

Comparison of Conventional Papanicolaou Smear and Liquid-based Cytology for Cervical Cancer Screening

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Abstract

Background: Cervical carcinoma is the fourth most common malignancy worldwide and the fourth most common cause of deaths due to cancer worldwide. Conventional Papanicolaou (PAP) smears were used for screening led to a drastic reduction in a number of cervical carcinoma cases, but have high false negativity. Hence, newer methods like liquid-based cytology (LBC) were introduced.

Aim: The aim of the study was to compare LBC with conventional PAP smear for cervical cancer screening.

Materials and Methods: This study was done on randomly selected 100 patients attending the pilot screening project at a tertiary care teaching institute in South India. The sample for conventional PAP smear was taken using Ayre's spatula and slide prepared. The sample for LBC was taken using the cytobrush, and the sample was rinsed in the fixative provided by the manufacturer. The sample was then centrifuged and slide prepared. Both the slides were then stained using the rapid PAP stain. The slides were analyzed and the following results were obtained.

Results: Most of the patients who attended the screening program were in the fourth decade of life. Dysplasia was diagnosed in 26% of cases and most were in the age group of 21–40 years. Most of the cases were in the socioeconomic Class II of the modified Prasad's classification. Dysplasia was found more in the socioeconomic Class III (12% of cases). 90% of cases started sexual activity before 25 years of age, and out of these 90 patients, 92.3% had dysplasia. Dysplasia was more in patients with parity 3 (14% of cases). 46% of cases presented with white discharge per vaginum. The cytological abnormality was found in 28 cases (28%) by LBC, whereas conventional Pap smear detected an abnormality in only 22 cases (22%). 96 cases (96%) were satisfactory for evaluation on LBC and 92 cases (92%) in conventional Pap smear. ASC was found in 12% of cases in conventional PAP whereas it was detected in only 6% of cases in LBC. Low-grade squamous intraepithelial lesion (LSIL) and high-grade squamous intraepithelial lesion (HSIL) were found in 8% and 2% of cases in conventional PAP smear whereas it was found in 12% and 8% of cases in LBC. No carcinoma was found in conventional PAP smear whereas 2% of cases had carcinoma features in LBC. Sensitivity and specificity of PAP smear in detecting LSIL was 40% and 93% whereas for HSIL it is 50% and 100%. Sensitivity and specificity of LBC in detecting LSIL is 66% and 94% whereas for HSIL it was 100% and 96%. Overall sensitivity and specificity for conventional PAP smear is 55.5% and 83.7% whereas for LBC it is 83% and 86.5%, respectively. There was a medium level of correlation between conventional PAP smear and LBC ($r = 0.59$).

Conclusion: LBC is strongly advocated in the best interest of public health especially in countries like India where more number of people are in the lower socioeconomic status category. It improves the sample quality and reduces the likelihood of false negative results and hence improving the efficacy of the screening programs.

Key words: Conventional Papanicolaou smear, Cytology, Liquid-based cytology

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INTRODUCTION

Cervical carcinoma is the fourth most common malignancy worldwide and the fourth most common cause of deaths due to cancer worldwide which makes it an important public health problem.^[1] The cellular changes in the cervix and intraepithelial lesions can be detected many years before

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the patients present with frank invasive carcinoma.^[2] Hence, cervical screening programs were introduced worldwide.

The introduction of Papanicolaou (PAP) stain by Dr. Papanicolaou and Traut made it possible.^[3] Cervical cancer screening was done using the conventional scrape smears stained by PAP stain. This led to a drastic reduction in the incidence of invasive cervical carcinoma.^[4] However, CP smears had high false negative rates. It was due to preparation (sampling) errors, the presence of blood or mucus (obscuring) material, screening, and interpretation errors.^[5]

In the past 15 years, several cytological techniques were developed to improve PAP smear sensitivity. Liquid-based cytology (LBC) was the most important development and accepted method. The advantages include removal of obscuring cells, mucus and blood, reduction of unsatisfactory smears and inadequate smears, reduction in reading time^[6] provision of cells for detection of HPV, and the presence of residual sample for performing ancillary techniques such as immunocytochemistry. LBC gives standardized slides containing a monolayer of well-stained well-preserved cells which is easier to interpret than the conventional smears.^[7]

Hence, the aim of this study is to compare the results of conventional PAP smear and LBC preparation for cervical cancer screening.

MATERIALS AND METHODS

This prospective study was conducted at the Department of Pathology, Thanjavur Medical College, Thanjavur. In our study, we proposed to compare conventional PAP with the new method LBC.

The study was conducted on 100 patients selected randomly from patients coming for a pilot screening project to the Department of Obstetrics and Gynaecology, Thanjavur Medical College.

Exclusion Criteria

The following criteria were as follows:

- Non-cooperative patients.
- Patients who do not give consent.
- Patients with massive bleeding per vaginum.
- Pregnant women.
- Treated cervical carcinoma cases.

After obtaining proper consent, pro forma was given to each patient and detailed history was obtained. After that, physical examination was done and the patient was put in lithotomy position for specimen collection.

For obtaining the specimens, first for conventional PAP, Ayer's spatula was inserted into the cervix and gently

rotated at 360°. Then, the sample was smeared onto a grease free slide and fixed in alcohol. After fixation, the smear was stained with the PAP stain.

For LBC, endocervical brush issued by the manufacturer was similarly inserted into the endocervical canal and rotated 360° 3–4 times. Then, the brush is detached and placed into a vial containing fixative issued by the manufacturer for transport. The vial is closed and shaken to obtain a homogenous mixing. The vial is taken to the lab where it is again shaken with the vortex to obtain a homogenous mixture. After agitation, centrifugal chambers are prepared by placing the slide onto the support; the chamber is then placed onto the slide and tightened. Into the centrifugal chamber, 2 ml of the separator solution given by the manufacturer and 5 ml of the sample is placed and fixed into a rotor and then centrifuged at the rate of 2100 rpm/min for 10 min. After centrifugation, the liquid is thrown into a container containing a disinfectant. Some drops of alcohol (100%) are poured along the inner side of cytochamber. The chamber is then turned onto a absorbent paper and drained. Then, all the parts are disassembled and slides are dried before staining.

Method of Staining

PAP smears after fixation in alcohol and LBC smears are taken for staining with PAP stain (rapid).

The PAP smears and the LBC slides were examined and recent 2001 Bethesda system of classification was used for reporting.

OBSERVATION AND RESULTS

This prospective study was conducted on 100 patients who attended the pilot screening project program conducted at the Department of Obstetrics and Gynaecology, Raja Mirasudar Hospital affiliated to Thanjavur Medical College, Thanjavur.

Clinical history regarding age, socioeconomic status, parity, and complaints were obtained from the patient, and thorough physical examination was done. Per speculum examination was done. Exfoliative cytology specimens were collected for conventional PAP smear and LBC.

Most of the cases who attended the screening program were in the fourth decade of life (50 cases, 50%) followed by 32 cases (32%) in the fifth decade. Minimum age of the patient screened was 25 years of age and the maximum age was 67 years. About 61.5% of cases who were diagnosed with low-grade squamous intraepithelial lesion (LSIL) and high-grade squamous intraepithelial lesion (HSIL) were in the age group of 21–40 years. Age-wise distribution of cases is shown in Table 1.

Out of 100 cases, 36(36%) of cases belonged to Class II of modified Prasad's classification,^[8] followed by 24 (24%) of cases in Class III. Out of 26 cases with dysplasia/carcinoma, 12 (46.1%) of cases belonged to Class III [Table 2].

About 90 cases (90%) started sexual activity before 25 years of age, and out of these 90 patients, 92.3% had dysplasia, but out of the remaining 10 cases, only 2 cases (2% of a total number of cases) showed dysplasia [Table 3].

In this study, about 46 cases (46%) had 2 children and 34 cases (34%) had 3 children. Most of the cases with dysplasia were seen when patients had 3 children (14 cases, 53.8% of the abnormal smears) [Table 4].

Most common presenting complaint was white discharge per vaginum (46 cases, 46%) followed by lower abdominal pain (26 cases, 26%) and bleeding per vaginum (16 cases, 16%). Other minor complaints were dysfunctional uterine bleeding (4 cases, 4%), itching (4 cases, 4%), difficulty in

Table 1: Age-wise distribution of cases

Age	Total	Normal	Abnormal	LSIL	HSIL	Carcinoma
25–30	12	10	2	2	-	-
31–35	24	16	8	3	2	3
36–40	26	20	6	3	2	1
41–45	20	14	6	4	2	-
46–50	12	12	-	-	-	-
51–55	2	1	1	-	-	1
56–60	1	-	1	-	-	1
>60	3	1	2	-	-	2
Total	100	74	26			

LSIL: Low-grade squamous intraepithelial lesion, HSIL: High-grade squamous intraepithelial lesion

Table 2: Case distribution according to the socioeconomic status (Modified Prasad's classification)^[8]

Class (rupees)	Total number of cases	Normal cases	Abnormal cases
I (5571 and above)	10	10	-
II (2786–5570)	36	28	8
III (1671–2785)	24	12	12
IV (836–1670)	12	10	2
V (<836)	18	14	4
Total	100	74	26

Table 3: Case distribution according to the onset of sexual activity

Age	Total number of cases	% of patients with dysplasia
<25 years	90	92.3% of 90 cases
>25 years	10	2% of 100 cases

micturition (2 cases, 2%), and post-coital bleeding (2 cases, 2%) [Table 5].

Out of the 50 cases studied, conventional PAP smear detected an abnormality in 22 cases (22%) whereas LBC detected an abnormality in 28 (28%) of cases [Table 6].

Out of the 100 cases, 92 cases (92%) were satisfactory for evaluation in conventional PAP smear whereas 96 cases (96%) were satisfactory in LBC. About 60 cases (60%) in conventional PAP smear and 12 cases (12%) were satisfactory but limited by factors such as blood and inflammatory cells, air drying, 8 cases (8%) and 4 cases (4%) were unsatisfactory. The most common cause for unsatisfactoriness in conventional PAP smear is thick smear and reduced cell number in LBC [Table 7].

Table 4: Case distribution according to parity

Gravida	Total number of cases	Number of cases with dysplasia (%)
Nulligravida	6	2 (2)
1	8	-
2	46	7 (7)
3	34	14 (14)
>3	6	3 (3)

Table 5: Case distribution according to the presenting complaints

Complaints	Number of cases (%)
White discharge P/V	46 (46)
Lower abdominal pain	26 (26)
Bleeding P/V	16 (16)
Dysfunctional uterine bleeding	4 (4)
Difficulty in micturition	2 (2)
Post-coital bleeding	2 (2)

Table 6: Number of abnormal cases

Study	Abnormal cases (%)
Conventional PAP	22 (22)
LBC	28 (28)

PAP: Papanicolaou, LBC: Liquid-based cytology

Table 7: Comparison of PAP and LBC results

Category	PAP (n)	PAP (%)	LBC (n)	LBC (%)
Unsatisfactory	8	8	4	4
Normal	70	70	68	68
ASC	12	12	6	6
LSIL	8	8	12	12
HSIL	2	2	8	8
Carcinoma	-	-	2	2
Total	100	100	100	100

PAP: Papanicolaou, LBC: Liquid-based cytology, LSIL: Low-grade squamous intraepithelial lesion, HSIL: High-grade squamous intraepithelial lesion

Statistics

Sensitivity and specificity of PAP smear in detecting LSIL is 40% and 93%, respectively. The sensitivity of PAP smear in detecting HSIL is 50% and specificity of PAP smear in detecting HSIL is 100%. The sensitivity and specificity of LBC in detecting LSIL is 66% and 94%, respectively. The sensitivity and specificity of LBC in detecting HSIL is 100% and 96%, respectively. The sensitivity and specificity of LBC in detecting carcinoma is 100% and 100%, respectively.

Overall sensitivity and specificity of PAP smear is 55.5% and 83.7%, respectively.

Overall sensitivity and specificity of LBC is 83% and 86.5%, respectively.

Statistical Correlation

Controlling for age factor partial correlation coefficient between LBC and PAP smear is 0.59 (Medium level of correlation) [Figures 1-11].

DISCUSSION

For >50 years, PAP smear remained the only modality for screening which had a high false positive rate. Due to this, LBC was developed. This study was done to compare both methods.

A total of 100 patients were randomly selected from those attending the pilot screening project conducted at the Department of Obstetrics and Gynaecology, Thanjavur Medical College for the study and the samples were taken from all the cases, and the results analyzed.

Out of the 100 cases, 50 cases (50%) of cases were in the fourth decade of life, and most of the LSIL and HSIL cases were in the fourth decade, a finding similar to Sherwani *et al.*,^[9] Richard,^[10] Zhu *et al.*,^[11] İlter *et al.*,^[12] Khamankar *et al.*,^[13] Macharid *et al.*,^[14] and Almonte *et al.*^[15] However, studies by Ibrahim,^[16] Chinaka *et al.*,^[17] and Nigerio *et al.*^[18] reported cases mostly in the fifth decade of life which in contrast to a study by Sharma *et al.*,^[19] who reported most number of cases in the third decade of life. Invasive cancer was diagnosed in 35 years of age in our study which was similar to that of Sherwani *et al.*,^[9] but the contrast to Parker *et al.*^[20] who reported carcinomas above the age of 70 years. Early marriage and early sexual activity in this part of the country may be responsible for the early onset of invasive cancer [Table 8].

About 46.1% of the abnormal smears belonged to Class III socioeconomic status, and most of the dysplasia cases were observed in this group which was similar to

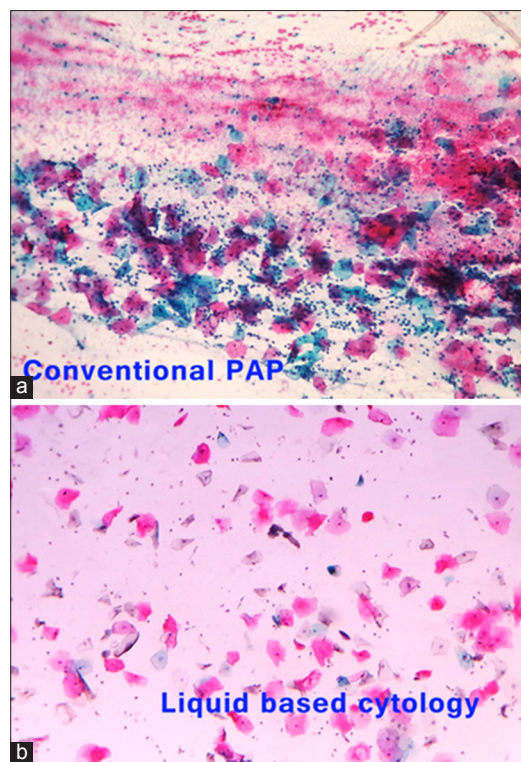


Figure 1: (a and b) Comparison of microscopy of conventional Papanicolaou (PAP) and liquid-based cytology. In PAP smear, cells are obscured by blood, mucous, and inflammatory cells whereas liquid-based cytology has a clean background with monolayering of cells.

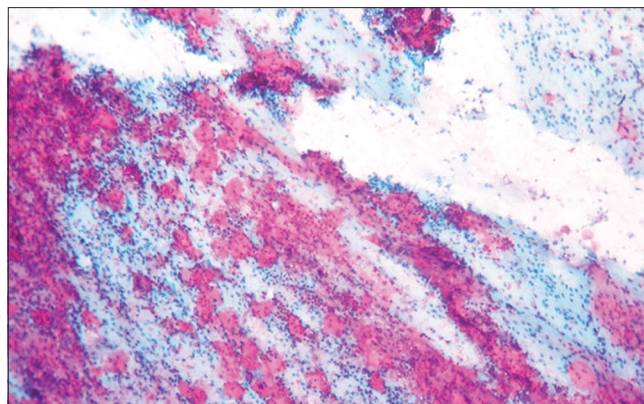


Figure 2: Unsatisfactory smear - conventional papanicolaou. Cells are obscured by blood and inflammatory cells

Sherwani *et al.*^[9] and Sharma *et al.*^[19] Parker noted that lower socioeconomic status women had marriage at a younger age and childbirth. Latest, the WHO report shows that 70% of cases are from the lower socioeconomic status due to lack of access to screening programs and late detection of diagnosis and treatment.^[1] A thesis done by Ibrahim^[16] showed that uneducated and unemployed from the lower socioeconomic status showed more dysplasia. Furthermore, Nigerio *et al.*^[18] postulated that illiteracy, poverty, nonuse of screening methods, and lack of communication after

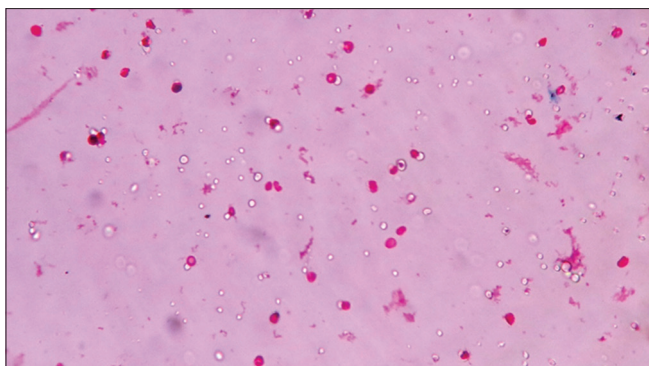


Figure 3: Unsatisfactory smear - liquid-based cytology. Only blood components found with no diagnostic cells

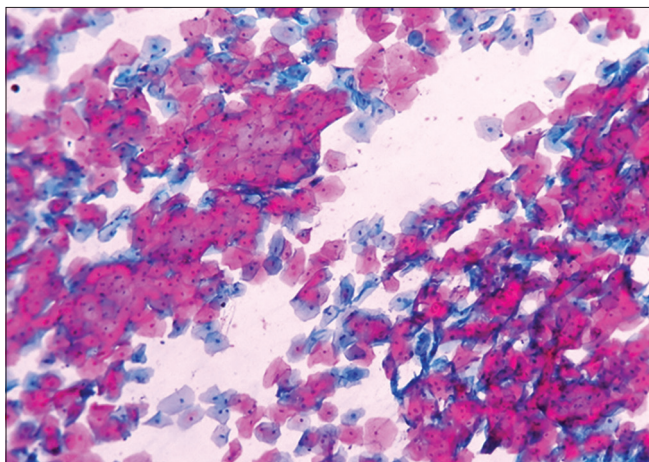


Figure 4: Satisfactory smears - conventional Papanicolaou. This slide shows approximately 100 cells. Entire side covered at this level of cellularity has 1000 cells

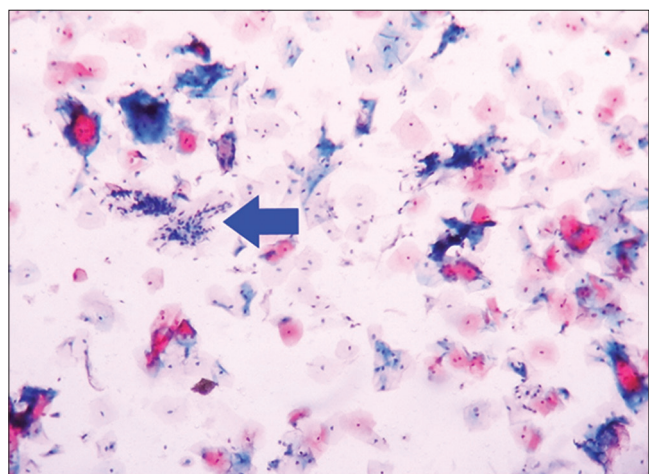


Figure 5: Satisfactory smears - liquid-based cytology. This slide has approximately 50 cells. Entire slide covered at this level of cellularity has 5000 cells. Few endocervical clusters found (arrow)

referral among lower socioeconomic status persons were responsible for the increased number of dysplasia among these persons.

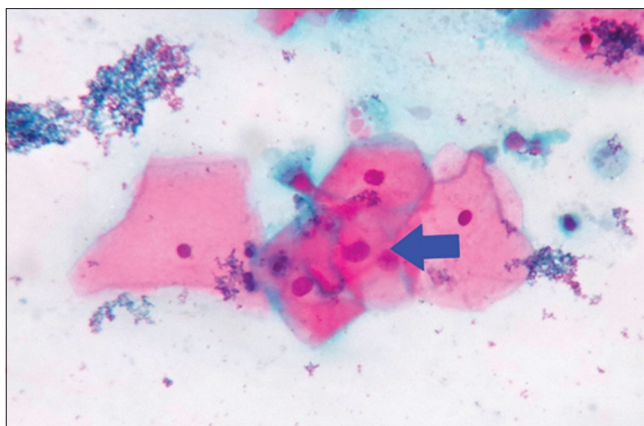


Figure 6: Atypical squamous cells - Papanicolaou. Superficial cells are seen with enlarged nuclei, slightly increased N/C ratio, regular nuclear contour with focal irregularity (arrow), dense, and orangeophilic cytoplasm

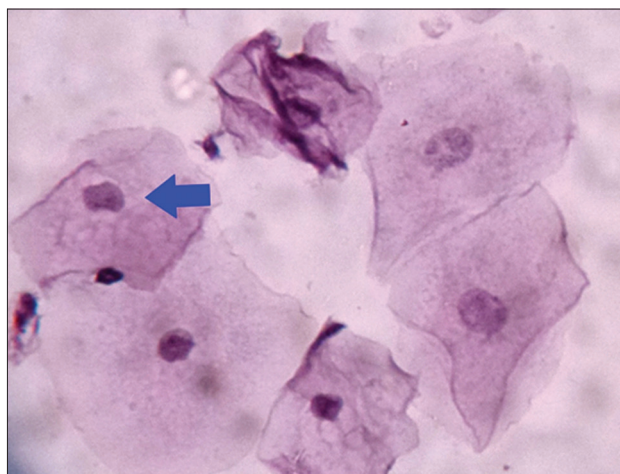


Figure 7: Atypical squamous cells - liquid-based cytology. Focal irregularity is shown by arrow

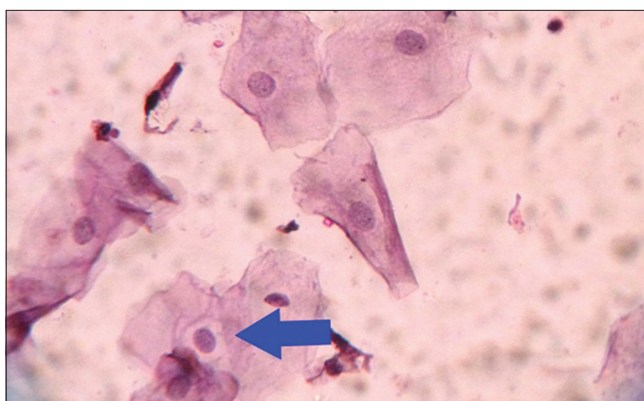


Figure 8: Low-grade squamous intraepithelial lesion (koilocytosis) - conventional Papanicolaou. Koilocytes are large cells with sharply defined perinuclear cytoplasmic cavities surrounded by a dense rim of cytoplasm with enlarged nuclei and irregular nuclear membrane.

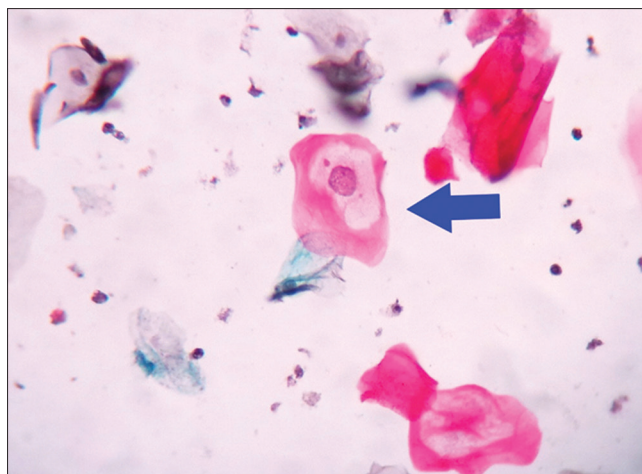


Figure 9: Low-grade squamous intraepithelial lesion (koilocytes) - liquid-based cytology

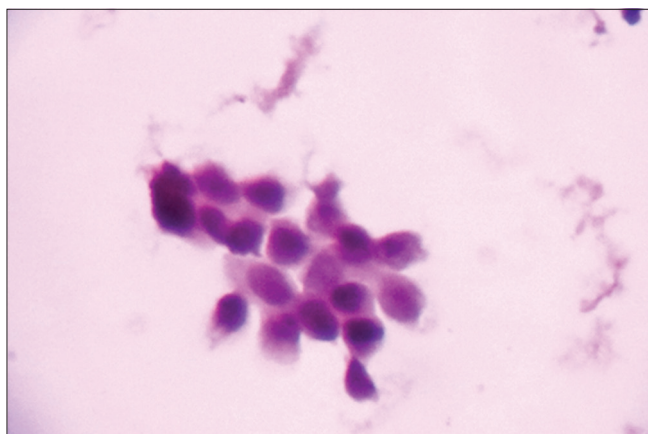


Figure 10: Squamous cell carcinoma - liquid-based cytology. This smear shows pleomorphic malignant cells in syncytial clusters with scant cytoplasm and markedly hyperchromatic nuclei and irregular nuclear outlines

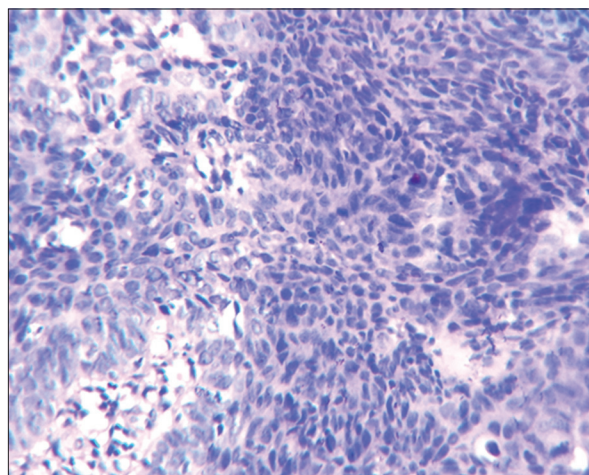


Figure 11: Squamous cell carcinoma - histopathological examination. This section shows sheets of malignant cells with markedly pleomorphic hyperchromatic nuclei with increased N/C ratio and scant cytoplasm

Carcinoma and dysplasia were mostly diagnosed when the parity was three or more in this study (53.8% of abnormal smears) similar to Sharma *et al.*^[19] and Khamankar *et al.*^[13] Almonte *et al.*^[15] reported more incidence of dysplasia when the parity was four. Sherwani *et al.*^[9] and Shakarnarayana *et al.*^[21] reported a high incidence of dysplasia when the parity was >5. Parker *et al.*^[22] showed four-fold increase in the incidence of dysplasia when the parity was seven or more similar to Nigerio *et al.*^[18] Brinton and Reeves^[23] found a five-fold increase in the risk of dysplasia when the parity was 14 or more [Table 9].

About 90% (90 cases) of cases in this study had the onset of sexual activity before 25 years of age where the majority of dysplasia was noted. Only 2 patients with the start of sexual activity above the age of 25 years had dysplasia. This finding was similar to Sherwani *et al.*^[9] and Rotkin *et al.*^[24] Rotkin postulated that during intercourse, there is a higher probability of transmission of infections and hence dysplasia is more common when there is early onset of sexual activity.^[24] Nigerio *et al.*^[18] and Sharma *et al.*^[19] also postulated that early marriage and early onset of sexual activity were responsible for increased dysplasia.

Most of our cases complained of white discharge PV (46 cases, 46%) followed by lower abdominal pain and bleeding PV (26 cases (26%) and 16 cases (16%), respectively. Sherwani *et al.*,^[9] Kenneth and Fu,^[25] Nigerio *et al.*,^[18] Sharma *et al.*,^[19] and Khamankar *et al.*^[13] also had patients with similar complaints. Kenneth and Fu noted that white discharge was associated with neoplastic changes in cervix similar to our study where most of the dysplastic changes were in this subset of patients. In a study done by Robert and Fu,^[26] post-coital bleeding was noted in many patients, and all these had dysplasia (66.7%) and carcinoma (33.3%). In contrast, only 2 cases in this study had this complaint and similar to Robert and Fu^[26] this patient had carcinoma. Study done by Tarney and Han,^[27] also had more number of patients with complaints of post-coital bleeding in contrast to our study [Table 10].

In our study, the number of satisfactory smears was 92% (92 cases) in conventional PAP smear compared to (96 cases) 96% in LBC. Most of the unsatisfactory smears in conventional PAP were due to thick and bloody smears whereas, in LBC, it is due to reduced cell number [Table 11].

In all these studies, LBC had more number of satisfactory smears than the conventional PAP smear. In our study, the reason for unsatisfactoriness in conventional PAP smear is thick smear and obscuring blood, and inflammatory cells and LBC are reduced number of cells similar to Monsanego *et al.*^[29] According to Sherwani *et al.*,^[9] in LBC cytolysis and

Table 8: Studies showing their ages with maximum dysplasia

Studies	Decade with maximum dysplasia
This study	Fourth decade
Sherwani <i>et al.</i> ^[9]	Fourth decade
Richard ^[10]	Fourth decade
Zhu <i>et al.</i> ^[11]	Fourth decade
İlter <i>et al.</i> ^[12]	Fourth decade
Khamankar <i>et al.</i> ^[13]	Fourth decade
Macharid <i>et al.</i> ^[14]	Fourth decade
Almonte <i>et al.</i> ^[15]	Fourth decade
Ibrahim ^[16]	Fifth decade
Chinaka <i>et al.</i> ^[17]	Fifth decade
Nigerio <i>et al.</i> ^[18]	Fifth decade
Sharma <i>et al.</i> ^[19]	Third decade
Parker <i>et al.</i> ^[20]	>70 years

Table 9: Studies showing parity with maximum dysplasia

Studies	Parity
This study	3
Sharma <i>et al.</i> ^[19]	3
Khamankar <i>et al.</i> ^[13]	3
Almonte <i>et al.</i> ^[15]	4
Sherwani <i>et al.</i> ^[9]	5
Shankaranarayana <i>et al.</i> ^[21]	5
Nigerio <i>et al.</i> ^[18]	7
Parker <i>et al.</i> ^[22]	7
Louise <i>et al.</i> ^[23]	14

Table 10: Studies and their most common complaints

Studies	Most common complaint
This study	White discharge P/V
Sherwani <i>et al.</i> ^[9]	White discharge P/V
Kenneth and Fu ^[25]	White discharge P/V
Nigerio <i>et al.</i> ^[18]	White discharge P/V
Sharma <i>et al.</i> ^[19]	White discharge P/V
Khamankar <i>et al.</i> ^[13]	White discharge P/V
Turney and Han ^[27]	Post-coital bleeding
Robert and Fu ^[26]	Post-coital bleeding

drying artifact are minimal or absent due to immediate fixative in a liquid fixative and lesser limited factors such as inflammatory cells, blood, and mucus and in conventional PAP is due to thick smear.

In the present study, number of ASC cases in CP was 12% (12 cases) and 6% in LBC (6 cases) [Table 12].

The number of smears diagnosed as ASC was more in conventional PAP smear (12 cases, 12%) compared to LBC (6 cases, 6%) similar to that of Zhu *et al.*^[11] and Diaz-Rosario *et al.*^[37] but contrast to studies by Davey *et al.*^[35] İlter *et al.*^[12]

Table 11: Studies and their percentage of satisfactory smears

Studies	Conventional PAP (%)	LBC (%)
This study	92	96
İlter <i>et al.</i> ^[12]	99.50	99.95
Beerman <i>et al.</i> ^[28]	99.1	99.87
Monsonogo <i>et al.</i> ^[29]	99.52	99.47
Sykes <i>et al.</i> ^[30]	97.3	98.9
Filho <i>et al.</i> ^[31]	89.6	98.6
Weintraub and Morabia ^[32]	72.2	92
Sherwani <i>et al.</i> ^[9]	31.9	83.1
Chinaka <i>et al.</i> ^[17]	53.3	83.3
Guidelines for the use of LBC in cervical cancer screening ^[33]	90.9	98.4
GP notebook ^[34]	91	98.6
Almonte <i>et al.</i> ^[15]	88.6	94.5
Singh <i>et al.</i> ^[34]	95.7	98.3

PAP: Papanicolaou, LBC: Liquid-based cytology

Table 12: Studies with their percentage of atypical squamous cells

Studies	CP (%)	LBC (%)
This study	12	6
Davey <i>et al.</i> ^[35]	3.8	4
İlter <i>et al.</i> ^[12]	2.1	2.6
Zhu <i>et al.</i> ^[11]	8	4
Abulafia <i>et al.</i> ^[5]	7.35	8.31
Bolick and Hellman ^[36]	2.42	2.97
Diaz-Rosario and Kabawat ^[37]	4.76	4.53
Weintraub <i>et al.</i> ^[32]	1.50	2.40
Hatch ^[38]	7.04	8
Guidos and Selvaggi ^[39]	2.03	3.40

LBC: Liquid-based cytology

Table 13: Studies with their percentage of LSIL cases

Studies	Conventional PAP (%)	LBC (%)
This study	8	12
Sherwani <i>et al.</i> ^[9]	10.6	18.1
Hutchinson <i>et al.</i> 1992 ^[40]	9	10.6
Diaz-Rosario and Kabawat ^[39]	1.6	2.7
Beerman <i>et al.</i> ^[28]	0.22	0.27
Monsonogo <i>et al.</i> ^[30]	1.2	1.84
Hutchinson <i>et al.</i> 1999 ^[41]	3.03	3.40
Zhu <i>et al.</i> ^[11]	29	32
Sykes <i>et al.</i> ^[30]	21	24.4
Abulafia <i>et al.</i> ^[5]	6.24	7.15
Almonte <i>et al.</i> ^[15]	0.9	13.8
Chinaka <i>et al.</i> ^[17]	10.6	12.6

LBC: Liquid-based cytology, LSIL: Low-grade squamous intraepithelial lesion, PAP: Papanicolaou

Abulafia *et al.*^[5] Bolick and Hellman,^[36] Weintraub and Morabia,^[32] Hatch *et al.*^[38] and Guidos and Selvaggi^[39] who showed that LBC was a better test for the diagnosis of ASC.

In the present study, the number of LSIL increased from 8% in conventional PAP to 12% in LBC. Other studies with similar results are shown in Table 13.

In all these studies, it can be seen that the rate of detection of LSIL is higher in LBC than conventional PAP smears.

In our present study, the rate of detection of HSIL was more with LBC (6 cases, 6%) compared to that of conventional PAP (2 cases, 2%). Many studies have found similar results and these are shown in Table 14.

Similar to LSIL, LBC detected more HSIL lesions than conventional PAP smear.

In our study, 1 frank carcinoma was detected in LBC, whereas no case was detected in conventional PAP because the carcinoma cases in conventional PAP smears were bloody and hence unsatisfactory for evaluation. In contrast to our study, Beerman *et al.*,^[28] Hutchinson *et al.*,^[41] Sykes *et al.*,^[30] and Abulafia *et al.*^[5] reported higher detection of carcinoma in conventional PAP than LBC.

Concordance between CP and LBC

This study showed 84% concordance between conventional PAP and LBC. Quite similarly, Hussein *et al.*^[42] showed 73% agreement, and Abulafia *et al.*^[5] study, which is a comparison of 17 paired studies showed in general 90% concordance and 10% discordance. He showed that in various studies, discordance was as low as 1% and as high as 20%.

Table 14: Studies with their percentage of HSIL cases

Studies	Conventional PAP (%)	LBC (%)
My study	2	6
Sherwani <i>et al.</i> ^[9]	0.6	4.3
Diaz-Rosario and Kabawat ^[37]	0.3	0.5
Beerman <i>et al.</i> ^[28]	0.56	0.64
Monsonogo <i>et al.</i> ^[29]	0.52	0.60
Hutchinson <i>et al.</i> 1999 ^[41]	1.54	1.60
Abulafia <i>et al.</i> ^[5]	4.24	4.45
Almonte <i>et al.</i> ^[15]	0.9	3.1
Chinaka <i>et al.</i> ^[17]	8.0	10.0

HSIL: High-grade squamous intraepithelial lesion, PAP: Papanicolaou, LBC: Liquid-based cytology

Table 15: Sensitivity of the screening tests in various studies in detecting LSIL

Studies	CP (%)	LBC (%)
This study	40	66
Lee <i>et al.</i> ^[43]	62.6	91.7
Kim <i>et al.</i> ^[44]	64	86
Jeon <i>et al.</i> ^[45]	73.7	78.9
Lim <i>et al.</i> ^[46]	87.2	94.9
Park <i>et al.</i> ^[47]	89.6	82.8
Arbyn <i>et al.</i> ^[48]	75.6	79.1
Ilter <i>et al.</i> ^[12]	37.5	54.5
Almonte <i>et al.</i> ^[15]	26.21	69.66

LBC: Liquid-based cytology, LSIL: Low-grade squamous intraepithelial lesion

Sensitivity of the Screening Tests in Detecting Low-Grade SIL

Our study showed a sensitivity of 40% in CP and 66% in LBC for detecting LSIL. The sensitivity of other studies is shown in Table 15.

Except for a study done by Park *et al.*,^[47] in all the other studies LBC was more sensitive than CP in detecting LSIL.

Sensitivity of the Screening Tests in Detecting High-Grade SIL

Our study showed a sensitivity of 50% in CP and 100% in LBC. The sensitivity of other studies is shown in Table 16.

In all these studies, LBC was a better test for diagnosing HSIL lesions.

Overall Sensitivity

Our study showed a sensitivity of 55.5% in CP and 83% in LBC. The sensitivity of other studies is shown in Table 17.

Sheets *et al.*,^[51] Sherman *et al.* 1997,^[52] Roberts *et al.* 1997,^[53] Papillo *et al.* 1998,^[54] Sherman *et al.* 1998,^[55] and Yeoh *et al.* 1999^[56] also showed higher sensitivity for LBC than CP and higher detection rate similar to our study. Abulafia *et al.*^[5] compared 10 studies and showed that most of the studies had higher sensitivity for LBC and a wide range of sensitivity (50–90%).

Specificity of the Screening Tests for Detection of LSIL

Our study showed a specificity of 93% for CP and 94% for LBC. Specificity of other studies is shown in Table 18.

Table 16: Sensitivity of the screening tests in various studies in detecting HSIL

Studies	CP (%)	LBC (%)
This study	50	100
Lee <i>et al.</i> ^[43]	62	85.1
Oh <i>et al.</i> ^[49]	76	92
Arbyn <i>et al.</i> ^[48]	55.2	57.1
Ilter <i>et al.</i> ^[12]	50	61
Zhu <i>et al.</i> ^[11]	47	66

HSIL: High-grade squamous intraepithelial lesion, LBC: Liquid-based cytology

Table 17: Overall sensitivity of the screening tests in various studies

Studies	Conventional PAP (%)	LBC (%)
My study	55.5	83
Abulafia <i>et al.</i> ^[5]	68	76
Sykes <i>et al.</i> ^[30]	73.7	79.1
Karimi-Zarchi <i>et al.</i> ^[50]	51	55.3
Bolick and Hellman ^[36]	85	95
Hussein <i>et al.</i> ^[42]	83	92
Sherwani <i>et al.</i> ^[9]	53.7	97.6
Chinaka <i>et al.</i> ^[17]	86	100

PAP: Papanicolaou, LBC: Liquid-based cytology

Our study showed increased specificity for LBC than CP similar to studies done by Lim *et al.*^[46] and Park *et al.*^[47] but the contrast to Lee *et al.*,^[43] Kim *et al.*,^[44] Jeon *et al.*,^[45] and Arbyn *et al.*^[48] who showed that CP is more specific than LBC.

Specificity of the Screening Tests for the Detection of HSIL

This study showed a specificity of 100% for CP and 96% for LBC. Specificity of other studies is shown in Table 19.

In contrast with other studies, our study showed that CP was more specific than LBC in the detection of HSIL.

Overall Specificity

Our study showed specificity of 83.7% and 86.5% in CP and LBC, respectively. Specificity of other studies is shown in Table 20.

Other studies which show higher specificity of LBC are Sheets *et al.*,^[51] Sherman *et al.* 1997,^[52] Roberts *et al.* 1997,^[53] Papillo *et al.* 1998,^[54] Sherman *et al.* 1998,^[55] Yeoh *et al.* 1999,^[56] Guidos *et al.* 1995,^[59] Hatch 2000^[38] Chinaka *et al.*,^[17]

Table 18: Specificity of the screening tests for the detection of LSIL in various studies

Studies	CP (%)	LBC (%)
This study	93	94
Lee <i>et al.</i> ^[43]	96.1	75.9
Kim <i>et al.</i> ^[44]	79.5	66
Jeon <i>et al.</i> ^[45]	90.9	81.6
Lim <i>et al.</i> ^[46]	87.2	92.3
Park <i>et al.</i> ^[47]	69.8	83
Arbyn <i>et al.</i> ^[48]	81.2	78.8

LSIL: Low-grade squamous intraepithelial lesion, LBC: Liquid-based cytology

Table 19: Specificity of the screening tests for the detection of HSIL in various studies

Studies	CP (%)	LBC (%)
This study	100	96
Lee <i>et al.</i> ^[43]	96.5	98.3
Oh <i>et al.</i> ^[49]	76	79
Arbyn <i>et al.</i> ^[48]	96.7	97

HSIL: High-grade squamous intraepithelial lesion, LBC: Liquid-based cytology

Table 20: Overall specificity of screening tests in various studies

Studies	Conventional PAP (%)	LBC (%)
My study	83.7	86.5
Abulafia <i>et al.</i> ^[5]	79	86
Sykes <i>et al.</i> ^[30]	69	69
Karimi-Zarchi <i>et al.</i> ^[50]	66	77.7
Bolick and Hellman ^[36]	36	58
Sherwan <i>et al.</i> ^[9]	50	50
Chinaka <i>et al.</i> ^[17]	97	100
Macharid <i>et al.</i> ^[14]	11	75

LBC: Liquid-based cytology, PAP: Papanicolaou

and Macharid *et al.*^[14] similar to our study. However, a study done by Hussein *et al.*^[42] showed high specificity for CP (82% vs. and 76%).

CONCLUSION

In a country where more number of people belong to lower socioeconomic status and with a higher incidence of cervical cancer, screening plays an important role in prevention. Hence, awareness should be created about the screening programs and the government should take adequate measures to improve the quality of the screening procedures by introducing improved methods like LBC, since cervical cancer is preventable by early detection and intervention.

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