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Original Research Article

Preservation of parathyroid gland during total thyroidectomy and its outcome

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ABSTRACT

Background: Parathyroid insufficiency is a frequent complication of total thyroidectomy, often leading to hypocalcaemia, which can be transient or permanent. This condition arises from factors like disrupted blood supply, injury or accidental removal of parathyroid glands. Since parathyroid hormone (PTH) is essential for calcium regulation, this study investigated parathyroid preservation, the timing of tetany symptoms post-surgery and the incidence of hypocalcaemia tetany after thyroidectomy.
Methods: This cross-sectional observational study, conducted from January to December 2021 at the Department of Otolaryngology-Head & Neck Surgery, Combined Military Hospital, Dhaka, included 42 randomly selected patients who underwent thyroid surgery. Data were collected systematically using structured data sheets.
Results: Among the 42 patients, 18 (42.86%) developed hypocalcaemia 16.67% within 24 hours, 61.11% after 48 hours and 16.67% after 72 hours. Of these, 77.78% had asymptomatic hypocalcaemia, while 22.22% showed symptoms. Transient hypocalcaemia occurred in 38.10% and permanent hypocalcaemia in 4.76% of cases.
Conclusions: The study revealed a significant postoperative decrease in serum calcium levels, particularly within 48–72 hours, with a 42.86% incidence of hypocalcaemia. These findings align with reported rates in other studies.

Keywords: Hypocalcaemia, Parathyroid insufficiency, Total thyroidectomy, Serum calcium levels

INTRODUCTION

Hypoparathyroidism is a significant complication that can arise following thyroidectomy, making it crucial to preserve the parathyroid glands and their vascular supply during surgical procedures.[1] Historically, the mortality rate associated with thyroidectomy exceeded 40%, coupled with high morbidity levels. However, contributions from pioneering surgeons such as Billroth, Halsted and Kocher have resulted in thyroid surgery evolving into a relatively safe operative procedure.[2] Typically, individuals possess at least two pairs of

parathyroid glands, which appear yellow-brown to orange in color. During surgery, these glands can be mistaken for surrounding tissues such as brown fat, yellow fat, sequestrated thyroid tissue, the thymus, lymph nodes and autonomic ganglia.[3] Each parathyroid gland weighs approximately 50 mg.[4] Thyroid surgeries rank among the most common surgical interventions globally, serving as the definitive treatment for both malignant and benign thyroid conditions, including multinodular goiter with compressive symptoms.[5,6]

Early hypocalcemia frequently occurs as a complication following thyroid surgery.[7] This condition may manifest as either permanent or transient, even in the hands of highly skilled surgeons. Typically, hypocalcemia develops 24 to 72 hours post-thyroidectomy, with up to 30% of patients experiencing asymptomatic transient hypocalcemia immediately after surgery, while approximately 6% may require calcium supplements due to temporary hypocalcemia.[8,9] The incidence of postoperative permanent hypocalcemia is relatively low, ranging from 0.1% to 3%.[9] Various studies have reported differing incidences of permanent hypocalcemia, from 0 up to 10%, with figures of 0.7%, 5%, 5.4% and 7.7%, while one study indicated a rate as high as 16.77%.[10-15] Reported incidences of postoperative hypocalcemia following total thyroidectomy have varied widely, from 1.6% to 50%, with some series noting rates as high as 83%.[16]

Post-thyroidectomy hypocalcemia is primarily attributed to parathyroid insufficiency resulting from injury, devascularization or accidental excision of the parathyroid glands.[17] The likelihood of these complications is influenced by surgical techniques, the need for reoperations, neck dissection and the experience of the surgical team.[18] Other factors that may contribute to post-thyroidectomy hypocalcemia include increased calcium uptake by bone as a result of postoperative reversal of thyrotoxic osteodystrophy, commonly referred to as "hungry bone syndrome," especially in patients with thyrotoxicosis.[19]

Varying definitions of hypocalcemia present challenges in the clinical relevance of outcome studies in thyroidectomy. Some researchers define hypocalcemia based on biochemical measures, using thresholds of serum calcium concentrations below 8 mg/dL (normal range: 8.5 mg/dL to 10.5 mg/dL). Clinically, symptoms such as circumoral and peripheral tingling, carpopedal spasms, hyperreflexia, as well as signs like Chvostek's and Trousseau's signs, are classic indicators of hypocalcemia. Early paresthesia can often be subtle but, if left untreated, may lead to severe hypocalcemia, resulting in complications such as tetany, laryngospasm, seizures or cardiac arrhythmias.[20] Most cases of hypocalcemia following thyroid surgery are self-limiting; however, they can also lead to potentially serious consequences. Although long-lasting effects are rare in instances of transient hypocalcemia, it is essential to consider hypocalcemia permanent in patients who require calcium supplementation beyond six months post-surgery.[21] The long-term morbidity associated with permanent hypocalcemia post-thyroidectomy is a significant medical concern, necessitating extended treatment and care for affected patients. This aids Otolaryngology-Head and Neck surgeons in preventing hypocalcemia following the preservation of the parathyroid gland during total thyroidectomy. Additionally, it facilitates the identification and management of potential complications, which may reduce the morbidity and mortality associated with the procedure.

The objective of this study is to evaluate the outcomes of parathyroid preservation during thyroid surgery. This includes two specific aims: first, to determine the average interval from total thyroidectomy to the onset of hypocalcaemic tetany symptoms and second, to assess the incidence of hypocalcaemic tetany in the postoperative state following total thyroidectomy.

METHODS

Study design

This study employed a cross-sectional observational design conducted at the Department of Otolaryngology-Head and Neck Surgery, Combined Military Hospital, Dhaka, Bangladesh, between January 2021 and December 2021. The study population consisted of patients undergoing total thyroidectomy who adhered to the follow-up schedule during the one-year duration of the study.

Sampling method was convenience. All patients meeting the inclusion criteria were incorporated into the study, with data collected on demographics (name, age, sex, blood group), medical histories, clinical examination findings, reasons for thyroidectomy, operative notes and postoperative follow-ups. Postoperative data included clinical presentations and serum calcium levels, systematically recorded in structured questionnaires.

Sample size

The targeted sample size was calculated using formula, which resulted in an intended sample of approximately 272 due to an expected proportion of 23% from the literature. However, owing to COVID-19 constraints, the actual sample size was reduced to 42 patients.

The inclusion criteria encompassed all patients indicated for total thyroidectomy, while the exclusion criteria eliminated those who underwent less than total thyroidectomy. Operational definitions were established total thyroidectomy refers to the complete excision of the thyroid gland, with hypocalcemia defined as plasma calcium levels below 8 mg/dl. Additionally, transient hypocalcemia required calcium supplementation for less

than six months, whereas permanent hypocalcemia necessitated it for more than six months. Data preparation involved the creation of a structured questionnaire and consent form, with relevant data collected upon obtaining informed consent. Common surgical instruments for ENT operations, a biochemical analyzer for serum calcium measurement and basic office equipment were utilized.

Data collection

Data collection procedures included enrolling patients scheduled for total thyroidectomy, obtaining informed consent, measuring preoperative serum calcium levels and attempting to preserve parathyroid glands during surgery. Postoperative monitoring of serum calcium levels occurred at 24, 48 and 72 hours, with further follow-up for patients displaying tetany. Expert surgeons provided professional assistance throughout the study.

Ethical approval

Ethical approval was secured from the Ethical Committee of the Armed Forces Medical Institute, with all participants providing written informed consent, ensuring voluntary participation and confidentiality and retaining the right to withdraw at any stage.

Statistical analysis

Data analysis was performed using SPSS-17, with the results presented through tabulation and graphical formats to ensure clarity. Quality assurance measures included meticulous data collection and processing to ensure the reliability of findings.

RESULTS

The study was conducted involving patients from the Department of Otolaryngology-Head and Neck Surgery at Combined Military Hospital, Dhaka, who underwent total thyroidectomy within a one-year period, from January 2021 to December 2021. The sample consisted of 42 patients, out of which 18 experienced hypocalcemia as determined by measuring their calcium levels at 24, 48 and 72 hours following the surgical specimen removal. Participants were selected based on established eligibility criteria.

A standardized data collection sheet was utilized to document patient demographics, medical histories and surgical details from the time of admission throughout the treatment process. Information regarding sex distribution, calcium status, calcium levels, symptomatology, diagnoses, types of surgeries and calcium measurements at the specified intervals was meticulously recorded. The observations and results of this study are presented in tabular and graphical formats on the following pages.

Among 42 patients, highest number of cases were found in 4th decade of age (35.71%). Among 42 patients, 12 (28.6%) were male and 30 (71.4%) were female patients. So, the male to female ratio was 1:2.5.

Among 42 patients, all are presented with thyroid swelling. Out of them 10 (23.81%) patients presented with cervical lymphadenopathy. Out of 42 patients 10 (23.81%) had lymph node metastases. Lymph node involvement was most common in level III (40%), level IV (20%) and VI (20%). Clinically no palpable lymph node was found in level I.

Among 42 patients, the highest number of indications belong to papillary thyroid malignancy (42.86%) followed by multinodular goitre (35.71%). Hypocalcaemia developed most frequently in cases of thyroidectomy with neck dissection 7 (70%).

Among 18 patients, the highest number of incidences belong to papillary thyroid malignancy (44.44%) followed by multinodular goitre (38.89%). Follicular carcinoma (11.11%).

Graves' disease (5.56%) belongs to the lowest number of incidences of thyroid surgery. In this study, 15 (38.47%) patients developed hypocalcaemia in group A where parathyroid were identified and 3 (75%) patients developed hypocalcaemia in group B where parathyroid were not identified.

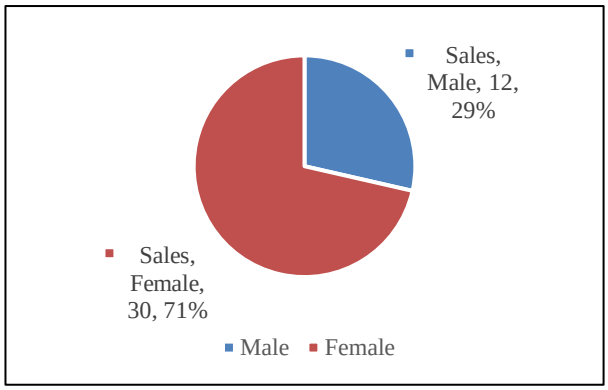

Figure 1: Sex distribution of the study population (n=42).

On the first postoperative day, serum calcium levels were recorded as above 8 mg/dl in 15 cases. On the second postoperative day, levels ranged between 6-8 mg/dl in 11 cases, while 3 cases showed levels below 6 mg/dl. During the third postoperative day, serum calcium levels of 6-8 mg/dl were noted in 15 cases, with 1 case exhibiting levels below 6 mg/dl. By the fourth postoperative day, serum calcium levels remained within the 6-8 mg/dl range in 17 cases.

Hypocalcaemia was observed to develop in 3 cases (16.67%) on the first postoperative day, while 11 cases (61.11%) were noted on the second day. The incidence decreased with 3 cases (16.67%) on the third

postoperative day and further reduced to 1 case (5.55%) on the fourth postoperative day. Postoperative hypocalcaemia was observed to develop in 18 patients, representing 42.86% of the total study population. Among these cases, permanent hypocalcaemia was documented in 2 patients, accounting for 4.76% of those affected. Subclinical hypocalcaemia developed in 14 patients, representing 77.78% of the cases, while clinical hypocalcaemia occurred in 4 patients, accounting for 22.22% of the total population studied.

Table 1: Age distribution of the study population (n=42).

Age (in years)	Number of patients	(%)
10-20	2	4.76
21-30	11	26.19
31-40	15	35.71
41- 50	6	14.29
>50	8	19.05
Total	42	100

Table 2: Clinical presentation of the study population (n=42).

Relation with metastasis	Number of patients	(%)
Only thyroid swelling	32	76.19
Thyroid swelling with nodal metastasis	10	23.81
Total	42	100

Table 3: Level of lymph node involvement (n=10.

Level of lymph node involvement	Number of patients	(%)
II	1	10
III	4	40
IV	2	20
V	1	10
VI	2	20
Total	10	100

Table 4: Distribution of surgical indication in different diseases (n=42).

Name of diseases	Number of patients	(%)
Papillary carcinoma	20	47.62
Multinodular goitre	15	35.71
Follicular carcinoma	04	9.52
Graves' Disease	02	4.76
Medullay carcinoma	01	2.39
Total	42	100

Table 5: Frequency of hypocalcaemia on the basis of extent of surgery.

Name of surgery	Number of patients	Number of hypocalcaemia	(%)
Total thyroidectomy without neck dissection	32	11	34.36
Total thyroidectomy with neck dissection	10	7	70

Table 6: Distribution of hypocalcaemia in different diseases (n=18).

Indication of surgery	Number of patients	(%)
Papillary carcinoma	8	44.44
Multinodular goitre	7	38.89
Follicular carcinoma	2	11.11
Graves' disease	1	5.56
Total	18	100

Table 7: Frequency of hypocalcaemia in parathyroid identified and not identified during total thyroidectomy.

Parathyroid identification	Hypocalcaemia	No hypocalcaemia	Number of patients	(%)
Parathyroid identified	15	23	38	39.47
Parathyroid not identified	3	1	4	75
Total	18	24	42	

Table 8: Serum calcium level in post operative period (n= 18).

Serum calcium level (mg/dl)	1st POD	2nd POD	3rd POD	4th POD
8-10	15	4	2	1
6-8	3	11	15	17
<6		3	1	0

Table 9: Type of hypocalcaemia after total thyroidectomy (n=42).

Type	Number of patients	(%)	Total	(%)
Temporary hypocalcaemia	16	38.10	18	42.86
Permanent hypocalcaemia	2	4.76		
Sub-clinical	14	77.78	22	100
Clinical	4	22.22		

DISCUSSION

Total thyroidectomy is often the preferred treatment for patients with thyroid diseases, particularly for those whose conditions affect both lobes or involve a high risk of recurrence, such as benign multinodular goiter, Graves' disease or thyroid cancer. A frequent complication during total thyroidectomy is the inadvertent removal or disruption of blood supply to the parathyroid glands, leading to parathyroid insufficiency. The incidence of hypocalcemia tetany reported in various studies ranges from 1.6% to 50%.[22]

To investigate parathyroid failure following thyroid surgery, a cross-sectional study was conducted at the Department of Otolaryngology-Head and Neck Surgery, Combined Military Hospital, Dhaka, from January 1 to December 31, 2021. As similar research had not previously been carried out in our country, this study serves as a baseline for future investigations. The study involved 42 patients who underwent total thyroidectomy, with or without neck dissection. A majority of participants (35.71%) were in their fourth decade of life, which aligns with findings from other studies.[23] Of the 42 patients, 12 (28.6%) were male and 30 (71.4%) were female, resulting in a male-to-female ratio of 1:2.5 (Figure 1). This gender distribution is consistent with another research.[24]

In terms of clinical presentation, thyroid swelling was noted in all cases (100%), with 10 (23.81%) patients also exhibiting cervical lymphadenopathy (Table 2). Lymph node involvement was most prevalent at levels III (40%), IV (20%) and VI (20%), while no palpable lymph nodes were detected at level I (Table 3), a finding that correlates with other studies.[25]

The indications for surgery within this cohort included 20 (47.62%) cases of papillary thyroid carcinoma, 15 (35.71%) with multinodular goiter, 4 (9.52%) due to follicular carcinoma, 2 (4.76%) for Graves' disease and 1 (2.39%) for medullary carcinoma (Table 4). The findings indicate that total thyroidectomy was performed in 59.53% of cancer cases and 40.47% of benign thyroid disease cases.[26]

In terms of parathyroid identification, 38 out of 42 patients (90.48%) had their parathyroid glands identified, while 4 (9.52%) did not (Table 5). Superior parathyroid glands were more frequently located than inferior ones, likely due to the less consistent positioning of the inferior glands.

Hypocalcemia was observed in the majority of patients undergoing total thyroidectomy with neck dissection (7 out of 10 patients or 70%), compared to 11 (34.36%) who had the procedure without neck dissection (Table 6). This can be attributed to difficulties preserving the blood supply to the parathyroid glands, excessive manipulation or inadvertent removal during central compartment clearance.[27] Hypocalcemia was noted in 10 (55.55%) cases of malignant thyroid disease and in 8 (44.45%) cases of benign thyroid disease (Table 7), aligning with findings from other studies.[24]

The study also demonstrated that the occurrence of hypocalcemia tetany was higher in patients where parathyroids were not identified during surgery. The difference in incidence between those with and without identification of the parathyroid glands was statistically significant, indicating a strong association between hypocalcemia and lack of parathyroid identification intraoperatively, corroborating findings from another

study.[28] On the first postoperative day, serum calcium levels were above 8 mg/dl in 15 cases. On the second postoperative day, 11 cases exhibited calcium levels between 6-8 mg/dl and 3 cases had levels below 6 mg/dl. By the third postoperative day, serum calcium levels were between 6-8 mg/dl in 15 cases, while 1 case was below 6 mg/dl. On the fourth postoperative day, serum calcium levels between 6-8 mg/dl were recorded in 17 cases.[24]

Our results indicated that the majority (11 or 61.11%) of patients developed hypocalcemia tetany on the second postoperative day (n=18), while 3 (16.67%) cases presented with hypocalcemia on the third day (Table X). This aligns with other literature confirming that symptoms of hypocalcemia typically manifest within 24 to 48 hours post-surgery.[24] Subclinical hypocalcemia was identified in 14 (77.78%) patients, while clinical hypocalcemia was observed in 4 (22.22%) patients.[29]

In summary, this study found that temporary hypocalcemia occurred in 38.10% of cases, while permanent hypocalcemia was observed in 4.76% of cases (Table XII), which is consistent with findings in other studies.[30]

The study is subject to several limitations, including a short duration, which may restrict the comprehensiveness of the findings. Additionally, the sample size is relatively small, limiting the generalizability of the results. The research does not reflect the scenario of the entire country, as it is confined to a specific demographic or geographic area. Furthermore, the study was conducted during the COVID-19 pandemic, which may have influenced the outcomes and overall context of the findings.

CONCLUSION

Hypoparathyroidism is a prevalent complication following total thyroidectomy, particularly among patients with thyroid carcinoma. Despite efforts to preserve at least two parathyroid glands during surgery, a notable incidence of hypoparathyroidism was still observed. This suggests that vascular impairment of the preserved parathyroid glands may contribute to the condition. Following total thyroidectomy, there is a significant decline in serum calcium levels, particularly within the first 72 hours post-surgery. To determine whether patients have fully recovered, long-term follow-up is essential. The issue of parathyroid preservation has garnered increasing global attention and the use of magnification during surgical procedures has proven beneficial in safeguarding the parathyroid glands.

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