

Intraoperative nerve monitoring during parathyroid surgery: The Fort Worth experience

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Abstract

Background: Avoidance of recurrent laryngeal nerve (RLN) injury during parathyroid surgery is of paramount importance. The purpose of this study was to determine if intraoperative nerve monitoring allowed for decreased rates of RLN injury during parathyroid surgery.

Method: Between 1997 and 2016, 213 patients undergoing parathyroidectomy were retrospectively analyzed to determine postoperative recurrent nerve injury. Eighty-seven patients did not have intraoperative nerve monitoring, whereas 126 patients did.

Results: Based on the number of patients presenting with nerve injury during the postoperative period operated on with and without nerve monitoring, it was found that the difference in the 2 modalities was not statistically significant ($P > .05$).

Conclusion: Routine use of intraoperative nerve monitoring during parathyroid surgery may not yield any additional benefit in preventing injury to the RLN.

KEYWORDS

intraoperative nerve monitoring, nerve injury, parathyroidectomy, recurrent laryngeal nerve, vocal fold paralysis

1 | INTRODUCTION

Recurrent laryngeal nerve (RLN) injury is one of the most feared complications of thyroid and parathyroid surgery. Unilateral RLN injury alone can be associated with significant functional compromise. Furthermore, RLN injury can significantly add to healthcare costs.¹⁻³ As such, protecting the RLN is a major goal in thyroid/parathyroid surgery. Direct visualization of the nerve during surgery is considered to be the gold standard by many surgeons; however, there is no consensus in the literature regarding routine identification and dissection of the RLN.^{4,5} Over the last decade, various intraoperative nerve monitoring (IONM) techniques have been popularized, from the use of endotracheal tubes with electromyography electrodes to the placement of electrodes through the cricothyroid membrane.⁶ All of these have been used in an attempt to reduce the risk of iatrogenic injury to the RLN.

Several studies have attempted to evaluate the efficacy of IONM in reducing RLN injury.⁷⁻¹² The proponents of IONM argue that nerve monitoring can aid in revision surgery, as IONM has been shown by

select authors to be useful in predicting postoperative nerve function.^{11,12} One of the biggest pitfalls of IONM remains that although a positive signal from the nerve monitoring apparatus is reassuring, the lack of nerve stimulation during surgery can represent anything from equipment malfunction to stimulation of a non-nerve structure or an injured RLN.^{13,14} As such, there is no consensus in the literature regarding the reliability of IONM in preventing RLN injury.

Despite the lack of consensus and multiple trials examining IONM for thyroid surgery, there remains a paucity of data regarding the role of IONM during parathyroid surgery. The purpose of this study was to assess the efficacy in IONM in preventing RLN injury during parathyroid surgery. In this study, we present a series of 213 patients who underwent parathyroid surgery, 87 without IONM and 126 with IONM.

2 | MATERIALS AND METHODS

Before beginning the study, institutional review board approval was granted from John Peter Smith Hospital in Fort Worth, Texas.

The purpose of this study was to analyze RLN paralysis after parathyroid surgery with and without IONM. This was a retrospective study of 213 patients undergoing parathyroid surgery between September 1997 and February 2016. Patients operated on between September 1997 and January 2007 all underwent parathyroid surgery without the use of IONM with the Medtronic NIM device (Minneapolis, MN), whereas the patients operated on from January 2007 to February 2016 did have IONM used. The anesthesiologist and the surgical team placed the nerve monitor, with continuous monitoring during the case from both entities. Both latencies and potentials were examined, and loss of signal was reported when noted.

During the aforementioned time points, patient age, sex, and final pathology was recorded. All patients underwent a preoperative and postoperative fiberoptic nasopharyngolaryngoscopy to assess true vocal fold motion. Patients with a lack of documented fiber-optic examination, preoperative paralysis, known parathyroid malignancy, or concurrent thyroidectomy were excluded from the study. Patients with any evidence of vocal fold dysfunction, or those with symptoms, such as dysphonia, underwent stroboscopy by a speech-language pathologist.

All patients were followed for a minimum of 90 days, during which postoperative vocal fold dysfunction could be documented in the outpatient setting. All patients were operated on by a single surgeon (Y.D.) at a tertiary referral center in Fort Worth, Texas.

After all information was collected, the number of patients with postoperative paralysis was compared between both groups using a Fisher test and significance threshold of $\alpha = 0.05$ in order to determine if there was a significant difference in postoperative cord paralysis with and without the use of IONM.

Because several patients regained vocal fold function, the statistics were reanalyzed with those values taken into account as well.

3 | RESULTS

After review of the patients' medical records, a total of 213 patients were included in the study. First examining patients undergoing parathyroid surgery without nerve monitoring during the first 10-year period of the study, there were 87 patients. Of these, 58 were women (mean age 42.7 years; range 24–76 years) and 29 were men (mean age 48.2 years; range 22–88 years). In this group of patients, final pathology revealed 64 parathyroid adenomas, 9 patients with parathyroid hyperplasia, and 3 patients with mediastinal glands. Eleven patients also had reoperations revealing an additional 2 adenomas, 4 hyperplasias, and 5 mediastinal glands.

Preoperative examination revealed normal vocal fold motion in all of these patients. Postoperatively, 4 patients were found to have vocal fold paralysis, 2 of whom had adenomas and 2 of whom had parathyroid hyperplasia. Of note, 1 of these cases was a revision case. At 4 months postoperatively, 1 patient had a return of vocal fold motion.

During the next 10-year period, all patients undergoing parathyroid surgery had IONM with the Medtronic NIM system. This group included a total of 126 patients, 96 women (mean age 46.1 years;

range 21–84 years) and 31 men (mean age 44.6 years; range 19–76 years). After surgery, pathology revealed 104 patients with parathyroid adenomas, 7 patients with parathyroid hyperplasia, and 1 patient with mediastinal parathyroid. This group also included 15 reoperations, revealing an additional 7 patients with adenomas, 4 patients with mediastinal glands, and 4 patients with hyperplastic glands.

Preoperative examination revealed normal vocal fold motion in all of these patients. Postoperatively, 5 patients were found to have vocal fold paralysis, 2 of whom had hyperplasia, 2 had adenomas, and 1 had a mediastinal gland. Of note, 3 of those cases were revision cases. At 4 months and 7 months postoperatively, 2 patients had a return of vocal fold motion.

In order to determine if a difference in postoperative vocal fold paralysis existed in patients operated on with and without IONM, a Fisher test was first done examining all patients with postoperative paralysis, and then with those same patients but excluding those with a return of function. In both scenarios, the Fisher statistic yielded a *P* value $> .05$, deeming the differences to not be statistically significant.

4 | DISCUSSION

This study examined the differences in postoperative RLN injury after parathyroid surgery with and without IONM. To date, this represents the first study in the English language literature providing a dedicated evaluation of nerve monitoring in regard to parathyroid surgery alone.

The current study retrospectively examined nerve injury outcomes over a 20-year period during which the senior author (Y.D.) changed his practice pattern from initially not using IONM to (first 10-year span) to later utilizing nerve monitoring (second 10-year span) for all of his parathyroid surgeries. Analysis of the postoperative recurrent nerve paralysis rates revealed that there was no significant difference between the 2 modalities (*P* $> .05$), suggesting that the use of IONM may not yield any additional benefit in preventing nerve injury.

Both patient populations were similar in terms of final pathology and indication for surgery. Although only a small number of patients in each group had postoperative paralysis, a large majority of those patients were revision cases. Given the low rate of paralysis in each group, statistical examination of injury rates in revision cases compared to primary surgical cases was limited. Presumably, the results could be heavily surgeon dependent, with experienced parathyroid surgeons having generally lower postoperative complications compared with less experience surgeons regardless of nerve monitoring. A large multi-institutional study could perhaps provide a more standardized result taking into consideration the training and expertise of multiple surgeons.

The literature on this particular subject is sparse, with no dedicated studies on parathyroid surgery and recurrent nerve monitoring. The majority of literature has reported on nerve injury in thyroid and parathyroid surgery as a combined cohort, or on thyroid surgery alone. In 2004, a study by Robertson et al⁷ reported no difference in outcomes when IONM was used for thyroidectomy. These findings were corroborated by Chan et al¹³ in a study of 1000 RLNs. Interestingly, a more

recent study in 2014 actually reported an increase in RLN injury with IONM.¹⁵ Although unable to make a direct comparison given the differences in thyroid and parathyroid surgery, the results obtained in this study are in agreement with the current literature showing no increased efficacy of IONM in preventing nerve injury.

This study represents the first study examining differences in nerve injury in patients undergoing a parathyroidectomy with and without IONM. Although the results of this study suggest that there may be no additional benefit to using IONM, it is important to recognize that these results represent those of a single surgeon at one institution. The strength of this study lies in the large patient volume only undergoing parathyroid surgery not confounded by patients undergoing thyroidectomy surgery, as well as the consistent surgical technique used by one surgeon. In future trials, multiple centers should be enrolled in a similar study. Moreover, it would be interesting to determine if nerve monitoring is more beneficial in revision parathyroidectomy compared to primary parathyroid surgery.

5 | CONCLUSION

Based on this single surgeon experience of 20 years, there may be no additional benefit in preventing RLN injury with the use of IONM.

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