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WILEY
Perceptions of Pain of Laryngeal Electromyography

Ashley P. O’Connell Ferster, MD; Amanda Hu, MD, FRCSC

Objective: To evaluate pain associated with laryngeal electromyography (LEMG).

Study Design: A prospective case series.

Methods: Adult patients scheduled for LEMG in a tertiary care laryngology practice were recruited between July 20, 2016, and March 1, 2017. Demographic and clinical data were extracted from the charts. Study participants reported their anticipated pain level using a visual analog scale (VAS) prior to the procedure. VAS was administered again within 10 minutes after the procedure, along with the validated McGill Pain Questionnaire, to gauge patient’s pain perception after undergoing LEMG.

Results: Results were reviewed for 80 patients (mean age 48.2 ± 16.6 years, 37.5% male). Preprocedure VAS pain scores (4.59 ± 2.3 out of 10) were not significantly different than postprocedure VAS pain scores (4.61 ± 2.4) (P = 0.95). The McGill Pain Questionnaire reported a moderate pain level (32.1 ± 12.7 out of 78). Females anticipated a higher preprocedure VAS pain score (5.04 ± 2.3) than males (3.85 ± 2.2) (P = 0.02); however, postprocedure scores were not significantly different between genders. The following factors did not influence the pain scores: age, professional voice use, history of previous EMG, chronic pain diagnosis, psychiatric diagnosis, or current treatment with pain/psychiatric medications. All LEMGs were completed without any complications.

Conclusion: Patients appropriately anticipated their pain levels for the LEMG, which may be attributed to proper patient education and counselling before the procedure. Overall pain levels were mild to moderate, and all LEMGs were completed; thus, LEMG was well tolerated.

Key Words: Laryngeal electromyography, procedural pain, McGill pain score, visual analog scale, in-office procedure.

Level of Evidence: 4.

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INTRODUCTION

The field of otolaryngology is one that conducts a wide array of in-office procedures, including laryngeal electromyography. Laryngeal electromyography (LEMG) is a procedure used to assess neurologic disorders of the larynx and to differentiate from other disorders affecting laryngeal function, such as mechanical cricoarytenoid fixation.1 This procedure is performed by placing needle electrodes transcutaneously into individual laryngeal muscles to assess their function.1,2 The use of LEMG varies across the country. Possible uses of LEMG include guidance for injection of botulinum toxin, diagnosis of vocal fold paresis, predicting recovery from acute unilateral vocal fold paralysis/paresis after recurrent laryngeal nerve injury, diagnosis of neuromuscular diseases of the larynx (e.g., myasthenia gravis), and differentiation between central nervous system and behaviorally based laryngeal disorders.

Assessment of the patient’s periprocedural pain experience with in-office procedures such as LEMG has been minimally investigated within the field of otolaryngology. In-office procedures carry the risk of both preprocedure anxiety and discomfort for the patient. Depending on the type of procedure, patients can receive topical or local anesthetic agents to improve their pain and tolerance of the procedure.3,4 Anesthetic agents during the procedures also are used in an effort to suppress the patient’s gag reflex, especially for transoral procedures. Most patients do not require pain medications beyond 24 hours following the procedure, although those undergoing in-office procedures have been reported as taking acetaminophen and/or prescribed narcotics.4 Crawley et al. presented on periprocedural pain with in-office procedures in the field of otolaryngology.5 The available otolaryngology literature on this topic is mostly level of evidence III and IV, with heterogeneous outcome measures. Some studies used validated measures such as the visual analog scale (VAS), but the majority used nonvalidated surveys.5,6 In other fields with frequent in-office procedures, such as dentistry (periodontics), the experience of periprocedural pain is much better studied. For example, the impact of preprocedure anxiety has been shown to be directly correlated with perception of procedural pain in the periodontal literature.7,8

Additional supporting information may be found in the online version of this article.

From the Department of Surgery, Division of Otolaryngology–Head & Neck Surgery, Penn State Health: Milton S. Hershey Medical Center (A.P.O’C.), Hershey; and the Department of Otolaryngology–Head & Neck Surgery, Drexel University College of Medicine, Philadelphia (A.H.), Pennsylvania, U.S.A.

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Send correspondence to Ashley P. O’Connell Ferster, MD, Otolaryngology–Head & Neck Surgery, Penn State Health: Milton S. Hershey Medical Center, 500 University Dr., Hershey, PA 17033. E-mail: ashleyoconn@gmail.com

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Our study's objectives were 1) to evaluate preprocedure, anticipated pain, and postprocedure perceptions of pain in patients undergoing laryngeal electromyography; and 2) to evaluate patient tolerance of the procedure, defined as the patient's ability to endure and complete the procedure. Our hypotheses were that mild to moderate levels of pain are experienced with this procedure and that all LEMGs will be completed. With this study, we hope that this information can be used to counsel our patients, who usually present with much anxiety prior to this procedure.

**MATERIALS AND METHODS**

The study was approved by the medical institutional review board at Drexel University College of Medicine in Philadelphia, Pennsylvania. Adult patients in a tertiary care laryngology practice were recruited for the study between July 20, 2016, and March 1, 2017. All patients already were scheduled for LEMG as part of their standard clinical care in the laryngology clinic. Patients were excluded if they did not speak English. Eight patients were excluded because they were under 18 years of age. Of those qualifying otherwise based on the aforementioned criteria, a total of 16 patients declined participation in the study. Demographic and clinical data were extracted from the charts. The consent process was performed in a standard, informed fashion via written, informed consent by the senior author (A.H.), therefore providing patients with consistent descriptions of all risks, benefits, potential complications, and expectations of the procedure.

Prior to the start of their procedure, patients were asked to complete a preprocedure evaluation. This included completion of the Voice Handicap Index-10 (VHI-10). Patients were also asked to rate the amount of pain that they anticipated to experience during the LEMG using a 10-cm blank VAS, with 0 representing no pain/discomfort and 10 representing the worst imaginable pain (Appendix 1). VAS scores from 0 to 0.4 represent no pain, from 0.5 to 4.4 represent mild pain, from 4.5 to 7.4 represent moderate pain, and from 7.5 to 10 represent severe pain.

LEMG was conducted by the senior author (A.H.) at the Drexel University College of Medicine. In addition to the senior author being present for the procedure, an assistant also was there for the procedure; otherwise, no family members or other companions familiar to the patient were present for the procedure. The procedure was performed in a standard fashion for all patients, using no local anesthesia or sedation. Patients were placed in a supine position with a shoulder roll to extend the neck. Surface or ground electrodes were placed on the clavicle, and an alcohol swab was used to clean the neck. Monopolar needle electrodes were placed transcutaneously at the anterior neck and inserted into the laryngeal musculature, including the bilateral cricothyroid muscles, bilateral posterior cricoarytenoid muscles, and bilateral thyroarytenoid muscles. Each of the aforementioned muscles was tested in each patient included in the study. Needles were placed while instructing the patient to phonate or sniff to assess neuromuscular function. A detailed description of the procedure can be found in a previous publication.

Within 10 minutes after the procedure, patients were asked to complete the VAS once again but this time rating the pain/discomfort they actually experienced during the LEMG. In addition to the VAS, patients also completed the McGill pain questionnaire, a validated, internationally accepted questionnaire used to assess patient's perception of pain, with higher scores indicating higher pain levels. Scores for the pre- and postprocedure surveys were recorded.

Statistical analysis was performed with commercial software (Excel 2010; Microsoft Corporation, Redmond, WA). Descriptive measurements were calculated (e.g., means, standard deviations [SD]). Pre- and postprocedure VAS scores were analyzed and found to be normally distributed (Figs. 1 and 2). Two-tailed paired Student t test with an a priori probability level of 0.05 was performed for categorical variables. Each patient acted as their own control. Correlation coefficients were calculated to determine the association between two continuous variables. The following variables were investigated to...
determine if they affect the perception of pain: age, gender, professional voice use, history of previous EMG, chronic pain diagnosis, psychiatric diagnosis, and current treatment with pain/psychiatric medications.

RESULTS

A total of 80 patients were enrolled in the study (37.5% male, age 48.2 ± 16.6 years). Table I shows the demographic data of the study population. Of these patients, 76 patients had complete data recorded. Four patients incorrectly completed the McGill Pain Questionnaire; therefore, their results were excluded for the McGill Pain Questionnaire analysis only. Referral for LEMG was typically due to patient history of hoarseness. Of the referred patients, 35 patients had findings concerning for vocal fold paresis and/or paralysis on pre-procedure videostroboscopy. Other diagnoses prompting referral for LEMG included concern for paradoxical vocal fold movement (3 patients) and spasmodic dysphonia (2 patients).

Of the study population, 22 patients had a history of anxiety, attention deficit disorder, and/or depression. Twenty-three patients had a history of chronic pain, with arthritis and migraines being the most common chronic pain diagnoses. Twelve patients had undergone an EMG procedure in the past.

Pre- and postprocedure VAS and McGill pain scores are summarized in Table II. Means and SDs of the pre- and postprocedure VAS scores for the total study population were 4.59 ± 2.3 and 4.61 ± 2.4, respectively. Because the total VAS score is out of 10, patients reported moderate amounts of pain for the procedure. There was no significant difference between the pre- and post-VAS scores for the total population (P = 0.95). The McGill pain scores averaged 32.14 ± 12.7 on a scale of 78, representing a mild to moderate level of pain. All of the LEMGs were completed, with none of the procedures aborted, and there were no complications.

The following variables did not affect the pre- or postprocedure VAS and McGill pain scores: age (P = 0.95), professional voice use (P = 0.39), history of previous EMG (P = 0.30), chronic pain diagnosis (P = 0.51), psychiatric diagnosis (P = 0.60), and/or current treatment with pain/psychiatric medications (P = 0.68). The only variable that affected the VAS score was gender. Female patients had a significantly higher preprocedure VAS score (5.04 ± 2.3) than male patients (3.85 ± 2.2) (P = 0.02) (Table II). Both postprocedure VAS (P = 0.12) and McGill pain scores (P = 0.21) were not found to differ significantly between genders. Correlation values were calculated between each pain score. Correlation value for pre- and postprocedure VAS was 0.42. Correlation value for McGill and postprocedure VAS was 0.46.

For the descriptive components of the McGill pain questionnaire, all patients indicated that their pain was experienced at the central neck, which corresponded to the location of the electrode insertion. When asked aggravating and alleviating factors on the McGill pain questionnaire, most patients responded that “insertion of the needles” increased their pain, whereas “removing the needles” relieved their pain. Most common adjectives used to describe the pain were pricking, pinching, and sharp.

DISCUSSION

Laryngeal electromyography for diagnosis of voice disorders has been performed as an adjunct to clinical assessment. Originally described 70 years ago, LEMG increasingly has been used over the last three decades. This procedure requires patient participation because the patient is awake. The patient needs to phonate or sniff for the physician to assess neuromuscular function. Surprisingly, LEMG has not been well assessed for pain and patient tolerance.

Pain is a subjective experience and a multidimensional construct. In 1996, the American Pain Society introduced the concept of “pain as the 5th vital sign” to promote the importance of pain assessments with every

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<th>TABLE I. Demographic Data of the Study Population (n=80).</th>
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<td>Characteristics</td>
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<td>----------------------------------------------------------</td>
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<td>McGill Pain Questionnaire (mean ± SD)</td>
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<th>TABLE II. Pre- and Postprocedure Visual Analog Scale and McGill Pain Scores for Patients Undergoing Laryngeal Electromyography (Mean ± Standard Deviation).</th>
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<td>VAS: preprocedure</td>
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<td>VAS: postprocedure</td>
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<td>McGill pain score</td>
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*Significant P < 0.05.

Table II.

Laryngoscope 128: April 2018 O’Connell Ferster and Hu: Tolerability of Laryngeal Electromyography
patient.\textsuperscript{15,16} With the rise of in-office procedures in otolaryngology, the patient’s experience of pain of the procedure has become of great concern because this often can be the limiting factor in successfully completing the procedure.\textsuperscript{17,18} Pain and tolerance of pulsed dye and CO\textsubscript{2} laser treatments in the upper aerodigestive tract and vocal fold injections previously have been studied, with high tolerance reported by each study.\textsuperscript{4,6,18} Assessment of pain and tolerance for these procedures was performed using a variety of pain scales, including pain scales ranging from 1 to 10 or larger scales ranging from 1 to 100, with the first study using 10 scores to represent minimal discomfort and the other study using 100 scores to represent maximal discomfort.\textsuperscript{3,4,18}

Because patients are awake for the procedures, anxiety and periprocedural pain may differ between in-office laryngologic procedures and those performed under general anesthesia. To our knowledge, however, periprocedural pain and anxiety for laryngologic procedures performed under general anesthesia previously has not been published. Overall, for in-office laryngologic procedures, data supports that patients tolerate such procedures well.

As evident in the aforementioned examples, the use of arbitrary, nonvalidated scales can be quite confusing. To prevent this confusion, we elected to use scales that extensively have been studied in pain management literature. Both the VAS and McGill Pain Questionnaires are standard scales frequently used to monitor and assess pain. VAS has been previously used in the otolaryngology literature to assess pain tolerance for in-office percutaneous laryngoplasty.\textsuperscript{5,6} It has been used in several studies to provide a metric for patient’s anticipated pain from a given procedure in a variety of medical specialties.\textsuperscript{6,7,19–21} It has been found to provide a simple yet standardized technique to measure a patient’s experience, either during an acute procedure and/or over time with the use of serial measurements.\textsuperscript{22} Although it is quite easy to use, it is thought to be best utilized for patients with mild to moderate pain levels because it may have increased error and decreased sensitivity if used for patients with higher pain levels.\textsuperscript{22,23}

The McGill pain questionnaire also was selected for this study. This questionnaire uses four subscales to assess sensory, affective, evaluative, and miscellaneous aspects of pain at a single point in time and often is used to evaluate nociceptive and pain disorders.\textsuperscript{11,24} It has been validated and extensively used in pain assessment and management around the world and is available in 26 different languages.\textsuperscript{24} A known weakness of this assessment, however, is that it involves an understanding of the vocabulary listed in order for patients to accurately complete the questionnaire. Additionally, with multiple steps involved in the questionnaire, it requires that the study subject follow the directions or risk compromising the validity of the questionnaire. We had four patients who incorrectly completed the McGill questionnaire; therefore, their results were excluded.

According to our VAS and McGill questionnaire results, moderate levels of pain were experienced with LEMG, thus confirming our hypothesis. Preprocedure VAS pain scores (4.59 \pm 2.3 out of 10) were not significantly different than postprocedure VAS pain scores (4.61 \pm 2.4) (P = 0.95). Thus, patients were able to anticipate their pain experience quite well, although most patients never before had this procedure. This result may be attributed to the thorough patient education prior to the procedure. Patients are given a written consent form, and the laryngologist (A.H.) spends a significant amount of time explaining the procedure and answering all the patients’ questions.

Between genders, females did anticipate higher preprocedure VAS pain scores than males did, although there was no difference for postprocedure scores. The gender difference in pain perception has been studied in the pain literature. Racine et al. conducted a 10-year systemic review on gender differences on the perception of pain, first in a laboratory setting\textsuperscript{25} and second with biopsychosocial factors that alter pain perception between genders.\textsuperscript{26} In a laboratory setting, various types of pain were studied, such as thermal, pressure, and ischemic. Some evidence shows that females have a lower threshold for thermal and pressure pain, although there are similar thresholds for ischemic pain between genders. Pain intensity and unpleasantness were similar between genders. For biopsychosocial factors, the effect of hormonal or physiological mechanisms to explain gender differences in pain perception was inconsistent. There were mixed results with the theory that women have less efficient endogenous pain inhibitory systems. The roles of anxiety and depression in mediating gender differences in pain perception were inconclusive. Overall, the gender difference in pain perception still requires further understanding and was an interesting result of this study.

In our study, completion rate of LEMG was 100%; thus, LEMG were well tolerated with mild to moderate levels of discomfort. Our high completion rate further supports the high tolerance of LEMG when comparing our results to other studies. In the Birkent et al. study, a true completion rate is not reported, although they report that 74.3% of their patients had complete data.\textsuperscript{6} Higher completion rates were reported in both the Young et al. and Halum and Moberly studies, reporting 92% and 100% completion rates, respectively.\textsuperscript{3,4} Overall, the results from our study, as well as those from the aforementioned studies, support fair tolerance of in-office procedures, with some reported variation between studies.

Compared to tolerance of other in-office procedure, assessment of LEMG tolerance is unique in that patients in our clinical practice do not receive preprocedural anesthetics. For the aforementioned studies, each patient population did receive a topical and/or injected anesthetic. Compared to the study by Birkent et al., similar VAS values were recorded in their study (preprocedure: 4.57 \pm 3.15; postprocedure: 4.41 \pm 3.05) compared to ours.\textsuperscript{6} Although their reported VAS scores were slightly lower, the close values between this and our study was interesting because both were percutaneous procedures. The patients in Birkent et al.’s study, however, received topical anesthetic, whereas ours did not.

Although widely used in the pain-management literature, the McGill Pain Questionnaire has not been
widely used to assess tolerance of in-office procedures in otolaryngology. Crawley et al. used the Short-Form McGill Pain Questionnaire (SF-MPQ) to study periprocedural pain with in-office injection laryngoplasty; however, the article has not yet been published and preliminary results were orally presented.9,27 The Crawley et al. study looked at a different procedure— injection laryngoplasty—whereas our study looked at LEMG. The SF-MPQ utilizes a smaller set of words in the sensory and affective categories compared to the Long-Form McGill Pain Questionnaire (LF-MPQ).11,27 Although the LF-MPQ takes slightly longer for study participants to complete, we elected to use the long form rather than the short form in the hopes of obtaining more information on the quality of pain and tolerance with LEMG. We look forward to comparing the results of these two studies once Crawley et al.’s data are published.

Our study has some limitations. There was a sample size of 80 patients. Future studies with larger patient populations will aid in obtaining a more complete understanding of patient tolerance of LEMG. As mentioned, both tools used to assess pain have some flaws, including the simplicity of VAS and, alternatively, the complexity of the McGill Pain Questionnaire. We mitigated this limitation by using both tools, which are complementary. Lastly, we limited our patients to English speakers. There may be cultural differences in the experiences of pain in non-English speakers. We were unable to explore these differences by limiting our surveys to English.

CONCLUSION

LEMG was well tolerated by patients, with our study revealing that patients experienced mild to moderate levels of pain during the procedure. Comparing the pre-and postprocedure pain scores showed that patients were able to anticipate their pain levels. This may be due to the patient’s knowledge of their personal pain thresholds and/or the preprocedure education and counseling provided by the authors. These results will be useful for patient education and the informed consent process because patients usually are apprehensive about this procedure. This study also adds to the pain and tolerability literature of in-office procedures because these procedures are becoming more widely adopted in the otolaryngology community.

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BIBLIOGRAPHY