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Comparison of Corrected Serum Calcium Fluctuations after Thyroid versus Non-thyroid Neck Surgeries

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ABSTRACT

Introduction: Neck surgeries, including thyroid and non-thyroid procedures, are common globally. Thyroid surgeries, such as total and hemithyroidectomy, often cause postoperative hypocalcemia due to parathyroid gland injury or dysfunction. Postoperative hypocalcemia can lead to serious complications like tetany and cardiac arrhythmias. Corrected serum calcium levels, adjusted for albumin, are essential for monitoring calcium status. Identifying hypocalcemia early in the postoperative period is critical for timely management and improved patient outcomes.

Objective: The study aims to assess compare the corrected serum calcium changes following thyroid and non - thyroid neck surgeries.

Methods: This prospective observational comparative study was conducted at BSMMU, Dhaka, from June 2022 to July 2023, enrolling 60 adult patients undergoing thyroid (Group A, n=28) or non-thyroid neck surgeries (Group B, n=32). Preoperative and postoperative corrected serum calcium levels were measured at baseline, within 6 hours post-surgery, on days 1 and 4. Patients were monitored for hypocalcemic symptoms and calcium supplementation. Data were collected using structured proformas and analyzed using SPSS 26.

Results: This study compared corrected serum calcium changes following thyroid and non-thyroid neck surgeries. Preoperative calcium levels were similar ($p>0.05$). Immediately after surgery, thyroid surgery patients had significantly lower calcium levels ($p<0.05$), with a 2.85 times higher risk of transient hypocalcemia ($p<0.05$). However, calcium levels normalized by postoperative day 1 and day 4 ($p>0.05$). Thyroid surgeries were predominantly performed on females (82.1%), while non-thyroid surgeries were more common among males (68.8%), a significant gender difference ($p<0.001$). Age and BMI were comparable between groups ($p>0.05$). Overall, thyroid surgeries carried a higher risk of transient hypocalcemia immediately after surgery.

Conclusion: This study found that thyroid surgery patients face a greater and more immediate drop in serum calcium, raising the risk of transient hypocalcemia. By day 4, calcium levels normalized across both groups. Vigilant monitoring and timely supplementation are essential, especially after thyroid procedures, to prevent symptomatic hypocalcemia and ensure patient safety.

Keywords: Serum calcium, Thyroid surgery and non-thyroid neck surgery.

INTRODUCTION

Neck surgeries, particularly thyroid and non-thyroid operations, are common procedures performed worldwide. While thyroid surgeries such as total and hemithyroidectomy are routinely carried out for benign and malignant thyroid diseases, non-thyroid neck surgeries, including lymph node dissection and parotid surgeries, are essential for treating various head and neck conditions. One critical postoperative concern following these surgeries is the alteration in serum calcium levels, which can lead to hypocalcemia, a potentially life-threatening condition [1,2]. Hypocalcemia, particularly in thyroid surgery, is primarily caused by damage to the parathyroid glands or interference with calcium homeostasis due to altered parathyroid function [3]. Although this is a well-established complication after thyroid surgery, its occurrence and significance in non-thyroid neck surgeries remain underexplored [4]. In thyroid surgery, hypocalcemia is often transient and related to the temporary dysfunction of the parathyroid glands, which may recover with time [5]. It is well documented that a decrease in corrected serum calcium levels is observed postoperatively, especially within the first 24 to 48 hours [6]. However, the risk factors and extent of calcium depletion vary between surgical approaches and patient demographics [7]. On the other hand, non-thyroid neck surgeries, such as those involving the parotid gland or lymph nodes, may also pose a risk to calcium homeostasis. However, the frequency and severity of hypocalcemia in these surgeries have not been as extensively studied. Corrected serum calcium levels are a reliable indicator of calcium status, accounting for variations in albumin levels and providing a more accurate reflection of the biologically active calcium [8]. Monitoring calcium levels during the immediate postoperative period and recovery phase is crucial for the timely identification of hypocalcemia, which can result in symptoms like muscle spasms, tetany, and, in severe cases, cardiac arrhythmias [5]. This study compares corrected serum calcium changes following thyroid and non-thyroid neck surgeries.

MATERIALS AND METHODS

This prospective observational comparative study assessed changes in corrected serum calcium levels following thyroid and non-thyroid neck surgeries. The study was conducted in the Department of Otolaryngology - Head & Neck Surgery at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Over one year, from June 2022 to July 2023, 60 patients were enrolled. Patients undergoing thyroid surgeries were assigned to Group A, while those undergoing non-thyroid neck surgeries were placed in Group B. Prior to enrollment, written informed consent was obtained from all participants, and ethical approval for the study was obtained from the Institutional Review Board (IRB) of BSMMU.

- **Group A with 28 patients (Thyroid Surgery Group):** Patients undergoing thyroid surgeries, including total thyroidectomy, hemithyroidectomy, and subtotal thyroidectomy.
- **Group B with 32 patients (Non-Thyroid Neck Surgery Group):** Patients undergoing neck surgeries unrelated to the thyroid gland, including lymph node biopsy, parotid surgery, neck dissection, and parathyroid surgery.

Inclusion Criteria

- Adult patients (≥18 years) undergoing planned thyroid or non-thyroid neck surgeries.
- Patients with preoperative corrected serum calcium within normal range.
- Patients are willing to provide written informed consent.

Exclusion Criteria

- Patients with pre-existing calcium or parathyroid disorders.
- Patients with chronic kidney disease or malignancies with bone metastasis.
- Patients receiving calcium or vitamin D supplementation preoperatively.
- Patients undergoing emergency neck surgeries.
- Re-exploration or revision surgeries involving the neck.

The data were collected using a structured data collection sheet, which included demographic information such as age, gender, and BMI, along with surgical details, including the type of surgery, duration, and extent of the procedure. Corrected serum calcium levels were measured at multiple time points: preoperatively (baseline), immediately after recovery (within 6 hours post-surgery), on postoperative day 1 (POD-1), and on postoperative day 4 (POD-4). Patients were also monitored for hypocalcemic symptoms, including numbness, tingling, muscle cramps, and tetany, with any calcium supplementation (oral or intravenous) documented if administered. All patients underwent baseline investigations, including serum calcium and serum albumin levels, at least 3-4 days before surgery. Thyroid patients were made euthyroid prior to surgery if they were initially hypothyroid or hyperthyroid. Faculty members performed surgeries exclusively following standard surgical steps, and all details were recorded in a clinical-biochemical proforma. To ensure accurate postoperative calcium assessment, a tourniquet was avoided. Blood samples for serum calcium and albumin estimation were collected from the recovery room (immediate postoperative period) on POD-1 and POD-4. Both thyroid and non-thyroid neck

surgeries were recognized as potential causes of significant drops in corrected serum calcium levels, with hypocalcemia being the most common complication following thyroid surgery.

Statistical Analysis:

Data were analyzed using SPSS software (version 26). Descriptive statistics (mean, standard deviation, percentages) were used to summarize the data. Independent t-tests were used to compare continuous variables (age, BMI, calcium levels) between the groups. The chi-square test was applied to compare categorical variables (gender, symptoms, supplementation). Odds ratios (OR) with 95% confidence intervals (CI) were calculated to assess the risk of hypocalcemia in thyroid versus non-thyroid surgeries at different postoperative time points. A p-value <0.05 was considered statistically significant.

RESULTS

In this study comparing corrected serum calcium changes following thyroid and non-thyroid neck surgeries, significant differences were observed between the two groups. The mean age and BMI were comparable between thyroid and non-thyroid surgery patients, with no statistically significant differences ($p>0.05$). However, there was a clear gender disparity, with thyroid surgeries being predominantly performed on females (82.1%). In comparison, non-thyroid neck surgeries were more common among males (68.8%), a statistically significant difference ($p<0.001$). Preoperative calcium levels were similar across both groups ($p>0.05$). However, during the immediate postoperative recovery phase, thyroid surgery patients exhibited significantly lower corrected serum calcium levels compared to the non-thyroid group ($p<0.05$), highlighting a higher risk of transient hypocalcemia following thyroid procedures. By postoperative day (POD) 1 and POD 4, calcium levels were comparable between the groups ($p>0.05$), indicating gradual normalization. The odds of developing hypocalcemia were 2.85 times higher in thyroid surgery patients during the recovery period ($p<0.05$), but this elevated risk was not statistically significant on POD 1 or POD 4 ($p>0.05$). These findings reinforce that transient hypocalcemia is a common early complication of thyroid surgery, underscoring the importance of vigilant calcium monitoring and timely supplementation to prevent symptomatic hypocalcemia in this population.

Table 1: Comparison of Demographic Characteristics of the study groups

Variables	Group A (N=28)	Group B (N=32)	P-value
	Mean±SD	Mean±SD	
	n(%)	n(%)	
Age (in years)	42.3±10.8	44.6±11.5	>0.05
BMI (kg/m²)	24.5±3.2	23.9±3.5	>0.05
Gender			
Male	5 (17.9%)	22 (68.8%)	<0.001
Female	23 (82.1%)	10 (31.2%)	

Table 2: Comparison of Calcium Levels in both groups

Variables	Group A (N=28)	Group B (N=32)	P-value
	Mean±SD	Mean±SD	
Calcium levels (mmol/l)			
Pre-op	2.05±0.07	2.05±0.09	>0.05
Recovery	1.65±0.24	1.79±0.18	<0.05
POD-1	1.95±0.15	1.96±0.14	>0.05
POD-4	2.01±0.06	1.98±0.05	>0.05

Table 3: Odds Ratios and 95% Confidence Intervals for Hypocalcemia

Days	Odds Ratio (OR)	95% CI	P-value
Recovery	2.85	1.15-7.09	p<0.05
POD-1	1.21	0.45-3.26	p>0.05
POD-4	0.96	0.30-3.06	p>0.05

DISCUSSION

This study observed a significant decrease in corrected serum calcium in the recovery room (immediate postoperative period) for both the thyroid and non-thyroid neck surgery groups. However, the decrease in thyroid surgery patients was more pronounced than in the non-thyroid neck surgery group. The mean corrected serum calcium level was 2.05 mmol/l for both groups pre-operatively. By postoperative day 1 (POD-1), the levels dropped to 1.65 mmol/l for thyroid surgeries and 1.95 mmol/l for non-thyroid surgeries. Interestingly, by postoperative day 4 (POD-4), the corrected calcium levels in both groups were almost identical, with values of

2.05 mmol/l and 1.98 mmol/l, respectively. These findings align with the results of Mehta et al. [9]. According to de Andrade Souse et al., ionized calcium concentrations less than 1.03 mmol/l on POD-1 suggest the presence of symptoms and the need for treatment [10]. Routine calcium supplementation is unnecessary if the serum calcium level exceeds 1.81 mmol/l [11]. Several studies have reported a decline in serum calcium levels following major surgeries [12-14], with multiple factors contributing to this decline, including hemodilution, hypoparathyroidism, and hypomagnesemia. Some studies suggest that hypoparathyroidism is the sole cause of hypocalcemia. In contrast, hypercalcemia may be observed in patients diagnosed with epidermoid carcinoma of the head and neck, with pseudo-hyperparathyroidism being a suspected cause in these cases [15]. The role of hypoparathyroidism in our study appears less likely, as the corrected serum calcium levels for both thyroid and non-thyroid cases on POD-4 remained close to their pre-operative levels. On POD-4, the mean corrected calcium levels were 1.98 mmol/l for thyroid surgery patients and 2.01 mmol/l for non-thyroid surgery patients, showing minimal change (0.04 mmol/l) from the pre-operative levels (2.05 mmol/l), which was not statistically significant (>0.05) in hemithyroidectomy cases. Measuring or calculating ionized calcium levels post thyroidectomy to avoid unnecessary calcium supplementation resulting from diagnosing hypocalcaemia by measuring total calcium level alone is more accurate and appropriate [16]. This result is similar to that of Cannon et al., who specifically studied 107 patients undergoing hemi-thyroidectomy [17]. Mehta et al. were the first to compare thyroid and non-thyroid neck surgeries concerning changes in corrected serum calcium levels using albumin [6]. This study shares similarities with ours, as Mehta et al. compared perioperative calcium changes following total and completion thyroid surgeries with a control group undergoing non-thyroid neck surgery. All three groups significantly decreased corrected serum calcium from pre-operative levels to POD-1. The study by Snow et al. provides further insight into the factors contributing to hypocalcemia following neck surgeries. Snow identified several etiological factors, including hypoalbuminemia, thyroidectomy, hypoparathyroidism, hypomagnesemia, estrogen replacement therapy, oral contraceptives, blood transfusions, hyperventilation alkalosis, depression, emotional stress, and diet. Additionally, Snow's study demonstrated that the symptoms and signs of hypocalcemia typically appear within 24 to 48 hours post-operation [18]. Lepage et al. also supported our findings, showing that the fall in ionized serum calcium during major and minor abdominal surgeries was partially related to reductions in albumin levels due to acute hemodilution from physiological saline [19]. This highlights the importance of considering albumin levels when assessing calcium status after surgery.

CONCLUSION

In conclusion, this study highlights significant differences in corrected serum calcium changes between thyroid and non-thyroid neck surgeries. Thyroid surgery patients experienced a more pronounced and immediate postoperative decline in serum calcium, increasing their risk of transient hypocalcemia. However, calcium levels gradually normalized by postoperative day 4, with no significant differences between the two groups. This emphasizes the need for vigilant monitoring and appropriate supplementation to prevent symptomatic hypocalcemia, particularly in thyroid surgery patients. Factors such as hemodilution, hypoalbuminemia, and transient hypoparathyroidism may contribute to calcium fluctuations, underscoring the importance of comprehensive perioperative management to ensure optimal calcium homeostasis after neck surgeries.

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