

Diagnostic Efficacy of Ultrasound (using TI-RADS) Compared to Fine Needle Aspiration Cytology (Using Bethesda Classification) in Diagnosing Thyroid Nodule

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Abstract:

Introduction: Fine-needle aspiration cytology (FNAC) is an invasive test used to assess if a nodule is cancerous or whether surgery is required to make a conclusive diagnosis. It would be ideal to have a reliable, noninvasive approach for determining which nodules merit FNAC based on a realistic chance of physiologically relevant cancer. As a result, we compared the Thyroid Imaging Reporting and Data System (TI-RADS) classification of thyroid nodules on ultrasound with the Bethesda System results on fine-needle aspiration cytology (FNAC).

Methods and Materials: Prospective research was conducted in individuals with thyroid nodules visiting tertiary care hospitals from April 2022 to December 2022 after ethics committee approval. Purposive sampling was used to recruit 100 patients in the trial after they provided informed permission. Patients who agreed to have ultrasound and FNAC had bedside imaging of thyroid nodules and ultrasound guided FNAC by a single radiologist and pathologist. The following parameters were calculated: sensitivity, specificity, illness prevalence, positive and negative predictive value, and accuracy.

Results: The average SD of age was 34.12.3. Females made up 74% of the population. According to the Bethesda classification for FNAC, 23 individuals have malignant lesions (Bethesda V and VI) and 77 patients have benign lesions (Bethesda V grade). At 95% CI, the sensitivity and specificity of ultrasonography over FNAC of thyroid nodule were 84.21% (60.42% to 96.62%) and 92.5% (84.39% to 97.20%), respectively, with an accuracy of 90.91% (83.44% to 95.76%).

Conclusions: A significant relationship was found in this research between the Ultrasound (TI-RADS) and FNAC (Bethesda scores) ($X^2 = 41.74$, $p = 0.001$). At 95% confidence intervals, the sensitivity and specificity of ultrasonography over FNAC of thyroid nodule were 84.21% (60.42% to 96.62%) and 92.5% (84.39% to 97.20%), respectively.

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Introduction

Now, fine-needle aspiration cytology (FNAC) is the most effective and practicable technique for determining if a nodule is malignant or whether surgery is required to provide a conclusive diagnosis.[1]

However, most nodules are benign, and even malignant nodules, especially that less than 1 cm in size, usually demonstrate indolent or nonaggressive behaviour. [2,3] As a result, not all identified nodules need FNAC and/or surgery. As a result, a dependable, non-invasive approach for determining which nodules need FNAC based on a realistic risk of physiologically relevant malignancy would be exceedingly desired. Thyroid Imaging Reporting and Data System (TI-RADS) of classifying thyroid nodules on ultrasound was published in 2015 by ACR committees that presented an approach to

incidental thyroid nodules and proposed standard terminology (lexicon) for ultrasound reporting [4,5]. We compared the Thyroid Imaging Reporting and Data System (TI-RADS) classification of thyroid nodules on ultrasonography to the Bethesda System results on fine-needle aspiration cytology (FNAC).

Materials and Methods

A prospective study was conducted in patients with thyroid nodules attending tertiary care hospitals from April 2022 to December 2022. After obtaining informed consent from patients, 100 patients were enrolled in the study by purposive sampling method. Patients who were willing for Ultrasound and FNAC underwent bedside imaging

of thyroid nodule and ultrasound guided FNAC performed by a single radiologist and pathologist.

Procedure

All US scans of the thyroid gland and neck were performed using a linear-array transducer (5–12 MHz) on a Philips US scanner (Philips Healthcare Affiniti 70 G, USA) using an optimized gain by the same radiologist. Axial images of both thyroid lobes were obtained, with quantification and measurement of all detected TNs. Systematic exploration was then made of the lateral neck lymph node chains, sub maxillary glands and parotid glands. The following ultrasound characteristics were evaluated in each Thyroid Nodule to obtain the corresponding TI-RADS Grade

1. Ultrasound structure
2. Echogenicity
3. Morphology
4. Anteroposterior/transverse diameter ratio
5. Contours
6. Presence/absence of a capsule
7. Calcifications
8. Hyper echogenic foci
9. Vascularization

Nodule size was not included among the ultrasonography features analysed since it is not indicative of malignancy.[6,7] Each patient had a TI-RADS score assigned to the nodule with the highest TIRADS grade. Sonographically, the thyroid nodules were categorised as TI-RADS 2 and TI-RADS 3 for benign and possibly benign appearance, respectively. The Bethesda Class II for

benign thyroid nodules was used to compare them. TI-RADS 4 nodules were identified as indeterminate or suspected of a follicular lesion or tumour and compared to Bethesda Class III (follicular lesion of unknown significance) and Bethesda Class IV (follicular neoplasm). In this investigation, we did not divide the TI-RADS 4 sonographic category into the various subcategories (4a, 4b, and 4c). Thyroid nodules with all five worrisome ultrasonography characteristics were identified as TI-RADS 5 and compared to the Bethesda Class V and Class VI FNAC classifications. Patients with TI-RADS 1 (normal thyroid gland) were omitted since there was no evidence that they should be subjected to FNAC. Following a US examination of the thyroid gland, FNAC was performed using a 23 G needle connected to a 10 ml syringe, which was then linked to a syringe holder. Smear slides were stained with haematoxylin and eosin (H&E), papanicolaou (PAP), and May-Grunwald-Giemsa (MGG) in each instance. The number of needle passes, kind of aspirate, and cytological diagnosis were all performed using the Bethesda classification for cytodiagnosis of thyroid lesions. An professional pathologist then examines the slides.

Results

The age range of the 100 patients enrolled was 15-72 years, with 62% of patients being 15-40 years old, 23% being 41-60 years old, and 15% being >60 years old. The mean SD of age was 34±12.3. Females made up 74% of the population, with a female: male ratio of 74:26. (Table 1)

Table 1: Distribution by Patient’s characteristics

Patient Characteristic	Group	Frequency
Age	15-40 Years	62 (62%)
	41-60 Years	23 (23%)
	>60 years	15 (15%)
	Mean ±SD	34±12.3
Sex	Male	26 (26%)
	Female	74 (74%)

According to the Bethesda classification for FNAC, 23 individuals have malignant lesions (Bethesda V and VI) and 77 patients have benign lesions (Bethesda V grade). According to TI-RADS on ultrasonography, 22 individuals had TI-RADS 5 and 78 patients had TI-RADS 5. The TI-RADS and Bethesda scores were shown to be significantly related in this research (X²- 41.74, p 0.001). (Table 2)

Table 2: Ultrasound finding versus pathological finding

Ultrasound Finding	Pathological Finding		Total	X ² / P value 41.74/ <0.00001
	Malignant (Bethesda V and VI)	Benign (Bethesda < V)		
Positive (TI-RADS ≥ 5)	16 True Positive	6 False positive	22	
TI-RADS <5	7 False Negative	71 True Negative	78	
Total	23	77	100	

At 95% confidence intervals, the sensitivity and specificity of ultrasonography over FNAC of thyroid nodule were 84.21% (60.42% to 96.62%) and 92.5% (84.39% to 97.20%), respectively. The positive and negative predictive values with 95% confidence intervals were 72.73% (54.66% to 85.50%) and 96.10% (89.71% to 98.59%), respectively, with an accuracy of 90.91% (83.44% to 95.76%). (Table 3)

Table 3: Diagnostic Accuracy Parameters of Ultrasound (TI-RADS) over FNAC (Bethesda Classification)

Statistic	Value	95%CI
Sensitivity	84.21%	60.42% to 96.62%
Specificity	92.50%	84.39% to 97.20%
Positive Likelihood Ratio	11.23	5.08 to 24.83
Negative Likelihood Ratio	0.17	0.06 to 0.48
Disease prevalence (*)	19.19%	11.97% to 28.34%
Positive Predictive Value (*)	72.73%	54.66% to 85.50%
Negative Predictive Value (*)	96.10%	89.71% to 98.59%
Accuracy (*)	90.91%	83.44% to 95.76%

Discussion

TIRADS and the Bethesda method of categorization were used in this research to compare ultrasonography results of thyroid nodules to FNAC findings. The age range of the 100 patients participating in the present research was 15-72 years, with 62% of patients being 15-40 years old, 23% being 41-60 years old, and 15% being >60 years old. Similarly, patients in Banstola L et al's research varied in age from 16 to 70 years.[9] In the research by Warpe B et al. The ages of those who presented varied from 3 to 75 years old, with a mean of 38.41 14.49 years.[10]

The average age of the 47 samples in the research by Alshahrani A S et al was 44.27 (SD = 13.5) years.[11] Females made up 74% of the population in the present research, with a female: male ratio of 74:26. Female to male ratio was 9:1 in a research by Banstola et al.[9] Thyroid lesions were 6.02 times more prevalent in females than men in a study by Warpe et al.[10] In a research conducted by Alshahrani et al., 85.1% of the participants were female.[11] In a research conducted by Mohamed Aya E et al, there were 15 (75%) female and five (25%) male patients, with a male to female ratio of one to three.[12]

According to Bethesda classification on FNAC, 23 individuals have malignant lesions (Bethesda V and VI) and 77 patients have benign lesions (Bethesda V grade). According to TI-RADS on ultrasonography, 22 individuals had TI-RADS 5 and 78 patients had TI-RADS 5. In the research by Alshahrani A S et al, the majority (85.1%) had multiple nodules, 38.3% had a TR4 US finding score, and the median size of the nodule on US was 3 cm, with an average range of 0.6 to 14 cm.[11] Fernandez et al included a total of 263 patients in their investigation.

Histological examination showed 188 benign and 75 malignant lesions.[13] The TI-RADS and Bethesda scores were shown to be significantly related in this research (X²- 41.74, p 0.001). Alshaikh R et al discovered a substantial positive association between the TI-RADS and Bethesda scores (r = 0.338, p 0.001). [14] In this research, the sensitivity and specificity of ultrasonography over FNAC of thyroid nodule were 84.21%

(60.42% to 96.62%) and 92.5% (84.39% to 97.20%), respectively. Positive and negative predictive values at 95% confidence intervals were 72.73% (54.66% to 85.50%) and 96.10% (89.71% to 98.59%), respectively, with an accuracy of 90.91% (83.44% to 95.76%). Singaporewalla et al. compared ultrasonographic TI-RADS findings to all cytological Bethesda categories in a retrospective study involving 100 consecutive cases, finding a concordance rate of 83% with sensitivity (70.6%), specificity (90.4%), and NPV (93.8%) that was lower than the current study.[15]

Conclusion

In this study, a significant association was noted between the Ultrasound (TI-RADS) and FNAC (Bethesda scores) (X²- 41.74, p ≤ 0.001). Sensitivity and specificity of ultrasound over FNAC of thyroid nodule, at 95% CI was 84.21% (60.42% to 96.62%) and 92.5% (84.39% to 97.20%). Positive and negative predictive value at 95% confidence intervals was 72.73% (54.66% to 85.50%) and 96.10% (89.71% to 98.59%) with accuracy of 90.91% at 95% CI (83.44% to 95.76%).

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