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Does the presence of radiculopathy affect sleep quality and lower extremity functionality in neuropathic low back pain?

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SUMMARY

OBJECTIVE: Sleep disturbance in chronic neuropathic low back pain is a well-known condition. In this study, we aimed to investigate the effect of lumbar radiculopathy on sleep quality and lower extremity functionality in the presence of neuropathic low back pain.

METHODS: A total of 79 patients diagnosed with disk herniation, needle electromyography, and neuropathic pain were included in the study. Visual Analog Scale, Pittsburg Sleep Quality Index, and Lower Extremity Functionality Scale were applied to the patients.

RESULTS: Of the 79 patients who participated in the study, 34 (43%) were females and 45 (57%) were males. No significant difference was found between the group with and without radiculopathy in terms of sleep quality and lower extremity functionality (p=0.245 and p=0.092, respectively). In our study, a negative correlation was found between night pain and the presence of radiculopathy (p=0.006). The number of lumbar herniated disk levels was higher in the group without radiculopathy and was statistically significant (p=0.023).

CONCLUSION: We found that the presence of radiculopathy did not affect sleep quality and lower extremity functionality in disk herniation patients with neuropathic pain. Although it was not statistically significant in our study, we think that the degree of herniation may affect sleep and lower extremity functionality rather than the number of disk herniation levels with the available data. The fact that neuropathic pain is not limited to disk herniation and radiculopathy, and that neuropathic pain is intertwined with clinical conditions such as anxiety, sleep disorders, and depression are among the conditions that make the studies difficult.

KEYWORDS: Radiculopathy. Sleep quality. Back pain with radiation.

INTRODUCTION

Neuropathic pain (NP) is defined as pain that occurs as a result of injury, dysfunction, or change in excitability of a part of the peripheral or central nervous system. The definition of pain arising from somatosensory system lesions or diseases has also been used for NP[1]. The ability of NP to cause pain away from the affected area, the absence of continuous nociceptive stimulation, and its neuroanatomical distribution are the features that distinguish NP from nociceptive pain. Stroke, spinal cord injury, syringomyelia, multiple sclerosis, and cortical atrophy are among the causes of central NP. Diabetes, hypothyroidism, HIV, rheumatoid arthritis, collagen tissue diseases, vasculitides, radiculopathies, and entrapment neuropathies may be the causes of peripheral NP. Symptoms of NP include loss of tendon reflexes, muscle atrophy, weakness, allodynia, hyperalgesia, burning, tingling, and sudomotor changes. Conditions such as wind, temperature changes, friction of clothing, or emotional stress can trigger NP[2].

In chronic low back pain (CLBP), NP may occur due to inflammatory mediators released from the disk, or untreated nociceptive pain as well as NP may occur with direct compression of the nerve by the radiculopathy[3].

Lumbar radiculopathy (LRP) is a clinical condition that can lead to dermatomal pain, muscle weakness, and a decrease in deep tendon reflexes due to compression of spinal nerve roots. The most common cause is herniated disk, and infection, malignancy, and inflammations can cause radiculopathy. The most frequently affected levels are L5 and S1 roots. The diagnosis is made by visualization of the pressure with magnetic resonance imaging (MRI) and electrophysiological examinations[4].

In the literature, studies on chronic pain, CLBP, LRP, and NP show that patients' sleep can be disturbed, and sleep problems are common, especially in patients with chronic neuropathic low back pain[5-7].

In this study, we aimed to examine the effect of radiculopathy on sleep quality and lower extremity functionality in patients with lumbar disk herniation (LDH) with NP. This is the first study in the literature to examine the effect of radiculopathy on sleep quality and lower extremity functionality in patients with LDH and NP.

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METHODS

Study design

This prospective case-control study was conducted in Şanlıurfa Training and Research Hospital Physical Medicine and Rehabilitation outpatient clinic.

Participants

Patients aged between 18 and 75 years were admitted to an outpatient clinic with complaints of CLBP and radicular pain, and 148 patients who had lumbar spinal MRI in the last 3 months and were diagnosed with LDH, who underwent needle electromyography (EMG) with a preliminary diagnosis of radiculopathy in the last 3 months, and who had no motor deficit were analyzed.

Patients with LDH who have conditions such as fibromyalgia, stroke, multiple sclerosis, spinal cord injury, vasculitis, diabetes, hypothyroidism, HIV, herpes simplex, cirrhosis, and malignancy that can cause central or peripheral NP, who have been operated for LDH, who have known sleep disorders, and who are under treatment were not included in the study. A total of 79 patients with NP were included in the study after verbal and written consent.

Data collection

Socio-demographic and anthropometric parameters of the patients were analyzed. Visual Analog Scale (VAS) was used to measure pain. VAS is a well-known, easy-to-implement method. On a 100-mm line, no pain is written on one end and very severe pain on the other end, and the patient marks his current condition on this line. The length of the distance from the point where there is no pain to the point marked by the patient indicates the patient's pain in centimeters. The NP Diagnostic Questionnaire (DN4) was applied to detect NP. DN4 is an open-access, validated, and reliable inventory in Turkish. A score of 4 or higher indicates NP[8].

Pittsburgh Sleep Quality Index (PSQI) and Lower Extremity Functionality Scale (LEFS) were applied to the patients included in the study. PSQI is an open-access index consisting of 18 questions and 7 components, and Turkish validity and reliability studies have been conducted using this index which evaluate sleep disorders and sleep quality in the last 1 month. As a result of the questionnaire, if the total score is above 5, it indicates poor sleep quality[9]. LEFS is an open-access questionnaire consisting of 20 questions, and Turkish validity and reliability studies have been conducted using this questionnaire which evaluate functional impairment in the lower extremities. The total score is between 0 and 80. A high score indicates good lower extremity functions, and a low score indicates poor lower extremity functions[10].

Statistical analysis

Analyses were evaluated in 22 package programs of SPSS (Statistical Package for Social Sciences; SPSS Inc., Chicago, IL). Descriptive data are shown as n and percentage values in categorical data, and mean±standard deviation (mean±SD) values in continuous data. Chi-square analysis (Pearson chi-square) was used to compare categorical variables between groups. The conformity of continuous variables to normal distribution was evaluated by the Kolmogorov-Smirnov test. Student's t-test was used to compare paired groups, and one-way ANOVA was used to compare more than two variables. The statistical significance level in the analyses was accepted as $p<0.05$.

Ethical considerations

Written permission was obtained from the Harran University Faculty of Medicine Clinical Research Ethics Committee (HRU.23.02.23) and the institution where the study was conducted prior to data collection. In addition, all study participants were informed about the nature of the study and that participation was on a voluntary basis. Informed consent was obtained from all participants.

RESULTS

A total of 79 patients with a mean age of 44.1±12.7 years were included in the study. Of the patients, 43% (n=34) were females and 57% (n=45) were males. The mean body mass index (BMI) of the patients was 28.7±5.3 kg/m^2, and the mean duration of pain was 17.8±23.6 months. There was a history of low back pain at night in 78.5% (n=62) of the patients and a family history of low back pain in 22.8% (n=18). There was radiculopathy in needle EMG in 53.2% (n=42) of the patients. In needle EMG, 2.5% (n=2) of the patients with radiculopathy were L3-L4, 8.9% (n=7) were L4-L5, 48.1% (n=38) were L5-S1, and 2.5% (n=2) had multiple root involvement. Root involvement was on the right in 27.8% (n=22) of patients with radiculopathy, on the left in 20.3% (n=16), and bilateral in 5.1% (n=4). A total of 60.8% (n=48) of the patients had good sleep and 39.2% (n=31) had poor sleep quality. The mean LEFS of the patients was 35.0±15.3. A total of 51.9% of the patients had 1 level, 35.4% had 2 levels, and 12.7% had 3 levels of LDH (Table 1).

LRP was found to be significantly higher in women (76.5%) than in men (35.6%) ($p<0.001$). The incidence of night pain in patients with LRP (66.7%) was significantly lower than the

Table 1. General characteristics and parameters of the patients.

			Number	%
Age, Mean±SD			44.1±12.7	
Sex		Female	34	43.0
		Male	45	57.0
BMI, Mean±SD			28.7±5.3	
Pain duration (months), Mean±SD			17.8±23.6	
Night pain		Yes	62	78.5
		No	17	21.5
Family low back pain history		Yes	18	22.8
		No	61	77.2
Needle EMG radiculopathy		Yes	42	53.2
		No	37	46.8
VAS, Mean±SD			6.3±1.1	
Needle EMG affected root levels	L3-4	Yes	2	2.5
		No	77	97.5
	L4-5	Yes	7	8.9
		No	72	91.1
	L5-S1	Yes	38	48.1
		No	41	51.9
	Multiple	Yes	2	2.5
		No	77	97.5
Pittsburg Sleep Quality Index		Poor sleep	48	60.8
		Good sleep	31	39.2
LEFS, Mean±SD			35.0±15.3	
Affected root side		No LRP	37	46.8
		Right	22	27.8
		Left	16	20.3
		Bilateral	4	5.1
Affected disk herniations levels number		1 level	41	51.9
		2 levels	28	35.4
		3 levels	10	12.7

SD: standard deviation; BMI: body mass index; EMG: electromyography; VAS: Visual Analog Scale; LEFS: Low Extremity Functional Scale; LRP: lumbar radiculopathy.

rate of night pain in patients without radiculopathy (91.9%) (p=0.006). The mean VAS score of those with radiculopathy was found to be significantly higher than the VAS score of those without radiculopathy (p=0.002). There was no significant difference between the groups in terms of pain duration, BMI, and family history of LBP. While 64.3% of those with radiculopathy had 1 level, 31% had 2 levels, and 4.8% had 3 levels of LDH, 37.8% of those without radiculopathy had 1 level, 40.5% had 2 levels, and 21.6% had 3 levels of LDH. The number of affected disk levels was significantly higher in patients without radiculopathy compared with those who had (p=0.023) (Table 2).

There was no significant relationship between the sleep quality of the participants in terms of age, gender, BMI, duration of pain, night pain, VAS, affected root level, and direction. The LEFS score of those with good sleep quality was found to be significantly lower than those with poor sleep quality (p=0.008). Poor sleep quality was observed in 63.4% of those with 1 level of LDH, 14.3% of those with 2 levels of LDH, and 10% of those with 3 levels of LDH, and there was a significant difference between the number of LDH levels in terms of sleep quality (p<0.001) (Table 3).

DISCUSSION

The incidence of NP in CLBP varies according to countries in the literature, and 53.3% (n=79) of 148 patients with CLBP examined in our study had NP. In a study conducted in a different city in Türkiye using DN4 in 2021, the frequency of NP in CLBP was found to be 43.9%[11]. The reason for this difference may be that NP is associated with conditions such as socio-cultural level and lifestyle.

A total of 53.2% of the patients included in our study had radiculopathy. In our study, the incidence of LRP in females (76.5%) was found to be significantly higher. The most common level of radiculopathy was L5-S1 roots. Our study is compatible with the literature with these results[4,12,13].

In our study, there was no statistical difference between the group with and without radiculopathy in terms of PSQI and LEFS. An increase in the affected disk levels increases the pressure and inflammation in the nervous system and may cause an increase in nerve damage[3,6]. In our study, it was observed that the disk levels in the group with radiculopathy were significantly lower than the group without radiculopathy, and similarly, the affected levels in the patients without radiculopathy were found to be higher. The reason for this situation may be the low number of volunteers and the bulging stages in MRI are considered as herniated disks. It is known in the literature that herniation causing radiculopathy is mostly caused by disk disorder in the protrusion stage[12]. In this respect, our study seems to be compatible with the literature. In terms of sleep quality, we found that patients with a high number of herniated disks had less radiculopathy and better sleep quality. Although it is not statistically significant, we can say that disk herniations that do not reach the stage of radiculopathy have better sleep with our data.

In our study, the rate of night pain in patients with radiculopathy (66.7%) was found to be significantly lower than the rate of night pain in patients without radiculopathy (91.9%). Root irritation symptoms are known to decrease with rest or in positions that reduce the load on the root. Although disk herniation is considered to be the cause of NP in the patient group without radiculopathy, in many studies with CLBP and

Table 2. Comparison of various parameters according to the presence of radiculopathy.

		With radiculopathy		Without radiculopathy		p-value
		Number	%	Number	%	
Age, Mean±SD		46.6±12.1		41.2±12.8		0.056*
Sex[a]	Female	26	76.5	8	23.5	**<0.001****
	Male	16	35.6	29	64.4	
BMI, Mean±SD		28.7±4.5		28.6±6.2		0.950*
Pain duration (months), Mean±SD		16.3±23.3		19.5±24.1		0.544*
Night pain	Yes	28	66.7	34	91.9	**0.006****
	No	14	33.3	3	8.1	
Family history of low back pain	Yes	10	23.8	8	21.6	0.817**
	No	32	76.2	29	78.4	
VAS, Mean±SD		6.7±0.9		5.9±1.2		**0.002***
PSQI[b]	Good sleep	23	54.8	25	67,6	0.245**
	Poor sleep	19	45.2	12	32,4	
LEFS, Mean±SD		32.2±11.8		38.2±18.2		0.092*
Affected disk herniations levels number[b]	1 level	27	64.3	14	37.8	**0.023****
	2 levels	13	31.0	15	40.5	
	3 levels	2	4.8	8	21.6	

*Student's t-test, **Chi-square tests were applied. [a]Row percentage; [b]Column percentage. SD: Standard deviation; BMI: body mass ındex; VAS: Visual Analog Scale; PSQI: Pittsburg Sleep Quality Index; LEFS: Low Extremity Functional Scale. Statistically significant p-values are indicated in bold.

Table 3. Comparison of sleep quality of various parameters[a].

		Good sleep		Poor sleep		p-value
		Number	%	Number	%	
Age, Mean±SD		43.2±11.9		45.4±13.9		0.457*
Sex	Female	19	55.9	15	44.1	0.440**
	Male	29	64.4	16	35.6	
BMI, Mean±SD		29.3±5.6		27.7±4.8		0.201*
Pain duration (months)		16.8±18.6		19.4±30.0		0.629*
Night pain	Yes	41	66.1	21	33.9	0.062**
	No	7	41.2	10	58.8	
Family history of low back pain	Yes	12	66.7	6	33.3	0.559**
	No	36	59.0	25	41.0	
VAS, Mean±SD		6.5±1.2		6.2±1.0		0.242*
LDH level L3-4	Yes	1	50.0	1	50.0	1.000**
	No	47	61.0	30	39.0	
LDH level L4-5	Yes	2	28.6	5	71.4	0.105**
	Yok	46	63.9	26	36.1	
LDH level L5-S1	Yes	22	57.9	16	42.1	0.616**
	No	26	63.4	15	36.6	
Multiple LDH levels	Yes	1	50.0	1	50.0	1.000**
	No	47	61.0	30	39.0	
LEFS, Mean±SD		31.4±14.5		40.6±15.0		**0.008***
In LRP affected root side	No	25	67.6	12	32.4	0.159**
	Right	15	68.2	7	31.8	
	Left	6	37.5	10	62.5	
	Bilateral	2	50.0	2	50.0	
Affected disk herniations levels	1 level	15	36.6	26	63.4	**<0.001****
	2 levels	24	85.7	4	14.3	
	3 levels	9	90.0	1	10.0	

*Student's t-test, **Chi-square test was applied. [a]Row percentage. SD: standard deviation; VAS: Visual Analog Scale; BMI: body mass ındex; LDH: lumbar disk herniation; LEFS: Low Extremity Functional Scale; LRP: lumbar radiculopathy. Statistically significant p-values are indicated in bold.

NP, these patients had disturbed night sleep, frequent painful awakenings, frequent accompanying psychiatric disorders such as depression and anxiety, and central sensitization, with or without radiculopathy. Syndromes have been shown to be more common than the general population[5-7,14].

In our study, 39.2% of the patients had poor sleep quality. When our study is viewed from the perspective of CLBP and NP, it is compatible with the literature[6,11,13].

The LEFS score of those with good sleep quality was found to be significantly lower than those with poor sleep quality. This may be due to the fact that patients with NP who do not have radiculopathy due to LDH, which may be accompanied by central sensitization, were grouped in the poor sleep quality group.

In a study comparing patients with NP due to LRP and fibromyalgia patients with healthy volunteers, it was found that pain threshold values in both fibromyalgia and LRP were lower than the healthy control group, pain modulations were weaker than the healthy control group, and the results of LRP and fibromyalgia were similar[15]. From our study and literature review, we observed that the symptoms in LRP without motor loss are caused by NP and its accompanying clinical problems.

CONCLUSION

We found that the presence of radiculopathy did not affect sleep quality and lower extremity functionality in patients with LDH with CLBP with NP component. The major limitation of our study is the inability to clearly define the etiology of NP in patients. In the presence of disk herniation, NP due to non-disk origin and untreated nociceptive pain may also develop. In the presence of radiculopathy, there were also patients whose DN4 result was not found to be NP and who were excluded from the study. In which of the two patients with radiculopathy at the same root level, the same disk herniation classification, no motor deficit, and similar socio-demographic and anthropometric parameters, does NP occur? The fact that we did the NP research with a single inventory in our study may have caused these questions. Studies with a large number of patients and using more than one inventory will help to find answers to these questions. Although we did not include patients with known psychiatric sleep disorders and fibromyalgia-like chronic pain disorders in our study, it is an important problem affecting the results of our study that low back pain, which has the character of NP, creates similar situations independent of etiology.

AUTHORS' CONTRIBUTIONS

BKA: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing. **MT:** Conceptualization, Data curation, Formal Analysis, Software, Supervision, Validation, Writing – original draft, Writing –review & editing.

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