



Ultrasound Evaluation of Thyroid Gland Abnormalities at the University of Port Harcourt Teaching Hospital

Chinwe Regina Onwuchekwa

Department of Radiology, University of Port Harcourt Teaching Hospital, Alakahia, PMB 6173, Port Harcourt, Nigeria

Correspondence: chichekwas2003@yahoo.com

ABSTRACT

Background: Diseases of thyroid gland are diverse and present with varied patterns in ultrasound scan. In some cases, the patterns are overlapping, making it difficult to differentiate the lesions and reach a definitive diagnosis. The study analysed the sonographic features of common thyroid lesions in our environment with the aim of improving the objective diagnostic accuracy of sonography reports.

Methods: This was a prospective descriptive study of all consecutive cases with symptomatic thyroid gland lesions referred to the radiology department for ultrasound scan. The study lasted for 18 months from January 2016 to June 2017. The study was approved by the ethics committee of the institution. The data were analysed using SPSS for windows version 20.

Results: There were 132 patients scanned for thyroid gland assessment during the period. Of

these, 105(79.5%) were females and 27(20.5%) were males. The mean age was 34.73 ± 1.36 years. The most common diagnosis was multinodular goitre which constituted 32 (24.24%) cases. Graves' disease was also prevalent with a frequency of 21(15.91%) cases. Sixty patients had thyroid nodules which were of mixed echogenicity in 15 (25%) cases; hypoechogenicity in 28(46.67%) cases, hyperechogenicity in 11 (18.33%) and isoechochogenicity in 6 (10%) cases.

Conclusion: Thyroid gland abnormalities were common in our environment and were seen more in females. The most common thyroid gland lesions were multinodular goitre, Graves' disease and Hashimoto thyroiditis. Gray scale and Doppler evaluation are of higher sensitivity in differentiating benign from malignant nodules.

Key words: thyroid gland, multinodular goitre, Graves' disease, Hashimoto's thyroiditis, ultrasonography.

INTRODUCTION

The thyroid gland consists of two lobes and an isthmus. The lobes lie on the anterolateral surface of the trachea and are linked by the isthmus in 'H' shaped form. The lobes are asymmetrical with the right larger than the

left. Researchers on the size and volume of the lobes and gland had shown that in Nigerian adults the glands are larger in males than females and that the gland's volume ranges from $5 - 8.55 \text{ cm}^3$.¹⁻³ They had also shown that it is smaller in size in Nigerian





adults compared to the Caucasians.² Diseases of thyroid gland are diverse and in ultrasound they present with varied patterns which in some cases are overlapping.⁴ These features made it difficult to differentiate the lesions and reach a definitive diagnosis. Ultrasound is the best diagnostic imaging modality of choice in evaluating the size, shape and abnormalities of thyroid gland.⁴ Ultrasound scanning does not use ionizing radiation; it is painless, non-invasive, widely available, easy to use and less expensive than the other imaging modalities. However, the main limitations are its operator dependency and in some cases, it may fail to distinguish benign from malignant lesions. It cannot determine thyroid function, i.e., whether the thyroid gland is underactive, overactive or normal in function; for which a blood test or radioactive isotope uptake test is generally required.^{5,6}

The aim of the study was to describe the sonographic features of common thyroid lesions in our environment in order to improve the objective diagnostic accuracy of sonography reports.

METHODS

This was a prospective descriptive study of all consecutive cases presenting with symptomatic thyroid gland lesions to the radiology department of University of Port Harcourt Teaching Hospital for ultrasound scan. The study lasted for eighteen months from January 2016 to June 2017.

MINDRAY DC-8 (2013) ultrasound machine fitted with high frequency linear transducer of 7.5-10MHz was used for scanning the patients. The patients were examined in supine position with neck hyperextended

over a pillow placed under the shoulders. Ultrasound coupling gel was applied over the anterior neck for lubrication and for elimination of air bubbles. A longitudinal and transverse scan of the anterior neck were done to locate the thyroid gland and to obtain an over view of the surrounding structures. The craniocaudal, transverse and anteroposterior dimensions were measured using the largest plane. The glands were assessed for the size, echotexture, echogenicity, Doppler signal and tenderness. Presence of nodules, cyst, calcification, cervical enlarged lymph nodes was also assessed. Following the ultrasound characteristics of identified lesions, the diagnoses with possible differentials were recorded. For the volume calculations the following formula was used;

Volume = Length × width × thickness × 0.523 (conversion factor)

When: Length = Craiocaudal dimension

Width = Transverse dimension

Thickness = anterior posterior dimension

The study was approved by the ethics committee of University of Port Harcourt Teaching Hospital and informed consent was obtained from all patients who participated in the study.

All pregnant women and women less than one -year post-partum were excluded from the study to avoid confounders. This was because previous studies had shown that the thyroid gland may increase in size during pregnancy and early post -partum period.^{7,8}

The data were analysed using SPSS for windows version 20 and P < 0.05 was taken as significant. Results were presented in text, tables and figures.

RESULTS

There were 132 patients scanned for thyroid gland assessment during the period. Of these, 105(79.5%) were females and 27(20.5%) were males; giving male/ female ratio of 1: 3.9. The age range was 3- 65years and the mean age was 34.73 ± 1.36 years [Table 1].

Table 1. Age distribution of the patients

Age range in years	Number of patients	Percentage
1-10	3	2.27
11-20	15	11.36
21-30	42	31.82
31-40	33	25.00
41-50	15	11.36
51-60	12	9.09
61-70	12	9.09
TOTAL	132	100%

Neck swelling 69(52.27%) was the most frequent indication for referral, this is followed by nodular goitre 30(22.73%) [Table 2].

Table 2. Clinical indications for thyroid gland ultrasound scan

Clinical indication	Number	Percentage
Neck swelling	69	52.27
Nodular goitre	30	22.73
Hyperthyroidism	18	13.64
Toxic nodule	7	5.30
hypothyroidism	6	4.55
Anterior neck pain	2	1.52
Total	132	100%

Of the 132 patients, 12 (9.09%) had no lesion detected on sonography, the gland showed normal features (Fig.1), while 120 (90.91%) had lesion with varied sonographic characteristics leading to diagnosis as shown in table 3.

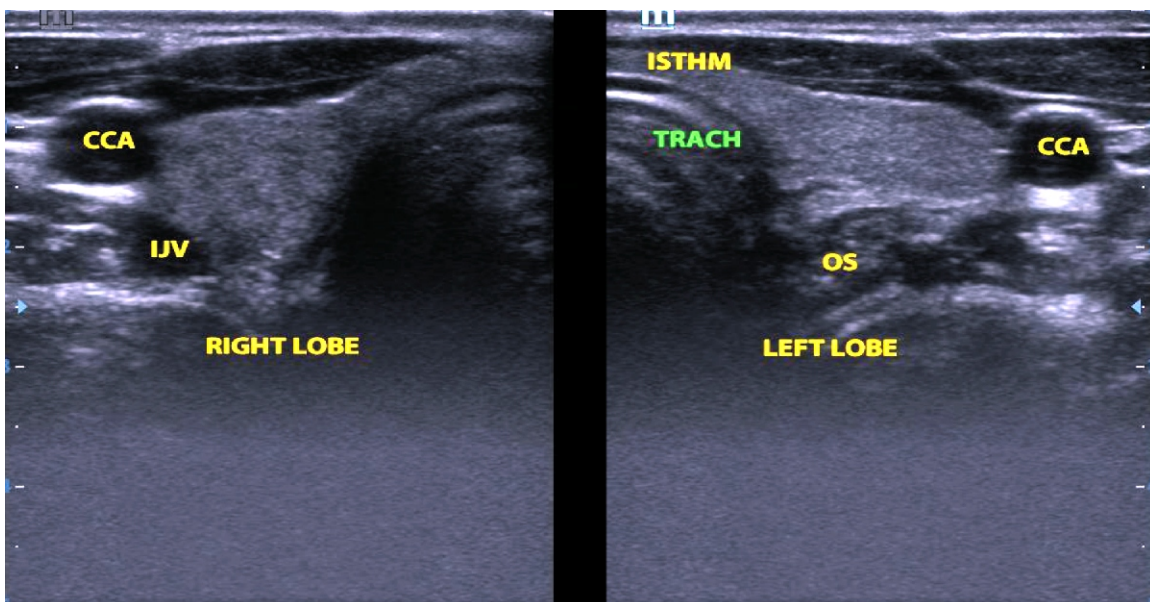


Figure 1. Gray scale transverse ultrasound image of normal thyroid gland and surrounding structures

Table 3. Frequency of thyroid disorders on ultrasound scan

Diagnosis	Number	Percentage
Normal	12	9.09
Multinodular goitre	32	24.24
Graves' disease	21	15.91
Colloid cyst	15	11.36
Diffused hyperplasia	14	10.61
Hashimoto's thyroiditis	13	9.85
Adenoma	11	8.33
Thyroiditis	6	4.55
Cancer	5	3.79
Simple cysts	2	1.52
Paediatric toxic polycystic thyroid	1	0.76
TOTAL	132	100%

The most common diagnosis was multinodular goitre (Fig. 2) which constituted 32 (24.24%) cases.

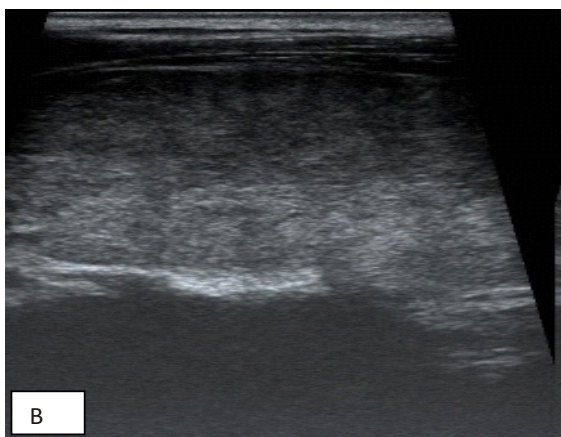
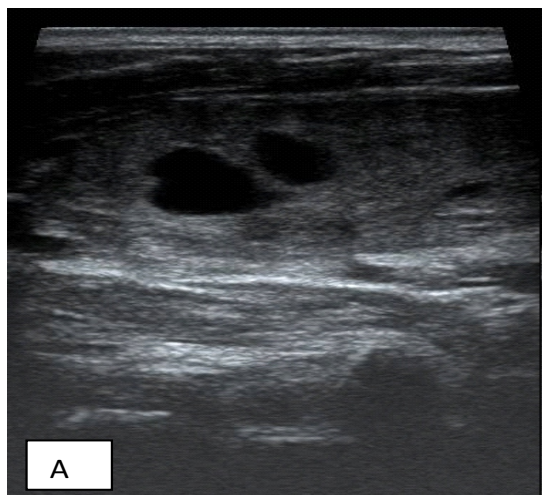


Figure 2. Gray scale images of multinodular goitre showing an enlarged thyroid gland having multiple iso to hyper-echoic nodules of varying sizes. Note the cystic degeneration in A.

Graves' disease was also prevalent with a frequency of 21 (15.91%) cases (Fig. 3).

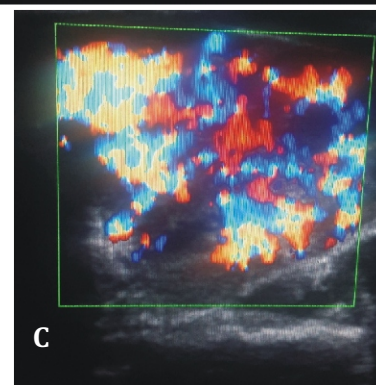
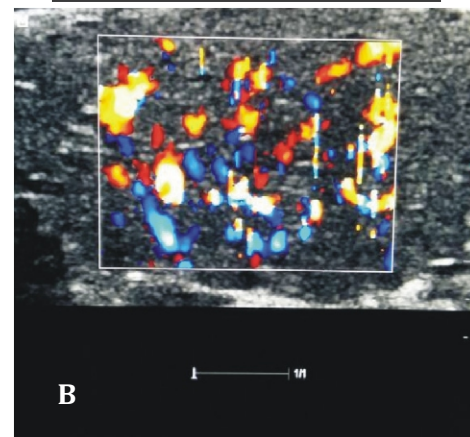
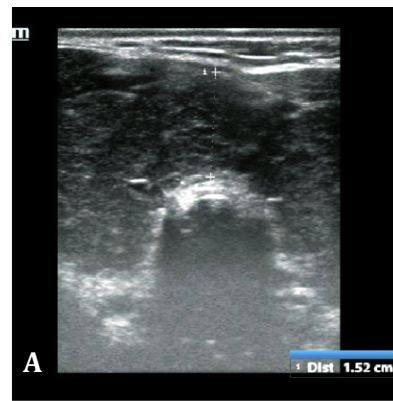


Figure 3. Showing A, transverse gray scale image of a 27- year old lady with Graves' disease. Note the diffused enlargement and hypoechogenicity of the gland involving both lobes and the isthmus. B & C are longitudinal images of the same gland showing the heterogeneous echotexture and the hypervascularity.

(40%) of the nodular lesions were associated with calcification while 10 (16.67) had cystic degeneration. Twenty-eight (46.67%) of the nodules were of hypo-echogenicity, 15 (25%) had mixed echogenicity, 11 (18.33%) had hyper-echogenicity while 6 (10%) were isoechoic with the normal thyroid tissue. Most of the nodules 56 (93.33%) had only peripheral Doppler signal while 4 (6.67%) had both peripheral and intra-nodular Doppler signal.

Sixty patients (45.45%) had thyroid nodules (Fig.4) in each lobe, which were single in 31 (51.67%) and multiple in 29(48.33%). 24

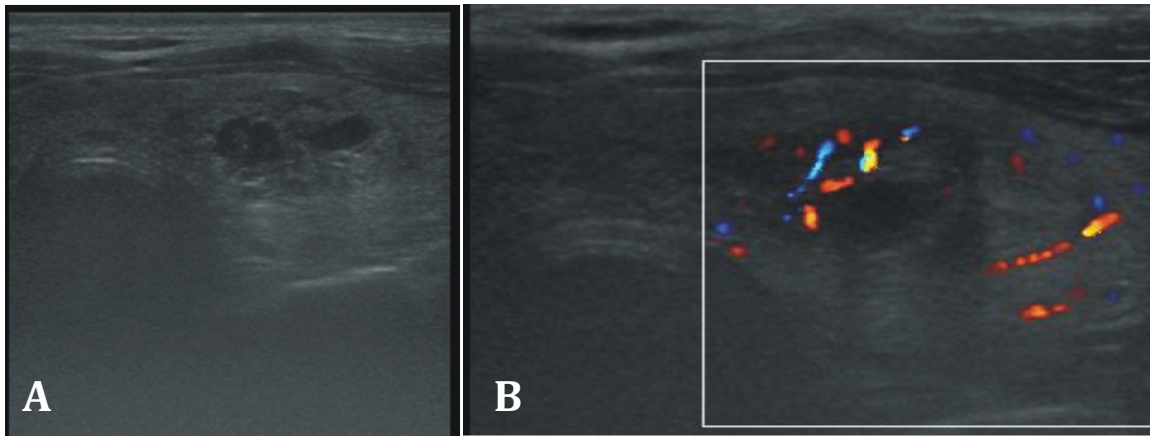


Figure 4. Gray scale images of the thyroid gland, showing an ill define heterogeneous hypoechoic nodule [A] with intranodular vascularization [B] suggestive of malignancy. Colloidal or adenomatous nodules with cystic areas and associated comet-tail artefacts (Fig.5) were found in 15 (11.36%) cases.

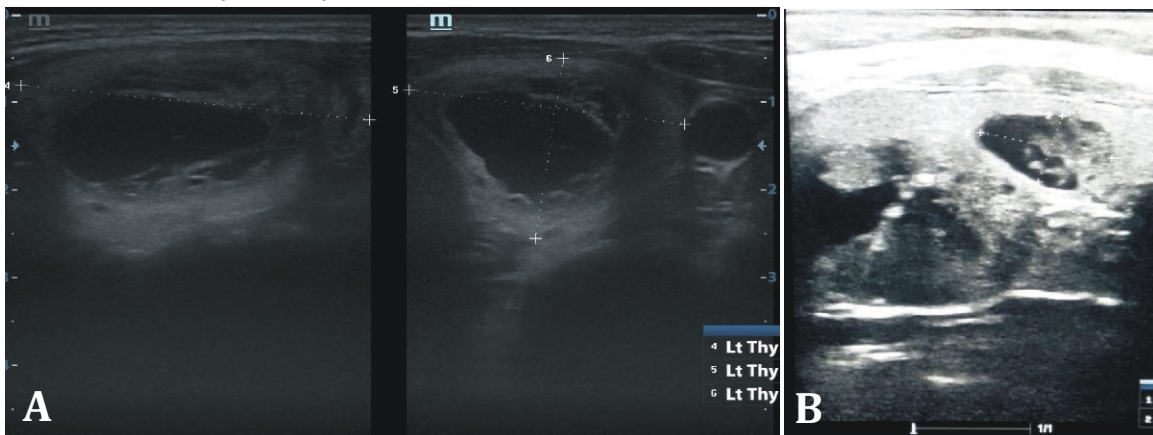


Figure 5. A & B are Gray scale ultrasound images showing thyroid colloid cyst with comet-tail artefacts in A.

Hashimoto's thyroiditis constituted 9.85% of the cases and presented with diffused glandular enlargement and hypoechogenicity of the gland (Fig.6). The gland was of normal size in 33 (25%) of the

patients and enlarged in 99 (75%) of the patients. Diffuse glandular enlargement was more common, being present in 41 (31.06%) cases. These involved both lobes and the isthmus. This was followed by enlargement of both lobes in 30 (22.73%) cases. For single lobe enlargement, the right lobe was more involved than the left lobe, 15% and 5.30% respectively [Table 4].

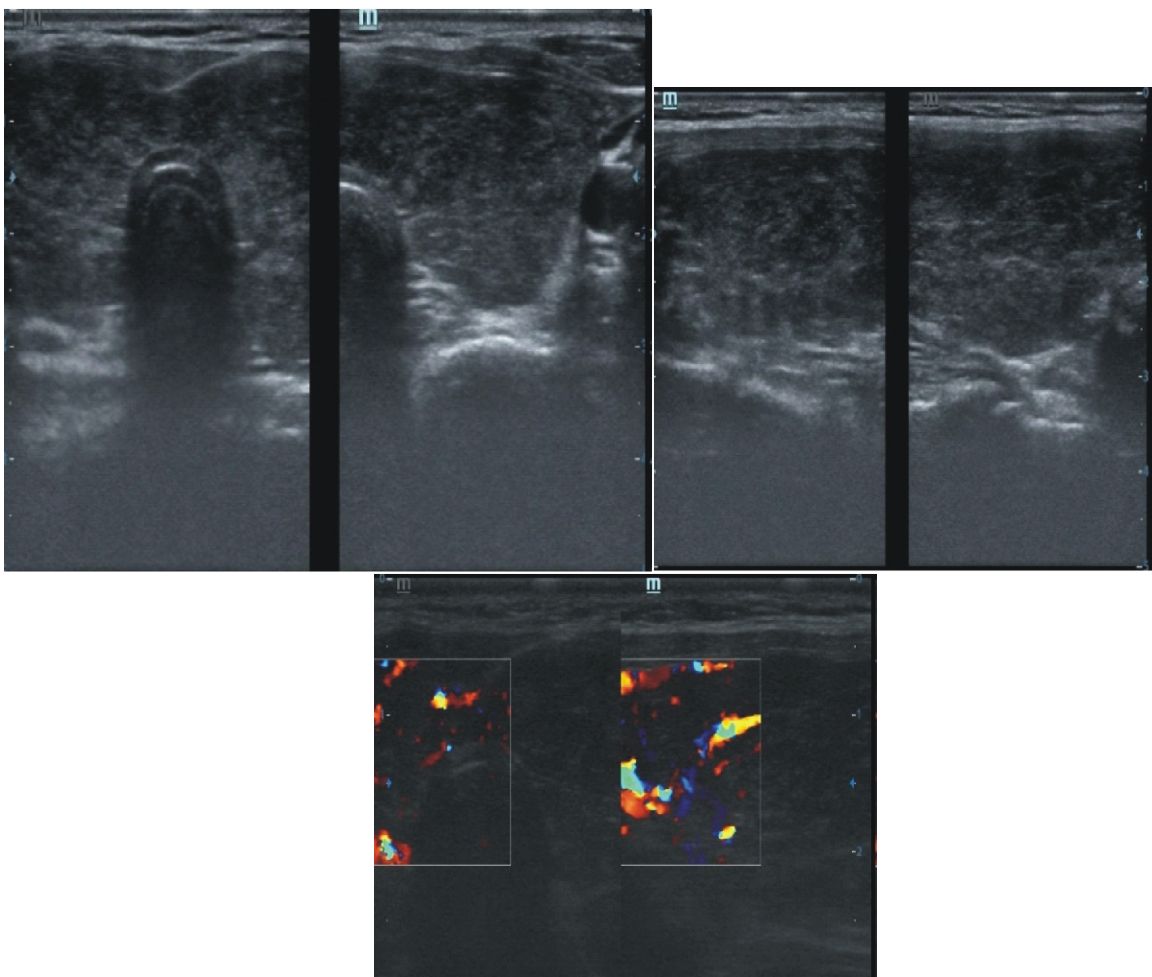


Figure 6. transverse A and longitudinal B, gray scale ultrasound images and C, Doppler image of the thyroid gland of a 43-year old female with Hashimoto's thyroiditis. Note the

diffused heterogeneous, hypoechogenicity of the thyroid and the moderate hypervascularity.

Thyroid size	Number	Percentage
Normal	33	25.00
Diffuse enlargement	41	31.06
Bi-lobe enlargement	30	22.73
Right lobe enlargement	21	15.91
Left lobe enlargement	7	5.30
Total	132	100%

DISCUSSION

The morphological features of the thyroid gland can be assessed by cross sectional imaging. Nuclear scintigraphy, positron emission tomography, ultrasound, Computed tomography and magnetic resonance imaging provide anatomical and functional details of the thyroid gland. Sonographic pattern lacks histological specificity, however, recognition of the sonographic patterns of the thyroid diseases may be invaluable in selecting patients for fine needle aspiration biopsy (FNAB) and surgery.⁹ Sonography has high sensitivity for small nodule detection and for distinguishing cystic from solid lesions.

Diseases of the thyroid are more common in females than males. This was demonstrated in this study where the females were more than three times the number of males and in other previous studies.^{10,11} Hashimoto's thyroiditis and Graves' disease had been shown to be more prevalent in females.¹²⁻¹⁴ Fathimabeebi et al¹⁵ in their study showed that 78% of the patients with thyroid cancer were females. The reason for this is not clear but may be attributed to genetic predispositions.¹⁶

The most common indication for which the patients were referred for ultrasound scan in the index study was neck swelling. Enlargement of the thyroid gland, causes a lump formation in the lower anterior part of

the neck. Depending on the size of the lump, it may be associated with difficulties in respiration and swallowing. The patients being females in majority of the cases, for cosmetic reasons may consider the anterior neck lump unsightly and this may be the reason for their presentation to the clinics. In addition, the fear of the lump being cancerous may probably be another reason for which these patients with neck swelling present to the clinic for evaluation.

In this study, thyroid enlargement (goitre) was found to be unilobular, bilobular or diffused with involvement of the isthmus. Most cases were multinodular goitre, with majority of the nodules being hyperechoic or isoechoic giving the gland a heterogeneous echotexture. Well circumscribed nodules without internal vascularization on Doppler interrogation were more common. Few cases had calcifications which were mainly peripheral, while others were internal microcalcifications. These sonographic features of benign thyroid nodules had been reported in previous studies.¹⁷ They are universally applied in sonography to distinguish malignant from benign lesions and had been very useful in preventing unnecessary biopsy and surgery.¹⁷ Cystic degeneration was more common in benign nodules, but rarely seen in malignant nodules. Cystic degeneration gives anechoic appearance to the nodule; with haemorrhage there may be internal echoes. The index study showed that Graves' disease was the more common of the diffused non-nodular thyroid diseases. The patients with Graves' disease were found to have the largest gland volume. On gray-scale ultrasound scan, the thyroid was diffusely enlarged, involving the lobes and the isthmus. It is hypoechoic with

heterogeneous echotexture. Colour flow imaging reveals a spectacular marked hyper vascularity that simulates arterovenous shunt. This pattern demonstrates extensive intra-thyroid flow both in systole and diastole which had been described as 'thyroid inferno'.^[18] Similar sonographic pattern had been reported by previously.^[19] The hypervascularity is seen during the period of hyperthyroidism, and wanes with treatment; based on this, Doppler analysis can be used to monitor therapeutic response in patients with Graves' disease.^[20] Hypervascularity was also noted in the acute phase of Hashimoto's thyroiditis; which was one of the auto-immune thyroid diseases we came across in this study. Sonographically, it may be homogeneously or heterogeneously hypoechogenic making differentiation from Graves' disease difficult.²¹ Hence for patient sonographically defined as having Grave's disease or Hashimoto's thyroiditis, clinical and laboratory evaluation should be advised to confirm the diagnosis.

Occasionally, nodular form of Hashimoto's thyroiditis may occur; within a sonographic background of diffuse Hashimoto's thyroiditis or within normal thyroid parenchyma.²² Both benign and malignant nodules are known to co-exist within a background of diffuse Hashimoto's thyroiditis; on ultrasound, hyperechoic nodules are more likely to be benign, whereas hypoechoic nodules are more likely to be malignant. In this study hyperechoic nodules were seen in some cases of Hashimoto's thyroiditis; Anderson et al showed that 84% of these nodules were benign.²²

The echogenicity of thyroid nodule is one of the sonographic characteristics for

differentiating malignant nodules from benign nodules, although this feature alone is not pathognomonic as both malignant and benign lesions could be hypoechoic. Some literatures had stated that majority of malignant lesions are hypoechoic;^{23,24} however, we recorded high frequency of benign nodules which were hypoechoic in this study, hence the echogenicity of a nodule alone should not be used to characterise the nodule as being malignant or benign. This is because no single ultrasound characteristics had both high sensitivity and high specificity in pointing towards malignancy.²⁵ Other features such as presence of punctate or microcalcification, intranodular vascularity, taller-than-wide shape and irregularity of the margin should all be assessed before discrimination of malignant or benign nodules.²³ Cervical lymph adenopathy should also be assessed in evaluation of malignant characteristics. Most benign nodules are either hypo echoic, mixed echogenicity, hyper echoic and this is depicted in the ultrasonic morphology of the nodules found in this study. Only 4 cases (6.67%) had Doppler and morphological characteristics of malignancy. Local invasion of adjacent structures and metastases to regional cervical lymph nodes are highly specific signs of thyroid malignancy. The most common pattern of vascularity in thyroid malignancy is marked intranodular hyper vascularity.

The limitation in this study is our inability to procure a thyroid function test for all the patients. We were also unable to carry out FNAC for patients with nodules to correlate the pathologic finding with the ultrasound diagnosis. Further studies focusing on correlation of the ultrasound characteristics of the thyroid diseases with pathological

features are encouraged.

CONCLUSION

Thyroid abnormalities are common in our environment and are more prevalent in females. Ultrasound is the best imaging modality of choice for evaluating thyroid lesions which present with varied features. The most common lesions are multinodular goitre, Graves' disease and Hashimoto thyroiditis. Gray scale and Doppler evaluation are of higher sensitivity in differentiating benign from malignant nodules.

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