Turkish Journal of Geriatrics
2015;18(2):130-135

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RESEARCH

PAIN SENSITIVITY IN THE ELDERLY

ABSTRACT

Introduction: In previous studies of pain sensitivity in the elderly, reliance on experimental assessments of the pain threshold has led to inconsistent results; thus, the impact of ageing on pain sensitivity is still uncertain. In this study, we investigate the changes in experimental and clinical pain sensitivity in an elderly population.

Materials and Method: Pressure pain threshold measurements were obtained using a digital algometer for 80 elderly patients with chronic low back pain and 80 younger patients with low back pain (control group). A visual analog scale was used to assess the sensitivity of the thumbnail bed to painful stimuli (Thumb-VAS) and to low back pain (Low back pain-VAS). Correlation analyses were then used to explore the association between parameters of experimental and clinical pain sensitivity.

Results: Both groups had comparable gender distribution, body mass index, Beck Depression Inventory scores and pain duration (p>0.05 for all). There was no difference between the groups in experimental pain sensitivity parameters, including deltoid, 1st dorsal interosseous, tibial pressure pain threshold, thumb-VAS and low back pain-VAS (p > 0.05 for all). While experimental pain sensitivity parameters were highly correlated with each other (p=0.000 for all), they did not show a correlation with clinical pain sensitivity.

Conclusion: Healthy physiological ageing does not have a considerable impact on pain sensitivity as assessed by either experimental pain or clinical pain sensitivity.

Key Words: Ageing; Pain Perception; Pain Threshold.

ARAŞTIRMA

YAŞLILARDA AĞRI DUYARLILIĞI

ÖZ

Giriş: Deneysel ağrı eşiği ölçümlerine dayanan çalışmalarda elde edilen çelişkili sonuçlar nedeniyle yaşlanmanın ağrı duyarlılığı üzerine etkisi kesin olarak belirlenememiştir. Çalışmamızın amacı yaşlılarda deneysel ve klinik ağrı duyarlılıklarında oluşabilecek değişiklikleri araştırmaktır.

Gereç ve Yöntem: Kronik bel ağrılı 80 yaşlı hasta (71.3±5.4 yıl) ile 80 genç hastadan (28.8±4.4 yıl) oluşan kontrol grubunda dijital algometre ile basınç ağrı eşiği ölçümleri yapıldı. Visuel analog skala kullanılarak tırnak yatağının eşit düzeydeki ağrılı uyaranlara duyarlılığı (Başparmak-VAS) ve hastaların bel ağrısına olan duyarlılıkları (Bel ağrısı-VAS) değerlendirildi. Yüzaltmış hastanın tümü üzerinde yapılan korelasyon analizleri ile deneysel ve klinik ağrı duyarlılığı parametrelerinin ilişkisi incelendi.

Bulgular: Gruplar cinsiyet dağılımı, vücut kitle indeksi, Beck Depresyon Ölçeği skorları ve ağrı süresi açısından birbirine benzerdi (Bütün p'ler>0.05). Deneysel ağrı duyarlılığı göstergeleri olan deltoid, 1.dorsal interosseöz, tibia basınç ağrı eşiği ölçümleri ve başparmak-VAS'ın yanı sıra bel ağrısı-VAS değerlerinde de gruplar arasında fark bulunmadı (Bütün p'ler>0.05). Deneysel ağrı duyarlılığı parametreleri birbirleri ile ileri düzeyde ilişkili olmalarına rağmen (Bütün p'ler=0,000) klinik ağrı duyarlılığı (Bel ağrısı-VAS) ile ilişkili bulunmadılar.

Sonuç: Gerek deneysel gerekse klinik ağrı duyarlılıkları ile değerlendirildiğinde sağlıklı fizyolojik yaşlanmanın ağrı duyarlılığı üzerine belirgin etkisi görünmemektedir.

Anahtar Sözcükler: Ağrı Algılaması; Ağrı Eşiği; Yaşlanma.

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Received: 22/04/2014

Accepted: 28/04/2015

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INTRODUCTION

Prolongation of life expectancy over the past few decades has produced a significant population of aged people, many of whom experience significant pain. According to the United Nations, the number of persons aged 60 or over is expected to increase globally from 841 million in 2013 to 2 billion in 2050 (1).

Ageing is associated with structural, functional and biochemical changes at every level of the nociceptive pathways, from the receptors to the cerebral cortex (2). Thus, there has been an interest in the impact of ageing on pain perception. The most common method used for assessment of pain perception in healthy elderly people is measurement of the pain threshold (PT). To date, data from these studies has been inconsistent; some studies suggest an increased PT with advancing age (3-5) while others show reduced (6-8) or unchanged PT (9-12).

It has been reported that while thermal stimulation generally leads to an increase in PT with age, pain pressure threshold (PPT) has had varied results in published studies and no overall changes in PT have been shown after electrical stimulation in the elderly (2). Studies have even shown that PT may vary in the same individual with the use of different stimulation methods (6,8). During PPT assessment, measurements over muscles has shown increased PT in the elderly (3,4), whereas measurements taken from points close to the bone gave decreased PT (6-8). An important consideration in these studies is the requirement for assessing the mental state of the elderly people, since pain rating relies on the patient's report (13,14). With so many factors affecting PT measurement and the wide range of results obtained, the question that comes to mind is, 'is PT alone sufficient to evaluate pain sensitivity in the elderly?'

Changes in pain sensitivity may be more accurately determined when clinical pain sensitivity is assessed in addition to experimental PT. Few data exist on the association of PT with clinical pain scores (PS) in elderly people (12). Similarly, available data on the association between the sensitivity to supra-threshold painful stimuli and age are also scarce (7). In this study, the following were our primary objectives: 1) to compare PPT levels in elderly and younger people by inducing experimental pressure pain, 2) to evaluate the sensitivity of elderly and younger people to equally intense supra-threshold painful stimuli and 3) to investigate how both groups rate their current low back pain (self-reported pain) in order to evaluate the impact of ageing on pain perception. A secondary objective of the study was to investigate the association of experimental and clinical pain sensitivities with each other.

MATERIALS AND METHOD

Subjects

The study was conducted in patients with chronic low back pain who were patients at the physical therapy and rehabilitation outpatient clinics of our hospital. Approval was obtained from the ethics committee before initiation of the study. Participating patients provided written informed consent prior to enrollment in the study. A total of 80 patients (40 females, 40 males) 65 years of age and older with chronic low back pain were included in the elderly patient group. The control group comprised a total of 80 patients (40 females, 40 males) from 18 to 35 years of age with chronic low back pain. An equal number of males and females were included in the groups due to the well-known effect of gender on PS (15).

Patients with low back pain for more than 6 months without a history of neurological deficit, severe vertebral deformity, or surgical intervention were qualified to enroll, while those with an inflammatory, infectious or malignant disease, central or peripheral nervous system disorders, diabetes mellitus or serious cardiac, pulmonary or psychiatric diseases were excluded. Patients who were treated with antidepressants, gabapentin or pregabalin for management of chronic pain and those who received opioid analgesics or underwent spinal injection were also excluded.

Assessment of Cognitive State

All pain severity scales used for assessment of pain perception which rely on self-reported pain have been shown to be affected by cognitive changes (14). Thus, the cognitive state of all patients was evaluated using the Turkish version of the Mini Mental State Examination (MMSE) before enrollment (16). Those patients who scored 25 points or higher were enrolled in the study (7).

Pressure Pain Threshold Measurement

Measurements were obtained using a digital pressure algometer (Storz Medical F-metre) version 5.0 with a 64 mm^2 circular probe. Three sites were used for measurements: the deltoid muscle, the first dorsal interosseous muscle (FDI) and the proximal 1/3 of the anterior side of tibia. Care was taken to avoid intake of an analgesic or any agent for pain relief in the 24 h to measurement. While taking measurements, pressure was increased in increments of 1 Newton per second. The level at which the patient first felt pain was recorded as PPT.

Three readings were obtained for each area and the average was used for assessment. PT results were expressed in kilopascal (kPa) units. Ten-minute intervals elapsed between measurements from different sites and 30-min intervals between measurements from the same site. All PT measurements were carried out by the same operator for both groups.

Assessment of Supra-threshold Pain Sensitivity

In order to examine the sensitivity of elderly and younger people to supra-threshold painful stimuli, the sensitivity of their thumbnail beds to pressure pain was assessed. For this purpose, 25 Newton/cm^2 pressure, a pressure level shown to produce pain in 20 volunteers before initiation of this study, was applied to the thumbnail bed of each patient. Following this painful stimulus, elderly and younger patients were asked to rate the severity of their pain on a 10-cm visual analog scale (Thumb-VAS). The left end of the 10-cm line was labelled as 'no pain' while the right end was considered 'worst imaginable pain'.

Assessment of Clinical Pain Sensitivity

Patients in both groups were asked to separately rate the intensity of their current low back pain at rest and during activity in order to examine their sensitivity to clinical pain. A 10-cm horizontal VAS was used for this purpose.

Assessment of Depression

Since depression can affect PT (17), patients in both groups were evaluated for symptoms of depression at the start of the study using the Beck Depression Inventory.

Statistical Analyses

Study findings were statistically analysed using Statistical Package for Social Sciences (SPSS) for Windows version 19.0. For analysis of the study data, descriptive statistical methods (mean, median, standard deviation, minimum-maximum) were used as well as the Mann–Whitney U test for between-group comparisons of non-normally distributed quantitative data. Inter-correlations between pain sensitivity parameters were explored using Spearman's correlation analysis. Results were interpreted at 95% confidence interval with significance level set at $p < 0.05$.

Results

Age ranges for the two groups were as follows: 17–35 years for the younger patient group and 65–84 years for the elderly group. The mean age of each of the study groups is shown in Table 1. There was no difference between groups in body mass index (p=0.260) and the groups did not differ in the duration of low back pain (p=0.078). Depression has a known effect on PPT results, but depression scores were not significantly different between our study groups (Table 1).

Table 1— Study Group Characteristics.

	Elderly (n=80) Mean±SD	Young (n=80) Mean±SD	p
Age (years)	71.3±5.4	28.8±4.4	0.000
Sex (%female)	40 (50%)	40 (50%)	
BMI (kg/m^2)	26.9±4,2	26.1±4.1	NS
BDI	12.6±7.5	11.6±8.7	NS
Pain duration (months)	9.5±3.2	8.7±2.7	NS

BDI: Beck Depression Inventory, BMI: body mass index, NS: nonsignificant, SD: Standard deviation.

Figure 1 shows the median pressure PT values for both groups. Tibial PPT measurements were not significantly different between groups (p=0.516). A slight reduction observed in the measurements from the first dorsal interosseous muscle in the elderly was not statistically significant (p=0.521), and both groups were found to have the same median value for the deltoid muscle measurement (Figure 1).

VAS values for pain sensitivity of the thumbnail bed (Thumb-VAS) were not different between the groups (p=0.564). VAS scores for low back pain at rest (LBP VAS-R) and VAS scores for low back pain during activity (LBP VAS-

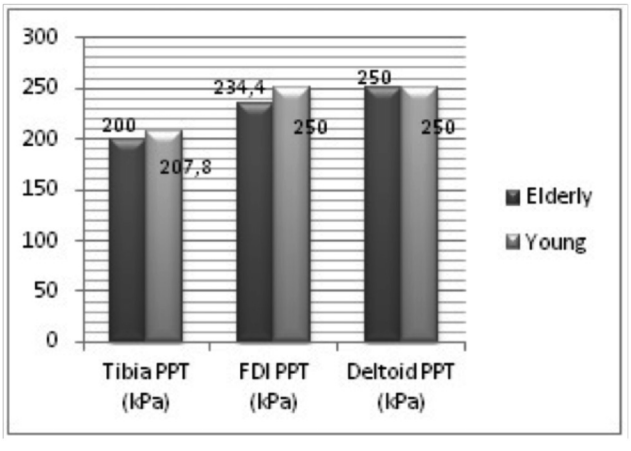

Figure 1— Median values of pressure pain threshold at three sites.

Table 2— Pain Sensitivity Parameters Compared Between Groups.

	Elderly Median (min-max)	Young Median (min-max)	p
Thumb VAS	7 (3-10)	8 (1-10)	0,564*
LBP VAS-R	5 (1-10)	4 (1-10)	0,155*
LBP VAS-A	7 (2-10)	6 (1-10)	0,338*

*Mann-Whitney U Test. LBP: low back pain, VAS: visual analog scale, VAS-A: visual analog scale activity, VAS-R: visual analog scale rest.

A) as measured by patient ratings were also not different between the groups (Table 2).

Results of correlation analysis for six parameters used for assessment of PS in both groups are shown in Table 3. Among these parameters, results of PT measurements obtained from the deltoid muscle, tibia and FDI showed a highly significant intercorrelation (p=0.000 for all). Thumb-VAS (another assessment performed after induction of experimental pain) showed a highly significantly correlation with PT values obtained at the other three sites (p=0.000). LBP VAS-A and LBP VAS-R scores, which reflect the sensitivity to clinical low back pain, showed a significant intercorrelation (p=0.000). However, there was no association between the clinical VAS scores and the four parameters used to indicate experimental pain sensitivity (Table 3).

Discussion

In this study, we examined the sensitivity of aged individuals to supra-threshold painful stimuli as well as to clinical pain and did not observe a substantial change in pain sensitivity with ageing for any of the parameters tested. PPT levels at each of the three measurement sites were comparable between the elderly and younger groups. Previously published studies have shown similar results; PPT measurements obtained by Edwards et al. from the trapezius and masseter muscles (9), by Donat et al. from the second and fifth digits (10) and by Gokoglu et al. from 18 fibromyalgic and 3 control points (11) have not shown a difference in PTs between elderly and younger patients.

Some studies have reported increased PPT levels with advancing age (3,4). Jensen et al.'s study is noteworthy because PPT was found to be increased only in female subjects (4). Visceral PPT was reported to be increased in the elderly using intra-oesophageal balloon distension test (18). In the literature, there are also studies reporting reduced PPT in elderly people (6-8). However, Lautenbacher et al. did not identify any age-related change in thermal PT in one of these studies (6), whereas Pickering et al. reported lower PPT only among male subjects and no age-related change in thermal PT (8).

The majority of studies that performed thermal PT measurements concluded that ageing was associated with increased PT (2,5). In most of these studies, heat was delivered using non-contact methods (2,19) and increased PT was attri-

Table 3— Correlation Analyses of Pain Sensitivity Parameters.

		DELTOID-PPT	FDI-PPT	TIBIA-PPT	THUMB-VAS	LBP VAS-R	LBP VAS-A
DELTOID-PPT	Cor. coeff.	1,000	**,482**	**,487**	-,333	-,041	-,034
	P value		**,000***	**,000***	**,000***	,621	,680
FDI-PPT	Cor. coeff.	**,482**	1,000	**,515**	**-,405**	-,031	-,016
	P value	**,000***		**,000***	**,000***	,712	,848
TIBIA-PPT	Cor. coeff.	**,487**	**,515**	1,000	**-,541**	-,105	-,148
	P value	**,000***	**,000***		**,000***	,207	,073
THUMB-VAS	Cor. coeff.	**-,333**	**-,405**	**-,541**	1,000	,049	,150
	P value	**,000***	**,000***	**,000***		,558	,070
LBP VAS-R	Cor. coeff.	-,041	-,031	-,105	,049	1,000	**-,311**
	P value	,621	,712	,207	,558		**,000***
LBP VAS-A	Cor. coeff.	-,034	-,016	-,148	,150	**-,311**	1,000
	P value	,680	,848	,073	,070	**,000***	

*p<0,001. Cor. coeff: correlation coefficient, FDI: first digital interosseöz, LBP: low back pain, PPT: pain pressure threshold, VAS: visual analog scale; VAS-A: visual analog scale activity; VAS-R: visual analog scale rest.

buted to age-related changes in the dermoepidermal region. However, according to Gibson, PT does not generally differ between elderly and younger people when contact methods are used (2).

In most of the studies that induced experimental pain by electrical stimulation, there was no marked change in PT with advancing age (2,12). In direct contrast, Tucker et al. reported increased PPT in people older than 75 years of age, particularly when they have age-related health problems (20).

According to Gibson, changes in PT with thermal and mechanical pain stimulation versus the lack of PT change with electrical stimuli observed in the elderly can be explained by the direct stimulation of the primary afferent fibres by the electric current. Nocioceptive receptors are activated when pain is induced with thermal and mechanical stimulation. It is known that the thermal detection threshold is increased with changes in the skin and subcutaneous tissue in the elderly (21). Also, Helme et al. demonstrated that elderly people have an increased threshold for thermal and electrically induced pain when the stimulus duration is kept short (22).

In one study, Mylius et al. examined the nociceptive flexion reflex (NFR) by delivering painful electrical stimuli to the sural nerve to assess pain sensitivity; they found that age did not have an effect on NFR threshold. When they evaluated responses to supra-threshold painful stimuli, there was no difference between elderly and younger patients (23). This finding is consistent with our data on the sensitivity to supra-threshold painful stimuli.

Pain perception may be diminished with ageing due to impairment of the myelinated A-delta fibres (24). Mylius et al. reported that NFR acts via A-delta fibres; their findings did not suggest a considerable loss of these fibres with advancing age. Before initiation of the study, patients with peripheral nervous system pathologies such as small fibre neuropathy were identified by electromyography and excluded from the study. Accordingly, it was reported that the normal range of afferent nerve fibre loss as part the physiological ageing process does not produce loss of nociception as shown by NFR (23).

Huang et al. reported that PTs show a high degree of variability for people over 70 years of age. While they concluded that thermal PT was reduced with ageing, no age-related change in PT was observed when patients younger than 70 years of age were studied. However, the study lacked assessment of the cognitive state of patients (5) and elderly people with cognitive impairment may not be able assess pain accurately (14).

During assessment of pain sensitivity, utilization of clinical pain not affected by confounding factors such as age-related changes in the stimulated region may deliver more robust findings. When we looked at the VAS ratings by both elderly and younger patients for the severity of their low back pain, we observed that both age groups perceived their current chronic pain at a comparable intensity. This finding is consistent with literature on the effect of age on perceived pain severity. In a study with 5239 subjects, Jarvik et al. reported that age was not associated with an increased perceived intensity of low back pain in people 65 years of age and older (25).

Lucantoni et al. reported that patients with silent ischemic cardiomyopathy had increased PT and suggested that this was related to individual PS irrespective of age (12). However, experimental pain sensitivity and clinical pain sensitivity were not correlated in our patients.

One of our study's limitations is the use of PPT alone for assessment of PT. PT could have been examined more extensively using other methods such as EPT. Another limitation is the non-representation of patients at a very advanced age due to our strict inclusion criteria.

In conclusion, although several factors including comorbid conditions, cognitive disorders and measurement errors associated with PT testing may lead to misconceptions regarding diminished pain perception in the elderly, for the time being, it is difficult to assume that elderly people experience reduced pain sensitivity than their younger counterparts. In future studies with a larger number of patients are needed to evaluate both experimental and clinical pain sensitivity taking into account such factors. Both our study and a major portion of the literature suggest that normal, physiological ageing does not produce a prominent change in pain sensitivity unless there is an undiagnosed neurological pathology or cognitive impairment, both of which could directly affect pain perception.

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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