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Original Research Article

Pathology For Better Disease Understanding

Evaluation and Diagnostic Utility of Endometrial Aspiration Cytology In Abnormal Uterine Bleeding In Compare With Histopathology.

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Abstract: Abnormal uterine bleeding (AUB) is a frequently encountered problem for which women used to have gynecological consultation. Endometrial aspiration cytology (EAC) is an acceptable and valuable diagnostic procedure for screening the endometrial status. The study was conducted to evaluate the utility of EAC in women with AUB, and to compare cytological findings were compared with the histopathological findings. Cross-sectional cohort study done at different districts of Gujarat from October 2011 to June 2021. A total of 1405 patients presenting with AUB were subjected to EAC using a 4?mm Karman's cannula. We have also performed endometrial dilation and curettage. The cytology smears were prepared and evaluated for various cytomorphological features. The cytological diagnoses made were compared with the histopathological diagnosis to obtain sensitivity, specificity, and diagnostic accuracy of EAC. Statistical analyses were performed using the IBM SPSS (Statistical package for the Social Sciences v15.0) and Microsoft Excel 2007 software. EAC showed a sample adequacy of 96.65% in relation to 98.15% for histopathology. EAC showed a sensitivity of 98% and 100% for diagnosing benign and malignant conditions, respectively. There was a good correlation between cytological and histopathological diagnosis (? = 0.643). EAC is a cost effective and least invasive procedure for the primary investigation & work up of women with AUB.

Key-Words: Histopathology, Abnormal Uterine Bleeding, Endometrial Aspiration Cytology. Dilatation & Curettage,

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1. INTRODUCTION

Endometrial cytopathology is a powerful test for the detection of a wide variety of benign lesions ranging from atypias and inflammatory changes to infectious organisms. It can be used for the cytohormonal evaluation of the endocrine status of patients and for screening for malignancy. Abnormal uterine bleeding (AUB) is characterized by bleeding at abnormal or unexpected times or by excessive flow at the time of an expected menses.[1] Dilatation and curettage (D and C) has for long been considered the "gold standard" in the diagnosis of endometrial pathology.[2] One of the most commonly performed gynecological surgery, it accounts for a large proportion of hospital bed use and operating room time. The cost is significant and carries the complications of anesthesia. For these reasons, there is a need for a simple, accurate and good out-patient department (OPD) procedure as an alternative to D and C. Endometrial aspiration cytology (EAC) can be used as a safe, minimally invasive and reliable OPD procedure with minimum discomfort to the patient. [3] Prevalence rate of AUB is 17.9% in India.[4] It is a rapid and noninvasive modality that can be done as an outpatient department (OPD) procedure without the requirement for anesthesia.[5] Studies done across the globe have reported its sensitivity and specificity between 83%–89% and 92%–100%, respectively.[6-9] However, the results may not be comparable due to differences in EAC techniques used in the studies. As per relative simplicity and cost effectiveness, EAC would be a better option for OPD based routine screening as well as mass screening of patients with various endometrial pathology, mainly malignancy. So this study was planned to evaluate usefulness of EAC, in terms of specificity and sensitivity, and to compare EAC findings with histopathological findings in the evaluation of patients presented with AUB. Diagnostic dilatation and curettage is frequently performed in Gynaecological procedure. It requires hospitalization, anaesthesia and the cost is significant. Some complications are faced by the patients. For these reasons, various endometrial sampling techniques are used now a day. The aims and objective of the present study was to describe the spectrum of lesions along with their cytomorphological features and compare the results of EAC with subsequent histopathology in order to assess the value of the former and its shortcomings.

1.1 Need Of Study

Endometrial aspiration is of special value in the investigation of women in whom there are much greater risks associated with general anaesthesia and in whom D&C procedure is not advisable. This technique would eliminate an endometrial curettage in those patients in whom there is no clinical suspicion of endometrial carcinoma, and the cytology is negative.

1.2 Change Or Impact Of Study

By this study we avoid unnecessary expenditure of indoor admissions and anesthesia-related costs required in D&C procedure. We hope that this study will inculcate further interest amongst the gynaecologists and cytologists for good coordination among them is required to make aspiration cytology a routine screening procedure.

1.3 The Novelty Of Study

Present study we have included a large sample size with diverse etiologies that might help to consolidate the role of the EAC in the evaluation of AUB. Many previous studies included less sample size and less duration of the study. So by this study, we were going through all etiologies and pathologies.

1.4 Problems Relevant To Study Field

The cytological morphology of simple hyperplasia reflects an exaggeration of the appearance of the proliferative phase and features may be due to '[the exogenous estrogenic effect on the endometrium. On cytology, the degree of hyperplasia is not easy to interpret. Nuclear enlargement and the presence of small nucleoli may indicate hyperplasia. In the same way, the cytological pattern of atypical hyperplasia and endometrial adenocarcinoma is difficult to interpret. The background of such smears shows abundant aggregates of nuclear debris, leucocyte infiltration, and degenerated cells.

2. MATERIALS AND METHODS

This study was carried out in different districts of Gujarat from October 2011 to June 2021. A total of 1405 endometrial aspiration cytology and Dilatation and curettage specimens were included in the study. Informed consent was taken from local Institutional Review Board (IRB) the patients before the enrollment (IRB/HREC/PSMC/PATHO/RES/03/2011). The study was approved by the Institutional Ethics Committee. The study group included cases of Dysfunctional uterine bleeding (DUB) and local uterine lesions like, endometrial polyps, fibroids and adenomyosis. Cases of infertility and atrophic endometrium were also studied. The pertinent patient details like age, hospital, menstrual history, obstetric history, chief complaints, history of hormonal use and the clinical diagnosis of the patient were also studied. Specimens of D and C and EAS were examined for adequacy and those containing only blood were not included in the study.

1.5 Inclusion Criteria

1. All female patients with age > 18 years.
2. Patients willing to return for follow-up.
3. Patients with complain of abnormal uterine bleeding, infertility, post-menopausal bleeding.

1.6 Exclusion Criteria

1. Age < 18 years.
2. Pregnant women.
3. Women with a history of psychiatric disorders.

The tissues were fixed in 10% formalin and processed routinely. Sections of 3-micron thickness were stained with Hematoxylin and Eosin (H and E) stain. The material was obtained by aspiration method using Karman's cannula with 4 mm diameter. With proper aseptic precautions, the cannula was inserted into the endometrial cavity. Along with it 5 ml of normal saline was introduced followed by suction of the cavity by using a 10 ml syringe. Aspirated contents were examined for the presence of tissue fragments and then smears were prepared and stained by hematoxylin and eosin (H and E) stain. The prepared cytology slides were reported by two

pathologists and classified into benign, malignant, or inadequate. All benign lesions were further categorized as proliferative phase, secretory phase, shedding endometrium, and hyperplasia with or without atypia. Different cytomorphological features like cellularity, epithelial/stromal ratio, epithelial architecture, cytoplasmic vacuolations, nuclear atypia, mitosis, stromal decidualization and background characteristics were noted on the cytology smears. Based on frequency of epithelium to stroma, there were four categories: Group - ve: Only epithelial cells with no stromal cells; Group 1+: Epithelial cells twice as stromal cells; Group 2+: Epithelial cells same as stromal cells; and Group 3+: Epithelial cells less as compared to stromal cells. Endometrial D & C was performed at the same setting by gynecologist. Biopsy materials sent to histopathology department under 10% formalin and processed tissue as routine than stained with H & E staining. The pathologist who examining the biopsy slides were unaware of the cytological findings of the aspiration smears. The observations made on cytological analysis were compared with histopathological findings for sensitivity, specificity, and diagnostic accuracy using appropriate statistical tests.

3. STATISTICAL ANALYSIS

Statistical analyses were performed using the IBM SPSS (Statistical package for the Social Sciences v15.0) and Microsoft Excel 2007 software.EAC showed a sample adequacy of 96.65% in relation to 98.15% for histopathology. EAC showed a sensitivity of 98% and 100% for diagnosing benign and malignant conditions, respectively. There was a good correlation between cytological and histopathological diagnosis (κ = 0.643). EAC is a cost effective and least invasive procedure for the primary investigation & work up of women with AUB.

4. RESULTS

The present study was carried out on 1405 female patients presenting with AUB, and the age ranged from 19 to 70 years with most of them being in the fourth and fifth decades of life (78%). The chief pattern of AUB was menorrhagia (52%), followed by amenorrhea and postmenopausal bleeding (12% each), menometrorrhagia (12%), metrorrhagia (10%), polymenorrhea (2%) and oligo menorrhea (1%). Age wise distribution of 1405 patient is given in Table 1.

Table 1: Age wise distribution of patients (n=1405)

Age (Years)	No. of Patients (n)	Percentage (%)
18-30	130	9.3
31-40	142	10.1
41-50	566	40.3
51-60	530	37.7
61-70	37	2.6
Total	1405	100

(Total 1405 female patients presenting with AUB, and the age ranged from 19 to 70 years with most of them being in the fourth and fifth decades of life (78%), the mean age of patients was 45 years)

The results of 1405 cytological aspirations in the present study were broadly categorized as follows (Table 2 showing: Correlation of cytological and histopathological findings. (n=1405))

1. Benign endometrium, including normal phases of endometrium, irregular and atrophic endometrium, as well as decidual reaction.
2. Hyperplasia.
3. Malignancy (Adenocarcinoma), which included endometritis with a suspicious pathology.
4. Inadequate or unsatisfactory smears.

Table 2: Correlation of cytological and histopathological findings. (n=1405)

Cytological diagnosis	No. of cases	Histopathological diagnosis	No. of Cases	Sensitivity (%)	Specificity (%)	Diagnostic accuracy
Secretary phase	758	Secretary phase	706	98.55	93.13	94
		Proliferative phase	19			
		Simple endometrial hyperplasia	14			
		Atrophic endometrium	08			
		Inadequate	11			
Proliferative phase	452	Proliferative phase	424	99.11	93.80	94
		Secretary phase	11			
		Simple endometrial hyperplasia	09			
		Atrophic endometrium	04			
		Inadequate	04			
Shedding endometrium	11	Shedding endometrium	10	90.90	90.90	91
		Inadequate	1			

Endometrial hyperplasia without atypia	86	Simple endometrial hyperplasia	82	100	95.34	96
		Proliferative phase	04			
Endometrial hyperplasia with atypia	34	Endometrial hyperplasia with atypia	33	100	97.05	97
		Adenocarcinoma	01			
Adenocarcinoma	17	Adenocarcinoma	17	100	100	100
Inadequate	47	Secretary phase	20	---	----	---
		Proliferative phase	15			
		Atrophic endometrium	02			

(Above table showing: Correlation of cytological and histopathological findings. (n=1405), table showing cytological diagnosis as per aspiration cytology reports and also showing histopathological diagnosis as per reports. We also mentioned total numbers of cases in each diagnosis with accuracy, sensitivity and specificity)

1.7 Cytological Findings

On cytological examination, totally 1341 patients were diagnosed as benign lesions, 17 were reported as malignant, and 47 patients were marked as inadequate. The smears were labelled as inadequate if there was no/scanty cellularity, stromal cells, or endocervical cells only. Benign lesions on cytology were further sub classified into various phases as per Table 1.

1.8 Cytomorphological Features

Various cytomorphological and architectural patterns were observed on cytology smears as shown in Table 3.

Table 3: Different cytomorphological features as studied on cytology smears

	Total (N= 1358)	Cellularity (3+)	Epithelial/stroma ratio Group	Epithelial architecture	Cytoplasmic Vacuolations	Nuclear atypia	Mitosis	Stromal decidualization	Predominant background
Secretary phase	758	747	0	Honeycomb sheets, Tubes	751	00	04	758	Stripped nuclei
Proliferative phase	452	448	0	Tubes and dense sheets	00	00	03	00	Clean
Shedding endometrium	11	10	0	Ball-like clusters	01	00	00	00	Stripped nuclei and inflammatory
Endometrial hyperplasia without atypia	86	86	0	Oval clusters	00	00	00	00	Stripped nuclei
Endometrial hyperplasia with atypia	34	34	0	Oval clusters With few Irregular clusters	00	34	00	00	Stripped nuclei
Adenocarcinoma	17	17	17	Irregular clusters and singly scattered	02	17	17	00	Necrotic

(Above table we observing that morphological findings like epithelial/stromal ratio, architectural pattern of epithelial cells, nuclear atypia, and mitosis used to differentiate between benign and malignant conditions whereas epithelial architecture, cytoplasmic vacuolations, and background were useful cytomorphological findings that differentiating among various benign lesions)

It was observed that morphological findings like epithelial/stromal ratio, architectural pattern of epithelial cells, nuclear atypia, and mitosis used to differentiate between benign and malignant conditions whereas epithelial architecture, cytoplasmic vacuolations, and background were useful cytomorphological findings that differentiating among various benign lesions. Figure 1,2 & 3 shows histopathological features of the secretory phase of the endometrium, proliferative phase of endometrium & simple endometrial hyperplasia respectively.

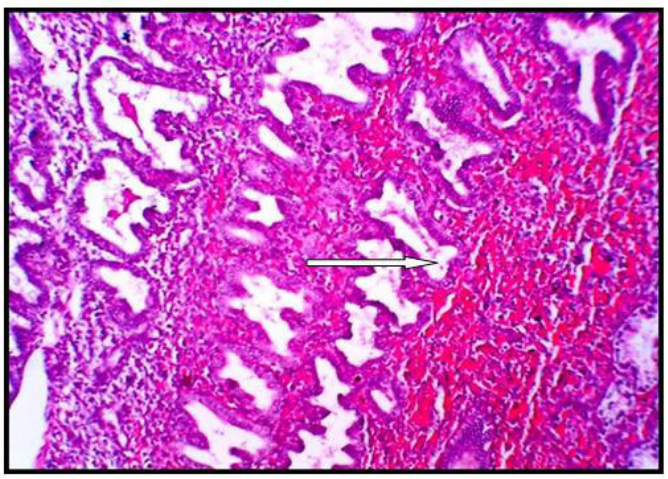


Fig 1 Microphotograph of Secretory endometrium:

The outline of the glands becomes markedly irregular. The secretory vacuoles have by now all moved to the luminal side of the cell, ready to be discharged into the lumen. The nuclei are oriented in straight line and they are now round, vesicular and pale staining. (H&E stain X 100)

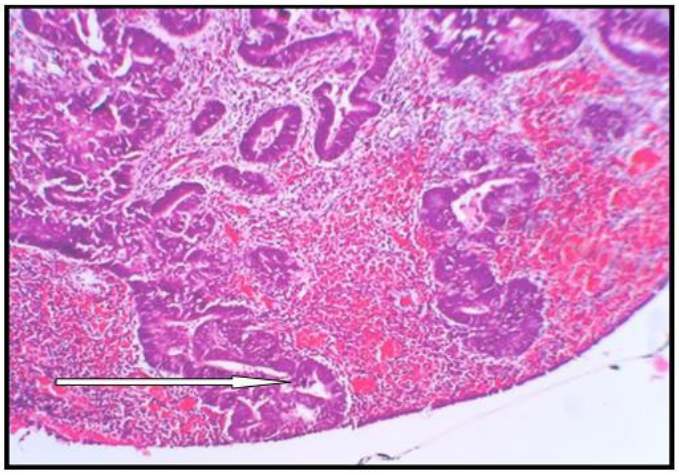


Fig 2 Microphotograph of Proliferative endometrium:

The endometrium is low with sparse, small, straight glands and a loose stroma of spindled cells. The epithelial cells lining the glands take on a pseudostratified appearance. Mitoses are frequent in both glands and stroma and are a direct result of stimulus by oestrogen. (H&E stain X 100)

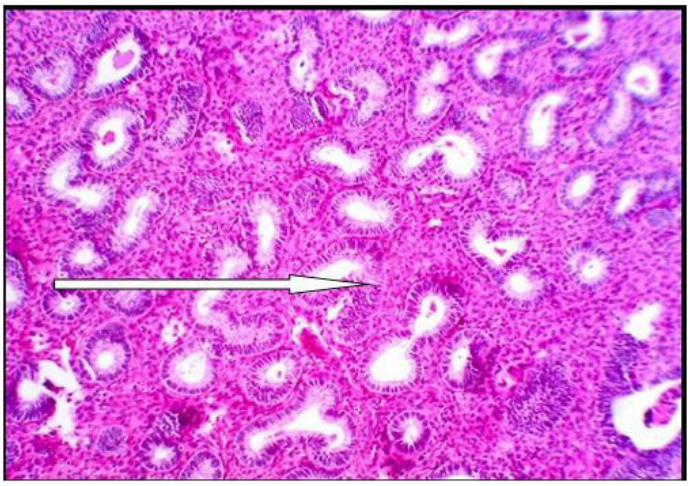
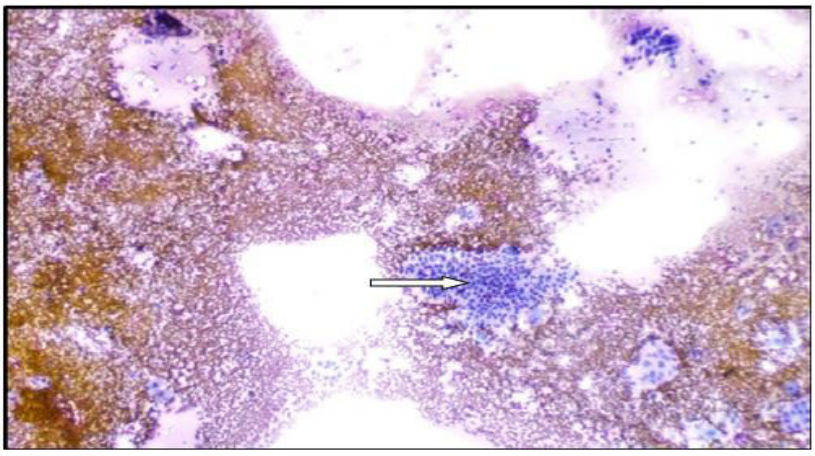


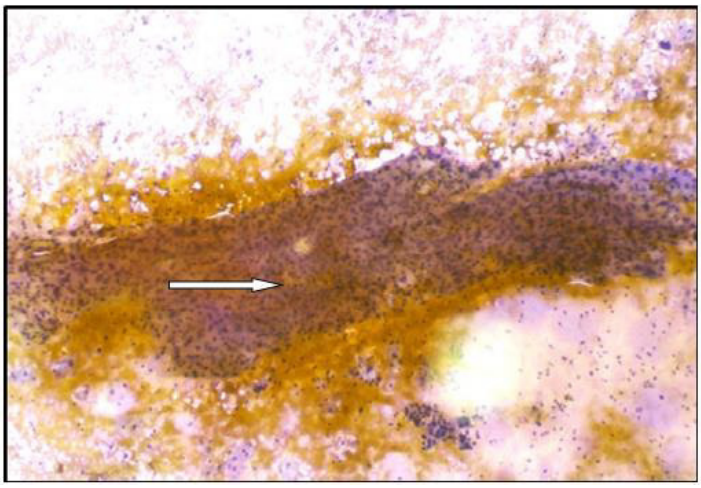
Fig 3 Microphotograph of Simple glandular hyperplasia of endometrium (H&E stain X 100):

Architectural changes in glands of various sizes, producing irregularity in gland shape with cystic alterations. The glands, although not increased in number, proliferate intensely and undergo cystic dilatation; producing the characteristic Swiss cheese appearance in the endometrium. The epithelial growth pattern and cytology are similar to those of proliferative endometrium.



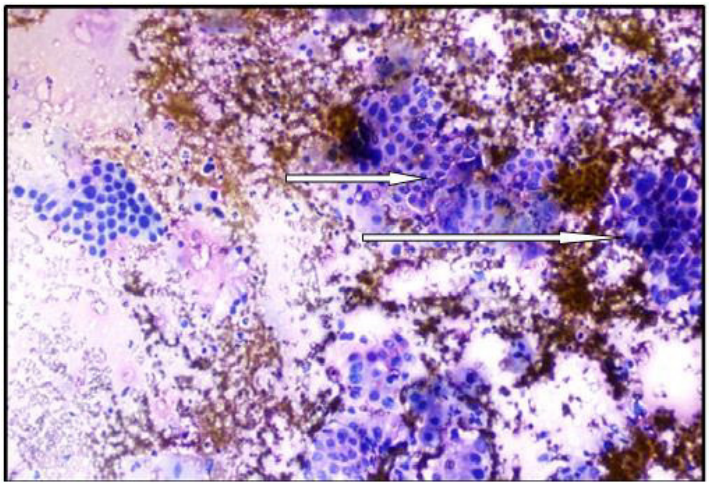
Honeycomb sheets, cytoplasmic vacuolations, and stripped nuclei (H&E stain X 100)

Fig 4 Aspiration Cytology Secretary Endometrium



Tubes and dense sheets of endometrial cells (H&E stain X 100)

Fig 5 Aspiration Cytology Proliferative Endometrium



Scattered cells, irregular clusters, marked nuclear atypia, and atypical mitosis. Also show scattered tumor cells with marked nuclear pleomorphism and prominent nucleoli (H&E stain X 100)

Fig 6 Aspiration Cytology Adenocarcinoma

All 758 cases of secretory phase confirmed on histopathology which is characterized by honeycomb sheets, cytoplasmic vacuolations, and stripped nuclei in the background on cytology [Figure 4] whereas there are tubes and dense sheets were noted in the most of cases (452 cases) of proliferative phase on cytology [Figure 5]. We have 17 cases of endometrial adenocarcinoma which is characterized by predominance of singly scattered cells, irregular clusters, marked nuclear atypia, and atypical mitosis revealed on cytology. [Figure 6]. We have reported 86 cases of endometrial hyperplasia without atypia showing oval clusters while 34 cases of Endometrial hyperplasia with atypia showed oval clusters with occasional irregular clusters. The sensitivity, specificity, and diagnostic efficacy of the EAC for diagnosis of benign and malignant lesions of endometrium are described in Table 1. There was excellent correlation between cytology and histopathology with kappa value of 0.64. We have observed that EAC was superior in diagnosing malignant lesions than for cyclical endometrium.

1. DISCUSSION

Endometrial cytology is recently reported as one of the useful diagnostic methods with good sensitivity and specificity for the detection of endometrial malignancies. About 80% patients of with endometrial cancer are diagnosed at an early stage. But our intention is to provide attention to the early diagnosis of endometrial malignant diseases, mainly its precancerous lesion. This study was conducted to evaluate the efficacy of EAC as compared with histopathological findings in patients who came with AUB. The results showed a good correlation between EAC and histopathology. Adequate material of the representative sample is a challenging factor that limit the utility of EAC. In the present study, sample adequacy of 96.65% was achieved by using Karman's cannula which was a simple and cost-effective technique. Different studies, using different techniques & instruments for endometrial sample collection, have shown variable adequacy. Data ranging from 59% to 100%.[6,10-13] Some of these techniques are insemination cannula, infant feeding tube, intra- cath cannula, Isaac's cell sampler, Karman's cannula, and pistol aspirator. One of the major difficulties that come across in the cytological study of the endometrium is to obtain a satisfactory and representative cellular sample consistently. Over the period of time, various authors opined that endometrial aspiration techniques were an acceptable and valuable method of detecting the endometrial pathology as a minimally invasive, least painful, and less time-consuming OPD procedure.[6,11-13] It is observed that

the difference in methodology did not affect the sensitivity and specificity of the cytological findings that remained between 68.2%–97% and 79%–100%, respectively.[6] As compared with studies,[10,12] the present study showed a 98% sensitivity, 100 % specificity, and 100 % diagnostic accuracy of EAC for the diagnosis of endometrial carcinoma. As a result, benign lesions dominated the diagnoses in the study cohort. The sensitivity, specificity, and diagnostic accuracy of EAC for diagnosing benign lesions was 98%, 100%, and 100%, respectively. The results are quite comparable with previous studies that showed a diagnostic accuracy of 93.8[12] and 97.6%,[10] respectively. On sub-classification, EAC showed 98.55% sensitivity and 93.13% specificity for diagnosing secretory phase and 99.11% sensitive and 93.15% specific for diagnosing proliferative phase. In contrast, other studies [6,10,12] showed a better sensitivity for detecting the proliferative phase. In this study, A cytological analysis of the endometrial lesions was performed based on eight cytomorphological parameters as described by Kobayashi *et al.*[14] These parameters were used to diagnose different benign and malignant lesions of the endometrial pathology. As compared to previous studies,[6,15,16] features like the predominance of irregular clusters and singly scattered epithelial cells, marked nuclear atypia, and significant mitosis on the necrotic background was found to be more specific for endometrial carcinoma [Table 2]. The secretory phase is diagnosed by the presence of honeycomb sheets of cells with cytoplasmic vacuolations in various studies.[14,17] This finding is correlated well with other studies. However, the present study favors the role of the efficacy of EAC in the evaluation of AUB. Histopathological correlation and blinded study pattern improve the validity of results. We used mainly H & E staining techniques in aspiration cytology and whenever required May-Grünwald-Giemsa (MGG) and Papanicolaou (PAP) stain that helped in the comprehensive evaluation of all the cytomorphological features. This is very cost-effective, less time consuming with quite comparable findings with histopathology. The procedure is useful to be a good screening tool for endometrial carcinoma. Cytopathological screening, histopathological correlation, and provision of human papillomavirus vaccine are collectively used to prevent and allow early diagnosis of cervical cancer, which results in lower mortality due to cervical cancer.[13] Without such screening methods and prevention Programmes, endometrial malignancies are becoming the most prevalent cancer of the female genital tract in developing countries.[13,14] There is a certain limitation of our study like, in the case of small sample size, results cannot be exploring all possible causes of AUB. The advanced technology in medical science and the latest devices for EAC procedures may improve the utility in the future.[13,14] The cytological morphology of simple hyperplasia reflects an exaggeration of the appearance of the proliferative phase and features may be due to the exogenous estrogenic effect on the endometrium. On cytology, the degree of hyperplasia is not easy to interpret. Nuclear enlargement and the presence of small nucleoli may indicate hyperplasia. In the same way, the cytological pattern of atypical hyperplasia and endometrial adenocarcinoma is difficult to interpret. The background of such smears shows abundant aggregates of nuclear debris, leucocyte infiltration, and degenerated cells.

2. CONCLUSION

We thus conclude from the study that endometrial aspiration is an effective, useful and minimally invasive procedure. This is an easy technique, OPD procedure with only mild to moderate discomfort. The procedure was rapid, hardly takes two minutes. There was no haemorrhage, infection, or perforation after the procedure and also there was a low risk of anesthesia. A very important criterion is the cytologist's ability in reporting the findings. With an experienced cytologist, it can be used routinely for the primary investigation of women with AUB, provided all the points of discrepancies are taken care of. Endometrial aspiration is of special value in the investigation of women in whom there are much greater risks associated with general anesthesia and in whom no curetting is obtained. This technique would eliminate an endometrial curettage in those patients in whom there is no clinical suspicion of endometrial carcinoma, and the cytology is negative. Unnecessary hospital expenditure as a result of indoor admissions and anesthesia required for D and C can be avoided. We hope that this study will inculcate further interest amongst the gynecologists and cytologists and good coordination among them is required to make aspiration cytology a routine screening procedure.

3. ACKNOWLEDGEMENT

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4. AUTHOR CONTRIBUTION STATEMENTS

Desai KN, Maru AM, Satapara VK and Rathod G conceived of the presented idea. Desai KN and Maru AM developed the theory and performed the computations. Satapara VK and Rathod G verified the analytical methods. Satapara VK, Rathod G encouraged and Desai KN, Maru AM to investigate utility of endometrial aspiration cytology and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

5. CONFLICT OF INTEREST

Conflict of interest declared none.

6. REFERENCES

1. Shwayder JM. Pathophysiology of abnormal uterine bleeding. Obstet Gynecol Clin North Am 2000; 27:219-34. 10.1016/s0889-8545(00)80017-0.
2. Cooper JM, Erickson ML. Endometrial sampling techniques in the diagnosis of abnormal uterine bleeding. Obstet Gynecol Clin North Am 2000; 27:235-44. 10.1016/s0889-8545(00)80018-2
3. Hemalatha AN, Pai MR, Raghuveer CV. Endometrial aspiration cytology in dysfunctional uterine bleeding. Indian J Pathol Microbiol 2006; 49:214-7.
4. Sharma A, Dogra Y. Trends of AUB in tertiary centre of Shimla hills. I Midlife Health 2013; 4:67- 8. 10.4103/0976-7800.109648
5. Livingstone, M., & Fraser, I. S. (2002). Mechanisms of abnormal uterine bleeding. Human reproduction

update, 8(1), 60–67. https://doi.org/10.1093/humupd/8.1.60

6. Malik R, Agarwal R, Tandon P. Cytological assessment of endometrial washings obtained with an insemination cannula and its histological correlation. J Cytol [serial online] 2008 [cited 2022 Jan 31]; 25:128-32. Available from: https://www.jcytol.org/text.asp?2008/25/4/128/50797
7. Tansathit T, Chichareon S, Tocharoenvanich S, Dechsukhum C. Diagnostic evaluation of karman endometrial aspiration in patients with abnormal uterine bleeding. J Obstet Gynaecol Res 2005; 31:480‐ 5. 10.1111/j.1447-0756.2005.00324
8. Maksem JA, Meiers I, Robboy SJ. A primer of endometrial cytology with histological correlation. Diagn Cytopathol 2007; 35:817‐ 44.
9. Isaacs JH, Ross FH Jr. Cytologic evaluation of the endometrium in women with postmenopausal bleeding. Am J Obstet Gynecol 1978; 131:410‐ 5. 10.1016/0002-9378(78)90416-7.
10. Adhav MV, Phatke AS, Kadgi NV, Rane SR, Kulkarni KK. Endometrial aspiration cytology in gynecological disorders. J Cytol [serial online] 2016 [cited 2022 Jan 31]; 33:13-6. https://www.jcytol.org/text.asp?2016/33/1/13/175488
11. Liza Sister, Rameshkumar K, Lillian Sister. Value of endometrial aspiration cytology in assessing endometrial status in symptomatic peri and postmenopausal women. Indian J Cancer 1999; 36:57‐ 61.
12. Kaur N, Chahal JS, Bandlish U, Kaul R, Mardi K, Kaur H, *et al.* Correlation between cytological and histopathological examination of the endometrium in abnormal uterine bleeding. J Cytol 2014; 31:144‐ 8. 10.4103/0970-9371.145645.
13. Handa U, Bansal C, Aggarwal P, Huria A, Mohan H. Diagnostic utility of endometrial aspiration cytology in women with abnormal uterine bleeding. J Mid-life Health [serial online] 2018 [cited 2022 Jan 31]; 9:140-4. https://www.jmidlifehealth.org/text.asp?2018/9/3/140/241946
14. Kobayashi H, Otsuki Y, Simizu S, Yamada M, Mukai R, Sawaki Y, *et al.* Cytological criteria of endometrial lesions with emphasis on stromal and epithelial cell clusters: Result of 8 years of experience with intrauterine sampling. Cytopathology 2008; 19:19‐ 27. 10.1111/j.1365-2303.2007.00493
15. Norimatsu Y, Shimizu K, Kobayashi TK, Moriya T, Tsukayama C, Miyake Y, *et al.* Cellular features of endometrial hyperplasia and well differentiated adenocarcinoma using the endocyte sampler: Diagnostic criteria based on the cytoarchitecture of tissue fragments. Cancer 2006; 108:77‐ 85. 10.1002/cncr.21734
16. Skaarland E. New concept in diagnostic endometrial cytology: Diagnostic criteria based on composition and architecture of large tissue fragments in smears. J Clin Pathol 1986; 39:36‐ 43. 10.1136/jcp.39.1.36.
17. Remondi, C., Sesti, F., Bonanno, E., et al Diagnostic accuracy of liquid-based endometrial cytology in the evaluation of endometrial pathology in postmenopausal women. Cytopathology: official journal of the British Society for Clinical Cytology, 2013:24(6);365–371. https://doi.org/10.1111/cyt.12013