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Identification of Recurrent Laryngeal Nerve and Parathyroid Glands Intraoperatively by Methylene Blue Spraying Technique

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Abstract

Background: Thyroid surgery has been associated with complications ranging from recurrent laryngeal nerve injury, inadvertent para- thyroidectomies to death. Improvement in thyroidectomy techniques have reduced the mortality rate to minimum, while morbidity remained a significant concern. **Aims:** This study aims to assess a method to identify recurrent laryngeal nerve and localize the parathyroid glands during thyroid surgery by using methylene blue stain which improve outcomes following thyroidectomy.

Materials and methods : This a prospective cross- sectional study was performed on 48 adult patients of both sexes who presented to the surgical ward at Salah Al-Deen general hospital in Tikrit city between October 2017 and July 2018. Full medical history was taken and clinical examination was done to those who were suitable for surgery. After indirect larngyoscopic confirmation of normal vocal cord mobility, in addition hospital medical records were obtained including patient's name, age, gender, residence, nature of thyroid disease, duration of thyroid disease, previous thyroid surgery, family history of thyroid disease and past medical history, relevant investigations like final histopathology ; all were chosen to undergo thyroidectomy, following superior but before inferior thyroid pedicles ligation, methylene blue dye, in a concentration of 2:8 and 1:10 of Methylene Blue: Normal Saline was sprayed over the thyroid lobe and perilobar area, in the region where recurrent laryngeal nerve is predictable to be found. Recurrent laryngeal nerve and parathyroid glands were identified and safe dissection of the thyroid without injuring these structures were ensured. **Results:** Recurrent laryngeal nerve was not stained in all cases, in contrast to the blue stained adjacent tissue. Within three minutes parathyroid glands washed out the dye and the yellow color was regained. **Conclusions:** Several techniques of recurrent laryngeal nerve and parathyroid glands identification were established , our study demonstrate that visual delineation of these structures by methylene blue dye spraying during dissection of thyroid is a simple, safe and effective method for localization and injury avoidance to both recurrent laryngeal nerve and parathyroid glands during thyroid surgery.

Keywords : *Recurrent Laryngeal Nerve ; Parathyroid Glands ; Intraoperatively ; Methylene Blue Spraying Technique*

Introduction

Disorders of the thyroid gland constitute the second most common endocrine disease following diabetes mellitus [(1)].The burden of thyroid disease is in an increment, therefor thyroidectomy is a very common operation, although the most frequent indications for surgery are goitre due to iodine-deficiency, other indications are;un certainty about the nature of the thyroid mass or treatment of large goitre causing compressive symptoms, thyroid cancer and thyrotoxicosis that may or may not be refractory to medical treatment [(2,3)]. Total thyroidectomy(TT)provides the advantages of complete removal of suspicious malignant thyroid tissue from a point and eliminating the risk of recurrence of benign conditions from another point, this resulted in increasing the number of TT [(4,5)].

The significant complications associated with thyroidectomy include: hemorrhage, respiratory obstruction, infection, transient or permanent

recurrent laryngeal nerve(RLN) palsy, and parathyroid insufficiency [6, 7].

A number of investigational methods for identification of RLN have been used, including visual and palpatory approach, intraoperative neuromonitoring, laryngeal nerve electromyographic activity recording, electrophysiologic nerve monitoring and staining[8,9,10]. These techniques are companied with differing degrees of accuracy as well as safety to the patient and are of little help in the dissection of the tissue planes at the time of surgery, thus most surgeons nowadays prefer accurate dissection to preserve the RLN and delicate parathyroid vasculature, in order to avoid nerve injury and postoperative hypocalcaemia[11].

Materials and Method

This prospective, cross-sectional study was conducted from October 2017 to July 2018 on forty eight adult patients, belonging to both genders, with thyroid swelling who underwent thyroidectomy in Salah Al-Deen General Hospital, Iraq.The study sample involving patients with different thyroid lesions were undergoing thyroidectomy. The patients classified into 16 patients their lobar and perilobar areas stained by syringe group (A); the remaining 32 patients their lobar and perilobar areas stained by spraying pump group (B) .

After positioning the patient on the operating table and induction of general anesthesia, surgical field was painted with 10% povidone iodine solution and draped. After the standard Kocher incision, total or partial thyroidectomy was performed according to the need. Following the elevation of flaps, lateral thyroid vein ligation and dissection of thyroid lobes were done. The superior pole was ligated and cut. Before ligation the inferior pedicle , the thyroid lobe rotated medially, normally at this stage the identification of RLN or the parathyroid gland is difficult ,so we spray the area with methylene blue aqueous staining solution (CDH Co. India)with the following concentrations and techniques.

In group A1: A concentration of 2:8 of (MB: NS) was sprayed over the thyroid lobe and perilobar area of 6 patients , requiring 1 min. to be stained and 2 times washing with normal saline and In group A2: A concentration of 1:10 of (MB: NS) was sprayed over the previously mentioned area in 10 patients, requiring 2 min. to be stained and rinse one time with normal saline, so In group B1:A concentration of (2:8) MB: NS was sprayed in over the lobe and perilobar area of 12 patients , the time needed for staining the tissue was I min. and 2 times washing for washing out the stain, In group B2:A concentration of (1:10) MB:NS respectively was sprayed over the same area in the remaining 20 patients of this group, the tissue took 2 min. to be stained without washing

Different thyroid procedures were done for the cases of the study sample

Statistical analysis:The Statistical Package for Social Sciences (SPSS, version 18) was used for data entry and analysis. One way ANOVA- test was used to compare mean of different factors among different groups of study sample. P value of ≤ 0.05 was regarded as statistically significant. Bar charts, and Pie graphs used to present the data.

Finding

The sex distribution show that 44(91.7%) of the patient were females versus 4(8.3%) males

The patient distribution according to the address show that 37(77.1%) of the patient from rural versus11 (22.9%) from urban , The histopathological type was : FA 1(2.1%), HT 3(6.3%). STN 3(6.3%)., MNG 26(54.2%), CG 15 (31.3%), as shown in table(1).

Table(1): The histopathological type of the goitre

Histopathological type	Frequency	Percent	Valid Percent	Cumulative Percent
FA	1	2.1	2.1	2.1
HT	3	6.3	6.3	8.3
STN	3	6.3	6.3	14.6
MNG	26	54.2	54.2	68.8
CG	15	31.3	31.3	100.0
Total	48	100.0	100.0	

The nature of thyroid disease was diffuse thyroid enlargement (DTE) 20(41.7%), multi nodular goitre (MNG) 28(58.3%),

Forty six (95.8%) were not previously undergo thyroid surgery versus 2(4.2%) had previous thyroid surgery.

The mean No. of washes was lower among group B2 0.1±0.3, versus 1.2±0.4 for groups A2and B1, and A1 2.2±0.4this relation was statistically significant as shown in table (2).

Table(2): The mean Number of washes among study groups

Number of washes	N	Mean	Std. Deviation	Minimum	Maximum	P (F)
A1	6	2.2	0.4	2	3	<0.001(59.9) significant
A2	10	1.2	0.4	1	2	
B1	12	1.2	0.4	1	2	
B2	20	0.1	0.30	0	1	
Total	48	0.9	0.8	0	3	

The mean volume for staining was lower among group B2 0.4±0.1, versus 2.3±0.4, 2.15±0.6, 0.3±0.1 for groups A1, A2 and B1 respectively, this relation was statistically significant as shown in table (3).

Table (3):The mean volume of staining among study groups

Volume for staining	N	Mean	Std. Deviation	Minimum	Maximum	P (F)
A1	6	2.3	0.4	2	3	<0.001(112) significant
A2	10	2.15	0.6	1.5	3	
B1	12	0.3	0.1	0.25	0.5	
B2	20	0.4	0.1	0.25	0.5	
Total	48	1.01	0.9	0.25	3	

The mean Time for parathyroid identification was lower among group B2 0.6±0.3, versus 1.5±0.3, 1.8±0.6, 0.8±0.4 for groups A1, A2 and B1 respectively, this relation was statistically significant as shown in table (4).

Table(4):The mean time for parathyroid identification among study groups

Time for parathyroid identification	N	Mea n	Std. Deviatio n	Minimu m	Maxim um	P (F)
A1	6	1.5	0.3	1.3	2	<0.001 (30.9) significant
A2	10	1.8	0.6	1.45	3	
B1	12	0.8	0.4	0.4	1.25	
B2	20	0.6	0.3	0.45	1.35	
Total	48	0.99	0.6	0.4	3	

The mean Time for RLN identification was lower among group B2 1.1±0.2, versus 1.9±0.3, 2.08±0.5,1.2±0.2 for groups A1, A2 and B1 respectively, this relation was statistically significant as shown in table(5).

Table(5):The mean time for RLN identification among the study groups

Time for RLN identification	N	Mean	SD	Minimu m	Maximu m	P (F)
A1	6	1.9	0.3	1.45	2.2	<0.001 (43.6) significant
A2	10	2.08	0.5	1.4	3	
B1	12	1.2	0.2	1	1.5	
B2	20	1.0	0.2	0.5	1.35	
Total	48	1.4	0.5	0.5	3	

Intraoperatively, RLN could be identified in all the patients, as an unstained structure in the tracheoesophageal groove. The parathyroid glands washing out methylene blue stain within approximately 3 minutes and then become visible in their original yellow colour, whereas it took nearly 15 minutes for the thyroid tissue to wash out the stain in all cases. The perithyroid muscles, tendons and lipoid structures retained the blue colour for more than 30 minutes.

Discussion

Complications associated with thyroid surgery is comparatively reduced now a days. Standardization of the thyroidectomy technique and advances in perioperative management have led to significant decrease in the overall mortality and morbidity over the past decades[2,4,19] . The most important and serious complications following thyroidectomy are RLN injury and parathyroid insufficiency (transient and permanent), when they occur, they cause catastrophic lifelong handicap [12].

Among the various risk factors that results in injury to these structures are reoperation, malignancy, retrosternal goitre, graves' disease and surgeon inexperience[13] .

Another important factor is the extent of resection i.e. TT in opposition to partial thyroidectomies. Permanent post-operative RLN palsy occurs in approximately 0.3–3% of cases and transient palsies in 3–8% of cases(Hayward 2013), while temporary hypocalcemia occurs in 50–68% of post-TT patients and permanent hypocalcemia occurs in 3% of post-TT patients [13] .

The key method to protect RLN and parathyroid glands during thyroid surgery is meticulous dissection, this can be achieved by various means including capsular dissection, protection of parathyroids arterial branches and avoidance of excessive manipulation [14,15] .

Several methods are used to identify the RLN intraoperatively including visual inspection first described by Lahey and Hoover in1938, laryngeal palpation, finger palpation of cricoarytenoid during nerve stimulation, intraoperative neuromonitoring(IONM), direct or fibreoptic laryngoscopy for observation of vocal cords and the use of intramuscular vocal cord electrodes[16,17] .

In a current multicenter trial of 16,448 thyroidectomies, concluded that visual nerve localization, in respect to RLN, is emphasized as the "gold standard" of maintenance [18].

The technique of using dyes in identification of parathyroid glands and prevention of hypoparathyroidism, was first described by Klopper PJ and Moe RE. Initial studies were conducted using dyes like toluidine blue and tryptan blue, however, these were replaced by methylene blue as their teratogenic effects were discovered. All the studies in the literature which are associated with thyroid surgery and parathyroid staining was performed by injecting the dye via intravenous or intra-arterial route. Dudley NE applied an intravenous infusion method on 17 patients and revealed one or more parathyroid glands by this technique. Elias D et al., had

applied the similar technique over 59 cases and was able to precisely localise the parathyroid glands in 87% cases (9).

The technique above ensure the visualization of the parathyroid glands only. This is because of the rich vascularity of the glands, while RLN cannot be identified.

In our study forty eight adult patients were divided into group (A) where the spraying technique was done by a syringe in 16 patients , while in group (B) the spraying technique was achieved by a spraying pump in the remaining 32 patients.

In group A1: with the use of concentration of (2:8) MB :NS, both the concentration and the time required for staining the tissue was agree with Nofal A A ,while differ in the volume of solution needed for staining

,inasmuch we found 2ml of solution is required for adequate staining of the whole perilobar area for better identification of RLN and parathyroid glands . The number of washings required to rinse the tissue are variable with a mean 2.2 ± 0.4 while are not mentioned in any previous study.

In groups B1 and B2 the spraying technique was performed by a spraying pump with both concentrations of (2:8) and (1:10) respectively.MB: NS. We observe that the mean time for staining, number of washings and the stain volume required for staining was much less than that with a syringe insofar the staining by a pump with the concentration (1:10) did not required washing with normal saline. In addition, the resolution was better than the staining with a syringe with both concentration used.We did not find in literatures the usage of spraying pump in the staining of thyroid lobe and perilobar area for identification of both RLN and parathyroid glands

Conclusions

- intraoperative identification of RLN and parathyroid glands by Methylene Blue Spraying is safe, cheap and readily available method which allow the surgeon especially junior one to perform safe thyroidectomy with lower level of stress.

- Both concentration of (1:10) and (2:8) mL of MB: NS by either a syringe or spraying pump helps in the identification of both RLN and parathyroid glands in all patients with disparity in resolution .The technique of spraying by a spraying pump had the superiority to that with a syringe for both concentrations ultimately for that of (1:10) mL of MB: NS in rapid and easier identification of RLN and parathyroid glands.

Conflict of Interest: None

Source of Fndings: Self

Ethical Clearance: Nil

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