Original Research Article

Evaluation of correlation between TIRADS [Thyroid Imaging Reporting and Data System] and FNAC of thyroid nodules.

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Abstract

Purpose: To characterize the thyroid nodules according to grey scale ultrasonographic features using TIRADS scoring system into various categories. Then correlate the results with the cytopathological examination findings.**Materials and Method:** The present study was carried out in 100 patients in the tertiary care institute. Patients were enrolled prospectively for the study after obtaining informed consent. These patients were subjected to high resolution ultrasonography and fine needle aspiration as per pre-decided protocol. All thyroid nodules were characterized according to the consistency, margin, echogenicity, evidence of calcification and shape. Each nodule was classified into TIRADS categories [2,3,4A,4B and 5] based on ultrasound features. The ultrasound findings were correlated with FNAC and data was analyzed statistically.**Results:** The sensitivity and specificity for irregular contours were 93.33 % and 94.12%, for taller than wide shape were 20.0% and 100%, for microcalcification were 53.33% and 94.29%, for marked hypoechogenicity were 73.33% and 60.89% and for solid consistency were 53.33% and 62.86%. The risk of malignancy was found to increase from TIRADS3 to TIRADS5 in the study. All the cases [100%] of TIRADS 5 turned out to be malignant on cytopathology.**Conclusion:S**onographic features like irregular margins, marked hypoechogenicity, microcalcification and taller-than-wider shape were all associated with increased risk of malignancy. The risk of malignancy was found to increase from TIRADS 3 to TIRADS 5 when different TIRADS categories were confronted with results of pathology and risk of malignancy was calculated.

Keywords: US - Ultrasonography; FNAC - Fine needle aspiration cytology; TIRADS - Thyroid imaging reporting and data system; BIRADS - Breast Imaging Reporting and Data System.

Introduction

The nodular thyroid disease is relatively common. It can manifest clinically with one or more thyroid nodules. Such nodules represent common and controversial clinical problems. Although thyroid cancer is rare and accounts for less than 1% of all malignant neoplasms[1].The overwhelming majority of thyroid nodules are benign.To distinguish clinically is challenge between benign and malignant.

Malignant nodules needed surgical excision. Imaging plays significant role in characterization of lesions, complementary to clinical diagnosis and classification of the lesions.

Now ultrasonography is widely accepted for the risk stratification of thyroid nodules.

The prevalence of non-palpable nodules has increased recently, as a consequence of the increasing application of ultrasound.

High resolution ultrasound is a valuable,safe, nonionizing, cost effective, widely available, and easily reproducible imaging tool for diagnosis of clinically suspected thyroid lesions. Various ultrasound characteristics of thyroid nodules have proven to high predictive diagnostic value in suspicion of malignancy, with particular focus on which nodules should be subjected to USG guided fine needle aspiration cytology.US characteristics of malignant nodules includes-intranodular vascularity, the presence of microcalcifications, a taller than wider pattern, hypoechogenicity and spiculated margins. Horvath et al envisaged the categorisation of thyroid nodules using multiple sonographic determinants so that an overall stratification of risk of malignancy can be done[2]. Thyroid Imaging Reporting and Data Systems (TI-RADS) was developed to categorize different malignancy risks for thyroid nodules, which followed the concept of Breast Imaging Reporting and Data System (BI-RADS) of the American College of Radiology. TIRADS classification is a reliable imaging modality with good interobserver agreement in differentiating benign lesions from the malignant lesions and the presence of sonological features of malignant cervical lymphadenopathy enhances the radiologist's confidence while classifying a lesion as malignant on TIRADS. Furthermore, TIRADS can safely preclude unnecessary FNACs in a significant group of benign thyroid lesions. Ultrasound-assisted fine needle aspiration cytology (FNAC) is known as the "gold standard" for thyroid nodule diagnosis and management[3]. FNAC results are interpreted using a widely accepted cytopathological grading system (Bethesda). Cytological results are assigned to one of the six categories, each of which has a different range of malignant risk.

Materials and Methods

Subject

This was a prospective observational study carried out in a University-based tertiary care hospital from October 2017 to June

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2019 in radiodiagnosis and imaging department with collaboration with departments of surgery and pathology. The Institutional ethical committee approved the study and written informed consent was obtained from all the patients in this study.

The patient group was selected and recruited from among those who were referred from the Department of surgery.

Ultrasound scan

All ultrasonography scans were performed using high-end sonographic equipment(IU22,Philips Medical System,The Netherlands).

The scans were performed using a linear electronic array transducer of frequency range 5–17 Hz. Scans were done in supine positions with hyperextended neck. The skin and the linear transducer were cleansed with Betadine (povidone-iodine) solution. A sterile gel used as a coupling agent. The Initial US study was done to recognize the nodule of interest that indicated for FNAC according to the guidelines.

Ultrasonography Interpretation

Features evaluated in case of thyroid nodules were:

1. Internal components (solid, cystic, mixed)
2. Margin (Irregular, Smooth)
3. Echogenicity (Hyperechoic, Isoechoic, hypoechoic, markedly hypoechoic)
4. Type of calcification if present (microcalcification, if less than 3mm and macrocalcification, if more than 3mm)
5. Shape of nodule (taller than wider, if greater in anteroposterior dimension than in its transverse dimension).
6. Then nodules were classified into TIRADS category [2, 3, 4A, 4B, 5] based on these ultrasound features. Lesions were further subjected to fine needle aspiration cytology.

TIRADS Classification Alogrithm:-

The terminology of TIRADS was first used by Hogarth et al. They described 10 ultrasound patterns of thyroid nodules and related the rate of malignancy according to the pattern. The following categories were established:

TIRADS 1:Normal Thyroid gland
TIRADS 2:Benign conditions [0%malignancy]
TIRADS 3:Probably benign nodules [5%malignancy]
TIRADS 4:Suspicious nodules [5-80%malignancy]. A subdivision into4a[malignancy between 5and10%] and 4b[malignancy between 10 and 80%] was optional.
TIRADS 5:Probably malignant nodules [>80% malignancy]
TIRADS 6:Category included biopsy proven malignant nodules.

Table 1:TIRADS Classification

High Suspicious Aspects • Taller than wide shape • Irregular or microlobulated margins • Microcacifications • Marked hypoechogenicity	TIRADS 5 ≥3 signs and /or adenopathy TIRADS 4B 1 or 2 signs and no adenopathy
Low Suspicious Aspects • None of the high suspicious aspects • Moderately hypoechogenic	TIRADS 4A
Probably Benign Aspects • None of the high suspicious aspects • Isoechogenicity • Hyperechogenic	TIRDS 3
Benign Aspects • Simple cyst • Spongiform nodule • "White knight'' aspect • Isolated microcalcification • Typical subacute thyroiditis	TIRADS 2
Normal Thyroid USG	TIRADS 1

Inclusion criteria

- Patients with palpable lump with or without any symptoms.
- Patients with non-palpable lesions in thyroid region detected by High Resolution Ultrasonography in our department.

Exclusion criteria:

- Previously diagnosed cases of benign disease and thyroid malignancies.
- Cases undergoing treatment.
- Diagnosed cases of carcinoma thyroid on follow up for residual disease or recurrence.
- Patients with no focal lesions on US (TIRADS-1 category).
- Patients who did not undergo FNAC were excluded from the study.
- This study was carried out in 50 patients in the Department of Radiodiagnosis& Imaging in collaboration with the Department of Pathology and Department of General Surgery, in tertiary care institute. It was an institute based study. Patients were enrolled prospectively for the study after obtaining informed consent.

Statistics

The results of cytopathology were correlated with ultrasound features and statistical analysis was done. Sensitivity, specificity, positive predictive value and negative predictive value for each feature was calculated.

Results

This study was carried out in 100 patients in which 86 were female (M/F ratio was 1:6.1). Majority of the malignant nodules were found in the females. These thyroid nodules are predominantly found in second-fourth decade of life which accounts 64% of study population.

In this study, 42 cases were solidconsistency and rest of the 58 nodules were of mixed consistency. 16 out of the 42 nodules of solid consistency and 14 out of the 58 of the nodules of mixed consistency were malignant (Fig.1).

32 out of the 100 lesions hadirregular margin and 68 cases had regular margin. 28 out of the 32 cases showing irregular margin were malignant (Fig.2).

28 out of the 100 nodules markedly hypoechoic,22 cases hypoechoic, 26 casesisoechoic and 24 cases hyperechoic (Fig.3).

No calcification was noted in 64 (64%) cases, microcalcification was in 20(20%) cases and macrocalcification in 16 (16%) of the cases. 16 out of the 20 nodules having microcalcifications were malignant (Fig.4).

Majority of the throid nodules (94 cases) had wider than taller shape, rest 6 cases had taller than wide shape. All the 6 cases having taller than wide shape and 24 out of the 94 cases had wider than taller shape turned out to malignant (Fig.5).

Sensitivity,specificity,positive predictive value and negative predictive value of USG features of TIRADS for irregular margin (93.33%, 94.29%, 87.5% & 97.06%), markedly hypoechoic (73.33%, 60%, 44% & 84%), microcalcification (53.33%, 94.29%, 80% & 82.5%), solid components (53.33%,62.86%,38.1% & 75.86%), taller than wider (20%,100%,100% & 74.47%),halo (80%,60%,46.15% & 87.5%) and internal vascularity (80%,74.29%,57.14% &89.66%) respectively.(Fig. 6,7)

Taking into account all nodules in the analysis, a significant association was observed between the TI-RADS and the Bethesda ($p<0.001$) classification, and those with TI-RADS rating 2 or 3 were mostly Bethesda 2 (93.7% and 90%, respectively). Among those classified as TI-RADS 4B and 5 (46.8% and 91.6%, respectively), the majority was Bethesda 6 (Table 1.).

Out of 100 cases, there were 16 cases(16%) of TIRADS 2, 20 cases (20%) of TIRADS 3, 20 cases (20%) of TIRADS 4a, 32 cases (32%) of TIRADS 4B and 12 cases (12%) of TIRADS 5.

In this study, out of 100 cases, 70 cases (70%) turned out to be benign and 30 cases (30%) malignant in cytopathology. No malignant cases were seen in TIRADS category 2 and 3, only 10% of the nodules turned out malignant in TIRADS 4A, 50% of the nodules turned out malignant in TIRADS 4B. All of the nodules of TIRADS 5 category turned out malignant. (Table 2.)(Fig. 8)

Fig 1:Grey scale ultrasonography showing hyperechoic nodule- TIRADS 3.

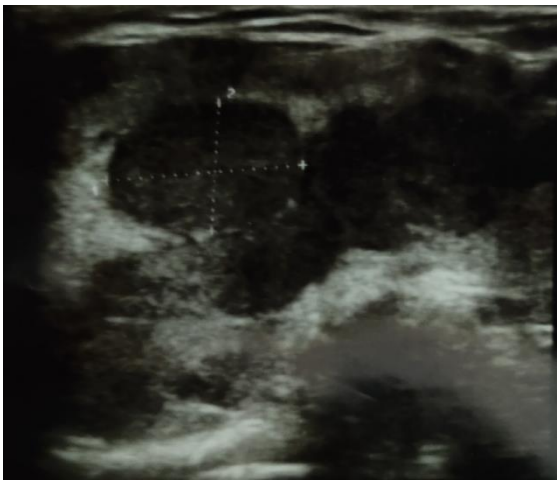

Fig 2: Grey scale ultrasonography showing moderately hypoechoic nodule- TIRADS 4A.

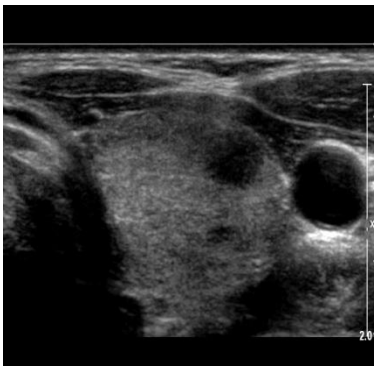

Fig 3: Grey scale Ultrasonography showing markedly hypoechoic nodule with ill-defined irregular margin- TIRADS 4B.

Fig 4: Grey scale ultrasonography showing taller than wide shape of the nodule, irregular margin and multiple foci of microcalcifications within- TIRADS 5.

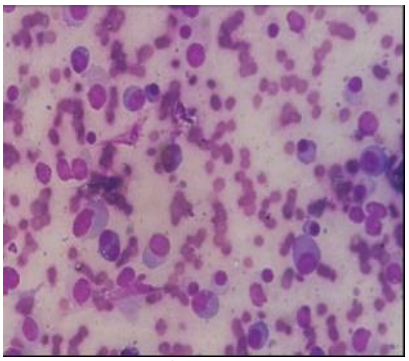

Fig 5: Smear from medullary carcinoma showing numerous isolated cells with eccentrically placed nuclei giving plasmacytoid appearance.

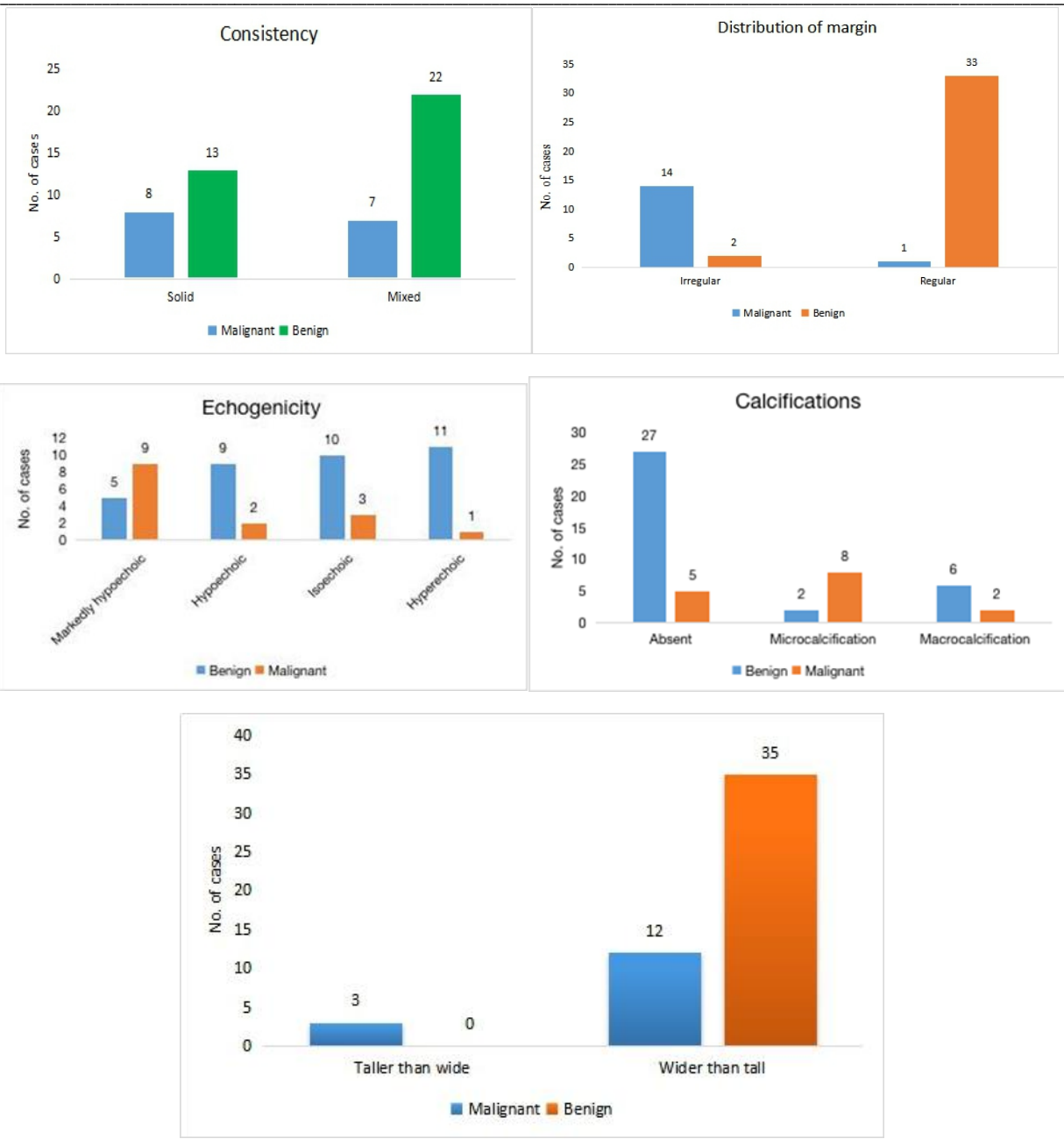

Fig 6: Based on (a) consistency, (b) margins, (c) echogenicity, (d) shape and (e) taller than wider characteriscs of nodules to differentiation of benign and malinant nodules.

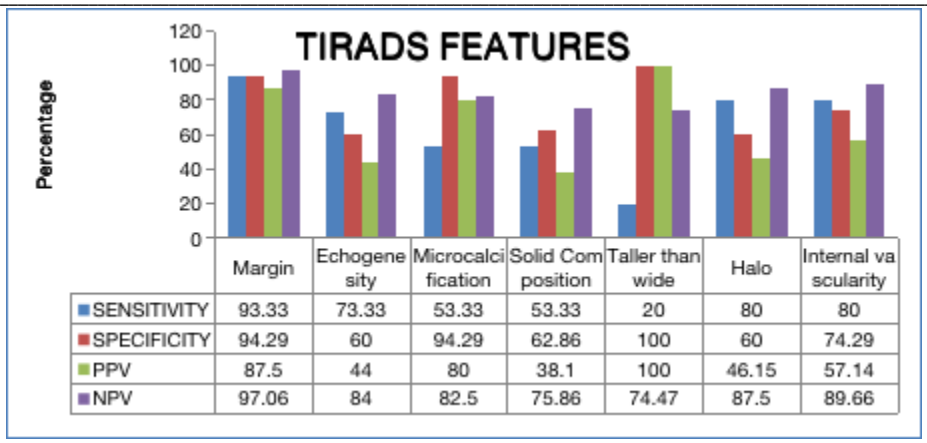

Fig 7: Statistical results of thyroid imaging reporting and data system

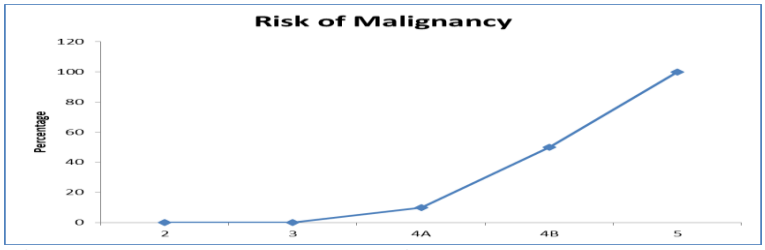

Fig 8: Risk of malignancy was progressively increased from TIRADS category 2 to TIRADS cateogory 5.

Table 1: Thyroid Imaging Reporting and Data System (TI-RADS) and Bethesda correlation

TI-RADS classification	Bethesda results					
	2	**3**	**4**	**5**	**6**	**Total**
All nodules	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
2	15 (93.7)	1 (6.25)	0 (0)	0 (0)	0 (0)	16
3	18 (90)	2(10)	0 (0)	0 (0)	0(0)	20
4A	14 (70)	3(15)	1(5)	1 (5)	1(5)	20
4B	13 (40.6)	2 (6.25)	1(3.12)	1 (3.12)	15 (46.8)	32
5	0 (0)	0 (0)	0 (0)	1(8.3)	11 (91.6)	12
Total	60 (60)	8 (8)	2 (2)	3(3)	27(27)	100

Table 2: Thyroid Imaging Reporting and Data System (TI-RADS) and correlation with risk of malignancy

TI-RADS All nodules	Malignancy			p value
	Benign	**Malignant**	**Total**	
	n (%)	**n (%)**	**n (%)**	
2	16 (100)	0 (0)	16	0.45
3	20 (100)	0(0)	20	Reference
4A	18 (90)	2(10)	20	0.002
4B	16(50)	16 (50)	32	<0.001
5	0(0)	12(100)	12	<0.001
Total	70 (70)	30 (30)	100	

Table 3: Comparison of the current study with other studies regarding the Thyroid Imaging Reporting And Data System (TIRADS) stratification

TIRADS	Risk of malignancy (In percentage)				
	Horvath et al	**Park et al**	**Kwak et al**	**Moifo et al**	**Current study**
2	0	9.6	0	0	0
3	<5	31.1	1.7	2.2	0
4A	5-10	76.8	3.3	5.9	10
4B	10-80		9.2	57.9	50
5	>80	100	87.5	100	100

Discussion

In present study, our results suggested that five independent sonological features significantly associated with malignancy are solid composition, marked hypoechogenicity, irregular margins, micro calcifications and taller than wide shape. Among these features, irregular margins were the most sensitive for malignancy

followed by hypoechogenicity,microcalcifications, solid composition and taller than wide shape in the descending order. Taller than wider shape was the most specific feature followed by irregular margin and presence of microcalcification. Taller than wider shape showed highest positive predictive value and irregular margin showed maximum negative predictive value.

Risk of malignancy was progressively increased from TIRADS category 2 to TIRADS cateogory 5.(fig.8) . In this study risk of malignancy was TIRADS 2,3,4a,4b and 5 as 0%, 0%, 10%, 50% and 100% respectively. Similar observation was made by moifo et al. in their study.Reported rates of malignancy for TIRADS 2–5 categories, respectively, were 0, 14.1, 45 and 89.6% by Horvath et al.[2] and 9.6, 31.1, 76.8 and 100% by Park et al. [4]. Kwak et al. [5] reported risk of malignancy for TIRADS 2, 3, 4a, 4b, 4c and 5 as 0%, 1. 1.7, 3.3, 9.2, 44.4–72.4 and 87.5% respectively. (Table 3)

The TI-RADS system allows the clinicians to easily understand the malignancy risk of a thyroid nodule from the Ultrasonography report and make more correct treatment decisions such as follow-up, FNAC or surgery[6].

Limitations of study was small sample size, prospective study.

Conclusion

The TI-RADS system is may appropriate for assessment of risk of maligncy of thyroid nodules and avoid unnecessary fine needle aspiration in TIRADS II and III, as well as to assist in decision making, course of action and management.

Acknowledgement

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Conflict of Interest: Nil

Source of support:Nil

References

1. Grebe SK, Hay ID. Follicular cell-derived thyroid carcinomas. Cancer Treat Res. 1997;89:91-140.
2. Horvath E, majlis S, Rossi R, Franco CNiedmann JP, Castro A, Dominguez M. "An ultrasonogram reporting system for thyroid nodules stratifying cancer risk for clinical management", "J Clin Endocrinol Metab", 2009; 90(5):1748-51
3. Amrikachi M,I. Ramzy et al. Accuracy of fine-needle aspiration of thyroid.ArchPathol Lab Med. 2001; 125(4):484-8.
4. Park JY, Lee HJ, Jang HW, Kim HK, Yi JH, Lee W et al. A proposal for a thyroid imaging reporting and data system for ultrasound features of thyroid carcinoma. Thyroid. 2009;19: 1257-64.
5. Kwak JY, Han KH, Yoon JH, Moon HJ, Son EJ, Park SH et al. Thyroid imaging reporting and data system for US features of nodules: A step in establishing better stratification of cancer risk. Radiology. 2011;260:892-9.
6. Moifo B, Takoeta EO, Tambe J, Blanc F, Fotsin JG. Reliability of Thyroid Imaging Reporting and Data System (TIRADS) classification in differentiating benign from malignant thyroid nodules. Open J Radiol. 2013;3:103-7.