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Original article

Role of high frequency ultrasound in evaluation of solitary thyroid nodule and comparison with fine needle aspiration cytology

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ABSTRACT

Objective : To determine the diagnostic accuracy & efficacy of high frequency ultrasound in differentiating benign from malignant solitary thyroid nodules and compare the results with FNACMethods: In 300 patients with suspected solitary thyroid nodule referred from the Departments of Otorhinolaryngology, Medicine, Surgery, Endocrinology, ultrasound was performed in the Department of Radiology & Imaging Sciences. Ultrasonogram of thyroid was done on ALOKA-SSD 4000 scanner with a 7.5/mHz flat probe, with the patient in the supine position with the neck extended. Fine needle aspiration of the thyroid nodule was performed in 292 of these patients in the Dept. of Endocrinology and the smears sent for cytology. Ultrasound diagnosis was compared with the fine needle aspiration cytology report. Results:- Thyroid nodules were found predominantly in females (Ratio 4:1) both in benign as well as in malignant lesions. The most common presenting symptom was a painless swelling in the neck followed by hoarseness of voice. The age group commonly affected was 3rd to 4th decade. On US examination, additional nodules were detected in 72 patients Benign lesions accounted for 74% of the patients and malignant lesions for 26%. The benign lesions in descending order of occurrence were Colloid nodules (46%) Cystic lesions (14.4%) Adenomas (5%) Thyroiditis (5%) Abscess (1.5%). The most common benign lesion was nodule with cystic degeneration. The diagnostic accuracy in the evaluation of colloid nodules on USG is 100%. Nodules with well defined margins and which were predominantly hyper echoic with cystic contents were more likely to be benign. The presence of a peripheral halo, coarse calcification and peripheral blood flow pattern also favored benignancy. Malignant lesions in descending order of occurrence were Papillary carcinoma (17.3%) follicular carcinoma (7.2%), and Anaplastic carcinoma (2%). Nodules with ill defined margins and which were predominantly hypo echoic, with solid internal contents and those with microcalcification and internal blood flow pattern were more likely to be malignant. The diagnostic accuracy of cystic thyroid lesion was 100%. 16 cases of solid hypoechoic nodules with no flow pattern represented Hashimoto's Thyroiditis. Thus on comparison US with FNAC, few nodules which were diagnosed as benign turned out to be malignant. But none of the lesions predicted as malignant turned out to be benign. Conclusion: High frequency ultrasound has a sensitivity and specificity of 72% and 100% respectively for predicting benign and malignant lesions. US showed sensitivity of 75% for papillary carcinomas and 60% for follicular carcinomas. The overall diagnostic accuracy of high frequency ultrasound in the evaluation of solitary nodule was 85%.

1.Introduction:

The importance of solitary thyroid nodule lies in the increased risk of malignancy compared with other thyroid swellings, incidence varying from 15-25% [1] . The challenge in clinical practice therefore is to identify the small number of patients presenting with neoplastic disease from the majority, to avoid unnecessary surgery in about 90% of patients with solitary thyroid nodules. Evaluation of thyroid gland can be performed using radiography, CT, MRI, Ultrasonography & Radionuclide studies. However all these modalities have their own limitations [2, 3]. FNAC is almost accepted now as the single most reliable and accurate test in the evaluation of a thyroid nodule. [4, 5] The thyroid

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radionuclide scan was a main stay in the evaluation of the thyroid nodule prior to the wide spread use of FNAC. But radionuclide scan cannot exclude or confirm the presence of malignancy[5].Plain radiographs can show soft-tissue mass, tracheal deviation, calcifications, bone and lung metastases. But these findings are neither sensitive nor specific. CT is not a sensitive technique for demonstrating intra-thyroid lesions. However, CT is useful in evaluating lymphadenopathy, local tumor extension and extension into the mediastinum or retrotracheal region, and for detecting regional and distant metastases. So the study is undertaken to determine diagnostic accuracy & efficacy of high frequency ultrasound in differentiating benign from malignant solitary thyroid nodules and compare the results with FNAC

2. Materials and Method

A prospective study of 300 patients with suspected solitary thyroid nodule referred from the Departments of Otorhinolaryngology, Medicine, Surgery, Endocrinology was performed in the Department of Radiology & Imaging Sciences. All patients were subjected to an ultrasound examination of thyroid gland with ALOKA-SSD 4000 scanner with a 7.5/mHz flat probe, with the patient in the supine position with the neck extended.

Fine needle aspiration of the thyroid nodule was performed in 292 of these patients in the Dept. of Endocrinology and the smears sent for cytology. Ultrasonography diagnosis was compared with the fine needle aspiration cytology report.

Inclusion Criteria:

Asymptomatic / symptomatic patients detected to have solitary nodule of thyroid on clinical examination.

Exclusion Criteria

1. Patients with suspected diffuse lesion of thyroid.
2. Physiological goiter.
3. Multinodular goiter

3. Results

Detection and characterization of thyroid nodules was done in 300 patients using high frequency ultrasound. Nodules were found predominantly in females (Ratio 4:1) both in benign as well as in malignant lesions. On US examination, additional nodules were detected in 72 patients. The diagnostic accuracy in the evaluation of colloid nodules on USG is 100%.Nodules with well defined margins and which were predominantly hyper echoic with cystic contents were more likely to be benign. (Fig:I)The presence of a peripheral halo, coarse calcification and peripheral blood flow pattern also favored benignancy (Fig II,III,IV)

Nodules with ill defined margins and which were predominantely hypo echoic, with solid internal contents and those with microcalcification and internal blood flow pattern were more likely to be malignant.(fig V, VI, VII) The diagnostic accuracy of cystic thyroid lesion was 100% .16 cases of solid hypoechoic nodules with no flow pattern represented Hashimoto's Thyroiditis. Thus on comparison US with FNAC, few nodules which were diagnosed as benign turned out to be malignant. But none of the lesions predicted as malignant turned out to be benign. Compared with FNAC, the overall diagnostic accuracy of high frequency ultrasound in the evaluation of solitary nodule was found to be 85%

Age distribution in patients with solitary thyroid nodule

Age	No. Of Cases	Percentage(%)
0-10	-	-
11-20	8	2.5%
21-30	52	18
31-40	84	25.5
41-50	40	13
51-60	64	21.5
61-70	28	10
71-80	24	9.5

Location of Lesions

LOCATION	No. OF CASES
RIGHT LOBE	120
LEFT LOBE	112
BOTH	72
ISTHMUS	4

Incidence of benign and malignant lesions in patients with solitary thyroid nodule

Total No. Of Cases	BENIGN	MALIGNANT	FNAC NOT DONE (small size)	INADEQUATE MATERIAL
300	204	72	8	16

Clinical features of patients presented with solitary thyroid nodule

Clinical Features	Numbers	Percentage%
Swelling in the neck	300	100%
Pain	24	8%
Dysphagia	28	9%
Hoarseness of voice	24	8%
Weight loss	8	2.5%
Menstural irregularities	8	2.5%
Palpitation	4	1.5%
Dyspnoea	4	1.5%

Incidence of various FNAC confirmed Benign lesions

Diagnosis	Incidence	Percentage%
Goiter with cystic changes	128	46.5%
Adenoma	24	8.5%
Cystic lesion	40	14.5%
Thyroiditis	16	6
Abscess	4	1.5

Incidence of various FNAC confirmed malignant lesions

Diagnosis	Incidence	Percentage%
Papillary CA	48	17%
Follicular CA	20	7%
Anaplastic CA	4	1.5%

No. of Ultrasonography Diagnosis of Various Benign & Malignant Lesions Confirmed By Fnac

Diagnosis	Numbers	Percentage%
Benign Nodules	204/224	91%
Malignant Nodules	52/52	100%

Fig I -Well Defined Cystic Lesion

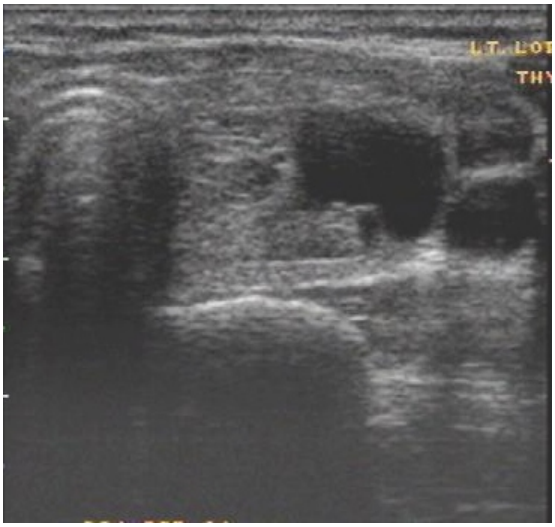

Fig II-Hyperechoic Nodule With Peripheral Halo

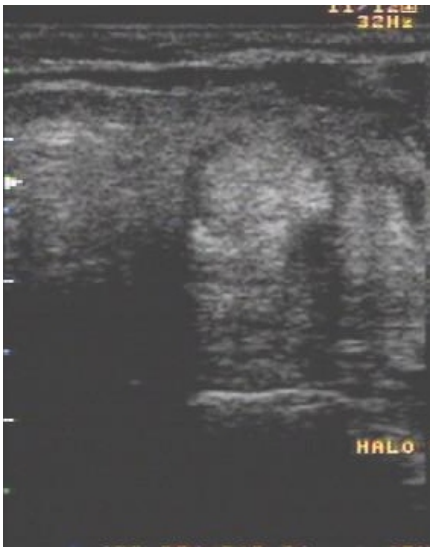

Fig III-Coarse Calcification In A Benign Nodule

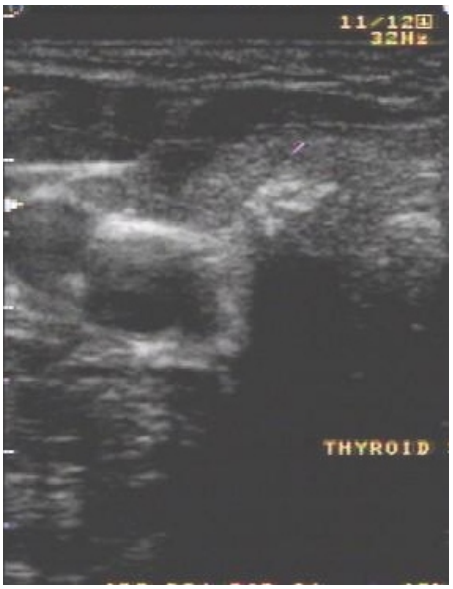

Fig IV -Benign Nodule With Peripheral Blood Flow Pattern

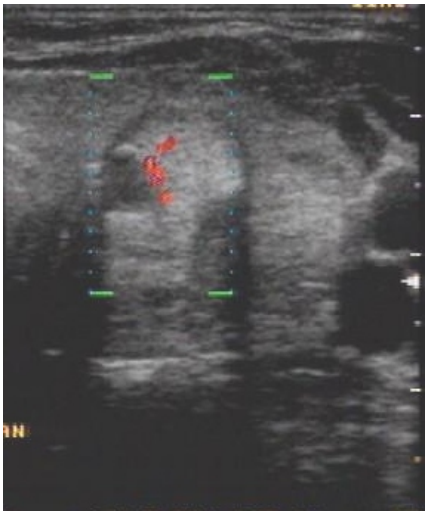

Fig V- Ill Defined Hypoechoic Malignant Nodule

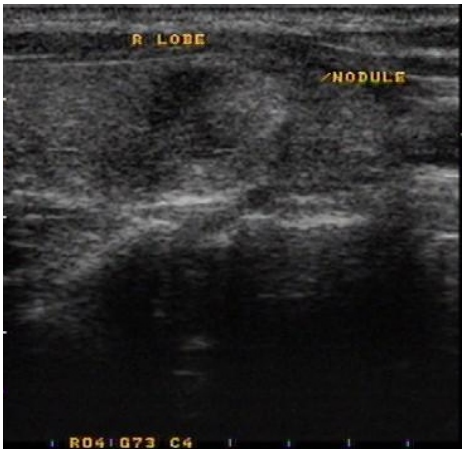

Fig VI- Microcalcifications In A Case Of papillary Carcinoma

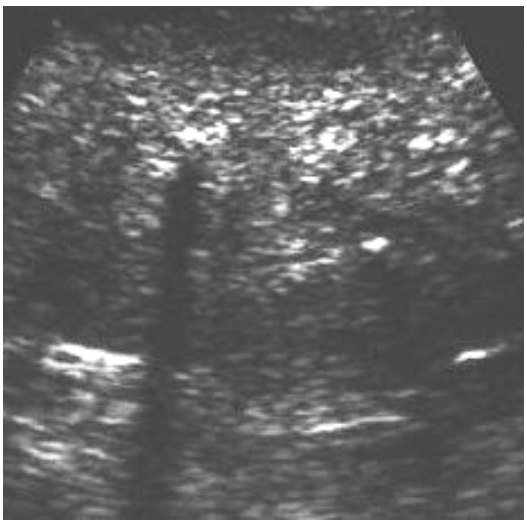

Fig VII- Malignant Nodule With Internal Blood Flow Pattern

4. Discussion

Nodules which occur in the elderly men, are more likely to be cancerous. Belfiore et al [6] found that the odds of cancer in men quadrupled by the age of 64%, reaching a frequency of more than 50% by 70 years. In our series 20 men with FNAC confirmed malignancy were over the age of 50 years.

The most common presentation of a thyroid nodule, benign or malignant, was a painless mass within the gland. (7) 24% of clinically diagnosed solitary nodules were infact multinodular. This was marginally higher in females (20%) than in males (4%).According to Spencer et al (1977), 92% of multinodular lesions clinically labelled as solitary nodules could be correctly diagnosed on ultrasound [8]. This is of importance, since the chance of malignancy in a multinodular goiter significantly reduces to 1-6% [9]. However, Hay et al (1991) found that 64% of patients with thyroid cancer had at least one nodule detected on ultrasound, in addition to the palpable dominant nodule. In our series only 8 out of 72 malignancies coexisted with multiple nodules, 4 being papillary carcinoma and 4 follicular carcinoma [10].

All benign nodules invariably have well defined margins and the majority of malignant nodules have ill defined margins. But according to James et al 1991(11), for any given nodule, the appearance of margins cannot be completely relied upon to predict benignancy, because of the many exceptions. This holds true for our series also as 20 of the 72 malignant nodules had well defined margins.

A complete thin halo was seen with five colloid nodules, and with a papillary carcinoma and a follicular carcinoma. Thick irregular halo, which is suggestive of malignancy, was not encountered in our series. In lesions without halo 72% were benign 28% malignant. Thus presence of complete regular thin halo favored a diagnosis of benign lesion, when compared to a lesion without halo. But halo sign is not completely reliable as it was seen with two cases of malignant nodules. However, if the 'Halo sign' is present with other features of benignancy, the chance of that nodule being benign is much higher.In the series by Solbiati et al (1985), 96% of hyperechoic lesions were benign. This decreased to 74% of isoechoic nodules and only 37% of hypoechoic nodules.[12] This descending order of probability of occurrence coincides well with our series.

According to James et al 1991 [11] 70% of solitary nodules are solid and the rest have cystic changes. The incidence of malignancy in nodules demonstrating cystic changes is low (11%). Pure cystic lesions in the thyroid are invariably benign. 5% of papillary and 4% of follicular carcinomas had cystic degeneration [12].In our study only 46% of the solitary nodules had cystic degeneration. Of the solid lesions, 45% were papillary carcinomas, 20% were follicular carcinomas and 2% anaplastic carcinoma. The rest were benign lesions, namely adenomas and thyroiditis. None of the papillary neoplasms in our series had cystic degeneration.

Locations and patterns of calcification have more predictive value in distinguishing benign and malignant lesions. The presence of any calcification within the nodule raises the likelihood of malignancy. In particular, microcalcifications in a predominantly solid nodule are associated with an approximately threefold increase in cancer risk and coarse calcifications are associated with a twofold increase, as compared with predominantly solid nodules without calcifications (13). Microcalcifications likely represent multiple calcified psammoma bodies, which are typical of papillary thyroid cancer (14). Care must be taken to differentiate these fine punctate calcifications, which are individually too small to induce posterior acoustic shadowing, from echogenic foci with posterior comet-tail artifacts, which are commonly seen in benign cystic or partially cystic nodules (15). In the absence of comet-tail artifacts, tiny echogenicities must be assumed to be calcifications when considering the risk of cancer. There are insufficient data to know whether intense rim calcification, as opposed to calcifications within the nodule, is associated with malignancy.In our series, there were 72 FNAC proven malignant cases, of which in 8 cases neck nodes were detected on palpation, 4 being a papillary carcinoma and 4 follicular carcinoma. On US examination of these patients, all the cases positive for nodes by palpation were confirmed. On US examination, two enlarged cervical nodes were detected. No nodes that were palpable were missed on US. This correlates well with the study of Solbiati et al (1992) (11).one patient with follicular carcinoma was in addition found to have skeletal metastasis to the skull.

The role of colour flow imaging in the evaluation of thyroid lesions has significantly increased over the past two decades.75% of cancers showed intra nodule blood flow pattern.Irregular margins, intranodular vascular spots, and microcalcifications were independent risk factors of malignancy [16]. 80-90% of hyper plastic goiter and adenomatous nodules display peripheral flow pattern [11], while 70-90% of thyroid malignancies display internal flow pattern [17, 18 19]. 75.5% of benign nodules showed peripheral flow pattern and 72.5% of malignant nodules showed internal flow pattern in our study. This data correlates well with the study conducted by Solibiati et al[11].According to some reports [20, 21] Color Doppler is not a reliable aid in the sonographic diagnosis of thyroid nodules, but according to Giammanco et al (2002), color-dopplersonography is undoubtedly an advantage not only in terms of cutting the false negatives, but also in the aim of obtaining a higher effectiveness in the screening of goitrogenic pathology [22].

Thus in our series, we found that, high frequency ultrasound has a sensitivity and specificity of 72% and 100% respectively for predicting thyroid malignancies. US showed sensitivity of 75% for papillary carcinomas and 60% for follicular carcinomas. In our study, the overall diagnostic accuracy of high frequency ultrasound in the evaluation of solitary nodule was 85%.

To conclude, many studies have been published in which the ability to predict whether a thyroid nodule is benign or malignant on the basis of US findings was assessed (16, 23-26). Nodule size is not predictive of malignancy, because the likelihood of cancer in a thyroid nodule has been shown to be the same regardless of the size measured at US (16, 24, 26,). Several US features have been found to be associated with an increased risk of thyroid cancer, including presence of calcifications, hypoechogenicity, irregular margins, and absence of a halo, predominantly solid composition, and intranodule vascularity.

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