ORIGINAL ARTICLE

Effect of Truncal Versus Branch Ligation of Inferior Thyroid Artery on Postoperative Hypocalcemia Patients Undergoing Thyroid Surgery: Rawalpindi

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ABSTRACT

Objective: To investigate the effect of truncal or branch ligation of the inferior thyroid artery on postoperative hypocalcemia.

Study Design: Quasi-experimental study.

Place and Duration of Study: The study was conducted at the Department of Surgery, Pak Emirates Military Hospital (PEMH), Rawalpindi, Pakistan from July 2021 to June 2022.

Methods: For this study, 60 patients were enrolled who underwent total thyroidectomy at the Department of Surgery from July 2021 to June 2022. Patients were divided into Group 'A' and Group 'B', with an equal number of 30 patients in each group. Patients in group 'A' underwent bilateral ITA ligation at the trunk, while patients in group 'B' underwent ligation of terminal branches of ITA on the gland capsule. The primary outcome was postoperative hypocalcemia on 1st postoperative day.

Results: Our results showed a significant difference in hypocalcemia in both groups. Decreased incidence of biochemical hypocalcemia was found in branch ligation of ITA (3.33%) than trunk ligation (36.36%) *P* value 0.025.

Conclusion: Branch ligation of ITA decreases the incidence of hypocalcemia after total thyroidectomy.

Keywords: *Branch Ligation, Euthyroid, Hypocalcaemia, Thyroidectomy, Truncal.*

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Introduction

For general as well as endocrine surgery, thyroidectomy is one of the commonest procedures.[1] Due to advanced preoperative diagnostic techniques, a better understanding of anatomy and physiology, refined operative skills, and anesthesia, thyroid surgery is considered a safe surgery.[2] As reported in studies, postoperative hypocalcemiahypocalcemia is most frequent complication faced after thyroidectomy.[3] HypocalcemiaHypocalcemia is associated with prolonged hospitalization and higher costs. Postoperative hypocalcemia depends on patient-related factors, indication for surgery, disease severity, preoperative calcium levels, preoperative vitamin D levels, size and type of gland, injury to parathyroid gland, surgical technique, and surgeon's experience.[4] Hypocalcemia can be asymptomatic or may develop neurological or cardiac symptoms like tetany, perioral or digital paresthesia, or arrhythmias. It should be taken as an acute emergency and should be treated with oral or intravenous calcium supplementation depeneding on the severity of symptoms. Permanent hypocalcemia can cause fatal results leading to renal impairment, psychiatric illness or the development

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of cataracts.[5] The incidence of hypocalcemia after thyroidectomy is taken as a matter of scientific debate whether inferior thyroid artery (ITA) ligation is done at the trunk level or branch level.[6] Different strategies for surgeries have been employed to decrease this postoperative hypocalcemia rate.[7] American Thyroid Association (ATA) emphasizes different techniques and strategies that should be employed by surgeons to prevent postoperative hypocalcemia.[5]

Using intravenous methylene blue or fluorescent staining is described by some authors for the location of parathyroid glands during the surgical process.[8] Some other authors have mentioned techniques during surgery to prevent possible injury to the vascular blood supply of these glands.[9] Blood supply to superior and inferior parathyroid glands is through the inferior thyroid artery by 80-90%. Hence, there is a strongly suggested opinion for mandatory ligation of these secondary and tertiary ITA branches near the gland capsule. This will help to avoid ligation of truncal arteries and thus to prevent the devascularization of the parathyroid gland.[6] Our study aim is to evaluate post-operative hypocalcemiahypocalcemia in patients after truncal or branch ligation of the inferior thyroid artery in total thyroidectomy. The end point of the study is to analyze the impact of truncal ITA ligation versus branch ITA ligation on postoperative serum calcium levels.

Methods

This study was conducted in the Department of General Surgery, Pak Emirates Military Hospital (PEMH), Rawalpindi, Pakistan, from July 2021 to June 2022 after obtaining permission to conduct study from the ethical committee vide letter no: (A\28\EC\227\2020) dated January 26, 2020. Written consent was obtained from all the patients. Patients were prepared for total thyroidectomy and were divided into two equal groups non-randomly with 30 patients in each group. The sample size was calculated using a reference study.[10] In Group A, all patients had bilateral truncal ligation of ITA, and in group B, branch ligation of ITA near to the gland capsule. Preoperatively, serum calcium levels were estimated for all patients.

Inclusion criteria were all patients of age above 18 years with multinodular euthyroid goiter undergoing total thyroidectomy regardless of pathology at the department of general surgery PEMH. Exclusion criteria were patients under 18 years of age, malignancy, patients undergoing lobectomy, lateral or central neck dissection, recurrent disease, history of taking drugs that interfere with calcium metabolism(lithium, diuretics, bisphophonates), renal insufficiency, co-existing parathyroid disease, pre-operative hypocalcemia.

Pre-operative investigations were done in all patients to check for functional status of the thyroid, clinical status of thyroid toxicity and American Society of Anaesthesiologists (ASA) grading. All patients were made euthyroid before surgery. All surgeries were performed by the same consultant under General anesthesia. A Readivac drain was placed in all patients, which was removed if drain value was less than 30ml/ 24 hours. No iatrogenic injury to parathyroids was observed during the procedure. No event of post-operative bleeding was observed. Following surgery, serum calcium levels were evaluated on 1st postoperative day. A comparison of two groups were made for the frequency of hypocalcemia defined as single setting-corrected levels of calcium below 8.0mg/dl.[8,9] The need for exogenous replacements was also noted.

SPSS 23 was used for data analysis. The frequency of hypocalcemia in group A was compared with the frequency of hypocalcemia in group B and Chi-square test was employed, and $p \leq 0.05$ was considered statistically significant.

Results

Age range in this study was from 32 to 68 years, with mean age of 50.43 ± 10.28 years in group A and 50.40

Table 1: Group wise distribution of age in years (n=30)

Demographics	Group-A Mean±SD	Group-B Mean±SD
Age (years)	50.43 ± 10.28	50.40 ± 10.42

± 10.42 years in Group B as shown in Table 1.

There was a roughly equal distribution of genders among the thirty participants in Groups A and B. Group A has 53.33% men and 46.67% women, whereas Group B comprise of 56.66% men and 43.33% women, as shown in Table 2.

Table 2: Gender wise Distribution of patients (n=30)

Gender	Group-A n (%)	Group-B n (%)
Males	16 (53.33%)	17 (56.66%)
Females	14 (46.67%)	13 (43.33%)
Total	30 (100%)	30 (100%)

During the pre-operative day, the average serum Calcium levels were 8.66 ± 0.33 mg/dl for trunk ligation and 8.74 ± 0.45 mg/dl for branch ligation. The statistical analysis revealed a *P*-value of 0.4355, indicating that the difference in Calcium levels between the two ligation methods was not statistically significant. Nevertheless, following the first day after surgery, the average levels experienced a decline to 8.33 ± 0.42 mg/dl for trunk ligation and 8.66 ± 0.47 mg/dl for branch ligation. A statistically significant distinction was observed, as indicated by a *P*-value of 0.0058 (Table 3).

Table 3: Calcium levels on pre and post-operative day

Observation Day	Trunk ligation	Branch ligation	*P*-value
Pre Operation	8.66± 0.33 mg/dl	8.74± 0.45 mg/dl	0.4355
1st postoperative day	8.33± 0.42 mg/dl	8.66± 0.47 mg/dl	0.0058

When analyzing and comparing surgical techniques, it was observed that the incidence of hypocalcemia differed between truncal and branch surgery. Among the 22 cases of truncal surgery, hypocalcemia was observed in 8 cases, representing a prevalence of 36.36%. Conversely, in the 30 cases of branch surgery, hypocalcemia was observed in only 1 case, accounting for a prevalence of 3.33%. The observed distinction demonstrates statistical significance, as evidenced by a *P*-value of 0.0257 (Table 4).

Table 4: Frequency of Hypocalcemia following thyroidectomy

Hypocalcemia	Surgical Technique		*P* Value
	Truncal	Branch	
Yes	8 (36.36%)	1 (3.33%)	
No	22 (73.33%)	29 (96.66%)	0.0257
Total	30 (100%)	30 (100%)	

Discussion

Hypocalcemia is a concerning condition occurring frequently in patients undergoing thyroidectomy. Transient hypocalcemia may occur after thyroidectomy, ranging from 50% to 68%, but out of these, some may develop permanent hypocalcemia 5%.[11] Hypocalcemia increases the morbidity of the patient. It must be taken as vital to leave parathyroid glands with intact pedicles intra operatively to prevent hypocalcemia after thyroidectomy.[12] Patients with low levels of serum calcium pre operatively are tend to develop temporary post-thyroidectomy hypocalcemia.[13] However, we excluded those patients in our study. Some authors still favor truncal ligation as it does not cause definitive hypocalcemia post operatively.[12] Salamatullah J, et al. reported that truncal ligation of ITA bilaterally have not been shown to increase the risk of hypocalcemia in the transient postoperative period.[14] Some authors argued that hypocalcemia was seen only transiently, which came back to

normal in early postoperative days.[15] Thus, they favor truncal ligation to avoid blood loss, save time, and prevent recurrent damage of laryngeal nerve. In some studies, authors conclude that branch ligation of ITA near the capsule decreased the chances of post-thyroidectomy hypocalcemia 35.2 % (*P* value 0.017).[16] Our results were also consistent with this study which showed a decrease incidence of post-operative hypocalcemia in branch ligation at 3.33% with a significant difference as compared to trunk 36.36% (*P* value 0.025). In those cases where developing hypocalcemia appeared significantly, they were normalized by following up visit after 3 months. Similarly, Waseem T stated that ligating the ITA near the gland capsule prevents the devascularisation of the parathyroid gland and decreases the incidence of transient post-operative hypocalcemia22.9% vs 3.1%. (*P* value 0.003).[6] Author also stated that dissection along the gland capsule also decreases the incidence of recurrent laryngeal nerve injury as compared to trunk ligation. Kebsch et al. stated decrease in parathyroid levels post operatively after bilateral truncal ligation of ITA.[17]

Many authors have also claimed devascularization of parathyroid gland gland during manipulation which causes vascular spasm and iatrogenic injury as a cause of post-operative hypocalcemia which is usually recovered in long term due to retake of vascularization by the gland.[9] Authors supported literature in their article and metanalysis by stating no impact on definitive and temporary hypocalcemia after trunk ligation of the inferior thyroid artery.[18,19] However, later, his review was questioned due to the inclusion of low power studies.

Chang Yk et al. have related post-operative hypocalcemia with the identification of the parathyroid gland during surgery.[20] He stated that number of parathyroid glands identified during surgery is related to a greater risk of hypocalcemia. At least one in situ pedicle attached to the parathyroid gland should be left to prevent iatrogenic hypocalcemia.

Chisthi MM et al. explained post thyroidectomy hypocalcemia to be transient and associated with the release of calcitonin in the blood due to handling of the thyroid gland and also associated with the dilution effect of serum albumin secondary to surgical stress, but this needs to be further evaluated.[21]

Thomusch O et al. carried out a multifactor analytical analysis and postulated that bilateral peripheral ligation of the inferior thyroid artery near the gland capsule should be performed to minimize the risk of post-operative hypoparathyroidism.[22] Parathyroid gland preservation mainly depends on its blood supply, anatomical variation, surgeons' expertise, and accurate tissue identification.

Some articles suggested female gender and old age to be a significant risk factors for hypocalcemia,[23] however, our study showed no association of hypocalcemia with gender and age.

Data by Cocchiara et al. supports our study by terminal ligation of ITA in total thyroidectomy procedure for multinodular goiter, reported normal level of mean postoperative calcium as well as PTH compared to patients who underwent truncal ligation.[24]

The discrepancies observed in the results of different trials may be due to different sample sizes, the diversity of the studies, and distracting variables. Post thyroidectomy hypocalcemia is related to surgeons' experience and technique of surgery. Temporary hypocalcemia is related to the devascularization of the parathyroid gland. Dissection near to the gland capsule allows the preservation of vasculature of parathyroid gland and to avoid potential risk of transient hypocalcemia.[13] So our observation in this study is that hypocalcemia is more common where truncal ligation is performed than the branch ligation of inferior thyroid arteries. These results also lead us that it may be safer to perform dissection along the capsule. We can say that identifying the nerve is important for safety of this operation and dissecting along the gland capsule add to this safety.

Conclusion

In conclusion, branch ligation leads to a decrease in the risk of postoperative hypocalcemia after thyroidectomy. Ligation at branches of the inferior thyroid artery near the capsule further helps to lower postoperative hypoparathyroidism incidence, restrain extensive dissection and devascularization of the parathyroid and may improve the postoperative course of the patient.

Authors Contribution

RJ: Idea conception, study designing, data collection, data analysis, results and interpretation, manuscript writing and proof reading

MQB: Idea conception, study designing, data collection, data analysis, results and interpretation, manuscript writing and proof reading

MT: Idea conception, study designing, data collection, data analysis, results and interpretation, manuscript writing and proof reading

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