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ORIGINAL RESEARCH

HRSG Evaluation of Thyroid Nodules with Pathologic Correlation-A Prospective Study

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ABSTRACT

Introduction: Thyroid nodules are very common and can occur in up to 50% of the adult population. Thyroid nodules can be single or multinodular and benign or malignant. Ultrasonography is often the initial investigative modality used in the detection and characterization of various thyroid nodules.

Aim: To evaluate the diagnostic accuracy of HRSG in characterizing benign and malignant thyroid nodules by correlating the sonographic findings with pathological diagnosis as reference.

Material and methods: in this prospective study 40thyroid nodules detected on HRSG were further evaluated with FNAC and/or Histopathological Examination (HPE). The sonographic features such as internal composition, echotexture, shape, margins, presence or absence of peripheral halo, calcification and internal vascularity were correlated with the final diagnosis.

Results: the incidence of malignancy in this study was 15% (6/40). Malignant nodules tended to show solid or predominantly solid composition, hypoechoic pattern, taller than wider shape, irregular margins, micro or punctate calcifications, absence of peripheral halo and internal vascularity. 9cases with suspicion of malignant thyroid nodules demonstrated these 2 or more HRSG features, out of which 6 cases confirmed malignant by pathologic correlation (FNAC/HPE).

Conclusions: HRSG is a sensitive and specific modality in the assessment of thyroid nodules with good overall accuracy. The most useful sonographic features that helped to predict malignancy were a solid composition, hypo echogenicity, taller than wider shape, irregular margins, internal vascularity and presence of micro or punctate calcifications. Thyroid nodules were found to have more malignant potential when 2 or more of these HRSG features were present.

INTRODUCTION

Thyroid nodules are a very common clinical finding, with an estimated prevalence on the basis of palpation that ranges from 3% to 7%[1]. With the widespread use of HRSG, many

more subclinical nodules are being detected. They are found in 4% to 8% of adults by means of palpation, 10% to 41% by means of ultrasonography, and in up to 50% at autopsy [2].
However, while thyroid nodules are common, thyroid malignancy is relatively rare, constituting about 1% of all malignancies [2,3]. Thyroid cancer is reported to occur in about 5% to 7% of all thyroid nodules, irrespective of size [3-5] and 9.2% to 13.0% of all nodules undergoing cytologic evaluation are reported as malignant [2].
In view of this, the pre-operative evaluation of thyroid nodules is crucial to distinguish between benign and malignant nodules, so as to avoid unnecessary biopsies or surgeries in the vast majority of patients who have benign nodules.
HRSG has emerged as the best method to evaluate the thyroid gland and thyroid nodules [4-6]. It is widely available, relatively inexpensive, non-invasive, has excellent resolution, detects non-palpable and clinically silent nodules, and guides for fine needle aspiration of suspicious nodules.
The purpose of this study was to study the sonographic features of various benign and malignant thyroid nodules, and to correlate the sonographic findings with Fine Needle Aspiration Cytology (FNAC) and/or Histopathological Examination (HPE), so as to evaluate the accuracy of ultrasonography in diagnosing malignant nodules.

MATERIALS AND METHODS

This prospective study was carried out at the L N Medical College and J K Hospital, Kolar Road Bhopal, Madhya Pradesh, India, for one and half years between October 2019 and March 2021. Informed consent was obtained from all patients. Patients who were referred for USG evaluation of the thyroid gland and detected to have thyroid nodules on HRSG, were subjected to further evaluation with FNAC/HPE. A total of 60 patients fulfilled these inclusion criteria, and were considered for the study. In patients with multiple nodules, the dominant nodule was evaluated with FNAC/HPE.
Patients who were not evaluated with FNAC/HPE, or had inadequate or indeterminate FNAC/HPE reports were excluded from this study. Patients with diffusely enlarged glands with multiple nodules and no intervening normal parenchyma were classified as multinodular goiter were also excluded. All 60 patients had FNAC/HPEand few of them who had small nodules, aspiration done under USG guidance after USG. 9 patients with FNAC/HPE diagnosis of malignancy.
All scans were performed on a GE Versana Premier Ultrasound equipment using a high frequency 6–12 MHz probe. The nodules were assessed on the basis of internal composition, echogenicity, margins, shape of the nodule, presence or absence of peripheral halo, calcifications and internal vascularity. The nodules were categorized as solid, predominantly solid (50% cystic changes). The echogenicity was assessed as hyperechoic, isoechoic, hypoechoic, or anechoic in comparison to normal thyroid parenchyma. The margins were assessed as smooth/well defined, irregular/ ill defined, and whether surrounded by a circumferential peripheral halo. Based on the shape, nodules were characterized as taller-than-wider or wider-than-tall. Calcifications, when present were characterized as micro-calcifications or punctuate calcifications (tiny calcifications upto 1mm) and macro-calcifications (>1 mm). Presence of internal vascularity on Doppler was documented.
These HRSG findings were tabulated and correlated with the final pathological diagnosis.

RESULTS

There were 51 females and 9 males in this study. Of the 60 nodules that were encountered, 51(85%) were benign and 9(15%) were malignant [Table-1]. HRSG was able to correctly identify 7 out of 9 malignancies, and 48 out of 51 benign nodules. 5 nodules were described as suspicious for malignancy on HRSG; final pathologic diagnosis was malignancy in 2

cases, benign follicular nodule in 3 cases. The HRSG findings in these 60 nodules are summarized in [Table-2]. All the nodules that were diagnosed as malignant in our series were solid or predominantly solid lesions on HRSG. None of the cystic/predominantly cystic nodules were malignant. The majority of malignant nodules 8/9 (88%) showed hypoechoic internal echo texture, while most benign nodules 42/51 (82%) were either hyperechoic or anechoic (cystic). Similarly, majority of malignant nodules 8/9 (88%) demonstrated a taller-than-wider shape, while benign nodules 45/51 (88%) tended to show wider than taller shape. Most of the malignant nodules 7/9 (77%) had poorly defined margins, i.e., the margins were either indistinct or were irregular in outline, while the majority 42/51 (82%) benign nodules showed a smooth, well-defined outline. Calcifications were seen in 6/9 (66%) malignancies and in 12/51 (23%) benign nodules. These calcifications were either micro-calcification or macro-calcification. Micro-calcifications were seen exclusively in papillary carcinomas in our study, occurring in 5/6 (83%) cases. Macro calcification was seen in 1/9 (11%) malignancies and in 12/51 (23%) benign nodules. Majority of malignant lesions 8/9 (88%) showed internal vascularity within the nodule, while benign nodules predominantly were either avascular or showed a peripheral vascular pattern.

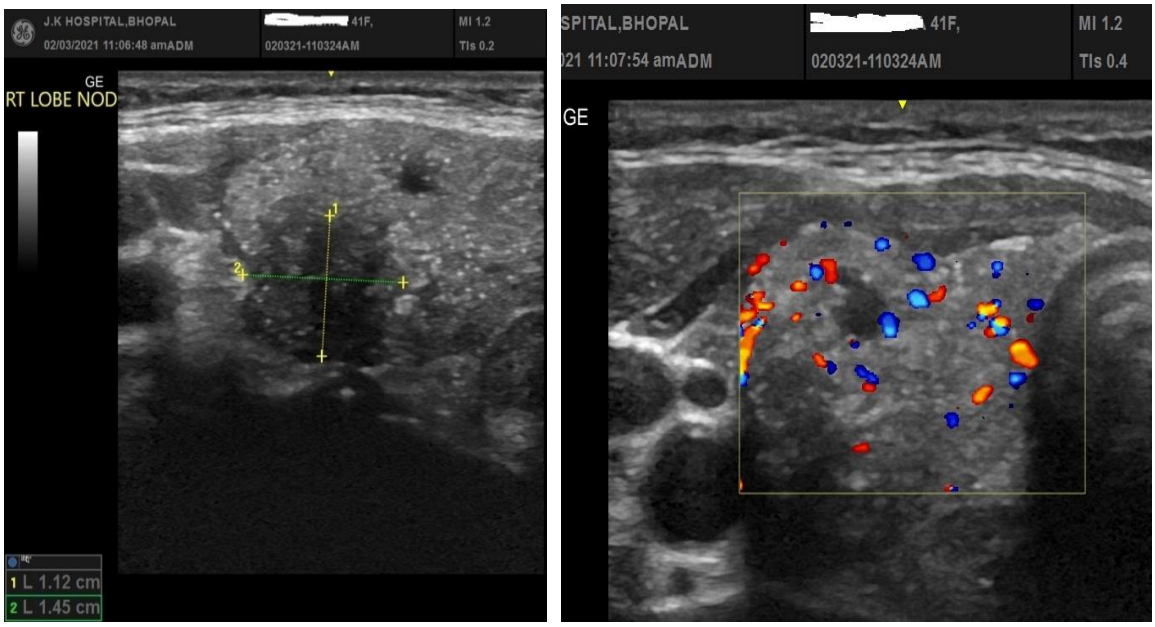

Fig-1 Papillary Carcinoma (a)Gray scale HRSG showing hypoechoic, solid, irregular margins, taller than wider lesion with microcalcifications in right lobe of thyroid (b)Doppler USG shows increased internal vascularity.

Final Diagnosis (FNAC/HPE)	No. of cases
Malignant (n=9)	
Papillary Ca	06
Follicular Ca	03
Medullary Ca	00
Anaplastic Ca	00
Benign (n=51)	
Colloid nodule	36
Follicular Adenoma	10
Hashimoto's Thyroiditis	03
Cyst	02

Table-1: Number of cases and final diagnosis.

HRSG Features	Malignant	Benign	Total
1.Composition			
Solid	07	06	13
Predominantly solid	02	09	11
Predominantly cystic	00	24	24
Cystic	00	03	03
Honeycomb	00	09	09
2.Echogenicity			
Hyperechoic	01	12	13
Hypoechoic	08	09	17
Anechoic	00	30	30
3.Shape			
Wider than tall	01	45	46
Taller than wide	08	06	14
4.Margins			
Well defined	02	42	47
Ill defined	07	09	13
5.Calcifications			
Present	06	12	18
Absent	03	39	42
6.Peripheral halo			
Present	01	30	31
Absent	08	21	29
7.Internal vascularity			
Present	08	45	53
Absent	01	06	07

Table-2: HRSG features of various benign and malignant thyroid nodules.

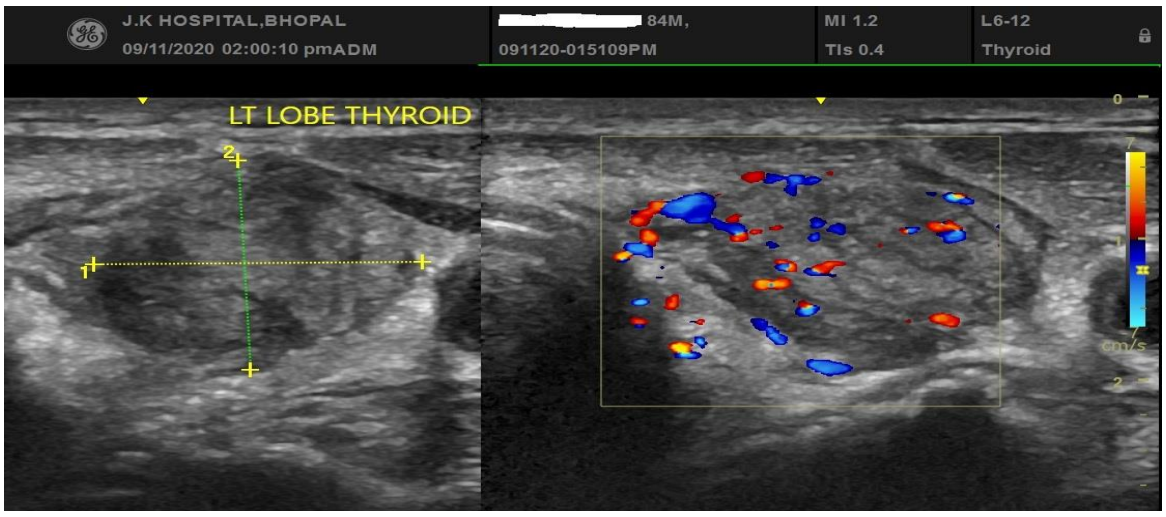

Fig-2 Papillary Carcinoma (a)Gray scale HRSG showing hypoechoic, solid, rounded lesion,irregular margins with microcalcifications in left lobe of thyroid (b)Doppler USG shows increased internal vascularity.

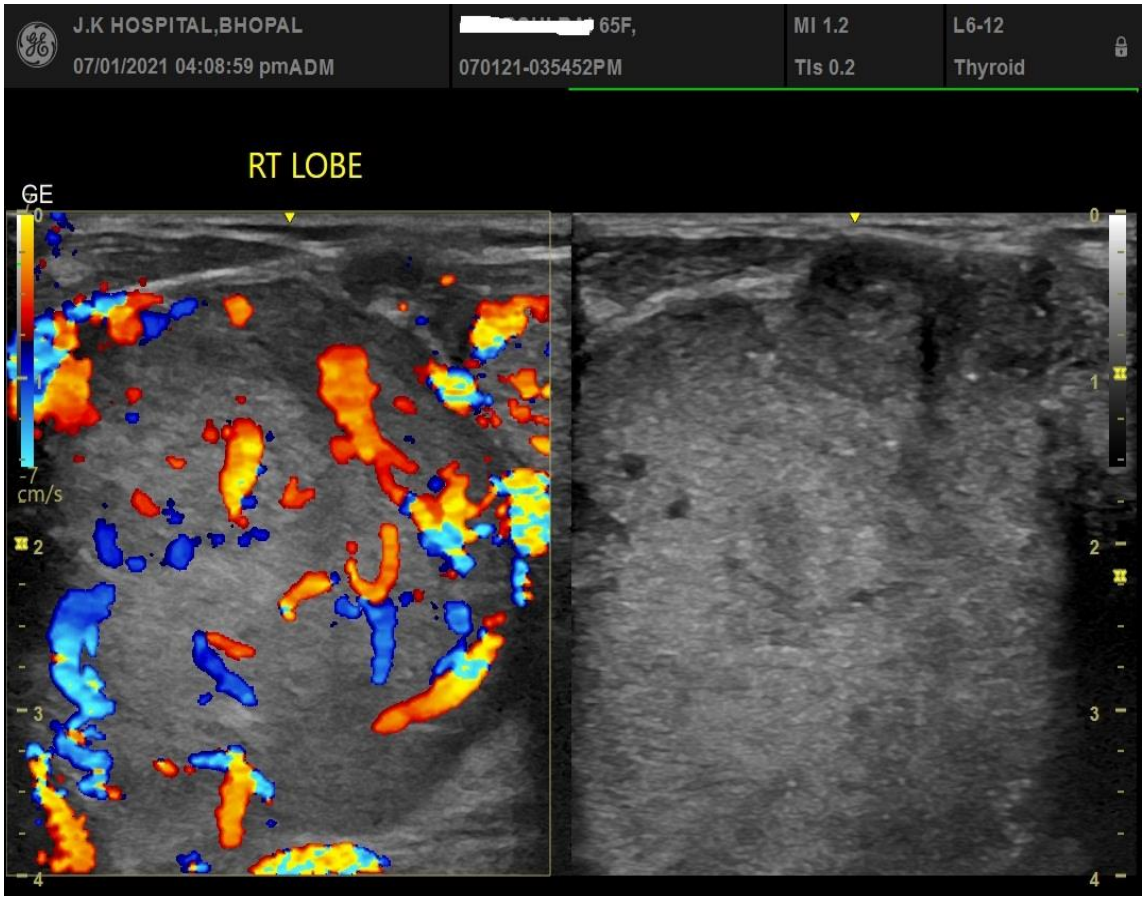

Fig-3 Follicular Carcinoma-Gray scale HRSG showing hypo to isoechoic, solid, irregular margins, taller than wider lesion in right lobe of thyroid (b)Doppler USG shows increased internal vascularity.

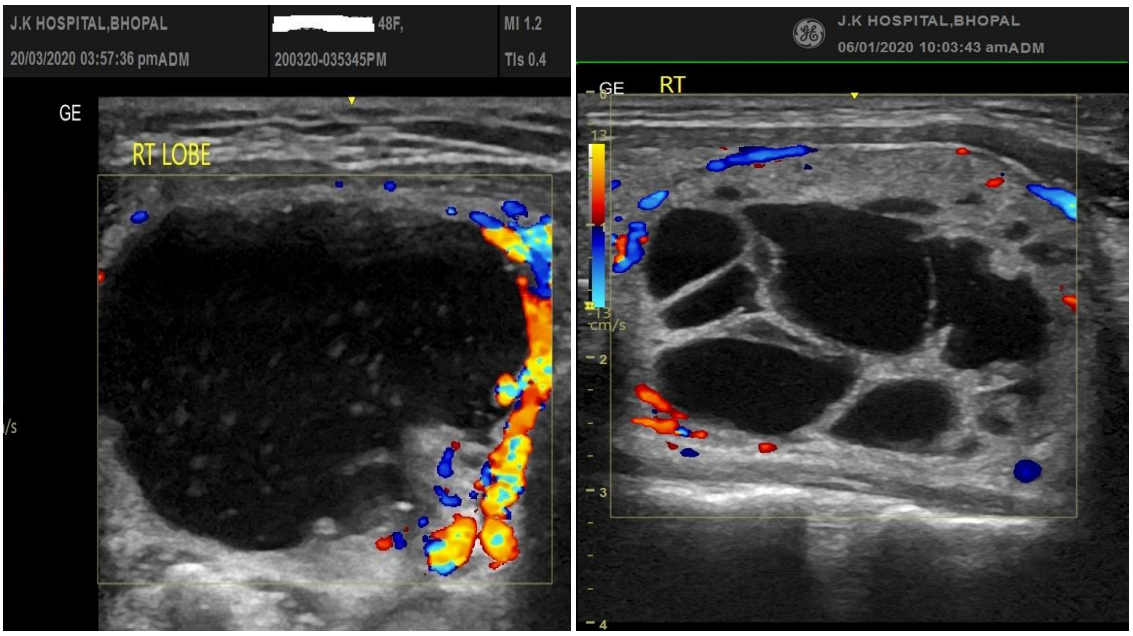

Fig-4 Colloid cyst/nodule (a)Doppler USG showing well defined cystic lesion with peripheral vascularity and internal echogenic content showing comet tail artefacts. (b)Doppler USG well defined wider than tall cystic lesion shows honey comb pattern with peripheral vascularity.

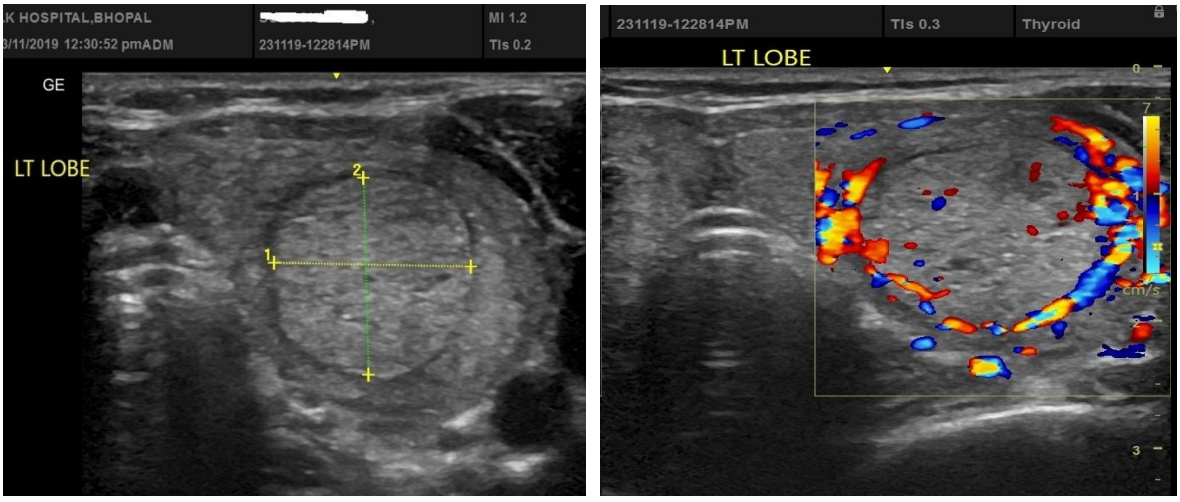

Fig-5 follicular adenoma(a)Gray scale HRSG showing hyperechoic, predominantly solid, wider than tall lesion with peripheral halo in left lobe of thyroid (b)Doppler USG shows peripheral vascularity.

DISCUSSION

A thyroid nodule is defined as a discrete area of abnormality in the background of normal thyroid gland [2]. Thyroid nodules are common, and constitute the commonest referral for USG of the thyroid. HRSG is the modality of choice in the initial workup of thyroid nodules to differentiate between benign and malignant nodules [4,5]. HRSG features that are suspicious for malignancy include predominantly solid component, hypo echogenicity, micro-calcifications, taller-than-wider shape, irregular margins, internal vascularity and absence of peripheral halo [2,4,6,7].

All the malignant nodules in our study were solid or predominantly solid. Malignant nodules typically appear hypoechoic [Fig-1-3] when compared to the normal thyroid parenchyma.The shape of the nodule has also been studied as a potentially useful USG feature of malignancy. Malignant nodules often assume a taller-than-wider shape, i.e., antero-posterior diameter > transverse diameter on a transverse scan [Fig-1-3]. It is opined that a taller-than-wider shape was a useful feature for the identification of malignant lesions in their series [8].A thyroid nodule is considered to have ill-defined margins if more than 50% of its border is not clearly demarcated [6]. Malignant nodules tend to have ill-defined or irregular margins due to the infiltrative nature of their growth [Fig-1-3]. A thin, well-defined peripheral halo represents displaced blood vessels coursing around the lesion [Fig-5] and is considered highly suggestive of a benign nodule [6]. An incomplete or complete absence of peripheral halo is often associated with a malignant nodule, probably due to rapid growth of the tumor [9]. Micro-calcifications had high specificity for malignancy mainly for papillary carcinoma[Fig-1,2] [10].Internal vascularity is defined as flow that is higher in the central part of the nodule than in the thyroid parenchyma, and is a feature of malignant thyroid nodule [11] [Fig-1-3].

10 nodules in our study showed a honeycomb internal echotexture, described as multiple tiny cystic spaces within the nodule which are separated by thin septa [Fig-4b]. All these nodules were reported as benign colloid nodule on cytology. It is reported that a honeycomb or "spongiform" appearance was highly specific for a benign colloid nodule, especially if it was also avascular [12]. Similarly, also reported that a spongiform appearance was sufficiently characteristic of a benign etiology so as to obviate the need for FNAC [13].

LIMITATIONS

The small sample size of malignancies that we encountered in our study is an important limitation. Another potential limitation was that most of the diagnosis was made on cytology

rather than histology. In patients with multiple nodules, only the dominant nodule was evaluated and other nodules were not evaluated.

CONCLUSION

HRSG is a sensitive and specific modality for assessing thyroid nodules with good overall accuracy in differentiating benign from malignant thyroid nodules. While FNAC/HPE remains the gold standard for establishing the final diagnosis, awareness of the specific USG features might be useful to target suspicious nodules, and to avoid unnecessary intervention in the vast majority of nodules that are benign. The most useful indicators of malignancy in this study were a solid composition, hypo echogenicity, poorly defined margins and a taller-than-wider shape of the nodule. Presence of micro-calcifications was highly specific for papillary cancer.

ABBREVIATIONS

HRSG: High resolution sonography; FNAC: FINE needle aspiration cytology; HPE: Histopathological examination; USG: Ultrasonography.

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