ISSN No:-2456-2165

Comparison of Efficiency of Electromyography and Nerve Conduction Velocity Studies in Diagnosis of Diabetic Neuropathy

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Abstract:- Aim and Objectives:- To study the Comparison of Efficiency of Electromyography (EMG) and Nerve Conduction studies (NCV) velocity in diagnosis of Diabetic Neuropathy.

- **To evaluate the more efficient diagnosis in Diabetic Neuropathy between the EMG and NCV studies.**
- **Materials: A Total of 30 diabetic subjects were taken between the ages of 40-70 years from MGM hospital, Vaagdevi physiotherapy and pediatric rehabilitation center, Warangal.**
- **Method Of Data Collection: History of subjects with diabetes. EMG and NCV studies in diagnosis of Diabetic Neuropathy were performed using Bio-Tech Company 2007 model. Subjects were informed about the study and written consent is taken.**
- **Results: EMG output, out of 30 subjects 14 subjects are diagnosed with Diabetic Neuropathy. So the probability rate is 46% (P= 0.46). Therefore it is less than 50% of success rate.**
- **NCV output, out of 30 subjects 27 subjects are diagnosed with Diabetic Neuropathy. So the probability rate is 90% (P= 0.9 $\cong$ 1). Therefore it is more than 50% of success rate. It is nearer to 100%.**
- **Conclusion: The results of outcome measure provide strong evidence which conclude NCV is proven to be a momentous and effective approach in improving diagnostic criteria of Diabetic Neuropathy.**

Keywords:- *Diabetes Mellitus (DM), Diabetic Neuropathy (DN), Electromyography (EMG), Nerve conduction velocity (NCV).*

I. INTRODUCTION

Diabetic mellitus [DM] is a group of metabolic disorders characterized by a chronic hyperglycemic condition resulting from defects in insulin secretion, insulin action or both.

Diabetic Neuropathies are nerve damaging disorders associated with diabetes mellitus and it is the most common micro vascular complication of diabetes. It represents most health problem worldwide and it is a major cause of morbidity and mortality.

Neuropathy is estimated to be present in 10% to 90% of the patient with diabetes although it changes according to diagnostic criteria and patient population. [1]

Diabetic Peripheral Neuropathy affects at least 50% of patients with both Type1 and Type2 Diabetes and is a leading causing of foot Amputation. Poor Glycemic control is a major risk factor for development of diabetic neuropathy.

The common clinical symptoms of Diabetic Neuropathy are numbness or tingling sensation, insensitivity pain [i.e., burning, excruciating, intractable, stabbing], impaired temperature sensation, weakness.

According to American Diabetes Association [ADA] recommendations, Diabetic Peripheral Neuropathy Diagnosis in clinical practice is made in the presence of signs and symptoms of Peripheral Nervous System Dysfunction after other causes of Neuropathy are excluded in patients with diabetes to confirm the diagnosis, qualitative electro physiological test and sensory and autonomic function tests can be performed. [1]

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The incidence of DN in India is not well known but in a study from South India 19.1% type II diabetic patients had peripheral neuropathy[2]. DN is one of the commonest causes of peripheral neuropathy. It accounts for hospitalization more frequently than other complications of diabetes and also is the most frequent cause of non-traumatic amputation. Diabetic autonomic neuropathy accounts for silent myocardial infarction and shortens the lifespan resulting in death in 25%–50% patients within 5–10 years of autonomic diabetic neuropathy.[3, 4] According to an estimate two thirds of diabetic patients have clinical or subclinical neuropathy. The diagnosis of subclinical DN requires electro diagnostic testing and quantitative sensory and autonomic testing. All types of diabetic patients-insulin dependent diabetes mellitus (IDDM), non-insulin dependent diabetes mellitus (NIDDM), and secondary diabetic patients-can develop neuropathy. The prevalence of neuropathy increases with the duration of diabetes mellitus. In a study, the incidence of neuropathy increased from 7.5% on admission to 50% at 25 years follow up[5].

There are many etiologies to neuropathies and these differ according to their varying Neurophysiological findings. One approach described in an excellent review is to use NCS/EMG as the primary method of classification of a patient suspected of having a Neuropathy. [6]

The conditions where there is the best published evidence on Sensitivity[the ability to detect those diseases] and Specifying[the ability to detect those without] are those where there is another more definitive method of achieving a diagnosis, this being used as the gold standard against which NCS/EMG can be compared.[6]

For the most part changes in Nerve Conduction studies and EMG leads to a clear categorization of neuropathy however there are potential traps. [6]

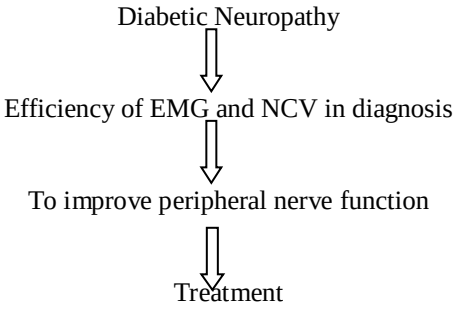
- As the Nerve fibre tested, are large myelinated fibres, small fibres, Neuropathy may not be associated with changes and other diagnostic test such as thermal threshold may help.
- b) In patients with Demylinating Neuropathy [for eg: early guillian-barre syndrome] investigated early in disease course, changes can be relatively subtle or absent.

NCV and EMG are commonly performed by physical medicine and rehabilitation or Neurology specialists to assess the ability of the nervous system to conduct electrical impulses and to evaluate nerve/muscle function to determine if neuromuscular disease is present.

II. MATERIALS AND METHODS

A. Study Design

Comparative study design.



B. Sample of The Study

- Sample design: Simple random sampling
- Sample size: 30 subjects
- Source of data: Subjects has been selected randomly from MGM hospital, Vaagdevi

Physiotherapy and Pediatric Rehabilitation Centre, Warangal.

C. Inclusion Criteria

- Subjects with diabetes are included.
- Age 40-70 yrs.
- Both males and females are included.
- People who are ready to give consent.

D. Exclusion Criteria

- Those who are not willing to give consent.
- Mentally retarded patients.
- Severe perception of cognitive defects.
- Patients with severe cardiac problems
- Unwilling to participate
- Hypersensitivity to skin
- History of other any Neurological, Neuromuscular, Orthopedic disorders.

E. Measurement Tools

- EMG machine(bio- tech Company 2015 model India Private Limited)
- NCV machine (bio- tech Company 2015 model India Private Limited)

III. PROCEDURE

30 Subjects are randomly selected from the MGM hospital, Vaagdevi Physiotherapy and Pediatric Rehabilitation Centre. They were assigned and diagnosed with EMG & NCV studies. The results are compared to check the efficiency between 2 forms of diagnosis (which one is better).

A. EMG

Recording, Display, Measurement & Interpretation of action potential arise from muscle.

B. Equipment setup

Sweep speed	5-10 ms/div
Amplification	50 µV/div
Spontaneous activities [MUP]	200µV /div
Filter settings	20-10000 Hz
Gain	100µV/div

Select muscle
↓
Instruct the patient to contract and relax
↓
Locate the disc point
↓
Don't put at motor point, make sure it is slightly away from it
↓
Sharp MUP are arises [if not it should be replaced]

C. NVC

Recording of action potential which are generated by Nerve

NCV → MNCV
NCV → SNCV

D. MNCV

Settings:

pulse duration of stimulus	0.1 ms
Intensity of stimulus	5-40m Amp
Filter settings	5Hz- 10kHz
Sweep speed	2-5ms/division

➔ Motor NCS are performed by electrical stimulation of peripheral nerve and recording from a muscle supplied by nerve. The time taken for electrical impulse to travel from the stimulation site to the recording site is measured. This value is called the latency and usually measured in millisecond (ms). The size of response called the amplitude is also measured. Motor amplitudes are measured in Mille volts (mV). By stimulating in two or more different locations along the same nerve, the NCV across different segments can be determined.

Calculations are performed using the distance between the different stimulating electrodes and the differences in latencies.

E. SNCV

Filter Settings:

Sensory Nerve conduction	10 Hz-2 kHz
Sweep speed	1- 2 ms/div
Gain	1- 5 µV/div

➔ Sensory NCS are performed by electrical stimulation of a peripheral nerve and recording from a purely sensory portion of the nerve. Sensory amplitudes are much smaller than the motor amplitudes usually in micro volt (mV) range. The sensory NCS is calculated based upon the latency and the distance between the stimulating and recording electrodes.

IV. STATISTICAL ANALYSIS

We consider 30 subjects, in which 20 were males and 10 were females. Their gender ratio, average age and standard deviation were as follows.

Gender	No. of Subjects	Percentage	Average Age	S. D.
Male	20	66.67%	57.9	8.018
Female	10	33.33%	53.4	7.323
Total	30	100%	56.4	8.077

Table 1. Gender Ratio, Average Age & S.D.

ISSN No:-2456-2165

EMG Values

PARAMETERS	No. Of Subjects	Right Tibialis Anterior		Right Extensor Digitorum Brevis	
		Mean	S.D.	Mean	S.D.
EMG Value	30	14.366	0.475	11.373	0.460
Amplitude	30	384.233	128.115	376.833	128.087
Duration	30	12.933	6.180	12.766	6.795

Table 2 represents the EMG values of right Tibialis anterior and extensor digitorum brevis mean and standard deviations are as follows

NCV Values of Right Peroneal Nerve

PARAMETERS	No. of Subjects	SNCV				MNCV			
		Below knee		Above knee		Below knee		Above knee	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Latency	30	2.65	0.497	2.68	0.450	2.70	0.535	2.72	0.511
Amplitude	30	29.754	15.877	31.671	16.054	23.094	17.661	26.259	20.646
Area	30	33.198	14.916	36.699	14.983	46.182	14.542	43.44	15.916
Velocity	30	43.956	2.588	46.16	3.545	43.665	4.037	48.526	4.094

Table 3 represents the NCV values of right peroneal nerve (Below & Above knee) mean and standard deviations are as follows

V. RESULT

As can be seen for the EMG output, out of 30 subjects 14 subjects are detected with Diabetic Neuropathy. So, the probability rate by EMG is 46% (P= 0.46) therefore it is less than 50% of success rate.

As can be seen for the NCV output, out of 30 subjects 27 subjects are detected with Diabetic Neuropathy. So, the probability rate by NCV is 90% (P= 0.9≅ 1) therefore it is more than 50% of success rate and nearer to 100%.

So, the probability of NCV diagnosis in detecting Diabetic Neuropathy is more than 90% of success rate when compared with EMG diagnosis.

VI. DISCUSSION

Diabetic Neuropathy has been defined as presence of symptoms and or signs of peripheral nerve dysfunction in diabetics after exclusion of other causes ,which may range from hereditary, traumatic, compressive, metabolic, toxic, nutritional, infectious, immune mediated, neoplastic and secondary to other systemic illnesses.

Diabetic Neuropathy is the common micro vascular complication of diabetes and it has significant impaired sensation.

Early diagnosis and appropriate treatment are important to prevent disease complications, especially Diabetic foot ulceration in case of distal sensory Neuropathy.

The main aim of the study is to compare the efficiency of EMG and NCV studies in diagnosis of Diabetic Neuropathy.

The study included 30 subjects suffering with Diabetes and diagnosed with EMG and NCV for 8Weeks

EMG & NCV are taken as the outcome measure, which measures abnormal values in Diabetic subjects.

Table 1. Represents gender ratio, averages and standard deviations of age.

Table 2. Describe EMG of right Tibialis anterior & right Extensor digitorum brevis parameters such as EMG value, amplitude and duration with mean and standard deviations.

Table 3. Describe NCV values (SNCV & MNCV) of right peroneal nerve at below & above knee segment parameters such as latency, amplitude, area and velocity with mean and standard deviations.

The result of 30 subjects outcomes suggest they are independently efficient in improving the diagnostic criteria.

There is an efficient diagnosis result when studied in between the EMG and NCV. Therefore, it is suggested that the subjects who received NCV have shown appreciably more efficient than the subjects in EMG.

VII. LIMITATIONS

Almost each and every study has some limitations and this study in its course has come up with some limitations

due to some unavoidable practical, physiological, psychological and environmental factors.

Therefore it is suggested that the further studies can be done keeping some points in consideration as given below.

- Sample size taken was small.
- Follow up was not done after the last assessment
- During this study the environmental factors and psychological factors are not controlled as they may also have effect on the uncomplaining performance.

VIII. CONCLUSION

According to the present study findings, Diabetic Subjects who experience Nerve damage can achieve better diagnosis through EMG and NCV studies.

As the significant result shows, that NCV diagnosis is able to detect Diabetic Neuropathy before the presentation of symptoms when compared to EMG.

Therefore, the results for outcome measures provide strong evidence which conclude NCV is proven to be a momentous and effective approach in improving diagnostic criteria in Diabetic Neuropathy.

IX. ACKNOWLEDGMENT

I sincerely thank Mr. Ch. Devender Reddy secretary & Correspondent, Dr. Sampath Reddy principal of Vaagdevi college of Physiotherapy, Mr. Bal Raj statistician for his support in the completion of this work.

Conflict of Interest:- Nil
Source of Support:- Self
Ethical Clearance:- VCOP/MPT/2015/2 (IHEC approved by CDCSO ECR/257/Indt/TG/2015)

REFERENCES

[1]. M Turkan, A Yusuf, S Mustafa et al, Comparison of Efficiencies of Michigan Neuropathy Screening Instrument, Neurothesiometer, and Electromyography for Diagnosis of Diabetic Neuropathy (2013).
[2]. S Ashok, M Ramu, R Deepa. *et al* Prevalence of neuropathy in type 2 diabetes patients attending diabetes center in South India. J Assoc Physicians India 200250546–550.550
[3]. N S Levitt, K B Stansberry, S Wychanck. *et al* Natural progression of autonomic neuropathy and autonomic function tests in a cohort of IDDM. Diabetes Care 199619751–754.754
[4]. W Rathmann, D Ziegler, M Jahnke. *et al* Mortality in diabetic patients with cardiovascular autonomic neuropathy. Diabet Med 199310820–824.824
[5]. J Pirart. Diabetes mellitus and its degenerative complications: a prospective study of 4400 patients observed between 1947 and 1973 (third and last part). Diabetes Metab 19773245–256.256
[6]. G Fuller,"how to get the most out of nerve conduction studies and electromyography". (2005)
[7]. A L Kakrani, VS Gokhale, K V Vohra, et al Clinical and Nerve Conduction Study Correlation in Patients of Diabetic Neuropathy Journal of the association of physicians of india. (2014).
[8]. E Karagoz, T Tanridag, G Karlikaya, et al, "The Electrophysiology Of Diabetic Neuropathy" (The International Journal of NeurologyVolume 5 Number 1)
[9]. P. J. Dyck, K. M. Kratz, J. L. Karnes et al., "The prevalance by staged severity of various types of Diabetic Neuropathy, retinopathy and nephropathy in a population-based cohort: the Rochester Diabetic Neuropathy Study," *Neurology*, vol. 43, pp. 817–824, 1993.
[10]. A. J. M. Boulton, A. I. Vinik, J. C. Arezzo et al., "Diabetic Neuropathies: a statement by the American Diabetes Association," *Diabetes Care*, vol. 28, no. 4, pp. 956–962, 2005.
[11]. J.D. England, MD; G.S. Gronseth, MD; G. Franklin, MD, et al"Distal symmetric polyneuropathy:A definition for clinical researchReport of the American Academy of Neurology, theAmerican Association of Electrodiagnostic Medicine, andthe American Academy of Physical Medicine andRehabilitation".
[12]. American Association of Electrodiagnostic Medicine. Guidelines in electrodiagnostic medicine. Recommended policy for electrodiagnostic medicine. Muscle Nerve Suppl. 1999;
[13]. Gooch CL, Weimer LH. The electro diagnosis of neuropathy: basic principles and common pitfalls. Neurol Clin. [2007]
[14]. Lee DH, Claussen GC, Oh S. Clinical nerve conduction and needle electromyography studies. J Am Acad Orthop Surg. [2004]
[15]. Rossitza I. Chichkova, MD, MS Lara Katzin, MD" EMG and NerveConduction Studies in Clinical Practice".
[16]. Solomon Tesfaye et al. Diabetic neuropathies Update on definitions,diagnostic criteria, estimation of severity , and treatments .Diabetes care 2010.