Journal of Surgery and Medicine

Investigation of concordance between referral diagnosis and electroneuromyographic diagnosis

Klinik ön tanı ile elektronöromiyografik tanı uyumunun araştırılması

Ali Rıza Sonkaya [1], Mustafa Karaoğlan [2]

[1] Okmeydani Training and Research Hospital, Department of Neurology, Istanbul, Turkey
[2] Ankara Training and Research Hospital, Department of Neurology, Ankara, Turkey

ORCID ID of the author(s)
ARS: 0000-0001-9218-4502
MK: 0000-0001-9420-2663

Corresponding author / Sorumlu yazar:
Ali Rıza Sonkaya
Address / Adres: Okmeydani Eğitim ve Araştırma Hastanesi, Nöroloji Anabilim Dalı, İstanbul, Türkiye
e-Mail: drsonkay@gmail.com

Abstract

Aim: Electroneuromyography (ENMG) is an electrophysiological method of examination for neurophysiological state of motor neuron, peripheral nerve and muscle functions. This study was aimed to investigate the concordance of between referral diagnosis and ENMG diagnosis in patients referred to the electrophysiology laboratory.

Methods: A retrospective cohort study is planned. Patients, whose evaluations of ENMG were requested by the orthopedic, neurology and physical therapy and rehabilitation physicians between June 2015 and December 2018, were included in this study. Descriptive statistics and Cohen's Kappa Test were run for data set analysis.

Results: A total of 486 patients are included in the study. Of the 486 patients undergoing ENMG examination, 362 were female (74.5%) and 124 were male (25.5%). The mean age was 46.71±12.41. 35.2% (n=171) of the referral diagnoses were requested by orthopedics, 32.7% (n=159) by physical therapy and rehabilitation and 32.1% (n=156) by neurology clinics. When the consistency between the preliminary diagnosis and post-ENMG diagnosis was examined; 65.4% of the results were found to be compatible. According to the clinics; 76.3% of the requests referred by the neurology clinic and 64.8% of the requests referred by the physical therapy and rehabilitation clinic, 56.1% of the requests referred by the orthopedic clinic were confirmed by ENMG. As a result of the Cohen's Kappa test, the total (κ) correlation between clinical preliminary diagnosis and ENMG diagnosis was found to be 0.574 (p<0.001). These findings demonstrated a moderate (0.41-0.60) concordance. When examined according to the clinics, compliance values; for the orthopedic clinic were 0.484 (p<0.001), 0.571 for the physical therapy and rehabilitation clinic (p<0.001) and 0.685 for the neurology clinic (p<0.001).

Conclusion: This study confirmed that ENMG should be considered as an extension of neurological examination.

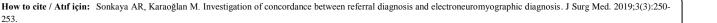**Keywords:** Electroneuromyography, Clinical preliminary diagnosis

Öz

Amaç: Elektronöromiyografi (ENMG) motor nöron, perifer sinir ve kas fonksiyonlarının nörofizyolojik olarak değerlendirilmesinde kullanılan yöntemdir. Bu retrospektif çalışmada Nörofizyoloji laboratuvarında değerlendirilmiş olan hastaların klinik ön tanıları ile ENMG tanıları arasındaki uyumun araştırılması amaçlanmıştır.

Yöntemler: Çalışmada, Haziran 2015- Aralık 2018 yılları arasında Ortopedi, Nöroloji ve Fizik Tedavi ve Rehabilitasyon (FTR) uzmanları tarafından ENMG istemleri yapılmış olan 486 hastanın sonuçları, ön tanı ile elektrodiagnostik uyumluluğu açısından retrospektif olarak incelendi. Verilerin analizinde betimsel istatistik ve Cohen's Kappa Testi kullanıldı. ENMG incelemesi yapılan toplam 486 hastanın 362'si kadın (%74,5), 124'ü erkekti (%25,5) ve hastaların yaş ortalaması 46.71±12.41 idi.

Bulgular: Hastaların %35,2'sinin (n=171) istemi Ortopedi, %32,7'sinin (n=159) istemi FTR, %32,1'inin (n=156) istemi Nöroloji kliniklerinden yapılmıştı. En çok ön tanı Karpal Tünel Sendromu (%44,4) idi. Ön tanılar ile ENMG sonrasında raporlanan tanılar arasındaki tutarlılık incelendiğinde; sonuçların %65,4 oranında uyumlu olduğu görüldü. Kliniklere göre değerlendirme yapıldığında ise Nöroloji kliniğince yapılan isteklerin %76,3'ü, FTR kliniğince yapılan isteklerin %64,8'i ve Ortopedi kliniğince yapılan isteklerin %56,1'i ENMG ile doğrulanmıştı. Ön tanıların ENMG ile desteklenme oranları incelendiğinde; peroneal nöropati (%78,8) en yüksek orana sahipti. Chen's Kappa testi sonucunda toplamda klinik ön tanılar ile ENMG tanıları arasındaki uyum (κ) değeri 0,574 olarak bulundu (p<0,001). Bu, orta düzeyde (0,41-0,60) bir uyumu gösteriyordu. Kliniklere göre incelendiğinde ise uyum değerleri; Ortopedi kliniği için 0,484 (p<0,001), FTR kliniği için 0,571 (p<0,001) ve Nöroloji kliniği için 0,685 (p<0,001) idi.

Sonuç: Bu çalışma ENMG'nin nörolojik muayenenin bir uzantısı olarak görülmesi gerektiğini doğruladı.

Anahtar kelimeler: Elektronöromiyografi, Klinik ön tanı

Introduction

Electroneuromyography (ENMG) is an electrophysiological method of examination for neurophysiological state of motor neuron, peripheral nerve and muscle functions. Although an important diagnostic tool such as genetic examination and fast-growing imaging techniques nowadays, ENMG has frequently been used examination and treatment response of entrapment neuropathies, anterior horn motor neuron disease, neuropathy, polyneuropathy, radiculopathy, nerve muscle junction disease and muscle diseases since the year 1940 [1,2]. ENMG still maintains its importance despite advanced diagnostic tools also it is considered as the gold-standard tool to evaluate the nerve function [3,4]. Main parameters of the electrophysiological studies are latency, amplitude and conduction velocity. Furthermore, ENMG can identify subclinical changes in nerve functions at up to 12 weeks before becoming clinically detectable [5].

ENMG provides significant information about the diagnosis and differentiation of peripheral nerve diseases, muscle diseases, radiculopathy, motor neuron diseases and motor endplate diseases, determination of their severity and prevalence, localization of the lesion and prediction of prognosis [6,7]. In addition, ENMG contributes the proper and effective use of other laboratory tests, guides the selection and planning of medical or surgical treatments and has an important role in the follow-up of the response to treatment [4,8]. Therefore, ENMG is accepted as a continuation of the neurological examination of the clinicians. In addition to directing the clinician to a correct diagnosis, the patient also provides the opportunity for better clinical improvement [1,9].

In addition to neurologists, ENMG is a valid technique in the diagnosis of many diseases which affects peripheral nervous system either alone or by ancillary methods for many clinicians in different areas such as neurosurgery, physical therapy and rehabilitation and orthopedics [10].

ENMG is an experience that can be uncomfortable for the patient due to its electrical stimulation and needle inspection requirement [11]. In addition, the clinical findings of the patient before the ENMG and the preliminary diagnosis of the referring physician should be taken into consideration [12]. For this reason, it is very important to be known the clinical findings and referral diagnosis [13]. Referring the patient without preliminary diagnosis to ENMG examination, it can be resulted in unnecessary prolongation of the procedure and unnecessary procedures for the patient [14]. These procedures can be reduced the value of electro-diagnostic test and results in elongation of waiting time, unnecessary patient intensity, lots of time and sources [7].

Concordance between preliminary diagnosis and post-ENMG diagnosis of patients has been discussed in many studies. Different consistency rates were determined in these studies [3,9]. It is thought that the present study will contribute to the existing literature. Therefore, this retrospective study was aimed to investigate the concordance of the referral diagnosis and post-ENMG diagnosis of patients referred to the electrophysiology laboratory.

Materials and methods

This study was conducted at Health Science University Okmeydani Training and Research Hospital. The patients, aged between 18 and 85 years, whose ENMG evaluations were requested by the orthopedic, neurology and physical therapy and rehabilitation physicians between June 2015 and December 2018 were included in the study.

All laboratory procedures had been carried out using the MEDELEC Synergy ENMG instrument. All ENMG recordings were performed by the same experienced researcher and if it was a needle ENMG, it was performed with a concentric needle electrode. It was followed to be the guidelines recommended on the basis of clinical findings and preliminary diagnosis for selection of nerve conduction studies [2]. The study was approved by local ethics committee (Protocol no: 48670771-514.10).

Demographic data, techniques used during ENMG, referral diagnoses and post-ENMG diagnoses were all recorded for each patient. The referral diagnoses and post-ENMG diagnoses were classified into groups. The consistency between referring diagnosis and post-ENMG diagnosis was compared. For the purpose of comparison, 'consistency' was described as a similarity between the referral diagnosis and the post-ENMG diagnosis. 'Inconsistency' was described as the difference between the referral diagnosis and the post-ENMG diagnosis or a normal ENMG result.

Statistical analysis

SPSS 25.0 for Windows (Statistical Package for Social Sciences Inc. Chicago, IL, USA) is used for analysis. Statistical analysis of the data was performed using descriptive statics and Cohen's Kappa Test. Cohen's Kappa Test is a statistical measure created by Jacob Cohen in 1960 to be a more accurate measure of reliability between two raters making decisions about how a particular unit of analysis should be categorized [15]. Kappa measures not only the percentage of agreement between two raters; it also calculates the degree to which agreement can be attributed to chance [16].

Results

A total of 486 patients undergoing ENMG examination included in the study, 362 were female (74.5%) and 124 were male (25.5%). The mean age was 46.71±12.41 (range 18-84). 35.2% (n=171) of the referral diagnoses were requested by orthopedics, 32.7% (n=159) by physical therapy and rehabilitation and 32.1% (n=156) by neurology clinics.

According to frequency sequence, the preliminary diagnoses of the ENMG request was followed as Carpal tunnel syndrome (CTS) in 216 (44.4%), ulnar entrapment neuropathy in 78 (16.0%), polyneuropathy in 75 (15.4%), peroneal neuropathy in 66 (13.6%) and brachial plexopathy in 51 (10.5%).

Post-ENMG diagnosis were found to be 147 (30.2%) for carpal tunnel syndrome, 138 (28.4%) for normal, 54 (11.1%) for polyneuropathy, 52 (10.7%) for peroneal neuropathy, 40 (8.2%) for brachial plexopathy, 39 (8.0%) for ulnar entrapment neuropathy and 16 (3.3%) for others.

When the consistency between the referral diagnoses and post-ENMG diagnoses ratio were examined; the

concordance ratio was found to be 78.8% (n=52) for peroneal neuropathy, 70.6% (n = 36) for brachial plexopathy, 68.1% (n=147) for carpal tunnel syndrome, 58.7% (n=44) for polyneuropathy and 50% (n=39) for ulnar entrapment neuropathy. The compliance rate was 65.4% (n=318) in all patients (Table 1).

Table 1: Concordance of clinical preliminary diagnosis and ENMG diagnosis

Clinic	Diagnosis	Number of requests (n=486)		Confirmed with ENMG (n=318)		Unconfirmed with ENMG (n=168)	
		n	%	N	%	n	%
Orthopedy	Ulnar entrapment neuropathy	33	19.3	12	36.4	21	63.6
	Carpal tunnel syndrome	66	38.6	42	63.6	24	36.4
	Brachial plexopathy	24	14.0	15	62.5	9	37.5
	Polyneuropathy	27	15.8	9	33.3	18	66.7
	Peroneal neuropathy	21	12.3	18	85.7	3	14.3
	Total of Clinic	171	100.0	96	56.1	75	43.9
Neurology	Ulnar entrapment neuropathy	18	11.5	15	83.3	3	16.7
	Carpal tunnel syndrome	81	51.9	60	74.1	21	25.9
	Brachial plexopathy	12	7.7	12	100.0	0	0.0
	Polyneuropathy	21	13.5	14	66.7	7	33.3
	Peroneal neuropathy	24	15.4	18	75.0	6	25.0
	Total of Clinic	156	100.0	119	76.3	37	23.7
Physical Medicine and Rehabilitation	Ulnar entrapment neuropathy	27	17.0	12	44.4	15	55.6
	Carpal tunnel syndrome	69	43.4	45	65.2	24	34.8
	Brachial plexopathy	15	9.4	9	60.0	6	40.0
	Polyneuropathy	27	17.0	21	77.8	6	22.2
	Peroneal neuropathy	21	13.2	16	76.2	5	23.8
	Total of Clinic	159	100.0	103	64.8	56	35.2
Total	Peroneal neuropathy	66	13.6	52	78.8	14	21.2
	Brachial plexopathy	51	10.5	36	70.6	15	29.4
	Carpal tunnel syndrome	216	44.4	147	68.1	69	31.9
	Polyneuropathy	75	15.4	44	58.7	31	41.3
	Ulnar entrapment neuropathy	78	16.0	39	50.0	39	50.0
	Total	486	100.0	318	65.4	168	34.6

As a result of the Cohen's Kappa test, the total (κ) correlation between clinical preliminary diagnoses and post-ENMG diagnoses were found to be 0.574 (p<0.001). These findings demonstrated a moderate (0.41-0.60) concordance.

When examined according to the clinics, compliance value (κ) was found to be 0.484 (p<0.001) for the orthopedic clinic (n=171) and 0.571 (p<0.001) for the physical therapy and rehabilitation clinic (n=159). It was observed a moderate concordance between referral diagnosis and post-ENMG diagnosis in these two clinics. As for ENMG requests of patients in the neurology clinic (n=156), compliance value (κ) was found to be 0.685 (p<0.001) between referral diagnosis and ENMG diagnosis. According to these findings, it was observed a concordance (0.41-0.60) at good level (Table 2).

Table 2: Concordance of referral diagnosis and post-ENMG diagnosis according to Cohen's Kappa Test

Clinic	Diagnosis	ENMG Diagnosis (1)	(2)	(3)	(4)	(5)	Other	Normal	Total	Cohen's Kappa Test	P
Orthopedic	Ulnar entrapment neuropathy (1)	12	0	4	0	0	5	12	33		
	Carpal tunnel syndrome (2)	0	42	0	3	0	0	21	66		
	Brachial plexopathy (3)	0	0	15	0	0	3	6	24	0.484	<0.001
	Polyneuropathy (4)	0	0	0	9	0	0	18	27		
	Peroneal neuropathy (5)	0	0	0	3	18	0	0	21		
	Total of Clinic	12	42	19	15	18	8	57	171		
Neurology	Ulnar entrapment neuropathy (1)	15	0	0	0	0	0	3	18		
	Carpal tunnel syndrome (2)	0	60	0	1	0	2	18	81		
	Brachial plexopathy (3)	0	0	12	0	0	0	0	12	0.685	<0.001
	Polyneuropathy (4)	0	0	0	14	0	0	7	21		
	Peroneal neuropathy (5)	0	0	0	0	18	3	3	24		
	Total of Clinic	15	60	12	15	18	5	31	156		
Physical Medicine and Rehabilitation	Ulnar entrapment neuropathy (1)	12	0	0	0	0	1	14	27		
	Carpal tunnel syndrome (2)	0	45	0	3	0	0	21	69		
	Brachial plexopathy (3)	0	0	9	0	0	0	6	15	0.571	<0.001
	Polyneuropathy (4)	0	0	0	21	0	0	6	27		
	Peroneal neuropathy (5)	0	0	0	0	16	2	3	21		
	Total of Clinic	12	45	9	24	16	3	50	159		
Total	Ulnar entrapment neuropathy (1)	39	0	4	0	0	6	29	78		
	Carpal tunnel syndrome (2)	0	147	0	7	0	2	60	216		
	Brachial plexopathy (3)	0	0	36	0	0	3	12	51	0.574	<0.001
	Polyneuropathy (4)	0	0	0	44	0	0	31	75		
	Peroneal neuropathy (5)	0	0	0	3	52	5	6	66		
	Total of Clinic	39	147	40	54	52	16	138	486		

Discussion

According to our results, 35.2% (n=171) of the referral diagnosis were requested by orthopedics, 32.7% (n=159) by physical therapy and rehabilitation and 32.1% (n=156) by neurology clinics. The referral diagnosis of the ENMG request was existed; carpal tunnel syndrome in 216 (44.4%), ulnar entrapment neuropathy in 78 (16.0%), polyneuropathy in 75 (15.4%), peroneal neuropathy in 66 (13.6%) and brachial plexopathy in 51 (10.5%). The highest ratio of carpal tunnel syndrome was found to be compatible and 44.4% ratio was similar with the literature. Otherwise, post-ENMG diagnosis were found to be 30.2% for carpal tunnel syndrome, 11.1% for polyneuropathy, 10.7% for peroneal neuropathy, 8.2% for brachial plexopathy, 8.0% for ulnar entrapment neuropathy and 3.3% for others. According to these findings the highest ratio was found to be in carpal tunnel syndrome, and it was in a line with the literature. Even so, this ratio was lower than the previous studies [1,4,8].

Frequency sequence of other referral diagnosis was found to be generally different from the literature. For example, ulnar entrapment neuropathy was found to be second and polyneuropathy was found to be third common in our study while polyneuropathy was found to be second and ulnar entrapment neuropathy was found to be fourth common in study which was carried out by Okuyucu et al [1] and Türkel et al [4]. In addition, in our study the ratio of polyneuropathy was found to be 15.4% in referral diagnosis which was higher than the ratios of Atalay et al [8] (8.3%) and Ustaömer et al [7] (14%). Also, in this study the ratio of polyneuropathy was found to be lower when compared to the ratios of Okuyucu et al [1] and Türkel et al [4], which were reported 17.1% and 27.7% in these studies, respectively.

The ratio of ulnar entrapment neuropathy was 16% within referral diagnosis in this study. This ratio was higher when compared to previous studies carried out by Okuyucu et al [1], Türkel et al [4] and Atalay et al [8]. The ratios were reported 7.3%, 6.6% and 9.5% in these studies, respectively.

When the consistency between the preliminary diagnosis and post-ENMG diagnosis was examined; 65.4% of the results were found to be compatible. Although, this ratio was found to be in a parallel way with the literature, it was also higher than the results of previous studies [1,4,7,8].

When the consistency between the referral diagnoses and the reported diagnoses post- ENMG ratio was examined; the concordance ratio was found to be 78.8% for peroneal neuropathy, 70.6% for brachial plexopathy, 68,1% for carpal tunnel syndrome, 58,7% for polyneuropathy and 50% for ulnar entrapment neuropathy. According to the clinics; 76.3% of the requests sent by the neurology clinic and 64.8% of the requests sent by the physical therapy and rehabilitation clinic, 56.1% of the requests sent by the orthopedics clinic were confirmed by ENMG.

As a result of the Cohen's Kappa test, which excludes the chance factor, the total (κ) correlation between clinical preliminary diagnoses and ENMG diagnoses was found to be 0.574 (p<0.001). This demonstrated a moderate (0.41-0.60) concordance. When examined according to the clinics,

compliance values were found to be 0.484 (p<0.001) for the orthopedic clinic, 0.571 for the physical therapy and rehabilitation clinic (p<0.001) and 0.685 (p<0.001) for the neurology clinic. These findings demonstrated a good level concordance between referral diagnosis and ENMG in neurology clinic, and also showed moderate levels in other clinics.

In conclusion, our results confirmed that ENMG is an extension of neurological examination. Especially, the ratio as a 76.3% and Kappa value as a 0.65 was found in this study and these findings supported a good level concordance between referral diagnosis and ENMG in neurology clinic. However, in this study it was also found to be 23.7% for inconsistency Kappa value. This relatively low Kappa value demonstrated the inconsistency which is not underestimate and necessity of its shortened. We believe that it can be increased by taking precautions such as taking the detailed medical history and physical examination of the patients.

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