Sonographic Features of Thyroid Nodule For Predicting Risk of Malignancy

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ABSTRACT

INTRODUCTION: Thyroid nodules present a challenge in their diagnosis, evaluation and management. Ultrasonography (USG) and Fine Needle aspiration Cytology (FNAC) are initial steps of evaluation of mass whether the nodule is benign or malignant. Although individual USG features may be of limited value, when multiple signs of thyroid malignancy appear in combination it is possible to make an accurate prediction. USG of thyroid nodule can be useful tool to predict the malignancy of thyroid gland.

METHOD: This study was aimed to evaluate the validity of USG findings in predicting risk of malignancy in thyroid nodules. USG of including color flow Doppler was performed in 54 cases with clinically palpable thyroid nodule/s in the department of Radiology and Imaging, NAMS (National Academy Of Medical Science), Bir Hospital from July 2007 to June 2008. USG guided fine needle aspiration for cytological examination was followed by USG.

RESULT: USG diagnosed 49(90.7%) cases as benign and 5(9.3%) cases as malignant. The sensitivity, specificity, Positive predictive Values (PPV) and Negative predictive Values (NPV) of micro calcification in nodule is 89%, 100%, 100% and 90% respectively. Similarly ill-defined margin and regional lymph node had sensitivity (100%), specificity (85.7%), PPV (41.6%), NPV (100%) and sensitivity (80%), specificity (92.1%), PPV (57%), NPV (97.2%).All values are statistically significant. Central vascularity also had sensitivity 100% and significant p value 0.001. The validity of non-echogenicity and solitary nodule was statistically less significant.

CONCLUSION: Sonographic findings of thyroid nodule like presence of micro calcification, ill-defined margin, internal central vascularity and presence of regional lymphadenopathy can be used to predict malignancy of thyroid nodules.

KEY WORDS: Thyroid nodule, USG, Sensitivity, Specificity

INTRODUCTION:

The term thyroid nodule refers to any abnormal growth of the thyroid cell into a lump within the thyroid. True solitary nodules occur in 4-7% of adult population. They are more common in females as compared to males(1).Thyroid nodules are usually found by the patient or a family member, or during a general physical examination, but increasingly they are incidentally discovered during neck imaging undertaken for other reasons, such as carotid duplex ultrasonography. Thyroid nodules present a challenge in their diagnosis, evaluation and management. It is important to determine whether the nodule is benign or malignant. Thyroid nodules are very common and may be observed at USG in 50% of the adult population however, thyroid malignancy is relatively rare and is diagnosed in approximately 25,000 patients per year in the United States (2). The most common cause of benign thyroid nodules is nodular hyperplasia (3). Although less than 7% of thyroid nodules are malignant (3), it is essential that they should be accurately identified. USG is the choice of imaging modality for the investigation of thyroid nodules as it is non invasive easy to perform, and widely available. Although individual USG features

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Ultrasound is an ideal imaging modality for detection and assessment of a thyroid nodule. It is easy to perform, widely available and does not involve ionizing radiation (5). High-resolution ultrasonography has become a very valuable role in diagnosis of the diseases of thyroid and parathyroid glands. After clinical examination ultrasonography plays key role in evaluation of thyroid lesions (6). Ultrasound specify the feature of nodules (size, echotexture, number, echogenicity, presence or absent of lymphnodes, peripheral or central vascularity etc), so it is the evidence based diagnostic method for thyroid nodules. One obvious advantage of ultrasound over other imaging modality is its ability to combine with fine needle aspiration cytology (FNAC) to increase the diagnostic accuracy. The vast majority of thyroid nodules are benign, and the role of a radiologist in assessment of the thyroid gland is to differentiate a malignant thyroid nodule from the more commonly seen benign ones. It is therefore important to evaluate the sonographic features to differentiate benign and malignant character. Among them echogenicity, micro-calcification, irregular margin, increased nodular flow visualized by Color Flow Doppler (CFD), and regional lymphadenopathy are associated with increased risk of malignancy. According to many study micro calcification has the highest accuracy (75%), specificity (94%) and positive predictive value (70%) for malignancy, but sensitivity is low (56%) (7, 8, 9). However ultrasound alone cannot make the diagnosis of cancer. This test will usually help tell us that the nodule has a low chance of being cancer (has characteristics of a benign nodule), or that it has some characteristics of a cancerous nodule and therefore a biopsy is indicated.

FNAC is inexpensive, widely available and easy to perform, and is therefore regarded as a part of the initial investigation for a thyroid nodule. Acute complications are rare and there is no reported case of cutaneous implantation of malignant cells following FNAC of thyroid nodule till date. It has a pre-operative predictive accuracy of more than 90 % and aids the surgeon in selecting the most appropriate procedure prior to surgery. However it is not necessary to perform FNAC on every thyroid nodule. Invasive procedure (FNAC) can be avoided on those nodules which have benign characteristics on USG.

**METHOD**

This was a prospective study carried out from July 2007 to June 2008 in National Academy of Medical sciences, Bir hospital. Fifty four patients of both sex and of age above 15 years with clinically palpable thyroid nodules were subjected to the study. Patients with thyroid nodule already diagnosed with FNAC were excluded. Ethical approval was taken from IRB of NAMS. Written consent was taken. After clinical evaluation of thyroid nodules demographic details of patient like patient like age, associated family history were noted. All patient included in the study underwent USG examination which was carried out by the radiologists with using high frequency (7.5 MHz) linear array transducer.

Following USG findings were evaluated in each thyroid nodules and all patients were subjected to fine needle aspiration and material was sent for cytological study which was carried out by experienced pathologists.

Presence of micro calcification (hyper-echoic focus less than 1mm in size is considered as micro calcification)

Ill-defined margin (Indistinct or poorly defined outer margin of the nodule)

Solitary nodule (Single in number)

Non-hyper echogenicity (Hypo-Iso- and Hypochoic nodules)

Regional lymphadenopathy – (Lymphnodes with Short Axis Diameter more than 10mm)

Internal vascularity (Peripheral vs Central)

According to cytological evaluation lesion were
classified as benign nodules and malignant nodules. Each USG characteristics were subjected to sensitivity, positivity predictive value, negative predictive value and accuracy as needed. Statistical analysis were performed using SPSS software and calculation were performed with Chi square, Fisher Exact tests.

Data associations were considered statically significant at P < 0.005

RESULT

Total fifty four patients with thyroid nodules were diagnosed by USG. Among which 38(72.2%) were female and 15(27%) were males. Among 49 benign nodules, 37(75.5%) benign nodules were found in female and 12(24.4%) were in male. Whereas, among 5 malignant nodules 3(60%) in males and 2(40%). The mean age of the patients was 41.67, +/- 14.29.

DISCUSSION

The purpose this study was to predict the risk of malignancy in thyroid nodule as assessed by universally accepted sonographic features so that the risk of malignancy can be predicted and sent those nodules for FNA and avoiding sonographically benign nodules from unnecessary invasive FNA. In our study 54 patients from different parts of the country, with single or multiple thyroid nodules were sonographically scanned and USG diagnosis was compared with FNA diagnosis.

Among 54 nodules, 49(90.7%) nodules were benign 5(9.3%) nodules were malignant. The prevalence of malignant nodule in this study resembles to the prevalence as shown by the study of Papini E, Guglielmi R, Bianchini A, et al. (3) 9.2%. Out of 54 patients with thyroid nodules, 39(72.2%) were female and 15(27%) were males. While talking about 49 benign nodules, 37(75.5%) benign nodules were found in female and 12(24.4%) were in male. whereas, among 5 malignant nodules 3(60%) in males and 2(40%) in females.

The comparative study of 54 cases regarding margins were as followed, 42(77.8%) thyroid nodules had well defined margin and 12 nodules had ill defined margin. As compared with FNAC all 5(100%) malignant nodules had ill defined margin, where as among benign 7(14%) nodules had ill-defined margin. The ill defined margin had sensitivity 100%, specificity 85.7%, PPV 41.6% and NPV 100% which is similar to the study carried out by Kovacevic DO and Skurla MS. (10) which indicate irregular margins was significantly associated with malignancy. Another study by Papini E, Guglielmi R, Bianchini A, et al. (3) support our result regarding margin of nodules, however a study by Chan et al showed that 47% of papillary carcinoma had well defined margin.

While evaluating calcification, out of 54 cases 17 patients had calcification out of which 13 had macro calcification and 4 patients had micro calcification. No benign nodules contain micro calcification, but 80% of malignant nodules had micro calcification. In our study result micro calcification was found to have sensitivity 80%, specificity 100%, PPV 100% and NPV 98% which closely resemble the study by Papini E, Guglielmi R, Bianchini A, et al (3) which showed 95% specificity of micro calcification for malignancy. Similar result was shown by Wang N, Xu Y, Guo R et al (11), who also found high incidence of micro calcification in thyroid carcinoma patients than in benign nodules. The regional lymphadenopathy had sensitivity 80%, specificity 92.1%, PPV 57% and NPV 97.2%. Our finding is comparable to the study by Kamaljit K, Nishi

![Bar Diagram 1. Nodularity among the patients](image-url)

Table no. 1. Sonographic features of nodules

<table>
<thead>
<tr>
<th>USG findings</th>
<th>Benign (n=49)</th>
<th>Malignant (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro calcification</td>
<td>0(0%)</td>
<td>4(80%)</td>
</tr>
<tr>
<td>Ill-defined margin</td>
<td>7(14.2%)</td>
<td>5(100%)</td>
</tr>
<tr>
<td>Non-hyperechogenecity</td>
<td>38</td>
<td>5(100%)</td>
</tr>
<tr>
<td>Regional lymphadenopathy</td>
<td>3(6%)</td>
<td>4(80%)</td>
</tr>
<tr>
<td>Central vascularity</td>
<td>0(0%)</td>
<td>5(100%)</td>
</tr>
</tbody>
</table>

Table no. 2. Validity of USG findings

<table>
<thead>
<tr>
<th>USG findings</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro calcification</td>
<td>83%</td>
<td>100%</td>
<td>100%</td>
<td>39%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Ill-defined margin</td>
<td>100%</td>
<td>85.7%</td>
<td>41.6%</td>
<td>100%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Non-hyperechogenecity</td>
<td>100%</td>
<td>22.4%</td>
<td>9.25%</td>
<td>100%</td>
<td>0.36</td>
</tr>
<tr>
<td>Regional lymphadenopathy</td>
<td>82%</td>
<td>92.1%</td>
<td>57%</td>
<td>57%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Solitary Nodule</td>
<td>100%</td>
<td>34%</td>
<td>13.5%</td>
<td>100%</td>
<td>0.138</td>
</tr>
</tbody>
</table>
In this study, among 54 nodules 5(9.3%) nodules had increased central vascularity and 9(16.7%) nodules had peripheral vascularity. All 5(100%) malignant nodules had increased central vascularity, whereas among 49 benign nodules 9 had peripheral vascularity, taking increased central vascularity of the nodule as a single parameter, it had 100% sensitivity and P value is 0.001, which is statistically significant. Many studies showed internal vascularity is closely associated with risk of malignancy. According to study conducted by A. Holden et al. (13) all neoplastic nodules (adenomas, carcinomas) contained intra-nodular flow signals. The majority of the colloid nodules were either avascular or had peripheral signals only.

High sensitivity and negative predictive value of solitary nodule suggest presence of solitary nodule indicates possibility of malignancy but does not confirm it as the specificity is low. Despite the malignancy is more associated with solitary nodules but without statistical significance. Non-hyperechogenicity had high sensitivity and negative predictive value but low specificity. In our study 80% patients with malignant nodules had non-hyperechogenicity which closely resembles result of Baum K, Reiners c, Wiedemann W et al. (14) which showed hypo echoic texture in 85% of thyroid carcinoma. However the study by Jason D. Iannuccilli, John J. Cronan, and Jack M. Monchik (15) showed that only 47.1% of malignant nodules were hypo echoic and even 5% malignant nodules were hyper echoic.

**CONCLUSION**

This study has shown that ill-defined margin and presence of microcalcification are good predictor of malignancy in thyroid nodules with sensitivity 100% and 80% specificity 85.7% and 100% PPV 41.6% and 100% and NVP 100% and 98% each with significant p value 0.001 in both parameters. Similarly non-hyperechogenicity is also reliable predictor of malignancy with sensitivity 100%, NVP 100% however it had low specificity 22.4% and PPV 9.25%. Regional lymphadenopathy is a high specific feature of thyroid malignancy but less commonly seen. In our study all 5 malignant nodules had central vascularity with sensitivity 100% and significant p value 0.001. Therefore ultrasound findings of non-hyperechoic nodules with ill-defined margin, microcalcification, central nodular vascularity and associated regional lymphadenopathy need an immediate cytological evaluation to rule out malignancy.

**REFERENCE**