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ORIGINAL ARTICLE

Accuracy of Preoperative TIRAD Classification Versus Postoperative Histopathology in Nodular Goiter

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Abstract

Background: ***Epidemiologic research indicates The prevalence of thyroid nodules detected by HRUS in people in general ranges from nineteen to sixty-eight percent.***

Aim: ***To evaluate the efficacy of the thyroid imaging, reporting, and data system (TIRAD) in detecting thyroid nodule cancer using histological findings obtained after surgery.***

Patients and methods: ***Twenty patients undergoing open total thyroidectomy at Al-Azhar University Hospitals' general surgery for thyroid surgery departments were included in this prospective research. The patients all had nodular goiters.***

Results: ***For benign tumor diagnosis, TIRAD classified 20%, while histopathology identified 45% as benign (P Value= 0.096). TIRAD had a sensitivity of 33.33%, specificity of 90.91% &overall accuracy of 65%. For the suspicious group, TIRAD classified 70% as suspicious, while histopathology indicated 35% (P= 0.0266); TIRAD had a sensitivity of 71.43%, specificity of 30.77%, and accuracy of 45%. In the malignant group, TIRAD classified 10% as malignant, while histopathology identified 20% (P= 0.3888). TIRAD showed a sensitivity of 25%, a specificity of 93.75%, and an accuracy of 80%.***

Conclusion: ***TIRADS grading is a useful instrument for preoperative evaluation therapy as we found that for benign tumor diagnosis, TIRAD classified 20% with a sensitivity of 33.33%, specificity of 90.91%, overall accuracy of 65%, while for the Suspicious group, TIRAD classified 70% as suspicious with a sensitivity of 71.43%, specificity of 30.77%, & accuracy of 45%. In the Malignant group, TIRAD classified 10% as malignant with a sensitivity of 25%, specificity of 93.75%, an accuracy of 80%.***

Keywords: TIRAD; Nodular goiter; Open total thyroidectomy

1. Introduction

A common clinical finding, thyroid nodules are typically asymptomatic. Thyroid nodules detected by HRUS in the general population are reported to be prevalent by 19–68%, according to epidemiological research.[1]

It is critical to differentiate benign nodules from malignant ones, as the incidence of cancer ranges from seven to fifteen percent of all nodules.[2]

At present, the US stands as the preferred diagnostic modality for the preliminary assessment of thyroid nodules. The primary objective of a thyroid ultrasound examination is to differentiate benign nodules from those that are presumed to be malignant and necessitate additional investigation. Around ninety percent of thyroid lesions are asymptomatic upon initial detection and subsequent monitoring.[3]

FNAB, the other antiquated procedure for assessing thyroid nodules, plays a negligible role in preoperative thyroid nodule evaluation. In light of the aforementioned factors, the American Association of Clinical Endocrinologists and the American Thyroid Association have collaborated to develop the TIRADS classification, a pragmatic clinical statement intended to enhance communication among clinicians and US practitioners.[4]

Horvath et al. initially proposed the TIRADS, which originated from the Breast TIRADS. Subsequent to its inception, multiple iterations of the TIRADS have received endorsement from international medical organizations as a means to approximate the ultimate evaluation and treatment of thyroid lesions. All of them categorize nodules according to US characteristics that are considered suspicious, including composition, echogenicity, morphology, margin, and echogenic foci.[5,6]

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The European Thyroid Association introduced a novel and straightforward European (EU-TIRADS) in 2017. This system categorizes the malignancy risk of thyroid nodules in adults into benign, low, intermediate, and high-risk (e.g., EU-TIRADS 1 indicates a normal examination, whereas EU-TIRADS 5 indicates a high risk of malignancy).[7]

The objective of this research endeavor was to evaluate the clinical utility of TIRAD classification in relation to postoperative histopathological findings for the diagnosis of thyroid nodule malignancy.

2. Patients and methods

This prospective study was conducted on 20 patients with nodular goiter who underwent open total thyroidectomy at the general surgery department with regard to thyroid surgery at Al-Azhar University hospitals.

Inclusion criteria: Both genders and ages above 18 years old, multinodular goiter, and solitary thyroid nodule.

Exclusion criteria: Recurrent thyroid goiter, history of head-neck surgery or irradiation, evidence of clinical hyperthyroidism, lymph node metastasis, and patients unfit for general anesthesia.

Ethical Consideration

The information collected from participants is strictly confidential. The identities of the research's participants will not be disclosed in any report or publication associated with this research. The participants were provided with a comprehensive explanation of the research's objectives, characteristics, and risk-benefit analysis prior to their admission. A consent that was informed was obtained.

Methods:

TIRADS: EU-TIRADS 1 categorized a normal thyroid gland, EU-TIRADS 2 benign nodules, EU-TIRADS 3 nodules with low suspect for malignancy, EU-TIRADS 4 nodules with intermediate suspicion for malignancy, EU-TIRADS 5 nodules that strongly suggested the presence of malignancy.

Surgical procedure:

Positioning to draping:

Positioning is crucial for thyroid bed exposure and maneuvers. After anesthesia, the patient should remain supine with full neck extension, supported by a sandbag and silicone gel. Draping involves placing three sheets of cloth across and under the head, covering the entire face and clavicles. Centralizing the neck and adjusting the operational table lights are also essential.

Proper skin crease incision

The low collar transverse skin crease incision is a common technique for thyroid surgeries, providing cosmetic benefits and minimal scar healing. This incision is typically made along the natural skin crease or fold, between 1.5 and 2 centimeters from the costoclavicular joints or sternal depression. Prior to the incision being expanded to the anterior borders of the sternocleidomastoid muscle, a topical anesthetic can be injected to minimize bleeding. This procedure typically takes around three minutes.

Raising the Sub-Platysmal flap

In order to elevate the Subplatysmal flap, a transverse incision is made in the epidermis and subcutaneous platysmal muscle, then dissected with skin hooks above the thyroid cartilage border. Silk sutures may be used to secure this technique to sheets for continuous use. Exposure and prevents marginal mandibular nerve injury.

Incising investing layer of deep cervical fascia and muscle retraction/division:

The subplatysmal flap provides access to the strap muscles that encase the sternocleidomastoid muscles, which are concealed within the deep cervical fascia. By employing electro-cautery to vertically incise the investing layer, it is possible to isolate strap muscles from adipose areolar tissue and subsequently retract them laterally. However, large goiters make muscle retraction challenging; therefore, in order to spare the Ansa cervicalis in the lower neck, surgeons divide the strap muscles in the upper one-third of muscle length.

Middle Thyroid Vein Dissection

The middle thyroid vein, a fragile structure unsupported by any artery, is dissected once the thyroid lobe has been delivered and the adventitial tissues and strap muscles have been retracted. Following ligation and division of the vein with sutures, the vein is dissected in a superior direction, reaching the superior lobe.

Superior Pedicle Management

Following individual identification, the superior thyroid artery & vein were ligated independently in order to prevent damage to the external laryngeal nerve. The landmark for the superior thyroid vessel was identified using Joll's triangle, which passes through external laryngeal nerves.

Recurrent Laryngeal Nerve and Parathyroid Glands Identification

In addition to the elevated thyroid lobe, the adventitial tissues and strap muscles are retracted in close proximity. Identification of the recurrent laryngeal nerve is imperative prior to ligating any structure in the neck. It terminates obliquely into the larynx after running parallel to the trachea. Beahr's triangle is an identification tool for nerves. RLN, the inferior thyroid artery, and the common carotid artery comprise the base. During dissection, the fascia covering should be retained to prevent exposure to extraneous substances or toxic metabolites.

Inferior Thyroid Vessels Management

Identify RLN and inferior parathyroid gland, preserve inferior thyroid artery (ITA) and divide it near gland capsule to reduce parathyroid gland devascularization. Ligation of capsule vessels during thyroid dissection preserves ITA.

Thyroid Dissection from Bed

Thyroid gland dissection involves lifting it from the tracheal bed, usually due to Berry's ligament's holdup. Bipolar cautery can be used to control minor vessels, but uncontrolled vessels may result in postoperative reactionary hemorrhage.

If total or near-total thyroidectomy was necessary, the identical procedure should be repeated on the opposite side. Hemostasis was of the utmost importance, as postoperative bleeding inwards could cause difficulty breathing or a feeling of choking. Alongside tracheal leaking, vascular pedicels on both sides were frequent sites of hemorrhage during the postoperative period.

Drain placement: have a 14 F' vacuum drain placement as lateral as close to the incision as feasible so that the scar can be concealed in the collar. Place beneath the muscle layer prior to closure.

Wound closure:

Wound closure involves muscle layer and cervical fascia closure with 2-4 loose sutures in the midline, & skin flap closure with platysma without a buttonhole. Sutures made of monocryl 4-0' are sufficient to close the subcuticular epidermis. Assess the mobility of the vocal cords during anesthetic recovery in the operating room.

Postoperative care includes monitoring for bleeding and distress, serum calcium, removing drain, reassessing vocal cord mobility and thyroid function tests, and replacing thyroxin therapy for life.

Complications:

Early: Wond hemorrhage and infection; Hypoparathyroidism, excessive laryngeal nerve damage, external laryngeal nerve damage

Late: Keloid and thyroid storm

3. Results

The mean age is 40.05 ± 14.14 years, with a predominantly female representation (95%). The majority of subjects reside in rural areas (75%) (Table 1)

Table 1. Demographic data of involved subjects of our research

	VALUE (N = 20)
AGE (YEARS)	40.05 ± 14.14
SEX	
FEMALE	19 (95%)
MALE	1 (5%)
RESIDENCE	
URBAN	5 (25%)
RURAL	15 (75%)

All participants have normal levels of TSH (100%), T4 (100%), and T3 (100%) (Table 2).

Table 2. Hormonal profile of included subjects of our study

	VALUE (N = 20)
NORMAL TSH	20 (100%)
NORMAL T4	20 (100%)
NORMAL T3	20 (100%)

Notably, 40% of lesions exhibit a solid composition, with 45% being of mixed composition. The echogenicity of solid components varies, with 35% being isoechoic, 15% hyperechoic, and 45% hypoechoic. The shape analysis reveals that 65% of lesions are wider than taller, and 75% have smooth margins. The majority of lesions exhibit no calcification (70%) (Table 3).

Table 3. Evaluation of thyroid lesion among included subjects of our study

	VALUE (N = 20)
COMPOSITION	
SOLID	8 (40%)
CYSTIC	3 (15%)
MIXED	9 (45%)
ECHOGENICITY OF THE SOLID COMPONENT	
ISOECHOIC	7 (35%)
HYPERECHOIC	3 (15%)
HYPOECHOIC	9 (45%)
SHAPE	
TALLER THAN WIDER	4 (20%)
WIDER THAN TALLER	13 (65%)
MARGINS	
SMOOTH	15 (75%)
ILL-DEFINED	3 (15%)
IRREGULAR	2 (10%)
CALCIFICATION	
NONE	14 (70%)
MACROCALCIFICATION	1 (5%)
MICROCALCIFICATION	4 (20%)

TIRAD 4 is the most prevalent (40%), followed by TIRAD 3 (30%), TIRAD 2 (20%), and TIRAD 5 (10%) (Table 4).

Table 4. TIRAD classification of included subjects of our study

	VALUE (N = 20)
TIRAD 2	4 (20%)
TIRAD 3	6 (30%)
TIRAD 4	8 (40%)
TIRAD 5	2 (10%)

Follicular adenoma (35%), adenomatous goiter (35%), and papillary carcinoma (15%) are among the observed pathologies. Notably, adenomatous colloid goiter, minimally invasive follicular carcinoma, and multinodular goiter each account for 5% of cases (Table 5).

Table 5. Histopathological evaluation of included subjects of our study

	VALUE (N = 20)
FOLLICULAR ADENOMA	7 (35%)
PAPILLARY CARCINOMA	3 (15%)
ADENOMATOUS COLLOID GOITER	1 (5%)
ADENOMATOUS GOITER	7 (35%)
MINIMALLY INVASIVE FOLLICULAR CARCINOMA	1 (5%)
MULTINODULAR GOITER	1 (5%)

For benign tumor diagnosis, TIRAD classified 20%, while histopathology identified 45% as benign (P. Value= 0.096). TIRAD had a sensitivity of 33.33%, specificity of 90.91% & overall accuracy of 65%. For the Suspicious group, TIRAD classified 70% as suspicious, while histopathology indicated 35% (P= 0.0266), TIRAD had a sensitivity of 71.43%, specificity of 30.77%, &accuracy of 45%. In the Malignant group, TIRAD classified 10% as malignant, while histopathology identified 20%. (P= 0.3888) TIRAD showed a sensitivity of 25%, specificity of 93.75% &an accuracy of 80% (Table 6)

Table 6. Comparison between TIRAD classification and Histopathological evaluation regarding tumor suspicion

SUSPICION	TIRAD	HISTOPATHOLOGY	P. VALUE	SENSITIVITY	SPECIFICITY	PPV	NPV	ACCURACY
BENIGN	4 (20%)	9 (45%)	0.096	33.33	90.91	75	62.5	65
SUSPICIOUS	14 (70%)	7 (35%)	0.0266	71.43	30.77	35.71	66.67	45
MALIGNANT	2 (10%)	4 (20%)	0.3888	25	93.75	50	83.33	80

4. Discussion

According to our findings, the average age of the patients under research was 40.05 ± 14.14 years, with a predominantly female representation (95%). The majority of subjects reside in rural areas (75%).

This came in accordance with Chandra BS[8] who aimed in order to evaluate the accuracy of TIRADS in distinguishing between benign &malignant thyroid nodules, using histopathology as the standard reference, a study was conducted on an Indian population. The study included 82 patients with clinically palpable thyroid nodules, of which seventy (85.4%) were females &twelve (14.6 percent) were males.

On the other hand, Ramani PA et al[9] In an effort to compare the nature of nodular goiter with postoperative histology and assess the accuracy of TIRADS& fine needle aspiration cytology, the researchers examined one hundred patients, the majority of whom were from the urban area of Visakhapatnam.

Regarding the hormonal profile of our study cohort, we found that all participants have normal levels of TSH (100%), T4 (100%), and T3 (100%).

Schenke S et al,[10] aimed to evaluate the Thyroid nodule risk stratification using TIRADS, they reported that among 582 patients with thyroid nodules, there were 117 (20.1%) with hyperthyroidism.

Regarding the evaluation of thyroid lesions in the research population, our findings revealed that 40% of lesions exhibit a solid composition, with 45% being of mixed composition. The echogenicity of solid components varies, with 35% being isoechoic, 15% hyperechoic, and 45% hypoechoic. The shape analysis reveals that 65% of lesions are wider than taller, and 75% have smooth margins. The majority of lesions exhibit no calcification (70%).

Our result contrasts with Dy JG et al.,[11] who aimed in order to assess the sensitivity of TIRADS in identifying thyroid malignancy, as well as to identify the ultrasound attributes that are associated with malignancy; the following objectives will be pursued: As stated, the investigation comprised 149 patients who presented with thyroid nodules. (62.42%) of lesions exhibit a solid composition, with 37.58 % being of mixed composition. The echogenicity of solid components varies, with 35.57 % being isoechoic, 35.57 % hyperechoic, and 37.58 % hypoechoic. The shape analysis reveals that 6582.55 % of lesions are wider than taller and 56.38 % with no calcification.

Our results showed that TIRAD 4 is the most prevalent (40%), followed by TIRAD 3 (30%), TIRAD 2 (20%), and TIRAD 5 (10%).

Our results supported by Mostafa EA et al,[12] who reported that The category most frequently observed in their analysis was TIRADS 4, which accounted for 18 cases (39.1%).

On the other hand, Osseis M et al.,[13] This research attempted to compare Fine Needle Aspiration Cytology with Histopathology in diagnosing thyroid nodules. The study included 357 cases. The distribution of EU-TIRADS categorization groups was as follows: There were three patients classified as EU-TIRADS 2, accounting for 0.88 percent of the total. Additionally, there were 202 cases classified as EU-TIRADS 3, representing 58.72% of the total. Furthermore, there were 117 cases classified as EU-TIRADS 4, accounting for 34 percent of the total. Lastly, there were 22 cases classified as EU-TIRADS 5, representing 6.40 percent of the total.

Regarding histopathological findings for the 20 participants, our current study showed that Follicular adenoma represented in (35%) of the studied patients, adenomatous goiter (35%), and papillary carcinoma (15%) are among the observed pathologies. Notably, adenomatous colloid goiter, minimally invasive follicular carcinoma, and multinodular goiter each account for 5% of cases

Our results are supported by Ramani PA et al.,[9], who reported that regarding histopathology report, papillary carcinoma was reported in (15%) of the observed pathologies, and adenomatous colloid goiter was reported in (5%). Otherwise, they reported that Follicular adenoma was reported in (20 %), adenomatous goiter in (5%) and multinodular goiter was reported in (50%)

For benign tumor diagnosis, TIRAD was classified at 20%, while histopathology identified 45% as benign (P. Value= 0.096). TIRAD had a sensitivity of 33.33%, specificity of 90.91% &overall accuracy of 65%. For the Suspicious group, TIRAD classified 70% as suspicious, while histopathology indicated 35% (P= 0.0266); TIRAD had a sensitivity of 71.43%, specificity of 30.77%, and accuracy of 45%. In the Malignant group, TIRAD is classified as 10% malignant, while histopathology is identified as 20%. (P= 0.3888) TIRAD showed a sensitivity of 25%, a specificity of 93.75%, an accuracy of 80%

Atar C et al.,[14] The study aimed to assess the predictive value of TIRADS scoring in determining the presence of cancer in thyroid nodules. The researchers examined the relationship between TIRADS scoring, fine needle aspiration biopsy, and postoperative and histopathological results. Their findings indicated that TIRADS scoring can accurately distinguish malignancy with a 75 percent accuracy rate. The ideal threshold was identified as TR4, with a sensitivity of 80.3 percent and a specificity of 60.8 percent.

While Abdelkader AM et al,[15] The study found that the US TI-RADS had an overall concordance rate of 75.4 percent with the final PO histological data for predicting malignancy. The sensitivity was 76.9%, specificity was 91.3 percent, PPV was 71.4 percent, & NPV was 76.4 percent.

Recommendations: Future studies should be conducted using well-designed randomized controlled trials or large, comparative observational studies. Inclusion of a representative sample of patients with similar age, gender, and disease severity. The sample size of future studies should be large enough to provide meaningful conclusions and to control for confounding factors. To accurately assess long-term outcomes, studies should have a longer follow-up period. We recommended that future research should include multicenter studies to validate our findings.

4. Conclusion

TIRADS grading is a useful instrument for preoperative evaluation and therapy as we found that for benign tumor diagnosis, TIRAD classified 20% with a sensitivity of 33.33%, specificity of 90.91%, overall accuracy of 65%, while for the Suspicious group, TIRAD classified 70% as suspicious with a sensitivity of 71.43%, specificity of 30.77%, & accuracy of 45%. In the Malignant group, TIRAD classified 10% as malignant with a sensitivity of 25%, specificity of 93.75%, and an accuracy of 80%.

Disclosure

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There are no conflicts of interest.

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