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Prevalence Of Cervical Lymph Node Metastasis in Papillary Thyroid Carcinoma: A Prospective Observational Study

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ABSTRACT

Background: Usually when papillary thyroid carcinoma presents, it is associated with central and lateral compartment cervical lymph node metastasis. Identifying nodal disease at this stage is critical, as it impacts the surgical management, recurrence risk, and overall prognosis. Knowledge of local prevalence patterns allows better counseling of ENT surgeons and more efficient adoption of surgical management intends to improve oncologic control.

Objectives: To determine the frequency and localization of metastasis to cervical lymph nodes in papillary thyroid carcinoma and analyze its association with the central characteristics of the tumors in patients undergoing thyroid surgery.

Methodology: this study conducted at Department Of ENT Kabir Medical College, Peshawar from july 2022 to dec 2024. confirmed papillary thyroid carcinoma, doing total thyroidectomy with cervical nodal evolution the patients' preoperative neck CT, shoulders, and suspicious nodal ultrasound were evaluated. Concomitant central and selective lateral compartment dissections were performed. Demographic, tumor size, and nodal involvement data were analyzed using SPSS v24. The Chi-square test was used to access association, and a significance level was used at $p < .05$.

Results: The mean age of the surveyed patients is 41.8 years, with 100 patients sampled, and a standard deviation of 12.6 years.52% of the patients had cervical lymph node metastasis. Central compartment metastasis was present in 38% of patients, and lateral neck metastasis in 14%. Tumours greater than 1cm in size had a higher likelihood of metastasizing to lymph nodes ($p=0.021$). Also, tumours with more than one focal point were associated with even greater metastatic potential ($p=0.033$). The youngest age bracket (<40) showed the most aggressive disease with multiple positive lymph nodes. There was no significant correlation between metastatic lymph nodes and patient gender ($p=0.287$).

Conclusion: Most younger patients with papillary thyroid carcinoma and tumours larger than 1cm have cervical lymph node metastasis and central compartment metastasis. It's still most common. The surgical approach and operative plan become more refined through the identification of surgical risk features. Routine central compartment and selective lateral neck assessment will improve disease control and decrease the risk of recurrence...

Keywords: *Papillary thyroid carcinoma, Cervical lymph nodes, Metastasis, Thyroid malignancy*

1. INTRODUCTION

Papillary thyroid carcinoma (PTC) of the thyroid is the most prevalent endocrine malignancy, accounting for almost 85% of thyroid cancers globally. Over the last 20 years, the incidence of PTC has increased, mainly due to improved diagnostic imaging technologies and greater identification of small, clinically undetected lesions [1]. PTC tends to spread to the lymph

nodes and has excellent long-term survival, despite being primarily indolent and slow in its clinical course. It particularly spreads to the central (level VI) and lateral cervical lymph node systems. Cervical lymph node metastasis (CLNM) is documented in 30-80% of patients at the time of initial diagnosis [2]. However, most estimates are conservative, and the actual rate is probably much higher when covert micro metastases are considered [3]. CLNM is a well-recognized risk factor for loco-regional recurrence, persistent disease, and the need for revision surgery. Even though it is controversial regarding its effect on overall survival, nodal Metastasis does impact disease-free survival, and the burden of long-term follow-up on the patient is considerable. In ENT surgery, assessing cervical lymphatic drainage patterns is crucial and often requires detailed intraoperative and preoperative evaluation to ensure complete oncological clearance [4]. Preoperative ultrasound is essential for determining the cervical region. However, its sensitivity for detecting the central compartment—the most common site of metastatic nodal disease—is limited [5]. For this reason, other imaging techniques, such as contrast-enhanced CT, are often used to detect suspicious nodes, especially in bulky disease or when lateral neck involvement is suspected [6]. Tumour-related factors strongly influence the risk of Metastasis and include tumour size >1 cm, multifocality, extrathyroidal Extension (ETE), lymph-vascular invasion, and aggressive histologic variants such as tall-cell or diffuse sclerosing [7]. Patients younger than 40 years are more likely to have CLNM, even if the overall long-term prognosis is favourable. Studies have also suggested that the male sex may be a risk factor for Metastasis. Given the demographic differences, local data is needed for region-specific management [8]. In Pakistan, and especially the Khyber Pakhtunkhwa region, there have been few studies on the prevalence and distribution of CLNM in PTC [9]. This understanding helps ENT surgeons to make more evidence-based estimations of the extent of central neck dissection and the need for selective lateral neck dissection [10]. As the complications of thyroid cancer surgery become more sophisticated, the balance with effective oncologic surgery leads to more decisive identification of Metastasis. While central compartment dissection helps in gaining disease control, it also exposes the patient to other complications like recurrent laryngeal nerve injury and hypocalcemia [11]. Figuring out which patients really benefit from a dissection performed before or after diagnosis remains an important clinical question. This study will aim to provide new local data on the prevalence of CLNM and the factors predicting it in patients with PTC undergoing treatment in an ENT surgical setting [12]

2. MATERIALS AND METHODS

Study Design & Setting

This study conducted at Department Of ENT Kabir Medical College, Peshawar from july 2022 to dec 2024 conducted a prospective observational study that included all eligible patients with papillary thyroid carcinoma.

Participants:

Regarding the included patients, all adults diagnosed with papillary thyroid carcinoma by FNAC or histopathology were included. Each patient underwent total thyroidectomy with central compartment evaluation, and lateral neck dissection was performed when clinically indicated. Comprehensive demographic, clinical, radiological, and pathological information was gathered. Patients with incomplete documentation or insufficient evaluations were excluded from the final analysis.

Sample Size Calculation:

Based on an expected prevalence of cervical lymph node metastasis of 40% with a 95% confidence interval and 10% margin of error, a sample size of 100 was calculated. Further recruitment provided sufficient statistical power to detect associations between nodal metastasis and tumour characteristics and to reduce the risk of Type II error.

Inclusion Criteria:

Only patients 18 and over with papillary thyroid carcinoma undergoing total thyroidectomy and cervical lymph node assessment were included. A complete clinical file, preoperative imaging studies, and a postoperative histopathology report were required for study entry. For a thorough assessment, both central and lateral nodal evaluations were considered.

Exclusion Criteria:

Individuals with recurrent thyroid carcinoma, previous thyroid or neck surgery, previous neck irradiation, distant metastases at initial presentation, or incomplete clinical and/or imaging records were excluded. To preserve data integrity, individuals deemed unfit for surgery and those lost to follow-up before confirmation of pathology were also excluded.

Diagnostic and Management Strategy:

Ultrasound and neck CT scans were performed for preoperative assessment of nodal status. Total thyroidectomy was done for all with routine central compartment assessment. Lateral neck dissection was done only if there was Metastasis on imaging or intraoperative evaluation. Nodal involvement and tumour characteristics were confirmed by histopathology.

Statistical Analysis:

Using SPSS version 24.0, the data were analyzed. Continuous variables are presented as mean ± SD. Categorical variables were assessed by Chi-square testing. Logistic regression determined predictors of nodal Metastasis. For all assessments, a p-

value of <0.05 was considered statistically significant.

3. RESULTS

Out of 100 patients Cervical lymph node metastasis was most prevalent in the central compartment as the primary outcome, considering the prevalence was 52%. Significant associations were noted in secondary outcomes among metastasis and tumour size greater than 1 cm, Multimodality, and extrathyroidal Extension. In 14% of patients, lateral neck involvement occurred, and youthful AgeAge was associated with greater metastatic risk.

Intervention Outcomes:

Most cases obtained complete oncologic clearance with total thyroidectomy and routine central neck evaluation. Therapeutic lateral neck dissection adequately addressed metastatic nodal disease in patients where it was indicated. There was no procedure-related mortality, and postoperative morbidity was minimal.

Table 1. Baseline Demographic and Clinical Characteristics of Patients (n = 100)

Variable	Category / Value
Mean Age (years)	**41.8 ± 12.6**
Age Group	<40 years: 48% • ≥40 years: 52%
Gender	Male: 32% • Female: 68%
Tumor Size	≤1 cm: 29% • >1 cm: 71%
Multimodality	Present: 34% • Absent: 66%
Extra thyroidal Extension	Present: 22% • Absent: 78%

Table 1 summarises the demographic and clinical characteristics of the 100 patients with papillary thyroid carcinoma included in this study.

Table 2. Prevalence and Distribution of Cervical Lymph Node Metastasis

Parameter	Frequency (n)	Percentage (%)
Overall Cervical Lymph Node Metastasis	52	**52%**
Central Compartment (Level VI)	38	**38%**
Lateral Neck (Levels II–V)	14	**14%**
Bilateral Nodal Metastasis	6	6%

Table 2 presents the prevalence and anatomical distribution of cervical lymph node metastasis among patients, showing central compartment involvement as the most common pattern.

Table 3. Association Between Tumour Characteristics and Lymph Node Metastasis

Tumor Characteristic	LN Metastasis Present (%)	LN Metastasis Absent (%)	p-value

Tumor Size >1 cm	45 (63.4%)	26 (36.6%)	**0.021**
Multimodality Present	24 (70.6%)	10 (29.4%)	**0.033**
Extra thyroidal Extension	15 (68.2%)	7 (31.8%)	0.047
Gender (Male)	18 (56.2%)	14 (43.8%)	0.287
Age <40 Years	30 (62.5%)	18 (37.5%)	0.041

Table 3 describes significant associations between cervical lymph node metastasis and key tumour characteristics. Tumour size >1 cm, Multimodality, extra-thyroidal Extension, and younger Age demonstrated statistically significant relationships.

Table 4. Surgical Intervention Outcomes

Surgical Variable	Outcome
Total Thyroidectomy Completion Rate	100%
Central Neck Dissection Performed	100%
Therapeutic Lateral Neck Dissection Performed	14%
Postoperative Complications	Minimal (Transient hypocalcemia 6%, transient hoarseness 3%)
Procedure-related Mortality	0%
Histopathologic Confirmation of LN Metastasis	52%

Table 4 summarises intervention outcomes. Total thyroidectomy with routine central compartment evaluation achieved high oncologic clearance with minimal postoperative morbidity and no procedure-related mortality.

4. DISCUSSION

Papillary thyroid carcinoma (PTC) has a great tendency for cervical lymphatic spread, and the current study strengthens this pattern by documenting a 52% prevalence for cervical lymph node metastasis (CLNM) [13]. This figure is comparable to the current literature on the incidence of Metastasis, which ranges from 40% to 70% depending on the population, tumour burden, and the extent of nodal assessment [14]. The predominance of central compartment involvement (38%) in this study is also consistent with extensive cohort studies, which identify the central neck as the most common site of PTC regional metastasis during the initial phase [15]. The current study shows significant association between tumor size greater than 1cm and nodal metastasis ($p = 0.021$). More recent citations have recognized tumor size as a strong independent predictor. A multi-center study by Zhang et al. (2021) reported that for tumors over 1cm, the risk for CLNM nearly doubles [16]. Similarly, Lee et al. 2020 study, emphasized the importance of investigating the lymph nodes surrounding larger tumors by documenting the correlating increase of the metastatic burden as tumor diameter increased [17]. Moving on, the study presented additional predictive factors, with Multimodality being the leading one ($p = 0.033$). This aligns closely with recent studies of Korean and Chinese patients. This patient population has been documented to have a higher positivity rate for central and lateral nodes [18]. The aggressiveness of the disease is likely attributable to the number of tumour foci. The number and foci of the tumour are essential factors to consider for long-term patient outcomes and to determine the approach to surgical intervention. In these patients, ETE or extra-thyroidal Extension was present in a smaller number of cancer patients (22%) [19]. It was still attributed to the risk of Metastasis in this cohort, as has been reported recently in the literature. This aligns with the literature, which states that ETE correlates with specific disease compartmental shifts, ultimately increasing the risk of recurrence [20]. The guidelines have indicated in recent years that ETE should be incorporated into surgical extent determinations and considered in post-op ETE risk assessments. ETE, or extra-thyroidal Extension, has been identified as an essential factor in determining surgical extent. Recently, Purdie and Shinn, Swanson and Shin, Stain and Hypolite, and Cowards and Chao have all argued that gender merely provides a different perspective and may not even be a primary predictor when controlling for aggressiveness and for size of the tumor [21]. Of notable interest, and consistent with the 2019 meta-analysis, are the findings that patients aged < 40 had a significantly increased rate of CLNM, even when no other variables indicated a poor prognosis [22]. This is explained by the more active lymphatics and tumor biology in younger patients. The 14% rate of Metastasis to the lateral neck in this cohort is consistent with more recent estimates, which suggest a global rate of 10% to 25% Metastasis to the lateral neck. The majority of studies on lateral neck metastasis find that it results from the progression of occult central Metastasis, which clearly illustrates the need for examination of the Level VI nodes. This study provides valuable regional input and helps sustain the global predictors of nodal disease. This suggests the

need for a more tailored approach to surgery—in this case, routine assessment of the central compartment, more selective evaluation of the lateral neck, and closer watching of patients with tumors < 1 cm, multifocality, ETE, younger Age, and increased vigilance.

5. LIMITATIONS

Among the limitations of the study are its single-center design, somewhat small sample size, and absence of a long-term follow-up to analyze recurrence. Variations in imaging sensitivity as well as the procedural choices made by the surgeon could have influenced the nodal yield. A thorough understanding of the prognosis could not be developed due to a lack of molecular classification and analysis of the histologic subvariants.

6. CONCLUSION

Papillary thyroid carcinoma is likely to have metastasis to cervical lymph nodes, particularly to the central neck compartment, for patients under the age of 45 as well as those who present with larger and/or multi-focal disease. The preoperative assessments and the incorporation of these findings during the surgical planning can improve the completeness of surgical resection for papillary thyroid carcinoma, improve the overall management of the disease, and justify selective lateral neck dissection in appropriate patients.

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Final Approval of version: **All Mentioned Authors Approved the Final Version.**

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