

Safe Thyroidectomy without Nerve Detector Stimulation. A Maneuver Adds More Safety during Total Thyroidectomy, Comparative Study

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ABSTRACT

Background: One of the most invasive procedures in endocrine surgery is the thyroidectomy. When the procedure is carried out in the appropriate surgical settings, it is safe with little morbidity and zero fatality

Objective: We aimed to visualize the RLN and parathyroid and confirm it by staining with Diluted gentian violet for safe total thyroidectomy.

Patients and Methods: At Assiut University Hospital, a quasi-experimental study was conducted on primary (not recurring) complete thyroidectomy that was performed on 100 individuals with benign and malignant goitre diseases. The patients were divided into two groups: 50 cases were operated on using the diluted gentian violet spraying approach in group 1 (interventional group), and 50 cases were established using the traditional procedure in group 2 (control group). The perilobe and thyroid lobe were covered with diluted gentian rinse. The recurrent laryngeal nerve and parathyroids were discovered and assessed.

Results: In all cases, the recurrent laryngeal nerve was left uncolored and remained white, while all other tissues were coloured blue. The blue stain was washed out and the parathyroid glands' natural yellow hue appeared within three minutes. The thyroid gland was washed out in about 15 minutes.

Conclusion: A new method called diluted gentian violet spraying makes it possible to recognise both parathyroid glands and recurrent laryngeal nerves. This method is technically sound, reliable, and safe.

Keywords: Intraoperative, Diluted gentian violet, Safe, Spraying, Thyroidectomy.

INTRODUCTION

One of the most invasive procedures in endocrine surgery is the thyroidectomy. When the procedure is carried out in the appropriate surgical settings, it is safe with little morbidity and zero fatality⁽¹⁾. The extent of the excision and the surgeon's level of experience are both directly connected with thyroid surgery complications^(1, 2). As a result, thorough dissection techniques, proper training, and an understanding of anatomy and pathology are the cornerstones of safe and effective thyroid surgery. It is possible to use the thorough dissection approach by properly exposing all fine anatomical features in a dry, bloodless operating room. Additionally, a thorough understanding of the three-dimensional topographic anatomy, common landmarks, and potential anatomic deviations must underpin the dissection.

PATIENTS AND METHODS

The Medical School of Assiut University uses the hospital as its primary teaching facility. The research was carried out from May 2017 to February 2020. Participants in the study, one hundred patients underwent complete thyroidectomy for benign and malignant goitre illnesses.

Exclusion criteria: People who had recent surgery, had vocal cord dysfunction before surgery, or had mental impairment were not included.

The patients were split into two groups: group 1 (interventional group) had 50 cases operated on using the diluted gentian violet spraying approach, and group

2 (control group) had 50 cases set up using the traditional technique.

METHODOLOGY

Investigation design: This quasi-experimental study was conducted at the University Hospital of Assiut. All patients were subjected to: Serum T3, T4, and TSH levels estimation, vocal cord examination by direct laryngoscope, serum calcium level determination (total and ionized), neck ultrasound, and fine-needle aspiration cytology. Follow-up was offered to all patients particularly those who developed hypoparathyroidism and monitoring of calcium level was done every week until serum calcium level returned to normal.

Procedures: Surgeons of Assiut General Surgery Department performed operations and general anesthesia was used. Collar incision was made in the skin, the subcutaneous tissue, and platysma muscle. The superior thyroid pole was dissected, the middle thyroid vein was tied off, and the strap muscles split vertically in the midline and retracted laterally. When the superior vessels are separated, which enables us to medially rotate and anteriorly mobilise the gland, the critical components in this region are best exposed. The thyroid lobe and perilobe area were sprayed with diluted gentian violet in 4 ml (0.1%) strength ampules. Both the parathyroid glands and the recurrent laryngeal nerve are susceptible to damage in this area. Although, the wash-out time for thyroid glands was longer than 15 minutes,

we discovered that it was less than 3 minutes for parathyroid glands. But the recurrent laryngeal nerve (RLN) barely picked up the dye (Figs. 1–3). The parathyroid glands were located, and an effort was made to remove the gland from the thyroid lobe while still ensuring that each had a sufficient blood supply. All along its path, care was made to prevent harm to the recurrent laryngeal nerve. With care given to prevent harm to the nerve, it is carefully shielded from the tissue around it. When the parathyroid and nerve have been located and preserved, we ligate the inferior pole removing it from its tracheal attachments.

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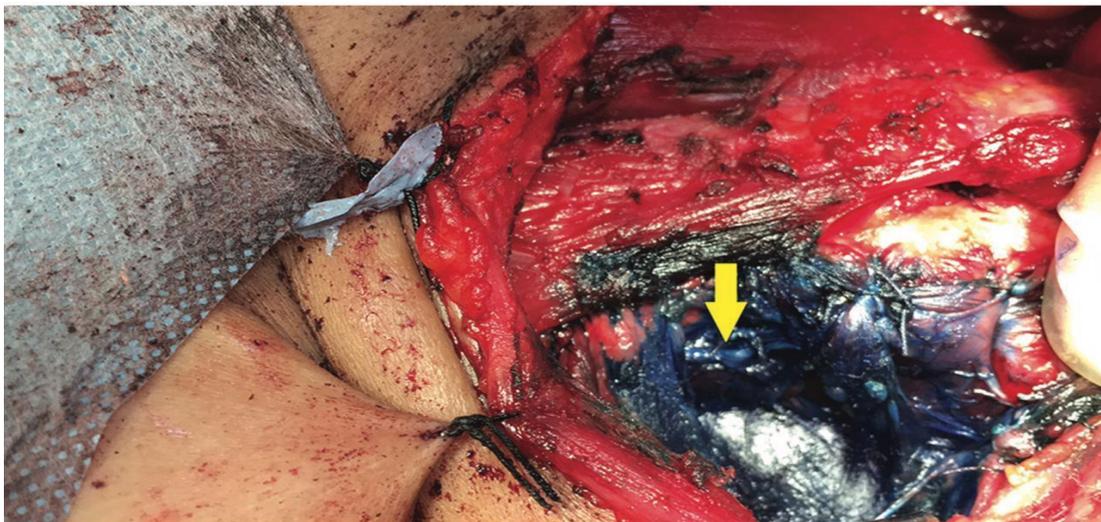


Fig (1): Recurrent laryngeal nerve identification, the nerve did not take the stain (yellow arrow).



Fig (2): Recurrent laryngeal nerve (yellow arrow) and parathyroid gland (white arrow) identification.

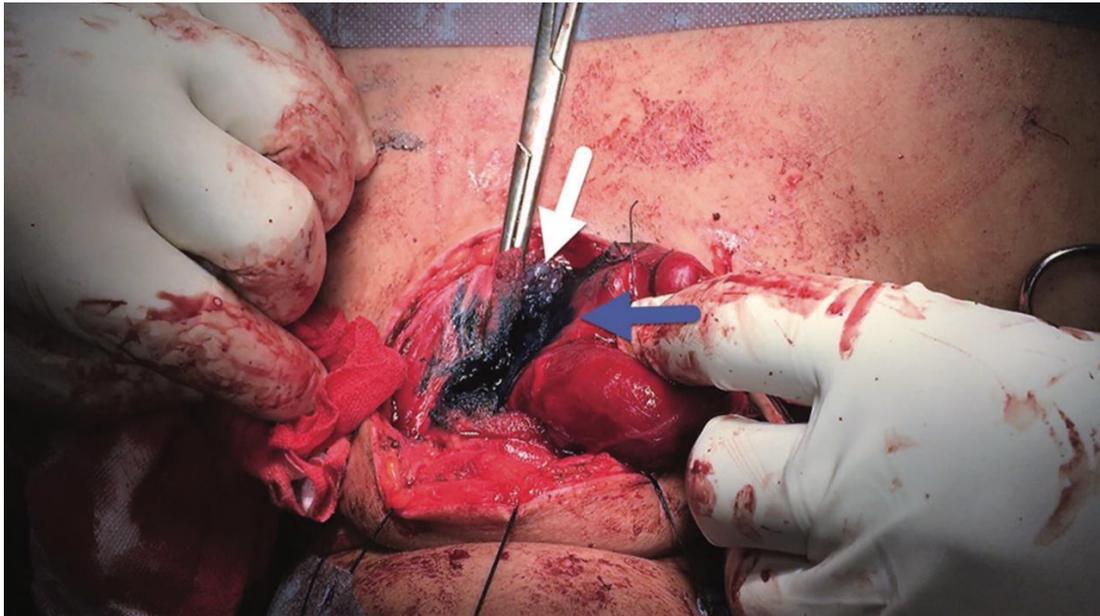


Fig (3): Wash out of the stain from parathyroid gland (white arrow) and thyroid gland still blue (blue arrow).

Ethical Approval: Each participant in the study provided written informed consent, which was obtained after the study was given the go-ahead by Assiut University Ethics Board. The Declaration of Helsinki, the code of ethics of the World Medical Association, was followed when conducting this research on humans.

Statistical analysis

Data were entered and analyzed using IBM-SPSS software (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp). Data expression: Qualitative data were expressed as N (%). Quantitative data were initially tested for normality using Shapiro-Wilk’s test with data being normally distributed if $p > 0.050$. Presence of significant outliers (extreme values) was tested for by inspecting boxplots.

Quantitative data were expressed as median (minimum – maximum) as data were not normally distributed / have significant outliers.

RESULTS

This study was conducted on 100 cases of total thyroidectomy (200 thyroid sides), 87 females and 13 males. Two groups of patients were formed: group 1 (the interventional group) consisted of 50 cases treated using the diluted gentian violet spraying approach, and group 2 (the control group) consisted of 50 cases using the traditional technique. The mean age for the study groups was 49.52 ± 13.97 for group 1 and 45.38 ± 9.30 for group 2 (**Table 1**).

Table (1): Personal data of the studied groups

		Group I (n= 50)		Group II (n= 50)	
		No.	%	No.	%
Sex:	Male	9	18	4	8
	Female	41	82	46	92
Age: (years)	Mean \pm SD	49.52 \pm		45.38 \pm 9.30	
	Range	25.0 - 85.0		26.0 - 62.0	

In group 1, there were 45 (90%) cases with simple nodular goiter (SNG), two (4%) cases with malignant nodules, two (4%) cases with primary toxic goiter, and one (2%) case with secondary toxic goiter. In group 2, there were 46 (92%) cases with SNG, 0 case with malignant nodule, two (4%) cases with primary toxic goiter, and two (4%) cases with primary toxic goiter (**Table 2**).

Table (2): Examination and clinical diagnosis

	Group I		Group II (n=	
	No.	%	No.	%
Examination:				
Multiple nodules	40	80	42	84
Solitary nodule	6	12	4	8
Dominant nodule	2	4	2	4
Symmetrical enlargement	2	4	2	4
Clinical				
S.N.G.	45	90	46	92
Malignant nodule	2	4	0	0
1ry toxic	2	4	2	4
2ry toxic	1	2	2	4

All patients in the study had mobile vocal cords by preoperative vocal cord examination. One case developed postoperative transient bilateral vocal cord paralysis in group 2 and no vocal cord affection was noticed in group 1 (Table 3).

Table (3): Vocal cords examination pre-operative and post-operative

Vocal cords examination	Group I (n= 50)		Group II (n= 50)	
	No.	%	No.	%
Pre-operative:				
Mobile	50	100.0	50	100.0
Post-operative:				
Mobile	50	100.0	49	98.0
Unilateral immobile	0	0.0	0	0.0
Bilateral immobile	0	0.0	1	2.0

When we compared calcium level preoperatively and postoperatively, we found that in group 1 all the cases (50 patients) had normal Ca⁺⁺ level (100%). But in group 2, four (8%) patients had hypocalcemia with significant difference between calcium level preoperatively and postoperatively (Table 4). The four patients who developed hypocalcemia were managed with oral supplementation of calcium and vitamin D and recovery occurred within a period of 1 week to 1 month.

Table (4): Neck ultrasound

Neck US	Group I		Group II	
	No.	%	No.	%
Multiple nodules	40	80.0	42	84.0
Dominant nodule	3	6.0	2	4.0
Solitary nodule	5	10.0	4	8.0
Symmetrical	2	4.0	2	4.0

DISCUSSION

The second most prevalent endocrine ailment at Assiut University Hospital, behind diabetes mellitus, is thyroid disorders. This work was motivated by the desire to discover a thyroidectomy technique that was effective, secure, and cost-effective.

While the thyroid glands took more than 15 minutes to wash off, the parathyroid glands took less than 3 minutes, and RLN did not remove the stain at all. The lympho-vascular pattern of the tissues is what causes the time disparities. The parathyroid glands have a wealthy lympho-vascular system. The Schwann sheath that covers the recurrent laryngeal nerve prevents it from becoming stained.

Evaluation of postoperative hypoparathyroidism:

Postoperative hypo-parathyroidism is a serious problem that could result in an extended hospital stay and ultimately higher costs. There is a clear distinction between the two study arms in postoperative hypocalcemia. In group 1 (with diluted gentian violet spraying technique), there were no cases detected in comparison with the other group (with the conventional technique), where four (8%) cases developed transient hypocalcemia. Transient hypoparathyroidism was reported to occur between 6.9 and 46% of the time, whereas persistent hypoparathyroidism was reported to occur between 0.4 and 3.3% of the time.

According to **Falk et al.** (3), temporary hypoparathyroidism affected 27.8% of patients and was easily treated with oral vitamin D and calcium. All studies including thyroid surgery and the staining of the parathyroid glands used intravenous or intra-arterial injections of diluted gentian violet. Histological proof of only one or a few of the parathyroid glands has been provided. The identical method was applied by **Elias et al.** (4) to 59 thyroidectomy patients. In 87% of cases, gland localization was possible. The aforementioned intravascular (intravenous and/or intra-arterial) procedures only provide parathyroid gland vision, which makes hypoparathyroidism prevention simpler. In our investigation, 96% of the time it was possible to locate and identify the glands (4-6).

Sari and colleagues (7) studied 56 patients who had undergone primary (non-recurrent) thyroid surgery for a variety of thyroid diseases using the diluted gentian violet spraying technique. There was no surgical mortality, although 5% of patients experienced transient hypoparathyroidism. Temporary hypocalcemia occurred in three cases, but only for a maximum of three days. Hypoparathyroidism improved with oral calcium supplementation, and normal serum parathyroid hormone levels followed (7).

Assessment of postoperative RLN injury:

Recurrent laryngeal nerve palsy is another significant side effect of thyroid surgery (8). This significantly lowers life quality and has a major impact on how well people perform at work (9-11). Recurrent laryngeal nerve palsy was reported to occur in 1.8% of cases by **Erbil et al.** (12). The gold standard in thyroid surgery is the preservation of RLN' anatomy and functionality.

The incidence of permanent RLN palsy following thyroid procedures has decreased because to visual RLN detection. Unexpected RLN palsy still happens. In contrast to group 2, which had one case of bilateral vocal cord affection, there were no cases of RLN injury in group 1 (using the diluted gentian violet spraying approach) of our study. Over the past few decades, a variety of medical equipment have been developed for intraoperative use to aid in the identification of the RLN

and the measurement of its function prior to thyroid excision.

The use of intramuscular vocal cord electrodes, finger probing of the cricoarytenoid muscle during nerve stimulation, and direct or fiberoptic laryngoscopy observation of the vocal cords are a few techniques that have been documented for RLN monitoring⁽¹³⁾. Today, especially in specialised institutions, the RLN is frequently identified by intraoperative nerve monitoring (IONM), which enables identification and functional evaluation of the RLN in the operating field. Shedd and Flisberg first suggested using IONM during thyroid surgeries in 1966 and 1970 respectively⁽¹⁾.

In 449 thyroid and parathyroid procedures, **Randolph and colleagues**⁽¹⁴⁾ evaluated the laryngeal palpation technique employing RLN stimulation. During surgical RLN stimulation, laryngeal palpation and laryngeal Electromyography (EMG) recordings were compared in a group of patients. No RLN paralysis that lasted forever was observed in this investigation. One incidence of transient RLN paralysis was brought on by neural stretch and was recovered six weeks after surgery (temporary paralysis rate: 0.2% of patients).

Between June 2007 and December 2012, 2034 thyroidectomy patients were investigated by **Cal and colleagues**⁽¹⁵⁾. They contrasted individuals who underwent IONM with those who underwent surgery alone using nerve imaging. Nine hundred and ninety-three patients underwent IONM surgery, while 1041 patients underwent nerve visualisation alone. 28 (2.82%) recurrent laryngeal nerve damage in IONM patients were noted, 21 (2.11%) temporary, and seven (0.7%) permanent. 23 (2.21%) recurrent laryngeal nerve injuries were noted in individuals with RLN visualisation alone, with 17 (1.63%) cases being temporary and six (0.58%) being permanent. Statistics did not support differences. Therefore, in thyroid surgery, visual nerve identification continues to be the gold standard for recurrent laryngeal nerve identification. However, **Calo et al.**⁽¹⁵⁾ study found that IONM did not reduce nerve injury compared to vision alone. It did, however, assist in identifying the nerve, particularly in challenging situations.

Gremillion and associates⁽¹⁶⁾ performed a retrospective chart review, analysis of the operation, comparison of the time spent with and without IONM, evaluation of postoperative vocal cord function, and literature study. They concluded that, in 119 procedures, neither lobectomy nor complete thyroidectomies were faster thanks to IONM. The cost of each surgery increased by \$387 due to the use of IONM, yet the number of injured nerves did not significantly reduce.

Strengths of the study:

The current study entails identifying not only the parathyroid glands but also recurrent laryngeal nerves. We aimed to visualize the RLN and parathyroid and

confirm it by staining with Diluted gentian violet. The intravascular techniques ensure only parathyroid gland visualization. The current study adds no additional cost on the patient unlike the technique of IONM. We did not use any expensive device. Only the dye and our vision were used. Diluted gentian violet dye is inexpensive and is readily prepared in the bacteriology unit in the Clinical Pathology Department in Assiut University Hospital, where it is packed in ampules at 4 ml (0.1%) concentration and sterilized.

STUDY LIMITATIONS

The number of cases was limited and many surgeons perform thyroidectomy without trial to identify the RLN and parathyroid in anticipation of their injury. It's crucial to conduct additional research with a bigger sample size of patients and to have many surgeons use the approach in order to verify its dependability and efficiency.

CONCLUSION

All thyroid surgeons wanted to avoid any hazards to the nerves and parathyroid glands during the thyroidectomy. Some surgeons believe that identifying the RLN and parathyroid entails a higher risk of harm and do not choose to do so. Others observe that the surgeon experiences less stress the sooner the nerve and parathyroid glands are found. Diluted gentian violet spraying technique is safe, effective, and technically feasible. In order to identify the RLN and parathyroid, we showed that the spraying method was effective and that intravascular injection, with all of its possible hazards, was not required. It's crucial to confirm the validity and utility of this procedure in new trials involving bigger numbers of patients and application by various surgeons. None in terms of funding or sponsorship. There are no interests that could be at odds with one another.

DECLARATIONS

- **Consent for Publication:** I confirm that all authors accepted the manuscript for submission
- **Availability of data and material:** Available
- **Competing interests:** None
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Authorship Criteria

1. Authors made substantial contributions to conception and design, and/or acquisition of data, and/or analysis and interpretation of data.
2. Authors participated in drafting the article or revising it critically for important intellectual content.
3. Authors gave final approval of the version to be submitted and any revised version to be published.

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