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PRESERVATION TECHNIQUE FOR EXTERNAL LARYNGEAL NERVE IN THYROID SURGERY

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Abstract

A prospective comparative study conducted at Basrah Teaching Hospital in Basrah between December 2000 and February 2002. Eighty patients included, they were 13 (16.2%) male and 67(83.7%) female patients, most of the patients aged between 20-50 year (81%). The patients were allocated in two groups, each comprises 40 patients. The external laryngeal nerve (E.L.N) is a motor nerve to cricothyroid muscle of the larynx which concerned with high pitch voice. The incidence of injury to this nerve during thyroid surgery is between 11-25% in the literature. This study aimed to compare the incidence of ELN injury in thyroid surgery between the ordinary approach and the nerve stimulator approach in two groups, and to evaluate the efficacy of nerve preservation technique using nerve stimulator. In the first group, thyroid surgery was done with the aid of nerve stimulator, while in the second group the surgery was done in classical way; we found that the incidence of ELN injury in rthe first group was zero while in the second group was 12.5% (5/40). We Also found increase risk of injury to ELN in thyrotoxic patient and it was about 30.7% (4/13). We concluded that nerve stimulation is an effective method for preservation of ELN in thyroid surgery and we recommend its use in every thyroidectomy specially in cases having thyrotoxicosis, thyroiditis, huge goitre and in certain professional groups like teachers, lectureres singers and female patients.

Introduction

Goiter has been known since 2700 BC[1]. The first thyroidectomy was reportedly performed by moorish surgeon in 952 AC. Thyroid surgery is followed by many complications, one of the most important complication which attract attention is the laryngeal nerve injuries, which include recurrent laryngeal nerve and external laryngeal nerve injuries.

The ELN is a motor nerve to cricothyroid muscle that concerned with high pitch voice. The nerve is a branch of superior laryngeal nerve at the level of hyoid bone[1].

The external laryngeal nerve run on the lateral surface of the inferior constrictor muscle of the pharynx, descend in close proximity to superior thyroid artery, then in 80% it run on the surface of cricothyroid muscle and in 29% within it[2] as shown in figure 1.

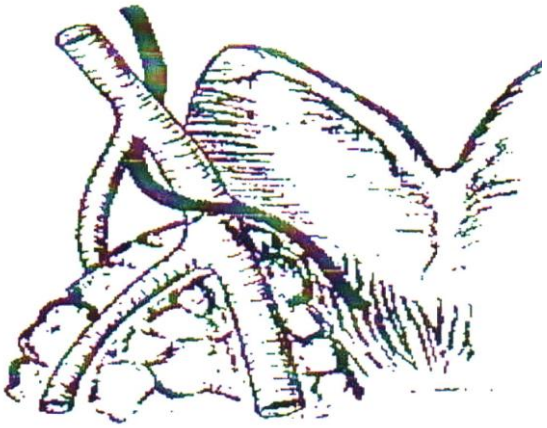

Fig.1: The relationship between external branch of superior laryngeal nerve and superior thyroid artery. The nerve runs partly around the artery or its branches[14].

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Injury to ELN during thyroid surgery is due to its aberrant anatomical course, can lead to change in voice pitch and have devastating results specially to professional voice users like teachers, lecturers and singers. Incidence of such injury is between 11-25% in the literature[3].

This study is designed to compare the incidence of ELN injury in thyroid surgery between the ordinary approach and nerve stimulator approach in two groups of patients, and to evaluate the efficacy of nerve preservation using nerve stimulator.

PATIENTS AND METHODS

This is a prospective study conducted at Basrah Teaching Hospital between December 2000 and February 2002. All our patients presented with thyroid enlargement underwent the usual preoperative investigations and assessment at the ENT department. The assessment included; voice evaluation with special attention to the voice pitch and character, indirect laryngoscopy seeking for cord symmetry, mobility and bowing which is a sign of ELN palsy. Any patient with cord abnormality, laryngeal infection and subclinical laryngeal nerve dysfunction was excluded from the study.

Our patients were divided into two groups; Group I: Thyroid surgery was done with the aid of nerve stimulator, Group II: thyroid surgery was done in the usual way. Induction of anaesthesia was completed with 3-5 mg/kg thiopentone. Intubation was performed with the aid of 1 mg/kg suxamethonium. Patient was put in head extension position with endotracheal tube on one side in order to visualize the cords with the laryngoscope during the operation. Maintenance of anaesthesioa was achieved by neuroleptic anaesthesia with oxygen and halothane beside the use of intermittent suxamethonium as it is needed for the purpose of relaxation. Positive assisted ventilation was set using high rate and low pressure ventilation. Intravenous fluid used accordingly, monitoring tools were the pulse oxymetry, blood pressure and heart rate.

Operative technique: Surgical procedure conducted in the usual steps. The superior thyroid pole was mobilized, gently drawn caudally and rotated laterally to demonstrate the cricothyroid space. The nerve stimulator needle electrodes (Electro-acupuncture unit IC-1107, ITO Ltd) (Figure 2) was prepared. Stimulation was started by one milliamp (1mA) with frequency of 1.5 Hz to the uppermost point of the superior pedicle downward. The surgeon notice rhythmic contraction of ipsilateral cricothyroid muscle and at the same time the anaesthesiologist checks the rhythmic cord movements by direct laryngoscopy. The point at which the movement of the cord disappears was marked by ligature and the superior pedicle was ligated at this point which is far from any ELN fibers.

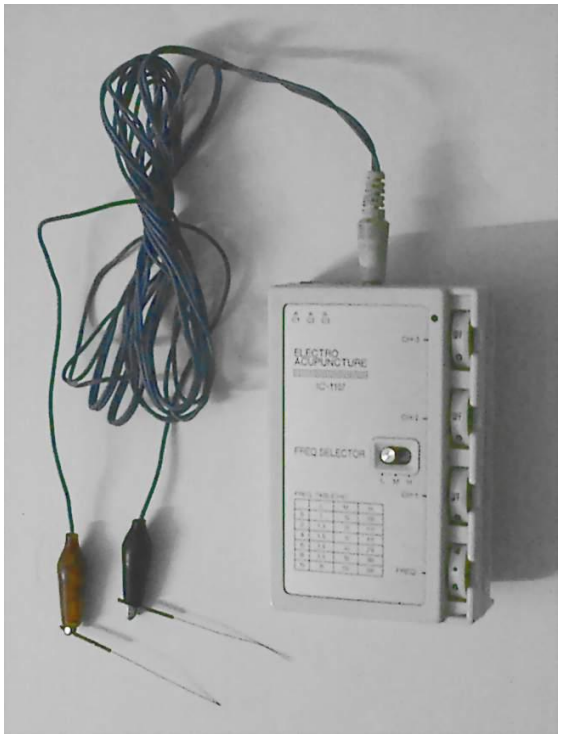

Fig.2: Electro-acupuncture unit IC-1107, ITO Ltd.

We repeat the procedure at the contralateral side and the rest of the surgery was conducted in the usual fashion. At recovery, the cords were checked again by direct laryngoscopy to assess the cords position and movement.

In group II patients, the procedure was done as usual without nerve stimulator.

All the patients were discharged at the second or third postoperative day. Indirect laryngoscopy was done at the fifth postoperative day by the same ENT doctor and any changes from the base line were recorded.

Any patient discovered to have ELN injury was followed up weekly for 2-3 visits. All the patients were operated upon by the same team with the same described steps of surgery and nerve stimulation.

Results

Eighty patients included in this study were allocated in 2 groups, each containing 40 patients. They were 13 (16.2%) male and 67 (83.7%) female patients as shown in table I.

Table I: Sex distribution of patients in both groups.

Sex	Male	Female	Total
Group I	7	33	40
Group II	6	34	40
Total	13	67	80

Most of our patients aged between 20-50 years (81%) as shown in table II.

Table II: Age distribution of patients in both groups.

Age yr.	Group I	Group II	Total
10-20	1	-	1
20-30	5	12	17
30-40	13	14	27
40-50	14	7	21
50-60	7	4	11
60-70	-	3	3
Total	40	40	80

The patients underwent different forms of thyroid resection; 25 (31%) having lobectomy, 53 (66%) having subtotal thyroidectomy and 2 (2.5%) having total thyroidectomy as shown in table III.

Table III: Type of thyroidectomy.

	Lobectomy	Subtotal	Total
Group I	13	26	1
Group II	12	27	1
Total	25	53	2

Table IV shows the patient distribution with regards to thyroid state in which 22 (27.5%) hyperthyroid patients and 58 (72%) were in euthyroid status.

Table IV: Thyroid functional status.

Status	hyperthyroid	Euthyroid
Group I	9	31
Group II	13	27
Total	22	58

The incidence of ELN injury among group I patients was zero while in group II it was 12.5% (5/40). It represents a serious problem to those patients specially female patients as shown in table V.

Table V: Patients with ELN injury.

	ELN injury	ELN normal
Group I	0	40
Group II	5	35
Total	5	75

Table VI shows the histopathological diagnosis of all the cases.

Table VI: Histopathological diagnosis.

	Group I	Group II
Multinodular goiter	30	29
Toxic nodular goiter	2	5
Lymphocytic thyroiditis	3	3
Papillary carcinoma	1	1
Follicular carcinoma	1	1
Follicular adenoma	1	1
Diffuse toxic goiter	2	0
Total	40	40

We also found that ELN injury occurs mostly in thyrotoxic patients of group II (4/13, 30.7%) as shown in table VII which show the characteristics of patients suffered from ELN injury.

Table VII: Characteristics of patients with ELN injury.

Case No.	Thyroid status	Type of thyroidectomy	Gender	Histopathology
I	Hyperthyroid	Subtotal	F	Toxic nodular goiter
II	Hyperthyroid	Subtotal	F	Toxic nodular goiter
III	Euthyroid	Total	M	Papillary carcinoma
IV	Hyperthyroid	Subtotal	F	Toxic nodular goiter
V	Hyperthyroid	Subtotal	F	Toxic nodular goiter

Discussion

The ELN has an important aberrant anatomical course that increases the chance of its injury during thyroid surgery. In a study done by Kierner AC et al in 1998 they found four types of relationship between the ELN, the upper pole of the thyroid gland and the superior thyroid artery (STA). In 42% the ELN cross the STA more than 1 cm above the upper pole of the thyroid gland (type I). In 30% the ELN cross the STA less than 1 cm above the superior thyroid pole (type II). In 14% the eln cross the STA undercover of the upper pole (type III) and in type IV, 14% of ELN descend dorsal to the artery and only cross the branches of STA immediately above the upper pole[4].

In similar study done by Cernea CR et al in 1992, they found that 37% of the nerve were type II which was subdivided into type IIa in which the ELN remain cranial to the upper pole and they also found that 20% were type IIb which means crossing the vessel below the upper border of the pole, this was considered as a high risk as shown in figure 3 and also they found a dangerous anatomic variation of ELN in range of 15%-68% confirming that significant portion of those nerves might be at risk during surgery of superior pole[5] as shown in table VIII which demonstrate the percentage of a high risk nerve in many studies[14].

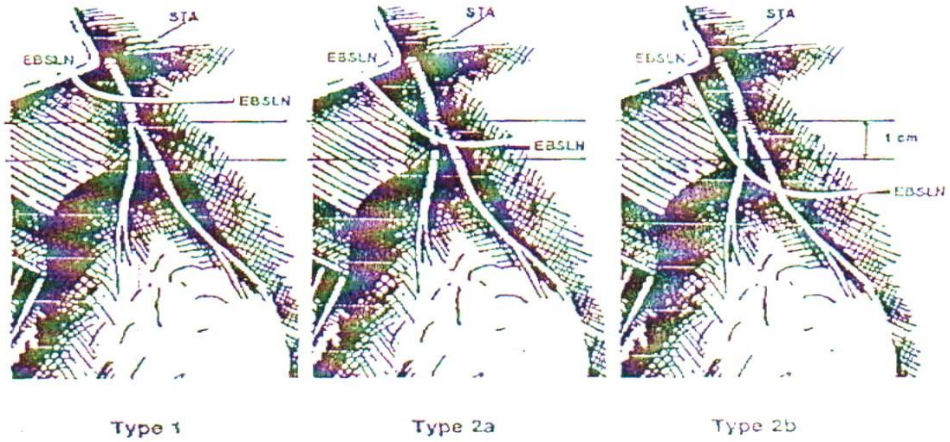

Figure 3. Classification of the external branch of the superior laryngeal nerve (EBSLN) according to the potential risk during thyroid operation. (STA superior thyroid artery.) Type 1: EBSLN crossing the superior thyroid vessels 1 cm or more above the upper border of the superior thyroid pole. Type 2a: EBSLN crossing the vessels less than 1 cm above the upper border of the superior thyroid pole. Type 2b: EBSLN crossing the vessels below the upper border of the superior thyroid pole[(14)].

Table VIII: Percentage of high risk external branch of superior laryngeal nerve.

Study	Dissections No.	High risk %
Cernea et al	**30**	**20**
Cernea et al	**28**	**14**
Clader et al	**96**	**68**
Durham et al	**100**	**25**
Espinosa et al	**30**	**15**
Lennquist et al	**50**	**18**
Moosman et al	**400**	**21**

We found that direct intraoperative search for nerve fiber is rather difficult and time consuming procedure owing to the above anatomical variations. Le febree B in his study tried strictly to avoid even minor mass ligature, and all vascular structures selectively iden tified, of this consecutive series of 161 upper pole dissection the ELN found only in 31%[6]. also Choksy SA et al found that even with individual ligation of STA glandular branches, it is unusual to visualize the ELN because of its small size and variable course[7].

This study showed that effective intraoperative prevention of ELN injury is by using the nerve stimulator as none of our cases operated upon by this method showed any voice change or cord abnormality on postoperative laryngoscopic examination. In contrary, we found that 12.5% of the patients managed by ordinary approach have ELN injury.

Ferraz AR et al in 1992 used a nerve stimulator to identify ELN with no nerve injury and they found that 28% of cases done without nerve stimulator experienced complete lesion of ELN[8].

In another study in 1988 conducted by Choksy and Nicholson they used a nerve stimulator during thyroidectomy for 3 singers and they record no postoperative voice change in those professional voice users[7].

In our study, we used the nerve stimulator in thyroidectomy for 3 teachers and proved an excellent protection to their voice, also 33 female patients done with this method showed no voice changes as shown in table I.

Zerilli M in 1994 used the electro-myography of cricothyroid muscle for preoperative and postoperative evaluation of the patients with goiter and found fairly high incidence of permanent and temporary lesions of ELN[9]. But the EMG of cricothyroid muscle is difficult technically because: Difficult electrode placement in such small muscle, Evoked EMG is not a practical test because of the difficulty to locate and selectively stimulate a motor nerve, also the close proximity of cricothyroid muscle to the large strap muscles[10]. Another study by Teitelbaum BJ et al in 1995 used both cricothyroid EMG and laryngeal videostroboscopy which maybe necessary for the diagnosis of ELN injury[11].

Table VII showed the characteristics of patients with ELN injuryand as shown, most of the patients were thyrotoxic underwent subtotal thyr-oidectomy (4/5). The fifth patient had total thyroidectomy for carcinoma of the thyroid so as known the surgery for thyrotoxicosis is somewhat difficult and associated with increased incidence of complications and the use of nerve stimulator in such cases may minimize the injury to ELN. It is also important to use this technique in thyroidectomy for patients who rely on their voice professionally like teachers, lecturers and singers.

Table IX showed previous studies trying to preserve the ELN with nerve stimulator technique with the results they had achieved in comparison with this study.

Table 1X: Incidence of ELN injury with the use of nerve stimulator in all studies.

Team	Year	No. of cases	Incidence of injury
Choksy	**1996**	**3**	**0%**
El-Guindy[12]	**2000**	**74**	**2.4%**
This study	**2001**	**40**	**0%**

Table X shows the incidence of ELN injury in previous studies that did not used nerve stimulator technique. As shown in these tables that our results are comparable with these studies.

Table X: Incidence of ELN injury without use of nerve stimulator in all studies.

Team	Year	No. of cases	Incidence of injury
Ferraz	**1992**	**76**	**28%**
Mclvor[13]	**2000**	**50**	**10%**
This study	**2001**	**40**	**12.5%**

We conclude that the technique of ELN preservation during thyroidectomy by nerve stimulator is an efficient way and showed encouraging results in prevention of voice changes following thyroidectomy, therefore we recom mend its use in every thyroidectomy specially in cases of thyrotoxicosis, thyroiditis, huge goiter and in certain professional groups such as teachers, lecturers and singers.

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