

EFFICACY OF DOPPLER ULTRASOUND IN DETECTING MALIGNANT PALPABLE THYROID NODULES

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(Received, 30th January 2023, Revised 27th May 2023, Published 24th July 2023)

Abstract: *This study aimed to assess the efficacy of Doppler Ultrasound in detecting malignant palpable thyroid nodules. A Cross-sectional, descriptive study was conducted in the Department of Radiology, Nishtar Medical College and Hospital, Multan, from January 2022 to December 2022. A total of 196 patients with palpable thyroid nodules were included in the study. Doppler ultrasound was performed on all patients. Samples were sent for histopathology to the same laboratory whose pathologist was blinded to ultrasound results. On histopathology, 37 patients (18.9%) showed malignancy, and 159 (81.1%) showed no malignant nodules. On Doppler ultrasound, 36 (18.37%) patients were positive for malignancy, and 160 (81.63%) showed no malignancy. Doppler ultrasound showed excellent sensitivity (86.4%), specificity (97.4%), positive predictive value (88.9%), negative predictive value (96.8%), and diagnostic accuracy (95.4%). Doppler ultrasound has a higher diagnostic accuracy for palpable thyroid nodules than histopathology.*

Keywords: Doppler Ultrasound, Histopathology, Malignancy, Palpable Thyroid Nodules

Introduction

Thyroid nodules are a prevalent condition ranging from 4-7% as revealed by thyroid examination and 13-67% by Sonography (Durante et al., 2018). 20% of these palpable nodules are malignant (Al Mamun et al., 2018). Clinically, thyroid nodules are significant as they help to exclude malignancy. In Pakistan, the frequency of thyroid disease is increasing rapidly due to low iodine diet (Nawaz et al., 2018). UNICEF has predicted that almost 70% of the Pakistani population will be affected by thyroid disease due to iodine deficiency. 1.2% of malignant tumors are caused by thyroid cancer (Ishtiaq et al., 2022).

Ultrasound, computed tomography, and MRI are used to diagnose thyroid disorders (Durante et al., 2018). Ultrasonography is widely used for assessing thyroid nodules because it is safe, non-invasive, cost-effective, and can detect malignancy. Doppler ultrasound has been reported to identify malignant lesions with high specificity and sensitivity (Sahu and Padhy, 2018). Much research has been done to evaluate the effectiveness of Doppler ultrasound to differentiate between benign and malignant lesions, but the role of Doppler parameters is still controversial due to limited data.

We studied only one Doppler parameter, the resistive index, thus avoiding unnecessary machine use and saving much time. In our population area where we lack resources, this non-invasive cheap modality can help us in the early detection of lesions and, eventually, better outcomes. This study assessed the efficacy of Doppler Ultrasound in detecting malignant palpable thyroid nodules.

Methodology

A Cross-sectional, descriptive study was conducted in the Department of Radiology, Nishtar Medical College and Hospital, Multan, from January 2022 to December 2022. A total of 196 patients with palpable thyroid nodules were

included in the study. Patients previously diagnosed with malignant thyroid nodules who did not agree to FNAB and biopsy and with inconclusive histopathological results were excluded from the study. All patients provided their informed consent to become a part of the study. The Ethical committee approved the study design.

Doppler ultrasound was performed by a radiologist who has at least five years post-fellowship experience on a Toshiba nemio XG Doppler machine using a 7.5 MHZ linear array probe. Histopathology report was obtained from the same laboratory for all patients, keeping pathologists blinded about ultrasound diagnosis to make results standardized.

All the data was analyzed by SPSS version 23. Mean and standard deviation were used to present descriptive variables such as age, time of illness, and nodule size. Categorical variables like sex and nodule type were calculated by frequency and percentage. Stratification was done for age, nodule size, and type and duration of disease.

Results

Among 196 patients, 56 (28.5%) ranged from 18 to 30 years. The mean age was 41.98 ± 14.65 years. One hundred sixteen patients (59.2%) were male and 80 (40.8%) were female. Seventy-four patients (37.7%) had thyroid nodules from 13 to 24 months, and 54 patients (27.5%) had them for more than 2 years (Table I, Figure 1).

On histopathology, 37 patients (18.9%) showed malignancy, and 159 patients (81.1%) showed no malignant nodules (Table II).

On Doppler ultrasound, 36 (18.37%) patients were positive for malignancy, and 160 (81.63%) showed no signs of malignancy (Table III).

Doppler ultrasound showed excellent sensitivity (86.4%), specificity (97.4%), positive predictive value (88.9%), negative predictive value (96.8%), and diagnostic accuracy (95.4%) (Table IV).

Malignancy was stratified according to age and gender in Table V. Out of 37 malignant cases, 9 (24.3%) belonged to the age group 18-30 years, followed by 8 cases (21.6%) from the age range 61-70 years. Concerning gender, 21 malignant patients (56.7%) were men and 16 (43.2%) were women. The RI values of different nodules, whether malignant or non-malignant, range between 0.55-0.78. Most solid nodules have higher values of RI. The RI value for malignant lesions ranges between 0.71-0.78

Table I: Patients' Demographic Data (n=196)

Variable	N (%)
Gender	
Male	116 (59.2%)
Female	80 (40.8%)
Duration of disease	
6-12	68 (34.7%)
13-24	74 (37.8%)
>24	54 (27.5%)

Table II: Histopathologic Evaluation of Malignancy

Malignancy	N (%)
Yes	37 (18.8%)
No	159 (81.1%)

Table III: Evaluation of Malignancy by Doppler Ultrasound (n=196)

Doppler Diagnosis	Histopathology Diagnosis		Total
	Positive	Negative	
Positive	True positive (a) 32	False positive (b) 4	36 (18.37%)
Negative	False negative (c) 5	True negative (d) 155	160(81.63%)
Total	37 (18.88%)	159 (81.12%)	196(100%)

Table IV: Sensitivity, Specificity, Predictive Values, and Diagnostic Accuracy of Doppler Ultrasound

	Percentage
Sensitivity	86.4%
Specificity	97.4%
Positive predictive value	88.9%
Negative predictive value	96.8%
Diagnostic accuracy	95.4%

Table V: Stratification of Malignancy concerning Age and Gender (n=37)

Malignancy	
Age	
18-30	9 (24.3%)
31-40	7 (18.9%)
41-50	7 (18.9%)
51-60	6 (16.2%)
61-70	8 (21.6%)
Gender	
Male	21 (56.7%)
Female	16 (43.2%)

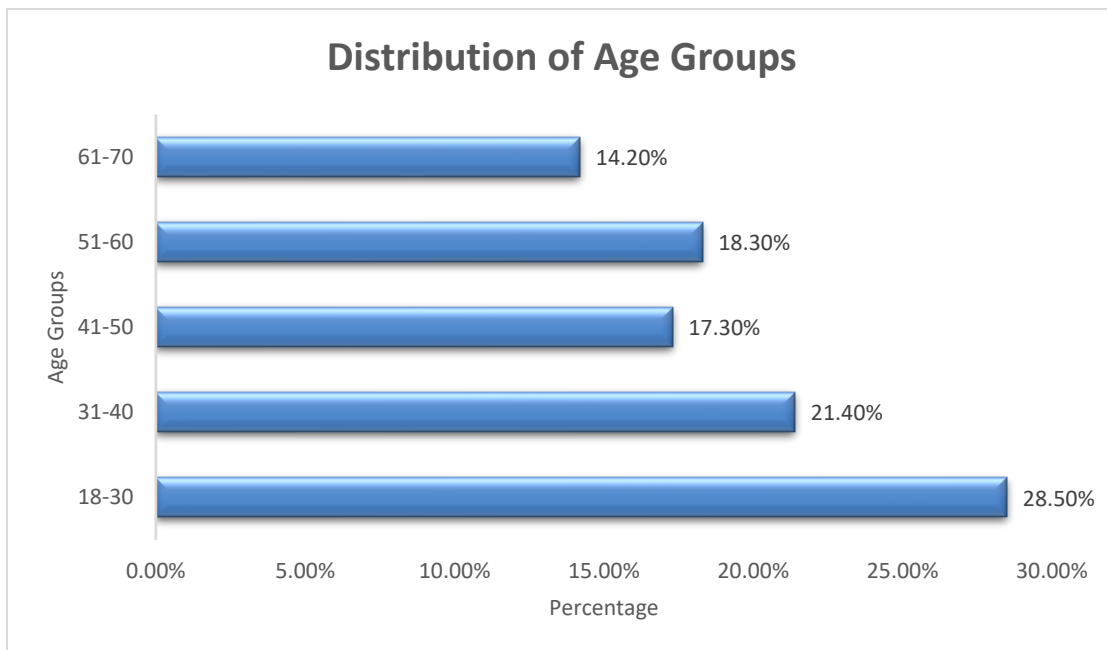


Figure 1: Distribution of participants in different age groups

Discussion

We conducted this study to evaluate the diagnostic accuracy of Doppler ultrasound in detecting malignancy in thyroid nodules. The results showed high accuracy, sensitivity, and specificity, making it a better option than histopathology in addition to being safer and non-invasive.

The findings of our study revealed an overall malignancy rate of 18.88% (n=37). The results are in close accordance with Koh et al. and Maddaloni, which showed that up to 20% of palpable thyroid nodules are malignant (Koh et al., 2020; Maddaloni et al., 2021).

Doppler ultrasound showed excellent sensitivity (86.4%), specificity (97.4%), positive predictive value (88.9%), negative predictive value (96.8%), and diagnostic accuracy (95.4%).

Comparable results were reported by Kalantari, who recorded a sensitivity of 92.3% and specificity of 88% of power Doppler and duplex Doppler US for evaluating thyroid nodules (Kalantari, 2018). Zhan and Ding also showed similar results (Zhan and Ding, 2018)

Our results are also consistent with other studies where different Doppler parameters like high vascularization and RI values have high diagnostic accuracy values ranging from 81.5% to 97% (Ahn et al., 2018; Chambara and Ying, 2019; Radzina et al., 2021).

YR et al. conducted a study to evaluate thyroid nodules as small as 1 cm or smaller, and the reported high sensitivity (83.3%), specificity (94.9%), positive predictive value (62.5%), negative predictive value (98.2%) and accuracy (93.8%) which illustrates the usability of ultrasonography for detection of thyroid nodules (Du et al., 2018). However, the PPV in this study is much less than ours.

The mean RI value for malignant lesions was 0.73 in our study, which also agrees with the study done by Chung et al., which found it to be 0.75 (Chung et al., 2020). The overall accuracy they found was 91% using the cutoff RI value of 0.75, while it was 95.41% in our study. Similarly, other studies by Aslan et al. found cutoff RI values of 0.76 and 0.75 for carcinomas, respectively (Aslan et al., 2018).

Our study has some limitations. Our study was single-centered, with a limited number of patients. A multi-centered study with a large sample size may yield better results.

Conclusion

Doppler ultrasound has a higher diagnostic accuracy for palpable thyroid nodules than histopathology..

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Funding

Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

References

- Ahn, H. S., Lee, J. B., Seo, M., Park, S. H., and Choi, B. I. (2018). Distinguishing benign from malignant thyroid nodules using thyroid ultrasonography: utility of adding superb microvascular imaging and elastography. *La radiologia medica* **123**, 260-270.
- Al Mamun, A., Alam, Z., Islam, M., Mahamud, M., Rahman, M., and Aich, M. L. (2018). Study of pathological variations of solitary thyroid nodule. *Bangladesh Journal of Otorhinolaryngology* **24**, 105-114.
- Aslan, A., Sancak, S., Aslan, M., Ayaz, E., Inan, I., Ozkanli, S., Alimoğlu, O., and Yıkılmaz, A. (2018). Diagnostic value of duplex Doppler ultrasound parameters in papillary thyroid carcinoma. *Acta Endocrinologica (Bucharest)* **14**, 43.
- Chambara, N., and Ying, M. (2019). The diagnostic efficiency of ultrasound computer-aided diagnosis in differentiating thyroid nodules: A systematic review and narrative synthesis. *Cancers* **11**, 1759.
- Chung, J., Lee, Y. J., Choi, Y. J., Ha, E. J., Suh, C. H., Choi, M., Baek, J. H., Na, D. G., of Radiology, K. S., and Radiology, K. S. o. T. (2020). Clinical applications of Doppler ultrasonography for thyroid disease: consensus statement by the Korean Society of Thyroid Radiology. *Ultrasonography* **39**, 315.
- Du, Y.-R., Ji, C.-L., Wu, Y., and Gu, X.-G. (2018). Combination of ultrasound elastography with TI-RADS in the diagnosis of small thyroid nodules (≤ 10 mm): A new method to increase the diagnostic performance. *European journal of radiology* **109**, 33-40.
- Durante, C., Grani, G., Lamartina, L., Filetti, S., Mandel, S. J., and Cooper, D. S. (2018). The diagnosis and management of thyroid nodules: a review. *Jama* **319**, 914-924.
- Ishtiaq, S., Arshad, N., Ali, A., and John, A. (2022). Role of Ultrasound and Color Doppler in Assessment of Thyroid Nodules: Ultrasound and colour doppler for thyroid nodules. *Pakistan BioMedical Journal*, 51-54.
- Kalantari, S. (2018). The diagnostic value of color Doppler ultrasonography in predicting thyroid nodules malignancy. *The international tinnitus journal* **22**, 35-39.
- Koh, J., Lee, E., Han, K., Kim, E.-K., Son, E. J., Sohn, Y.-M., Seo, M., Kwon, M.-r., Yoon, J. H., and Lee, J. H. (2020). Diagnosis of thyroid nodules on ultrasonography by a deep convolutional neural network. *Scientific reports* **10**, 15245.
- Maddaloni, E., Briganti, S. I., Crescenzi, A., Anguissola, G. B., Perrella, E., Taffon, C., Palermo, A., Manfrini, S., Pozzilli, P., and Pantano, A. L. (2021). Usefulness of color Doppler ultrasonography in the risk stratification of thyroid nodules. *European thyroid journal* **10**, 339-344.
- Nawaz, S., Khan, M. B., Parveen, B., Asif, M., Rashid, M., Azeem, M., and Nawaz, M. (2018). Diagnostic

- accuracy of thyroid ultrasound in detection of malignancy in thyroid nodules. *Pakistan Journal of Physiology* **14**, 11-13.
- Radzina, M., Ratniece, M., Putrins, D. S., Saule, L., and Cantisani, V. (2021). Performance of contrast-enhanced ultrasound in thyroid nodules: review of current state and future perspectives. *Cancers* **13**, 5469.
- Sahu, N., and Padhy, R. N. (2018). Bayesian analysis of high-resolution ultrasonography and guided fine needle aspiration cytology in diagnosis of palpable thyroid nodules. *Brazilian Journal of Otorhinolaryngology* **84**, 20-27.
- Zhan, J., and Ding, H. (2018). Application of contrast-enhanced ultrasound for evaluation of thyroid nodules. *Ultrasonography* **37**, 288.



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