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*Original Article*

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# Malignancy Risk of Incidental Thyroid Gland Pathologies Detected on Thoracic Computed Tomography

*(**Running title:** Thyroid pathologies in computed tomography)*

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***Abstract***

***Background:*** *Careful evaluation of the thyroid gland in Thoracic Computed Tomography is important in the early diagnosis and treatment of thyroid pathologies. The study aimed to determine the incidence of thyroid pathologies detected in Thoracic Computed Tomography and then to determine thyroid pathologies and their malignancy potential in those who underwent Thyroid Ultrasonography.*

***Methods:*** *Our study included 2655 patients that underwent Thoracic Computed Tomography between January 2023 and November 2023. Cases with thyroid gland pathologies were assessed in Thoracic Computed Tomography. Among assessed patients, those who underwent Thyroid Ultrasonography were identified, and the findings were classified according to the Thyroid Imaging Reporting and Data System (TIRADS).*

***Results:*** *Thyroid pathology was detected in 238 of 2655 cases who underwent Thoracic Computed Tomography. Thyroid Ultrasonography was performed in 38 of these cases leading the diagnosis of TIRADS II, III, and IV lesions in 12, 18, and 8 cases, respectively.*

***Conclusions:*** *Careful evaluation of the thyroid gland in Thoracic Computed Tomography by clinicians and radiologists allows early diagnosis and treatment of premalignant and malignant lesions of the thyroid gland.*

***Keywords:*** *Thoracic computed tomography, thyroid cancer, incidental thyroid pathology.*

## Introduction

Incidentaloma is an unexpected, asymptomatic mass discovered incidentally during imaging performed for another reason. With the increased use of imaging methods, the prevalence of incidentaloma increased and became an important issue [1]. With the developments in Computed Tomography (CT) technology in recent years, multi-slice, high-resolution, and thinner-slice images have begun to be obtained. Thus, the possibility of detecting incidental lesions has increased [2]. In cases of respiratory complaints, the entire cervical area within the examination area can be evaluated using Thorax CT (TCT) in addition to the lung parenchyma and mediastinum. Careful evaluation of the thyroid gland in TCT is important in the early diagnosis and treatment of thyroid pathologies [3]. The density and contrast enhancement of the thyroid nodule on TCT can distinguish cystic/solid nodules. Complicated cysts can be seen with high density. Calcifications in the thyroid gland can be seen on TCT. However, CT is inadequate in distinguishing benign/malignant calcification types. Large thyroid nodules detected on CT may be difficult to characterize because CT is not planned to target the thyroid gland. In TCT, the patient's arms are placed above the head. When the examination is with intravenous contrast, the high-density contrast material in the subclavian veins causes beam hardening artifacts in the thyroid gland. The clavicle may also cause thyroid artifacts. These artifacts may obscure nodules or create pseudolesions. Additionally, small nodules are difficult to characterize on CT unless fine collimation and multiplanar reconstruction are available. Routine TCT is usually performed with a slice thickness of 3 to 5 mm, which is not ideal for characterizing nodules smaller than 1 cm [4]. Therefore, Thyroid Ultrasonography (TUS) should be recommended to patients with pathology detected in the thyroid gland on CT [5].

The thyroid gland can be evaluated best and fastest with TUS. TUS is noninvasive, fast, easily accessible, and does not involve radiation. TUS provides information about thyroid gland dimensions, parenchymal homogeneity, Graves' Disease, multinodular goiter, Hashimoto's thyroiditis, infectious thyroiditis, and diffuse thyroid gland diseases such as nodules [6]. Criteria such as the size, borders, internal structure of the thyroid nodule, calcification in the nodule, and Doppler TUS findings guide the distinction between benign and malignant nodules [7].

To reduce unnecessary imaging and biopsies, it is necessary to evaluate the US features of thyroid nodules in a standardized manner. For this purpose; The American College of Radiology (ACR); established the Thyroid Imaging Reporting and Data Systems (TIRADS) reporting system in 2015 [8]. In TIRADS

evaluation, US findings are divided into 5 categories. TIRADS 1: Normal thyroid gland, TIRADS 2: Benign findings (0% risk of malignancy), TIRADS 3: Probably benign nodules (5% risk of malignancy), TIRADS 4: Suspicious nodules, 4A: 5% to 10% risk of malignancy, 4B: 10% to 80% risk of malignancy, TIRADS 5: Probably malignant nodule (malignancy risk >80%). Recommendations for biopsy or US follow-up are determined depending on the ACR TIRADS level and maximum diameter of the nodule and are reported in a common language [9]. Accordingly, biopsy should be performed to make a definitive diagnosis in TIRADS 4 and above nodules [10].

Our aim in this study is to determine the incidence of thyroid pathologies detected in TCT and the malignancy potential of the findings in those who underwent TUS according to the TIRADS classification. In addition, underlines the importance of careful evaluation of the thyroid gland in TCT.

## Materials and Methods

Patients who presented to our institution's outpatient clinics with thoracic symptoms and underwent TCT between January 2023 and November 2023 were evaluated retrospectively. The images and reports of the cases in our hospital's Picture Archiving and Communication System (PACS) were retrospectively reviewed by a single experienced radiologist (D.D.). Demographic data of the cases were obtained from the hospital electronic record system. TCT was performed with or without contrast. A 64-slice CT (Optima CT 660, General Electric Medical Systems, Milwaukee, Wisconsin, USA) device was used in all scans. Contrast-enhanced Thorax CT images were obtained by administering water-soluble non-ionic high-iodine contrast material (350-370 mg/ml) with an automatic dual injector system at a dose of 1 ml/kg (90-100 ml) at a rate of 3-5 ml/s through an 18-gauge cannula placed in the antecubital vein. IV contrast material timing was performed with a bolus tracking technique. Slice thickness was set as 1.25, 2.5, and 5 mm, and multiplanar CT images were obtained.

First, cases with incidental thyroid pathology detected in TCT were identified. Then, the results of those who underwent TUS were classified according to ACR-TIRADS. Cases with TIRADS scores between 2 and 5 were identified, and the risk of malignancy was analyzed. Ethics committee approval (İstanbul Okan University noninvasive clinical research ethics Received No:171/18, dated 6-12-2023) before initiating the research. The study complies with the principles of the Declaration of Helsinki and relevant legislation was carried out appropriately.

In the descriptive statistics of the data, mean, standard deviation, median minimum, maximum, frequency, and ratio values were used. SPSS 28.0 program was used in the analyses.

## Results

Thyroid pathology was seen in 238 of 2655 cases. Of those with thyroid pathologies, 129 (54.2%) were male and 109 (45.8%) were female. TUS was performed in 38 of these cases (16.0%). Of these, 12 (31.6%) were evaluated as TIRADS 2 (Figures 1a and 1b), 18 (47.4%) were evaluated as TIRADS 3 (Figures 2a and 2b), and 8 (21.0%) were evaluated as TIRADS 4 (Figures 3a and 3b). There was found no case of TIRADS 5 (Table 1).

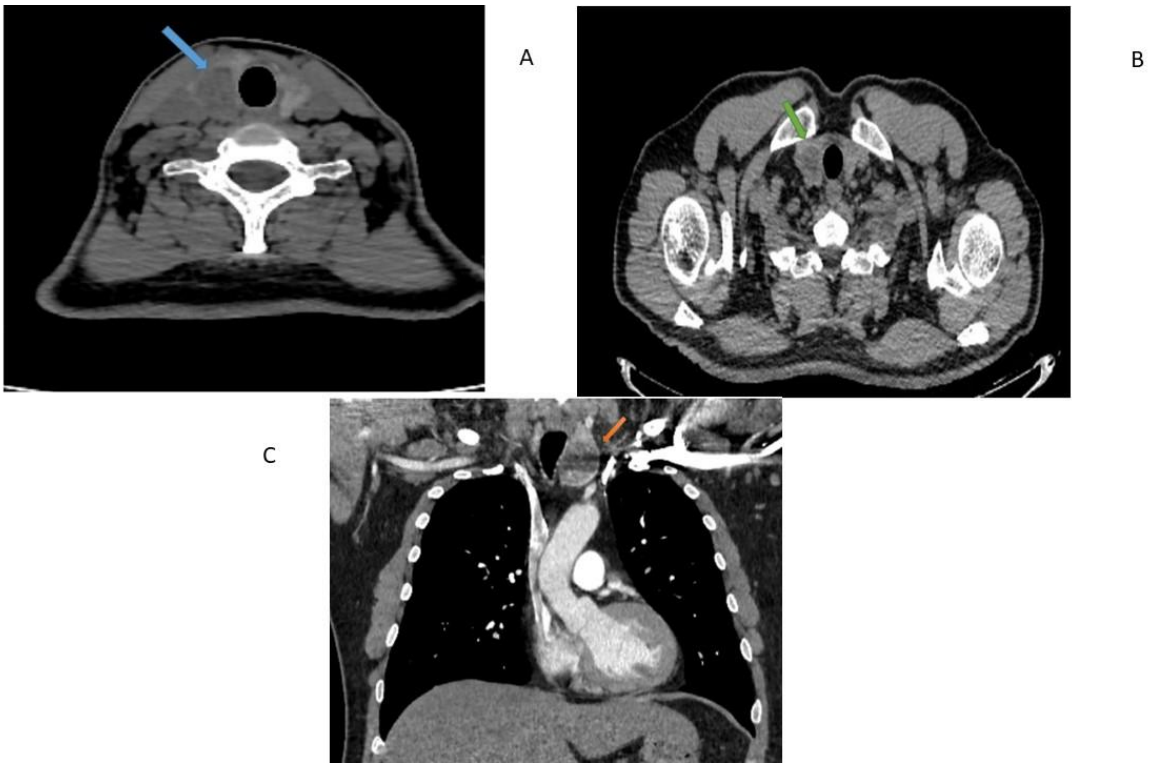



**Figure 1:** Non-contrast axial section TCT showing a hypodense nodule in the right thyroid gland (blue arrow) (A), a hypodense nodule in the right thyroid gland (green arrow) (B), a heterogeneous hypodense nodule with slight contrast enhancement in the left thyroid gland (orange arrow) (C)

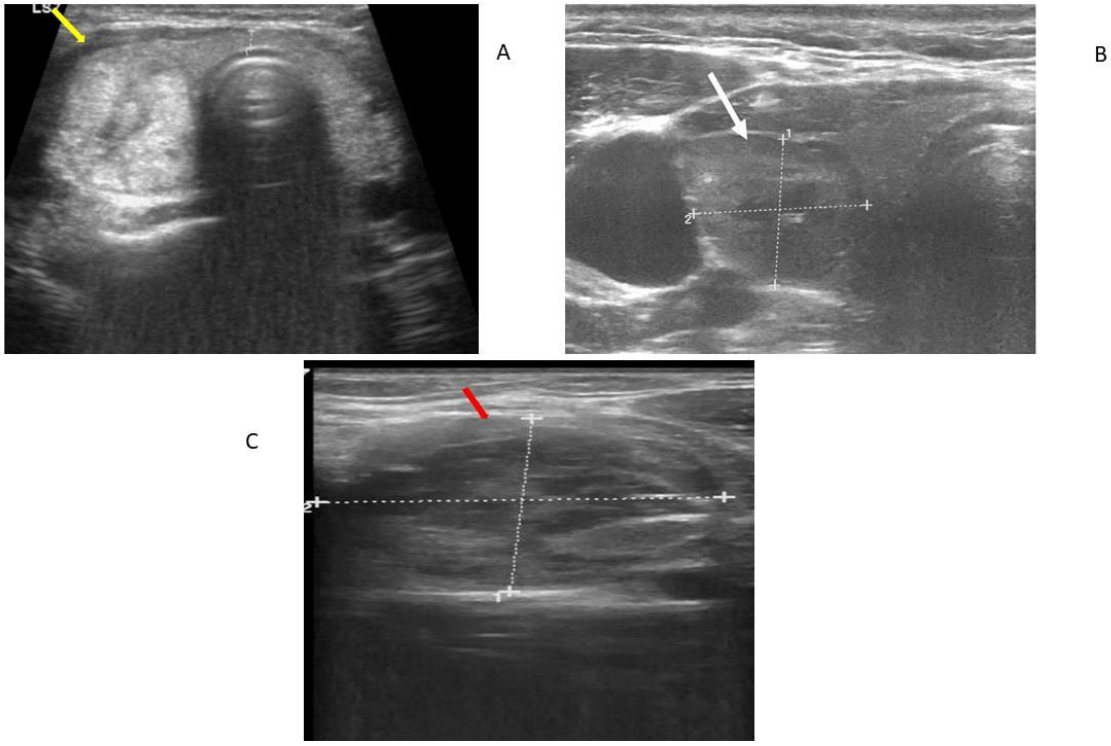



**Figure 2:** Thyroid Ultrasonography findings: Isoechoic nodule with peripheral hypoechoic halo in the right lobe; TIRADS 2 (yellow arrow) (A), a hypoechoic nodule in the right lobe with a peripheral hypoechoic halo and slightly heterogeneous internal structure, containing coarse calcific and cystic foci; TIRADS 3 (white arrow) (B), Heterogeneous hypochoic nodule with millimetric calcifications, TIRADS 4 (red arrow) (C)

**Table 1:** Demographic information, TUS, and biopsy results of the cases.

| | |
|---|---|
| Mean age, year | 55.0±16.2 |
| Gender, % | |
| Male | 129 (54.2%) |
| Female | 109 (45.8%) |
| TUS, % | |
| Done | 38 (16.0%) |
| Not done | 200 (84.0%) |
| TIRAD (of 38 cases) | |
| II | 12 (31.6%) |
| III | 18 (47.4%) |
| IV | 8 (21.0%) |

Of 12 patients with TIRADS II, 4 were female and 8 were male with the mean age of 53.5±16.6 years. Of 18 cases with TIRADS III, 10 were female and 8 were male, with a mean age of 53.0±16.4 years. Of the TIRADS IV cases, 4 were female and 4 were male, with an average age of 45.0±16.6 years (Table 2).

**Table 2:** Distribution of lesions by gender and mean age according to TIRADS classification.

| TIRADS | Female | Male | Mean age |
|---|---|---|---|
| TIRADS II (n = 12) | 4 (33.3) | 8 (66.7) | 53.5±16.6 |
| TIRADS III (n = 18) | 10 (55.6) | 8 (44.4) | 53.0±16.4 |
| TIRADS IV (n = 8) | 4 (50.0) | 4 (50.0) | 45.0±16.6 |

## Discussion

The term incidentaloma, which emerged with the use of CT scans in 1982, refers to findings detected in an imaging test performed for another reason in an asymptomatic patient [11]. Incidentalomas are now commonly detected in many solid organs [12]. Thyroid incidentaloma is defined as an unsuspected, asymptomatic thyroid lesion discovered on imaging or during surgery that is unrelated to the thyroid gland. The thyroid gland is a vascular, encapsulated structure comprising of right and left lobes connected by the isthmus. It surrounds the trachea. The thyroid gland is one of the organs where incidentalomas are most commonly seen on TCT. The CT scan findings of the thyroid gland may include calcifications, single or multiple nodules, cysts, or diffuse enlargement [13]. The prevalence of nodules within the thyroid gland is high, especially in regions with an iodine deficiency, where nodular goiter is predominant [14]. The prevalence of incidental thyroid nodules in TCT in the adult population is 16-25% [15]. While

some of these pathologies seen on CT may be benign, some may be malignant. Detection of thyroid incidentalomas is especially important for the early diagnosis of thyroid cancers and early initiation of treatment [16,17]. Incidental thyroid nodules may be found on TCT obtained for the evaluation of lung disease, cervical spine disease, and traumatic injury. Incidental thyroid nodules may be found on CT angiography obtained for the evaluation of pulmonary embolism or blunt carotid artery injury. Positron Emission Tomography (PET), which is increasingly used for the evaluation and follow-up of patients with known malignancy, is known to detect incidental lesions in the thyroid gland. The detection rates of thyroid incidentalomas have been reported to be 8% with CT and MRI and 11% with PET or PET/CT scans [18]. In our study, this rate was 8.96% in TCT.

During the pandemic, Thorax CT imaging was frequently performed in patients suspected of COVID-19 all over the world. Many studies have been conducted to investigate the frequency of thyroid incidentaloma in imaging performed during this period. In a series of 1992 patients, the frequency of thyroid incidentaloma was found to be 4.8% (95 patients). It was found that the incidence increased with age, female gender, and history of malignancy [19].

In a study of 1326 patients hospitalized due to COVID-19 (mean age 49.4 and 55.3% female), the prevalence of thyroid incidentalomas was found to be 20.2%. Patients with thyroid incidentalomas were found to be older (59.6 years vs. 46.8 years, $p<0.001$) and more frequently female than those without incidentalomas (63.4% vs. 53.2%, $p=0.003$) [20].

In a large-scale study conducted on 35,113 patients during the COVID-19 pandemic, the prevalence of thyroid nodules reported with thoracic CT was 3.82%, while thyroid cancer was detected histopathologically in 1.30% of these cases. In this study, it was concluded that TCT scans obtained for various reasons may provide an opportunity for early diagnosis and treatment of thyroid diseases, including cancers [21].

With the development of computer-aided diagnostic methods, differential diagnosis of thyroid pathologies on CT has been attempted to be facilitated. A ratio of the anterior-posterior diameter of the nodule to the transverse diameter of more than 1 on CT, the presence of calcification, and an attenuation value of more than 130 HU on contrast-enhanced examinations suggest malignancy. However, no CT feature can reliably distinguish benign from malignant lesions in the thyroid gland, and CT underestimates the number of nodules compared to TUS, so CT is of limited use in the early detection and evaluation of thyroid cancer in the thyroid gland. TUS is a highly useful examination method after an incidentally detected thyroid abnormality on CT. In suspicious thyroid nodules, fine needle aspiration biopsy (FNAB) is considered the "gold standard" method for diagnosing thyroid nodules. It is a rapid, safe, sensitive, and cost-effective test to evaluate these nodules [22-24].

The American Thyroid Association (ATA) recommends diagnostic thyroid/neck ultrasound for all patients with incidental thyroid pathologies [25,26]. In today's TUS application, the use of ACR TIRADS classification has become an increasingly widespread reporting system. In studies, the sensitivity value of the TIRADS classification was reported as 88% and the specificity rate as 49% [27,28]. In our study, TIRADS 4 lesions were detected in 3.4% of the cases in which TUS was performed, and FANB was recommended for them.

While evaluating incidental thyroid nodules, nodules 10 mm and above were subjected to further examination in one approach, while patients under the age of 35 and nodules over 15 mm were subjected to further examination in another approach. The results showed that the risk of mortal cancer could be detected at approximately the same rates in both approaches [28]. In our study, we used the current approach, TIRADS categorization, and determined the risk of malignancy accordingly.

In cases presenting to a health institution with thoracic symptoms, the clinician may not need other organ imaging findings, or some incidental pathologies may not be reported by radiologists. Studies on current practices for reporting thyroid nodules seen on CT and MRI examinations by radiologists have yielded quite variable results. While some radiologists report all incidental thyroid nodules due to the possibility of malignancy, others prefer not to report them, assuming that thyroid cancers in incidental thyroid nodules are relatively rare and that small thyroid cancers generally follow an indolent course [29,30].

The study had some limitations. Due to the retrospective nature of our study, sonographic evaluation was not performed in our hospital in every case where thyroid pathology was incidentally seen on CT, and ultrasound examination was recommended. Therefore, US reports of all patients for whom TUS was recommended could not be obtained.

## Conclusion

When evaluating TCT studies, careful evaluation of all sections allows early diagnosis of thyroid pathologies in cases that are clinically asymptomatic or have nonspecific symptoms and helps prevent the progression of possible malignancy.

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The authors have no acknowledgements to declare.

**Ethics Committee Approval**

The approval of this study in accordance with the ethical rules of the Declaration of Helsinki was approved by the ethics committee of İstanbul Okan University at the meeting numbered 171 on 6.12.2023 with decision number 18. The written informed consent to participate was obtained from all of the participants in the study.

**Authorship Contributions**

Concept, study designing and supervising: KG, DD, HA, ZG, MS, Data collection and entry: KG, DD, HA, ZG, MS, Analysis, and interpretation: KG, MS, analyzing and writing: KG, MS. All authors read and approved the final version of the manuscript.

**Conflict of Interest**

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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**Consent for publication**

Not Applicable

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