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Corresponding Author
Abhishek Anand,
Department of Pathology, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India
anandabhishek55@gmail.com

Author Designation
[1,2]Associate Professor
[3]Assistant Professor

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Diagnostic Efficacy of Fine Needle Aspiration Cytology in Solitary Thyroid Nodules

[1]Abhishek Anand, [2]Surbhi Sindhu and [3]Beenu Prajapati
[1]Department of Pathology, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India
[2]Department of Microbiology, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India
[3]Department of Physiology, Shri Gorakshnath Medical College Hospital and Research Centre, Gorakhpur, India

Abstract
Solitary thyroid nodules (STN) are a common clinical finding, with approximately 5% of palpable nodules being malignant. Accurate diagnosis is essential for guiding management. Fine Needle Aspiration Cytology (FNAC) is widely recognized as a simple, safe, cost-effective, and reliable diagnostic tool. To evaluate the diagnostic efficacy of FNAC in solitary thyroid nodules in patients presenting at a tertiary care hospital. This prospective study was conducted in the Department of Pathology, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, from July 2022 to June 2023. A total of 105 patients aged 15-70 years with clinically or radiologically detected solitary thyroid nodules underwent FNAC under aseptic precautions. Smears were stained using May-Grünwald-Giemsa, H and E, and Papanicolaou stains. Adequate aspirates were obtained in 98/105 cases (93.3%). Of these, 37 (37.7%) were non-neoplastic, 58 (59.2%) neoplastic, and 3 (3.1%) indeterminate. The most frequent non-neoplastic lesions included colloid goiter (27.5%) and Hashimoto's thyroiditis (6.05%). Among neoplastic lesions, follicular neoplasm (39.85%) was most common, followed by papillary carcinoma (11.25%). Female predominance was observed (M:F ratio 1:6.5), with peak incidence in the 3rd and 4th decades. FNAC is a highly effective first-line investigation for solitary thyroid nodules. It provides early diagnosis, facilitates appropriate management, and reduces unnecessary surgery. Its utility is further enhanced when combined with the Bethesda System for Reporting Thyroid Cytopathology.

INTRODUCTION

The thyroid gland consists of two lobes connected by an isthmus and normally weighs 15-30 grams in adults. It secretes thyroxine (T4) and triiodothyronine (T3), hormones essential for metabolic regulation[1-10].

A solitary thyroid nodule (STN) is defined as a palpable swelling in an otherwise normal thyroid gland. While the majority are benign, approximately 5% are malignant, making accurate diagnosis critical for clinical decision-making. Several diagnostic tools are available, including thyroid function tests, ultrasonography, and radionuclide scanning. However, Fine Needle Aspiration Cytology (FNAC) has emerged as the gold standard due to its simplicity, accuracy, and cost-effectiveness.

The technique of thyroid aspiration was first introduced by Martin and Ellis in 1930 using an 18-gauge needle. Since then, FNAC has become a widely accepted first-line investigation for thyroid lesions.

Aim: This study was undertaken to evaluate the diagnostic role of FNAC in solitary thyroid nodules in patients attending our institution.

MATERIALS AND METHODS

Study Design and Setting: A prospective study conducted in the Department of Pathology, Lord Buddha Koshi Medical College and Hospital, Baijnathpur, Saharsa, Bihar, from July 2022 to June 2023.

Study Population: A total of 105 patients aged 15-70 years presenting with solitary thyroid nodules were included[11].

Inclusion Criteria:

- Patients aged 15-70 years.
- Both male and female patients.
- Clinically palpable solitary thyroid nodules.
- Clinically non-palpable lesions detected on ultrasonography (USG) and subjected to USG-guided FNAC.

Exclusion Criteria:

- Swellings arising from skin or adjacent structures.
- Diffuse thyroid enlargement.
- Patients with history of thyroid surgery.

Procedure: After obtaining informed consent, FNAC was performed with the patient in supine position and neck extended. A 10 mL syringe with a 22-23 gauge needle was used under aseptic precautions. Multiple passes were made, and aspirates were smeared onto slides. In cases yielding fluid, repeat aspiration was performed on residual solid areas or USG-guidance was used.

Staining and Processing:

- Air-dried smears: May-Grünwald-Giemsa (MGG).
- Alcohol-fixed smears: Hematoxylin & Eosin (H&E) and Papanicolaou (PAP).
- Smears with inadequate material were re-aspirated after 3 weeks.

Analysis: Data were analyzed as frequencies and percentages.

RESULTS AND DISCUSSIONS

Male: Female ratio was (14/91) 1: 6.5 and age of the patients range from 15 years to 70 years. Maximum number of cases was in 3rd and 4th decades and minimum number of patients were in 7th decade[12].

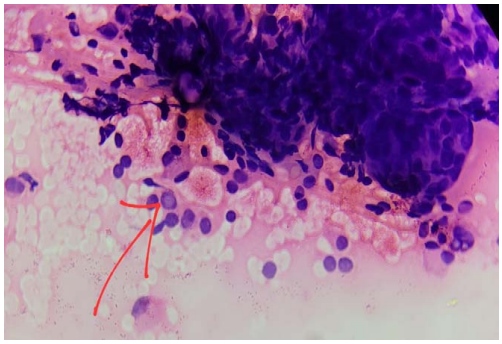

Fig. IA: Papillary carcinoma intranuclear inclusion (40x H and E stain)

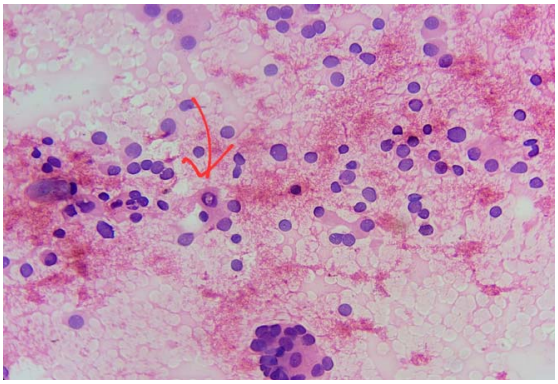

Fig. IB: Papillary carcinoma intranuclear inclusion (40x HandE stain)

Cases with adequate cellularity were divided in to Non-Neoplastic 37 cases (37.7 %), Neoplastic 58 (59.2%) and Indeterminate 03 cases (3.1%). Indeterminate category included cases in which a firm diagnosis could not be rendered despite an adequate aspirate. In one case clear distinction between Non-

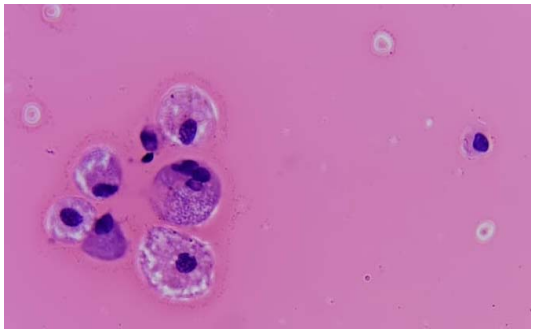

Fig. 2: Colloid nodule (40x Geimsa stain)

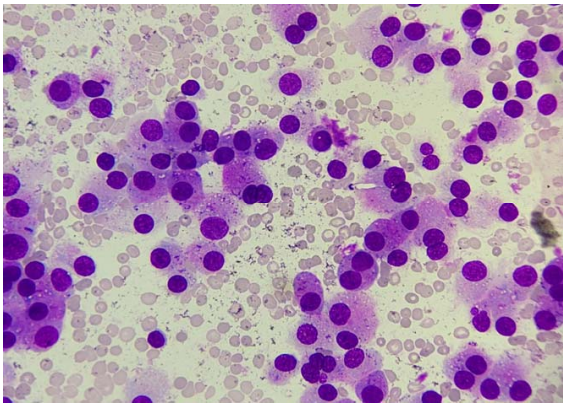

Fig. 3: Medullay carcinoma of thyroid (40x Geimsa stain)

Table 1: Distribution of cases according to Sex

S. No.	Sex	No. Of Cases	Percentage
1	Female	91	86.7%
2	Male	14	13.3%
	Total	105	100.0%

Table 2: Distribution of cases according to Age

S. No.	Age Range (Years)	No. Of Cases	Percentage
1	10- 19	03	2.8%
2	20- 29	26	24.8%
3	30- 39	38	36.2%
4	40- 49	30	28.6%
5	50- 59	06	5.7%
6	>60	02	1.9%
	Total	105	100.0%

Table 3: Frequency of Non- Neoplastic and Neoplastic diagnosis rendered on adequate aspirates sample

S. No.	Diagnosis	No. Of Cases	Percentage
1	Non- Neoplastic	37	37.7%
2	Neoplastic	58	59.2%
3	Indeterminate	03	3.1%
	TOTAL	98	100.0%

Neoplastic and Neoplastic could not be made and in the remaining 03 cases there was some degree of suspicion for Neoplasm but cytological feature were not sufficiently conclusive.

The main complain of these patients was neck swelling with 84.7% cases. The solitary nodule was found mainly in the right lobe of thyroid in 73.5% cases.

Table 4: Frequencies of various diagnoses rendered on adequate aspirates

S. No.	Diagnosis	No. of cases	Percentage
1	Colloid Goiter	27	27.50%
2	Hashimoto's Thyroiditis	06	6.05%
3	Hyperplastic Nodules	02	2.05%
4	Lymphocytic Thyroiditis	02	2.05%
5	Subacute Thyroiditis	03	3.05%
6	Indeterminate Cases	03	3.05%
7	Follicular Neoplasm	39	39.85%
8	Papillary Carcinoma	11	11.25%
9	Medullary Carcinoma	03	3.05%
10	Anaplastic Carcinoma	01	1.05%
11	Squamous Cell Carcinoma	01	1.05%

Table 5: Clinically presentation of Solitary Thyroid Nodules

Characteristics	No. of cases	Percentage
Complaint		
Neck Pain	12	12.2%
Neck Swelling 83	84.7%	
Neck Discomfort	05	5.1%
Duration of complaint		
<1 month	15	15.3%
01- 12 months	76	77.6%
01- 02 years	07	7.1%
Site of swelling		
Right Lobe	72	73.5%
Left Lobe	21	21.4%
Isthmus	05	5.1%
History of treatment		
Yes	24	24.5%
No	74	75.5%

Table 6: Clinical features of patients

Sign and symptom	No. of cases	Percentage
Neck Swelling 81	82.60%	
Difficult Breathing	11	11.20%
Hoarseness	03	3.10%
Dysphagia	01	1.05%
Loss of weight02	2.05%	

Thyroid lesions are a common clinical problem worldwide. FNAC remains the initial diagnostic tool due to its simplicity, safety, and high diagnostic accuracy, comparable to frozen section examination[13-15].

In our study, maximum cases occurred in females with a M:F ratio of 1:6.5, which aligns with findings from Silverman et al., Handa et al., and Yassa et al. The highest incidence was seen in the 3rd and 4th decades, similar to other studies.

Our study found a predominance of malignant to benign lesions, consistent with Handa *et al*. (87.7% benign, 7.1% malignant) and Swamy *et al*. (83.6% benign, 16.6% malignant). However, Singh *et al*. reported higher malignancy rates, likely due to a study population restricted to solitary nodules.

Three cases of medullary carcinoma were observed, consistent with reports by Handa *et al*. and Rangaswamy *et al*. Hashimoto's thyroiditis presented as solitary nodules in six cases, reaffirming earlier observations that diffuse thyroid diseases may occasionally manifest as nodular lesions.

Strengths: First-line, minimally invasive test for STN.

Limitations: Single-center study, lack of histopathological correlation in all cases.

CONCLUSION

FNAC is a safe, economical, and reliable diagnostic tool for solitary thyroid nodules. It enables early detection, reduces unnecessary surgeries, and guides clinical management effectively. Repeat aspiration and strict adherence to the Bethesda System can further improve diagnostic accuracy.

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