EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 3
Issue: 1
376-379
Year: 2016

THE DIAGNOSTIC UTILITY OF H-REFLEX LATENCY IN LUMBOSACRAL RADICULOPATHY

Sachin Pawar[1], Vinod Shende*[2], Ramji Singh[3], AR Chaudhari[4], Jayashree Pawar[5]

[1, 2]Assistant Professor, Dept of Physiology, Mahatma Gandhi Institute of Medical Sciences, Sevagram
[3]Professor, Dept of Physiology, AIIMS, Patna.
[4]Professor and Head, Dept of Physiology, Mahatma Gandhi Institute of Medical Sciences, Sevagram
[5]Jayashree Pawar, Consultant Dental Surgeon, Wardha.

***Author for Correspondence: Dr. Vinod Shende**
Asst Professor, Department of Physiology, Mahatma Gandhi Institute of Medical Sciences, Sewagram, 442102. Dist. Wardha. Maharashtra.

Article Received on 16/11/2015 **Article Revised on 08/12/2015** **Article Accepted on 31/12/2015**

ABSTRACT

Introduction: H-reflex is one of the types of late response in electrodiagnosis which allows evaluation of the functional state of the proximal portions of the peripheral nervous system, which are affected to a greater or lesser extent in the course of lumbosacral radiculopathy. Detection of structural abnormality in this disease by radiological imaging modalities is having high rate of false positivity and occasionally false negativity. Therefore, it is pertinent to study the effectiveness of H latency in diagnosis of lumbosacral radiculopathy. **Objectives:** The present study was undertaken to evaluate the diagnostic efficacy of H-minimum latency in lumbosacral radiculopathy. **Methodology:** In this cross- sectional study, a total of 283 subjects(168 males and 115 females) aged 40 years and above who were clinically diagnosed as having lumbosacral radiculopathy were enrolled after getting ethical approval and informed written consent. After doing detailed clinical and neurological examination, all the patients were subjected to electrophysiological evaluation using RMS EMG EP Mark –II machine in Clinical Neurophysiology unit, Department of Physiology through which their H-reflex study was conducted. Electrophysiological parameters studied was H-min latency in milliseconds (ms). **Result:** No statistically significant difference was observed between right and left sided values for the H-minimum latency tested in posterior tibial nerves (P >0.05). Accuracy of this electrophysiological parameter was observed to be 71.37% as compared to gold standard test and by using kappa statistics fair agreement was found between H-latency and MRI. Sensitivity and specificity of H-latency were found to be 66.67% and 90.91%. **Conclusion:** H-reflex studies are useful supportive diagnostic tool for lumbosacral radiculopathy.

KEYWORDS: H-minimum latency, lumbosacral radiculopathy, nerve conduction study.

INTRODUCTION

The clinical condition in which the function of one or more lumbosacral nerve roots are disturbed due to the disease process is called as Lumbosacral radiculopathy.[1] This disease is commonly caused by the compression of nerve root while coming out of the intervertebral foramen. Studies have reported that lumbosacral radiculopathy affects 4-6% of the population at some point in their lives[2] and it has also been shown that L4-5 and L5-S1 are the most common level affected in lumbosacral radiculopathy.

The correct diagnosis of lumbosacral radiculopathy is very essential for administration of timely and appropriate treatment. The diagnosis of a suspected radiculopathy is usually done by employing radiological imaging techniques, electrophysiological evaluation involving nerve conduction studies and EMG, and rarely cerebrospinal fluid examination.[3] Detection of structural abnormality in lumbosacral radiculopathy by imaging modalities is having high rate of false positivity and occasionally false negativity.[4,5] In such cases, electrophysiological studies are the valuable methods in the diagnosis and prognosis of lumbosacral radiculopathies.

Late response study which is one of the type of electrophysiologic study can allow evaluation of the functional state of the proximal portions of the peripheral nervous system, which are affected to a greater or lesser extent in the course of this pathological state. H-reflex is one of the type of late response in electrodiagnosis.

Hoffmann first described the H-reflex in 1918. Traditionally, this response has been considered the electrophysiologic equivalent of the Achilles' tendon muscle stretch reflex. H-minimum latency is the most commonly used parameter of H-reflex study in electrodiagnosis.

In such situations, it is reasonable to study the usefulness of various electrophysiogical tests to diagnose lumbosacral radiculopathy. Whenever possible, accurate identification of lumbosacral radiculopathy by electrodiagnosis provides valuable and crucial information that can direct the treatment and minimizes the other invasive and expensive diagnostic and therapeutic procedures. Therefore, the present study was undertaken to evaluate diagnostic efficacy of H-minimum latency in lumbosacral radiculopathy.

MATERAIALS AND METHODS

In this cross- sectional study, a total of 283 subjects aged 40 years and above who were clinically diagnosed as having lumbosacral radiculopathy were enrolled. The study population was selected from patients attending orthopedic department, with supportive inclusion and exclusion criteria under supervision of consultant orthopedician. The subjects with Diabetes mellitus, Clinical or electrophysiological evidence of polyneuropathy, myopathy, myelopathy, neuromuscular transmission disorders, having symptoms of less than 3 weeks duration, in whom spinal surgery was performed within the preceding 15 years and the patients with local injuries/lesion that may interfere with the electrophysiological study were excluded from this study. The study population comprised of 168 males and 115 females. Prior Ethics approval from the Institutional Ethics committee was obtained. The purpose and objectives of study were explained to the subjects and the written Informed consent was taken from them before the study after explaining the details including the necessity for an examination. Detailed history taking and clinical examination was performed in all the subjects in structured format. After doing detailed clinical and neurological examination, all the patients were subjected to electrophysiological evaluation using RMS EMG EP Mark –II machine in Clinical Neurophysiology unit, Department of Physiology through which their H-reflex study was conducted. All tests were performed under constant room temperature (30^0C) to shortlist the errors.

H reflexes were readily obtained using percutaneous stimulation and surface recording techniques. The stimulating cathode was placed proximally to avoid the theoretical possibility of anodal block. Stimulus pulses of long duration (1 ms) were used to preferentially activate large sensory fibers. The stimulus frequency was 1 per 3 seconds or less to allow full recovery of the H reflex from a prior stimulus. By starting with submaximal stimuli and increasing to supramaximal stimulation, we determined that: (1) the ''late'' response should be larger than the preceding direct motor response, (2) the H reflex with the largest amplitude, and (3) the inhibition of the H reflex with increasing stimulus intensity. Latencies were measured to the onset of the responses. For calf H reflexes, the tibial nerve was stimulated in the popliteal fossa. Surface recordings were made from the soleus muscle. Active electrode was placed medial to the tibia at a point that was one half the distance between the stimulation site and the medial malleolus, with the indifferent electrode placed on the Achilles' tendon. Setting were kept at sweep speed 10 ms/D, intensity 2 mV, frequency 2 Hz and stimulus strength duration was 1 ms. Stimulus intensities were amplified gradually in steps of 1-2 mA until the maximum H-wave amplitude was obtained and further by 2-5 mA until the maximum M-wave amplitude was obtained. Three stimuli were live averaged for single response. Downward deflection was marked as latencies of waveforms. Minimum stimulus intensity required obtaining an H-wave and M-wave of 0.4mV amplitude was considered H and M threshold respectively. [6, 7]

Electrophysiological parameters studied was H-minimum latency in milliseconds (ms),structured format was used to record the observations. Statistical analysis was done by using descriptive and inferential statistics using Kappa Statistics, z-test for difference between two means and diagnostic accuracy. The study observations were analyzed to find the Specificity, Sensitivity, Positive Predictive Value and Negative Predictive Value. The software used in the analysis were SPSS 17.0 and Graph Pad Prism 5.0 and $p<0.05$ was considered as level of significance ($p<0.05$).

RESULTS

Table 1 depicts the age and gender wise distribution of patients and physiological variable of study subjects are shown in table 2. Descriptive statistics of H-wave study in posterior tibial nerves are shown in Table 3. No statistically significant difference was observed between right and left sided values for the H-minimum latency tested in posterior tibial nerves ($P >0.05$). The sensitivity, specificity, positive and negative predictive values of H-minimum latency is shown in Table 4. H-minimum latencies were found to have reliable sensitivity and specificity in diagnosing lumbosacral radiculopathy. Accuracy of this electrophysiological parameter was observed to be 71.37% as compared to gold standard test and by using kappa statistics fair agreement was found between H-latency and MRI. (Table 4).

Table 1: Age and gender wise distribution of patients

Age Group(Years)	Male (N)	Female(N)	Total(N)
40-49	75(26.50%)	45(15.90%)	120(42.40%)
50-59	47(16.61%)	33(11.66%)	80(28.27%)
60-69	32(11.31%)	31(10.95%)	63(22.26%)
70-79	12(4.24%)	5(1.77%)	17(6.01%)
≥80	2(0.71%)	1(0.35%)	3(1.06%)
Total	168(59.36%)	115(40.64%)	283(100%)

Table 2: Physiological variable in study population

Physiological Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age(years)	283	40	81	53.31	9.89
Height(cm)	283	145	180	161.42	7.19
Weight(kg)	283	40	95	62.37	7.96
BMI(kg/m^2)	283	17.54	33.76	23.91	2.48

Table 3 :Descriptive Statistics for H-minimum latency

Electrophysiological Parameters	Right Side		Left Side		z-value	p-value
	Mean	SD	Mean	SD		
H- latency(ms)	32.19	4.31	31.64	3.89	0.11	0.90 NS,p>0.05

Table 4: Diagnostic Accuracy of H-Reflex , H-Latency study

Diagnostic Accuracy	Percentage (%)	95% CI
Sensitivity	66.67	60.14-72.75
Specificity	90.91	80.05-96.98
Positive Predictive Value	96.82	92.72-98.96
Negative Predictive Value	39.68	31.08-48.78
Accuracy	71.37	
Likelihood Ratio	7.33	
Kappa Statistics	0.38	Fair Agreement

DISCUSSION

H reflexes involve conduction in proximal fibres, and provide a valuable technique for defining proximal nerve injury and may be abnormal even when more distal studies are unremarkable.[8] Researchers noted the H-reflex's sensitivity of 51%, specificity of 91%, PPV of 64% and NPV of 84% in S1 radiculopathy.[9,10] Our results are comparable with these findings. Our findings are also supported by the previous studies by Haig AJ et al (2005) who reported specificity to be 91.3%.[11] However, they observed quite lesser value of its sensitivity to the extent of 36.4% only; this is in contrast to our findings as we recorded its sensitivity around 60%.Riccardo Mazzocchio et al (2001) confirmed the importance of H-reflex study in diagnosis of lumbosacral radiculopathy.[12] They found it to be more valuable than F-wave or EMG study. They recorded decrease in H-amplitude and prologation of H-latency as the important abnormality in the diagnosis of radiculopathy. R E Rico and E J Jonkman (1982) observed that H-reflex was not of any value in diagnosing L5 radiculopathy.[13] This is in contrast to our findings as we found it to be useful diagnostic tool in L5, S1 radiculopathy.

H-reflex, a monosynaptic reflex can differentiate to some extent, L5 from S1 radiculopathy. Many researcher have found its sensitivities and specificities with respect to lumbosacral radiculopathy ranging from 32% to 88%.[14,15,16,17,18] Human sensory and motor axons have been shown to differ in excitability in many ways.[19,20] This difference may give rise to a differential susceptibility of sensory and motor axons in nerve root lesions. The large diameter sensory fibres which are stimulated in the H-reflex pathway are very sensitive to the effects of cuff compression of the sciatic nerve.[21] It may thus be considered that the H-reflex changes reported in this study may be the expression of damage produced at S1 root level by mechanical,physical or ischemic factors. The severity of the compression of nerve roots may explain the prolongation of H latency of Soleus H-reflex study. [22] Because of nerve root compression, there is

insufficient microcirculation and ischemia present in lumbosacral radiculopathy, this may lead to membrane potential and ion channel changes in the nerve fiber as well as focal disturbance to myelin. Both these factors together may influence the temporal dispersal of the compound sensory afferent volley and/or axonal conduction block. [23] This might be the reason why did we get abnormality in the H- minimum latency tested in lumbosacral radiculopathy.

CONCLUSION

H-reflex study is valuable in the diagnosis of lumbosacral radiculopathy and H- minimum latency is the highly sensitive and specific parameter for its diagnosis.

ACKNOWLEDGEMENT

We are grateful to UGC, Pune for funding this project and all the study subjects who wllingly participated in this study.

SOURCE OF FUNDING

University grant commission, Pune, India.

REFERENCES

1. Tarulli AW, Raynor EM. Lumbosacral radiculopathy. Neurol Clin, 2007; 25: 387.
2. Frymoyer JW. Lumbar disk disease: epidemiology. Instr Course Lect, 1992; 41: 217-23.
3. Robinson LR. Electromyography, magnetic resonance imaging, and radiculopathy: it's time to focus on specificity. Muscle Nerve, 1999; 22(2): 149-50.
4. Wiesel SW, Tsourmas N, Feffer HL, Citrin CM, Patronas N. A study of computer-assisted tomography. I. The incidence of positive CAT scans in an asymptomatic group of patients. Spine, 1984; 9(6): 549–551.
5. Jensen MC, Brant-Zawadzki MN, Obuchowski N, et al. Magnetic resonance imaging of the lumbar spine in people without back pain. N Engl J Med., 1994; 331(2): 69–73.
6. Preston DC and Shapiro BE. Late responses: In (2nd Ed) Electromyography and Neuromuscular Disorders, Elsevier: 2005; 47.
7. Mishra UK, Kalita J. Clinical neurophysiology. Elsiver pub. 2nd edition 2006. 21-30.
8. Fisher MA. AAEM minimonograph#13. H reflex and F waves: Physiology and clinical application. Muscle Nerve, 1992; 15: 1223.
9. Albeck MJ, Taher G, Lauritzen M, Trojaborg W. Diagnostic value of electrophysiological tests in patients with sciatica. Acta Neurol Scand, 2000; 101: 249–54.
10. Marin R, Dillingham TR, Chang A, Belandres PV. Extensor digitorum brevis reflex in normals and patients with radiculopathies. Muscle Nerve, 1995; 18: 52–9.
11. Haig Andrew J,Tong Henry C,Yamakawa Karen S J, Quint Douglas J,Hoff Julian T,Chiodo Anthony,Miner Jennifer A, Choksi Vaishali R, Geisser Michael E. The Sensitivity and Specificity of Electrodiagnostic Testing for the Clinical Syndrome of Lumbar Spinal Stenosis. Spine, 2005; 30(23): 2667-2676.
12. Mazzocchio R, Scarfo GB, Mariottini A, Muzil VF, Palma L. Recruitment curve of the soleus H-reflex in chronic back pain and lumbosacral radiculopathy. BMC Musculoskelet Disord, 2001; 2: 4.
13. R E Rico and E J Jonkman. Measurement of the Achilles tendon reflex for the diagnosis of lumbosacral root compression syndromes. J Neurol Neurosurg Psychiatry. 1982 September; 45(9): 791–795.
14. Wilbourn AJ, Aminoff MJ. AAEM minimonograph 32: the electrodiagnostic examination in patients with radiculopathies. Muscle Nerve, 1998; 21(12): 1612–31.
15. Kuruoglu R, Oh SJ, Thompson B. Clinical and electromyographic correlations of lumbosacral radiculopathy. Muscle Nerve, 1994; 17: 250–1.
16. Leblhuber F, Reisecker F, Boehm-Jurkovic H, Witzmann A, Deisenhammer E. Diagnostic value of different electrophysiologic tests in cervical disk prolapse. Neurology, 1988; 38: 1879–81.
17. Linden D, Berlit P. Comparison oflate responses, EMG studies, and motor evoked potentials (MEP's) in acute lumbosacral radiculopathies. Muscle Nerve, 1995; 18: 1205–7.
18. Sabbahi MA, Khalil M. Segmental H-reflex studies in upper and lower limbs of patients with radiculopathy. Arch Phys Med Rehabil, 1990; 71: 223–7.
19. Bostock H, Burke D, Hales JP. Differences in behaviour of sensory and motor axons following release of ischaemia. Brain, 1994; 117: 225–234.
20. Mogyoros I, Kiernan MC, Burke D, Bostock H. Excitability changes in human sensory and motor axons during hyperventilation and ischaemia. Brain., 1997; 120: 317–325.
21. Zhu Y, Starr A, Haldeman S, Chu JK, Sugerman RA. Soleus H-reflex to S1 nerve root stimulation. Electroencephalography clinical Neurophysiol., 1998; 109: 10–14
22. Rydevik B, Brown MD, Lundborg G. Pathoanatomy and pathophysiology of nerve root compression. Spine., 1984; 9: 7–15.
23. Balaji Ghugare, Piyali Das, Jayshri Ghate, Kisan Patond, Manisha Koranne, Ramji Singh. Assessment of nerve conduction in evaluation of Radiculopathy among chronic low back pain patients without clinical neurodeficit. Indian J. Physiol Pharmacol, 2009; 54(1): 63-68.