Diagnostic accuracy study of clinical evaluation with MRI findings in patients with radiculopathy due to lumbar disc herniation

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ABSTRACT

Background:
Lumbar radiculopathy presents a clinical challenge among primary care clinicians in both assessment and diagnosis. This often leads to misdiagnosis and inappropriate treatment of patients resulting in poor health outcomes, exacerbating this debilitating condition.

Methodology:
51 consecutive patients presenting with low backache were included in the study. the selected clinical evaluation parameters were then correlated with MRI findings and their accuracy was calculated using sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, positive predictive value, and negative predictive value.

Result:
The study demonstrates that certain clinical parameters are having fairly good accuracy in diagnosing lumbar radiculopathy.

Key words: Lumbar radiculopathy, diagnostic accuracy, clinical evaluation.

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1. INTRODUCTION

Lumbar radiculopathy presents as a clinical challenge among primary care clinicians in both assessment and diagnosis. This often leads to misdiagnosis and inappropriate treatment of patients resulting in poor health outcomes, exacerbating this debilitating condition.

Lumbo-sacral radiculopathy is a cause of disability and morbidity and represents a distinct presentation of low back-related leg pain, which constitutes between 23% - 57% of low back pain (LBP) cases [1]. Lumbo-sacral radiculopathy refers to a pathologic process involving the lumbo-sacral nerve roots causing radicular symptoms of the lower extremity [2], which may or may not be accompanied by other radicular irritation symptoms and/ or symptoms of decreased function [3]. Lumbar intervertebral disc protrusion (IVDP) is the most common cause of underlying nerve root irritation and subsequent radiculopathy [1-3]. However, other mechanical factors including, lumbar vertebrae osteophytes, lumbar facet joint hypertrophy or ligamentum flavum hypertrophy may also cause lumbar nerve root compression [3]. Radicular symptoms may also be primarily caused by inflammatory reactions of the neural or surrounding muscular and articular structures [4], hence suggesting that lumbar radiculopathy is not always mechanically mediated, and that mechanical nerve root compression on its own does not necessarily determine radicular symptoms as seen with positive MRI findings in asymptomatic subjects [5]. In clinical practice, the diagnosis of lumbo-sacral radiculopathy involves the use of various tools and procedures including neuropathic pain screening, clinical neurological examination, electro-diagnosis, nerve root blockage and radiological imaging [3-5]. Clinical neurological tests include sensory, motor, reflexes, neurodynamic and nerve trunk palpation procedures. These tests are designed to assess the physiological and bio-mechanical status of specific lumbar nerve roots that are thought to be responsible for the patient's signs and symptoms [5].

Determination of the presence or absence of radiculopathy is dependent upon the examiner's awareness of clinical signs and symptoms, physical examination, knowledge of possible pathology, mechanisms of injury and ability to perform the tests correctly [6-8]. The clinical usefulness of neurological examination tests is largely determined by the accuracy with which they determine the presence or absence of the suspected pathology. MRI is frequently utilized in detecting nerve root compression, one of the many causes of radiculopathy [4]. While the accuracy of MRI in detecting alterations in both the anatomy and tissue properties is well established, the relationship between the detected anatomical abnormalities and clinical history and patient's outcomes remain controversial [6]. Clinical neurological examination tests could be used to discriminate patients with radiculopathy distinct from other low back pain sub-types like non-specific low back pain of somatic origin, lumbar facet or intervertebral joint derangement disorder.

In the present era of medical practice in which there is an over reliance on imaging findings; clinical judgement using a thorough clinical evaluation still finds its place to delineate radicular low back ache. A thorough clinical evaluation would include history taking, physical tests and neurological examination. These tests are easy to perform, cost-effective and run a relatively very low health risk to patients. It is therefore imperative to identify the physical tests which have an acceptable diagnostic sensitivity and specificity.

2. MATERIAL AND METHODS

This is a cross sectional analytical study conducted in a tertiary care facility. 51 consecutive patients aged between 20 years to

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80 years who met the following inclusion criteria were included in the study; Low back ache radiating to lower limb, radicular pain along a specific dermatome, nerve root tension signs like straight leg raising test (SLRT), and presence of neurological symptoms and signs are included in the study. The exclusion criteria were patients with spinal neoplasm, infection, traumatic fractures, metabolic disorders and congenital deformities.

The clinical parameters evaluated and correlated with MRI in this study can be categorised as follows;

1. **History taking,**
    a. History of pain worse in the leg than in back.
    b. History of radiating pain from buttock to thigh/lower limb.
    c. History of subjective sensory loss.
2. **Physical examination,**
    a. Straight leg raising test.
    b. Crossed straight leg raising test
    c. Motor system examination with muscle power.
    d. Sensory system examination with fine touch and crude touch.
    e. Deep tendon reflexes.

All these patients were examined thoroughly by a consultant orthopaedic in spine surgery following which a clinical diagnosis was made. Patient demographics (gender and age), as well as examination findings and clinical diagnosis, were then recorded using a standardized Performa. The reference test was Magnetic resonance imaging (MRI) as there is no consensus on the gold standard investigative for identifying disc prolapse [9]. MRI was performed with a dedicated magnetic extremity coil of 1.5 tesla strength and reported by the radiologist. The composite data was tabulated on Microsoft excel spread sheet and studied for correlation using sensitivity, specificity, positive

likelihood ratio (PLR), negative likelihood ratio (NLR), positive predictive value (PPV) and negative predictive value (NPV) within a confidence interval of 95%.

3. RESULTS

The study demonstrates that a higher number of males reporting with low back ache. The majority age group was between 30-39 years. The results pertaining to history taking and physical examination are discussed here,

HISTORY:

Among the 51 patients, A history of pain worse in leg than back reported a sensitivity of 58%, specificity of 54%, PPV of 75%, NPV of 34% and PLR of 1.25 and NLR of 0.78. A history of radiating pain from lower back to buttock/lower limb has been attributed with a sensitivity of 91%, specificity of 57%, PPV of 84%, NPV of 72%, positive likelihood ratio of 2.14, negative likelihood ratio of 0. 14. A history of subjective feeling of numbness is associated with a sensitivity of 17%, specificity of 80%, PPV of 78%, NPV of 19%, positive likelihood ratio of 0.85 and negative likelihood ratio of 1.04. (Table 1)

PHYSICAL EXAMINATION:

Among the study population, Straight leg raising test demonstrated a sensitivity of 72.22%, s specificity of 66.67%, positive likelihood ratio of 2.17, negative likelihood ratio of 0.42, positive predictive value of 83.87%, negative predictive value of 50%

The crossed straight leg raising test demonstrated a sensitivity of 33%, specificity of 71%, PLR of 1.17, NPV of 0.93, positive predictive value of 62.5%, negative predictive value of 42.86%. Motor system examination was associated with a sensitivity of 35%, specificity of 64%, positive likelihood ratio 0.98, negative likelihood ratio 1.01, positive predictive value 72.2%, negative predictive

value 27.2%. The sensory system examination with fine touch and crude touch revealed a sensitivity of 41%, specificity of 82%, positive likelihood ratio of 2.33, negative likelihood ratio of 0.71, positive predictive value of 82% and negative predictive value of 41%. Deep tendon reflexes demonstrated a sensitivity of 64%, specificity of 57%, positive likelihood ratio of 1.51, negative likelihood ratio of 0.61, positive predictive value of 80% and negative predictive value of 38%. (Table 1)

Table 1 : Results of clinical evaluation in comparison with MRI.

Predictor	Specificity	Sensitivity	Positive predictive value	Negative predictive value	Positive Likelihood ratio	Negative Likelihood Ratio
HISTORY						
History of Pain worse in leg than back	*54*	*58*	75	34	1.25	0.78
History of radiating pain from lower back to buttock/lower limb	57	91	84	72	2.14	0.14
History of subjective sensory loss	80	17	78	19	0.85	1.04
PHYSICAL EXAMINATION						
Straight Leg Raising test	66.67	72.22	83.87	50	2.17	0.42
Crossed Straight Leg Raising Test	71	33	62.5	42.86	1.17	0.93
Motor System Examination	*64*	*35*	72.2	27.2	0.98	1.01
SENSORY SYSTEM EXAMINATION WITH FINE TOUCH AND CRUDE TOUCH	82	41	82	41	2.33	0.71
DEEP TENDON REFLEXES.	57	64	80	38	1.51	0.61

4. DISCUSSION

Lumbar radiculopathy is one of the most common cause of back pain and occupational disability, with significant impact on patients' quality of life, and marked functional impairment. As a large percentage of older individuals maintain a very active lifestyle, it is important for orthopaedic surgeons to be able to accurately identify and appropriately manage patients with lumbar radiculopathy. The history and physical examination of patients with low back pain has traditionally been a cornerstone of the diagnostic process. The following discussion encompasses the results obtained in our study in comparison with similar studies done over the years.

AGE INCIDENCE:

In our study among the 51 subjects in the age group between 20- 80 years, the mean age was 47 years. We have noted that the incidence of lumbar radiculopathy was comparatively higher in the age group between 30-39 years and 40-49 years. Vroomen et al observed an odds ratio of 2.2 in the age group of 40-50 years [10]. The findings in our study correlate with the observations made by Vroomen et al.

SEX INCIDENCE:

Among our study population of 51 patients, 27 of them were females and 24 were males. Vroomen et al noted an odds ratio of 1.8 for disc herniation with nerve root impingement in males. Our study reports a slightly higher incidence in women. However, there is no established consensus on the gender prevalence in lumbar radiculopathy.

OCCUPATION:

In our study, majority were home makers, the others included farmers, mechanic, business and IT professionals with a mean duration of symptoms of 4 months (+/- 1.5 months). Milton et al [11] had stated that age, posture and fatigue at work are considered high risk for developing low back ache relapses. They have also charted out the high-risk factors for low back pain that includes, cumulative trauma, dynamic activities related to movement of flexion and rotation, heavy physical work, bending or squatting activities. The occupations of the subjects included in our study also expose the patients to the aforementioned risk factors by Milton et al [11].

The findings from the study largely correlates with previous studies performed [12-16]. However, the findings to be noted in our study are Majority of the patients were in the age group 30-39 years. Majority of them were females. A history of radiating pain from buttock/thigh to lower limb was associated with high sensitivity (91%) and a good positive likelihood ratio (2.14). A history of subjective loss of sensation was associated with high specificity (80%). Among physical examination tests, straight leg raising test was indicative of nerve root tension with a high sensitivity (72.2%). Sensory system examination with fine touch and crude touch was associated with a good positive likelihood ratio (2.33).

Regarding straight leg raising test numerous studies [10,12,13] have reported a wide variation in the diagnostic accuracy of SLRT. Vroomen et al [10] had demonstrated that SLRT was not a significant predictor of nerve root compression. However, when the test is used in combination with other physical tests it holds relevance in diagnosing lumbar radiculopathy more accurately.

Our study has its limitations. First, this study was performed in a spine unit of a tertiary care hospital. Hence a higher prevalence of nerve root impingement was noted, as well as a different spectrum of severity, than in primary care settings. Second, only patients with lower extremity radiating pain were considered for

entry into this study. Given that a history of lower extremity pain is itself sensitive for the diagnosis of sciatica, the sensitivities and specificities determined in this study should be viewed in this context. However, it could be argued that these physical examination tests for the localization of nerve root impingement should only be performed in situations where there is some prior suspicion of impingement, such as a history of sciatica. Therefore, our use of lower extremity pain as criterion for inclusion is consistent with clinical practice in specialty spine clinics. A final limitation of this study is that the relatively small sample size studied resulted in wide confidence intervals for some estimates of accuracy; future studies may wish to include larger sample sizes and randomisation.

5. CONCLUSION

Our results suggest that a thorough clinical assessment with proper history taking and physical examination can identify nerve root impingement. In our study, the highest sensitivity was for a history of radiating pain. Among physical tests, the highest sensitivity was for straight leg raising test. The highest specificity was for a history of subjective sensory loss   and the highest specificity for a physical examination was for decreased sensation with fine touch and crude touch. However, in studies involving diagnostic accuracy of history and physical examination; the likelihood ratios carry more importance. In history taking, the positive likelihood ratio was highest for radiating pain from lower back to buttock/lower limb. In physical examination the positive likelihood ratio was highest for sensory system examination with fine touch and crude touch. Compared to other studies which calculate diagnostic accuracy of these tests we got high specificity and overall accuracy for all the tests. This may be due to the fact that our study sample is less and most of the cases where

referred cases from primary care centres. We need further randomized studies with more sample size for detailed evaluation of diagnostic accuracy of these tests. These special tests when used in combination provide a very good screening tool to find out who needs further expensive investigation to evaluate for lumbar radiculopathy and thus reduce the financial burden of this common problem.

Conflict of interest:

The authors have nothing to disclose.

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