Article

Development of a Nomogram Using Lipid Profiles and Ultrasonic Thyroid Features as Potential Predictors of Postoperative Nausea and Vomiting After Thyroid Lobectomy

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AIM: This study aims to evaluate the predictive performance of preoperative blood lipid profiles combined with thyroid ultrasound features for postoperative nausea and vomiting (PONV) after thyroid lobectomy, and to develop a nomogram for individualized risk assessment.

METHODS: This retrospective study included 269 patients who underwent thyroid lobectomy for nodular thyroid disease at the People's Hospital of Pingyang between January 2022 and December 2024. Study participants were divided into non-PONV (n = 102) and PONV (n = 167) groups. Preoperative clinical details, thyroid ultrasound parameters, and lipid profiles were compared between the two groups. Statistically significant variables ($p < 0.05$) from the univariate analysis were included in the multivariate logistic regression to identify independent risk predictors. A nomogram was constructed and internally validated using bootstrap resamples (1000 iterations).

RESULTS: Multivariate analysis identified Apfel score, thyroid volume, maximum nodule diameter, presence of diffuse changes, total cholesterol (TC), high-density lipoprotein cholesterol (HDL), and low-density lipoprotein cholesterol (LDL) as independent risk predictors of PONV. The nomogram showed favorable discriminative performance with an area under the receiver operating characteristic curve of 0.804 (95% CI: 0.749–0.859) and a bias-corrected area under the curve (AUC) of 0.794 (95% CI: 0.737–0.850) after bootstrap validation. Additionally, the model demonstrated favorable calibration and superior clinical utility, as assessed using the decision curve analysis.

CONCLUSIONS: Multivariate analysis identified that preoperative blood lipid profiles and thyroid ultrasound features are independently associated with PONV. Incorporating these indicators along with established clinical risk factors into a nomogram enables accurate individualized prediction and may support targeted prophylactic interventions.

Keywords: postoperative nausea and vomiting; thyroidectomy; dyslipidemias; ultrasound; predictive model

Introduction

Postoperative nausea and vomiting (PONV) are common adverse events after thyroidectomy and remain a leading cause of patient distress and reduced satisfaction [1,2]. Beyond impairing patient well-being, PONV is linked to increased risk of postoperative complications, prolonged hospitalization, and higher healthcare costs [3,4]. Persistent nausea or vomiting can significantly hinder recovery after thyroidectomy, even in the absence of other severe complications. It may delay the resumption of oral intake, thereby disrupting early nutrition and calcium supplementation, which are essential components of postoperative management in thyroidectomy patients [5].

Inadequate oral intake may increase the risk of hypocalcemic symptoms, including perioral numbness and limb paresthesia, further prolonging the required monitoring period. Additionally, persistent PONV often necessitates additional antiemetic management or extended monitoring, further increasing nursing workload and healthcare costs. Even moderate PONV may impede functional recovery, delay readiness for discharge, and adversely affect patient satisfaction. Therefore, promptly identification of individuals at increased risk for PONV is crucial to guide targeted prophylactic interventions and optimize perioperative care.

Several detrimental factors have been associated with PONV, which include demographic and physiological attributes (such as age, sex, and a previous tendency toward motion sickness), anesthetic-related factors, and the nature of surgical procedure [6–8]. The Apfel score, which integrates four established predictors (female sex, prior PONV or motion sickness, non-smoking status, and postoperative opioid use), is widely validated and routinely applied for risk stratification [9,10]. Given its robust predictive performance, the Apfel score is a valuable component to be integrated into more comprehensive predictive models. However, most existing models predominantly prioritize demographic and anesthetic variables, with limited attention to underlying metabolic or anatomical determinants that may influence individual susceptibility to PONV.

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Emerging evidence suggests that metabolic status, particularly lipid metabolism, may be linked to the incidence of PONV, although the precise mechanisms remain to be fully elucidated [11,12]. Additionally, preoperative thyroid ultrasonography provides anatomical parameters, including thyroid volume, nodule dimensions, and parenchymal characteristics, which reflect the potential technical complexity of surgery and extent of tissue manipulation, factors that may be associated with postoperative discomfort [13]. However, few studies have concurrently assessed preoperative lipid profiles and thyroid ultrasonographic findings to predict PONV in patients undergoing thyroidectomy.

To specifically investigate PONV following thyroid lobectomy, we evaluated whether integrating preoperative blood lipid profiles with thyroid ultrasound parameters could predict its occurrence and developed a nomogram for individualized risk estimation. By incorporating metabolic and anatomical indicators, this study aims to develop a more comprehensive, clinically feasible predictive model to support targeted prophylaxis and improve perioperative management.

Methods

Study Design and Population

This retrospective cohort study included patients who underwent thyroid lobectomy for nodular thyroid disease at the People's Hospital of Pingyang between January 2022 and December 2024. A total of 269 patients were enrolled, including 167 patients in the PONV group and 102 in the non-PONV group. Inclusion criteria were as follows: (1) age $\geq$18 years; (2) diagnosis of nodular thyroid disease confirmed by preoperative imaging; and (3) undergoing elective thyroid lobectomy. However, those with a history of previous thyroid surgery, concurrent major systemic diseases, or incomplete clinical data were excluded from the study cohort.

Data Collection

Clinical variables and demographic data collected from the patients included age, sex, body mass index (BMI), smoking and drinking history, preoperative thyroid ultrasound measures (thyroid volume, maximum nodule diameter, nodule location (upper pole or dorsal side), and diffuse parenchymal changes, which are defined as decreased echogenicity and heterogeneous echo pattern on ultrasound), preoperative thyroid function indicators [free triiodothyronine (FT3), free thyroxine (FT4), thyroid-stimulating hormone (TSH)], and lipid profile parameters [triglyceride (TAG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL)]. All laboratory and imaging assessments were conducted within 7 days before surgery. Thyroid volume for each lobe was calculated as follows: Volume = length $\times$ width $\times$ depth $\times$ $\pi/6$, and the total thyroid volume was obtained by summing the volumes of both lobes [14].

Preoperative systemic health status was assessed by attending anesthesiologists using the American Society of Anesthesiologists (ASA) physical status classification. Only patients classified as ASA I–III were enrolled in this study, where Class I indicates healthy individuals without systemic disease; Class II means patients with mild systemic disease without functional limitations (e.g., well-controlled hypertension or diabetes); and Class III represents patients with severe systemic disease causing functional limitations but not incapacitation (e.g., poorly controlled hypertension, morbid obesity).

The Apfel score, representing composite risk for PONV, was assessed as previous described [10], assigning 1 point each for female sex, non-smoking status, history of PONV or motion sickness, and postoperative opioid use (total score range: 0–4). For analysis, patients with an Apfel score $\geq$2 were identified, and the corresponding frequencies were used as an independent variable in subsequent analyses. ASA classification and Apfel score were regarded as separate predictors.

Initially, 19 candidate variables were included in the multivariate logistic regression analysis. These variables, along with their established clinical relevance based on previous studies, lipid profile indicators, and ultrasonographic characteristics, were the primary focus of this study.

Outcome Definition

PONV was defined as any episode of nausea or vomiting occurring within 24 hours after thyroid lobectomy, as documented in nursing notes or medical records, or inferred from the use of antiemetic medications. This approach is consistent with the criteria recommended by the Society for Ambulatory Anesthesia Guidelines [15]. Accordingly, patients who experienced at least one episode of nausea or vomiting or required antiemetic intervention within 24 hours postoperatively were assigned to the PONV group, while those without such events were classified as the non-PONV group.

Statistical Analysis

All Statistical analyses were performed using SPSS 29.0 (IBM Corp., Armonk, NY, USA) and R (version 4.3.1, R Foundation for Statistical Computing, Vienna, Austria). A p-value of $<$0.05 was considered statistically significant.

Descriptive and Univariate Analyses

Continuous variables were examined for normality using the Shapiro–Wilk test. Normally distributed variables were expressed as mean $\pm$ standard deviation and compared using the independent-samples t-test. However, non-normally distributed variables were expressed as median (interquartile range, IQR) and analyzed using the Mann–Whitney U test. Categorical variables were presented as frequencies and percentages, with group comparisons performed using the chi-square test. Statistically significant variables in univariate analysis ($p < 0.05$) were selected for subsequent multivariate modeling.

Multivariate Modeling and Variable Screening

Variables identified as significant in univariate analysis were further examined for multicollinearity using variance inflation factors (VIFs), with VIFs >5 indicating potential multicollinearity. Independent predictors of PONV were assessed using multivariate logistic regression analysis. Continuous variables were analyzed in their original scale without arbitrary dichotomization to maintain data integrity. Given the low overall proportion of missing data (<5%), a complete case analysis was primarily applied. For variables with relatively higher missingness, multiple imputations using chained equations were performed to minimize potential bias. Furthermore, odds ratios (ORs) and 95% confidence intervals were calculated for each predictor.

To ensure the adequacy of the sample size and the stability of the model, a post hoc justification was performed beyond the traditional events per variable (EPV) ≥10 criteria. The effective sample size was evaluated in relation to model complexity, and the EPV ratio in the final model exceeded the recommended threshold. Model robustness was further assessed using bootstrap resampling with 1000 iterations, which demonstrated minimal optimism-corrected bias and stable discrimination performance. A nomogram was constructed based on the final regression model to enhance individualized risk prediction.

The predictive performance of the nomogram was assessed using internal validation with bootstrap samples (1000 repetitions). Model discrimination was evaluated using the area under the receiver operating characteristic (ROC) curve, which reflects the ability of the model to differentiate between patients with and without PONV. Model calibration was assessed using calibration plots comparing predicted probabilities with observed outcomes, and further supported by the Brier score, which measures the average squared difference between predicted and observed outcomes, with lower values indicating better calibration.

Finally, the clinical utility of the nomogram was assessed using decision curve analysis (DCA), which estimates the net clinical benefit across a range of threshold probabilities to determine its significance in clinical decision-making. This comprehensive validation process supports the robustness, reproducibility, and transparency of the predictive model.

Results

Assessment of Baseline Characteristics Across Study Participants

This retrospective study enrolled 269 patients who underwent thyroid lobectomy, comprising 167 with PONV and 102 without PONV (Table 1). There were no substantial differences between the two groups regarding sex distribution, BMI, smoking or drinking history, ASA classification, nodule location (upper pole or dorsal side), FT3, FT4, TSH, or TAG levels (all $p > 0.05$).

Compared with patients without PONV, those who developed PONV were significantly older (54.37 ± 9.58 vs. 51.36 ± 10.15 years, p = 0.015) and had a higher proportion of Apfel scores ≥2 (85.63% vs. 60.78%, $p <$ 0.001). Ultrasonography-guided assessment revealed that the PONV group had larger thyroid volumes (13.75 ± 2.11 vs. 12.93 ± 1.97 cm^3, p = 0.002), greater maximum nodule diameters [1.03 (0.50, 1.35) vs. 0.77 (0.34, 1.04) cm, $p <$ 0.001], and a higher frequency of diffuse changes (37.13% vs. 20.59%, p = 0.004).

Furthermore, patients in the PONV group demonstrated higher TC (4.72 ± 0.77 vs. 4.27 ± 0.72 mmol/L, $p < 0.001$) and LDL levels (2.67 ± 0.48 vs. 2.53 ± 0.45 mmol/L, p = 0.019), along with substantially lower HDL levels (1.16 ± 0.29 vs. 1.41 ± 0.37 mmol/L, $p < 0.001$).

Multivariate Logistic Regression Analysis

Variables that were significantly associated with PONV in the univariate analysis (age, Apfel score, thyroid volume, maximum nodule diameter, presence of diffuse changes, TC, HDL, and LDL) were examined for multicollinearity, and no substantial collinearity was observed (all VIF <5). These variables were then included in the multivariable logistic regression model.

As shown in Table 2, an Apfel score ≥2 (OR = 2.247, 95% CI: 1.084–4.655, p = 0.029), larger thyroid volume (OR = 1.170, 95% CI: 1.010–1.355, p = 0.036), greater maximum nodule diameter (OR = 1.864, 95% CI: 1.023–3.395, p = 0.042), higher presence of diffuse changes (OR = 2.094, 95% CI: 1.061–4.130, p = 0.033), higher TC (OR = 2.252, 95% CI: 1.477–3.434, $p < 0.001$), and higher LDL (OR = 2.035, 95% CI: 1.072–3.866, p = 0.030) were identified as independent risk factors for PONV after thyroid lobectomy. In contrast, HDL was found to be an independent protective factor (OR = 0.083, 95% CI: 0.030–0.230, $p < 0.001$). However, no significant correlation was observed between age and PONV in the adjusted model (p = 0.154).

Collectively, both clinical variables (Apfel score, thyroid volume, maximum nodule diameter, and diffuse thyroid changes) and lipid parameters (TC, LDL, HDL) substantially contributed to PONV risk. Notably, patients with larger thyroid nodules or diffuse thyroid changes were more likely to develop PONV, highlighting a crucial role of thyroid structural alterations on postoperative outcomes. Furthermore, the strong association between dyslipidemia and PONV, evidenced by elevated TC and LDL and reduced HDL, indicates a potential metabolic component in the pathogenesis of PONV after thyroid lobectomy.

Table 1. Comparison of baseline clinical characteristics between the two groups.

Variable	Non-PONV group	PONV group	Statistic	p-value
	(n = 102)	(n = 167)		
Sex (n%)			0.568	0.451
Male	28 (27.45%)	39 (23.35%)		
Female	74 (72.55%)	128 (76.65%)		
Age (years)	51.36 ± 10.15	54.37 ± 9.58	–2.443	0.015
BMI (kg/m^2)	21.31 (19.30, 24.31)	22.40 (19.70, 25.05)	1.513	0.130
Smoking history (n%)	8 (7.84%)	14 (8.38%)	0.025	0.875
Drinking history (n%)	12 (11.76%)	17 (10.18%)	0.165	0.684
ASA (n%)			1.137	0.566
I	65 (63.73%)	96 (57.49%)		
II	32 (31.37%)	63 (37.72%)		
III	5 (4.90%)	8 (4.79%)		
Apfel score (≥2)	62 (60.78%)	143 (85.63%)	21.557	<0.001
Thyroid volume (cm^3)	12.93 ± 1.97	13.75 ± 2.11	–3.149	0.002
Maximum nodule diameter (cm)	0.77 (0.34, 1.04)	1.03 (0.50, 1.35)	3.601	<0.001
Nodule located near the upper pole (n%)	32 (31.37%)	55 (32.93%)	0.071	0.791
Nodule located on the dorsal side (n%)	26 (25.49%)	47 (28.14%)	0.225	0.635
Presence of diffuse changes (n%)	21 (20.59%)	62 (37.13%)	8.117	0.004
FT3 (pg/mL)	3.12 (2.92, 3.49)	3.23 (2.98, 3.44)	1.295	0.195
FT4 (ng/dL)	1.17 ± 0.19	1.19 ± 0.21	–0.713	0.476
TSH (uIU/mL)	1.62 (1.07, 2.22)	1.65 (1.22, 2.26)	1.055	0.291
TAG (mmol/L)	1.34 (0.87, 1.86)	1.41 (0.97, 1.88)	0.982	0.326
TC (mmol/L)	4.27 ± 0.72	4.72 ± 0.77	–4.760	<0.001
HDL (mmol/L)	1.41 ± 0.37	1.16 ± 0.29	6.168	<0.001
LDL (mmol/L)	2.53 ± 0.45	2.67 ± 0.48	–2.351	0.019

BMI, body mass index; ASA, American Society of Anesthesiologists; FT3, free triiodothyronine; FT4, free thyroxine; TSH, thyroid-stimulating hormone; TAG, triglyceride; TC, total cholesterol; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol.

Table 2. Multivariate logistic regression analysis of risk factors associated with PONV after thyroid lobectomy.

Factor	B	Std. Error	Wald	p-value	OR (95% CI)
Age	0.023	0.016	2.035	0.154	1.023 (0.992–1.055)
Apfel score	0.809	0.372	4.744	0.029	2.247 (1.084–4.655)
Thyroid volume	0.157	0.075	4.392	0.036	1.170 (1.010–1.355)
Maximum nodule diameter	0.623	0.306	4.138	0.042	1.864 (1.023–3.395)
Presence of diffuse changes	0.739	0.347	4.546	0.033	2.094 (1.061–4.130)
TC	0.812	0.215	14.225	<0.001	2.252 (1.477–3.434)
HDL	–2.495	0.523	22.733	<0.001	0.083 (0.030–0.230)
LDL	0.711	0.327	4.715	0.030	2.035 (1.072–3.866)

PONV, postoperative nausea and vomiting; OR, odds ratio.

Development of the Nomogram

A predictive nomogram was developed based on the results from multivariable regression analysis. The nomogram incorporated Apfel score, thyroid volume, maximum nodule diameter, presence of diffuse changes, TC, HDL, and LDL to predict the individual risk of PONV after thyroid lobectomy (Fig. 1).

The discriminative performance of the nomogram was assessed using ROC analysis, yielding an area under the curve (AUC) of 0.804 (95% CI: 0.749–0.859), indicating strong classification capability. The concordance index (C-index) of the nomogram was 0.804, consistent with the AUC given in this binary outcome model. At an optimal threshold probability of 0.59, the model yielded a sensitivity of 79.0% and a specificity of 69.6% (Fig. 2). Internal validation with bootstrap resamples (1000 iterations) and bias-corrected estimation yielded an AUC of 0.794 (95% CI: 0.737–0.850), confirming the robustness and reliability of the model's discriminative performance.

Model calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test and calibration plotting. The non-significant p-value (0.6101) suggested good agree-

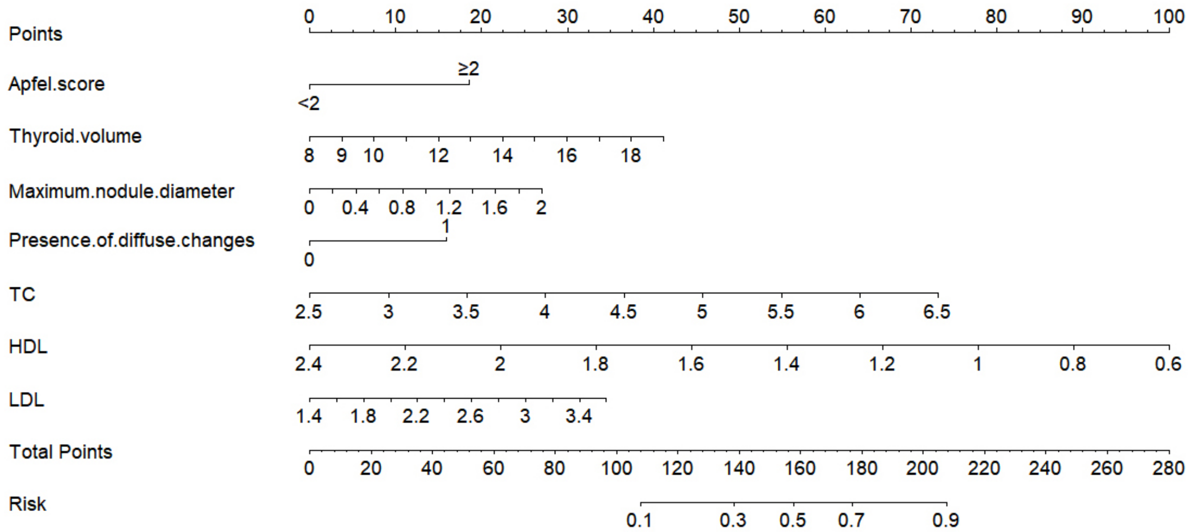

Fig. 1. Nomogram for predicting PONV risk after thyroid lobectomy. Variables encoding: presence of diffuse changes: 0 indicates NO, 1 indicates Yes. PONV, postoperative nausea and vomiting.

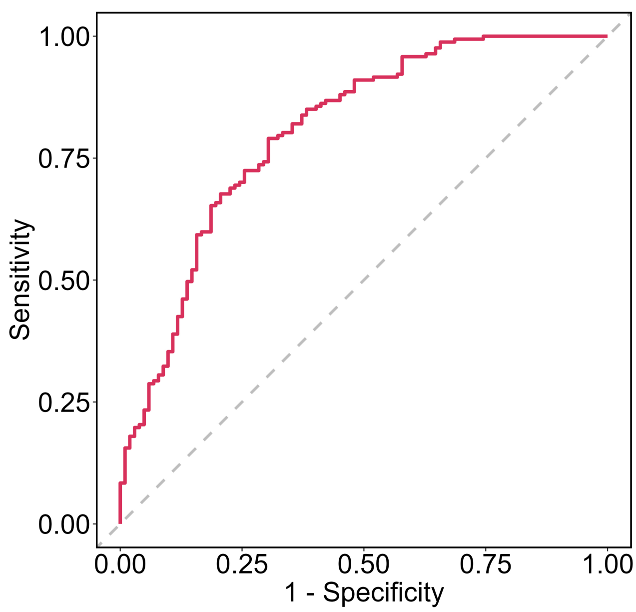

Fig. 2. ROC analysis of the nomogram for predicting PONV after thyroid lobectomy. ROC, receiver operating characteristic.

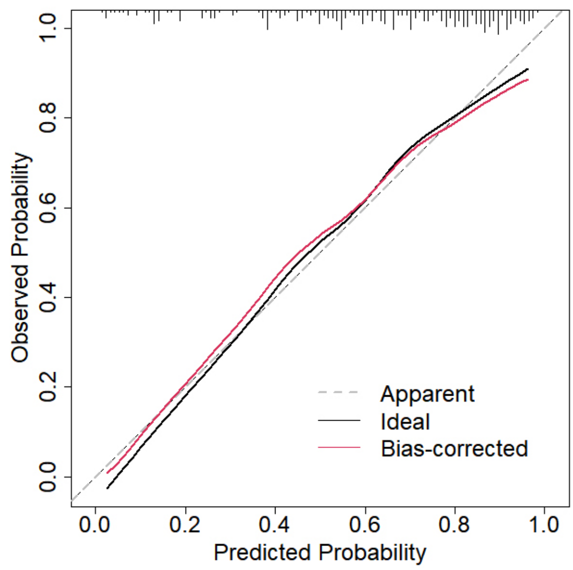

Fig. 3. Calibration curve of the nomogram for predicting PONV after thyroid lobectomy.

ment between the predicted and observed event rates, which was further supported by a Brier score of 0.167, with lower value indicating higher overall predictive accuracy. The calibration curve (Fig. 3) showed close alignment between predicted risks and observed outcomes, confirming satisfactory reliability. Clinical applicability was determined using DCA (Fig. 4), which yielded consistent net benefits across a wide range of threshold probabilities (20%–80%), suggesting that the model can improve individualized risk stratification and support perioperative management. Collectively, these results confirm the robustness, internal validity, and low risk of overfitting of the predictive model.

Discussion

PONV is a common and clinically significant complication after thyroid lobectomy, which may be particularly concerning in patients with laryngeal nerve injury. Forceful retching or vomiting can aggravate airway irritation and impair vocal cord function, potentially leading to hoarseness, dyspnea, or even airway obstruction [16,17]. Therefore, careful prevention and early management of PONV are crucial to minimize postoperative airway-related complications and facilitate a smoother recovery.

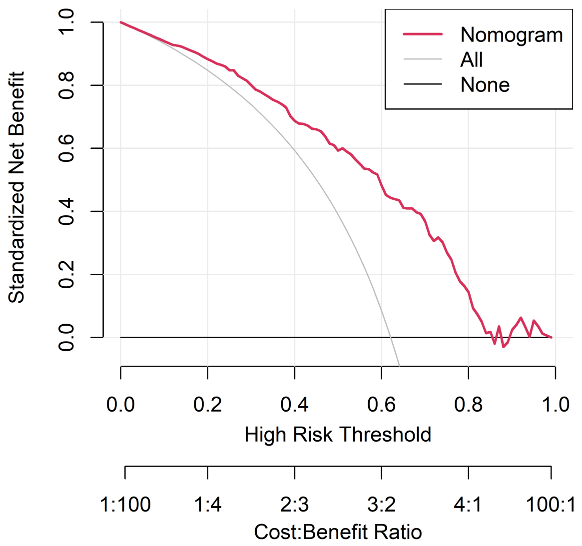

Fig. 4. DCA of the nomogram for predicting PONV after thyroid lobectomy. DCA, decision curve analysis.

This study identified multiple independent predictors of PONV following thyroid lobectomy, including Apfel score, thyroid volume, maximum nodule diameter, presence of diffuse changes, TC, HDL, and LDL. Higher Apfel score, larger thyroid volume, greater maximum nodule diameter, diffuse changes, elevated TC, and raised LDL were found as independent risk factors, whereas higher HDL was a protective factor. The nomogram model incorporating these seven predictors exhibited strong discriminatory performance, with a bias-corrected AUC of 0.794 (95% CI: 0.737–0.850). At the optimal cutoff value (0.59), the model achieved a sensitivity of 79.0% and a specificity of 69.6%, supporting its potential clinical utility. Calibration analysis further confirmed the reliability of the model, evidenced by close concordance between predicted and observed risks, further supported by a Brier score of 0.167, indicating satisfactory overall accuracy. Moreover, the DCA curve revealed superior net benefit across clinically relevant threshold probabilities compared with non-selective management strategies. Collectively, these results support the proposed model as a feasible and reliable tool for individualized risk prediction and prophylactic decision-making in patients undergoing thyroid lobectomy.

Consistent with previous evidence, higher Apfel scores were strongly associated with increased susceptibility to PONV, confirming their clinical utility in risk stratification [18,19]. In a comparative analysis of predictive models among patients undergoing breast cancer surgery, both the Apfel and Koivuranta scores demonstrated comparable diagnostic performance, with the Apfel model showing slightly higher predictive accuracy (AUC = 0.686, sensitivity = 80%, specificity = 46%) [18]. Similarly, a large-scale retrospective analysis of 908 thyroid cancer patients identified the Apfel score as an independent risk factor for PONV, confirming its predictive robustness across different surgical contexts [19]. These findings highlight the reliability and adaptability of the Apfel classification as a key tool for assessing PONV risk. The Apfel scoring system integrates multiple well-established contributors, including female sex, prior history of motion-related nausea or PONV, non-smoking habits, and postoperative opioid use. Although not all components achieved statistical significance in our cohort, the composite score still demonstrated robust predictive validity. This finding aligns with meta-analytic evidence supporting the Apfel score as a widely applicable and reliable tool for perioperative PONV risk assessment [20].

Increased thyroid volume and larger maximum nodule diameter were also identified as independent predictors of PONV. Enlarged thyroid glands and bulky nodules may necessitate more extensive manipulation and traction of cervical tissues, thereby stimulating vagal afferents and improving the emetogenic response. Moreover, thyroid enlargement has been associated with longer surgical duration and greater intraoperative blood loss [21], both of which have been independently identified as significant risk predictors for PONV in large-scale retrospective cohorts. Specifically, extended surgical duration has been linked to a higher incidence of PONV in same-day surgical patients [7], while machine learning analysis of over 30,000 cases identified total blood loss as an intraoperative determinant of PONV risk [22]. These findings suggest that physiological stress and anesthetic exposure accompanying longer and more hemorrhagic procedures may increase susceptibility to postoperative nausea and vomiting. Consistently, study has also reported that thyroid morphology and gland size influence the technical complexity of thyroidectomy and may indirectly affect postoperative recovery [23].

Furthermore, the presence of diffuse changes on preoperative ultrasound were also a significant predictor of PONV. Such parenchymal alterations, often linked to chronic thyroiditis or autoimmune thyroid disease, may increase tissue fragility and vascularity [24]. These pathological characteristics may complicate surgical dissection, prolong operative time, and intensify perioperative tissue trauma, thereby contributing to greater postoperative discomfort and a higher likelihood of PONV. Comparable associations between inflammatory thyroid disease and increased perioperative complications have been described in previous clinical investigations [25].

Lipid parameters also emerged as substantial predictors of PONV. Elevated TC and LDL levels were correlated with increased PONV susceptibility, whereas higher HDL levels appeared to exert a protective effect. Dyslipidemia is known to be linked to low-grade systemic inflammation and endothelial dysfunction [26,27], which may exacerbate the surgical stress response and sensitize central emetic pathways. LDL cholesterol, in particular, has been implicated in oxidative stress and reduced endothelial nitric oxide bioavailability [28,29], mechanisms that may contribute to postoperative nausea. Conversely, HDL cholesterol possesses anti-inflammatory, antioxidative, and endothelial-protective properties [30], which may help mitigate inflammatory responses and modulate neuronal excitability, thereby reducing the risk of PONV.

Nonetheless, the physiological basis for these associations remains speculative, as direct evidence linking lipid metabolism to PONV is limited. To enhance robustness, we assessed potential multicollinearity among lipid-related variables, and the variance inflation factor (VIF) values for TC, LDL, and HDL were all below 5, indicating acceptable independence among these predictors. Additionally, all lipid parameters were analyzed in standardized SI units (mmol/L) to minimize potential unit effects on the regression coefficients. Despite these precautions, the relatively high effect sizes observed may partly reflect model fitting within a limited single-center dataset, and the possibility of overfitting cannot be fully excluded. Therefore, these findings should be interpreted with caution and warrant further validation in future prospective studies to elucidate the potential mechanistic link between lipid metabolism and PONV.

The nomogram showed favorable predictive performance, with an AUC of 0.804, indicating good discriminative power. Compared with traditional risk stratification tools such as the Apfel score alone, which typically achieve an AUC of approximately 0.70 [31], the integrated model showed superior predictive accuracy. Similar performance metrics have been reported in a large retrospective cohort study of 7759 patients undergoing same-day surgery under general anesthesia, in which a predictive nomogram achieved AUCs of 0.81 and 0.83 in the training and validation cohorts, respectively [7].

In comparison, our study specifically targeted a homogeneous cohort of thyroid lobectomy patients, rather than a broader general anesthesia population. While both models demonstrated comparable discriminative performance (AUC 0.804 in our study vs. 0.81–0.83 in the previous study), our nomogram uniquely incorporated procedure-specific parameters, such as preoperative lipid profiles and thyroid ultrasound features, alongside established risk factors. This tailored strategy offers more optimized risk stratification for patients undergoing thyroid lobectomy and improves the clinical utility of the nomogram in this surgical setting.

Despite promising findings, certain limitations should be acknowledged in this study. First, the investigation was conducted retrospectively within a single institution, which could have limited the generalizability of the findings to other settings. The relatively small number of patients, particularly those without PONV, may also have reduced sensitivity to detect weaker associations. Second, although we incorporated multiple preoperative indicators, including ultrasound features and lipid profiles, other potential confounding factors, such as intraoperative and postoperative factors (e.g., intraoperative anesthetic doses, analgesia regimens and operative time) were not included, which may influence PONV risk. Third, PONV was assessed based on clinical records and patient-reported symptoms, which may have led to underrecognition of mild or transient events. Finally, although the nomogram demonstrated good internal predictive performance, it has not yet been externally validated, and its utility across different institutions and populations remains to be validated.

Independent validation in larger, multicenter cohorts is required to confirm the stability and generalizability of this model across diverse surgical settings. Future prospective trials should also assess whether implementing risk-guided prophylactic strategies based on this tool can effectively reduce the incidence of PONV and enhance postoperative recovery. Collectively, these findings should be viewed as hypothesis-generating and form a foundation for subsequent confirmatory investigations.

Conclusions

This retrospective cohort study identified the Apfel score, thyroid volume, maximum nodule diameter, presence of diffuse changes, TC, HDL, and LDL as independent predictors of PONV after thyroid lobectomy. Using these factors, we developed a nomogram that demonstrated favorable discrimination, calibration, and clinical utility in internal validation. The model outperforms conventional risk assessment tools and offers a clinically feasible approach for individualized risk stratification and the optimization of prophylactic strategies in routine clinical practice.

Availability of Data and Materials

The data analyzed are available from the corresponding author upon reasonable request.

Author Contributions

XZ: conceptualization, study design, data collection, data analysis, manuscript drafting, and critical revision. WY: conceptualization, study design, data analysis, literature review, and critical revision. YW: conceptualization, supervision, project administration, and critical revision. All authors gave final approval of the version to be published. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

Ethics Approval and Consent to Participate

This study was carried out in the People's Hospital of Pingyang, with the approval of the Ethics Committee (approval no.: LW-2025-052). This study was conducted in accordance with the Declaration of Helsinki, and informed consent was obtained from all participants.

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Conflict of Interest

The authors declare no conflict of interest.

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