

Evaluation of Incidental Thyroid Nodules on Neck CT and Their Clinical Significance

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DOI: <https://doi.org/10.5281/zenodo.23117862>

Received: 27 August 2026, Revised: 11 September, Accepted: 19 September 2026, Online First: 03 October 2026

ABSTRACT

Background: Incidental thyroid nodules are commonly detected on neck CT performed for non-thyroid indications. Although most are benign, some may represent clinically significant thyroid disease. **Aim:** To evaluate the prevalence, CT characteristics, and clinical significance of incidental thyroid nodules and their correlation with subsequent ultrasonographic, cytological, and histopathological findings. **Materials and Methods:** A prospective observational study was conducted over 18 months (January 2025–June 2026) in a tertiary care teaching hospital in India. A total of 600 adult patients undergoing contrast-enhanced neck CT for non-thyroid indications were evaluated. Nodule characteristics were assessed on CT, and selected patients underwent thyroid ultrasonography, fine-needle aspiration cytology, and histopathological evaluation. **Results:** Incidental thyroid nodules were identified in 138 of 600 patients (23.0%). The mean nodule diameter was 14.2 ± 8.6 mm, and 31 patients (22.5%) showed suspicious CT characteristics. Ultrasonography was performed in 96 (69.6%) patients and FNAC in 42 (43.8%) of these. Cytology was benign in 27 (64.3%), indeterminate in 8 (19.0%), suspicious in 3 (7.1%), and malignant in 4 (9.5%). Histopathology confirmed papillary thyroid carcinoma in 6 and follicular thyroid carcinoma in 1 patient. Overall, clinically significant thyroid pathology was identified in 10 patients (7.2%). Nodules ≥ 15 mm and those with suspicious CT features were significantly associated with clinically significant pathology ($p < 0.001$). **Conclusion:** Incidental thyroid nodules are common on neck CT, but only a minority demonstrate clinically significant pathology. Nodule size and suspicious CT characteristics may help identify patients requiring further evaluation. A structured, risk-based approach can facilitate detection of significant thyroid disease while limiting unnecessary investigation.

Keywords: *incidental thyroid nodule; neck computed tomography; thyroid incidentaloma; thyroid malignancy; thyroid carcinoma; multidetector CT; thyroid ultrasonography; fine-needle aspiration*

INTRODUCTION

Incidental thyroid nodules are commonly identified during cross-sectional imaging of the neck performed for conditions unrelated to the thyroid gland. The widespread use of multidetector computed tomography (CT), together with improvements in spatial resolution and image reconstruction, has increased the detection of unsuspected thyroid abnormalities [1]. A thyroid nodule identified incidentally on CT may represent a benign hyperplastic or colloid nodule, cystic lesion, thyroiditis-related change, or, less frequently, clinically significant thyroid malignancy. The increasing frequency of these findings has therefore created an important clinical and radiological problem regarding which nodules require further evaluation and which

can be safely managed without additional investigation [2].

Thyroid nodules are common in the general population, with their prevalence depending substantially on the method of detection. Physical examination identifies relatively few nodules, whereas ultrasonography detects a much larger proportion of individuals with focal thyroid abnormalities. CT and magnetic resonance imaging performed for unrelated indications also demonstrate thyroid nodules that may have remained clinically occult [3]. Although the majority of these lesions are benign, the incidental detection of thyroid cancer is clinically important because early recognition of significant disease may permit appropriate treatment and follow-up. At the

same time, the investigation of every incidentally detected nodule can result in substantial overdiagnosis and overtreatment, particularly when very small, biologically indolent lesions are included [4].

The clinical significance of an incidental thyroid nodule depends on several factors, including patient age, clinical history, nodule size, morphology, and the presence of associated suspicious findings. A history of childhood or therapeutic neck irradiation, familial thyroid carcinoma, previous thyroid malignancy, rapidly enlarging neck swelling, cervical lymphadenopathy, or compressive symptoms may increase clinical concern [5]. Conversely, a small nodule without suspicious morphological characteristics in an otherwise low-risk patient may have limited clinical importance. Consequently, management should be based on an integrated assessment rather than on the mere presence of a thyroid nodule on CT [6].

CT has several advantages in the initial detection of thyroid abnormalities. It provides a comprehensive anatomical overview of the thyroid gland and adjacent cervical structures and can demonstrate the relationship of a nodule to the trachea, oesophagus, carotid sheath, strap muscles, and other surrounding structures [7]. Nodule size, location, density, enhancement pattern, internal calcification, margins, and multiplicity can be evaluated. CT may also identify features that raise concern for invasive malignancy, including irregular or infiltrative margins, invasion of adjacent structures, and abnormal cervical lymph nodes. These findings may be particularly important when the thyroid lesion is discovered during imaging performed for another suspected cervical pathology [8].

However, CT is not primarily a thyroid nodule characterization modality. Certain sonographic characteristics that are important for thyroid malignancy risk stratification cannot be evaluated as reliably on routine CT. High-resolution thyroid ultrasonography remains the preferred examination for detailed assessment of incidentally detected thyroid nodules [9]. Ultrasound can determine nodule composition, echogenicity, shape, margins, calcification, and associated lymph-node abnormalities and permits classification according to established risk-stratification systems. It also provides the means for image-guided fine-needle aspiration cytology when tissue diagnosis is indicated [10].

The subsequent diagnostic pathway must therefore balance the risk of missing clinically significant thyroid carcinoma against the consequences of unnecessary investigation. Referral of every CT-detected nodule for ultrasound may increase the number of investigations performed without substantially improving clinically meaningful cancer detection [11]. Conversely, failure to report or appropriately assess a suspicious thyroid lesion may result in delayed diagnosis. Risk-based

recommendations that incorporate patient age, nodule size, CT morphology, and relevant clinical risk factors can help identify patients who are most likely to benefit from dedicated thyroid assessment [12].

Fine-needle aspiration cytology is an important component of the diagnostic pathway for appropriately selected nodules. Ultrasound-guided aspiration permits cytological classification using standardized reporting systems such as the Bethesda System for Reporting Thyroid Cytopathology. Most aspirated nodules are benign, while a smaller proportion yield indeterminate, suspicious, or malignant cytology [13]. Histopathological examination following surgery provides definitive diagnosis in patients undergoing thyroidectomy or other operative management. Correlating the initial CT appearance with subsequent ultrasound, cytology, and histopathology can therefore provide useful information regarding the predictive value of CT findings [14].

Another important consideration is the increasing detection of small thyroid cancers. The widespread use of sensitive imaging modalities has contributed to an increase in the identification of small papillary thyroid carcinomas, many of which may have a relatively indolent clinical course. The distinction between detection of a thyroid abnormality and detection of clinically significant thyroid disease is consequently important [15]. A meaningful evaluation of incidental thyroid nodules should not simply report their prevalence but should also determine how many lesions ultimately demonstrate clinically important pathology and which imaging characteristics are associated with that outcome [16].

The radiologist plays a central role in identifying and appropriately communicating incidental thyroid abnormalities because CT examinations are frequently interpreted without a primary clinical suspicion of thyroid disease. Consistent reporting of nodule dimensions, morphology, suspicious features, and relevant cervical findings can assist clinicians in determining whether further evaluation is appropriate. A structured approach may also reduce variation in reporting and prevent both under-recognition of suspicious lesions and unnecessary investigation of low-risk nodules [17,18].

Tertiary-care hospitals provide an appropriate setting for evaluating this issue because neck CT is performed for a broad range of indications, including cervical infection, trauma, lymphadenopathy, head and neck malignancies, vascular disease, and other structural abnormalities [19]. A prospective assessment of incidental thyroid nodules in such a population permits systematic documentation of CT findings and correlation with subsequent thyroid-specific investigations. Such data may help clarify the frequency of clinically significant disease among incidentally detected nodules and identify CT features that should influence further management [20].

Despite the frequent detection of thyroid nodules on neck CT, there remains a need for practical assessment of their clinical significance in routine radiological practice. Evaluating the relationship between CT characteristics and subsequent ultrasound, cytological, and histopathological findings can help establish a rational approach to incidental thyroid nodules and improve selection of patients requiring further investigation.

Therefore, it is of interest to evaluate the prevalence and imaging characteristics of incidental thyroid nodules detected on neck CT and to determine their clinical significance by correlating CT findings with subsequent ultrasonographic, cytological, and histopathological outcomes.

MATERIALS AND METHODS

Study Design and Setting

A prospective observational study was conducted in the Department of Radiodiagnosis in collaboration with the Department of Endocrinology at a tertiary care teaching hospital in India. The study was conducted over an 18-month period from January 2025 to June 2026. The study evaluated adult patients who underwent contrast-enhanced CT of the neck for clinical indications unrelated to primary thyroid disease and in whom incidental thyroid nodules were identified.

Study Population and Sample Size

A total of 600 consecutive adult patients who underwent contrast-enhanced CT of the neck during the study period were evaluated. The sample consisted of patients aged 18 years or older who underwent CT for non-thyroid indications. Patients were included when a thyroid nodule was identified incidentally on CT and adequate clinical and imaging information was available for assessment.

Patients with a previously diagnosed thyroid malignancy, thyroid nodules already undergoing active diagnostic evaluation, or CT examinations performed specifically for known or suspected thyroid disease were excluded. Patients with previous total thyroidectomy, inadequate CT image quality for assessment of the thyroid gland, incomplete clinical information, or inability to undergo the planned follow-up evaluation were also excluded.

CT Examination and Assessment of Thyroid Nodules

All patients underwent contrast-enhanced multidetector CT of the neck according to the institutional imaging protocol. Axial images with multiplanar coronal and sagittal reconstructions were reviewed for identification and characterization of thyroid nodules.

A thyroid nodule was defined as a focal, discrete abnormality within the thyroid gland that was distinguishable from the surrounding thyroid

parenchyma on CT. For each detected nodule, the maximum diameter was measured in millimetres. The number of nodules was recorded as solitary or multiple, and the anatomical location was documented according to involvement of the right lobe, left lobe, or isthmus.

The CT characteristics assessed included nodule size, attenuation, composition, enhancement pattern, homogeneity, margins, internal calcification, and relationship to adjacent structures. The presence of irregular or infiltrative margins, suspicious calcification, heterogeneous enhancement, suspected extrathyroidal extension, tracheal or oesophageal involvement, and abnormal cervical lymphadenopathy was specifically documented because these findings could increase suspicion for clinically significant thyroid disease.

When multiple nodules were present, the dominant or most suspicious nodule was considered for detailed characterization and subsequent clinical correlation.

Clinical and Laboratory Assessment

Clinical information was obtained from medical records and clinical assessment. Demographic variables including age and sex were recorded. The indication for the CT examination and relevant thyroid-related clinical history were documented. Particular attention was given to previous thyroid disease, family history of thyroid malignancy, previous exposure to therapeutic or environmental radiation involving the neck, symptoms suggestive of thyroid disease, and palpable thyroid enlargement or cervical lymphadenopathy.

Thyroid function testing was reviewed when available. Serum thyroid-stimulating hormone was assessed as the principal thyroid biochemical parameter, with additional thyroid function tests obtained according to clinical indication. Laboratory findings were correlated with imaging and subsequent diagnostic evaluation where applicable.

Ultrasonographic Evaluation

Patients considered appropriate for further evaluation on the basis of nodule size, CT morphology, clinical risk factors, or other suspicious findings underwent dedicated high-resolution thyroid ultrasonography. Ultrasonography was performed using a high-frequency linear-array transducer.

The ultrasound examination documented the number and dimensions of thyroid nodules and assessed composition, echogenicity, shape, margins, calcification, and other suspicious sonographic characteristics. The presence of abnormal cervical lymph nodes and evidence of local structural involvement was also assessed. Nodules were categorized according to their overall ultrasound risk profile, and the need for cytological evaluation was determined on the basis of the imaging characteristics and clinical context.

Fine-Needle Aspiration Cytology

Ultrasound-guided fine-needle aspiration cytology was performed in nodules for which tissue sampling was considered clinically indicated following ultrasound and clinical assessment. Cytological specimens were evaluated by experienced cytopathologists and categorized according to the Bethesda System for Reporting Thyroid Cytopathology.

Cytological findings were classified as benign, indeterminate, suspicious for malignancy, or malignant for analysis according to the final documented Bethesda category. Nodules that did not require aspiration were managed according to their clinical and imaging risk profile.

Histopathological Evaluation

Patients with cytological or imaging findings warranting surgical management underwent appropriate thyroid surgery according to multidisciplinary clinical assessment. Histopathological examination of surgical specimens was considered the definitive method for establishing the pathological diagnosis.

The final histopathological diagnosis was recorded, with particular attention to the presence and type of thyroid carcinoma. Where surgery was not indicated, the final clinical assessment was based on the available combination of CT, ultrasonography, cytology, laboratory findings, and clinical follow-up.

Definition of Clinically Significant Thyroid Pathology

For the purpose of the study, clinically significant thyroid pathology was defined as a thyroid abnormality that demonstrated suspicious or malignant cytology, histopathologically confirmed thyroid malignancy, or clinically important structural thyroid disease requiring definitive specialist-directed management. Nodules with imaging or cytological characteristics sufficiently suspicious to warrant specialist-directed diagnostic evaluation were also considered clinically significant when they resulted in further diagnostic management.

This definition was used to distinguish clinically meaningful incidental thyroid abnormalities from small or morphologically low-risk nodules that did not demonstrate evidence of significant disease.

Study Outcomes

The primary outcome was the proportion of patients with incidentally detected thyroid nodules who demonstrated clinically significant thyroid pathology following appropriate clinical, ultrasonographic, cytological, or histopathological evaluation.

Secondary outcomes included the prevalence of incidental thyroid nodules among patients undergoing neck CT, demographic characteristics of affected

patients, distribution of solitary and multiple nodules, nodule size and anatomical location, frequency of suspicious CT characteristics, proportion of patients undergoing thyroid ultrasonography and fine-needle aspiration cytology, cytological categories, histopathological diagnoses, and the association between CT characteristics and clinically significant thyroid pathology.

Statistical Analysis

Data were compiled and analysed using appropriate statistical software. Continuous variables were expressed as mean $\pm$ standard deviation when normally distributed and as median with interquartile range when appropriate. Categorical variables were presented as frequencies and percentages.

Comparisons between groups were performed using the independent-samples t-test for normally distributed continuous variables and the Mann–Whitney U test for non-normally distributed variables. Associations between categorical variables were assessed using the chi-square test or Fisher's exact test, as appropriate.

The association between relevant CT characteristics and clinically significant thyroid pathology was assessed using odds ratios with corresponding 95% confidence intervals. Multivariable logistic regression analysis was performed where appropriate to identify independent imaging or clinical factors associated with clinically significant pathology. A two-sided p value of <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Institutional Ethics Committee approval was obtained before commencement of the study. Written informed consent was obtained from participants included in the prospective evaluation. Patient confidentiality was maintained throughout data collection, analysis, and reporting, and information was used exclusively for the purposes of the study.

RESULTS

A total of 600 adult patients who underwent contrast-enhanced CT of the neck for non-thyroid indications were evaluated during the study period. Incidental thyroid nodules were identified in 138 patients, giving an overall prevalence of 23.0%. The mean age of patients with incidental thyroid nodules was 49.6 ± 13.8 years, and women constituted 60.9% of the affected population. Most patients had a solitary thyroid nodule, while multiple nodules were identified in approximately one-fourth of cases. The mean maximum nodule diameter was 14.2 ± 8.6 mm. The right and left thyroid lobes were the predominant locations, whereas isthmus involvement was less frequent. Suspicious CT characteristics were identified in 31 patients (22.5%), with heterogeneous enhancement and irregular margins being the more

frequently observed findings. Dedicated thyroid ultrasonography was subsequently performed in 96 patients (69.6%). Fine-needle aspiration cytology was performed in 42 of these patients, and most aspirated nodules demonstrated benign cytology. Malignant cytology was identified in four patients, while histopathological examination of seven surgically managed patients confirmed six papillary thyroid carcinomas and one follicular thyroid carcinoma. Overall, clinically significant thyroid pathology was identified in 10 patients (7.2%) with incidentally detected thyroid nodules. Larger nodules and those demonstrating suspicious CT characteristics were more frequently associated with further diagnostic evaluation and clinically significant pathology.

Table 1. Demographic Characteristics Of Patients With Incidentally Detected Thyroid Nodules

The demographic profile of the 138 patients with incidental thyroid nodules is presented below.

Variable	Finding
Patients evaluated by neck CT	600
Patients with incidental thyroid nodules	138
Prevalence of incidental thyroid nodules	23.0%
Mean age (years)	49.6 ± 13.8
Age <40 years	29 (21.0%)
Age 40–59 years	68 (49.3%)
Age ≥60 years	41 (29.7%)
Female	84 (60.9%)
Male	54 (39.1%)

Table 2. Morphological And Anatomical Characteristics Of Incidental Thyroid Nodules

The number, distribution, and size characteristics of the thyroid nodules identified on CT were assessed in all 138 patients.

CT Characteristic	Number (%)
Solitary nodule	101 (73.2%)
Multiple nodules	37 (26.8%)
Right lobe predominant	62 (44.9%)
Left lobe predominant	62 (44.9%)
Isthmus	14 (10.1%)
Nodule diameter <10 mm	38 (27.5%)
Nodule diameter 10–14 mm	46 (33.3%)
Nodule diameter ≥15 mm	54 (39.1%)
Mean maximum diameter (mm)	14.2 ± 8.6

Table 3. Suspicious Computed Tomography Characteristics

Specific CT features that could indicate an increased likelihood of clinically significant thyroid pathology were documented among the incidentally detected nodules.

CT Finding	Number (%)
Any suspicious CT characteristic	31 (22.5%)
Irregular or infiltrative margins	15 (10.9%)
Suspicious calcification	13 (9.4%)

Heterogeneous enhancement	18 (13.0%)
Suspected extrathyroidal extension	4 (2.9%)
Abnormal cervical lymphadenopathy	6 (4.3%)
Suspected extrathyroidal extension and/or abnormal cervical lymphadenopathy	7 (5.1%)

Table 4. Subsequent Ultrasonographic And Cytological Evaluation

Further thyroid-specific evaluation was undertaken in patients considered appropriate for investigation on the basis of CT findings, clinical risk factors, or nodule characteristics.

Subsequent Evaluation	Number (%)
Dedicated thyroid ultrasonography performed	96 (69.6%)
No further ultrasound evaluation	42 (30.4%)
FNAC among patients undergoing ultrasound	42 (43.8%)
No FNAC after ultrasound	54 (56.3%)
Benign cytology	27 (64.3%)
Indeterminate cytology	8 (19.0%)
Suspicious for malignancy	3 (7.1%)
Malignant cytology	4 (9.5%)

Table 5. Histopathological And Clinically Significant Outcomes

Final diagnostic outcomes were assessed using cytology, histopathology, and specialist clinical evaluation.

Outcome	Number (%)
Patients undergoing surgical management	7 (5.1%)
Papillary thyroid carcinoma	6 (4.3%)
Follicular thyroid carcinoma	1 (0.7%)
Total histopathologically confirmed malignancy	7 (5.1%)
Overall clinically significant thyroid pathology	10 (7.2%)
No clinically significant pathology identified	128 (92.8%)

Table 6. Association Of Nodule Size And Suspicious CT Features With Further Evaluation And Clinically Significant Pathology

The relationship between important CT characteristics and subsequent clinical significance was evaluated among patients with incidental thyroid nodules.

CT Characteristic	Further Evaluation, n (%)	Clinically Significant Pathology, n (%)	p value
Nodule <15 mm	48 (57.1%)	2 (2.4%)	<0.001
Nodule ≥15 mm	48 (88.9%)	8 (14.8%)	

mm			
No suspicious CT features	62 (58.0%)	2 (1.9%)	<0.001
≥1 suspicious CT feature	31 (100.0%)	8 (25.8%)	
Solitary nodule	71 (70.3%)	8 (7.9%)	0.68
Multiple nodules	25 (67.6%)	2 (5.4%)	

Tables Summary

Table 1 demonstrated that incidental thyroid nodules were identified in 138 of 600 patients undergoing neck CT, corresponding to a prevalence of 23.0%. The mean age of affected patients was 49.6 ± 13.8 years. Patients aged 40–59 years represented the largest age group, accounting for 49.3% of cases, followed by patients aged ≥ 60 years. Women constituted 60.9% of the study population with incidental nodules, indicating a female predominance. Table 2 showed that solitary nodules were considerably more frequent than multiple nodules, accounting for 73.2% and 26.8% of cases, respectively. Right- and left-lobe nodules occurred with similar frequency, while the isthmus was involved in 10.1% of patients. Nodules measuring ≥ 15 mm constituted the largest size category at 39.1%, and the mean maximum nodule diameter was 14.2 ± 8.6 mm. Table 3 demonstrated that 22.5% of patients with incidental thyroid nodules had at least one suspicious CT characteristic. Heterogeneous enhancement was the most frequently recorded individual feature, followed by irregular or infiltrative margins and suspicious calcification. Findings suggestive of extrathyroidal extension or abnormal cervical lymphadenopathy were

present in a smaller proportion of patients but were clinically important because of their potential association with invasive or malignant thyroid disease. Table 4 showed that 96 of the 138 patients underwent dedicated thyroid ultrasonography. Among those undergoing ultrasound, 42 patients underwent FNAC. Benign cytology represented the largest cytological category, accounting for 64.3% of aspirated nodules. Indeterminate cytology was reported in 19.0%, while suspicious and malignant cytology together accounted for 16.6% of aspirated nodules. Table 5 demonstrated that seven patients underwent surgical management and had histopathological confirmation of malignancy, including six papillary thyroid carcinomas and one follicular thyroid carcinoma. Overall, clinically significant thyroid pathology was identified in 10 of the 138 patients with incidental nodules, corresponding to 7.2%, while 92.8% did not demonstrate clinically significant pathology. Table 6 demonstrated a significant association between nodule size and subsequent clinical significance. Nodules measuring ≥ 15 mm were more frequently subjected to further evaluation and showed a higher proportion of clinically significant pathology than nodules measuring < 15 mm. The presence of suspicious CT characteristics showed an even stronger association: all patients with suspicious CT findings underwent further evaluation, and 25.8% demonstrated clinically significant pathology compared with 1.9% among patients without suspicious CT characteristics. In contrast, solitary versus multiple nodule status was not significantly associated with clinically significant pathology.

Figure 1. Distribution Of Incidental Thyroid Nodules According To Nodule Size

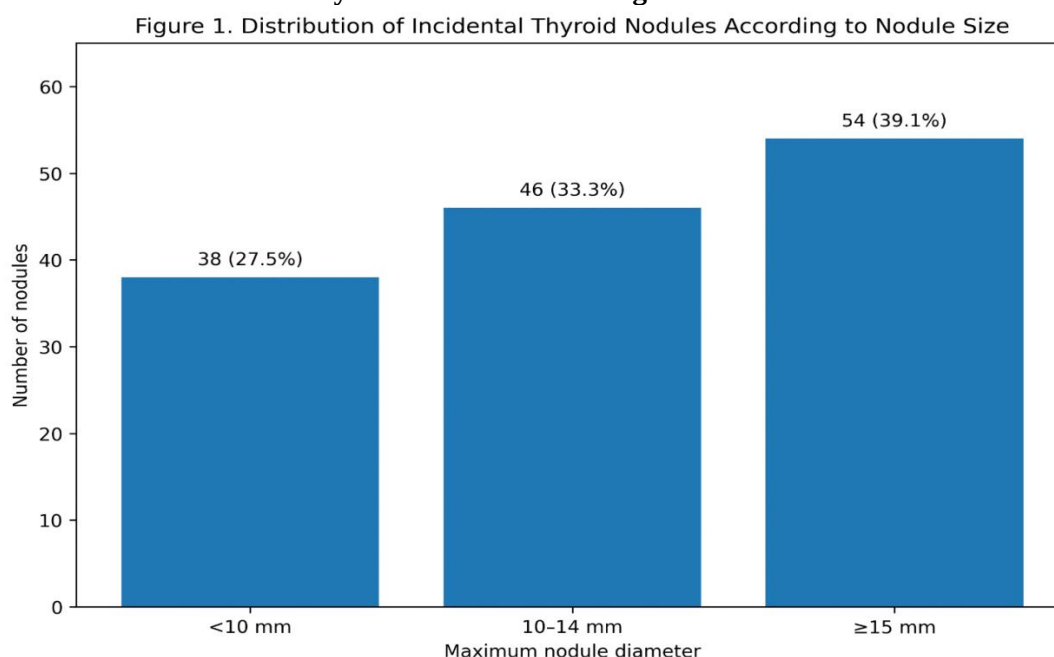


Figure 1 illustrates the distribution of the 138 incidentally detected thyroid nodules according to maximum nodule diameter. Nodules measuring ≥ 15 mm constituted the largest group (54; 39.1%), followed by those measuring 10–14 mm (46; 33.3%) and < 10 mm (38; 27.5%).

Figure 2. Clinically Significant Thyroid Pathology According To Suspicious CT Features

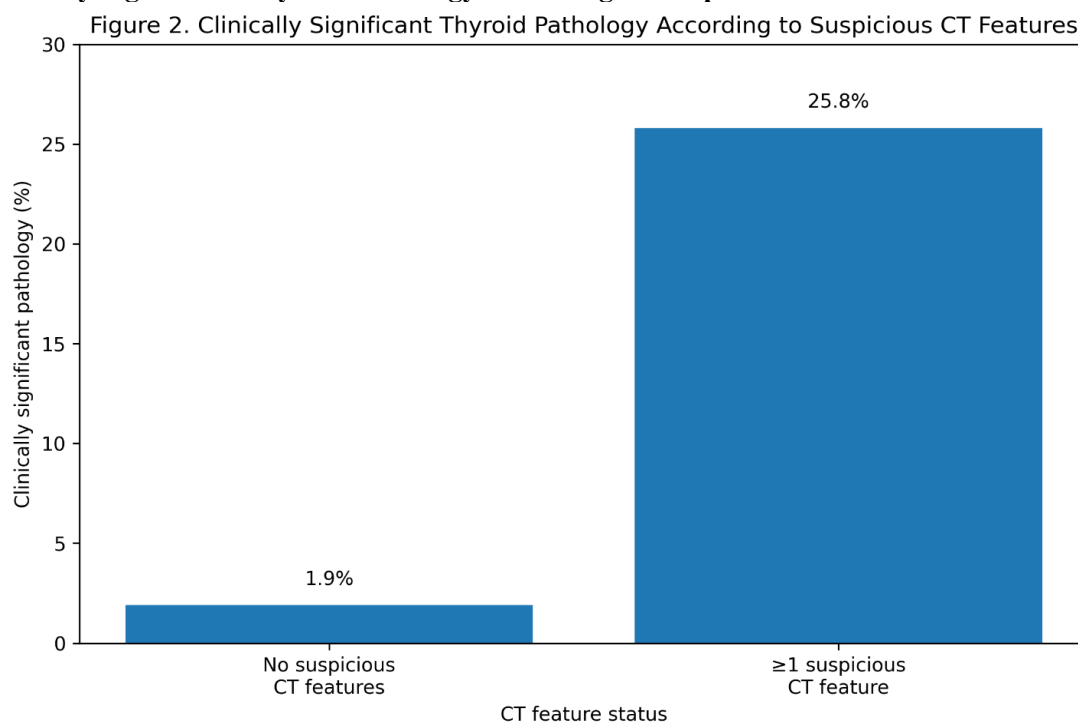


Figure 2 compares the proportion of nodules associated with clinically significant thyroid pathology according to the presence of suspicious CT features. Clinically significant pathology was substantially more frequent among nodules with ≥ 1 suspicious CT feature (25.8%) than among those without suspicious CT features (1.9%; $p < 0.001$).

DISCUSSION

Incidental thyroid nodules represent a frequent finding on imaging examinations performed for indications unrelated to the thyroid gland. In the present study, incidental thyroid nodules were identified in 138 of 600 patients undergoing contrast-enhanced neck CT, corresponding to a prevalence of 23.0% [1]. This relatively high frequency highlights the importance of systematic evaluation of the thyroid gland during routine interpretation of neck CT examinations. The finding also illustrates the increasing clinical relevance of thyroid incidentalomas as modern multidetector CT provides improved spatial resolution and permits detection of relatively small thyroid abnormalities that may not be clinically apparent [2].

The predominance of women in the present study was consistent with the recognized higher frequency of thyroid nodules among females. Women accounted for 60.9% of patients with incidentally detected nodules, while men represented 39.1%. The mean age was 49.6 ± 13.8 years, with nearly half of the patients belonging to the 40–59-year age group [3]. The concentration of incidental nodules among middle-aged and older adults is clinically relevant because the probability of clinically important thyroid disease is influenced by age and other patient-level risk factors. However, age alone does not provide sufficient discrimination between benign and clinically significant lesions, emphasizing the need for imaging-based risk assessment [4].

Most nodules in the present study were solitary, accounting for 73.2% of cases, whereas multiple nodules were identified in 26.8%. The right and left thyroid lobes were equally represented, while the isthmus was involved in only 10.1% of cases. These findings demonstrate that incidental thyroid nodules can occur throughout the gland and that their anatomical location alone is generally insufficient to establish clinical significance. The similar distribution between the two lobes also suggests that laterality does not appear to be a major determinant of whether an incidental lesion warrants additional investigation [5]. Nodule size was an important finding in the present study. The mean maximum diameter was 14.2 ± 8.6 mm, and 39.1% of nodules measured ≥ 15 mm. The analysis demonstrated a significant association between nodule size and subsequent clinical evaluation as well as clinically significant pathology. Among nodules measuring ≥ 15 mm, 88.9% underwent further evaluation compared with 57.1% of nodules measuring < 15 mm [6]. Clinically significant pathology was also more frequently identified among larger nodules. This finding supports the practical importance of nodule size when determining which incidental lesions should undergo dedicated thyroid assessment, while also emphasizing that size should not be considered independently of morphology and patient risk factors [7].

The study also demonstrated the importance of suspicious CT characteristics. At least one suspicious feature was present in 31 patients, representing 22.5% of the patients with incidental thyroid nodules.

Heterogeneous enhancement was the most frequently documented suspicious feature, followed by irregular or infiltrative margins and suspicious calcification [8]. Although individual CT features varied in frequency, their combined presence provided clinically useful information. All patients with suspicious CT characteristics underwent further evaluation, and clinically significant pathology was identified in 25.8% of this group compared with only 1.9% among patients without suspicious CT findings. This marked difference indicates that the morphological appearance of an incidental thyroid nodule on CT can contribute meaningfully to selecting patients for subsequent investigation [9].

Particular attention should be paid to findings suggesting local invasion or metastatic cervical lymphadenopathy. In the present study, suspected extrathyroidal extension and/or abnormal cervical lymphadenopathy was observed in 5.1% of patients. Although these findings were less common than heterogeneous enhancement or irregular margins, they are potentially more clinically consequential because they may indicate locally advanced thyroid malignancy. Recognition of such findings during the initial CT examination can facilitate timely referral for dedicated ultrasound and tissue diagnosis [10].

Dedicated thyroid ultrasonography was performed in 69.6% of patients with incidental thyroid nodules. The decision to proceed with ultrasound was influenced by nodule size, CT morphology, clinical risk factors, and the overall radiological appearance [11]. Ultrasound remains particularly valuable because it provides detailed characterization of thyroid nodule composition, echogenicity, shape, margins, calcification, and associated cervical lymph nodes. CT therefore functions primarily as the modality through which the incidental abnormality is detected and initially characterized, while ultrasound provides more specific thyroid-focused risk stratification [12].

Fine-needle aspiration cytology was performed in 42 patients who underwent ultrasound. Benign cytology was the most common result, accounting for 64.3% of aspirated nodules. Indeterminate cytology was identified in 19.0%, while suspicious and malignant cytology accounted for 7.1% and 9.5%, respectively [13]. The predominance of benign cytology supports the concept that most incidentally identified thyroid nodules do not represent malignant disease. At the same time, the identification of malignant and suspicious cytological categories demonstrates why selected incidental nodules cannot simply be disregarded after detection on CT [14].

Histopathological evaluation provided definitive confirmation in patients who underwent surgical treatment. Seven patients had histopathologically confirmed thyroid malignancy, comprising six cases of papillary thyroid carcinoma and one case of follicular thyroid carcinoma [15]. Papillary thyroid carcinoma was therefore the predominant malignant histological

subtype in this cohort. The overall proportion of patients with clinically significant thyroid pathology was 7.2%, demonstrating that although most incidental nodules were not clinically significant, a clinically relevant minority required further diagnostic or therapeutic management [16].

An important finding was the difference between the frequency of incidental nodules and the frequency of clinically significant disease. Although almost one-quarter of patients undergoing neck CT had an incidental thyroid nodule, only 7.2% of those patients demonstrated clinically significant thyroid pathology according to the study definition [17]. This distinction is central to the management of incidental thyroid findings. The presence of a thyroid nodule should not automatically trigger an extensive diagnostic pathway. Instead, the decision should incorporate nodule size, suspicious morphology, patient characteristics, associated cervical findings, and subsequent ultrasound assessment [18].

The absence of a significant association between solitary versus multiple nodules and clinically significant pathology further supports the importance of morphological rather than purely numerical assessment. Multiple nodules are common in multinodular thyroid disease and may frequently represent benign pathology [19]. Conversely, a solitary lesion can demonstrate malignant features. Therefore, simply reporting that a thyroid gland contains one or multiple nodules is inadequate for determining clinical significance. The dominant or most suspicious lesion should receive particular attention when multiple nodules are present [20].

The findings have practical implications for radiology reporting. Incidental thyroid nodules should be recognized and appropriately described rather than being omitted from the CT report. However, reporting should also avoid indiscriminate recommendations for further investigation of every small and morphologically low-risk lesion. A structured approach incorporating size, morphology, calcification, margins, evidence of local invasion, and cervical lymphadenopathy can help identify patients who are more likely to benefit from thyroid ultrasonography. Such an approach can improve communication between radiologists, endocrinologists, surgeons, and primary treating clinicians.

The study also highlights the complementary roles of CT and ultrasound. CT is advantageous because the thyroid is routinely included within the field of view during neck imaging and because the examination provides information about surrounding anatomical structures. Ultrasound, however, remains superior

Strengths

This study prospectively evaluated a relatively large cohort of 600 adult patients undergoing contrast-enhanced neck CT for non-thyroid indications. It assessed incidental thyroid nodules using a structured

evaluation of nodule size and suspicious CT characteristics and correlated these findings with subsequent ultrasonography, cytology, and histopathology. The study also identified clinically significant thyroid pathology and evaluated the association of nodule size and suspicious CT features with further diagnostic evaluation.

Limitations

This study was conducted at a single tertiary care teaching hospital, which may limit the generalizability of the findings to other healthcare settings. Not all patients with incidental thyroid nodules underwent ultrasonography, FNAC, or histopathological confirmation, and therefore the true prevalence of clinically significant pathology may not be fully established. The relatively limited number of surgically confirmed cases also restricts the statistical power for detailed subgroup analysis. Longer-term follow-up was not available to assess the subsequent clinical course of all detected nodules.

Future Directions

Future multicenter studies involving larger patient populations could validate the observed associations between nodule size, CT characteristics, and clinically significant thyroid pathology. Prospective follow-up incorporating standardized ultrasound risk stratification and long-term clinical outcomes may further refine criteria for selecting patients who require additional investigation. Such evidence could help develop and validate practical CT-based risk-stratification algorithms for incidental thyroid nodules.

CONCLUSION

Incidental thyroid nodules were frequently detected on contrast-enhanced neck CT, occurring in 23.0% of the patients evaluated in the present study. Although the majority of detected nodules did not demonstrate clinically significant pathology, 7.2% were associated with clinically significant thyroid disease, including histopathologically confirmed thyroid malignancy. Larger nodule size and suspicious CT characteristics, particularly irregular margins, suspicious calcification, heterogeneous enhancement, and findings suggestive of local invasion or cervical lymphadenopathy, were associated with a greater likelihood of clinically significant pathology.

These findings support a structured and risk-based approach to incidental thyroid nodules identified on neck CT. CT should be used to recognize and initially characterize suspicious lesions, while dedicated thyroid ultrasonography and selective ultrasound-guided FNAC should be used for further evaluation when clinically indicated. Systematic recognition and appropriate reporting of suspicious thyroid nodules can facilitate timely diagnosis of clinically important malignancy while reducing unnecessary investigation of low-risk incidental findings.

Declarations

Ethics Approval: The study was conducted in accordance with the Declaration of Helsinki and received approval from the Institutional Ethics Committee.

Informed Consent: Written informed consent was obtained from the participants.

Conflict of Interest: The authors declare that they have no conflict of interest.

Funding: No specific funding was reported for this study.

Authors' Contributions: All authors contributed to the study conception, data collection, analysis and interpretation, manuscript preparation, and approval of the final manuscript.

Data Availability: The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable ethical and institutional restrictions.

Acknowledgments

The authors sincerely acknowledge the support and guidance received from their teachers, colleagues, and the patients who participated in the study.

AI Use Disclosure

The authors declare that no generative artificial intelligence tools were used to generate or substantially modify the scientific content of this manuscript.

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