ORIGINAL ARTICLE

Ultrasonography and computed tomography scan in evaluation of thyroid nodule – A cross-sectional study

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Background: Thyroid nodules are a common endocrine condition, often detected incidentally through imaging. While ultrasonography (USG) serves as the first-line modality due to its sensitivity and accessibility, computed tomography (CT) can provide additional anatomical clarity in complex or retrosternal cases. The combined use of both modalities may improve diagnostic precision and guide appropriate management. **Objectives:** The objective is to evaluate and correlate the findings of USG and CT in patients with clinically suspected thyroid nodules, and to assess their diagnostic utility and accuracy in differentiating benign from malignant lesions. **Materials and Methods:** A cross-sectional study was conducted at the Department of Radiodiagnosis, Rohilkhand Medical College, over 1 year, involving 60 patients with thyroid nodules. All participants underwent USG and CT imaging. USG findings were scored using the Thyroid Imaging Reporting and Data System criteria. CT was used to assess nodule extent and anatomical relationships. Data were analyzed using Statistical Package for the Social sciences version 23.0. **Results:** USG and CT diagnoses showed strong and statistically significant correlations with final diagnosis ($P < 0.001$). USG demonstrated a stronger correlation ($\rho = 0.681$) compared to CT ($\rho = 0.646$). No individual imaging feature independently predicted malignancy. **Conclusion:** Combining USG and CT enhances diagnostic accuracy, especially in anatomically challenging thyroid nodules, supporting a multimodal imaging approach.

KEY WORDS: Computed tomography, cross-sectional studies, diagnostic imaging, Thyroid Imaging Reporting and Data System, thyroid nodule, ultrasonography

INTRODUCTION

Thyroid nodules are among the most common endocrine findings, frequently discovered during routine clinical evaluations or incidentally through imaging. While physical palpation detects nodules in 4–7% of adults, ultrasonography (USG) identifies them in up to 50% of individuals over the age of 60, highlighting its superior sensitivity and diagnostic relevance.[1,2] Despite the fact that most nodules are benign, approximately 5–15% may harbor malignancy, necessitating accurate characterization to guide appropriate clinical management.[3] USG remains the first-line imaging modality for evaluating thyroid nodules due to its non-invasive nature, real-time imaging capability, and ability to detail internal nodule features such as echogenicity, calcifications, margins, and vascularity.[4,5] However, its diagnostic accuracy can vary considerably depending on the operator's expertise. Moreover, USG offers limited anatomical resolution in cases involving retrosternal extension or compressive symptoms. Computed tomography (CT), though not routinely employed as a primary imaging tool, plays a pivotal role in evaluating complex or large thyroid nodules. It provides high-resolution cross-sectional images that assist in delineating anatomical relationships, detecting intrathoracic involvement, and evaluating adjacent lymph nodes-crucial information for

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surgical planning.[6] Nonetheless, CT carries drawbacks such as radiation exposure and the use of iodinated contrast, which may interfere with radioactive iodine uptake during therapy.[7]

Considering the complementary diagnostic capabilities of USG and CT, our study is designed to correlate imaging findings from both modalities in the evaluation of thyroid nodules. The purpose of the study is to enhance diagnostic precision, optimize risk stratification, and contribute to the development of standardized imaging protocols for improved clinical decision-making.

Aim and Objectives

The study aims to correlate the findings of USG and CT scan in the evaluation of thyroid nodules.

The objectives include:

1. To evaluate the pattern of clinically significant thyroid nodule by USG
2. To evaluate the extent and spread of the disease using CT scan as an additional diagnostic tool.

MATERIALS AND METHODS

This hospital-based cross-sectional study was conducted in the Department of Radiodiagnosis, Rohilkhand Medical College, over 1 year, from August 1st, 2023 to July 31st, 2024, following approval from the Institutional Ethics Committee. A total of 60 patients presenting clinically with thyroid nodules were enrolled. Inclusion criteria comprised patients above 18 years of age, of either gender, with clinically suspected thyroid nodules, while pregnant patients were excluded from the study.

USG was used as the first-line imaging tool, performed using high-resolution linear transducers (7.5–15 MHz) with Samsung HS70A, HS40, and V7 ultrasound systems. The thyroid gland was assessed in transverse and longitudinal planes with patients positioned supine, neck extended, and a shoulder pad to improve visibility. Swallowing was encouraged to visualize the lower poles and isthmus. Nodules were characterized using the Thyroid Imaging Reporting and Data System scoring based on echotexture, margins, calcifications, and other features. CT imaging was then performed for further anatomical assessment using a GE BrightSpeed 16-slice scanner. Patients were scanned in a supine position with the neck slightly extended to reduce radiation exposure and enhance gland delineation. CT was particularly useful in assessing the extent of disease, retrosternal extension, and lymph node involvement. Image reconstruction was done in axial, coronal, and sagittal planes, with sagittal sections aiding in differentiating nodules and evaluating lymph nodes anterior to major neck vessels. To minimize artifacts, proper shoulder-down positioning and craniocaudal scanning were employed.

All data were recorded in Microsoft Excel and analyzed using Statistical Package for the Social Sciences version 23.0. Descriptive statistics were used to summarize patient demographics and imaging findings. Means and standard deviations were calculated for continuous variables, whereas categorical variables were expressed as frequencies and percentages. A $P < 0.05$ was considered statistically significant.

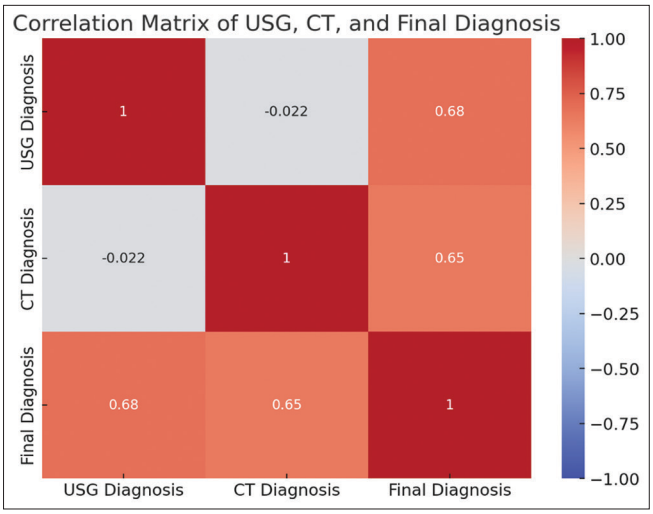


Figure 1: Ultrasonography and computed tomography show strong, significant correlations with the final diagnosis of thyroid nodules.

RESULTS

In our study of 60 patients, females constituted 70% and males 30%, with a statistically significant gender association ($\chi^2 = 9.60$, $P = 0.002$). The mean age was 48.0 ± 15.9 years, with the highest proportion in 31–40 years of age group (21.7%). Age distribution showed no significant association with thyroid nodules ($\chi^2 = 2.80$, $P = 0.731$). In our study, we assessed the association between thyroid nodule composition, evaluated by ultrasonography (USG) and computed tomography (CT), and diagnostic outcomes. Solid and cystic nodules were predominantly benign in both imaging modalities, but no significant association was found between nodule composition and diagnostic outcome (USG: $\chi^2 = 0.677$, $p = 0.713$; CT: $\chi^2 = 0.433$, $p = 0.805$) (Table 1). We examined the association between the echogenicity of thyroid nodules assessed by USG and CT and their diagnostic outcomes. While hypoechoic and hyperechoic nodules were more likely to be benign, the Chi-square tests revealed no significant association between echogenicity and diagnostic outcome (USG: $\chi^2 = 1.87$, $p = 0.394$; CT: $\chi^2 = 2.65$, $p = 0.266$) (Table 2). We explored the association between USG and CT diagnostic outcomes and their correlation with the final diagnosis of thyroid nodules. Both USG and CT diagnoses showed high concordance with the final diagnosis, with significant associations (USG: $\chi^2 = 27.9$, $p < 0.001$; CT: $\chi^2 = 27.9$, $p < 0.001$), demonstrating diagnostic accuracy (Table 3). The correlation matrix demonstrated a moderate positive correlation between USG diagnosis and final diagnosis ($r = 0.68$) and CT diagnosis and final diagnosis ($r = 0.65$). However, the correlation between USG and CT diagnoses was very low ($r = -0.022$), indicating minimal agreement between the two imaging modalities (Figure 1).

Table 1: Association of USG and CT composition with their respective diagnostic outcomes

Parameters	Benign (%)	Malignant (%)	Total (%)	Chi-square and *P* value
USG composition		USG diagnosis		
Solid	22 (84.6)	4 (15.4)	26 (43.3)	χ^2=0.677, *P*=0.713
Mixed	15 (75.0)	5 (25.0)	20 (33.3)	
Cystic	11 (78.6)	3 (21.4)	14 (23.3)	
CT composition		CT di agnosis		
Solid	16 (84.2)	3 (15.8)	19 (31.7)	χ^2=0.433, *P*=0.805
Mixed	13 (76.5)	4 (23.5)	17 (28.3)	
Cystic	20 (83.3)	4 (16.7)	24 (40.0)	

USG: Ultrasonography, CT: Computed tomography

Table 2: Association of USG and CT echogenicity with their respective diagnostic outcomes

USG echogenicity	USG diagnosis			
	Benign (%)	Malignant (%)	Total (%)	Chi-square and *P*-value
Hypoechoic	15 (71.4)	6 (28.6)	21 (50.0)	χ^2=1.87, *P*=0.394
Isoechoic	16 (88.9)	2 (11.1)	18 (16.7)	
Hyperechoic	17 (81.0)	4 (19.0)	21 (33.3)	
CT echogenicity	**CT diagnosis**			
Low	21 (80.8)	5 (19.2)	26 (43.3)	χ^2=2.65, *P*=0.266
Moderate	15 (93.8)	1 (6.2)	16 (26.7)	
High	13 (72.2)	5 (27.8)	18 (30.0)	

USG: Ultrasonography, CT: Computed tomography

Table 3: Association of USG and CT diagnosis with their respective final diagnosis

USG diagnosis	Benign (%)	Malignant (%)	Total (%)	Chi-square and *P*-value
		Final diagnosis		
Benign	39 (81.3)	9 (18.8)	48 (80.0)	χ^2=27.9, *P*≤0.001
Malignant	0 (0.0)	12 (100.0)	12 (20.0)	
CT diagnosis	**Final diagnosis**			
Benign	39 (79.6)	10 (20.4)	49 (81.7)	χ^2=27.9, *P*≤0.001
Malignant	0 (0.0)	11 (100.0)	11 (18.3)	

USG: Ultrasonography, CT: Computed tomography

DISCUSSION

This cross-sectional study evaluated the diagnostic utility of USG and CT in assessing thyroid nodules. The mean patient age was 48.0 ± 15.9 years, with the highest prevalence in the age group of 31–40 years, aligning with global data from Wu *et al*.[8] and Tao *et al*.,[9] confirming that thyroid nodules predominantly affect middle-aged adults. A significant female predominance (70%) was observed, consistent with prior findings by Wu *et al*.[8] and Alshaikh *et al*.,[10] underscoring the well-established gender disparity in thyroid pathology.

Solid nodules were the most frequent on USG and CT, and while malignancy was more common in mixed and hypoechoic nodules, none of the individual imaging features–composition, echogenicity, shape, margin, or echogenic foci–showed a statistically significant association with malignancy. These findings reflect similar conclusions drawn by Arpana *et al*.[11] and Uttarakar *et al*.,[12] suggesting that no single USG or CT feature reliably predicts malignancy in isolation.

Critically, both USG and CT demonstrated excellent diagnostic accuracy. All nodules identified as malignant by either modality were confirmed malignant on final diagnosis, though CT misclassified 20.4% of malignant nodules as benign. USG showed a stronger correlation with final diagnosis (ρ = 0.681) compared to CT (ρ = 0.646), while the correlation between USG and CT diagnoses was weak and non-significant. These results align with those of Kim *et al*.[13] and Eun *et al*.,[14] who also emphasized the value of combining modalities rather than relying on one.

Our findings confirm USG as the primary imaging tool for thyroid nodules, while CT adds value in complex cases. Their complementary use enhances diagnostic accuracy, guiding better clinical decisions and management.

CONCLUSION

We concluded that USG is an effective first-line tool for thyroid nodule evaluation, while CT adds value in complex cases. Their combined use enhances diagnostic accuracy, improves risk stratification, and supports better clinical and surgical decision-making.

Strengths

The strengths of the study are its direct USG-CT comparison, correlation with final diagnosis, and clinical applicability. Standardized imaging parameters and statistical analysis enhance reliability and support the role of multimodal imaging in thyroid nodule assessment.

Limitations

The limitations of the study are its small sample size, single-center scope, and lack of universal histopathological confirmation. Operator dependence in USG and exclusion of advanced imaging techniques also limit generalizability.

FUNDING

None.

ETHICAL APPROVAL

Obtained.

CONSENT

Written consent secured.

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