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Original Research Article

Cytological Evaluation by Rapid Onsite Evaluation Technique, Correlating with Cytological Study by Bethesda System in Thyroid Swelling

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Abstract:

Fine-needle aspiration cytology (FNAC) is widely used for the stratification of thyroid nodules . Results of FNAC were reported as per the Bethesda System for Reporting of Thyroid Cytopathology Rapid on-site evaluation (ROSE) has been proposed to improve the overall adequacy of FNA. ROSE is a simple technique, which helps in the immediate assessment of sample adequacy. This reduces the turnaround time for reporting the cases. And hence, in turn, allowing early intervention and treatment of the patient.

Keywords: FNAC, ROSE.

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Introduction

The term "thyroid" is derived from the Greek word "thyreos, " meaning "shield." It was first introduced by Thomas Wharton (1614-1673), a London-based anatomist, who coined the term Glandularis thyroideis in his 1656 book Adenographia [1]. Historically, the thyroid gland was referred to by various names, including struma (the Latin term for a swollen gland), bronchocele (a cystic mass in the neck), and goiter (derived from the Latin word gutter, meaning throat), with the latter still in use today [2].

In 1927, Dudgeon and Patrick in the United Kingdom proposed the use of needle biopsy for rapid microscopic diagnosis of tumors. The fine needle aspiration technique for thyroid diagnosis was further developed in Sweden in the 1950s, at the Rudinhelment Hospital of Stockholm [3]. By 1983, Frable W. J. advocated the use of FNAC for diagnosing most thyroid masses, classifying them as either neoplasms or goiter nodules [4].

Fine-needle aspiration cytology (FNAC) is widely used for the stratification of thyroid nodules [1]. Results of FNAC were reported as per the Bethesda System for Reporting of Thyroid Cytopathology [1]. Rapid on-site evaluation (ROSE) has been proposed to improve the overall adequacy of FNA. ROSE is a simple technique, which helps in the immediate assessment of sample adequacy. This reduces the turnaround time for reporting the cases. And hence, in turn, allowing early intervention and treatment of the patient [12].

Methodology:

The present study deals with FNAC of 120 cases of thyroid swellings referred to cytology lab over a period from March 2023 To August 2024 in the Department of Pathology, Ballari Medical College and Research Centre, Ballari

The FNAC was done as an outpatient procedure after explaining the details of the procedure to the patient and taking an informed written consent. Prior to aspiration a local examination was carried out to locate and identify the site of the swelling, shape, size, and consistency. The patient is made to lie supine with the neck extended, a 21-23 G needle attached to a 10ml disposable syringe is taken and 2-3 passes made in each case. When material starts to collect in the needle hub, the syringe is withdrawn and the aspirate is transferred to clean glass slides and smears are prepared. In the case of a fluid aspirate, the aspirate is centrifuged, and slides are made from the sediment. Several smears are made in each case and smears are fixed in 95% ethyl alcohol and then rapid onsite evaluation was done on one slide using the toluidine stain and examined for the presence of six clusters of thyroid follicular cells and at least ten cells in each cluster [3]. If the smears stained by toluidine are adequate, then the other slides are stained by the routine H & E method and a cytological diagnosis were given and categorized

according to the Bethesda system of reporting the thyroid.

If there were no adequate follicles in the toluidine-stained slide then the FNAC is repeated again, FNAC is repeated for a maximum of 3 times and if still no adequate follicles present in the slide, then the it is considered as inadequate.

Inclusion Criteria

Fine needle aspiration cytology of clinically palpable thyroid lesion referred to cytology Laboratory

Exclusion Criteria

Non-cooperative patient.

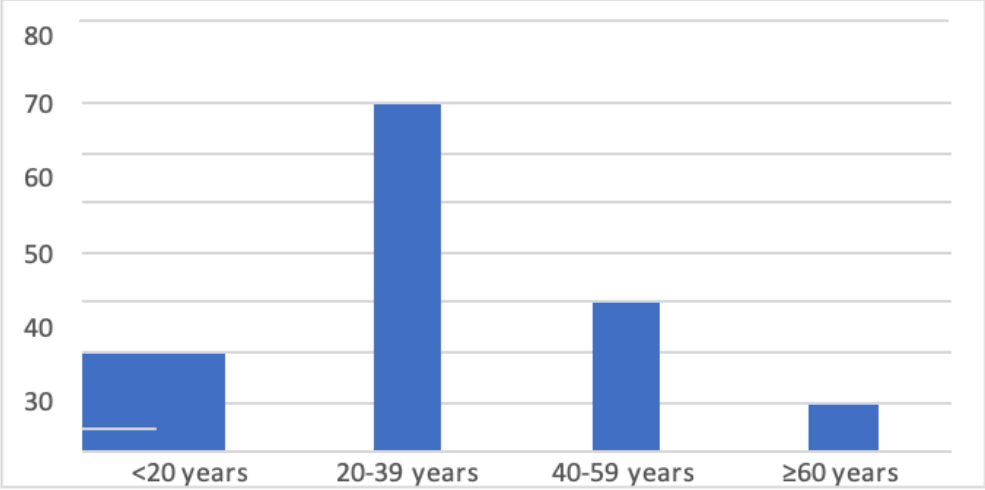
Neck swellings other than thyroid

Results

The present study was conducted at Ballari Medical College & Research Centre, Ballari, over a period of March 2023 to August 2024 and deals with the FNAC of thyroid swellings and rapid onsite evaluation of FNAC sample for sample adequacy. A total of 120 patients with thyroid swellings were taken for the study.

Table 1: Distribution of patients by age group

Age Group	Frequency (%)
<20 years	13 (10.8%)
20-39 years	70 (58.3%)
40-59 years	28 (23.3%)
≥60 years	9 (7.5%)
Total	120 (100%)

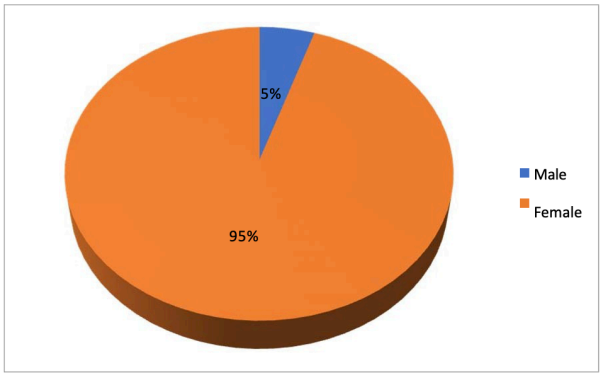


Graph 1: Age wise distribution of thyroid FNAC

The study included a total of 120 patients distributed across four age groups. The majority of patients (58.3%) fell within the 20-39 years age group, with 70 individuals. The second largest group was 40-59 years with 28 patients (23.3%). Younger patients under 20 years accounted for 13 cases (10.8%), while the elderly population (≥60 years) had the smallest representation with only 9 patients (7.5%). This age distribution indicates that thyroid swellings are most prevalent in young to middle-aged adults, with significantly fewer cases in pediatric and geriatric populations.

Table 2: Distribution of patients by gender

Gender	Frequency (%)
Male	6 (5.0%)
Female	114 (95.0%)
Total	120 (100%)

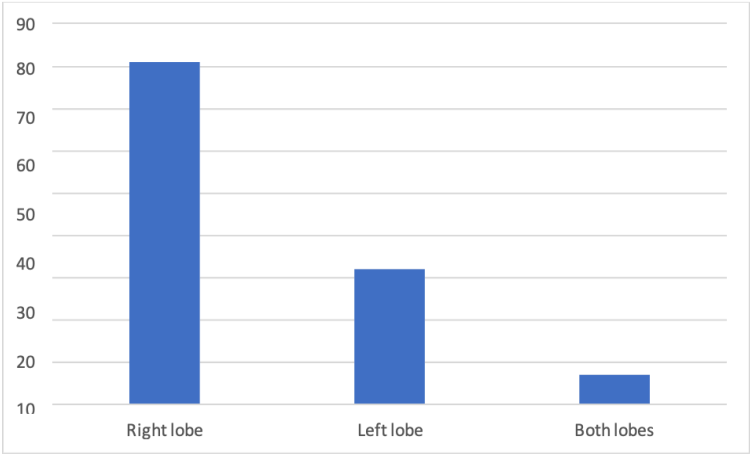


Graph 2 : Gender wise distribution of thyroid FNAC

The gender distribution showed a striking predominance of female patients, with 114 cases (95.0%) compared to only 6 male patients (5.0%). This represents a female-to-male ratio of 19:1, which is considerably higher than many reported series. This overwhelming female predominance strongly supports the well-established epi-demiological pattern of thyroid disorders being significantly more common in women than men, possibly due to hormonal influences on thyroid pathology.

Table 3: Distribution of thyroid swelling location

Location	Frequency (%)
Right lobe	81 (67.5%)
Left lobe	32 (26.7%)
Both lobes	7 (5.8%)
Total	120 (100%)

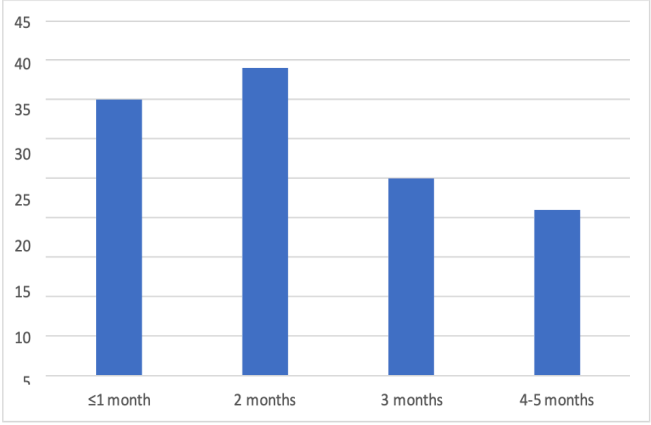


Graph 3: Distribution of site of swelling

Regarding the anatomical location of thyroid swellings, the right lobe was most commonly affected with 81 cases (67.5%), followed by the left lobe with 32 cases (26.7%). Bilateral involvement was observed in only 7 patients (5.8%). This right-sided predominance is consistent with many clinical observations and may relate to anatomical differences between the two lobes, though the exact mechanism remains unclear. The relatively low frequency of bilateral involvement suggests that most pathological processes in this cohort were localized rather than diffuse.

Table 4: Distribution of thyroid swelling duration

Duration	Frequency (%)
≤1 month	35 (29.2%)
2 months	39 (32.5%)
3 months	25 (20.8%)
4-5 months	21 (17.5%)
Total	120 (100%)

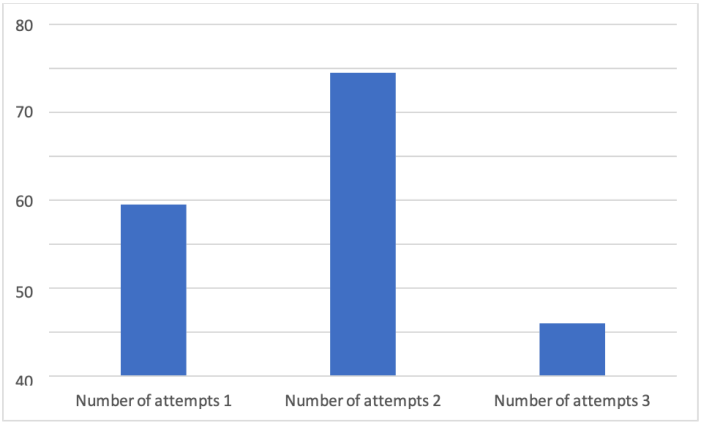


Graph 4: Distribution of duration of thyroid swelling

The duration of thyroid swelling showed that 39 patients (32.5%) presented with a 2-month history, making it the most common duration. Patients with ≤1 month duration were the second most common group with 35 cases (29.2%). Twenty-five patients (20.8%) reported a 3-month duration, while 21 patients (17.5%) had swellings for 4-5 months. This temporal distribution suggests that most patients in this cohort sought medical attention relatively early, with over 60% presenting within 2 months of noticing the swelling.

Table 5: Number of FNAC attempts required for adequate sampling

Number of attempts	Frequency (%)
1	39 (32.5%)
2	69 (57.5%)
3	12 (10.0%)
Total	120 (100%)

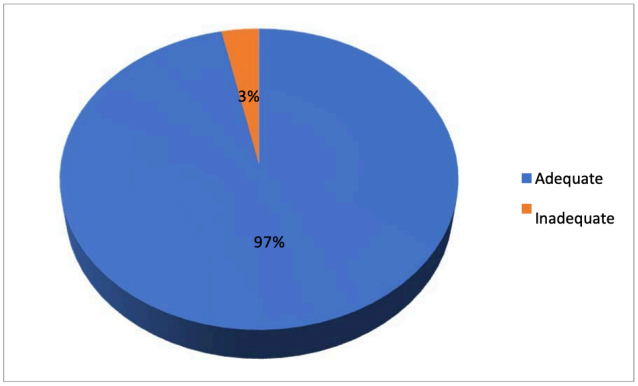


Graph 5: Distribution of number of attempts required for adequate sample

In terms of the FNAC technique, 69 patients (57.5%) required two attempts to obtain adequate sampling, making this the most common scenario. A single attempt was sufficient in 39 cases (32.5%), while three attempts were needed in 12 patients (10.0%). This demonstrates that multiple passes are frequently necessary to obtain diagnostic material, with the majority requiring at least two attempts

Table 6: Proportion of adequate vs inadequate samples

Sample adequacy	Frequency (%)
Adequate	116 (96.7%)
Inadequate	4 (3.3%)
Total	120 (100%)

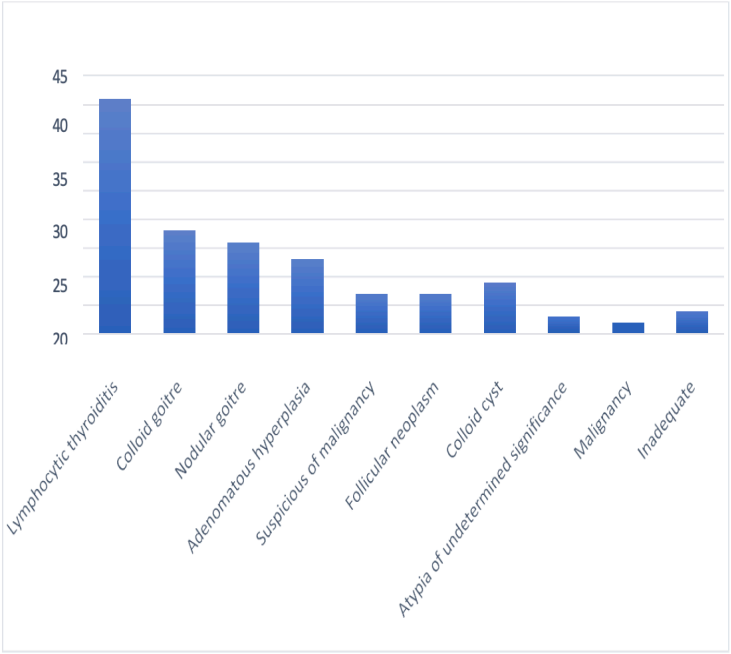


Graph 6: Proportion of adequate vs inadequate samples

Sample adequacy assessment revealed that 116 samples (96.7%) were adequate for diagnosis, while only 4 samples (3.3%) were deemed inadequate. This high adequacy rate of nearly 97% reflects good technique and possibly the benefit of having the ROSE procedure in place, allowing for immediate assessment and additional sampling when necessary

Table 7: Distribution of cytological diagnoses

Diagnosis	Frequency (%)
Lymphocytic thyroiditis	41 (34.2%)
Colloid goiter	18 (15%)
Nodular goiter	16 (13.3%)
Adenomatous hyperplasia	13 (10.8%)
Suspicious of malignancy	7 (5.8%)
Follicular neoplasm	7 (5.8%)
Colloid cyst	9 (7.5%)
Atypia of undetermined significance	3 (2.5%)
Malignancy	2 (1.7%)
Inadequate	4(3.3%)
Total	120 (100%)



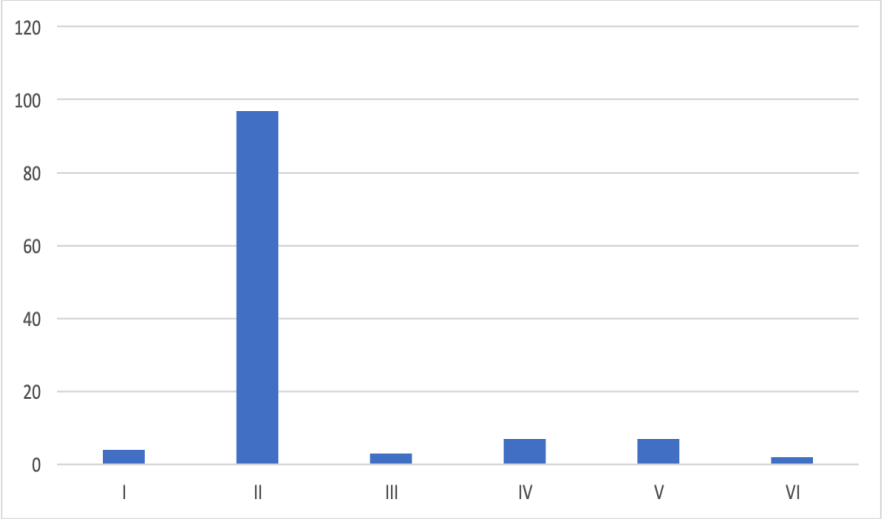
Graph 7: Distribution of cytological diagnoses

The cytological diagnoses showed that lymphocytic thyroiditis was the most common diagnosis with 41 cases (34.2%), followed by colloid goiter with 18 cases (15%). Nodular goiter accounted for 16 cases (13.3%),

and adenomatous hyperplasia for 13 cases (10.8%). Suspicious of malignancy was found in 7 cases (5.8%), follicular neoplasm in 7 cases (5.8%), and colloid cyst in 9 cases (7.5%). Less common were atypia of undetermined significance with 3 cases (2.5%), frank malignancy with 2 cases (1.7%), and inadequate samples with 4 cases (3.3%). These findings highlight the predominance of benign inflammatory and hyperplastic conditions in this population, with potential malignancies (suspicious, follicular neoplasm, and malignant categories combined) constituting approximately 13.3% of cases

Table 8: Distribution of Bethesda categories

Bethesda category	Frequency (%)
I	4 (3.3%)
II	97 (80.8%)
III	3 (2.5%)
IV	7 (5.8%)
V	7 (5.8%)
VI	2 (1.7%)
Total	120 (100%)



Graph 8: Distribution of Bethesda categories

According to the Bethesda system, 97 cases (80.8%) were classified as Category II (benign), making it by far the most common category. Categories IV (follicular neoplasm) and V (suspicious for malignancy) had 7 cases each (5.8% each). Category I (non-diagnostic) included 4 cases (3.3%), Category III (atypia of undetermined significance) had 3 cases (2.5%), and Category VI (malignant) was found in only 2 cases (1.7%).

Discussion

Demographic Profile and Clinical Presentation: The present study comprised 120 patients with thyroid swellings, with a striking female predominance (95%) and a male-to-female ratio of 1:19. This marked female preponderance is consistent with established epidemiological patterns of thyroid disorders, though our ratio exceeds that reported in many comparable studies.

Table 9: Comparison of Gender Distribution with Other Studies

Study	Year	Sample Size	Female (%)	Male (%)	Female: Male Ratio
Present study	2024	120	95.0	5.0	19:1
Sharma et al. [13]	2020	218	84.9	15.1	5.6:1
Bagga and Mahajan [14]	2018	252	87.0	13.0	6.7:1
Aramani et al. [15]	2015	51	82.4	17.6	4.7:1
Mangshetty et al. [16]	2017	178	86.0	14.0	6.1:1
Chandanwale et al. [17]	2012	370	82.7	17.3	4.8:1

The extreme female predominance in this study reflect regional variations in thyroid disease epidemiology or referral patterns specific to our institution.

The age distribution in the present study revealed a peak incidence in the 20-39 years age group (58.3%),

followed by the 40-59 years group (23.3%).

Table 10: Comparison of Age Distribution with Other Studies

Study	Year	Sample Size	Peak Age Group	Percentage (%)
Present study	2024	120	20-39 years	58.3
Guhamallick et al. [18]	2008	288	21-40 years	51.8
Mangshetty et al. [16]	2017	178	21-40 years	52.0
Sharma et al. [13]	2020	218	31-40 years	35.8
Bukhari et al. [19]	2008	405	31-40 years	36.8
Sikder et al. [20]	2012	217	21-40 years	49.3

This finding aligns with observations by most referenced studies, showing the predominance of thyroid disorders in young to middle-aged adults. This may be attributed to heightened medical surveillance and increased healthcare-seeking behavior in this demographic, particularly among women during their reproductive years when hormonal influences on thyroid physiology are most pronounced.
The present study found a notable predilection for right lobe involvement (67.5%) compared to left lobe (26.7%) or bilateral disease (5.8%)

Table 11: Comparison of Thyroid Swelling Location with Other Studies

Study	Year	Sample Size	Right Lobe (%)	Left Lobe (%)	Bilateral (%)
Present study	2024	120	67.5	26.7	5.8
Aramani et al. [15]	2015	51	57.0	37.0	6.0
Chandanwale et al. [17]	2012	370	53.4	38.2	8.4
Sengupta et al. [21]	2011	178	47.3	38.1	14.6
Kaliszewski et al. [22]	2016	1,424	55.8	35.6	8.6
Ghosh et al. [23]	2008	288	58.7	32.6	8.7

This right-sided predominance has been consistently documented in the literature, though with varying proportions. The anatomical basis for this distribution pattern remains incompletely understood, but may relate to differences in vascular supply, lymphatic drainage, or embryological development between the two lobes. The relatively low frequency of bilateral involvement in the present study (5.8%) contrasts with some reports in the literature, such as that by Sengupta et al. who described bilateral involvement in 14.6% of their cases.

Regarding the duration of thyroid swelling, the present study shows majority of patients (61.7%) presented within two months of noticing the swelling suggests good health awareness and access to medical care in study population. Comparable temporal data are inconsistently reported in the literature, making direct comparisons challenging. However, Bukhari et al. noted that patients in their series had a mean duration of symptoms of 2.7 years before presentation, considerably longer than in our cohort. This stark difference may reflect variations in healthcare systems, patient education, or cultural factors influencing healthcare-seeking behavior across different regions

Procedural Aspects and Sample Adequacy

In the present study, the majority of cases (57.5%) required two FNAC attempts to obtain adequate sampling, while 32.5% were successful on the first attempt.

Table 12: Comparison of FNAC Attempts Required for Adequate Sampling

Study	Year	Sample Size	First Attempt (%)	Second Attempt (%)	Three or More Attempts (%)
Present study	2024	120	32.5	57.5	10.0
Ghosh et al. [23]	2008	288	38.8	53.2	8.0
Collins et al. [24]	2013	1,412	43.7	49.2	7.1
Yang et al. [25]	2001	1,135	41.2	48.4	10.4
Schmidt et al. [26]	2012	674	36.2	52.1	11.7
Nasuti et al. [27]	2011	182	38.5	49.4	12.1

This finding is comparable to that reported by other investigators, showing that multiple passes are frequently necessary to obtain diagnostic material, with the majority requiring at least two attempts.
The overall sample adequacy rate in the present study was 96.7%, with only 3.3% of samples deemed inadequate for diagnosis.

Table 13: Comparison of Sample Adequacy Rates

Study	Year	Sample Size	ROSE Used	Adequate Samples (%)	Inadequate Samples (%)
Present study	2024	120	Yes	96.7	3.3
and Ezzat [28]	2012	296	No	89.5	10.5
Wu et al. [29]	2012	1,382	No	83.4	16.6
Witt and Schmidt [30]	2013	834	Yes	91.4	8.6
Zhu and Michael [31]	2013	1,024	Yes	93.0	7.0
Yang et al. [25]	2001	1,135	Yes	93.0	7.0

This high adequacy rate exceeds those reported in many comparable studies. These superior adequacy rate may be attributed to the implementation of the ROSE technique, which allows for immediate assessment of sample cellularity and adequacy.

The value of ROSE in improving sample adequacy is underscored by the highly significant association ($p < 0.001$) between initial ROSE assessment and the need for additional sampling in present study. This finding is concordant with those reported by other investigators who have documented substantial reductions in inadequacy rates after implementing ROSE.

An intriguing finding in the present study was that despite the strong association between ROSE assessment and final diagnosis, there was no significant association between the number of FNAC attempts and either sample adequacy ($p = 0.40$) or Bethesda category ($p = 0.70$). This suggests that while ROSE accurately identifies cases requiring additional sampling, the ultimate diagnostic yield is not significantly influenced by the number of passes performed. This observation diverges somewhat from findings by Nasuti et al, who reported a direct correlation between the number of passes and diagnostic yield in endoscopic ultrasound-guided FNA. The discrepancy may relate to differences in the tissue types sampled or the techniques employed.

Cytological Diagnoses and Bethesda Classification: The distribution of cytological diagnoses in the present study revealed lymphocytic thyroiditis as the most common pathology (34.2%), followed by colloid goiter (CG) (15%) and nodular goiter (13.3%).

Conclusion

This comprehensive analysis of 120 thyroid Fine-Needle Aspiration Cytology (FNAC) cases demonstrates the effectiveness and reliability of FNAC with Rapid On-Site Evaluation (ROSE) for evaluating thyroid swellings. The demographic profile of our cohort shows a striking female predominance (95.0%) and peak incidence in young to middle-aged adults (58.3% in 20-39 years), consistent with established epidemiological patterns of thyroid disorders.

The implementation of ROSE significantly enhanced the diagnostic yield of FNAC, as evidenced by the high sample adequacy rate (96.7%) and the highly significant associations between ROSE parameters and final outcomes ($p<0.001$). The initial ROSE assessment strongly predicted the need for additional sampling, potentially reducing patient discomfort and procedure time by minimizing unnecessary passes. The strong correlation between ROSE cellularity assessment and final Bethesda categories validates the reliability of preliminary on-site assessments.

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