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ORIGINAL ARTICLE

Routine pathological nodal status evaluation significantly modifies 2025 ATA risk category of patients with unifocal cN0 cT1b-T2 PTC eligible for thyroid lobectomy: results from a multicentre international study

Francesco Pennestrì[1,2] · Antonio Laurino[1] · Priscilla Francesca Procopio[1,2] · Fatih Tunca[3] · Emanuela Traini[4] · Carmela De Crea[2,5] · Kemal Alagol[1] · Giulia Carnassale[4] · Milena Pia Cerviere[5] · Andrea Corsello[5] · Pierpaolo Gallucci[1] · Yalin Iscan[3] · Irem Karatas[6] · Annamaria Martullo[1] · Amelia Mattia[4] · Alfredo Pontecorvi[7,8] · Francesca Prioli[1] · Maria Pia Ricciato[4] · Esther Diana Rossi[9,10] · Marco Raffaelli[1,2]

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Abstract

Occult lymph node metastases occur in up to 50% of patients with clinically node-negative papillary thyroid carcinoma eligible for thyroid lobectomy. Nevertheless, the 2025-ATA guidelines discourage routine prophylactic ipsilateral central neck dissection in clinically node-negative clinical T1b–T2 low-risk disease. This multicentric retrospective study evaluated the impact of routine ipsilateral central neck dissection on recurrence risk stratification in patients with unifocal clinically node-negative clinical T1b–T2 papillary thyroid carcinoma eligible for thyroid lobectomy. Among 9,028 thyroidectomies performed in four referral centres, 264 patients met the inclusion criteria. Lymph node metastases were found in 135 (51.1%) patients, with extranodal extension in 8.9% of node-positive cases. Median tumour size was 12 mm. Final histopathology showed pT1a disease in 88 (33.3%), pT1b in 165 (62.5%), and pT2 in 11 (4.2%). Extrathyroidal extension, vascular invasion, multifocality, and aggressive histologic variants were observed in 12.1, 60.6, 43.2, and 18.9%, respectively. According to the 2025-ATA risk stratification system, excluding pathologic nodal status, 60 (22.7%) patients were low risk, 31 (11.8%) low–intermediate risk, 170 (64.4%) intermediate–high risk, and 3 (1.1%) high risk. After inclusion of nodal status, 54 (20.4%) were low risk, 24 (9.1%) low–intermediate risk, 171 (64.8%) intermediate–high risk, and 15 (5.7%) high risk ($p<0.001$). Overall, 8% of patients experienced risk upgrading, and >70% were classified in higher-risk categories. Pathologic nodal assessment substantially modifies recurrence risk stratification in clinical node-negative T1b–T2 papillary thyroid carcinoma eligible for thyroid lobectomy, supporting routine ipsilateral central neck dissection for staging and tailored surgical decision-making.

Keywords Papillary thyroid carcinoma · Occult lymph node metastases · Central neck dissection · ATA risk · Thyroid lobectomy · Total thyroidectomy

Introduction

Until the release of the 2015 American Thyroid Association (ATA) guidelines [1], the management of most papillary thyroid carcinomas (PTCs) was based on old paradigms [2], whereby patients underwent total thyroidectomy (TT), followed by radioactive iodine (RAI) adjuvant therapy and levothyroxine suppressive therapy, regardless of structural recurrence risk stratification. The 2015 ATA guidelines [1] firstly introduced a more personalized approach, supporting thyroid lobectomy (TL) in unifocal clinical node-negative (cN0) cT1-2 (1–4 cm) PTC, in absence of other risk

Francesco Pennestrì and Antonio Laurino are co-first authors as they equally contributed to the work.

Extended author information available on the last page of the article

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factors [1], thereby balancing perioperative complications and oncologic outcomes. According to the most recent 2025 ATA guidelines [3], the initial surgical procedure for cN0 cT1-T2 PTC should be TL in the absence of bilateral disease or other indications for TT, although robust evidence supporting TL over TT in cT2 PTC remains limited. Moreover, the last decade evidence has shown that up to 60% of patients initially classified as low-risk PTC were reassigned to a higher ATA risk category based on final pathology findings [4–7]. This risk upstaging may lead to reoperative surgery (completion thyroidectomy, CT) and subsequent RAI treatment [7, 8].

As emphasized by the 2025 ATA guidelines, the main therapeutic goal is complete resection of the primary tumour together with any extrathyroidal extension (ETE) and clinically significant nodal disease. The extent and adequacy of surgical resection are key determinants of oncologic outcome. Cervical lymph nodes represent the most frequent site of disease persistence or recurrence (up to 74% of cases) [3]. Moreover, despite being the gold standard for preoperative staging of most differentiated thyroid carcinomas, neck ultrasonography demonstrates limited accuracy in evaluating central compartment lymph node metastases (LNMs) [9, 10]. Furthermore, the incidence of occult nodal metastases in PTC is not negligible (43.1–46% in pT1b-2 PTC). However, the 2025 ATA guidelines recommend against prophylactic ipsilateral (I) central node dissection (CND) for cN0 cT1b-2 unifocal low-risk PTC (strong recommendation, moderate certainty evidence) [3]; the same guidelines postulate a potential role for prophylactic I-CND when this information is used to plan further therapy (conditional recommendation, low certainty evidence). This recommendation is supported by findings from our prior studies [11, 12], showing that I-CND contributes to tailor the therapeutic strategy in these patients.

The new 2025 ATA guidelines have profoundly revised the structural recurrence risk stratification framework by incorporating specific pathologic nodal (pN) features into the risk assessment system. Within this updated classification, pN1 disease with extranodal extension (ENE) is categorized as high risk, while the burden and size of nodal metastases further refine the intermediate-risk strata. Specifically, the presence of more than five micrometastases (≤2 mm) in association with at least one macrometastasis (>2 mm) corresponds to high–intermediate risk; more than five micrometastases or at least one macrometastasis defines low–intermediate risk; five or fewer micrometastases are classified as low risk [3].

Several studies have demonstrated the adverse prognostic impact of LNMs [13] in terms of disease-free and overall survival. Considering the available evidence, a clear dichotomy emerges within the 2025 ATA guidelines [3] between the recommendation against routine prophylactic CND and the acknowledged oncologic relevance of accurately defining pN status and its specific features—such as ENE—which are now extensively integrated into the structural recurrence risk stratification system. This issue is further amplified by the aforementioned limited diagnostic accuracy of preoperative ultrasound in assessing lymph node involvement within the central compartment [9, 10]. As a consequence, histopathologic evaluation currently remains the only reliable method for a precise assessment of this critical prognostic factor.

This multicentre retrospective cohort study assessed the impact of routine I-CND on risk stratification in preoperatively low-risk unifocal cN0 cT1b–T2 PTC eligible for TL.

Material and methods

Study design

We performed a retrospective multicentre international study across four referral centres for endocrine surgery including patients who underwent surgery for PTC between September 2014 and September 2025. Inclusion criteria were adult patients (≥18 years) with clinically unifocal and intrathyroidal (tumour size > 1 cm and ≤ 4 cm) cN0 PTCs scheduled for TL plus I-CND. Exclusion criteria included age < 18 years, previous head and neck irradiation, familial thyroid carcinoma, clinically evident multifocality, ETE or lymph node metastases, and follow-up shorter than six months.

The study was conducted in compliance with the principles of the Declaration of Helsinki and approved by the local Ethics Committee of the promoter Centre (ID 6584).

Follow-up ended on 31st March 2026.

All patients included in this study provided written informed consent at the time of surgery for the use of their clinical data in future research.

Definitions

The definitions of cN0, TL, TT, I-CND, and bilateral (B) CND have been previously described [7, 8, 11, 12, 14]. Pathologic tumour staging was defined according to the UICC TNM staging system (9th edition, 2025) [14], whereas histological subtypes/variants were described according to the 2022 WHO classification [15] and 2025 ATA guidelines [3]. For the purpose of the present analysis, aggressive histological subtypes included tall cell, solid/trabecular, hobnail, infiltrative follicular, diffuse sclerosing variants, and high-grade PTC. Histologic high-risk features have been defined according to the ATA 2025 risk of recurrence [3]. Pathological multifocality was defined as the presence

of two or more distinct malignant tumour foci within the thyroid specimen at final histopathological examination, irrespective of whether additional foci were located in the ipsilateral or contralateral thyroid lobe. ETE was defined as microscopic tumour extension beyond the thyroid capsule identified at final histopathological examination. The estimated risk of structural recurrence has been classified according to the 2025 ATA guidelines [3] and encompassed four categories: low (< 10%), low–intermediate (10–15%), intermediate–high (16–30%), and high (> 30%). The criteria used to define transient and permanent recurrent laryngeal nerve (RLN) palsy [16–18], as well as immediate [19] and permanent [20] hypoparathyroidism, have been previously described in the literature. Biochemical cure and persistent—both biochemical and structural—disease were assessed in accordance with the ATA recommendations [3]. Locoregional structural recurrence was defined as clinically evident disease in the thyroid bed and/or central or lateral cervical compartments detected after completion of the planned initial treatment strategy, including the final extent of surgery and risk-adapted RAI when indicated.

Preoperative assessment, postoperative management, and follow-up evaluation

Preoperative evaluation included physical examination, biochemical testing, fine-needle aspiration cytology, and laryngoscopic assessment. In all cases, neck ultrasound was performed by an experienced endocrine surgeon to assess cN-status. Patients treated with TT and B-CND subsequently underwent RAI therapy according to tumour stage and individual risk factors, following multidisciplinary tumour board evaluation.

Study endpoints

The primary endpoint was the incidence of lymph node metastases in patients with clinically unifocal cT1b–T2 cN0 PTC scheduled for TL plus I-CND.

Secondary endpoints included the rates of pathological high-risk features, specifically ENE, aggressive histological variants, ETE, vascular invasion, and multifocality. Additionally, we compared ATA risk stratification with and without incorporation of pN status and analysed the association between ATA risk categories and pN-status features.

Data collection and statistical analysis

Data were collected and managed using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) software using a specifically designed deidentified database. The database was created and distributed by the coordinating centre to all participating institutions. The coordinating centre performed the statistical analysis, while each participating centre retained responsibility for data integrity and the accuracy of its own data. All data were anonymized prior to analysis and handled in accordance with applicable data protection regulations.

Follow-up data were obtained from outpatient assessments, clinical records, and/or direct telephone contact.

The following variables were prospectively recorded and analysed. Preoperative data included patient age, sex as assigned at birth, and primary tumour size. Intraoperative parameters focused on lymph node assessment on frozen section examination when performed. Postoperative variables comprised pathologic stage, lesion size, pN-status, presence of ENE, multifocality, vascular invasion, ETE, and aggressive histological variants. The 2025 ATA risk category was also determined. In addition, early and late postoperative complications, RAI therapy, and follow-up outcomes were collected.

Statistical analyses were performed using IBM SPSS Statistics version 31 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize patient characteristics. Continuous variables were expressed as median and interquartile range (IQR: Q1-Q3), whereas categorical variables were reported as frequencies and percentages. Categorical variables were compared using the chi-square test. The Wilcoxon signed-rank test was applied to compare ATA risk scores calculated with and without incorporation of pN status. Univariable logistic regression analysis was conducted to explore the association between ATA risk categories and pN-status features, with results presented as odds ratios (ORs) and corresponding 95% confidence intervals. All analyses were two-tailed, and the threshold for statistical significance was set at $p < 0.05$.

Results

Among 9028 thyroidectomies for malignancies performed across the four participating centres during the study period, 264 (2.9%) patients met the inclusion criteria and were included in the final analysis. The number of thyroidectomies performed for thyroid malignancies and the number of patients included per centre are reported in Table 1. Demographic, perioperative, and follow-up characteristics are summarized in Table 2.

Eighty-seven (33%) patients were male and 177 (67%) were female. The median age was 40 (31–50) years. Two hundred forty (90.9%) tumours were staged cT1b and 24 (9.1%) cT2. Intraoperative frozen section examination of I-central compartment lymph nodes was performed in 242 (91.7%) cases. The median number of lymph nodes

Table 1 Number of thyroidectomies performed for thyroid malignancies and number of included patients per centre

Centre	Thyroidectomies for malignancy	Included patients
Division of Endocrine and Metabolic Surgery, Fondazione Policlinico Universitario Agostino Gemelli IRCCS, Rome, Italy	7646	190
Division of Endocrine Surgery, Ospedale Isola Tiberina-Gemelli Isola, Rome, Italy	377	17
Division of Endocrine Surgery, Ospedale San Carlo di Nancy, GMV Care and Research, Rome, Italy	625	24
Division of Endocrine Surgery, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey	380	33

examined at frozen section was 4 (2–6), with a median of 2 (1–3) identified LMNs. At definitive histopathology, the median tumour size was 12 (10–14) mm, corresponding to 88 (33.3%) pT1a, 165 (62.5%) pT1b, and 11 (4.2%) pT2 tumours. Overall, 135 (51.1%) patients had central compartment LNMs and were classified pN1a, whereas 129 (48.9%) were staged pN0. The median number of retrieved central lymph nodes at final histology was 8 (5–12), with a median of 2 (1–5) metastatic nodes. ENE was identified in 12 patients with nodal metastases. Among pN1a patients, 56 presented exclusively with micrometastases, and in 2 of these cases more than five micrometastases were detected. Aggressive histologic variants and ETE were observed in 50 (18.9%) and 32 (12.1%) patients, respectively; no cases of macroscopic/gross ETE were identified.

Regarding histological subtypes, 14 (5.3%) patients had tall cell variant, 3 (1.1%) solid/trabecular variant, 3 (1.1%) hobnail variant, 28 (10.6%) infiltrative follicular variant PTC, 1 (0.4%) diffuse sclerosing variant, and 1 (0.4%) high-grade PTC. Vascular invasion and multifocality were observed in 160 (60.6%) and 114 (43.2%) patients, respectively.

Overall, 140 (53%) patients underwent TL plus I-CND, 87 (33%) TT plus B-CND and 37 (14%) CT plus contralateral CND. In these 37 patients, CT was not prompted by FSE positivity but was performed after multidisciplinary reassessment of the complete final pathology and patient preference (Fig. 1).

Among the 124 patients who ultimately underwent TT and B-CND (synchronous or delayed), 10 had contralateral structural disease (bilateral multifocality), although none of these lesions exceeded 1 cm. Among patients with pathological multifocality, the median size of the largest additional malignant focus was 1 (1–2.5) mm. In addition, 6 patients had contralateral central LNMs.

Transient and permanent RLN palsy occurred in 21 (5.4%) and 0 (0%) cases, respectively, among 388 nerves at risk. Among the 124 patients who underwent TT and B-CND, immediate hypoparathyroidism was observed in 43 (34.7%) cases and permanent hypoparathyroidism in 6 (4.8%).

The risk of structural recurrence was also evaluated. When lymph node staging was not incorporated, 60 (22.7%) patients were classified as low risk, 31 (11.8%) as low–intermediate risk, 170 (64.4%) as intermediate–high risk, and 3 (1.1%) as high risk. After incorporation of pN-status, 54 (20.4%) patients were classified as low risk, 24 (9.1%) as low–intermediate risk, 171 (64.8%) as intermediate–high risk, and 15 (5.7%) as high risk (Figs. 2 and 3). The difference between risk recurrence calculated without and with nodal staging was significant ($p<0.001$). ATA risk category increased in 21 (7.9%) patients, and 186 (70.4%) were ultimately classified in the higher recurrence-risk categories.

As shown in Table 3, LNMs were significantly more frequent in the intermediate–high/high-risk group compared to the low/low–intermediate-risk group: 118 (87.4%) vs. 68 (52.7%) ($p<0.001$). Patients in the higher-risk categories had an OR of 6.227 (95% CI 3.367–11.515; $p<0.001$) for LNMs.

The median follow-up was 33 (15–53) months. Sixty-seven (25.4%) patients received RAI. During follow-up, three patients (1.1%) developed confirmed structural locoregional nodal recurrence.

All three patients had undergone TT with synchronous CND at the index operation. One patient with multifocal classic PTC with a 20% columnar cell component (pT1bm pN1a; TT with synchronous CND) developed right lateral neck recurrence and underwent right functional lateral neck dissection (levels II–V) 14 months after the index operation. One patient with classic PTC with a 20% tall cell component (pT1b pN1a; TT with synchronous CND) developed right lateral nodal recurrence and underwent right functional lateral neck dissection 32 months after initial surgery. Finally, one patient with infiltrative follicular variant PTC (pT1b pN1a; TT with synchronous CND) developed right lateral neck recurrence and underwent right functional lateral neck dissection 10 months after the index procedure.

Discussion

This study highlights the role of prophylactic I-CND in accurate staging and prognostic risk stratification in patients with preoperative low-risk unifocal cN0 cT1b–T2 PTC.

Overall, 51.1% of patients had occult central compartment LNMs not detected on preoperative ultrasound, including cases with ENE, macrometastatic disease, or

Table 2 Demographic, clinical, operative, pathologic, and follow-up characteristics of the 264 included patients

Patients (n°)	264		
Age (Median) (IQR)	40 (31–50)		
Sex° (%)	87 (33%)		
M	177 (67%)		
F			
cT (%)	240 (90.9%)		
cT1b	24 (9.1%)		
cT2			
FSE (%)	No 22 (8.3%), Yes 242 (91.7%)		
N° LN on FSE (Median) (IQR)	4 (2–6)		
N° LNM on FSE (Median) (IQR)	2 (1–3)		
Postoperative tumour size, mm (Median) (IQR)	12 (10–14)		
pT stage* (%)	88 (33.3%)		
pT1a	165 (62.5%)		
pT1b	11 (4.2%)		
pT2			
pN stage* (%)	129 (48.9%)		
pN0	135 (51.1%)		
pN1a			
N° LN on DH (Median) (IQR)	8 (5–12)		
N° LNM on DH (Median) (IQR)	2 (1–5)		
Extranodal extension	12 out 135 pN1a patients		
Aggressive subtyes/variants (%)	50 (18.9%)		
Extrathyroidal extension (%)	32 (12.1%)		
Vascular invasion (%)	160 (60.6%)		
Multifocality (%)	114 (43.2%)		
ATA risk (%)	*without pN*	*with pN*	$p < 0.001$
1 low	60 (22.7%)	54 (20.4%)	
2 low-intermediate	31 (11.8%)	24 (9.1%)	
3 intermediate-high	170 (64.4%)	171 (64.8%)	
4 high	3 (1.1%)	15 (5.7%)	
Surgical procedures (%)	140 (53.0%)		
TL + I-CND	87 (33.0%)		
TT + CND, synchronous	37 (14.0%)		
TT + CND, delayed			
Transient RLN palsy (%)	21 (5.4%) out of 388 nerves at risk		
Definitive RLN plasy (%)	0 (0%) out of 388 nerves at risk		
Immediate hypoparathyroidism (%)	43 (34.7%) out of 124 TTs		
Permanent hypoparathyroidism (%)	6 (4.8%) out of 124 TTs		
Follow-up time, months (Median) IQR	33 (15–53)		
RAI (%)	67 (25.4%)		
Structural recurrence (%)	3 (1.1%)		
Locoregional nodal recurrence	3 (1.1%)		
Distant metastasis	0 (0%)		

M, Male; F, Female; IQR, Interquartile range; FSE, Frozen section examination; LN, Lymph node: LNM, Lymph node metastasis; DH, Definitive histology; ATA, American Thyroid Association; TL, Thyroid lobectomy, I: Ipsilateral; CND, central neck dissection; TT, Totale thyroidectomy; RAI, Radioactive iodine

°As assigned at birth

*according to UICC TNM 9th edition 2025 Continuous variables are expressed ad median and interquartile range (IQR: Q1-Q3), whereas categorical variables are reported as value and frequency (%)

more than five micrometastases. These findings confirm the limited sensitivity of preoperative ultrasound for central nodal disease and are consistent with previous reports showing occult central LNMs in more than 40% of patients with 1–4 cm PTC [21]. Importantly, occult nodal disease is not restricted to larger tumours: Tang et al. [21] reported rates of 32.7% even in tumours ≤ 1 cm. Therefore, the observation that one-third of patients were classified as pT1a at final histology does not undermine the study rationale, as final pT1a classification does not imply absence of occult central compartment nodal metastases. Rather, this finding should be interpreted in light of known discrepancies between preoperative ultrasound-based tumour size and final pathological measurement, particularly around the 10-mm threshold separating T1a from T1b disease.

Regarding the secondary endpoints, ETE, aggressive variants, vascular invasion, and multifocality were documented in 32, 50, 160, and 114 patients, respectively. Previous studies have reported heterogeneous results. Hartl et al. [33] reported ETE, aggressive variants and vascular invasion in 23.4, 6.6 and 29.3% of patients, respectively. Conversely, Bakkar et al. [23] reported rates of ETE, aggressive variants, vascular invasion, and multifocality of 12, 33, 17, and 30%, respectively. Chidambaranathan et al.

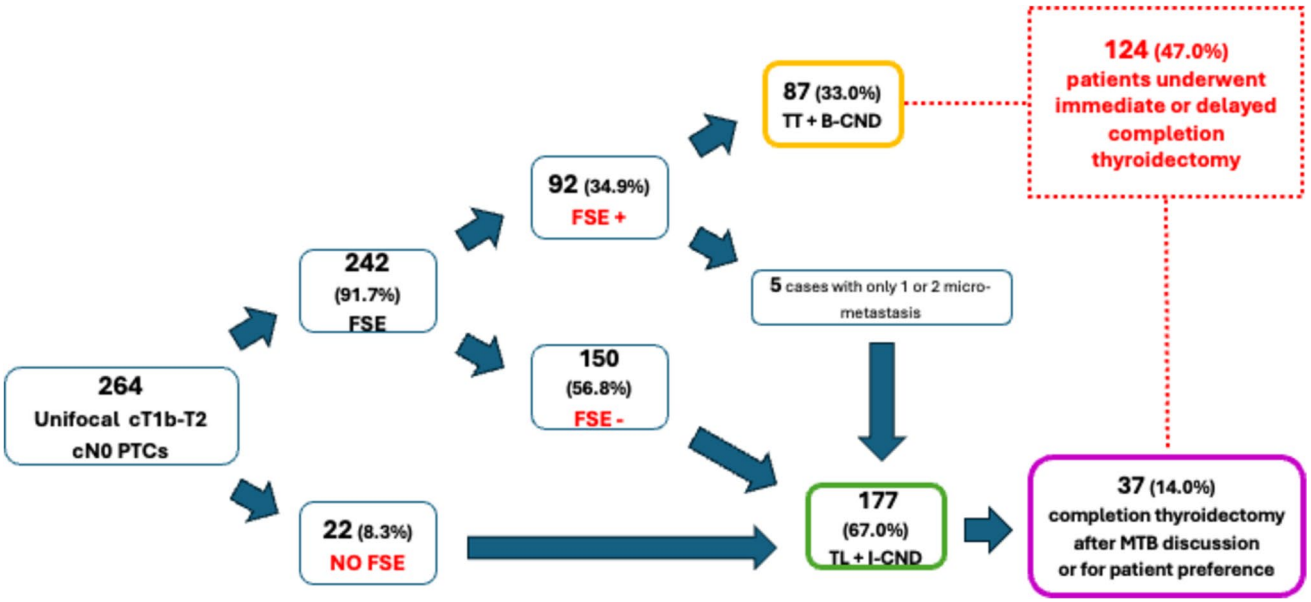


Fig. 1 Patients' diagram: Flowchart of the included/excluded patients for each stage

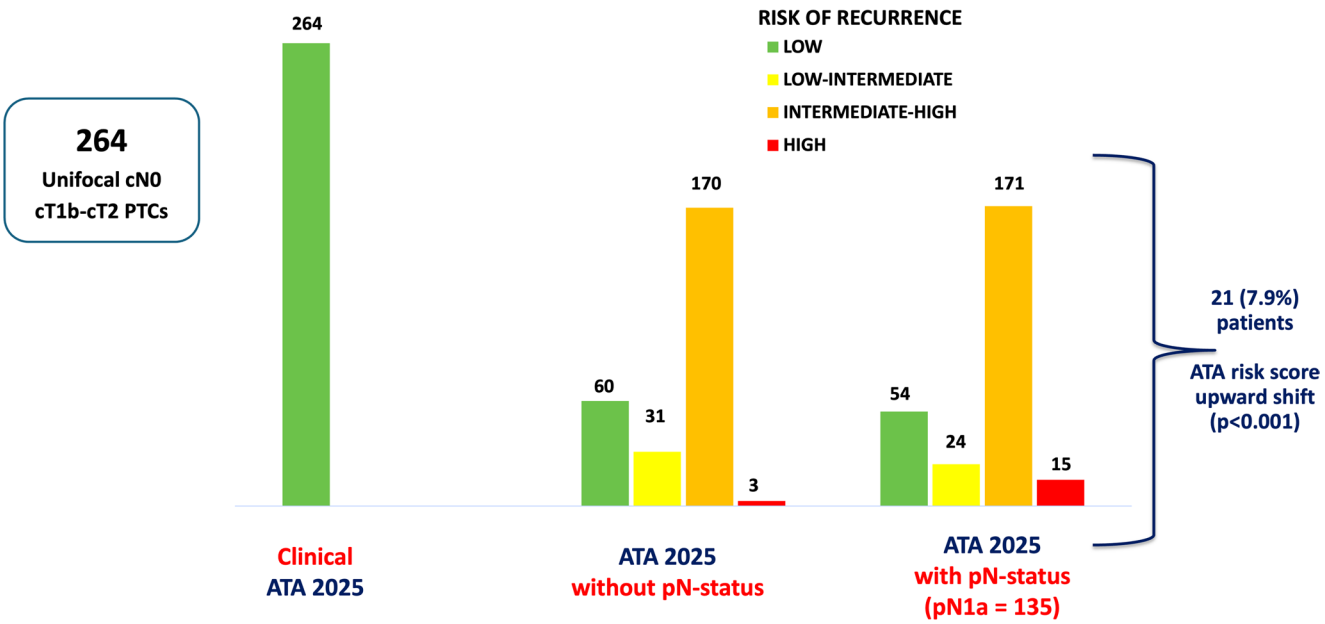


Fig. 2 Comparison of ATA structural recurrence risk categories according to three different levels of assessment: preoperative clinical evaluation, postoperative pathological evaluation without inclusion of pN status, and postoperative pathological evaluation including pN status

[24] performed a comprehensive evaluation of the prognostic impact of ENE on recurrence, reporting LNMs in 859 of 1,428 patients, with ENE identified in 26.8% of cases. Conversely, in our previous study on cN0 cT1a PTC, the reported rates of ETE, aggressive variants, vascular invasion, and multifocality were 1.5, 14.8, 45.8, and 34.0%, respectively [8]. The variability in biological aggressiveness likely reflects the cohort heterogeneity and differences in pathologic assessment.

Historically, ATA guidelines recommended TT for most differentiated thyroid carcinomas >1 cm, whereas TL was considered adequate mainly for unilateral T1a tumours without evidence of metastatic disease [25, 26]. This approach was progressively revised after accumulating evidence suggested comparable oncological outcomes between unilateral and bilateral thyroid resection in selected low-risk patients, together with lower complication rates after TL [27–35]. Accordingly, the 2015 ATA guidelines acknowledged TL as a reasonable alternative to TT in selected unilateral

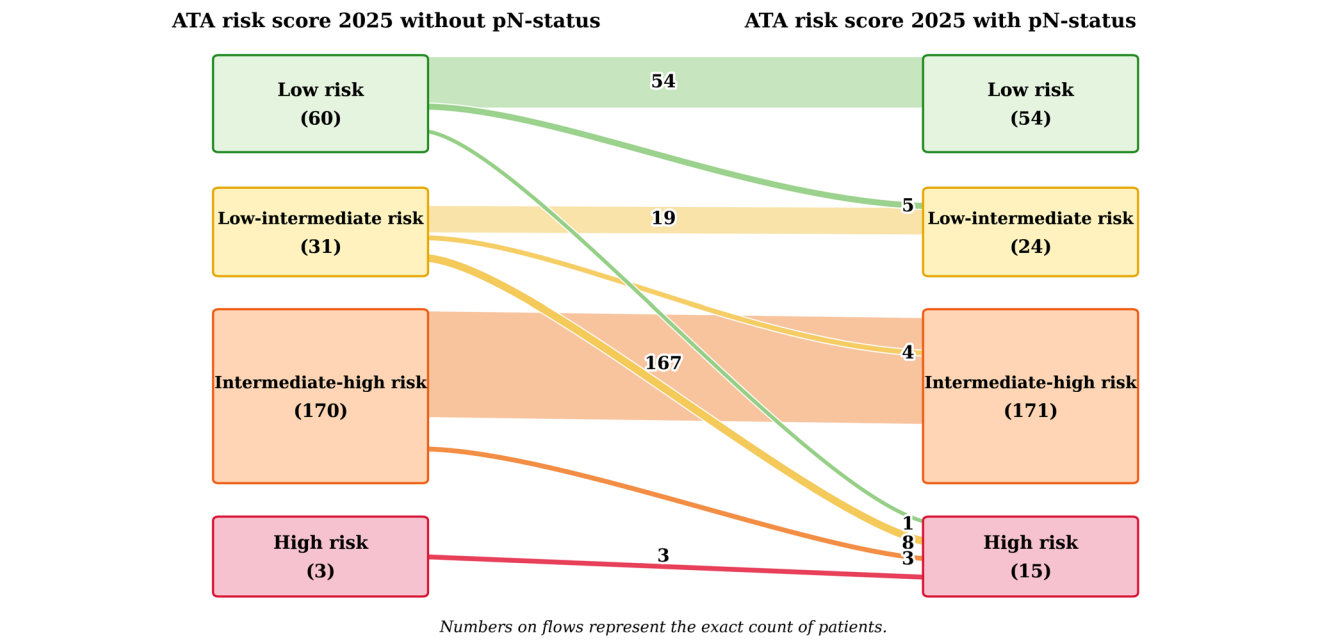


Fig. 3 Sankey diagram of 2025 ATA risk-category changes after incorporation of pathological nodal status

Table 3 Correlation between pathological nodal status (pN) and ATA risk categories (2025 ATA Risk Stratification System)

	Low/low-intermediate	Intermediate-high/high	*p*-value	OR
pN0	61 (47.3%)	68 (52.7%)	$p<0.001$	6.227 (3.367–11.515), p<0.001
pN1a	17 (12.6%)	118 (87.4%)		

Categorical variables are reported as value and frequency (%), whereas odds ratio (OR) is expressed as value and corresponding 95% confidence intervals

cT1b–T2N0M0 PTC, and the 2025 ATA guidelines further support TL as the preferred initial procedure for many low-risk tumours in the absence of bilateral disease or other indications for TT [1, 3]. This de-escalation strategy, however, relies on accurate postoperative risk stratification. Patients undergoing TL should therefore be counselled regarding the potential need for intraoperative conversion to TT or subsequent CT if higher-risk pathological features are identified.

Moreover, a comparison in terms of structural recurrence risk stratification between the 2015 ATA guidelines [1] and the 2025 update [3] highlights the introduction of several features related to lymph nodes, including the size and number of metastases and ENE presence. These modifications further emphasise the prognostic relevance of pN status in determining the risk of structural recurrence. Nevertheless, the role of I-CND remains controversial in the current literature [7, 8]. Although CND is recommended in patients with clinically evident nodal disease, the 2025 ATA guidelines [3] discourage routine prophylactic I-CND while acknowledging a potential role when information on pN-status can influence subsequent treatment [3]. Several studies have reported lower locoregional recurrence rates after prophylactic I-CND, although this potential benefit is associated with higher postoperative morbidity [3]. However, most of the evidence comes from cohorts predominantly treated with TT, while studies focused on patients eligible for TL remain limited [3].

Furthermore, an ATA working group in 2012 concluded that conducting a prospective randomized controlled trial evaluating prophylactic CND in cN0 PTC would have been difficult, mainly due to the large sample size required, given the relatively low rates of locoregional recurrence and the prolonged follow-up needed to adequately assess outcomes [31]. In contrast, the higher recurrence rates can largely be explained by the well-recognised incidence of occult LNMs in these patients. As consistently reported in the literature [7, 8, 12]—and confirmed by our results—occult nodal disease is found in nearly half of patients preoperatively staged as cN0.

During the past decade, the management of thyroid carcinoma has shifted from TT, RAI, and long-term suppressive therapy to a more individualised strategy based on accurate risk stratification. In this context, the 2025 ATA guidelines further refined the structural recurrence risk stratification system by incorporating nodal features, including the number and size of metastases and ENE. Importantly, these recommendations also emphasise that patients initially treated

with TL should be counselled regarding the potential need for intraoperative conversion to TT or subsequent CT if higher-risk pathologic features are identified during surgery or final histopathologic evaluation. As extensively reported in the literature, LNMs represent a major risk factor for recurrence, along with multifocality, tumour size, bilateral disease, and ETE [32].

Since 2014, systematic lymph node assessment has been incorporated into our practice to achieve accurate nodal staging, thereby enabling appropriate stratification of structural recurrence risk and modulation of surgical and therapeutic strategy in patients undergoing TL or TT [7, 8, 11, 12]. This strategy has also been acknowledged in the ATA 2025 guidelines [3]. Within this framework, this multicentre retrospective study evaluated the impact of histologic assessment of pN-status on structural recurrence risk stratification according to the 2025 ATA system in patients with cN0 cT1b–T2 PTC eligible for TL. This scoring system was adopted because it integrates tumour and nodal characteristics. Specifically, the presence of at least one macrometastasis or more than five micrometastases defines a low–intermediate risk category, while the coexistence of both conditions identifies an intermediate–high risk group. Finally, ENE is associated with a high risk of structural recurrence [3].

Our findings indicate that systematic pathological nodal assessment resulted in an ATA 2025 risk-category increase in 21 patients (7.9%). Overall, 186 patients (70.4%) were ultimately classified in higher recurrence-risk categories. Hartl et al. [33] reported a similar rate of risk upgrading, with 8% of cases reclassified after considering the pN status of the I-central compartment and an additional 2% when contralateral nodal status was included. However, their interpretation differed, as they considered this rate insufficient to support routine prophylactic lymph node dissection. Importantly, the therapeutic strategies in the two studies were substantially different. In the study by Hartl et al. [33], all patients underwent TT and 79.5% received RAI. In contrast, in our cohort all patients were initially considered candidates for a less invasive approach (TL), allowing subsequent modulation of treatment according to intraoperative or postoperative risk stratification. Moreover, the risk stratification system retrospectively applied by the authors to evaluate the impact of pN status appears less comprehensive compared to the one adopted in the present study. Nonetheless, other authors have reported that prophylactic I-CND may result in risk upstaging in up to 40% of cases [34]. Improving the accuracy of structural recurrence risk stratification offers clear advantages. First, it allows appropriate identification of patients who may benefit from more extensive treatments, such as CT and RAI. Moreover, as shown by our data (OR = 6.227), the highest recurrence risk categories are those with a significantly greater incidence of LNMs. This is consistent with the well-established association between LNMs and other markers of biological aggressiveness [7, 8, 12]. These observations have important implications for subsequent therapeutic strategy, particularly when I-CND has not been performed during the initial operation. When CND is performed at the time of CT, the procedure becomes technically more demanding and may be associated with higher intra- and postoperative complication rates [7, 8, 12]. Conversely, performing I-CND during the initial surgery allows any reoperation to be limited to a previously unexplored surgical field. Although more extensive surgery has historically been associated with higher complication rates [7, 8], our results are comparable with literature reports [7, 8, 35]. In our series, transient and permanent RLN palsy occurred in 5.4 and 0%, respectively, whereas immediate and permanent hypoparathyroidism occurred in 34.7 and 4.8% of cases, respectively. In a recent meta-analysis, Wang et al. [35] reported complication rates ranging from 0 to 9.8% for transient RLN palsy, 0.4 to 4.0% for permanent RLN palsy, 7.4 to 68.9% for immediate hypoparathyroidism, and 0 to 8.1% for permanent hypoparathyroidism. It should also be emphasized that patients who underwent TT and CND, either in a single stage or as completion surgery, generally presented LNMs; therefore, lymph node dissection was performed with therapeutic intent. Furthermore, improving the accuracy of nodal staging may reduce the risk of persistent disease and recurrence during follow-up. In our series, three confirmed structural loco-regional nodal recurrences were observed, corresponding to approximately 1% of the cohort, consistent with recurrence rates reported in the literature, generally ranging from 0 to 4.4% [35]. Given the limited number of events and median follow-up time, recurrence outcomes should be interpreted cautiously.

To our knowledge, this is the first study assessing the prognostic impact of routine nodal staging in patients with low-risk cN0 cT1b–T2 PTC eligible for TL using the newly introduced 2025 ATA risk score. In addition, all patients included in the present analysis were treated in referral endocrine surgery centres. The main limitations are the retrospective design, the limited sample size, and the long enrolment period. In addition, histopathological assessment was performed at each participating centre by different pathologists, and centralised pathology review was not performed. Therefore, interobserver variability and centre-specific differences in pathological reporting may have influenced the assessment of histopathological features, including microscopic ETE, multifocality, vascular invasion, aggressive histological subtypes, and nodal disease burden. Finally, owing to the limited number of recurrence events and the relatively short and heterogeneous follow-up, the present study was not designed to derive robust

conclusions on disease-free survival. Accordingly, our findings should be interpreted as demonstrating the impact of routine pathological nodal status evaluation on ATA 2025 risk stratification and postoperative decision-making, rather than as direct evidence of improved disease-free survival. Nevertheless, a randomised trial evaluating the role of prophylactic CND in this setting would be difficult to conduct, given the large sample size and prolonged follow-up required to adequately assess recurrence outcomes [31].

In conclusion, the management of unifocal cN0 cT1b–T2 low-risk PTC has progressively evolved towards a more personalised strategy based on accurate structural recurrence risk stratification. In this context, precise evaluation of nodal status is essential, as occult LNMs are present in nearly half of patients and may significantly influence risk stratification and subsequent treatment decisions. Furthermore, performing I-CND during the initial operation may reduce the technical complexity and potential morbidity of completion surgery, as reintervention may be limited to a previously unexplored surgical field.

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Data availability The data presented in this study are available on request from the corresponding author.

Declarations

Conflict of interest Marco Raffaelli has a consultant agreement with Medtronic, AB Medica, and Intuitive Surgical. Priscilla Francesca Procopio, Francesco Pennestrì, Antonio Laurino and Pierpaolo Gallucci have a consultant agreement with Medtronic. Fatih Tunca, Emanuela Traini, Carmela De Crea, Kemal Alagol, Giulia Carnassale, Milena Pia Cerviere, Andrea Corsello, Yalin Iscan, Irem Karatas, Annamaria Martullo, Amelia Mattia, Alfredo Pontecorvi, Francesca Prioli, Maria Pia Ricciato, and Esther Diana Rossi, declare that they have no conflicts of interest.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants for whom identifying information is included in this article.

Research involving human participants and/or animals

This article does not contain any studies with animals performed by any of the authors.

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Authors and Affiliations

Francesco Pennestrì[1,2] · Antonio Laurino[1] · Priscilla Francesca Procopio[1,2] · Fatih Tunca[3] · Emanuela Traini[4] · Carmela De Crea[2,5] · Kemal Alagol[1] · Giulia Carnassale[4] · Milena Pia Cerviere[5] · Andrea Corsello[5] · Pierpaolo Gallucci[1] · Yalin Iscan[3] · Irem Karatas[6] · Annamaria Martullo[1] · Amelia Mattia[4] · Alfredo Pontecorvi[7,8] · Francesca Prioli[1] · Maria Pia Ricciato[4] · Esther Diana Rossi[9,10] · Marco Raffaelli[1,2]

✉ Francesco Pennestrì
francesco.pennestri@policlinicogemelli.it

[1] UOC Chirurgia Endocrina e Metabolica, Fondazione Policlinico Universitario Agostino Gemelli IRCCS, L.Go A. Gemelli 8, 00168 Rome, Italy

[2] Centro di Ricerca in Chirurgia delle Ghiandole Endocrine e dell'Obesità, Università Cattolica del Sacro Cuore, Rome, Italy

[3] Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey

[4] Ospedale San Carlo di Nancy, GMN Care and Research, Rome, Italy

[5] Ospedale Isola Tiberina–Gemelli Isola, Rome, Italy

[6] Istanbul Prof. Dr. Cemil Tascioglu City Hospital, Istanbul, Turkey

[7] UOC Medicina Interna, Endocrinologia e Diabetologia, Fondazione Policlinico Universitario Agostino Gemelli IRCCS, Rome, Italy

[8] Dipartimento di Medicina e Chirurgia Traslazionale, Università Cattolica del Sacro Cuore, Rome, Italy

[9] UOC Anatomia Patologica della Testa e Collo, del Polmone e dell'Apparato Endocrino, Fondazione Policlinico Universitario Agostino Gemelli IRCCS, Rome, Italy

[10] Dipartimento di Scienza della Vita e Sanità Pubblica, Università Cattolica del Sacro Cuore, Rome, Italy