Original Article

DOI: 10.21276/APALM.2854

Cell Block: A Tool to Improve Cytopathologic Diagnostic Value of Fine Needle Aspiration Material

Vaishali Baburao Nagose[1]*, Shruthi Amit Deshpande[2], Dinesh Kasturi[2] and Varsha Ashok Jadhav[3]

[1]Dept. Of Pathology, Dr Ulhas Patil Medical College & General Hospital, Jalgaon (Khurd), 425309, Maharashtra, India.
[2]Department of Pathology, Mamata Medical College, Rotary Nagar, Khammam-507002. Telangana. INDIA
[3]Dept. of Pathology, Apollo Institute of Medical Sciences & Research, Chittoor, Murukambattu, Chittoor, AP, India.

ABSTRACT

Background: The various advantages of Fine-needle aspiration (FNA) biopsy/ cytology can be limited due to inadequacy of the specimen and expertise required for diagnosis. Cell blocks (CBs), though routinely used in cytology of body fluids, can also be used in FNA material with considerable increase in diagnostic accuracy. Aims & objectives: To compared FNA & CB as diagnostic tool and to evaluate whether cell block adds to the diagnostic accuracy of FNA.

Methods: This is a two years prospective study carried out in the pathology department of a tertiary heath care hospital and medical college of South India which included the cases undergoing the FNAC, and followed by the biopsy. CB was prepared using Tissue coagulum clot (TCC) method. The smears and tissue sections were assessed for cellularity and adequacy for diagnosis. CBs were grouped into four diagnostic categories. FNA & CB were compared with histopathology (HPE) diagnosis to calculate Sensitivity, Specificity and Diagnostic Accuracy.

Result: A total of 195 cases were included. Cellularity and adequacy for diagnosis were higher in CB. They were diagnostically better (superior) in 13.84% (27) cases. The sensitivity (95.77%) and diagnostic accuracy (94.87%) of CB was found to be considerably higher than FNA (78.84% and 78.46% respectively).

Conclusion: In cases of suspicious/ intermediate diagnosis or diagnosis discordant with clinical ones, by FNA; should be followed with the CB to improve the diagnostic yield & to facilitate accurate diagnoses. TCC method is a simple CB method which has higher diagnostic accuracy than FNA.

Keywords: *FNAC, FNAB, Cell Block, Cytology, Cytopathology, Diagnostic Accuracy.*

Introduction

Fine-needle aspiration (FNA) biopsy/ cytology is an easy, OPD basis, minimally invasive and cost-effective technique with good accuracy and efficiency in routine cytopathology. However, the inadequacy of the specimen can be as high as upto 30%. [1] Associated is, always a risk of false negative diagnosis or other situations requiring use of experience and expertise for a confidant diagnosis which itself may be limiting the result. [2, 3] However, the advantage of histopathology (HPE) over the cytological examination can be obtained by using all the remaining material of the FNA for making cell blocks (CBs) which gives a better morphological and histological detail. Thus, the diagnosis may be refined. Also, the benefit of availability of the multiple sections for special stains and IHC form cell block makes it a desirable practice in the set up with required resources. Both techniques together can improve the diagnostic accuracy, eliminate the need of repeat FNA for non diagnostic cases and avoid the trauma and risks of biopsy. [4]

In the present study, we compared these two methods as a diagnostic tool and evaluated whether cell block adds to the diagnostic accuracy of FNA.

Materials and Methods

The present study was two years prospective study carried out in the pathology department of a tertiary heath care hospital and medical college of South India. The cases undergoing the FNAC, and followed by the biopsy were included.

FNAC was performed under aseptic condition using 21, 22 or 23 gauge needles attached to the 10 ml disposable syringes with or without aspiration as required. Smears were prepared without delay taking care to avoid the coagulation of the sample. All of them were immediately alcohol fixed in 95% ethyl alcohol for Papanicolaou (Pap) stain & hematoxylin and eosin (H & E) stain except a few which were air dried for May Grunwald – Giemsa (MGG) stain and in the suspected cases of Tuberculosis (TB), Zeihl – Neelson stain (ZN stain) for demonstrating Acid Fast Bacilli.

The method used for preparation of the CB was Tissue coagulum clot (TCC) method. The material remaining in the needle hub and attached syringe was allowed to clot, later left overnight to fix in the mixture of 10% formalin and 95% alcohol (1 part each). The material thus obtained was processed as routine biopsy specimen and the tissue sections were stained with H & E stain.

The smears and tissue sections were assessed for cellularity and adequacy for diagnosis. All the cases were categorized as having abundant, moderate, scant and no cellularity on smears as well as cell block. Again, they were divided into adequate and inadequate. The diagnoses on FNAC were given according to criteria of reporting the various organs smears in the textbook of Orell and textbook of Koss. The cell blocks were also reported separately. They were grouped into 1) Non-Diagnostic/ Diagnosis Discordant with FNA & HPE 2) Diagnostically equal (same diagnosis as of FNA and HPE), 3) Diagnostically aiding (confirming a suspicious/ possible/ intermediate FNA diagnosis, which was confirmed by same diagnosis on HPE) and 4) Diagnostically Superior (giving a different diagnosis than one of FNA, or giving a specific neoplastic lesion in cases suspicious of malignancy - same diagnosis on HPE). HPE diagnosis was taken as gold standard and the diagnosis of FNA & CB were compared with it to calculate Sensitivity, Specificity and Diagnostic Accuracy. The statistical analysis was done after recording the complete data on Excel worksheet.

Result

A total of 195 cases were included in this study with FNA and HPE both samples available. The age of patients ranged from 5 years to 85 years. Thyroid was the most common site for FNA (32.8%) followed by lymph node, breast, and soft tissue & bone (Table 1).

Cellularity was better marginally in CB (Table 2). The adequacy for diagnosis was also higher in CB (94.87%) by a little difference than FNA (92.3%) (Table 3). Out of the 15 cases found to be inadequate for diagnosis by FNAC, eight cases were adequate by CB. But three of the adequate FNAC cases were inadequate by CB.

On comparison with the HPE diagnosis, CB was found to be diagnostically better (superior) in 13.84% (27) cases and aiding the final diagnosis in 12.83% (25) cases than FNA (Table 4). Most of the cases in the former category were from lymph nodes and thyroid. The latter category had maximum cases of suspicious for malignancy diagnosis on FNAC.

The discordant cases on FNA with respect to HPE belonged to lymph nodes (nine cases) and thyroid (seven cases) mainly (Table 1). CB was found to be diagnostically superior in all of these, giving the diagnosis same as HPE. In lymph nodes both neoplastic and non neoplastic lesions were found to have discordant cases, but in all the neoplastic cases of these, the CB gave correct diagnosis. There were three cases proved to be metastatic deposits of squamous cell carcinoma by CB and HPE, of which two were diagnosed as suppurative lymph node and another as keratinous cyst on FNA. Similarly, in three breast FNAs, malignancy was correctly diagnosed on CBs, as compared to fibroadenoma with atypia and inconclusive diagnosis given by FNA. Correct typing of the malignancy was evident by CB in the cases diagnosed as malignancy or suspicious of malignancy from lung masses (five cases) and thyroid (two cases). Also, two cases diagnosed as goiter by FNA were found to be follicular neoplasm on CB, later confirmed to be follicular adenoma. A case of goiter, simple cyst breast and a parasitic cyst each were inconclusive due to lack of cellularity on CB when FNA was able to give correct diagnosis.

The sensitivity (95.77%) and diagnostic accuracy (94.87%) of CB was found to be considerably higher than FNA (78.84% and 78.46% respectively) (Table 4).

Table 1: Sources of FNA/ CB with the site-wise discordant cases.

Sr. no.	Site	No of cases	FNA diagnosis		CB diagnosis in discordant cases/ ones with superior diagnosis	HPE Diagnosis in discordant cases/ ones with superior diagnosis	No of discordant cases of FNA vs CB & HPE	No of discordant cases of CB vs FNA & HPE
			n	Diagnosis				
1	Soft tissue, bone.	30 (15.38%)	13	Lipoma				
			1	Reactive l n	Neurofibroma	Neurofibroma	1	
			6	Keratinous cyst				
			2	BNST				
			6	Abscess				
			1	Parasitic cyst	Inconclusive	Parasitic cyst		1
			1	Cystic lesion - bone	Giant cell lesion	Giant cell tumour	1	

Sr. no.	Site	No of cases	FNA diagnosis		CB diagnosis in discordant cases/ ones with superior diagnosis	HPE Diagnosis in discordant cases/ ones with superior diagnosis	No of discordant cases of FNA vs CB & HPE	No of discordant cases of CB vs FNA & HPE
			n	Diagnosis				
2	Lymph nodes	43 (22.05%)	13	Tb ln	Suppurative ln (2 cases)	Suppurative ln (2 cases)	2	
					Suppurative ln (1 case)	Tb ln (1 case)		1
			9	Reactive ln	TB ln (1)	TB ln (1)	1	
			4	Mets – SCC				
			1	? Keratinous cyst	Mets SCC	Mets SCC	1	
			1	Lepromatous ln				
			4	Suppurative ln	Mets SCC (2 case) TB ln (2 case)	Mets SCC (2 case) TB ln (2 case)	4	
					Abscess (1 case)	Suppurative ln (1 case)		1
			3	Chronic non-specific ln				
			1	Hodgkin disease				
			2	NHL				
			5	Inconclusive	Reactive ln (1 case) Mets (1 case)	Reactive ln (1 case) Mets (1 case)	2	
3	Breast	32 (16.41%)	13	Fibroadenoma	Ca breast (2 cases)	Ca breast (2 cases)	2	
			3	Breast abscess				
			2	Gynecomastia				
			8	Ca breast	Atypical Fibroadenoma (1 case)	Atypical Fibroadenoma (1 case)	1	
			3	Simple cyst	Inconclusive (1 case)	Simple cyst (1 case)		1
			3	Inconclusive	Ca breast (1 case)	Ca breast (1 case)	1	
4	Thyroid	61 (31.28%)	3	Neoplastic	PCT (2 cases)	PCT (2 cases)	2	
			3	PCT				
			3	Follicular neoplasm		Follicular adenoma		
			32	Goiter	Follicular neoplasm (2 cases)	Follicular adenoma (2 cases)	2	
					Inconclusive (1 case)	Goiter (1 case)		1
			7	Thyroiditis	Inconclusive (1 case)	Thyroiditis (1 case)		1
			9	Benign cystic lesion	Thyroiditis (1 case)	Thyroiditis (1 case)	1	
			4	Inconclusive	Goiter (1 case) Thyroiditis (1 case)	Goiter (1 case) Thyroiditis (1 case)	2	

Sr. no.	Site	No of cases	FNA diagnosis		CB diagnosis in discordant cases/ ones with superior diagnosis	HPE Diagnosis in discordant cases/ ones with superior diagnosis	No of discordant cases of FNA vs CB & HPE	No of discordant cases of CB vs FNA & HPE
			n	Diagnosis				
5	Salivary gland	10 (5.13%)	1	Myoepithelioma	Pleomorphic adenoma	Pleomorphic adenoma	1	
			5	Pleomorphic adenoma				
			3	Sialadinitis	Abscess (1 case)	Sialadinitis (1 case)		1
			1	Inconclusive	Pleomorphic adenoma	Pleomorphic adenoma	1	
6	Skin subcut	6 (3.08%)	1	Keratinous cyst				
			1	Keloid				
			2	SCC				
			1	Inconclusive	? Spindle cell lesion	Fibrotic lesion	1	
7	Lung, pleura	10 (5.13%)	4	Koch's				
			5	Malignant	SCC (3 cases), Adenocarcinoma (2 cases)	SCC (3 cases), Adenocarcinoma (2 cases)		
			1	Inconclusive	s/o Malignancy	SCC	1	
8	Oral cavity	3 (1.54%)	3	SCC				
Total		**195**					**27**	**7**

Table 2: Cellularity in FNA vs CB.

Cellularity	FNA	CB
Abundant	41 (21.10%)	46 (23.52%)
Moderate	104 (53.34%)	104 (53.34%)
Scant	42 (22.16%)	41 (21.10%)
No cellularity	7 (3.4%)	4 (2.04%)
Total cases	195 (100%)	195 (100%)

Table 3: Distribution of adequacy between FNAC & CB.

		FNAC		Total
		Adequate	Inadequate	
Cell Block	Adequate	177 (90.77%)	8 (4.1%)	185 (94.87%)
	Inadequate	3 (1.53%)	7 (3.6%)	10 (5.13%)
Total		**180 (92.3%)**	**15 (7.70%)**	**195 (100%)**

Table 4: Diagnostic categories of CB and Statistics.

Diagnostic categories of CB		n (%)
	Diagnostically Superior	27 (13.84%)
	Diagnostically aiding	25 (12.83%)
	Diagnostically equal	129 (66.15%)

Diagnostic categories of CB		n (%)	
	Non-Diagnostic (HPE diagnostic)/ CB Diagnosis Discordant with FNA & HPE	14 (7+7), (7.18%)	
Diagnosis		FNA [n (%)]	CB [n (%)]
True Positive	Offered Diagnosis same as HPE	149 (76.41%)	181 (92.82%)
True Negative	Inconclusive, HPE as well Inconclusive	4 (2.05%)	4 (2.05%)
False Negative	Offered Diagnosis different from HPE	29 (14.87%)	2 (1.03%)
	Inconclusive, HPE Diagnostic	11 (5.64%)	6 (3.08%)
False Positive	Diagnosis offered, HPE inconclusive	2 (1.03%)	2 (1.03%)
Sensitivity		78.84%	95.77%
Specificity		66.67%	66.67%
Diagnostic Accuracy		78.46%	94.87%

Table 5: Comparison of adequacy, sensitivity, specificity and diagnostic accuracy of FNA & CB in recent Indian works.

Author	Site – if specific	Adequacy		Sensitivity		Specificity		Diagnostic Accuracy	
		FNA	CB	FNA	CB	FNA	CB	FNA	CB
Wadhwa et al.[18]	HNF			88.8%	96%	--	100%	92%	97.67%
Parate et al.[19]		90%	86.94%	88.06%	90.91%	92.86%	92.86%	89.47%	91.47%
Mathew et al.[20]	GFNA	100%	100%	62.22%	71.11%	100%	100%	63.04%	71.73%
Barsagade et al.[21]		81.85%	79.25%						
Patil et al.[22]		87.83%	81.08%	94.90%	98.92%	93.75%	96.30%	94.61%	98.33%
Present study		92.3%	94.87%	78.84%	95.77%	66.67%	66.67%	78.46%	94.87%

HNF – Head Neck Face, GFNA – Guided FNAs.

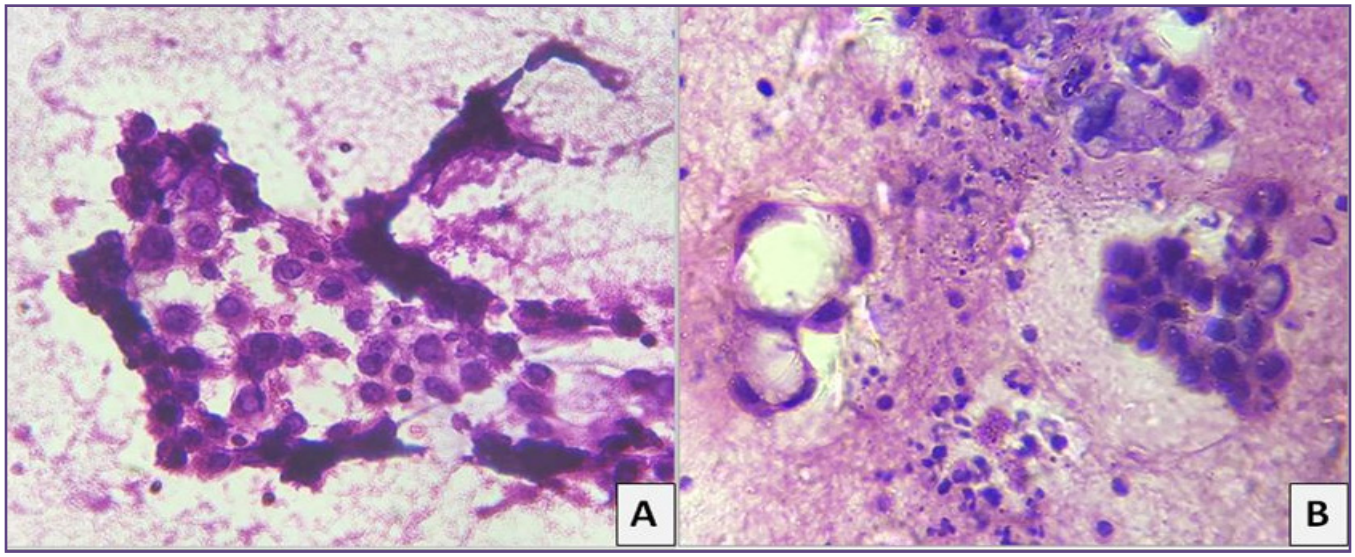

Fig. 1 a – Smear prepared from FNAC lung mass showing loosely cohesive malignant epithelial cells. (400x MGG). Other fields showed doubtful signet ring cells as well. Figure 1 b - corresponding cell block showing acini and signet ring cells. (400x H & E).

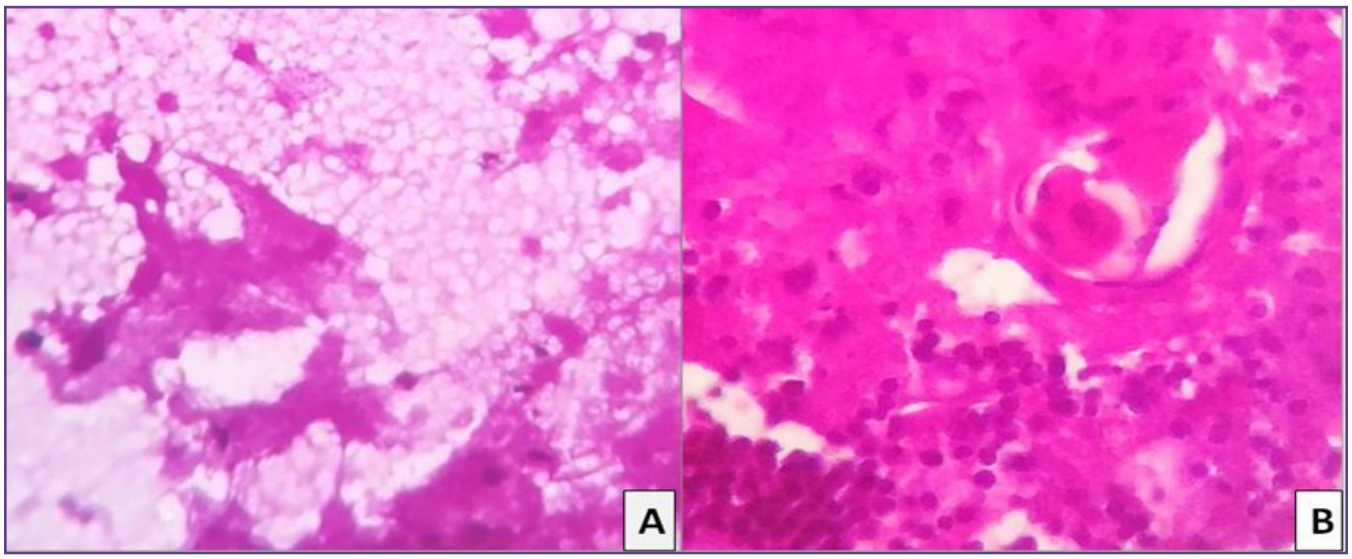

Fig. 2 a - Smear prepared from FNAC right submandibular lymph node. Shows few anucleate and nucleated squamous cells only, with occasional dysplastic squamous cells and mononuclear inflammatory infiltrate. (400x H & E). Figure 2 b - corresponding cell block showing keratin pearl with surrounding lymphocytes. (400x H & E).

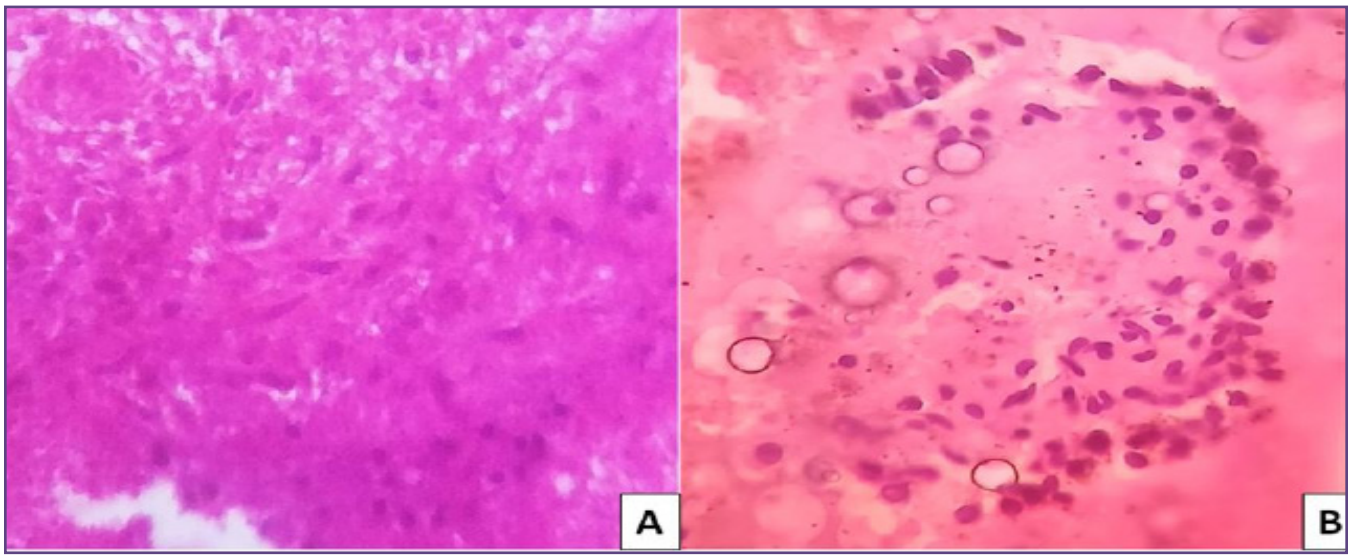

Figure 3 a & b - Cell block showing ill formed epitheloid cell granuloma formation. (400x H & E). The corresponding FNAC smears showed only scant cellularity comprising of few lymphocytes with occasional epitheloid cell.

Discussion

The history of FNA for the diagnosis of the neoplastic lesion goes back to 1847, then described as a "new instrument for the diagnosis of tumors" by Kun. Afterwards it was applied by various practitioners to different sites.

Cell block technique was first used almost a century ago by Bahrenburg (in1896), approximately five decades later to FNA initial use, as an alternative to the preparation of conventional smear from ascitic fluid.[5] Since then, other than various fluids, it has also been prepared from hemorrhagic aspirates.[6, 7] To the various advantages of FNA, it adds diagnostic architecture just as a histological diagnosis.[8] Another very important virtue is that multiple sections can be taken from the cell block to be used for special staining and IHC other than routine staining.[9, 10]

CBs have been popularly prepared from the material of FNA by paraffin- embedding the direct transfer of all centrifuged cellular material wrapped in lens paper,[11, 12] or embedding in plasma,[13, 14] or agar.[15, 16] Afterwards it is processed as a routine histological specimen. The Tissue

coagulum clot (TCC) method has an advantage over the conventional aspiration needle rinse in the recovery of cellular material and prevention of the loss of diagnostic material. Also, there is no requirement of any special equipment or reagents in TCC method.[17] This makes it feasible method in any modest laboratory.

Less dispersal of the cells in the CBs, may result in improved adequacy and ease at microscopic examination. The adequacy of the CBs has been found to be 79.25% to 100% by the recent works, with concordant finding in the present one (94.87%) as well (Table 5).[18-22] It is little less than or equal to that of FNA in all, but we found the adequacy to be a bit higher than that of FNA. The possible reason may be the high dependence of FNA on the expertise of the person performing the aspiration. Also, if the blood appears in the needle hub, the diagnostic material may be sucked in syringe; as a result it will be processed in CBs, against hemorrhagic FNA smears.[23] A common finding is increase in adequacy when the two methods are combined.[21, 22]

The CBs are known to show additional diagnostic information along with architectural patterns, than FNAC smears aiding in increased diagnostic accuracy with them and confirmation of many suggestive/ suspicious/ intermediate diagnosis by FNA.[21, 22] The present work has same finding. The architectural features better appreciated in CB included gland formation of malignant cells in adenocarcinomas in lung aspirate (Figure 1), keratin pearl formation in lymph node (Figure 2) and lung lesion aspirates in SCC. The epitheloid granulomas were seen in a lymph node aspirate CB when only necrotic material and scant chronic inflammatory infiltrate seen in smears (Figure 3).

As widely known, the CB is contributory in only upto one third of cases in the diagnosis of thyroid lesions. One of the main causes is the low cellularity, and yet another cause may be hemorrhagic nature of the thyroid aspirates.[24, 25] The case inconclusive by CB in our work was due to very low cellularity and colloid being better appreciated in the smears. The neoplastic lesions could be confirmed and subtyped due the architectural details available from CB including papillary arrangement in PCT. The findings are similar to some recent works showing better CB diagnosis than FNA from thyroid.[18, 22]

In lung carcinoma CB is important in the subtyping of by morphology,[26] and also in IHC for squamous and adenocarcinoma markers.[27] Endobronchial ultrasound-guided transbronchial needle aspirates (EBUSTBNAs) samples' CBs have been found to yield adequate tissue for cytological analysis in over 97% of cases.[28, 29] Similarly, in the present study and yet another recent one,[22] correct typing of the malignancy was done in the lung masses by CB, where FNA gave diagnosis of malignancy.

Another site with noticeable role of CB in this research was breast lesions where they confirmed, ruled out or diagnosed malignancy against suspicious malignancy cases, negative ones in FNA or inadequate ones respectively. This is concordant with other Indian works.[21, 22] The possible cause may be better appreciation of cellular and architectural details of the cellular material entangled in the hemorrhagic aspirate. Also, in lymph nodes the cases of malignant deposits either missed or misdiagnosed on the FNA were correctly diagnosed in CB, as in other studies.[21, 22]

The sensitivity, specificity and diagnostic accuracy of CB has been found to be higher than FNA in the recent works (Table 6).[18-22] The present study found the sensitivity and diagnostic accuracy of CB more than FNA; and same specificity of CB and FNA. Concordant finding is present in another work.[19] If only neoplastic diagnoses are considered, then the specificity is found to be very high.

Despite all the above positive findings, CBs were found have longer processing time, due to histopathology processing to be used in them and the cost would increase due to additional method. However, in cases where the FNA has not been diagnostic should be followed with the CB to increase the diagnostic rate and accuracy.

Conclusion

The less frequently used technique of Cell block actually allows the recovery and use of even minimum amounts of diagnostic cellular material, thus facilitating the correct diagnosis when FNA is not conclusive or does not give correct diagnosis. TCC method being a simple method, not requiring special reagents or expertise to handle the specimen; is feasible in any resource limited laboratory. CBs give advantage of HPE from the cytology sample. Thus, cases where the FNA has given inaccurate/ suspicious/ intermediate diagnosis should be followed with the CB to improve the diagnostic yield & to facilitate accurate diagnosis.

Acknowledgements

We would like to extend our sincere thanks to all the staff of the department of Pathology, Mamata Medical College and Hospital, Khammam for their support for this work.

Funding
None

Competing Interests
None

Reference
1. Singh N, Ryan D, Berney D, Calaminici M, Sheaff MT, Wells CA. Inadequate rates are lower when FNAC samples are taken by cytopathologists. Cytopathology. 2003 Dec 1;14(6):327-31.
2. Basnet S, Talwar OP. Role of cell block preparation in neoplastic lesions. Journal of Pathology of Nepal. 2012;2:272-276.
3. Kulkarni MB, Prabhudesai NM, Desai SB, Borges AM. Scrape cell block technique for fine needle aspiration cytology smears. Cytopathology. 2000;11:179-84.
4. Buscarini L, Fornari F, Bolondi L, Colombo P, Livraghi T, Magnolfi F, Rapaccini GL, Salmi A. Ultrasound-guided fine-needle biopsy of focal liver lesions: techniques, diagnostic accuracy and complications: a retrospective study on 2091 biopsies. Journal of hepatology. 1990 Nov 1;11(3):344-8.
5. Bhatia P, Dey P, Uppal R, Shifa R, Srinivasan R, et al. Cell blocks from scraping of cytology smear: Comparison with conventional cell block. ActaCytol. 2008;52:329-333.
6. Bodele AK, Parate SN, Wadadekar AA, Bobhate SK, Munshi MM. Diagnostic utility of cell block preparation in reporting fluid cytology. J Cytol. 2003;20:133-135.
7. Qui L, Crapanzano JP, Saqi A, Vidhun R, Vazquez MF. Cell block alone as an ideal preparatory method for hemorrhagic thyroid nodule aspirates procured without onsite cytologists. Acta Cytol. 2008;52:139-144.
8. Khan AJ, Hingway SR, Raut WK. A new cost- effective cell block technique for optimisation of fine needle aspirates in bone Lesions. International journal of medical and applied sciences. 2013;2:324-333.
9. Zito FA, Gadaleta CD, Salvatore C, Filático R, Labriola A, et al. A modified cell block technique for fine needle aspiration cytology. Acta Cytol. 1995;39:93-99.
10. Krogerus LA, Anderson LC. A simple method for the preparation of paraffin-embedded cell blocks from fine needle aspirates, effusions and brushings. Acta Cytol. 1998;32:585-587.
11. Brown KT, Fulbright RK, Avitabile AM, Bashist B. Cytologic analysis in FNA biopsy: Smears versus cell blocks. AJR Am J Roentgenol 1993;161:629-31.
12. Wojcik EM, Selvaggi SM. Comparison of smears and cell blocks in the fine needle aspiration diagnosis. Acta Cytol 1991;35:773-6.
13. Karnanuchow PN, Bouin RE. Cell block technique for fine needle aspiration biopsy. J Clin Pathol. 1992;35:688.
14. Burt AD, Smillie D, Cowan MD, Adams FG. Fine needle aspiration cytology: Experience with a cell block technique. J Clin Pathol. 1986;39:114-5.
15. Kung IT, Yuen RW. Fine needle aspiration of the thyroid. Distinction between colloid nodule and follicular neoplasm using cell blocks & 21 gauze needles. Acta Cytol. 1989;33:53-60.
16. Kung IT, Chan SK, Lo ES. Application of the immunoperoxidase technique to cell blocks preparations from the fine needle aspirates. Acta Cytol. 1990;34:297-303.
17. Jain D, Mathur SR, Iyer VK. Cell blocks in cytopathology: a review of preparative methods, utility in diagnosis and role in ancillary studies. Cytopathology. 2014;25(6):356-71. doi: 10.1111/cyt.12174. Epub 2014 Aug 11.
18. Wadhwa K, Bagga PK, Singh B, Paul S. Comparative Analysis of Cell Block Preparation Versus Smear Examination in the Fine Needle Aspirates of Head & Neck Lesions with Application of IHC Markers on Cell Block Preparation. International Journal of Contemporary Medical Research. 2019 June;6(6): F45-F49. DOI: http://dx.doi.org/10.21276/ijcmr.2019.6.6.42
19. Parate SN, Pawar PS, Kakade A. Role of Cell Block Preparation in Cytopathological Diagnosis. International Journal of Contemporary Medical Research 2019 July;6(7):G26- G31. DOI: http://dx.doi.org/10.21276/ijcmr.2019.6.7.47
20. Mathew EP, Nair V. Role of cell block in cytopathologic evaluation of image-guided fine needle aspiration cytology. J Cytol. 2017;34:133-8. Available from: http://www.jcytol.org/text.asp?2017/34/3/133/208112
21. Barsagade AK, Umap P, Deshpande A, Male P, Dhadas A, Jungare A et al. Diagnostic Utility of Cell Block Preparation of Fine Needle Aspiration Material. Sch. J. App. Med. Sci., Dec 2017; 5(12D): 5031-5037.
22. Patil RN, Mahore SD, Kolhe HS, Bothale KA, Gowardhan VP, Taori HS, et al. Cell Block Technique: An Effective Tool in Diagnostic Cytopathology. IOSR-JDMS. 2016 Dec;15(12):99-106.
23. Dahnert WF, Hoagland MH, Hamper UM, Erozan YS, Peirce JC. Fine needle aspiration biopsy of abdominal lesions: Diagnostic yield of different needle tip configurations. Radiology. 1992;185:263-8.
24. Sanchez N, Selvaggi SM. Utility of cell blocks in the diagnosis of thyroid aspirates. Diagn Cytopathol 2006;34:89–92.
25. Saleh HA, Hammoud J, Zakaria R, Khan AZ. Comparison of Thin-Prep and cell block preparation for the evaluation of thyroid epithelial lesions on fine needle aspiration biopsy. CytoJournal 2008;5:3.
26. Loukeris K, Vazquez MF, Sica G et al. Cytological cell blocks: predictors of squamous cell carcinoma and adenocarcinoma subtypes. Diagn Cytopathol 2012; 40:380–7.

27. Righi L, Graziano P, Fornari A et al. Immunohistochemical subtyping of nonsmall cell lung cancer not otherwise specified in fine-needle aspiration cytology: a retrospective study of 103 cases with surgical correlation. Cancer 2011;117:3416–23.
28. Esterbrook G, Anathhanam S, Plant PK. Adequacy of endobronchial ultrasound transbronchial needle aspiration samples in the subtyping of non-small cell lung cancer. Lung Cancer 2013;80:30–4.
29. Collins BT. Endobronchial ultrasound fine-needle aspiration biopsy of pulmonary non-small cell carcinoma with subclassification by immunohistochemistry panel. Cancer Cytopathol 2013;121:146–54.

***Corresponding author:**
Dr. Vaishali Baburao Nagose, C/o Dr Shivanand Rathod, Flat no 306, B wing, Gyan Chetna Residency, Opposite Godavari College of Engineering, Bhusawal Road, Jalgaon, 425001, Maharashtra. INDIA
Phone: +91 8500571871, 7025740648
Email: vaishali.nagose@gmail.com

Financial or other Competing Interests: None.

Date of Submission : 19/05/2020
Date of Acceptance : 24/06/2020
Date of Publication : 29/07/2020