

A Study on Role of Ultrasonogram in Diagnosing Malignancy in Thyroid Nodules

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Abstract

Palpable thyroid nodules are noted in 5% of general population. High-resolution ultrasound depicts nodules in up to 67% of the population. Malignant nodules have seen less than ten percentage. To standardize thyroid nodules reporting TIRADS (Thyroid Imaging Reporting and Data System) was developed. It's used to classify the nodules into benign and malignancy and planned early FNAC and further treatment.

Aim: To evaluate the Ultrasound features of thyroid nodules and to detect the characteristic radiological features of benign and malignant nodules and by using TIRADS (Thyroid Imaging Reporting and Data System), which would prove findings to detect the Malignant nodules. So, they advised early FNAC and early detection of malignant nodules and further management.

Materials and Methods: Total of 400 patients underwent ultrasonography during the study period. Shape, echogenicity, content, calcification, margins of the nodules and cervical lymphadenopathy were analysed by ultrasound and FNAC done for TIRADS category 3 to 5 nodules lesions. The USG and FNAC results were compared and analysed.

Results: Increased hypoechogenicity, Taller than wider shape, micro-lobulated margin and microcalcification commonly seen in malignant nodules and confirmed by FNAC. Iso echogenicity / Hyper echogenicity, wider than taller, macro calcification and mixed content (Solid/cystic content) commonly seen in benign nodules.

Conclusion: The Ultrasound findings of Increased hypoechogenicity, Taller than wider shape, micro-lobulated margin and microcalcification commonly seen in malignant nodules and FNAC needed for these nodules which included in TIRADS category 4a, 4b and 5 and early detection malignant nodules and further management.

Keywords: Ultrasonogram, Thyroid nodules, TIRADS, FNAC.

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Introduction

Thyroid gland affected by various disease which can represent clinically as thyroid nodule. Ultrasound is one of the main investigations to evaluate thyroid nodules but ultrasound is not confirmatory. Fine

needle aspiration cytology (FNAC) is used to differentiate / confirm benign and malignant nodules. FNAC is the painful invasive test / procedure. It is also difficult to decide which thyroid nodule needs

FNAC. TIRADS category-based ultrasound reporting/findings used to improve the sensitivity and specificity of ultrasound to differentiate the benign and malignant nodules. So, ultrasound is used to the first screening tool for thyroid nodules. TIRADS based ultrasound reporting is used to improve the detection of benign and malignant nodules. Then suspicious nodules were confirmed by FNAC and further management.

Materials and Methods

The present study was single - center, Prospective study, conducted in the department of radiology in association with the department of surgery and with help of Pathology department at the Government Sivagangai Medical College and Hospital, Sivagangai, Tamilnadu, India. The patients were referred for USG Thyroid to the department of radio diagnosis. The study was conducted for a period of two years from June 2020 to June 2022. Patients who were referred for USG Thyroid by the clinician and Surgery department when clinically indicated.

Patients with history of Neck / Thyroid swelling and neck pain were included in the study. Past history of lymphomas, Naso pharyngeal, oro pharyngeal carcinoma cases, other than thyroid swelling in neck cases and FNAC contra indicated cases excludes from the study.

A total of 400 patients who fulfilled the inclusion criteria were enrolled in the study. Ultrasound was performed using High frequency linear probe (MINDRAY DC 60). Patients / Thyroid nodules were analyzed in terms of shape, content, calcification, echogenicity and cervical lymphnodes. TIRADS category then used to differentiate the nodules into separate groups according to the findings. After USG, the patients underwent FNAC of thyroid nodules in TIRADS category of 3 to 5 group. The FNAC reports were compared with USG features / Reports (TIRADS category) of the patients and

analyze the results of both. In some cases, compared to the Histo pathological reports after surgery.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done using descriptive statistics.

Results

After performing USG for 400 patients, we did the analysis and observed the following results, Thyroid nodules are more commonly seen in 35 to 45 years of age. Male to female ratio of 1: 2.8.

In ultrasound, we look the thyroid size, vascularity, nodules shape, calcification, margins, contents, echogenicity and cervical lymph nodes.

Most common Ultrasound findings in benign nodules – Wider than taller, Isoechogenicity / hyperechogenicity, Mixed (solid and cystic) content and Macro-calcification.

Most common Ultrasound findings in malignant nodules - Taller than wider, Marked hypoechogenicity, Micro lobulated margins, microcalcifications and cervical lymph nodes.

Shape: Out of 400 nodules evaluated, 382 nodules were wider than taller in shape and 18 nodules were taller than wider in shape. Among the 382 nodules which were wider than taller in shape, 370 nodules showed benignity on FNAC report. The remaining 12 nodules were malignant in nature on FNAC. All the nodules which showed taller

than wider in shape showed malignant character. With a P value of 0.012 taller

than wider in shape nodules has more propensity for malignancy.

TIRADS	Signification	Ultrasonographic characteristics	Malignancy risk (%)
TIRADS 1	Normal thyroid	▪ Normal thyroid US	-
TIRADS 2	Benign aspects	▪ Simple cyst ▪ Spongiform nodule ▪ 'White knight' aspect ▪ Isolated macrocalcification ▪ Typical sub-acute thyroiditis	0.0
TIRADS 3	Probably benign aspects	▪ None of the high suspicious aspect ▪ Isoechogenic ▪ Hyperechogenic	0.25
TIRADS 4A	Low suspicious aspect	▪ None of the high suspicious aspect ▪ Moderately hypoechogenic	6.0
TIRADS 4B	High suspicious aspects with 1 or 2 signs and no adenopathy	▪ Taller-than-wide shape ▪ Irregular or microlobulated margins ▪ Microcalcifications ▪ Marked hypoechogenicity	69.0
TIRADS 5	High suspicious aspects with ≥ 3 signs and/or adenopathy	▪ Taller-than-wide shape ▪ Irregular or microlobulated margins ▪ Microcalcifications ▪ Marked hypoechogenicity	100

Image 1: TIRADS classification

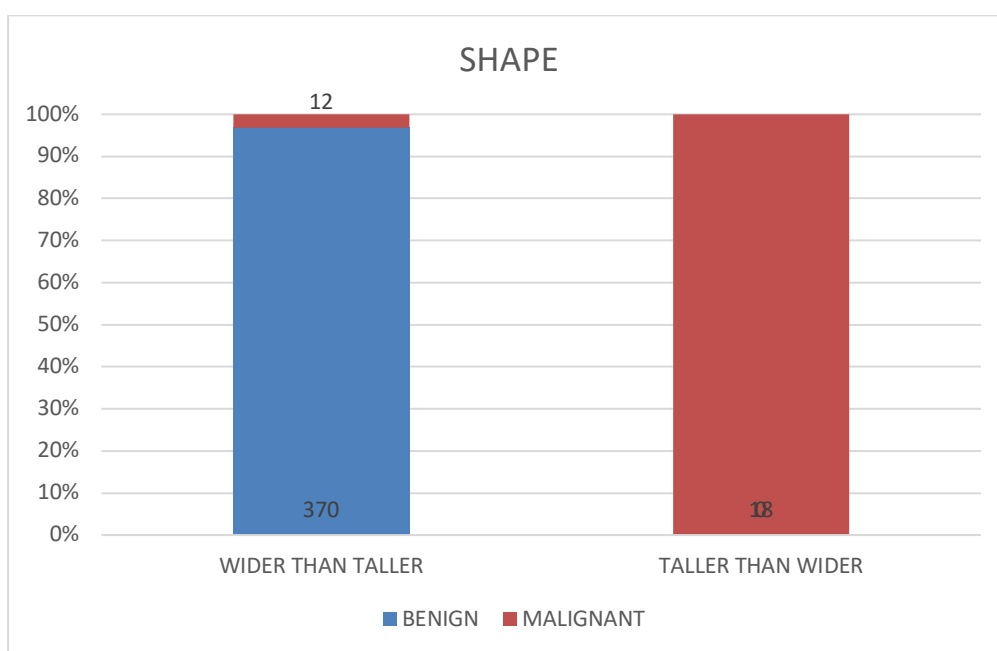


Figure 1: Chart showing the percentage of thyroid nodules depending upon the Shape

Echogenicity: Ultrasonographically 342 thyroid nodules showed either iso echogenicity or hyperechogenicity, 34 nodules showed hypo-echogenicity and the remaining 24 nodules demonstrated marked hypoechogenicity. All the 342 nodules which had iso or hyper echogenicity on USG have demonstrated benignity on FNAC. Among the 34 nodules which had hypoechogenicity 28 nodules were benign and 6 were malignant on FNAC. All the nodules which showed marked hypoechogenicity were proved malignant on FNAC. With a P value of 0.03 marked hypoechogenicity nodules has more propensity for malignancy.

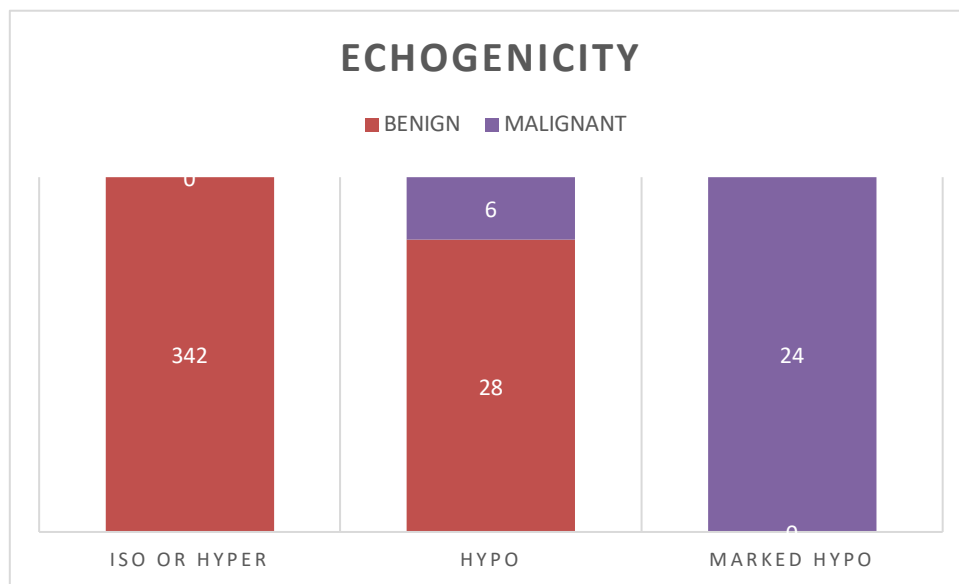


Figure 2: Chart showing the percentage of thyroid nodules depending upon Echogenicity

Contents: Ultrasonographically 208 nodules were solid in nature and 192 nodules demonstrated mixed content (solid and cystic). Out of 208 nodules which were solid in nature, 178 nodules were benign and 30 nodules were malignant on FNAC. All 192 nodules with mixed content were benign on FNAC. With a P value of 0.001 solid nodules has more propensity for malignancy.

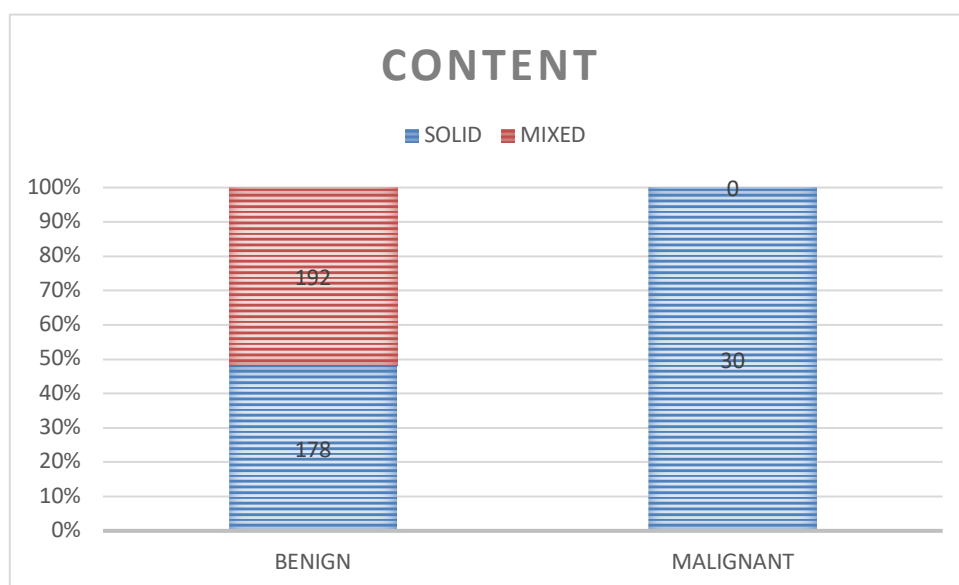


Figure 3: Chart showing the percentage of thyroid nodules depending upon the Content

Calcifications: Out of the 400 nodules analysed 354 nodules had no calcification, 18 had macro- calcification and 28 had microcalcification. Out of 354 nodules which had no calcification 349 nodules were benign and 5 nodules were malignant on FNAC. All 18 nodules with macro-calcification had benign character on FNAC. Out of 28 nodules which had micro-calcification, 25 nodules were malignant and 3 nodules were benign on FNAC. With a P value of 0.041 microcalcification in nodules has more propensity for malignancy.

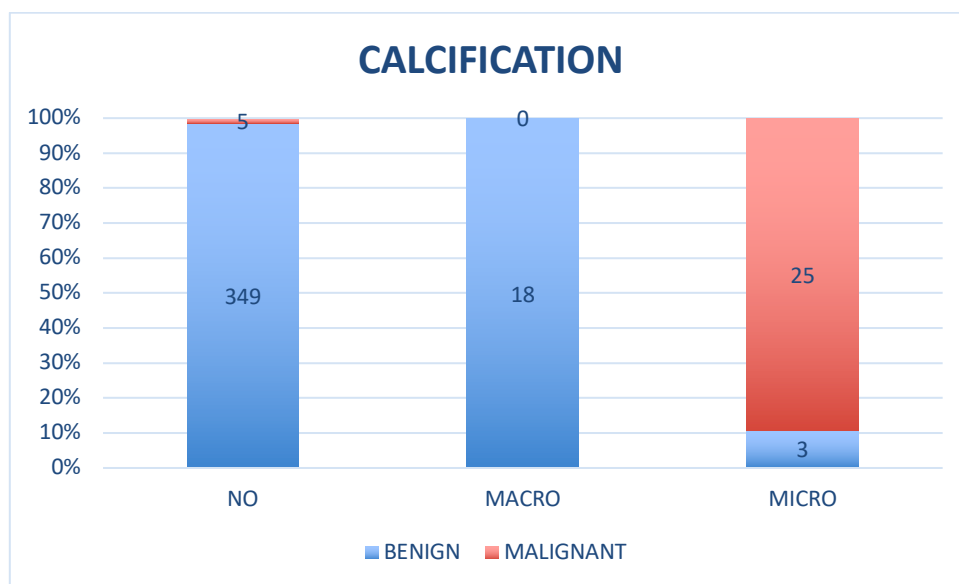


Figure 4: Chart showing the percentage of thyroid nodules depending upon the Calcification

Margins: Among the 400 nodules,282 nodules had smooth margin, 102 nodules had irregular margin and 16 nodules had microlobulated margin on USG. Out of 282 nodules which had smooth margin on USG, 278 nodules were benign and 4 nodules were malignant on FNAC. Among the 102 nodules which had irregular margin 92 were benign and 10 were malignant on FNAC. Out of 16 nodules which had micro-lobulated margin, all were proved malignant on FNAC. With a P value of 0.001 micro-lobulated margins has more propensity for malignancy.

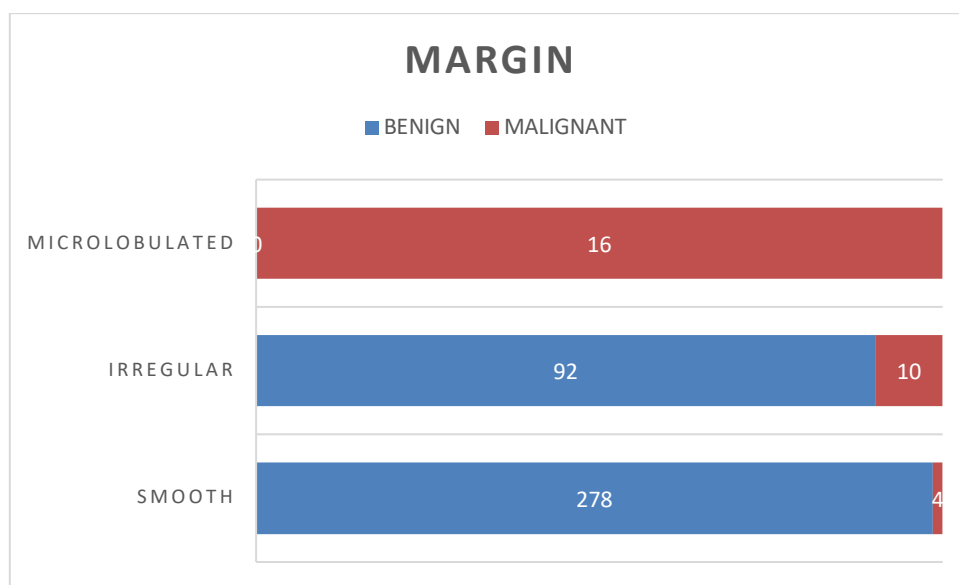


Figure 5: Chart showing the percentage of thyroid nodules depending upon the margin

According to the ultrasound features all the thyroid nodules were categorized into TIRADS category. Out of the 400 nodules evaluated 284 nodules were included in TIRADS category 3, 26 nodules in category 4a and 74 nodules in category 4b. The remaining 16 nodules were included under category 5. All the nodules in category 3 were shown benign character on histopathology. 4 nodules in category 4a and 10 nodules in category 4b were malignant and all the 16 nodules in category 5 had malignant character in histopathology.

Table 1: TIRADS category & FNAC result

USG Category		FNAC Result	
Category	No of Nodules	Benign	Malignant
TIRADS 3	284	284	0
TIRADS 4a	26	22	4
TIRADS 4b	74	64	10
TIRADS 5	16	0	16

We also evaluated the sensitivity and specificity of all five USG features and TIRADS grade 4B and 5 together which has high suspicion with TIRADS 5, margin, shape and echogenicity having high sensitivity.

Table 2: Sensitivity and Specificity

Usg features	Sensitivity	Specificity	PPV	NPV	Accuracy
SHAPE	60%	100%	100%	97%	97%
ECHOGENICITY	80%	100%	100%	98%	50%
CONTENT	100%	53%	15%	100%	56%
CALCIFICATION	83%	99%	89%	90%	98%
MARGIN	53%	100%	100%	100%	96%
TIRADS 4B&5	87%	83%	79%	98%	83%
TIRADS 5	53%	100%	100%	96%	96%

Representative images

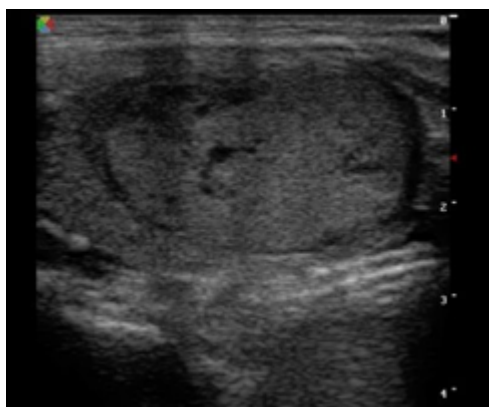


Figure 1: Typical features of benign nodule:

Image shows – Oval shape, smooth margin, No calcification, Iso echogenic and Solid and cystic contents thyroid nodule

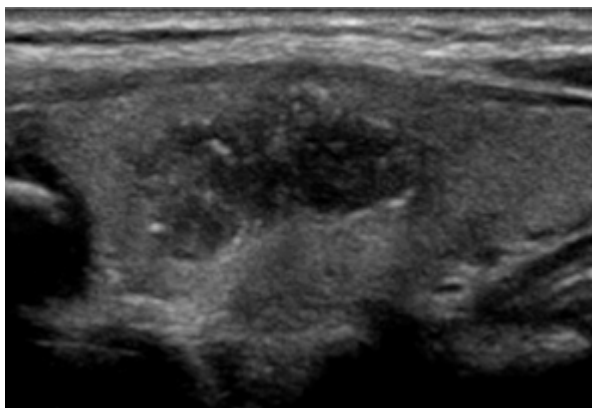


Figure 2: Typical features of malignant nodule:

Image shows - Taller than wider shape, Hypo echoic, Irregular margin, Solid content and micro calcification thyroid nodule.

Discussion

Nearly two third of the population shows thyroid nodules in high resolution ultrasonogram of thyroid gland [1-4]. In our study thyroid nodules more commonly seen in 35 to 45 years of age. Male to female ratio of 1: 2.8. In some studies, less than ten percentage nodules were malignant [5,6]. In our study 7.5 % of thyroid nodules were malignant on histopathology report. It also correlates with the previous study done by Thayalnayaki *et al* [7,8]. In a study done by MoifoBetalit was stated that the risk of malignancy increased from TIRADS category II to category V. In our study also malignancy nodules increased from TIRADS category increased, 3 to 5. In our study malignancy risk more in TIRADS category 5. It's also correlate with study done by Horvath *et al* study [3]. Our study features are well correlated with study done by Horvath *et al*, except category 4A. It may be due to inter observer variation. In our study, The most common Ultrasound findings in benign nodules – Wider than taller, Isoechogenicity / hyperechogenicity, Mixed (solid and cystic) content, Macrocalcification. Most common Ultrasound findings in malignant nodules - Taller than wider, Marked hypo echogenicity, Micro lobulated margins, micro calcifications and cervical lymphnodes. It's well correlate with previous study done by Thaiyal nayaki *et al* [8]. Cervical metastatic lymphnodes

commonly seen in malignant nodules only. There are various ultrasound features associated with increased risk of thyroid malignancy. These features include taller-than-wider shape, irregular contour, marked hypoechogenicity and the presence of micro-calcifications. Presence of these features is suspicious for malignancy. Moifo *et al* reported that the presence of irregular contour of the thyroid nodules had the sensitivity, specificity of 34.78%, 99.51% respectively. Similarly, Kwak *et al* reported that the odds ratio for microlobulated margin is 20.135 (CI – 14.038 – 28.880). Also, Moifo B *et al* had sensitivity, specificity, positive predictive value and negative predictive value 30.4%, 98.8%, 58.3%, 96.2% for microcalcification. Coming to echogenicity Moifo B *et al* had sensitivity, specificity, positive predictive value and negative predictive value 13.04%, 99.51%, 60%, 95.29% respectively with odds ratio 12.75 (CI – 5.54 – 29.35).

Conclusion

Using TIRADS category system in USG reporting of nodules in thyroid increased the detection of malignant nodules and early detection of malignant nodules, early FNAC and further management. Its also avoid unnecessary FNAC and invasive procedure.

So, ultrasound used early screening tool for thyroid nodules, early detection of malignant nodules and further management. TIRADS category system is used to support that. Both USG thyroid, TIRADS category system and FNAC all combined used to detect thyroid malignant nodules early and further management

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