Original Research Article

Ultrasonography in the evaluation of complex thyroid nodule and correlation with fine needle aspiration cytology

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Abstract

Problem Statement: Ultrasonography is a sensitive technique to evaluate the thyroid gland. It can detect clinically impalpable nodules in cases of multinodular goiter. USG was not found very effective in identifying malignant lesions. However, combination of USG and USG guided FNAC is very useful in identifying malignant lesions. It has a positive predictive value of 80%. **Methods:** This study was conducted on 30 patients with complex thyroid lesions belonging to 15-65 years age group, in the department of Radiodiagnosis, M.G.M. Medical College and L.S.K. Hospital, Kishanganj, Bihar, during the period between April 2016 and February 2017. Clinical presentation, ultrasonography findings, FNAC and histopathological examination findings were documented. The male to female ratio was 5:1 and most cases belong to the age group of 21-40 years. **Results:** In the present study of 30 cases, female: male ratio is 5:1. 71% of cases belong to the age group of 20-40. Carcinoma was found in patients as young as 28 years and as old as 65 years. 6 out of 8 cases of carcinoma were in female patients (66.6%). In this study 66.6% carcinoma were papillary carcinomas with female being affected in 83.3% of cases. **Conclusion:** Constellation of sonographic findings can indicate towards a possible malignant process of the thyroid gland. USG guided FNAC allows tissue samples to be taken more accurately and from more suspicious places of the nodule. It is a very useful investigation to predict the nature of small thyroid nodules where FNAC is technically difficult.

Key Words: radiodiagnosis, USG, thyroid nodule, lymphadenopathy, multinodular goiter, malignancy.

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INTRODUCTION

USG is ideal for thyroid imaging because

- Of high echogenicity of thyroid tissue.
- Superficial site of the gland, that allows use of high frequency transducer yielding high resolutions and low expense.
- No ionizing radiation.
- No invasiveness.
- No patient discomfort.
- Provides high accurate information on physical characteristic of goiter reliably distinguishing solid nodule from those, which are cystic, or of mixed echogenicity.
- Also detects non palpable nodules.
- Also determines size of nodules and monitor nodule growth.

Alternative methods of radiological evaluation include CT scan or MRI.

- CT scan has the disadvantage of ionizing radiation. Tissue resolution by MRI and USG are comparable but disadvantage of MRI are its longer scan time and high cost.

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The thyroid gland is a highly vascular ductless gland situated in front and at the sides of the trachea opposite 5th, 6th, 7th cervical and 1st thoracic vertebra. It is formed by two lateral lobes connected centrally by an isthmus. The lobes are approximately 40 to 60 mm in length and 13 to 18 mm in antero-posterior diameter. The mean thickness of the isthmus is 4 to 6 mm. The lateral lobes run alongside the trachea medial to the carotid sheath and sternocleido-mastoid muscle. The sternohyoid and sternothyroid muscles are placed anterior to the gland. In 10 to 40% of individuals, a pyramidal lobe is present, usually just to the left of the midline, extending upward from the isthmus along the anterior surface of thyroid cartilage. The parathyroid glands are closely related to the thyroid gland found on the posterolateral surface of the lobes, within 1 cm of the inferior thyroid artery in 80% of individuals. The thyroid gland is enveloped by a loosely connecting fascia formed from the deep cervical fascia. The gland is attached to the trachea and suspended from the larynx, hence it moves upward with deglutition. The true capsule of thyroid is a thin, fibrous, layer, densely, adherent, that sends out septa that invaginate the gland, forming pseudolobules. Sonography is an accurate method to use in calculating thyroid volume. In approximately one third of cases, the sonographic measurement of volume differs from the physical size estimate derived from examination. Thyroid volume measurements may be useful for goiter size determination to assess the need for surgery, to permit calculation of the dose of iodine – 131 needed for treating thyrotoxicosis, and to evaluate the response to suppression treatments. Thyroid volume can be calculated with linear parameters or more precisely with mathematical formulas. Among the linear parameters, the anteroposterior diameter is the most precise, because it is relatively independent of possible dimensional asymmetry between lobes. When the anteroposterior diameter is more than 2 cm, the thyroid gland may be considered enlarged. Normal thyroid parenchyma has a homogeneous medium to high level echogenicity that makes detection of focal cystic or hypoechoic thyroid lesions relatively easy in most cases. Crocker E. F., Mc Laughin A. F., Kossof G *et al* suggested differences in echo pattern that would distinguish between benign and malignant solid lesions in 1974.[1] In 1976, Wayne S Chillcote using grey – scale Ultrasonography of the thyroid illustrated the U.S appearance of thyroid cysts, adenoma, goiter, and carcinoma. They differentiated solid from cystic lesions but it was impossible to tell benign from malignant tumours. Hassani S.N., Bard R.L., in their study 45 thyroid lesions, raised the possibility and hope, that the "halo" sign might be a significantly reliable criterion for benign lesions. (1977)[2] In 1979, Scheible G.R., Woo V. L., Gosink B. B.,[3] with the use of high resolution real – time Ultrasonography detected cystic lesions as small as 1 mm and small lesions as small as 3 mm in diameter, but could not differentiate between benign and malignant lesions. In a study of 73 patients with solitary lesions, 29 had a second lesion. Again in a series of 25 patients with clinically apparent diffuse abnormal gland, 21 were confirmed by ultrasound, in 4 only solitary lesions were identified. In 1979, Allen FH, Krook PM, De Groot WPH, ultrasonographically demonstrated the presence of thyroid carcinoma within benign cyst.[4] In 1980, M Leon *et al*, in a case study of 28, pathologically co-related solid solitary masses. 2 to 10 lesions demonstrating a halo sign on ultrasound examination proved to be carcinomas. Brateman and associates, emphasized the question of radiation exposure to personnel's doing Ultrasonography on patients immediately after radionuclide examination as it constitutes an unnecessary hazard. Delayed Ultrasonography scanning for a period of 4 – 5 half – lives of the diagnostic tracer preludes an unnecessary radiation exposure with minimum time delay. In 1982, Joseph F Simeone, Gilbert H Daniel *et al*,[5] used high resolution to examine 550 patients. Surgical and pathological proofs were obtained in 133. US findings were demonstrated in follicular adenoma, multinodular goiter, thyroiditis, haemorrhagic cyst, simple cysts and malignant tumours as shown in the table below. Primary uses they described were in detection of multinodular goiter when only one nodule is suspected and detection of occult carcinomas.

MATERIAL AND METHODS

It was a prospective study undertaken in the department of Radiology; M.G.M. Medical College and L.S.K. Hospital between April 2016 and February 2017. Clinical presentation, ultrasonography findings, FNAC and histopathological examination findings were documented. The above findings were correlated and evaluated along with a review of literature. The patient is examined in supine position with neck extended. A small pad is placed under the shoulder to provide better exposure of neck. A coupling gel is applied to the skin of the neck. The examiner stands on the right hand side of the patient holding the transducer in right hand across the patient's neck. The examination is carried out with a transducer (linear 7-10 MHz). The overall gain is adjusted to produce a medium gray echo from the thyroid substance. The "low sensitivity" was arbitrarily described as the level at which the gland is completely echo free while the surrounding structures give clean echoes. The suprasternal notch is used as the baseline and serial transverse, longitudinal and oblique scanning is done to image the whole gland. The examination is carried out

laterally to include the region of the carotid artery and internal jugular vein in order to identify enlarged lymph nodes and vascular involvement. Sonograms are made at high and low gain settings, particularly at points of interest where differentiation between solid and cystic echoes are necessary. Age, sex and clinical presentations were considered and size, echo texture, perinodular halo, calcification, margin, surrounding structures of the nodule were noted. Any local lymphadenopathies were identified. USG guided FNAC was performed in all cases using 22G/23G needle and 20cc syringe fitted in a FNAC handle. Free hand technique was used. 3.5 MHz convex transducer was used in larger nodules whereas 7 MHz linear transducer was used for nodules which were small. The needle was guided into the solid component avoiding the cystic areas as far as possible. For multinodular goiter, nodule which was hypoechoic or had suspicious features of malignancy was selected. Aspiration from multiple nodules was also performed in some cases. Aspirated material was smeared on glass slides and sent for examination.

RESULTS

Table 1: Sex wise distribution

SEX	No. of Cases	Percentage
Female	25	83.3
Male	5	16.7
Total	**30**	**100**

These patens belonged to various age groups ranging from 15 years to 65 years.

Table 2: Age distribution

Age Group	Males	Females	Total	Percentage
15-20	0	3	3	10.0
21-30	1	11	12	40.0
31-40	2	7	9	30.0
41-50	2	3	5	16.7
51-65	0	1	1	3.3

Thus it is evident that most cases belong to the 21-40 years age group. All the patiens presented with swelling in front of neck for varying durations. Some cases had additional complaints like pain, change of voice, dysphagia.

Table 3: Distribution of chief complaints

Sl. No.	Chief Complaint	No. of Cases
1	Swelling in Neck	30
2	Pain in neck	6
3	Change of Voice	2
4	Dysphagia	5

The duration of swelling ranged from 5 months to 10 years.

Table 4: Duration of swelling

Duration of Swelling	No. of Cases
0-6 Months	4
6-12 Months	8
1-5 Years	15
6-10 Years	2
11-15 Years	1

The nodules were diagnosed clinically after taking detailed history and examination of the nodule. Swelling with history of hoarseness of voice, sudden increase in size, hard on palpation, fixity and cervical lymphadenopathy were diagnosed clinically as malignant nodules.

Table 5: Clinical diagnosis

Clinical Diagnosis	No. of Cases	Percentage
Cyst	1	3.3
Solitary Thyroid Nodule	14	46.7
Multinodular Goitre	10	33.3
Carcinoma	5	16.7

Thus most of the cases presented with solitary nodule. Multinodular goiter was diagnosed on the basis of a multinodular surface. Thyroid cysts showed evidence of fluctuation on palpation.

Ultrasonographic features

Table 6: Showing USG diagnosis of the cases

USG Diagnosis	No. of Cases	Percentage
Colloid goiter	17	56.7
Adenoma	2	6.7
Multinodular goiter	3	10.0
Carcinoma	8	26.6

On USG 8 cases were diagnosed as malignant. Sonographic criteria suggesting malignancy were-

- Marked hypoechogenecity
- Irregular tumour margins
- Absence of halo
- Microcalcification(They are highly reflective foci less than 2mm in diameter, with or without posterior shadowing or are seen as shadows without a reflective focus.
- Increased central vascularity
- Tortuous or chaotic arrangement of internal blood vessels
- Encasement of adjacent vessels.
- Cervical lymphadenopathy

On USG 17 cases were diagnosed as Colloid goiter showed solid nodules with some cystic changes with evidence of comet tail artifact or coarse calcification. Adenomas were predominantly solid nodules with some

cystic changes having peripheral coarse calcification and surrounding thick smooth halo. On USG 2 cases were diagnosed as adenoma.

Table 7: Showing the results of FNAC

FNAC Diagnosis	No. of cases
Colloid goiter	17
Hyperplastic goiter	2
Follicular neoplasm	6
Papillary carcinoma	4
Medullary carcinoma	1

Colloid goiter was the most common diagnosis on FNAC. It was the diagnosis on 17 cases. Follicular neoplasm was the diagnosis in 6 cases, Papillary carcinoma in 4 cases and Medullary carcinoma in only 1 case. Histopathological results were obtained in all cases and correlated with FNAC and USG diagnosis.

Table 8: The results of Histopathology

Histopathological Diagnosis	No. of cases
Colloid	12
Hyperplastic goiter	2
Follicular adenoma	6
Papillary carcinoma	6
Medullary carcinoma	1
Follicular carcinoma	2
Hashimoto's Thyroiditis	1

Table 9: Correlation of FNAC and USG finding

FNAC	USG	
	Benign	Malignant
Benign	16	3
Malignant	0	5
Inconclusive/Doubtful	6	0

USG diagnosed 17 cases as colloid goiter out of which 2 turned out to be carcinoma, one as papillary carcinoma and the other as follicular carcinoma. Both the cases lacked any cervical lymmhadenopathy and papillary carcinoma lacked any calcification. USG diagnosed 8 cases as carcinoma out of which 4 turned out to be papillary carcinoma, 1 as medullary carcinoma. 2 cases were diagnosed as follicular adenoma and 1 as colloid goiter. 1 case of Hashimoto's thyroiditis was diagnosed as multinodular goiter on USG. 2 cases that were diagnosed as colloid goiter on USG were later found out to be follicular carcinoma. 1 case of papillary carcinoma was diagnosed as colloid goiter on USG.

Table 13: Showing sensitivity specificity and positive predictive value of USG and FNAC in malignant lesions

	Sensitivity	Specificity	Positive Predictive value
USG	55.55%	86.36%	62.5%
FNAC	66.67%	95.45%	80%

From the above discussion it is quite clear that USG is accurate in detecting nodule but not in confirming presence of a carcinoma evident by the low sensitivity. However, it is a good investigation in excluding malignancy because of high specificity. FNAC on the other hand is a better diagnostic tool in excluding malignancy although it also has a low capacity for detection of malignancy.

DISCUSSION

In the present study of 31 cases, female: male ratio is 5.0:1. 71% of cases belong to the age group of 21-40. Carcinoma was found in patients as young as 27 years and as old as 64 years. 6 out of 9 cases of carcinoma were in female patients (66.67%). In this study 66.6% carcinoma were papillary carcinomas with female being affected in 83.3% of cases. 2 cases of follicular carcinoma were in male patients aged 28 years and 65 years and 1 case of medullary carcinoma was in a female patient aged 28 years. The benign lesions were also more common in female patients. Based on the history and clinical examination 26 cases were diagnosed as benign lesions out of which 15 cases as solitary adenoma,10 cases as multinodular goiter and 1 case as thyroid cyst. Cases with multinodular goiter were thought of as benign because it is believed that multinodularity rules out malignancy. 5 cases were diagnosed as malignant based on history of recent rapid increase in size, hoarseness of voice, hard on palpation and presence of jugular lymphadenopathy. In the study of I.B. Rosen of 230 cases, they were able to give a prediction of 92% accuracy and none of the errors that occurred in the interpretation resulted in adverse results on patient management. All the 3 cases of thyroiditis were diagnosed correctly. They had mentioned the characteristic pseudocystic appearance in cases of subacute thyroiditis, as persistence of sonolucency at high gain setting without a discrete posterior wall. In the present study only 1 case was diagnosed as Hashimoto's thyroiditis. The importance of detection of multinodularity lies in the fact that solitary nodule carries a probability of malignancy between 15-25% where as that in multinodular goiter is less than 1%. Luigi Solbiati, Luca Volterrani, Rizzati G *et al* demonstrated that complete or incomplete "halo" appeared to be helpful in differentiating benign from malignant lesions.[6] M Leon *et al*, in a case study of 28, pathologically co-related solid solitary masses. 2 to 10 lesions demonstrating a halo sign on ultrasound examination proved to be carcinomas. In the present study the halo sign was present 10 lesions out of which 8 were benign lesions and 2 were malignant lesions. 1 case with thick regular halo was diagnosed as follicular adenoma. Solbiati *et al* demonstrated that

"micro calcification" can be regarded as a reliable sign of malignancy while coarse intra nodular calcifications were found in both benign and malignant conditions. They also stated that peripheral or egg shell calcification is a reliable feature of a benign nodule.[6] Solbiati L *et al* again showed that ultrasound can detect calcification as small as 5mm; they are rare in nodular goiter or adenoma but are present in 75% of papillary and medullary cancers.[6] Haber RS showed that presence of microcalcification raises the suspicion of a malignanat lesion. Micro calcifications can be confidently detected only with high resolution transducer (10 MHz).[7] In the present study, microcalcificaton was present in 6 cases out of which 4 were malignant lesions and 2 turned out to be benign. Among the benign lesions 1 was a follicular adenoma and the other one was a colloid goiter.

CONCLUSION

USG was not found very effective in identifying malignant lesions. However, combination of USG and USG guided FNAC is very useful in identifying malignant lesions. It has a positive predictive value of 80%. USG guided FNAC allows tissue samples to be taken more accurately and from more suspicious places of the nodule. Although USG alone has a low sensitivity, combination of USG and FNAC is more accurate in predicting the nature of thyroid nodules. It is a very useful investigation to predict the nature of small thyroid nodules where FNAC is technically difficult.

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