ORIGINAL ARTICLE

Frequency and Histopathological Spectrum of Thyroid Carcinoma in Solitary Thyroid Nodules: A Cross-Sectional Study

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Abstract

Background: Thyroid gland malignancy is the most common endocrine malignancy in the world. However, the available population-based statistics related to frequency and histopathological spectrum are limited.

Objective: To determine the frequency and histopathological type of thyroid carcinoma in patients presenting with a solitary thyroid nodule in a tertiary care hospital.

Methods: A cross-sectional study was conducted from December 2024 to June 2025 after IRB approval. All cases diagnosed with solitary thyroid nodules presenting at the Department of General Surgery, Jinnah Postgraduate Medical Center (JPMC), Karachi, during the assigned dates were included in our study. A structured proforma was designed to collect the data. Data was analyzed by using SPSS version 22.0.

Results: The mean age of the patients was 42.18±5.64 years. Of the 158 participants, the majority were female (62.6%). On histology, 15.8% cases were reported as malignant and 84.1% were benign. The most common malignant lesion on histopathological analysis was papillary carcinoma (64%). Significant statistical associations were found between histopathological findings and the duration of nodule development ($p=0.0047$) and between FNAC and final histopathology ($p<0.001$).

Conclusion: Papillary carcinoma was the most common histopathological type among the cases analyzed. A notable proportion of solitary thyroid nodules was found to be malignant, emphasizing the need for a high index of suspicion when evaluating solitary thyroid nodules.

Keywords: *Thyroid, epidemiology, frequency, malignancy, solitary nodule, biopsy.*

INTRODUCTION

Thyroid gland malignancy is the most common endocrine malignancy in the world [1]. It constitutes about 1% of human neoplasms, 1-5% of all malignancies in females, and less than 2% of all malignancies in males [2, 3]. Female gender, increasing age, exposure to ionizing radiations, and residence in endemic areas for iodine deficiency are some of the key factors contributing to increased risk for development of thyroid carcinoma [4, 5]. Differentiated (includes papillary, follicular, Hurthle cell) and undifferentiated (medullary, anaplastic) thyroid carcinomas are the two main histologic types of thyroid carcinoma [6]. Papillary thyroid carcinoma is responsible for around 90% of all cases of thyroid carcinoma. Other types of thyroid carcinoma, including follicular, medullary, and anaplastic carcinoma, account for 4%, 2%, and <1% of all thyroid carcinoma cases, respectively [7]. Appropriate management and a successful outcome in thyroid disease depend on accurate diagnosis. Standard diagnostic tools for thyroid swelling include neck ultrasound and fine-needle aspiration cytology. However, histopathology remains the gold standard investigation [8, 9].

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According to WHO, the highest incidence of thyroid cancer, *i.e*. 47.6% was reported in the Western Pacific region, despite representing only 25.4% of the world's population. Incidence and mortality of thyroid cancer are expected to increase by up to 67% by 2040. The most significant increase in both incidence and mortality is likely to occur in Africa. Moreover, Southern and Eastern Asia account for 50% burden of thyroid cancer across the globe [10].

The available population-based statistics on thyroid cancer and its risk factors are limited in our population. By documenting the frequency of histopathological characteristics, guidelines for screening and diagnostic protocols can be better tailored, thereby enabling early detection and improving patient outcomes. It will also fill the epidemiological gap in global health data. Hence, the present study was designed to determine the frequency and histopathological characteristics of thyroid carcinoma in patients presenting with a solitary thyroid nodule in a tertiary care hospital.

MATERIALS AND METHODS

A cross-sectional study was conducted at the Department of General Surgery, Jinnah Postgraduate Medical Centre, Karachi, over 7 months following IRB approval (letter No. F.2-81/2024-GENL/142/JPMC). All consenting patients of both genders aged >16 years, clinically and ultrasonographically diagnosed with a

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solitary thyroid nodule who underwent FNAC followed by histopathological examination, were included, irrespective of Bethesda category [11]. Patients with a prior history of thyroid surgery, Graves' disease, or any other benign disorder diagnosed on histopathology were excluded.

The sample size was calculated using the OpenEPI software. Using a 95% confidence interval, a 5% margin of error, and 88.41% prevalence of thyroid carcinoma on histopathology from a previous study [12], the sample size obtained was 158. The consecutive sampling technique was used. A total of 165 patients who presented with solitary thyroid nodules during the study period were initially evaluated. Of these, 7 patients were excluded from the study due to incomplete medical records.

A structured pro forma was prepared following an extensive literature review for data collection. The proforma included questions regarding socio-demographic characteristics, family history of thyroid cancer or any other malignancy, findings of FNAC, US scan, and histopathology. The data was collected *via* face-to-face interviews. However, ultrasound, FNAC, and histopathological findings were obtained from existing medical records.

Data was analyzed using SPSS version 22.0. Descriptive statistics were used to determine the mean and standard deviation for numerical variables. Categorical variables were reported as frequencies and percentages. Chi-square/Fisher's Exact test was used to compare US and FNAC findings with the final histopathology report. A p-value of less than or equal to 0.05 was considered statistically significant.

RESULTS

The mean age of the patients was 42.18±5.64. The majority of patients were females (37.3%). All patients had exposure to X-rays, and around half had a family history of thyroid nodules (**Table 1**).

More than three-fourths of the patients presented with swelling in the front of the neck and a firm thyroid nodule. Around two-thirds were found to have papillary carcinoma on histopathology report (**Table 2**).

The majority of the nodules reported as benign and malignant on FNAC were confirmed as such by histopathology ($p<0.001$). Nodules for duration of less than two years had a higher likelihood of malignancy ($p=0.005$). In contrast, Ultrasonography findings showed no significant association with malignancy ($p=0.894$) (**Table 3**).

Table 1: Summary of socio-demographic characteristics of participants.

Parameter	Mean ± SD or Frequency (%)
Age in years	42.18±5.64
Body mass index in Kg/m^2	25.23±4.75
Gender	
Male	59(37.3)
Female	99(62.6)
Exposure to X-rays	
Yes	158(100)
No	0(0)
Family history of thyroid nodule	
Yes	82(51.8)
No	76(48.10)

Table 2: Summary of clinical features of participants.

Parameter	Frequency (%)
Symptoms	
Swelling in front of the neck	128(81.01)
Palpable cervical lymph node	21(13.2)
Dysphagia	5(3.16)
Dyspnea	2(1.26)
Hoarseness of voice	2(1.26)
Location of nodule	
Right lobe	60(37.9)
Left lobe	50(31.6)
Isthimus	48(30.37)
Consistency of thyroid nodule on examination	
Firm	121(76.6)
Hard	29(17.7)
Cystic	8(5.06)
Type of thyroid carcinoma on histopathology	
Papillary Carcinoma	16(64)
Follicular Carcinoma	6(24)
Medullary Carcinoma	2(8)
Anaplastic Carcinoma	1(4)

DISCUSSION

A solitary thyroid nodule can be detected *via* palpation or imaging [13]. Clinically, it is significant due to its potential to be malignant [14]. Male gender, rapid growth, rigid or fixed nodule, hoarseness of voice, dysphagia, and difficulty breathing are some of the clinical features suspicious for malignancy [15, 16]. In our study, thyroid nodules were most frequently reported in females compared to males. However, malignancy was more common in male patients. The results were consistent with a study by Naz *et al*., which highlighted significant gender-related differences in the burden of disease [17].

Table 3: Comparison between FNAC, duration of thyroid nodule, US findings, and histopathology.

Variables	Groups	Histopathology			p-value
		Benign n (%)	Malignant n (%)	Total n (%)	
FNAC	Benign	123 (95.3)	5 (17.2)	128 (81.1)	<0.001
	Malignant	6 (4.6)	24 (82.7)	30 (18.9)	
Duration of thyroid nodule	<2 years	42 (31.5)	22 (88)	64 (40.5)	0.005
	>2 years	91 (68.4)	3 (12)	94 (59.4)	
Ultrasonography findings	Cystic	15 (11.2)	2 (8)	17 (10.7)	0.894
	Solid	118 (88.7)	23 (92)	141 (89.2)	

Our study reported a significant association between histopathological findings and the duration of nodule development. It is supported by a study conducted by Al Mamun *et al*. [18]. Hence, long-standing stable swellings are most likely benign. However, rapidly growing masses should raise suspicion of a malignant lesion and require urgent evaluation.

In our study, we found that nodules were most commonly located in the right lobe of the thyroid gland. Nodules situated on the isthmus have a higher risk of malignancy, particularly papillary thyroid carcinoma. Their proximity to the trachea also increases the risk of invasion and compressive symptoms, including dyspnea and stridor [19-21].

The most common nodule type in our study was firm, and among the 29 hard nodules, 24 were diagnosed as malignant. The consistency of a thyroid nodule provides a significant clue about its benign or malignant nature. Hard nodules are highly suspicious for malignancy and invasive disease. However, thyroid nodule hardness is an essential indicator of malignancy, but it is not conclusive [22].

Ultrasound is used to establish the physical characteristics of nodular lesions, including size, echogenicity, composition, margins, microcalcifications, shape, vascularity, and extrathyroidal extension [23]. Our study reported no significant association between the ultrasound structure of thyroid nodules and final histopathology ($p>0.05$). Similarly, studies have reported that specific characteristics of thyroid nodules, such as irregular margins, microcalcifications, and a taller-than-wide shape, may not always predict malignancy [24, 25]. In contrast to our study, a study conducted by Al Mamun *et al*. reported a significant association between the type of nodule on ultrasound scan and final histopathology [18].

Our study reported a statistically significant association between FNAC and final histopathology. These findings are in accordance with a survey conducted by Nazmul Haque *et al*. [26]. However, FNAC cannot distinguish follicular adenoma from follicular carcinoma, and histopathology is required after surgery [27].

LIMITATIONS

In our study, the most common malignancy was papillary carcinoma. These findings are consistent with the study by Miranda-Filho *et al*. [28]. Despite its critical role, histopathology has limitations, particularly in differentiating well-differentiated thyroid carcinoma from borderline lesions, which requires adjunctive techniques such as immunohistochemistry and molecular testing [29].

CONCLUSION

In the present study, a notable proportion of solitary thyroid nodules was found to be malignant. There should be a high index of suspicion while evaluating a solitary thyroid nodule, which will help in early diagnosis and proper treatment. However, further comparative studies are recommended to assess the relative risk of malignancy in solitary *versus* multiple thyroid nodules.

ETHICAL APPROVAL

Ethical approval was obtained from the Institutional Review Board of Jinnah Postgraduate Medical Center, Karachi (REF letter No. F.2-81/2024-GENL/142/JPMC Dated: 3 December, 2024). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/ or national research committee and the Helsinki Declaration.

CONSENT FOR PUBLICATION

Written informed consent was taken from the participants.

AVAILABILITY OF DATA

The data set may be acquired from the corresponding author upon a reasonable request.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Declared none.

AUTHORS' CONTRIBUTION

DZ conceived the idea and wrote the manuscript. AK wrote the manuscript and handled statistics. GR handled statistics and manuscript writing. SA performed a critical review and revision. KK did data collection, literature review and study design. FS conducted the literature review and study design.

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