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Evaluation of Breast, Lymph Node, and Thyroid Fine Needle Aspiration Cytology by Liquid Based Smears and Conventional Smears

Rajesh Reddy[1], Shailaja Prabhala[2,*], Shrinivas B Somalwar[2], Ashok Kumar Deshpande[3]

[1]Consultant Pathologist, JP Hospital, Hyderabad, Telangana

[2]Additional Professor, Department of Pathology and Lab Medicine, All India Institute of Medical Sciences, Hyderabad, Telangana

[3](Retd) Professor, Department of Pathology, Kamineni Academy of Medical Sciences and Research Centre, Hyderabad, Telangana

*Correspondence should be addressed to Shailaja Prabhala, shailajaprabhala@yahoo.co.in

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Abstract

Introduction: Fine needle aspiration cytology (FNAC) is a first-line investigation for palpable lumps and is a highly cost-effective and accurate investigative technique. It is a safe, simple, rapid, minimally invasive technique. Liquid-based cytology (LBC) has been used in gynecologic-cytology for over three decades. Many laboratories have adopted LBC technique for exfoliative and FNA samples. We undertook the present study to compare the advantages and disadvantages of conventional and liquid based cytology preparations.

Aim of the study: To evaluate the diagnostic accuracy of LBC and Conventional smears in fine needle aspiration cytology samples from breast, lymph nodes, and thyroid tissue.

Materials and methods: FNA material from accessible sites such as palpable breast lumps, thyroid, and lymph nodes were collected from 100 patients and was processed by two different methods, i.e., Conventional smears and by LBC. Various parameters on the slides were considered and compared for both the preparations. Out of 100 FNA samples, 51% were of Thyroid, 34% were of lymph node and 15% were of breast lumps.

Observations and results: Adequate cellularity and better architecture was present in conventional smears than LBC preparations. Background material was less, and monolayers were better in the LBC preparations. Informative background material (i.e. Colloid, lymphoglandular bodies, etc) was more in cases of Conventional smears. The nuclear and cytoplasmic details were nearly equally good in both the preparations.

Conclusion: Both these methods have their own advantages and disadvantages. Before incorporating LBC as a routine method, pathologists should familiarize themselves with all the aspects of LBC.

Keywords: Conventional cytology, Liquid based cytology, FNAC of breast, Lymph nodes and thyroid, LBC in breast, lymph nodes and thyroid aspirates, Advantages of LBC, Monolayer

Introduction

In India, fine needle aspiration cytology (FNAC) was first introduced during the early 1970s and gradually became an accepted practice. FNAC is a safe, simple, rapid, and relatively pain free, minimally invasive technique [1]. Liquid-based cytology (LBC) has been in use in the field of gynecologic-cytology for three decades [2]. Most laboratories have started to apply LBC technique for exfoliative cytology and FNA samples too [3]. The advantages of LBC are quick fixation, a smaller stained slide area with evenly distributed cells, reduced obscuring background elements of blood, inflammation, and

mucus. It gives an opportunity to do ancillary techniques and store cells. In general, the adequacy criteria of cellularity of aspirates i.e. number of cells aspirated in conventional and liquid based cytology are similar [4]. It is inherent for LBC preparations to lose, or to have reduced background material, small/ more fragmented cell clusters, smaller cell size, well preserved nuclear detail, more prominent nucleoli and more easily visualized cytoplasm.

Breast lesions range from inflammations to malignancy and a palpable breast lump is a common diagnostic problem for general practitioners and surgeons [5]. Preoperative pathological diagnosis is an essential part of the work up of breast lesions [6]. Similarly thyroid nodules are a common clinical finding and have a reported prevalence of 4–8% in the general population, and most of them are non-neoplastic. Of all palpable thyroid nodules, only 4-10% are malignant and incidence of malignancy in pediatric thyroid nodules is higher [7]. Similarly, enlarged lymph nodes are also frequently encountered in clinical practice and are often subjected to FNAC [7].

In the present study, FNA material from accessible sites such as palpable lumps of breast, thyroid, and lymph nodes was collected from patients and was processed. The LBC method is quite efficient in gynecologic cytology but the same for non-gynecologic samples needs to be studied. This study compares the conventional smear (CS) method and LBC at a tertiary care center in Telangana, India.

Aim of the Study

To evaluate the diagnostic accuracy of LBC and Conventional smears in FNAC samples from breast, lymph nodes, and thyroid tissue.

Materials and Methods

This was a prospective study carried out over a period of two years in the Department of Pathology at Kamineni Academy of Medical Sciences and Research Centre, Hyderabad from June 2017 to May 2019. Permission was taken from the Institutional Ethics Committee. Informed consent from all patients was taken. In this study a total of 100 fine needle aspiration samples were studied, out of which 51 were from thyroid, 34 were from lymph nodes, and 15 were from breast lesions. Both conventional and liquid based smears were prepared using the aspiration material.

Inclusion criteria

All FNACs from breast, lymph nodes, and thyroid.

Exclusion criteria

Inadequate smears and Image guided FNACs.

Methodology and technique used

The FNA was done by using a 23 or 22 gauge needle with attached 5 ml syringe. Both LBC and Conventional smears were done in all cases.

Smears were prepared by cytological material obtained by separate needle passes from the site. The material obtained by the first needle pass was used in making conventional smears. The material obtained by the second needle pass was transferred to commercially available Eziprep Preservative Solution® used in LBC Procedure.

LBC procedure: The sample was processed according to the manufacturer's instructions in Nanocyt Neo instrument by LBC India, (ISO 09001 and ISO 13485). The cells were fixed/ preserved in the liquid preservative for minimum of thirty minutes to provide adequate fixation to the cells. The sample was added with cell separator solution and centrifuged at 2000 rpm for seven minutes. The supernatant was disposed, and the pellet was agitated with normal saline to get a homogenous sample. This sample was added to a holder fixed to opti-coated slide with distilled water in a central slide rack. Then it was subjected to centrifuge at 1000 rpm for 2 minutes twice. The slides were stained by Papanicolaou stain (PAP) and Hematoxylin and eosin (H&E) stains. May-Grunwald Giemsa (MGG), Hematoxylin and Eosin (H&E) stains were used for conventional smears. Special stains such as Acid Fast Stain and Periodic Acid Schiff stain were used as and when required.

Statistics

Statistics are depicted as number of cases and percentage, and Cohen's Kappa analysis.

The following scoring system was used to standardize the observations [8] (**Table 1**):

Table 1. Scoring system.

Cytological features	Score 0	Score 1	Score 2
Cellularity	Nil	Scanty	Adequate
Background blood, cell debris	Nil	Occasional	Good amount
Informative background	Absent	Present	-

Monolayer	Absent	Occasional	Good amount
Cell architecture	Not recognized	Partially recognized	Well recognized
Nuclear details	Poor	Fair	Good
Cytoplasmic details	Poor	Fair	Good

Observations and Results

A total of 100 samples of Fine needle aspirations were studied. Smears were studied by both Conventional preparation and LBC methods. No discrepancy or mismatch was seen in the diagnosis with both methods.

Distribution of samples based on location

Most of the cases of FNAC were from thyroid, accounting for 51% cases. Lymph node aspirates were 34%, and breast lump aspirates were 15% (**Table 2**). In FNAC from thyroid, nodular goitre was the commonest lesion and accounted for 20 (39.2%) cases. In lymph node lesions, reactive changes were the commonest and in breast FNAC, the most common lesion was Fibroadenoma.

Cyto-morphological correlation

The LBC and Conventional smears were compared for cellularity, background, presence of monolayer, cell architecture, nuclear and cytoplasmic details (**Tables 3**). The architecture of cells and their relation to each other was better maintained in CS than in LBC preparations. Cytoplasmic details were appreciated in both preparations equally well. The nuclear details were better appreciated in conventional smears than in LBCs.

Table 2. Cytological diagnosis given on conventional smears.

Site of aspirate	Cytological diagnosis	No of cases (%)
Thyroid lesions (n=51)	Nodular goitre	20 (39.2%)
	Colloid goitre	12 (23.5%)
	Hashimoto's Thyroiditis	11 (21.5%)
	Papillary carcinoma	3 (5.8%)
	Adenomatous Hyperplasia	2 (3.9%)
	Follicular Neoplasm	2 (3.9%)
	Anaplastic Carcinoma	1 (1.9%)
Lymph node lesions (n=34)	Reactive lymphadenitis	11 (32.3%)
	Metastatic deposits (7 cases of squamous cell carcinoma, 2 cases of adeno-carcinoma, 1 case of papillary thyroid carcinoma)	10 (29.4%)
	Suppurative inflammation	7 (20.5%)
	Granulomatous inflammation	4 (11.7%)
	Lympho-proliferative disorder (1 case each of Hodgkins and Non-Hodgkins lymphoma)	2 (5.8%)
Breast lesions (n=15)	Fibroadenoma	8 (53.3%)
	Fibrocystic disease	2 (13.3%)
	Breast abscess	1 (6.6%)
	Gynecomastia	1 (6.6%)
	Duct cell carcinoma	1 (6.6%)
	Invasive ductal carcinoma	1 (6.6%)
	Papillary neoplasm	1 (6.6%)

Table 3. Comparison of cellularity, background, and monolayer between liquid based and conventional smear (CS) method.

Parameter compared		LBC	Conventional smears
Cellularity	0 - Zero	0	0
	1 - Scanty	68	37
	2 - Adequate	32	63
Background material	0 - Zero	56	0
	1 - Occasional	39	16
	2 - Good amount	5	84
Informative background	0 - Absent	77	4
	1 - Present	23	96
Monolayer	0 - Not recognized	0	0
	1 - Partially recognized	26	81
	2 - Well recognized	74	19
Cell architecture	0 - Not recognized	0	0
	1 - Partially recognized	86	26
	2 - Well recognized	14	74
Nuclear details	0 - Poor	0	0
	1- Fair	10	15
	2 - Good	90	85
Cytoplasmic details	0 - Poor	0	0
	1 - Fair	5	10
	2 - Good	95	90

Cohen's Kappa analysis was done for inter-rater reliability (**Table 4**). There was good inter-observer variability by both the methods as most of the values were above 0.75.

Discussion

Over the past two decades, the LBC method has emerged as a newer technique in the field of cytology. Although the LBC method is routinely used at many diagnostic centers, it has not completely replaced the conventional method. The opinion regarding the best method is still controversial among cytopathologists. The advantages offered by liquid-based preparations include a smaller number of slides to be screened, uniform cellular layer, clean bloodless background,

Table 4. Cohen's Kappa analysis for inter-observer reliability by LBC and Conventional smear method.

Parameter	Kappa value for Liquid based cytology Kappa value	Kappa value for conventional smears
Cellularity	0.82	0.91
Background material	0.89	0.87
Informative background	0.85	0.64
Monolayer	0.81	0.68
Cell architecture	0.79	0.89
Nuclear details	0.76	0.77
Cytoplasmic details	0.57	0.77

and better preservation of cell morphology [4,8]. Few authors [9-11] suggested that a special pass has to be done for the collection of liquid based samples that yield adequate number of cells, preserved background elements and well preserved cellular architecture and morphology. As per the above suggestions, in this study, liquid based sample was collected from a separate needle pass. The lytic agents added to collecting solution allowed the sample to be of better quality with less obscuring background elements as compared to the thicker conventional smears with obscuring blood and/ or inflammatory cells. The nature of LBC processing technique allows deposition of a monolayer of representative sample in a well-defined area and enables rapid screening by cytologists.

Cellularity

In a broader terminology, sample is said to be adequate if it is cellular and of good quality with well-preserved cellular morphology and is representative of the lesion.

Dey et al. [8] reported the cellularity in LBC was equal to that of conventional preparation. A few authors [12,13] described in their studies, that cellularity in LBC and conventional preparations was same. Some authors [14,15] reported that the cellularity in LBC preparations is slightly inferior or superior to the conventional smears.

Almost all the above studies mentioned that the cellularity in both the LBC and conventional smears preparations are equal [8,12-14]. In our present study, a high number of cases (68% cases) showed moderate to scanty cellularity on LBC and adequate cellularity in 32% cases. For those cases which showed low cellularity, second slides were made with the remaining material and the diagnosis was performed. This reproducibility is one of the advantages in LBC preparation. Conventional smears (CS) showed adequate cellularity in most of the cases i.e., in 63% cases and 37% showed low cellularity. In low cellularity cases when opinion was not easily made, the patient had to be called and had to undergo a second repeat aspirate. This repeat aspirate is undesirable on the part of the patient, and it is not usually required when LBC samples are collected. In a few cases where the CS showed scant cellularity, LBC slides showed adequate cellularity (possibly due to centrifugation). In our study, the cellularity in LBC preparation was inferior to CS preparation, and these observations are in concordance with those of Michael et al. and Leung et al. [14,15] (**Table 3**).

Background material (blood, necrosis, debris)

Gerhard et al. and Dey et al. [12,15], described loss of background material like blood and necrosis in LBC, which gives clean background and helps in easier screening. In our study, most of cases (56%) of LBC preparations showed clean background with absence of blood, cell debris, and necrosis and this helps in easy screening. In CS preparations, almost 84% showed bloody material in the background which obscured the cells in various studies [8,12]. None of the CS preparations showed a completely clean background. Obscuring material may mask the cells of interest, especially when they are few, hence, risking a false negative diagnosis. This is one of the disadvantages of the CS method (**Table 3**). Our findings agree well with those of the above authors.

Informative background

Dey et al. and Veneti et al. [8,16], described loss of informative background in LBC which is of disadvantage in diagnosing benign cases like fibroadenoma and malignant cases like mucinous carcinoma. Informative background is a diagnostic clue in any cytology preparation. In our study it was found to be reduced but not lost in cases of LBC. In 23% cases good informative background was seen as compared to 96% cases of CS preparations. This is one of the disadvantages of the LBC method as described by many authors [8,13-16]. The preserved informative background in CS definitely helps in diagnosis (**Table 3**).

Cell architecture

In the present study cell architecture was well recognized with LBC (36/100 cases). Conventional smear showed well recognizable architecture in 94/100 cases. This is probably due to the faulty LBC smear preparation or faulty procedure during the second pass. Other studies show results as better assessment of cell morphology and architecture in LBC method (**Table 4**). In our present study, cell architecture features are not concordant with other authors [17,18].

Nuclear detail and cytoplasmic detail

Nuclear and cytoplasmic details were of equally good quality in almost all cases in both LBC and CS method and these findings are concurrent with Dey et al [8] (**Table 4**).

Breast

Benign lesions / Fibroadenoma: The benign category included in the present study were fibroadenoma and fibrocystic disease of breast and gynecomastia. They constituted about 53.3%, 13.3%, and 6.6% respectively of all the breast lesions diagnosed in conventional and LBC methods (**Table 2**). Current study showed that the diagnostic accuracy for LBC and CS preparation was 97% and 94% respectively. These values imply that our study results are almost equal to those observed in many studies. The sensitivity and specificity in our study is 100% and 96%. LBC preparation in fibroadenoma showed benign ductal epithelial cells, arranged in sheets, small clusters, three dimensional and staghorn clusters with isolated myoepithelial cells. Most of the cases showed loss or paucity of stromal/ fibromyxoid elements.

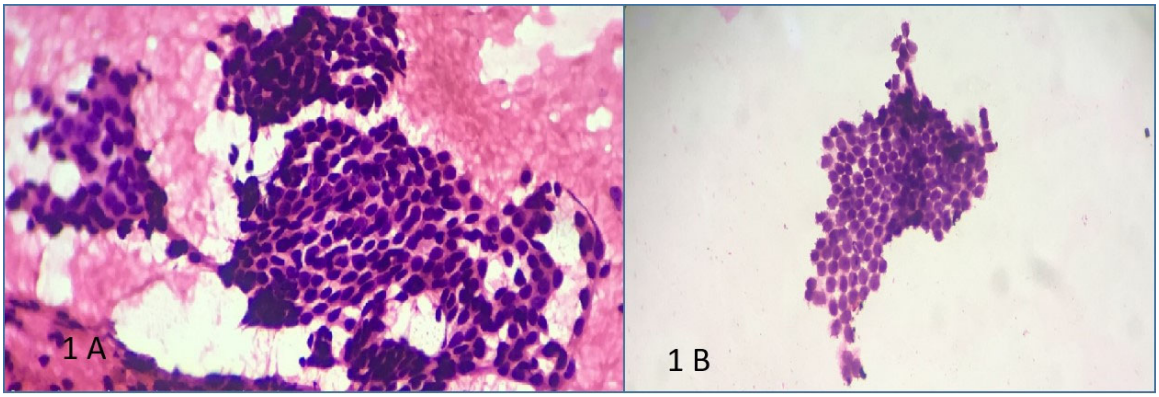

Figure 1. Fibroadenoma- **(A)** Conventional smear and **(B)** LBC smear (H and E stain) 40X.

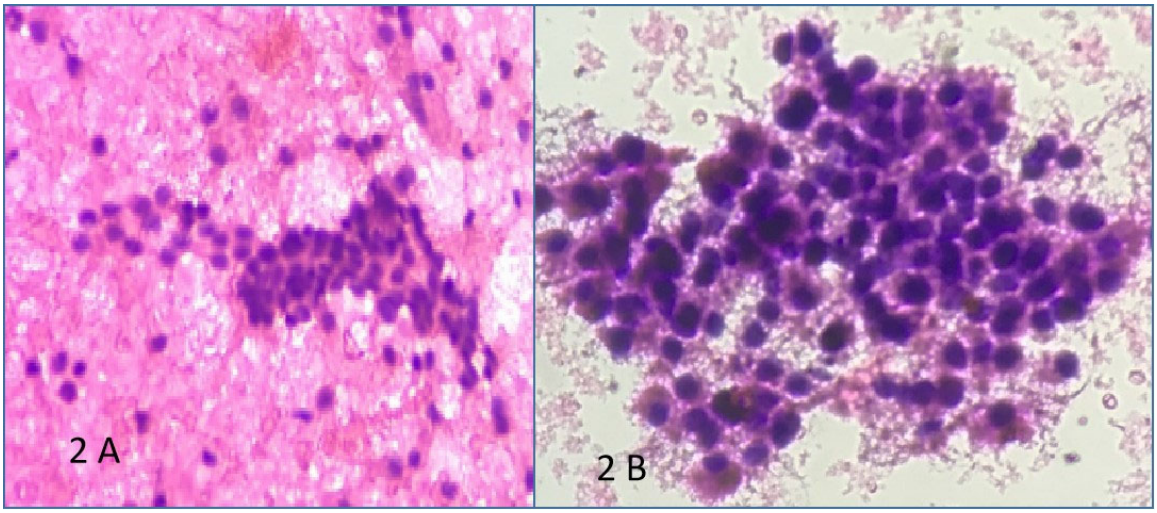

Figure 2. Adenomatous hyperplasia of thyroid. (**A)** Conventional smear and **(B)** LBC smear (H&E stain) 40X and 100X.

Diagnosing fibroadenoma on LBC preparation is difficult as compared to CS and there could be false positive diagnosis and also risk of over classifying these benign lesions as atypical lesions. It is easier to diagnose ductal carcinomas on LBC as the background is clean and nuclear details are better appreciated [8]. In fibroadenoma, though there was loss of stromal fragments, LBC proved to be useful in the diagnosis based on visualization of ductal aggregates and bipolar cells.

Many authors [4,14,15] have observed paucity or loss of stromal elements and decrease in myoepithelial cells in fibroadenomas. Ryu et al. [13] has interpreted some of the breast lesions, that showed a false increase in ductal epithelial cells due to decrease in the fibromyxoid stroma and myoepithelial cells, due to these features these cases are mis-diagnosed as suspicious for malignancy. In our study we also encountered a similar problem, but upon review of the doubtful cases, we could identify the predominance of cell clusters arranged in small clusters and three- dimensional clusters without crowding or overlapping. Even though there is loss or paucity of background material, presence of uniform cell morphology, without increase in nuclear cytoplasmic ratio and the arrangement helps diagnose fibroadenoma in LBC. In conventional preparation, the diagnosis of fibroadenoma is easily done because of the stag-horn arrangement of the cells with myoepithelial cells and background fibromyxoid stroma. But some cases show blood in background and, a greater number of slides have to be screened, which consumes more time when compared to LBC where most of the cases are reported with a single slide. The diagnosis of fibrocystic disease of breast by CS and LBC preparation showed similar features in both methods. Ductal epithelial cells and scattered apocrine metaplastic cells were abundant. But the cellularity in the conventional preparation was low. But LBC preparation

shows moderate cellularity in such cases due to centrifugation which helps in diagnosing the case, which is one of the advantages of LBC. Gynecomastia cases in both methods showed ductal epithelial cells. In CS preparation, cellularity was low to moderate, so two to three slides are needed to report whereas in LBC, the cells are subjected to centrifugation and the diagnosis is made with a single slide itself.

Malignant cases: Most of the breast carcinomas are easily diagnosed with the help of FNA. Some authors [13,16,19] described that both the types of cytological preparations CS and LBC preparations have comparable features for detection of ductal carcinomas. Dey et al [8] stated that it was easier to diagnose ductal carcinoma in LBC preparation because of the clean background. This study also stated that the loss of blood and necrosis which are main features of carcinomas will be absent in LBC preparations thereby taking away the advantage of background information contributing to the diagnosis. The results of the present study are in concordance with the observation made by most of the above authors. The sensitivity, specificity, and the diagnostic accuracy for ductal carcinoma in CS and LBC preparations was 100%. LBC preparation showed malignant ductal epithelial cells arranged in three dimensional clusters, small clusters and singly scattered in a clean background. Cells had scant to moderate amount of cytoplasm with markedly pleomorphic nuclei. Most of the cases showed fine chromatin. CS preparation showed sheets of ductal epithelial cells in the background of blood. Nuclear features were almost the same for both the preparations as described by Dey et al. [8], Ryu et al. [13] and many other authors [8,16]. But cytology preparation may not help to categorize the ductal carcinomas which is a major disadvantage of all FNA samples of both LBC and CS preparations.

Thyroid

Thyroid nodular disease comprises a wide spectrum of disorders. In adults, FNAC has become a part of the routine evaluation of thyroid nodules. Since the introduction of thyroid FNAC, the rate of thyroidectomy has decreased by 25% to 50%.

In FNAC of thyroid lesions, Lee et al. [21] observed that informative background material was slightly superior in LBC preparation than CS preparation. However, in the present study, and in another study by Arul [22], colloid was diminished and appeared fragmented and dense. LBC was not useful in goiter and infectious lesions [23]. It gave better results in malignant lesions of anaplastic carcinoma and medullary carcinoma. In a study of thyroid FNAC by Cochand-Priollet et al [23], the diagnostic accuracy of CS was found to be better than that of LBC. Whereas oncocytic tumors and lymphocytic thyroiditis presented diagnostic problems in their study, the lack of background colloid with LBC was also a confounding factor [24,25]. Keyhani et al. [26] did a comparative study between CS and LBC. The authors showed that for cases with a "benign reference diagnosis" LBC performed better than CS, however, for cases with a reference diagnosis of "Papillary thyroid carcinoma" CS was better. Most authors note that lymphocytic and Hashimoto's thyroiditis may lead to overestimation of LBC direct smears due to cellular atypia and absence of colloid [27]. The presence of lymphocytes may be missed or considered to be derived from the peripheral blood. In a retrospective study, Scurry and Duggan pointed out that in 'suspicious for malignancy' cases because of marked cellular pleomorphism, lymphocytes were also present [28]. Cochand-Priollet et al. [23] stated that the distinction of follicular adenoma from Hashimoto's thyroiditis was very difficult due to the presence of reactive cells with few lymphocytes in the background. Studies based on conventional cytology show that adequate sampling of the thyroid is very important. In the present study, most cases of Lymphocytic / Hashimoto's thyroiditis revealed the presence of lymphocytes in a clear background, requiring meticulous screening under high power magnification. The cytological pattern in Hashimoto's thyroiditis depends on the stage of the disease and the heterogeneity of the material and is often obvious.

There have been several studies comparing the utility and advantages of thin preparation (TP) method and the conventional direct smear method in thyroid FNAC samples [19,23,29]. Fewer studies, however, were conducted to compare the utility and advantages of TP slide method with that of CB slides in thyroid FNAB specimens [30,31].

Frost et al. [32] found that TP slides of thyroid aspirates have an 85% diagnostic accuracy, and that preparation of only two TP slides is sufficient for accurate cytologic interpretation. A study by Hasteh et al. [33] found that only one TP slide is representative of the specimen and is sufficient to make an accurate diagnosis. Irizar et al. [29] observed that the diagnostic accuracy of thyroid FNAB samples improves with TP. On the other hand, Biscotti et al. [19] found that similar diagnostic accuracy to that of conventional smear preparations is offered by TP slides.

Papillary thyroid carcinoma (PTC) is the most common malignant tumor of the thyroid. The presence of three out of the following five features facilitate the diagnosis – papillae, psammoma bodies, nuclear grooves, intranuclear cytoplasmic inclusions (INCI), and fine powdery chromatin. The presence of grooves and INCI in high frequency is most dependable [34]. The presence of cystic changes marked Hurthle cell changes, if any variant of papillary carcinoma is there, or a differential diagnosis of hyalinizing trabecular adenoma are the common difficulties in PTC [27].

Lymph node

Studies comparing the diagnostic accuracy and morphology of CS and LBC in the evaluation of lymph nodes gave variable

conclusions [4]. Lee et al. [21] described many differences between the two preparation techniques and emphasized the importance of experience with LBC for a correct interpretation. LBC has less obscuring material; however, this feature could be a hindrance because presence of tumor diathesis and necrosis may be helpful in establishing a diagnosis [35]. In their study, no statistically significant difference was seen between LBC and CS regarding informative background, monolayer sheets, and cellularity.

Garbar et al. [36] found more inadequate samples for LBP than for CS. There was absence of blood in the background and better nuclear and cytological details were seen in LBC in the present study.

In a study comparing TP and CS in head and neck FNAC, the authors found no statistical difference between the two groups with regard to the presence of monolayer cells, cell architecture, nuclear details, and cytoplasmic details. Cellularity, informative background, and cytoplasmic details were statistically more significant in the CS group [37].

Dey et al. [8] noted that TPs were superior to CS with regard to clear background, monolayer cells, and cell preservation. In the study by Ford et al. [38], TP was found to be equal to CS in terms of the degree of monolayer detail and cellular yield. Ryu et al. [13] reported that when compared with CS, SurePrep (SP) produced prominent 3D configurations for epithelial clusters that occasionally caused difficulty in recognizing nuclear characteristics.

Similarly, in our study 3D clusters were present more frequently in LBC preparations. Previous studies observed that LBC shows more hyperchromatic nuclei and prominent nucleoli.

Garbar et al. [36] stated that the Reed–Sternberg cells were more difficult to observe, due to retraction/ lysis of their cytoplasm by the alcohol fixation and hemolytic propriety of CytoRich Red or mechanical process. The size difference among centroblasts, small lymphocytes, and centrocytes is not obvious. The accuracy of FNA cytology for general lymph node enlargement was identical between CS cytology and LBC.

Kim et al. [35] documented that lymphoma was difficult to evaluate using LBC because lymphoid cells clumped together and appeared smaller. Ford et al. [38] also highlighted that lymphoid cells have a tendency to aggregate so they might be erroneously considered as epithelial cells; however, similar aggregations were not observed in other studies [9] and even in the present study.

Dey et al. [8] described that in granulomatous lymphadenitis, granulomas have a rounded contour and consist of epithelioid histiocytes with interspersed lymphoid cells in LBC. Granulomas seen on LBC in our study were ill-formed architecturally as compared to those seen in CS and was not identified in one case in LBC.

Kim et al [35] identified three benign lesions with granuloma on CS but none on LBC in their study. Ford et al [38] stated that accuracy is the ultimate diagnostic goal of FNAC with secondary goals of safety, speed, and cost-effectiveness. The cyto-preparatory technique used to prepare the specimen is integral to obtaining diagnostic accuracy.

Nasuti et al. [39] demonstrated that FNA cytology of lymph nodes could be used effectively for staging a variety of non-lymphoid malignancies, as evidenced by a 94% correlation with the surgical pathology diagnosis. In this study, the sensitivity for metastatic carcinoma to a lymph node increased from 71.4% obtained with CS cytology to 100% with LBC.

Rossi et al. [40] reported a higher diagnostic value with a sensitivity of 98.6% and a specificity of 100%, of LBC combined with immuno-cytological analyses in FNA specimens from general lymph nodes compared with CS cytology. Mygdakos et al. [4] showed that LBC was greatly superior to CS cytology in all cases with non-gynecological lesions including cervical lymph nodes.

Arul [22] observed that LBC smears in lymph node lesions were superior to CS as immature lymphoid cells and Reed-Sternberg cells were better visualized but found difficulty in identification of lympho-glandular bodies and granulomas. Garbar et al. [36] found no difference in the results of lymph node FNAC between CS and LBC though there is difference in the cost.

SurePath (SP) technique can be a viable alternative for clinicians who infrequently perform FNAC. From the pathologist's view, diagnosis obtained from using SP is more efficient because only one slide is needed for the technique, and it presents stained cells within a 13 mm diameter circle which is less time consuming to read [21]. Moreover, the cytology laboratory should obtain experience with and verify the features produced on LBCs when compared to CSs on a wide variety of lesions before implementing LBC methodology to FNAC material [4].

The key advantages of the LBP technique are efficiency, minimal skill requirement, and safety while diagnostic accuracy and cost favor the use of the conventional smear technique [38].

Most of the studies have suggested that because of diagnostic problems and unfamiliarity, application of the LBC method on FNAC cytology is limited. So currently, the LBC method can supplement conventional preparations but cannot replace it on FNAC cytology [4].

Advantages of liquid based cytology

- A smaller number of slides - mostly single slide is enough for reporting.
- Absence of artifact in preservation.
- Absence of obscuring background elements (RBCs, necrosis).
- Presence of cells in monolayers.
- The remaining sample can be used for adjuvant study like immunocytochemistry, cell block preparation, immunohistochemistry.
- Cell morphology and nuclear details are similar in both the preparations.
- Abundant cellularity in LBC with no overlapping of the cells along with absence of obscuring background material is very helpful in diagnoses with some exceptions.
- Cytoplasmic and nuclear details are similar to conventional smear.
- If the initial slide is inadequate due to any reason, the LBC sample can be centrifuged again, and a second slide can be prepared and checked before directly asking for a repeat FNA procedure which is the case in conventional smear.

Disadvantages liquid based cytology

- Preparation of slide is slightly more time consuming.
- Loss or paucity of informative background (fibromyxoid stroma, mucus, colloid, etc).
- Loss of architectural pattern.
- Requires LBC instrument and commercial available fixative solution vials, which may not be available or affordable in relatively low resource settings.

Advantages of conventional preparation

- Preserved architectural arrangement.
- The presence of informative background.

Disadvantages of conventional smears

- Presence of obscuring background material.
- Screening time for the number of slides is long and exhaustive, especially when the smears are paucicellular.
- Two or more slides are needed on average.
- If cellularity is low, a second time aspirate has to be made.
- Less monolayering with more overlapping of cells.

Conclusion

FNAC is a rapid, simple, effective, and reliable technique to get early diagnosis in easily accessible sites such as breast, thyroid, and lymph nodes. Conventional and liquid based smears, both provide good cellularity and good cytoplasmic and nuclear details. CS in addition provide preserved architectural details, informative background material, which help in diagnosing the lesions.

Obscuring elements may require a repeat FNA procedure. LBC also provides good cellularity, good nuclear and cytoplasmic details, they are mostly devoid of obscuring elements and give excellent monolayers. Also, as only a single slide has to be seen and a smaller area is to be screened, it is pathologist-friendly as it saves time and obviates the fatigue associated with screening of multiple conventional smear slides. Both the techniques are equally good, and both have their own advantages and disadvantages. LBC can be used for routine diagnosis and reporting of FNA material but first the procedure needs to be validated against the time-tested conventional smears and an acclimatization of the pathologist for this method of reporting is required.

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