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St. Paul's Hospital Millennium Medical College



**CORRELATION BETWEEN ULTRASONOGRAPHY AND HISTOPATHOLOGY IN
DETERMINATION OF BENIGNITY AND MALIGNANCY OF THYROID NODULES
AT SAINT PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE, ADDIS ABABA,
ETHIOPIA**

BY

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**A RESEARCH PAPER SUBMITTED TO THE DEPARTMENT OF RADIOLOGY,
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Addis Ababa, Ethiopia

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August, 2019

**Saint Paul’s Hospital Millennium Medical College
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**SAINT PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE
DEPARTMENT OF RADIOLOGY**

This is to certify that the research paper prepared by Solomon Tessema, entitled **“EVALUATION OF CORRELATION BETWEEN ULTRASONOGRAPHY AND HISTOPATHOLOGY IN DETERMINATION OF BENIGNITY AND MALGNANCY OF THYROID NODULES”** is submitted in partial fulfillment of postgraduate study in radiology and meets the accepted standards with respect to the originality and quality.

Name _____

Signature _____

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I. List of Acronym and Abbreviations

- **A/T** ratio-the ratio of anteroposterior (A) and transverse (T) diameter
- **CT**-computed tomography
- **FNAC**-Fine needle aspiration cytology
- **HPE**-Histopathologic examination
- **USG**- Ultrasonography
- **MRI**-Magnetic Resonance Imaging
- **PPV**- positive predictive value
- **SPHMMC**-Saint Paulo's Hospital Millennium Medical College

I. Abstract

Background: Sonography and fine-needle aspiration cytology (FNAC) have been approved as method of choice in diagnosis of malignant thyroid nodules. Unnecessary FNAC not only is invasive and costly but also results in second biopsy or unnecessary surgery because up to one-third of the FNAC are not diagnostic and require open biopsy. So we aimed to determine the specificity and sensitivity of sonography and histopathology, in diagnosis of malignant and benign thyroid nodules.

Objective: In this study, we aimed to determine the reliability of ultrasound-based characteristics of thyroid nodules, in diagnosis of malignant thyroid nodules in comparison with histopathology assessment as a gold standard.

Methods: Patients with thyroid nodule referred to SPHMMC 2017–2018 and candidates for surgical nodule resection were selected consecutively till sample size attained.

Patients were evaluated by sonography. Sonographic characteristics of nodule were described. All patients underwent surgical resection and gross samples were sent for pathological evaluation, the gold standard for measuring the specificity and sensitivity of sonographic findings in diagnosis of malignant nodules.

Results: Out of 106 cases, 44 had malignant nodules and 56 cases had benign nodules. Nodules were assessed on the basis of echogenicity, vascularity, calcification, texture and presence of lymphadenopathy.

Conclusion: Ultrasound is a sensitive and specific modality in assessment of thyroid nodules with good overall accuracy.

Keywords: Ultrasound, thyroid, accuracy, ecogenesity, sensitivity, specificity.

1. Introduction

1.1 Back ground

Thyroid nodules are one of the most common clinical problems of thyroid gland.^{1,2} Palpable thyroid nodules have a prevalence of 4–7% (3–5) and nodules >1 cm have been found in 50–60% of autopsies of individuals without clinical thyroid disease.^{4,5} Sonography, which is more sensitive than palpation, shows a prevalence of 67% for thyroid nodules in general population. Most of the thyroid nodules are symptomless and malignant transformation occurs in 5–10% of them which depends on age, gender, X-ray exposure history, and family history of thyroid cancer. Sonography and fine-needle aspiration cytology (FNAC) under sonography guidance have been approved as method of choice in differentiation of benign and malignant thyroid nodules.^{4–6} Sonography can detect nonpalpable nodules as well as lymphadenopathies.⁵ FNAC is being used as the most reliable and gold standard diagnostic method, with 65–98% sensitivity and 72–98% specificity, for reducing unnecessary thyroid nodule surgery resection. ^{2,3} Unnecessary FNAC not only is invasive and costly but also results in second biopsy or unnecessary surgery because up to one-third of the FNAC are not diagnostic and require open biopsy⁽¹⁾.

Applying an alternative method for FNAC, which is both less expensive and more accurate, results in less use of other diagnostic methods such as CT scan and MRI and consequent lower diagnostic expenses. It can also prevent unnecessary FNAC in patients with thyroid nodule, especially in endemic regions. Previous studies have shown that specific sonography findings can accurately differentiate benign and malignant nodules.⁷ So using sonography and its specific criteria in determining malignant nodules help us refer only patients suspicious for malignancy for more accurate assessment by FNAC⁽¹⁾.

FNAC is, however, not without limitations; accuracy is lower in suspicious cytology and in follicular neoplasms. The main aim of FNAC is to identify nodules that require surgery and those benign nodules that can be observed clinically and decrease the overall thyroidectomy rate in

patients with benign diseases (2). Limitation of FNAC is mainly because of inadequate sampling, in experience of the pathologist and overlapping cytological features (3).

1.2 Statement of the problem

Nodular thyroid disease is common throughout the world, and the incidence has been rising in recent decades (4). The prevalence of thyroid nodules is about 3%-8% in the general population and is greater than 50% after age 65 years (3). The reported prevalence of goitre in Ethiopia varies between 18% and 30 %.(5).

The prevalence of goitre in different geographic areas of Ethiopia is also high. A cross-sectional survey in Sekotta district showed the overall prevalence of goitre to be 22.8%. Similarly a study carried out to detect the prevalence of goitre in school children and household members has shown the prevalence of goitre to be 30.6% and 18.7 % respectively (5).

The goal of this diagnostic work up now is to select those patients who have a high likelihood of harboring malignancy in the nodule. Among these diagnostic workup, ultrasonography (USG) and fine needle aspiration cytology (FNAC) are commonly used but there are drawbacks of each technique and the final answer to the problem is still elusive (6).

Data on correlation between ultrasound and histopathology in determination of benignity and malignancy of thyroid nodules are lacking in this area.

This retrospective study is to analyze the accuracy of ultrasound of the thyroid nodule, which allows for the simultaneous evaluation of clinical and macro-morphological (ultrasound image) to predict the risk of malignancy, as ultimately demonstrated in the histological specimens.

2. Literature Review

According to research done on reliability of Fine-Needle Aspiration and Ultrasound-Based Characteristics of Thyroid Nodules for Diagnosing Malignancy in Iranian Patients Total of 90 patients with the mean age of 45.95612.3 years were evaluated (17 male and 73 female patients). The mean nodule length, width, and area were 30.12 6 14.7 mm, 21.9369.8 mm, and 771.96696 mm², respectively, with no significant differences in male and female patients. The single nodule was significantly more in male patients (P50.014). The nodule had micro calcification in 39 patients, irregular border in 9 patients, solid part in 72 patients, hyper vascularity in 21 patients, tall shape in 3 patients, and cervical lymphadenopathy in 5 patients. There were no significant differences in nodule characteristics between the male and female patients.

The nodules were malignant in 12 patients and benign in 78 patients based on the diagnosis of sonographer. These nodules were malignant in 15 patients and benign in 75 patients based on the diagnosis using FNA. The final pathology report was malignant in 16 patients and benign in 74 patients. Compared to the gold standard (pathology), the diagnosis of sonographer had 56.25% sensitivity and 95.9% specificity, and the FNA-based diagnosis had 81.25% sensitivity and 93.7% specificity (1).

A study done by ChintaVittal Prasad* in 2016 in MNR medical college and Hospital, India Out of 100 lesions, 68 (64 benign and 4 were malignant) were hyper echoic, 27 (9 benign and 18 malignant) were hypo echoic and 3 were iso-echoic and 2 were anechoic.

If hypo echoic nature of the lesion is considered as an independent factor in identifying malignancy in a thyroid lesion, it could detect malignancy with a sensitivity, specificity, positive predictive value, negative predictive value of 72%, 88% 67% and 90% respectively.

Out of 100 lesions in this same study seen at HRUSG, 70 lesions (65 benign, 5 malignant.) showed macro calcifications, 27 lesions (17 malignant, 10 benign) showed micro calcifications. If micro calcification was considered as an independent factor identifying malignant lesion, it could detect malignancy with sensitivity, specificity positive predictive value and negative predictive value of 68%, 87%, 63% and 89% respectively.

Out of 100 lesions seen at HRUSG, 67 lesions (63 benign, 4 turned out to be malignant) showed peripheral vascularity, 28 lesions (12 benign, 16 malignant) showed central vascularity. If central vascularity was considered as an independent factor for malignancy, it would detect malignancy

with a sensitivity, specificity, positive predictive value and negative predictive value of 64%, 84%, 57% and 88% respectively.

In this study the overall sensitivity, specificity, positive value and negative predictive value of ultra-sonography in identifying a malignant lesion were 64%, 87% respectively. Hence USG is good at ruling out a malignancy lesion, thus playing a role in management.

The sensitivity rate for malignancy on HRUSG in the study by Won-Jin Moon, et al. was as follows hypo echoic nature (87%), ill-defined margins (48%), micro calcifications (44%), and A/T ratio more than one (40%)(3).

The prevalence of malignant thyroid nodules according to Anuradha Kapali¹, 2016(2) was 42.2%. In this study ten male patients presented with nodules out of which 40% were malignant and 47 female patients had nodules out of which malignancy was reported in 44.6% of patients. The nodules assessed in this study ranged from 5mm to 5 cms. The higher incidence of malignancy reported in this study is due to the fact that this center is a tertiary referral center. In the same study study 51% nodules were hypo echoic, 49% nodules were hyper echoic. Central vascularity was present in 68.4% patients and no significant central vascularity was seen in 31.5% patients. No calcification was identified in 54.3% patients, macro calcification was seen in 26.3% patients, micro calcification was seen in 17.5% patients and one patient had mixed macro calcification and micro-calcification (1.7%). Cystic areas were identified in 23% patients, two patients had honeycombing and 56.1% (32) patients had no cystic areas. Four patients had significant nodes two of these patients had micro calcification in the nodes and other two had no calcification. Normal thyroid background was present in 67% patients; colloid/ adenomatous hyperplasia changes were seen in background thyroid in 29.8% patients, Hashimoto's thyroiditis was seen in 2 patients. In this study the sensitivity of hypo-echogenecity, central vascularity, calcification, micro calcification, and lymphadenopathy was 84%, 74%, 64%, 29% and 16% respectively. The specificity of hypoechogenecity, central vascularity, calcification, micro calcification, and lymphadenopathy was 75%, 48%, 65%, 94%, and 100% respectively in diagnosing malignant nodules.(7)

A study done by Ankush Dhanadia, Harshad Shah and Asutosh Dave in Shah Medical College out of 100 cases, 8% was malignant, 66% were benign and 26% were indeterminate lesions on grey scale ultrasound. All the 8 malignant cases were correctly diagnosed as malignant on

pathology. Out of 66 benign cases, 2 benign cases proved to be malignant on pathology as papillary carcinoma. Both cases on USG presented as a hypo echoic lesion with well-defined margin and coarse calcification. Due to coarse calcification they were diagnosed as benign on ultrasonography but turned out to be malignant on pathology as papillary carcinoma. Out of 26 indeterminate cases, 2 cases proved to be malignant and 24 cases benign on pathology(8).

According to research done in Ethiopia around the world, FNAB has been recognized for years as an excellent technique for the diagnosis of superficial and deep mass lesions.7–16 Fine-needle biopsy is widely practiced in Africa as evidenced by the many publications on the topic, only a few of which are cited.17–25 Reports on the use of FNAB in Ethiopia have appeared, including diagnosis of solitary thyroid nodules (9).

A study in Tikur Anbessa Hospital to determine the histologic patterns of thyroid nodule ,Seven hundred and eighty consecutive patients with thyroid disease were included in the study and Six hundred and sixty(79%) were found to be non-neoplastic and 164 (21%) were neoplastic. Nodular colloid goiter (NCG) was found in 600 (76.9%) cases. Adenoma, Carcinoma and thyroiditis accounted for 100 (12.8%), 64 (8.2%) and 16 (2.1%) cases respectively. Female to male ratio was 4.5:1. Eighty five point seven per cent of the thyroid diseases were found in the age group 20-59 years.(13), papillary carcinoma was the most frequent carcinoma in this series(5).

A study done in India to determine role of ultrasonography to differentiate benign and malignant thyroid nodules in correlation with Fine-needle Aspiration Cytology, of the 70 nodules examined, 6 (8.57%) were found to be malignant on cytopathology. The malignant nodules demonstrated solid or predominantly solid composition (sensitivity 100% and specificity 9.37%); presence of micro calcification (sensitivity 66.6% and specificity 98.4%); irregular or poorly defined margins (sensitivity 83.3% and specificity 92.06%); anteroposterior diameter more than transverse diameter (sensitivity 50% and specificity 93.75%); absent or thick incomplete halo (sensitivity 83.3% and specificity 82.8%); markedly hypo echoic character (sensitivity 66.6% and specificity 90.6%)

3. Significance of the study

Nodular disease of the thyroid is very common, while cancer is less common; a definite diagnosis of either is difficult to make. The general prevalence of thyroid nodules is very high. The awareness of prevalence of thyroid nodules and benignity or malignancy in ultrasound or FNAC alone is not satisfactory, so knowing correlation of ultrasonography and histopathology of thyroid nodules is needed to compare the histology of thyroid nodules to sonographic findings and to determine whether US findings are helpful in the interpretation of histological results.

Knowing the correlation between ultrasonography and histopathology helps to know which features on the ultrasound are most predictive of benign nodule and which features are most predictive of malignancy.

The present study will be undertaken to correlate the ultrasound findings with histopathology.

4. Objectives

4.1. General Objective

To assess the correlation between ultrasonography and histopathology in determination of the benignity and malignancy among patients with thyroid nodules At Saint Paul's Hospital, Addis Ababa from 2017-2018.

4.2. Specific objectives

- A. To determine the correlation between ultrasound and histopathology in prediction of malignancy of thyroid nodules.
- B. To determine the sensitivity, specificity, PPV, NPV and accuracy of ultrasound in determination of the benignity and malignancy among patients with thyroid nodules.

5. Methods and Materials

5.1. Study area and period: The study was conducted at St Paul's Hospital Millennium Medical College, which is found in Addis Ababa and is the 2nd largest hospital in the country. St Paul's Hospital Millennium Medical College, as it is known today, was established through a decree of the council of Ministers in 2010, although the medical school opened in 2007 and the hospital was established in 1968 by the late Emperor Haile Selassie. It is governed by a board under the Federal Ministry of Health. The College initiated Ethiopia's first integrated modular and hybrid problem-based curriculum for its undergraduate medical education, and is currently expanding to postgraduate programs and diversifying its undergraduate program offerings. It is the training center for undergraduate and a wide spectrum of postgraduate. The radiology department has consultants, residents and radiology technicians. St Paul's is in the process of building its capacity quickly in a short period of time, growing from 3 to 250 faculty members in the last six years, and expanding teaching facilities. The college has more than 2800 clinical, academic and administrative and support staffs that provide medical specialty services to patients who are referred from all over the country, teaching medicine and nursing students and doing basic and applied researches. While the patient capacity is more than 700 beds, the college sees an average of 1200 emergency and outpatient clients daily. The study was conducted from April 1- July 30, 2019.

5.2. Study design: the study design was facility based retrospective cross sectional study.

5.3. Population

5.3.1. Source Population

All patients with thyroid nodules.

5.3.2. Study Population

All patients with thyroid nodules who are referred to SPHMMC for ultrasound and who have undergone surgery and biopsy subjected to pathology.

5.4. Inclusion and exclusion criteria

5.4.1. Inclusion Criteria

- Patients who have sonography for thyroid nodules
- Patients who have undergone surgery for thyroid nodule and biopsy subjected to pathology

5.4.2. Exclusion criteria

- Patients with ultrasound but no biopsy result.
- Patients who undergone surgery without biopsy/ultrasound.

5.5. Sample Size and Sampling Procedures

5.5.1. Sample Size

The sample size was calculated using a formula for estimating a single population

$$n = \frac{Z^2 (a/2)^2 P (1-P)}{d^2}$$

Where

n= the required sample size

Z (a/2) = the critical value at 95% level of significance (1.96)

d= Precision of measure (acceptable margin of error)

P= the prevalence of malignant thyroid nodules in one study in our country was 8.2%(5),

p=0.082

d= 0.05

$$n = \frac{(1.96)^2 0.082(0.918)}{0.05^2} = 116$$

n= 116

5.5.2. Sampling procedures

All consecutive patients with ultrasonography and histopathology will be included purposely.

5.6. Methods of Data Collection

A structured Questionnaire was developed based on study objectives and available literature. Data was collected by the radiology residents by reviewing the record of patients. The principal investigator supervised the data collection for the utmost quality.

5.7. Study Variables

5.7.1. Dependent Variables

Nodule status (benign, malignant,)

5.7.2. Independent Variables

- age
- sex
- presenting complaint (neck swelling, neck pain)
- number of thyroid nodules
- duration of symptoms
- nodule size
- echogenicity
- irregular margins
- site (Right lobe, isthmus, left lobe)
- vascularity
- calcification
- lymphadenopathy

6. Data Processing and analysis

Descriptive statistics was used to infer results. Microsoft excel was used to generate tables. Editing and sorting of the questionnaires was done to determine completeness manually. Data entry and analysis was performed using SPSS.

Descriptive statics such as Frequency distribution and measure of central tendency and variability (mean and standard deviation) was computed to describe the major variables of the study. To indicate the strength and statistical significance of the association of the selected independent and dependent variables, crude and adjusted odds ratio was used. For all of statistical tests used in this study, the significant level for bivariate and multivariate analysis was set at p-value < 0.2 and < 0.05 respectively. The analysis was done using chi-square and binary logistic regression.

7. Data Quality Control

The questionnaires was designed in English language and pre-tested on 8 records of patients similar to the study population (5% of the sample size) in the study hospitals which was not included in the study. The finding of the pre-test was incorporated into the final instrument for the study. The data collectors was given training by the PI on the final questionnaire and data collection techniques.

8. Operational Definition and terms

Hypo-echoic: nodules with lower echogenicity when compared with thyroid gland

Hyper-echoic: nodules are more echogenic when compared to background thyroid parenchyma

Micro calcification: calcification without shadowing and measuring about 1mm.

Macro calcification: calcification with shadowing measuring more than 1mm, including coarse and curvilinear calcification.

Vascularity: degree flow on color Doppler.

Irregular margins: micro lobulated or speculated in appearance

Ill-defined nodules: the demarcation between the tumor and the surrounding normal glandular parenchyma is indistinct

Lymphadenopathy: nodes more than 1 cm in their short axis or had micro calcification or cystic areas (irrespective of size) and architectural distortion.

9. Ethical Consideration

The proposal was approved by the Ethical Review Committee of department of Radiology. Permission was requested from the hospital to access the clients data included in the study. Concerning the right to anonymity and confidentiality, the study participants names was not documented on the questionnaire.

The study participant did not receive any financial or any other type of reward or inducement to be enrolled into the study.

10. Dissemination of the Result

After accomplishing the study, the results was presented to department of Radiology. Subsequently, attempts will be made to present it on scientific conferences and publish it on scientific journals.

11. RESULT

A. Socio-demographic status

A total of 126 cases with thyroid nodule were studied from which 26 were excluded due to lack of histological result. The mean age was 37.4 years with age range from 13 years to 70 years.

Table 1: The age category of study participants (N=100)

Age category	Frequency(N)	Percentage
10-19	6	6
20-29	28	28
30-39	20	20
40-49	28	28
50-59	10	10
60-69	6	6
70-79	2	2
Total	100	100.0

- ✓ Out of 100 cases 80%(80) were females and 20%(20) were males with female to male ratio of 4:1.

Table 2: sex distribution of the study cases

Sex category	Frequency	Percent
Male	20	20
Female	80	80
Total	100	100

- ✓ Most cases 76%(76) were in the age range of 20-49 years in both sexes.

Table 3: age distribution by sex of the study cases

Age category	Sex category		total
	male	female	
10-19	2	4	6
20-29	8	20	28
30-39	4	16	20
40-49	4	24	28

50-59	2	8	10
60-69	0	6	6
70-79	0	2	2
Total	20	80	100

B. Clinical presentation: Out of 100 patients, most 84%(84) presented with neck swelling, 6%(6)neck pain, 6%(6)neck discomfort and 4%(4)hoarseness of voice.

Table 4: Presenting complaint of the study cases

Presenting complaint	Frequency (N)	Percentage
Neck swelling	84	84
Neck pain	6	6
Neck discomfort	6	6
Voice change	4	4
Total	100	100

C. Clinical Diagnosis: Out of 100 cases, 42%(42) are diagnosed as multinodular goiter and 40%(40) as rule out thyroid ca clinically. The remaining clinical diagnosis includes 8%(8) r/o metastasis, 6%(6)toxic goiter and 4%(4) rule out lymphadenopathy.

Table 5: Clinical Diagnosis of the study cases

Clinical diagnosis	Frequency(N)	Percentage
Multinodular goiter	42	42
Rule out thyroid ca	40	40
Rule out metastasis	8	8
Toxic goiter	6	6
Rule out lymphadenopathy	4	4
Total	100	100

D. Radiological diagnosis: Out of 100 cases 54%(54) were benign and 46%(46) were suspicious for malignancy sonographically.

Table 6: Radiologic Diagnosis of thyroid Lesions

Radiological Diagnosis	Frequency	Percentage
Benign	54	54
Suspicious for malignancy	46	46
Total	100	100

E. Sonographic features of thyroid nodules: The most common sonographic finding was mixed echogenicity 30%(30), multiple nodule 66%(66), solid and mixed consistency 92%(92), smooth margin 48%(48), increased vascularity 24%(24), macrocalcification 28 and no lymphadenopathy 52%(52).

Table 7: Sonographic features of various thyroid nodules

Ultrasound features		Benign	Malignant	Total
echogenicity	isoechoic	4	2	6
	hypoechoic	4	22	26
	hyperechoic	8	6	14
	anechoic	4	0	4
	Mixed	16	14	30
	Not mentioned	18	2	20
Multiplicity	solitary	18	12	30
	Multiple	34	32	66
	Not mentioned	2	2	4
consistency	solid	10	36	46
	mixed	36	10	46
	cystic	8	0	8
Margin	smooth	32	16	48
	irregular	0	10	10
	Not commented	22	20	42
vascularity	increased	8	16	24
	Similar to thyroid	8	0	8
	Not commented	38	30	68
calcification	NO	6	2	8
	micro	0	10	10
	Macro	14	14	28
	Rim calcification	2	14	16
	Not commented	32	18	50

LAP	NO	24	28	52
	YES	2	10	12
	Not commented	28	8	36

F. Pathologic Diagnosis: in this study, out of 100 cases, 56%(56) were benign and 44%(44) were malignant. Benign cases includes multinodular goiter, solitary thyroid nodule and toxic goiter.

Table 8: Pathologic Diagnosis of thyroid Lesions

Pathologic Diagnosis	Frequency(N)	Percentage (%)
Benign	56	56
Malignant	44	44
Total	100	100

- ✓ Out of 44 malignant cases 32(72.7%) were seen in females and 12(27.3%) were seen in males with wide age range of 13-70years. Percentage of malignancy in males is 12(60%) out of 20 and in females is 32(40%) out of 80 cases.

Table 9: age distribution by sex and status of nodule of the study cases

Age category	Sex Category				Total
	Male		Female		
	Benign	Malignant	Benign	Malignant	
10-19	0	2	0	4	6
20-29	4	4	16	4	28
30-39	2	2	12	4	20
40-49	2	2	12	12	28
50-59	0	2	6	2	10
60-69	0	0	2	4	6
70-79	0	0	0	2	2
Total	8	12	48	32	100

G. Correlation of sonographic features with pathologic Diagnosis: Out of 44 malignant cases, 18(40.9%) of cases were hypoechoic, 26(59%) cases had multiple nodules, 32(72.7%) were solid, 14(31.8%)cases had smooth margin, 12(27.2%) of the malignant cases have increased

vascularity, 14(31.8%) had macro calcification, 28(63.6%) malignant cases have no lymphadenopathy.

Table 11: Correlation of various sonographic features with pathologic Diagnosis

	Sonographic feature	Histopathology result			
		Benign		Malignant	
		Reading	%	Reading	%
Echogenicity	isoechoic	4	4%	2	2%
	hypoechoic	8	8%	18	18%
	Hyperechoic	12	12%	2	2%
	anechoic	4	4%	0	0
	mixed	14	14%	16	16%
	Not commented	14	14%	6	6%
Multiplicity	Solitary	18	18%	16	16%
	Multiple	36	36%	26	26%
	Not mentioned	2	2%	2	2%
Consistency	Solid	14	14%	32	32%
	Cystic	6	6%	2	2%
	mixed	36	36%	10	10%
Margin	smooth	34	34%	14	14%
	irregular	2	2%	6	6%
	Not commented	20	20%	22	22%
vascularity	increased	12	12%	12	12%
	similar	8	8%	0	0%
	Not commented	36	36%	32	32%
calcification	No	8	8%	0	0%
	Micro calcification	2	2%	8	8%
	Macro calcification	14	14%	14	14%
	Eggshell calcification	8	16%	8	8%
	Not commented	28	28%	22	22%
LAP	No	26	26%	28	28%

	Yes	4	4%	8	16%
	Not commented	26	26%	8	8%

H. Correlation of radiologic diagnosis with pathologic diagnosis : Out of 44 pathologically malignant cases, 10 were falsely benign sonographically. Out of 56 pathologically benign cases, 12 were falsely malignant sonographically giving accuracy of 78%.

Table 10: Correlation of radiologic diagnosis with pathologic diagnosis

Radiological diagnosis	Pathologic diagnosis		
	Malignant	Benign	
Malignant	34	12	56
Benign	10	44	54
Total	44	56	100

Sensitivity, specificity, PPV, NPV and accuracy of ultrasound for detecting malignant thyroid nodule. In this study for detection of malignancy, ultrasound has **sensitivity of 77.3%, specificity 78.6%, PPV 74%, NPV 81.5% and accuracy of 78%.**

12. DISCUSSION

In the present study the mean age was 37.4 with 80 female and 20 males similar to study by Akhavan et al with mean 45.9, 73 female and 13 males. So, according to this study, thyroid lesions are commoner in females. Most patients 84% present with complaint of anterior neck swelling, similar to study which is 80% were presented with neck swelling done by Gupta et al.

In this study 44%(44) malignant nodules were reported. The higher incidence of malignancy reported in our study is due to the fact that our center is a referral hospital which is comparable with the study done by Kapali, et al. which is 42.2%.

The percentage of malignancy in males is 12(13.6%) and in females is 32(72.7%), this is likely due to the high number of females with thyroid disease compared with males, as majority are benign, but the total number of malignant cases were more in females than males, as is total thyroid disease.

In our study for detection of malignancy, overall ultrasound has sensitivity of 77.3%, specificity 78.6%, PPV 74%, NPV 81.5% and accuracy of 78%. In study by Kapali, et al. ultrasound has sensitivity 88.4%, specificity 73.3%, PPV 74%, NPV 88% and accuracy of 80.3% which is comparable to our study except the sensitivity. In our study ultrasound has lower sensitivity likely due to in our study there are multiple sonographic features which were not commented in the ultrasonographic reports which are echogenicity, multiplicity, margin of the nodule, vascularity calcification and lymphadenopathy.

Out of 44 malignant cases in our study, 18(40.9%) cases were hypoechoic, 26(59%) cases had multiple nodules, 32(72.7%) were solid, 14(31.8%) cases had smooth margin, 12(27.2%) of the malignant cases have increased vascularity, 14(31.8%) had macro calcification and 28(63.6%)

malignant cases have no lymphadenopathy. The sonographic features were not completely documented and it is difficult to make analysis.

13.CONCLUSION

Ultrasound is a sensitive and specific modality in assessment of thyroid nodules with good overall accuracy. High resolution grey scale ultrasound has emerged as an initial imaging modality of choice for the evaluation of patients with thyroid enlargement .Ultrasound can detect solitary nodule, multiple nodules and diffuse thyroid enlargement. It can also differentiate solid and cystic lesions.

Various sonographic features help to characterize the thyroid lesion which is not possible on any other imaging modality. The most common ultrasound feature in suspecting malignancy is hypoechogenicity, multiplicity of the nodule, solid texture, smooth margin, increased vascularity, macrocalcification and no lymphadenopathy.

Thyroid malignancy cannot be diagnosed on ultrasonography but various sonographic features in combination can be used to predict malignancy in thyroid lesions. A benign FNAC diagnosis should be viewed with caution as false negative results do occur and these patients should be followed up and any clinical suspicion of malignancy even in the presence of benign FNAC requires surgery.

14.LIMIATION

In this study the limitation is incomplete reports in which some sonographic features were not commented in most of the cases.

15.RECOMMENDATION

1. Preparing reporting format that include all features is important as is using TIRADS in reporting of thyroid nodules so that reporting will be uniform.
2. Large sample size and prospective study preferably with single radiologist.

16. References

1. Akhavan A, Jafari MS, Khosravi MH, Khajepour H and Karimi-Sari H. Reliability of Fine-Needle Aspiration and Ultrasound-Based Characteristics of Thyroid Nodules for Diagnosing Malignancy in Iranian Patients. *Diagn. Cytopathol.* 2016;44(4): 269–273
2. Gupta M, Gupta S and Gupta BV. Correlation of Fine Needle Aspiration Cytology with Histopathology in the Diagnosis of Solitary Thyroid Nodule. *Journal of Thyroid Research.* 2010;2010
3. Prasad VC. Evaluation of correlation between ultrasonography and FNAC of thyroid nodules. *IAIM.* 2016; 3(2): 92-97
4. Bhuiyan UZMM, Machowski A. Nodular thyroid disease and thyroid malignancy: Experience at Polokwane Mankweng Hospital Complex, Limpopo province, South Africa. *SAMJ.* 2015;105:7
5. Tsegaye B and Ergete W. Histopathologic pattern of thyroid disease. *East African Medical Journal.* 2003;80: 10
6. Patel NR *et al.* Ultrasonographic and fine needle aspiration cytology correlation of thyroid gland lesions: a study of 100 cases . *Int J Otorhinolaryngol Head Neck Surg.* 2019 Mar;5(2):xxx-xxx
7. Kapali, et al. Role of Ultrasonography in Thyroid Nodules with Pathological Correlation. *International Journal of Contemporary Medical Research.* 2016; 3(5): 1451-1453
8. Ankush Dhanadia* , Harshad Shah***, Asutosh Dave***. Ultrasonographic and FNAC correlation of thyroid lesions. *Gujarat Medical Journal.* 2014; 69 (1): 75-81
9. Yeshe et al. Fine-Needle Aspiration Cytology in Ethiopia. *Arch Pathol Lab Med.* 2013;137:791–797
10. Avinash, *et al.* Role of Ultrasonography to Differentiate Benign and Malignant Thyroid Nodules in Correlation with Fine-needle Aspiration Cytology. *International Journal of Scientific Study.* 2016: 4(5): 81- 87

17. Annexes

Questionnaires

No _____

I. Demographics

1. Age _____
2. Sex---M _____ F _____
3. MRN _____

II. History

1. Duration of symptoms _____
2. Presenting complaint
 - A. neck swelling _____
 - B. neck discomfort _____
 - C. neck pain _____
 - D. hoarseness of voice _____
 - G. others specify _____

18. Ultrasound Features date _____

1. Echogenicity---
 - A. Iso-echoic _____
 - B. hypo-echoic _____
 - C. hyper-echoic _____
 - D. anechoic _____
 - E. heterogenous _____
 - F. not mentioned _____
- 2 Texture
 - A. Solid _____
 - B. cystic _____
 - C. mixed _____
 - D. not mentioned _____
- 3 Number
 - A. Solitary _____
 - B. multiple _____
 - C. not mentioned _____
4. Echogenic foci: (choose one or more)
 - A. None _____
 - B. large comet tail artifact _____
 - C. macrocalcification _____
 - D. peripheral rim calcifications _____
 - E. punctuate echogenic foci. _____
 - F. not mentioned _____

7. Margins

A. smooth_____

B. irregular_____

D. Extracapsular extension/ invasion_____

C. not mentioned_____

8. Vascularity

A. .increased_____

B. similar to normal thyroid_____

C. not mentioned_____

9. lymphadenopathy---

A. No_____

B. Yes_____

C. not mentioned_____

IV. Biopsy result --- 1. Benign _____

2. malignant _____

