Section: Pathology

Original Research Article

EFFICACY OF FINE NEEDLE ASPIRATION CYTOLOGY IN THE DIAGNOSIS OF NEOPLASTIC THYROID LESIONS IN CORRELATION WITH THE HISTOPATHOLOGICAL DIAGNOSIS – OUR INSTITUTIONAL EXPERIENCE

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Abstract

Background: The present study aims to determine the efficacy of FNAC in thyroid lesions in diagnosing neoplastic lesions, in correlation with histopathological diagnosis. **Materials and Methods:** The present study is a retrospective descriptive study carried out in the pathology department, at a teaching hospital. Thyroid FNACs done during three years (Jan 2020 to Dec 2022) were reviewed by slides and reports. Statistical analysis was done to find out the efficacy of FNAC in diagnosing neoplastic lesions in the thyroid. The thyroid FNAC cases that had undergone surgical management in our institution were included for statistical analysis. The TBSRTC diagnostic categories were correlated with the final histopathological examination (HPE) diagnosis. **Finding:** Of 417 cases of thyroid FNACs, 386 (92.57%) were female and 31 (7.43%) were male, with a female-male ratio of 12.5: 1. The maximum number of cases was in their fourth decade followed by the fifth and sixth decade respectively. The most common TBSRTS DC was II – Benign lesions (79.38%, n- 331), followed by 6.24% (n-26) of DC III, 4.32%(n-18) of DC IV, 3.84% (n-16) of DC I, 3.36% (n-14) of DC V, 2.88% (n-12) of DC VI cases. The total number of FNAC cases that have undergone surgical management was 113 (27.10%). Among them, the frequency of discordant diagnosis is highest in DC III at 57.14%. The next highest frequency of discordant cases was found in DC IV (33.33%). The sensitivity of FNAC for detecting neoplastic thyroid lesions was 65.52%, with specificity being 88.75%, a positive predictive value of 67.86%, and a negative predictive value of 87.65%. diagnostic accuracy of FNAC in neoplastic thyroid lesions was 82.57%. **Conclusion:** It is concluded that FNAC thyroid has good diagnostic accuracy in diagnosing neoplastic lesions. Continuous correlation of cytological diagnoses with histopathology and molecular testing will help to improve diagnostic accuracy.

INTRODUCTION

Fine needle aspiration cytology (FNAC) is an inexpensive, easy, and often done outpatient procedure for evaluating thyroid lesions. The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) established a standardized, category-based reporting system for thyroid fine-needle aspiration (FNA) specimens.[1] TBSRTC recommended six diagnostic categories (DC) from benign to malignant as well as clinical management for each category.

DC I: Nondiagnostic/ unsatisfactory: includes cases inadequate by cellularity, unsatisfactory by quality, and, cyst fluid-only specimens. Management is reaspiration, except for pure cyst.

DC II: Benign: Cytology sample that is adequate for evaluation and consists of colloid and benign-appearing follicular cells. Management is follow-up based on ultrasound pattern.

DC III: Atypia of undetermined significance/ Follicular lesion of undetermined significance (AUS/FLUS): Aspirates with few cells that have distinct but mild nuclear atypia or with more extensive but very mild nuclear atypia. Management is reaspiration or molecular testing

DC IV: Follicular neoplasm/ Suspicious for follicular neoplasm (FN/SFN): Cases with most of the follicular cells arranged in cell crowding or microfollicle formation. Management is diagnostic thyroid lobectomy or molecular testing.

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DC IV: Follicular neoplasm, Hurthle cell type/ Suspicious for follicular neoplasm, Hurthle cell type (FN-H/SFN-H). Management is diagnostic thyroid lobectomy, molecular testing is not helpful.

DC V: Suspicious for malignancy. Used when cytology strongly suggests malignancy but is not sufficient for a conclusive diagnosis. Management is usually by surgery.

DC VI: Malignant. Used when cytology strongly suggests malignancy. Management is usually by surgery.

Using TBSRTC, cytopathologists can communicate their interpretations to the referring clinician in an unambiguous, and clinically useful manner.[1]

The aim of this study is the determination of the efficacy of FNAC in diagnosing neoplastic thyroid lesions, in correlation with histopathological diagnosis.

With this study, probable reasons for false negative or false positive reports in thyroid FNAC could be analyzed. This will aid in a nearly accurate diagnosis of thyroid lesions in FNAC.

MATERIALS AND METHODS

The present study is a retrospective descriptive study carried out in the pathology department, at a teaching hospital. Thyroid FNACs done for the duration of three years (Jan 2020 to Dec 2022) were reviewed by slides and reports. Statistical analysis was done to find out the efficacy of FNAC in diagnosing neoplastic lesions in the thyroid. The thyroid FNAC cases that had undergone surgical management in our institution were included for statistical analysis. The TBSRTC diagnostic categories were correlated with the final histopathological examination (HPE) diagnosis. For calculation purposes, the cases were defined as follows,

True positives (TP) are neoplastic cases diagnosed correctly by FNAC.

False positives (FP) are nonneoplastic cases diagnosed as neoplastic by FNAC

False negatives (FN) are neoplastic cases diagnosed as nonneoplastic in FNAC

True negatives (TN) are nonneoplastic diagnosed as nonneoplastic in FNAC

DC III, IV, V, and VI were considered neoplastic so the HPE diagnosis of neoplastic lesions in these DCs was considered TP. DCII was considered nonneoplastic so the HPE diagnosis of a nonneoplastic lesion in DC II was considered TN. DC I was excluded from the calculation.

RESULTS

Out of 2195 FNACs done during the study period 417 (18.10%) were done for thyroid lesions. Of 417 cases of thyroid FNACs, 386 (92.57%) were female and 31 (7.43%) were male. The female-male ratio was 12.5: 1. The maximum number of cases was in their fourth decade followed by the fifth and sixth decade respectively [Figure 1].

The most common TBSRTS diagnostic category was category II – Benign lesions (79.38%, n- 331), followed by 6.24% (n-26) of DC III, 4.32%(n-18) of DC IV, 3.84% (n-16) of DC I, 3.36% (n-14) of DC V, 2.88% (n-12) of DC VI cases.

The total number of FNAC cases that have undergone surgical management was 113 (27.10%) [Table 1]. There was a 100% correlation with HPE diagnosis for DC VI (malignant). All five cases in DC VI were papillary thyroid carcinoma (PTC). [Figure 2]

Three cases of PTC, one case of anaplastic carcinoma [Figure 3], and one case of follicular carcinoma were diagnosed by HPE in DC V cases (71.43%). The two nonneoplastic cases that were assigned DC V in FNAC were a case of adenomatous hyperplasia and Hashimoto's thyroiditis (28.57%). [Figure 4]

HPE diagnosis in DC IV includes six neoplastic lesions (66.67%) distributed as follows, two follicular adenomas (FA), one minimally invasive follicular carcinoma [Figure 5], one non-invasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP) [Figure 6], and two PTC. Three cases were discordant with the diagnosis of (33.33%) of adenomatous hyperplasia.

In HPE three (42.86%) neoplastic lesions were diagnosed in DC III, including two PTC and one FA. Four multi-nodular goiters (MNG) (57.14%) were diagnosed in DC III cases.

There was an 85.92% positive correlation with HPE diagnosis in DC II. There were only ten discordant cases (14.08%) in DC II. Their HPE diagnosis was three PTC, two papillary microcarcinomas [Figure 7], two NIFTP, one invasive encapsulated follicular variant of papillary thyroid carcinoma (IEFVPTC) [Figure 8], and two FA.

Among the neoplastic lesions in HPE, PTC, and its subtypes account for the majority of cases with a relative frequency of 74.19%, n- 23 [Table 2]. Among these 95.65% (n- 22) were female patients and 4.35% (n-1) was male patient. The maximum number of PTC cases was in the fourth to sixth decade (78.26%, n- 18).

The sensitivity of FNAC for detecting neoplastic thyroid lesions was 65.52%, with specificity being 88.75%, a positive predictive value of 67.86%, and a negative predictive value of 87.65%. The diagnostic accuracy of FNAC in neoplastic thyroid lesions was 82.57%. The false positive rate was 11.25% and the false negative rate was 34.48%.

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Table 1: Correlation of Bethesda diagnostic categories with histopathological examination (HPE)

FNAC results according to Bethesda system diagnostic categories	Nonneoplastic according to HPE	Neoplastic according to HPE	Discordant cases
I -4	2	2	Not applicable
II -81	71	10	10 (14.08%)
III -7	4	3	4 (57.14%)
IV - 9	3	6	3 (33.33%)
V - 7	2	5	2 (28.57%)
VI - 5	0	5	0
Total - 113	82	31	19 (16.81%)

Table 2: Distribution of neoplastic cases in HPE

Papillary carcinoma	**17 (54.84%)**
Papillary microcarcinoma	2 (6.45%)
NIFTP *	3 (9.68%)
IEFVPTC †	1 (3.23%)
Follicular carcinoma	2 (6.45%)
Follicular adenoma	5 (16.13%)
Anaplastic	1 (3.23%)
Total	31

** - non-invasive follicular thyroid neoplasm with papillary-like nuclear features, † invasive encapsulated follicular variant of papillary thyroid carcinoma*

Table 3: Neoplastic lesions in each Bethesda category after HPE diagnosis in various studies

Study done by	DC II	DC III	DC IV	DC V	DC VI
Yaprak BB et al,[8]	-	25%	27.6%	-	-
Machała E et al,[3]	8.33%	17.1%	32.61%	89.51%	91.83%
Muratli A et al,[5]	20.5%	63.2%	87.5%	80%	79%
Hajmanoochehri F et al,[4]	6.9%	50%	37%	81.2%	100%
Present study	14.08%	42.86%	66.67%	71.43%	100%

Table 4: Comparison of the results with previous studies

Authors of the study	Year of the study	Number of patients	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Diagnostic accuracy (%)
Muratli A et al,[5]	2014	126	87.1	64.6	76.1	79.5	77.3
Hajmanoochehri F et al,[4]	2015	101	95.2	68.4	83.3	89.6	85.14
Machała E et al,[3]	2018	1262	60.28	98.05	90.10	89.35	89.46
Singh P et al,[9]	2020	70	83.3	100	100	96.7	95.71
Present study	2022	113	65.52	88.75	67.86	87.65	82.57

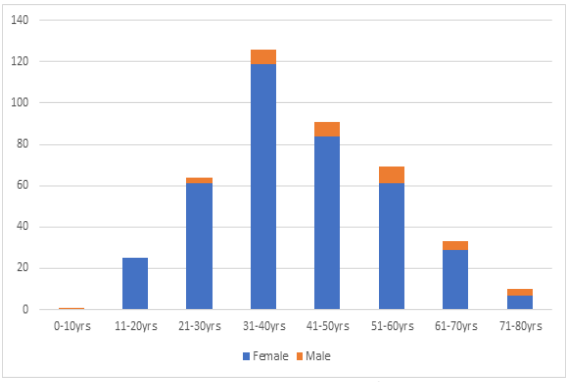

Figure 1: Age and sex wise distribution of thyroid FNA cases

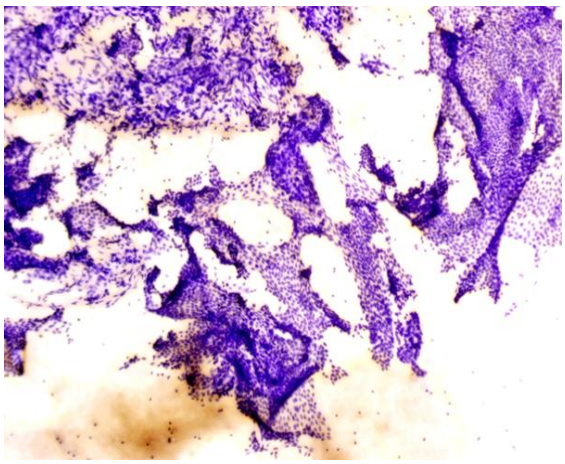

Figure 2: Cytology - (H&E x10) Papillary carcinoma thyroid

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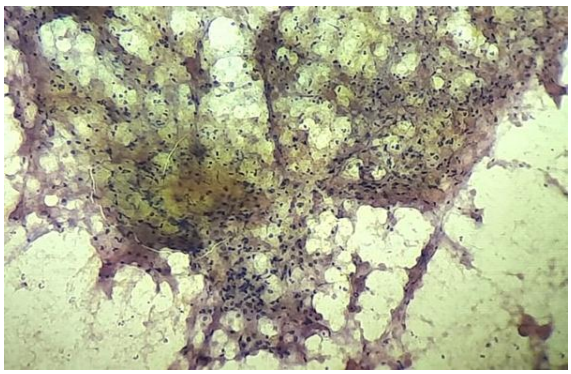

Figure 3: Cytology - (H&E x 10) Anaplastic carcinoma with extensive necrosis and scattered malignant cells

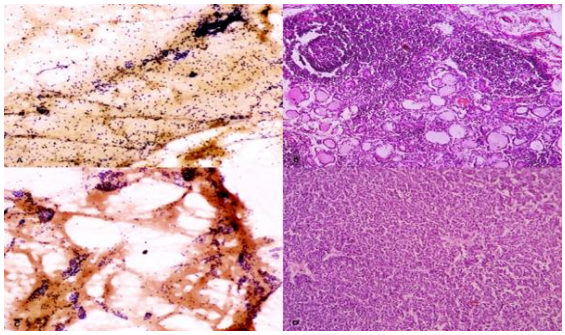

Figure 4: A) Cytology - (H&E x 10) Hashimoto's thyroiditis showing abundant lymphocytic infiltration of thyroid follicles B) HPE - (H&E x10) Hashimoto's thyroiditis showing abundant lymphocytic infiltration of thyroid follicles C) Cytology – (H&E x10) Adenomatous hyperplasia D) HPE – (H&E x10) adenomatoid nodule

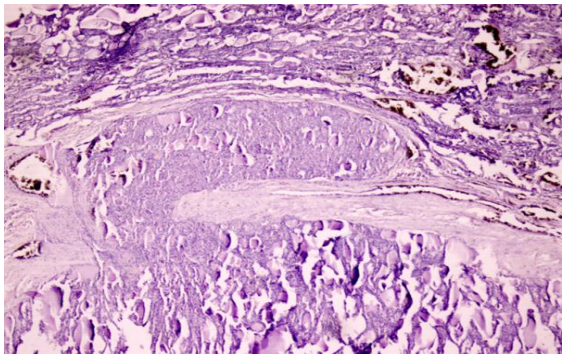

Figure 5: HPE – (H&E x4) Minimally invasive follicular carcinoma showing capsular invasion

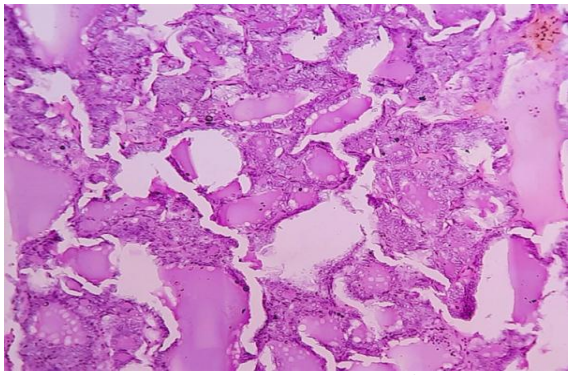

Figure 6: HPE - (H&E x10) Non-invasive follicular thyroid neoplasm with papillary-like nuclear features

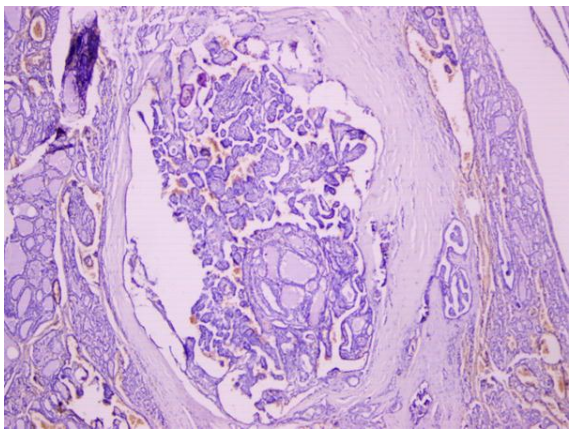

Figure 7: HPE – (H&E x 4) Papillary microcarcinoma

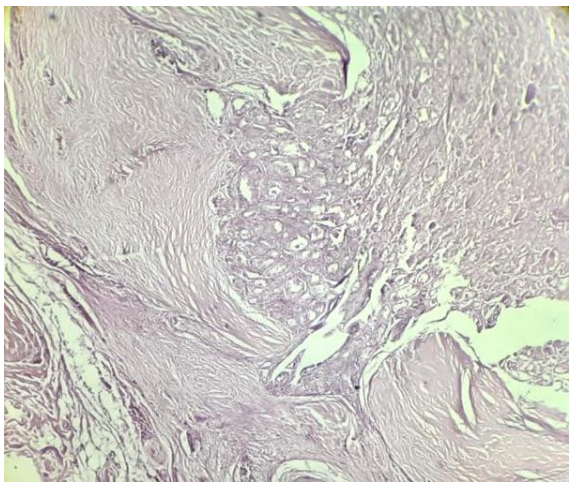

Figure 8: HPE - (H&E x 4) Invasive encapsulated follicular variant of papillary thyroid carcinoma (4X H&E)

DISCUSSION

This present study aims to the determination of the efficacy of thyroid FNAC in diagnosing neoplastic lesions. The maximum number of cases was in the third decade and fifth decade in the similar studies of Rangaswamy M et al,[2] and Machała E.[3] In the present study, the maximum number of cases is in the fourth decade. In the present study, the female-male ratio is 12.5: 1, which is relatively higher than the similar studies of Hajmanoochehri F et al (5.31:1),[4] Rangaswamy M et al (3:1),[2] and Machała E (3.4:1).[3]

Among all thyroid FNACs, the number of DC II (non-neoplastic) is higher (79.38%, n- 331), which is comparable with the results of Muratli A et al (59.5%, n-956).[5] In the study done by Hajmanoochehri F et al non-neoplastic cases accounted for 28.7%, n-101 in FNAC.[4]

Among the cases who underwent thyroidectomy, the frequency of discordant diagnosis is highest in DC III at 57.14%. All four discordant cases in DC III were diagnosed as multinodular goiter in HPE. On reviewing the cytology slides it is found that the high cellularity and indeterminate nuclear features from the aspiration of hyperplastic nodules lead to the categorization into the DC III. Even though

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management for DC III is reaspiration or molecular testing, in our institution surgery has been performed because of concerns regarding the size of the thyroid, long-term follow-up, and economic reasons.

The next highest frequency of discordant cases was found in DC IV (33.33%). Those three discordant cases were adenomatous hyperplasia which was assigned DC IV because of high cellularity and microfollicular pattern.

In DC V one case of Hashimoto's thyroiditis was falsely diagnosed as suspicious for PTC in cytology because of atypical nuclear features.

Out of ten discordant cases in DCII three were PTC in further HPE. In these three cases, the tumour's size ranged between two to three centimetres in the background of MNG. On review of the above cytology slides, it was found that MNG areas were only sampled. Two micropapillary carcinoma cases were missed in FNA sampling due to the tiny size of the lesion. Two cases of NIFTP were misdiagnosed as adenomatous hyperplasia due to microfollicular architecture and subtle nuclear features 6. Ultrasound-guided FNAC technique will reduce the misdiagnosis by targeting the lesion.

PTC is the most common type of thyroid cancer, occurring predominantly in females, in all age groups but most often in the third to fifth decades 7. In the present study among the neoplastic lesions in HPE, PTC and its subtypes account for the majority of cases with a relative frequency of 74.19%, n- 23, and also with female predominance of 95.65%. In the present study, the maximum number of PTC cases was in the fourth to sixth decade.

The relative frequency of neoplasms correctly diagnosed by FNAC is comparable with similar studies in literature [Table 3].

Similar studies in the literature have sensitivity and specificity in the range of 60.28-95.2% and 64.6-100% respectively [Table 4].[3-9] The sensitivity and specificity of FNAC in detecting neoplastic thyroid lesions were 65.52%, and 88.75% respectively in the present study. Diagnostic efficacy is 82.57% in the present study, which is close to the results of Machała E et al (89.46%) and Hajmanoochehri F et al (85.14%).[3,4]

CONCLUSION

Even though FNAC has high diagnostic efficacy in identifying neoplastic thyroid lesions, the following pitfalls must be kept in mind. 1) Unguided FNA technique may lead to non-targeting of the lesion. 2) Cytological features like cellular crowding, and nuclear atypia, may also be seen in some non-neoplastic cases.

Reaspiration in DC III cases could avoid unnecessary surgeries. The experience of the cytopathologist also plays an important role in thyroid FNACs. Continuous correlation of cytological diagnoses with histopathology and molecular testing will help to improve diagnostic accuracy and avoid unwanted surgery.

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