ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 08 | August - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ROLE OF ULTRASOUND IN DEMOGRAPHIC ANALYSIS AND EVALUATION OF THYROID NODULES.

Radiology

Shanmuga Priya Krishnaswamy	Junior Resident, Department of Radiodiagnosis, SRM Medical College Hospital and Research Centre, Potheri, Kattankulathur, Chengalpattu District, SRM IST, Tamil Nadu – 603203, India.
Mandadapu Sri Padma	Junior Resident, Department of Radiodiagnosis, SRM Medical College Hospital and Research Centre, Potheri, Kattankulathur, Chengalpattu District, SRM IST, Tamil Nadu – 603203, India.
Kaavya Bandari	Junior Resident, Department of Radiodiagnosis, SRM Medical College Hospital and Research Centre, Potheri, Kattankulathur, Chengalpattu District, SRM IST, Tamil Nadu – 603203, India.
Yatham Rama Rao	Junior Resident, Department of Radiodiagnosis, SRM Medical College Hospital and Research Centre, Potheri, Kattankulathur, Chengalpattu District, SRM IST, Tamil Nadu – 603203, India.
Varsha Reddy Kondampally	Junior Resident, Department of Radiodiagnosis, SRM Medical College Hospital and Research Centre, Potheri, Kattankulathur, Chengalpattu District, SRM IST, Tamil Nadu – 603203, India.
Senthil Kumar Aiyappan*	Professor and Head, Department of Radiodiagnosis, Department of Radiodiagnosis, SRM Medical College Hospital and Research Centre, Potheri, Kattankulathur, Chengalpattu District, SRM IST, Tamil Nadu – 603203, India. *Corresponding Author

ABSTRACT

Introduction: The clinical condition of thyroid swelling is one that is most frequently seen in surgical practise. They are primarily caused by the generalised enlargement. Being non-invasive, USG helps to diagnosis the thyroid pathologies and manage accordingly. Inspite of all the advantages, in few cases, ultrasound cannot distinguish between malignant and benign masses. It needs to be correlated with FNAC to confirm definitive diagnosis. **Aim:** To establish the demographic data of thyroid nodules using ultrasonography and to assess the diagnostic accuracy of ultrasound for evaluation of thyroid nodules. **Materials and methods:** The study was conducted after getting approval from our institution ethical committee and after obtaining written informed consent from the patients during the period from January 2021 to June 2022 in the Department of Radiology, SRM Medical College hospital and Research center, Kattankulathur, Chengalpattu district."It is a cross sectional study done on fifty patients who were diagnosed to have thyroid nodules by B-mode ultrasound or by palpation." Patients who fulfilled the inclusion criteria were undertaken for the study."Detailed history and reports of thyroid function tests were collected from these patients. Following ultrasound evaluation of thyroid nodules using TIRADS scoring, the final diagnosis was confirmed by histopathology or cytology. **Results:** In this study done with 50 patients, thyroid nodules were observed in the age group from 21-70 years. Of this, most of them were found in the age group of 21-30 years. Majority of thyroid nodules found in men were benign nodules. Majority presented with neck swelling followed by swelling associated with pain and incidentally detected nodules. Most of the cases were euthyroid with few of them being hypothyroid. Majority presented with complaints for more than 6 months duration. Most of the patients had duration of symptoms more than 6 months for both benign and malignant nodules. It was seen that the ultrasonography and HPE diagnoses were similar in 97.22% of the cases with benign lesions and 40% of cases with malignant lesions. The sensitivity of diagnosing malignant lesions on ultrasound was 87.5% and specificity was 83.33%. Accuracy of ultrasound was 84%. **Conclusion:** The study was able to establish the demographical data of thyroid nodules and diagnostic accuracy of ultrasound with FNAC/HPE as a gold standard technique.

KEYWORDS

Thyroid; ultrasound; nodules; FNAC

INTRODUCTION:

The thyroid gland, the biggest endocrine gland, is the first gland to form throughout foetal life. It is located superficially which helps in physical examination, easy visualization and anatomical evaluation using real time high resolution grey scale ultrasound for detecting any pathological conditions.[1] Being non-invasive, Ultrasonography (USG) helps in diagnosis of thyroid pathologies and manage accordingly. Real time high resolution grey scale ultrasound and Color doppler can aid in demonstrating normal thyroid and also pathologies with remarkable quality.[2]USG delineates intrathyroid architecture, differentiate cystic and solid lesions. It also helps in checking whether the nodule is solitary or multinodular, and accurately locates and measures a nodule. It also demonstrates associated lymphadenopathy. In USG, thyroid nodules are evaluated using size, echotexture, location, margins, calcification, presence of halo, vascularity and cervical lymphadenopathy to differentiate between malignant and benign nodule.[3]

Fine needle aspiration cytology (FNAC) gives most specific information regarding thyroid swellings. It helps to reduce thyroidectomies required, by approximately 50%. FNAC is a specific, sensitive, and accurate technique for evaluation of thyroid swellings.[4] Inspite of all the advantages, in few cases, ultrasound cannot distinguish between malignant and benign masses. It needs to be correlated with FNAC to confirm definitive diagnosis. The overall sensitivity of FNAC have is high, ranging from 90-100%, for detection of malignancy in thyroid lesions.[5-10] Apart from this USG can predict disease progression, response to treatment, and recurrence.[11-13]

MATERIALS AND METHODS

The study was conducted after getting approval from our institution ethical committee and after obtaining written informed consent from the patients during the period from January 2021 to June 2022 in the Department of Radiology, SRM Medical College hospital and Research center, Kattankulathur, Chengalpattu district. It is a cross sectional study done on fifty patients who were diagnosed to have thyroid nodules by B-mode ultrasound or by palpation.

Inclusion And Exclusion Criteria:

Patients who were diagnosed to have thyroid nodules by B-mode ultrasound or by palpation or incidental detection and patients of any age group and both sex were included in the study. The exclusion criteria included those patients who refused to do FNAC, purely cystic thyroid nodules and TIRADS 6 category.

Study Method:

Patients who fulfilled the inclusion criteria were undertaken for the study. Detailed history and reports of thyroid function tests were collected from these patients.Following ultrasound evaluation of thyroid nodules using TIRADS scoring, the patients were then subjected to FNAC/HPE.

Ultrasound evaluation:
50 individuals who were sent to the Radiology department were evaluated for thyroid nodule. All scans were done using PHILIPS AFFINITY 30 equipped with a linear array transducer of 7–11 MHz.

Nodules smaller than 5mm were not characterized. Nodules larger than 5mm were characterized based on the composition, echogenicity, shape of the nodule, margins of the nodule, calcifications in the nodule and vascularity in the nodule and were classified according to TIRADS Scoring system.

Tirads Classification Of Thyroid Nodule
Classification system has been proposed by Horvath et al, with a modified recommendation from Jin Kwak et al .

Tirads 1: Thyroid appears normal.
Tirads 2: Those having benign lesions.
Tirads 3: Those lesiosn that are probably benign
Tirads 4: Those having suspicious lesions (dividedinto 4a, 4b and 4c with more risk of tumor potential)
Tirads 5: Those lesions that are probably malignant (> 80% risk of malignancy)
Tirads 6: Malignant lesions which are biopsy proven

Tirads 2
- A lesion which is anechoic, avascular having echogenic specks (type I colloid)
- A lesion which is non-encapsulated, heteroechoic, vascular, non-expansile with peripheral halo (type IIcolloid)
- A lesion which is non-encapsulated, heteroechoic or isoechoic, vascular, expansile nodules (type IIIcolloid)
- These lesions have no risk of malignant potential.

Tirads 3
- Iso-echoic hyperechoic, or hypoechoic nodules, with peripheral vascularity and partial capsule formation, seen in(Hashimoto's pseudonodule) Hashimoto's thyroiditis.
- These lesions have none of the suspicious malignant features on ultrasound as described below.
- They have<5% risk of malignant potential.

Tirads 4, 5
5 suspicious ultrasound characteristics of malignancy:
- microlobulations or irregular margins
- solid component
- markedly hypoechoic nodule
- taller-than-wider shape
- microcalcifications
- highly stiff on elastography

Subclassification
Tirads 4a: 1 suspicious feature
Tirads 4b: 2 suspicious features
Tirads 4c: 3/4 suspicious features
Tirads 5: Has all 5 suspicious features
TIRADS 4a shows 5-10% risk of malignant potential, 4b and 4c may show 10-80% risk of malignant potential.

TIRADS 5 category lesion have >80% risk of malignancy.

Fnac Of Thyroid:
After USG examination, all patients with thyroid nodules underwent FNAC. Few of these patients also underwent surgery. Ultrasound character of the lesion was correlated with the FNAC. Follicular neoplasm and follicular adenoma could not be differentiated by FNAC. So in those cases, histopathological report was obtained from the surgical specimen.

RESULTS:
Demographic data
Table 1:Age distribution among study patients with HPE diagnosis

AGE	Benign		Malignant	
	Number	Percent	Number	Percent
21-30	10	23.8%	6	75%
31-40	8	19.04%	2	25%
41-50	12	28.5%	-	-
51-60	7	16.66%	-	-
>60	5	11.9%	-	-

Many benign lesions were between 41 to 50 years i.e. 28.5% and those with malignant lesions were among 21 to 30years age group i.e. 75%.

Table 2:Gender distribution of patients and its correlation with histopathological examination

SEX	Benign		Malignant		TOTAL
	Number	Percent	Number	Percent	
Male	3	7.1%	-	-	3(6%)
Female	39	92.8%	8	100%	47(94%)

There were 47 females i.e. 94% and 3 males i.e. 6% among the study patients with more of female patients. Out of 50 cases in the study, 42 were benign and 8 were malignant on HPE. All the 3 male patients were diagnosed to have benign lesion on HPE examination. 8(17.02%) out of 47 female patients had malignancy.

Table 3: Thyroid function test distribution among study patients

TFT	Frequency	Percent	Benign	Percent	Malignant	Percent
Euthyroid	44	88%	36	81%	8	18%
Hypothyroid	6	12%	6	12%	-	12%
Hyperthyroid	-	-	-		-	-

Among the study patients 44(88%) had normal thyroid function test, while 6(12%) were Hypothyroid.

Table 4: Correlation of Duration of complaints with HPE diagnosis

Duration of symptoms	Benign		Malignant		TOTAL
	Number	Percent	Number	Percent	
< 3 Months	14	33.33%	2	25%	16
3M – 6M	13	30.95%	3	37.5%	16
>6 months	14	33.33%	3	37.5%	17
Incidental	1	2%	-	-	1

Most common presenting complaint among the study patients was swelling i.e. 84%. 14% patients presented with pain associated with swelling. In 1(2%) patient thyroid swelling was noted incidentally on routine examination.3(37.5%) patients each with malignant lesion had symptoms for 3 months to 6 months and more than 6 months. Among benign lesion, 14(33.33%) patients each had symptoms less than 3 months and > 6months respectively.

Out of 50 patients, 24 patients (48%) of thyroid lesions were solitary nodule and 26(52%) were multiple nodules. On correlation with HPE diagnosis, 57.1% benign cases had multiple nodule and 75% malignant cases had solitary thyroid nodule.

Table 5 : Histopathological diagnosis distribution among study patients

HPE RESULTS	Frequency	Percent
Adenomatoid nodule	35	70%
Colloid nodule	2	4%
Focal asymmetrical thyroiditis	4	8%
Papillary carcinoma	5	10%
Follicular adenoma	1	2%
Follicular neoplasm	3	6%
Total	50	100%

Common lesions diagnosed on HPE were adenomatoid nodule (70%). Other lesions detected include colloid nodule (4%), focal asymmetrical thyroiditis (8%), papillary carcinoma (10%), follicular adenoma (2%), follicular neoplasm (6%)

Ultrasound diagnosticaccuracy
Table 6: Comparison of ultrasound diagnosis with HPE diagnosis

USG diagnosis (TIRADS Score)	HPE diagnosis		
	MALIGNANT	BENIGN	
MALIGNANT	7(50%)	7(50%)	14
BENIGN	1(2.78%)	35(97.22%)	36
TOTAL	8	42	50

Table 7: NPV, PPV, specificity, sensitivity of ultrasound for Malignant vs benign lesions.

	Malignant lesion	Benign lesion
Sensitivity	87.5%	83.33%
Specificity	83.33%	87.5%
Positive predictive value	50%	97.22%
Negative predictive value	97.22%	50%
Accuracy	84%	84%

It was seen that the ultrasonography and HPE diagnoses were similar in 97.22% of the cases with benign lesions and 40% of cases with malignant lesions.

The sensitivity of diagnosing malignant lesions on ultrasound was 87.5%and specificity of the USG diagnosis compared with HPE diagnosis for diagnosing malignant lesions was 83.33%. The positive predictive value for diagnosing malignant lesions on Ultrasound was 50% and NPV was 97.22%. Accuracy of the USG for diagnosing Malignant lesion is 84%.

Summary of results:

In this study done with 50 patients, thyroid nodules were observed in the age group from 21-70 years. Of this, most of them were found in the age groupof 21-30 years. The thyroid nodules were less frequently observed in population more than 50 years.Most with benign lesions were between the age of 41 to 50 and those with malignant lesions were among 21 to 30 years age group (Table1). Most of the benign and malignant lesions were detected in female patients. Majority of thyroid nodules found in men were benign nodules(Table 2).

Majority presented with neck swelling followed by swelling associated with pain and incidentally detected nodules. Most of the cases were euthyroid with few of them being hypothyroid(Table 3). Majority presented with complaints for more than 6 months duration. Most of the patients had duration of symptoms more than 6 months for both benign and malignant nodules (Table 4). Among benign lesion, 14(33.33%) patients each had symptoms less than 3 months and > 6months respectively.

Majority of the patients had multiple nodules (52%) as compared to solitary nodule. On correlation with HPE diagnosis, 57.1% benign cases had multiple nodule and 75% malignant cases had solitary thyroid nodule. Common lesion diagnosed on HPE was adenomatoid nodule (70%) **(Table5/Fig 1).** Other lesions detected include colloid nodule (4%), focal asymmetrical thyroiditis (8%), papillary carcinoma (10%)**(Fig 2),** follicular adenoma (2%), follicular neoplasm (6%). It was seen that the ultrasonography and HPE diagnoses were similar in 97.22% of the cases with benign lesions and 40% of cases with malignant lesions(Table6). The sensitivity of diagnosing malignant lesions on ultrasound was 87.5%and specificity of the USG diagnosis compared with HPE diagnosis for diagnosing malignant lesions was 83.33%. Accuracy of the USG for diagnosing Malignant lesion is 84%(Table7).

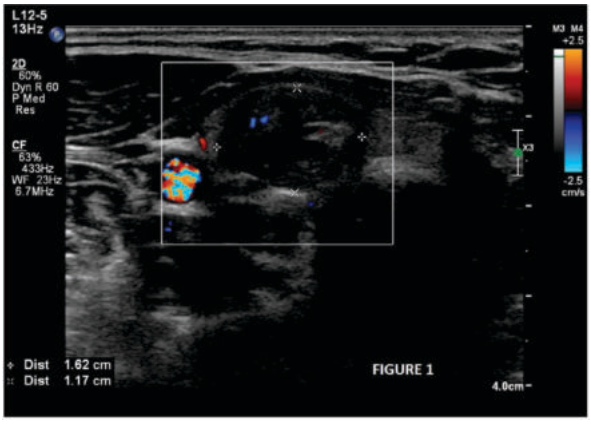

Figure 1: USG done on a female aged 35 years with neck swelling for the past 1 year Shows a well defined solid hypoechoic wider than taller lesion with cystic area in right lobe of thyroid – TIRADS 3. Final Cytological Diagnosis: Colloid nodule

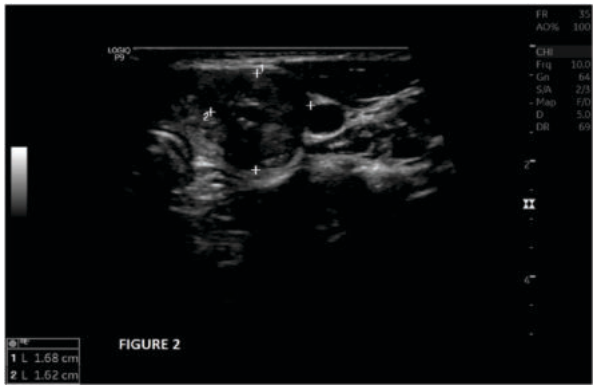

Figure 2: USG done on a 37 year old female came with complaints of swelling in the neck for the past 6 months shows a relatively well defined solid cystic hypoechoic taller than wider lesion showing macrocalcifications in left lobe of thyroid – TIRADS 5. Final Cytological Diagnosis: Papillary carcinoma

DISCUSSION

Demographic profile:

In this study, there was a 94% female preponderance, which is clearly visible. The results were consistent with a study by Palaniappan et al. that found that females are more likely than males to experience thyroid disorders.[14] In the literature, males had more malignancies than females, however in our investigation, all three of the men had benign tumours.

The incidence of malignant thyroid nodule was significantly more in younger age group of 21-30 years in this study. The results were consistent with study conducted by Palaniappan et al at a tertiary care hospital which showed that most of the malignant thyroid nodules were detected in younger population.[14]

In a case study done by Bamanikar, et al in a tertiary care hospital showed that common presenting complaint was neck swelling and most cases were of euthyroid.[15] This is similar to our study which showed the common presenting complaint was swelling in the neck and with 88% of the patients being euthyroid.

Out of 50 patients, 24(48%) of thyroid lesions were solitary nodule and 26(52%) were multiple nodules. These findings were consistent with the study conducted by Manoj Kumar Palaniappan et al showing that majority of the thyroid nodules were multiple.[5]

Most common lesion that was diagnosed on HPE in our study was adenomatoid nodule (70%). Other lesions detected include colloid nodule (4%), focal asymmetrical thyroiditis (8%), papillary carcinoma (10%), follicular adenoma (2%), follicular neoplasm (6%). Our results were identical to studies conducted by Patel Nr et al, in a study group of 100 cases showing benign colloid goitre as the most commonly detected lesion.[7] Similar research done by Mallikarjunappa et al, Sreeramulu et al also showed colloid goitre as the most predominant lesion.[9,15]

Correlation of Ultrasonography and HPE diagnoses:

In our study 14 out of 50 patients were given an ultrasonographic diagnosis of malignancy and rest of the 36 patients were found to have benign nodules. Out of 14 malignant lesions diagnosed on USG, 7(50%) cases were true positive for malignancy, 7(50%) cases were false positive, 1(2.78%) cases were false negative and 35(97.22%) were true negative for malignancy. USG sensitivity, specificity and positive predictive value for malignancy were 87.5%, 83.33% and 50% respectively. one malignant case was missed on ultrasonography, i.e. follicular carcinoma. The follicular carcinoma case had cystic change, so the USG diagnosis of colloid goiter was given.

Santos et al[16], reported 10 cases of papillary carcinoma out of 71 cystic thyroid nodules and authored that 14% of cystic thyroid nodules were malignant compared with the 23% of solid lesions that were malignant. In our study we encountered 5 cases of papillary carcinoma, out of which 3 showed cystic changes.

All cases of thyroiditis were diagnosed correctly on USG, as they were showing peripheral pattern of flow and diffuse pattern of increased vascularity.

Patel NR et al[7] 2019 out of 100 (100%) patients, 94 % were found to have Benign thyroid nodules by USG, while 6 % were found to be malignant lesions. However on HPE, out of 6% malignant lesions, 4% were diagnosed as benign, rest 2% patients were confirmed to be malignant.

These studies [table 8] were comparable to our study in which out of the 50 cases, 28% were identified to have malignant features on USG using the TIRADS scoring and the rest 72% were diagnosed to be benign. Of the 28% diagnosed as malignant on USG, 50% cases were confirmed as malignant on HPE/ FNAC examination. Whereas out of the 72% diagnosed as benign using USG TIRADS, 1.3% turned out to be malignant on HPE/ FNAC examination. Hence ultrasound can effectively predict benign than malignant nodules.

Table 8: Comparison of our study with previously published papers showing the sensitivity and specificity of USG

Reference	Cases	Sensitivity	Specificity
Santos et al16	71	75%	70.87%
Skowronska et al,201817	140	75	94.1
Horvath et al, 201718	502	74.4	99.6
Dia Eddine et al,201719	400	88	92
Srinivas et al,201620	365	96	92.6
Zhang J et al,201521	3980	97	91
Wei et al,201622	10487	81	95
PRESENT STUDY	50	87.5%	83.3%

Most of the previously published studies were comparable to our study.

CONCLUSION:

The study was able to establish the demographical data of thyroid nodules using ultrasonography along with diagnostic accuracy of ultrasound with FNAC/HPE as a gold standard technique.

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