ROLE OF ELECTROMYOGRAPHY IN DIAGNOSIS OF CLINICALLY SUSPECTED CASES OF AMYOTROPHIC LATERAL SCLEROSIS (ALS): EXPERIENCE FROM A TERTIARY CARE HOSPITAL IN BANGLADESH

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Abstract:

This cross sectional observational study was carried out in the department of Neurology, Dhaka Medical College and Hospital (DMCH), Dhaka, On 42 Patients of Amyotrophic Lateral Sclerosis (ALS) to find out their clinical and electrophysiological profiles, as well as to study the correlation between clinical presentation and electrophysiological findings. The mean age was found 44.64± 16.4 years. Majority of the patients were males.The mean duration of illness was found to be 1.33±0.53 Years and majority 35(83.3%) of the patients suffered from illness for 1-2 years. Most 57.1% of the patients had upper limb onset, whereas 33.3% had lower limb onset and 9.5% had bulbar onset, muscle wasting, weakness and fasciculations were the most frequent presenting features. Clinically number of definite, probable and possible ALS cases were 4 (9.5%), 11 (26.2%) and 27 (64.3%) respectively. After doing electromyography, the definite cases increased 40(95.3%) significantly among which 29 cases did not have LMN features in e 3 regions clinically. Finally, this study reveals that the diagnostic yield is significantly higher with combine clinical and electrophyiological features compare to clinical feature alone for diagnosis definite ALS cases.

Key Words: *Amyotrophic lateral Sclerosis (ALS).*

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Introduction

Amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig disease, is the most common variant of mator neuron disease (MND) characterized by a combination of upper and lower motor neuron features. Since its discovery in 1874, is has remained a medical mystery. Researchers have not yet able to detect its cause, cure and effective treatment (Clark et al. 2005). Epidemiological study conducted in the western world reveals Amyotrophic lateral sclerosis (ALS) develops with a uniform frequency in major western countries. The annual incidence is about 2 per 100,000 in the United States; peak age of onset is between 55 and 75 years. Men are affected more frequently than women; however, this sex discrepancy is not as pronounced in familial cases. The clinical feature of ALS in different regions of the world was studied extensively in the researches published by Gubbay et al.(1985); Mortara et al.(1981); David et al. 1981) and Rosen (1978). It was noted that almost all the features including sex distribution, pattern of presentation, and most importantly prognosis varied from western population to indian

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population. Clinical electromyography is a distinct medical discipline that plays a pivotal role in the diagnosis of neuromuscular disorders (Katirij et al. 2002). The clinical EMG examination is an important diagnostic tool that helps localize a neuromuscular problem at the motor neurons,nerve roots, peripheral nerves, neuromuscular junction, or muscle. It also helps establish the underlying process in these disorders and assess their managemant and prognosis. The clinician should perform a detailed or focused neurological examination before referring the patient for a clinical EMG, which in turn serves as an independent procedure to provide an objective assessment of the peripheral nervous system (PNS) (Katirji,2002). The clinical EMG examination is composed of two main tests: nerve conduction studies (NCS) and needle EMG. These tests complement each other, and both often are necessary for a definite diagnosis Neurovascular disorder. Additional electro diagnostic procedures include assessment of F waves. A focused history and examination will help the electromyographer design the most appropriate electro diagnostic study (Preston and Shapiro,2005). Considering these diversity of presentation of ALS especially predominant in india, who have almost similar epidemiological pattern of distribution of population in comparison to Bangladesh, this study intend to evaluate the pattern of clinical presentation along with electrophysiological study and to inquest any risk factor association in our population.

Materials and Method

This is a hospital based cross sectional observational study done in Department of Neurology, Dhaka Medical College Hospital (DMCH) during the period of Januray 2012 to June 2013. Study population included 42 patients admitted or attended in the Department of Neurology, Dhaka Medical College Hospital with presinting features of Amyotrophic Lateral Sclerosis (ALS).

Selection criteria:

Inclusion criteria:

All the patients attending the OPD/Ward during the study period clinically and with necessary investigations diagnosed as Amyotrophic Lateral Sclerosis (ALS) as per Airlie House criteria and revised EL-Escorial criteria.

Exclusion Criteria:

1. The patients who were suspected to have a secondary cause for motor system disease.
2. The patients who did not give consent to undergo electrophysiological study and other necessary (CSF study, MRI of brain and spinal cord).

Electrophysiological diagnostic criteria of ALS (Kimura, 2001):

A set of electro physiologic criteria has gained general acceptance to avoid falsely diagnosing this fatal disease.

1. Fibrillation and fasciculation in at least two muscles innervated by different nerves and roots in each of three limbs, or in two limes and the head.
2. Reduction in number and increase in amplitude and duration of motor unit action potentials.
3. Normal electrical excitability of the serving, motor nerve fibers.
4. Motor fiber conduction velocity within the normal range in nerves less than 70 percent of the average normal value according to age in nerves of more severely affected muscles.
5. Normal excitability and conduction velocity of Afferent nerve fiber even in severely affected limbs.

Operational definitions:

Motor Neuron Diseaser: It is an idiopathic progressive degenerative disorder of upper motor neuron and lower motor neuron or both.

Amyotrophic lateral sclerosis (ALS):

It is classical variety of motor neuron disease where combination of UMN and LMN lesions are present, diagnosed on the basis of Awaji-shima consensus using Airlie House criteria and El Escorial criteria.

Electrophysiology:

a) Nerve Conduction Studies:

CMAP amplitude: The usual measure of amplitude is from baseline to negative peak

and expressed in millivolts. When recorded with surface electrodes, CMAP amplitude is a semiquantitative measure of the number ofaxons conducting between the stimulating and recording points.

Latencies: Latency is the time interval between nerve stimulation (shock artifact) and the CMAP onset. Expression of latency is in milliseconds and reflects the conduction rate of the fastest-conducting axon.

Conduction velocity: This is a computed measurement of the speed of conduction expressed in meters per second.

SNAP amplitude: This semi quantitatively measures the number of sensory axons that conduct between the stimulation and recording sites. The calculation is from the baseline to negative peak or from negative peak to positive peak, and expressed in microvolts.

b) Needle Electromyography:

During an EMG, electrical potential in MND derived from contracting and no contracting muscle are recorded from a small disposable needle electrode and are displayed on an oscilloscope screen. The amplified electrical activity may be heard

Through a loudspeaker. Insertion of the needle may be uncomfortable, but causes no long-term complications.

MUAPs are not seen with minimal contraction.

EMG is reviewed under four headlines:

a) Insertional activities
b) Spontaneous activities
c) Volitional MUAP
d) Recruitment pattern

Study Pocedure:

Amyotrophic lateral sclerosis, cases were selected on the basis of Awaji-shima consensus using Airlie House criteria and El Escorial criteria after detail history and . meticulous clinical examination, initially by the investigator and then by a consultant neurologist. Final diagnosis was established by electrophysiological (EDX) study by competent electro physiologist at DMCH.

All the data including sex and age of onset, duration of illness was noted in standard questionnaire. Tobacco and alcohol use, occupational history, previous medical history including infection of nervous system like polio and relevant family history of the study population was recorded. The medical and occupational backgrounds, history of drug, of these patients was taken from the study place during the study period.

Statistical analysis:

Statistical analyses were carried out by using the Statistical Package for Social Sciences version 16.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as mean, standard deviation, and categorical variables as frequencies and percentages. The differences between groups were analyzed by appropriate statistical tests of significance. A p-value <0.05 was considered as significant.

Ethical consideration:

Prior to the commencement of this study, the research protocol was approved by the local ethical committee.

Results

A total of 42 patients were included in this study, majority 10 (23.8%) patients were age belonged to 51-60 years (Table-I). The mean age was found 44.64± 16.4 years with range from 18 to 85 years. Male-female ratio was 3.2: 1 (Figure-I). Majority 35(83.3%) patients had duration of illness for 1-2 years. Regarding the pattern of involvement at the onset of the disease, it was observed that majority 24(57.1%) patients had upper limb onset, followed by 14(33.3%) and 4(9.5%); who had lower limb onset and bulbar onset respectively (Table-II). Among them a large proportion of patients (40.5%) had muscle wasting followed by 14 (33.4%) and 9 (21.40%), who had muscle weakness and muscle fasciculation respectively (Table-III). Twenty seven (64.3%) patients had possible ALS followed by 11(26.2%) had probable ALS and 4(9.5%) had definite ALS (Table-IV). In electrophysiology lab the motor NCS of the study patients showed that in upper limbs, abnormal CMAP, distal latency and

Table I

Distribution of the study patients by age (n=42)

Age (years)	No. of patients	Percentage
d" 20	4	9.5
21-30	7	16.7
31-40	9	21.4
41-50	9	21.4
51-60	10	23.8
>60	3	7.1

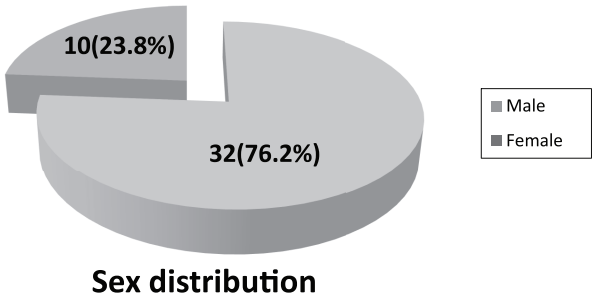

Fig.-1: *Distribution of the study patients by sex (n=42)*

Table II

Distribution of the study patients by clinically first involved region (n=42)

First involved region	No. of patients	Percentage
Bulber onset	4	9.5
Upper lim	24	57.1
Lower limb	14	33.3

Table III

Distribution of the study patients by first presenting symptoms (n=42)

First Presenting Symptoms	No. of Patients	Percentage
Muscle wasting	17	40.5
Muscle weakness	14	33.4
Muscle fasciculation	9	21.4
Dysphagia	2	4.8
Dysarthira	2	4.8

Table IV

Categorization of ALS cases on the basis of clinical examination as per El-Escorial criteria (n=42)

Category of ALS	No. of patients	Percentage
Definite	4	9.5
Probable	11	26.2
Possible	27	64.3

conduction velocity were found in 16 (38.1%), 6 (14·.3%) and 3 (7.1%) patients, respectively. In lower limbs, abnormal CMAP, distal latency and conduction velocity were found in 10 (23.8%), 5(11.9%) and 5 (11.9%) patients respectively. F wave latency was normal in all patients, in both upper and lower limbs (Table-V). The sensory NCS (nerve conduction studies) were normal in all patients (Table-VI). The electromyography (EMG) of the study patients showed features of denervation (increased insertional activities and spontaneous activities) and reinnervation (neurogenic MUAP and reduced recruitment) in cervical, thoracic and lumbo-sacral regions in most of the patients and bulbar region in 9.5% patients (Table-VII). Thirty six patients had EMG evidence ofLMN lesion in three regions (85.7%). Four and two region involvement was found in 4(9.5%) and 2 (4.8%) patients respectively (Table-VIII). LMN features were detected in three or more regions 11 (26.20%) cases with clinical examination. and 40 (95.3%) cases by combined clinical and electrophysiological examinations (out of which, 29 cases did not have LMN features in e" 3 regions clinically (Table-IX). This difference was statistically significant ($p<0.05$). Sixteen (38.1%) patients had probable ALS followed by 15(35.7%) possible ALS and 11(26.2%) definite ALS cases as per EI-Escorial criteria (Table-X). Four (9.5%) cases were diagnosed as definite ALS with clinical examination and 11 (26.2%) cases by combined clinical and electrophysiological examinations (out of which, 7 cases were probable or possible ALS clinically). This difference was statistically significant ($p<0.05$) (Table-XI).

Twenty seven (64.3%) cases were diagnosed as possible ALS with clinical

Examination and 15 (35.7%) cases by combined clinical and electrophysiological examinations. This difference was statistically significant ($p<0.05$) (Table-XI).

Table V

Distribution of the study patients by motor nerve condition study (n=42)

Motor NCS	No. of patients	Percentage
Upper Limb		
Compound motor action potential		
Normal	26	61.9
Decreased	16	38.1
Distal latendy		
Normal	36	85.7
Increased	6	14.3
Condition velocity		
Normal	39	92.9
Decreased	3	7.1
F wave latency		
Normal	42	100
Increased	0	0.0
Lower Limb		
Compound motor action potential		
Normal	32	76.2
Decreased	10	23.8
Distal latency		
Normal	37	88.1
Increased	5	11.9
Conduction Velocity		
Normal	37	88.1
Decreased	5	11.9
F wave latency		
Normal	42	100
Increased	0	0.0

Table VI

Distribution of the study patients by sensory nerve conduction study (n=42)

Sensory NCS	No. of patients	Percentage
Normal	42	100.00.0
Abnormal	0	

Table VII

Distribution of the study patients by needle electromyography (EMG) (n=42)

Needle EMG	No. of patients	Percentage
Bulbar		
Increased insertional activities	4	9.5
Spontaneous activities	4	9.5
Neurogenic MUAPs	4	9.5
Reduced recruitment	4	9.5
Cervical		
Increased insertional activities	38	90.5
Spontaneous activities	36	85.7
Neurogenic MUAPs	40	95.2
Reduced recruitment	39	92.9
Thoracic		
Increased insertional activities	40	95.2
Spontaneous activities	40	95.2
Neurogenic MUAPs	33	78.6
Reduced recruitment	34	80.9
Lumbo-sacral		
Increased insertional activities	37	88.1
Spontaneous activities	40	95.2
Neurogenic MUAPs	39	92.9
Reduced recruitment	38	90.5

Table VIII

Distribution of patients according to number of regions with lower motor neuron (LMN) features in EMG (n=42)

Number of regions* with LMN features in EMG	No. of patients	Percentage
One region	0	0.0
Two regions	2	4.8
Three regions	36	85.79.5
Four regions	4	

Table IX

Comparison between number of regions with LMN features detected clinically and by combined clinical and electrophysiological examination (n=42)

Combined clinical & electrophysiology examination	Clinical number of regions ≥3 (n=11)	<3 (n=31)	P-value*
≥ 3 regions (n=40)	11(26.2%)	29(69.1%)	<0.001
<3 regions (n=02)	0(0.0%)	2(4.7%)	

Table X

Comparison between categorization of ALS cases on the basis of only clinical and combined clinical and electrophysiology examination.

Category of ALS	Only clinical		Combined Clinical and Electrophysiology	
	n	percentage	n	percentage
Definite	4	9.5%	11	26.2%
Probable	11	26.2%	16	38.1%
Possible	27	64.3%	15	35.7%

Table XI

Categorization of ALS cases on the basis of combined clinical and needle electromyographic features (n=42)

Category of ALS	Number of Patients	Percentage
Definite	11	26.2
Probable	16	38.1
Possible	15	35.7

Table XII

Comparison between Proportion of definite ALS detected clinically and combined clinical electrophysiological (n=42)

Combined clinical & electrophysiological examination	Clinical category of ALS		P-value*
	Definite (n=4)	Probable and possible (n=38)	
Definite (n=11)	4(9.5%)	7(16.7%)	0.015
Probable and possible(n=31)	0(0.0%)	31(73.8%)	

Table-XIII

Comparison between Proportion of possible ALS detected clinically and by combined clinical and electrophysiological examination (n=42)

Combined clinical & electrophysiological examination	Clinical category of ALS		P-value*
	Definite (n=15)	Probable and possible (n=27)	
Definite and Probable (n=27)	15(35.7%)	12 (28.3%)	0.001
Possible (n=15)	0(0.0%)	15(35.7%)	

Discussion

This cross sectional observational study was carried out with an aim to find out the clinical and electrophysiological profiles of patients presented with amyotrophic lateral sclerosis (ALS) as well as to assess the correlation between clinical presentation and electrophysiological findings in Amyotrophic lateral sclerosis (ALS). In this series the mean age of patients was 44.64±16.4 years. Brugman et al. (2009) showed in their study similar age of onset, mean was 49 years with range from 18-76 years. But Pugdahl et al. (2007) has observed higher mean age in patients having Amyotrophic lateral sclerosis (ALS), which was 63.6 years varied from 36-85 years. This may be due to geographical and racial impacts. In this study male to female ratio was 3.2:1. Mortara et al. (1981) showed a male to female ratio of 2.08:1. This may be due to the large

proportion of bulbar onset ALS cases included in that study.

Though most of the previous studies found bulbar onset ALS in 22% to 40% cases (Gubbay et al. 1985, Brugman et al. 2009 and Sathasivam et al. 2008) we had only 9.5% case.The discrepancy can be explained by racial variation or small sample size in this study. But the symptoms of muscle wasting, muscle weakness and muscle fasciculation were consistent with similar studies by Gubbay et al. (1985) and Brugman et al. (2009).

Number of definite, probable and possible ALS increased with the addition of the findings of the electrophysiological studies to clinical criteria as per El Escorial criteria with clinical examination alone which is consistent with results of previous similar studies by Traynor et al. (2000) who found 30% definite, 31 % probable and 35% possible ALS, and Beghi et al. (2002) who showed 300% definite, 35 % probable ALS and 38% had possible ALS. Number of definite ALS was higher and possible ALS were lower, both statistically significant, after addition of EMG findings with that of clinical examination. This is because of the fact that EMG can detect LMN features in regions without clinical features of LMN.

In this study, sensory nerve conduction studies and F-wave latencies were normal in all cases. CMAP was reduced in 38.1 % cases in upper limbs and 23.8% cases in lower limbs, which is consistent with standard nerve conduction studies in ALS. However, motor nerve conduction velocity and distal latency were abnormal in few cases, though none was in the range of demyelinating neuropathy. Mills and Nithi (1998) also showed that reduction in the amplitude of compound muscle action potentials (CMAP), prolongation of distal motor latency (DL) and F wave latency were found in 36%, 34% and 19% of hands respectively. This features probably reflected the physiological age-related conduction slowing.

We had several limitations. Firstly, study period was very short. Secondly the sample size was small and finally, the data 'from a tertiary care hospital may not reflect the total scenario of the country.

Conclusion:

Electrophysiological study is invaluable tool in the diagnosis of Amyotrophic lateral Sclerosis (ALS), particularly when clinical evidence of lower motor neuron features are lacking or absent in some of the body region. Our study showed that the diagnostic yield is significantly higher with combine clinical and electrophyiological features compare to clinical feature alone for diagnosing ALS cases.

References:

1. Beghi, E., Balzarini, C., Bogliun, G., Logroscino, G., Manfredi, L., Mazzini, L., et al. 2002. Reliability of the El Escorial diagnostic criteria for amyotrophic lateral sclerosis. Neuroepidemiology, 21(6), pp.265-70.
2. Brugman, F., Veldink, J.H., Franssen, H., Visser, M., Vianney de Jong, J., Faber,
3. C.G., et aI., 2009. Differentiation of Hereditary Spastic Paraparesis From Primary Lateral Sclerosis in Sporadic Adult-Onset Upper Motor Neuron Syndromes. Arch Neurol, 66(4), pp.509-514.
4. Clark, J., 2005. The epidemiology and etiology of ALS : An executive summary. A report to the department of public health, state of Massachusetts, pp.1-15. available from http:// www .researchals.org/uploaded _files/ / mdph _ alsreport_ 211 aDS.pdf. Accessed on 15.03.2013.
5. David, P., Lo-Manaco, M., Palieri, G., 1981. Clinical features of amyotrophic lateral sclerosis. Italian Journal of Neurological Sciences, 2, pp.113-7.
6. Gubbay,S.S., Kahana, E., Zilber, N., Cooper, G., Pintov, S., Leibowitz, Y., 1985. Amyotrophic lateral sclerosis. A study of its presentation and prognosis. 232(5),' pp.295-300.
7. Katirji, B., Kaminski, H.J., 2002. Electrodiagnostic approach to the patient with suspected neuromuscular junction disorder. Neurol Clin, 20, pp.557-586.
8. Kimura, J., 2001. Electrodiagnosis in diseases of nerve and muscle. Oxford: Oxford University Press, pp. 79.
9. Mills, K.R., and Nithi, K.A., 1998. Peripheral and central motor conduction in amyotrophic lateral sclerosis. J Neurol Sci, 159(1), pp. 82-7.
10. Mortara,P., Bardelli, D., Leone,M., Schiffer,D., 1981. Prognosis and clinical varieties of ALS disease. Ital J Neurol Sci, 2(3), pp.237-42.

11. Preston, D.C., Shapiro, B.E., 2005. Electromyography and Neuromuscular Disorders. Clinical-Electrophysiologic Correlations. second edt Philadelphia, Elsevier/ Butterworth Heinemann.

12. Pugdahl, K., Fuglsang-Frederiksen, -A., de Carvalho, M., Johnsen, B., Fawcett.

13. Rosen, A.D., 1978. Amyotrophic lateral sclerosis; clinical features and prognosis. Arch Neurol (Chicago), 35, pp.638-42.

14. Sathasivam, S., 2008. (Brown-Vialetto-Van Laere syndrome) Orphanet -Journal of

15. Rare Diseases. Orphanet Journal of Rare Diseases, 3, p. 9.

16. Traynor, B.J., Codd, M.B., Corr, B., Forde, C., Frost, E., Hardiman, O.M., 2000 . . Clinical features of amyotrophic lateral sclerosis according to the EI Escorial and Airlie House diagnostic criteria: A population-based study. Arch Neurol, 57(8), pp.1171-6.

17. Wolfson, C., Kilborn, S., Oskoui, M., Genge, A., 2009. Incidence and prevalence of amyotrophic lateral sclerosis in Canada: a systematic review of the literature. Neuroepidemiology, 33(2), pp.79-88.