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Parathyroid gland preservation in laryngectomy patients with total thyroidectomy

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Abstract

Background Postoperative hypocalcemia in laryngectomy patients can occur when part or whole of the thyroid gland has been removed. Preservation of the parathyroid glands in situ is considered one of the initial measures to prevent postoperative hypocalcemia even if all thyroid gland is removed. Our study aims to assess the efficacy of parathyroid gland preservation in situ to prevent postoperative hypocalcemia in cases where total laryngectomy is done with total thyroidectomy.

Methods The study included all laryngectomy patients done during a period from April 2020 to May 2021. Parathyroid gland preservation was done in both primary (12 cases) and salvage (16 cases). Both PTH and corrected calcium level were measured at different time points and used as a guide for further replacement.

Results We studied the association between outcome including recovery from transient hypocalcemia and certain variables like age, type of surgery, stage of tumor, and extent of neck dissection. Regarding type of surgery, all patients that underwent primary laryngectomy were totally recovered ($n = 12$, 100%); however, salvage cases were partially recovered ($n = 10$, 62.5%).

Conclusion Parathyroid preservation is achievable in cases of salvage laryngectomy in addition to primary laryngectomy with total thyroidectomy. Early monitoring of the patients PTH and Ca during their hospital stay is a good indicator of successful preservation. Long-term follow-up is advised for potential recovery from transient hypoparathyroidism.

Keywords Parathyroid gland preservation, Total laryngectomy, Total thyroidectomy, Hypocalcemia

Background

Total laryngectomy patients could suffer from some postoperative comorbidities of which hypocalcemia is a lifelong sequel. Survival of parathyroid gland is affected

by many factors including type of primary surgery, type of neck dissection, salvage or initial treatment, tumor extension, reconstruction, and postoperative adjuvant treatment [1, 2]. This harbors direct or indirect effect on parathyroid gland either direct tissue damage by mechanical or thermal injury or indirect by compromising their blood supply up to complete avulsion [1].

Postoperative hypocalcemia in these patients can occur when part or whole of the thyroid gland has been removed [3] Literature reported rates of 5.6–59.3% and 0–12.8% for both transient and long-term hypocalcemia respectively [1].

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Preservation of the parathyroid glands in situ is considered one of the initial measures to prevent postoperative hypocalcemia; this has been well described in thyroid surgery especially in total thyroidectomy [4], but with total laryngectomy, few literatures have studied that [1, 2]. Authors have found that the superior parathyroid was frequently located just above the intersection between the recurrent laryngeal nerve and the inferior thyroid artery. The inferior parathyroid most often lay somewhat more ventrally, close to the posterior aspect of the lower thyroid pole between the junction of the inferior thyroid artery/thyroid gland and inferior thyroid vein/thyroid gland, or in the upper thymus or thyrothymic ligament but in few cases was found higher in the neck [5, 6].

Our study aimed to assess the efficacy of parathyroid gland preservation in situ to prevent postoperative hypocalcemia in cases where total laryngectomy is done with total thyroidectomy. We utilized PTH as early predictor of survival.

Methods

The study included all laryngectomy patients done during a period from April 2020 to May 2021 at the Department of Otolaryngology Head and Neck Surgery, Alexandria University Hospital. A total of 28 patients were included.

Parathyroid gland preservation was done in both primary (12 cases) and salvage (16 cases). Total thyroidectomy was performed in 22 cases, while hemithyroidectomy was done in other 6 cases again with preservation of parathyroid gland on resected side as well. Based on the inferior thyroid artery, the inferior parathyroid gland on both sides was kept in place after confirmation of their location in relation to the recurrent laryngeal nerve and inferior thyroid artery, where just the minor branches of the artery that enter the thyroid gland were sacrificed (Fig. 1).

Partial pharyngectomy was done based on intraoperative evidence of involvement in conjunction with total laryngectomy. Reconstruction is done in all salvage cases and in advanced tumor involving the skin or cases of partial pharyngectomy. Bilateral or unilateral lateral neck dissection is done according to the location and type of laryngectomy being either primary or salvage. All our primary cases were T4a in which total thyroidectomy has been performed with parathyroid gland preservation.

Protocol for parathyroid hormone and calcium monitoring after PTG preservation

Both PTH and corrected calcium level were measured overnight and used as a guide for further replacement. If both calcium and PTH were low, calcium replacement using IV or NG route started straightaway. Repeated measurements were performed at day 5 following

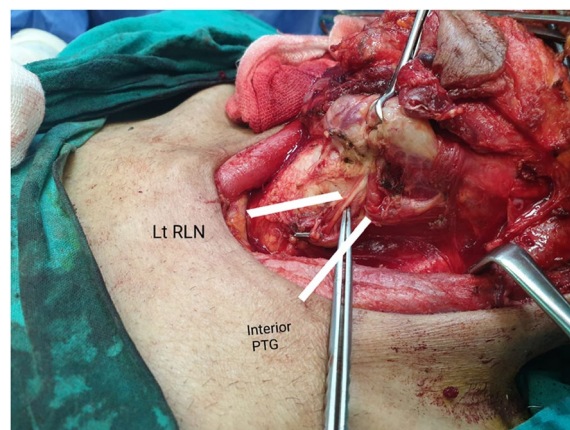


Fig. 1 Parathyroid gland preservation on left side. Lt RLN, left recurrent laryngeal nerve; PTG, parathyroid gland

laryngectomy for PTH and at days 7–10 for corrected calcium. If only PTH was low at day 1 postoperatively with normal corrected calcium levels and no symptoms, patients were closely observed for hypocalcemia symptoms. Repeated measurements were done following the same protocol. If patients develop hypocalcemia symptoms or their measurements are low, calcium replacement was resumed, and follow-up measurements were done on day 21 and 3 months following surgery.

Results were analyzed using Statistical Package for Social Sciences (SPSS) version 26. The data is presented as mean, standard deviation, and ranges. Categorical data is presented by frequencies and percentages. Independent *t*-test (two tailed) was used to compare the continuous variables according to outcome. Chi-square test was used to assess the association between outcome and certain information, while Fisher exact test was used instead when the expected frequency was less than 5. A level of *p*-value less than 0.05 was considered significant.

Results

Twenty-eight patients were included in the study. Table 1 shows demographic distribution of the patients. Salvage surgery was performed in 57.1% of our cases. Of all patients included in our study, 16 patients were staged as T4a.

Reconstruction was used in most cases ($n = 18$, 64.3%), and most of cases underwent bilateral neck dissection ($n = 22$, 78.6%). Total thyroidectomy was performed in 22 patients (78.6%) explained by advanced tumor at presentation either in salvage or primary cases.

Parathyroid gland preservation was performed in all cases as described before. Both calcium and PTH were assessed following the protocol on days 1, 3, and 7 after surgery. Results were collected after 3 months to check

Table 1 Distribution of study patients by certain characteristics

Variable	No. (n = 28)	Percentage (%)
Age years old		
< 60	10	35.7
≥ 60	18	64.3
Type		
Primary	12	42.9
Salvage	16	57.1
Stage		
T3	12	42.9
T4a	16	57.1
Intervention		
Total thyroidectomy	22	78.6
Hemi thyroidectomy	6	21.4
Flap use		
Yes	18	64.3
No	10	35.7
Extent of nodal surgery		
Bilateral neck dissection	22	78.6
Ipsilateral neck dissection	6	21.4

recovery in cases of transient hypoparathyroidism (Table 2).

We studied the association between outcome including recovery from transient hypocalcemia and certain variables like age, type of surgery, stage of tumor, and extent of neck dissection. Regarding patients age either below or above 60 years, there was no effect on postoperative hypocalcemia rates ($n=8$, 80% and $n=14$, 77.8%, respectively). Regarding the type of surgery, all patients who underwent primary laryngectomy were totally recovered ($n=12$, 100%); however, salvage cases were partially recovered ($n=10$, 62.5%). Tumor stage had a little effect on recovery as T3 ($n=10$, 83.3%) and T4a ($n=12$, 75%). Most of our cases underwent bilateral neck dissection.

Only four patients did not show good recovery from hypoparathyroidism among this category explained by fact that central neck dissection was performed in these cases (Table 3).

Discussion

Postoperative hypocalcemia can really affect patient’s life, and surgeons studied different intraoperative methods aiming to preserve parathyroid glands function in thyroid surgery [4–11] and in laryngectomy or pharyngolaryngectomy [1, 2, 12].

In our study, we classified our patients’ groups into primary laryngectomy ($n=12$, 42.9%) and salvage laryngectomy ($n=16$, 57.1%). All salvage cases underwent total thyroidectomy on the base that most cases had either advanced tumor stage as T4a or chondroradionecrosis in which the thyroid gland cannot be preserved, while primary cases underwent hemithyroidectomy ($n=6$) when possible and total thyroidectomy ($n=6$) in advanced tumor. Every J. D. et al. [2] preferred hemithyroidectomy to total thyroidectomy (57% vs 7%). Gurbuz M. K. et al. [13] recommend that hemithyroidectomy considered the least procedure performed in advanced laryngeal cancer. Panda S. et al. [14] recommended that thyroidectomy is done in central compartment and subglottic extension in order to decrease endocrinological dysfunction.

Parathyroid gland preservation was undertaken in both primary (12 cases) and salvage (16 cases) with and without thyroid gland preservation. Based on the inferior thyroid artery preservation, we succeeded to keep bilateral inferior PTG (only) in place after confirmation of their location in relation to the recurrent laryngeal nerve and inferior thyroid artery according to anatomical distribution and depending on the surgeon experience, where just the minor branches of the artery that enter the thyroid gland were sacrificed. This technique for some extent is close to what has been innovated by other surgeons [7,

Table 2 Comparison in calcium and PTH level according to outcome

Parameter	Outcome		p-value
	Recovered Mean ± SD	Not recovered Mean ± SD	
Calcium level (mmol/l)	Normal range: 2–2.5 mmol/L		
Day 1	2.22 ± 0.18	2.04 ± 0.2	0.045
Day 7	2.07 ± 0.19	1.8 ± 0.15	0.005
Day 21	2.37 ± 0.14	2.06 ± 0.12	0.001
After three months	2.21 ± 0.22	1.58 ± 0	0.001
PTH level (pg/ml)	Normal range: 15–65 pg/ml		
Day 1	11.3 ± 9.9	1.02 ± 0.67	0.001
Day 5	25.13 ± 18.6	1.14 ± 0.43	0.001

Table 3 Association between outcome and certain characteristics

Variable	Outcome		Total (%) n = 28	p-value
	Recovered (%) n = 22	Not recovered (%) n = 6		
Age (year)				
< 60	8 (80.0)	2 (20.0)	10 (35.7)	0.891
≥ 60	14 (77.8)	4 (22.2)	18 (64.3)	
Type				
Primary	12 (100.0)	0 (0)	12 (42.9)	0.021
Salvage	10 (62.5)	6 (37.5)	16 (57.1)	
Stage				
T3	10 (83.3)	2 (16.7)	12 (42.9)	0.479
T4a	12 (75.0)	4 (25.0)	16 (57.1)	
Intervention				
Total thyroidectomy	16 (72.7)	6 (29.3)	22 (78.6)	0.149
Hemithyroidectomy	6 (100.0)	0 (0)	6 (21.4)	
Extent of nodal surgery				
Bilateral neck dissection	18 (81.8)	4 (18.2)	22 (78.6)	0.423
Ipsilateral neck dissection	4 (66.7)	2 (33.3)	6 (21.4)	

8, 10] in effort to keep parathyroid gland functioning in place but differ from what been done by others [9, 15].

Survival of glands in place has been observed based on early PTH and Ca readings. The early measurement of Ca and PTH in correlation with postoperative symptoms of hypocalcemia has been observed to get an idea how things can go according to the results. In all the recovered cases (n = 22, 78.6%), their early PTH was low and then partially recovered at day 5, and then all of them have normal PTH before discharge. So, persistent low-level PTH level without recovery is a strong predictor for non-survival that occurred in (n = 6, 21.4%) cases; all were salvage cases which showed similar results to Every J. D. et al [2]. Most of total thyroidectomy cases (n = 16, 72.7%) have been recovered, while all cases (n = 6, 100%) in which hemithyroid preserved their PTH level were recovered. Xing Z. et al. [4] and Edafe O. et al. [1] proved that total thyroidectomy is associated with decreased regaining of parathyroid gland function than lobectomy. Basheeth N. et al., [16] Galbo A. M. et al. [17], and Negm H. et al. [18] all have proved that hemithyroidectomy is not protective against hypoparathyroidism. Harris A. S. et al. [3] revealed that total thyroidectomy significantly increases the risk of hypoparathyroidism in any situation. Every J. D. et al. [2] found that total thyroidectomy and lobectomy have same results from hypoparathyroidism point of view.

Preservation of PTG in place gave a good outcome (n = 22, 78.6% in our study) for early gaining of function and decrease risk of prolonged hypoparathyroidism. Xing Z. et al. [4] reported that thyroid lobectomy

with preservation of parathyroid in place has better functional outcome. El-Sharaky et al. [11] reported that recovery for autotransplanted gland took at least 2–4 weeks to restore its functioning.

One limitation of our study was to assess success of gland preservation in paratracheal central neck dissection explained by the fact that surgeons did not do central neck dissection routinely and restrict that only if there was subglottic extension.

Conclusions

Parathyroid preservation is achievable in cases of salvage laryngectomy in addition to primary laryngectomy with total thyroidectomy. Early monitoring of the patients PTH and Ca during their hospital stay is a good indicator of successful preservation. Long-term follow-up is advised for asymptomatic patients who have low PTH level with normal calcium levels for potential recovery from transient hypoparathyroidism.

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Authors' contributions

SA was the main author that organized the study and made data collection, MZ added a major contribution for literature review and writing manuscript, AM helped with data analysis and writing the manuscript, and MA helped with anatomical knowledge and description of our technique. AY is the supervisor of study that helped with surgical technique, data collection/analysis, and literature review. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the research ethical committee (REC), Alexandria University. Written consent was obtained from the patients prior to contribution in the study after clarifying the importance of the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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