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Original Research Article

Comparative study of body fluid cytology using cytocentrifuge and ordinary centrifuge

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ABSTRACT

Background: The detection of numerous bacterial, fungal, or viral illnesses as well as malignancies is aided by the cytologic study of bodily cavity fluids. The focus of this study is on the type of malignant cells, their distribution and preservation of morphology, cell yield, and comparing the outcomes for positive cases.
Aims and Objective: To assess the utility, sensitivity and compare the results obtained by cytocentrifuge (Pr0Cyt.LED4) with those of conventional centrifuge in cytodiagnosis in Tertiary Care Hospital.
Materials and Methods: A prospective investigation was carried out using ascitic, pleural, cerebrospinal, and other bodily cavity fluid samples that were split equally and centrifuged simultaneously at predetermined parameters in an ordinary centrifuge and a cytocentrifuge.
Result: For cytodiagnosis, 100 samples were examined. With a p-value less than 0.05, the results demonstrated a statistically significant difference between the two approaches.
Conclusions: According to this comparison study, the cytocentrifuge preparation outperforms the ordinary centrifuge in terms of cell yield, well-preserved cell morphology, and ability to pick up malignant cells, hence enhancing its sensitivity and improving its diagnostic use.

1. Introduction

The basic principle of exfoliative cytology is the spontaneous shedding of cells into a bodily cavity that originate from the lining of an organ and can be extracted using nonabrasive techniques.[1] The diagnosis of bacterial, fungal, or viral infections as well as malignancies can be made with the use of the cytologic analysis of bodily cavity fluids.[2] As a result, cytological examination of bodily effusions is a comprehensive diagnostic technique that seeks to identify the cause of the effusion and, in certain situations, to predict the course of the illness.[2] Given that the cell population found in sediment is indicative of a far broader surface area than that acquired by needle biopsy, the cytologic investigation of the fluid may have performed better in terms of diagnosis than the needle biopsy.[3]

In this study, the cytocentrifuge's utility and sensitivity in comparison to the ordinary centrifuge method are evaluated for cytodiagnosis. A cytocentrifuge is specifically made to concentrate small amounts of cells. Nucleoli may appear more prominent than they would in peripheral smears due to the technique's ability to stretch and deform nuclear and cellular shape. Nevertheless, neither the relative chromatin textures nor the clumping patterns are affected, nor are the nuclear: cytoplasmic ratios changed.[4] Through centrifugation, the cells that had exfoliated in the fluids and washes were concentrated. They were then immediately transferred to the smears and viewed under a microscope. The focus was on comparing the outcomes and on the types of malignant cells, their distribution, and the preservation of their morphology.

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2. Materials and Methods

This prospective study was approved by the Institute's Ethics Committee and conducted in the Department of Pathology of Tertiary Care Hospital over the course of a year (June 2022–2023).

One hundred samples of ascitic, pleural, cerebrospinal, and other bodily cavity fluids were examined in this investigation. The fluids were split evenly and centrifuged in a cytocentrifuge (PrO-Cyt.LED4) and an ordinary centrifuge simultaneously. Three parameters were chosen: acceleration rate, time, and speed. The fluids were centrifuged in a cytocentrifuge at 1800 rpm for one minute and in an ordinary centrifuge at 2000 rpm for five minutes. After fixing, hematoxylin and eosin stain had been used to the smears made using both techniques. When necessary, additional stains, such as Giemsa stain, were also applied. Following staining and mounting, the slides were inspected under a microscope and compared with regard to background, cell distribution, cell morphology, and cell yield.[5]

They received a score ranging from 0 to 2+ using the Mair et al. scoring system shown below.[6]

Table 1:

Parameter	Quantitative description	Point score
Background blood or Proteinaceous Material	Large amount, great compromise in diagnosis	0
	Moderate amount, diagnosis possible	1
	Minimal, diagnosis easy	2
Amount of cellular Material	Minimal to absent, diagnosis not possible	0
	Sufficient for cytodiagnosis	1
	Abundant, diagnosis simple.	2
Cell morphology, cellular degeneration and trauma	Marked cellular degeneration, diagnosis not possible	0
	Moderate cellular degeneration, diagnosis possible	1
	Minimum cellular degeneration, diagnosis easy	2
Distribution of cells	Totally in the periphery or sparsely distributed	0
	Combination	1
	Evenly distributed	2

2.1. Statistical techniques

Chi-square test and determining the significant value (p-value <0.05) were employed to compare the outcomes of the cytocentrifuge preparation and a conventional smear.

3. Results

For this comparison, hundred samples were examined. Out of these one hundred samples, the table below reveals that forty samples were of pleural fluid, fifty samples were of ascitic fluid, eight samples were of cerebrospinal fluid, and two samples were of other body cavity fluid (synovial fluid), shown in Table 2.

Table 2:

Type of fluid	Number of cases
Pleural fluid	40
Ascitic fluid	50
Cerebrospinal fluid	08
Other body fluids (synovial fluid)	02

In 40 Pleural fluid samples 02 were malignant and 38 were benign.

In 50 Ascitic Fluid samples 04 were malignant and 46 were benign.

In CSF samples all 08 cases were benign.

In other body cavity fluids (synovial fluid) all 02 samples were benign as shown in the Table 3.

Table 3:

Type of fluid	Benign	Malignant	Total
Pleural fluid	38	02	40
Ascitic fluid	46	04	50
Cerebrospinal fluid	08	0	08
Other body fluids (synovial fluid)	02	0	02
Total	94	06	100

For each of the 100 samples, a chi square test was used for statistical analysis. The morphological criteria of cell yield, cell morphology, cell distribution, and background were the basis for the analysis.

The cytocentrifuge method produced a higher cell yield than the ordinary method, as seen by the significant statistical variations between the two methods. The P-value is 0.00004.

According to the data, which indicated a statistically significant difference between the approaches, it was better retained in smears collected by cytocentrifuge than in conventional smear method. P less than 0.00001.

It was statistically significant that the cytocentrifuge showed a more homogeneous distribution of cells than the traditional smear method. P value is less than 0.00001.

4. Discussion

In our lab, smears from fluid samples are regularly prepared using the traditional centrifugation process. Unfortunately, the reduced cellularity and inadequate preservation of the

Table 4: Shows statistical analysis of cellyield

Parameters	Score	Centriguge	Cytospin	Chi-square	P value
	0	08	07		
Cell Yield	1	76	48	20.176	0.00004
	2	16	45		

Table 5: Shows statistical analysis of cellmorphology

Parameters	Score	Centriguge	Cytospin	Chi-square	P value
	0	08	07		
Cell morphology	1	71	16	66.836	<0.00001
	2	21	77		

Table 6: Shows statistical analysis of cell distribution

Parameters	Score	Centriguge	Cytospin	Chi-square	P value
	0	15	12		
Cell Distribution	1	70	26	49.188	<0.00001
	2	15	62		

Table 7: Shows statistical analysis of background

Parameters	Score	Centriguge	Cytospin	Chi-square	P value
	0	14	10		
Background	1	62	63	0.851	0.6533
	2	24	27		

p value = 0 6533 indicates that these findings were not statistically significant

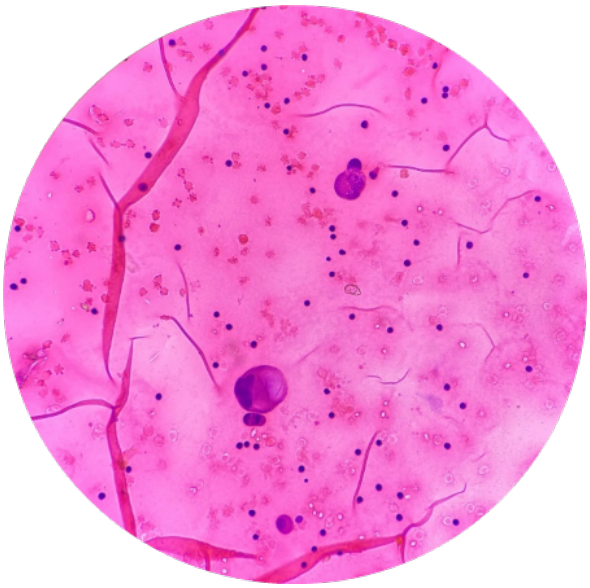

Figure 1: Uneven distribution and cell yield in centrifuge smear

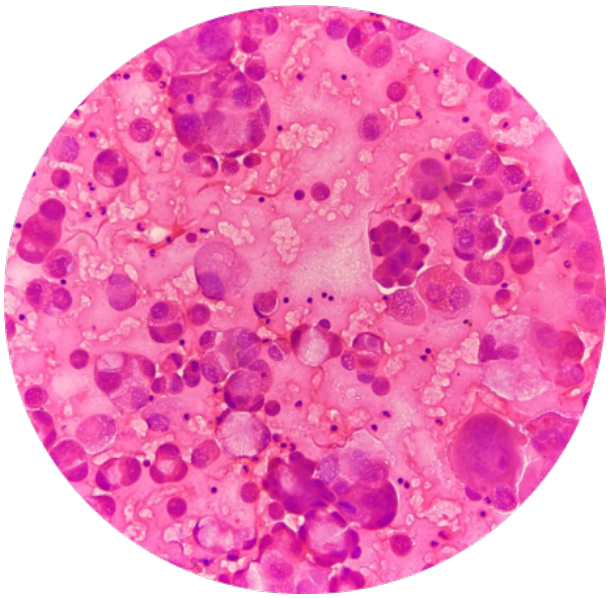

Figure 2: Even distribution and cell yield in cytocentrifuge smear

cell architecture have made it extremely challenging to analyse these fluids. Therefore, we carried a research contrasting the traditional method with the cytocentrifuge method.

In clinical medicine, the cytological analysis of serous effusions has become more and more accepted to the point that a positive result typically eliminates the need for exploratory surgery and is regarded as the final test. It is crucial for staging and prognosis in addition to helping with the diagnosis of malignant lesions.[7] In addition to increasing cellularity when compared to ordinary centrifugation, the usage of a cytocentrifuge facilitates

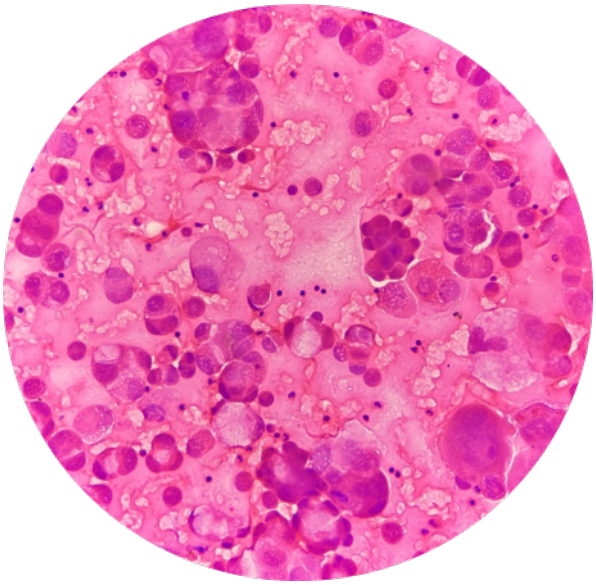

Figure 3: Cell morphology in smears obtained by centrifuge

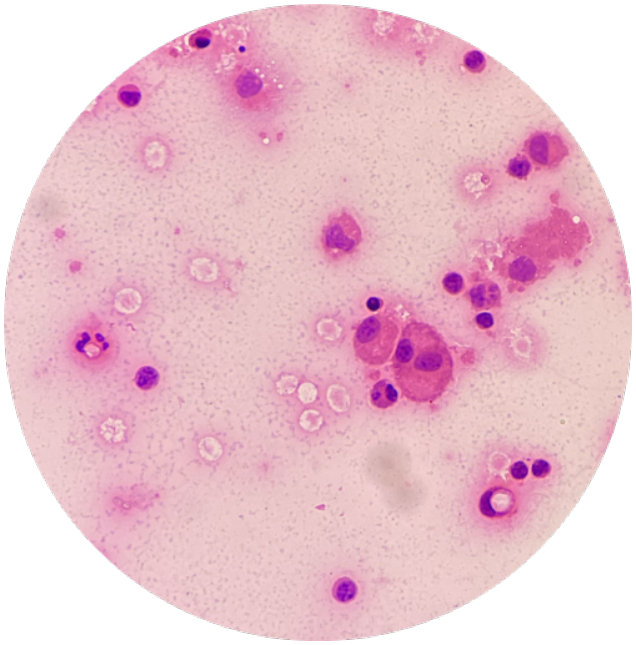

Figure 4: Cell morphology in smears obtained by cytocentrifuge which are preserved better

uniform cell distribution. On a cytocentrifuge, the cellular morphology, nuclear, and cytoplasmic features were also more clearly seen.[2]

When cells are flattened onto a glass slide after being subjected to a centrifugal force during the preparation of cytocentrifuge smears, it is anticipated that this will increase the cellular area measurement,[8] something that is not accomplished by ordinary centrifuged smears when done for a scanty cellular smear. Better cellularity hence reduces the need for multiple taps and aids in early diagnosis. On cytocentrifuge preparation, the degree of irregularity in the nuclear contour was easier to perceive,[9] increasing its sensitivity.

All age groups' bodily cavity fluids submitted to cytopathology laboratories for diagnostic workup, so comparing the fluids across age ranges is unnecessary until a malignancy is clinically suspected.[6] In the current investigation, benign pathologies predominated over malignant pathologies, regardless of the kind of fluid (pleural or ascitic) and also seen in study done by Ankita S et al.[6] In our study 100 samples were studied, out of which 06 samples were positive for malignancy while 94 cases were benign. This was consistent with the research conducted by Ankita S. et al.[6] in which 60 samples were studied, out of which 21 samples were positive for malignancy and 39 were benign. Comparable findings regarding the diseases present in the fluids have been documented by Vidushi et al.[4] in which 100 samples were studied, out of which 05 were positive for malignancy and 95 were benign. In the study done by Deshpande et al.[10] in which 150 samples were studied, out of which 25 cases being positive for malignant cells and 125 being benign. In the study done by Joshi et al.,[2] out of 150 samples, 34 were positive for malignancy and 116 were benign. In the study done by Mahajan et al.,[8] out of 150 cases 15 were positive for malignancy and 135 were benign.

The smears were then scored from 0 to 2+ based on a comparison of morphological criteria, including cellularity, cytomorphology, cell distribution, and background, using the Mair et al. grading system.[6] In comparison to traditional centrifuge preparations based on the Mair system,[6] the current investigation has found that cytocentrifuge preparations perform well for the diagnostic cellular yield and morphology. Ankita Sain et al.[6] conducted a similar study in which they examined similar morphological metrics using the Mair scoring system and discovered that the cytocentrifuge preparations' overall performance using the Mair scoring method was higher than that of smears from ordinary centrifuges.

Other studies which included Mair scoring system for comparison of the results were by Mahajan et al.,[8] Mahendra et al.[5] and Archana et al.[2] making it the most widely used and apt method for scoring and comparing the different parameters for cytodiagnosis.

Based on the findings of the current investigation, the Chi square test was used to determine the significance value (p-value) for each of the individual features of background, cellularity, morphology, and distribution as per Mair scoring system.

Cell yield: This investigation has demonstrated the presence of a significant p-value of less than 0.05 for cell yield for the cytocentrifuge preparations when compared with conventional smears which is in accordance with the

study done by Vidushi et al.,[4] Mahajan et al.,[8] Mahendra et al.[5] and Archana et al.[2] stating that because the results were statistically significant (p<0.05), the cytocentrifuge performed better in terms of producing a higher cell output.

Cell morphology: Based on the current investigation, a significant p-value of less than 0.05 is present for cell morphology which is in accordance with the study done by Vidushi et al.,[4] Mahajan et al.,[8] Mahendra et al.[5] and Archana et al.[2] in which given that the results were statistically significant (p<0.05), cytocentrifugation is a superior method for maintaining cell shape. Identification of the diagnostic cells is significantly aided by cytomorphological preservation. It is employed to distinguish between benign and cancerous cells.

Cell distribution: The results of the current study indicate that there is a significant p-value of less than 0.05 for cell distribution. This is consistent with research conducted by Vidushi et al.,[4] Mahajan et al.,[8] Mahendra et al.,[5] and Archana et al.,[2] which found statistically significant results (p<0.05) supporting the superiority of cytocentrifuge in cell distribution. It facilitates quick and simple screening and lowers the quantity of subpar specimens.

Background: The present study has shown that for the feature of background, a p-value of >0.05 was observed for cytocentrifuge preparations when compared with conventional smears. Background was therefore not comparable between the two approaches.

This was in accordance with the study done by Vidushi et al.[4] in which the result for background were not statistically significant (p value >0.05).

On the other hand, research by Ankita S et al.,[6] Mahajan et al.,[8] Mahendra et al.,[5] and Archana et al.[2] revealed a significant p-value when background was compared between cytocentrifuge and ordinary centrifuge smears.Comparable reports were reviewed for this study by Joshi et al.,[2] who discovered that conventional smear results differ significantly from cytocentrifuge results, and by Mahajan et al.,[8] who discovered that the differences between the two methods for a number of parameters were statistically significant, or (p<0.05).[8]

Few other related studies[11–15] were also reviewed which showed the significant potential of cytocentrifuge over ordinary centrifuge method and comparison with other diagnostic techniques used in cytodiagnosis like ThinPrep preparations and cell block. The research conducted by Straccia et al.[11] revealed that cytocentrifuge distinguishes well between normal cells, reactive cells and atypical cells. In the study done by Mulkalwar M et al.,[12] direct comparison of effusion analysis by cytocentrifuge and cell block methods revealed that there is no difference between these methods.

Qamar et al.[13] conducted a comparative study between the cytocentrifuge and cell block techniques. The results showed that the cytocentrifuge technique is superior to the cell block method for concentrations of cells from fluid sample, particularly in hypocellular fluids, and allows better preservation of cell morphology. This could be explained by the diverse modifications that the tissue goes through at different phases of fixation and tissue processing using the latter technique. Furthermore, the cytocentrifuge technique requires less technical manpower, is easier to use, and takes less time. It is also reasonably inexpensive.

Study done by Ashwini B.R. et al.,[14] demonstrated that cytocentrifuge is efficient in making smears from inadequate samples.

In the study done by Ayesha et al.,[15] it was found that cytocentrifuge was superior to conventional smear in reaching to a correct diagnosis.

5. Conclusion

This comparison research showed that, when compared to a cytocentrifuge, a regular centrifuge is not very satisfactory at reporting fluids with little cellularity. Therefore, a cytocentrifuge can be preferred over other techniques for fluids with minimal cellularity. Furthermore, smears made using a cytocentrifuge demonstrated a better appreciation of the cell morphology than smears created using an ordinary centrifuge, which aided in a precise diagnosis. It was discovered that the cytocentrifuge is a more sensitive diagnostic instrument. Because of this, cytocentrifuges may be chosen for cytologic analysis of body cavity fluids rather than traditional smears.

6. Source of Funding

None.

7. Conflict of Interest

None.

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