



OUTCOMES OF THYROIDECTOMY IN PATIENTS WITH THYROID NODULES: A PROSPECTIVE ANALYSIS OF PRE AND POSTOPERATIVE COMPLICATIONS AND QUALITY OF LIFE

General Surgery

Dr. Shireesh Gupta	Professor Department Of General Surgery, Mahatma Gandhi Medical College And Hospital, Jaipur
Dr. Abhinav Dana	Pg Residents Department Of General Surgery, Mahatma Gandhi Medical College And Hospital, Jaipur
Dr. Soham Solanki	Pg Residents Department Of General Surgery, Mahatma Gandhi Medical College And Hospital, Jaipur
Dr. Arshiya Gupta	Pg Residents Department Of General Surgery, Mahatma Gandhi Medical College And Hospital, Jaipur

ABSTRACT

Thyroidectomy is a common surgical procedure for managing thyroid nodules, but its impact on patients' quality of life (QoL) remains a subject of ongoing research. This prospective study aimed to investigate the effects of thyroidectomy on QoL in patients with thyroid nodules and to assess the significance of various factors affecting the outcome. Eighty patients with thyroid nodules underwent thyroidectomy between March 2023 and June 2024. QoL was assessed using the ThyPRO questionnaire before and 6 months after surgery. Preoperative and postoperative scores were compared, and univariate and multivariate analyses were performed. Results showed a significant improvement in overall QoL scores postoperatively ($p < 0.001$). Factors such as age, nodule size, and preoperative thyroid function significantly influenced QoL outcomes. Complication rates were low, with transient hypocalcemia (15%) and recurrent laryngeal nerve palsy (2.5%) being the most common. This study demonstrates that thyroidectomy generally leads to improved QoL in patients with thyroid nodules, with minimal complications. These findings can help inform clinical decision-making and patient counseling regarding thyroidectomy for thyroid nodules.

KEYWORDS

Thyroidectomy; Thyroid nodules; Quality of life; ThyPRO; Complications; Prospective study

INTRODUCTION

Thyroid nodules are a common clinical finding, with a prevalence of up to 68% in the general population when high-resolution ultrasound is used for detection.¹ The prevalence increases with age, iodine deficiency, and exposure to radiation.² While most thyroid nodules are benign, a small proportion may be malignant or cause compressive symptoms, necessitating surgical intervention.³

Thyroidectomy, the surgical removal of part or all of the thyroid gland, is a well-established treatment for thyroid nodules.⁴ The procedure can be performed as a total thyroidectomy (removal of the entire gland) or as a hemithyroidectomy (removal of one lobe), depending on the clinical scenario.⁵ The choice between these approaches is influenced by factors such as nodule characteristics, risk of malignancy, and patient preferences.⁶

Despite the widespread use of thyroidectomy, its impact on patients' quality of life (QoL) remains a subject of debate. Some studies have reported improvements in QoL following surgery⁷, particularly in terms of relief from compressive symptoms and resolution of thyroid dysfunction. Others have found no significant change or even deterioration in certain aspects of QoL⁸, potentially due to the need for lifelong thyroid hormone replacement or surgical complications.

These conflicting results highlight the need for further investigation into the factors that influence postoperative QoL outcomes. Understanding these factors is crucial for several reasons:

1. Informed decision-making: Patients and clinicians can make more informed decisions about proceeding with thyroidectomy when they have a clear understanding of the potential impacts on QoL.
2. Patient counseling: Healthcare providers can better prepare patients for what to expect post-surgery, potentially improving patient satisfaction and compliance with follow-up care.
3. Identification of at-risk patients: Recognizing factors that predict poor QoL outcomes could help identify patients who may benefit from additional support or alternative management strategies.
4. Optimization of care: By understanding which aspects of QoL are most affected by thyroidectomy, care pathways can be optimized to address these specific areas.

The aim of this prospective study was to investigate the impact of thyroidectomy on QoL in patients with thyroid nodules and to assess the significance of various factors affecting the outcome. By using a validated, disease-specific QoL instrument (ThyPRO) and conducting a comprehensive analysis of pre- and postoperative factors, this study

seeks to provide valuable insights into the patient-reported outcomes of thyroidectomy.

Methodology

This prospective cohort study was conducted between March 2023 and June 2024 at Mahatma Gandhi Medical College and Hospital, Jaipur, a tertiary care center with a high volume of thyroid surgeries. The study included 80 consecutive patients diagnosed with thyroid nodules who underwent thyroidectomy. Inclusion criteria were age ≥ 18 years, presence of thyroid nodules requiring surgical intervention, and willingness to participate in the study. Patients with a history of previous neck surgery, inability to complete the questionnaire due to cognitive or language barriers, or presence of other malignancies that could affect QoL independently of thyroid disease were excluded. The study was approved by the institutional ethics committee, and all participants provided written informed consent.

Preoperatively, we collected comprehensive demographic data, clinical characteristics, and laboratory results. This included age, gender, body mass index (BMI), smoking status, comorbidities, thyroid function tests (TSH, free T4, free T3), thyroid autoantibodies (anti-TPO, anti-Tg), ultrasound characteristics of thyroid nodules (size, number, echogenicity, vascularity), and fine-needle aspiration cytology results. Surgical details, including the extent of thyroidectomy, operative time, and any complications, were recorded. Postoperative data collection included final histopathology results, calcium levels, and any complications during the follow-up period.

ThyPRO Questionnaire

To assess quality of life, patients completed the ThyPRO questionnaire, a validated thyroid-specific quality of life instrument⁹, before surgery and 6 months postoperatively. The ThyPRO consists of 85 items summarized in 13 scales: goiter symptoms, hyperthyroid symptoms, hypothyroid symptoms, eye symptoms, tiredness, cognitive problems, anxiety, depression, emotional susceptibility, impaired social life, impaired daily life, impaired sex life, and cosmetic complaints. Each item is rated on a 5-point Likert scale, and the scales are linearly transformed to range from 0-100, with higher scores indicating worse QoL¹⁰.

Surgical Procedure

All thyroidectomies were performed by experienced endocrine surgeons (defined as those performing >25 thyroidectomies annually) using a standardized technique. The extent of thyroidectomy (total or hemithyroidectomy) was determined based on preoperative findings

and intraoperative assessment. Intraoperative neuromonitoring was used routinely to aid in the identification and preservation of the recurrent laryngeal nerves.

Postoperative Follow-up

Patients were followed up at 2 weeks, 3 months, and 6 months postoperatively. At each visit, we performed a clinical examination, thyroid function tests, and serum calcium and parathyroid hormone levels (if indicated). Laryngoscopy was performed if voice changes were present. Levothyroxine therapy was initiated in all patients who underwent total thyroidectomy and adjusted based on thyroid function tests. Complications such as hypocalcemia, recurrent laryngeal nerve palsy, and wound infection were recorded and managed according to standard protocols.

Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were expressed as mean ± standard deviation or median (interquartile range) depending on the distribution of data. Categorical variables were expressed as frequencies and percentages.

Paired t-tests were used to compare pre- and postoperative ThyPRO scores. Cohen's d was calculated to assess the effect size of changes in QoL scores. Univariate analysis was performed using Pearson's correlation coefficient for continuous variables and independent t-tests or ANOVA for categorical variables. Variables with p<0.1 in univariate analysis were included in a multivariate linear regression model to identify independent predictors of QoL outcomes. A p-value < 0.05 was considered statistically significant for all analyses. The Bonferroni correction was applied for multiple comparisons to control for Type I error.

RESULTS

The study included 80 patients (62 females, 18 males) with a mean age of 48.3 ± 12.7 years. Table 1 summarizes the demographic and clinical characteristics of the study population.

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Value
Age (years), mean ± SD	48.3 ± 12.7
Gender, n (%)	
• Female	62 (77.5%)
• Male	18 (22.5%)
BMI (kg/m²), mean ± SD	26.4 ± 4.2
Smoking status, n (%)	
• Never smoker	52 (65%)
• Former smoker	18 (22.5%)
• Current smoker	10 (12.5%)
Preoperative diagnosis, n (%)	
• Benign nodules	65 (81.25%)
• Suspected malignancy	12 (15%)
• Toxic nodules	3 (3.75%)
Preoperative thyroid function, n (%)	
• Euthyroid	70 (87.5%)
• Subclinical hyperthyroidism	7 (8.75%)
• Overt hyperthyroidism	3 (3.75%)
Largest nodule size (cm), median (IQR)	2.8 (1.9-3.7)
Type of surgery, n (%)	
• Total thyroidectomy	55 (68.75%)
• Hemithyroidectomy	25 (31.25%)

Table 1 reveals a study population predominantly composed of middle-aged females, reflecting the higher prevalence of thyroid nodules in women. The mean BMI falls in the overweight category, which may have implications for surgical outcomes. The majority of patients (81.25%) had benign nodules, with a smaller proportion presenting with suspected malignancy or toxic nodules. This distribution is representative of typical thyroid nodule presentations in clinical practice. The median nodule size of 2.8 cm indicates that most patients had nodules large enough to potentially cause compressive symptoms or cosmetic concerns. The higher proportion of total thyroidectomies (68.75%) compared to hemithyroidectomies suggests a tendency towards more comprehensive gland removal, possibly due to multinodular involvement or risk factors for malignancy.

Quality of Life Outcomes

Overall, there was a significant improvement in QoL scores 6 months after thyroidectomy compared to preoperative scores. Table 2 presents the mean ThyPRO scores for each scale before and after surgery, along with the p-values and effect sizes. All scores are presented as mean ± SD. P-values are from paired t-tests. Effect sizes: small (0.2-0.5), medium (0.5-0.8), large (>0.8).

Table 2: Comparison of Pre- and Postoperative ThyPRO Scores

ThyPRO Scale	Preoperative Score	Postoperative Score	p-value	Effect Size (Cohen's d)
Goiter symptoms	40.2 ± 15.6	12.3 ± 8.7	<0.001	2.18
Hyperthyroid symptoms	22.7 ± 18.3	15.4 ± 12.1	0.003	0.47
Hypothyroid symptoms	25.1 ± 16.8	23.8 ± 15.2	0.578	0.08
Eye symptoms	18.3 ± 14.2	16.7 ± 13.5	0.412	0.12
Tiredness	45.6 ± 22.1	35.2 ± 18.7	<0.001	0.51
Cognitive problems	28.4 ± 19.5	24.1 ± 17.3	0.089	0.23
Anxiety	38.7 ± 20.3	25.6 ± 15.8	<0.001	0.72
Depression	29.5 ± 18.7	24.8 ± 16.2	0.047	0.27
Emotional susceptibility	35.2 ± 21.4	28.7 ± 18.9	0.018	0.32
Impaired social life	22.8 ± 17.6	18.3 ± 15.1	0.042	0.27
Impaired daily life	26.4 ± 18.9	21.5 ± 16.3	0.038	0.28
Impaired sex life	19.7 ± 16.5	17.8 ± 15.2	0.387	0.12
Cosmetic complaints	32.6 ± 23.1	18.4 ± 14.7	<0.001	0.74
Composite score	40.2 ± 15.6	28.7 ± 12.4	<0.001	0.82

Table 2 demonstrates significant improvements in most ThyPRO scales following thyroidectomy, with particularly large effect sizes in goiter symptoms, anxiety, and cosmetic complaints. These findings suggest that thyroidectomy effectively addresses the primary physical and psychological burdens associated with thyroid nodules. The lack of significant change in hypothyroid symptoms and cognitive problems may reflect the challenges of achieving optimal thyroid hormone replacement postoperatively. The substantial improvement in the composite score (effect size 0.82) indicates an overall positive impact of thyroidectomy on quality of life. However, the persistence of some symptoms, particularly tiredness, highlights the need for comprehensive postoperative care and patient education.

Factors Affecting QoL Outcomes

Multivariate analysis revealed several factors that significantly predicted postoperative QoL improvement as shown in Table 3.

Table 3: Multivariate Analysis of Factors Affecting QoL Improvement

Factor	Beta Coefficient	95% CI	p-value
Age	-0.28	-0.52 to -0.04	0.03
Preoperative nodule size	0.35	0.09 to 0.61	0.01
Preoperative thyroid function (ref: euthyroid)			
• Subclinical hyperthyroidism	0.22	0.01 to 0.43	0.04
• Overt hyperthyroidism	0.31	0.06 to 0.56	0.02
Gender	0.11	-0.18 to 0.40	0.45
Extent of thyroidectomy	0.09	-0.22 to 0.40	0.57
Final histopathology (benign vs. malignant)	0.07	-0.25 to 0.39	0.67

Table 3 identifies key factors influencing postoperative QoL improvement. Younger age is associated with greater QoL benefits, possibly due to better physiological recovery or higher baseline expectations. Larger preoperative nodule size predicts greater improvement, likely due to more significant symptom relief. Preoperative thyroid dysfunction, both subclinical and overt hyperthyroidism, is associated with greater QoL gains, suggesting that resolution of hormonal imbalances contributes significantly to postoperative well-being.

Interestingly, gender, extent of thyroidectomy, and final histopathology do not significantly impact QoL outcomes, indicating that the benefits of surgery may be more related to symptom relief and resolution of uncertainty than to these factors.

Complications

Table 4 presents a reassuring complication profile, with an overall rate of 18.75%. Transient hypocalcemia is the most common complication (15%), followed by transient recurrent laryngeal nerve palsy (2.5%), both resolving within 3 months. The absence of permanent complications speaks to the safety of the procedure when performed by experienced surgeons. The low complication rate and transient nature of observed complications likely contribute to the overall positive QoL outcomes observed at 6 months post-surgery. These findings support thyroidectomy as a safe procedure with manageable short-term complications, which should be communicated to patients during preoperative counseling to alleviate potential concerns about surgical risks.

Table 4: Postoperative Complications

Complication	n (%)	Resolution Time
Transient hypocalcemia	12 (15%)	Within 3 months
Transient recurrent laryngeal nerve palsy	2 (2.5%)	Within 3 months
Wound infection	1 (1.25%)	Within 2 weeks
Permanent complications	0 (0%)	N/A

DISCUSSION

This prospective study demonstrates that thyroidectomy for thyroid nodules generally leads to improved quality of life, as measured by the ThyPRO questionnaire. The significant improvements observed in goiter symptoms, anxiety, and cosmetic complaints scales are consistent with previous studies reporting positive QoL outcomes following thyroidectomy.^{11,12}

The large effect size (Cohen's $d = 2.18$) observed for the improvement in goiter symptoms is particularly noteworthy. This substantial improvement likely reflects the direct impact of removing the thyroid gland and associated nodules, which can cause discomfort, difficulty swallowing, and cosmetic concerns.¹³ The significant reduction in anxiety scores (Cohen's $d = 0.72$) may be attributed to the resolution of uncertainty regarding the nature of the thyroid nodules and the elimination of ongoing surveillance.¹⁴ Similarly, the improvement in cosmetic complaints (Cohen's $d = 0.74$) likely reflects the resolution of visible neck swelling associated with thyroid nodules.¹⁵

Interestingly, while most ThyPRO scales showed improvement, the changes in hypothyroid symptoms and cognitive problems were not statistically significant. This finding may be related to the challenges of achieving optimal thyroid hormone replacement in some patients following total thyroidectomy.¹⁶ It underscores the importance of careful postoperative management and individualized hormone replacement strategies.

The finding that age, preoperative nodule size, and preoperative thyroid function significantly influenced QoL outcomes provides valuable insights for patient selection and counseling. The negative association between age and QoL improvement ($\beta = -0.28$, $p = 0.03$) suggests that younger patients may experience greater benefits from thyroidectomy. This could be due to a variety of factors, including better physiological reserve, quicker recovery, or higher baseline expectations.¹⁷

The positive association between preoperative nodule size and QoL improvement ($\beta = 0.35$, $p = 0.01$) is intuitive, as larger nodules are more likely to cause compressive symptoms and cosmetic concerns.¹⁸ This finding supports the current practice of considering nodule size as one of the criteria for surgical intervention.

The observation that patients with preoperative subclinical or overt hyperthyroidism experienced greater QoL improvements is noteworthy. This may be due to the resolution of hyperthyroid symptoms following thyroidectomy, which can significantly impact various aspects of life.¹⁹ It suggests that patients with functional thyroid nodules may be particularly good candidates for thyroidectomy from a QoL perspective.

The lack of significant association between the extent of thyroidectomy (total vs. hemithyroidectomy) and QoL outcomes is somewhat surprising. It suggests that the benefits of thyroidectomy in terms of symptom relief and anxiety reduction may outweigh the potential negative impacts of more extensive surgery and the need for lifelong thyroid hormone replacement in total thyroidectomy

patients.²⁰ However, this finding should be interpreted cautiously, as the study may not have been powered to detect subtle differences between these groups.

The complication rates observed in this study are comparable to or lower than those reported in the literature.^{21,22} The relatively low incidence of transient hypocalcemia (15%) and recurrent laryngeal nerve palsy (2.5%), with no permanent complications, supports the safety of thyroidectomy when performed by experienced surgeons in high-volume centers. The quick resolution of these complications (within 3 months) is reassuring and likely contributed to the overall positive QoL outcomes at 6 months post-surgery.

CONCLUSION

This prospective study demonstrates that thyroidectomy for thyroid nodules is associated with significant improvements in quality of life, particularly in terms of goiter symptoms, anxiety, and cosmetic concerns. Factors such as age, nodule size, and preoperative thyroid function play a significant role in determining postoperative QoL outcomes. The low complication rates observed further support the safety and efficacy of thyroidectomy in managing thyroid nodules. These findings have several important clinical implications:

- 1. Patient selection:** Younger patients, those with larger nodules, and individuals with preoperative thyroid dysfunction may be particularly likely to experience QoL benefits from thyroidectomy.
- 2. Preoperative counseling:** Surgeons can use these data to provide patients with more accurate expectations regarding postoperative QoL changes, potentially improving patient satisfaction and decision-making.
- 3. Postoperative management:** The persistent hypothyroid symptoms in some patients highlight the need for careful postoperative thyroid hormone management and patient education.
- 4. Surgical technique:** The low complication rates underscore the importance of referral to high-volume centers with experienced surgeons.

Future research directions could include longer-term follow-up to assess the sustainability of QoL improvements, investigation of strategies to mitigate persistent hypothyroid symptoms, and exploration of patient-reported outcomes in specific subgroups (e.g., patients with thyroid cancer).

In conclusion, this study provides robust evidence that thyroidectomy for thyroid nodules generally leads to improved quality of life with minimal complications. These findings can inform clinical decision-making and enhance patient counseling regarding the expected outcomes of thyroidectomy for thyroid nodules.

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