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Original Research Article

Efficacy of Fine Needle Aspiration Cytology in the Analysis of Thyroid Swellings with Histologic Correlation in Tertiary Care Hospital of Central Rajasthan

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Abstract

Introduction: In the human body, the thyroid is frequently the source of illness. In these situations, fine needle aspiration cytology is a quick, effective, affordable, and secure diagnostic technique. It makes it possible to make surgical decisions with greater precision than any other way. It enables the doctor to make a diagnosis in the majority of cases with the least amount of time and money spent, and frequently without the need for unneeded surgery. It is an important tool in the diagnosis and treatment of patients with thyroid lesions because it has high rates of sensitivity and positive predictive value in identifying thyroid lesions.

Methodology: (1) In the current investigation, 704 thyroid FNA cases were analysed, and wherever possible, cyto-histopathological connection was interpreted. (2) Where histopathological correlation was available, all thyroid lesions that were conventionally diagnosed by FNA were classified according to TBSRTC and assessed for the risk of malignancy.

Results: A total of 704 thyroid swelling cases were examined for this investigation. Out of these 704 cases, FNAC determined that 626 cases were non-neoplastic lesions, 6 cases were suspect of malignancy, and 72 cases were neoplastic lesions. 125 of the 704 patients underwent follow-up biopsies and histological analysis. The sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of the FNAC in the current investigation were 72.2%, 99.06%, 92.86%, 95.49%, and 95.2% respectively.

Keywords: Fine needle aspiration cytology; cyto-histopathological correlation; TBSRTC (The bathesda sytem for reporting thyroid cytopathology); sensitivity; specificity; diagnostic accuracy.

Background

One of the common conditions seen in clinical practise are thyroid lesions. The diseases of thyroid are of great importance because most of them are amenable to medical or surgical treatment [1]. Making an appropriate diagnosis only based on a clinical evaluation is frequently challenging. Therefore, to aid in proper diagnosis, Fine Needle Aspiration Cytology (FNAC) investigation of such lesions is stressed along with clinical evaluation.

The evolution of important scientific contribution in medicine requires both the elixir of time and synthesis of a number of observations.There are additional social and economic considerations that influence the ultimate acceptance of medical facts and development of medical procedures. The history of aspiration biopsy was influenced by such factors. The roots of FNAC can be traced to Scandinavian countries [2].

Cytological diagnosis of thyroid nodules by fine-needle aspiration has become the standard of care. It was after World War II, articles started appearing in the medical literature stating that the incidence of thyroid cancer of the entire nodular goitre population in surgically removed thyroid nodules was 20% to 30% [3,4]. Within the general population, palpable thyroid nodules are present in 4% to 7% of adults and subclinical (nonpalpable) nodules are present in up to 70% of individuals. Of these thyroid nodules, 90% to 95% are benign [5].

Use of fine needle aspiration to procure tissue for microscopic diagnosis is almost 100 years old. In 1904 Greig and Gray reported that trypanosomal organisms could be detected in needle aspiration material from lymph nodes in a patient with sleeping sickness. In 1934 that Martin and Ellis reported a large series of tumors diagnosed by FNA [6].

Fine-needle aspiration cytology of the thyroid was described by N. Soderstrom in 1952 and has been generally available since the 1970s [7]. From then on, FNA enjoyed an increasing popularity in many countries, as the technique proved to be a highly accurate and cost-effective procedure with low morbidity. During the 1960s FNA became a standard procedure in Sweden not only for the thyroid but for all palpable lumps in the body [8].

By late 1970s, the Canadians had reported experience with fine-needle biopsy and [9] groups in Cleveland and Boston had evaluated large-needle biopsy [10,11]. The first American study combining both was reported in 1979 [12].

The major impetus in the development of the needle aspiration biopsy was provided by physicians from two institutions – "The memorial center for cancer and allied diseases" in New York and the "Karolinska Institute" in Stockholm, Sweden.

The present study aims at diagnosing various thyroid diseases based upon cyto-morphological features in FNAC and wherever possible with its histopathological correlation, which is the gold standard. Also, the study is intended to evaluate the sensitivity and specificity of fine needle aspiration procedure. We classified all thyroid lesions which were conventionally diagnosed by FNA according to TBSRTC (The bathesda sytem for reporting thyroid cytopathology) and evaluated the risk of malignancy retrospectively where histopathological correlation was available.

Methodology

The present study was undertaken to analyze the role of fine needle aspiration cytology in the cytomorphological features of various thyroid lesions with histopathological correlation wherever the surgery was done and to determine its

diagnostic accuracy and to classify all the fine needle aspiration performed thyroid lesions according to TBSRTC. Study was performed for a period of 2 years from 1st June 2020 to 31st May 2022 retrospectively in the Department of Pathology at a Tertiary care hospital in Rajasthan. History and clinical details of all cases were noted already.

In the current investigation, the patient was instructed to lie on his or her back with the head and neck supported by a pillow. The amount of extension shouldn't cause skin tension that prevents older people from palpating nodules or partially blocks vertebral artery blood flow. The needle puncture site was cleansed by wiping an alcohol wipe over it.

Syringe- 10 or 5 mL syringes were used.

Needle- Use of a 21 gauge needle in the current investigation.

To and fro movements of the needle into the nodule were performed for nodules 1.5 cm or smaller. Larger nodules were taken from the periphery of the nodule rather than its centre. In the current investigation, a minimum of three passes were completed. Every time fluid was retrieved, it was aspirated and centrifuged to remove all of the contents.

After aspiration, the plunger is retracted and the needle is taken out.

The specimen is expressed onto the slide, the needle is reattached, and the edge of another slide is used to spread the specimen.

Smears were made from the sediment in the case of a cystic nodule that had been entirely emptied.

Fixation and staining- 95% ethyl alcohol was used to fix the samples for the Papanicolaou (Pap) and Haematoxylin and Eosin (H&E) stains.

Slides for the Leishman stain were air dried.

When the surgery was done, the received specimens were fixed with 10% formalin and detailed gross examination was done and sections were taken from the representative areas for paraffin sections and stained by H &E. The sections were studied under light microscopy.

Cytological diagnosis was correlated with histopathology whenever thyroidectomies were available.

Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of FNAC, relative to the final histological diagnoses was calculated using the following formulas.

For classification of lesions following classification was used.

The Bethesda Classification System for Reporting Thyroid Cytopathology (TBSRTC): 6 diagnostic categories [14].

I. Nondiagnostic or Unsatisfactory

-Cyst fluid only

-Virtually acellular specimen

-Other (obscuring blood, clotting artifact, etc.)

II. Benign

- Consistent with a benign follicular nodule (includes adenomatoid nodule, colloid nodule, etc.)

- Consistent with lymphocytic (Hashimoto's) thyroiditis in the proper clinical context

- Consistent with granulomatous (subacute) thyroiditis

- Other

III. Atypia of Undetermined Significance or Follicular Lesion of Undetermined Significance

IV. Follicular Neoplasm or Suspicious for a Follicular Neoplasm

- specify if Hürthle cell (oncocytic) type

V. Suspicious for Malignancy

- Suspicious for papillary carcinoma
- Suspicious for medullary carcinoma
- Suspicious for metastatic carcinoma
- Suspicious for lymphoma
- Other

VI. Malignant

- Papillary thyroid carcinoma
- Poorly differentiated carcinoma
- Medullary thyroid carcinoma
- Undifferentiated (anaplastic) carcinoma
- Squamous cell carcinoma
- Carcinoma with mixed features (specify)
- Metastatic carcinoma
- Non-Hodgkin lymphoma
- Others

Results

The Department of Pathology received referrals for the study from the Departments of Surgery, Medicine, and ENT for FNA procedures on 704 patients who had a history of swelling in front of the neck.

The age, sex, clinical presentation, and ultrasound imaging features of the patients were among the numerous study parameters. The thyroid lesions were subsequently analysed for cytomorphological characteristics and categorised in our institute using the accepted procedure. Thyroidectomies might be used for histopathological correlation in 125 cases. We compared FNA diagnosis to confirming histopathology diagnosis. The Bethesda approach was subsequently used to categorise these thyroid lesions that had been conventionally diagnosed.

In the present study, the following parameters were studied:

1. Age

Table 1: Table showing age distribution of thyroid lesions in FNAC:

Age (years)	No of patients	%
<20	61	8.66
21-30	169	24.00
31-40	199	28.26
41-50	140	19.89
51-60	84	11.93
61-70	40	5.68
>70	11	1.56
Total	704	100

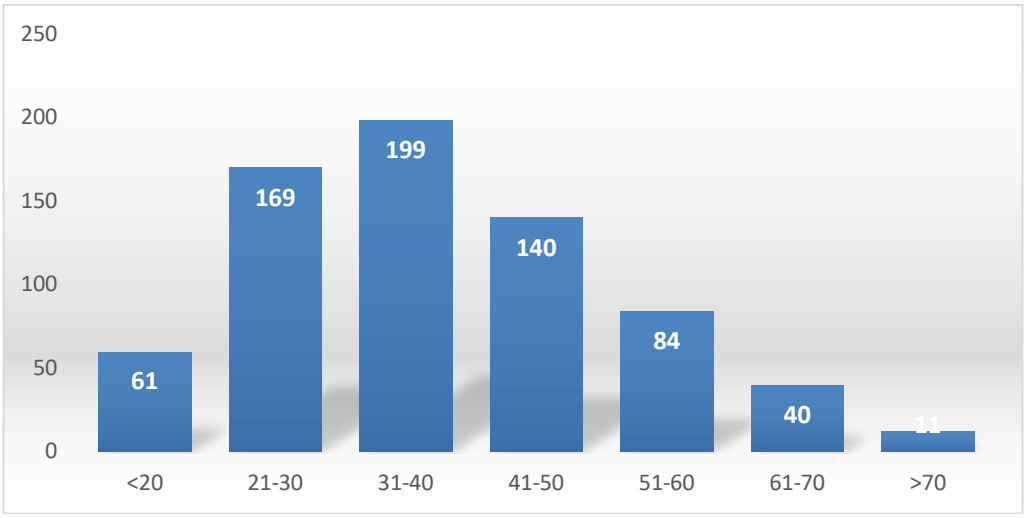

Figure 1: Graph showing age distribution of thyroid lesions in the present study:

2. Sex

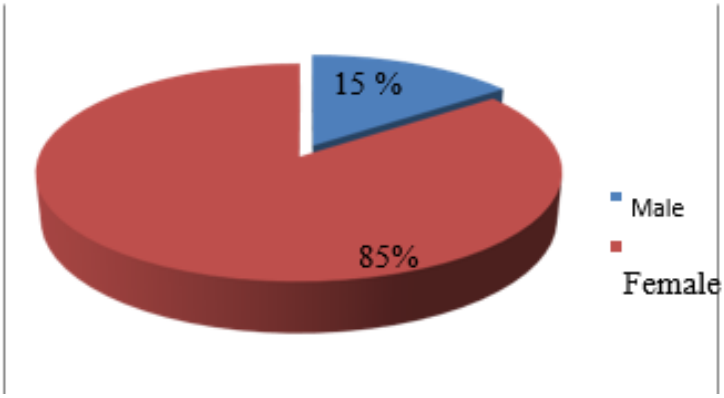

Figure 2: Graph showing sex distribution of thyroid lesions:

The male to female ratio was 1:5, with 85% of the patients being female and 15% being male.

3. Clinical presentation

Clinically, diffuse, right, and left lobe thyroid swellings were separated.

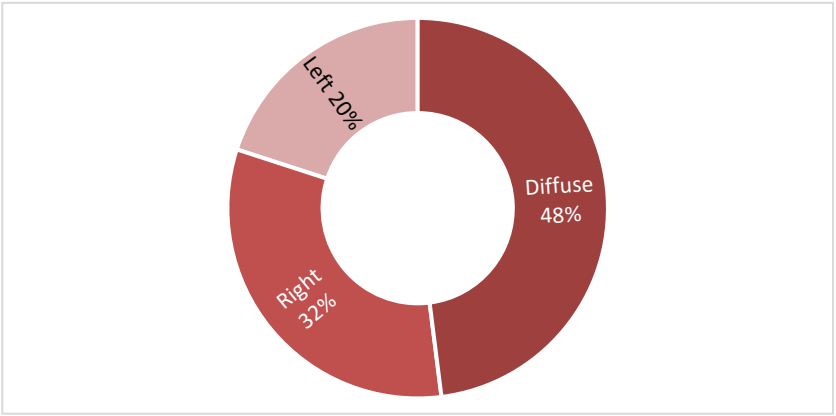

Figure 3: Graph showing lobe-wise distribution of thyroid swellings

4. Cytological diagnosis

All FNACs conducted at our facility were categorised into the following thyroid lesions for the current study. In a five-year period, we performed FNAC on 704 patients, and we categorised them as follows:

I. Non neoplastic lesions

II. Suspicious of malignancy

III. Neoplastic lesions

Table 2: Table showing distribution of thyroid lesions by FNAC in each group:

Lesions	No of patients	%
Non neoplastic	615	87.36
Suspicious of malignancy	9	1.27
Neoplastic	80	11.36
Total	704	100

In the present study, non - neoplastic lesions formed the major group i.e. 615 cases (87.36%) followed by 80 cases (11.36%) of neoplastic lesions and 9 cases (1.27%) of suspicious of malignancy.

Table 3: Table showing dispersal of non- neoplastic lesions on FNAC:

Lesions		No of patients	%
Inconclusive		16	2.56
Goitre	Colloid goitre	142	65.50
	Nodular goitre	149	
	MNG	84	
	Adenomatoid goitre	35	
Thyroiditis	Lymphocytic thyroiditis	5	26.67
	Hashimoto thyroiditis	160	
	De quervains thyroiditis	2	
Primary hyperplasia		33	5.27
Total		626	100

Table 4: Table displaying the distribution of neoplastic and suspicious-for-malignancy lesions on FNAC:

Lesions		No of patients	%
Suspicious of malignancy		8	10.26
Follicular neoplasm		45	57.69
Carcinoma	Papillary carcinoma	21	32.05
	Medullary carcinoma	2	
	Anaplastic carcinoma	1	
	Squamous cell carcinoma	1	
Total		78	100

Table 5: Table showing distribution of cases under neoplastic lesions by FNAC:

Lesions	No of patients	%
Benign	40	55.56
Malignant	32	44.44
Total	72	100

Table 6: On histology, the following table displays the distribution of lesions among non-neoplastic lesions:

Lesions		No of patients	%
Goitre	Colloid goitre	6	91.13
	Nodular goiter	58	
	Adenomatoid goiter	8	
Hashimoto's thyroiditis		6	7.61
Primary hyperplasia		1	1.26
Total		79	100

Table 7: Table showing neoplastic lesions on histopathology:

Lesions		No of patients	%
Adenoma	Follicular adenoma	24	60.87
	Hurthle cell adenoma	4	
Carcinoma	Papillary carcinoma	15	39.13
	Follicular carcinoma	1	
	Medullary carcinoma	1	
	Squamous cell carcinoma	1	
Total		46	100

Table 8: Showing Cytohistological correlation:

Histopathology diagnosis												
FNAC diagnosis												
Colloid goitre	N	Colloid goitre	Nodular goitre	Adenomatoid goitre	Hashimoto thyroiditis	Hyperplasia	Follicular adenoma	Hurthle cell adenoma	Papillary carcinoma	Follicular carcinoma	Medullary carcinoma	Squamous cell
Nodular goitre	63		57				2	1	3			
Adenomatoid goitre	9			8			1					
Hashimoto thyroiditis	6				6							
Hyperplasia	1					1						
Follicular neoplasm	22						21			1		
Hurthle cell neoplasm	3							3				
Papillary carcinoma	12		1						11			
Medullary carcinoma	1										1	
Squamous cell carcinoma	1											1
Total	125	6	58	8	6	1	24	4	15	1	1	1

Table 9: Table showing concordant and discordant cases among non- neoplastic lesions:

Lesions	No of patients	%
Concordant cases	77	89.53
Discordant cases	9	10.47
Total	86	100

Table 10: Table showing concordant and discordant cases among neoplastic lesions:

Lesions	No of patients	%
Concordant cases	37	94.87
Discordant cases	2	5.13
Total	39	100

Table 11: Statistical data of cytohistologically correlated 125 cases:

Fnac	Histopathology		
	Malignant N (%)	Benign N (%)	Total
Malignant	12(9.6)	2(1.6)	14
Benign	6(4.8)	105(84)	111
Total	18	107	125

12 cases (9.6%) out of the 125 cases in our study that had cytohistological correlations were malignant on both FNAC and histopathology. On FNAC, 6 instances (4.8%) were benign, but on histology, they were cancerous. 105 instances (84%) had benign histology and FNAC results. Only 2 (1.6%) of the cases had benign histology but were malignant on FNAC.

Discussion

Thyroid disorders are the commonest endocrine disorders worldwide, including India. According to a project from various studies on thyroid disease, it has been estimated that about 42 million people in India suffer from thyroid disease .Thyroid diseases are different from other diseases in terms of their ease of diagnosis, accessibility of medical treatment and the relative visibility that even a small swelling of the thyroid offers to treating physician. Early diagnosis and management remains the cornerstone of management [15].

In the presence of patient presenting with thyroid swelling, the clinician should consider some questions: is it a benign or malignant lesion? If it is benign one, what kind of treatment must be given: surgical or medical treatment? If a surgical treatment is chosen, how extensive should the surgery be in order to secure a better and greater therapeutic success? The answers to these questions will depend on the previous clinical study performed on the patient: the more meticulous and accurate the study, the easier the answers and [16]. this is made easy by following the Bethesda System of Reporting Thyroid Cytopathology wherein the patient management has been provided for each category along with the percentage risk of malignancy which is helpful for the clinicians for better judgment and to reduce unnecessary thyroidectomies.

For early diagnosis and management of all thyroid swellings, the protocol to be followed in presence of a thyroid nodule is clinical evaluation, clinical laboratory investigations which include T3, T4 and TSH levels, thyroid scintigram, thyroid echosonogram, FNAC and excision biopsy.

Amongst all FNAC will be cheaper, cost effective and shows reproducible results [17].

Table 12: Comparison of the percentages of distribution of fine needle aspiration diagnosis in TBSRTC.

Diagnostic categories	Jo *et al* [17]	Yassa *et al* [18]	Yang *et al* [19]	Nayar & Ivanoic [20]	Mondal S K [21]	Present study
Nondiagnostic I	18.6	7	10.4	5	1.2	2.84
Benign –II	59	66	64.6	64	87.5	86.07
Atypiaof undetermined	3.4	4	3.2	18	1	0.14
Suspiciousof follicular	9.7	9	11.6	6	4.2	6.25
Suspicious of malignancy –V	2.3	9	2.6	2	1.4	0.71
Malignancy - VI	7	5	7.6	5	4.7	3.98

According to the above table, it was seen that the distribution of cases as per the six-tier Bethesda system in our study differed from that in the above mentioned studies with the percentage of cases in the benign category being higher and that in the non-diagnostic, atypia of undetermined significance and suspicious of malignancy categories being lower. The reason for the number of cases in the benign category being higher can be attributed to the fact that, our institute caters to the needs of patients on a referral basis, but also patients come here directly without referral. So a large population, representative of the general population, is encountered in our institute. Therefore, the proportion of benign cases that is a lot higher in the general population is reflected proportionately in our study.

Table 13: Table showing comparison of the percentages of risk of malignancy:

Diagnostic categories	Jo *et al* [17]	Yassa *et al* [18]	Yang *et al* [19]	Nayar and Ivanoic [20]	Mondal S K [21]	Present study
Nondiagnostic –I	8.9	10	10.7	9	0	10
Benign –II	11	0.3	0.7	2	4.5	4.93
Atypia of undetermined significance – III	17	24	19.2	6	20	0
Suspicious of follicular neoplasm –IV	25.4	28	32.2	14	30.6	4.76
Suspicious of malignancy –V	70	60	64.8	53	75	0
Malignancy – VI	98.1	97	98.4	97	97.8	92.30

The malignancy risk for the different categories in our study as seen by follow-up histopathology, has corroborated well with the implied risks mentioned in the Bethesda System and also with the studies of Jo *et al*., Yassa *et al*, Yang *et al* and Nayar and Ivanov and Mondal S though few differences have been noted.

In the present study, no cases were seen under atypia of undetermined significance and suspicious of malignancy categories.

Conclusion

The management of visible thyroid lesions has been demonstrated to benefit from the safety, simplicity, cost-effectiveness, and accuracy of FNAC.

Differentiating between non-neoplastic and neoplastic thyroid lesions is useful. The quantity of surgeries has decreased as a result of its utilisation.

It is a straightforward minimally invasive procedure performed with a single disposable 10 cc syringe. In comparison to other pricey approaches, the syringe utilised in the current study is more affordable.

The collection of an accurate and thorough clinical history, technical proficiency in extracting the aspirate, production of the initial smears, and their evaluation are essential to success.

The accuracy of FNAC allows for surgical progression or abstinence. In the majority of situations, it fills the gap between the clinical assessment and the definitive surgical pathological diagnosis. It assists the physician in obtaining a diagnosis in the majority of cases with the least amount of time and financial investment, frequently avoiding the need for unneeded surgery.

It is important to properly understand the breadth and restrictions of FNAC, particularly when interpreting follicular neoplasms and other kinds of thyroid cancer, particularly papillary carcinoma.

We emphasise the importance of examining nuclear characteristics of the follicular cells in the cytological smears in order to avoid both overdiagnosis and underdiagnosis of papillary carcinoma. In ambiguous situations, repeat aspirations are indicated to gather enough information to rule out cancer. Both non-neoplastic and neoplastic lesions, such as malignant (Papillary carcinoma) diseases, can experience cystic transformation. Fluid should be thoroughly extracted from cystic nodules, and FNA should be performed on the remaining mass. In the absence of a palpable mass, the patient should undergo a follow-up USG examination and, if necessary, a USG-guided FNAC.

However, clinical follow-up and repeat aspiration to collect sufficient aspirates and a thorough cytologic diagnosis may be used to minimise the delay in diagnosis caused by false negative needle aspirations. Combining sophisticated imaging methods with immunologic analysis can increase the diagnosis accuracy.

According to the current study, FNAC has a strong positive connection with histology and a high level of sensitivity and specificity.

The use of FNAC aids in the early detection and effective treatment of thyroid cancer. Repeated aspiration, accurate sample from the lesions, and rigorous examination and reporting can lower the likelihood of false negative and false positive results.

The diagnostic method for reporting thyroid FNA has been standardised by the Bethesda System for Reporting Thyroid Cytopathology, improving cyto-histological connection.

The widespread use of this standardised nomenclature could increase interlaboratory consensus and result in a more uniform management strategy.

FNAC, coupled with the Bethesda System for Reporting Thyroid Cytopathology, is a well-established first-line diagnostic test and an efficient screening technique that helps in the accurate diagnosis and management of patients with thyroid abnormalities.

References

1. Mitra A, Abbas AK. The endocrine system. In: Robbins and Cotran

Pathologic Basis of Disease, 8th edn. Kumar V, Abbas AK, Fausto N, Aster JC (eds). Philadelphia: Saunders 2010:1097- 1164.
2. Thyroid. In: Fine needle aspiration cytology, 4thedn. Orell SR, Sterrett GF,Whitaker D. Philadelphia: Churchill Livingstone;2005:125-164
3. Cerise EJ, Randall S, Ochsner A. Carcinoma of the thyroid and nontoxic nodular goitre. Surgery. 1952; 31:552.
4. Cole WH, Majarakis JO, Slaughter OP. Incidence of carcinoma of the thyroid in nodular goitre. J Clin Endocrinol. 1949; 9:1007.
5. Clark DP.Introduction and clinical aspects.In:Thyroid Cytopathology,1st edn. Clark DP,Faquin WC (eds).Springer 2005:1-6.
6. Werga P, Wallian G, Skoog lamberth, Hamberger B. Expanding Role of Fine-needle Aspiration Cytology in Thyroid Diagnosis and Management. World J Surg. 2000; 24:907-912.
7. Sakorafas GH. Historical Evolution of Thyroid Surgery: From the Ancient Times to the Dawn of the 21st Century. World J Surg. 2010; 34:1793-1804.
8. Miller JM. Carcinoma and thyroid nodules. Problem in endemic goitre. N Engl J Med. 1955; 252:247–251.
9. Crockford PM, Bain GO. Fine-needle aspiration biopsy of the thyroid. Can Med Assoc J. 1974; 110:1029–1032.
10. Crile G Jr, Hawk WA Jr. Aspiration biopsy of thyroid nodules. Surg Gynecol Obstet. 1973; 136:241–245.
11. Wang C, Vickery AL Jr, Maloof F. Needle biopsy of the thyroid. Surg Gynecol Obstet. 1976; 143:365–368.
12. Miller JM, Hamburger JI, Kini SR. Diagnosis of thyroid nodules by fine needle aspiration and needle biopsy. JAMA.1979;241:481–486.
13. Sanchez MA, Stahl RE. The thyroid, parathyroid and neck masses other than lymphnodes. In: Diagnostic cytology and its histopathological basis, 5th edn. Koss LG, Melamed MR, Philadelphia: Lippincot Williams and Wilkins; 2006:1234-1402.
14. Ali SZ, Cibas ES. The Bethesda System for Reporting Thyroid Cytopathology. Am J Clin Pathol 2009; 132:658-65.
15. Unnikrishnan AG, Menon UV. Thyroid disorders in India: An epidemiological perspective. Indian Journal of Endocrinology and Metabolism. 2011; 15:78-81.
16. Landa JA, Perez EG. Clinical-cytological study of thyroid nodule. International congress series. 2002:121-130.
17. Jo VY, Stelow EB, Dustin SM, Hanley KZ. Malignancy risk for fine-needle aspiration of thyroid lesions according to the Bethesda system for reporting thyroid cytopathology. Am J Clin Pathol. 2010; 134: 450–6.
18. Yassa L, Cibas ES, Benson CB,Frates MC, Doubilet PM, Gawande A. A et al.Long-term assessment of a multidisciplinary approach to thyroid nodule diagnostic evaluation. Cancer. 2007;111:508-516.
19. Yang J, Schnadig V, Logrono R, et al. Fine-needle aspiration of thyroid nodules: a study of 4703 patients with histologic and clinical correlations. Cancer. 2007; 5:306-315.
20. Nayar R, Ivanovic M. The indeterminate thyroid fineneedle 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; 3:195-202.
21. 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; 30:94-9.
22. Nurismah MI, Sharifah NA, Usama AE, Rohaizak M, Naqiyah I, Jasmi A. Fine needle aspiration (FNA) cytology of the

thyroid: A cyto-histopathological study of 361 cases in hospital university Kebangsaan Malaysia. Med & Health 2007; 2:58-65.
23. Swamy GG, Madhuravani S, Swamy GM. Fine needle aspiration cytology - A reliable diagnostic tool in the diagnosis of Thyroid gland enlargements. Nepal Med Coll J. 2011; 13: 289-92.
24. Tauro LF, Lobo GJ, Fernandes H, George C, Aithala PS, Shenoy D et al. A Comparative Study on Fine Needle Aspiration Cytology versus Fine Needle Capillary Cytology in Thyroid Nodules. Oman Medical Journal. 2012; 27:151-56.
25. Rangaswamy M, Narendra KL, Patel S, Gururajprasad C, Manjunath GV. Insight to neoplastic thyroid lesions by fine needle aspiration cytology. Journal of cytology. 2013;30:23-27.