

# Neuropathic Low Back Pain: Evaluation of Diagnostic

Waseem H. Alkhaffaf and Sara S. Mustafa

<sup>1</sup>Department of Medicine, College of Medicine, Ninevah University, Mosul, Iraq.

<sup>2</sup>Department of Neurophysiology unit, Ibn- Sina Teaching Hospital, Mosul, Iraq

**Abstract— Background:** Low back pain (LBP) is progressively being considered to be a mixed pain syndrome combining both neuropathic and nociceptive components. Neuropathic LBP (NLBP) may still be underestimated.

**Objectives:** to determine the correlation between the diagnosis of NLBP and the outcomes of MRI and Electrodiagnostic studies (EDX).

**Materials and Methods:** A cross-sectional prospective study was conducted and 427 patients with a history of LBP from both sexes were randomly enrolled. To assess neuropathic pain, a screening questionnaire called the Douleur Neuropathique 4 (DN4) was used. The evaluation involved the use of MRI and EDX (with a Paraspinal mapping technique).

**Results:** According to DN4, there were 42.15% of patients suffering from NLBP, and their disabilities were more severe. Those who were investigated found that there were significant positive correlations between the results of diagnostic tests and the presence of neuropathic pain. The MRI was found to be more sensitive than the EDX, but the EDX was more specific.

**Conclusion:** NLBP is regarded as one of the most common neuropathic pains in the population. MRI has a high sensitivity to identify structural abnormalities, while the EDX is specific in determining nerve root damage. Therefore, these diagnostic methods are needed to enrich the diagnosis and decide on the most appropriate plan of management.

**Index Terms—** low back pain, paraspinal mapping technique, Douleur Neuropathique 4, neuropathic pain.

## I. INTRODUCTION

Low back pain is defined as pain, tension or discomfort sensation localized between the costal margin and the inferior gluteal folds, whether or not there is pain in the lower limb, and without any traumatic injury or intraabdominal pathology that may be causing this pain. LBP is established as chronic when the pain persists for 12 weeks or more. (1,2).

LBP is one of the main causes of long lasting disabilities and decreasing work capabilities(3,4). it is a very common pain and the lifetime incidence is 58-84%(3).

Chronic LBP is a complex condition and it is progressively more considered to be a mixed pain syndrome compromising from both nociceptive and neuropathic components. Nociceptive pain is produced by stimulation of nociceptors which innervate joints, muscles, ligaments, fascia and tendons as a response to inflammation, injury and biomechanical stress. Neuropathic LBP (NLBP) demonstrates the pain that arise from

disease or injury affects the nerve tissue(5).

At present, numerous studies have revealed that a nociceptive origin is more common in chronic LBP 6. Two studies done by the Freynhagen team in Germany found that the prevalence rates of neuropathic component in LBP patients, were 37% and 33.5%, respectively(7,8). In Saudi Arabia, two studies showed that the proportion of neuropathic pain among patients suffering from chronic LBP were 41% and 54.7%(9,10)

The percentage of chronic LBP patients with a neuropathic component is dependent on the classification manner, and is between 17 and 54%. However, NLBP may still be undervalued considering that up to 28% of patients have an undetermined diagnosis.

Mechanical compression of the nerve root, lesions of nociceptive sprouts within a degenerated disc and impact of inflammatory mediators emerging from a degenerative disc, which may cause inflammation and damage to the nerve roots, can be causes of NLBP (5).

The diagnosis of NLBP in clinical practice involves the use of history, neurological exam, and investigations, such as neuroimaging and neurophysiological testing.

MRI of spine plays an essential role in differential diagnosis of NLBP. The interpretation of MRI should be meticulous as older adults are more possible to have asymptomatic degenerative disorders, and abnormal MRI signals are not always revealing tissue damage or dysfunction(5).

Electrodiagnostic studies (EDX) are usually used and objectively support the diagnosis of NLBP. They are valuable in determining the root level, chronicity, and severity of problem. Also, These tests have no serious complications(12). In addition, they can differentiate radiculopathy from mimics such as polyneuropathy and plexopathy(13,14). While the sensitivity of these tests has been discussed in number of studies but they were unimpressive and ranged from 49-92%(15).

In the absence of a gold standard method for the diagnosis of NLBP, many studies relied on physicians' opinions to differentiate between neuropathic and non-neuropathic pain. Sometimes, It can be challenging to resolve this issue through complementary investigations, as they are uninformative and missing in specificity. The clinical identification and characterization of NLBP must be improved as a result. Recent research has sought to do this by using questionnaires, physical examinations, and quantitative sensory testing(16).

The Douleur Neuropathique 4 (DN4) is one of the most

significant screening questionnaires created to evaluate both sensory symptoms and signs that relate to neuropathic pain. It has been established to be very sensitive and specific for identifying neuropathic pain among patients with LBP(5,17).

The complaints of Iraqi patients with neuropathic low back pain were not properly evaluated and managed, leading to persistent pain and reduced quality of life.

#### *Objectives of this study:*

The purpose of this evaluation is to determine the correlation between the diagnosis of NLBP and the outcomes of lumbosacral spine MRI and EDX.

## II. STUDY DESIGN AND PARTICIPANTS:

### *A. Study design and Participants:*

A random enrollment of 427 patients with a history of LBP of both sexes was performed in a cross-sectional prospective study. They were referred to an outpatient clinic at Teaching Hospitals in Mosul city during 2022, and 2023. Ninevah university's ethics committee granted the ethical approval.

Patients were only included if they had a 3-month history of LBP, with or without pain radiating to the legs.

Those who have spinal cord diseases like traumatic injury, infection, inflammatory condition, tumors, or other space-occupying lesions, as well as peripheral nerve diseases, are not permitted to participate in the study. Finally, no analgesic or pain killer medication should have been taken in a week period prior to the assessment.

### *B. Test methods:*

After describing this study, written informed consents were obtained from all patients. All patients were given a history, and then a complete neurological examination was performed on them.

The DN4 is comprised of four sections along with a ten-item checklist for assessing neuropathic pain. Seven items are related to the characteristics of pain (burning, painful cold, electric shocks) and pain-associated symptoms (tingling, pins and needles, numbness and itching), and three items are related to a neurological examination in the pain area (hypoesthesia to touch, hypoesthesia to prick and brushing). A yes answer receives a (1), while a no answer receives a (0). The overall score is calculated by adding up all 10 items, with a cut-off score of 4/10 used to diagnose neuropathic pain(18)

The DN4 classified LBP patients into negative and positive groups. In cases where there were multiple areas of pain in some patients, the neuropathic pain classification was applied to the maximum pain area.

One of the most popular disability surveys for LBP patients is the Quebec Back Pain Disability Scale. It is a self-administered tool consisting of 20 items evaluates how hard it is to carry out simple physical activities(19). Perceived disability percentage can be calculated by total scores that range from zero to 100, with higher scores indicating greater

perceived disability levels(19). By using this scale, it was possible to compare the disability of those in the LBP-positive neuropathic group to those in the negative group.

The patients who had MRI of the lumbosacral spine were divided into two groups: Those who have normal or mild degenerative abnormalities (group 1) and Those who have structural spinal lesions, affect the nerve root and cause neuropathic pain, such as disc herniation and spinal stenosis(group 2). If there were multiple abnormalities, the one that was the most severe was taken into account.

For patients who underwent EDX, we looked at the methods and those with unreliable or insufficient results were excluded. These tests include nerve conduction study and electromyography (EMG) for both limbs. In addition, it is generally accepted that paraspinal abnormalities must exist in order to diagnose radiculopathy in patients with LBP because they are absent in other mimic illnesses. The Mini PM (mini paraspinal mapping) technique is used to measure these paraspinal abnormalities. It can be recognized if the total score is greater than 4 (20, 21). The abnormalities in EMG were believed to be radiculopathic and the pain was described as neuropathic, as if fibrillation potentials were present in the lumbar paraspinal muscles and two limb muscles.

### *C. Statistical analysis:*

After the collection of data forms, descriptive statistics were performed to analyze the clinical and investigational findings. All of these were done using Statistical Package for the Social Sciences (SPSS, version 25);  $P < 0.05$  was adopted to indicate the statistical significance.

## III. RESULTS

### *A. Participants:*

This study included 427 subjects aged between 22 and 75 years, with a mean age of  $54.47 \pm 14.19$  years. The female population comprised 239 individuals; their average age was  $55.82 \pm 14.27$  years, and the male population consisted of 188 individuals; their average age was  $52.82 \pm 13.96$  years. In terms of age, the number of patients was 174 for those under 50 and 253 for those over 50.

### *B. Test results:*

The assessment of included patients with chronic LBP according to DN4 was done, and the distributions of them according to gender, age, and presence of diagnostic tests are shown in Table 1. The NLBP patients (according to DN4) had a percentage of 42.15% (180 patients, including 79 males and 109 females). There were no significant differences according to gender in this study, but patients over the age of fifty had a higher prevalence of LBP (59.25% compared to 40.75%) and neuropathic components (32.08% compared to 14.75%) than younger age groups.

The Quebec Back Pain Disability Scale revealed a significant disparity between the DN4 negative and positive groups, with the disability being more prominent in the positive group.

There were no significant differences between male and female groups in this study for all variables, as all P values were > 0.05.

TABLE I:  
THE COMPARISON BETWEEN POSITIVE AND NEGATIVE NLBP ACCORDING TO DN4 IN DEMOGRAPHIC DATA , DISABILITY SCALE RESULTS AND INVESTIGATIONS:

Data		N. / Mean ± SD	Dn4 Positive	Dn4 Negative	P value
		<b>Total= 427</b>	<b>180 (42.15%)</b>	<b>247 (57.85%)</b>	
Gender	Male	188(44.03%)	79(18.50%)	109(25.53%)	0.960
	Female	239(55.97%)	101(23.65%)	138(32.32%)	
Ages	≤ 50	174(40.75%)	63(14.75%)	111(26.00%)	0.000
	>50	253(59.25%)	137(32.08%)	116(27.16%)	
The Quebec Back Pain Disability Scale		51.90 ± 16.87	55.42±16.25	49.34±16.89	0.000
	MRI	198(46.37%)	107(25.05%)	91(21.32%)	0.20
	EDX	103(24.12%)	49(11.47%)	54(12.65%)	0.59

\*Significant P value at < 0.05.

The percentage of patients who had MRI of lumbosacral spine was around 46%, while only about 24 % of them correctly underwent EDX (including EMG with paraspinal technique).

There were no significant differences in the frequency of performing MRI or EDX between the negative and positive DN4 groups.

The clinical classification of DN4 negative and positive groups was used as a “gold standard” to determine the diagnostic accuracy of these tests. Tables 2, 3 and 4 describe the correlation between the clinical diagnosis based on DN4 and MRI and EDX findings. According to our findings, there was a significant correlation between the diagnosis of NLBP and positive findings of MRI and EDX tests.

In addition, It was concluded that the MRI was more sensitive than the EDX (82.24% vs. 77.55%) and slightly more accurate (71.21%) than the EDX (69.90%). While the EDX had a higher specificity (62.96% vs. 58.24%) than MRI

TABLE II:  
THE CORRELATION BETWEEN MRI FINDINGS AND NLBP DIAGNOSIS ACCORDING TO DN4:

Test	Dn4 Positive	Dn4 Negative	Total
MRI (group 1)	88 (44.4%)	38 (19.2%)	126 (63.6%)
MRI (group 2)	19 (9.6%)	53 (26.8%)	72 (36.4%)
Total	107 (54%)	91 (46%)	198 (100%)

(group 1): Patients with structural spinal lesions that affect the nerve root  
(group 2): Patients with only normal or mild degenerative abnormalities  
The p value is 0.000. significant at p<0.05

TABLE III:  
THE CORRELATION BETWEEN EDX FINDINGS AND NLBP DIAGNOSIS ACCORDING TO DN4 :

Test	Dn4 Positive	Dn4 Negative	Total
EDX (group 1)	38(36.9%)	20(19.4%)	58(56.3%)
EDX (group 2)	11(10.7%)	34(33.0%)	45(43.7%)
Total	49(47.6%)	54(52.4%)	103(100%)

(group 1): positive result for radiculopathy  
(group 2): negative result  
The p value is 0.000. significant at p<0.05

TABLE IV:  
CLINICAL ACCURACY OF MRI AND EMG TESTS IN DIAGNOSIS OF NLBP PATIENTS:

Test	Sensitivity	Specificity	PLR*	NLR*	PPV*	NPV*	Accuracy
MRI	82.24%	58.24%	1.97	0.30	69.84%	73.61%	71.21%
EDX	77.55%	62.96%	2.09	0.36	65.52%	75.56%	69.90%

Confidence interval=95 %,"PLR: positive likelihood ratio, NLR: negative likelihood ratio, PPV: positive predictive value, NPV: negative predictive value".

#### IV. DISCUSSION

The diagnostic accuracy of NLBP is important because of therapeutic and prognostic issues. A main limitation of diagnostic studies is the lack of a gold standard method, which makes the assessment of their comparative diagnostic sensitivity is highly controversial(12). in addition, the diagnostic value of clinical assessment (by history and physical examination) has not been fully studied(22).

The classification approach of NLBP according to the DN4 is applicable because the DN4 is consists of both interview

questions and physical examination, and has been revealed high sensitivity and specificity for the finding of neuropathic pain components in LBP patients (5).

MRI is the best test for diagnosis of structural lesions in radiculopathy, while EDX is used mainly for assessment of physiological nature of nerve root damage. According to many studies and literatures, Both tests have false negative and false positive results, and we cannot depend on single test for the diagnosis but each one has a complementary role in assessment of LBP patients.

In this study sample, the percentage of LBP patients who aged more than 50 years was (59.25%), and the mean age of whole patients was > 50 years, in addition, we found that there were a relation between diagnosis of NLBP according to the DN4 and the age, as older age group reported more NLBP than younger group ((32.0% vs. 14.7%).

Many other studies reported similar results, e.g. Tomić S. et al(23) found that the maximum occurrence of extensive radiculopathies was in the oldest age group, and Mehra et al(11) reported that the mean age of LBP patients without neuropathic component was to some extent lower than that of patients who had neuropathic LBP.

Female percentage is slightly higher than of male. also this is reported by many studies as in Nafissi S. et al(13) and Arslan Y. et al(24), but it is not by Hasankhani EG. and Omid-Kashani F(4). Jimenez-Sanchez S. et al(25) estimated that females were more liable to develop chronic LBP than males (24.2 vs. 12.3%), possibly due to hormonal factors, especially after menopause age as reported by Wáng Y. et al in a literature review(26). In addition, the higher prevalence of chronic LBP in females may be related to complicated mechanisms (e.g. pain acclimatization, genetic sensitivity, in addition to less efficient pain inhibitory control). Further, women have osteopenia, osteoporosis and osteoarthritis more commonly(27).

There is no statistical differences between both genders in the value of diagnostic parameters that are used in this study.

According to the clinical classification of DN4, 42.15% of patients who complained from LBP are considered to have neuropathic components. This result is not compatible with Mehra et al(11). who found that most of chronic LBP patients had neuropathic components (about 90%). Several reports proposed that as many as 16–55% of chronic LBP patients had likely components of neuropathic pain (Fishbain et al., 2014; Beith et al., 2011; Freynhagen and Baron, 2009; Freynhagen et al., 2006a,b; Kaki et al., 2005; and Hassan et al.,2004)(28,29,30,7,8,10,9).

The broad differences in the reported prevalence of the neuropathic LBP are most probably due to the variations in methodology between studies, mainly in definition of neuropathic pain terms, pain evaluation tools, processes of data collection, the body areas that evaluated and possibly the samples that studied

For those patients who did MRI, 63.6% had significant structural spinal lesions, this result is compatible with Nafissi S. et al(13) who found that there are positive findings in 64%, but it is not compatible with Hasankhani EG. and Omid-Kashani F. (4) and Forero JJ. et al(14), who reported abnormal

MRI in 92% of study sample. This variation is mainly depend on epidemiological factors, the type and accuracy of MRI machine and on the radiologists that interpreted the results.

In the present study, as most studies that discussed the diagnosis of radiculopathy by EDX, we depend on EMG results, in spite of some articles signifying F-wave testing importance, the F-wave is not sensitive and it is rarely abnormal in radiculopathy while the needle EMG remain the essential test for the diagnosis(31).

The segmental localization of sensory radiculopathy cannot be dependably determined by EDX for the following explanations: pain and paraesthesia symptoms are mainly mediated through C-type fibers, which are very small to be examined by routine EDX; in addition, the peripheral sensory root fibers remain unharmed with intraspinal lesions and the Sensory Nerve Action Potentials normally remain(32).

In the present study, 56.3 % of subjects who did EDX had abnormal findings suggestive radiculopathy. the sensitivity of EDX in diagnosis of radiculopathy is different between the studies. e.g. in Nafissi S. et al (13) and Kuruoglu R. et al(33) studies, it was  $\geq 80\%$ . While in other studies e.g. Weber F and Albert U(34), the sensitivity was only 60%. In this study the sensitivity is 77.5%. this variation is depend on many factors including the sample subjects, the technique of test that is depended, the type and accuracy of machine and neurophysiologist experiences.

The literatures discussing the relative accuracies of MRI and EDX in the radiculopathy evaluation and degree of correlation between these diagnostic tests are limited.

This study revealed that MRI and EDX tests have an important role in diagnosis of radiculopathy in LBP patients. However, the sensitivity of MRI (82.24%) was higher in comparison to EMG (77.55%), and the reverse occurred with specificity (62.96% vs. 58.24%). these results are different in percentages from those reported by Hasankhani EG. and Omid-Kashani F(4) and Soltani ZR. et al(12) but all these studies agreed that MRI is sensitive rather than specific and EMG had higher specificity but with lower sensitivity than MRI.

The information we will obtain from conducting these tests has a significant impact on confirming the clinical diagnosis of NLBP and thus determining the clinical outcomes and the appropriate therapeutic decisions, As a significant percentage of patients lack the appropriate diagnosis, and this means prolonging their suffering and their inability to fulfill the requirements of life, oppositely, the early and accurate diagnosis means reducing excessive use of analgesic medications or unnecessary surgical interventions and improving quality of life of those with chronic LBP.

Lastly, although it is uncommon, but we should remember that radiculopathies may be presented without significant findings in the diagnostic tests and vice versa(4,13,15).

#### LIMITATIONS:

Some limitations are detected in this study, including absence of gold standard method for detection of the sensitivity and

specificity of MRI and EDX. In addition, MRI and EDX abnormalities can be evaluated differently and it is may be variable.

#### CONCLUSION

NLBP is considered as one of the most frequently occurring neuropathic pain in the population. In language of screening tests, for identifying structural abnormalities and giving good anatomical details of lesions, MRI is sensitive and used; while for evaluation of the physiological nature and confirming the nerve root damage, EDX, including EMG examination of both lower limbs and paraspinal technique, is indicated. Therefore, the assessment of chronic LBP by these tests is needed in enrichment of the diagnosis and we should discuss how their results impact in determining the clinical outcomes and therapeutic decisions.

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