Role of intraoperative neuromonitoring of the recurrent laryngeal nerves during thyroid reoperations of recurrent goiter

Jan Sopiński, Krzysztof Kuzdak, Masoud Hedayati, Krzysztof Kotomecki

Department of Endocrine, General and Vascular Surgery, Medical University of Lodz, Poland. Head: Prof. Krzysztof Kuzdak, MD PhD

ABSTRACT:
Reoperations of the thyroid gland are challenging to any surgeon. Such procedures are technically difficult and involve higher risk of complications than primary procedures. Recurrent laryngeal nerve (RLN) palsy is one of such complications.

The aim of the study was to evaluate the effectiveness of intraoperative neuromonitoring (IONM) in preventing RLN palsy during recurrent goiter operations.

Material and methods. We retrospectively analyzed the results of thyroid reoperation performed at the Department of Endocrine, General and Vascular Surgery of Medical University of Lodz in the period from January 2014 to June 2016. The study included 80 patients, who were divided into two groups: group A consisted of 27 patients, who had undergone surgery with the use of IONM, while group B included 53 patients, in whom RLN was identified visually. During statistical analysis we took into account the number of nerves at risk, not the number of patients. There were 47 nerves at risk in group A and 86 in group B. We analyzed whether application of IONM had any effect on the frequency of RLN palsy and procedure duration.

Results. The frequency of RLN palsy was 10.64% (5/47) in group A and 15.12% (13/86) in group B (no statistical significance, p=0.47). Mean operation time was shorter in group B 71.29 ± 17.125 minutes vs. 75.75 ± 17.94 minutes in group A (no statistical significance, p=0.377).

Conclusion. Use of IONM did not significantly reduce the occurrence of RLN palsy and procedure duration.

KEYWORDS:
recurrent goiter, recurrent laryngeal nerve, intraoperative neuromonitoring

INTRODUCTION

Thyroid gland reoperations pose a challenge to any surgeon. Such procedures are characterized by a high degree of manual difficulty and are burdened with greater risk of complications than primary surgery [1,2] due to fibrous tissue proliferation and scarring in the previously operated region, which may lead to increased risk of intra- and postoperative bleeding and changes to the anatomy of cervical structures [3].

Recurrent laryngeal nerve damage (RLN) is one of the complications of thyroid surgery. Disorders of phonation, breathing, or even stridor and respiratory failure due to bilateral nerve palsy may occur as a result [4,5]. Frequency of RLN palsy ranges from 1% to 20%. The proportion rises for malignant thyroid tumor or recurrent goiter surgery. Some authors report eightfold increase in the risk of RLN damage during surgical procedures for recurrent goiter. On the other hand, operator’s experience and proper surgical technique reduce the rates of this complication [2,6].

For many years the gold standard of management aimed at reducing the frequency of RLN damage was to visualize their course in the surgical field before performing thyroid resection [7,8]. As early as in 1938 Lahey asserted that visualization and preservation of RLN during thyroid surgery reduces the frequency of nerve damage [9]. Nevertheless, such complications still occur; therefore, there was an ongoing search for a tool aiding in localization of this structure. Intraoperative neuromonitoring (IONM) of recurrent laryngeal nerve is an example of such a tool. This technique was first used by Shedd et al. in 1996 [10]. Technology has been constantly improving since then and neuromonitoring is being used in an increasing number of centers [11]. International guidelines for standardization of this method have also been developed [12].

The goal of this study was to assess the efficacy of intraoperative monitoring in prevention of recurrent laryngeal nerve damage during thyroid reoperations due to recurrent goiter.

MATERIAL AND METHODS

Retrospective analysis of the outcomes of thyroid reoperations due to recurrent goiter at the Department of Endocrine, General and Vascular Surgery of the Medical University of Lodz between January 2014 and June 2016 was conducted. The study included 80 patients – 76 women and 4 men (Table 1 presents group characteristics). Patients with diagnosed or suspected malignant thyroid tumor, patients undergoing surgery of the pyramidal alone, and patients with previously diagnosed vocal fold paresis were excluded from the study. Patients were divided into two groups: group A – 27 (33.75%) patients were operated on using IONM, group B – 53 (66.25%) patients with only visual localization of RLN during surgery. Patients were randomly allocated to either group depending on the availability of neuromonitoring equipment. Statistical analysis took into account not the number of patients, but the number of laryngeal nerves at risk (133 RLN in total) – 47 RLN in group A and 86 RLN in group B. The effect of IONM on the frequency of RLN palsy and procedure time was assessed.

All patients underwent preoperative diagnostics. Hormonal function of the thyroid (TSH, fT3, fT4) was assessed, ultrasound examination of the gland and fine needle biopsy of suspicious focal lesions, laryngoscopic assessment of vocal fold function were per-
formed. Chest x-ray was performed in every case and computed tomography of the neck and chest only in those patients with mediastinal location of the thyroid.

As for the preoperative diagnosis, neutral recurrent nodular goiter was diagnosed in 70 (87.5%) cases and recurrent toxic nodular goiter in 10 (12.5%) cases.

During surgery patient was in supine position with the head tilted posteriorly. Thyroid was accessed with a collar-shaped cut at the base of the neck through the previous surgical scar.

A total of 53 (66.25%) complete thyroid resections and 27 (33.75%) lobectomies were performed. Mediastinal location of the thyroid was identified in 11 (13.75%) cases, which required extending the scope of surgery to mediastinal exploration, and partial sternotomy for safe removal of tissues was necessary in 2 (2.32%) cases. Table 2 presents data describing the scope of performed surgical procedures.

Surgery was performed under general endotracheal anesthesia. Vocal fold function was assessed laryngoscopically in all patients before and after the procedure. Patients undergoing IONM received a short-acting striated muscle relaxing agent during induction of anesthesia. Intermittent neuromonitoring technique using C2 NerveMonitor (Inomed, Germany) was applied in Group A patients. A bipolar electrode (Inomed, Germany) was used to map the nerve course. Signal was received through an electrode fixed onto the endotracheal tube at the level of vocal cords. Vagal nerve on the operated side was identified before lobar resection in order to acquire signal from the receiving electrode (V1), followed by identification of the recurrent laryngeal nerve (R1). After lobar resection recurrent laryngeal (R2) and vagal (V2) nerve neuromonitoring was repeated according to the recommendations of the International Nerve Monitoring Study Group in Thyroid and Parathyroid Surgery [12]. If surgery involved both thyroid lobes, the above-described procedure was repeated on the contralateral side.

Surgical material was sent for routine histopathological examination after the operation. Proliferative changes were found 75 cases, inflammatory lesions in 5, and in 1 case papillary thyroid cancer focus was identified.

Obtained results were subject to statistical analysis using Statistica software. The following descriptive statistics were elaborated for each group based on the acquired data: arithmetic mean, standard deviation (SD), minimal and maximal values, median, and proportion (expressed in percentages). Chi-square (χ²) test was used to compare the results in both groups in case of categorical variables and Student’s t-test was used for quantitative variables. Value of p<0.05 was considered statistically significant.

RESULTS

There were 47 nerves at risk of damage in the group of patients undergoing intraoperative monitoring of RLN (group A). Five (5/47; 10.64%) cases of RLN were identified in the postoperative period. In the group of patients without neuromonitoring (group B) 86 nerves were at risk of damage. RLN palsy was diagnosed in 13 cases (13/86; 15.12%). The difference in the frequency of this complication between our groups was not statistically significant (p=0.47) (Table 3).

In group A, bilateral vocal fold palsy was identified in 2 cases (7.41%) and unilateral palsy was diagnosed in 1 case (3.70%).

Mean procedure time was shorter in group B and amounted to 71.29 ± 17.125 minutes, while in group A mean duration of surgery was 75.75 ± 17.94 minutes. The difference was not statistically significant (p=0.377) (Figure 1).

DISCUSSION

Frequency of RLN palsy after thyroid surgery differs significantly in the scientific literature on the topic. In case of transient palsy it amounts to 0-7.1%, while the prevalence of permanent palsy ranges from 0% to 11%. Application of IONM during surgery failed to significantly influence the frequency of this adverse event [11].

In 2011 the results of a meta-analysis comparing frequency of vocal fold palsy after thyroid surgery with and without application of neuromonitoring were published [13]. Results of 43 studies (20 prospective and 23 retrospective) were analyzed, with a total of 64699 RLNs at risk of damage. The total fraction of vocal fold palsy amounted to 3.52% in the group of patients with IONM and 3.12% in patients without neuromonitoring. Frequency of occurrence of temporary palsy amounted to 2.74% and 2.49%, respectively, and permanent – 0.75% and 0.58%, respectively. The differences were not statistically significant.

In 2013 Sanabria et al. published the results of a meta-analysis that included 6 randomized trials [14]. The analysis encompassed a total of 1602 patients. It assessed whether application of IONM reduced the frequency of RLN and external branch of superior laryngeal nerve palsy during thyroid surgery. Results of surgery were assessed in 1513 patients (2912 nerves at risk) with regard to the frequency of RLN palsy. The proportion of
transient palsy amounted to 2.2% in the group with neuromonitoring and 3.9% in the group where it had not been used. On the other hand, the frequency of permanent palsy equaled 0.5% and 0.8%, respectively. These differences were not statistically significant. However, researchers concluded that despite inclusion of a large group of patients into the meta-analysis, the statistical power of the study is insufficient, especially with regard to the group with permanent RLN palsy. It was emphasized that such analysis should include results of surgery on 4500 patients or 9000 at-risk nerves.

Authors focused also on the economic issues related to the use of IONM. They observed that from the health care point of view, the effect of IONM is virtually insignificant because it has to be used in 100-200 surgeries in order to prevent 1 permanent RLN palsy, underscoring that the price of neuromonitoring equipment should be calculated appropriately.

Authors of a meta-analysis that was published in the following year and took into account the results of surgery in 23512 patients, totaling 35513 at-risk nerves (24038 in the group where IONM was used - the IONM group, and 11475 where the nerve was identified visually – the VA group) [15]. The total proportion of palsy in the IONM group was 3.47%, while in the VA group it amounted to 3.67%. The frequency of transient palsy was 2.62% and 2.72%, respectively, and permanent palsy 0.79% and 0.92%, respectively.

Summarizing the results of meta-analyses, it was demonstrated that application of IONM does not significantly influence the frequency of RLN palsy during thyroid surgery. IONM is a useful tool for identifying nerve location, but RLN dissection in order to visualize its course should not be abandoned. This problem requires conducting well-designed, prospective, randomized, multicenter trials on large groups of patients, especially those at high risk of complications. Methodology of those studies should be based on the standards of neuromonitoring use. It should be also emphasized that in the majority of cases palsy was transient [13,14,15].

Nerve damage occurs more often in high-risk thyroid surgery. Such procedures include surgery for large thyroid goiter, substernal goiter, Graves-Basedow disease, hyperthyroidism, thyroiditis, or thyroid cancer [6,13,15,16,17]. Frequency of RLN palsy in the cited literature ranges from 3.0% to 8.8% in patients who underwent surgery with the use of IONM and from 5.8% to 9.1% among patients, in whom the RLN was identified without neuromonitoring. In the majority of cases these differences were not statistically significant. Only Barczynski et al. reported that application of IONM does not significantly influence the frequency of transient RLN palsy in such types of surgery [6].

Identification of recurrent laryngeal nerve during thyroid reoperation is sometimes incredibly difficult. Alesina et al. evaluated the efficacy of neuromonitoring in thyroid reoperations [18]. They analyzed the results of 250 reoperations performed on 246 patients due to recurrent goiter (203 cases), hyperthyroidism (26 cases), and recurrence of thyroid cancer (17 cases). IONM was applied in 89 patients (NM group), while 131 individuals were operated on without the use of IONM (NV group). Patients undergoing adjuvant thyroidectomy due to thyroid cancer, patients who had previously undergone surgery on the contralateral side, and subjects with regrowth of thyroid tissue in the pyramid lobe were excluded from the study. A total of 250 procedures were performed. The risk of RLN damage was noted in 128 cases from the NM group and in 161 patients from the NV group. Frequency of transient RLN palsy equaled 6.2% in the NM group and 2.5% in the NV group. No statistically significant difference was noted. In summary, the researchers concluded that surgeon’s experience is the most important factor determining the success of thyroid reoperation. In order to reduce the risk of RLN to the minimum authors suggested beginning dissection from the dorsal side of the gland, where in theory scar tissue should be least abundant. They also noted that preservation of a small fragment of thyroid tissue in the area of suspensory ligament of Berry is a perfectly acceptable method of protecting the nerve. Finally, they underscored that use of neuromonitoring cannot replace routine visualization of recurrent laryngeal nerve in the surgical field and careful dissection of tissues.

In our study, frequency of RLN palsy was lower (10.64%) in the group where IONM was used compared to patients, in whom nerves were identified visually (15.12%). The difference, however, was not statistically significant. The relatively high frequency of palsy ensued from the fact that other risk factors for RLN damage were often identified during surgery. In 10 (12.5%) cases surgery was performed for toxic goiter, in 11 (13.75%) cases thyroid lesions were located in the mediastinum, sternotomy was required in 2 (2.32%) cases, and 2 patients were
diagnosed with giant goiter (thyroid mass > 300g). Moreover, in our analysis we took into account all cases of postoperative palsy (identified on day 1 after surgery). In the majority of cited reports, researchers evaluated the percentages of transient and permanent palsy (in such cases the frequency of complications was significantly lower). There are two definitions of transient and permanent RLN palsy in the literature on the topic. Some authors claim that permanent palsy is such that persists for over 6 months after surgery, while other researchers believe that such complication may be diagnosed as long as 12 months after the procedure [15]. Our follow-up is still continuing and we will be able to report our full data after 12 months from the last surgery.

Use of neuromonitoring did not significantly impact procedure duration. Mean time of surgery was shorter in group B and amounted to 71.29 ± 17.125 minutes, while in group A mean procedure time was 75.75 ± 17.94 minutes. The difference was not statistically significant (p=0.377). The authors of the above-mentioned studies obtained similar results. Mean duration of surgery was longer in the IONM group compared to the group where it had not been used: 97.6 minutes vs. 94.6 minutes – Pisanu et al. [15]; 119 ± 51 minutes vs. 116 ± 37 minutes – Chan et al. [17]; 99 ± 43 minutes vs. 80 ± 27 minutes – Alesina et al. [18]. These differences were also not statistically significant. In our experience, longer duration of procedures with neuromonitoring results from the necessity of additional dissection of cervical vessel area in order to identify vagal nerves and obtain V1 signal before and V2 signal after thyroid resection.

In summary, thyroid reoperations are associated with elevated risk of damage to the recurrent laryngeal nerves. Visualizing the nerve course before resection of the gland is the gold standard for this type of surgery. Use of intraoperative recurrent laryngeal nerve neuromonitoring does not significantly reduce the risk of damage to these nerves. Further studies assessing the efficacy of this procedure on larger groups of patients are necessary.

**CONCLUSIONS**

Application of intraoperative neuromonitoring of recurrent laryngeal nerves does not significantly reduce the proportion of nerve palsy or procedure duration.

**REFERENCES**

Jan Sopiński; Wojewódzki Szpital Specjalistyczny im. M. Kopernika; Pabianicka 62 93-513 Łódź; Tel. +48 42 689 51 71; E-mail: sopinskijan@gmail.com

Sopiński J., Kuzdak K., Hedayati M., Kolomecki K.; Role of intraoperative neuromonitoring of the recurrent laryngeal nerves during thyroid reoperations of recurrent goiter; Pol Przegl Chir 2017: 89 (3): 11-15