

Role of ultrasonography in the evaluation of thyroid nodules with FNAC correlation

ABSTRACT

BACKGROUND:

To ascertain different morphologic patterns of clinically palpable thyroid nodule by ultrasound. To correlate ultrasound findings with FNAC and to evaluate the efficacy of ultrasound in differentiating benign and malignant thyroid nodules.

METHODS:

This is a prospective, diagnostic study. The study period is from October 2023 till July 2025. Patients of all age groups and both sexes.

RESULTS:

Out of 100 patients evaluated by USG, 80 were diagnosed to be benign thyroid nodules, 20 were malignant thyroid nodules. After FNAC correlation, 82 cases were found to be benign thyroid nodules and 18 were malignant thyroid nodules.

CONCLUSIONS:

Among benign thyroid nodules benign multinodular goiter were most common followed by benign colloid nodule. Among malignant nodules, papillary carcinoma was most common followed by follicular carcinoma. Thyroid nodules were common in the female of age group 31-40 years compared to male population. USG is safe radiation free cost effective fairly accurate investigation of choice in any patient presenting with clinically suspecting thyroid nodule. It also helped to differentiate between benign and malignant lesions. Associated with FNAC correlation it helps in early diagnosis and management.

KEYWORDS: USG-ultrasonography

INTRODUCTION

The thyroid gland is unique among endocrine glands in that it is the first endocrine gland to appear in the foetus. It is the largest of all endocrine glands (weighing about 25 g) and is the only one which is amenable to direct physical examination because of its superficial location.

Thyroid nodules are a very common clinical finding, with an estimated prevalence on the basis of palpation that ranges from 3% to 7%¹. In a large population study (in Framingham, Massachusetts), clinically apparent thyroid nodules were present in 6.4% of women and 1.5% of men². During the past 2 decades, the widespread use of ultrasonography (US) for evaluation of thyroid and neck disease has resulted in a dramatic increase in the prevalence of clinically inapparent thyroid nodules, estimated at 20% to 76% in the general population. Moreover, 20% to 48% of patients with a single palpable thyroid

nodule are found to have additional nodules when investigated by US^{3,4}. As a consequence, we are now facing an epidemic of thyroid nodules; the prevalence is similar to that reported in autopsy data, 50%, in patients with no history of thyroid disease⁵⁻⁷. Thyroid nodules are more common in elderly persons, in women, in those with iodine deficiency, and in those with a history of radiation exposure. The clinical implications of these data are overwhelming.

The growth of nodules can lead to a multinodular goiter. The clinical importance of thyroid nodules, besides the infrequent cases of local compressive symptoms or thyroid hyperfunction, is primarily the need to exclude the presence of a thyroid malignant lesion, which accounts for about 5% of all thyroid nodules, independent of their size^{7,8}. Because of the high prevalence of nodular thyroid disease, it is neither economically feasible nor necessary to submit all or even most thyroid nodules for a complete work-up for the assessment of their structure and function. Therefore, it is essential to develop and follow a reliable, cost-effective strategy for diagnosis and treatment of thyroid nodules. Most patients with thyroid nodules have few or no symptoms, and usually no clear relationship exists between nodule histologic features or size and the reported symptoms. Thyroid nodules can grow insidiously for many years and are often discovered incidentally on physical examination, self-palpation, or imaging studies performed for unrelated reasons.

There is considerable controversy over whether clinically unapparent thyroid lesions should be assessed by fine needle aspiration biopsy (FNA)^(9, 10). The conflicting attitudes are due to uncertainty about the prevalence of malignancy in small thyroid lesions and the biological behavior of thyroid microcarcinomas¹¹⁻¹⁶, usually diagnosed retrospectively in resected goiters. Few prospective studies¹⁷⁻¹⁹ have been addressed to the systematic evaluation of thyroid nodules incidentally discovered at sonography to correlate the dimensions and the US and color-Doppler (CFD) findings with the prevalence of cancer and its pathologic staging.

AIMS OF THE STUDY

1. To study the gray scale ultrasound features in patients presenting with thyroid nodules of different pathologies.
2. To study the role of Colour Doppler & Power Doppler in the evaluation of nodular thyroid disease.
3. To study the accuracy of gray scale, Colour Doppler & Power Doppler ultrasound features in differentiating benign from malignant thyroid nodules.
4. To study & compare ultrasound features with that of fine needle aspiration cytology findings in differentiating benign from malignant thyroid nodules.

MATERIALS AND METHODS: This study was conducted in the Department of Radio-Diagnosis. This is a prospective, diagnostic study. The study period is from October 2023 till July 2025. Patients of all age groups and both sexes.

Inclusion criteria:

Patients referred by the clinicians as cases of swelling in the neck region and found to have nodular thyroid disease on examination.

Exclusion criteria:

1. Patients who had already undergone neck surgery or received radiotherapy.
2. Patients presenting with diffuse enlargement of thyroid.

Equipments used :

1. Ultrasound with colour Doppler VOLUSON S6 PRO
2. Ultrasound with colour Doppler SIEMENS ACUSON X 300
3. Linear array transducer of 7-9 megahertz frequencies.
4. Image soft programme for recording images.

Consent:- Prior to each FNAC investigation, consent was taken from the patient.

METHODS :

TECHNIQUE OF HIGH SONOGRAPHY

PATIENT POSITION:

Thyroid ultrasound was performed with the patient in supine position and with a pillow placed between the shoulders to allow hyperextension of the neck and to elevate the thyroid gland away from sternal notch area. This is helpful in visualizing the inferior poles of both thyroid lobes, especially in a patient with a short neck.²³

PROCEDURE:

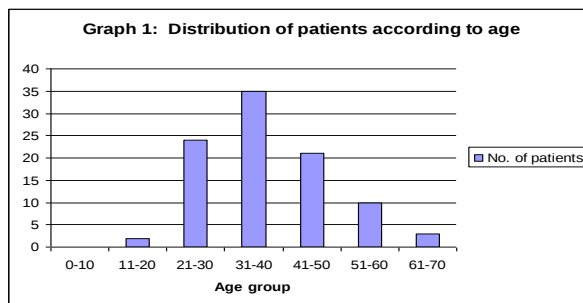
A 7.5 MHz transducer is universal for sonographic thyroid imaging. More superficial lesions with involvement of the strap muscles imaged with 10 MHz or higher frequency transducers.

The thyroid gland examined thoroughly in both transverse and longitudinal planes. Imaging of the lower poles can be enhanced by asking the patient to swallow, which momentarily raises the thyroid gland in the neck. The probe moved laterally to include the region of the carotid artery and jugular vein in order to identify enlarged jugular chain lymph nodes, superiorly to visualize submandibular lymphadenopathy, and inferiorly to define any pathologic supraclavicular lymph nodes. The thoracic inlet evaluated by angling the transducer inferiorly in the area of the sternal notch to look for a substernal goiter.²³

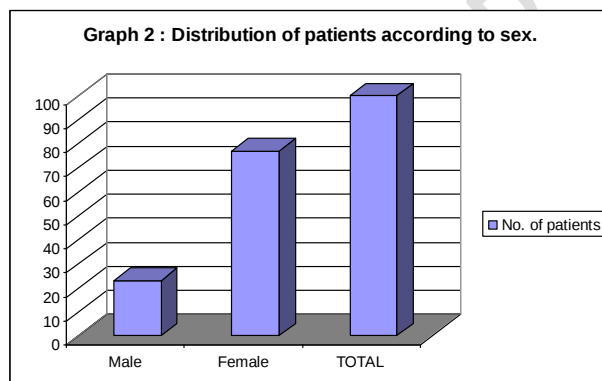
Sonography of larger goiters may require lower frequency transducers, such as 5 MHz, which allow better penetration at the expense of resolution.²⁴

RESULTS

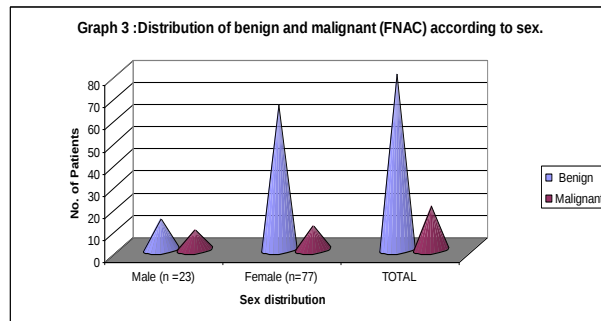
In this study, maximum number of cases fell in the age group of 31-40 years (n=35) followed by 21-30 years age group (n= 24). The youngest patient was 14 years old and oldest was 70 years old. Graph 1. Shows the distribution of patient according to age.



Out of the 100 cases in this study, 23(23.0%) were male and 77(77.0%) were females. Females 77(77.0%) were more commonly affected than males 23(23.0%).Graph 2. Shows distribution of patients according to sex.



Out of 100 cases in the study, 80 were benign and 20 were malignant on FNAC. 9 (39.1%) out of 23 male patients had malignancy. 11(14.3%) out of 77 female patients had malignancy. Males had malignancy proportion more than females.Graph 3. Shows distribution of benign and malignant cases according to sex.



Out of the total 100 patients evaluated, 44 (44.0%) patients had solitary thyroid nodule as compared to 56 (56.0%) patients who had multinodular goiter. Of the 44 solitary thyroid nodules, 37 were benign and 7 were malignant. Of the 56 multinodular goiter, 43 (76.8%) were benign and 13 (23.2%) were malignant. Table clearly shows that multinodular goiter cases are more than solitary nodule cases. The proportion of malignant cases were more in multinodular goiter 13 (23.2%) out of 56 cases as compared to 7 (15.9%) out of 44 solitary thyroid nodule cases. Graph 4. Shows distribution of nodularity and FNAC correlation.

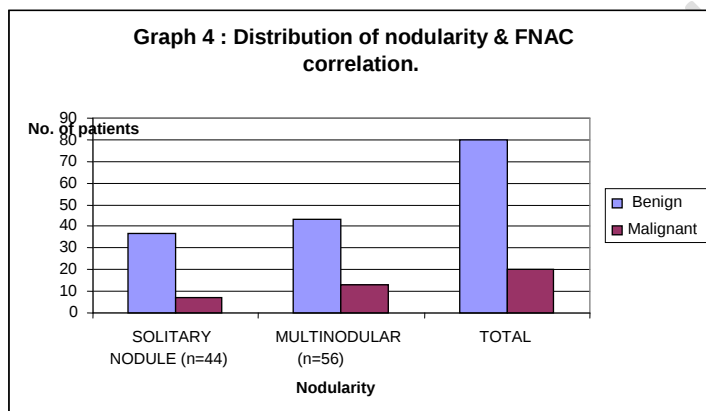
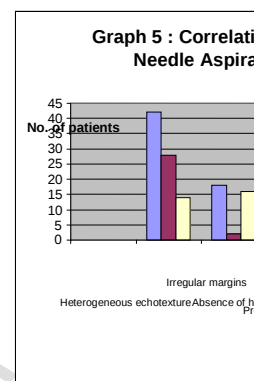


Table 1: Correlation between Sonographic features and Fine-Needle Aspiration findings in 100 Thyroid Nodules.

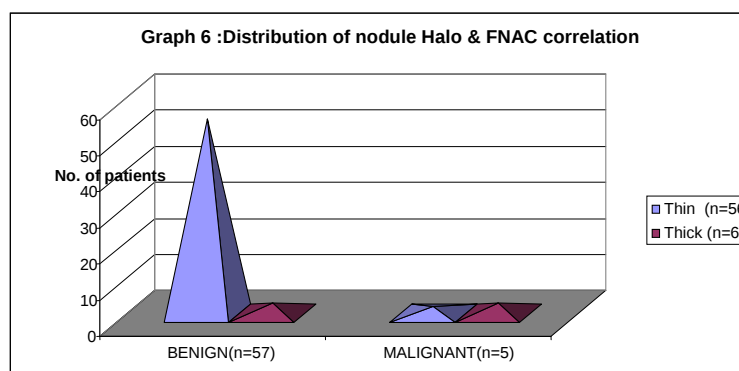
Sonographic Characteristic	No of Nodules	Benign Cytology (FNAC)	Malignant Cytology (FNAC)	P value
Heterogeneous echotexture	42	28	14	NS
Irregular margins	18	2	16	$p < 0.05$
Absence of hypoechoic rim	38	23	15	$p < 0.05$
Presence of microcalcifications	8	2	6	$p < 0.05$
Presence of macrocalcifications	1	0	1	NS



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138 Halo was observed in a total of 62 (62%) nodules. Of the 80 benign nodules 57 (71%) showed halo and
 139 was absent in 23 (29%) nodules. Of the 20 malignant nodules 5 (25%) showed halo. When present, thin
 140 halo was observed in significant proportion of benign nodules (95%). Out of the 5 malignant nodules
 141 with halo 3 (60%) cases showed thick halo and 2(40%) showed thin halo. Graph 6. Shows distribution of
 142 nodule halo and FNAC correlation.

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SUMMARY

- A total of 100 patients having palpable thyroid nodule and suspected of having thyroid nodule were studied.
- The maximum patients were in their fourth decade of life.
- Female preponderance was observed in this study with male to female ratio being 1:3.35.
- The final diagnosis was established in all the cases by FNAC.
- Total numbers of benign nodules were 80 and the malignant nodules 20.
- Malignancy was suspected clinically in only 3% of the patients where there were palpable enlarged lymph nodes. It has been proven by FNAC that the malignant cases were 20%, indicating clearly the non reliability of clinical diagnosis and the need for the diagnostic studies.
- Right lobe of thyroid is affected more than left lobe.
- Out of the benign thyroid swellings, colloid goiter was the most common cause (69%).
- Out of the 20 malignant thyroid lesions, papillary carcinoma was the most common variety accounting for 55% of the cases.
- Halo was present in a significant number of benign nodules. Thin, complete and regular halo was characteristically noted in higher percentage of benign nodules, where as thick and irregular halo was observed in malignant nodules.

CONCLUSION

- Ultrasound is very sensitive in detecting subtle variations in thyroid architecture. Glandular size, symmetry and the presence of nodules can be well evaluated with ultrasound.
- It is the imaging modality of choice for evaluating thyroid nodules.
- In both sexes the average age of presentation of the malignant thyroid nodule was significantly higher.
- The features predicting benign nature are well defined margins, cystic nature, hyperechogenicity, shape that is wider than taller, peripheral egg shell calcifications and presence of well defined thin peripheral halo.
- The features in support of malignancy are poorly or ill defined margins, marked hypoechogenicity and more taller than wider in shape.

DISCUSSION

In this study, a clear female pre-ponderance was observed with the male to female ratio of 1:3.35, the incidence is almost similar to the data by Solbiati et al¹⁷, (ratio of 1:3.5), Sabel et al¹⁸ (ratio 1:3.2). In this study the youngest patient was of solitary thyroid nodule while the oldest one had multinodular goiter. However, no significant conclusion can be drawn concerning the correlation between the age and benign or malignant pathology. Marqusee et al¹⁹ reported that half of the patients referred for a solitary nodule on physical examination (a group previously not thought to benefit from ultrasonography) were found to have multiple nodules. They suggested that routine ultrasonography should be seriously considered for all patients with suspected thyroid nodules. They concluded that ultrasonography altered the clinical management of patients referred to the thyroid nodule clinic after abnormal results on thyroid physical examination. The sonographic diagnosis of malignancy was made in 20 patients whereas

clinically it was suspected in only 3 patients i.e., 15%, indicating clearly the non reliability of clinical diagnosis and the need for the diagnostic studies. Tollin et al²⁰, Hagag et al²¹ found that over all malignancy rate in thyroid nodules among patients with multinodular goiter is comparable to that associated with solitary thyroid nodules. Messaris et al²² reported that the right lobe was more frequently involved 57.6% than the left. Solbiati et al¹⁷ observed the solid hypoechoic pattern in 63 % of malignant.

REFERENCES

1. Hegedus L. Clinical practice: the thyroid nodule. *N Engl J Med*. 2004; 351:1764-1771.
2. Vander JB, Gaston EA, Dawber TR. The significance of nontoxic thyroid nodules: final report of a 15-year study of the incidence of thyroid malignancy. *Ann Intern Med*. 1968; 69:537-540.
3. Tan GH, Gharib H. Thyroid incidentalomas: management approaches to nonpalpable nodules discovered incidentally on thyroid imaging *Ann Intern Med*. 1997; 126:226-231.
4. Ezzat S, Sarti DA, Cain DR, Braunstein GD. Thyroid incidentalomas: prevalence by palpation and ultrasonography. *Arch Intern Med*. 1994; 154:1838-40.
5. Mortensen JD, Woolner LB, Bennett WA. Gross and microscopic findings in clinically normal thyroid glands. *J Clin Endocrinol Metab*. 1955; 15:1270-1280.
6. Ross DS. Diagnostic approach to and treatment of thyroid nodules. I. In: Rose BD, ed. *Up To Date*. Wellesley, MA: Up To Date, 2005.
7. Gharib H. Fine-needle aspiration biopsy of thyroid nodules: advantages, limitations, and effect. *Mayo Clin Proc*. 1994; 69:44-49.
8. Belfiore A, Giuffrida D, La Rosa GL, et al. High frequency of cancer in cold thyroid nodules occurring at young age. *Acta Endocrinol (Copenh)*. 1989; 121:197-202.
9. Giuffrida D, Gharib H. Controversies in the management of cold, hot, and occult thyroid nodules. *Am J Med*. 1995; 99:642-650.
10. Mazzaferri EL, de los Santos ET, Rofagha-Keyhani S. Solitary thyroid nodule: diagnosis and management. *Med Clin North Am*. 1988; 72:1177-1211.
11. Baudin E, Travagli JP, Roper J, Mancusi F, Bruno-Bossio G, Caillou B, Cailleux AF, Lumbroso JD, Parmentier C, Schlumberger M. Microcarcinoma of the thyroid gland. The Gustave-Roussy Institute experience. *Cancer* 1998; 85:553-9.
12. Sugino K, Ito Jr K, Ozaki O, Mimura T, Iwasaki H, and Ito K. Papillary microcarcinoma of the thyroid. *J Endocrinol Invest* 1998; 21:445-448.
13. Hay ID, Grant CS, van Heerden JA, Goellner JR, Ebersold JR, Bergstralh EJ. Papillary thyroid microcarcinoma: a study of 535 cases observed in a 50-year period. *Surgery* 1992; 112:1139-1147.
14. Jen-Der Lin, Tzu-Chieh Chao, Hsiao-Fen Weng, Hong-So Huang, and Yat-Sen Ho. Clinical presentations and treatment of 74 occult thyroid carcinoma. Comparison with non occult thyroid carcinoma in Taiwan. *Am J Clin Onco*. 1996; 15:504-508.
15. Lissak B, Vannetzel JM, Galloudec N, Berrod JL, and Rieu M. Solitary skin metastasis as the presenting feature of differentiated thyroid microcarcinoma: report of two cases. *J Clin Endocrinol Invest*. 1995; 18:813-816.

16. Yamashita H, Noguchi S, Murakami N, Toda M, Uchino S, Watanabe S, Kawamoto H. Extracapsular invasion of lymph node metastasis. A good indicator of disease recurrence and poor prognosis in patients with thyroid microcarcinoma. *Cancer* 1999; 86:842–849.
17. Solbiati L, Volterrani L, Rizzatto G, et al. The thyroid gland with low uptake lesions: evaluation by ultrasound. *Radiology*. 1985; 155:187-191.
18. Sabel MS, Staren ED, Gianakakis LM, et al. Effectiveness of the thyroid scan in evaluation of the solitary thyroid nodule. *Am Surg*. Jul 1997;63(7):660-3.
19. Marqusee E, Benson CB, Frates MC, Doubilet PM, Larsen PR, Cibas ES, Mandel SJ. Usefulness of Ultrasonography in the Management of Nodular Thyroid Disease. *Ann Internal Med* 2000;133: 696-700.
20. Tollin SR, Fallon EF, Mikhail M, Goldstein H, Yung E. The utility of thyroid nuclear imaging and other studies in the detection and treatment of underlying thyroid abnormalities in patients with endogenous subclinical thyrotoxicosis. *Clin Nucl Med*. 2000;25:341-347.
21. Hagag P, Strauss S, Weiss M. Role of ultrasound-guided fine-needle aspiration biopsy in evaluation of non palpable thyroid nodules. *Thyroid* 1998; 8:989–995.
22. Messaris G., Kyriakou K., Vasilopoulos P et al. The single thyroid nodule and carcinoma. *British Journal of Surgery* 1974; 61:943-944.
23. Khafagi F., Wright G., Castles H, et al. Screening for thyroid malignancy: The role of fine needle aspiration biopsy. *Med J Aust* 1988; 149: 302-303, 306-307.
24. Hall TL, Layfield LJ, Philippe A, Rosenthal DL: Sources of diagnostic error in fine needle aspiration of the thyroid. *Cancer* 1989; 63:718-725.

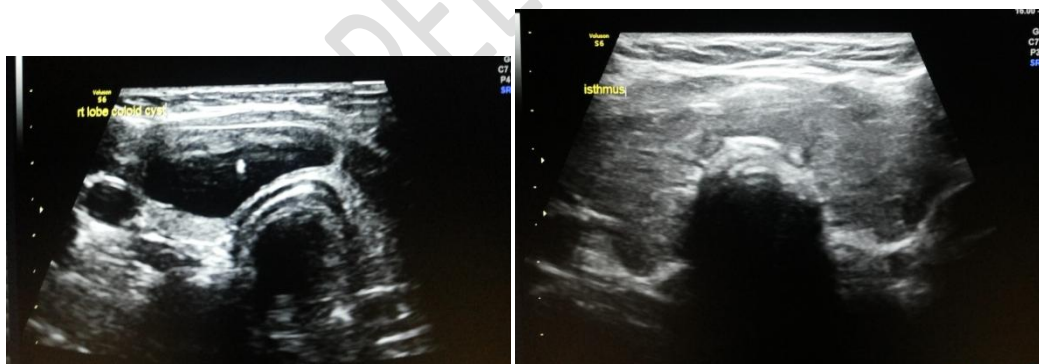
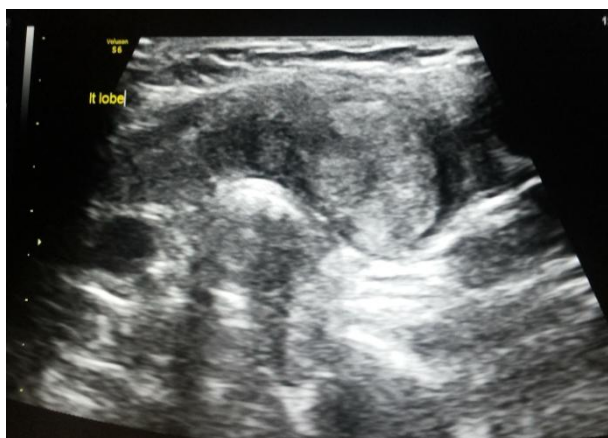


Fig. 1. USG longitudinal view reveals colloid cyst with comet tail artifact in the right lobe of thyroid gland.

Fig.2. USG transverse view reveals diffuse enlargement of the thyroid gland (diffuse thyroiditis).



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253 Fig.3. USG longitudinal view reveals a benign follicular adenoma in left lobe of thyroid gland.



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255 Fig. 4. USG transverse view of right lobe of thyroid gland reveals an ill defined hyperechoic lesion. FNAC
 256 proved anaplastic carcinoma.



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258 Fig.5. USG longitudinal view reveals an ill defined heterogeneously hyperechoic lesion in the right lobe
259 of thyroid gland. FNAC proved medullary carcinoma of thyroid.