Neuropathic Pain in Lumbar Disc Herniation: A Comparative Study of Surgical Outcomes

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Abstract

Aim: This study aimed to assess the prevalence of neuropathic pain in patients diagnosed with lumbar disc herniation and to examine the correlation between neuropathic pain and surgical intervention.

Methods: We performed a retrospective cohort study involving 217 patients diagnosed with lumbar disc herniation who reported persistent low back pain from January to December 2023. We assessed the existence of neuropathic pain using the Douleur Neuropathique 4 (DN4) questionnaire. We evaluated pain severity using the Visual Analogue Scale (VAS). We categorized the patients into three groups: non-operated, operated without stabilization, and operated with stabilization.

Results: The patients had a mean age of 45.09 ± 14.28 years, with 57.6% being male. A DN4 score of > 4 indicated that neuropathic pain was present in more than half (51.2%) of the patients. The prevalence of neuropathic pain was 32.8% in the non-operated cohort, 67.3% in the operated cohort without stabilization, and 85% in the operated cohort with stabilization. Age exhibited a positive link with neuropathic pain score ($r = 0.16$, $p<0.05$), whereas no significant association was identified between sex and body mass index (BMI).

Conclusion: Individuals with lumbar disc herniation frequently experience neuropathic pain. Surgical intervention, particularly stabilization surgery, is a significant risk factor for the onset of neuropathic pain. Consequently, it is advisable to assess the risk of neuropathic pain and implement appropriate interventions for patients planned for surgical intervention. Age plays a significant role in the development of neuropathic pain, indicating that older patients require closer monitoring.

***Keywords**: Chronic low back pain, lumbar disc herniation, neuropathic pain*

1. Introduction

Lumbar disc herniation is a condition in which an intervertebral disc in the lower spine shifts or ruptures, resulting in protrusion. This typically compresses the spinal nerve roots, resulting in symptoms such as low back pain, leg pain, and neurological deficits[1]. However, some patients may also experience neuropathic pain, a type of pain resulting from nerve damage or dysfunction, which can significantly affect their quality of life[2]. Neuropathic pain is a notably difficult illness because of its propensity to become chronic and its potential resistance to existing therapies.

Studies on pain associated with lumbar disc herniation have generally focused on mechanical pain. However, there has been limited research on neuropathic pain, and its prevalence, risk factors, and effects on the clinical management of patients are not fully understood[3,4].

In particular, there is a lack of data related to assessing the risks of developing neuropathic pain in the operated patients and the demographic or clinical variables associated with such risks. As a result, clinicians do not have sufficient knowledge to predict and manage the risks associated with neuropathic pain in patients with lumbar disc herniation.

This study presents significant factors regarding the prediction and management of neuropathic pain risks, particularly in patients scheduled for surgical intervention.

2. Materials and Methods

This retrospective data study included patients aged 18 to 65 years who reported to our outpatient clinic with low back pain between January and December 2023 and had a history of chronic low back pain for a minimum of 3 months. The study's further inclusion criteria were a positive straight leg raise test, a positive Schober test, and a diagnosis of lumbar disc herniation confirmed by lumbar magnetic resonance imaging (MRI) data. The exclusion criteria included the presence of additional MRI findings; clinical indicators of significant pathology during physical examination (red flags); abnormal

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laboratory test results (blood glucose, alanine transaminase [ALT], aspartate transaminase [AST], urea, creatinine, complete blood count, sedimentation rate, C-reactive protein, and urinalysis); a history of stroke, spinal surgery, diabetes, malignancy, chronic inflammatory low back pain, and ongoing use of analgesics and/or antidepressants within the past six months. We evaluated pain intensity using the Visual Analogue Scale (VAS)[5]. The VAS is a scale ranging from 0 to 10, where 0 indicates the absence of pain and 10 signifies the most intense pain. The patients were instructed to indicate the position on the scale that reflected their pain level. We conducted the assessment of neuropathic pain using the Douleur Neuropathique 4 (DN4) questionnaire[6]. The DN4 is a 10-item questionnaire that consists of 7 items that assess pain features and perceptions, and 3 items that pertain to examination. Each item receives a score of 1 for a "yes" response and 0 for a "no" response. A cumulative score of 4 or above signifies the presence of neuropathic pain in the patient. Tests were performed on operated patients at least 2 months after surgery.This study also assessed demographic and clinical data, including age, sex, body mass index (BMI), and surgical status.

2.1. Statistical Analysis

The data was analyzed statistically using SPSS 25.0 software (IBM Corp., Armonk, NY, USA). The normality of the data distribution for continuous variables was assessed using the Shapiro-Wilk test. Data that followed a normal distribution were expressed as mean ± standard deviation, whereas data lacking a normal distribution were expressed as median (minimum-maximum). One-way analysis of variance (ANOVA) was employed for normally distributed data, while the Kruskal-Wallis test was utilized for non-normally distributed data to evaluate the differences between the groups. The chi-square test was utilized to compare categorical data. The Pearson correlation analysis was conducted to assess the linear correlations among the variables. Furthermore, multivariate linear regression analysis was conducted to assess the impact of factors like age, sex, BMI, and surgical intervention on neuropathic pain. The neuropathic pain score (DN4) served as the dependent variable in the regression model. The significance threshold was established at $p<0.05$ for all statistical analyses.

3. Results

This research comprised a total of 217 patients. Of these patients, 125 (57.6%) were male and 92 (42.4%) were female. The average age of the patients was calculated to be 45.09±14.28 years. The proportion of patients having a DN4 score of 4 or above in the general population was established at 51.2%. The patients were categorized into three groups according to their surgical intervention history: non-operated, operated without stabilization, and operated with stabilization. The incidence of neuropathic pain in these groups was shown to be 32.8%, 67.3%, and 85%, respectively (Table 1). A significant connection was shown between age and DN4 score ($r = 0.16$). The regression analysis indicates that age significantly affects the DN4 score ($p<0.05$), revealing a small rise in the neuropathic pain score with advancing age. No statistically significant correlation was seen between sex and DN4 score ($p = 0.75$). The correlation between BMI and the DN4 score was not statistically significant ($p = 0.95$) (Table 2). A statistically significant, moderately positive connection between DN4 and VAS ratings was identified ($r = 0.318$, $p < 0.001$) (Graphic 1).

Figure 1

The regression plot shows the relationship between the Visual Analogue Scale (VAS) and DN4 scores, which measure the intensity of pain and the presence of neuropathic pain, respectively.

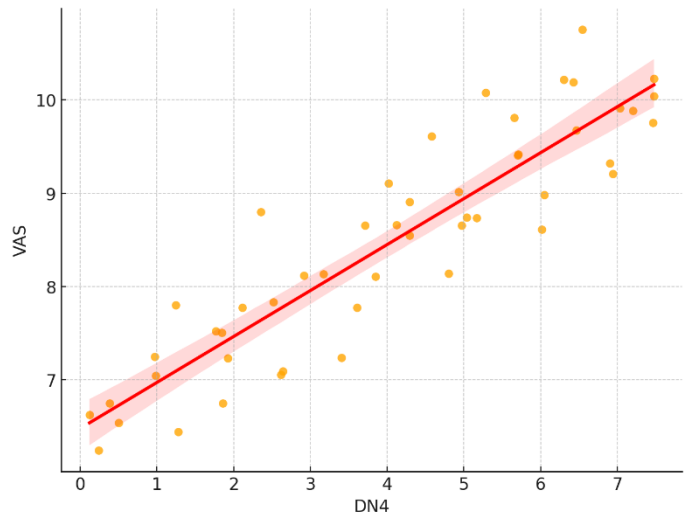

Table 1

Distribution of Patients Based on DN4 Scores and Surgical Intervention Status

	DN4<4	DN4 ≥ 4	Total
Non-Operated	82	40	122
Operated Without Stabilization	18	37	55
Operated With Stabilization	6	34	40
Grand Total	106	111	217

Table 2

Demographic and Clinical Characteristics Based on DN4 Scores

	DN4<4	DN4 ≥4	p
Age (Mean ± SD)	42.7 ± 15.1	48.5 ± 13.2	0.03
Sex			
·Male	%57	%42	0.75
·Female	%43	%58	
BMI (Mean ± SD)	28.2 ± 4.8	27.9 ± 4.5	0.7

4. Discussion

This study's findings indicate that neuropathic pain is prevalent among individuals with lumbar disc herniation and that surgical intervention significantly influences the progression of neuropathic pain. The prevalence of neuropathic pain was particularly elevated in individuals who underwent stabilization surgery.

Epidemiological studies indicate that the incidence of neuropathic pain among patients with low back pain is 19.3% and

65.3%[7,8]. This heterogeneity may be influenced by the length of low back pain (acute, subacute, chronic), the demographic characteristics of the study group (ethnicity, rural, or urban inhabitants), the screening test employed, and the kind of institution where the study was done (primary, secondary, or tertiary). Chronic lumbar disc herniation is identified as the most prevalent neuropathic pain condition[9]. Freynhagen et al. highlighted that 37% of 7,772 patients with persistent low back pain experienced neuropathic pain[10]. Kaki et al. conducted multicenter research involving 1,169 patients across 117 locations, indicating that 54.7% of individuals with chronic low back pain (CLBP) experienced neuropathic pain[11]. The literature suggests that age and sex significantly influence the presence of neuropathic pain. Sakai et al. reported in their series that the frequency of neuropathic pain decreased with age[12], whereas Shiri et al.'s 11-year longitudinal study, which included 3.505 patients, reported an increase in neuropathic pain frequency with age[13]. In a 300-patient cohort of Siddiqui et al., 61.7% of the patients were female [14], while in a small observational study by Ulutaş et al., the male sex was predominant (60%) [15]. We observed neuropathic pain in 51.2% of the patients in our study. The incidence of neuropathic pain increased with age, and male sex was predominant (57.6%). The variations observed in the literature may stem from the demographic characteristics of the patient populations, as well as environmental and genetic factors or the methodological approaches employed in the studies. In particular, factors such as hormone differences, genetic predispositions, and biological variations in the nervous system may have affected our results.

A study involving 300 patients with lumbar disc herniation reported a statistically significant relationship between pain score and BMI (p = 0.0005) [14]. The writers said that being overweight makes you more likely to have chronic systemic inflammation. This is because being overweight raises the production of cytokines and the activation of proinflammatory substances, such as TNF-α, IL-6, and blood IL-6 levels. In a separate study, the authors indicated a noteworthy correlation between BMI and DN4 score (p = 0.034) [16]. In a study with 141 patients, Karacif and Bölükbaşı found that there was no significant link between sex and BMI in relation to the development of neuropathic pain compared to the non-neuropathic group [17]. Our study found no significant relationship between neuropathic pain and sex or BMI (p = 0.7 and p = 0.9, respectively). Dolgun et al. conducted a prospective observational study that identified neuropathic pain in 54 out of 710 patients following lumbar disc herniation surgery. The authors proposed that nerve injury from disc herniation and/or lumbar discectomy could compromise normal nerve conduction. They indicated that receptors for inflammatory cytokines, including TNF-alpha, IL-1, and IL-6, may accumulate in the affected sensory neurons, potentially altering their functions. Furthermore, this accumulation may elevate the levels of allodynia-related cytokines, which could be linked to nerve transection, glutamate release, and the activation of N-methyl-D-aspartate (NMDA) receptors [18]. Our study revealed that the incidence of neuropathic pain was notably greater in patients who underwent surgical procedures in comparison to those who received conservative treatment.

This study has specific limitations. The study's retrospective design necessitated the collection of data from patient records, which may introduce specific limitations regarding data quality and integrity. Furthermore, our study was conducted at a single center and did not incorporate data from diverse geographic regions and various patient populations, which may restrict the generalizability of the findings. Self-report scales DN4 and VAS were used to assess the neuropathic pain and pain intensity. Since these self-report scales involve subjective responses, there is a risk of bias in the patient responses. The sex distribution is not balanced in our study; male patients outnumbering females (57.6%), which may hinder a sound assessment of the effect of sex on neuropathic pain. Furthermore, our study lacks sufficient data on the long-term outcomes of neuropathic pain after surgical intervention, which limits our ability to evaluate the long-term effects of neuropathic pain progression during the postoperative phase. Finally, other potential factors that may influence the development of neuropathic pain (e.g., psychosocial status, genetic factors, and environmental factors) were not taken into consideration in our study. The limitations outlined must be taken into account when interpreting the findings of our study. Future research should strive to address these limitations and concentrate on achieving more comprehensive results.

5. Conclusion

This study demonstrated that neuropathic pain is a common complication in patients diagnosed with lumbar disc herniation, and that this risk is higher among patients who undergo surgical treatment. The study determined that patients who underwent stabilization surgery had a higher prevalence of neuropathic pain. This finding highlights the importance of considering the risk of developing neuropathic pain when scheduling surgical treatment. The study also shows that age is an important factor in the development of neuropathic pain. The risk of neuropathic pain increases with age, indicating a need for closer postoperative follow-up monitoring for older patients. In conclusion, the early diagnosis of neuropathic pain in the patients with lumbar disc herniation and the development of personalized treatment strategies for these patients may increase treatment success. We should accept a detailed assessment of the risk of neuropathic pain in patients undergoing surgical treatment as a crucial step in patient management. To the best of our knowledge, this study is the first to investigate the prevalence of neuropathic pain in patients diagnosed with lumbar disc herniation based on the history and type of surgical treatment, thereby making a significant contribution to the literature.

Statement of ethics

This study was approved by the Ethics Committee of the Adana City T&E Hostital (2024/5-160). The principles of patient privacy and confidentiality were observed, and data were collected in accordance with the Declaration of Helsinki.

Author Contributions

Concept: ZSŞ/AY, Design: ZSŞ/AY, Literature search: GI, Data Collection and Processing: ZSŞ/AY, Analysis or Interpretation: ZSŞ/AY, Writing: ZSŞ/AY,

Source of Finance

The authors declare that they have received no financial support for this study

Conflict of interest statement

The authors declare that they have no conflict of interest.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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