ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at:www.ijmacr.com

Volume – 6, Issue – 1, February - 2023, Page No. : 302 - 309

Correlation between TIRADS Ultrasound Criteria and Bethesda 2017 System for Reporting Thyroid Cytopathology - A three-year study at a Tertiary Care Teaching Hospital in Haryana

[1]Dr. Manish Gulia, MD Radio-Diagnosis, Assistant Professor Dept. of Radio-Diagnosis, Adesh Medical College &Hospital, Mohri Shahbad (M), Kurukshetra, Haryana 136135

[2]Dr. Sandhya Panjeta Gulia, MD Pathology, Professor, Dept. of Pathology, Adesh Medical College &Hospital, Mohri Shahbad (M),Kurukshetra, Haryana 136135

[3]Dr. Neharica Joshi, MD Pathology, Assistant Professor, Dept. of Pathology, Adesh Medical College & Hospital, Mohri Shahbad (M), Kurukshetra, Haryana 136135

[4]Dr. Akshita Rattan, MD Pathology, Assistant Professor, Dept. of Pathology, Adesh Medical College & Hospital, Mohri Shahbad (M), Kurukshetra, Haryana 136135

[5]Dr. Rohit Bhatta, MS General Surgery, MCH Surgical Gastroenterology, Assistant Professor, Dept. of General Surgery, Adesh Medical College & Hospital, Mohri Shahbad (M),Kurukshetra, Haryana 136135

Corresponding Author: Dr. Sandhya Panjeta Gulia, MD Pathology, Professor, Dept. of Pathology, Adesh Medical College & Hospital, Mohri Shahbad (M), Kurukshetra, Haryana 136135

How to citation this article: Dr. Manish Gulia, Dr. Sandhya Panjeta Gulia, Dr. Neharica Joshi, Dr. Akshita Rattan, Dr. Rohit Bhatta, "Correlation between TIRADS Ultrasound Criteria and Bethesda 2017 System for Reporting Thyroid Cytopathology - A three-year study at a Tertiary Care Teaching Hospital in Haryana", IJMACR- February - 2023, Volume – 6, Issue - 1, P. No. 302 – 309.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Nodular thyroid disease is common among the population and some of the thyroid nodules are known to harbor malignancy. Currently it is common for the clinician to advise ultrasound of the thyroid gland and fine needle aspiration cytology from the nodule together for all such patients. But a correlation of the ultrasound findings and the cytological findings seems to suggest that in many of such cases, fine needle aspiration cytology can be avoided and this scarce facility can be more optimally utilised. The current study was undertaken to provide clarification in the matter.

Material and Methods: This is a retrospective cross-sectional study carried out in Departments of Radiology and Pathology of a tertiary care hospital in Haryana, India between January 2018 and December 2020. The study included those patients diagnosed to be having thyroid nodules on ultrasound of the thyroid gland.

These patients subsequently underwent ultrasound guided fine needle aspiration cytology. On ultrasonography the thyroid nodules were categorised in to various TIRADS categories using the American College of Radiology TIRADS system. The cytopathological findings were categorised on the Bethesda 2017 system. The data from the ultrasonological and cytopathological systems was tabulated together and various statistical analysis values were obtained.

Results: 492 patients were included in this study. After tabulating the data from the TIRADS and the Bethesda systems together, we obtained a sensitivity of 85.7%, specificity of 97.7%, positive predictive value of 52.2%, negative predictive value of 99.6%, and accuracy of 97.4%. Pearson Chi-square value was 212.4 and p-value <0.001 indicating significant association between the two systems. Area under ROC curve was 0.99 indicating that the results are very good. We calculated that 95% of our patients (belonging to TIRADS categories 2 & 3) had only 1.7% overall risk of malignancy.

Conclusions: There is significant correlation between TIRADS and Bethesda systems for thyroid nodules. Vast majority of patients with thyroid nodules can be kept under follow-up following ultrasound examination and need not undergo the invasive fine needle aspiration cytology procedure.

Keywords: Bethesda, Fine needle aspiration cytology, malignancy risk, thyroid image reporting and data system, thyroid nodule.

Introduction

Nodular thyroid disease is detected in 3-7% of the adult population worldwide.[1] Though most of the thyroid nodules are benign, some of them are known to harbor malignancy.[2] Thyroid cancers carry good long-term prognosis after surgical excision.[3] Selecting those patients whose thyroid nodules harbor malignancy accurately would prevent unnecessary thyroidectomies in those persons carrying benign thyroid lesions.[4] Thyroid Scintigraphy was once used for the purpose of this selection but has largely been replaced by thyroid ultrasonography (USG) and fine needle aspiration cytology (FNAC) of thyroid nodule and subsequent cytopathological study.[5]

However, it needs to be determined whether all thyroid swellings detected to be nodular in nature on USG should be subjected to the invasive FNAC procedure (with its inherent risks) or not as most of the nodules are generally benign.[6] Thyroid image reporting and data system (TIRADS) classification system was developed by Horvath et al in 2009.[7] Their system was based on ten sonological patterns observed on ultrasound examination. Other authors have followed slightly different and often overlapping sonological criteria to arrive at TIRADS grading.[8-12] An effort has been made to correlate the thyroid ultrasound findings (TIRADS) with cytopathological findings on fine needle aspiration cytology (FNAC) from thyroid nodule (Bethesda 2017 system for reporting thyroid cytopathology).[13-21] The present study would attempt to establish a correlation between the TIRADS and Bethesda 2017 systems of classification of Ultrasonological and Cytopathological findings based on the data collected in this study. To the best of our knowledge, this would be the first such study from Northern India. If a correlation is established, the advantage would be that numerous FNACs for thyroid nodules can be avoided just on the basis of ultrasound findings and patients with such nodules can just be kept on clinical follow-up.[22] This would also lead to optimal

utilization of the scarce fine needle aspiration cytology facility.

Material and Methods

This is a retrospective cross-sectional study carried out in Departments of Radiology and Pathology of a tertiary care hospital in Haryana, India between January 2018 and December 2020.

Inclusion Criteria

All adult male and female patients with clinically palpable thyroid swellings in neck diagnosed to be of nodular nature on ultrasonography and undergoing ultrasound guided FNAC.

Exclusion Criteria

1. TIRADS categories 1 & 6.
2. Patients refusing to give consent for the investigations.
3. Diffuse Goiters
4. Thyroid Swellings with hyperthyroidism / hypothyroidism
5. Patients with bleeding diathesis

Thyroid Ultrasound

All ultrasound scans were performed by a single experienced ultrasonologist using the GE logiq P9-ultrasound machine having linear probe GE 12L, 5-13 MHz. The thyroid nodules were categorised into various TIRADS categories using the American College of Radiology TIRADS system (ACR-TIRADS). The nodules were assessed for the five feature categories namely composition, echogenicity, shape, margin and echogenic foci.[12]

Ultrasound Guided FNAC

Ultrasound guided FNAC was done by a pathologist (preferably at same sitting or within 1-3 days) using a 23-gauge needle attached to a 5 ml syringe and two to three aspirations were performed.

Material obtained from aspiration was transferred to glass slides, smeared and sent to pathology laboratory where the cytopathologists interpreted the smears. The cytopathology reporting was done based on Bethesda 2017 system. Patients with grades 4 to 6 were recommended to undergo thyroidectomy.[23]

Statistical Analysis of the Data Obtained

The data thus collected was tabulated to check for correlation of the TIRADS and Bethesda 2017 systems. Statistical analysis of the accumulated data was done. Sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV) and accuracy figures were derived. TIRADS grades 4 and 5 were considered positive for malignancy, while grades 2-3 were considered negative for malignancy.

Cross-tabulation of TIRADS classification and Bethesda results was prepared. Data were analysed by Chi-square test or Fisher's exact test for categorical variables of benign and malignant nodules. Pearson Chi-square and p-values were obtained.

Receiver Operating Characteristics (ROC) curve was prepared to measure accuracy of results. Risk of malignancy for various TIRADS grades was obtained.

Results

There were 492 patients in all who were included in this study with 418 of them being females. [M:F ratio = 15.1: 84.9] Around 360 patients were aged from 20 to 60 years of age.

Following the ACR- TIRADS system, 354 [72.0%] patients were categorised in TIRADS 2 grade, 115 [23.4%] in TIRADS 3, 16 [3.3%] in TIRADS4 and 7 [1.3%] in TIRADS 5 grade. Representative ultrasound images of TIRADS grade 2 (benign) and TIRADS grade 5 (highly suspicious of malignancy) are shown in figures 1 & 2.

Cytopathologically, 16 FNAC samples were categorised (as shown in figure-3) in Bethesda 1 grade, 452 in Bethesda-2, 10 in Bethesda-3, 8 in Bethesda-4 and 6 in Bethesda-5 grade. None of the samples in our study had frankly malignant features deserving categorisation in Bethesda-6 grade.

These results have been tabulated in Table-1 alongwith corresponding TIRADS grades.

Cross tabulation of TIRADS and Bethesda grades is depicted in Table-2 alongwith sensitivity, specificity, PPV, NPV and accuracy values. These values are also shown graphically in Fig.-4

We obtained Pearson Chi-square value of 212.4 and p-value < 0.001 indicating significant correlation between TIRADS and Bethesda systems of classification of thyroid nodules. Area under ROC curve of 0.99 (fig-5) indicates that the results are very good.

Risk of malignancy calculated for TIRADS-2 grade was 0% and as low as 1.7% for TIRADS-3 grade in our study. On the other hand, it was as high as 37.5% and 85.7% respectively for TIRADS grades 4 & 5. Hence, based on these results, we recommend follow up for thyroid nodules falling in TIRADS grades 2 and 3 and FNAC for higher TIRADS grades. Thus, approximately 95% of patients with thyroid nodules referred for ultrasound study can avoid undergoing FNAC and can be kept on follow up.

Discussion

Various TIRADS classification system have been reported ever since Horvath et al reported their system in 2009. [7-10,12] In this study, we followed the easy-to-use American College of Radiology TIRADS (ACR-TIRADS) system. In the ACR-TIRADS a nodule is assigned points in five ultrasound categories to determine its TIRADS level, namely composition, echogenicity, shape, margin and echogenic foci.[12] Hoang et al, in their study regarding 100 thyroid nodules in 2018, found that ACR-TIRADS criteria, offer a meaningful reduction in the number of thyroid nodules recommended for biopsy and significantly improve the accuracy of recommendations for nodule management.[22]

Similarly, Grani et al in 2018 stated that internationally endorsed sonographic risk stratification systems vary widely in their ability to reduce the number of unnecessary nodule fine needle aspirations. They found that ACR- TIRADS outperformed the others, classifying more than half the aspirations as unnecessary.[20]

A high accuracy of any classification in predicting malignant thyroid lesions will be particularly of help in resource-limited settings where pathological analysis is not routinely performed even when confronted with some suspiciously malignant lesions.[11] In this study we obtained excellent correlation between TIRADS and Bethesda grades. We obtained sensitivity of 85.7%, specificity of 97.7%, PPV of 52.2%, NPV of 99.6% & accuracy of 97.4% for the TIRADS data. Chandra Mohan et al in their study on TIRADS in 2016 also found high PPV apart from finding TIRADS to be a simple and practical method of assessing thyroid nodules.[14] Similarly, Vargas-Uricoechea et al in 2017 found that TIRADS criteria had a good concordance with the Bethesda system and that ultrasound findings of benign pathology are aligned with cytology results.[16] However, Biswas et al in 2020 cautioned that careful application of both grading systems in essential for the proper segregation of thyroid nodules to facilitate effective clinical and surgical management.[21]

The risk of malignancy for various TIRADS grades in our study was 0% for TIRADS-2, 1.7% for TIRADS-3,

37.5% for TIRADS-4 and 85.7% for TIRADS-5 grades. In Table-3, findings of present study have been tabulated along with findings of study by Moifo et al[11] and by Periakaruppan et al.[6] 71% of patients in study conducted by Moifo et al had only 2.2% risk of malignancy. Similarly, nearly 88% of patients in study conducted by Periakaruppan et al had 2.2% risk of malignancy and in our study, 95% of patients had 1.7% overall risk of malignancy. Such patients can be kept on regular follow-up rather than subjecting them to invasive procedures like FNAC provided such recommendations are based on robust data. Statistical analysis of data in our study shows significant ($p< 0.001$, Pearson Chi-square value 212.4 and area under ROC curve of 0.99) correlation between TIRADS and Bethesda grades justifying above recommendation. However, it is still a common practice that the clinician, when confronted with a suspicious thyroid nodule in his / her patient, advises for both ultrasound of thyroid gland as well as FNAC from thyroid nodule simultaneously. Obviously, as has been shown in present study as well as some previous studies, that practice needs to be changed. [13-21]

There are some limitations in our study. One is that our study has been of retrospective nature. Besides, we did not include histopathological reports of those patients' undergoing thyroidectomy in our study as such reports were not available for all thyroid nodules for the obvious reason that those nodules with a benign cytology were not operated for ethical reasons.

Conclusions

There is significant correlation between TIRADS and Bethesda systems for thyroid nodules. Vast majority of patients with thyroid nodules can be kept under follow-up following ultrasound examination and need not undergo the invasive fine needle aspiration cytology procedure. Thus, the scarce resource of fine needle aspiration cytology can be more optimally utilised in those cases where there is a high index of suspicion of malignancy.

References

1. Patel NR, Patel AV, Patel VV, Vadher PR, Kakadia MB. Ultrasonographic and fine needle aspiration cytology correlation of thyroid gland lesions: a study of 100 cases. Int J Otorhinolaryngol Head Neck Surg 2019; 5: 319-325. doi: http://dx.doi.org/ 10.18203/issn.2454-5929.ijohns20190084

2. Lokhande RB, Gedam BS, Shah Y, Kale V. The accuracy of ultrasonography and fine needle aspiration cytology in the diagnosis of nodular goitre: A prospective analysis of 42 cases. Int J Biomed Adv Res 2015; 6: 43-46. doi: 10.7439/ijbar

3. Avinash B, Ahmed N, Sreedevi T, Swapna Ch, Latha RM, Babu J. Role of Ultrasonography to Differentiate Benign and Malignant Thyroid Nodules in Correlation with Fine-needle Aspiration Cytology. Int J Sci Stud 2016; 4: 81-87. doi: 10.17354/ijss/2016/434.

4. Gupta M, Gupta S, Gupta VB. Correlation of Fine Needle Aspiration Cytology with Histopathology in the Diagnosis of Solitary Thyroid Nodule. Journal of Thyroid Research 2010; Article ID 379051, 5 pages. doi: 10.4061/2010/379051.

5. Sachin ID, Omprakash M, Amarendra P. Correlation of clinical, cytological, sonological diagnosis with histopathological diagnosis in cases of clinically diagnosed solitary thyroid nodule. Int Surg J 2019; 6:2849-2855. doi: 10.18203/2349-2902. Isj20193329.

6. Periakaruppan G, Seshadri K, Vignesh Krishna GM, Mandava R, Sai V, Rajendiran S. Correlation between ultrasound – based TIRADS and Bethesda

system for reporting thyroid – cytopathology: 2-year experience at a tertiary care Center in India. Indian J Endocr Metab 2018; 22:651-655. doi: 10.4103/ ijem. IJEM_27_18.

7. Horvath E, Majlis S, Rossi R, Franco C, Niedmann JP, Castro A, Dominguez M. an ultrasonogram reporting system for thyroid nodules stratifying cancer risk for clinical management. J Clin Endocrinol Me tab. 2009;94(5):1748-1751. doi: 10.1210/jc.2008-1724.

8. Kwak JY, Han KH, Yoon JH, Moon HJ, Son EJ, Park SH, Jung HK, Choi JS, Kim BM, Kin E. Thyroid Imaging Reporting and Data System for Ultrasound Features of Nodules: A Step in Establishing Better Stratification of Cancer Risk. Radiology. 2011;260(3):892-899. doi: 10.1148/radiol.11110206.

9. Park JY, Lee HJ, Jang HW, Kim HK, Yi JH, Lee W, Kim SH. A Proposal for a Thyroid Imaging Reporting and Data System for Ultrasound Features of Thyroid Carcinoma. Thyroid 2009;19(11):1257-1264. doi: 10.1089/thy.2008.0021.

10. Russ G, Bigorgne C, Royer B, Rouxel A, Bienvenu-Perrard M. The Thyroid Imaging Reporting and Data system (TIRADS) for Ultrasound of the Thyroid. Journal of Radiology 2011; 92:701-713. doi: 10.1016/j.jradio.2011.03.022.

11. Moifo B, Takoeta EO, Tambe J, Blanc F, Fotsin JG, Reliability of thyroid imaging reporting and data system (TIRADS) classification in differentiating benign from malignant thyroid nodules. Open J Radiol 2013; 3:103-107. doi: 10.4236/ojrad.2013.33016.

12. Tessler FN, Middleton WD, Grant EG, Hoang JK, Berland LL, Tee fey SA, Cronan JJ, Beland MD, Dessr TS, Frates MC, Hammers LW, Hamper UM, Langer JE, Reading CC, Scoutt LM, Stavros AT. ACR Thyroid Imaging, Reporting and Data System (TI-RADS): White Paper of the ACR TI-RADS Committee. J Am Coll Radiol 2017;14(5):587-595. doi: 10.1016/j. jacr.2017.01.046.

13. Junior AR, Falsarella PM, Rocha RD, Lima JPBC, Iani MJ, Vieira FAC, de-Queiroz MRG, Hidal JT, Neto MJF, Garcia RG, de Gusamo Funari MB. Correlation of Thyroid Imaging Reporting and Data System [TI-RADS] and fine needle aspiration: experience in 1000 nodules. Einstein. 2016;14(2):119-123. doi: 10.1590/s1679-45082016AO3640.

14. Chandra Mohan A, Khurana A, Pushpa BT, Manipadam MT, Naik D, Thomas N, Abraham D, Paul MJ. Is TIRADS a practical and accurate system for use in daily clinical practise? Indian J Radiol Imaging 2016; 26:145-152. doi: 10.4103/0971-3026.178367.

15. Srinivas MNS, Amogh VN, Gautam MS, Prathyusha IS, Vikram NR, Retnam MK, Balakrishna BV, Kudva N. A Prospective Study to Evaluate the Reliability of Thyroid Imaging Reporting and Data System in Differentiation between Benign and Malignant Thyroid Lesions. J Clin Imaging Sci 2016; 6:5. doi: 10.4103/2156-7514.177551.

16. Vargas – Uricoechea H, Meza-Cabrera I, Herrera-Chaparro J. Concordance between the TIRADS Ultrasound Criteria and the Bethesda Cytology criteria on the non-toxic thyroid nodule. Thyroid Research 2017; 10:1-9. doi: 10.1186/s13044-017-0037-2.

17. Garcia-Monco Fernandez C, Serrano-Moreno C, Donnay-Candil S, Carrero-Alvaro J. A correlation study between histological results and thyroid ultrasound findings. The TI-RADS classification. Endocrinol Diabetes Nutr. 2018; 65:206-212. doi: https://doi.org/10.1016/j.endien.2018.04.004.

18. Tan H, Li Z, Li N, Qian J, Fan F, Zhong H, Feng J, Xu H, li Z. Thyroid imaging reporting and data system

combined with Bethesda classification in qualitative thyroid nodule diagnosis. Medicine 2019; 98: 50 (e18320). doi: 10.1097/MD. 0000000000018320.

19. Saito Osmar. Correlation of Bethesda Cytopathological classification with Tirads: When surgery is necessary? https://doi.org/10.1016/j.ultrasmedbio.2019.07.381.

20. Grani G, Lamartina L, Ascoli V, Bosco D, Biffoni M, Giacomelli L, Mara Nghi M, Falcone R, Ram undo V, Cantisani V, Filetti S, Durante C. Reducing the Number of Unnecessary Thyroid Biopsies While Improving Diagnostic Accuracy: Toward the "Right" TIRADS. J Clin Endocrinol Metab, January 2019;104(1):95-102. doi: 10.1210/jc.2018-01674.

21. Biswas A, Basu K, De S, Karmakar S, De D, Sengupta M, Ghosh S. Correlation between thyroid imaging reporting and data system and Bethesda system of reporting of thyroid cytopathology of thyroid nodule: A single centre experience. J Cytol 2020; 37:193-199. doi: 10.4103/JOC.JOC_57_19.

22. Hoang JK, Middleton WD, Farjat AE, Langer JE, Reading CC, Tee fey SA, Abinanti N, Boschini FJ, Bronner AJ, Dahiya N, Hertzberg BS, Newman JR, Scanga D, Vogler RC, Tessler FN. Reduction in Thyroid Nodule Biopsies and Improved Accuracy with American College of Radiology Thyroid Imaging Reporting and Data System. Radiology 2018; 287:185-193. doi: 10.1148/radiol.2018172572.

23. Cibas ES, Ali SZ. The 2017 Bethesda System for Reporting Thyroid Cytopathology. Thyroid 2017;27(11):1341-1346. doi: https://doi.org/10.1089/thy.2017.0500

Tables and figures

Table 1: Data from the TIRADS and Bethesda systems tabulated together

	Bethesda 1	Bethesda 2	Bethesda 3	Bethesda 4	Bethesda 5	Bethesda 6	Total
TIRADS 1	0	0	0	0	0	0	0
TIRADS 2	11	341	2	0	0	0	354
TIRADS 3	4	105	4	2	0	0	115
TIRADS 4	1	6	3	4	2	0	16
TIRADS 5	0	0	1	2	4	0	7
Total	16	452	10	8	6	0	492

Table 2: Cross tabulation of TIRADS and Bethesda Grades.

	Bethesda 4-6	Bethesda 1-3	Total	Sensitivity	Specificity	PPV	NPV	Accuracy
TIRADS 4-5	12	11	23	85.7%	97.7%	52.2%	99.6%	97.4%
TIRADS 2-3	2	467	469					
Total	14	478	492					

Table 3: Comparison of risk of malignancy in three studies

	Moifo et al, 2013		Periakaruppan et al, 2018		Present study	
TIRADS GRADE	% Of study population	% Risk of malignancy	% Of study population	% Risk of malignancy	% Of study population	% Risk of malignancy

TIRADS 2	19.3	0.0	63.6	0.0	72.0	0.0
TIRADS 3	52.6	2.2	24.5	2.2	23.3	1.7
TIRADS 4	27.9	5.9-57.9	7.0	38.5	3.3	37.5
TIRADS 5	0.2	100	4.9	77.8	1.4	85.7

Figure 1: Ultrasound image of TI-RADS grade-TR2 nodule

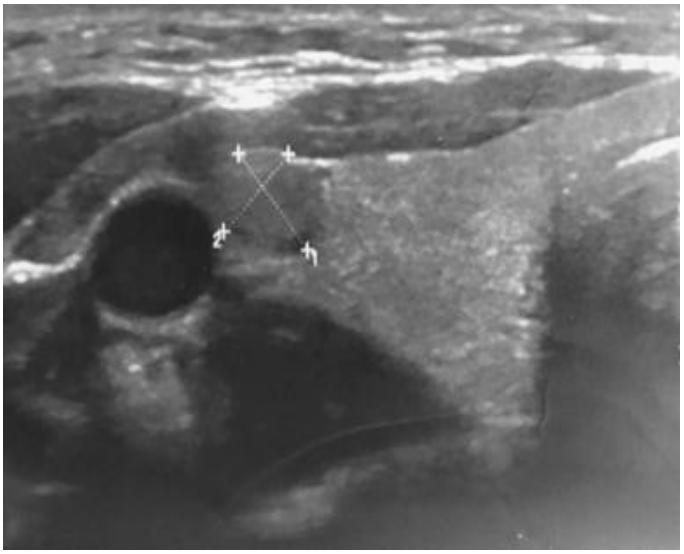

Figure 2: Ultrasound image of TI-RADS grade-TR5 nodule.

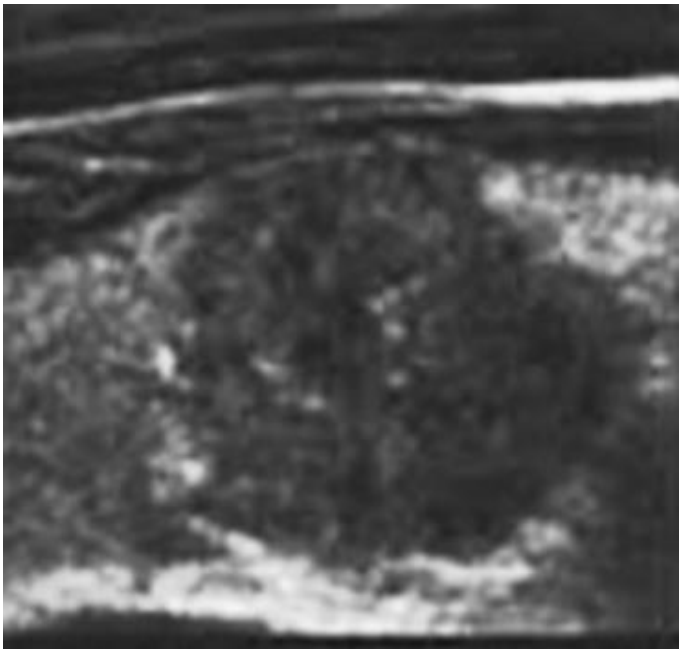

Figure 3: Depiction of percentage of thyroid nodules in various Bethesda grades in this study

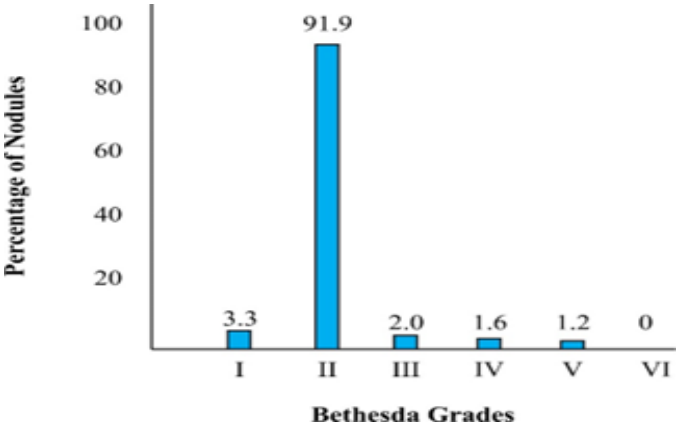

Figure 4: Graphical representation of Sensitivity, Specificity, PPV, NPV & Accuracy

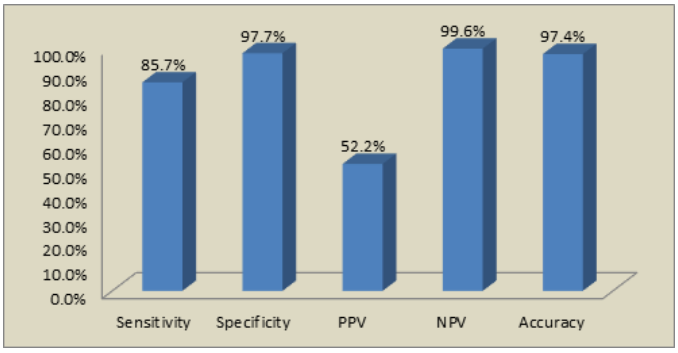

Figure 5: ROC Curve