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ORIGINAL ARTICLE

Altering Electromyography Studies: Importance of the Electromyographer's Perception of Patient Pain

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Abstract

Objective: To determine the relation between the patient's actual pain, the electromyographer's perception of patient pain, and whether an electromyogram (EMG) is altered.

Design: Patients undergoing electromyography reported expected pain and procedure-related overall pain on a 100-mm visual analog scale (VAS). Blinded electromyographers estimated patient pain levels and indicated if they altered the study in any way because of this perception. Multivariable logistic regression was used to determine predictors of altering the EMG. Paired *t* tests were used to compare overall pain with expected pain and electromyographer perception of pain.

Setting: Tertiary referral center.

Participants: Referred sample of adult subjects (N = 304).

Interventions: Not applicable.

Main Outcome Measures: Patient pain, electromyographer perception of patient pain, and whether an EMG was altered because of the electromyographer's perception of patient pain.

Results: Mean VAS scores ± SD were 48±25mm for patient-expected pain ($P<.001$), 42±24mm for electromyographer perception of pain ($P<.0001$), and 36±25mm for actual overall pain. Electromyographers altered their study 31.7% of the time because of concerns about pain. For every 13-mm increase on the VAS (a prespecified clinically meaningful difference), the electromyographer perception of pain increased the odds of altering a study 2.36 times (95% confidence interval [CI], 1.71−3.26), whereas patient overall pain did not have a significant effect (odds ratio = 1.12; 95% CI, .86−1.47).

Conclusions: Patients expect EMGs to be more painful than they are. Electromyographers overestimate patient pain and are more likely to alter their studies when they believe patients are experiencing more pain, independently of whether patients actually have more pain. Improving the communication between electromyographers and patients may prevent unnecessary alterations.

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The most appropriate use of electromyography is as an extension of patient history and examination. The electromyographer must study the correct muscles to address the diagnoses in question, and study each muscle for long enough to identify relevant abnormalities.[1]

Pain is a common cause of incomplete or inconclusive electromyography studies.[2-8] Of surveyed electromyographers, 60.1% reported altering >10% of their needle examinations because of the perception of patient pain.[9] In doing so, electromyographers choose to disregard their own judgment about what constitutes an appropriate and complete study, potentially reducing the diagnostic accuracy of the test. Prior studies have suggested that needle electromyography is less painful than patients expect, and most patients undergoing electromyography would be willing to have the test performed again.[10] On the other hand, electromyographers have been shown to underestimate the pain that patients are experiencing.[11]

We sought to explore how patient-reported electromyography pain compares with patient-expected pain and the electromyographer's perception of pain, how often studies are altered because of pain, and whether patient demographics or different measures of pain predict whether a study will be altered.

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Methods

Adult subjects undergoing electromyography at an academic institution were recruited to participate. Patients with severely impaired vision or cognition were excluded.

All patients and electromyographers provided informed consent. The study was approved by the institutional review board of the University of Michigan Health System.

Prior to the study, patients filled out a demographic survey that included the following patient-level characteristics: age, sex, baseline pain (ie, how much pain they were experiencing at the time of survey completion, prior to electromyography) and expected level of pain on a visual analog scale (VAS), and whether the patient had ever previously undergone electromyography.

After the study was completed, patients rated their overall pain on a 100-mm VAS.[12,13] Electromyographers, blinded to patient pain ratings, also estimated patient pain levels on a VAS after study completion. Electromyographers documented whether they used active techniques to limit pain, including a simultaneous finger slap next to the insertion site or a minimal insertion technique (~1mm per insertion). Electromyographers indicated if they studied fewer muscles, studied different muscles, or spent less time in some muscles because of their perception of patient pain.

Statistical analysis

Paired *t* tests were used to compare overall pain with expected pain and electromyographer perception of pain. To explore the extent to which the multilevel structure of the data (ie, patients nested within electromyographer) influences the association between overall pain and perception of pain, we first developed an empty model with a random electromyographer-level intercept. The intraclass correlation coefficient was .40 at the electromyographer level, meaning that 40% of the variance explained by the model is explained at the electromyographer level. Multilevel logistic regression was then used to determine predictors of altering the electromyography with a series of covariates (age, sex, whether the patient had previously undergone electromyography, baseline pain, expected pain, patient actual overall pain, electromyographer perception of pain, whether the electromyographer used an active technique to limit pain, and a random electromyographer-level intercept). Two secondary analyses were performed to explore post hoc hypotheses. First, to explore how electromyographer characteristics (level of training, specialty, and years of practice) influence the probability of discontinuing a study, we repeated our primary model by including these covariates. Second, to determine whether having a prior electromyography fundamentally changed the association between patient characteristics and the likelihood of altering a study, we repeated our primary model, stratifying by whether a patient had a prior electromyography. A study was considered to be altered if the electromyographer noted that they changed the study in any way. All analyses were performed with Stata version 12.1.[a]

Results

Three hundred and four patients underwent electromyography. Of the participants, the mean age was 52.7 years, 49.5% were women, and 85.5% were white. Of these, 53.5% had undergone a prior electromyography (table 1). A total of 26 electromyographers participated in the study, of which 54% were trained in neurology and the rest in physical medicine and rehabilitation. Half of the electromyographers were resident physicians.

Table 1 Characteristics of patients

Factor	Value
Age	52.7±14.8
Female	150 (49.5)
Race	
White	259 (85.5)
Black	29 (9.6)
Asian	5 (1.7)
Other	10 (3.3)
Previous electromyography	162 (53.5)
Baseline pain (VAS)	21.6±24.8
Expected pain (VAS)	47.8±24.7

NOTE. Values are mean ± SD or n (%).

The mean baseline pain level ± SD prior to the examination was 22±25mm. The expected pain level ± SD was 48±25mm ($P<.001$ compared with actual pain). The mean actual overall pain ± SD that patients reported after the study was 36±25mm. The mean electromyographer perception of patient pain was 42±24mm ($P<.0001$ compared with actual pain). There was a moderate correlation between electromyographer perception of patient pain and actual patient pain ($r=.58$, $P<.0001$).

Electromyographers altered their study in some way 31.7% of the time because of concerns about pain. Specific ways in which studies were altered included spending less time in some muscles (24.1% of studies), studying fewer muscles (11.2% of studies), and studying different muscles (5.2% of studies).

Table 2 shows the association between various factors and any electromyographer-reported electromyography study alteration. The model was highly predictive (c statistic = .94). For every 13-mm increase on the VAS (a prespecified clinically meaningful difference in individual patients), electromyographer perception of pain increased the odds of altering a study 2.36 times (95% confidence interval, 1.71−3.26).[13-15] When using finger slapping or minimal insertion techniques to limit pain, electromyographers were 6.02 times (95% confidence interval, 1.50−24.13) more likely to alter their studies. The odds of an electromyographer altering the study in any way were not significantly affected by patient overall pain, patient baseline pain, or patient expected pain. The propensity to alter studies was not associated with patient age, sex, or whether the patient had undergone a prior electromyography.

When adding electromyographer characteristics to the model, in a secondary analysis, resident physicians were more likely to alter studies than attending physicians ($P=.03$). The electromyographer's specialty (neurology vs physiatry) and years of electromyography experience did not significantly affect the probability of altering the study.

When stratified by whether or not a patient had undergone prior electromyography, there was no significant change in the association between pain scores (baseline, actual, or electromyographer perception) and the likelihood of studies being altered.

List of abbreviations:

VAS visual analog scale