

The Tubercle of Zuckerkandl : An Important Landmark Revisited

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Abstract To study the incidence of the tubercle of Zuckerkandl (ZT) among Indian patients subjected to thyroid surgery at a tertiary care cancer centre and its relevance in localization of recurrent laryngeal nerve (RLN). Prospective study on 144 patients (48 males, 96 females) undergoing thyroidectomy (35 hemithyroidectomies, 109 total thyroidectomies) from September 1st 2010 - February 28th 2013. 144 specimen/253 lobes (129 right, 124 left) were evaluated. Findings were recorded by the same team to ensure consistency. Presence, shape, grade (Pelizzo's) of ZT and relationship to RLN were documented. ZT was identified in 90.5 % ($n = 229$), commoner on the right ($n = 120$) than on left ($n = 109$). ZT was Grade 0 in 9.5 %, Grade I in 28.9 %, Grade II in 50.5 % and Grade III in 11 % of cases. In all patients ZT was unilobed. Recurrent laryngeal nerve (RLN) was consistent in position and was posterior to ZT in all cases. There were no branches of the RLN above the ZT. The ZT is a useful guide in locating RLN. Surgeon should be aware about the incidence, shape, grade and relation to RLN which is different in the Indian population as compared to what has been reported globally.

Keywords Thyroidectomy · Tubercle of zuckerkandl · Recurrent laryngeal nerve · Anatomical landmark

Introduction

Thyroid cancers have an indolent course and surgery is the mainstay of treatment. Therefore avoiding morbidity is of paramount importance. Complication rates vary from 0 to 50% [1, 2]. The main concern is with regards to safety of the RLN and parathyroid glands. Literature has excellent description of various landmarks and approaches to thyroid surgery with their pros and cons [1, 3–6]. While the incidence of injury to RLN is relatively low, in enthusiasm to safeguard the nerve, the blood supply to parathyroid is damaged resulting in its dysfunction [2, 7]. Superior approach of identifying the recurrent laryngeal nerve has been gaining popularity over other approaches as it avoids unnecessary dissection in the tracheoesophageal groove and safeguards the blood supply to parathyroid. However this approach provides limited working space and has a possibility of damaging the nerve or its branches. Therefore it would be ideal to have an anatomical marker to help identify the RLN easily. ZT is a constant landmark which can locate the nerve through this approach.

Tubercle of Zuckerkandl (ZT), named by an Austrian anatomist, Emil Zuckerkandl, is defined as posterior extension of the lateral lobe which is composed of thyroid tissue only [8]. The importance of the tubercle emerged after Pelizzo in 1980's described ZT as an anatomical landmark for safe identification of RLN [9].

However there is little Indian data from a prospective study, single author, cancer cases with analysis of in situ thyroid specimen. We aim to study the presence of ZT and its relationship with RLN during surgical dissection of the lobes of the thyroid gland.

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Patients and Methods

A prospective anatomical study was conducted on 144 thyroidectomy patients between September 1st 2010 and February 28th 2013. All patients were cytologically proven thyroid carcinoma and operated at our institution. All cases with previous surgery, extensive adenopathy in central compartment where gland had to be extensively mobilized to identify ZT and non malignant multinodular goiter were excluded. All operations were performed by a single senior head and neck surgeon (AKD). Identification and measurements were done with gland in situ by the first lead author (NI) in order to provide uniformity and to reduce bias. Each case finding was recorded in a separate book with photographic documentation.

Surgery was performed in standardized manner starting superiorly after ligating middle thyroid vein. Thyroid gland was mobilized and posterior border of the gland was identified in entirety. ZT was identified and measured before ligation of any major pedicle or further mobilization with thyroid gland still in situ. The ZT was measured using a fine metal scale to avoid discrepancy and error that may occur with other stretchable instruments (tape). ZT was measured, dissected and retracted medially to identify its relation to the RLN.

The size of ZT was classified according to Pelizzo's grading system: grade 0 (unrecognizable), grade I (only thickening of lateral edge of thyroid lobe), grade II (<1 cm), and grade III (> 1 cm) [9].

RLN function was recorded post surgery in all cases.

Results

144 thyroids in situ (253 sides; 129 right, 124 left) in 48 male and 96 female patients with average age 50.30 years (range 18–84 years with median 54 years) were examined.

Study includes 35 hemithyroidectomies and 109 total thyroidectomies. 87.5 % (126) were papillary, 7.6 % (11) of follicular, 2.1 % (3) medullary, 2.1 % (3) poorly differentiated and 0.7 % (1) hurthle cell cancer.

ZT was identified in 229 of 253 specimens (90.5 %). Among total thyroidectomy patients, 88 (80.7 %) had bilateral ZT. ZT was found more frequently on the right side ($n = 120$) than on left ($n = 109$). All identified ZT were unilobed in shape.

The distribution of ZT's according to grade was as follows : Grade 0, right 3.6 % ($n = 9$) and left 5.9 % ($n = 15$); Grade I, right 11.9 % ($n = 30$) and left 17 % ($n = 43$); Grade II, right 29.6 % ($n = 75$) and left 20.9 % ($n = 53$); Grade III, right 5.9 % ($n = 15$) and left 5.1 % ($n = 13$). Table 1 shows the distribution of tubercle according to the side and grade.

Table 1 Shows the distribution of tubercle according to side and grade

Side	Grade 0 (%)	Grade I (%)	Grade II (%)	Grade III (%)
Right	3.6	11.9	29.6	5.9
Left	5.9	17	20.9	5.1

We observed that all RLN were located postero –medial in relation to the ZT and were placed between the tubercle and trachea (Fig. 1).

There was no case of RLN damage.

Discussion

ZT was first described by Otto Wilhelm Madelung in 1867 as a posterior horn of thyroid [10], but it was Emil Zuckerkandl who popularized it in 1902 and mentioned it as “processus posterior glandula thyroidea” [8]. Gilmour in 1938 described its relationship with RLN and superior parathyroid [11]. Having been described over a century it is frequently underutilized. In 1998 Pelizzo ‘re-discovered’ this structure as a constant anatomical surgical landmark for identifying the RLN and graded it according to the size [9].

Embryologically, the thyroid gland develops after the fusion of median anlage, which descends down from foramen caecum, with the paired smaller lateral anlage (arising from the ultimobranchial body). The median anlage, recognizable by the end of third week forms the main part of thyroid gland. The lateral anlage becomes attached to the posterior surface of the thyroid during the fifth week. This lateral anlage gives rise to parafollicular C cells of neural crest origin which produce calcitonin. The causes of the fusion of median and lateral anlages are unknown. ZT may correspond to these lateral anlages [12].

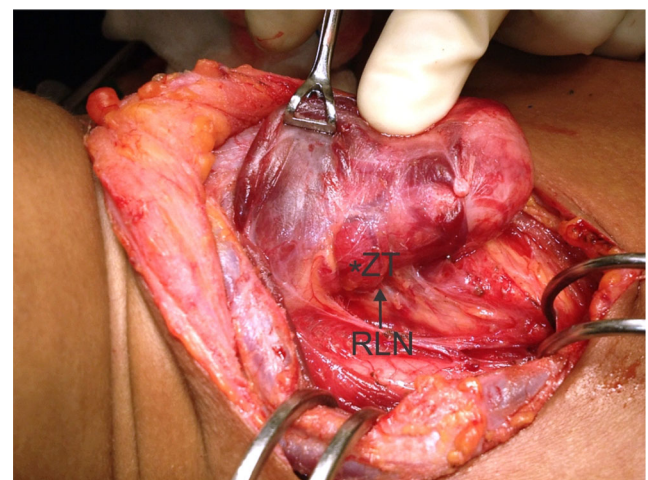


Fig. 1 Relation of Recurrent Laryngeal Nerve with respective to ZT. ZT: Tubercle of Zuckerkandl. RLN: Recurrent Laryngeal Nerve

The incidence of ZT reported in literature varies from 7.04 % to upwards of 80 % [13, 14, 15, 16, 17]. In our study ZT was identified in 90.5 % of the cases. There is vast heterogeneity in the incidence which probably can be explained on the basis of geographical, genetic or ethnic factors. However our study shows that it is a constant landmark and if meticulously sought would be seen in majority of patients which can be used to identify RLN.

Grade I and II together constituted about 80 % of all ZT in our study. In 1998, Pelizzo et al. [9] reported the presence of ZT in 104 Italian patients during lobectomy and found grade 0 in 24 (23 %), grade I in 9 (8.6 %), grade II in 56 (53.8 %), and grade III in 15 (14.4 %) sides. Majority of the studies have documented grade I and grade II ZT with highest occurrence with incidence ranging from 18 to 90 % as summarised in Table 2 [5, 9, 16, 18–21]. Thus majority of the ZT are less than 1 cm in size. Therefore an active effort has to be made to identify it while performing the dissection otherwise it is likely to get missed. Our results show that Grade III was identified in only 11 % cases. The incidence of grade III was as high as 55 % as reported by Hisham et al. [21]. In all probability the reason for low incidence of grade III in our study could be the study cohort being cancer patients. Grade III probably is more commonly seen in enlarged thyroid glands with multinodular goiter or ectopic thyroid rests mimicking the ZT. The discrepancy may also have been influenced by cadaveric versus live patient study and interpersonal variation [22].

The incidence of ZT in our study was higher on the right side (93 %) compared to left (88 %). This is in accordance with what has been reported in literature. In a recently published study by Mehanna et al. which looked at the difference in incidence of ZT on both sides, reported the incidence of 72.6 % on the right and 53.9 % on the left side [19]. Multiple other studies across the globe have also reported the incidence to be higher on the right side [16–18]. Even though the incidence is higher on the right side it is commonly present bilaterally. Gauger et al. [5] and Gurleyik and Gurleyik [23] reported the incidence of bilateral ZT to be 15 and 25 % respectively. Study published by Yun et al. documented presence of

bilateral ZT in up to 91 % of cases [17]. Out of 109 total thyroidectomy performed in our study, bilateral ZT was documented in 88 (80.7 %) cases. Therefore it can be used as landmark to identify RLN bilaterally.

ZT is like an eloquent arrow pointing to the nerve. Similar description is provided by Pelizzo in literature [9]. If mobilized medially ZT would allow easy identification of the nerve before it turns below the inferior cricothyroid articulation. In our study ZT in all cases was unilobed, arrow pointing to ZT. Various other shapes like bilobed or bifid have also been described by other authors which was present in about 5 % of cases. [19, 24]. The occurrence of these shapes can be due to nodular changes in ZT in setting of multinodular goiter.

Gauger et al. [5] reported that in 93 % of patients, the nerve was located medial to ZT, while in 7 % cases RLN passed laterally. In another study by Yun et al. the nerve was posterior to ZT in more than 90 % of cases and only in 0.5 % of cases it lied anterior to ZT surface. It was present lateral to ZT in less than 10 % of cases [17]. Gil-Carcedo E et al. found RLN posterior to ZT in 95 % of cases [25]. In our study, all RLN ran posterior and medial to the ZT. Higher incidence (98 %) of RLN located medial to ZT was also reported by Pradeep et al. [20]. This study is also from India and strengthens the conclusion that this is a constant finding in the Indian population which is in variance with the rest. No branches were identified above the ZT. Thus, the ZT is a useful guide to locate and protect the RLN as it enters the cricothyroid muscular interval.

Using tubercle of Zuckerkandl as an anatomical landmark to dissect thyroid gland, none of the patients had RLN damage as documented by postoperative assessment of cord mobility.

Conclusion

ZT is a consistent and a sturdy structure identified in majority of cases. The ZT is a useful guide in locating RLN. Surgeon should be aware about the incidence, shape, grade and relation

Table 2 Comparison result of studies

Studies	Grade 0	Grade 1	Grade 2	Grade 3
Gauger et al. (%)	37	18(gd 1 + 2)		45
Pelizzo et al. (%)	23	8.6	53.8	14.4
Sheahan et al. (%)	29 % (gd 0 + 1)		37	24
Rajapaksha et al. (%)	20.6	36.2	30.6	12.5
Mehanna et al. (%)	30.1 (gd 0 + 1)		29.8	22.1
Pradeep et al	0	65.2	25.1	9.5
Hisham and Aina (%)	19.8 (gd 0 + 1)		25	55.2
Present study (%)	9.5	28.9	50.5	11

to RLN which is different in Indian population as compared to what has been reported globally. Thus it is very useful landmark in thyroid surgery in Indian population

Compliance with Ethical Standards

Conflict of Interest The author(s) declare that they have no conflict of interest.

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