Original Article

Diagnostic Accuracy of Color Doppler Ultrasonography in Detection of Malignancy in Cold Nodule Thyroid Gland

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ABSTRACT

Objectives: To determine the diagnostic accuracy of color Doppler ultrasound in the detection of malignancy in cold nodules in thyroid gland at Nishtar Hospital Multan, taking histopathology as gold standard

Materials & Methods: This cross-sectional study was carried out at Department of Diagnostic Imaging in Nishtar Hospital, Multan during May, 2012 to May, 2013. 81 patients with solitary thyroid nodule were included in the study. Ultrasonography including gray scale and color Doppler ultrasound was performed in each patient with high resolution probe. Findings suggestive for malignancy like microcalcifications, irregular margins, marked hypoechogenicity, shape taller than wider and intranodular vascularity on color Doppler ultrasound were noted. Nodules were labeled as malignant, if one or more positive findings were present. Sonographic findings were compared with histopathology. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated.

Results: Total 81 patients fulfilling inclusion criteria were included. 58.02% (n=47), were male and 41.08% (n=34) were female. Mean age and SD was calculated as 35.67± 4.78.Frequency of malignancy in thyroid nodules (on histopathology) was recorded in 22.22% (n=18) while 77.78% (n=63) were benign. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of ultrasonography were 83.33%, 88.89%, 68.18%, 94.92% and 87.65% respectively.

Conclusion: Ultrasonography is a non-invasive technique having high diagnostic accuracy in detection of malignancy in cold nodules thyroid gland.

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INTRODUCTION

Thyroid nodules are one of the most common presentations of many benign and malignant thyroid disease.[1] In general population, prevalence of thyroid nodules is 4–7% by palpation alone and 13% to 67% by sonographic evaluation. However, less than 7% of thyroid nodules are malignant.[2]

Thyroid disease is a major public health problem in Pakistan because of iodine deficient diet. About 70% of the total population in Pakistan is at risk of developing thyroid disease due to iodine deficiency as reported by UNICEF.[3] In Pakistan, thyroid cancer is responsible for 1.2% cases of all malignant tumors.[4]

Increasing with patient age, thyroid nodules are found in up to 20% of adults by palpation and in up to 70% on sonography and autopsy studies; malignancy rate of cold nodules is 10% to 25%.[5]

Although a number of imaging modalities like radionuclide thyroid scan, computed tomography and magnetic resonance imaging are used for the diagnosis of thyroid diseases, but ultrasound (USG) is modality of choice for the investigation of thyroid nodules.

USG is widespread technique, especially for evaluation of thyroid nodules because of its cost effectiveness, safety and noninvasiveness.

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Ultrasound studies could detect thyroid nodules in 19–67% of selected individuals with higher frequencies mainly in women and elderly people.[6] Potentially malignant thyroid nodules include microcalcifications, marked hypoechogenecity, irregular or microlobulated margins and intra-nodular central vascularity.[7] Ultrasound is helpful in detecting cancer in thyroid nodules on the basis of different features like echogenicity, margins, micro calcification, size, shape, internal contents and abnormal neck lymph nodes.[8] Histopathology is considered the most reliable test for the diagnosis of thyroid nodules and is considered gold standard for the detection of thyroid nodules.[9]

Thyroid disease being a major health problem in our country especially in our region Southern Punjab and the fact that limited data is available in our set up which evaluates the accuracy of ultrasound in detecting malignancy in cold thyroid nodules, a study of this kind is deemed necessary. By doing this study we will be able to see the diagnostic accuracy of ultrasound in detection of malignancy. Thus by using a cheap, non-invasive, non-ionizing modality of investigation, we can detect thyroid malignancy at earlier stage easily. This will be beneficial in early diagnosis and treatment of thyroid malignancy reducing its morbidity and mortality.

MATERIALS & METHODS

This cross-sectional study was carried out in department of radiology Nishtar Medical College & Hospital, Multan in one year from May, 2012 to May, 2013 on eighty one patients. Socio-demographics such as age, gender and duration of swelling were collected. Those patients who have age range between 20 to 70 years and having cold nodule of >1cm for more than 6 months were included in the study, while the patients having proven malignancy were excluded from the study.

Informed consent was taken. Patients were ensured of confidentiality, explaining risks/benefits of the study.

Gray scale Ultrasound and Color Doppler study were performed by consultant radiologist with Toshiba Nemio XG machine using 7.5MHz linear high resolution probe. Sonographic characteristics suggesting malignancy were defined as microcalcifications, an irregular or microlobulated margins, marked hypoechogenecity, a shape that was taller than it was wide and intranodular vascularity on color Doppler ultrasound.

Nodules were prospectively classified as positive or negative .If one or more features suggestive of malignancy were present, the nodule was classified as positive (Malignant).If a nodule had no suspicious features, it was classified as negative (Benign).

After ultrasound examination, an ultrasound guided fine needle aspiration cytology was performed in all patients.

Pathologist having at least three years of post-qualification experience analyzed the biopsy specimen who was kept blinded to the diagnosis of ultrasound in order to control bias. Histopathology diagnosis of malignancy in cold thyroid nodules was obtained from the medical records of patients by the principal researcher. The outcome variable of the study i.e. malignancy (+ve, -ve) on ultrasound and malignancy (+ve ,-ve), confirmed on histopathology was noted.

Data was entered and analyzed by using SPSS version 10. Descriptive statistics were used to calculate the mean and standard deviation for age of the patients and duration of thyroid nodules. Frequencies and percentages were calculated for categorical variables like gender, presence or absence of malignancy in thyroid nodules. Effect modifiers like age, gender and duration of thyroid nodules were controlled by stratifications. Sensitivity, specificity, positive, predictive value and negative predictive value were calculated.

RESULTS

A total of 81 cases fulfilling the inclusion/exclusion criteria were enrolled to determine the diagnostic accuracy of color Doppler ultrasound in the detection of malignancy in cold thyroid nodules at Nishtar Hospital Multan taking histopathology as gold standard.

Age distribution of the patients was done which shows 25.93% (n=21) between 21-30 years of age, 22.22% (n=18) between 31-40 years, 19.75% (n=16) between 41-50 years, 23.46% (n=19) between 51-60 years and only 8.64% (n=7) between 61-70 years of age, mean and SD was calculated as 35.67 ± 4.78.

Gender distribution of the patients shows 58.02 % (n=47) male and 41.98 % (n=34) female patients. We recorded duration of disease, where 35.80 % (n=29) were between 6-12 months duration, 41.98 % (n=34) between 13-24 months and 22.22 % (n=18) with >24 months duration of disease.

The frequency of malignancy in thyroid nodules (on histopathology) was recorded in 22.22% (n=18) while 77.78 %(n=63) had no findings of malignancy.

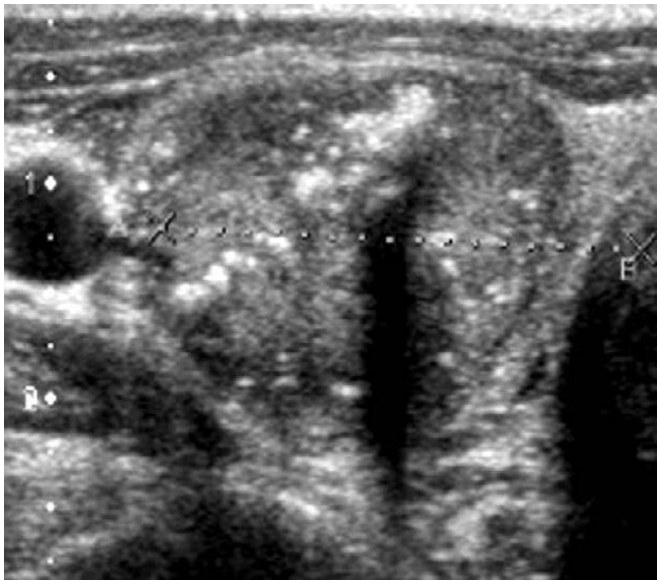

Fig. I: Malignant nodule on ultrasonography showing micro-calcifications in the hypo echoic nodule.

Diagnostic accuracy of US for detection of malignancy of thyroid nodules was calculated and analyzed by drawing a 2X2 table which reveals 83.33% sensitivity, 88.89% specificity, 68.18% positive predictive value, 94.92% negative predictive value and diagnostic accuracy was calculated as 87.65%. (Table No. I)

Stratification of malignancy of thyroid nodules for age of the patients was done, where out of 18 cases of malignancy, 22.22% (n=4) were between 20-30 years, 33.33%(n=6) between 31-40 years, 16.67%(n=3) between 41-50 years, 22.22%(n=4) between 51-60 years and only 5.56%(n=1) between 61-70 years of age.

Stratification of malignancy of thyroid nodules for gender was also done, which shows that out of 18 cases of malignancy, 61.11%(n=11) were male and 28.89%(n=7) were females.

Table 1: Diagnostic Accuracy Of Ultrasound In The Detection Of Malignancy In Cold Nodules Thyroid Taking Histopathology As Gold Standard (n=81)

USG	Thyroid Carcinoma		Total
	Positive	**Negative**	
Positive	True positive (a) 15 (18.52%)	False positive (b) 7 (8.64%)	a + b 22(27.16%)
Negative	False negative (c) 3 (3.70%)	True negative (d) 56 (69.14%)	c + d 59(72.84%)
Total	**a + c 18 (22.22%)**	**b + d 63(77.77%)**	**81(100%)**

Sensitivity = a / (a + c) x 100 = 83.33%
Specificity = d / (d + b) x 100 = 88.89%
PPV = a / (a + b) x 100 = 68.18%
NPV = d / (d + c) x 100 = 94.92%
Accuracy = a + d / (a + d + b + c) x 100 = 87.65%

DISCUSSION

The thyroid nodule is a common entity. Although autopsy data indicate a 50% prevalence of thyroid nodules larger than 1 cm in patients without clinical evidence of thyroid disease, the prevalence of palpable nodules is only 4% to 7%.[10]Ultrasonography is far more sensitive than palpation because it detects nodules of any size in up to 67% of the general population.[11,]Thyroid nodules warrant removal when they are large enough to be symptomatic or if there is a concern for malignancy. The majority of nodules are asymptomatic, and with only 5% to 10% of nodules being malignant, the decision to operate is made on therapeutic or diagnostic grounds.[12] Ultrasound imaging studies and cytology from fine-needle aspiration (FNA) are the main tools used by the clinician to decide whether surgical excision of a thyroid nodule is warranted.

Molecular genetic biomarker analysis are now being used to increase the accuracy of fine-needle aspiration cytology (FNAC), and appear to

substantially alter the clinical decision-making process as they become more widely available and more thoroughly evaluated.[13]

We planned this study to see the diagnostic accuracy of ultrasound in detection of malignancy. Thus by using a cheap, non-invasive, non-ionizing modality of investigation, we can detect thyroid malignancy at earlier stages easily. This will be beneficial in early diagnosis and treatment of thyroid carcinoma reducing its morbidity and mortality.

The findings of the study reveals most of the patients i.e. 25.93% (n=21) between 21-30 years of age, 58.02% (n=47) male and 41.98% (n=34) female patients, the frequency of malignancy in thyroid nodules (on histopathology) was recorded in 22.22% (n=18) while 77.78% (n=63) had no findings of malignancy, diagnostic accuracy of US for detection of malignancy of thyroid nodules was calculated which shows 83.33% sensitivity, 88.89% specificity, 68.18% positive predictive value, 94.92% negative predictive value and diagnostic accuracy was calculated as 87.65%.

The results of the study are in agreement with Tae HJ and colleagues who recorded sensitivity of the ultrasonography 87%, specificity 86.5%, positive predictive value was 48.4%, negative predictive value was 97.8%, and the overall diagnostic accuracy was 86.5% in detecting malignancy in thyroid nodules.[14]

Our findings are further correlate with other studies where it is stated as 85.8% to 95% and positive predictive value 66.7% which is in agreement with other studies where it has been 4.8% to 94.2%.[15]

In a recent trial by Ozel A and colleagues[18]analyzed to increase the objective diagnostic accuracy of ultrasonography and nodules greater than one centimeter, the calculated diagnostic performances including sensitivity, specificity, positive predictive value and negative predictive value, and accuracy were 62.5%, 91.5%, 30.3%, 97.7%, and 89,9%, respectively, in this study sensitivity, and positive predictive value was less than the finding of the current study but specificity, negative predictive value and overall accuracy are in agreement with results of the current study.

Ozel A and colleagues[15,16] further studied for nodules smaller or equal to one centimeter; and the sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 83.3%, 94.9%, 62.5%, 98.2% and 93.8%, respectively, these findings also show higher diagnostic accuracy even in smaller than one centimeter nodules, though we did not included <1 cm nodules in our study.[17]

However, the results of the study proved that by using a cheap, non-invasive, non-ionizing modality of investigation, we can detect thyroid malignancy at earlier stages easily and it is beneficial in early diagnosis and treatment of thyroid carcinoma reducing its morbidity and mortality.

CONCLUSION

The results of the study reveal higher diagnostic accuracy of ultrasound in the detection of malignancy in cold thyroid nodules taking histopathology as gold standard.

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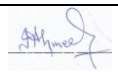
Dr. Ijaz Ahmad	2nd Author	
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