Risk Management and Healthcare Policy

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

A Nomogram Model Integrating Inflammation Markers for Predicting the Risk of Recurrent Sciatica After Selective Nerve Root Blocks

Meng Cai*, Jing Yin*, Yi Jin, HongJun Liu

Department of Pain Medicine, Jinling Hospital, Affiliated Hospital of Medical School, Nanjing University, Nanjing, People's Republic of China

*These authors contributed equally to this work

Correspondence: HongJun Liu, Department of Pain Medicine, Jinling Hospital, Affiliated Hospital of Medical School, Nanjing University, 305# Zhongshan East Road, Nanjing, Jiangsu, 210002, People's Republic of China, Email spike810@163.com

Background: Lumbar disc herniation (LDH) usually c auses sciatica. Although selective nerve root block (SNRB) is an effective, highly target-oriented interventional procedure for patients with LDH, accurately predicting the risk of sciatica recurrence in such patients after SNRB remains a major challenge.

Objective: We aimed to construct a nomogram model by integrating clinical data, imaging features and inflammation markers that could predict recurrent sciatica following SNRB in LDH patients, which fill the inflammation data gaps during model construction.

Methods: In total, 121 sciatica patients were enrolled and assigned to the recurrence group (n = 41) and non-recurrence group (n = 80). By performing the logistic regression analyses, we identified risk factors serving as independent predictors and constructed the nomogram prediction model. Then, the performance and clinical practicality of the nomogram model were validated by performing the receiver operating characteristic curve (ROC) analysis, calibration curve analysis, and decision curve analysis (DCA). The bootstrap method was applied for the internal validation of the nomogram model.

Results: Preoperative sensory symptoms (odds ratio [OR] [95% confidence interval (CI)]: 2.933 [1.211–7.353]), type of herniation (OR [95% CI]: 2.712 [1.261–6.109]), and systemic inflammation response index (OR [95% CI]: 2.447 [1.065–6.271]) were included in the nomogram for predicting unfavorable outcomes following sciatica. The nomogram AUC was 0.764, and the prognostic precision, validated using the bootstrap method, reached 0.756. The ROC and calibration curve analyses, and DCA also produced excellent results, exhibiting favorable predictive performance and clinical benefit.

Conclusion: This study thus identified risk factors that predict unfavorable outcomes after sciatica and developed a risk prediction model based on clinical, radiologic, and inflammatory factors, thereby facilitating early predictions by clinicians and offering an individualized medical interventions for patients with recurrent sciatica in early stages.

Keywords: lumbar disc herniation, sciatica, selective nerve block, nomogram

Introduction

Sciatica presents as radiating lower limb pain extending from the buttock to the path and the distribution area of the sciatic nerve.[1] The lifetime incidence of sciatica ranges from 10% to 40% or even up to 70%. With time, the pain easily progresses to a chronic and recurrent stage.[2,3] This condition may cause severe disability, thereby significantly affecting the patient's quality of life and causing economic or social disability. Of the sciatica patients, approximately 85% develop sciatica due to lumbar disc herniation (LDH),[4,5] which results in the rupturing of a fibrous ring, thereby allowing the nucleus pulposus to compress the adjacent lumbar nerve roots or the cauda equina nerve, as part of intervertebral disc degeneration.[6]

The primary conservative treatments for sciatica secondary to LDH include anti-inflammatory, anti-edema, analgesic, and neurotrophic medications.[7] However, the clinical effectiveness of these approaches was deemed unsatisfactory

Received: 28 October 2024
Accepted: 26 March 2025
Published: 12 April 2025

because of the associated high short-term recurrence rate. The most common surgical treatment for LDH-induced sciatica is lumbar discectomy,[8] although evidence supporting surgical treatment for sciatica is ambiguous.[9]

Selective nerve root block (SNRB), a highly target-oriented procedure in which steroid is directly injected near the dorsal root ganglion and the inflamed nerve root, is being increasingly used in sciatica patients.[10] SNRB was effective in the treatment of disc herniation-induced radicular pain.[11] Moreover, a nerve block is more cost-effective in most cases than other operative interventions.

Although definite pathogenesis mechanisms remain unclear, emerging evidence suggests that inflammation plays a crucial role in neuropathic pain disorders such as trigeminal neuralgia, postherpetic neuralgia, diabetic neuropathy, and sciatica.[12–15] Classical hematological markers of systemic inflammation, such as neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), lymphocyte-to-monocyte ratio (LMR), systemic immune inflammation index (SII), and systemic inflammation response index (SIRI) are considered novel valuable biological predictors in various diseases, including cancer, bone metabolism disease, myasthenia gravis, and ulcerative colitis.[16–19] The levels of these inflammation markers can be measured through peripheral blood count, which is an accessible, reproducible, non-invasiveness, cost-effective, and convenient assessment method. However, previous studies have often confined themselves to clinical and imaging factors rather than incorporating inflammation markers, which has potentially led to inaccurate outcomes.[20–22] Limited studies have explored the role of these inflammation markers in LDH-induced sciatica.

Materials and Methods

Patient Population

The electronic health records of 121 patients diagnosed as having LDH-induced sciatica and treated with SNRB were extracted from the archives for January 2022 to August 2023 at Jinling Hospital (Nanjing University School of Medicine, People's Republic of China). All participants signed explicit informed consent forms, and the study was approved by the institutional ethics committee(2024DZKY-024-02). The study was conducted in accordance with the principles of the Declaration of Helsinki (October 2013).

The study included patients who were diagnosed as having sciatica secondary to LDH with MSU grade one or two through clinical presentation and imaging data and whose comprehensive clinical and 1-year follow-up data were available.

We excluded patients complicated by lumbar instability, spondylolisthesis, or spinal stenosis; those who underwent previous lumbar spine surgery; those who had severe liver and kidney dysfunction, malignant tumors, or mental disorders; and those who required decompression surgery for excruciating pain or neurological dysfunction.

Nerve Block Procedure

In the operating room, electrocardiography, blood pressure, peripheral oxygen saturation, and respiratory status were routinely monitored for the patients. The patients were positioned in a prone position with a cushion supporting the abdomen, and computed tomography (CT) was performed to identify the puncture site.

After the patients were disinfected, they were draped with towels were draped, and local anesthesia was administered. Then, a 21-G Touhy needle was precisely positioned within the ventral epidural space, which was verified through CT. Finally, 2 mL of 0.125% ropivacaine was mixed with 4 mg methylprednisolone and injected around the nerve root.

Data Collection and Definition

The clinical data of the participants, including age, sex, smoke, alcohol consumption, body mass index, hypertension, diabetes, preoperative sensory symptoms (subjective paresthesia and objective anesthetic zones), preoperative Visual Analog Scale (VAS) score, back pain, modic changes, Pfirrmann grade, type of herniation, and degree and level of herniation, were systematically extracted from the hospitals' electronic medical records. Pfirrmann grades I–III were considered to indicate mild LDH, whereas IV–V were considered to indicate severe LDH. The levels of hematological inflammatory markers, determined through the preoperative routine serum test, were calculated and documented as follows: NLR = neutrophil/lymphocyte, PLR = platelet/lymphocyte, LMR = lymphocyte/monocyte, SII = platelet ×

neutrophil/ lymphocyte, and SIRI = neutrophil × monocyte/lymphocyte. A reduction in the VAS score of <50% was considered to indicate a recurrence of sciatica, whereas that of >50% was considered to indicate an improvement of symptoms. All patients were followed up by telephone, and the final 1-year follow up was completed in August 2024.

Statistical Analysis

These data were used as dichotomous variables for the non-recurrence and recurrence groups, respectively.

The chi-square test or Fisher's exact test was employed to compare categorical variables, whereas the t-tests or Mann–Whitney *U*-test was conducted to compare continuous variables. Univariate and multivariate analyses were performed using the logistic regression model to evaluate prognostic factors.

To identify independent risk factors, a prediction model and nomogram were established based on the results of the multivariate logistic regression analyses. Receiver operating characteristic (ROC) curves were plotted, and the area under the curve (AUC) was calculated using the pROC package. The calibration of our model was assessed using the Hosmer–Lemeshow goodness-of-fit test and calibration curve. Decision curve analysis (DCA) was performed to determine the clinical effectiveness of the prediction model, and the predictive power of the model was internally validated using the repeated sampling method (bootstrap method). Statistical analyses were performed using R software (version 4.3.2) with a significance threshold set at 0.05.

Results

Patient Characteristics

The flowchart of patient selection is shown in Figure 1. In total, 121 patients who met the inclusion criteria were finally enrolled in this study. Of them, 80 patients (non-recurrence group) experienced good pain relief after 1 year of follow-up, whereas 41 patients (recurrence group) experienced recurrent sciatica (66% vs 34%). Table 1 presents the comparison of patient baseline characteristics in the two groups. Significant differences in sex, smoke, preoperative sensory symptoms, type of herniation, SII, and SIRI were observed between the two groups ($P < 0.05$).

Univariate and Multifactorial Analyses

Univariate and multivariate logistic regression analyses were performed to identify independent predictors, and 22 variables were analyzed. In the univariate analysis, sex ($p = 0.001$), smoke ($p = 0.03$), preoperative sensory symptoms ($p = 0.002$), type of herniation ($p = 0.004$), and SIRI ($p = 0.001$) were significantly correlated with sciatica recurrence. Then, multivariate logistic regression was applied using the five parameters for further analysis. According to the results, preoperative sensory symptoms (odds ratio (OR) = 2.933, 95% confidence interval (CI): 1.211–7.353, $p = 0.019$), type of herniation (OR = 2.712, 95% CI: 1.261–6.109, $p = 0.013$), and SIRI (OR = 2.447, 95% CI: 1.065–6.271, $p = 0.048$) were independent influencing factors for recurrent sciatica (Table 2).

Construction of the Nomogram Model

Based on the risk factors determined through the multivariate logistic analyses, a nomogram model was formulated integrating three potential predictors of the risk of recurrent sciatica (Figure 1A). The model with a high total score indicated a high risk of recurrent sciatica. For example, an sciatica patient with preoperative sensory symptoms, aracentral herniation, and SIRI of 0.82 had an estimated probability of recurrent sciatica of 83.6% (Figure 2A).

Evaluation and Validation of the Nomogram Model

The ROC curve was plotted to assess the discriminatory ability of the predictive nomogram model, and the AUC was 0.764 (95% CI: 0.663–0.864), which suggested that the nomogram had a good predictive ability (Figure 3A).

The model was then internally validated using the bootstrap validation method. The nomogram's prognostic precision reached 0.756 (Figure 3B). Moreover, the calibration curve corroborated that the probability predicted by the nomogram corresponded well with the actual observations (Figure 4). The DCA curve result showed that the nomogram holds substantial predictive power and thus offers remarkable benefits to patients (Figure 5).

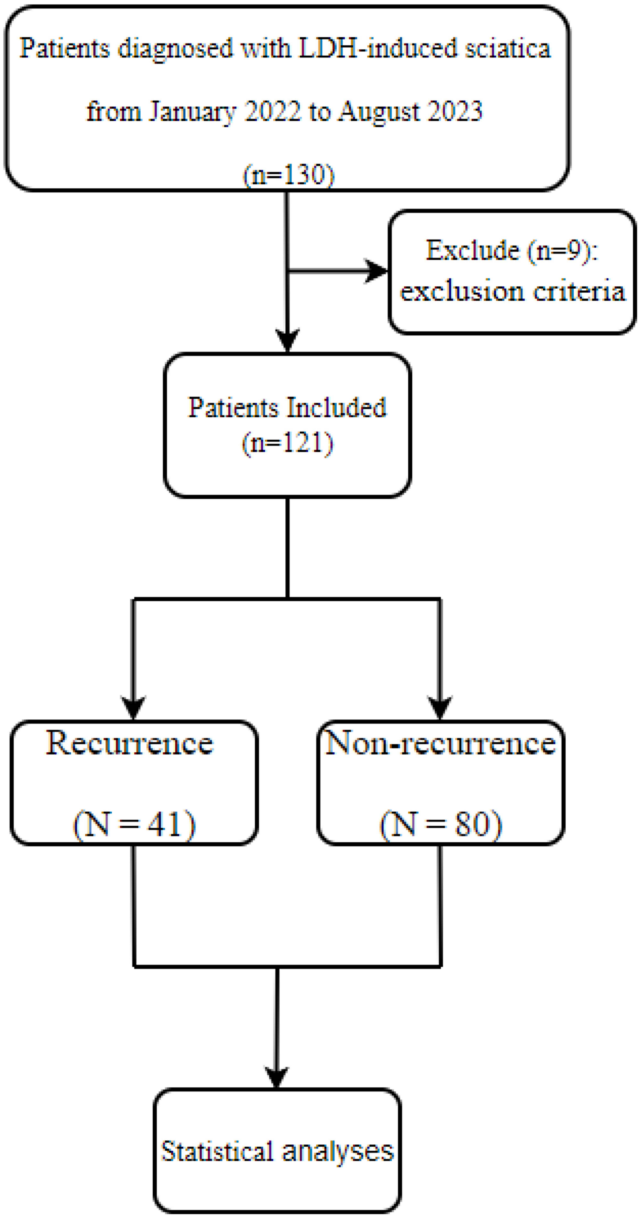

Figure 1 Flow chart depiction of the study protocol.
Abbreviations: LDH, Lumbar disc herniation.

Discussion

According to the univariate logistic regression analysis, five variables, namely sex, smoke, preoperative sensory symptom, type of herniation, and SIRI were significantly associated with recurrent sciatica (all $p < 0.05$). Furthermore, the aforementioned factors were also analyzed using multivariable logistic regression, and the results indicated that preoperative sensory symptoms, type of herniation, and SIRI were independent predictors. The odds of sciatica recurrence among sciatica patients with preoperative sensory symptoms, aracentral herniation, or SIRI were 2.933, 2.712, and 2.477 times higher than patients without that, respectively. Based on the results of the logistic regression analysis, the three independent predictors were incorporated to build a nomogram model for predicting the probability of sciatica recurrence. Furthermore, the ROC, DCA, and calibration curve results unveiled that the nomogram has good predictive and clinical application values, which may offer a basis for clinical decision-making in sciatica.

Table 1 Comparison of Baseline Data Between Non-Recurrence Group and Recurrence Group

Variables	Non-Recurrence Group (N = 80)	Recurrence Group (N = 41)	*P* value
Sex (Male/Female)	31/49	12/29	0.001
Age (years)	56.650±17.153	59.195±17.315	0.443
Smoke (yes/no)	10/70	12/29	0.024
Alcohol Consumption	14/66	9/32	0.555
BMI (kg/m^2)	24.454±3.248	25.141±4.560	0.340
Hypertension	27/53	19/22	0.177
Diabetes	12/68	5/36	0.674
Preoperative sensory symptoms	27/53	26/15	0.002
Preoperative VAS score	4(2)	5(1)	0.160
Back pain	48/32	28/13	0.372
Modic Changes	5/75	3/38	0.823
Pfirrmann grade (mild vs severe)	46/34	24/17	0.913
Type of Herniation			0.004
Central	53	18	
Paracentral	27	19	
Lateral or Extreme Lateral	0	4	
Degree of Herniation			0.091
1	34	11	
2	46	30	
Level of Herniation			0.513
L4-L5	44	24	
L5-S1	27	15	
Others	9	2	
NLR	1.790(1.42)	1.960(1.38)	0.155
PLR	109.680(48.04)	117.680(73.82)	0.204
LMR	5.340(2.74)	4.410(3.51)	0.068
SII	339.285(304.78)	403.390(285.28)	0.048
SIRI	0.570(0.52)	0.900(1.02)	0.001

Abbreviations: BMI, Body Mass Index; NLR, neutrophil-to-lymphocyte ratio; PLR, platelet-to-lymphocyte ratio; LMR, lymphocyte-to-monocyte ratio; SII, systemic immune inflammation index; SIRI, systemic inflammation response index.

In some studies, gender was found to be one of the few variables influencing the outcome of sciatica, and female gender predicted worse outcomes compared with male gender.[23] A randomized trial including 283 persistent sciatica patients found that women had a slower rate of perceived recovery than men, and female gender was an independent

Table 2 Results of Univariate and Multivariate Analyses of Factors Associated With Recurrent Sciatica

Variables	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Sex	3.820(1.735–8.832)	0.001		
Age	1.009(0.987–1.032)	0.440		
Smoke	2.897(1.129–7.599)	0.027		
Alcohol consumption	1.326(0.505–3.356)	0.555		
BMI	1.049(0.949–1.164)	0.342		
Hypertension	1.695(0.784–3.674)	0.179		
Diabetes	0.787(0.235–2.305)	0.675		
Preoperative sensory symptoms	3.402(1.569–7.617)	0.002	2.933(1.211–7.353)	0.019
Preoperative VAS score	1.240(0.906–1.712)	0.182		
Back pain	1.436(0.656–3.248)	0.373		
Modic changes	1.184(0.233–5.088)	0.823		
Pfirrmann grade	1.043(0.488–2.259)	0.913		
Type of Herniation	2.787(1.411–5.727)	0.004	2.712(1.261–6.109)	0.013
Degree of Herniation	0.701(0.419–1.674)	0.094		
Level of Herniation	0.790(0.428–1.407)	0.433		
NLR	1.352(0.936–1.967)	0.108		
PLR	1.006(0.999–1.014)	0.099		
LMR	0.865(0.712–1.033)	0.123		
SII	1.001(1.000–1.003)	0.051		
SIRI	3.778(1.798–8.871)	0.001	2.447(1.065–6.271)	0.048

Abbreviations: BMI, Body Mass Index; NLR, neutrophil-to-lymphocyte ratio; PLR, platelet-to-lymphocyte ratio; LMR, lymphocyte-to-monocyte ratio; SII, systemic immune inflammation index; SIRI, systemic inflammation response index.

predictive determinant for an unsatisfactory outcome at 1 year.[24] In our study, gender was associated with recurrent sciatica in the univariate analysis, which may be explained as a consequence of the differences in emotional and coping responses to pain between men and women.

According to a previous meta-analysis, smoking is a modest risk factor for lumbar radicular pain and clinically verified sciatica, and smoking cessation was found to reduce the harmful effect of smoking on lumbar intervertebral discs.[25] Another prospective cohort study reported that smoking increases the hospitalization risk for sciatica.[26] In this study, although smoking was excluded as a risk factor for recurrent sciatica in the multivariable analysis, patients with smoking were found to have a higher recurrent risk than those without smoking. The mechanism underlying the influence of smoking on sciatica is only partially known. Smoking impedes the healing process by elevating the production and release of inflammatory cytokines in intervertebral discs, which then leads to a higher risk of recurrent sciatica.[27]

Studies have identified preoperative sensory symptoms as a potential clinical factor that predicts a failure in patients undergoing SNRB, which often causes patients excessive worry and leads to earlier surgical intervention.[28] Our study result also indicated that preoperative sensory symptoms are an independent risk factor for sciatica recurrence, and

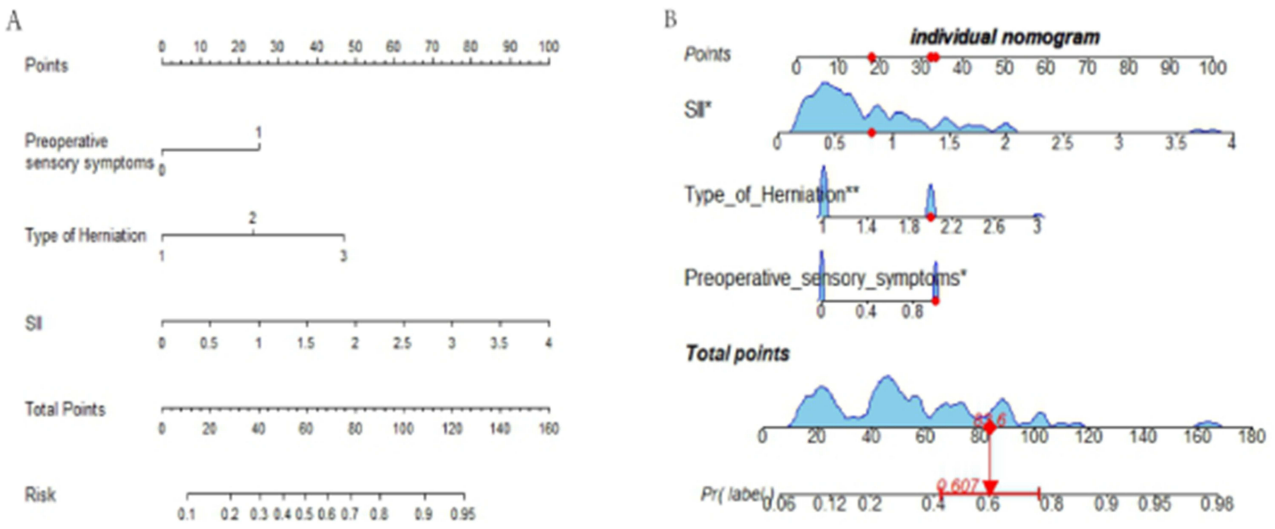

Figure 2 The nomogram and dynamic nomogram for predicting the risk of recurrent sciatica after SNRB. (**A**) Each predictor corresponds to a specific point, and a vertical line straight up to the point axis is drawn. The points received of each predictor are then summed to obtain the total point. Based on the total point, vertical lines can be drawn to the risk axis to determine the probabilities of recurrent sciatica for the patient. (**B**) A sciatica patient with preoperative sensory symptoms, aracentral herniation, and SIRI of 0.82 had an estimated probability of recurrent sciatica of 83.6%.
Abbreviations: SII, platelet × neutrophil/ lymphocyte.

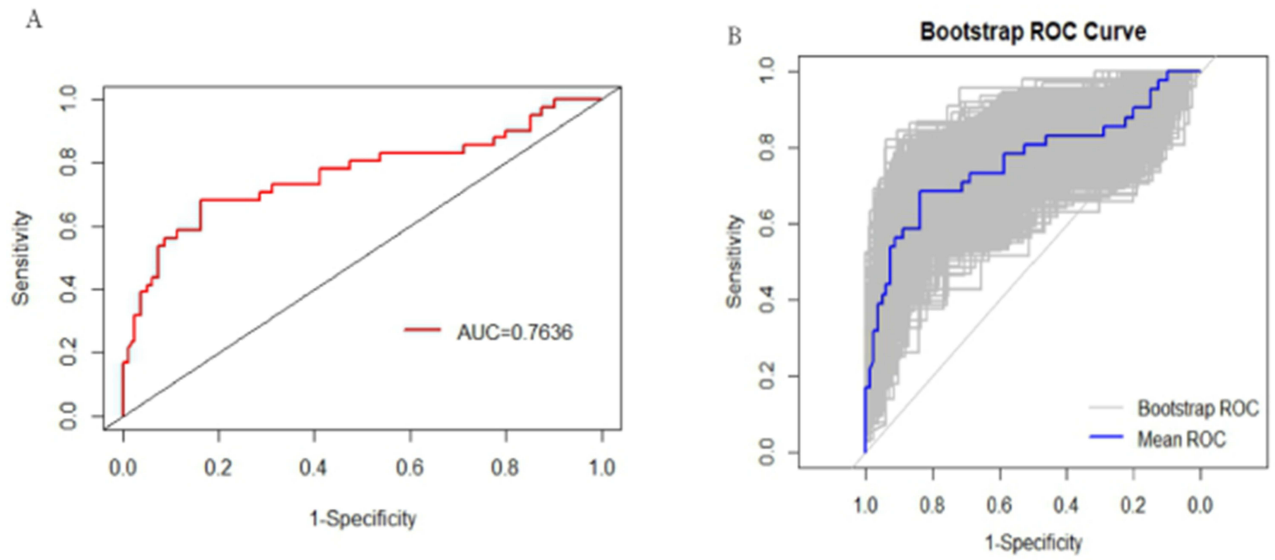

Figure 3 Receiver operating characteristic curve. (**A**) The area under the ROC curve of the predictive model was 0.764, indicating good predictive performance of the nomogram for recurrent sciatica. (**B**) The nomogram's prognostic precision reached 0.756, indicating good prognostic precision.
Abbreviations: AUC, the area under the ROC curve.

patients with these symptoms had a poor outcome following SNRB, which further confirmed the aforementioned finding. The poor outcome may be a result of damage to the nerve, as indicated by the lower extremity sensory symptoms.

Radiologic predictors based on magnetic resonance imaging (MRI) were also evaluated as potential predictors of recurrent sciatica. In the present study, type of herniation was statistically significant, whereas modic changes, Pfirrmann classification, and degree and level of herniation were not statistically significant as predictors of sciatica recurrence. The herniated nucleus pulposus may be present in different locations such as central, paracentral, lateral, or extreme lateral, and thus exert varying effects on the nerve roots. In our study, patients with lateral or extreme lateral herniated nucleus pulposus had a higher risk of recurrence.

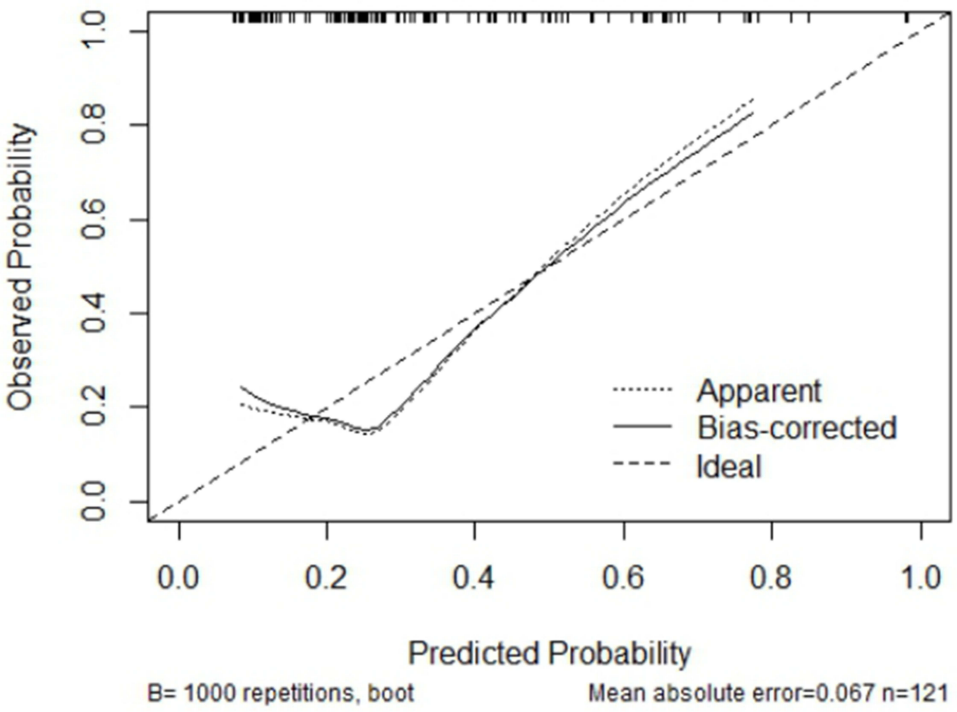

Figure 4 Calibration curves of the nomogram. The prediction curves closely align with the diagonal line, indicating the predicted (x-axis) and observed probabilities (y-axis) correspond well.

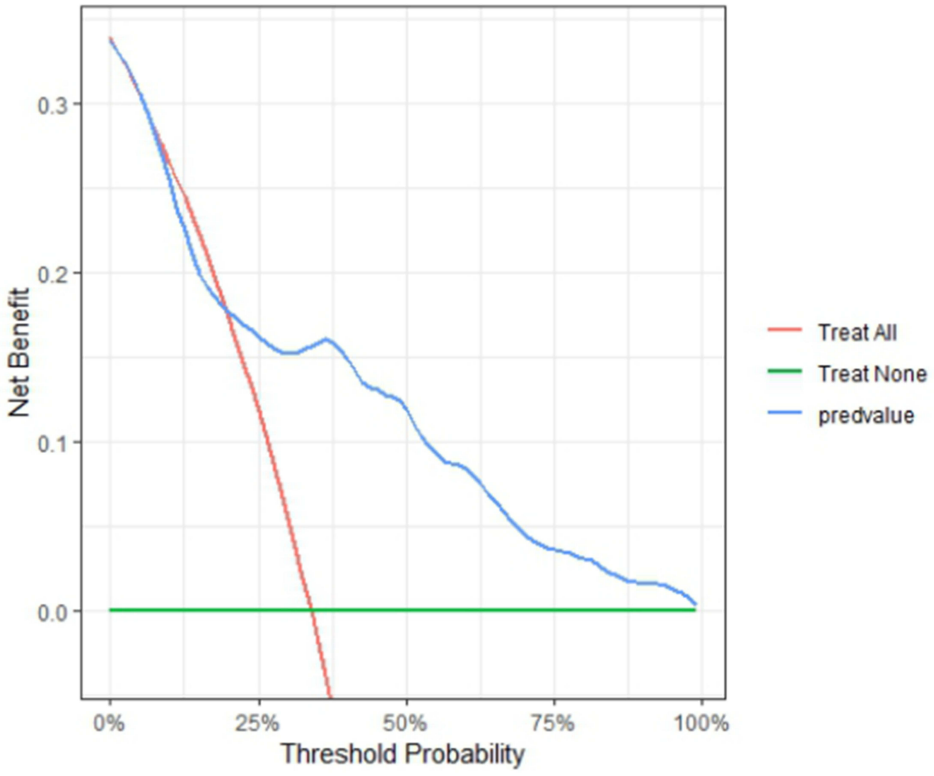

Figure 5 Decision curves of the nomogram. The y-axis and x-axis indicate the net benefit and the threshold probability, separately.

Accumulating evidence indicates that herniated nucleus pulposus tissue-triggered inflammation exerts a pivotal function in LDH-induced sciatica.[15] When the herniated nucleus pulposus tissues are exposed to the immune system because of annular tear, a cascade of immune responses and massive inflammatory mediators was induced, thereby irritating the dorsal root ganglia and causing radicular pain.[29,30] Several inflammatory parameters, which could affect LDH and sciatica, were also evaluated in previous studies. A Mendelian randomization study analyzed the significant causal effects of over 50 inflammatory mediators on sciatica risk, which indicated the potential for developing inflammation-centered prognostic biomarkers for sciatica patients.[31] In another single-center small sample study of 20 LDH patients who underwent surgery, a statistically significant positive correlation was observed between NLR and the preoperative and postoperative VAS scores, which further indicated the possible significance of inflammatory parameters in LDH.[32]

In our study, apart from clinical and radiologic factors, five inflammatory parameters were also examined through univariate and multivariate analyses. The results revealed that SIRS was an independent risk marker for patients with sciatica, whereas other factors including NLR, PLR, LMR, and SII were not statistically significant. SIRI can reflect the balance between the inflammatory response and immune status,[33] and the good predictive power has been validated in various diseases. An elevated SIRI indicates relatively increased neutrophil or monocyte counts, whereas decreased lymphocyte counts. The crucial role of the neuroinflammatory response in the development and maintenance of inflammatory and neuropathic pain has recently been repeatedly emphasized. This role was triggered by inflammatory cells including monocytes, T and B lymphocytes, and neutrophils.[34] Neutrophils exert substantial pro-inflammatory effects in neuropathic pain genesis. A related study demonstrated that neutrophil depletion can block ongoing inflammation and diminish the generated pain.[35–37] Monocytes are identified as major producers of TNF-α in peripheral blood, which is a pivotal player at both peripheral and central levels of sensitization in neuropathic pain.[38,39] Lymphocytes exert several pro-inflammatory effects, but may also mediate anti-inflammatory effects in neuropathic pain.[40–42]

To the best of our knowledge, this is the first study exploring the combined role of clinical variables, radiologic factors, and inflammatory parameters and identifying SIRI as independent risk marker for patients with sciatica who underwent SNRB. The nomogram model has clinical implications generalizable to clinical prediction of recurrent sciatica, so that timely treatment measures can be taken to relieve pain and improve quality of life.

However, this study has several limitations. Firstly, this was a non-randomized retrospective study based on a single database including 121 patients. This may have introduced inherent selection bias and inclusion biases, and reduced the reliability of our prognostic model. Secondly, the relatively small sample size may limited the generalizability of the results to other clinical settings and diverse populations. Moreover, although the model performance was internally validated using the bootstrap method, external validation using geographical validation through a large-scale multicenter prospective cohorts is warranted to further substantiate our results.

Conclusion

Collectively, our study demonstrated that preoperative sensory symptoms, type of herniation, and SIRI were independent prognostic factors for patients with LDH-induced sciatica who underwent SNRB, and then constructed a prognostic prediction model Based on these three predictors.

Data Sharing Statement

The original contributions presented in the study are included in the article1. Further inquiries can be directed to the corresponding authors.

Funding

This project was supported by the Key Research and Development Plan of Jiangsu Province (BE2021728).

Disclosure

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

1. Xia J-C, Huang Y-C, Wu K, Pang J, Shi Y. Efficacy of electroacupuncture combined with Chinese herbal medicine on pain intensity for chronic sciatica secondary to lumbar disc herniation: study protocol for a randomised controlled trial. *J Pain Res*. 2024;17:1381–1391.
2. Zhang D, Jing B, Chen Z-N, et al. Ferulic acid alleviates sciatica by inhibiting neuroinflammation and promoting nerve repair via the TLR4/NF-κB pathway. *CNS Neurosci Ther*. 2023;29(4):1000–1011. doi:10.1111/cns.14060
3. Lindblom K, Rexed B. Spinal nerve injury in dorso-lateral protrusions of lumbar disks. *J Neurosurg*. 1948;5(5):413–432. doi:10.3171/jns.1948.5.5.0413
4. Lu X, Chen L, Jiang C, Cao K, Gao Z, Wang Y. Microglia and macrophages contribute to the development and maintenance of sciatica in lumbar disc herniation. *Pain*. 2023;164(2):362–374. doi:10.1097/j.pain.0000000000002708
5. Ananthakrishnan N, Diwana VK, Rao AV. An evaluation of the relative utility of different criteria of positivity in assessing the response to insulin induced hypoglycemic stimulation of the vagus as test for completeness of vagotomy. *Indian J Med Sci*. 1989;43(7):184–188.
6. Wang L, Fan W, Yu C, Lang M, Sun G. Clinical effects of electrical stimulation therapy on lumbar disc herniation-induced sciatica and its influence on peripheral ROS level. *J Musculoskelet Neuronal Interact*. 2018;18(3):393–398.
7. Zhang J, Zhang R, Wang Y, Dang X. Efficacy of epidural steroid injection in the treatment of sciatica secondary to lumbar disc herniation: a systematic review and meta-analysis. *Front Neurol*. 2024;15:1406504. doi:10.3389/fneur.2024.1406504
8. Weinstein JN, Tosteson TD, Lurie JD, et al. Surgical vs nonoperative treatment for lumbar disk herniation: the Spine Patient Outcomes Research Trial (SPORT): a randomized trial. *JAMA*. 2006;296(20):2441–2450.
9. Liu C, Ferreira GE, Abdel Shaheed C, et al. Surgical versus non-surgical treatment for sciatica: systematic review and meta-analysis of randomised controlled trials. *BMJ*. 2023;381:e070730. doi:10.1136/bmj-2022-070730
10. Ter Meulen BC, Maas ET, van der Vegt R, et al. Cost-effectiveness of transforaminal epidural steroid injections for patients with ACUTE sciatica: a randomized controlled trial. *BMC Musculoskelet Disord*. 2024;25(1):247. doi:10.1186/s12891-024-07366-5
11. Smith CC, McCormick ZL, Mattie R, MacVicar J, Duszynski B, Stojanovic MP. The effectiveness of lumbar transforaminal injection of steroid for the treatment of radicular pain: a comprehensive review of the published data. *Pain Med*. 2020;21(3):472–487. doi:10.1093/pm/pnz160
12. Ericson H, Abu Hamdeh S, Freyhult E, et al. Cerebrospinal fluid biomarkers of inflammation in trigeminal neuralgia patients operated with microvascular decompression. *Pain*. 2019;160(11):2603–2611. doi:10.1097/j.pain.0000000000001649
13. Cai M, Yin J, Zeng Y, Liu H, Jin Y. A prognostic model incorporating relevant peripheral blood inflammation indicator to predict postherpetic neuralgia in patients with acute herpes zoster. *J Pain Res*. 2024;17:2299–2309. doi:10.2147/JPR.S466939
14. Wang Y, Miao Y, Wan Q. Association of white blood cell count to mean platelet volume ratio with type 2 diabetic peripheral neuropathy in a Chinese population: a cross-sectional study. *BMC Endocr Disord*. 2024;24(1):129. doi:10.1186/s12902-024-01644-y
15. Jungen MJ, Ter Meulen BC, van Osch T, Weinstein HC, Rwjg O. Inflammatory biomarkers in patients with sciatica: a systematic review. *BMC Musculoskelet Disord*. 2019;20(1):156. doi:10.1186/s12891-019-2541-0
16. Wei L, Wu Y, Bo J, et al. Dual-energy computed tomography parameters combined with inflammatory indicators predict cervical lymph node metastasis in papillary thyroid cancer. *Cancer Control*. 2024;31:10732748241262177. doi:10.1177/10732748241262177
17. Zhuo H, Zhou Z, Chen X. Constructing and validating a predictive nomogram for osteoporosis risk among Chinese single-center male population using the systemic immune-inflammation index. *Sci Rep*. 2024;14(1):12637. doi:10.1038/s41598-024-63193-7
18. Dynamic changes of peripheral inflammatory markers link with disease severity and predict short-term poor outcome of myasthenia gravis. *J Neurochem*. 2024.
19. Alter CL. Palliative and supportive care of patients with pancreatic cancer. *Semin Oncol*. 1996;23(2):229–240.
20. Rishi MK, Ajoy PS, R S. Predictors of successful outcomes of selective nerve root blocks for acute lumbar disc herniation. *Global Spine J*. 2019;9(5).
21. The efficacy of therapeutic selective nerve block in treating lumbar radiculopathy and avoiding surgery. *J Pain Res*. 13;2020.
22. Joon Woo L, Sung hyun K, In Sook L, et al. Therapeutic effect and outcome predictors of sciatica treated using transforaminal epidural steroid injection. *AJR Am J Roentgenol*. 2006;187(6).
23. Kosteljanetz M, Espersen JO, Halaburt H, Miletic T. Predictive value of clinical and surgical findings in patients with lumbago-sciatica. A prospective study (Part I). *Acta Neurochir (Wien)*. 1984;73(1–2):67–76. doi:10.1007/BF01401785
24. Peul WC, Brand R, Rtwm T, Koes BW. Influence of gender and other prognostic factors on outcome of sciatica. *Pain*. 2008;138(1):180–191. doi:10.1016/j.pain.2007.12.014
25. Shiri R, Falah-Hassani K. The effect of smoking on the risk of sciatica: a meta-analysis. *Am J Med*. 2016;129(1):64–73.e20. doi:10.1016/j.amjmed.2015.07.041
26. Lifestyle risk factors increase the risk of hospitalization for sciatica: findings of four prospective cohort studies. *Am J Med*. 2017;130(12).
27. Mattila VM, Saarni L, Parkkari J, Koivusilta L, Rimpelä A. Early risk factors for lumbar discectomy: an 11-year follow-up of 57,408 adolescents. *Eur Spine J*. 2008;17(10):1317–1323. doi:10.1007/s00586-008-0738-2
28. Kanna RM, Shetty AP, Rajasekaran S. Predictors of successful outcomes of selective nerve root blocks for acute lumbar disc herniation. *Global Spine J*. 2019;9(5):473–479. doi:10.1177/2192568218800050
29. MdLÁ E, Croce E, Moviglia brandolino MT, Moviglia G, Grangeat AM. Ozone as modulator of resorption and inflammatory response in extruded nucleus pulposus herniation revising concepts. *Int J mol Sci*. 2021;22(18).
30. Urban JPG, Roberts S. Degeneration of the intervertebral disc. *Arthritis Res Ther*. 2003;5(3):120–130.
31. Wu Y, Lin Y, Zhang M, He K, Tian G. Causal association between circulating inflammatory markers and sciatica development: a Mendelian randomization study. *Front Neurol*. 2024;15:1380719. doi:10.3389/fneur.2024.1380719
32. Bozkurt H, Arac D, Cigdem B. Effect of preoperative uric acid level and neutrophil / lymphocyte ratio on preoperative and postoperative visual analogue pain scores in patients with lumbar disc herniation: a cross-sectional study. *Turk Neurosurg*. 2019;29(5):705–709. doi:10.5137/1019-5149.JTN.25897-19.2
33. Manjunath N, Borkar SA, Agrawal D. Letter: systemic Immune-Inflammation Index Predicts Delayed Cerebral Vasospasm After Aneurysmal Subarachnoid Hemorrhage. *Neurosurgery*. 2022;91(1):e27. doi:10.1227/neu.0000000000002014
34. Segal JP, Tresidder KA, Bhatt C, Gilron I, Ghasemlou N. Circadian control of pain and neuroinflammation. *J Neurosci Res*. 2018;96(6):1002–1020.

35. Austin PJ, Moalem-Taylor G. The neuro-immune balance in neuropathic pain: involvement of inflammatory immune cells, immune-like glial cells and cytokines. *J Neuroimmunol*. 2010;229(1–2):26–50. doi:10.1016/j.jneuroim.2010.08.013
36. Nadeau S, Filali M, Zhang J, et al. Functional recovery after peripheral nerve injury is dependent on the pro-inflammatory cytokines IL-1β and TNF: implications for neuropathic pain. *J Neurosci*. 2011;31(35):12533–12542. doi:10.1523/JNEUROSCI.2840-11.2011
37. Kim CF, Moalem-Taylor G. Interleukin-17 contributes to neuroinflammation and neuropathic pain following peripheral nerve injury in mice. *J Pain*. 2011;12(3):370–383. doi:10.1016/j.jpain.2010.08.003
38. Leung L, Cahill CM. TNF-alpha and neuropathic pain--a review. *J Neuroinflammation*. 2010;7(27):27. doi:10.1186/1742-2094-7-27
39. O'Brien JA, McGuire HM, Shinko D, et al. T lymphocyte and monocyte subsets are dysregulated in type 1 diabetes patients with peripheral neuropathic pain. *Brain Behav Immun Health*. 2021;15:100283.
40. Labuz D, Schreiter A, Schmidt Y, Brack A, Machelska H. T lymphocytes containing β-endorphin ameliorate mechanical hypersensitivity following nerve injury. *Brain Behav Immun*. 2010;24(7):1045–1053. doi:10.1016/j.bbi.2010.04.001
41. Ding W, You Z, Chen Q. Gut Microbiota Influences Neuropathic Pain Through Modulating Proinflammatory and Anti-inflammatory T Cells. *Anesth Analg*. 2021;132(4):1146–1155. doi:10.1213/ANE.0000000000005155
42. Tsai YC, Won SJ. Effects of tramadol on T lymphocyte proliferation and natural killer cell activity in rats with sciatic constriction injury. *Pain*. 2001;92(1–2):63–69.