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VARIATION IN NUMBER AND LOCATION OF HUMAN PARATHYROID GLAND -A POSTMORTEM STUDY

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Abstract

Objective - Parathyroid gland, the last important organ to be recognised in humans, has great variation in number and location; mainly attributable to its peculiar embryological development. The hormone secreted by the parathyroid gland provides a powerful mechanism for controlling extracellular calcium and phosphate concentration. These variation in number and location has important surgical implications in parathyroid disorders.

Material and methods- This study was conducted on 60 autopsy specimens in the department of anatomy in collaboration with the department of forensic medicine in post graduate institute of medical sciences, Rohtak.

Results- A total 203 parathyroid glands were identified in relation to posterior border of thyroid gland in 60 postmortem specimens. The highest number of parathyroid glands per person was 4 found in 56.66% cases. The lowest was 1 found in 1.66% of cases, 3 parathyroid glands in 26.66% cases and 2 parathyroids in 15% of cases, in none of the case we found more than 4 glands. Out of 203 parathyroid glands, 117 were superior and 86 were inferior. Most of the superior parathyroid glands (73) were found on the middle third of the posterior border of thyroid lobe (62.39%), at upper third it was 43 (36.75%), and 1(0.85%) at lower third. All the 86 inferior parathyroid glands were found at the lower one third of posterior border of thyroid gland.

Conclusion: parathyroid glands vary considerably in number, location.

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INTRODUCTION

The parathyroid gland was the last important organ to be recognised in humans^{1,2}. The first description of the parathyroid gland was given by a London anatomist Sir Richard Owen in 1850 in Rhinoceros³. In 1887 Ivar Sandstorm described these tiny glandular structure in 50 dissected human bodies⁴. His work was not well noticed for several years until Eugene Gley, a physiologist discovered the endocrine function of the parathyroid glands^{2,5}. Gley observed that the tetany and death caused by experimental thyroidectomy in dogs occurred only if the excised material include the glands described by Sandström and can be prevented by transplantation of these glands. This finding established the importance of parathyroid glands^{2,6,7}.

These glands are usually lying between the posterior lobar borders of the thyroid glands and its capsule. Usually there are two on each side, superior and inferior. Superior parathyroid glands are more constant in location than the inferior. Superior parathyroid glands are located most frequently near the junction of inferior thyroid artery and recurrent laryngeal nerve, usually superior to the artery and posterior to nerve, close to posterior border of thyroid^{9,11}. Inferior parathyroid glands usually lie near the inferior pole of thyroid and are inferior to the inferior thyroid artery and anterior to recurrent laryngeal nerve^{10,11}. Knowledge of location and number of parathyroid gland is essential to surgeon, endocrinologist, sonologist, and pathologist for better diagnosis and management of parathyroid disorders.

MATERIAL AND METHODS:

The present study was conducted in the department of anatomy in collaboration with the department of forensic medicine, Pt. B. D. Sharma University of Health Sciences, Rohtak. The research work was approved by ethical committee. The study was carried out on 60 autopsy specimens. After legal formalities and requisite permission from department of Forensic Medicine, the samples were collected within 24 hours of death without any sign of putrefaction. During collection appropriate age, sex, and cause of death were noted from morgue's record book.

Procedure of collection of sample:

From each cadaver the parathyroid glands were collected by "Block Dissection", using the following steps: During postmortem examination, neck, thoracic cavity and the abdominal cavity were routinely exposed by midline incision from chin to symphysis pubis. In the neck region, incision was given carefully to avoid any damage to thyroid gland, and the midline neck mass was collected enmass. The extent of neck tissue removed for study followed a consistent routine. The visceral contents of the neck were collected enmass including the thyrohyoid membrane superiorly, the strap muscles anteriorly, the esophagus posteriorly, and the bifurcation of the innominate and the common carotid arteries. Soon after collection, each sample was gently washed in tap water. Samples were tagged immediately, which was bearing a code number for subsequent identification and then fixed in 10 percent formaldehyde solution.

Exclusion criteria:

The following cases were excluded from the study:

- hanging
- Poisoning
- Any cutting or crushing injury involving neck
- Known case of parathyroid disease
- Burns
- Decomposed bodies

Variables Studied

- Location of parathyroid glands in relation to posterior border of thyroid lobe.
- Number of parathyroid glands identified.

Steps for the dissection of the Specimen:

First of all remaining fascia was removed, infrahyoid muscles were pulled upwards, and lobes of thyroid gland were cleaned from its surrounding structures and pulled medially. Both recurrent laryngeal nerve and inferior thyroid artery were traced. The pretracheal fascia was retracted laterally, thus exposing the posterior surface of thyroid gland. Searching for the parathyroids were done all along the posterior surface of thyroid gland by following the arterial twigs of inferior thyroid artery. Small yellowish brown parathyroid glands were embedded either in the posterior surface of the capsule or outside the capsule. Then the vertical distance between upper and lower pole of the thyroid lobe was measured with the slide caliper. The position of the parathyroid glands with respect to vertical length were noted and expressed as percentage of parathyroid glands in upper, middle, and lower third of the posterior border of the thyroid lobe. Photograph of the specimen were taken. Then the glands were dissected out and sent for histological confirmation.

The data obtained was subjected to statistical analysis using SPSS version 10.

RESULTS.

Table 1. Variation in number of parathyroid gland

Sr. No.	No of parathyroid gland	No of cases	%age
1	1	1	1.66
2	2	9	15.00
3	3	16	26.66
4	4	34	56.66
5	>4	0	0.00

In the present study of 60 cadavers, 203 parathyroid glands were identified in relation to posterior border of thyroid gland. The highest number of parathyroid glands per person was 4 found in 56.66% cases, and lowest was 1 found in 1.66% of cases, and 3 parathyroid glands in 26.66% cases and 2 parathyroids in 15% of cases, and in none of the case we found more than 4 glands as shown in table 1.

Table 2: Number of Parathyroid Glands found

Sr. No.	Parathyroid Gland	Number	%age
1	Right superior	58	96.66%
2	Right inferior	43	71.67%
3	Left superior	59	98.33%
4	Left inferior	43	71.67%
5	Total	203	84.58%

Out of 203 parathyroid glands, Right superiors were 58 (96.66%) in number, Right inferiors were 43 (71.67%) in number, left superiors were 59 (98.33%) and left inferiors were 43(71.67%) with a average of 84.58% as shown in table 2.

Table 3: Number of parathyroid glands found according to location on the posterior border of thyroid gland

Sr. No.	Location	Number	%AGE
1	Upper	43	21.18%
2	Middle	73	35.96%
3	Lower	87	42.86%
4	Total	203	100%

Out of total 203 parathyroid glands found, at the upper one third of posterior border of thyroid gland we found 43 (21.18%) of glands, at middle one third it was 73 (35.96%), at lower one third it was 87(42.86%) of glands found, as shown in table 3.

Out of total 117 superior parathyroid glands of both sides, 39 (67.24%) on the right side and 34 (57.63%) on the left side were found at middle one third of the posterior border of thyroid gland, the most common site of superior parathyroid glands. Rest of the superior parathyroid glands were at upper one third of the posterior border of thyroid gland with a number of 18 (31.04%) on the right side and 25 (42.37%) on the left side. Only 1(1.72%) of right superior parathyroid gland was found at the lower one third of thyroid gland, and none of the left superior parathyroid gland was found at lower one third of thyroid gland.

Most common location for superior parathyroid glands was middle third of the posterior border of thyroid lobe with total of 73 (62.39%), at upper third it is 43 (36.75%), and 1(0.85%) at lower third.

Out of total 86 inferior parathyroid glands of both sides, 43 (100%) was found on the right side and 43 (100%) on the left side were found at lower one third of posterior border of thyroid gland, the most common site of inferior parathyroid glands. None of the inferior parathyroid glands both on the right and left side was found at middle or upper one third of posterior border of thyroid gland.

Figure 1: showing left superior and left inferior parathyroid gland at middle and lower third of posterior border of thyroid gland with the inferior thyroid artery



Figure 2: showing right superior and right inferior parathyroid gland at middle and lower third of the posterior border of thyroid gland.



DISCUSSION

Usually there are four parathyroid glands in an individual, but the variation in number and location of these glands make the surgical exploration tricky. So its detailed anatomical knowledge is fundamental to avoid postsurgical complications. In the present study involving a total of 60 autopsy cases, 203 parathyroid glands were identified in relation to posterior border of thyroid gland. The highest number of parathyroid glands per person was four, found in 34 cases (56.66%) while three glands in 16 cases (26.66%), two glands in 9 cases (15%), and one gland was found in 1 case (1.66%). The average number of parathyroid glands per person was 3.38.

According to Mahbub et al, four parathyroid glands were found in 63.33% of cases, one in 5%, two in 8.33%, three in 23.33%, with the average of 3.45 per person³. Akerstrom et al stated that out of 503 autopsy cases, in 421 cases (84%) four parathyroid glands were found, in 64 cases (13%) more than four glands, and in 18 cases (3%) only three glands⁸.

Sultana et al observed that the average number of parathyroid gland per person was 3.4¹¹.

O Nanka et al concluded that parathyroid glands vary from one to four per individual with a average 2.77 ± 1.06 ¹².

Wang CA had recovered four parathyroid glands in 156 cases, three in 5 cases, and six parathyroid in one case¹³.

Pyrtok et al reported that average number of parathyroid gland per person was 3.9 per specimen¹⁴. Hojaij F et al found that 89.3% of individuals had four parathyroid glands¹⁵. Butterworth and Nicholson studied 241 parathyroid glands and found that 85% persons had four glands, 8% had supernumerary glands and 7% had only three glands¹⁶.

The results of the present study is not corresponding with the results of Alkerstrom, Wang CA, and Butterworth and Nicholson et al, in that they also found more than four glands per individual, but we didn't found more than four glands.

This difference may be due to the fact that the inferior parathyroid glands are more widely distributed owing to their embryologic development, they may be found anywhere from lower thyroid pole to the mediastinum, and we conducted our study in relation to posterior border of thyroid only.

Another reason may be that glands are quite regularly concealed in the connective tissue fibres that binds the posterior edge of thyroid lobe to the pharynx, and because of this in most cases dissection would have been inadequate due to technical difficulties and thus rest of the glands may be overlooked.

Location of parathyroid glands:

In the present study of 60 autopsy cases, 203 parathyroid glands were identified, in which 117 are superior and 86 are inferior. The most common location of parathyroid glands was inferior (42.86%) followed by middle (35.96%) and upper (21.18%). Most of the superior parathyroid glands were found on the middle third of the posterior border of thyroid lobe with an average of 73 (62.39%), at upper third it is 43 (36.75%), and 1(0.85%) at lower third. All the 86 inferior parathyroid glands were found at the lower one third of posterior border of thyroid gland.

According to O Nanka et al superior parathyroids were found at the cricothyroid junction posteriorly in the number of 241 (77%) out of 312 glands, 68 (22%) were at upper pole of thyroid, and rest 1% were at ectopic. Inferior parathyroids were found at lower pole of thyroid with an average of 42% and rest 39% were ectopic¹⁷. Sultana et al reported that most of the superior parathyroid glands were located opposite the middle third of the posterior border of thyroid lobe and about one third of all the inferior parathyroid glands were related to lower pole of thyroid lobe¹¹.

Alkerstrom et al stated that 80% of superior parathyroid glands were found at middle one third of posterior border of thyroid or at the intersection of recurrent laryngeal nerve and inferior thyroid artery, and rest were ectopic. Most of the inferior parathyroid glands were found at lower thyroid pole with an average of 61%⁸. Wang CA reported that out of total 312 superior parathyroids, 241 (77%) were found at cricothyroid junction posteriorly or at middle third of posterior border of thyroid gland, 68 (22%) were behind upper pole of thyroid and rest 1% were ectopic. Of all the inferior parathyroids 131 (42%) were at lateroposterior surface of lower thyroid pole, and rest were ectopic¹³.

Bustami FA et al noted that 155 (69.3%) superior parathyroids were found at cricothyroid junction posteriorly, 46 (29.3%) were behind upper pole of thyroid, and rest were ectopic. And most of inferior parathyroids were found at lower thyroid pole with an average of 68(47.15), and rest were ectopic¹⁸. Mahbub et al stated that around 48.79% of superior parathyroid glands were found at middle one third of posterior border of thyroid gland, 21.74% at upper one third and most of the inferiors 29.47% at lower one third³.

The findings of the present study was similar with the studies of O Nanka, Sultana, Wang CA, Bustami FA, Mahbub et al, and it is dissimilar with the study of Alkerstrom et al, because the position of parathyroid glands is highly variable due to its embryologic development.

Our study showed that despite the wide distribution pattern of the parathyroid glands, they all follow a definite pattern and can be uncovered in these locations in majority of cases. Like for the superior parathyroid glands they were found just above the intersection of recurrent laryngeal nerve and inferior thyroid artery, and it was the landmark for surgical exploration. The inferior parathyroid glands were more widely distributed, but the lower thyroid pole may serve as a landmark. So it is mandatory for the surgeons, always to do dissection very close to the thyroid, because as a considerable number of superior and inferior glands will be located in, or in close association of the thyroid capsule.

CONCLUSION

Our study of 60 cadavers revealed that there is a definite pattern of the anatomic distribution on the basis of embryologic development of parathyroid gland. Regarding variation in number of parathyroid glands, in the present study we found four glands per individual in 56.66% of cases, and in rest of the cases we found less than four glands. Same as with the location of parathyroid gland, most of the superior parathyroid glands 35.96% were found at middle one third of posterior border of thyroid, and inferior parathyroids 42.86% were found at lower one third of the thyroid lobe.

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