Expected and Experienced Pain Levels in Electromyography

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ABSTRACT

Introduction: The aim of the present study was to assess pain using a visual analogue scale (VAS) in patients awaiting an EMG procedure (i.e., expected VAS) and after an EMG procedure (i.e., experienced VAS).

Methods: Expected and experienced pain in response to nerve conduction studies (NCS) and needle EMG were assessed in 108 patients (61 females, 47 males; mean age 43.2±11.6) using a VAS.

Results: No significant correlations were noted between the expected or the experienced VAS in response to EMG and demographic features of the patients. The expected VAS was significantly higher than the experienced VAS in response to needle EMG (p=0.005). The lowest VAS level was noted in the experienced VAS in response to NCS (3.6±2.5).

Conclusion: The present study demonstrated that neither the expected nor the experienced pain associated with EMG exceeded a moderate level. Interestingly, we found that expected pain levels in response to needle EMG were significantly higher than experienced pain levels. Therefore, it may be possible to increase compliance if patients are provided with this information before undergoing electrophysiological procedures. (Archives of Neuropsychiatry 2013; 50: 364-367)

Key words: Electromyography, EMG, pain, nerve conduction studies, needle EMG

Conflict of interest: The authors reported no conflict of interest related to this article.

Introduction

Electromyography (EMG) is used to evaluate peripheral nervous system lesions. Pain is commonly associated with EMG, because the procedure involves the use of needles and electric shock. Not only friends and relatives who have had a previous EMG experience, but also physicians can sometimes discourage patients from undergoing EMG, believing that the test is very painful and of little benefit (1).

Previous studies have focused on the perceived pain associated with EMG, however, no relationships have been established between pain and race, level of education, anxiety, number of muscles examined, or the characteristics of the examiner (2,3). An association has been noted between EMG-induced pain and female gender (2,3,4,5), pre-test pain level (3), EMG-related anxiety (3,6), ineffective coping strategies (3), specific muscles (2), and the type of recording electrodes used for needle EMG (5, 8,9,10).

The visual analogue scale (VAS) is a response scale commonly used in pain research. Previous studies have demonstrated the reliability and validity of the VAS in the measurement of pain (11). A patient’s expectation of EMG-related pain is associated with
his/her anxiety about the procedure (6). Previous studies have evaluated pre-test and post-test pain perception in relation to EMG, however, expected and experienced pain levels have not previously been reported. The aim of the present study was to assess pain levels in patients before (expected VAS) and after (experienced VAS) an EMG procedure. We hypothesized that expected VAS levels would be higher than experienced VAS levels in response to nerve conduction studies (NCS) and needle EMG. Moreover, we predicted that expected and experienced VAS levels in response to needle EMG would be significantly higher than VAS levels in response to NCS.

**Methods**

The present study was approved by the Local Medical Committee on Clinical Investigation (2010/137). Written informed consent was obtained from all subjects before enrolment in the study. The subjects were adult patients who received a diagnosis of entrapment neuropathy or radiculopathy between January 2010 and June 2010 and were subsequently referred to the EMG laboratory at Acıbadem University. Individuals, who were seriously ill, displayed impaired consciousness, were illiterate, previously had an EMG, were diagnosed with polyneuropathy, or were currently taking medications affecting pain, including non-steroidal anti-inflammatory or antidepressant medications were excluded from the study. The participants completed a self-administered questionnaire which included information on age, height, weight, and educational level. Body mass index (BMI) was calculated as weight divided by height squared (kg/m²).

Verbal and written information about the EMG procedure was supplied to all subjects. VASs ranging from 0 cm (i.e., no pain) to 10 cm (i.e., worst pain imaginable) were used to measure pain. VAS measurements were obtained from patients before and after the procedures. The expected pain levels related to NCS and needle EMG were measured on two different VAS scales before the study. Experienced pain levels were measured immediately after the procedure. Two different pages were used for the expected and experienced VAS levels in an effort to avoid prejudice. In total, four VAS levels were measured for each subject.

NCS and needle EMG procedures were performed by one of three examiners: PYD, who examined 46 patients, GK, who examined 22 patients, and ELA, who examined 40 patients. A Medelec Synergy EMG machine was used. NCS recordings were obtained with standard bipolar surface electrodes. A skin temperature of 32 °C was maintained on the sole of the foot and on the back of the hand. Disposable concentric needle electrodes (CNE) which were 0.46 mm in diameter and 37 mm in length (Medelec, Oxford Instruments, Survey, UK, catalogue number: X53156) were consistent across examiners, as were needle movement techniques. The required needle movements were 0.5-1 cm, which resulted in an EMG burst of 300-500 ms in an normal muscle (8). A needle electrode was inserted into four different regions of the muscle through one skin insertion site. Three successive depths were sampled for each along each side of a pyramid (9). Examiners rehearsed the procedure 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. Needle EMG was not performed on subjects who were diagnosed with carpal tunnel syndrome. The EMG procedure took approximately 20-30 minutes for each patient.

Data are expressed as mean±standard deviation (SD). Means and standard deviations were calculated for each variable. Multiple regression analysis was used to calculate the correlations of age, sex, height, weight, BMI, location, referral diagnosis with the four VAS levels. VAS measurements were analyzed with two-tailed t-tests. The ANOVA was performed to determine the degree of variation between the investigators. All statistical analyses were performed using SPSS 17.0. The level of significance was set at p<0.05.

**Results**

One hundred and eight subjects (61 females and 47 males) participated in the present study. The subjects were 23-71 years old, with a mean age of 43.2±11.6. Patients' height, weight and BMI were 168.7±9.9 cm (range: 150-206 cm), 74.6±15.0 kg (range: 45-120 kg), and 26.1±4.0 kg/m² (range: 16.8-36.4 kg/m²), respectively. The subjects included 68 university graduates, 28 high school graduates and 16 elementary school graduates. The patients' diagnoses included entrapment neuropathy (n=51) and radiculopathy (n=57). Seventy patients had upper extremity procedures, 31 had lower extremity procedures, and 7 had both. NCS were performed on all patients, and needle EMG procedures were performed on 78 patients (72%) using CNE. The number of muscles tested per patient ranged from 1 to 8, with a mean of 6 muscles. Proximal (52%) and distal (48%) muscles were examined (Table 1).

No correlations were noted between expected (NCS/needle EMG) or experienced (NCS/needle EMG) VAS measurements and age, sex, height, weight, BMI, education, location, or referral diagnosis. Moreover, no correlations were noted between the number of muscles tested and post-needle EMG VAS levels (p=0.922). Post-hoc multiple comparisons were performed to assess differences between the investigators in pre- and post-EMG VAS measurements.

| Table 1. Examined muscles of upper and lower extremity
<table>
<thead>
<tr>
<th><strong>Proximal muscles</strong></th>
<th><strong>Distal muscles</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deltoid-medial head</td>
<td>Brachioradialis</td>
</tr>
<tr>
<td>Biceps brachii</td>
<td>Flexor carpi radialis</td>
</tr>
<tr>
<td>Triceps</td>
<td>Extensor digitorum communis</td>
</tr>
<tr>
<td>Iliopsoas</td>
<td>Flexor carpi ulnaris</td>
</tr>
<tr>
<td>Tensor facia lata</td>
<td>First dorsal interosseous</td>
</tr>
<tr>
<td>Rectus femoris</td>
<td>Tibialis anterior</td>
</tr>
<tr>
<td>Vastus lateralis</td>
<td>Peroneus longus</td>
</tr>
<tr>
<td>Vastus medialis</td>
<td>Gastrocnemius medial head</td>
</tr>
</tbody>
</table>
Table 2. Pre- and post-EMG VAS measurements and pre/post- EMG VAS comparisons

<table>
<thead>
<tr>
<th>VAS time</th>
<th>Mean VAS ± SD</th>
<th>Paired samples</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre NCS (n=108)</td>
<td>4.0±2.1</td>
<td>Pre and post NCS</td>
<td>0.122</td>
</tr>
<tr>
<td>Post NCS (n=108)</td>
<td>3.6±2.5</td>
<td>Pre and post nEMG</td>
<td>0.005*</td>
</tr>
<tr>
<td>Pre nEMG (n=78)</td>
<td>4.7±2.2</td>
<td>Pre NCS/ pre nEMG</td>
<td>0.01*</td>
</tr>
<tr>
<td>Post nEMG (n=78)</td>
<td>3.8±2.8</td>
<td>Post NCS/ post nEMG</td>
<td>0.311</td>
</tr>
</tbody>
</table>

VAS: visual analogue scale, N: number of subjects, NCS: nerve conduction study, nEMG: Needle Electromyography, SD: Standard deviation. * = p < 0.05.

Table 2 shows pre- and post-EMG VAS measurements. Mean VAS levels for NCS or needle EMG did not exceed a moderate level (3.6-4.7). Expected VAS levels were not statistically different from experienced VAS levels for NCS (p=0.122) (Table 2). Expected VAS levels were significantly higher than experienced VAS levels for needle EMG (p=0.005). Not surprisingly, patients anticipated more pain during the needle EMG than during NCS (p=0.01).

Discussion

The present study determined that neither the expected nor the experienced pain associated with EMG exceeded a moderate level (13). Kothari and colleagues (1) reported that although many patients were worried about the procedure, the experience was better than expected for 82% of patients. This was also true for our study; the expected pain levels were higher than the experienced pain levels for both NCS and needle EMG. The present study should allow physicians to reconsider warnings related to pain during EMG.

Several previous studies have attempted to discern variables predicting EMG-related pain (2-6). In the present study, no associations were noted between NCS and needle EMG VAS levels and gender, age, height, weight, BMI, educational level, upper or lower extremity studies, or referral diagnosis. Gender is often a confounding factor in pain studies, as females report more pain than males do (14). Moreover, females experience more pain during EMG (2,3,5) and are liable to more pain than males (15,16,17). Sixty-one female (56.5%) and 47 male (43.5%) subjects participated in the present study. Strommen and Daube (7) reported that gender did not predict the amount of pain associated with needle EMG. Our results are consistent with this study. Age was not an important factor in the present study, which is consistent with two previous studies (2,18). Moreover, our data suggest that expected and experienced pain levels are not associated with the examiner or the number of muscles being tested. In the present study, the type of CNE and the needle techniques used were consistent across subjects, since these are major determinants of pain during EMG (7). Small needle movements are less painful than large needle movements associated with standard insertion techniques (7).

Moderate pain intensity was noted in the four VAS measurements (13). In the present study, the highest VAS level was for the expected VAS measurement associated with needle EMG (4.7±2.2). The lowest VAS level was for the experienced VAS measurement in response to NCS (3.6±2.5). We imagined that the expected VAS levels for NCS and needle EMG would be higher than the experienced VAS levels. The expected and experienced VAS levels associated with needle EMG were, however, the only statistically significant differences noted (p=0.005). This may be related to needle phobia, a specific phobia, blood-injection injury subtype (19) in the DSM-4. Needle phobia has serious health, psychological, social, and physiological consequences. One study estimates that at least 10% of American adults have a phobia of needles (20). This may even be an underestimate, as individuals with the most severe needle phobia are likely to avoid all medical treatment. We found that experienced pain levels in association with needle EMG were significantly lower than expected pain levels.

Moreover, expected and experienced VAS levels for needle EMG were significantly higher than those for NCS (p=0.01). Gans and Kraft (2) reported that NCS was more uncomfortable for patients than needle EMG, however, this finding is not consistent with the present study.

The present study has some methodological advantages, including its value of a prospective design, the fact that a sufficient sample size was used to reduce the possibility of Type I error, and the use of a self-report instrument which is verified as valid and is more sensitive than pain descriptors (21,22). However, the present study also has several limitations. First, though pain levels in proximal and distal muscles may be different, such differences were not evaluated in this study. The percentage of proximal muscles (52%) was almost equal to the percentage of distal (48%) muscles examined in this study. Moreover, the baseline pain levels in the patients were not evaluated before the study, and the VAS levels were not assessed for each individual muscle. The education level was relatively high in this series of patients and this may have confounded our results. Finally, each subject’s past pain experiences and tolerance to pain, which are important determinants of pain perception, were not evaluated.

Pain experienced during EMG procedures may lead to incomplete, unsatisfactory and inconclusive results. Taken together, the results of the present study show that expected and experienced pain levels associated with EMG procedures are generally moderate. As expected, needle EMG is more painful than NCS. An important finding was that the expected pain levels associated with EMG were significantly higher than the experienced pain levels. Therefore, increased compliance may be achieved if patients are provided with this information before electrophysiological procedures.
References


