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Original Article

A Descriptive Study about the Cardinal Anatomical Structures to be Preserved during Thyroidectomy and tips for it

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Abstract

Background: *Thyroidectomy is one of the most commonly performed procedure for both benign and malignant diseases of the thyroid. By developing a thorough understanding of anatomical landmarks and by making use of them, the surgeon can minimise the risk associated with the procedure. Experience of the surgeon is a significant factor in minimising or dealing with the complications. During each thyroidectomy, recurrent laryngeal, external branch of superior laryngeal nerves, and parathyroids should be routinely preserved. For this, various approaches like inferior, superior or lateral, tubercle of Zuckercandl, or landmarks like inferior thyroid artery, space of reeves may be used. The unidentified nerves are most likely to be damaged leading to high morbidity and rarely mortality. Transient or permanent hypoparathyroidism is due to inadvertent gland removal or injury to its vascular pedicle.*

Aim: *To analyse the cardinal anatomical structures to be preserved during each thyroidectomy and the tips for safeguarding them. Material and methods: This is an observational study of 75 thyroidectomies performed for various indications from 2016 December to 2018 December. Surgical details from case sheets and surgical register were perused for it. Patients on medical treatment for thyroid diseases were excluded.*

Conclusions: *The recurrent laryngeal nerve, external branch of superior laryngeal nerve and parathyroids are the cardinal structures to be preserved during each thyroidectomy. Inferior, superior or lateral approaches, tubercle of Zuckercandl, superior or inferior thyroid arteries, space of reeves may be used.*

Keywords: *External branch of superior laryngeal nerve, Parathyroids, Recurrent laryngeal nerve, Thyroidectomy, Tubercle of Zuckercandl.*

Introduction

Thyroidectomy is one of the most commonly performed procedure for both benign and malignant diseases of the thyroid[1] . The first credible account of thyroid surgery was given in 1170 by Roger Frugardi Salerno in the Bamberg manuscripts. The mortality of thyroid surgery in early 1800s was approximately 50%. Theodor Kocher, Theodor Billroth, William Halsted are a few pioneers associated with the renaissance of thyroid surgery. By developing a thorough understanding about

the anatomical landmarks, and by making use of them during surgery , the surgeon can minimise the risk associated with the procedure. Experience of the surgeon is a significant factor in minimising or dealing with the complications. During each thyroidectomy, recurrent laryngeal, external branch of superior laryngeal nerves (RLN, EBSLN) and Parathyroids (PT) should be routinely preserved. For this, inferior, superior or lateral approaches(IA,SA,LA), tubercle of Zuckercandl (TZ), superior or inferior thyroid arteries (STA,ITA), space of reeves (SR) may be used[2,3,4,5]. The nerves not identified is most likely to be damaged leading to high morbidity and rarely mortality. Transient or permanent hypoparathyroidism is due to inadvertent gland removal or injury to its vascular pedicle. Dissection close to the thyroid capsule and ligation of capsular branches of thyroid avoiding the main trunk of inferior thyroid artery holds the key.

Aim

To analyse the cardinal anatomical structures to be preserved during each thyroidectomy and the tips for safe guarding them.

Material and Methods

This is an observational study of 75 thyroidectomies performed for various indications at a tertiary care institution at north Malabar, Kerala, from 2016 December to 2018 December. Surgical details from case sheets and surgical register were perused for it. Patients on medical treatment for thyroid disorders were excluded in this.

Data Collection: Intra operative documentation of indication, duration of surgery, anatomical landmarks and techniques for identification and safeguarding RLN, EBSLN and PT by various approaches, were noted.

Results

75 cases were analysed during the study period. RLN was identified by inferior approach in 27 cases, by lateral approach in 31 cases and by TZ in 15 cases. In 02 cases RLN was not identified. EBSLN were identified in 60 cases by opening up the space of reeves (SR) and dissecting medial to superior thyroid pedicle. Superior parathyroid was identified by tracing posterior branch of superior thyroid artery or was just superior to entry point of RLN into larynx. There was no intra or post operative mortality in this study. Tracheostomy was required in 2 cases, permanent hypo parathyroidism in 8 cases.

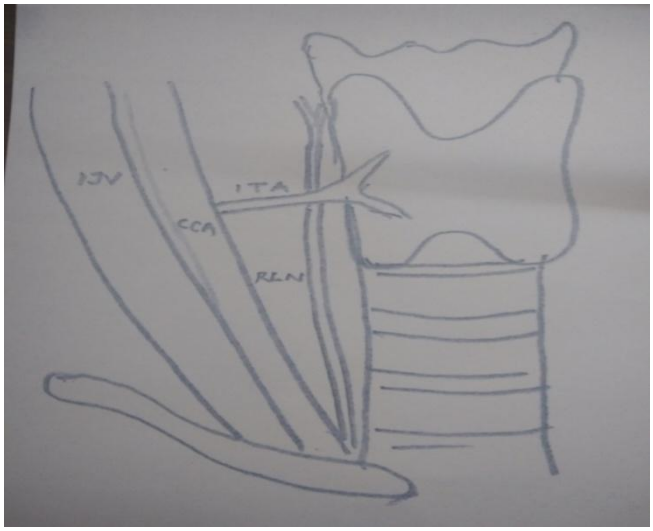

Fig 1 Riddle's triangle

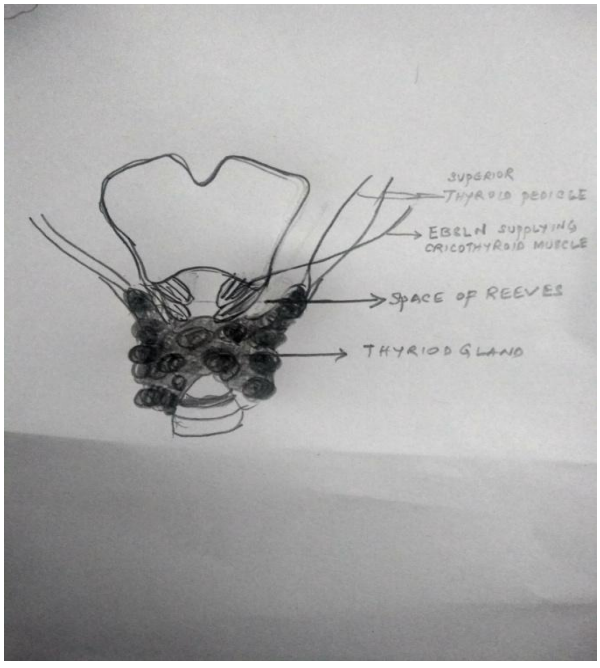

Fig 2 Space of reeves

Discussion

The three cardinal structures to be identified and preserved during each thyroidectomy are RLN, EBSLN and PT and is evident by the importance given to it by any operating surgeon. Withholding the use of diathermy during its dissection reduces the chances for a thermal injury to these vital structures. Complication rates were more commonly seen in males compared to females in our study contrary to the usual. All hemithyroidectomy procedures were free of complications. We could not identify the RLN in 02 cases. Two tracheostomies were needed in cases of thyroid malignancy in our study. One was due to permanent vocal cord palsy and the other due to tracheomalacia. The only way to avoid RLN injury is its deliberate identification in the neck. There are various landmarks like ITA, TZ, inferior or superior approaches(IA,SA) for it. In our experience IA was most commonly used, followed by LA and TZ. In inferior approach, the pretracheal fascia is opened laterally. First middle thyroid vein is identified, ligated and divided. Afterwards the gland is mobilised and the lobe is delivered out. The strap muscles are retracted laterally to expose the trachea esophageal groove(TEG). Riddles triangle (RT), which is bounded superiorly by the ITA, medially by the trachea, laterally by the common carotid artery is an important landmark[7].(fig1).The loose areolar tissue is incised at its apex, and is continued upwards towards the ITA to expose the RLN. A retractor is used on the lateral side to keep the sternomastoid and the strap muscle and the contents of the carotid sheath away from the gland and a finger traction on the trachea gives good exposure of the RT. Close to the entry point of the ITA, tubercle of Zuckerkandl (TZ), a tongue like postero lateal extension of the gland can be seen[8]. The RLN runs underneath this tubercle usually. Dissecting the loose areolar tissue just inferior to the TZ will enable us to locate the RLN. In lateral approach, after retracting the strap muscles laterally, the pretracheal fascia is opend longitudinally from lateral to medial thus exposing the ITA. Once it is identified, the RLN will be in close relation with it. RLN may pass superior, inferior to main trunk of ITA or may be in between the branches of it[9].

Identification and preservation of external branch of superior laryngeal nerve (EBSLN) is now standard step during thyroidectomy. The EBSLN is identified in the Joll's triangle[10]. It is bounded laterally by upper pole of thyroid gland and the vessels, superiorly the attachment of the strap muscles and investing layer of deep cervical fascia to hyoid and medially by the midline. The floor is formed by the cricothyroid muscle(CTM). The EBSLN lies within this triangle. During thyroidectomy, as one approaches the superior pedicle, the gland is pulled inferolaterally so that space opens up between the medial surface of superior pole and the cricothyroid muscle. This is space of reeves(SR)[11](fig 2). Once this is entered the EBSLN can be easily identified. It is also a good practice to ligate the STA and STV individually as close to the gland as possible to prevent EBSLN injury and a AV fistula formation. The nerve is always at risk, and morbidity associated with it is very high. It is the only motor innervation of the CTM that serves as the tensor of the vocal cord[12]. Unilateral EBSLN injury may result in mild voice huskiness, it is the bilateral injury which is more devastating. Temporary or permanent paralysis of CTM results in deterioration of quality of one's voice and or weakness, huskiness, decreased pitch, voice fatigue, inability to produce certain sounds. Cernea et al described the position of EBSLN with superior thyroid arery and classified them into type1, type 2a and 2b[13].

The type 2b EBSLN as described by Cernea is more injury prone, whereas type 1 is the least. In our series the EBSLN injury is to the tune of 2.1%. EBSLN injury incidence after thyroid surgery ranges widely in the literature (0 to 58%). Despite this wide variation, it appears that EBSLN injury is a not uncommon, and is a

frequently overlooked complication of thyroidectomy. An in-depth knowledge of the surgical anatomy of the EBSLN is therefore required from the part of the operating surgeon to protect this nerve during the procedure [14].

The best way to preserve the Parathyroid [PT] function is the deliberate identification of them and safeguarding its blood supply. Superior PT may be at the cricothyroid junction , intimately associated with the RLN, on the posterior surface of the upper part of the thyroid gland, some were located behind the junction of hypopharynx and upper esophagus[15]. The position of inferior PT is more variable. Majority were found on the anterior or lateral surfaces of the lower lobe of the thyroid, within the superior tongue of the thymus, extrathyroidal and lateral to thyroid, in mediastinal thymus or in carotid sheath[16]. The inferior PT receive the blood supply from ITA. The superior PT also receive the blood supply from ITA, but in some cases they receive the supply from superior thyroid artery (STA), the anastomotic loop between STA and ITA or from direct branches from thyroid[17]. So during thyroidectomy, ligation of the capsular branches of ITA alone is the key to prevent the hypoparathyroidism.

After ligation of the superior pedicle, the superior pole of gland is rotated medially, thus exposing the yellow pad of fat on the postero superior surface which contain the superior PT[18]. The capsule over the superior pole is incised to expose the PT with its arterial supply from STA and ITA. Combined with this, tracing the major ascending branch of ITA or the RLN upwards to its entry point to larynx also leads to superior PT. Any yellowish structure towards the inferior pole of thyroid should be viewed with suspicion of being inferior PT. Tracing the uppermost pointed end of thymus, ie flag sign is a commonly used method to identify the inferior PT[19].

Recognition of the PT which appear in a variety shades is critical. Devascularised PT turn black. Such a gland (confirmed by frozen) should be removed and put in ice saline, minced and reimplanted into muscle pockets in sternomastoid or brachioradialis[20]. Their location should be marked with a metal clip or non absorbable suture[21]. The identification and preservation of all PT should be attempted, especially the constant superior ones. Meticulous dissection and absolute haemostasis are the keys in this crucial step. Special care is taken to leave the branches to the parathyroids and ligate only the capsular branches of ITA.

Conclusions

Meticulous dissection, absolute hemostasis, and a thorough knowledge of neck anatomy are the key in identification and preservation of RLN, EBSLN, and PT. For the identification and preservation of the RLN, inferior, superior and lateral approaches, palpatory method, tubercle of Zuckercandl may be used. Transient or permanent hypo parathyroidism is due to inadvertent gland removal or injury to its vascular pedicle. Dissection close to the thyroid capsule and ligation of capsular branches of thyroid avoiding the main trunk of inferior thyroid artery holds the key. Incidence of EBSLN injury can be reduced by opening up of space of reeves, gentle dissection along superior thyroid pedicle, ligating its vessels individually as close to the gland as possible and moreover surgeon should be aware of the variability in its course.

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References

1. Hegner CF, A history of thyroid surgery. Annals of surgery. 1932 Apr;95(4):48

2. A E Giddings**,** The history of thyroidectomy J R Soc Med. 1998; 91(Suppl 33): 3–6.
3. Sakorafas, G.H. Historical Evolution of Thyroid Surgery: From the Ancient Times to the Dawn of the 21st Century World J Surg (2010) 34: 1793**.**
4. Hannan SA, The magnificent seven: a history of modern thyroid surgery. Int J Surg 2006;4(3):187-91. Epub 2006 May 4**.**
5. Max MH, Scherm M, Bland KI. Early and late complications after thyroid operations. South Med J 1983 Aug;76(8):977-80.
6. Huang CF et al, The preoperative evaluation prevent the postoperative complications of thyroidectomy, Ann Med Surg (Lond). 2014 Dec 18;4(1):5-10. doi: 10.1016
7. William Halsted, The Operative Story of Goitre: The Author's Operation Volume 19, Part 2 of Johns Hopkins Hospital Reports
8. Lifante JC, Payet C, Ménégaux F, Sebag F, Kraimps JL, Peix JL, Pattou F, Colin C, Duclos A, Arnalsteen L, Caizzo R. Can we consider immediate complications after thyroidectomy as a quality metric of operation?. Surgery. 2017 Jan 1;161(1):156-65.
9. Wittekamp BH, van Mook WN, Tjan DH, Zwaveling JH, Bergmans DC. Clinical review: post-extubation laryngeal edema and extubation failure in critically ill adult patients. Critical Care. 2009 Dec 1;13(6):1.
10. Karlan MS, Catz B, Dunkelman D, Uyeda RY, Gleischman S. A safe technique for thyroidectomy with complete nerve dissection and parathyroid preservation. Head & neck surgery. 1984 Jul 1;6(6):1014-9.
11. Ravikumar K, Sadacharan D, Muthukumar S, Mohanpriya G, Hussain Z, Suresh RV. EBSLN and factors influencing its identification and its safety in patients undergoing total thyroidectomy: a study of 456 cases. World journal of surgery. 2016 Mar 1;40(3):545-50.
12. Sung ES, Chang JH, Kim J, Cha W. Is cricothyroid muscle twitch predictive of the integrity of the EBSLN in thyroid surgery?. The Laryngoscope. 2018 Nov;128(11):2654-61.
13. Menon RR, Murali S, Nair CG, Babu MJ, Jacob P. Correlation between the Cernea classification of external branch of superior laryngeal nerve in relation to the ultrasound-based volume of thyroid gland. Indian journal of endocrinology and metabolism. 2017 Nov;21(6):845
14. Sakorafas GH, Kokoropoulos P, Lappas C, Sampanis D, Smyrniotis V. External branch of the superior laryngeal nerve: applied surgical anatomy and implications in thyroid surgery. The American Surgeon. 2012 Sep 1;78(9):986-91.
15. Akerström G, Malmaeus J, Bergström R. Surgical anatomy of human parathyroid glands. Surgery. 1984 Jan;95(1):14-21.
16. Hojaij F, Vanderlei F, Plopper C, Rodrigues CJ, Jácomo A, Cernea C, Oliveira L, Marchi L, Brandão L. Parathyroid gland anatomical distribution and relation to anthropometric and demographic parameters: a cadaveric study. Anatomical science international. 2011 Dec 1;86(4):204-12.
17. Park I, Rhu J, Woo JW, Choi JH, Kim JS, Kim JH. Preserving parathyroid gland vasculature to reduce post-thyroidectomy hypocalcemia. World journal of surgery. 2016 Jun 1;40(6):1382-9.
18. Elsheikh E. Superior parathyroid gland approach to the recurrent laryngeal nerve. Head & neck. 2017 Jul;39(7):1287-90.
19. Xie L, Wang J, Zhou L. Inferior Parathyroid Gland Preservation In Situ during Central Neck Dissection for Thyroid Papillary Carcinoma. InThyroid Disorders 2018 Nov 5. IntechOpen.

20. Cavallaro G, Iorio O, Centanni M, Porta N, Iossa A, Gargano L, Del Duca S, Gurrado A, Testini M, Petrozza V, Silecchia G. Parathyroid reimplantation in forearm subcutaneous tissue during thyroidectomy: a simple and effective way to avoid hypoparathyroidism. World journal of surgery. 2015 Aug 1;39(8):1936-42.