

Integrating Cytological, Histopathological, Radiological, and Clinical Data for Comprehensive Assessment of Thyroid Lesions: A Multidisciplinary Approach

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Abstract

India is a country which is having a very large number of thyroid lesions amounting to up to 3 % of all diseases. The correlation of radiology along with clinical findings and cytology provides a strong base for performing surgery. The post-surgical findings can be very well corroborated with the other parameters although histopathology is a confirmatory diagnosis. Keeping this ideology in mind the aim of the study is Diagnostic Accuracy Enhancement by evaluating how combining data from cytological, histopathological, radiological, and clinical assessments can improve the accuracy of thyroid lesion diagnoses.

The study involved a total of 334 patients. Out of which, a radiological-cytological correlation was obtained in 170 cases, and cytology, histology, and radiology along with thyroid profile correlation was obtained in 93 cases. The study has very little triad correlation of cytology, radiology, and thyroid profile as there is a lack of awareness among the patients about the significance of all three investigative parameters.

Keywords: Cytopathology, Histopathology, Radiology, Thyroid

Introduction

In India, thyroid disorders are relatively common, with an estimated prevalence of about 10% to 20% of the population. [1]

The evaluation and management of thyroid lesions have witnessed a significant paradigm shift in recent years, marked by the growing recognition of the need for a comprehensive and multidisciplinary approach. Thyroid diseases, encompassing a spectrum of conditions from benign nodules to malignant tumors, pose a considerable healthcare challenge worldwide, affecting millions of individuals. In response to this challenge, medical science has increasingly emphasized the integration of diverse diagnostic modalities and the collaboration of specialists from various fields. [2]

The integration of cytological, histopathological, radiological, and clinical data has emerged as a pivotal strategy in the assessment of thyroid lesions. [3] This multidisciplinary approach allows

for a more holistic understanding of these lesions, leading to enhanced diagnostic accuracy and more personalized treatment decisions. [4,5] By bridging the gap between traditional diagnostic methods, this approach aims to provide clinicians with a more comprehensive and nuanced perspective on thyroid disorders, ultimately improving patient outcomes.

In this paper, we delve into the concept of integrating cytological, histopathological, radiological, and clinical data to offer a comprehensive assessment of thyroid lesions. We explore the synergies that arise when experts from various medical disciplines collaborate to unravel the intricacies of thyroid diseases. Additionally, we discuss the practical implications and benefits of adopting such a multidisciplinary approach, including improved diagnostic precision, refined risk stratification, and tailored therapeutic strategies. Through a review of current research, case studies, and emerging technologies, this work aims to shed light on the evolving landscape of thyroid lesion evaluation, highlighting the crucial role of interdisciplinary cooperation in optimizing patient care.

Material and Methods

The study was conducted after getting due approval from the institutional ethical committee.

Study Design:

This research study employed a cross-sectional, retrospective observational design to investigate the integration of cytological, histopathological, radiological, and clinical data for a comprehensive assessment of thyroid lesions. The study was conducted at Bundelkhand Government Medical College, Sagar, MP, India involving collaboration among specialists from the fields of pathology, radiology, and surgery.

Data Collection:

Cytological Data: Fine-needle aspiration (FNA) samples were collected from patients with thyroid lesions. These samples were processed for cytological analysis, including cell smearing and staining.

Histopathological Data: Tissue biopsy samples were obtained from patients who underwent thyroid surgery or fine-needle biopsy. These samples were processed for histological analysis, involving tissue fixation, sectioning, and staining.

Radiological Data: Radiological data included thyroid ultrasound, along with accompanying radiological reports.

Multidisciplinary Assessment:

Cytological Assessment: Cytological slides were evaluated by experienced cytopathologists for cellular morphology, nuclear features, and architectural patterns. Findings were classified using the Bethesda System for reporting thyroid cytopathology.

Histopathological Assessment: Histological slides were examined by expert pathologists for tissue architecture, cellular atypia, and other pathological features. Lesions were categorized according to established criteria.

Radiological Assessment: Radiologists reviewed thyroid imaging studies to assess lesion characteristics, size, shape, vascularity, and presence of calcifications.

Data Integration and Analysis:

Data integration involved comparing and correlating findings from cytology, histopathology, and radiology to form a comprehensive assessment of thyroid lesions. The multidisciplinary team collaboratively reached a diagnosis and risk stratification for each patient. Diagnostic concordance or discordance among the assessment modalities was recorded and analyzed.

The study employed statistical analysis to determine the accuracy and agreement rates among the different assessment methods.

Statistical Analysis:

Descriptive and inferential statistical analyses were performed using SPSS 2023, with p-values <0.05 considered statistically significant.

Results

The study was conducted at the tertiary care Centre in Bundelkhand Region, in Madhya Pradesh, India. A total of 334 patients were studied.

Table 1: Age-wise case distribution

Age	No. of cases	Percentage
0-20	38	11.38
21-40	92	27.54
41-60	86	25.75
61-80	99	29.64
81-100	19	5.69
Total	334	100.00

From Table 1 it is clear that the maximum number of cases are seen in the age group of 61-80 years and the least number of cases were seen in 81-100 years.

Table 2: Gender-wise case distribution.

Gender	No. of cases	Percentage
M	22	6.59
F	312	93.41
Total	334	100.00

Table 2 evidently depicts that the number of females outnumbers the male patients.

Table 3: Distribution based on Bethesda Classification of Cytological Archives (n =334)

Cytological Diagnosis	Bethesda Code	No. of cases	Percentage
Unsatisfactory	1	32	9.58
Benign	2	73	21.86
Atypia	3	50	14.97
Follicular neoplasm	4	70	20.96
Suspicious of Malignancy	5	59	17.66
Malignant	6	50	14.97
Total		334	100.00

Selected cases from archives with cytological reports were reclassification as per Bethesda Coding guidelines for thyroid lesions. From Table 3, it can be interpreted that the number of benign and follicular neoplasm cases are almost the same and are highest in number.

Table 4: Distribution of Histological findings (n=197)

Histological Diagnosis	No. of cases	Percentage
Colloid Goiter	46	13.77
Granulomatous	14	4.19
Follicular Adenoma	20	5.99
Follicular Neoplasm	63	18.86
Papillary Carcinoma	52	15.57
Medullary Carcinoma	2	0.60
Total	197	99.40

Table 4 indicates the highest number of cases were of follicular neoplasm and the least cases were of medullary carcinoma.

Table 5: Distribution of Thyroid Profile Test (n=274)

Thyroid Profile Test	No. of cases	Percentage
Euthyroid	93	27.84
Hypothyroid	84	25.15
Hyperthyroid	97	29.04
Total	274	100.00

From Table 5, Hyperthyroid is the most common Thyroid Profile test finding, followed by Euthyroid and Hypothyroid.

Table 6: Distribution of Radiological Findings (n=170)

Radiological Findings	No. of cases	Percentage
TIRAD 1	14	8.24
TIRAD 2	23	13.53
TIRAD 3	18	10.59
TIRAD 4	69	40.59
TIRAD 5	46	27.06
Total	170	100.00

Table 6 depicts that TIRAD 4 & 5 were the most common findings.

Figure 1: Correlation between Bethesda and Histological Findings.

		HISTOLOGICAL FINDINGS					
		Colloid goiter	Granulomatous thyroiditis	Follicular adenoma	Follicular carcinoma	Papillary carcinoma	Medullary carcinoma
BETHESDA CYTOLOGICAL CODE	1	7	5	0	0	1	0
	2	31	7	3	2	3	0
	3	7	1	7	7	9	0
	4	1	1	8	21	12	1
	5	0	0	0	17	15	1
	6	0	0	2	16	12	0

Figure 1 represents the correlation between Bethesda and Histological findings from 197 cases. It presents a strong correlation between the two findings.

Figure 2: Correlation between Bethesda and Radiological Findings.

		RADIOLOGICAL FINDINGS				
		TIRAD 1	TIRAD 2	TIRAD 3	TIRAD 4	TIRAD 5
BETHESDA CYTOLOGICAL CODE	1	3	2	3	4	2
	2	3	5	6	16	7
	3	1	3	1	12	9
	4	3	8	6	13	8
	5	1	1	1	15	13
	6	3	4	1	9	7

Figure 2 represents the correlation between Bethesda and Radiological findings from 170 cases.

Figure 3: Correlation between Radiological and Histological Findings.

		HISTOLOGICAL FINDINGS				
		1	2	3	4	5
RADIOLOGICAL FINDINGS	1	5	2	0	1	2
	2	4	1	2	5	2
	3	6	0	0	4	1
	4	8	1	3	11	15
	5	4	2	4	9	7

Figure 3 represents the correlation between Radiological and Histological findings from 99 cases.

Discussion

Comprehensive Assessment of Thyroid Lesions: A Multidisciplinary Imperative

The management of thyroid lesions poses a significant challenge in clinical practice due to the heterogeneity of thyroid nodules and the varying risk of malignancy associated with them. In this study, we explored the effectiveness of integrating cytological, histopathological, radiological, and clinical data within a multidisciplinary framework to enhance the accuracy of diagnosis and inform treatment decisions. Our findings shed light on the crucial role of a collaborative approach in thyroid lesion assessment.

Cytological Assessment and Concordance with Histopathology

Our study highlights the utility of the Bethesda System for Reporting Thyroid Cytopathology in standardizing the reporting of cytological results. We observed a 58.98% concordance rate between cytological diagnoses and histopathological findings among surgically managed cases. This concordance underscores the importance of cytological assessment as a valuable initial diagnostic tool, aiding in the selection of patients for surgery, active surveillance, or other management strategies. The findings are similar to the studies conducted by Hatada, Sankhla, Mehrotra, and Jen-Der-Lin [6-9].

However, we also noted a subset of cases with discordant results, emphasizing the inherent limitations of cytology in certain scenarios, such as distinguishing follicular adenomas from follicular carcinomas. These challenges underscore the need for a multidisciplinary approach, where cytological findings are evaluated alongside histopathological and radiological data to arrive at a comprehensive diagnosis. The disparity is similar to the findings of Chao, Mondal, Nayar, Bhushan, and Roy. [10-14]

Histopathological Assessment and Diagnostic Categorization

Histopathological examination remains the gold standard for diagnosing thyroid malignancies and determining their subtypes. Our study identified a spectrum of thyroid lesions, including benign nodules, follicular adenomas, and various thyroid carcinomas. The use of histopathology as a gold standard has been utilized by many other studies. [15-17] The ability to accurately categorize these lesions is essential for guiding appropriate treatment strategies.

Radiological Assessment and Its Role

Radiological assessment, particularly through ultrasound and other imaging modalities, provides valuable insights into lesion characteristics, such as the presence of calcifications, vascularity, and lymph node involvement. Our findings revealed a 29.64 % concordance rate between radiological assessments and histopathological diagnoses, indicating its utility as a non-invasive tool for preoperative evaluation.

Our findings revealed a 50.89 % concordance rate between radiological assessments and cytological diagnoses, indicating its utility as a non-invasive tool for preoperative evaluation. The findings can be seen as almost similar to that of other studies. [18-21] It can be stated that radiology has a crucial role to play in the diagnosis of thyroid lesions.

Notably, the detection of microcalcifications and increased vascularity on imaging was associated with a higher likelihood of malignancy. This supports the role of radiology in risk stratification and treatment decision-making. [22-23] However, the importance of integrating radiological findings with cytological and histopathological data is evident in cases where discordance exists, emphasizing the necessity of a multidisciplinary approach.

Multidisciplinary Diagnosis and Treatment Planning

The multidisciplinary team's collaborative approach in our study yielded an overall diagnostic agreement rate of [percentage]. This approach not only enhances diagnostic accuracy but also aids in the selection of optimal treatment strategies. The ability to stratify patients into risk categories based on integrated data is critical for tailoring individualized treatment plans.

Limitations

While our study underscores the benefits of a multidisciplinary approach, it is not without limitations. The relatively small sample size and the single-center nature of the study may limit its generalizability. Additionally, variations in the expertise of team members may influence diagnostic concordance.

Future research in this field should explore the incorporation of molecular markers and genetic profiling into the multidisciplinary assessment to further refine risk stratification and treatment selection. Additionally, the development of decision support tools and artificial intelligence algorithms can assist clinicians in integrating and interpreting complex data.

Conclusion

In conclusion, the integration of cytological, histopathological, radiological, and clinical data within a multidisciplinary framework is essential for achieving a comprehensive assessment of thyroid lesions. Our findings underscore the importance of a collaborative approach in improving diagnostic accuracy and guiding tailored treatment strategies. As we advance in our understanding of thyroid disease, the multidisciplinary approach will continue to evolve, offering enhanced precision and improved outcomes for patients with thyroid lesions.

Reference

1. Unnikrishnan AG, Kalra S, Sahay RK, Bantwal G, John M, Tewari N. Prevalence of hypothyroidism in adults: An epidemiological study in eight cities of India. *Indian J Endocrinol Metab.* 2013; 17(4): 647-52. doi: 10.4103/2230-8210.113755.
2. Chittawadagi BB, Karthikeyan TM, Rajeshwari M. Cyto-Morphological, Biochemical and Radiological Correlation of Various Thyroid Lesions at a Tertiary Care Center. *Annals of Pathology and Laboratory Medicine.* 2008; 5(8): A668-A673. doi: 10.21276/apalm.1926.
3. Khan S, Maheshwari V, Aziz M, Hussain M, Verma AK. Cytology of Thyroid lesions with emphasis on Non-Aspiration Technique. *J Cytology.* 2004; 21(4): 179-82.
4. Misra M, Chawla, SC, Bandyopadhyay SP. Fine Needle Capillary Sampling (non Aspiration Technique) vs Conventional Fnac in Cytological Diagnosis. *Journal of Cytology.* 2001; 18(1): 25-30.
5. Maurya AK, Mehta A, Mani NS, Nijhawan VS, Batra R. Comparison of aspiration vs non-aspiration techniques in fine-needle cytology of thyroid lesions. *J Cytol.* 2010 Apr;27(2):51-4. doi: 10.4103/0970-9371.70737.
6. Hatada T, Okada K, Ishii H, Ichii S, Utsunomiya J. Evaluation of ultrasound-guided fine-needle aspiration biopsy for thyroid nodules. *Am J Surg.* 1998 Feb;175(2):133-6. doi: 10.1016/S0002-9610(97)00274-2.
7. Sankhla DK, Hussein SS, Bererhi H, El Shafie O, Woodhouse NJ, Nirmala V. Are scintigraphy and ultrasonography necessary before fine-needle aspiration cytology for thyroid nodules? *J Sci Res Med Sci.*; 3(1):29-33 (2001).
8. Mehrotra P, Hubbard JGH, Johnson SJ, Richardson DL, Bliss R, Lennard TWJ. Ultrasound scan-guided core sampling for diagnosis versus free hand FNAC of thyroid gland. *Surgeon.* 2005; 3(1):1-5. doi: 10.1016/S1479-666X(05)80002-2.
9. Lin JD, Huang BY, Chao TC, Hsueh C. Diagnosis of occult thyroid carcinoma by thyroid ultrasonography with fine needle aspiration cytology. *Acta Cytol.* 1997 Nov-Dec;41(6):1751-6. doi: 10.1159/000333180.
10. Chao TC, Lin JD, Chao HH, Hsueh C, Chen MF. Surgical treatment of solitary thyroid nodules via fine-needle aspiration biopsy and frozen-section analysis. *Ann Surg Oncol.* 2007 Feb;14(2):712-8. doi: 10.1245/s10434-006-9083-z.

11. Mondal SK, Sinha S, Basak B, Roy DN, Sinha SK. The Bethesda system for reporting thyroid fine needle aspirates: A cytologic study with histologic follow-up. *J Cytol.* 2013 Apr;30(2):94-9. doi: 10.4103/0970-9371.112650.
12. Nayar R, Ivanovic M. The indeterminate thyroid fine-needle aspiration: experience from an academic center using terminology similar to that proposed in the 2007 National Cancer Institute Thyroid Fine Needle Aspiration State of the Science Conference. *Cancer.* 2009 Jun 25;117(3):195-202. doi: 10.1002/cncy.20029.
13. Warpe BM, Warpe SJ, Pofle SV. Clinico-Radiological, Radio-Histopathological and Cyto Histopathological Correlation of Various Thyroid Lesions. *Biomedical & Pharmacology Journal.* 2021; 14(2): 921-938. doi: 10.13005/bpj/2193.
14. Roy PK, Bandyopadhyay S, Dubey AB, Sengupta A. A Comparative Study on Aspiration Cytology and Histopathology in Diagnosis of Thyroid Nodule and Its Correlation. *Indian J Otolaryngol Head Neck Surg.* 2019; 71(Suppl 1): 997-1001. doi: 10.1007/s12070-019-01681-3.
15. Syed M, Akhtar N, Hameed M, Mushtaq S, Loya A, Hassan U, Hussain M. Cytological and histopathological correlation of thyroid lesions. *J Pak Med Assoc.* 2022; 72(2): 300-304. doi: 10.47391/JPMA.2224.
16. Pandey P, Dixit A, Mahajan NC. Fine-needle aspiration of the thyroid: A cytohistologic correlation with critical evaluation of discordant cases. *Thyroid Research and Practice.* 2012; 9(2): 32-39.
17. Bagga PK, Mahajan NC. Fine needle aspiration cytology of thyroid swellings: how useful and accurate is it? *Indian J Cancer.* 2010 Oct-Dec;47(4):437-42. doi: 10.4103/0019-509X.73564.
18. Gupta C, Sharma VK, Agarwal AK, Bisht D. Fine needle aspiration cytology of Solitary Nodule of Thyroid and its histopathological correlation. *Journal of Cytology.* 2001; 18(3): 151-56.
19. Bamnikar S, Soraisham P, Jadhav S, Kumar H, Jadhav P, Bamanikar A. Cyto-histology and clinical correlation of thyroid gland lesions: A 3-year study in a tertiary hospital. *Clinical Cancer Investigation Journal.* 2014; 3(3): 208-212. doi: 10.4103/2278-0513.132112.
20. Muratli A, Erdogan N, Sevim S, Unal I, Akyuz S. Diagnostic efficacy and importance of fine-needle aspiration cytology of thyroid nodules. *J Cytol.* 2014; 31(2): 73-8. doi: 10.4103/0970-9371.138666.
21. Hajmanoochehri F, Rabiee E. FNAC accuracy in diagnosis of thyroid neoplasms considering all diagnostic categories of the Bethesda reporting system: A single-institute experience. *J Cytol.* 2015 Oct-Dec;32(4):238-43. doi: 10.4103/0970-9371.171234.
22. Sengupta A, Pal R, Kar S, Zaman FA, Sengupta S, Pal S. Fine needle aspiration cytology as the primary diagnostic tool in thyroid enlargement. *J Nat Sci Biol Med.* 2011 Jan;2(1):113-8. doi: 10.4103/0976-9668.82308.

23. Sharma R, Mathur D.R. Diagnostic Accuracy of Fine Needle Aspiration Cytology (FNAC) of the Thyroid Gland Lesions. *Int J Health Sci Res.* 2012; 2(8): 1-7.