

Original Research Article

Diagnostic accuracy of ultrasonography in goiters: a tertiary centre experience

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ABSTRACT

Background: Thyroid diseases are highly prevalent in India, especially in the southern states. Evaluation of thyroid pathologies revolves mainly on imaging and cytology. Recent advances in thyroid imaging have greatly improved the diagnosis, treatment and follow-up in thyroid diseases. Though there are advanced modalities including Computed Tomography and Magnetic Resonance Imaging, Ultrasonography remains the cornerstone for the evaluation of thyroid gland, due to its ubiquitous availability and cost-effectiveness. The objectives of the study were to find out the diagnostic accuracy of ultrasonography in thyroid swellings and to find out the most reliable diagnostic feature of thyroid malignancy in ultrasonography.

Methods: This was an observational study, conducted on 71 patients admitted to the General surgical wards of Government Medical College, Trivandrum, with thyroid swellings, for a period of 18 months. For all these patients, ultrasound scan of the thyroid gland was done on an ultrasound machine with a 17/5 MHz linear transducer, by experienced faculty.

Results: Ultrasonography was found to have a sensitivity of 87.2% and a specificity of 79.2% in diagnosing thyroid pathologies. The most common malignancy of thyroid found in the study was papillary carcinoma and the most reliable ultrasound finding suggestive of malignancy was microcalcification.

Conclusions: As per the present study, it is concluded that high resolution ultrasonography is very useful in diagnosing the nature of thyroid swellings, with an accuracy rate of 84.5%. Ultrasonography is a valuable diagnostic tool in the evaluation of thyroid diseases and is the imaging modality of choice.

Keywords: Diagnosis, Thyroid, Thyroid nodules, Ultrasonography

INTRODUCTION

The thyroid gland plays a critical role in regulating the metabolic functions of human body, including cardiac function, lipid metabolism, heat regulation and skeletal growth. Thyroid gland produces hormones that are helpful for the body to control metabolism. In general, thyroid diseases can be divided into two broad groups. The first group is the one which primarily affects the

function of the thyroid and the second is the one which involves neoplasms, or tumors of the thyroid. The former group of diseases manifest with other symptoms while the latter present with swelling in the neck and associated pressure symptoms. Malignant transformation of thyroid nodules usually occurs in only 5-10% of patients. The transformation depending on multiple factors including age, gender, history of radiation exposure, as well as family history of cancer.

All types of thyroid disorders are common in the general population in India. The prevalence of any form of thyroid diseases is found to be higher in females than in males. Most of patients with thyroid disorders come with clinical complaints of neck swelling, and occasionally with dysphagia and hoarseness of voice. Due to the relatively high prevalence of thyroid diseases in our population, proper investigation is essential for ensuring adequate management. Imaging and cytology form the principal forms of evaluation in thyroid pathologies.

Thyroid imaging plays an important role in detecting different types of thyroid diseases. Because of its superficial location, the thyroid gland is easily accessible to ultrasound or to aspiration biopsy. Imaging studies provide precise information regarding the volume, extent, and characteristics of thyroid swellings. Recent advances in thyroid imaging have considerably improved the diagnosis, treatment, follow-up, and prognosis of thyroid diseases. Various modalities that are used to detect and classify abnormalities of the thyroid gland are Ultrasound imaging (US), Computed Tomography scan(CT), Magnetic Resonance Imaging (MRI) and Computer Aided Diagnosis (CAD). Among these, Ultrasound has a special role because of its many advantages.

Ultrasound is also considered as a useful imaging modality for characterization of thyroid nodules since it does not use any ionizing radiation. Also, it is non-invasive, widely available and less expensive compared to the other investigative modalities. Accurate differentiation of benign from malignant nodules is an important and challenging feature of thyroid ultrasonography. High resolution ultrasonography (HRUS) is a highly sensitive imaging modality available for the examination of thyroid nodules. The ubiquitous adoption of high resolution ultrasound has revealed an even higher prevalence of nodules in thyroid, and the current suggestion is that all patients with palpable thyroid nodules should be submitted to ultrasound scan.¹ The gold-standard procedure for thyroid nodule evaluation, approved by the American Thyroid Association, is an ultrasound-guided FNA biopsy. In 2008, the Bethesda system was established in order to provide clear and unified cytological specimen assessment criteria.²

With this background, this study intended to analyze the utility of ultrasound scan as a diagnostic method in goiters. For this study, patients admitted in the surgical wards of our institution with complaints of thyroid swelling, who satisfied the inclusion criteria were included. The aim of the study was to determine the diagnostic accuracy of ultrasonography in thyroid swellings.

METHODS

The study was carried out in the surgical wards of the Department of General Surgery, Government Medical

College, Trivandrum from January 2015 to July 2016. Study was designed as an Observational study. The primary objective of the study was to find out the diagnostic accuracy of ultrasonography in thyroid swellings in term of sensitivity, specificity and positive predictive value. The secondary objectives were to determine the most common malignancy among thyroid cases operated in the study setting and to find out the most reliable feature of thyroid malignancy in ultrasonography.

The study protocol was approved by the scientific committee of the institution followed by Ethics committee. Study population included patients admitted with complaints of thyroid swelling and underwent surgery for the same, during the study period. All consecutive patients who satisfied the inclusion criteria within the study period were recruited into the study.

Inclusion criteria: Age more than 13 years, those who are willing for surgery at our center. Exclusion criteria: Recurrent thyroid malignancy, patients who did ultrasound scan outside the study setting

71 patients satisfied the selection criteria and were included in the study. Informed consent was obtained from all the patients. All these patients underwent ultrasound scan on Philips iU22 ultrasound machine with a 17/5 MHz linear transducer by experienced faculty in the Department of Radio-diagnosis of Government Medical College, Trivandrum. The patients also underwent routine investigations including pre-operative tests and cytology of the gland. The patients underwent surgical management in the department as per institutional protocols. After surgery, histological examination was done with paraffin wax embedding and was interpreted by pathologists.

Data was collected from patients and from the case records, using a prepared proforma. The variables studied included age, gender, occupation, residence, clinical features, ultrasound findings, FNAC findings as well as histopathology findings. Ultrasound findings were compared with the FNAC findings and the postoperative histopathology reports. The sensitivity, specificity and positive predictive value of ultrasound in diagnosing thyroid diseases were determined, taking histopathology as the gold standard. The relevant data were collected using pre-written proforma and entered into Microsoft Excel data sheets. All the statistical analyses were performed using IBM SPSS Statistics software version 16. Data is being presented as mean \pm standard deviation and proportions as appropriate. The case with a p value less than 0.05 was considered to be statistically significant as and when relevant.

RESULTS

Over a period of 18 months, we studied 71 patients with thyroid swellings. Out of the total 71 patients studied,

53(74.6%) were females and 18(24.4%) were males. There were 5 patients who were below 20 years of age and only one patient who was 70 years of age. The youngest patient was a 14-year-old female and the eldest was a 70-year-old female. 53.5% of the subjects were unemployed and 7% were students. Rest of the patients constituted the working group. 74.6 % of the subjects lived in rural areas and the others in urban areas. The most common clinical symptom apart from that of neck swelling, was dysphagia (53.5%). Eye signs were seen only in 1.4% of the study patients.

Ultrasonography findings showed benign nature of the swellings in 25 out of 71 subjects. The remaining 46 subjects had findings suggestive of malignancy. On FNAC, 32 subjects had findings suggestive of benign disease. Of these, ultrasound was also suggestive of benign disease in 20 subjects. For the rest of the 5 subjects with findings of benign disease on ultrasound, FNAC was suggestive of papillary carcinoma. Out of the 46 subjects with features of malignancy on ultrasound, only 33 had malignant findings on FNAC.

There were 47 subjects with findings of malignancy on histopathology. Out of these 47 subjects with histopathology reports suggestive of malignancy, 41 were found to have papillary carcinoma and 6 were found to have follicular carcinoma. The most reliable feature suggestive of malignancy in ultrasound was microcalcification, which was seen in 39 out of 46 subjects (Table 1).

Table 1: Distribution of ultrasonography findings.

USG findings	Frequency	%
Benign	25	35.2
Microcalcification	39	54.9
Hypoechoogenicity	35	49.3
Absence of halo	25	35.2
Cervical lymphadenopathy	35	49.3
Irregular margins	28	39.4
Hypervascularity	33	46.4

Of the 47 subjects with findings of malignancy on histopathology, ultrasound scan was also suggestive of malignancy in 41 which amounts to a sensitivity of 87.2% (Table 2).

Table 2: Comparison of ultrasonography findings with histopathology findings.

Ultrasonography	Histopathology		Total
	Malignant	Benign	
Malignant	41	5	46
Benign	6	19	25
Total	47	24	71

Of the 24 subjects with findings of benign disease on histopathology, ultrasound was also suggestive of benign in 19, thus amounting to a specificity of 79.2%. Thus, the

positive predictive value of ultrasonography was found to be 89.1% and negative predictive value 76%. The diagnostic accuracy of ultrasonography in thyroid swellings, taking histopathology as the gold standard was thus found to be 84.5% in this study.

DISCUSSION

This observational study was carried out at a tertiary care teaching institution over a period of 18 months to analyze the diagnostic efficacy of ultrasound scan in goiters. In this study of 71 patients with thyroid swelling, 74.6% was females which is in accordance with the literature as thyroid diseases are more common in females. The mean age in the study sample was 39.3 years. The youngest patient with malignancy was a 14-year-old female and the eldest was a 70-year-old female. This is also in concordance with the literature as females are more commonly affected than males. The most common clinical feature found apart from the swelling was dysphagia which is also in concordance with literature. Since the study setting was a tertiary care centre and most of the cases were referred from other hospitals, majority of the patients whose ultrasound scans which were done here during the study period were those with suspicious swellings and hence the majority suggestive of malignancies. In our study, there were 47 subjects with findings of malignancy on histopathology. Out of these 47 subjects with malignancy, 41 were found to have papillary carcinoma and 6 were found to have follicular carcinoma. Uzma Bukhari et al studied 998 thyroid swellings of which 153 cases were malignant. In their study, papillary carcinoma was the most common malignant lesion with a frequency of 90.2%, followed by medullary carcinoma of 4.5% and follicular carcinoma of 2%.³

The most reliable ultrasound feature suggestive of malignancy as per this study was micro calcification, which also agrees with the findings in literature. In a Chinese study, 762 patients (424 malignant and 338 benign) with thyroid nodules underwent ultrasonography to evaluate the efficacy of ultrasonic features in predicting the malignancy of thyroid nodules. Irregular margins and hypo-echogenicity combined with solid component or taller than wide shapes or micro-calcifications were found to have a high predicative value for malignant thyroid nodules in this study.⁴ These features have been identified as major predictors of malignancy in thyroid nodules in similar studies also.⁵ According to the 2015 American Thyroid Association Guideline Task Force, solid component hypoechoic thyroid nodules with one or more of the following features have over 70-90% risk of malignancy: irregular margins, micro-calcifications, taller than wide shape, and rim calcifications.⁶

In the present study, for detection of malignancy ultrasound has a sensitivity of 87.2%, specificity of 79.2%, positive predictive value of 89.1 %, negative

predictive value of 76% and an overall accuracy of 84.5%, which is in concordance with literature. In a study of 143 patients, with primary papillary thyroid microcarcinoma who underwent preoperative thyroid sonography, the sensitivity, specificity, positive and negative predictive values, and accuracy of sonography diagnosis for detecting contra-lateral malignancy were 86.7%, 100%, 100%, 98.3%, and 98.5% respectively.⁷ In the study conducted by Dhanadia A et al, for detection of malignancy ultrasound had sensitivity of 83.3%, specificity 72.7%, PPV 29.4%, NPV 96.9%.⁸ Another study which compared the efficacy of Ultrasound guided fine needle aspiration biopsy (USFNAB) for thyroid nodules with different sizes, it was found that USFNAB has similar diagnostic efficacy to thyroid nodules with different sizes.⁹

The use of ultrasound for the evaluation of the cervical region has led to the detection of large numbers of non-palpable nodules and thereby to controversies about whether they should all be analyzed for malignancy.¹⁰ To evaluate the characteristics of thyroid nodules and its association with malignancy, power doppler ultrasound is a possible alternative.¹¹ Power doppler studies for the diagnosis of malignant thyroid tumors claim that the risk of malignancy is greater when the vascularization is predominantly or exclusively intra-nodular or central.^{12,13} However, Faria et al observed that a significant proportion of papilliferous carcinomas do not show intranodular vascularization, suggesting that doppler ultrasound is the best method for the selection of nodules to be biopsied as well as for guidance during FNAB.¹⁴

Though several studies have mentioned hypoechogenicity as an important finding suggestive of malignancy, some studies have revealed that approximately 30–55% of benign nodules are also hypoechoic and most hypoechoic nodules are benign considering the high prevalence of benign lesions.^{15,16} This does bring down the usefulness of this sonologic feature. Marked hypoechogenicity is claimed to be a more specific and more reliable criterion for malignant thyroid nodules than hypoechogenicity, with a specificity of 92–94%.¹⁷ Another serious concern is that ultrasound echogenicity assessed by clinicians has been described qualitatively and thus potentially subject to intra-observer as well as inter-observer variability.¹⁸ Some radiologists have suggested that a special US sign of benign thyroid nodules, termed “onion skin-like sign,” can help to recognize some benign nodules with suspicious malignant US features. The “onion skin-like sign” is defined as a typical layered structure with hypoechogenicity and hyperechogenicity alternatively distributing from the edge to the center of the nodule.¹⁹

A group of researchers compared two methods: power doppler and thermography: for the analysis of vascularization in thyroid nodules and subsequent selection of nodules to be biopsied. Although an increase in cell metabolism occurs before angiogenesis in all types of neoplasias, thermography was found to reveal a

change in its pattern earlier than does power doppler, thus being more precise for the detection of malignancy in thyroid nodules. They concluded that thermography is more precise than power doppler for the indication of FNAB of thyroid nodules suspected of malignancy.²⁰

The combination of several suspicious US features is definitely more accurate than that of any single characteristic in predicting thyroid nodule as malignant. In 2009, Horvath et al and Park et al established a thyroid imaging reporting and data system (TI-RADS) to stratify cancer risk in thyroid nodules based on 10 and 12 sonographic features respectively.^{21,22} A recent meta-analysis proved that TI-RADS had a pooled sensitivity and specificity of 0.75 and 0.69, respectively.²³ However, there was a large range of sensitivity and specificity (0.57–0.96 and 0.43–0.94) with high heterogeneity. This is probably due to different US equipment, different US criteria, as well as the inevitable inter-observer variability among sonologists.

In the recent years, many technical advances have been evaluated in ultrasound with regard to thyroid pathology. These include techniques that improve quality of B-mode images, like harmonic imaging and compound spatial imaging, or views that alter the presentation of ultrasound data, like panoramic or trapezoid field of view, 3D ultrasound, or MicroPure imaging.²⁴ The vascularisation of the nodules is assessed with colour or power doppler or by adding contrast agents. Real-time elastography (RTE) and contrast enhanced ultrasound (CEUS) are newer methods which measure tissue elasticity and perfusion features. Combined use of RTE and CEUS along with HRUS is claimed to improve the diagnostic efficiency for thyroid nodules.²⁵

CONCLUSION

To summarize, the present study finds that ultrasonography is very useful in diagnosing the nature of thyroid swellings with an accuracy of 84.5%. The most common malignancy in the thyroid is papillary cancer and the most reliable ultrasound feature suggestive of malignancy is micro calcification. The limitation of this study includes the relatively low sample size and the limited study period. To conclude, with the development of real time high resolution sonography, ultrasound has surpassed other imaging modalities in the evaluation of goiters. Real time ultrasonography also helps to guide diagnostic and therapeutic procedures in various thyroid diseases. With affordable cost and easy availability, this modality has become the ideal investigation of choice for evaluating thyroid swellings.

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