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Original Research Article

Anatomical Prevalence of Zuckerkandl's Tubercle and Its Morphological Variations in South Indian Population Undergoing Thyroidectomy

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Abstract:

Background/Introduction: The Zuckerkandl tubercle (ZT) is a posterior projection of the lateral thyroid lobe and serves as an important anatomical landmark for identifying the recurrent laryngeal nerve (RLN) during thyroid surgery. Recognition of ZT can reduce the risk of RLN injury, a common complication in thyroidectomies. Given its close anatomical relationship with the tracheoesophageal groove, the study aimed to assess the frequency and size distribution of ZT in individuals undergoing thyroidectomy and its role in aiding RLN identification.

Objectives: To estimate the proportion of Zuckerkandl tubercle in patients undergoing thyroidectomy and evaluate its anatomical variations.

Materials and Methods: A hospital-based cross-sectional study was conducted over 2 years (November 2020 – October 2022) at the Department of General Surgery, Dr. SMCSI Medical College, and Karakonam. Fifty-five patients undergoing thyroidectomy for benign thyroid conditions were included using non-probability sampling. Patients with malignancy, prior neck surgery or radiation, or unfit for surgery were excluded. ZT presence, laterality, size, and its utility in RLN identification were recorded intraoperatively. Data were analyzed using SPSS software with Chi-square test applied for association. A p-value <0.05 was considered statistically significant.

Results: ZT was identified in 38 out of 55 patients (69.1%), while absent in 30.9%. ZT was found more frequently on the right side (38.2%) than the left (27.3%), and bilaterally in 3.6% cases. The size distribution among those with ZT showed equal proportions of ZT <10 mm and ZT >10 mm (both 50%). There was a highly significant association between ZT presence and its size ($\chi^2 = 55.000$, df = 2, $p < 0.001$). No significant association was found between ZT presence and age ($p = 0.219$) or gender ($p = 0.250$). Mean age was 44.76 ± 6.13 years with a female predominance (65.5%).

Conclusion: ZT was observed in nearly 70% of individuals undergoing thyroidectomy and served as a consistent and reliable anatomical marker for RLN identification. The tubercle was more frequently located on the right side and presented either as a small (<10 mm) or large (>10 mm) structure with equal prevalence. Recognizing and preserving this structure is essential to prevent RLN injury during thyroid surgeries.

Keywords: Zuckerkandl tubercle, recurrent laryngeal nerve, thyroidectomy, anatomical landmark, thyroid surgery.

Introduction

The Zuckerkandl tubercle (ZT) is an anatomic landmark that can be used for the identification of the RLN intra –operatively [1]. It is located between the superior and inferior pole, pointing towards the trachea-esophageal groove The ZT is a lateral or posterior projection from the lateral thyroid lobe. Sheahan and Murphy reported that ZT is a critical landmark in thyroid surgery, being present in most of the thyroid lobes, especially in the larger ones. They believed that adequate recognition and dissection of the ZT is essential for successful thyroid surgery [2]. There is a lateral thyroid gland component which arises from the 4thbranchial cleft and ultimo-branchial body of the lateral lobes of the thyroid gland to form a tubercle known as Zuckerkandle tubercle [3,4]. This tubercle is the most posterior pyramidal extension of pure. Thyroid tissues of the lateral lobes of the thyroid gland. Superior parathyroid gland is also derived from the 4th brachial clefts is commonly found in close association with that tubercle usually cephalad to that tubercle. This tubercle is usually found in the cleft between trachea and esophagus which is a common pathway of recurrent laryngeal nerve. It may be mistaken for a thyroid nodule, mass or lymph node. It is a projection of normal thyroid tissue from the posterior lateral lobes of the thyroid gland. It has been used as an anatomical landmark for location

of the recurrent laryngeal nerve, which can be easily and safely encountered even though it is not initially visible. This study was done to estimate the proportion of Zuckerkandl tubercle in individuals. [5,6,7]

Thyroid gland weight is approximately 20-25 grams. Lobule is the functioning unit and is supplied by a single arteriole and consists of 24-40 follicles lined by cuboidal epithelium. Thyroid gland is a bilobed structure and lies next to the thyroid cartilage. The lateral lobes are joined at the midline by an isthmus. In 30% of people a pyramidal lobe is seen which represents the most distal portion of the thyroglossal duct. Pyramidal Lobe typically lies on either side of midline. Thyroid is covered by a true capsule which cannot be easily separated. A thin layer of connective tissue that invests the trachea surrounds the thyroid gland which is different from the thyroid capsule. This fascia coalesces with the thyroid capsule laterally and posteriorly to form a suspensory ligament of berry. The ligament of berry is closely attached to the cricoid cartilage and it is the primary point of fixation of thyroid to surrounding structures. Ligament of berry is an important surgical landmark for the determination of Recurrent Laryngeal nerve (RLN) [6,7].

Materials and Methods

It was a Hospital based cross sectional study design. Conducted in the Department of General Surgery, Dr .SMCSI Medical College, and Karakonam between November2020–October2022 (2 years). Data is collected for a period of 18 months from the date of institutional ethical committee clearance. Those Individuals admitted for undergoing thyroidectomy in surgical ward at Dr .SMCSI Medical College and Hospital, Karakonam were included in the study.

Inclusion criteria: FNAC proven benign thyroid condition who are going to undergo thyroidectomy.

Exclusion criteria

- Unfit for surgery. Refusal for surgery.
- Malignancy with any expected infiltration. Prior surgery to the neck
- Prior radiation exposure to the head and neck area.

Sample size:

The reference study is a study published in International journal of surgery conducted by Dr. Priyanka Bagadia and Dr. Kamlesh Damor in Rajasthan, India. The study title is A Prospective study:- Zuckerkandl tubercle - an important landmark in identification of recurrent laryngeal nerve in thyroid surgery [8]. Non-probability sampling technique was used.

Q Sample Size ^{4PQ}

d2

P=87.86(as in reference study)

Q=100–P

D=10% of Prevalence

= (1.96)2x87.86x12.1 4/ .1x(87.86)2

~ 55

Study Variables

- Socio-demographic variables. Presence of ZT
- ZT found on right or left Relationship of RLN to ZT
- Whether it helped the surgeon to identify RLN Size of ZT
- Postoperative vocal cord palsy/paresis after identification of ZT

Operational Definition

The Zuckerkandl tubercle (ZT) is an anatomic landmark that can be used for the identification of the RLN intra-operatively. It is located between the superior and inferior pole, pointing towards the trachea-esophageal groove. The ZT is a lateral or posterior projection from the lateral thyroid lobe, which indicate the point of embryologic fusion of ultimo-branchial body and the principal median thyroid process.

Data Collection Method: Every case admitted in General surgery department for thyroidectomy which comes in included. Information recorded in the operative notes was considered as the documentary evidence supporting the findings.

Data Entry and analysis: Data entered into Microsoft excel sheet and analyzed using SPSS software. Quantitative variables expressed as mean and standard deviation. Qualitative variables expressed as frequency and percentage. Chi Square test used to find out any association between categorical variables. P value<0 .05 is considered as statistically significant.

Ethical consideration:

Proper informed consent was taken from the study participants, and their privacy was protected throughout the study and its publication. Permission from unit chiefs was taken to collect and record the data. The above-mentioned study was conducted in this institution after obtaining due clearance from the Scientific Committee and Ethical Committee of Dr SM CSI Medical college, Karakonam. No financial burden was imposed on the patients.

Results

Table 1: zuckerkandl tubercle distribution

Presence Of Zuckerkandi Tubercle	Frequency(N)	Percent (%)
Yes	38	69.1%
No	17	30.9%
Total	55	100.0%

In the present study the mean age was found to be 44.76. Minimum age was 32 and maximum age was 57. ZT was found in 69.1 of individuals and not found in 30.9% of individuals in my study. In this study females were found to be 65.50%. Males were found to be 34.50%.

Table 2: Distribution of zuckerkandl tubercle in right or left side of the study subjects (n=55)

ZT Found On Right or Left	Frequency(N)	Percent (%)
Right	21	38.2%
Left	15	27.3%
Bilateral	2	3.6%
Nil	17	30.9%
Total	55	100.0%

Table 3: Distribution of size of zuckerkandl tubercle in the study subjects (n=55)

Size Of Zuckerkandl Tubercle	Frequency(N)	Percent (%)
Zt<10	19	34.5%
Zt>10	19	34.5%
Nil	17	30.9%
Total	55	100.0%

Table 4: comparison of age

Zuckerkandl Tubercle	Mean	SD	P
Yes	45.45	5.88	0.219
No	42.24	6.57	

As per table 4 the mean age was not found to be significant.

Table 5: Comparison of Gender

Gender	Zuckerkandl Tubercle					X^2	DF	P
	Yes		No					
	Count	Percent	Count	Percent				
Male	15	39.5%	4	23.5%				
Female	23	60.5%	13	76.5%				
Total	38	100.0%	17	100.0%		1.321	1	0.250

As per table 5 the comparison for zukerkandl tubercle in gender was not found to be significant.

Table 6: Association between Identification of zuckerkandl tubercle and size of zt among study subjects

Size Of Zuckerkandl Tubercle	Zuckerkandl Tubercle				X^2	DF	P
	Yes		No				
	Count	Percent	Count	Percent			
ZT<10	19	50.0%	0	0.0%			
ZT>10	19	50.0%	0	0.0%	55.000	2	**<0.001**
Nil	0	0.0%	17	100.0%			
Total	38	100.0%	17	100.0%			

A total of 55 patients were included in the study. ZT Present: 38 cases (69.1%) ZT Absent: 17 cases (30.9%) ZT < 10 mm: 19 patients (50.0%) ZT > 10 mm: 19 patients (50.0%). This indicates equal distribution of small and large ZTs among the cases where it was observed. All 17 cases (100%) had no visible ZT, and hence size classification was "NIL." The p-value < 0.001, indicating a highly significant association between the size of the Zuckerkandl tubercle and its presence or absence. This statistically confirms that ZT is either present or measurable or completely absent, with no intermediate or misclassified forms in this study population. The presence of a ZT, whether small or large, is a discrete finding, and its identification is reliable when present. In surgical anatomy, particularly

thyroid surgeries, this finding reinforces the consistency of the ZT's presence and measurable size in a significant proportion of cases.

Discussion

A hospital based cross sectional study was done among 55 patients to estimate the proportion of ZT visualised in individuals during thyroidectomy and whether it helped the operating surgeon to identify RLN and on which side the ZT was more visualised. In this study the mean age was 44.76 +/- 6.131 in the study population. The minimum was 32 maximum was 57 in the study population. This result was comparable with a study done in Rajasthan, India in which mean age was 42.24 +/- 11.38(8).

In this study majority of the study population, 65.5 percent were females and 34.5 percent were males. Another study done in Rajasthan, India 18 percent were males and 82 percent were females in the study population [8]. In this study ZT was found in 69.1 percent of the individuals and not found in 30.9 percent of the individuals among the study population .In this study out of 50 cases, ZT was found in 35 individuals. In another study done in Rajasthan, ZT was unrecognised, absent in 30 percent. In 12 percent of individuals grade 1 ZT was found, 46 percent of the individuals Grade 2 ZT was found and in 12 percent. Grade 3 was found [9,10].

In this study, ZT was found in 38.2 percent of the individuals in the right, 27.3 percent of the individuals in left and 3.6 percent of individuals bilaterally .In another study conducted in London in 2016 published in Annuals of Medicine and surgery, ZT was detected in 78.16 percent of right thyroid lobes whereas in 68.60percent of left thyroid lobes, ZT was detected more frequently in the right side [10]. In this study, size of ZT was assessed and ZT less than 10mm was found in 37.5percent of the study population, ZT More than 10mm in 34.5 percent of the study population and ZT not visualised in 30.9 percent. In a study conducted in London in 2016 in 46 out of 173 lobectomies, ZT was not recognised [Grade0/1]. In 92[53.17percent] lobectomies ZT was less than 10mm.In the remaining 35[20.23 percent] lobectomies, ZT were more than 10mm. In this study, P value in comparison of mean age was found to be 0.219.The association between identification of ZT and gender among study subjects was found to have P value of 0.250. [10,11]

Grades of ZT Pelizzo [12]

- Grade 0 unrecognisable
- Grade 1- only a thickening of lateral lobe
- Grade 2- less than 1cm
- Grade 3-more than 1 cm

Conclusion

The current hospital based cross sectional study was done among 55 patients to estimate the proportion of presence of ZT in individuals undergoing thyroidectomy. In this study in 69% of individuals, ZT was visualised during thyroidectomy. Also ZT was visualised more on the right side (38.2%).

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