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Original Research Article

Role of Intraoperative Nerve Monitoring in Thyroid Surgery: A Comparative Study

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Abstract

Nerve monitoring is an essential part of thyroid, parotid and vestibular Schwannoma surgery in the present era. The use of nerve monitor while operating can reduce the damage to these vital structures. The recurrent laryngeal nerve (RLN) is the most important structure at risk during thyroidectomy. Damage to the recurrent laryngeal nerve (RLN) during thyroid surgery can result in voice changes and aspiration. Intra-operative nerve monitoring (IONM) has become one the most widely used adjunct for identifying the RLN and allows real-time identification and functional assessment of the RLN in the operative field. The basic aim of this study is nerve monitoring during thyroid surgery in order to avoid RLN injury. This prospective cohort study was performed in the Department of Otorhino-laryngology, MBS Hospital, Medical College Kota, and Rajasthan from 01 August 2018 to 31st Dec. 2020. The study concludes with, no significant difference was seen to nerve damage in thyroid disease among nerve monitoring and without nerve monitoring cases. IONM seemed to have impact over duration of surgery, significantly lower in nerve monitoring cases. No significant difference was seen in duration of hospital stay among the two groups. Use of IONM is quite debated topic and still consensus is underway.

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Introduction

Nerve monitoring is an essential part of thyroid, parotid and vestibular Schwannoma surgery in the present era. The use of nerve monitor while operating can reduce the damage to these vital structures [1]. Since facial nerve, recurrent laryngeal nerve, hypoglossal nerve, spinal accessory nerve and vagus nerve have precious role in day-to-day life. The damage to these nerves can lead to change in voice, facial asymmetry, deviation of tongue, nasal regurgitation and aspiration etc.

In order to avoid these complications, we require extensive nerve monitoring during surgical procedures. The recurrent laryngeal nerve (RLN) is the most important structure at risk during thyroidectomy.

Although, the rate of injury to the nerve has been reported to be relatively low i.e., up to 6% for temporary paresis and up to 2% for permanent paralysis but most of them believes that these types of injury must be reduce further. [2] Damage to the recurrent laryngeal nerve (RLN) during thyroid surgery can result in voice changes and aspiration. This study is based on nerve monitoring during thyroid surgery in order to avoid RLN injury. Multiple devices over the years have helped surgeons to identify the course of the RLN. Intra-operative nerve monitoring (IONM) has become one the most widely used adjunct for identifying the RLN and allows real-time identification and functional assessment of the RLN in the operative field [3]. The Nerve Integrity Monitor tube and the Dragon Stick-on Electrode are the two popular devices used to monitor the nerve via EMG [4]. This study is based on nerve monitoring during thyroid surgery in order to avoid RLN injury. This study also assesses the cost effectiveness of using IONM in thyroid surgeries.

Aims and Objectives

1. To determine whether IONM during thyroidectomy predicts recurrent laryngeal nerve (RLN) functions.

2. To assess the cost effectiveness of IONM during thyroid surgery.
3. To compare the time duration of total thyroidectomy and thyroid lobectomy from a single surgeon with and without the aid of IONM.
4. To determine efficacy of IONM in revision thyroid surgeries.

Materials and Methods

This prospective cohort study was performed in the Department of Otorhinolaryngology, MBS Hospital, Medical College Kota, and Rajasthan from 01 August 2018 to 31st Dec. 2020. Institutional review board approval was obtained for the study, and all patients of hemithyroidectomy or total thyroidectomy who gave consent for study were enrolled. Intra-operative RLN monitoring was performed. Preoperative flexible laryngoscopy confirmed the normal vocal cord mobility in all patients. The MEDTRONIC NIM 3.0 monitoring system was used in all cases to monitor, test and confirm visual identification of the RLN at the completion of the case. Patients were incubated with the NIM 3.0 contact endo-tracheal tube. Electrodes were placed at the level of the true vocal cords. Endo-tracheal tube position was confirmed by the surgeon and anesthetic with appropriate electromyographic signaling and direct laryngoscopy. The nerve stimulator was set at 0.5 mA and when the RLN was visually identified, it was stimulated with 0.5 mA to confirm identification and machine function. In some cases, if there was no response, 1.0-mA and then 2.0-mA stimuli was used. The number of times that the RLN was stimulated during the case was also recorded. Once the specimen was removed and hemostasis was obtained, each nerve was stimulated at the cricoarytenoid joint at 0.25 mA and if there was no response, the stimulus was increased successively to 0.35, 0.5, 1.0, and 2.0 mA until a positive NIM 3.0 response was achieved. Nerve testing was repeated at the most distal location of RLN dissection from the cricoarytenoid joint and the smallest stimulus to generate a response at the cricoarytenoid joint and distal dissection was recorded for each nerve. At the first postoperative appointment, 1 to 2 weeks after surgery, flexible laryngoscopy was performed in all cases. Pathology reports and information regarding patients' preoperative and postoperative vocal cord mobility was reviewed and documented. Permanent vocal cord paralysis was defined as impaired mobility at 3 to 4 months after surgery and for this follow-up of the cases was done till 4months. Statistical analysis was performed using a t test for continuous data. Statistical significance was set at P^{L} .05.M

Results

This study was conducted on patients with mobile vocal cord and confirmed by I L & VLS examinations. Total 100 subjects were studied, which were divided in two groups. 50 subjects were included in each group. Group A included subjects in which surgeries were done with nerve monitoring and in Group B surgeries were done without nerve monitoring.

Table 1: Distribution of Study Subjects According to Nerve Damaged While Operating For Various Thyroid Diseases

Thyroid Disease	Group A (with Nerve monitor)		Group B (without Nerve monitor)	
	No.	%	No.	%
Malignancy Thyroid	2	20	5	55.55
Controlled Toxic Nodular Goitre	0	0	1	33.33
Revision Thyroid Surgery	0	0	1	33.33
Euthyroid Nodular Goitre	0	0	0	0
Controlled Grave's Disease	0	0	0	0
Total	50	100	50	100
Result (P value)	0.693 (NS)			

S = Significant; NS = Non-Significant

Most of the subjects in both Group A (20%) and Group B (55.55%) got nerve injuries while operating for Malignancy thyroid. No nerve injuries observed while operating for Controlled toxic nodular goitre in Group A and observed in 33.33 % subjects in Group B. In those having Revision thyroid surgery, it was elicited in 0% of subjects in Group A and 33.33% subjects in Group B. Operating for both Euthyroid nodular and Controlled Graves' disease resulted in nerve injuries to 0% of subjects in both Group A and Group B subjects.

Table 2: Comparison of Mean Operative Time among Study Groups

	Group A (with Nerve monitor)		Group B (without Nerve monitor)	
	Mean	**SD**	**Mean**	**SD**
Mean operative time	79.24	3.62	82.18	2.16
Range (Min-Max)	75-85		80-86	
Result (P value)	p<0.001 (S)			

S = Significant; NS = Non-Significant

The mean operative time in Group A was 79.24 ± 3.62 min ranging from 75 – 85 min, while that in Group B was 82.18 ± 2.16 min ranging from 80 to 86 Minutes. The mean operative time was found to be significantly lower in Group A (p<0.001).

Table 3: Distribution of Subjects According to Type of Nerve Injury

Nerve injury	Group A (with Nerve monitor)		Group B (without Nerve monitor)	
	No.	**%**	**No.**	**%**
Permanent	5	10.00	5	10.00
Transient	4	8.00	4	8.00
Total	50		50	
Result (P value)	1.00 (NS)			

S = Significant; NS = Non-Significant

In this study permanent nerve injury was seen in 10% of subjects and Transient nerve injury was seen in 8% of subjects in both groups. No significant difference was seen in nerve injury among the two groups (p=1.000).

Table 4: Distribution of Subjects as Duration of Hospital Stay

Duration of hospital stay (days)	Group A		Group B	
	No.	**%**	**No.**	**%**
3	17	34.00	16	32.00
4	23	46.00	24	48.00
8	10	20.00	10	20.00
Total	50	100.00	50	100.00
Result (P value)	0.975 (NS)			

S = Significant; NS = Non-Significant

Most of the subjects in Group A had 4 days of stay (46%) followed by 3 days (34%) and only 20% had 8 days of hospital stay. In Group B also most subjects had 4 days of stay (48%) followed by 3 days (32%) and only 20% had 8 days of hospital stay. No significant difference was seen in duration of hospital stay among the two groups (p=0.975).

Discussion

Most of the subjects in both Group A (20%) and Group B (55.55%) got nerve injuries while operating for Malignancy thyroid. No nerve injuries observed while operating for Controlled toxic nodular goitre in Group A and observed in 33.33 % subjects in Group B. Chan WF et al (2006) [5] observed that nerve injuries was occurred during surgery in 56% cases of benign nodular goiter, 22% cases in thyroid malignancy, 13% among graves' disease, Follicular adenoma in 8% and 1% in thyroiditis.

Haitao Zheng et al (2015) [6] observed that out of 220 cases, 85 cases in the study had thyroid cancer, 19 cases had thyroid benign tumor, 90 cases had thyroid goiter, 3 cases had Hashimoto's diseases, and 23 cases had hyperthyroidism leading to nerve injury while operating procedure. Shun Yan Bryant Chan (2019) [7] found that surgery included 43 thyroid carcinoma (74.1%) and 15 thyrotoxicosis (25.9%); and of which, 22 (37.9%) were reoperations. IONM seemed to have impact over duration of surgery, as mean operative time in Group A was 79.24 ± 3.62 min ranging from 75 – 85 min, while that in Group B was 82.18 ± 2.16 min ranging from 80 – 86 min, significantly lower in group A. Serkan Teksoz et al (2013) [8] observed that duration of operation in IONM group (34.23±12.21 min) was statistically shorter than that in non-IONM group (36.98±16.79 min). Similar findings were observed by Suleyman Demiryas et al (2018) [9] and Dogan Yildirim et al (2018) [10]. However, Grayson Gremillion et al (2012) [11] found that IONM did not reduce the operative time significantly.

Permanent nerve injury was seen in 10% of subjects in both groups. Transient nerve injury was seen in 8% of subjects in both groups. No significant difference was seen in nerve injury among the two groups. Similar findings were also reported by Dralle H et al (2004) [12], Grayson Gremillion et al (2012) [11], Serkan Teksoz et al (2013) [8] and Robertson ML et al (2004) [13]. Chan WF et al (2006) [5], Frank R. Miller et al (2016) [14], Kai Pun Wong et al (2017) [15], Pietro Giorgio Calo et al (2017) [16] and Beata Wojtczak et al (2017) [17] found that transient as well as permanent RLN palsy associated more with the group without IONM but difference was statistically not significant. Shixing Zheng et al (2013) [18] found statistically significant differences in terms of total recurrent laryngeal nerve palsy (3.37% with intra-operative nerve monitoring [IONM] vs. 3.76% without IONM and transient recurrent laryngeal nerve palsy (2.56% with IONM vs. 2.71% without IONM. Ioannis Vasileiadis et al (2016) [19] concluded that that the use of IONM resulted in a significant reduction in RLN injury incidence. Gür EO et al (2019) [20] concluded that intra-operative neural monitoring can be used safely in thyroid surgery to avoid recurrent laryngeal nerve injury. No significant difference was seen in duration of hospital stay among the two groups.

Conclusion

In this study no significant difference was seen to nerve damage in thyroid disease among the two groups (p=0.693). IONM seemed to have impact over duration of surgery, significantly lower in group A (with Nerve monitoring). No significant difference was seen in duration of hospital stay among the two groups.

The thyroid gland lies close to the vocal cords and the nerves that control movement of the vocal cords (recurrent laryngeal nerves). Occasionally, during thyroid surgery these nerves got damaged (through traction, diathermy injury, or ligation and division).

Conventional thyroid surgery is done without the aid of continuous intra-operative nerve monitoring (IONM). Intra-operative nerve monitoring (IONM) has become the most widely used adjunct identification of the RLN and allows real-time identification and functional assessment of the RLN in the operative field. Use of IONM is quite debated topic and still consensus is underway.

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