A Comparative Evaluation of H-Reflex and MRI for Diagnosis of Lumbosacral Radiculopathy

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Abstract: Lumbosacral radiculopathy was first described by Mixter and Barr in 1934 and since then it has been one of the most common causes of low back pain. In present study we evaluated and compared the significance of Soleus H-Reflex study and MRI of lumbosacral spine for the diagnosis of lumbosacral radiculopathy. An observational cross-sectional study was performed on 20 patients (11 females and 9 males) clinically diagnosed as lumbosacral radiculopathy at orthopaedic OPD of R. G. Kar Medical College, Kolkata. Soleus H-Reflex study was performed at the Department of Physiology and they had undergone MRI of L-S spine. All collected data were analyzed by SPSS programme. Fifty-five percent patients showed radiculopathy in their MRI while H-Reflex was abnormal in 80% patients. Out of these 80%, 40% showed unilateral absence, 35% bilateral absence and 5% decreased H amplitude. There was significant correlation between MRI and H-reflex study with a *P* value of 0.013. According to kappa coefficient assessment there was moderate strength of agreement between these two tests (Kappa-0.468). An interesting finding was that 5 patients out of 9 who had normal MRI; had abnormal H-Reflex result (55.56%). 80% abnormal H-Reflex results in patients of L-S radiculopathy makes it an efficient diagnostic tool. More than 55% abnormal H-Reflex in patients of clinically diagnosed radiculopathy but having normal MRI, keeps ample room for further research to find out if functional change can occur earlier before structural anomalies detected in MRI.

Key words: Radiculopathy, H-reflex, MRI.

1. Introduction

Low back pain ranks second only to upper respiratory tract illness as a symptomatic reason for office visit to physicians. Its overall lifetime prevalence is 60-90%, but only 5% of patients develop persistent symptoms developing into chronic low back pain [1]. But unfortunately 85% patients cannot be given a definitive diagnosis because of weak association among symptoms, pathological changes and imaging studies. The diagnostic evaluation is difficult because its primary causes are different affecting intervertebral discs, ligaments, facets, joints, muscles etc. In patients presenting with leg pain greater than low back pain, lumbar radiculopathy and lumbar canal stenosis are described as the most common etiologies [2, 3].

Lumbosacral radiculopathy was first described by Mixter and Barr in 1934. It refers to a patho-logic process involving the lumbar nerve roots causing radicular symptoms into a lower extremity. The nerve root pathology arises primarily from direct neural compression irrespective of whether the etiology is an acute herniated or displaced disc, bony spurs, foraminal stenosis, central stenosis, or hypermobility of a vertebral segment [4]. Less commonly other compressive lesions like tumor and cysts may cause radiculopathy. The prevalence of lumbar radiculopathy varies from about 2.2% to 8% and the incidence ranges from 0.7% to 9.6% [5]. Despite the large number of nerve roots subject to potential compromise in the lumbosacral region, approximately 76.1% of lumbar radiculopathies involve the L5 and S1 nerve roots. Diagnosis of lumbar radiculopathy is particularly

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challenging due to the anatomy involved. In the lumbar spine, the dorsal and ventral lumbar roots exit the spinal cord at the T11-L1 bony level and travel in the lumbar canal as a group of nerve roots in the dural sac known as the “horse’s tail” or cauda equina. Multiple nerve rootlets that are descending in the cauda equina can be affected by a single central disk herniation or single level lumbar central stenosis. For example, a central L3-4 disc herniations or central canal stenosis can impact the L5 and S1 nerve roots bilaterally. This anatomy poses challenges to the diagnosis of lumbar radiculopathy and locating the compression site. MRI is exquisitely sensitive in detecting these anatomical changes. However MRI often shows disc disease and other degenerative diseases in asymptomatic people. Lumbar disc protrusion can be seen in as high as 67% of asymptomatic people, older than 60 years of age and 20% of them have lumbar canal stenosis [1]. Therefore MRI is very sensitive in detecting these anatomical changes but does not give any information about nerve function or whether these anatomical changes could be a source of symptoms.

Regarding nerve conduction studies there are limited data about their importance in diagnosis of radiculopathies. Soleus H-reflex study though is considered as sensitive marker of root dysfunction, information about its role in diagnosing radiculopathy is quite insufficient. There are studies showing strong correlation between pathological changes in H-reflex parameters and clinical findings in different segmental lesions [6]. In our study focus was made to evaluate the potential of soleus H-reflex for diagnosis of radiculopathies along with its comparison with imaging (MRI) and clinical examination. Patients with complaints of low back pain for more than 3 months will be evaluated clinically, radiologically and neurophysiologically. There after a comparative study will be done amongst these three types of findings, specially to evaluate the role of H-reflex in diagnosis of radiculopathy.

2. Materials and Methods

2.1 Study Area

Department of Physiology, Department of Radiology and Department of Orthopaedics, R. G. Kar Medical College, Kolkata.

2.2 Ethical Consideration

The study proposal with other relevant documents will be submitted to the institutional ethical committee for review and approval. The study will commence only after such approval is obtained in writing.

2.3 Study Population

20 patients, 11 females and 9 males, aged between 30-70 years presenting to orthopaedics OPD with complaints of low back pain were selected on basis of specific inclusion and exclusion criteria.

Inclusion criteria:

- (a) Age: 30-70 years
- (b) Complaints of low back pain for at least 3 months or more
- (c) Clinical features of radiculopathy as evidenced by clinical examinations
(Table stated below)
- (d) Physically capable of NCS (undergoing required test) and visit OPD
- (e) Patients who will sign informed consent.

Exclusion criteria:

- (a) Complaints of duration for less than 3 months
- (b) Patients aged more than 70 years
- (c) Patients with other causes of polyneuropathy including diabetes mellitus
- (d) Patients physically unable to undergo the test
- (e) Patients with major medical illness
- (f) Patients who are unwilling to give consent.

Study design: It will be an observational cross-sectional study.

Parameters to be tested:

- (a) Detailed history
- (b) Height and weight

(c) Clinical examination:

We have first measured the power of different lower limb muscles according to their root values. These are - Gluteus maximus (L4-L5), Hamstrings (L4,5-S1,2), Quadriceps (L3-L4), Tibialis anterior (L4-L5), Gastrosoleus (S1), Extensor Hallucis Longus (L5-S1).

Then, we performed sensory examination from root L2 to root S1, on the patients.

Thereafter, two special clinical tests namely “straight leg raising test” and “femoral stretch test” were performed.

Thus, first clinical diagnosis of lumbosacral radiculopathy was made. Then, the patients were explained about the purpose of our study and informed consent was taken from them. Thereafter, bilateral soleus H-Reflex study was performed using RMS EMG-EP, MARK-II 2011 machine, in the Department of Physiology.

It was first observed if H-Reflex was present bilaterally, unilaterally or it was absent. If it was present the latency, amplitude, threshold and H/M ratio were recorded and their inter-limb comparison was made (in case of bilateral H-reflex).

Following that, the patients had undergone MRI of lumbosacral spine in the Department of Radiology. Following points were searched for in the MRI reports-

If it was normal

If there was any Disc herniation and root compression.

If there was any Lumbar canal stenosis

If there was any Degenerative changes

If there was any other abnormalities like lumbar spondylosis

All the collected data in the form of MRI Reports and H-Reflex reports were analyzed by latest version SPSS software.

3. Result

Fifty-five percent patients showed features suggestive to cause radiculopathy (Fig. 1) in their MRI (like disc herniation with root compression,

degenerative disc disease etc.) while H-Reflex was abnormal in 80% patients. Out of these 80%, 40% showed unilateral absence, 35% bilateral absence and 5% decreased H amplitude (Fig. 2).

There was significant correlation between MRI and H-reflex study with a p value of 0.013. According to kappa coefficient assessment there was moderate strength of agreement between these two tests (Kappa-0.468) (Table 1).

Fig. 1 Result of MRI studies.

Fig. 2 Results of H-Reflex.

Table 1 Contingency table comparing the normal and abnormal results of MRI and H-reflex.

	MRI		
H-reflex	Abnormal MRI	Normal MRI	Total
Abnormal H-reflex	11	5	16
Normal H-reflex	0	4	4
Total	11	9	20

Fig. 3 Summary of findings.

An interesting finding was that 5 patients out of 9 who had normal MRI; had abnormal H-Reflex result (55.56%). (Fig. 3)

4. Discussion

We can see the result of our study from two main aspects. Firstly, it shows high diagnostic yield of soleus H-Reflex study for diagnosis of lumbosacral radiculopathy as evidenced by 80% abnormal results compared to MRI of lumbosacral spine which showed 55% positive findings.

Secondly, 55% abnormal H-Reflex in patients with normal MRI. In previous works Mazzochio, R., Scarfo, G. B., Cartolari, R. et al. studied with 26 patients with chronic low back pain of mechanical origin were examined the only abnormality detected was significant increase in H-reflex threshold with normal routine nerve conductions and other parameters of H-reflex study [7].

Kaylan, T. A. et al. showed in their work that The H-reflex is a sensitive (but less specific) marker of S1 radiculopathy, especially when the abnormality is unilateral.

In an article published in Neurol. Clinic 25 (2007) journal, Bryan Tsao showed that electrodiagnostic examination provides and important correlate to clinical diagnosis of lumbosacral radiculopathy. These electrodiagnostic examination can confirm the presence and severity of axon loss, localize which nerve root is affected and rule out other neuromuscular disorder that may be present.

In another study performed by Boden, S. D. et al.,

the finding of herniated discs and spinal stenosis in many asymptomatic persons indicated that imaging results alone can be misleading, and valid decision making requires correlation with the history and physical examination.

Ghugare, B. W. et al. had conducted a study to establish most common electrophysiological predictors of Lumbosacral Radiculopathy in MRI diagnosed L5S1 neural foramina compression subjects. Reduced H/M ratio in combination with absent H response was evident in 74 nerves. H-reflex study was abnormal in 88% subjects. Study concluded that, H/M ratio if used with other H-reflex study variables may be most common predictor of Lumbosacral Radiculopathy.

In 2009, Balaji, G. et al. had performed a study on assessment of NCS in evaluation of radiculopathy among chronic low back pain patients. They observed that routine NCS showed no significant difference whereas all the H-reflex parameters including H-threshold, H-amplitude, H-latency and H/M ratio were significantly different ($P < 0.0001$), when compared with controls. They concluded that patients had not only partial conduction block but also secondary axonal loss due to nerve root compression. They further suggested that soleus H-reflex study should be included in evaluation of radiculopathy. In our present study also there is a significant percentage of patients showing abnormal or absent H-Reflex.

In a recent study by Shahriar, N. et al. of Department of Neurology of Tehran University had undertaken a cross-sectional study with 97 patients with the clinical diagnosis of lumbosacral radiculopathy in 2013.

Abnormal electrophysiological finding was recorded in 82% of patients compared to 64% positive MRI findings. Here also electrophysiological studies were more sensitive in detecting radiculopathy.

Now regarding the second aspect of the result of our study which shows in 9 patients of clinically diagnosed lumbosacral radiculopathy, no detectable structural anomalies which can lead to radiculopathy but abnormal H-Reflex in 55% of them; there may be three

possible explanations.

There may be noncompressive causes of radiculopathy which include ischemia, trauma, neoplastic infiltration, spinal infections, postradiation injury, immune-mediated diseases; these present with electrodiagnostic patterns indistinguishable from nerve root compression [8].

MRI is unable to detect these non-compressive lesions. There is another entity called “chemical radiculopathy” where anatomical or structural anomalies are not essentially needed to cause symptoms [9]. Functional change in the form of abnormal H-Reflex may appear earlier before structural changes are detectable in MRI. So, these patients may be followed up for further research. Absent H-reflex may be a physiological in elderly people. But this does not explain its absence in younger population [10].

Regarding previous researches, the concept of radiculitis was first described by Lewin [11] in 1943, when he discussed the condition of irritation of the lumbar and sacral nerve roots.

In 1946, Holmes and Sworn [12] reported 5 cases of lumbosacral root pain without any identifiable mechanical cause. Saal and co-investigators found elevated levels of PLA2 (phospholipase A2), the rate limiting enzyme in the chemical cascade that liberates arachidonic acid, prostaglandins, and leukotrienes, in disc material obtained from patients surgically treated for radiculopathy due to a herniation [13].

Subsequently, Ozaktay et al. demonstrated that PLA2 can produce electrophysiologic and histologic changes in neural tissue [14]. Curtis, W. et al. performed a work which provides clinical evidence that anatomic abnormalities are not required to cause radiculopathy, thus implying that a biochemical etiology is likely to play a significant role in radiculopathy and radicular pain [9].

5. Conclusion

Thus, we can conclude from this study that H-reflex

is an efficient diagnostic tool for lumbosacral radiculopathy as evidenced by 80% abnormal result, whereas MRI showed 55% positive results. 55% abnormal H-reflex in patients with normal MRI study shows that normal MRI cannot rule out radiculopathy due to possibilities of non-structural or non-compressive aetiologies including “chemical radiculopathy”. At the same time it may suggest, although not proves, that functional change may take place earlier than structural changes are visible in MRI.

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