls : baseline = 1.00 ; T0 = 5.00 ; T20 = 1.00.). After plotting PAINDetect scores against POMS scores, no apparent pattern emerged to allow fitting of a correlation-derived model.

Temperature measures

At baseline, the axillar temperature was significantly higher in FM patients (Mean : 36.20°C, SD : 0.47) than in healthy controls (Mean : 35.80°C, SD : 0.47) (t1,36 = 2.286 ; P = 0.028)

The ear temperature did not significantly differ between FM patients (Mean : 36.8°C, SD : 0.43) and healthy controls (Mean : 36.70°C, SD : 0.49) (P = 0.910). Noteworthy, the right-left ear temperature difference was not significantly different between the 2 groups (t = 1.367, df = 36, P = 0.180). At baseline, the forearm temperature was significantly higher in FM patients (Mean : 31.90°C, SD : 1.05) than in controls (Mean : 30.90°C, SD : 1.42) (t = 2.526, df = 36, P = 0.016) (Table 1). The forearm/ear temperature ratio was significantly different between FM (Mean : 0.87) and Control group (Mean : 0.84 ; t = 2.406, df = 36, P = 0.021), but the index axilla/ear temperature ratio was not (Mean : 0.98 in both groups ; P = 0.083).

For the analyses of the absolute forearm temperature a 2 (Group) × 5 (Time (T0, T1, T2, T5, 23/04/15 14:34
T20)) ANOVA was performed. There was a main effect of Group, \( F_{1,36} = (5.4 ; 25.3), P = (0.001 ; 0.026) \) indicating that the reduction in forearm temperature was lower in FM than in healthy controls (13.50°C vs 17.40°C). There was a main effect of Time, indicating a gradual recovery (FM patients: \( t = (-13.256 ; -5.255), df = 22, P < 0.001 \); Healthy Controls: \( t = (-17.504 ; -4.328), df = 14, P < 0.001 \)). The average temperature gains in FM patients and controls were, respectively, 5.15 and 5.97 between T0 and T1, 1.25 and 2.51 between T1 and T2, 1.04 and 2.83 between T2 and T5, 1.35 and 1.43 between T5 and T10, and 1.34 and 1.39 between T10 and T20 (Table 1). The pattern of the recuperation process was generally comparable between groups, with statistical differences found between groups during the periods T1-T2 and T2-T5 (\( P < 0.01 ; F_{1,36} = 20.9 \) and 20.2, respectively) (Table 1). Healthy controls had a lower temperature after the experiment than FM patients (Mean: 12.9 and SD: 3.8 as compared to Mean: 18.5 and SD: 3.3). During the first 2 minutes, healthy controls showed faster recuperation than FM patients. From minute 5 to minute 20, temperature-gain rate was similar in both groups (Fig. 2). Taking account of the different immersion times, significant differences emerged when comparing absolute temperature recuperation after withdrawal of the forearm (\( t = 4.768, df = 36, P < 0.001 \)). After 20 minutes, FM patients had an average temperature recuperation of 10.12°C, whereas, in healthy controls, it was of 14.14°C.

Indeed, healthy controls started their recuperation from an average temperature of 12.92°C, that is 6°C less than FM patients (18.48°C). After 20 minutes, the forearm temperatures were rather similar between groups (FM patients: 28.60°C; healthy controls: 27.06°C).

Comparing temperature at basal (pre-immersion) conditions and after 20 minutes of recuperation temperatures, no statistically significant intergroup differences were found (\( t = -0.966, df = 36, P = 0.340 \)). FM patients had an average basal temperature of 31.94°C and an average recuperation temperature after 20 minutes of 28.60°C, indicating an incomplete recuperation (3.34°C deficit). Healthy controls had an average basal temperature of 30.93°C and an average recuperation temperature after 20 minutes of 27.06°C, also indicating an incomplete recuperation (3.87°C deficit) (Fig. 3).

During the T0-T5 minute period, FM patients showed a heavier cold-response (lower temperature gain) than healthy controls.

However, with further subdivision of this 5-minute period into 1-minute intervals, no significant differences were found regarding the temperature recuperation in any of the intervals.

As expected, there was a significant association between immersion duration and forearm temperature recovery. In order to limit the impact of this confound, we computed a new variable that accounted for the Cool-down rate, defined as the quotient of temperature decrease (°C) during immersion and time of immersion (seconds). There

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**Table 1**

Forearm temperatures and interphase gains throughout the Recuperation phase; * Statistically significant intergroup differences at a P threshold < 0.001.

<table>
<thead>
<tr>
<th>Period</th>
<th>Fibromyalgia Patients</th>
<th>Healthy Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basal</td>
<td>31.10</td>
<td>30.90</td>
</tr>
<tr>
<td>T0</td>
<td>18.48</td>
<td>12.92</td>
</tr>
<tr>
<td>Gain T0-T1</td>
<td>(5.15)</td>
<td>(5.97)</td>
</tr>
<tr>
<td>T1</td>
<td>23.63</td>
<td>18.89</td>
</tr>
<tr>
<td>Gain T1-T2</td>
<td>(1.25)</td>
<td>* (2.51)</td>
</tr>
<tr>
<td>T2</td>
<td>24.88</td>
<td>21.41</td>
</tr>
<tr>
<td>Gain T2-T5</td>
<td>(1.04)</td>
<td>* (2.83)</td>
</tr>
<tr>
<td>T5</td>
<td>25.92</td>
<td>24.23</td>
</tr>
<tr>
<td>Gain T5-T10</td>
<td>(1.35)</td>
<td>(1.43)</td>
</tr>
<tr>
<td>T10</td>
<td>27.27</td>
<td>25.67</td>
</tr>
<tr>
<td>Gain T10-T20</td>
<td>(1.34)</td>
<td>(1.39)</td>
</tr>
<tr>
<td>T20</td>
<td>28.60</td>
<td>27.06</td>
</tr>
</tbody>
</table>
was a statistically significant difference in cool-down rate between FM patients and healthy controls ($t = 5.505$, df = 36, $P < 0.001$). Mean cool-down rate for FM patients was 1.05 °C/s, as compared to 0.34 °C/s in controls. Therefore, FM patients, who generally stayed shorter time periods into cold water, had a higher cool-down rate (Fig. 4).

These results must, however, be cautiously interpreted, insofar as temperature transfer between bodies is not linear.

Similarly, the recovery progress between 5 and 20 minutes was not significantly different between FM patients and healthy controls, also after sub-analysis in 1-minute sub-periods.

Finally, regarding vital parameters (blood pressure), no significant statistical between-group differences were found. Control patients had slightly higher systolic and diastolic blood pressures, both during basal conditions and 1 minute after the beginning of recuperation (T1), but the difference did not reach statistical significance. Controls also had slightly higher pulse rates at T1, although this was not statistically significant.
DISCUSSION

Our study was designed to identify possible abnormal functioning of the ANS, using an easy to perform clinical test. We focused on localized thermal homeostatic responses to a stressor – in this case, slightly-above-freezing-point water. Regarding basal temperature measurements in a temperature regulated environment, our experiment detected significant differences in general resting body temperature (measured by axillary thermometer), right forearm temperature (measured by a thermal camera), forearm/ear temperature index, and right-left ear temperature difference. In the absence of evident confounders, these differences point a possible altered thermal homeostasis regulation in FM patients.

Striking and relatively limiting in the results analysis was the fact that FM patients were less able to withstand the immersion of their forearm into cold water, manifested by reaching high pain scores rapidly during the test. Whereas some controls were able to keep their forearm during 120 seconds into cold water, only one FM patient reached the 80 second barrier. As a consequence, controls had larger temperature drops than FM patients. These observations might be due to abnormal function of the ANS, and, therefore, faster ischemia, and/or aberrant pain perception in FM patients. These characteristics of FM have already been pointed out in previous studies (2, 3, 9, 12-17).

FM patients also presented a significantly faster cool-down rate. Nonetheless, one must consider that the lower pain-threshold demonstrated by FM patients, leading them to an earlier forearm withdrawal, impeded a fully comparable cool-down period. Bearing in mind the non-linear pattern of thermal equilibrium between bodies, independently of the rate of heat transfer, direct comparison of such rates is not meaningful. Nonetheless, they can be used as rather rough indicators of cooling, suggesting a possible abnormal ANS response. This abnormal ANS response could be related to increased sympathetic tone in FM patients during the first moments of the experiment.

Both populations showed similar temperature recovery patterns, in spite of the average 6°C temperature difference at the recovery starting point. None of the groups was able to return to initial temperature levels within the studied 20 minute recuperation period.

In spite of this initial temperature difference, the end temperature after 20 minutes of recuperation was similar between groups. Bearing in mind the lower immersion-times in FM patients (and, therefore, their smaller temperature drop), and the incapability of both groups to fully recover pre-immersion (equilibrium) temperature levels, there might have been aberrant ANS functioning leading to slower recovery in FM patients.

Analyzing other ANS-influenced parameters such as blood pressure and pulse rate, no significant alterations pointing towards ANS dysfunction were found. However, FM patients tended to have hyporeactive hypertensive and tachycardic responses.

From a psychological perspective, and supporting the vast majority of current literature descriptions, the applied POMS questionnaire revealed that FM patients exhibit more depressive and anxious moods in comparison to healthy controls. Given the sympathetic nature of the stress/anxiety response suggested by the POMS questionnaire in FM patients, one has to consider it as a potential vasoconstrictive confounding factor. Insofar as this mood profile is characteristic of FM syndrome, it seems reasonable to consider it an integrative component of the carried analysis. Moreover, no evident correlation was found between POMS score and immersion times in the FM group of patients.

This study has some limitations. Indeed, immersion durations were not equal for controls and FM patients. Future research should be performed using water at slightly higher temperatures, so that more participants are able to perform the task. Moreover, detailed analysis of the cool-down period might permit not only to document the thermal response to cold, but also allow correction for eventual inter-individual response differences.

Another point in our study is the extrapolation of ANS vasomotor responses based on thermographic evaluations, given the availability of other methods. Although most available studies prefer laser Doppler flowmetry or foot and hand electrical potentials measurements, some have indeed approached the potential use of this method. Its non-invasive and completely safe nature makes it a method that has to be considered for research purposes.

When interpreting our results, it must be kept in mind that chronic use of antidepressant medications was not an exclusion criterion for recruiting patients in our study. Indeed, 2 patients were taking serotonin reuptake inhibitors, and 3 were taking amitriptyline. Although a well-known relationship exists between depressive symptoms and alterations of ANS reactivity (26, 27), those patients were
included because polyfarmacy is a very common feature of FM. From a methodological point of view, withholding medication after inclusion was not considered, insofar as acute withdrawal of antidepressants and painkillers (the main consumed medications in our population) would expectably have been symptomatic, and have had repercussions onto the neuroendocrine system. This would have ultimately made interpretation of our data difficult (if not impossible). Progressive weaning from these medications was unpractical in terms of study design/inclusive criteria, and not ethically defendable, considering the needs of those patients. The potential interference of these medications on the observed results cannot be ignored. Recent pilot studies in FM patients indicate that amitriptyline conditions an increase in blood flow to the extremities, while not changing the basal autonomic tone (28). Although studies investigating the influence of serotonin reuptake inhibitors on peripheral blood flow in FM patients exist, their known inhibitory effects on the sympathetic nervous system lead to the assumption of increased peripheral blood flow (29).

This study was driven by clinical needs and a search for a better understanding and diagnosing of FM. Performing this simple cold-pressor-test, however, gave more information on the altered pain sensations than on eventual altered function of the ANS.

Further refinement of this test is needed, as well as comparisons with other methods of ANS function assessment. Heart rate variability could be an adequate comparison method.

References