International Journal of Otorhinolaryngology and Head and Neck Surgery
Sudhakar Rao MS et al. Int J Otorhinolaryngol Head Neck Surg. 2019 Jul;5(4):1025-1029
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2454-5929.ijohns20192724

Comparative study of colour Doppler vs. FNNAC findings in WHO grade II thyroid enlargement in adult females

Sudhakar Rao M. S.[1], Navneeth T. P.[1]*, John C. J.[2]

[1]Department of Otorhinolaryngology, Head and Neck, [2]Department of Radiodiagnosis, Combined Hospitals of MCH, VIMS, Ballari, Karnataka, India

Received: 08 March 2019
Revised: 17 May 2019
Accepted: 21 May 2019

***Correspondence:**
Dr. Navneeth T.P.,
E-mail: navnee23@gmail.com

ABSTRACT

Background: Thyroid gland disorders form one of the most common endocrinal and surgical problems encountered in clinical practice. FNNAC is widely accepted as the primary and better method than FNAC for investigation but has its disadvantages. Colour Doppler is a non-invasive, low cost, easily available and repeatable investigation with least patient discomfort and can be valuable in detection of benign and malignant thyroid enlargements.
Methods: Forty cases of adult females with WHO grade 2 thyroid enlargement attending the department of otorhinolaryngology selected on simple random basis were included in this study. Following written consent, Colour Doppler scanning and FNNAC test were done on the thyroid swelling and the results were analysed.
Results: The mean age of patients was 32.44 years. The mean age of malignancy was 44.66 years and showed statistically significant association. The Resistive and Pulsatility index and combination of both were found to have statistically significant results in detecting malignant and benign lesions The sensitivity, specificity, positive and negative predictive values of RI and PI were 83.33%, 94.12%, 71.43%, 96.97% and 50%, 94.12%, 60% and 91.43% respectively. On combining both the indices, the sensitivity was 91.67% and the positive predictive value was 97.06%.
Conclusions: Colour Doppler can differentiate between benign and malignant thyroid enlargements using Resistive index (of>0.75) and Pulsatility Index (of>1.5) and can be a complementary diagnostic tool in the thyroid enlargement lesions, considering its accuracy, cost-effectiveness, easy availability and non-invasive repeatable nature.

Keywords: FNNAC, Colour Doppler, Resistive index, Pulsatility index

INTRODUCTION

Thyroid gland disorders form one of the most common endocrinal and surgical problems encountered in clinical practice. The prevalence of thyroid enlargement is about 3%-8% in the general population and is greater than 50% after age of 65 years.[1, 2]

The prevalence increases to 19–27% on including enlargements found incidentally on ultrasonography.[3-5] Most of the enlargements are benign with malignant once forming about 4–14% of cases.[6]

WHO has classified thyroid enlargement as,

- Grade 1: A goitre that is palpable but not visible when the neck is in the normal position, even when the thyroid is not visibly enlarged. This category includes those nodules in thyroid, which is not enlarged otherwise.
- Grade 2: A swelling in the neck that is clearly visible when the neck is in a normal position and is consistent with an enlarged thyroid when the neck is palpated.[7]

Ultrasonography is a sensitive and available investigation for detecting thyroid lesions. With the advent of technology combining Doppler colour flow imaging, it is possible to study the flow patterns within thyroid enlargements. The vascular patterns and Doppler indices can reflect the abnormal vascularity and can be used to differentiate between benign and malignant neoplasms.[8]

Two doppler indices were used in this study: The resistive index and pulsatility index.

The resistive index (RI) was calculated using doppler in all patients with visible flow as below:[9]

RI=(S-D)/S.
S=Height of systolic peak.
D=Height of end diastolic peak.

The resistive index is a measure of the pulsatile blood flow, which shows the resistance caused by the microvascular bed to blood flow distal to the site of measurement.

The pulsatility index (PI) was calculated by using the following equation:

PI=(PSV-EDV)/TAV.
PSV=peak systolic velocity.
EDV=end diastolic velocity.
TAV=time averaged velocity.

It measures the changes or variation of the velocity of blood in a vessel.

FNAC is a widely accepted primary investigation for thyroid enlargements. It has a limitation that the gland being very vascular, can often yield sample or aspirate markedly admixed with blood. This problem can be overcome by using an alternative technique called Fine Needle Non Aspiration Cytology (FNNAC) or Cytopuncture, also called fine-needle capillary sampling. FNNAC eliminates the negative suction pressure and decreases the admixture of thyroid cells by blood. It also has its limitations such as inaccessible, too small , clinically undetectable or demarkable lesions to be evaluated and also that it is an invasive procedure.[10]

In this study we compare the colour Doppler and FNNAC findings in patients with WHO grade 2 thyroid enlargements in an attempt to overcome the limitations and to come out with an apt investigation for the definite diagnosis of thyroid enlargements.

METHODS

This study is carried out at Medical College Hospital, Vijayanagara Institute of Medical Sciences, Ballari, Karnataka, India, which spanned over the period of 1 year from February 2018 to January 2019. Approval from the ethical committee was obtained before starting the study.

Inclusion criteria

A statistically calculated sample size (n, error 5%) of forty cases (n=40) of adult females with WHO grade 2 thyroid enlargement attending the outpatient department of otorhinolaryngology selected on simple random basis were included in this study.

Exclusion criteria

Patients who had non-visible but palpable swellings or who didn't give consent and patients who were lost to follow up were excluded from the study.

Following written consent, Colour Doppler scanning and FNNAC test were done on the thyroid swelling and the results were analysed using SPSS software version 22 for windows.

RESULTS

A total of 40 females were enrolled in this study. The mean age was 32.48 years and most of the patients were in 18-25 (n=14) and 36-55 (n=14) years age group (Table 1).

Table 1: Age distribution.

Age (in years)	Frequency	Percentage (%)
18-25	14	35.0
26-35	11	27.5
36-55	14	35.0
>55	1	2.5
Total	40	100.0

Table 2: Age vs. diagnosis.

	Benign thyroid enlargements	Malignant thyroid enlargements
Mean age (years)	30.3235	44.6667
SD	10.6079	13.8804
N	34	6
Two-tailed P value equals 0.0059		

The mean age of malignancy was 44.66 years and showed statistically significant association (p=0.0059) (Table 2). Among the 40 swellings, 6 (15%) were malignant and 34 (85%) were benign on FNNAC.

The resistive index was more than 0.75 in 7 cases. Of these 5 were malignant and 2 were benign. There was statistically significant association between the cases which were detected as malignant and benign

respectively by the FNNAC procedure (p=0.0002) (Table 3).

The pulsatility index was more than 1.5 in 5 cases. Of these 3 were malignant and 2 were benign with statistically significant association (p=0.0178), among the cases which were detected as malignant and benign respectively by the FNNAC procedure (Table 4).

On combining both the indices, RI>0.75 and PI>1.5 was seen in 4 cases, of which 3 were malignant and 1 was benign having statistical significant p value of 0.0076 (Table 5).

The sensitivity of RI was 83.33%, specificity was 94.12%. The positive predictive value was 71.43% and the negative predictive value was 96.97%.The sensitivity of PI was 50%, specificity was 94.12%. The positive predictive value was 60% and the negative predictive value was 91.43% (Table 6). On combining both the indices, the sensitivity was 91.67% and the positive predictive value was 97.06%.

Table 3: Comparison of RI vs FNNAC results.

	Benign	Percentage (%)	Malignant	Percentage (%)
RI<0.75	32	80	1	2.5
RI>0.75	2	5	5	12.5
Total	34	85	6	15
Two-tailed P value equals 0.0002				

Table 4: Comparison of PI vs FNNAC results.

	Benign	Percentage (%)	Malignant	Percentage (%)
PI<1.5	32	80	3	7.5
PI>1.5	2	5	3	7.5
Total	34	85	6	15
Two-tailed P value equals 0.0178				

Table 5: Comparison of RI and PI vs FNNAC results.

	RI<0.75 n PI<1.5	Percentage (%)	RI>0.75 n PI>1.5	Percentage (%)
Benign	33	82.5	1	2.5
Malignant	3	7.5	3	7.5
Total	34	85	6	15
Two-tailed P value equals 0.0076				

Table 6: Comparison of RI vs PI.

	RI (%)	PI (%)
Sensitivity	83.33	50
Specificity	94.12	94.12
Positive predictive value	71.43	60
Negative predictive value	96.97	91.43

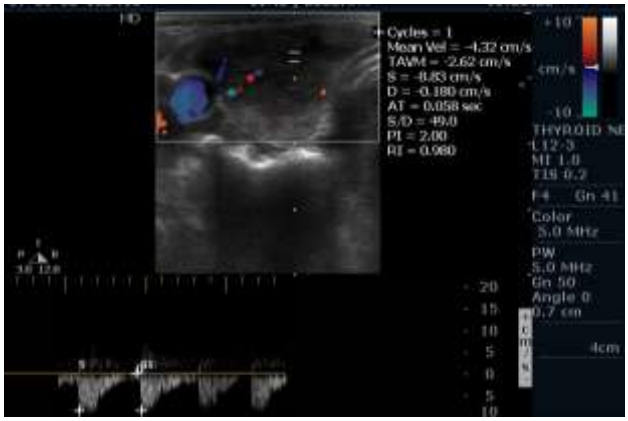

Figure 1: Colour Doppler showing resistive index and pulsatility index calculation. (RI is more than 0.75 and PI more than 1.5 and the lesion turned out to be malignant in FNNAC examination).

DISCUSSION

The mean age of patients in this study was 32.44 years. This is similar to studies done by Butt et al, Chaudhary et al pointing towards increased incidence of thyroid enlargements in middle aged females.[11,12] The youngest patient in this study was 18 years of age and the oldest being 67 years.

This study also emphasises on the relation between the age and the nature of thyroid enlargements and found results favouring increased chances of malignancy in older age group. (p=0.0059). These observations were in accordance with those of Kapur et al study who found maximum malignant lesions in thyroid at 3rd, 4th and 5th decades.[13]

Of the 40 thyroid enlargements, 34 (85%) cases were benign and 6 (15%) cases were malignant, as was seen in study by Aggarwal et al.[14]

Values of pulsatility index (PI)>1.5 and resistive index (RI)>0.75 were presumed to be suggestive of malignancy following results of Chammas et al, Holden et al and Cerbone et al studies (Figure 1).[15-17]

On statistical analysis, both these parameters on colour doppler examination were found to be statistically significant for predicting malignancy in thyroid enlargements. RI was found to be having p=0.0002 and hence extremely significant, while p value for PI was found to be 0.0178 and hence significant.

Our study also combined these indices for the diagnosis of thyroid enlargements (i.e., lesions having both RI>0.75 and PI>1.5) and the results were significant with p value of 0.0076, in detecting benign and malignant lesions.

In present study, RI had specificity of 94.12% and positive predictive value (PPV) of 71.43%, while

sensitivity was 83.33%, negative predictive value (NPV) was 96.97% for predicting malignancy. PI had specificity of 94.12% and positive predictive value (PPV) of 60%, while sensitivity was 50%, negative predictive value (NPV) was 91.43% for predicting malignancy. On combining both the indices, the sensitivity was 91.67% and the positive predictive value was 97.06%.

As per the study done by Nicola et al an RI cut off of 0.75 had high specificity, and negative predictive value but had lower sensitivity and positive predictive value for thyroid malignancy detection.[9] This was also evident in our study and we found that the sensitivity and positive predictive values were more in combined state.

Cytology is considered to be the gold standard for diagnosing thyroid enlargements. FNNAC even though relatively safe, still causes patient discomfort and can have false negative results in inexperienced hands due to inadequate or inappropriate thyroid tissue sampling. Therefore, there is a need to develop a simple, non-invasive, easily available and reliable technique in order to assess the thyroid enlargements.

Colour Doppler pictures the internal structure and vascularity of the thyroid gland. The procedure is safe and is less costly compared to other imaging techniques. There is least patient discomfort during the test and takes only a few minutes. In addition, it does not use ionizing radiation or iodine containing contrast medium, nor does it require discontinuation of any medication. Thus, Doppler ultrasonography being a non-invasive, inexpensive and repeatable modality can be used as a valuable tool during the diagnosis and follow up of patients with thyroid enlargements.

CONCLUSION

Colour doppler is a non-invasive investigation which can differentiate between benign and malignant thyroid enlargements using resistive index (of >0.75) and pulsatility index (of >1.5).

This study emphasises to consider resistive and pulsatality indices as non-invasive specific sensitive indices in diagnosing benign and malignant enlargements of thyroid gland which can be a complementary diagnostic tool in the thyroid enlargement lesions, considering its accuracy, cost-effectiveness, easy availability and non-invasive repeatable nature. This can help not only in avoiding unnecessary surgeries but also facilitate necessary surgery by helping the surgeon to prepare and plan the treatments of thyroid enlargements. Further studies are needed in this regard with larger sample size.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Wiest PW, Hartshorne MF , Inskip PD, Linda A, Crooks. Thyroid palpation verus high- resolution thyroid ultrasonography in the detection of nodules. J Ultrasound Med. 1998;17:487-96.
2. Morstensen JD, Woolner LB, Bennett WA. Gross and microscopic findings in clinically normal thyroid glands. J Clin Endocrinal Metab. 1955;15:1270-80.
3. Carroll BA. Asymptomatic thyroid nodules: incidental sonographic detection. Am J Roentgenol. 1982;138(3):499-501.
4. Woestyn J, Afschrift M, Schelstraete K, Vermeulen A. Demonstration of nodules in the normal thyroid by echography. Br J Radiol. 1985;58(696):1179-82.
5. Brander AE, Viikinkoski VP, Nickels JI, Kivisaari LM. Importance of thyroid abnormalities detected at US screening: a 5-year follow-up. Radiology. 2000;215(3):801-6.
6. Mazzaferri EL. Management of a solitary thyroid nodule. New England J Med 1993;328(8):553-9.
7. WHO|Data sources and inclusion criteria for the Database on Iodine Deficiency. Avaliable at https://www.who.int/vmnis/database/iodine/iodine_data_sources/en/
8. Prasad CV. Evaluation of correlation between ultrasonography and FNAC of thyroid nodules. IAIM. 2016;3(2):92-7.
9. De Nicola H, Szejnfeld J, Logullo AF, Wolosker AM, Souza LR, Chiferi V Jr. Flow pattern and vascular resistive index as predictors of malignancy risk in thyroid follicular neoplasms. Journal of ultrasound in medicine. Official J Am Institute Ultrasound Med. 2005;24(7):897-904.
10. Maurya A, Mehta A, Mani N, Nijhawan V, Batra R. Comparison of aspiration vs non-aspiration techniques in fine-needle cytology of thyroid lesions. J Cytol. 2010;27(2):51.
11. Butt MGM, Nafees M, Aquil H. Diagnostic accuracy of color flow doppler in thyroid tumors. Pak Armed Forces Med J. 2017;67(2):216-21.
12. Chaudhary S, Verma AP, Mishra HK. High resolution ultra sound and color doppler in evaluation of thyroid nodule with fine needle aspiration cytology correlation. Int J Res Med Sci. 201;4(9):4113-8.
13. Kapur MM, Sarin R, Karmakar MG, Sarda AK. Solitary thyroid nodule. Indian J Surg. 1982;44:174-9.
14. Aggarwal A, Kaur N, Bhardwaj, Grover AS. Color Doppler evaluation of thyroid nodules: validation of quantitative & qualitative analysis in predicting malignancy. Intern J Adv Res. 2015;(3)7:1120-6.
15. Chammas MC, Gerhard R, de Oliveira IR, Widman A, de Barros N, Durazzo M et al . Thyroid nodules: evaluation with power doppler and duplex doppler ultrasound. Otolaryngol Head Neck Surg. 2005;132(6):874-82.

16. Holden A. The role of colour and duplex doppler ultrasound in the assessment of thyroid nodules. Australas Radiol. 1995;39:343–9.
17. Cerbone G, Spiezia S, Colao A. Power doppler improves the diagnostic accuracy of color doppler ultrasonography in cold thyroid nodules: follow-up results. Horm Res. 1999;52:19–24.

Cite this article as: Sudhakar Rao MS, Navneeth TP, John CJ. Comparative study of colour Doppler vs. FNNAC findings in WHO grade II thyroid enlargement in adult females. Int J Otorhinolaryngol Head Neck Surg 2019;5:1025-9.