AN EXAMINATION OF THE THRESHOLD LEVEL OF PRESSURE PAIN IN CASES OF CHRONIC PAIN

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ABSTRACT

Introduction*: The aim of this study is to determine the threshold levels of pressure pain in individuals with chronic pain and to investigate the correlation between the different variables.*

Materials and methods*: The research sample consisted of 60 adult patients who were attending the algology outpatients' clinic, and who had complaints of chronic pain with a duration of at least six months relating to the musculoskeletal system. Before measuring the patients' pressure pain thresholds, they were asked to mark their severity of pain, taking into account their general pain when in motion. Later, an algometer was used to take measurements of the pressure pain threshold in the mid deltoid, mid ulna, hypothenar eminence, mid tibia, and quadriceps femoris regions.*

Results*: Results of statistical analysis showed no significant difference between the mean regional pressure pain thresholds of patients according to illness group ($P > 0.05$), but did show a significant difference between the mean regional pressure pain thresholds of male and female patients ($P < 0.05$).*

Conclusion*: It was concluded in this study that there was no difference between groups of patients with complaints of chronic pain relating to different musculoskeletal diseases and regional pressure pain threshold levels, that the factor of gender affected the regional pressure pain threshold level.*

Keywords*: baseline algometry, chronic pain, pressure pain threshold, musculoskeletal diseases.*

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Introduction

According to the definition of the International Association for the Study of Pain (IASP), pain is an unpleasant sensory and emotional experience accompanying real or possible tissue damage[1,2]. This definition also appears in the Kyoto protocol of IASP Basic Pain Terminology[3]. Pain today is one of the most important health problems which send people to seek help from health professionals. It has been reported that chronic pain especially is a problem which leads people to seek help, that it constitutes a serious burden on the health system, and that it raises health costs[4-7].

Pain is always subjective and is expressed parallel to the pain threshold which is effective in a person's social life[8]. Various scales are used to assess pain, and tenderness measurement has conventionally been achieved by triggering or pressurizing muscles[9]. The pressure algometer (dolorimeter) is used today to make quantitative assessments of an individual's pain level, to determine pain perception, and to measure the sensitivity of muscle and other soft tissue[9-12].

The pressure pain threshold is defined as the minimal pressure which causes pain[12]. Pressure pain threshold measurement using a pressure algometer was first performed by Libmann in 1934. Later, clinical use of the pressure algometer gradually became more widespread. Algometers used in the measurement of pressure pain threshold are hand-held pressure instruments with springs.

A part of the body is pressed with a rubber disk with an area of 1 cm^2, and the pressure is indicated in the instrument[9-10]. In addition, rather more sophisticated digital devices have been developed. The pressure algometer is reported not to cause any injury to the patient in clinical use, to give acceptably repeatable results and to be reliable[9,12,13].

The pressure algometer was in fact developed to assess various widespread diseases of the musculoskeletal system and to measure pressure pain thresholds and sensitivity. Studies have been conducted assessing pressure pain thresholds in various musculoskeletal diseases with the use of algometers[9,14-16]. In addition, studies exist which were performed with different groups[10,12,17-19]. It is reported in studies relevant to this topic that the pressure algometer is a valid and reliable method for use both with healthy individuals and with those with various diseases[10,12-14,17,20].

Another aspect is that it plays a major role in the assessment and control of pain by health professionals. A health professional can contribute to the process of patient pain management by knowing the methods of effective pain assessment and the factors which affect it. When health professionals are assessing pain, it is clear that they must use methods which have no possibility of side effects, which do not harm the patient, and which do not threaten the patient's safety. The aim of this study was to determine pressure pain threshold levels in individuals with chronic pain and to examine the relationship between the different variables.

Research questions

The research questions were as follows:

• Is there a difference between the pressure pain threshold levels of individuals with chronic pain?

• Do the different variables affect pressure pain threshold levels of individuals with chronic pain?

Materials and methods

This research was an experimental study. The study was conducted between September 2016 and February 2017 in the algology outpatients' clinic of a university hospital located in the Marmara Region of Turkey. The research sample consisted of 60 adult patients who were attending the algology outpatients' clinic, and who had complaints of chronic pain with a duration of at least six months relating to the musculoskeletal system, which was being followed in the clinic. Because most patients visiting the clinic where the research was performed had complaints of pain relating to the musculoskeletal system and because the disease group factor[9,10,17,22] could have affected the pressure pain threshold level, only individuals with complaints of pain relating to diseases of the musculoskeletal system were included in the study.

Permission to conduct the study was obtained from the Local Ethics Committee (Decision No. 2016-12/6). Also, information on the study was given to the individuals participating, after which their written and oral approval to participate voluntarily was obtained. The criteria for inclusion in the study were being over 18 years of age, not being pregnant, having had a complaint of chronic pain relating to a disease of the musculoskeletal system for at least six months, not having used medications such as analgesics or anti-inflammatory drugs for at least eight hours, not having in either the upper or lower extremities any previous surgery or hemiplegia, vasculitis, neurovascular skin diseases, peripheral vascular disease, spinal cord injury, burns or sensation disorder, and having voluntarily agreed to participate in the study. The size of the research sample was calculated statistically by power analysis. For 0.80 power and 0.05 type I error, a sample size of 45 was determined. This was calculated with the help of the program PASS 13.0 (PASS, Kaysville, Utah, USA). Sixty patients who conformed to the inclusion criteria on the dates of the study were included. A simple random sampling method was used in the selection of the research sample.

Individual Description Form and Visual Analog Scale (VAS)[23] are used as data collection tools. After ensuring the voluntary participation of the patients, their descriptive characteristics were recorded on the data collection forms. Then they were given information about the VAS. In measuring the patients' pressure pain threshold, they were first asked to indicate the severity of their pain at a point on the VAS which they thought suitable taking into account their general pains when in motion, and the values indicated were recorded.

All pressure pain threshold measurements were made by the same person, in the same place and at the same room temperature, and with the same equipment. Also, to ensure the reliability of the results, all measurements were made with each individual separately so that they would not affect

each other. After this stage, the patients' pressure pain threshold measurement was carried out using a Baseline Algometer (66 lb/30 Kg, Fabrication Enterprises, Inc (FEI), New York, USA). It was found that the manually operated baseline algometers used in other studies had high reliability and validity[12,24,25]. Calibration of the algometer used was made in terms of usability. Measurements were made with an apparatus with a 1 cm^2 disk attached to a calibrated pressure instrument. The patients were shown the measuring device and they were given information. In order to introduce the patients to the feeling of pressure, pressure was applied to an area, the antecubital region, other than the region where measurement was to be made. They were asked to say "Stop" at the first feeling of pain. This process was performed three times with each patient, and ensured the patients' compliance when the actual measurement was performed.

Measurements were always made to the different regions in the same order and bilaterally. The pressure applied was increased until the patient felt pain and gave the order to stop. Then the measurement was stopped. Three measurements were made in each region at 30-second intervals and their mean value was recorded as the pressure pain threshold for that region[18,26,27]. Measurements were taken with the individual sitting straight on a chair at a table with both feet on the ground. During all measurements, the researcher held the algometer in her free hand, preventing it from slipping under pressure. In the interests of reliability[9], all measurements were taken by the same researcher.

Mid Deltoid: With the patient in the sitting position, the researcher took a measurement by applying pressure to the lateral surface of the arm 2 cm below the acromion at an angle of 90° to the surface.

Mid Ulna: The patient's elbow was placed on the table with the forearm in flexion and the long axis of the forearm at an angle of 90° to the table. The researcher made the measurement at the midpoint of a line between olecranon and the ulnar styloid process.

Hypothenar eminence: The whole dorsal surface of the patient's forearm was placed on the table and the researcher performed the measurement at the midpoint of the hypothenar region of the palmar surface of the hand.

Mid tibia: The patient was placed in a sitting position with the feet flat on the floor and the knees at a flexion of 60°, and pressure was applied 6 cm distal to the tibial tubercule at an angle of 90°.

Femoral region (Quadriceps femoris): The patient was laid in a supine position on the treatment table, and measurement was made by applying pressure at an angle 90° at the midpoint of a line on the front surface of the thigh between the upper edge of the patella and the spina iliaca anterior superior.

The pressure applied was increased until the individual felt pain, at which point the patient gave the command to stop and the measurement was terminated. The value shown on the algometer screen was read, and the mean of three measurements was recorded as the pressure pain threshold for that region. The mean of these measurement results calculated from both left and right sides was taken as the pressure pain threshold for that region and the results were interpreted according to these values.

Statistical analysis

Statistical analysis of the research data was performed using the statistics package IBM SPSS 22.0 (SPSS Inc., Chicago, IL, USA). Numerical data was examined for normal distribution with the Shapiro-Wilk test. One-way variance analysis (ANOVA) and the Mann-Whitney test were used in data analysis. Also, correlations between variables were examined with Spearman correlation coefficients. Significance was taken as $P < 0.05$.

Results

The patient included in the study was 56.7% female, their mean age was 59.85±12.79 years, their mean body mass index was 28.52±4.45 kg/m2, and the mean duration of their illness was 4.27±4.23 years.

Mean pressure pain threshold values obtained from the patients were 5.44±1.62 for the mid deltoid region, 6.30±1.66 for the mid ulna region, 5.02±1.68 for the mid tibia region, 6.12±1.37 for the hypothenar eminence region and 6.26±2.0 for the femoral region. Table 1 shows the patients' mean pressure pain threshold values according to disease groups. According to the results of statistical analysis conducted in this way, there was no significant difference between regional pressure pain mean values according to the patients' disease groups ($P > 0.05$).

Table 2 shows the regional pressure pain mean values of patients included in the study according to the variable of gender. The results of the analysis

showed a significant difference between the regional pressure pain mean values of male and female patients ($P < 0.05$).

Pain pressure threshold	MPS Mean (SD)	AS Mean (SD)	RA Mean (SD)	OP Mean (SD)	P value
Mid deltoid	5.52 (1.79)	5.81 (1.49)	4.62 (1.10)	5.54 (1.87)	0.287
Mid ulna	6.62 (1.74)	6.35 (1.55)	5.51 (1.09)	6.40 (2.12)	0.356
Mid tibia	5.06 (1.59)	5.28 (1.90)	4.23 (0.92)	5.32 (2.03)	0.376
Hypothenar eminence	6.32 (1.38)	6.06 (1.24)	5.50 (1.21)	6.47 (1.66)	0.341
Quadriceps femoris	6.74 (2.26)	6.25 (1.61)	4.89 (1.25)	6.78 (2.25)	0.067

Table 1: Distributions of patients' regional pressure pain threshold levels according to their illness groups.
MPS, Myofascial Pain Syndrome; AS, Ankylosing Spondylitis; RA, Rheumatoid Arthritis; OP, Osteoporosis; SD, Standard Deviation

	Mid deltoid Mean (SD)	Mid ulna Mean (SD)	Mid tibia Mean (SD)	Hypothenar eminence Mean (SD)	Quadriceps femoris Mean (SD)
Gender					
Female	4.75 (1.31)	5.87 (1.62)	4.52 (1.56)	5.70 (1.34)	5.25(1.33
Male	6.35 (1.56)	6.86 (1.56)	5.66 (1.64)	6.66 (1.22)	7.58(1.98)
P value	**0.000**	**0.022**	**0.006**	**0.010**	**0.000**

Table 2: Distributions of patients' regional pressure pain threshold levels according to their gender.
SD, Standard Deviation

	Age r *P*	Illness duration r *P*	VAS r *P*
Pressure pain threshold			
Mid deltoid	0.203	-0.167	0 .169
	0.120	0.202	0.198
Mid ulna	0.128	-0.46	0.245
	0.328	0.726	0.060
Mid tibia	-0.180	-0.256	0.038
	0.889	**0.048**	0.774
Hypothenar eminence	0.085	-0.089	0.056
	0.519	0.499	0.669
Quadriceps femoris	0.06	-0.331	0.043
	0.651	**0.010**	0.747

Table 3: Correlation between patients' pressure pain threshold levels and their ages, pain severity and illness duration.
r, Spearman Correlation Coefficient

Examining the mean pain scores of the patients taking part in the study according to disease group, these were found to be 8.85±1.87 for patients with myofascial pain syndrome, 7.25±2.62 for those with ankylosing spondylitis, 7.90±3.02 for those with rheumatoid arthritis, and 5.58±2.78 for those with osteoporosis. A statistically significant difference was found between the patients' mean pain scores according to disease groups (K-W = 11.006, P = 0.012). The results of advanced analysis showed that there was a significant difference between the mean pain scores of patients with myofascial pain syndrome and those with osteoporosis (P = 0.006), but a significant difference was not found between the mean pain scores of patients with myofascial pain syndrome and those with ankylosing spondylitis or rheumatoid arthritis (P = 0.203 and P= 0.741, respectively).

Table 3 shows findings relating to the correlation between patients' regional pressure pain mean values and their mean ages, durations of illness and mean pain scores. A significant correlation was found between illness duration and the pressure pain threshold mean values of the mid tibia and quadriceps femoris regions ($P < 0.05$), but no statistical correlation was found between the patients' pressure pain threshold mean values and the other variables ($P > 0.05$).

Discussion

Chronic pain relating to diseases of the musculoskeletal system is one of the most important reasons for morbidity in societies today[14,28,29]. The effective and objective assessment of pain can contribute to the process of managing a patient's pain. Objective assessment of pain is very difficult. The correct assessment of pain level is important both to determine the effectiveness of the treatment being applied and in order to give individualized pain treatment. Monitoring the severity and continuity of pain improves patient care and helps to ensure that the treatment is suitable for the patient[30]. Pressure algometry, one of the methods of objective pain assessment, is used in the assessment of the pain of many diseases of the musculoskeletal system, in measuring the sensitivity of muscle and other soft tissue, in determining therapeutic effects, and in monitoring treatment[9,10,12].

The aim of the present study was to examine pressure pain threshold levels in individuals with complaints of chronic pain deriving from diseases of the musculo-skeletal system and the correlations between the different variables. The results showed no significant difference between regional pressure pain mean values according to the patients' illness groups (Table 1). It is thought that this result arises from the patients being in illness groups with chronic pain and similar complaints. The highest

pressure pain threshold was seen in patients with rheumatoid arthritis, although the difference was no statistically significant. In a study by Incel et al. pressure pain threshold values were compared in 18 regions in patients with ankylosing spondylitis and rheumatoid arthritis and healthy volunteers[15]. It was found that the patients with ankylosing spondylitis had lower pressure pain pressure thresholds than the healthy participants, the rheumatoid arthritis patients had a significantly low pressure pain threshold value, and ankylosing spondylitis did not have as widespread a pain table as rheumatoid arthritis.

In a study by Vladimirova et al. it was found that the pressure pain threshold values of patients with rheumatoid arthritis were very low[31]. In a study by Lee et al. with rheumatoid arthritis patients, the regional pressure pain threshold values of the patients were found to be similar to those in our study; arthritis-related inflammation in these patients increased pain sensitivity in their joints and muscles, resulting in a reduction of their pressure pain threshold levels[32].

It is reported in the literature that the pressure pain threshold level may vary by gender: the pressure pain threshold values of females are lower than those of males, and the gender difference affects the pain threshold value[9,10,18,31,33-35]. The result of this study showed that the mean pressure regional pain threshold values of female patients were significantly lower than those of male patients (Table 2). Our findings were similar to those of the literature.

The results of the present study showed that patients with myofascial pain syndrome had the highest mean pain severity score. It is noteworthy that even though the mean pain scores of patients in this group were high, this did not affect their pressure pain threshold values. It thought that this result may be because measurement of patients' pressure pain thresholds was not made at the pain trigger points of patients in this group.

A significant correlation was found in the study between the duration of illness and the mean pressure pain threshold values measured at the mid tibia and quadriceps femoris regions (Table 3). It was seen from this result that as the duration of the patients' illness increased, the pressure pain threshold levels measured from the lower extremities decreased. It is emphasized in the literature that pressure pain threshold levels vary from one region of the body to another[9,10,17,22,36]. Therefore, it is thought that the study result may arise from the possibility that sensitivity and pain perception in the lower extremities of patients are greater than in other regions.

Studies have reported that age[33,37] and pain severity[33,35] may be related to the pressure pain threshold level. Also, it has been emphasized that the effect of age on pain perception varies according to different pain stimuli and that the pressure pain threshold level increases with age[37,38]. Different from the results of the studies mentioned above, no correlation was found in our study between patients' age and mean pain scores and their mean pressure pain threshold values. Thus the results were found not to accord with those of previous studies. This has been interpreted as arising from factors such as the characteristics of the patient group included in the study and the type of algometer used[9,10,17,22].

Conclusion

As a conclusion of this study, no difference was found between the patient groups of individuals with complaints of chronic pain relating to various diseases of the musculo-skeletal system and regional pressure pain threshold levels; it was found that the gender factor affected the regional pressure pain threshold level, and that age and pain severity level did not affect it. Among the limitations of this study are that it was conducted with patients with diseases of the musculo-skeletal system and therefore cannot be generalized. The subjective nature of pain severity measurement is an important limitation of the study.

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