The Role of H-Reflex in the Diagnosis of Diabetic Polyneuropathy

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ABSTRACT

Introduction: Diabetic polyneuropathy (DPN) is the frequent complications of diabetes mellitus. Evaluation of H-reflex may be of use in diagnosis of polyneuropathy. The proximal portion of peripheral nerves are generally involved in pathological process of diabetic polyneuropathy, the assessment of their functional intactness may be done by this electrophysiological test. The present study was undertaken to detect the proportion of patients having DPN who were diagnosed by clinical examination or by H-reflex evaluation, among adult patients with type- 2 diabetes mellitus referred for neuropathy screening as well as to evaluate the predictive value of the H-reflex study in DPN diagnosis.

Material and Methods: In this cross- sectional study, a total of 100 subjects (65 males and 35 females) aged 20-80 years who were clinically diagnosed as having type 2 diabetes mellitus were enrolled after receiving approval from Institutional Ethics Committee and informed written consent from participants. After detailed clinical and neurological examination, electrophysiological evaluation of all the patients was done using RMS EMG EP Mark –II machine in Clinical Neurophysiology unit, Department of Physiology through which their H-reflex study was done. H-min latency in milliseconds (ms) was determined in H-reflex study

Result: H-reflex parameters were not statistically different between right and left side (P >0.05). In total 73% of the subjects with Type 2 diabetes mellitus abnormal H -reflex study was observed. H-reflex parameter (H-minimum latency) is found to have reliable sensitivity and specificity in diagnosing diabetic polyneuropathy. Sensitivity and specificity were found to be 98.63% and 81.41% respectively.

Conclusion: H-reflex studies are useful supportive diagnostic tool for diabetic polyneuropathy.

Keywords: H-reflex study, type 2 diabetes mellitus, polyneuropathy, predictive value

INTRODUCTION

Diabetic polyneuropathy (DPN) is the frequent complications of diabetes mellitus, affecting approximately half of the patients suffering with this disease.[1] However, the early stages of DPN are often symptomless, providing patients with no warning of their developing condition. Once clinical signs are apparent, damage to peripheral nerves is already irreversible. The mechanism of DPN is unclear and multifactorial and its prevalence increases with age and disease duration.[2]

The clinical history of patients and their complete neurophysiological examination is helpful in the classification and treatment of DPN. Electrophysiological studies are also the useful and valuable methods in the diagnosis and prognosis of diabetic polyneuropathy.[3] One such test involves measurement of the H-reflex. The proximal portion of peripheral nerves are generally involved in pathological process of diabetic polyneuropathy, the assessment of their functional intactness may be done by this electrophysiologic test. Evaluation of H-reflex may be of use in diagnosis of polyneuropathy. Hoffmann first described the H-reflex in 1918. Traditionally, this response has been considered the electrophysiologic equivalent of the Achilles' tendon muscle stretch reflex. Only the tibial H-reflex is routinely used in clinical practice, where it is an extremely sensitive test for the evaluation of the physiologic integrity of the tibial/S1 sensory pathway, including the intraspinal course of the S1 root. It is markedly reduced in amplitude or absent in axon loss lesions affecting the S1 root and the tibial nerve at or proximal to the popliteal fossa.[4]

Studies have shown that alterations in the H-reflex study gives an early clue for DPN, as they are evident before any alteration in motor nerve conduction velocity (NCV) occur. These findings shows that the H-reflex study may be useful and important as a criterion for the diagnosis of DPN.[5,6]

High prevalence of diabetic polyneuropathy in community, its substantial economic burden on society and usefulness of electrophysiological tests in diagnosing this malady were the factors responsible to undertake the present study. Thus the aim of the present study was to detect the proportion of patients having DPN who were diagnosed by clinical examination or by H-reflex evaluation, among adult patients suffering with type- 2 diabetes mellitus who were referred for neuropathy screening as well as to evaluate the predictive value of the H-reflex study in DPN diagnosis.

MATERIAL AND METHODS

A total of 100 subjects having type 2 diabetes mellitus aged 20-80 years were enrolled for the present cross sectional study. Prior Ethics approval from the Institutional Ethics committee was obtained. The subjects were explained the objectives and background of the study and the written Informed consent was taken from them before the study. The study subjects were from Medicine department, with supportive inclusion and exclusion criteria under supervision of consultant physician. The subjects with type 1 diabetes mellitus, alcoholism, renal complications, pacemaker application, carpal tunnel syndrome, radiculopathy, focal mononeuropathy, pure motor neuropathy, or neuropathy confined to the upper limbs were excluded from this study. Patients having cognitive impairment which may prevent proper understanding of instruction for the test procedure were also excluded. The study population comprised of 65 males

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and 35 females. Detailed history taking and clinical examination was performed in all the subjects in structured format. After that, electrophysiological evaluation of all the patients was done using RMS EMG EP Mark –II machine in Clinical Neurophysiology unit, Department of Physiology through which their H-reflex study was done. All tests were performed under constant room temperature (30^0C) to shortlist the errors. The diagnostic criteria for diabetic polyneuropathy were a minimum of two abnormalities in clinical neurophysiological examinations and electrophysiological evaluation.

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.[7,8]

Age Group (Years)	Male (N)	Female (N)	Total (N)
20-29	0(0%)	1(2.86%)	1
30-39	4(6.15%)	3(8.57%)	7
40-49	11(16.92%)	7(20%)	18
50-59	21(32.31%)	15(42.86%)	36
60-69	24(36.92%)	7(20%)	31
70-80	5(7.69%)	2(5.71%)	7
Total	65	35	100
Proportion of patient with DPN	53 (81.54%)	20(57.14%)	73%

Table-1: Age and gender wise distribution of patients and Proportion of patients with diabetic polyneuropathy as per abnormal H-reflex study

STATISTICAL ANALYSIS

H-min latency in milliseconds (ms) was determined in H-reflex study. Structured format was used to record the observations. Data was analyzed using Epi-info 6th version for developing bivariate distribution as well as summarizing the characteristics in term of mean, standard deviation and predictive value. Specificity, Sensitivity, Positive Predictive Value and Negative Predictive Value were evaluated through the study observations. The difference in mean values was assessed for its significance using statistical tests based on normal distribution (z test). Significance level was considered at 5%.

RESULTS

The age and gender wise distribution of patients is shown in table-1 and physiological variable of study subjects are presented in table-2. Descriptive statistics of H-reflex study is depicted in Table-3. H-reflex parameters were not statistically different between right and left side (P >0.05). Proportion of patients with diabetic polyneuropathy according to abnormal H-reflex study is demonstrated in table-1. In total 73% of the subjects with Type 2 diabetes mellitus abnormal H -reflex study was observed. Among males this proportion was 81.54% and among females it was 57.14%. The sensitivity, specificity, positive and negative predictive values of H-reflex is shown in Table-4. H-reflex parameter (H-minimum latency) is found to have reliable sensitivity and specificity in diagnosing diabetic polyneuropathy. Accuracy of this electrophysiological parameter was found to be 94%. By using kappa statistics, perfect agreement was found between between H-reflex study and clinical neurophysiological examination (Table-4).

DISCUSSION

Diabetic neuropathies are quite common and it includes extensive range of nerve abnormalities like motor neuropathy, sensory neuropathy, polyneuropathy, autonomic neuropathy etc.[9,10] The correct diagnosis of diabetic polyneuropathy is very crucial for administration of timely and appropriate treatment. Evaluation

Physiological Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age (years)	100	25	79	54.71	10.68
Height (cm)	100	145	173	161.72	6.68
Weight (kg)	100	48	75	61.35	6.63
BMI (kg/m^2)	100	18.78	28.89	23.44	1.99

Table-2: Physiological variable in study population

Electrophysiological Parameters	Right Side		Left Side		p-value
	Mean	SD	Mean	SD	
M- latency (ms)	5.48	2.57	5.27	2.63	NS, p>0.05
H- latency (ms)	34.63	5.98	33.95	6.24	NS, p>0.05
H-M latency (ms)	29.16	5.63	28.82	6.35	NS, p>0.05
H-amplitude (mV)	2.05	1.87	2.07	1.86	NS, p>0.05

Table-3: Descriptive Statistics for H-reflex study

Diagnostic Accuracy	Percentage(%)
Sensitivity	98.63
Specificity	81.48
Positive Predictive Value	93.51
Negative Predictive Value	95.65
Accuracy	94
Kappa Statistics	0.84(perfect agreement)

Table-4: Predictive value of H-reflex study in subjects with diabetic polyneuropathy

of H-reflex may be of use in diagnosis of polyneuropathy.

H-reflex is the electrophysiologic equivalent of the Achilles' tendon muscle stretch reflex. It involves conduction in proximal fibres, and offer a valuable technique for determining proximal nerve injury and may be abnormal even when more distal studies are unremarkable.[11] Abnormal H-reflex study is clinically indicative of nerve root injury, plexopathy and generalized peripheral neuropathy.[11,12] In the present study, total of 73% of the patients were diagnosed with diabetic polyneuropathy by H-reflex study. The most common type of neuropathy we observed was generalized motor-sensory symmetrical peripheral polyneuropathy. This was in accordance with the previous findings.[13,14]

The present study showed considerable association between H-reflex abnormality and the presence of diabetic polyneuropathy and concluded that it could be used as an early diagnostic test for neuropathy in diabetic patients. Our results are coexistent with observations by RO Millán-Guerrero et al.[14] Trujillo-Hernández B et al[5] demonstrated that asymptomatic diabetic patients showed a high incidence of subclinical neurophysiological abnormality. They reported H-reflex abnortmality in 58% of the diabetic patients. This is in agreement with our findings, though we have recorded higher percentage of H-reflex abnormality. Marya RK et al[15] have discerned the evidence of neuropathy in far greater number diabetic patients (54%) by abnormal H-reflex study compared to the proportion by abnormal motor nerve conduction study (28%).However, Lachman T et al[16] could identify the neuropathy in just 18% of diabetic patients.

Higher sensitivity of the H-reflex in the recognition of subclinical neuropathy may be due to the fact that (a) it is evaluating the long pathway; therefore slight abnormalities in conduction velocities are augmented, (b) routine methods are unable to detect the abnormality confined to proximal segments and (c) there is prolongation of "utilisation time" of the anterior horn cells by the neuropathy.[17]

Our findings are in contrast to the views expressed by Braddom and Schuchmann[18] who narrated that H-reflex latency is prolonged only after a significant reduction in the distal sensory and motor conduction velocities. In diabetic neuropathy the histological studies have depicted involvement of proximal as well as distal segments of the nerves.[19] This might be the reason why in peripheral neuropathy the H-reflex are getting altered. RJ Schimsheimer et al[20] demonstrated that 69% of patients with various polyneuropathies showed abnormalities in H- reflexes illustrating that proximal nerve segments were frequently involved. They also claimed that H-reflex examination is a valuable supplement to conventional conduction studies. Our findings are comparable with these reports.

It is generally proposed that oxidative stress is the primary pathological phenomenon inducing nerve injury in diabetes[21] which might be the reason for abnormal electrophysiological findings in diabetic polyneuropathy.

CONCLUSION

The present study concluded that H-reflex study in patients with type 2 diabetes mellitus is very useful in early diagnosis of diabetic polyneuropathy which is quite helpful in preventing the hazardous complications of this ailment.

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