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BMH Medical Journal 2014;1(4):66-71 **Research Article**

A Closer Look at Parathyroid Anatomy During Thyroid Surgery

PV Pradeep MS, DNB, MRCSEd, MCh (Endocrine Surgery)

Department of Endocrine Surgery, Baby Memorial Hospital Calicut.

Address for Correspondence: Dr. PV Pradeep MS, DNB, MRCSEd, MCh, Consultant, Department of Endocrine Surgery, Baby Memorial Hospital Calicut. E-mail: pradeepputhenveetil@yahoo.co.in

Abstract

Background: With the reduction in mortality from thyroid surgery, surgeons are now concentrating in decreasing the morbidity by improving the dissection technique. Morbidity is related to injuries to the parathyroids, recurrent laryngeal and external branch of superior laryngeal nerve. Mostly these are due to technical failure and the variations in the surgical anatomy. In this article we analyse the surgical anatomy of the parathyroids during the thyroid surgery in a set of Indian patients undergoing elective thyroid surgeries.

Material and Methods: Retrospective study conducted at a tertiary care centre in South India. Study period was from February 2011 to February 2013. Patients undergoing surgery for benign goitres, T1 and T2 thyroid cancers without lymph node involvement were included. Reoperative cases, advanced thyroid cancers were excluded. Data related to 1168 parathyroids which included 584 superior and 584 inferior parathyroids were included in this study.

Results: There were 404 thyroid surgeries performed during this period. This included 180 total thyroidectomy and 224 hemithyroidectomy. Among the HT 138 were left HT and 86 right HT. Mean age was 37.52+/-12.9yrs; mean duration of goitre was 39.49+/-46.82 months. Male: Female ratio was 1:8. The common positions of the superior parathyroids were in and around the entry point of recurrent laryngeal nerve (95.71%) and that of inferior parathyroid were around the lower pole in 83.38%. Superior parathyroid could be identified in 97.1% cases and inferior parathyroids in 94.52% cases. 2.9% of superior and 5.9% of inferior parathyroids is not visualized. Permanent hypocalcemia rate was 0.9% in this series.

Conclusions: Parathyroid glands are fairly constant in position. Meticulous dissection with blood less field ensures their identification especially those which are ectopically placed. Permanent hypocalcemia is avoided with careful identification and preservation of the parathyroids vascularity.

Key Words: parathyroid, anatomy

Introduction

The major concern during the thyroid surgery in early nineteenth century was the high mortality rate.

This high mortality (20%) was attributed to the lack of meticulous dissection techniques and occurrence of sepsis [1]. So much so, in the year 1850 the French Academy of Medicine banned thyroid surgery [2]. The refinement in surgical techniques, recognition of the presence of parathyroids, recurrent laryngeal nerve (RLN) and need to protect the external branch of superior laryngeal nerve (EBSLN) resulted in the improvement in the mortality and morbidity rates. Through understanding of the surgical anatomy has been crucial in decreasing the morbidity. Hypocalcemia is considered as a major morbidity since it affects the early discharge of the patient. Mostly this is due to technical failure to identify the parathyroids and the variations in the surgical anatomy. In this study we analyse the surgical anatomy of the parathyroids during the thyroid surgery and its variations in Indian patients undergoing elective thyroid surgeries.

Materials and Methods

This retrospective study was conducted at a tertiary care centre in South India during the period from 2011 to 2013 February. Patients who were operated for benign goitres including toxic goitres and early thyroid cancers (T1/T2 N0M0) were included. Patients undergoing surgery for recurrent goitres and advanced thyroid cancers were excluded. The surgical findings are recorded in predesigned "Operation notes" register. These were later entered in the SPSS software 13vs for the analysis. During all thyroid surgeries the parathyroid position is documented as per the system designed in our department (**Table 1**).

Table 1: Location of the Parathyroids

Type	**Superior Parathyroid**	**Inferior Parathyroid**
Type 1	At the entry point of RLN or within 1cm of it	At the Lower pole
Type 2	More than 1cm from the entry point of RLN	Less than 1cm from the lower pole
Type 3	At the superior pole/ pedicle	More than 1cm from the lower pole in the trachea esophageal groove. (including the thyro thymic ligament)
Type 4	Not seen	Not seen

Results

A total of 404 patients underwent thyroid surgery. Among these 180 underwent total thyroidectomy and 224 patients had hemi thyroidectomy. The male to female ratio was 1:8. The mean age was 37.52+/-12.9yrs and the mean duration of goitre was 39.49+/-46.82 months. The indications of surgery included Graves 'disease, toxic multinodular goitre, early carcinoma thyroid and non toxic benign goitres. A total of 1168 parathyroids are included in this study among which there were 584 superior and similar number of inferior parathyroids were dissected.

Our dissection technique is as described by Delbridge et al [1]. After delivering the gland out of the wound the tertiary branches are ligated close to the thyroid lobe and the parathyroids are encountered which is pushed postero-laterally along with their pedicle. The common location of the superior parathyroid is shown in **Table 2** and inferior parathyroids in **Table 3**. About 2.9% of the superior and 5.48% of the inferior parathyroid could not be identified during the dissection. 95.71% of the superior parathyroids are either at the entry point of RLN to the larynx or 1-2 cm around the entry point. 83.38% of the inferior parathyroids are either at the lower pole or within one cm of the lower pole. **Figure 1** shows superior parathyroid and **Figure 2** the inferior parathyroids.

Table 2: Common location of the superior parathyroid

Parathyroid Location	N= 584 (180 TT and 224 HT; Rt HT 86 and left HT 138)	Left superior parathyroids: n=318	Rt superior parathyroids: n=266
Type 1	451 (77.22%)	248 (77.98%)	203 (76.31%)
Type 1I:	108 (18.49%)	57 (17.92%)	51 (19.17%)
Type III.	08 (1.37%)	7 (2.2%)	1 (0.36%)
Type IV.	17 (2.9%)	6 (1.88%)	11(4.13)

HT: Hemithyroidectomy; TT: Total Thyroidectomy

Table 3: Common location of the inferior parathyroid

Parathyroid Location	N= 584 (180 TT and 224 HT; Rt HT 86 and left HT 138)	Left inferior parathyroids: n=318	Rt inferior parathyroids: n=266
Type 1	252 (43.15%)	139 (43.7%)	113 (42.48%)
Type 1I:	235 (40.23%)	130 (40.88%)	105 (39.47%)
Type III.	65 (11.13%)	36 (11.3%)	29 (10.9%)
Type IV.	32 (5.48%)	13(4.08%)	19 (7.14%)

HT: Hemithyroidectomy; TT: Total Thyroidectomy

The tubercle of Zuckerkandl (TZ) which is an extension from the posterior portion of the thyroid lobes was seen as Grade 1 in 65.2% (n=381), Grade 2 in 25.1% (n=147) and Grade 3 in 9.5% (n=56). Superior parathyroid had a close relationship with the TZ and the enlarged TZ displaces it laterally. The parathyroid identification was 3.62+/-0.62 glands in patients undergoing total thyroidectomy and 1.95+/-0.23 glands in patients undergoing hemithyroidectomy. Temporary and permanent hypocalcemia rates were 15.5% and 0.92% respectively.

Discussion

Thyroid surgery was infrequently performed in the early part of the nineteenth century [1,2] due to the associated high mortality rates. However later due to the introduction of general anaesthesia, antisepsis, understanding of the thyroid anatomy and pathology decreased the mortality rate from thyroid surgery. As the safety of thyroid surgery increased the complications of the procedure came to limelight and surgeons concentrated on preventing this. Post operative tetany and hypothyroidism

made Theodor Kocher to shift to hemithyroidectomy in all his cases [3]. It was later recognized that tetany was caused by the injury to the parathyroid glands [3]. Since the surgical anatomy is now documented this morbidity of thyroid surgery has decreased to less than 1% in expert hands.

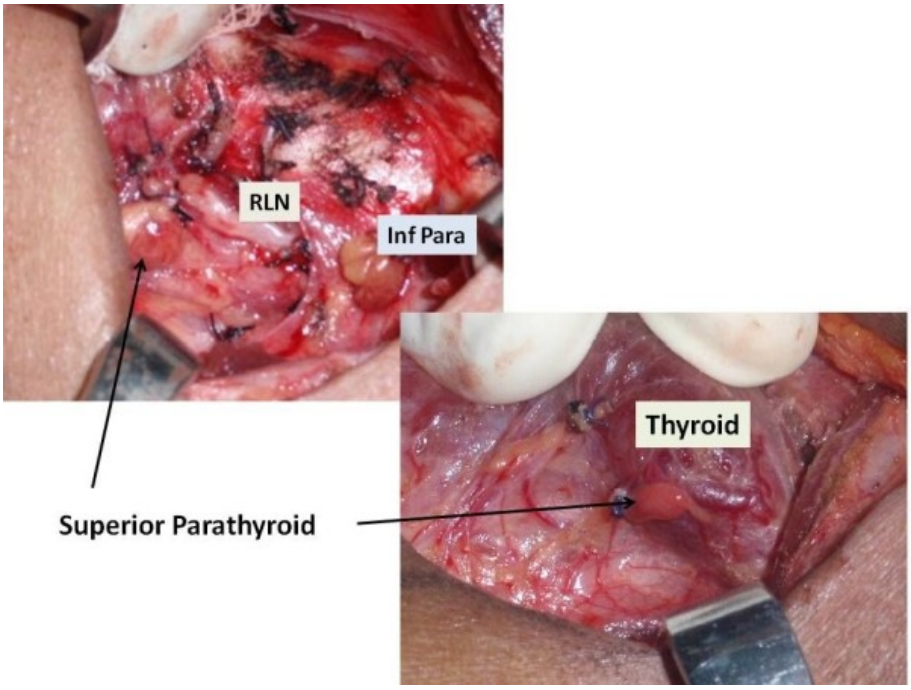

Figure 1: Showing the common locations of superior parathyroid glands. RLN: Recurrent laryngeal Nerve

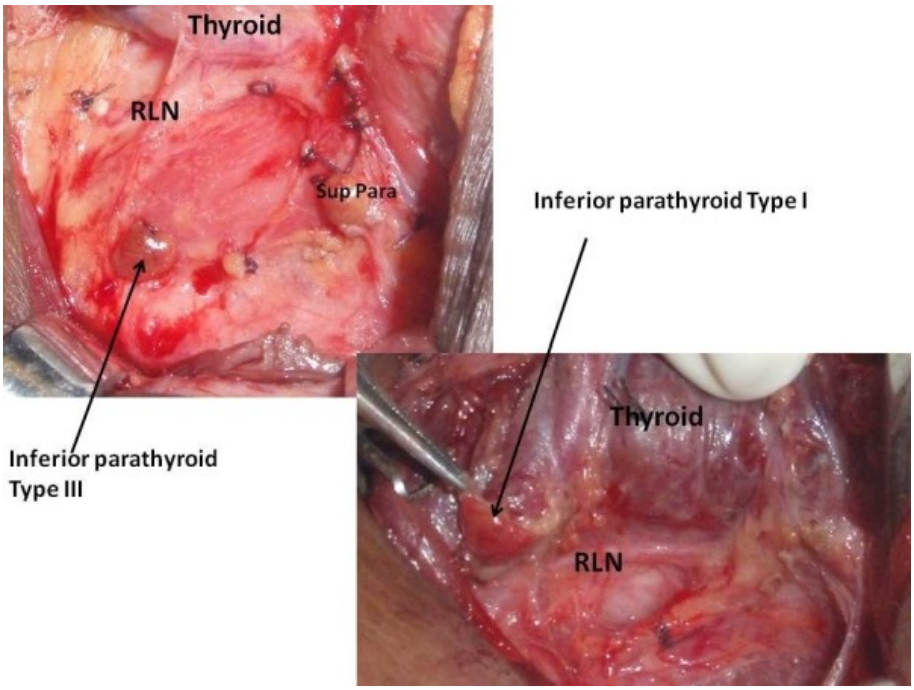

Figure 2: Showing the common locations of inferior parathyroid glands. RLN: Recurrent laryngeal Nerve

Parathyroids are generally identified by the position, shape, size and consistency. Additionally it blanches on gently pressing its surface and on putting in saline it does not float unlike fatty tissue. Akerstorm et al [4] found that there were four parathyroids in 84% and five parathyroids in 13% of their cases. In this series we have not made any deliberate attempt to identify supernumerary parathyroids. The superior parathyroids have a constant position. This is because the SP is derived from the fourth branchial pouch and in close relation to the developing thyroid. It also has very short distance to descent during the development [5]. In our patients 95.71% of the superior parathyroids

had fairly constant position around the entry point of the RLN to the larynx. We have noticed that 1.37% of them are at the superior pole (2.2% on the left side) which is also another reason for individual ligation of the superior pole vessels apart from protecting the Type 2B external branch of superior laryngeal nerve [6].

The inferior parathyroids are derived from the third branchial pouch along with the thymus. This results in long line of descent and variable position unlike the superior parathyroids. In our series nearly 16.62% of the inferior parathyroids were found to be away from the lower pole. 43.15% of the inferior parathyroids are at the lower pole which makes it susceptible to inadvertent removal if one is not familiar with the appearance of the parathyroid. Since nearly 85% of the inferior parathyroids are located close to the inferior pole care should be taken not to damage the vascularity when the thyroid gland is delivered out from the tracheo-oesophageal groove during thyroidectomy. If superior parathyroid is not found at dissection the removed gland should be carefully examined under good light for inadvertently removed parathyroid gland. However this may not be true for the inferior parathyroids since more than 16% of them were away from the inferior pole of the thyroid and may not be visualised at all.

In 34.6% of the cases the tubercle of Zuckerkandl was Grade 2 or 3 in our patients. The surgical significance of this tubercle is that the superior parathyroids and RLN can be injured during dissection.

Techniques to preserve vascularity after dissection

Preservation of functioning parathyroid gland insitu during thyroid surgery is an art. The most important pre requisite is bloodless clean field. This helps the surgeon to visualize the normal parathyroids which may be around 6mm in size. Frequent suctioning of the field is not advisable since the suction force if applied on the parathyroid it damages its end arteries. Surgeon well versed with the appearance and feel of the parathyroid also utilises the other features of parathyroids like size, shape, location in identifying them. Magnification is not helpful since a surgeon who cannot see the parathyroid with his naked eye will not see it even if the field in magnified. The dissection of parathyroid is done in a plain anterior to the gland since a posterior dissection will devascularize the gland. In spite of all these measures if the parathyroid gland shows signs of ischemia like discoloration and oedema performing capsulotomy restores the vascularity. However if the parathyroids are placed anteriorly on the gland surface and difficult to save the parathyroid is excised early before it devascularizes and stored in ice cold saline. At the end of thyroidectomy the parathyroid gland is autotransplanted to the sternocleidomastoid muscle.

To conclude in this paper we have analysed the parathyroid anatomy in Indian patients which is more relevant to us than the published Western data. In today's era thyroid surgery is one directed at preventing morbidity. This is achieved by through knowledge of the surgical anatomy in our patients and taking care of the vital structures like parathyroid glands.

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