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Assessment of quantitative spectral Doppler parameters; resistivity index (RI) and acceleration time (AT) together to show their reliability for differential diagnosis of parenchymal thyroid diseases

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Abstract

Aim: To assess some quantitative spectral Doppler parameters, resistivity index (RI) and acceleration time (AT) together to show their reliability for differential diagnosis of parenchymal thyroid diseases.

Methods: This study was conducted in the Department of Radiology, Maharishi Markandeshwar University, Solanfor the period of 1 year. Patientsweredivided into five groups such as group I (normal); group II had first detected, early untreated Hashimoto disease(EH);groupIII comprised of chronic Hashimoto patients that are under treatment and/or follow up (H); group IV had multinodular parenchymal hyperplasia (M) and group V had nodular hyperplasia with Hashimoto (HM). They underwent spectral Dopplerultrasound usingPhilipsAfiniti 70 G machine by a linear 5-12 MHz probe. Quantitative spectral Doppler parameters such as resistivity index (RI) and acceleration time (AT) were recorded.

Results: Out of 200, 62.5% were female and 37.5% male most of the patients between 30-40 years 42.5% and followed by 40-50 years was 30%. The distribution of patients was done based on diseases. The mean RI in group I was 0.57, in group II was 0.60, in group III was 0.45, in group IV was 0.51 and in group V was 0.53. Mean AT in group I was 25.9, in group II was 24.8, in group III was 69.5, in group IV was 45.8 and in group V was 44.5.The difference was significant ($P< 0.05$).

Conclusion: The resistivity index and acceleration time together are reliable for differential diagnosis of parenchymal thyroid diseases.

Keywords: Hashimoto disease, thyroid gland, ultrasonography

Introduction

Thyroid nodules have been defined by the American Thyroid Association (ATA) as "discrete lesions within the thyroid gland, radiologically distinct from surrounding thyroid parenchyma"[1].Thyroid nodules are commonly benign and the reported prevalence widely varies depending on the population studied and the methods used to detect the nodules[2].Globally, thyroid cancer is increasing rapidly and resulted in 36,000 fatalities in 2010, an increase from 24,000 in 1990, although 5 year survival rates are high following treatment[3-5].A previous study state that, between 1992 and 2006, a total of 43,644 thyroid cancer cases we diagnosed in the United States[6].In China, thyroid cancer is the 8th most frequent cancer, and the rapid increase in thyroid cancer incidence represents a substantial health burden[7, 8].(Ultrasound (US) is an accepted standard diagnostic method for the detection of thyroid nodules worldwide[9].

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Differential diagnosis in advanced stages of diffuse and nodular thyroid parenchymal diseases is quite difficult with gray-scale ultrasonography because findings are usually very similar to each other. Also, nodular changes in multinodular (M) form and a chronic autoimmune disease Hashimoto (H) could be seen together in clinical practice[10].Actually, chronic autoimmune disease may show different radiologic characteristics depending on its stage: for early-stage disease (Early Hashimoto, EH) ultrasonography is done at the beginning, and for chronic-stage disease (Chronic Hashimoto, H) ultrasonography is done when the patient is under a medical treatment. Different pathologic stages during progression of the disease are hard to differentiate from each other with the conventional ultrasound (US)[11, 12].Although there are many studies regarding radiological differential diagnosis of nodules (nodule-pseudo-nodule or benign-malignant nodule) in the literature, there are not enough studies on differential diagnosis of parenchymal changes in heterogeneous parenchyma of H, due to diffuse or other nodular parenchymal diseases with multinodular dysplasia.

Material and methods

This study was conducted in the Department of Radiology,Maharishi Markandeshwar University, Solanfor the period of 1 year, after taking the approval of the protocol review committee and institutional ethics committee.

Methodology

The technique, risks, benefits, results and associated complications of the procedure were discussed with all patients. Total 200 adults patients with age range 18-58 years both the gender were include in this study. All patients were informed regarding the study and their consent was obtained. Particulars such as name, age, gender was recorded in case history performa. A thorough clinical examination was performed in all patients. Patients were divided into five groups such as group I (normal); group II had first detected, early untreated Hashimoto disease(EH);groupIII comprised of chronic Hashimoto patients that are under treatment and/or follow up (H); group IV had multinodular parenchymal hyperplasia (M); and group V had nodular hyperplasia with Hashimoto (HM). They underwent spectral Doppler ultrasound using PhilipsAffiniti 70 G machine by a linear 5-12 MHz probe. Quantitative spectral Doppler parameters such as resistivity index (RI) and acceleration time (AT) was recorded.

Statistical analysis

Results were subjected to statistical analysis for correct inference. P value less than 0.05 was considered significant.

Results

Out of 200, 62.5% were female and 37.5% male most of the patients between 30-40 years 42.5% and followed by 40-50 years was 30% shows in table1.The Distribution of patients was done based on diseases as shown in table 2.The mean RI in group I was 0.57, in group II was 0.60, in group III was 0.45, in group IV was 0.51 and in group V was 0.53. Mean AT in group I was 25.9, in group II was 24.8, in group III was 69.5, in group IV was 45.8 and in group V was 44.5. The difference was significant ($P< 0.05$). Table.3

Table 1: Age and gender distribution of patients

Gender	N=200	%
Female	125	62.5
Male	75	37.5
Age		
Below 30	12	6
30-40	85	42.5
40-50	60	30
Above 50	43	21.5

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Table 2: Distribution of patients

Groups	Group I	Group II	Group III	Group IV	Group V
Diseases	Normal	Early untreated Hashimoto disease(EH)	Chronic Hashimoto (H)	Multinodular parenchymal hyperplasia (M)	Nodular hyperplasia with Hashimoto(HM)
Number	50	40	38	35	37

Table 3: Assessment of spectral Doppler parameters group

Parameters	Group I	Group II	Group III	Group IV	Group V	p-value
RI	0.57	0.60	0.45	0.51	0.53	0.01
AT	25.9	24.8	69.5	45.8	44.5	0.001

Discussion

The application of color and power Doppler modes has huge benefit to determine thyroid gland vascularity. This can evaluate the disease progression, specifically with Graves' disease and thyroiditis. Moreover it is also capable of assessing vascularity within septations in thyroid cystic lesions with RI in different groups[13].USG is better for post-operative follow up and for FNA and True cut needle biopsy guidance. However, it is still considered to be operator dependant, due to poorly identify the retrosternal and laryngeal extension and lack of sensitivity and specificity for some cases[14].Thyroid USG is used for the measurement of parenchymal volume, assessing vascular characteristic of gland, screening, and differentiation of the nodules[15].After the technologic developments about the transducers and high resolution screens, gray scale and Doppler examinations became easier[16, 17].The present study was conducted to determine parenchymal thyroid diseases using Ultrasonography (USG) in adult patients. In present study, we included 200 adult patients. Patients were divided into five groups such as group I (normal); group II had first detected, early untreated Hashimoto disease (EH); group III comprised of chronic Hashimoto patients that are under treatment and/or follow up (H); group IV had multinodular parenchymal hyperplasia (M); and group V had nodular hyperplasia with Hashimoto (HM). Yildirim *et al*. [18]in their study evaluated findings of 227 patients (179 females, 48 males) that underwent spectral Doppler ultrasound and acoustic radiation force impulse. Authors found no significant effect of gender or volume on thedifferentiationof disease pattern. RI (0.41±0.06) was the lowest. AT values (>55 ms) were the highest in EH group. Existence of H decreased RI values, while it extended AT in a different thyroid disease. We found that the mean RI in group I was 0.57, in group II was 0.60, in group III was 0.45, ingroup IV was 0.51 and in group V was 0.53, mean AT in group I was 25.9, in group II was 24.8, in group III was 69.5, in group IV was 45.8 and in group V was 44.5, mean SWV in group I was 1.49, in group II was 1.68, in group III was 1.18, in group IV was 1.42 and in group V was 1.67. The difference was significant ($P< 0.05$). Popoveniuc G, *et al*.,[19]in their study assessed of thyroid diseases by ultrasound in 167 patients. The study groups were classified into 9 groups. Authors found that thyroid USG has great role in assessment of thyroid disease and in their follow up.

Limitation of the study

The study has small sample size. Only one radiologist examined all the patients. There can be radiologist specific errors.

Conclusion

The resistivity index and acceleration time together are reliable for differential diagnosis of parenchymal thyroid diseases.

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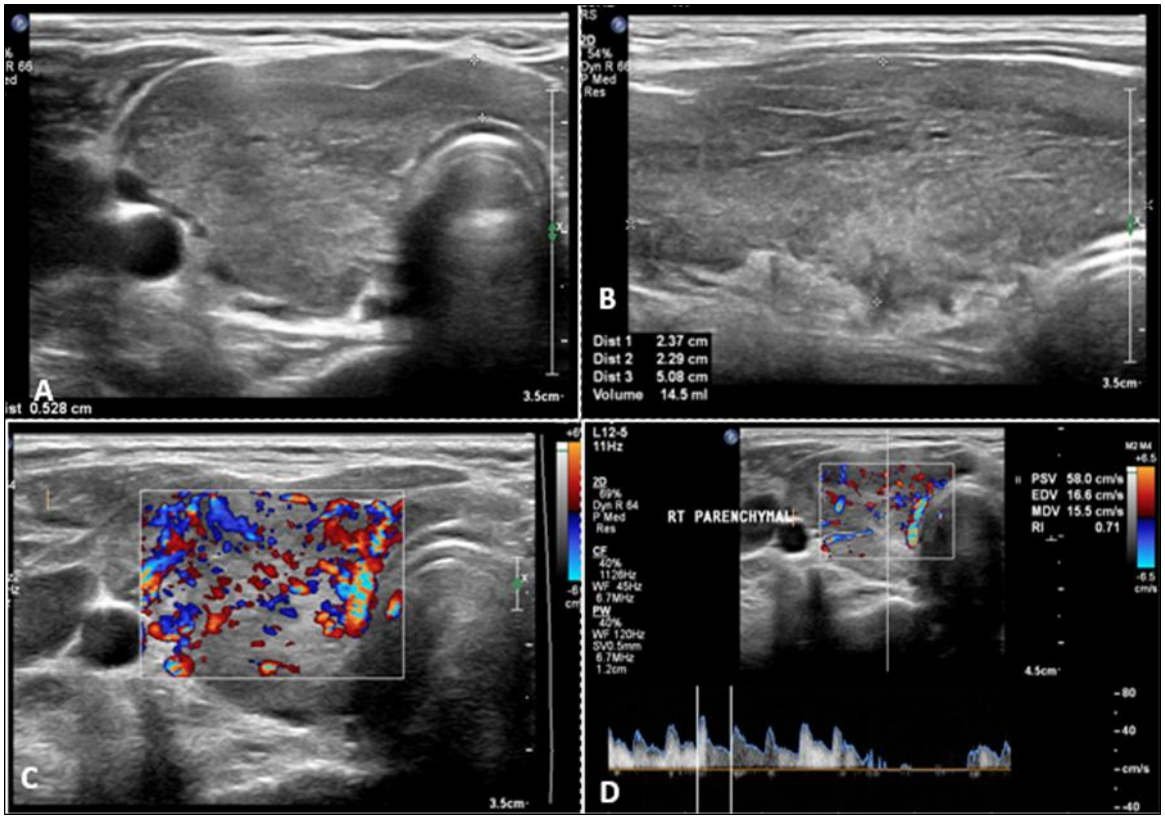

Fig 1(A-D): In patient of acute early Hashimoto thyroiditis (A) & (B) shows enlarged heterogeneously hypoechoic thyroid gland with multiple tiny hypoechoic micronodules and (C) increased vascularity on colour Doppler with (D) spectral Dopplerparametres

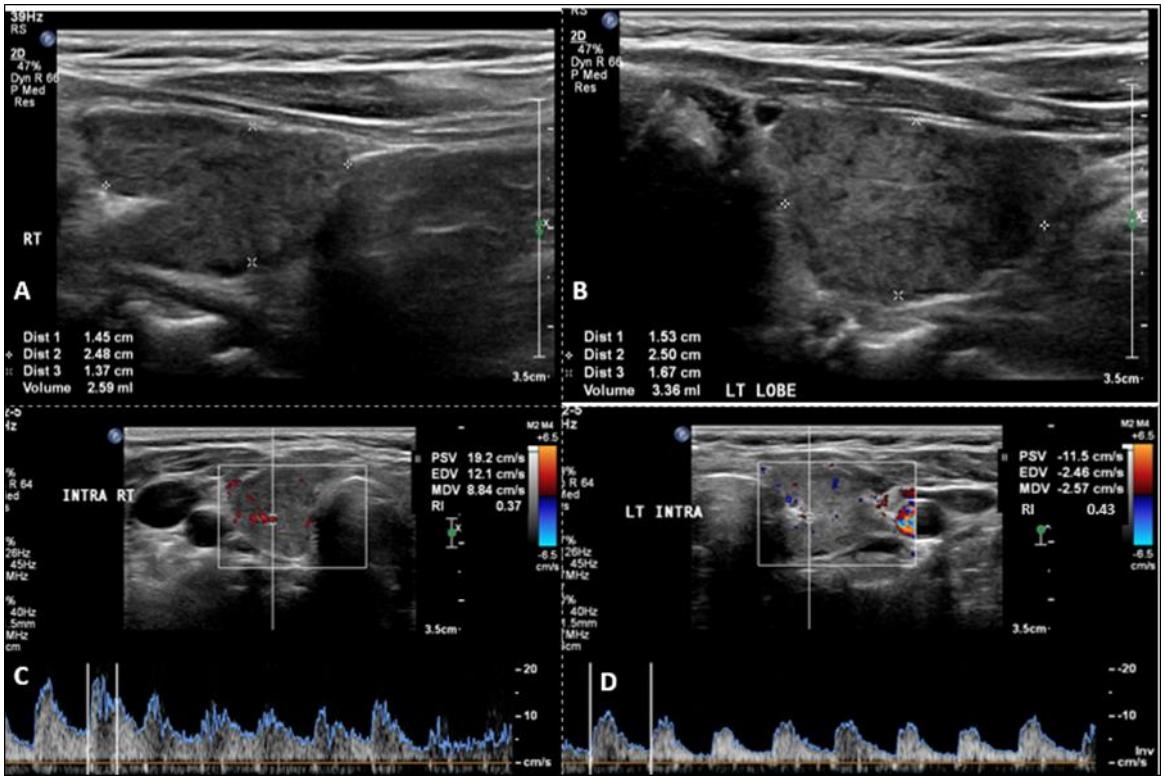

Fig 2(A-D): In patient of chronic Hashimoto thyroiditis (A) & (B) shows smallheterogeneous thyroid gland with progressive internal fibrosis and ill-defined margins suggestive of atrophy and (C) & (D) showing decreased vascularity on colour Doppler with spectral Dopplerparametres

Reference

1. Cooper DS, Doherty GM, Haugen BR, KloosRT, Lee SL, Mandel SJ, *et al*. Revised American Thyroid Association management guidelines for patients with thyroid nodules and differentiated thyroid cancer. Thyroid. 2009;19:1167-1214.
2. Dean DS, Gharib H. Epidemiology of thyroid nodules. Best Pract Res Clin. Endocrinol. Metab. 2008;22:901-911.
3. La Vecchia C, Malvezzi M, Bosetti C, Garavello W, Bertuccio P, Levi F, *et al*. Thyroid cancer mortality and incidence: A global overview. Int. J Cancer. 2015;136:2187-2195.
4. Vigneri R, Malandrino P, Vigneri P: The changing epidemiology of thyroid cancer: Why is incidence increasing? Curr. Opin. Oncol. 2015;27:1-7.
5. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, *et al*.: Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: A systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012;380:2095-2128.
6. Aschebrook-Kilfoy B, Ward MH, Sabra MM, Devesa SS. Thyroid cancer incidence patterns in the United States by histologic type, 1992-2006. Thyroid. 2011;21:125-134.
7. Chen W, Zheng R, Zeng H, Zhang S, He J. Annual report on status of cancer in China, 2011. Chin J Cancer Res. 2015;27:2-12.
8. Wang Y, Wang W. Increasing incidence of thyroid cancer in Shanghai, China, 1983-2007. Asia Pac J Public Health 27: NP223-NP229, 2015.
9. Morris LF, Ragavendra N, Yeh MW. Evidence-based assessment of the role of ultrasonography in the management of benign thyroid nodules. World J Surg. 2008;32:1253-1263.
10. Liang XN, Guo RJ, Li S, Zheng ZM, Liang HD. Binary logistic regression analysis of solid thyroid nodules imaged by high-frequency ultrasonography, acoustic radiation force impulse and contrast-enhanced ultrasonography. Eur. Rev Med Pharmacol. Sci. 2014;18:3601-10.
11. Russ G, Leboulleux S, Leenhardt L, Hegedüs L. Thyroid incidentalomas: Epidemiology, risk stratification with ultrasound workup. Eur. Thyroid J. 2014;3:154-63.
12. Nam-Goong IS, Kim HY, Gong G, Lee HK, Hong SJ, Kim WB, *et al*. Ultrasonography-guided fine-needle aspiration of thyroid incidentaloma: Correlation with pathological findings. Clin. Endocrinol. 2004;60:21-8.
13. Woliński K, Szczepanek-Parulska E, Stangierski A, GurgulE, Rewaj-Łosyk M, Ruchała M. How to select nodules for fine needle aspiration biopsy in multinodular goitre. Role of conventional ultrasonography and shear wave elastography-A preliminary study.Endokrynol Pol. 2014;65(2):114-118.
14. Jung WS, Kim JA, Son EJ, Youk JH, Park CS. Shear wave elastography in evaluation of cervical lymph node metastasis of papillary thyroid carcinoma: Elasticity index as a prognostic implication. Ann Surg. Oncol. 2015;22(1):111-116.
15. Szczepanek-Parulska E, Woliński K, Stangierski A, Gurgul E, Biczysko M, Majewski P. Comparison of Diagnostic Value of Conventional Ultrasonography and Shear Wave Elastography in the Prediction of ThyroidLesionsMalignancy.PLoS One. 2013;8(11):e815-32.
16. Colakoglu B, Yildirim D, Alis D, Ucar G, Samanci C, Ustabasioglu FE, *et al*. Elastography in Distinguishing Benign from Malignant Thyroid Nodules. J Clin. Imaging Sci. 2016;6:51-56.
17. Calvete AC, Mestre JDB, Gonzalez JMR, Martinez ES, Sala BT, Zambudio AR. Acoustic Radiation Force Impulse Imaging for Evaluation of the Thyroid Gland. J Ultrasound Med.2014;33(6):1031-1040.
18. Yildirim D, Alis D, Bakir A, Ustabasioglu F, Samanci C, Colakoglu B. Evaluation of parenchymal thyroid diseases with multiparametric ultrasonography. Indian J Radiol Imaging. 2017;27(4):463-463.
19. Sehgal.P, Kumar.B, Sharma.M, Salameh A.A, Kumar.S, Asha.P (2022), Role of IoT In

Transformation Of Marketing: A Quantitative Study Of Opportunities and Challenges, Webology, Vol. 18, no.3, pp 1-11

20. Kumar, S. (2020). *Relevance of Buddhist Philosophy in Modern Management Theory*. *Psychology and Education*, Vol. 58, no.2, pp. 2104–2111.
21. Roy, V., Shukla, P. K., Gupta, A. K., Goel, V., Shukla, P. K., & Shukla, S. (2021). Taxonomy on EEG Artifacts Removal Methods, Issues, and Healthcare Applications. Journal of Organizational and End User Computing (JOEUC), 33(1), 19-46. http://doi.org/10.4018/JOEUC.2021010102
22. Shukla Prashant Kumar, Sandhu Jasminder Kaur, Ahirwar Anamika, Ghai Deepika, MaheshwaryPriti, Shukla Piyush Kumar (2021). Multiobjective Genetic Algorithm and Convolutional Neural Network Based COVID-19 Identification in Chest X-Ray Images, Mathematical Problems in Engineering, vol. 2021, Article ID 7804540, 9 pages. https://doi.org/10.1155/2021/7804540
23. Popoveniuc G, Jonklaas J. Thyroid Nodules. Med Clin North Am. 2015;96(2):329-349.