[Downloaded free from http://www.advbiores.net on Monday, April 17, 2023, IP: 178.131.176.193]

Original Article

Assessment of electromyograghic findings in peroneus tertius, tibialis posterior and dorsal interoseous pedis muscles in patients with axonal polyneuropathy

Majid Ghasemi, Zahra Rajaei, Fariborz Khorvash, Bahador Asadi[1], Majid Rezvani[2]

Departments of Neurology, [2]Neurosurgery, Isfahan University of Medical Sciences, Isfahan, [1]Medical University of AJA, Tehran, Iran.

Abstract

Background: Axonal polyneuropathy (APN) is a common kind of neurologic disorders, which is normally diagnosed by electrodiagnostic methods. Different muscles were studied to find a muscle, which can be considered as a reliable site for early diagnosis of mild APN; this muscle should be easily activated by patient, has the highest sensitivity to EMG changes of APN, and has the lowest rate of false positive results in normal subjects.

Materials and Methods: Based on the inclusion and exclusion criteria, 32 patients were recruited, and all of them underwent needle EMG of 3 different muscles including Peroneus tertius (PT), tibialis posterior (TP), and dorsal interoseous pedis (DIP). EMG Findings of different muscles [Motor Unite Action Potential (MUAP) duration, MUAP amplitude, polyphasic MUAP, fibrillation potential (FP), and the ability of subjects to contract special muscle] were recorded and compared.

Results: Mean of MUAP amplitude was significantly different between all 3 muscles (*P*-values < 0.001). PT showed a significantly higher frequency of polyphasic MUAP than others (*P*-value: 0.001). The frequency of FP was significantly lower in TP than PT and DIP (*P*-values: 0.03 and 0.001, respectively). DIP showed significantly shorter MUAP duration than PT and TP (*P*-values 0.002 and 0.003, respectively). All cases were able to activate TP and PT voluntarily though only 20 patients could activate DIP (*P*-value < 0.0001).

Conclusion: The higher frequency of polyphasic MUAP, the higher frequency of FP, and finally, the ability of all patients in activation of PT voluntarily, all support the usefulness of PT for EMG studies in APN patients.

Key Words: Axonal polyneuropathy, dorsal interoseous pedis, electromyographic, peroneus tertius, tibialis posterior

Address for correspondence:
Dr. Zahra rajaei, Department of neurology, alzahra hospital, soffe ave, Isfahan, Iran. E-mail: zahra.rajaei@yahoo.com

Received: 21.04.2012, **Accepted:** 08.07.12

Access this article online	
Quick Response Code:	Website: www.advbiores.net
	DOI: 10.4103/2277-9175.109753

INTRODUCTION

Polyneuropathy is a common kind of peripheral neuropathies, caused by different underlying problems and afflicts 2.4% - 8% of people of different age groups.[1,2] The most common variety of polyneuropathies is axonal type, which may be caused by a broad range of systemic diseases and metabolic disorders.[2]

Copyright: © 2013 Ghasemi. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

How to cite this article: Ghasemi M, Rajaei Z, Khorvash F, Asadi B, Rezvani M. Assessment of electromyograghic findings in peroneus tertius, tibialis posterior and dorsal interoseous pedis muscles in patients with axonal polyneuropathy. Adv Biomed Res 2013;2:41.

[Downloaded free from http://www.advbiores.net on Monday, April 17, 2023, IP: 178.131.176.193]

In regard with the high prevalence of this disorder, it is not surprising that patients suffering from polyneuropathies comprise the majority of cases referred to electrodiagnostic laboratories.[3]

Electromyographic (EMG) examination is the standard choice for detecting polyneuropathy. In many cases, EMGs of distal muscles of lower extremities (foot muscles) are used to detect the early mild abnormality. However, using foot muscles for investigation of polyneuropathies is usually accompanied with some troubles.

For instance, abductor hallucis (AH) and dorsal interoseous pedis (DIP) have been commonly assessed in EMG studies for years, but their usefulness is nowadays in question due to difficulty in activating and having high false positive results in normal individuals.[4,5] Therefore, finding a muscle, which can be voluntarily contracted and has a low rate of false positive results, seems to be necessary to provide a good assessment of patients' condition and to solve the mentioned troubles.

Unlike AH, peroneus tertius (PT) has been introduced as a proper alternative for AH in EMG investigations for making the diagnosis of polyneuropathy.[4]

In normal cases, calf muscles such as tibialis posterior (TP) usually show no fibrillation potential (FP), hence they could be reliable indicators for the assessment of polyneuropathy, provided the patient can activate them.

In light of the above issues, we decided to determine and compare EMG characteristics of 3 different muscles including DIP, PT, and TP in APN cases and find out that which one is the most reliable site for EMG assessment in these patients.

MATERIALS AND METHODS

After the approval of the ethic committee of Isfahan University of Medical Sciences and obtaining an informed consent, 32 patients with the clinical diagnosis of mild axonal polyneuropathy (APN) were recruited from referred cases to the EMG laboratory at Kashani hospital, Isfahan, Iran.

Prior to involving patients, a neurologic history was taken and a physical examination was performed by the neurologist to confirm signs and symptoms for which patients were referred to our center.

Clinical manifestations including paresthesia, hypesthesia, dysesthesia, bilateral lancinating pain in the distal lower extremities, reduced Achilles tendon reflex (for age < 60 years), multimodality distal loss of sensation in lower extremities, and symmetric bilateral decrease in sensory nerve action potential (SNAP) of sural nerve were considered as inclusion criteria.

Distal atrophy, features of neuropathy in upper extremities, fibrillation potential (FP) or neurogenic motor unit action potential (MUAP) in proximal muscles or in both tibialis anterior and gastrocnemius muscles, and having other types of neuropathy simultaneously were considered as exclusion criteria.

In order to check inclusion criteria, initially all patients underwent peroneal and tibial motor nerve conduction study (NCS) and sural sensory NCS.

The diagnosis of axonal polyneuropathy was made based on American Academy of Neurology (AAN) guideline.[6]

Standard needle EMG was performed by disposable concentric electrodes for all patients on TP, PT, and DIP. Limb temperature was monitored and maintained above 33°C during EMG study.[4]

Muscles were studied regarding spontaneous activity [fibrillation potential (FP), positive sharp wave] polyphasic MUAP (> 4 phases),[4] MUAP amplitude, and MUAP duration. Motor unit action potential (MUAP) was quantified 20 times for each muscle, and average of these readings were recorded as the amplitude and duration. Patients' ability of activating muscles was also examined.

Data were analyzed by SPSS 16, and paired t-test and chi-square were applied as required.

RESULTS

This study was performed on 32 patients, consisted of 17 (53.1%) men and 15 (46.9%) women. Mean age of all patients was 58.84 ± 11.52 years; 60.00 ± 11.90 years for men and 57.53 ± 11.35 years for women.

Results are summarized in Table 1.

Although there was no significant difference in MUAP duration between PT and TP (*P*-value: 0.42), DIP showed significantly shorter MUAP duration than PT and TP (*P*-values 0.002 and 0.003, respectively).

Mean of MUAP amplitude was significantly different between all 3 muscles (*P*-values < 0.001); the highest was DIP, and the lowest was TP.

[Downloaded free from http://www.advbiores.net on Monday, April 17, 2023, IP: 178.131.176.193]

Table 1: Electromyographic findings in different muscles

	TP (N:32)	PT (N:32)	DIP (N:32)
FP (%)	15 (46.9)	23 (71.9)	28 (87.5)
MUAP amplitude (mV)	2.93 ± 0.82	3.60 ± 0.64	4.16 ± 0.74
MUAP duration (ms)	15.56 ± 2.97	15.15 ± 1.41	13.84 ± 1.41
Polyphasic MUAP (%)	20 (62.5)	31 (96.9)	20 (62.5)
Ability to activate muscle (%)	32 (100)	32 (100)	20 (62.5)

FP, Polyphasic MUAP and the ability to activate muscle are presented as number of positive cases (percent). MUAP amplitude and MUAP duration are presented as Mean ± SD of all cases. mV: Millivolt, ms: Millisecond

PT showed a significantly higher frequency of polyphasic MUAP than TP and DIP (*P*-value: 0.001); however, DIP and TP had similar frequency of polyphasic MUAP.

The lowest frequency of FP was found in TP, which was significantly lower than PT and DIP (*P*-values: 0.03 and 0.001, respectively). However, the difference between PT and DIP was not statistically significant (*P*-value: 0.10).

All cases (32 patients) were able to activate TP and PT voluntarily though only 20 patients could activate DIP (*P*-value < 0.0001).

DISCUSSION

This study was purposed to determine and compare needle EMG findings of 3 anatomically different muscles in APN subject. The compatibility of patients with study's inclusion criteria provided a high level of confidence that results would be representative of APN patients. Apart from the ability of patients in activating the intended muscle, different characteristics of MUAP including duration, amplitude, and polyphasic potentials were assessed to find out how helpful these muscles are in the diagnosis of APN paraclinically.

One important factor in distinguishing neurogenic disorders from primary muscle diseases on EMG is MUAP duration.[7,8] The longer MUAP duration increases the likelihood of neurogenic disorders.[9] Comparing to normal MUAP duration value for PT reported by *Boon AJ et al.*, our subjects had higher duration.[4]

Although all patients were clinically diagnosed to be suffering from APN, we found significantly shorter MUAP duration in DIP muscle than TP and PT.

Normative value of MUAP duration is only defined for PT;[3] therefore, more studies are needed to define it for TP and DIP before we can use it as a reliable factor.

Compared to previous studies, the mean of MUAP amplitude in PT was higher than normal value.[4] Generally, longer MUAP duration is considered to be associated with higher amplitude. Therefore, we might expect the lowest amplitude in DIP. Conversely, DIP found to have the highest amplitude value in this study.

But, it is of note that MUAP amplitude is not as useful as MUAP duration in assessing motor unit since it only reflects the few muscle fibers closest to the tip of needle. Therefore, MUAP amplitude does not provide a reliable and comprehensive assessment of the muscle, and it could either over-estimate or under-estimate the condition.[9]

The other studied parameter was polyphasic MUAP, which may occur as a result of re-innervation or an increase in nerve fiber density in neurogenic disorders.

Though the majority of patients had polyphasic MUAP in DIP and TP, almost all patients had polyphasic MUAP in PT. Given the fact that all cases of this study are afflicted by APN, this finding indicates that PT is a more suitable muscle than TP and DIP to study the effects of APN on muscle innervation.

We had hypothesized that TP could be a reliable choice to study FP in ANP patients because of not having false positive results in normal subjects; our study proved that only less than half of ANP patients had FPs. On the other hand, FPs were more frequently observed in DIP and PT while no significant difference was found between these 2 groups. This implies that both PT and DIP are more sensitive muscles in FP assessment of APN patients.

Besides all of the mentioned parameters, the ability of patients in activating a specific muscle is a vital factor that can affect the applicability of muscles for EMG.[10] Albeit more than half of the cases had the ability of activating DIP, all patients were able to activate PT and TP voluntarily; this trait makes PT and TP superior to DIP.

TP has significantly lower polyphasia, FP, and amplitude than PT; however, there is no significant difference in duration between these 2 muscles. Therefore, PT is more reliable than TP in the diagnosis of polyneuropathy.

The combination of the above evidence with the higher frequency of FP and the ability of all patients in activation of PT voluntarily all support the usefulness of PT for EMG studies in APN patients.

This finding is supported by another study, which introduces PT as a helpful choice in the diagnosis of

[Downloaded free from http://www.advbiores.net on Monday, April 17, 2023, IP: 178.131.176.193]

APN by EMG; however, this study has compared PT with AH, not TP and DIP. This study also reported inability of many patients in activation of AH. Moreover, they founded significantly more large amplitude MUAP – which is a sensitive parameter in the diagnosis of mild neuropathy- in PT than AH.[3]

This superiority may be caused by probably earlier involvement of PT in the course of APN, having less tendency to non-specific increase in insertional activity and easier activation of PT; therefore, its assessment lead to more reliable results.[3,4]

Limitations of present study include the relatively small sample size, relying on clinical diagnosis of APN as the gold standard, and lack of data about EMG characteristics of DIP and TP in normal subjects and as mentioned above, lack of normative values about studied muscles.

Comparing findings of APN subjects to normal cases will help us to find out that which one of these 3 muscles are able to make more prominent differentiation between normal and abnormal individuals, which is the ultimate goal of this study.

In conclusion, given the limitations and available data, our results provide a stronger tendency toward the use of PT as the muscle of choice in EMG study of APN patients.

REFERENCES

1. Rosenberg NR, Portegies P, de Visser M, Vermeulen M. Diagnostic investigation of patients with chronic polyneuropathy: Evaluation of a clinical guideline. J Neurol Neurosurg Psychiatry 2001;71:205-9.
2. England JD, Asbury AK. Peripheral neuropathy. Lancet 2004;363:2151-61.
3. Boon AJ, Harper CM. Electromyographic sensitivity of peroneus tertius relative to abductor hallucis in assessment of peripheral neuropathy. Muscle Nerve 2009;40:629-32.
4. Boon AJ, Harper CM. Needle EMG of abductor hallucis and peroneus tertius in normal subjects. Muscle Nerve 2003;27:752-6.
5. Morgenlander JC, Sanders DB. Spontaneous EMG activity in the extensor digitorum brevis and abductor hallucis muscles in normal subjects. Muscle Nerve 1994;17:1346-7.
6. England JD, Gronseth GS, Franklin G, Miller RG, Asbury AK, Carter GT, *et al.* Distal symmetric polyneuropathy: A definition for clinical research: Report of the American Academy of Neurology, the American Association of Electrodiagnostic Medicine, and the American Academy of Physical Medicine and Rehabilitation. Neurology 2005;64:199-207.
7. Pfeiffer G. The diagnostic power of motor unit potential analysis: An objective bayesian approach. Muscle Nerve 1999;22:584-91.
8. Rodriguez I, Gila L, Malanda A, Gurtubay IG, Mallor F, Gomez S, *et al*. Motor unit action potential duration, I: Variability of manual and automatic measurements. J Clin Neurophysiol 2007;24:52-8.
9. Daube JR, Rubin DI. Needle electromyography. Muscle Nerve 2009;39:244-70.
10. Dyck PJ, Litchy WJ, Lehman KA, Hokanson JL, Low PA, O'Brien PC. Variables influencing neuropathic endpoints: The Rochester Diabetic Neuropathy Study of Healthy Subjects. Neurology 1995;45:1115-21.

Source of Support: Nil, **Conflict of Interest:** None declared.