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SONOGRAPHIC & COLOR DOPPLER EVALUATION OF THYROID NODULE/S AND ITS CORRELATION WITH FNAC/ HPE FINDINGS

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ABSTRACT

Objective: To correlate provisional sonographic & Color Doppler diagnosis in differentiating benign & malignant thyroid nodules with pathological diagnosis on FNAC/ HPE.

Methods: Relevant history, clinical examination & laboratory investigations of patients (>15yrs) with thyroid nodule/s was taken & recorded. All the patients were subjected to thyroid gland USG scan on Logiq 500 pro (GE system, USA) high frequency (8-11MHz) linear array transducer. Findings were correlated with pathological diagnosis on FNAC/ HPE.

Results: Out of 30 cases studied, based on combined gray scale USG & Color Doppler features, 18 cases were diagnosed as benign & 12 cases were diagnosed as malignant. On pathological examination, 22 cases were proved with benign nodules & 8 cases were diagnosed with malignant nodules on FNAC/ HPE. In 17 benign & 7 malignant cases, provisional sonographic & Color Doppler diagnosis correlated well with pathological findings on FNAC/ HPE. In remaining 5 cases provisionally diagnosed as malignant & 1 patient provisionally diagnosed as benign, the sonographic diagnosis did not correlate with pathological diagnosis on FNAC/ HPE. These 5 provisionally diagnosed as malignant on USG were proved benign in nature &1 case provisionally diagnosed as benign was proved with malignant etiology on FNAC/ HPE.

Conclusion: Combined gray scale sonography with Color Doppler features has higher sensitivity, specificity & accuracy in differentiating benign & malignant thyroid nodules.

KEYWORDS : sonography, thyroid, benign, malignant

INTRODUCTION

Thyroid masses are seen as a common clinical problem. They present as diffuse enlargement or as palpable nodules. The diagnosis of thyroid has recently increased with the use of High resolution Sonography (USG). Sonography is generally the first choice of investigation for the evaluation of thyroid size and morphology in patients with suspected thyroid disease. Thyroid malignancies have been found in 9-15% of the nodules that were evaluated with fine-needle (FNA) cytology.[1]

The thyroid gland is one of the most vascular organs of the body. As a result, Color Doppler examination may provide useful diagnostic information in thyroid diseases. The Color Doppler feature that may be useful in differentiating benign from malignant is the distribution of the vessels.[2]

Because of its superficial location, the thyroid gland is ideally suitable for high frequency sonography because of its sensitivity for small nodule detection. It is also used to assess the volume of the thyroid tissue, to detect the character and number of lesions and to differentiate thyroid masses from adjacent non-thyroidal neck masses.[3]

The use of color Doppler imaging identifies multiple small vessels within and adjacent to the thyroid. Sonography can also be used as a guide for FNAC.[3]

The use of Color Doppler is particularly valuable in assessing thyroid lesions that may be predominantly cystic or have internal hemorrhage. With high-resolution scanners, the lack of internal flow or avascular debris indicates a low likelihood of tumor.[4]

The findings in benign lesions are cyst or predominantly cystic nodule with reverbating artifacts, isoechoic/ hypoechoic nodule with well defined margin, presence of hypoechoic halo on the periphery of the lesion, presence of cystic areas within the nodule, eggshell calcification and perilesional vascularity.[5,6,7]

The known findings for malignant nodules are the presence of hypoechoic nodule with irregular/ illdefined margin, loss of halo, microcalcifications and the presence of a solid nodule as well as intratumoral vascularity. The significant findings for malignant nodules were taller than wide shape, spiculated margins, marked hypoechogenicity and microcalcification.[7,8]

MATERIAL AND METHODS

The present study was prospective in nature & was carried out in thirty selected patients with thyroid nodule/s. The study was conducted in the Department of Radiodiagnosis, in the Maharishi Markandeshwar Institute of Medical Sciences & Research, Mullana, Ambala. Subjects included in this study were clinically diagnosed thyroid nodule referred from OPD. Patients who were already proven cases of thyroid malignancy & post-operative patients of neck surgery were excluded.

All the patients were subjected to thyroid gland USG scan on Logiq 500 Pro (GE system, USA) high frequency (8-11MHz) linear array transducer. The whole of the thyroid gland was scanned including adjacent neck structures & palpable lymph nodes. USG & Color Doppler features were documented prior to subjecting the patient for FNAC procedures and findings recorded in the proforma.

Depending upon USG & color Doppler features, the thyroid nodules were characterized as "benign" if the nodule was isoechoic or slightly hypoechoic with presence of complete peripheral halo. If calcification was present, peripheral eggshell macrocalcification was considered a feature of "benign" thyroid nodules. On color flow Doppler sonography, perinodular vascularity was seen in benign

thyroid nodules. A markedly hypoechoic nodule with absence of complete peripheral halo or with disrupted thick peripheral halo was characterized as "suspicious for malignancy". Central microcalcifications or presence of intranodular blood flow, if present suggested that nodule was "suspicious for malignancy" and required further evaluation.

Under USG-guidance FNAC of the thyroid nodules was performed. USG diagnosis was correlated with cytological examination. Wherever thyroid nodules were operated, the sonographic findings were compared with histopathological findings. The USG & color Doppler findings were correlated with FNAC/ HPE findings and the final diagnosis of the thyroid nodule was made.

OBSERVATIONS & RESULTS

Out of these 30 cases, 26 females and 4 males were seen. Age group was 17-65 yrs with a mean age of 41.3 yrs. Majority of the thyroid masses were firm in consistency on palpation (24 cases). Majority of the patients had normal thyroid functional status (Euthyroid) i.e. 22 cases (73%) out of total 30 cases. In 8 cases, increased TSH levels were seen s/o hypothyroidism (27%).

15 patients (50%) had single thyroid nodule on USG and others had multiple thyroid nodules. Maximum number of thyroid nodules was found to be 3-5cm in size. Smallest nodule was 1cm in size and largest thyroid nodule was 8.2cm in size.

50% patients showed hypoechoeic nodules. Rest was isoechoeic or heterogenous (Table-1). Calcification was seen in 19 patients (64%). Microcalcification was found in 9 cases (30%) whereas 8 patients (27%) had macrocalcifications. Only 2 patients (7%) had eggshell calcification. Comet tail sign was seen in 11 patients.

Maximum number of patients had irregular margins of thyroid lesions i.e. 13 cases (43%). Ill-defined margins of thyroid nodules were seen in 9 patients while 8 patients showed regular &well defined margins (Table-2).

Peripheral Halo was present in 28 cases (93%). 16 cases had complete peripheral halo; whereas 12 patients had incomplete Peripheral Halo. In 2 patients (7%), Peripheral Halo was absent around thyroid nodules (Table-3).

Size of involved lymph nodes varied from 13 to 16mm in size. Lytic bony metastasis to the contralateral arm with pathological fracture of lower 1/3rd of right humerus was seen in one patient only (3%).

Majority of the patients had perinodular vascularity on color Doppler i.e. 13 cases (43%), intranodular vascularity was seen in 6 cases.

On basis of combined gray scale ultrasonography & Color Doppler features, 18 patients (60%) were diagnosed with "benign" thyroid nodules and 12 cases (40%) were provisionally diagnosed as "suspicious for malignancy".

19 patients underwent USG-guidance FNAC of the thyroid nodules. 11 patients were operated (33%) & surgical specimen was subjected to HPE for the final diagnosis. 22 patients (73%) were finally diagnosed with "benign"thyroid nodules on FNA/HPE. Remaining 8 cases (37%) were diagnosed with "malignant" thyroid nodules. Five cases (23%) were misdiagnosed as "malignant" on USG. One case of follicular neoplasm was misdiagnosed as benign nodule (Table-4).

Majority of the benign lesions were single colloid nodule/ multinodular colloid goitre seen in 15 patients (68%). Out of total 8 malignant cases, most common was Hurthle cell carcinoma seen in 4 cases whereas three patients were diagnosed with Papillary carcinoma and one patient as Medullary carcinoma (Table-5)

Various diagnostic criteria for malignancy such as a**bsent Halo sign, microcalcification, hypoechogenicity, irregular/ill-defined margins** had low individual sensitivity and specificity as compared to combined sonographic criterias.

In the present study, **Hypoechogenicity with illdefined margins, presence of microcalcifications, absent halo sign & marked intranodular flow** had sensitivity of 12.5% and specificity of 100% in differentiating benign from malignant thyroid nodules.,,

DISCUSSION

The differential diagnosis between benign and malignant thyroid lesions is a challenge in the clinical practice. Development of high-resolution sonography has added a new dimension in the management of diseases of thyroid gland and it has become a routine to evaluate neck masses with gray scale and Color Doppler sonography.

Thus, this study was undertaken to assess the comparative ability of Gray scale Ultrasonography & Color flow Doppler in differentiating benign from malignant lesions and the results were compared with fine-needle aspiration cytology (FNAC) & histopathological (HPE) diagnosis.

The study group included 30 patients (>15 yrs) with clinically palpable thyroid nodule and was conducted in the Department of Radiodiagnosis, in the Maharishi Markandeshwar Institute of Medical Sciences & Research, Mullana, Ambala. Based on gray scale USG & Color Doppler findings, lesions were categorized into two major groups: Benign and Malignant.

There was preponderance of female patients in the present study. This finding is in accordance with study by Boone RT et al.[9]

Ross DS et al found that malignant thyroid masses were seen in patients older than 70 years.[10] This increased incidence of malignant thyroid mass occurring in older patients was also found in our study as 7 cases (87%) out of 8 malignant thyroid lesions were seen in patients above 40 years of age.

In the present study, 5 cases (23%) were misdiagnosed as "malignant" on USG who were proved benign on FNAC/ HPE. 1 patient (13%) who was misdiagnosed as "benign" on sonography was proved to be malignant. The incidence of misdiagnosed as benign & malignant nodules of 13% & 23% in the present study is comparable with incidence of misdiagnosed as benign & malignant nodules of 25% & 15% respectively in study by Garretti L.[11]

Lee MJ et al**,** found 0.4% incidence of misdiagnosed malignant lesion as benign compared to 6% incidence in present study.[12] This may be due to small sample size of the present study.

Wienke JR et al described the sonographic features of benign thyroid lesion: hypoechogenicity, well defined margins and absence of microcalcification.[7] Herle AJV et al stated that peripheral halo sign was found to be reliable for diagnosing benign adenoma and adenomatous nodules.[13] Ahuja A et al suggested the presence of comet tail sign as an indicator of benignity.[14]

Frates MC et al and Niedziela M et al described the ultrasonographic features of malignancy: solitary lesion, hypoechogenicity, irregular margins, absence of halo sign, microcalcification, invasion of surrounding structures, associated cervical lymphadenopathy and intranodular blood flow on Color Doppler.[15,16]

Frates MC et al found intranodular vascularity in 26 out 177 benign nodules and was found in 1 patient in our study.[15]

The incidence of 75% in predicting malignant nature of the lesion on the basis of hypoechogenicity in the present study was in accordance with incidence of 69.2% as reported by Garreti Let al.[11]

Location and pattern of the calcification have a more predictive value in distinguishing benign and malignant lesions (Solbiati L et al).[2] In the present study, 7 cases with malignant thyroid nodules showed calcification with microcalcification in 5 patients and macrocalcification in 2 cases.

Lee MJ et al reported 55.1% incidence of illdefined margins in malignant nodules in their study of 132 patients. In the present study, 3 cases had illdefined margins (37.5%).[17]

Koike E et al found that 80.4% malignant nodules showed absent peripheral halo sign in their study of 329 patients (55). In our study, in only 2 patients (25%) absent peripheral halo sign was seen.[18]

Solbiati L et al stated that distribution of vessels helps in differentiating benign from malignant nodules. The author further stressed that most well differentiated thyroid carcinoma are generally hypervascular with irregular, tortuous vessels and arteriovenous shunting. Poorly differentiated and anaplastic carcinomas are often hypovascular owing to extensive necrosis associated with their rapid growth.[19] In the present study, 6 out of 8 patients (38%) with malignant nodules were hypervascular while in only 2 patients (25%) hypovascular malignant nodules were seen.

Frates MC et al reported an incidence (43.8%) of intranodular bold flow in malignant nodules on color Doppler (58). In the present study, it was detected in only three patients (38%) out of 8 cases with malignant thyroid nodules.[15]

For differentiating benign from malignant lesions of thyroid overall Sensitivity, Specificity, Positive predictive value, Negative predictive value of combined ultrasound with Color Doppler in the present study was: 87.5%, 77.27%, 58.33% and 94.44% respectively.

Therefore, based on combined features of gray scale sonography with Color Doppler vascular patterns, benign thyroid lesions were differentiated from malignant thyroid lesions.

CONCLUSION

USG with Color Doppler is highly sensitive technique for detection of nodular thyroid disease in patients presenting with thyroid swelling. It provides detailed information about the location, number, size & echotexture of the nodules, margins, comet tail sign, calcification, peripheral halo and associated cervical lymphadenopathy. Vascular nature of the nodule is easily determined by Color Doppler sonography. Combined gray scale sonography & vascular patterns on Color flow Doppler sonography (CFDS) are more accurate in differentiating benign and malignant thyroid lesions with high sensitivity, specificity &accuracy. Therefore, it is the first preferred imaging investigation in cases of thyroid masses due to its low cost.

TABLES

Table 1: Echotexture of thyroid nodules on Gray Scale USG

Echotexture of lesion	Cases	%
Anechoic	3	10%
Isoechoic	6	20%
Hypoechoic	15	50%
Heterogenous	6	20%
Total	**30**	**100%**

Table 2: Margins of the thyroid nodules on Gray Scale Sonography

Margins of the nodules	No. of Cases	%
Irregular	13	43%
ILL defined	9	30%
Regular & well defined	8	27%
Total	**30**	**100%**

Table 3: Presence of Peripheral Halo around thyroid nodules on GrayScale USG

Peripheral Halo		Cases	%
Absent		2	7%
Present	Complete	16	53%
	Incomplete	12	40%
Total		30	100%

Table 4: Comparison of final diagnosis of thyroid nodules on FNAC/ HPE with provisional sonographic diagnosis

Diagnosis	No. of Benign cases		No. of Malignant cases		Total	
Provisional Sonographic diagnosis	18	60%	12	40%	30	100%
Final diagnosis on FNAC/ HPE	22	73%	8	37%	30	100%
Misdiagnosed as Malignant on USG	-	-	5	23%	5	23%
Misdiagnosed as Benign on USG	1	13%	-	-	1	13%

Table 5: Distribution of cases based on pathological diagnosis on FNAC/ HPE

Diseases		No of cases	Percentage
Benign	Colloid nodule/ nodules	7	32%
	Adenomatous nodule	2	9%
	Multinodular colloid goiter	8	36%
	Multinodular goitre with adenomatous changes	3	14%
	Hashimoto's Thyroiditis	2	9%
Malignant	Papillary carcinoma	3	38%
	Follicular carcinoma (Hurthe cell carcinoma)	4	50%
	Medullary carcinoma	1	13%

IMAGES

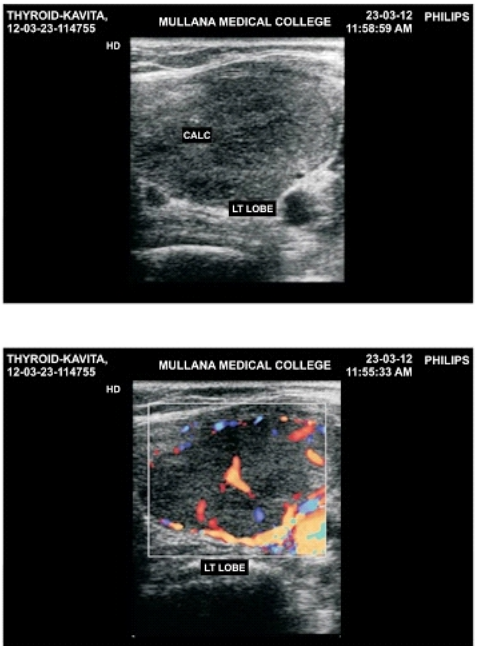


Figure 1: Well defined hypoechoeic nodule showing complete peripheral halo and comet tail sign with cart wheel type of blood flow (peripheral > intranodular) s/o benign adenoma. HPE- follicular adenoma

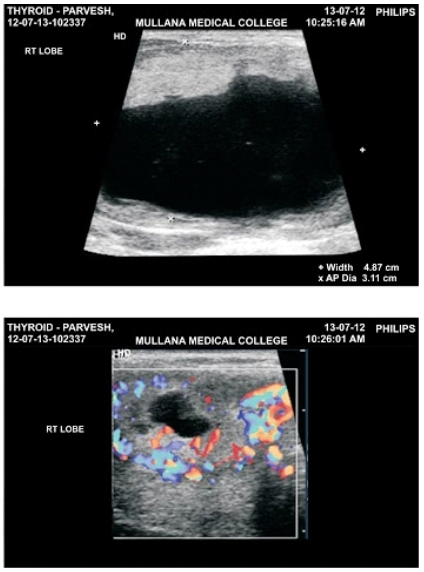


Figure 2: Heterogenous SOL with both solid and cystic components with irregular margins, incomplete peripheral halo and marked intranodular vascularity suggestive of malignant nodule
HPE- benign colloid nodule with cystic degeneration and areas of hemorrhag

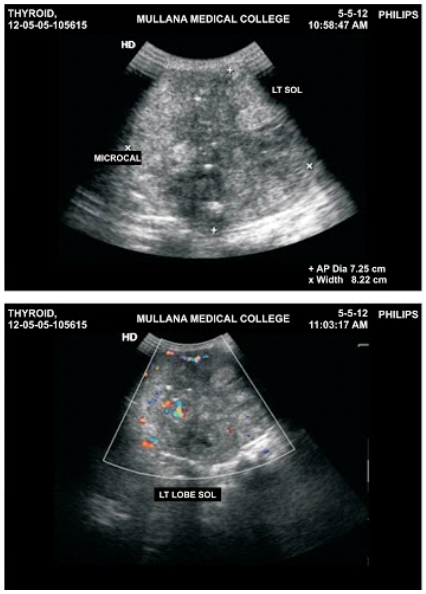
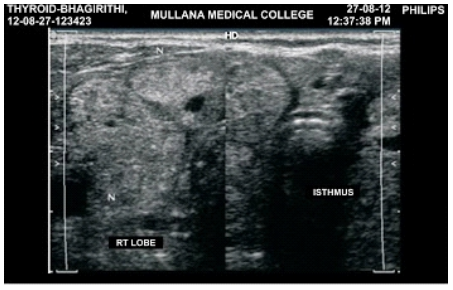


Figure 3: Ill-defined hypoechoeic mass with incomplete peripheral halo and microcalcification within the lesion showing perinodular flow> intranodular flow suggestive of malignant nodule
HPE: medullary carcinoma of thyroid



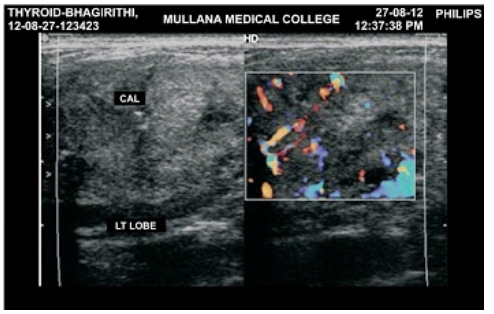


Figure 4: multiple isoechoeic well defined colloid nodules with complete peripheral halo, macrocalcification and perinodular as well intranodular blood flow-multinodular colloid goiter
HPE: Multinodular goiter with calcification and cystic degeneration

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