e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2021; 13(1); 100-108

Original Research Article

A Comparative Study of Cytological and Histopathological Findings in Thyroid Swellings

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Received: 03-01-2021 / Revised: 10-01-2021 / Accepted: 27-01-2021

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Conflict of interest: Nil

Abstract:

Background: The thyroid nodules constitute some of the most prevalent conditions within the realm of endocrine disease. The procedure commonly known as Fine Needle Aspiration Cytology (FNAC) is widely employed as an initial diagnostic tool due to its simplicity, speed, affordability, and low risk. Histopathology still represents the benchmark against which the reliability of any other form of diagnosis must be gauged, thus necessitating the correlation between the two.

Aim: To find out the relationship between cytology and histopathology in cases of thyroid enlargements and the accuracy of Fine Needle Aspiration Cytology (FNAC).

Methodology: The study is a prospective and observational study that was carried out at the Department of Pathology, Gouri Devi Institute of Medical Sciences and Hospital, Durgapur, West Bengal, India for a duration of one year. The total number of patients with thyroid swelling who underwent FNAC and histopathological diagnosis were 160. Data were obtained from clinical assessment, cytological findings, and histopathological diagnoses. Sensitivity, specificity, PPV, NPV, and accuracy were determined through histopathology as the gold standard.

Results: Most patients were from the 31 to 40 years old age category, and there was a distinct gender imbalance since females made up 81.9% of all subjects. The colloid goiter was the most commonly encountered cytologic diagnosis (43.1%), and similarly, it was the most common histopathological condition (40.6%). Hashimoto lymphocytic thyroiditis was another significant pathological finding in our sample population, while the papillary carcinoma was the commonest malignant thyroid condition detected by both cytology (10%) and histopathology (13.1%). FNAC had very high diagnostic capabilities with sensitivities, specificities, positive predictive values, negative predictive values, and accuracies of 91.3%, 95.6%, 87.5%, 97.1%, and 94.

Conclusion: This study shows a significant correlation between cytology and histopathology in thyroid swellings. Fine needle aspiration cytology showed a great degree of reliability, safety, non-invasiveness, and cost-effectiveness as a diagnostic method for the assessment of thyroid lesions prior to surgery. The high accuracy of diagnosis achieved in this study validates the use of fine needle aspiration cytology in distinguishing benign from malignant thyroid lesions.

Keywords: Thyroid swelling, Fine Needle Aspiration Cytology, Histopathology, Cytological correlation, Thyroid lesions, Papillary carcinoma

Introduction

Thyroid swellings constitute one of the frequently seen endocrinological diseases in clinics and pose a serious worldwide public health problem owing to their rising incidence rate and varied pathological features [1]. Lesions of the thyroid gland may appear as diffuse, solitary, multinodular, inflamed, benign growths, or malignant tumors. However, despite being more often benign, differentiation between benign and malignant thyroid swellings represents a significant diagnostic problem. Rapid detection is crucial since the malignant form of thyroid pathology can be quite aggressive and demands immediate therapy.

Thyroid hormones are secreted by the thyroid gland and play a vital part in the regulation of metabolism, growth, development, and endocrine balance [2]. The existence of any abnormality related to structure or functioning of the thyroid gland can

cause various clinical signs like neck enlargement, difficulty swallowing, hoarse voice, hormonal imbalance, and metabolic problems. There is an increased frequency of occurrence of thyroid disease in women. In addition, people in their thirties and forties are more prone to develop thyroid lesions.

Fine Needle Aspiration Cytology (FNAC) has gained the status of a gold standard diagnostic method in the investigation of thyroid swellings owing to its non-invasiveness, affordability, quick results, and relatively easy performance [3]. It provides pre-operative evaluation of the nodule of the thyroid gland and helps distinguish between benign and cancerous diseases. The common application of FNAC has led to a marked decrease in the number of thyroid surgery interventions performed since it helps determine benign cases requiring conservative management and cases requiring surgery [4].

While there are many benefits to FNAC, there are also certain disadvantages that come along when dealing with certain thyroid lesions, such as follicular-type thyroid lesions [5]. In cases where it is difficult to distinguish between follicular adenoma and follicular carcinoma, FNAC can be challenging due to the fact that both of these diagnoses require histopathology showing invasion of capsules or vessels. Improper collection of specimens, cystic changes, and wrong interpretation may cause incorrect results [6].

Histopathological analysis provides knowledge about the structure and cellular composition [7]. This helps to confirm the reality of abnormalities of the thyroid gland. Cytology versus histopathology has been proved to be highly relevant in assessing the accuracy of fine needle aspiration biopsy of the thyroid gland. Correlation studies help identify discrepancies and improve the efficacy of cytological diagnosis [8].

There is an evident increase in the number of people suffering from thyroid nodules due to an increased usage of diagnostic tools such as ultrasonography and CT scanning [9]. Research estimates that the palpation of thyroid nodules takes place among approximately 4 to 7 percent of adults, while ultrasound can diagnose thyroid nodules in about 50 percent of patients. Thyroid cancer too has been on the rise throughout the world, especially the type known as papillary thyroid carcinoma, which is the most common form of thyroid malignancy [10]. It must be noted that most thyroid nodules are usually benign in nature.

The presence of thyroid swellings places an enormous burden on the patients who suffer from such abnormalities [11]. Patients are usually concerned about their physical appearance due to neck swelling, the chances of developing cancerous disease, the possible need for surgery, and other factors that have an impact on patients' quality of life and mental condition [12]. The delayed diagnosis and improper approach to the problem can lead to the further development of the disease, which will be accompanied by serious complications [13].

Several studies carried out among various population groups have found a high level of sensitivity and specificity for FNAC in the diagnosis of thyroid nodules, although there are differences depending on the adequacy of sampling, level of technical skill, and criteria for diagnosis [14]. Continuous assessment of correlation between cytology and histopathology is thus important.

The purpose of the current study is to determine the relationship between the results of cytology and histopathology in patients with thyroid swelling and the effectiveness of fine needle aspiration cytology as a diagnostic tool [15]. This study seeks to add to the existing literature on the utility of FNAC in the diagnosis of thyroid lesions.

Methodology

Study Design: The study is an observational study with a prospective design intended to establish a relationship between cytology and histopathology of thyroid masses. The study mainly focused on collecting and analyzing data on patients with thyroid masses based on their clinical, cytological, and histopathological features to determine the effectiveness of FNAC as a diagnostic method. The reason for selecting a prospective study design was justified since the study entailed examining thyroid masses over a period of time.

Study Area: This study was conducted at the Department of Pathology of Gouri Devi Institute of Medical Sciences & Hospital, Durgapur, West Bengal, India.

Study Duration: This study was conducted for a period of one year.

Study Participants

Inclusion Criteria

- Patients having clinically diagnosed swellings of the thyroid gland at the study site.
- Patients undergoing FNAC and subsequent histopathological analysis.
- Patients visiting either outpatient or inpatient facilities within the study period.
- Patients who are willing to take part in the study.

Exclusion Criteria

- Patients with poor-quality or suboptimal cytology preparations.
- Patients without surgery or histopathologic evaluation.
- Patients with recurrent thyroid pathology.

- Patients with incomplete medical histories or pathologic records.

Sample Size: The total number of patients that qualified for the study was 160. The selection process of the specimens was done in such a way that the samples represented both benign and malignant tumors of the thyroid gland.

Procedure: The patients having thyroid enlargement were clinically examined, and the demographic and clinical characteristics of the patient were noted with the help of a questionnaire. Fine-needle aspiration cytology was performed using a 23–24-gauge needle. Smears made from the aspirated sample were stained according to the May-Grunwald Giemsa and Papanicolaou stain technique. The diagnoses were grouped into either non-neoplastic or neoplastic lesions of the thyroid gland based on conventional cytological criteria.

Surgical interventions followed for the patients based on clinical indications. The surgical specimens were subjected to fixation in 10% formalin followed by routine processing for histopathological study. The sections thus obtained were stained with hematoxylin and eosin staining technique. The cytology results were compared with their histopathological counterparts to arrive at the efficiency of FNAC in diagnosis. All patient data were kept confidential, and ethical clearance was obtained from the Institutional Ethics Committee of the concerned hospital.

Statistical Analysis: The obtained results were processed in SPSS version 26.0 (IBM, USA). For categorical data, frequency and percentage were computed as descriptive statistics. Sensitivity, specificity, positive and negative predictive values, and accuracy of FNAC were estimated based on the gold standard, which included histopathological diagnosis. Associations of cytological diagnosis with histopathological one was also analyzed statistically. Statistical significance was set at $p<0.05$.

Result

Table 1 shows the demographics of the 160 patients with thyroid swellings. In terms of the age range, the most frequent occurrence was among patients in the age range of 31-40 years, making up 51 patients (31.9%), followed by patients in the age range of 21-30 years, which made up 40 patients (25%). The next age range was 41-50 years, consisting of 32 patients (20%), followed by 11-20 years old with 18 patients (11.3%). There were fewer occurrences for patients older than 60 years, which made up five patients (3.1%). In terms of gender distribution, there was a dominance of females, with 131 patients (81.9%) compared to 29 males (18.1%). With regards to the duration of the thyroid swelling, 72 patients (45%) reported having swelling for one to three years, 48 patients (30%) reported a duration of less than a year, 28 patients (17.5%) reported 4-6 years, and finally, 12 patients (7.5%) reported more than six years of duration. Figure 1 provides the demographic profile of the study population.

Table 1: Demographic Characteristics of Study Participants

Parameter	Category	Frequency (n)	Percentage (%)
Age (years)	11–20	18	11.3
	21–30	40	25.0
	31–40	51	31.9
	41–50	32	20.0
	51–60	14	8.8
	>60	5	3.1
Gender	Male	29	18.1
	Female	131	81.9
Duration of Swelling	<1 year	48	30.0
	1–3 years	72	45.0
	4–6 years	28	17.5
	>6 years	12	7.5

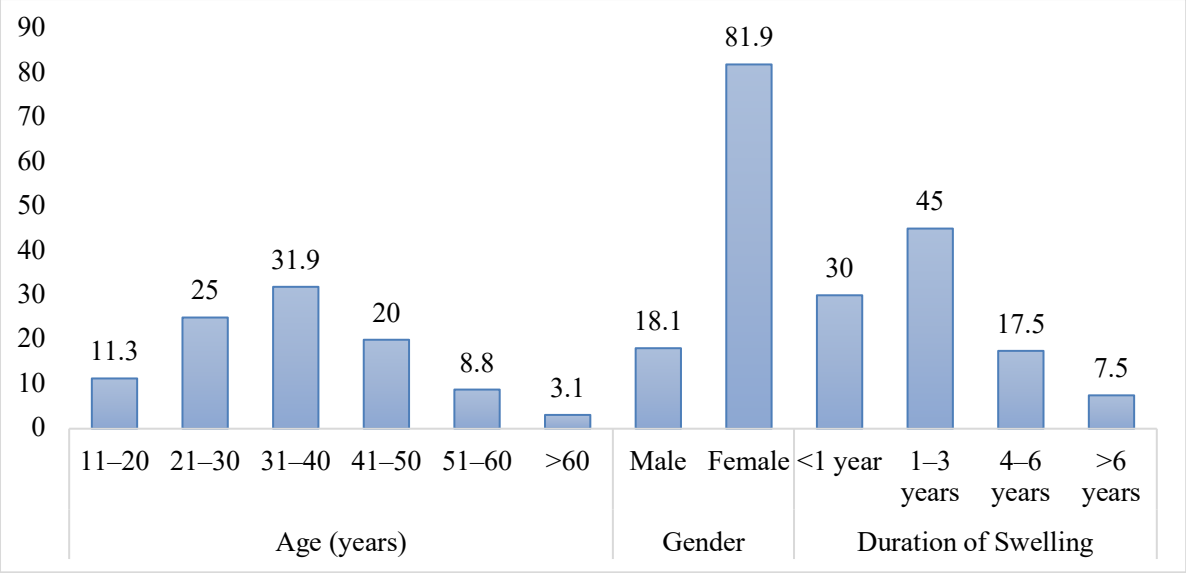

Figure 1: Visual Representation of Demographic Characteristics of Study Participants

These results show that thyroid enlargements were more common in people who were between 30-40 years old, meaning that thyroid problems are common in the working population. The high prevalence of females seen in the current study could be explained by the well-known fact that thyroid lesions are more common in females, which can be attributed to their hormonal changes and autoimmune response. Since most patients have presented themselves to the hospital within one to three years from the time they first noticed the problem, it means that thyroid enlargements take a long period to develop and become significant enough for them to consult a doctor. Since the low prevalence of thyroid enlargements in the elderly population could be explained by either the low incidence or failure to report the illness, it could mean that the lesions affect young people more than elderly persons.

Table 2 shows the cytological diagnosis of the thyroid lesions based on FNAC examination results from the 160 patients that were studied. The most common thyroid lesion was the colloid goiter, which occurred in 69 patients or 43.1% of the total subjects. The second most common lesion was lymphocytic thyroiditis, seen in 29 patients (18.1%). Nodular goiter and follicular neoplasm both occurred in 18 patients or 11.3%. There were 16 patients (10%) with papillary carcinoma, which was the most common malignant thyroid lesion found to be cytologically. Other rare thyroid lesions included the Hurthle cell lesion in 5 patients (3.1%), medullary carcinoma in 3 patients (1.9%), and anaplastic carcinoma in 2 patients (1.3%). Figure 2 provides a visual representation of the results.

Table 2: Cytological Diagnosis of Thyroid Lesions

Cytological Diagnosis	Frequency (n)	Percentage (%)
Colloid Goiter	69	43.1
Lymphocytic Thyroiditis	29	18.1
Nodular Goiter	18	11.3
Follicular Neoplasm	18	11.3
Papillary Carcinoma	16	10.0
Hurthle Cell Lesion	5	3.1
Medullary Carcinoma	3	1.9
Anaplastic Carcinoma	2	1.3

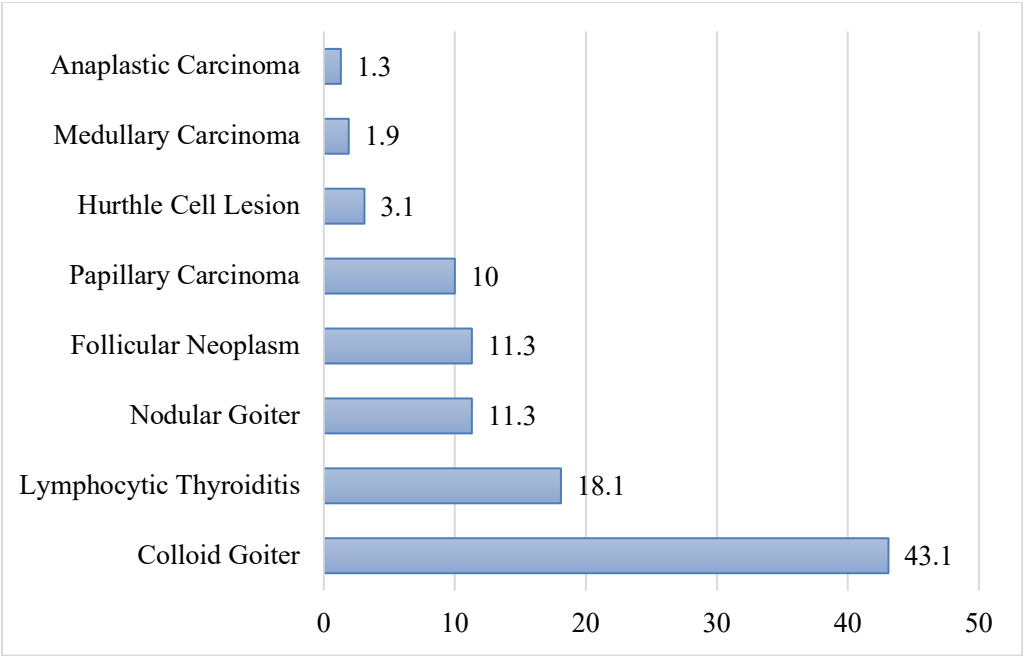

Figure 2: Visual Representation of Cytological Diagnosis of Thyroid Lesions

Cytological findings show that benign thyroid masses were the commonest types of thyroid masses, while colloid goiter was the most common type of mass. The above observation highlights the common occurrence of non-neoplastic diseases of the thyroid, particularly in regions where iodine deficiency or nodular thyroid is prevalent. As observed from the results, there is a high prevalence of lymphocytic thyroiditis, indicating that there is a substantial number of autoimmune thyroid disease cases in the subjects. In the case of malignant masses, papillary carcinoma was the most common type of mass. Papillary carcinoma is widely recognized as the most common type of thyroid cancer worldwide. Medullary and anaplastic carcinomas were less common, indicating that they are rare clinical cases.

As shown in Table 3, the histopathological classification of thyroid diseases in the 160 patients included in this study based on surgery thyroid tissue examination is presented. The most common histopathological classification of thyroid disease was colloid goiter, which was present in 65 patients (40.6%). In addition, 26 patients had Hashimoto thyroiditis (16.3%), while 20 patients had multinodular goiter (12.5%). The most prevalent type of malignancy as a neoplasm was papillary carcinoma, which affected 21 patients (13.1%). Follicular adenoma was present in 14 patients (8.8%), and follicular carcinoma was detected in seven patients (4.4%). Medullary carcinoma was observed in four patients (2.5%), and anaplastic carcinoma was seen in three patients (1.9%).

Table 3: Histopathological Diagnosis of Thyroid Lesions

Histopathological Diagnosis	Frequency (n)	Percentage (%)
Colloid Goiter	65	40.6
Multinodular Goiter	20	12.5
Hashimoto Thyroiditis	26	16.3
Follicular Adenoma	14	8.8
Papillary Carcinoma	21	13.1
Follicular Carcinoma	7	4.4
Medullary Carcinoma	4	2.5
Anaplastic Carcinoma	3	1.9

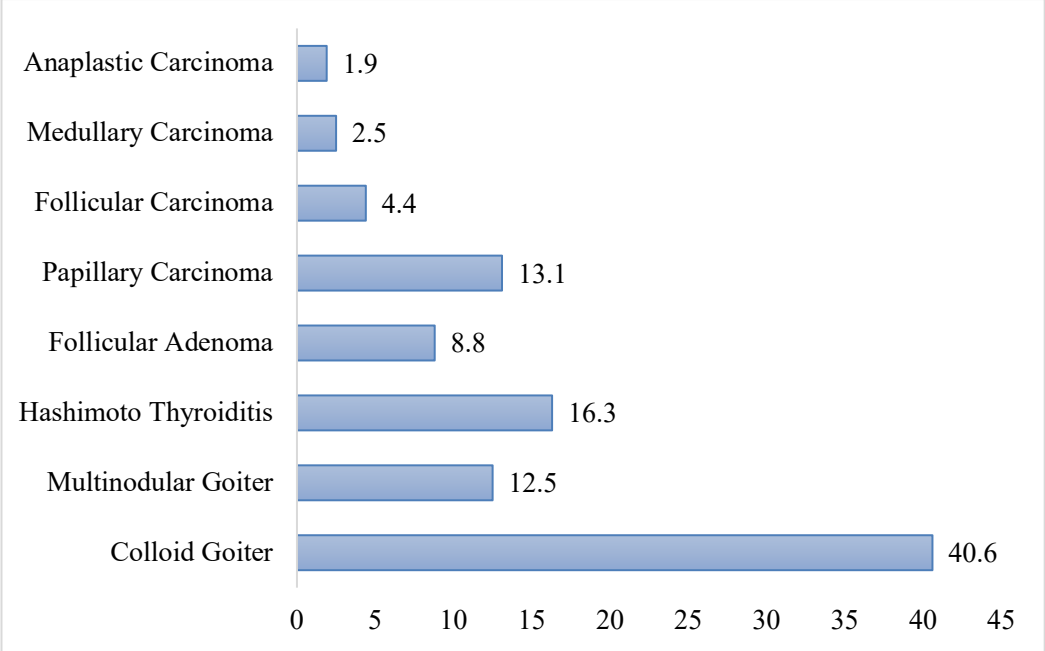

Figure 3: Visual Representation of Histopathological Diagnosis of Thyroid Lesions

The histopathology findings reveal that benign diseases of the thyroid made up a big proportion of the total thyroid lesions encountered among the subjects, with colloid goiter representing the most prevalent condition. This finding is consistent with the generally acknowledged fact that benign growths of the thyroid gland occur more frequently than the malignant cases. The relatively high frequency of Hashimoto thyroiditis highlights the role of autoimmunity pathologies among the thyroid gland-related diseases. Papillary carcinoma emerged as the most common form of malignancy of the thyroid gland, thereby confirming the worldwide trend of prevalence of different types of thyroid gland malignancies. The presence of both follicular adenoma and carcinoma highlights the necessity for histopathological examinations in order to diagnose follicular lesions because such diagnoses cannot be made exclusively through cytology. The relatively low prevalence of medullary and anaplastic carcinomas highlights the rarity of these cases but also highlights the need to make correct diagnosis due to the aggressiveness of these malignancies.

Table 4 highlights the effectiveness of Fine Needle Aspiration Cytology (FNAC) as an examination process to detect any pathological states present in the thyroid gland through the cytology diagnosis process compared with the histopathological findings. It can be seen that the sensitivity of FNAC was 91.3%. Hence, it can be said that its effectiveness in diagnosing thyroid malignancies was very high. It was further noted that its specificity was 95.6%, thereby making it accurate in diagnosing any benign states of the thyroid gland. The positive and negative predictive values were 87.5% and 97.1%, respectively, suggesting that FNAC is highly efficient in eliminating cases of malignancy when negative test results are obtained. Overall accuracy of FNAC in this study was 94.4%. Figure 4 demonstrates the performance indices of FNAC.

Table 4: Diagnostic Efficacy of FNAC in Thyroid Lesions

Parameter	Value (%)
Sensitivity	91.3
Specificity	95.6
Positive Predictive Value	87.5
Negative Predictive Value	97.1
Diagnostic Accuracy	94.4

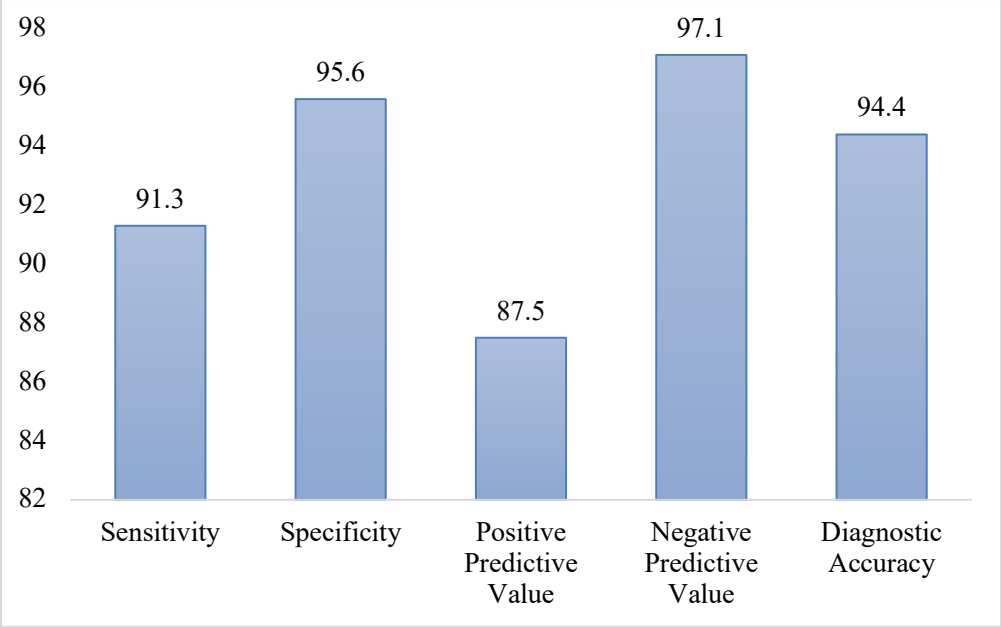

Figure 4: Visual Representation of Diagnostic Efficacy of FNAC in Thyroid Lesions

These results confirm that FNAC represents an extremely reliable and effective method for the investigation of thyroid masses. High sensitivity of FNAC revealed by our study proves its ability to reliably diagnose almost all malignant thyroid tumors, which contributes to their early detection and subsequent surgery. Likewise, the high specificity of the test demonstrates a low proportion of incorrect positive results, which reduces the frequency of performing unnecessary surgical procedures due to false diagnoses. The very high negative predictive value also confirms the reliability of this method since it proves that patients with negative results of cytological examination do not have a disease. Finally, a high accuracy of 94.4% testifies to the consistency of cytohistological data, which supports the common practice of conducting FNAC for thyroid masses prior to surgery.

Discussion

This current research analyzed the relationship between cytopathological and histopathological findings of thyroid swellings and the effectiveness of FNAC as a diagnostic tool for thyroid swellings in a tertiary healthcare center setting (Banu, 2012) [16]. From the demographic characteristics results, it is evident that there was a tendency of occurrence of thyroid swellings among individuals aged between third and fourth decades with a greater tendency among females. This observation has been made by several researchers who have established that there was greater incidence of thyroid diseases among females due to hormonal factors. Most of the patients had a history of thyroid swelling duration of 1-3 years. It is, therefore, clear that these are slowly developing conditions whose patients seek treatment when there is clinical manifestation (Rout, Ray, Behera, & Biswal, 2011) [17].

The results obtained from the cytological and histopathological studies of the current research showed that benign thyroid diseases were the most common type of thyroid swelling. Colloid goiter was the commonest benign lesion in FNAC and histopathology, while lymphocytic or Hashimoto thyroiditis was the second most common lesion (Kumar, 2009) [19]. This result is in agreement with the existing evidence which suggests colloid goiter as the commonest type of thyroid lesion, especially in areas where there is a high incidence of iodine imbalance or nodular thyroid disease. In the malignant lesions category, papillary carcinoma was the commonest thyroid malignancy both from FNAC and histopathological diagnosis, reinforcing its recognition as the commonest type of thyroid malignancy. Follicular patterned lesions such as follicular adenoma and follicular carcinoma were also noted to be common in the research, which is a reflection of the difficulty in making FNAC diagnoses of follicular lesions owing to the inability of capsule or vascular involvement assessment using FNAC. Medullary and anaplastic carcinomas were less common, due to their rare occurrence (Rathod & Parmar, 2012) [19].

The results of this study have revealed high sensitivity, specificity, positive predictive value, negative predictive value, and total diagnostic accuracy of FNAC. These results match those of previous researches done to determine the usefulness of FNAC in diagnosing thyroid lesions. High sensitivity implies that FNAC is highly sensitive in the detection of malignancies, hence facilitating prompt surgical intervention for malignant cases. In addition, high specificity of FNAC in this study implies low risk of false-positive diagnoses hence no unnecessary surgeries on benign lesions. Ex-

tremely high negative predictive value also implies that a benign diagnosis by FNAC is reliable and therefore capable of ruling out any malignancy (García-Pascual et al., 2011) [20]. High concordance rate in this study between the cytopathological diagnosis and the histopathological findings makes FNAC a reliable diagnostic tool for use before surgery of thyroid swellings because it is non-invasive, cheap, rapid and safe. Nonetheless, histopathological investigation is crucial for conclusive diagnosis especially when dealing with follicular-patterned lesions.

Conclusion

The current study revealed that there is a good correlation between the cytology and histopathology findings of thyroid swellings, and hence the important diagnostic role of Fine Needle Aspiration Cytology in thyroid lesions is evident. Thyroid swellings occurred mostly in women during the third and fourth decades of life, and mainly consisted of benign tumors like colloid goiter and Hashimoto thyroiditis. The papillary carcinoma was the most common malignant thyroid tumor encountered both cytologically and histopathologically. High sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were observed for FNAC, making it a reliable, minimally invasive, and fast method of diagnosing thyroid conditions. Thus, based on the findings of this study, one may conclude that FNAC is quite a vital test to differentiate benign from malignant thyroid conditions and thus prevent unnecessary surgeries. Histopathology is still the best way for diagnosing, particularly follicular-patterned and suspicious thyroid nodules.

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