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Original Article

"A clinical cross-sectional study on thyroid goitre: correlation of high-resolution ultrasonography and fine needle aspiration cytology with histopathological examination."

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Abstract

Background:

High-resolution ultrasonography (USG) detects nodules in 19–67% of cases, with higher prevalence in women and older adults. To evaluate the clinical, pathological, and demographic characteristics of patients with thyroid goitre and to assess the correlation between clinical findings, imaging, and histopathological outcomes.

Material and methods:

This descriptive cross-sectional study was conducted from 2022 to 2024 in the Departments of General Surgery, Pathology, and Radiology, South Central Railway Hospital, Lalaguda. All consenting patients presenting with thyroid goitre were included until the target sample size of 60 was reached. Each underwent clinical evaluation, ultrasonography, fine needle aspiration cytology (FNAC), and histopathological examination.

Results:

Most participants (41.7%) were aged 40–50 years, 30% were above 50 years, and 6.7% were under 30 years. Females predominated (83.3%). An insidious onset was reported in 90% of cases. Clinically, 41.7% were asymptomatic, while difficulty in swallowing (16.7%) was the most frequent symptom, followed by palpitations (10%), weight loss (8.3%), pain (6.7%), constipation (6.7%), weight gain (5%), and voice change (5%). Thyroid swellings most frequently measured 6×4 cm (21.7%) and 4×5 cm (20%). Morphologically, 83.3% of the specimens showed a butterfly shape. TIRADS imaging classified 38.3% as TIRADS 2, 21.7% as TIRADS 3, 20.0% as TIRADS 5, 18.3% as TIRADS 4, and 1.7% as TIRADS 1. FNAC revealed 56.7% as Bethesda 2 (benign), while 33.3% showed suspicious or malignant cytology.

Conclusion:

This study underscores the importance of combining imaging and cytological evaluation for accurate diagnosis of thyroid nodules. Correlation of TIRADS, FNAC, and histopathology improves diagnostic precision, guiding timely clinical management and enhancing patient outcomes.

Recommendations:

Wider application of standardized USG-based TIRADS reporting and Bethesda cytological classification should be encouraged to reduce unnecessary surgeries. Early evaluation of thyroid swellings, particularly in high-risk groups such as women over 40, is recommended.

Keywords: Thyroid gland, Goitre, thyroid-stimulating hormone (TSH), Thyroid Imaging Reporting and Data System, Fine Needle Aspiration Cytology, Histopathology.

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Introduction

Goitre remains a significant health concern, affecting more than 40 million people in India and over 2 billion individuals worldwide. High-resolution ultrasonography (USG) can detect thyroid nodules in approximately 19–67% of cases, with higher prevalence reported in women and elderly populations. Although thyroid cancer is relatively uncommon, occurring in around 5% of nodules, accurate diagnosis is essential to ensure appropriate management and avoid unnecessary surgical procedures. Most thyroid swellings are benign; however, a small but important proportion may be malignant, with an estimated 1,200 deaths attributed to thyroid cancer annually in India [1].

The pathogenesis of thyroid nodules varies with the underlying disease process. Benign macrofollicular nodules are the most common and may represent monoclonal adenomas or colloid nodules in multinodular goitre. Multinodular goitre results from the proliferation of relatively monoclonal cells arranged in nodular patterns. Thyroid hormone secretion is regulated by thyroid-stimulating hormone (TSH), which is controlled by thyrotropin-releasing hormone (TRH). A fall in circulating T3 and T4 stimulates the pituitary to release TSH, causing follicular cell hyperplasia and hypertrophy, with enhanced iodine uptake and hormone synthesis. Uneven hyperplasia, together with involution, fibrosis, and degenerative changes, eventually produces nodularity [2].

Most patients with thyroid nodules remain asymptomatic. When symptoms do appear, they commonly include globus sensation, dysphagia, odynophagia, dyspnea, voice change, choking, or pain. Symptom occurrence often relates to nodule size and location; for instance, nodules larger than 3 cm or those in the isthmus are more likely to produce a globus sensation, while posteriorly extending left-lobe nodules frequently cause dysphagia by compressing the cervical esophagus. On clinical examination, palpable or visible swellings may be identified, although small, posterior, or soft nodules often go unnoticed [3]. USG is a safe, sensitive, and inexpensive diagnostic tool that aids in the detection of nodules, characterization of their features, and differentiation of benign from malignant lesions.

The present study, conducted at South Central Railway Hospital, Lalaguda, was undertaken to assess the clinical, demographic, and pathological profile of patients with thyroid goitre and to analyze the correlation between ultrasonographic findings, fine-needle aspiration cytology (FNAC), and histopathological outcomes.

Material and methods

Study design

This descriptive cross-sectional study

Study setting

South Central Railway Central Hospital, Lalaguda, is a 300-bed tertiary care hospital located in Secunderabad, Telangana, under the administration of South Central Railway. Established in 1927 and expanded after 1966, it provides comprehensive services in medicine, surgery, obstetrics and gynecology, pediatrics, orthopedics, ENT, ophthalmology, pathology, and radiology, along with ICUs, dialysis, and emergency care. Equipped with advanced diagnostic facilities such as high-resolution ultrasonography, cytology, and histopathology, the hospital caters primarily to railway employees and their families, while also serving the general population in the region.

Study duration

was carried out over two years, from 2022 to 2024.

Sample size

Using the single proportion formula with a prevalence of 9.8% (as per N Knudsen et al), 95% confidence level, and 8% absolute precision, the minimum required sample size was calculated as 53. To enhance reliability and account for possible non-responses, a total of 60 participants were enrolled in the study.”

Inclusion criteria

- Patients presenting to the General Surgery outpatient department or admitted to surgical wards with clinically diagnosed thyroid enlargement (goitre).
- Individuals of all ages and both sexes.

Exclusion criteria

- Patients with recurrent goitre or a history of prior thyroid surgery.
- Individuals with previous head and neck radiotherapy.
- Patients receiving medications affecting thyroid function (e.g., amiodarone, lithium).
- Pregnant or lactating women.
- Patients with severe comorbid illnesses or systemic conditions that could interfere with surgical management or follow-up.



- Individuals unwilling or unable to provide informed consent.

Efforts to address bias:

Page | 3 Consecutive eligible patients were enrolled to minimize selection bias. Standardized proformas were used for data collection. Ultrasonography and FNAC were performed by experienced specialists, while histopathology served as the diagnostic gold standard. Radiologists and pathologists were blinded to each other's findings to reduce observer bias.

Data collection

Data collection was carried out using a structured proforma to ensure uniformity and minimize observer variation. For each participant, demographic details, clinical history, and relevant medical or family history were recorded. A detailed clinical examination of the neck was performed to assess the site, size, shape, consistency, surface, mobility, and tenderness of the thyroid swelling, along with associated symptoms such as dysphagia, dyspnea, hoarseness, or pain. Thyroid function tests (T3, T4, and TSH) were undertaken to determine hormonal status. All patients underwent high-resolution ultrasonography (HRUSG) of the neck, performed by experienced radiologists, to evaluate gland size, echotexture, margins, vascularity, nodules, calcifications, and to classify findings using the Thyroid Imaging Reporting and Data System (TIRADS). Fine Needle Aspiration Cytology (FNAC) was then performed under aseptic precautions using a 23–25 gauge needle, with smears prepared and stained using standard methods and reported as per the Bethesda System for Reporting Thyroid Cytopathology. Patients who underwent thyroidectomy had excised specimens preserved in formalin and processed in the Department of Pathology for histopathological examination (HPE), which served as the gold standard for

diagnosis. All clinical, radiological, cytological, and histopathological findings were systematically documented and entered into a master database. Finally, a comparative and correlative analysis was conducted to evaluate the diagnostic accuracy, sensitivity, specificity, and predictive values of HRUSG and FNAC in relation to HPE, thereby identifying concordance and discordance patterns among the three modalities.

Statistical analysis

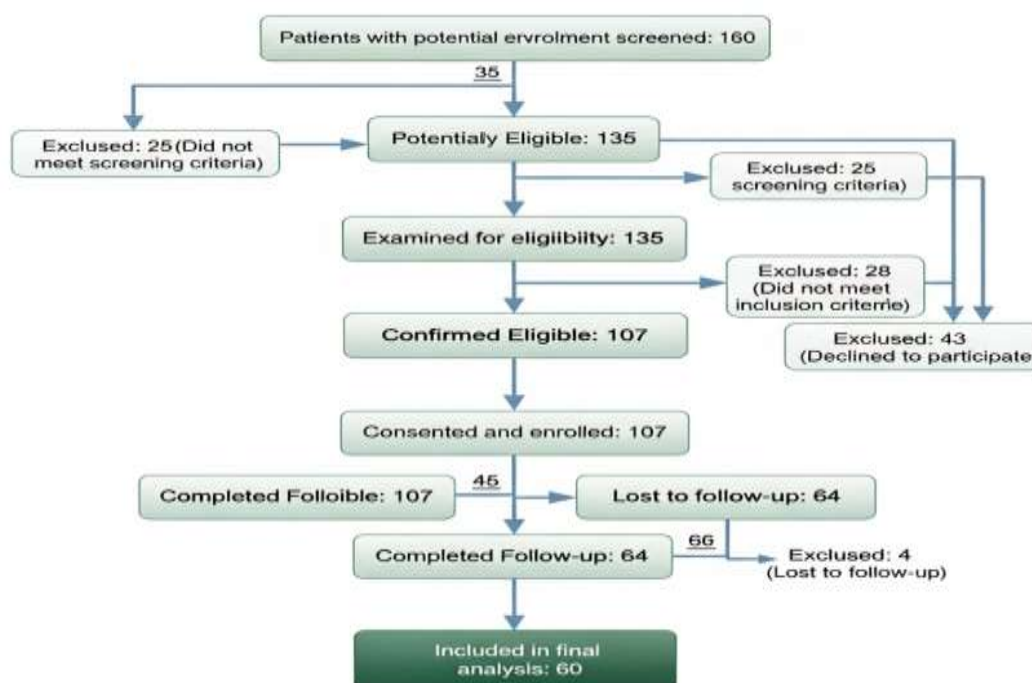
Data were entered in Microsoft Excel and analyzed using SPSS version XX. Descriptive statistics were applied, with continuous variables expressed as mean \pm SD and categorical variables as frequencies and percentages. The diagnostic performance of HRUSG and FNAC was assessed against histopathology (gold standard) by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy. Associations between categorical variables were tested using Chi-square or Fisher's exact test, while continuous variables were compared using Student's t-test or ANOVA as appropriate. A p-value <0.05 was considered statistically significant.

Ethical considerations

The study was reviewed and approved by the Institutional Ethics Committee of South Central Railway Central Hospital, Lalaguda, Secunderabad. All procedures were conducted in accordance with the ethical standards of the Declaration of Helsinki and relevant national guidelines. Before enrollment, written informed consent was obtained from all participants after explaining the nature, purpose, potential risks, and benefits of the study in their preferred language. Patient confidentiality and anonymity were maintained throughout the research process, with data used solely for academic and clinical purposes.

Results

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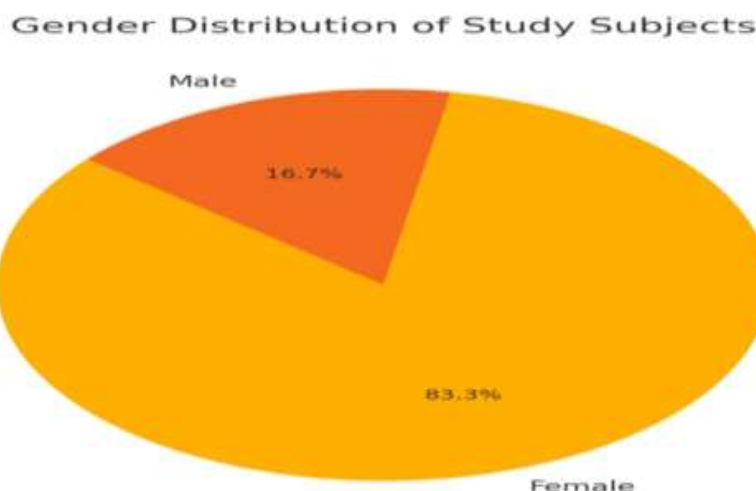
The highest percentage, accounting for 41.7% of the study population, was in the age group of 40-50 years. Additionally, 30% of the study subjects were aged above 50, while only 6.7% fell below 30 years.

Table 1: distribution of the study population as per age

Age (in years)	Frequency	Percent
< 30	4	6.7
30-40	13	21.7
40-50	25	41.7
> 50	18	30.0
Total	60	100.0

Among the 60 study participants, 83.33 of % study subjects were female, whereas the remaining 16.67% of % study subjects were male.

Fig 1: distribution of study subjects by gender



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Out of the 60 participants in the study, approximately 90% experienced an insidious onset, while the remaining 10% of the study subjects had an acute onset. Among the 60 study participants, it was observed that the highest percentage, 41.7 % of the patients, were asymptomatic, and the highest percentage, in symptoms at 16.7%, experienced difficulty in swallowing. Additionally, 10% of the subjects reported palpitations, 8.3% noted weight loss, 6.7% reported pain, 6.7% observed constipation, 5% observed weight gain, and another 5% noted a change in voice.

The present study findings indicate that the highest percentage, at 21.7%, had thyroid swellings measuring approximately 6x4 cm. Additionally, 20.0% of patients exhibited a size of 4x5 cm, 16.7% had a thyroid size of 5x7 cm, 13.3% had a size of 8x5 cm, and 11.7% had a thyroid size of 3x3 cm. (TABLE 5). Out of the 60 participants, it was observed that the majority, comprising 83.3% of patients, exhibited a butterfly shape. Additionally, 11.7% of the study subjects displayed an oval shape, while 5% had a spherical shape.

Among the 60 cases studied, 80.0% of the thyroid nodules were found in both lobes, indicating a prevalent occurrence in both the left and right lobes. Specifically, 11.7% were located in the left lobe, and 8.3% were in the right lobe. The

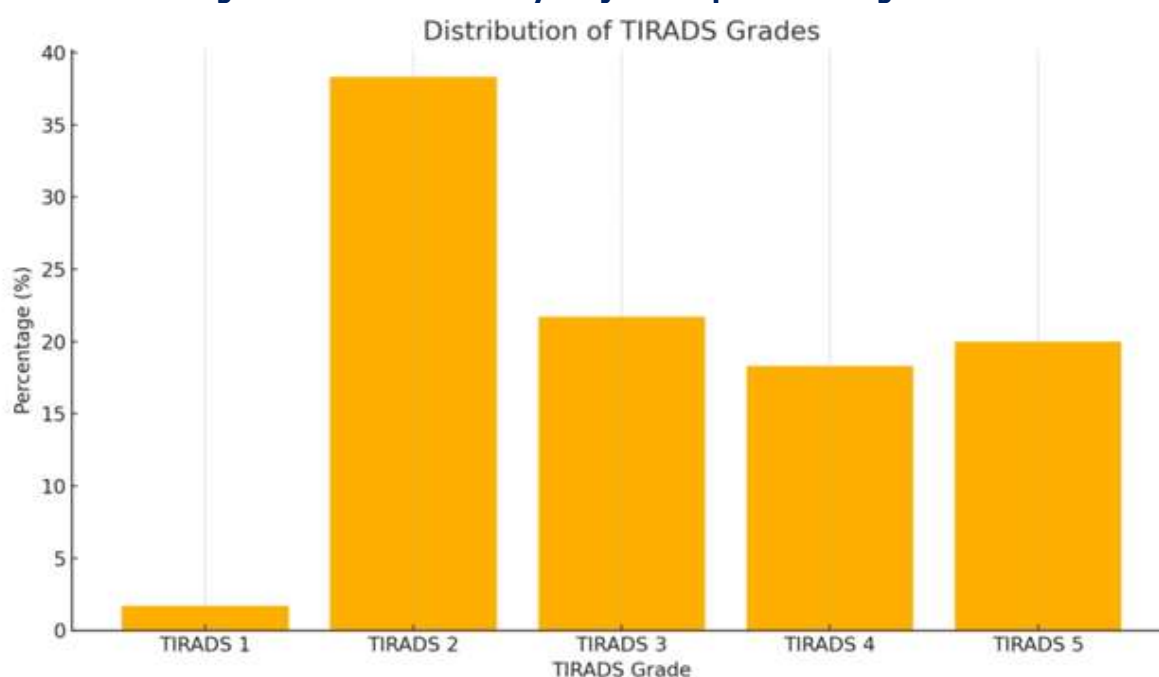
total percentage adds up to 100.0%, representing the entire study population. It was observed that only 5.0% of patients exhibited symptoms associated with tachycardia, specifically related to pressure and toxicity.

The majority of cases (78.3%) were diagnosed as multinodular goitre (MNG), suggesting the presence of multiple nodules in the thyroid gland. Additionally, 16.7% of cases were identified as simple diffuse goitre, a prevalent occurrence of benign, non-nodular thyroid enlargement without associated toxicity. A smaller proportion of cases (5.0%) were classified as toxic goitre, indicative of thyroid enlargement accompanied by hormonal imbalances. In summary, the table highlights the predominance of MNG in the studied population, with a notable representation of Simple Diffuse Goitre and toxic goitre cases.

Out of 60 subjects, the majority were classified as TIRADS 2 (38.3%), indicating a benign status. TIRADS 3 and TIRADS 5 grades had similar distributions with 21.7% and 20.0% respectively, suggesting indeterminate and suspicious for malignancy statuses. TIRADS 4 grade, indicating a higher suspicion for malignancy, was seen in 18.3% of the subjects. Only 1.7% of subjects were classified as TIRADS 1, which denotes a normal finding. This distribution highlights a significant number of subjects with

higher TIRADS grades, potentially requiring further investigation for malignancy.

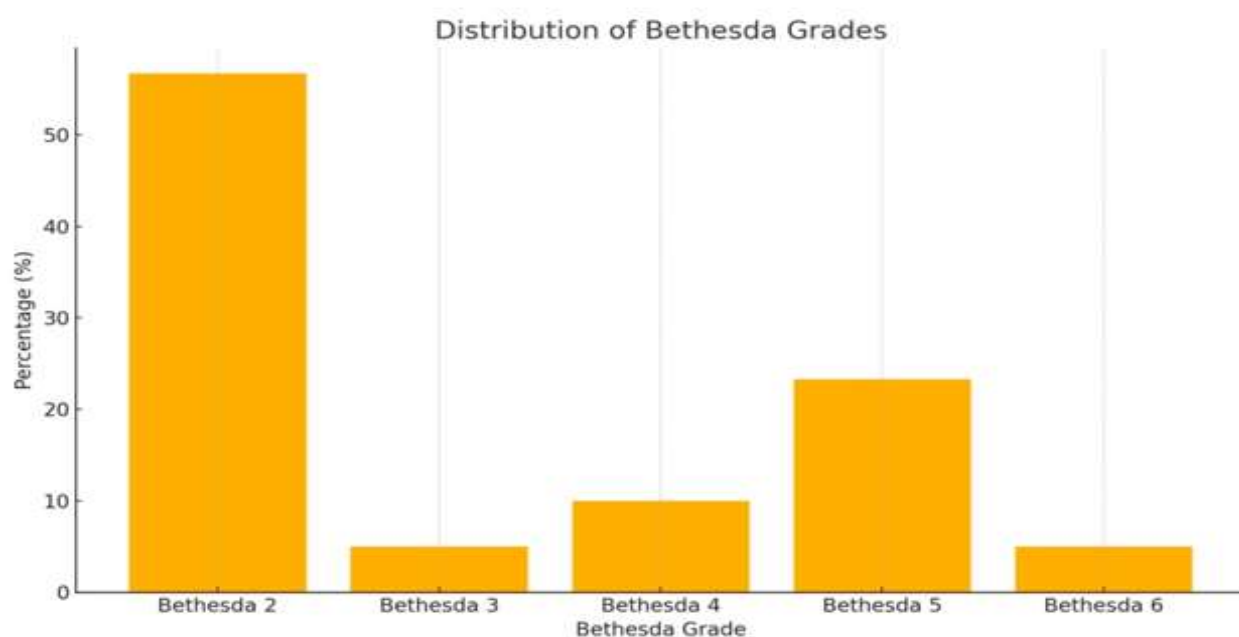
Fig 2: distribution of study subjects as per TIRADS grades



In the present study, among the 60 subjects, the majority (56.7%) were graded as Bethesda 2, indicating benign cytology. Bethesda grades 3 and 6, which suggest atypia of undetermined significance and malignancy, respectively, each constituted 5.0% of the subjects. Bethesda grade 4, indicating a suspicious follicular neoplasm, was observed in

10.0% of subjects, while Bethesda grade 5, indicating suspicion of malignancy, accounted for 23.3%. This distribution underscores that most subjects had benign findings, with a significant proportion (33.3%) exhibiting suspicious or malignant cytology, necessitating further clinical evaluation.

Fig 3: distribution of study subjects as per Bethesda grades



Out of the 60 subjects, the most common diagnoses were colloid goitre (CG) at 25.0% and adenomatous hyperplasia (AH) at 21.7%. Multinodular goitre (MNG) was diagnosed in 20.0% of the subjects. Papillary carcinoma (PC) accounted for 18.3%, with specific variants including the follicular variant (PC FV) and Hurthle cell variant (PC HT), each comprising 3.3%, and the sclerosing variant (PC SV)

at 1.7%. Less frequent diagnoses included follicular adenoma (FA) and follicular carcinoma (FC), each at 1.7%, as well as medullary carcinoma (MC) at 1.7%, and Hashimoto's thyroiditis (HC) at 3.3%. This distribution reflects a diverse range of thyroid pathologies among the study subjects.

Table 2: distribution of study subjects as per diagnosis

Diagnosis	Number of Cases (n)	Percentage (%)
Colloid Goitre (CG)	15	25
Adenomatous Hyperplasia (AH)	13	21.7
Multinodular Goitre (MNG)	12	20
Papillary Carcinoma (PC)	11	18.3
PC - Follicular Variant (PC FV)	2	3.3
PC - Hurthle Cell Variant (PC HT)	2	3.3
PC - Sclerosing Variant (PC SV)	1	1.7
Follicular Adenoma (FA)	1	1.7
Follicular Carcinoma (FC)	1	1.7
Medullary Carcinoma (MC)	1	1.7
Hashimoto's Thyroiditis (HC)	2	3.3



The TIRADS classification showed a high sensitivity of 91.3%, indicating it correctly identified 91.3% of malignant cases. It also had a high specificity of 94.6%, correctly identifying 94.6% of benign cases. The positive predictive value (PPV) and negative predictive value (NPV) were both

91.3% and 94.6%, respectively, indicating a high probability that the TIRADS results accurately predicted both benign and malignant cases. The overall accuracy was 93.3%, suggesting that TIRADS imaging is a reliable tool in diagnosing thyroid malignancy.

Table 3: association of FNAC result with TIRADS result

FNAC Result	TIRADS Benign (n)	TIRADS Malignant (n)	Total (n)
Benign	35	2	37
Malignant	2	21	23
Total	37	23	60

The data reveal that TIRADS imaging has a sensitivity of 89.5%, meaning it correctly identifies 89.5% of malignant cases. It also has a specificity of 85.4%, accurately identifying 85.4% of benign cases. The positive predictive value (PPV) is 73.9%, indicating that 73.9% of cases identified as malignant by TIRADS were confirmed as

malignant by histopathology. The negative predictive value (NPV) is 94.6%, showing that 94.6% of cases identified as benign by TIRADS were indeed benign. The overall accuracy of TIRADS imaging in predicting malignancy is 86.7%.

Table 4: association of TIRADS result and histopathology results

TIRADS Result	Histopathology Benign (Count)	Histopathology Malignant (Count)	Total Count
Benign	35	2	37
Malignant	2	21	23
Total	37	23	60

The data shows that FNAC Bethesda grading has a high sensitivity of 94.7%, correctly identifying 94.7% of malignant cases, and a specificity of 87.8%, accurately identifying 87.8% of benign cases. The positive predictive value (PPV) is 78.3%, indicating that 78.3% of cases

identified as malignant by FNAC were confirmed malignant by histopathology. The negative predictive value (NPV) is 97.3%, showing that 97.3% of cases identified as benign by FNAC were indeed benign. The overall accuracy of FNAC in predicting malignancy is 90.0%.

Table 5: association of FNAC and histopathology results

FNAC Result	HPE Benign (Count)	HPE Malignant (Count)	Total Count
Benign	36	1	37
Malignant	5	18	23
Total	41	19	60

Discussion

The clinical outcomes of thyroid disease depend largely on the underlying diagnosis, treatment provided, and follow-up response. Patients with benign disorders such as simple

diffuse goitre and multinodular goitre (MNG) generally had good outcomes with medical therapy, thyroid hormone supplementation, or surgical intervention when indicated. Those with toxic goitre were managed with antithyroid



medications, radioactive iodine, or thyroidectomy in selected cases, aiming to restore euthyroid status. Treatment response was monitored using thyroid function tests along with symptomatic improvement. Follow-up assessments included hormonal evaluation, repeat ultrasonography, radionuclide scans when required, and patient-reported outcomes. Overall, benign conditions showed excellent prognoses, while malignant cases required close surveillance and long-term management.

The present study adds to existing evidence on the demographic and clinical profile of goitre. In this cohort, the peak frequency of thyroid enlargement was observed in the 40–50 year age group (41.7%). This pattern is in agreement with Balaji Chittipotula's study [3] (2021), which reported maximum nodular goitre cases in the 31–40 and 41–50 year ranges, and also resonates with the findings of Karthik Kathladka Sanjeeva [4] (2015), who noted the highest incidence in the third decade of life.

Gender distribution in thyroid disorders continues to show a striking female preponderance. In the current series, all 60 participants were women (100%), consistent with earlier reports that highlight the predominance of goitre in females. Ramanachalam Chanda [5] (2020) documented a female-to-male ratio of 21:1, while Ashwini S. Rathod [6] (2020) and P. Sreenivas [7] (2017) reported ratios of 2.8:1 and 6:1, respectively. Collectively, these studies reaffirm the established observation that thyroid swellings are far more common in females, underlining the need for gender-sensitive approaches in thyroid disorder management.

Regarding onset, most patients in this study (90%) had an insidious development of swelling, typical of benign conditions such as multinodular goitre or colloid nodules. Acute onset (10%) was less frequent and is usually linked to haemorrhage within a nodule, thyroiditis, or rapidly growing malignancy. This trend mirrors prior work, such as Chittipotula [3] (2021), who found that 75% of malignant cases presented within one year of symptom onset, highlighting the faster progression in such cases.

A large proportion of patients (41.7%) were asymptomatic, reflecting the silent nature of thyroid nodules, while dysphagia (16.7%) was the most frequent complaint among symptomatic cases. Other symptoms included palpitations (10%), weight loss (8.3%), constipation (6.7%), weight gain (5%), pain (6.7%), and change in voice (5%). These patterns suggest that while many thyroid lesions remain clinically silent, symptomatic presentations usually arise due to compressive effects or altered thyroid function. Ramanachalam Chanda [5] (2020) also reported dysphagia and stridor in a minority of patients, whereas Chittipotula [3]

(2021) observed thyroid swelling as the predominant presentation without additional complaints. Karthik Kathladka Sanjeeva [4] (2015) noted palpitations, sweating, and anxiety as common features, reflecting hyperthyroid involvement.

Morphologically, most cases (83.3%) exhibited the typical butterfly shape, corresponding to the gland's normal anatomy. Oval (11.7%) and spherical (5%) shapes indicated asymmetrical or nodular enlargements. This is consistent with Ahuja and Evans [8] (2019), who noted the butterfly pattern as common in diffuse goitre, while Durante et al. [2] (2018) described oval shapes as indicative of asymmetric nodular growth. Spherical morphology, though rare, has been linked to solitary nodules or cysts.

In this study, bilateral nodular involvement was seen in 80% of cases, corroborating findings from Durante et al. [2] (2018) and Zhang et al. [9] (2019), who reported that multinodular goitre commonly affects both lobes. Importantly, bilateral nodularity has been associated with a higher risk of malignancy, warranting careful evaluation.

Distribution of TIRADS grades revealed that 38.3% of nodules were Th2 (benign), followed by Th3 (21.7%), Th5 (20.0%), Th4 (18.3%), and Th1 (1.7%). These findings agree with Grani et al. [10] (2018), who demonstrated the role of TIRADS in malignancy risk stratification. Tessler et al. [11] (2017) highlighted the need for FNAC in indeterminate (Th3) nodules, while Middleton et al. [12] (2017) emphasized the sensitivity of ultrasound in detecting thyroid abnormalities.

FNAC results in this study showed 56.7% Bethesda II (benign) cases, comparable with Ramanachalam Chanda [5] (2020), who reported 56.36% nodular goitre and other benign variants, and with Sanjeeva [4] (2015), who found 73% nodular goitre. Rathod [6] (2020) similarly reported 92% benign cytology cases.

Histopathological correlation revealed that 61.7% were benign and 38.3% malignant, paralleling Ramanachalam Chanda [5] (2020), who reported higher benign prevalence, and Chittipotula [3] (2021), who observed variability across populations, with papillary carcinoma as the most common malignancy.

Diagnostic performance analysis showed TIRADS sensitivity of 91.3% and specificity of 94.6%, consistent with findings by Grani et al. [10] (2020), Tessler et al. [11] (2017), and Middleton et al. [12] (2018), all of whom confirmed the accuracy of TIRADS in malignancy prediction and in reducing unnecessary biopsies. In the present study, FNAC with Bethesda grading demonstrated a sensitivity of 94.7% and specificity of 87.8%, comparable to



the results reported by Cibas and Ali [14] (2017) and Bongiovanni et al. [15] (2019), supporting the robustness of FNAC in thyroid cytology.

Generalizability

As this was a single-center study with a modest sample size (n=60) from a tertiary railway hospital in Secunderabad, the results may not fully represent the wider population, where demographic and environmental factors vary. However, the diagnostic correlations between ultrasonography, FNAC, and histopathology were based on standardized methods, making the findings applicable to similar tertiary care settings.

Conclusion

In conclusion, this study involving 60 participants provides a comprehensive overview of the demographic distribution, clinical characteristics, and diagnostic evaluations of thyroid conditions. The findings highlight a predominance of thyroid swellings in middle-aged females, with most cases exhibiting a gradual increase in size and common symptoms like constipation, though a significant proportion were asymptomatic. TIRADS and FNAC Bethesda grading emerged as highly reliable diagnostic tools, with TIRADS showing an accuracy of 86.7% and FNAC demonstrating even higher accuracy at 90.0%. The strong correlation between these diagnostic methods and histopathological findings underscores their effectiveness in identifying thyroid malignancies. The study reinforces the critical role of accurate imaging and cytological evaluations in the timely and precise diagnosis of thyroid nodules, which is crucial for appropriate clinical management and improving patient outcomes.

Limitations

This was a single-center study with a small sample size (n=60), which may limit generalizability. Its cross-sectional design precludes assessment of long-term outcomes, and reliance on patient recall for symptom onset may have introduced bias. Additionally, advanced molecular or immunohistochemical analyses were not included.

Recommendations

High-resolution ultrasonography and FNAC should be routinely employed for the evaluation of thyroid swellings, with histopathology serving as the gold standard where surgery is indicated. Standardized reporting systems like TIRADS and Bethesda should be uniformly adopted, and

larger multicenter studies with advanced diagnostic techniques are recommended to validate and extend these findings.

Acknowledgement

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List of abbreviations

- **FNAC** – Fine Needle Aspiration Cytology
- **HPE** – Histopathological Examination
- **HRUSG** – High-Resolution Ultrasonography
- **NPV** – Negative Predictive Value
- **PPV** – Positive Predictive Value
- **SCR** – South Central Railway
- **SPSS** – Statistical Package for the Social Sciences
- **TFTs** – Thyroid Function Tests
- **TIRADS** – Thyroid Imaging Reporting and Data System
- **TSH** – Thyroid-Stimulating Hormone
- **TRH** – Thyrotropin-Releasing Hormone
- **USG** – Ultrasonography

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This research did not receive any specific grant from funding agencies

Conflict of interest

The authors declare that there is no conflict of interest related to this study.

Author contributions

- **Dr. Jagadeesha Udupa (PG Resident, Department of General Surgery, Central Hospital, South Central Railway, Lalaguda):** Conception of the study, data collection, statistical analysis, and drafting of the manuscript.



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- **Dr. I. Siva Naga Prasad (Head of Department, Department of General Surgery, Central Hospital, South Central Railway, Lalaguda):** Supervision, critical review of the study design, guidance during data interpretation, and final approval of the manuscript.
- **Dr. Moulika N (Consultant, Department of General Surgery, Central Hospital, South Central Railway, Lalaguda):** Clinical evaluation of patients, surgical management, and contribution to manuscript editing.
- **Dr. Tarun Gattani (PG Resident, Department of General Surgery, Central Hospital, South Central Railway, Lalaguda):** Assistance in data collection, patient follow-up, literature review, and preparation of tables and figures.

Data availability

- The data supporting the findings of this study are available from the corresponding author, **Dr. Jagadeesha Udupa**, upon reasonable request. To protect patient confidentiality, individual-level data are not publicly accessible.

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