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A Cross-Sectional Study On The Prevalence Of Malignancy In Solitary Thyroid Nodules.

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ABSTRACT

Thyroid nodules are a common clinical finding, with solitary thyroid nodules (STNs) presenting a significant diagnostic challenge due to their malignancy potential. This study aimed to assess the prevalence of malignancy in STNs, evaluate associated risk factors, and correlate clinical, radiological, and histopathological findings. Conducted as a cross-sectional study at Thanjavur Medical College, patients with palpable STNs underwent ultrasonography (USG), fine-needle aspiration cytology (FNAC), and histopathological examination (HPE). The study found a malignancy prevalence of 24%, with papillary carcinoma being the most common subtype. The integration of imaging and cytology demonstrated high diagnostic accuracy, reinforcing the importance of a multidisciplinary approach in thyroid nodule management.

Keywords: Solitary thyroid nodule, malignancy, fine-needle aspiration cytology, histopathology, ultrasound, risk factors, thyroid cancer, thyroidectomy.

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INTRODUCTION

Solitary thyroid nodules (STNs) are defined as distinct, palpable swellings in the thyroid gland, separate from the surrounding parenchyma. They are more common in women and tend to increase with age. Although most STNs are benign, the risk of malignancy ranges from 5–24%, Necessitating thorough evaluation [1]. To enhance malignancy prediction in thyroid nodules and avoid unnecessary fine needle aspiration cytology (FNAC) from the benign nodules, various ultrasonographic systems have been described. American Thyroid Association (ATA) system categorized thyroid nodules based on echostructure, echogenicity, margins, presence or absence of microcalcifications, and shape [2]. It offers a 5-class scoring system with the following anticipated rates of malignancy for each class: 1% for benign class, 3% for very-low suspicion, 5–10% for low suspicion, 10–20% for intermediate suspicion, and >70–90% for high suspicion [3]. The British Thyroid Association (BTA) ultrasonographic classification of thyroid nodules consists of five categories: normal (U1), benign (U2), equivocal/indeterminate (U3), suspicious (U4), and malignant (U5). The following ultrasonographic features are considered predictors of malignancy: eccentric location of the solid portion in partially cystic nodules, non-smooth margins, hypoechogenicity of the solid portion, microcalcification, and taller-than-wide shape. However, the most widely accepted ultrasonographic classification system to evaluate thyroid nodules is Thyroid Imaging Reporting and Data System (TI-RADS). TIRADS 1 to TIRADS 5 are the categories. TIRADS 1 corresponds to a normal thyroid gland, TIRADS 2 to benign nodules, TIRADS 3 to possibly benign nodules, TIRADS 4 to nodules with ultrasound features suggestive of malignancy, and TIRADS 5 to nodules with ultrasound features strongly suggestive of malignancy [4]. Thyroid malignancies, especially papillary and follicular carcinomas, can have serious outcomes if not diagnosed early. Therefore, accurately identifying malignant nodules is critical to optimising patient care [5]. This study investigates the prevalence of malignancy in STNs, correlating clinical, radiological, and histopathological findings to refine diagnostic pathways and guide surgical decision-making.

MATERIALS AND METHODS

This Cross-sectional study Was conducted in the department of general surgery, Thanjavur Medical College, Tamil Nadu, India between August 2023 – December 2024.

Inclusion Criteria: Patients with clinically palpable STNs.

Exclusion Criteria: Patients with multiple nodules, prior thyroid malignancy, or history of neck irradiation.

Demographic and Clinical Data

Patients underwent a thorough clinical evaluation and ultrasound assessment.

Statistical Analysis

Sensitivity, specificity, and predictive values of USG and FNAC were calculated, and chi-square tests were used for associations.

RESULTS

The study included patients aged 20–70 years, with a clear female predominance (3:1 female-to-male ratio). Most patients presented with a painless neck swelling, although a few reported compressive symptoms like dysphagia or voice changes. Histopathological analysis confirmed papillary thyroid carcinoma as the most frequent malignancy, with the follicular variant being the most common subtype. Follicular carcinoma, though less common, was more likely to present with capsular or vascular invasion. Medullary and anaplastic carcinomas were rare but carried a worse prognosis, with anaplastic carcinoma presenting at more advanced stages.

Age and Malignancy Correlation

Older patients (**≥50 years**) demonstrated a significantly higher malignancy risk, with the likelihood of malignancy increasing progressively with age.

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Malignancy Prevalence and Histological Types

Overall Malignancy Rate: 24%

Common Malignancies: Papillary carcinoma (**70%**), follicular carcinoma (**20%**), medullary carcinoma (**6%**), anaplastic carcinoma (**4%**)

Table 1: Patient Demographics and Clinical Characteristics (Pages 49–50) — combines age, sex distribution, and nodule laterality for a holistic overview.

Age Group	Number of Patients (%)	Sex Distribution (F:M)	Nodule Side (L:R)
20–30	12 (16%)	10:2	6:6
31–40	20 (27%)	15:5	11:9
41–50	18 (25%)	14:4	9:9
51–60	15 (21%)	11:4	8:7
61–70	8 (11%)	6:2	4:4

Diagnostic Evaluation

Ultrasound was performed to assess nodule size, echogenicity, and suspicious features. FNAC was conducted for cytological assessment, and post-surgical specimens underwent HPE.

Figure 1: Ultrasound Features of Thyroid Nodules— shows sonographic characteristics linked to malignancy.

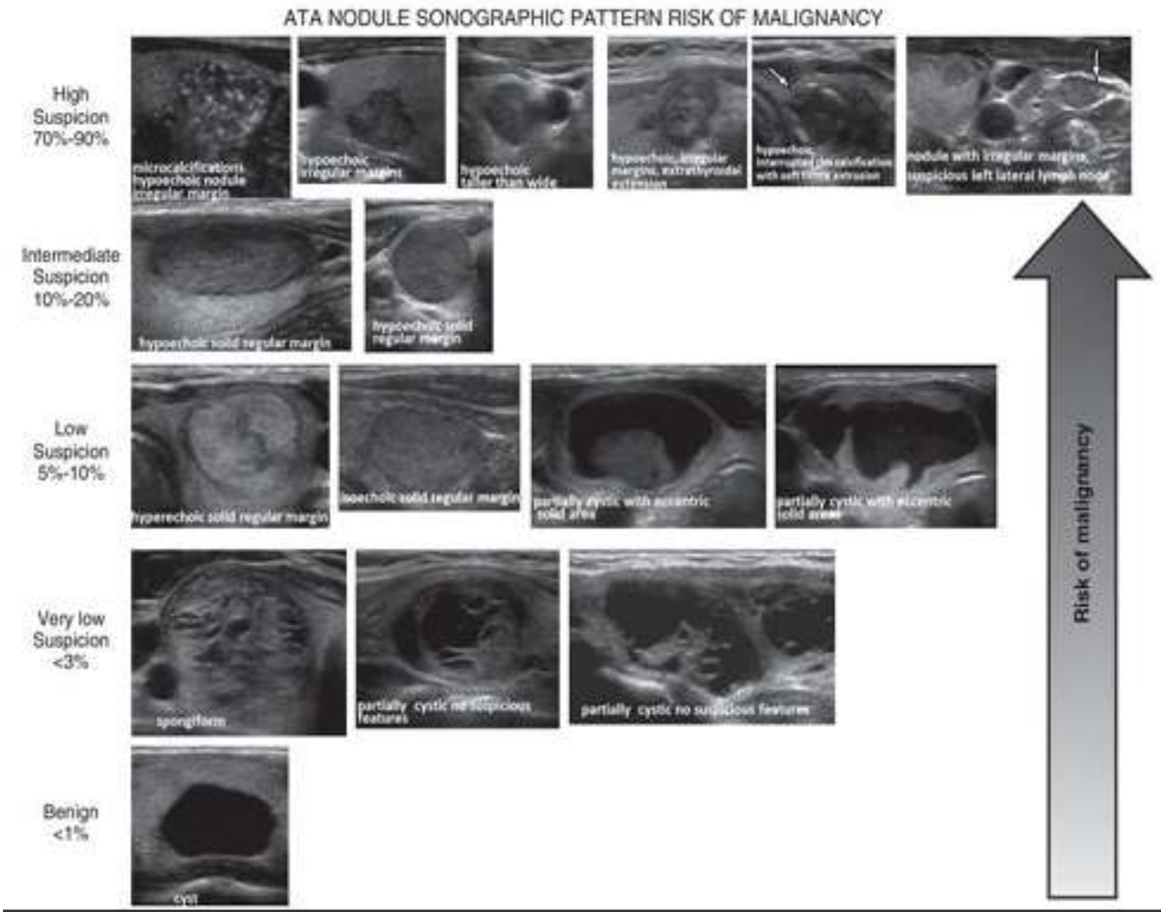
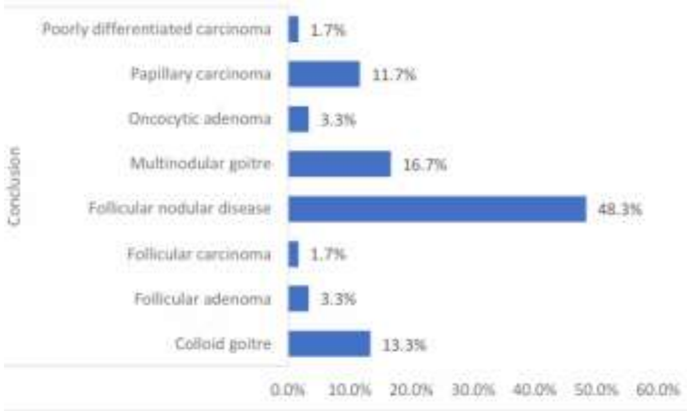


Table 2: Diagnostic and Surgical Data (Pages 51–52) — combines TIRADS, Bethesda, and surgical procedures.

TIRADS Grade	Bethesda Category	Procedure Performed
TIRADS 2	Benign	Observation
TIRADS 3	Atypia of undetermined significance	Hemithyroidectomy
TIRADS 4	Follicular neoplasm	Total thyroidectomy
TIRADS 5	Suspicious for malignancy	Total thyroidectomy + LN dissection

Graph 1: Final Diagnosis on Histopathological Examination (Page 55) — illustrates histological subtypes.



Malignancy Prevalence and Histological Types

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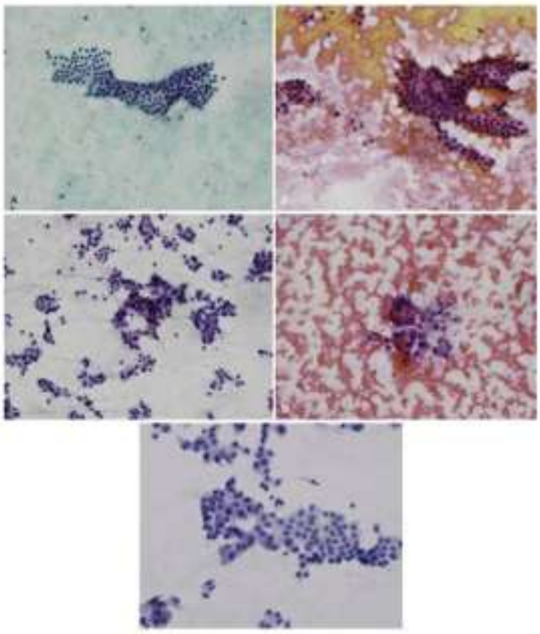
Figure 1: The Bethesda System for Reporting Thyroid Cytopathology (Page 28) — helps visualise FNAC classification.



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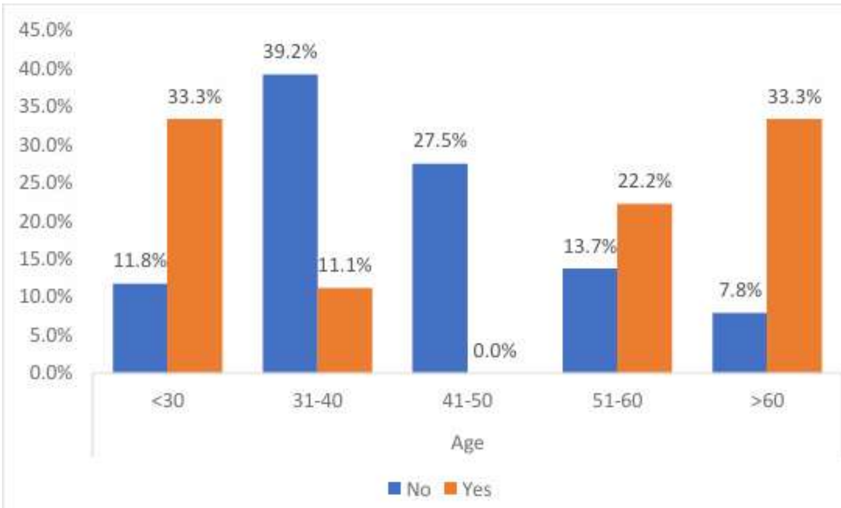
The combination of ultrasound and FNAC provided a robust diagnostic pathway, ensuring that malignant nodules were identified and benign ones were safely observed, reducing unnecessary surgeries.

Graph 2: The correlation between age and malignancy



The correlation between age and malignancy, particularly in patients over 50, suggests that clinicians should maintain a low threshold for biopsy in older patients. The consolidated tables and charts provide a streamlined representation of key findings, making it easier to translate results into clinical practice.

DISCUSSION

The findings of this study align closely with global literature, reinforcing that solitary thyroid nodules carry a significant malignancy risk, particularly in older patients and those with suspicious ultrasound or cytological features [6]. The overall malignancy rate of 24% falls within the expected range, supporting the necessity of a thorough evaluation for every clinically detected Solitary Thyroid Nodule (STN). Histological Spectrum and Age-Related Risk. Both solitary thyroid nodules (STN) and multinodular goiter (MNG) usually present with a single nodule on palpation because the dominant nodule in MNG obscures the detection of other smaller nodules [7]. A more substantial problem, however, arises when the results of cytological evaluation are indeterminate, and physicians are left withsurgery as the only option to definitively diagnose any malignancy [8]. However, given that surgical evaluation for all cases of indeterminate thyroid nodules is neither clinically possible nor recommended, it is imperative to establish variables such as nodularity as risk factors for malignancy in order to better clinically assess individual patient risk for cancer .It has been estimated that if surgery is performed for all indeterminate cases of FNAC, thyroid cancer will be found in only 10–40% of the cases making the rest of the surgeries needless and futile. It is therefore essential to preemptively predict the risk of carcinoma in patients based on their clinical characteristics and examination findings, particularly nodularity [9]. This will help formulate standard guidelines that can aid clinical decision making and management.[10]Our analysis corroborated the previously held view that single thyroid nodules are associated with a higher risk of thyroid carcinoma than multinodular goiter and hence can be considered an independent risk factor to be used for carcinoma risk stratification.[11] The purpose of thyroid nodule evaluation, therefore, is to identify both, nodules that may potentially be malignant and toxic nodules which are known to carry a lower risk of malignancy,[12]Such risk stratification allows to avoid histological evaluation, which is both needless and invasive, in cases of indeterminate thyroid nodules.The predominance of papillary carcinoma (70%) is consistent with global patterns, but the rising incidence of malignancy with age is a crucial finding [13]. Patients above 50 years had a markedly higher risk, with more aggressive histological subtypes like follicular carcinoma with vascular invasion and anaplastic carcinoma occurring predominantly in this age group. The presence of medullary carcinoma in 6% of cases also underscores the importance of calcitonin screening in select patients, especially those with a family history of thyroid malignancy or multiple endocrine neoplasia syndromes [14]. The study highlights the need for a nuanced approach to thyroid nodule management. Younger patients with low-risk nodules may benefit from active surveillance, whereas older patients or those with suspicious ultrasound features warrant early surgical intervention [15]. The findings also emphasise the need for intraoperative frozen section analysis in indeterminate cases, ensuring immediate, appropriate surgical decisions. Ultrasonography proved invaluable for initial risk stratification, with high sensitivity in detecting malignant features like microcalcifications, hypoechogenicity, and irregular margins. However, the limited specificity of ultrasound highlights the indispensable role of FNAC, which had a sensitivity of 90% and specificity of 95% in this study.[16]

CONCLUSION

This study reveals a 24% malignancy rate in solitary thyroid nodules, with papillary carcinoma as the most common subtype. Malignancy risk rises sharply in patients over 50 years of age, especially for aggressive variants like follicular carcinoma with vascular invasion and anaplastic carcinoma. The combination of ultrasonography (USG) and fine-needle aspiration cytology (FNAC) showed high diagnostic accuracy, reducing unnecessary surgeries and guiding precise treatment protocol. Histopathological examination (HPE) validated FNAC findings, confirming the critical role of pathology in diagnosis. The research underscores the need for a multidisciplinary approach and suggests future advancements, like molecular markers and artificial intelligence (AI), could refine risk stratification and improve patient care. Larger studies with long-term follow-ups will be vital for strengthening diagnostic algorithms and optimising outcomes.

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