



Pain levels of examined muscles and gender differences in pain during electromyography

Elektromiyografi sırasında incelenen kasların ağrı düzeyleri ve ağrıda cinsiyet farkları

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Summary

Objectives: The aim of this study was to evaluate the pain level of each muscle during an EMG study and also search for any association between the pain levels and gender.

Methods: Two hundred and twenty-seven subjects (166 females and 111 males) participated in the present study. Numeric analogue scale (NAS) was obtained from the patients after needle EMG for each muscle.

Results: In total, 1242 muscles were examined. The highest pain levels among examined muscles were found on Abductor Pollicis Brevis (APB) (5.8 ± 2.6), First Dorsal Interosseous (4.2 ± 2.6) and Vastus Lateralis (4.0 ± 2.6). NAS levels of the female patients (4.3 ± 2.7) were apparently higher than those of the male patients (2.8 ± 2.3) ($p < 0.01$).

Conclusion: First Dorsal Interosseous muscle was found less painful than APB muscle for the patients. Our study displayed greater pain sensitivity among females compared with males during the needle EMG; however, the pain levels of examined muscles were not higher than moderate for both genders.

Key words: Electromyography; EMG; muscle; needle EMG; pain perception.

Özet

Amaç: Bu çalışmanın amacı EMG incelemesi sırasında kaslardaki ağrı düzeylerini değerlendirmek ve ayrıca cinsiyet ile ağrı düzeyleri arasındaki ilişkiyi araştırmaktır.

Gereç ve Yöntem: İki yüz yirmi yedi olgu (166 kadın, 111 erkek) çalışmaya katıldı. Numerik analog skala (NAS)'sı her kas için iğne EMG'si sonrasında öğrenildi.

Bulgular: Toplamda 1242 kas incelendi. İncelenen kaslar arasında en yüksek NAS düzeyleri Abduktör Pollis Brevis (APB) (5.8 ± 2.6), 1. Dorsal Interosseöz (4.2 ± 2.6) ve Vastus Lateralis (4.0 ± 2.6) kaslarında bulundu. Kadın hastaların NAS düzeyleri (4.3 ± 2.7) erkek hastaların NAS düzeylerinden (2.8 ± 2.3) belirgin olarak yüksekti ($p < 0.01$).

Sonuç: Hastalar için 1. Dorsal Interosseöz kası APB kasından daha az ağrılı bulundu. Çalışmamız kadınların iğne EMG'de erkeklere kıyasla daha yüksek ağrı düzeyleri bildirdiğini, ancak her iki cinsde de incelenen kaslarda ağrı düzeylerinin ortadan daha yüksek olmadığını ortaya koymuştur.

Anahtar sözcükler: Elektromiyografi; EMG; kas; iğne EMG; ağrı algısı.

Introduction

Electromyography (EMG) is a painful examination which is widely used to evaluate peripheral nervous system lesions. An association has been noted between EMG-induced pain and female gender,^[1-5] pre-test pain level,^[3] EMG-related anxiety,^[3,6] inef-

fective coping strategies,^[3] specific muscles^[2] and the type of recording electrodes for needle EMG,^[5,7-9] while no relationship has been established between pain and race, level of education, number of examined muscles, or characteristics of the examiner.^[2,3]

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We observed that the pain tolerance of patients differs from patient to patient and from muscle to muscle in the same patient. Our aim was to evaluate the pain level of each muscle during EMG and search for any association between the pain levels and gender.

Materials and Methods

The present study was approved by the Acıbadem University Medical Committee on Clinical Investigation. Written informed consent was obtained from all subjects prior to enrolment in the study. The subjects were adult patients who received a diagnosis of entrapment neuropathy or radiculopathy between June 2011 and February 2012 and were subsequently referred to the EMG laboratory at Acıbadem University. Exclusion criteria included individuals who were seriously ill, displayed impaired consciousness, were illiterate, with previous history of EMG, were diagnosed with polyneuropathy or were currently taking medications that affect pain, such as non-steroidal anti-inflammatory or antidepressant medications. The age, height, and weight of participants were recorded.

Verbal and written information about the EMG procedure was provided to all subjects. Numeric analogue scales (NAS) ranging from 0 cm (i.e., no pain) to 10 cm (i.e., worst pain imaginable) was used to measure pain. NAS measurements were obtained from the patients before electrophysiological examination (baseline pain) and after needle EMG for each muscle. The needle EMG was done by three examiners depending on referral diagnosis. The muscles were carried out from proximal to distal by needle EMG on an upper extremity, while the muscles were exa-

mined from distal to proximal on a lower extremity. The type of disposable concentric needle electrodes and needle movement techniques were consistent across examiners (i.e., 0.46 mm in diameter and 37 mm in length; Medelec, Oxford Instruments, Surrey, UK, catalogue number: X53156). The required needle movements were 0.5-1 cm, which resulted in an EMG burst of 300-500 ms in normal muscle. A needle electrode was inserted into four different regions of muscle through one skin insertion site. Three successive depths were sampled for each along each side of a pyramid.^[10] Examiners rehearsed in order to standardize their technique before the study began. The total number of muscles tested with needle EMG was recorded. Facial and trunk muscles were not evaluated. The EMG procedure took approximately 20-30 minutes for each patient. At least three muscles were examined in each patient.

Means and standard deviations were calculated for each variable. ANOVA was used for comparison of muscles' NAS levels and to determine variation among the investigators. Extensor digitorum brevis (EDB) muscle NAS levels were not included statistical analysis because of insufficient number of patients. The level of significance was set at $p < 0.05$.

Results

Two hundred and seventy-seven subjects (166 females and 111 males) participated in the present study. The subjects were 18-75-years-old, with a mean age of 40.6 ± 12.8 . Patients' height, and weight were 169.4 ± 9.3 cm (range: 150-210 cm), 72.9 ± 15.0 kg (range: 45-125 kg), respectively. The subjects' referral diagnoses included entrapment neuropathy

Table 1. Pain levels of examined muscles

Upper extremity muscles	NAS \pm SD	Lower extremity muscles	NAS \pm SD
Deltoid (n=168)	2.7 \pm 2.4	Tibialis anterior (n=97)	3.2 \pm 2.5
Biceps (n=185)	3.5 \pm 2.6	Gastrocnemius-med (n=97)	3.8 \pm 2.7
Triceps (n=177)	3.9 \pm 2.6	Vastus lateralis (n=88)	4.0 \pm 2.6
Brachioradialis (n=96)	3.5 \pm 2.6	Vastus medialis (n=76)	3.8 \pm 3.0
Extensor digitorum communis (n=85)	3.7 \pm 2.6	Rectus femoris (n=73)	3.2 \pm 2.7
Flexor carpi radialis (n=86)	3.6 \pm 2.6	Iliopsoas (n=60)	2.9 \pm 2.4
First dorsal interosseous (n=177)	4.2 \pm 2.6	Tensor fascia lata (n=52)	2.3 \pm 2.4
Abductor pollicis brevis (n=110)	5.8 \pm 2.6	Extensor digitorum brevis* (n=12)	5.1 \pm 2.4

NAS: Numeric Analogue Scale; SD: Standard deviation; *NAS levels of EDB were not included statistical analysis due to insufficient number of patients.

(N=117) and radiculopathy (N=110). Eighty patients had lower extremity procedures, 177 patients had upper extremity procedures, and 20 patients had both. The results of the EMG studies were normal in 132 patients, while 145 patients had abnormal EMG results.

Baseline pain levels of patients were 1.2 ± 2.4 . Three investigators were examined 1242 muscles (muscles number of female $n=687$, and male $n=555$). NAS levels of the muscles are demonstrated in Table 1.

Abductor pollicis brevis (APB) muscle had the highest pain level (5.8 ± 2.6) amongst all upper and lower extremity muscles. Abductor pollicis brevis muscle had a significant higher NAS level compared to deltoid muscle ($p < 0.01$, $df=50$). NAS level of first dorsal interosseous (FDI) muscle was also higher than deltoid ($p < 0.01$, $df=167$) like APB. The pain levels of two distal muscles (APB vs. FDI) showed statistical difference ($p < 0.01$, $df=801$). NAS levels of EDB muscle were the highest of lower extremity muscles; however, EDB muscle was not included statistical analysis because of insufficient number. There was no difference among the NAS levels of vastus lateralis, vastus medialis and rectus femoris muscles, which were femoral nerve innervated muscles.

The NAS levels of female patients (4.3 ± 2.7) were apparently higher than the male patients (2.8 ± 2.3) ($p=0.00$). NAS levels of muscles obtained from patients by three different examiners were not showed statistically difference ($p=0.33$).

Discussion

Although the pain during EMG is generally tolerable, electromyographers usually observe that the amount of experienced pain depends on the examined muscles. In this study, pain levels of both upper and lower extremities' muscles were lower than moderate, so these findings are associated with our observations in daily practice.

In this study, the most painful muscles were APB and EDB, which often are not selected by examiners, because they are painful and some denervation may be seen in normal subjects without symptoms.^[11] They are both distal muscles, although EDB muscle were

not included statistical analysis due to insufficient number of patients, it seems that distal muscles are more painful than proximal ones (deltoid vs. APB and FDI). This study showed significant statistical differences between APB and FDI muscles' pain levels. NAS levels of APB muscle were higher than FDI muscle and also moderate level. This finding could be important in muscle selection while doing EMG for upper extremity radiculopathies. The reason that the hand and foot muscles are more painful than proximal ones might be that they are too small and the probability for needle electrode coming close to any motor end-plate zone could be increased. Another explanation of different pain levels of the body parts could be the peripheral nociceptor density of hands and feet. Depending on the type of nociceptor activated, pain-related information conveys to spinal cord and makes synaptic connections within eight distinct laminae of dorsal horn. It has been known that pain was not processed in a single cortical area, but in several distributed brain regions.^[12,13] Neuroimaging studies showed that the cortical and subcortical brain areas activated by nociceptive stimulation includes: anterior cingulate cortex, insula, frontal cortices, primary somatosensory cortex and second somatosensory cortex^[14] and are often referred as the pain matrix.^[15] It is well-known that foot and hands have a larger representation space in the motor and somatosensory homunculus. That might be the possible cause that hand and foot areas which have larger representation in pain matrix than others and since they are more painful compared to other muscles.

Studies have shown that women use more health care services than men,^[16-18] moreover a number of studies have demonstrated a higher prevalence of chronic pain states and greater pain sensitivity among women compared with men.^[2,3,19,20] In our data is consistent with previous studies^[2,3] and indicated greater pain levels among females compared with males.

In conclusion, the pain perceived by the patients during EMG of extremity muscles was not higher than moderate except for APB. Comparison of two distal muscles of upper extremity regarding pair showed that selecting FDI was less painful for the patient. As expected females' pain levels were greater

than males. These findings might give practical and beneficial insight to the physician, who informs the patient about EMG.

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