Current Science
CS 5 (5), 4695-4705 (2025)
Received 16 July 2025 | **Revised 13 August** 2025 | **Accepted 10 September** 2025 | **Online Available 08 October** 2025
https://doi.org0/10.52845/CS/2025-5-5-28

Current Science

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OPEN ACCESS

ISSN(O)2795-8639

Research Article

Risk Factors for Lymph Node Metastasis in Level Iib of Papillary Thyroid Carcinoma

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Abstract:

Objective: This study endeavors to delve into the risk factors associated with level IIb lymph node metastasis in patients with papillary thyroid carcinoma (PTC). **Methods:**A retrospective analysis was carried out on patients with PTC who underwent surgical treatment at our hospital between September 2019 and February 2025. Multiple factors were taken into consideration, including age, gender, thyroglobulin levels, blood glucose, blood lipid profiles, descriptions of color Doppler ultrasonography.

Results: A total of 217 patients with pathologically confirmed pN1b PTC were enrolled in this study. The patients were categorized into two groups according to the presence or absence of level IIb lymph node metastasis. Univariate analysis indicated that nodule location, maximum nodule diameter, capsular invasion or extrathyroidal invasion, maximum lymph node diameter, level IIa lymph node metastasis, and thyroglobulin levels were correlated with level IIb lymph node metastasis. Subsequent multivariate regression analysis further revealed that nodule location, maximum nodule diameter, and level IIa lymph node metastasis were independent risk factors for level IIb lymph node metastasis. Based on the receiver operating characteristic curve analysis, it was determined that when the maximum nodule diameter was ≥ 1.59 cm, the likelihood of level IIb lymph node metastasis was significantly higher.

Conclusion: In cases where preoperative color Doppler ultrasonography indicates that the nodule with the highest classification and largest diameter is located at the upper pole of the thyroid gland, with a diameter of ≥ 1.59 cm, or when level II lymph node metastasis is detected either preoperatively or intraoperatively, level IIb lymph node dissection is recommended.

Keywords: Papillary thyroid carcinoma; Lymph node metastasis; level IIb; Risk factor

1. Introduction

Thyroid cancer ranks as the most prevalent malignancy within the endocrine and head - neck levels. Despite exhibiting a lower mortality rate compared to other types of cancer, the incidence of thyroid cancer has been on a consistent upward trajectory across nearly every country and level globally. It constitutes 2.1% of all cancers worldwide, with a significant predominance among females[1].The majority of thyroid cancers are differentiated thyroid cancers. Among them, papillary thyroid carcinoma (PTC) represents the most prevalent type at present, accounting for around 85%[2].Surgery represents the primary therapeutic approach for papillary thyroid carcinoma.

PTC is widely recognized as an indolent neoplasm, typically associated with a favorable prognosis. Nevertheless, PTC demonstrates a significant propensity for early lymph node metastasis. Lymph node metastasis, particularly in the early stage, substantially elevates the likelihood of adverse prognostic outcomes. Among these, lymph node metastasis in the lateral cervical level holds particular significance. It is intricately linked to disease recurrence and the patient's risk of mortality, underscoring its critical role in the clinical course and management of PTC[3].In 2015, the American Thyroid

Association recommended that the scope of lateral cervical lymph node dissection should encompass lymph node levels II, III, IV, and VI. Nevertheless, a significant debate persists regarding whether to include level IIb in the dissection.Undoubtedly, a more extensive lymph node dissection can minimize the likelihood of undetected lymph nodes. However, this approach simultaneously presents a series of formidable challenges, including higher demands on the surgeon's expertise, more intricate incision planning, and an increased risk of surgical complications. Among these complications, shoulder syndrome is a prevalent consequence of radical cervical lymph node dissection.The demarcation between level IIa and level IIb is primarily based on the accessory nerve. During the surgical procedure, factors such as limited operative exposure and anatomical variations can frequently lead to damage of the accessory nerve. Even when efforts are made to preserve the integrity of the nerve, patients may still experience varying degrees of restricted shoulder joint mobility and pain postoperatively. These issues significantly impact the patient's quality of life and functional recovery, underscoring the need for careful consideration and refined surgical techniques in dealing with lymph node dissection in these levels[4].Performing lateral cervical lymph node dissection while preserving level IIb can significantly reduce the incidence of shoulder syndrome[5]. Numerous studies have shown that the incidence of lymph node metastasis in level IIb ranges from 8.2-21.9%[6], this does not justify the relatively high risk of accessory nerve injury. Therefore, is it necessary to perform lymph node dissection of level IIb in patients with papillary thyroid carcinoma accompanied by lateral cervical lymph node metastasis? This study aims to explore the risk factors for lymph node metastasis in level IIb among patients with papillary thyroid carcinoma, with the goal of formulating personalized surgical plans to strike an optimal balance between functional preservation and cancer treatment.

2 Patients and Methods

2.1 Patients

Clinical data of all patients hospitalized for thyroid cancer treatment between September 2019 and February 2025 were collected via the case system of our hospital. All patients have signed the "Informed Consent for the Retention of Biological Samples", consenting to the use of all clinical data for scientific research purposes. This study has received approval from the Medical Ethics Review Committee of our institution.

2.2 Inclusion and exclusion criteria

The inclusion criteria were as follows:

1. Patients who have undergone unilateral or total thyroidectomy combined with unilateral or bilateral radical cervical lymph node dissection, with the dissection scope covering at least lymph node levels II, III, IV, and VI.
2. For patients, the thyroid mass must be confirmed as papillary carcinoma by preoperative fine - needle aspiration biopsy pathology or postoperative pathology. When preoperative ultrasound indicates suspicious lateral cervical lymph nodes, radical cervical lymph node dissection is only performed on those patients whose preoperative fine - needle aspiration biopsy pathology diagnosis or the thyroglobulin level in the puncture washing fluid is > 500 μg/L, suggesting a thyroid origin.
3. Clear and complete preoperative ultrasound images should be available, with a detailed description of the location, size, number, and degree of capsular invasion of the thyroid mass.
4. Complete basic clinical data should be accessible.

The exclusion criteria for patients were as follows:

1. Patients who did not undergo radical lateral cervical lymph node dissection or had an incomplete dissection scope.
2. In the pathological examination of lymph nodes in level II, no differentiation was made between level IIa and level IIb.
3. Pathologically, there was co - existence of other types of thyroid cancer, such as follicular carcinoma, medullary carcinoma, anaplastic carcinoma, or poorly differentiated carcinoma.
4. Patients with a history of other malignant tumors.
5. Patients with distant metastases.

6. Patients with recurrent thyroid cancer.
7. Patients who had received radiotherapy or chemotherapy prior to surgery.
8. Patients presenting with severe organ dysfunction (including the brain, heart, lungs, liver, kidneys, etc.).
9. Patients with mental disorders or cognitive impairments.
10. Pediatric patients.

2.3 Data collection

All patients participating in this study underwent ultrasound examinations of the thyroid gland and neck. When suspicious metastatic lymph nodes were detected in the lateral neck, fine - needle aspiration cytology (FNA) or measurement of thyroglobulin in fine - needle aspiration washout fluid was subsequently carried out. Only when the cytology results confirmed metastasis or the thyroglobulin level in the aspiration washout fluid exceeded 500 μg/L[7], was the scope of lateral neck lymph node dissection defined as levels II, III, IV, and VI.

A retrospective analysis was conducted on the clinical data characteristics of patients before and after surgery. The variables of interest included patient age, sex, body mass index (BMI), Hashimoto's thyroiditis(HT), thyroglobulin(tg) levels, fasting plasma glucose(FPG), glucose - to - lymphocyte ratio(GLR), total cholesterol, triglycerides, low - density lipoprotein(LDL),High-density lipoprotein(HDL), the side (left, right, bilateral), location (upper, middle, lower), size, number, presence or absence of calcification, and TI - RADS classification of the thyroid nodules as described by ultrasound. Additionally, the level and size of metastatic lymph nodes as described by ultrasound, along with extrathyroidal invasion scenarios such as capsule infiltration, muscle invasion, tracheal invasion, nerve invasion, and vascular invasion, were recorded based on preoperative ultrasound findings or intraoperative discoveries.

It should be noted that there were sometimes discrepancies between the parameters such as the size and number of nodules and the size of lymph nodes reported by preoperative color Doppler ultrasound and the postoperative pathological results. Nevertheless, since this study aimed to provide a reference for the decision - making regarding whether to perform lymph node dissection in level IIb before surgery, the parameters provided by preoperative color Doppler ultrasound were primarily incorporated, rather than the final pathological reports.

Furthermore, the presence of multiple malignant tumors within the same thyroid lobe was defined as multiplicity. The situation where cancer cells skipped the level VI lymph nodes and directly metastasized to the lateral neck lymph nodes or where there was no lymph node metastasis in adjacent levels was defined as skip metastasis.

2.4 Statistical Analysis

Statistical analyses were performed using SPSS 26.0. For measurement data conforming to a normal distribution, the results were presented as mean ± standard deviation. The independent samples t - test was employed to compare between groups. For measurement data with a skewed distribution, the median and interquartile range(IQR) were used for representation, and the Mann - Whitney U test was utilized to describe the inter - group comparisons.Categorical data were expressed as frequencies (%) and Fisher's exact test was used to describe the differences between groups. Independent variables with a P value < 0.05 in the univariate analysis were incorporated into the multivariate Logistic regression analysis to identify the independent risk factors influencing patient prognosis.The receiver operating characteristic (ROC) curve was constructed to assess the value of individual or combined clinical data in predicting the risk of lymph node metastasis in the IIb level in papillary thyroid carcinoma. A significance level of $P < 0.05$ was regarded as statistically significant.

3 Results

3.1 Demographic Characteristics

We recruited patients with papillary thyroid carcinoma who underwent surgical treatment at our hospital between September 2019 and February 2025. Among these patients, 685 underwent lateral neck lymph node dissection. Following a meticulous exclusion process, a total of 217 patients with pathologically verified pN1b papillary thyroid carcinoma were enrolled in this study.

Among the 217 patients, 77 were male (35.5%) and 140 were female (64.5%). The median age of

the patients was 42 years (IQR: 33 - 52 years). Using 55 years as the cut - off age, 185 patients (85.3%) were 55 years old or younger, while 32 patients (14.7%) were older than 55 years.

3.2 Characteristics of color Doppler ultrasound, blood tests, and other indicators

There were 131 cases (60.4%) presenting with single lesions and 86 cases (39.6%) with multiple lesions. Regarding the lesion distribution, 85 cases (39.2%) were on the left side, 84 cases (38.7%) on the right side, and 48 cases (22.1%) were bilateral. For the highest - graded and largest - diameter nodules, 73 cases (33.6%) were located in the upper part of the thyroid gland, 114 cases (52.5%) in the middle part, and 30 cases (13.8%) in the lower part. The median value of the maximal diameter of the nodules with the highest grade was 1.40 cm (IQR: 0.925 - 2.27). Stratified by 1 cm, 62 cases (28.6%) were classified as microcarcinomas, while 155 cases (71.4%) were non - microcarcinomas. Calcification was observed in 132 cases (60.8%). TI - RADS classification was as follows: 7 cases (3.2%) were at grade 4a, 20 cases (9.2%) at grade 4b, 39 cases (18.0%) at grade 4c, 145 cases (77.8%) at grade 5, and 6 cases (2.8%) at grade 6. HT was concurrently present in 51 cases (23.5%). In 59 cases (27.2%), capsule invasion or extrathyroidal invasion was detected either by preoperative ultrasound or during the operation. Preoperative ultrasound revealed that the median maximal diameter of lymph nodes was 0.9 cm (IQR: 0.5 - 1.55). The distribution of lymph node metastasis was as follows: 184 cases (84.8%) in level VI, 170 cases (78.3%) in level III, 155 cases (71.4%) in level IV, 110 cases (50.7%) in level IIa, and 25 cases (11.5%) in level IIb. Skip metastasis in the lateral cervical level occurred in 33 cases (15.2%), among which 2 cases (0.9%) involved skip metastasis in level IIb. The median of BMI was 25.7 (IQR: 23.5 - 29.2). When classified into three groups according to the cut - off values of < 18, 18 - 24, and ≥ 24, there were 3 underweight patients (1.4%), 62 patients with normal body mass (28.6%), and 152 overweight patients (70%). The median of Tg was 23.04 μg/L (IQR: 7.94 - 72.52). The median of FPG was 4.66 mmol/L (IQR: 4.235 - 5.095). The median of GLR was 2.33 (IQR: 1.91 - 2.99). The mean value of total cholesterol was 4.3 ± 0.98 mmol/L. The median of triglyceride was 1.32 mmol/L (IQR: 0.995 - 1.8). The median of HDL was 1.22 mmol/L (IQR: 0.985 - 1.465). The mean value of LDL was 2.54 ± 0.8 mmol/L.

3.3 Univariate Analysis

A total of 217 patients were stratified into two groups according to postoperative pathology: those with lymph node metastasis in level IIb and those without. Appropriate statistical tests were performed based on different types of data.

In the univariate analysis, it was revealed that nodule location ($P < 0.001$), maximal diameter of nodules ($P = 0.002$), capsule invasion or extrathyroidal invasion ($P = 0.017$), maximal diameter of the lymph nodes ($P = 0.034$), lymph node metastasis in level IIa ($P < 0.001$), and Tg level ($P = 0.027$) were significantly associated with lymph node metastasis in level IIb. No statistical significance was observed for other factors ($P > 0.05$).(Table 1)

Table 1 Univariate analysis revealed an association between the clinical data of patients with pN1b papillary thyroid carcinoma and lymph node metastases in level IIb.

Factor		IIb(+) n=25(11.5%)	IIb(-) n=192(88.5%)	*P* value
Sex	Male Female	12(5.5%) 13(6.0%)	65(30.0%) 127(58.5%)	0.186
Age(years)		38(28,50)	42(34,52)	0.439
Age groups	≤55y >55y	22(10.1%) 3(1.4%)	163(75.1%) 29(13.4%)	1.000
Quantity of lesions	Single Multiple	19(8.8%) 6(2.8%)	112(51.6%) 80(36.9%)	0.127
Side	Left Right Bilateral	9(4.1%) 10(4.6%) 6(2.8%)	76(35.0%) 74(34.1%) 42(19.4%)	0.927
Location	Upper	18(8.3%)	55(25.3%)	<0.001

	Middle Lower	6(2.8%) 1(0.5%)	108(49.8%) 29(13.4%)	
Maximal diameter of nodules(cm)		2.15(1.55,2.86)	1.34(0.90,2.19)	0.002
Microcarcinomas Non-microcarcinomas	≤1cm >1cm	3(1.4%) 22(10.1%)	59(27.2%) 133(61.3%)	0.060
Calcification	Yes No	15(6.9%) 10(4.6%)	117(53.9%) 75(34.6%)	1.000
TI - RADS	4a 4b 4c 5 6	0(0.0%) 2(0.9%) 2(0.9%) 21(9.7%) 0(0.0%)	7(3.2%) 18(8.3%) 37(17.1%) 124(57.1%) 6(2.8%)	0.502
HT	Yes No	4(1.8%) 21(9.7%)	47(21.7%) 145(66.8%)	0.456
Capsule invasion or extrathyroidal invasion	Yes No	12(5.5%) 13(6.0%)	47(21.7%) 145(66.8%)	0.017
Maximal diameter of the lymph nodes(cm)		1.50(0.65,2.00)	0.90(0.50,1.50)	0.034
Level VI	Yes No	22(10.1%) 3(1.4%)	162(74.7%) 30(13.8%)	0.775
Leve IV	Yes No	21(9.7%) 4(1.8%)	134(61.8%) 58(26.7%)	0.164
Leve III	Yes No	19(8.8%) 6(2.8%)	151(69.6%) 41(18.9%)	0.797
Leve IIa	Yes No	23(10.6%) 2(0.9%)	87(40.1%) 105(48.4%)	<0.001
BMI	<18 18~24 ≥24	0(0.0%) 4(1.8%) 21(9.7%)	3(1.4%) 58(26.7%) 131(60.4%)	0.277
Tg(μg/l)		38.36(19.21,352.6)	22.27(7.59,68.65)	0.027
High Tg	Yes No	12(5.5%) 13(6.0%)	70(32.3%) 122(56.2%)	0.279
FPG(mmol/l)		4.57(4.15,5.10)	4.67(4.25,5.10)	0.362
High FPG	Yes No	0(0.0%) 25(11.5%)	14(6.5%) 178(82.0%)	0.379
GLR		2.24(1.80,2.91)	2.35(1.94,3.02)	0.260
Total cholesterol(mmol/l)		4.21±1.13	4.31±0.93	0.067
High Total cholesterol	Yes No	6(2.8%) 19(8.8%)	25(11.5%) 167(77.0%)	0.140
Triglyceride(mmol/l)		1.27(1.03,2.67)	1.32(0.95,1.79)	0.525
High Triglyceride	Yes No	9(4.1%) 16(7.4%)	54(24.9%) 138(63.6%)	0.483
HDL(mmol/)		1.20(0.96,1.34)	1.22(0.99,1.48)	0.345
Low HDL	Yes No	3(1.4%) 22(10.1%)	38(17.5%) 154(71.0%)	0.428
LDL(mmol/)		2.40±0.77	2.55±0.81	0.342
High LDL	Yes No	5(2.3%) 20(9.2%)	36(16.6%) 156(71.9%)	0.793

3.4 Multivariate regression Analysis

We incorporated the factors with $P < 0.05$ in the univariate analysis into the multivariate regression

analysis. Specifically, the location of nodules was initially classified into three levels: upper, middle, and lower. Given that the presence of nodules in the upper level represented the most prominent distinction, for the purpose of the multivariate regression analysis, the location variable was re - categorized into two groups: the upper part and the middle - lower part. This approach was adopted to enable a more precise analysis.

Through the multivariate regression analysis, we determined that the location of the nodule ($P < 0.001$), the maximal diameter of the nodule ($P = 0.024$), and lymph node metastasis in level IIa ($P = 0.004$) were independent risk factors for lymph node metastasis in level IIb.(Table 2)

Table 2 Perform multivariate regression analysis on relevant factors to explore in depth the independent risk factors for lymph node metastasis in level IIb.

Relevant factor	Odds ratio (OR) [95% confidence interval (CI)]	*P* value
Location	10.228(3.269~32.001)	<0.001
The maximal diameter of nodules	0.604(0.390~0.936)	0.024
Capsule invasion or extrathyroidal invasion	2.149(0.748~6.174)	0.155
The maximal diameter of lymph nodes	0.885(0.503~1.558)	0.673
Level IIa	9.890(2.097~46.652)	0.004
Tg	0.705(0.224~2.217)	0.550

3.5 ROC curve analysis to establish the optimal cut-off value

We further evaluated the predictive effect of the maximal diameter of nodules on lymph node metastasis in zone IIb through the ROC curve.

The Area Under the Curve (AUC) of the maximal nodule diameter was 0.686, with a 95% CI ranging from 0.581 to 0.792 ($P < 0.002$). To identify the critical value, we calculated the maximum Youden Index (Youden Index = Sensitivity + Specificity - 1).The optimal cut-off value for the maximum nodule diameter was determined to be 1.59 cm. At this cut-off, the sensitivity was 0.76, and the specificity was 0.38. This indicates that when the maximal nodule diameter is equal to or greater than 1.59 cm, the likelihood of lymph node metastasis in level IIb is higher.(Fig 1)

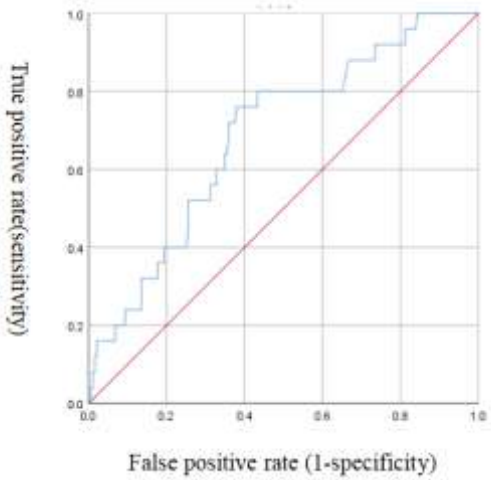

Figure 1 The predictive efficacy of The maximal diameter of the nodules for lymph node metastasis in level IIb.

4 Discussion

Currently, for patients diagnosed with papillary thyroid carcinoma who present with lateral cervical lymph node metastasis, the standard surgical procedure typically encompasses ipsilateral thyroid lobectomy, accompanied by radical dissection of the central compartment and

lateral cervical lymph nodes. This surgical approach is underpinned by compelling evidence demonstrating its therapeutic effectiveness. Nevertheless, it is of utmost importance that we do not perform overly extensive resections at the cost of compromising the patients' postoperative quality of life. A substantial number of scholars have already directed their attention to the fact that among patients who have undergone radical lateral cervical lymph node dissection, the prevalence of shoulder syndrome is approximately 94.8%[8].This is a staggering figure. The shoulder syndrome can result in symptoms such as scapular elevation weakness, an inability to pick up objects, pain, etc. Regardless of the severity of these symptoms, they will significantly impact the quality of life of patients. This may cause patients to be unable to pursue relevant occupations, lack confidence in social interactions, which in turn can give rise to mental health issues and even suicidal tendencies[9]. Particularly among young patients who did not have shoulder syndrome prior to surgery, they frequently present with a sorrowful expression during follow - up consultations, recounting their misfortunes to us. Among this group of patients, a significant proportion do not exhibit level IIb lymph node metastasis in the postoperative pathological examination. This compels us to focus on this matter: at what point is lymph node dissection in the level IIb appropriate?

Numerous scholars have carried out prospective studies regarding whether to perform lymph node dissection in the level IIb of head and neck tumors. It has been found that six months post - operation, compared with patients who underwent level IIb lymph node dissection, those who did not have significantly reduced proportions of shoulder joint mobility impairment and accessory nerve injury. It is proposed that, provided it is oncologically safe and feasible, lymph node dissection in the level IIb should be omitted[5,10].Won and colleagues conducted a meta - analysis incorporating 40 studies involving a total of 6,027 patients with well - differentiated thyroid cancer accompanied by lateral cervical lymph node metastasis. The overall metastasis rate in the level IIb was 13.7%. The recurrence rate in the group that underwent total cervical lymph node dissection was 11.2%, while that in the group without level IIb lymph node dissection was 11.0%. No significant difference was observed between the two groups. It is thus proposed that for patients with well - differentiated thyroid cancer complicated by lateral cervical lymph node metastasis, the omission of level IIb lymph node dissection can be selectively considered[6].

In our research, among 217 pN1b patients, only 11.5% experienced lymph node metastasis in level IIb. Moreover, only factors such as the nodule being located in the upper part, the maximal diameter of the nodule, capsular infiltration or extrathyroidal invasion, the maximal diameter of the lymph node, lymph node metastasis in level IIa, and Tg were identified as risk factors for lymph node metastasis in level IIb. This could be attributed to the advanced stage of PTC. At this stage, the disease state primarily depends on tumor characteristics and progression rather than characteristics of the patients such as gender and age.Multivariate regression analysis verified that the nodule being located at the upper pole, the maximal diameter of the nodule, and lymph node metastasis in level IIa were independent risk factors. Specifically, through the ROC curve analysis, it was confirmed that when the maximal diameter of the nodule was ≥ 1.59 cm, lymph node metastasis in level IIb was more likely to happen.

The study by Ding et al. pointed out an association between BMI and lymph node metastasis. Their view is that there is a positive correlation between BMI and the risk of thyroid cancer[11]. Meanwhile, some literature has indicated that leptin is a factor influencing lymph node metastasis in thyroid cancer[12]. Nevertheless, in our research, no association was detected between BMI and lymph nodes in the level IIb . We hypothesize that a high BMI may influence the microenvironment of specific regions through adipose tissue metabolism, rather than eliciting a homogeneous response across all regions.

Numerous previous studies have indicated that blood lipids are risk factors for lymph node metastasis in many cancers, suggesting that the growth of tumors partly depends on triglycerides, low-density lipoprotein, and others. Moreover, a high-fat diet can inhibit the anti-tumor activity of macrophages. Additionally, low-density lipoprotein can stimulate vascular endothelial cells to promote the expression of multiple

inflammatory factors, increasing the adhesiveness of vascular endothelium, which may enhance the metastasis of tumor cells[13–15]. The synthesis of fatty acids may promote the occurrence and progression of thyroid cancer[16].In our study, we also incorporated various blood lipid parameters, including triglycerides, cholesterol, LDL, and HDL. Regrettably, no association was found between blood lipids and lymph nodes in the level IIb. This could potentially be attributed to the fact that the expression gradient of lipid transport proteins in the local microenvironment of the level IIb is distinct from that in other parts of the body, which influences the efficiency of lipid uptake by tumor cells.

Numerous studies have indicated that glucose metabolism is intricately associated with the invasiveness of thyroid cancer. Hyperglycemia can facilitate the generation of advanced glycation end products, which in turn promotes the proliferation of tumor cells. Additionally, the energy metabolism of tumor cells predominantly depends on glycolysis[17–19].Jin et al. conducted an in - depth exploration of the relationship between the GLR and PTC. GLR, which has been recognized as a prognostic indicator for pancreatic cancer and gallbladder cancer, emerged as an independent predictive factor for central lymph node metastasis in PTC.Specifically, their research indicated that a high GLR value is associated with elevated blood glucose levels or reduced lymphocyte counts. This parameter can serve as a valuable tool for predicting the presence of central lymph node metastasis in PTC patients by reflecting the inflammatory status within the body[20].In our study, FPG and GLR were incorporated into the research factors. However, no associations were detected between FPG, GLR and lymph node metastasis in level IIb.It is possible that metastatic lymph nodes in level IIb do not depend on glycolysis for energy production. Additionally, this region may be insensitive to inflammatory factors, thus creating an immune - suppressed "cold tumor" state. As a result, GLR may not be able to detect region - specific immune - suppression signals.

In the realm of thyroid cancer research, HT is an inevitable consideration. In this disorder, an aberrant immune system triggers the substantial recruitment of lymphocytes into the thyroid tissue. This influx subsequently induces the apoptosis of thyroid cells and impairs thyroid function[21].Consequently, the immunological state and the alterations in the molecular structure of thyroid cells in HT might modulate the progression of thyroid cancer[22].In certain studies, this change has been posited to potentially represent a protective modification[23].In our study, we concur with the perspective of Zhou et al.,we do not hold the view that HT exerts a protective effect on lymph node metastasis in level IIb[24].The relationship between HT and thyroid cancer is complex. Its protective effect may be influenced by multiple factors such as anatomical location, tumor subtype, and heterogeneity of the immune microenvironment.

Our study has several limitations. First, the patient population was sourced from a single institution. Second, this study lacks long-term monitoring and research on the prognosis of lymph node metastasis. It remains unclear whether omitting lymph node dissection in the level IIb area will affect long-term survival rates. Moreover, regional differences, variations in surgical techniques, and environmental and cultural factors may all influence the results observed in different populations. To enhance the generalizability of these findings, future research should consider broadening the scope of the study. A larger sample size will help strengthen the statistical power of the analysis and enable the identification of other risk factors that may be specific to certain subgroups. These endeavors are of great significance for refining clinical guidelines and formulating personalized treatment plans.

5 Conclusions

Our retrospective study has revealed that for patients with papillary thyroid carcinoma presenting with lateral cervical lymph node metastases, if preoperative color Doppler ultrasonography indicates that the nodule with the highest classification and the largest diameter is located at the upper pole, has a diameter of ≥ 1.59 cm, or if lymph node metastases in level IIa are detected, a more proactive surgical strategy should be implemented. Lymph node dissection in level IIb is essential.However, this surgical approach demands that surgeons possess extensive experience and proficient techniques. Given the potential implications of this surgical procedure for local function and the occurrence of complications, for patients without the

aforementioned risk factors, we do not advocate for lymph node dissection in level IIb. The implementation of prophylactic lymph node dissection in level IIb should be carefully considered, aiming to strike an optimal balance between functional preservation and cancer treatment.

Statements and Declarations

Acknowledgments: We would like to express our sincere gratitude for the contributions made by the Head and Neck Oncology Department, Ultrasound Diagnosis and Therapy Department, Pathology Department, and Clinical Laboratory Department of Tianjin Cancer Hospital Airport Hospital.

Funding: No funds, grants, or other support was received.

Availability of Data and Materials: All data supporting the findings of this study are available within the paper and its supplementary Information.

Authors' Contributions: Shi-jie Zheng, Chuang-wu Ke, Wei-jing Hao, and Wen-chao Zhang designed the research. Shi-jie Zheng carried out the research. Shi-jie Zheng, Wei-jing Hao, and Chuang-wu Ke analyzed the data. Shi-jie Zheng drafted the paper. Shi-jie Zheng prepared the figures. Chuang-wu Ke and Wen-chao Zhang revised the paper.

Conflict of interests: The authors declare that they have no competing interests.

Ethical approval and consent to participate: All patients have signed the "Informed Consent for the Retention of Biological Samples", consenting to the use of all clinical data for scientific research. This study was carried out in accordance with the principles of the Declaration of Helsinki.The study has been approved by the Ethics Review Committee of Tianjin Cancer Hospital Airport Hospital.

Consent for publication: All authors have agreed to the publication of this paper.

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