Original Article

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Radiology Section

# Role of High Resolution Ultrasonography and Color Doppler in Assessment of Thyroid Swelling in Correlation with USG Guided FNAC

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## ABSTRACT

**Introduction:** High resolution US is the imaging modality of choice to investigate the thyroid nodules. When multiple characteristics of thyroid malignancy appear in combination, US help to make an accurate diagnosis. Fine-needle aspiration cytology may help in further assessment of the thyroid swelling.

**Aim:** Ultrasound and Doppler evaluation of thyroid swelling with differentiating benign and malignant lesions on basis of ultrasonographic characteristic and by USG guided FNAC and to determine specificity, sensitivity and efficacy of high resolution ultrasound and guided FNAC as a pre-operative tool.

**Materials and Methods:** Total of 60 patients (10 males and 50 females), with 60 nodules detected by USG from July 2014 to September 2015. The characteristic of each nodule were determined and correlated with FNAC diagnosis.

**Results:** Out of 60 nodules examined, 12 (20%) were found to be malignant on FNAC. The malignant nodules demonstrated following characteristics- solid or predominantly solid (sensitivity 75%, specificity 63.82%), presence of micro calcification (sensitivity 83.33%, specificity 82.97% ), irregular or poorly defined margins (sensitivity 83.33%, specificity 95.74%) , taller than wider (sensitivity 75%, specificity 82.97% ), and markedly hypo-echoic (sensitivity 66.67%, specificity 66.67%). There were 33.33%, malignant nodules found in males and 66.66% in females

**Conclusion:** Ultrasonographic and Doppler characteristic shows high accuracy to differentiate between benign and malignant nodules. USG guided FNAC can be used as preoperative diagnostic tool for management of thyroid swellings.

**Keywords:** Guided FNAC, Non-malignant, Thyroid nodule

## INTRODUCTION

Ultrasonography is considered important in the imaging of clinically suspected lesions of thyroid gland. It is the modality of choice for initial characterization of a thyroid swelling. Majority of thyroid nodules are non-malignant, accurate differentiation of benign from malignant nodule is an important and challenging features of thyroid ultrasonography. High resolution ultrasonography (USG) is highly sensitive imaging modality available for examination of the thyroid nodules. Ultrasound is also considered as 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. The incidence of all thyroid diseases is higher in females than in males. Most of patients with thyroid disorders come with clinical complaint of neck swelling, occasionally dysphasia and hoarseness of voice [1].

Broadly the thyroid nodules can be classified into three Categories: (i) benign thyroid nodule, (ii) malignant nodule and (iii) diffuse thyroid enlargement. Majority of these cases are clinically asymptomatic or patients present only with complaints of neck swelling, pain or other toxic symptoms of hyperthyroidism but readily can be detected by high-resolution ultrasonography (USG) [2]. Thyroid malignancy is rare and accounts for less than 1% of all malignancies. It has a good and prolonged prognosis after surgical excision.

Various features seen on USG, such as irregular margins, hypo echogenicity, absent, thick or irregular halo, calcifications, and solid internal composition, are important signs of malignancy.

## MATERIALS AND METHODS

This was a prospective study based on high resolution ultrasonography in 60 patients with clinically palpable thyroid

disorders. Approval from institutional ethical committee was obtained for this project.

Exclusion criteria was follow-up cases of patients treated with partial or near total thyroidectomy for thyroid carcinoma and coagulation disorder. The study was carried out from July 2014 to September 2015 in Department of Radio-diagnosis at JN Medical College, Sawangi. Total 60 patients with clinically palpable nodules referred from surgical and ENT outpatient department (OPD) of our hospital were included in our study. Of these, 10 were males and 50 were females. In all, 60 patients with clinically suspected nodules came for ultrasonography examination and all patients then proceeded for an FNAC exam. The patients were in the age range of 20–70 years. A detailed clinical history was taken from all patients. Written consent was taken from all patients after explaining the details of investigation which were to be performed. All USG examinations were performed with an Aloka pro-sound alpha 7 USG machine using 5-12 MHz transducer. USG features of each thyroid nodule were assessed in prior to examination.

All 60 cases of thyroid swelling were evaluated for their presence of circumferential halo, margin of nodule, shape, echogenecity, presence or absence of calcification, and internal composition [2]. Margins were assessed as well defined (smooth) or lobulated and poorly defined and whether peripheral halo was present or absent. On the basis of echogenecity of nodules were characterized as hypo echoic, hyper echoic, isoechoic in comparison to normal thyroid parenchyma. The hypoechoic nodules were further sub-classified as markedly hypoechoic if less echogenic than strap muscles of neck. The nodules were also categorized as solid, predominantly solid or predominantly cystic or cystic based on their composition. Presence or absence of calcification was also taken into consideration, On the basis of shape, nodules were classified as taller than wide and wider than tall on ultrasonography [2]. Fine needle aspiration cytology was done under USG guidance and it was considered gold standard in all cases.

## RESULTS

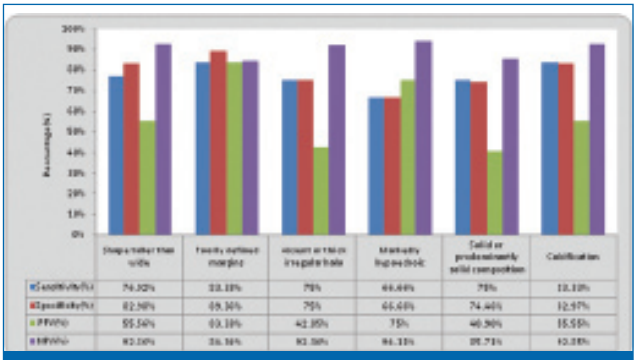
In present study of total 60 patients the most striking feature of thyroid disorders was the preponderance in females, with male to female ratio of 1:3. In our series the youngest patient was of thyroiditis and oldest one had multinodular goitre. In our study 50 patients had a complaint of swelling in neck; palpitation was seen in 6 patients and dyspnoea in 5 patients whereas very few patients had a complaint of exophthalmos and fine tremors. In present study, 45 patients had clinical complaints since 1-2 years, followed by 10 patients who have had clinical symptoms since 6 months – 1 year. In most of the cases clinical symptoms, duration and presentation was overlapping.

In present study ultrasonographic characteristics of thyroid nodule on their benignity or malignant outcome on histopathology is described in details in [Table/Fig-1]. The sensitivity and specificity of USG characteristic is graphically shown in [Table/Fig-2].

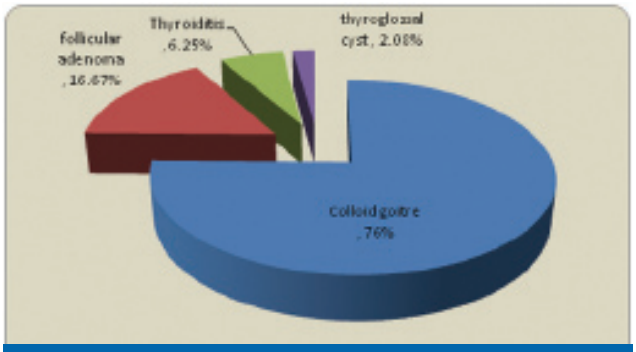
In present study according to USG 12(20%) came out to be malignant whereas 48(80%) came out to be benign. However according to FNAC, 16 (26.66%) came out to be malignant whereas 44(73.33%) came out to be benign. The distribution of benign and malignant lesion on histopathology is shown in [Table/Fig-3,4] respectively.

| Parameters | | Malignant (n=12) | Benign (n=48) | Total (n-60) |
|---|---|---|---|---|
| Gender | Female | 8 | 42 | 50 |
| | Male | 4 | 6 | 10 |
| Margin | Smooth | 2 | 41 | 43 |
| | Lobulated | 4 | 1 | 5 |
| | Poorly Defined | 10 | 2 | 12 |
| Calcification | Present | 10 | 8 | 18 |
| | Absent | 2 | 40 | 42 |
| Internal Contents | Solid | 8 | 6 | 14 |
| | Predominately Solid | 1 | 7 | 8 |
| | Predominately Cystic | 2 | 28 | 30 |
| | Cystic | 1 | 7 | 8 |
| Peripheral Halo | Present, thin and regular | 3 | 36 | 39 |
| | Absent, thick and irregular | 9 | 12 | 21 |
| Echogenicity | Hyper echoic | 2 | 11 | 13 |
| | Hypo echoic | 1 | 25 | 26 |
| | Markedly Hypo echoic | 8 | 5 | 13 |
| | Isoechoic | 1 | 7 | 8 |
| Shape | Taller than wide | 10 | 8 | 18 |
| | Wider than tall | 2 | 40 | 42 |

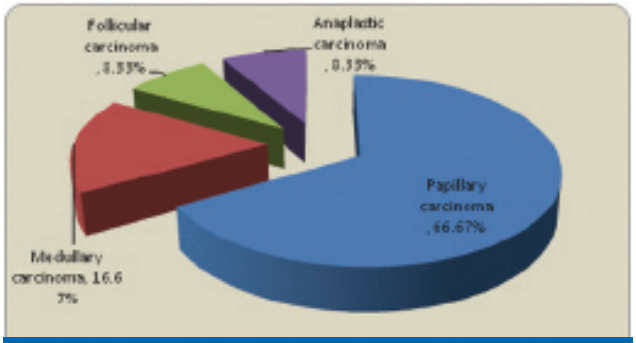
**[Table/Fig-1]:** Various USG features of benign and malignant thyroid nodules.



**[Table/Fig-2]:** Showing: sensitivity, specificity, positive predictive value, negative predictive values of various USG characteristic.




**[Table/Fig-3]:** Distribution of benign nodules.




**[Table/Fig-4]:** Distribution of malignant nodules.

## DISCUSSION

With the development of real time high resolution sonography, it has become practical to routinely evaluate superficial structures of the neck. This has added a new dimension to the management of thyroid lesions.

The most frequent abnormality of the thyroid gland encountered in our series was goitre in 36 out of 60 (76%) patients as compared to the study by Simeone et al., [3] where follicular adenoma formed the majority.

Out of 48 patients of benign thyroid nodule 25 were hypo-echoic (52.08%), 7 were isoechoic (14.58%), 11 hyperechoic (22.91%) and one (2.08%) marked hypoechoic. 7 out of 48 patients of benign thyroid nodule showed cystic degeneration (14.58%) 28 showed predominantly cystic degeneration (58.33%), 8(16.66%) patients showed calcification and 36(75%) revealed a well defined complete halo. 40 out of 48 patients had wider than tall shape (83.33%). Size of the smallest nodule found was 1.5 cm and the largest was of 4.5 cm. Using the criteria of gland asymmetry, multiple solid and cystic nodules with varying amounts of cystic and calcific degeneration, sonography is very accurate in the diagnosis of nodular goitre.

Follicular adenoma was the next most common group of thyroid lesions encountered. Follicular adenoma was found in 8 out of 60 (16.67%) patients. The study by Simeone et al., [3] demonstrate a predominance of hypoechoic nodules in follicular adenomas (64 out of 79 patients) whereas William Scheible et al., [4] demonstrated 2 hypo-echoic, 4 isoechoic and one hyper-echoic nodule in a total of 7 patients. Two out of 7 nodules (28.57%) demonstrated cystic degeneration. None of the nodules demonstrated calcification. Multiple adenomas could not be differentiated from multinodular goitre on ultrasonography.

The adenomas are usually solitary, slow growing and well encapsulated lesions. On ultrasound, a well defined, 1-2 mm, sonolucent rim or halo is seen around adenomas. Pathologically, the halo is probably due to combined effects of a thin capsule investing the adenoma plus compression of surrounding normal tissue. The halo when seen indicates that the lesion is benign and slow growing, but it may also be seen in few malignant lesions. Therefore, it is not specific for adenoma.

Thyroiditis was found in 3 (6.25%) out of 60 patients. In all these cases, the thyroid gland was diffusely enlarged and both the lobes were involved. There was decreased echogenicity of the thyroid gland as compared to the strap muscles. Two patients showed uniformly decreased echo texture while one patient showed nodular involvement. In such patients differentiation from multinodular goitre is important. The differentiating point is that the appearance of the non nodular thyroid parenchyma is always abnormal in thyroiditis and is normal in multinodular goitre. Out of 3 patients of thyroiditis, one was proved to be Hashimoto's thyroiditis and 2 were of lymphocytic thyroiditis on FNAC. It is not possible on sonography to differentiate the types of thyroiditis noted in our series.

One patient of thyroglossal cyst was found in our study. Ultrasound showed a well defined rounded midline cystic lesion anterior to the trachea and above the isthmus. The thyroid gland was otherwise normal. Surgical excision was done, confirming the diagnosis.

Thus ultrasound has proved to be a useful modality to detect an ectopic or hypo- plastic gland [5]. In our study, 12 out of 60 (20%) were found to have thyroid carcinoma. Out of these 8 were females (66.66%) and 4 males (33.33%) were found. Out of these 8 were papillary carcinomas (66.67%), 2 (16.67%) was medullary carcinoma, 1 (8.33%) was a follicular and one (8.33%) was an anaplastic carcinoma

Uzma Bukhari et al., studied about 998 thyroid lesions of which 153 cases were malignant and papillary carcinoma was the most common malignant lesion with a frequency of 90.2%, followed by medullary carcinoma of 4.5% and 2% for follicular carcinoma [6].

One patient of papillary carcinoma, a 37 years female patient showed a well defined rounded hypoechoic lesion 2.4 cm in diameter in right lobe of thyroid, rest of the thyroid gland was normal. Two enlarged round to oval hypoechoic deep cervical

lymph nodes ranging from 1-2 cms were found. However, there was no invasion of carotid sheath; no calcification was noted in the lesion. On FNAC, the lesion was found to be papillary carcinoma.

Another case of papillary carcinoma was encountered in a 55 year old male patient on ultrasonography. It was a large irregular isoechoic to hypo-echoic nodule replacing almost entire left lobe. Cervical lymphadenopathy was also found. No evidence of any cystic change was seen. There were fine non shadowing calcific foci seen.

Pedro Weslley et al., studied features of papillary carcinoma in 106 nodules which revealed hypo-echogenicity in 90.5% no calcification in 59.4% and micro calcification in 26.4% [7].

One patient of follicular carcinoma was found. There was a diffusely enlarged gland with heterogeneous echo pattern. There was displacement of the right carotid sheath. However, no invasion was seen. There was evidence of lymphadenopathy noted.

In a study conducted by Kamejt Kaur et al., of the 9 malignant cases 2 cases were diagnosed as follicular carcinoma which revealed similar findings of hypoechoic nodule with irregular margins and no cystic component [8].

One patient of anaplastic carcinoma was encountered in our series. This was a 44 year old female patient. On ultrasonography there was a heterogeneously enlarged gland with irregular margins. Coarse calcification was noted in the gland. Multiple hypo-echoic nodes were present along the right carotid sheath. There was no invasion of carotid sheath. This patient was operated and histopathology proved it to be an anaplastic carcinoma of thyroid.

The role of sonography in patients with occult papillary carcinoma lies in the extra ordinary high sensitivity of this technique in detecting small masses and lymph node enlargement, since most of the patient of papillary carcinoma present with cervical lymphadenopathy without clinically enlarged thyroid gland [9].

Although ultrasound is highly sensitive in detecting small nodules, cervical lymphadenopathy, carotid sheath and strap muscle invasion, the specificity is quite low. So also it is difficult to differentiate between the types of thyroid malignancies with this modality.

Any hypo-echoic mass detected with high frequency ultrasound in the post operative thyroid bed is suggestive of recurrence and a biopsy should be performed to confirm or rule out the same. Many cervical recurrences are clinically as well as biochemically occult and are detected only on sonography. Ultrasound guided biopsy becomes as integral part of evaluation of recurrent malignant.

| | Phuttharak et al., [10] | Lin JH et al., [11] | Present Study |
|---|---|---|---|
| Sensitivity | 40% | 51.9% | 83.33% |
| Specificity | 96.2% | 93.9% | 87.5% |
| PPV | 66.7% | 63.6% | 62.50% |
| NPV | 89.3% | 90.5% | 95.45% |

**[Table/Fig-5]:** Statistical analysis of present study with other studies.

### Diagnostic Validity of Duplex Sonography with FNAC Correlation

According to several reports, for the differentiation of benign versus malignant thyroid nodules, sonography has sensitivity rates ranging from 63% to 94%, specificity from 61% to 95% and an overall accuracy from 80% to 94%. In the study conducted by Dhanadia A et al., [12], for detection of malignancy ultrasound had sensitivity of 83.3%, specificity 72.7%, PPV 29.4%, NPV 96.9%. In present study for detection of malignancy ultrasound had sensitivity of 83.33%, specificity 87.50%, PPV 62.5%, NPV 95.45% [Table/Fig-5].

## LIMITATIONS

1. It is operator dependent hence considerable expertise is required for diagnostic accuracy.
2. It cannot differentiate between different types of thyroiditis as seen in this study.

These shortcomings can be overcome by combining ultrasound with Fine Needle Aspiration Cytology.

## CONCLUSION

Ultrasonographic and Doppler characteristic shows high accuracy to differentiate between benign and malignant nodules. In comparison to non-USG guided FNAC, combine use of USG characteristic and USG guided FNAC can be used as preoperative diagnostic tool for management of thyroid swelling.

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