Original Article

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Cervical Dysplasia among Women Living with HIV: A Comparative Accuracy of Different Screening Methods

Obstetrics and Gynaecology Section

PRATIBHA CHADDAR[1], JUHI AGARWAL[2], SUSHRUTA SHRIVASTAVA[3]

ABSTRACT

Introduction: Cervical cancer remains a significant public health concern, particularly among women living with Human Immunodeficiency Virus (HIV), due to the synergistic role of HIV in promoting high-risk Human Papillomavirus (HPV)-induced carcinogenesis. Early detection through effective screening methods is crucial to reduce morbidity and mortality.

Aim: To determine the prevalence of cervical dysplasia and associated risk factors in HIV-positive females, and to compare the diagnostic accuracy of conventional cytology with alternative cervical screening methods.

Materials and Methods: The present cross-sectional study was conducted at Gandhi Medical College from 1st August 2020 to 31st July 2021 after obtaining ethical clearance from the institute. A total of 250 HIV-positive females registered at the Antiretroviral Therapy (ART) Centre underwent cervical screening using conventional Papanicolaou (Pap) Smear, Liquid-Based Cytology (LBC), Visual Inspection With Acetic Acid (VIA), and Visual Inspection With Lugol's Iodine (VILI). Data were compiled using Microsoft Excel and analysed using IBM Statistical Package for Social Sciences (SPSS) software version 20. Categorical data were presented as frequency and percentage, whereas continuous data were expressed as mean±standard deviation.

Results: The mean age of the study participants was 38.01±9.18 years. Only 8 (3.2%) participants were aware of cervical screening, highlighting a critical gap in awareness. Risk factors significantly associated with abnormal cytology included age between 30-49 years, late menopause (46-50 years), higher parity, and CD4 count<500 ($p<0.05$). Liquid-Based Cytology demonstrated the highest sensitivity (100%) and negative predictive value, outperforming other screening methods. VIA and VILI showed positive findings in 16 (6.4%) and 9 (3.6%) cases, respectively, with VILI showing the highest specificity.

Conclusion: Cervical dysplasia was detected in 9.6% of screened HIV-positive women (24 out of 250 women), highlighting a substantial burden of pre-invasive disease. The findings underscore the value of regular cervical screening using Pap smear, LBC, VIA, and VILI as effective tools for early detection. Integrating cervical cancer screening into routine HIV care and improving awareness among women living with HIV may substantially reduce HPV-related morbidity and mortality.

Keywords: Conventional pap smear,Human immunodeficiency virus, Human papilloma virus, Liquid based cytology, Visual inspection with acetic acid, Visual inspection with Lugol's iodine

INTRODUCTION

Cervical cancer is one of the most preventable and treatable malignant diseases; however, it continues to pose a major public health challenge worldwide. Globally, it is the fourth most commonly diagnosed cancer among women, with disproportionately higher incidence and mortality rates in low- and middle-income countries. Persistent infection with high-risk human papillomavirus (HPV)-particularly types 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, and 59-is well established as the primary etiological factor for cervical carcinogenesis. [1]. However HPV infection alone is not sufficient to cause malignancy. Several cofactors, such as cigarette smoking, high parity, long-term use of oral contraceptives, and coinfection with HIV, influence HPV persistence and progression to high-grade lesions and invasive cancer [1,2].

Evidence from previous studies suggests that women living with HIV are at a significantly higher risk of acquiring and maintaining persistent HPV infection due to impaired cell-mediated immunity. HIV-related immunosuppression facilitates viral persistence, accelerates progression from Cervical Intraepithelial Neoplasia (CIN) to invasive carcinoma, and increases the likelihood of disease recurrence even after treatment [2-4]. Various cohort studies from sub-saharan Africa, Europe, and the United States have reported a two- to seven-fold higher risk of cervical precancer and cancer among women living with HIV compared with HIV-negative women.

While Antiretroviral Therapy (ART) has improved survival and reduced the burden of opportunistic infections, its influence on the natural history of HPV-related cervical disease remains variable across populations [4,5]. Some studies report a reduction in HPV persistence and CIN incidence with early and sustained ART, whereas others show limited benefit, suggesting variability related to timing of ART initiation, immunological recovery, and population-specific factors [6].

Despite substantial global evidence, there remains a significant gap in the Indian literature regarding the burden, progression, and predictors of cervical cancer among women living with HIV. India bears one of the highest burdens of both HIV-infected women and cervical cancer cases, yet integrated data addressing these dual public health challenges are limited. Screening coverage for cervical cancer in the general population is low and even lower among HIV-positive women due to barriers such as lack of awareness, stigma, limited accessibility, and absence of coordinated screening programs within HIV care settings [7].Most Indian studies have focused individually on HPV prevalence or Pap smear abnormalities, with very few evaluating cervical cancer risk and its determinants among women living with HIV [8,9].

Given this background, there is a compelling need to generate region-specific evidence to inform early screening, timely treatment, and preventive strategies. The present study aimed to assess the prevalence of cervical cancer among women living with HIV/Acquired Immunodeficiency Syndrome (AIDS) and to evaluate the influence of demographic, clinical, and behavioural factors on disease occurrence. It also seeks to compare the diagnostic

accuracy of conventional cytology with Liquid-Based Cytology (LBC), Visual Inspection With Acetic Acid (VIA), and Visual Inspection With Lugol's Iodine (VILI). The novelty of the present study lies in its integrated approach, linking cervical cancer screening outcomes with HIV-related characteristics in the Indian population. The findings are expected to support evidence-based recommendations for incorporating routine cervical screening into HIV care services, ultimately facilitating early detection, reducing morbidity and mortality, and strengthening national strategies against both HIV and cervical cancer.

MATERIALS AND METHODS

The present cross-sectional study was conducted at Gandhi Medical College, Bhopal, Madhya Pradesh, India, from 1st August 2020 to 31st July 2021 after obtaining ethical clearance from the institute (Letter No. 484/MC/IEC/2020).

Inclusion criteria: Women diagnosed as HIV-positive and registered at the ART Centre during the study period who provided written informed consent after being informed about the purpose and procedures of the study.

Exclusion criteria: HIV-positive women who declined to provide informed consent.

Sample size selection: A total of 250 HIV-positive women registered at the ART Centre and attending the ART outpatient department were included in the study.

Study Procedure

All participants underwent a detailed general physical and systemic examination, followed by a per-speculum pelvic examination. During the speculum examination, the appearance of the cervix-including colour, surface characteristics, presence of discharge, erosion, or visible lesions-was carefully documented. Cervical samples were then collected for cytological evaluation using both conventional Pap smear and Liquid-Based Cytology (LBC). Visual Inspection with Acetic Acid (VIA) and Visual Inspection with Lugol's Iodine (VILI) were performed as adjunct screening methods. Participants who tested positive on VIA or VILI, or who showed abnormal cytology on Pap smear or LBC, were advised to undergo cervical biopsy for histopathological confirmation.

STATISTICAL ANALYSIS

Data were compiled using Microsoft Excel and analysed using IBM SPSS software version 20. Categorical variables were expressed as frequency and percentage, while continuous variables were presented as mean±standard deviation. Abnormal cervical cytology and VIA/VILI findings were expressed as proportions. Diagnostic accuracy of conventional cytology, LBC, VIA, and VILI was calculated and presented as percentages. Cross-tabulation and univariate analysis were performed to assess risk factors for abnormal cytology in HIV-infected women. Associations were evaluated using the Chi-square (χ^2) test, and a p-value of <0.05 was considered statistically significant.

RESULTS

The mean age of the patients was 38.01±9.18 years. The majority of participants, 111 women (44.44%), were in the age group of 30-39 years. In contrast, only 22 women (8.8%) belonged to the 50-59-year age group, while 9 (3.6%) were aged above 60 years. Out of the 250 females, 57 (22.8%) belonged to the lower socioeconomic status.

The age at first pregnancy ranged between 21 and 25 years in the majority of females, whereas 0.8% of females had their first pregnancy before 18 years of age. Most HIV-positive females were asymptomatic 213 (85.2%). Among the symptomatic women, white vaginal discharge was the most common complaint, reported by 24 (9.6%) participants [Table/Fig-1].

Variables	Frequency (n=250)	Percentage
Age (years)		
20-29	42	16.8
30-39	111	44.4
40-49	66	26.4
50-59	22	8.8
>60	9	3.6
Mean	38.01±9.18	
Awareness of cervical cancer screening		
No	242	96.8
Yes	8	3.2
Socioeconomic status		
Lower middle	7	2.8
Upper lower	186	74.4
Lower	57	22.8
Age at marriage (years)		
≤18	10	4
18-20	113	45.2
21-25	113	45.2
26-30	11	4.4
>30	3	1.2
Mean	20.88±2.65	
Age at first pregnancy (years)		
≤18	2	0.8
18-20	55	22
21-25	167	66.8
26-30	17	6.8
>30	2	0.8
Nulligravida	7	2.8
Symptoms of participant		
No symptoms	213	85.2
White discharge	24	9.6
Lower abdominal pain	12	4.8
Recurrent genital ulcer	1	0.4

[Table/Fig-1]: Demographic characteristics of the participants and their presenting symptoms.

On per-speculum examination, 236 (94.4%) patients had a normal-looking cervix, 8 (3.2%) had an unhealthy-looking cervix, and 6 (2.4%) had a cervix suspicious for malignancy. Conventional Pap smear and Liquid-Based Cytology were performed in all patients, along with visual inspection with acetic acid (VIA) and visual inspection with Lugol's iodine (VILI).

On conventional Pap smear examination, inflammatory cervical mucosa was observed in 218 (87.2%) patients. Precancerous lesions included atypical squamous cells of undetermined significance (ASCUS) in 6 (2.4%) cases, low-grade squamous intraepithelial lesions (LSIL) in 2 (0.8%) cases, and high-grade squamous intraepithelial lesions (HSIL) in 14 (5.6%) cases. Squamous cell carcinoma (SCC) was identified in 3 (1.2%) patients [Table/Fig-2].

Liquid-Based Cytology revealed inflammatory lesions in 220 (88%) patients, and SCC was detected in 5 (2%) cases [Table/Fig-3]. A statistically significant association was found between the findings of conventional Pap smear and Liquid-Based Cytology ($p<0.05$) [Table/Fig-4]. Similarly, a significant association was observed among VIA, VILI, LBC, and conventional smear findings ($p<0.001$) [Table/Fig-5].

Among the screening methods evaluated, Liquid-Based Cytology demonstrated a sensitivity and negative predictive value of 100% for the detection of abnormal cytology, whereas VILI exhibited the

Conventional smear		Frequency (n=250)	Percentage
Normal	Inadequate	7	2.8
	Inflammatory	218	87.2
Precancerous	ASCUS	6	2.4
	LSIL	2	0.8
	HSIL	14	5.6
Carcinoma	SCC	3	1.2

[Table/Fig-2]: Distribution according to findings of conventional smear.
ASCUS-Atypical Squamous Cells of Undetermined Significance; LSIL -Low-Grade Squamous Intraepithelial Lesion; HSIL -High-Grade Squamous Intraepithelial Lesion; SCC-Squamous Cell Carcinoma

Liquid based cytology		Frequency (n=250)	Percentage
Normal	Inadequate	1	0.4
	Inflammatory	220	88
Precancerous	ASCUS	2	0.8
	LSIL	7	2.8
	HSIL	15	6
Carcinoma	SCC	5	2

[Table/Fig-3]: Distribution of patients according to findings of liquid based cytology

	Conventional smear					
LBC	Inadequate (n=7)	Inflammatory (n=218)	ASCUS (n=6)	LSIL (n=2)	HSIL (n=14)	SCC (n=3)
Inadequate (n=1)	1 (14.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Inflammatory (n=220)	5 (71.4)	215 (98.6)	0 (0)	0 (0)	0 (0)	0 (0)
ASCUS (n=2)	0 (0)	1 (0.5)	1 (16.7)	0 (0)	0 (0)	0 (0)
LSIL (n=7)	0 (0)	2 (0.9)	3 (50)	2 (100)	0 (0)	0 (0)
HSIL(n=15)	1 (14.3)	0 (0)	2 (33.3)	0 (0)	12 (85.7)	0 (0)
SCC (n=5)	0 (0)	0 (0)	0 (0)	0 (0)	2 (14.3)	3 (100)
$\chi 2$	526.99					
p value	0.001					

[Table/Fig-4]: Association between conventional smear and liquid based cytology.

Parameters		Conventional smear				Total	$\chi 2$	p value
		Normal		Abnormal				
		N	%	n	%			
VIA	Negative	222	98.7	12	48	234	96.42	0.001
	Positive	3	1.3	13	52	16		
VILI	Negative	223	99.1	18	72	241	47.65	0.001
	Positive	2	0.9	7	28	9		
LBC	Normal	221	98.2	0	0	221	211.7	0.001
	Abnormal	4	1.8	25	100	29		
Total		225	100	25	100	250		

[Table/Fig-5]: Association of findings of conventional smear with various methods.

highest specificity. Overall, Liquid-Based Cytology showed the highest diagnostic accuracy [Table/Fig-6].

Age between 30-49 years, menopause occurring between 46-50 years, higher parity, symptoms of white vaginal discharge, and CD4 counts below 500 cells/mm³ showed a statistically significant association with abnormal cervical cytology among HIV-positive women ($p<0.05$) [Table/Fig-7].

Parameters	VIA	VILI	LBC
Sensitivity	52	28	100
Specificity	98.7	99.1	98.2
PPV	81.25	77.8	85.2
NPV	94.9	92.5	100
Diagnostic accuracy	94	92	98.4

[Table/Fig-6]: Diagnostic accuracy of VIA, VILI and LBC.

DISCUSSION

The present study investigates the risk of cervical cancer among women living with HIV/AIDS and evaluates the influence of demographic, clinical, and behavioural variables on disease occurrence. By assessing multiple factors simultaneously, this study reinforces the understanding that cervical cancer risk in HIV-positive women is shaped by a complex interplay of host immunity, sexual and reproductive behaviours, and sociodemographic determinants.

The mean age of participants was 38.01±9.18 years, corresponding to the reproductive and perimenopausal period during which cervical neoplastic changes are commonly detected. These findings are concordant with those of Boddu A et al. (2021), who reported that the majority of HIV-positive women undergoing cervical screening were between 30 and 39 years of age, indicating that cervical dysplasia occurs predominantly during the third and fourth decades of life [10]. Similarly, Kelly HA et al. (2021) reported a median age of 34–36 years among HIV-infected women included in their study [11].

A key objective of this study was to compare the diagnostic accuracy of conventional cytology with Liquid-Based Cytology (LBC), visual inspection with acetic acid (VIA), and visual inspection with Lugol's iodine (VILI). Conventional Pap smear detected precancerous lesions in 22 (8.8%) women, whereas LBC identified such lesions in 24 (9.6%) women, suggesting that LBC is superior in detecting cervical dysplasia. Among the 250 HIV-positive women studied, squamous cell carcinoma was diagnosed in 5 (2%) cases, while cervical dysplasia was detected in 24 (9.6%) cases. The association between HIV infection, HPV persistence, and cervical cancer has been well documented [10-12]. Although the exact prevalence of cervical cancer among HIV-positive women in India remains uncertain, HIV is estimated to contribute to cervical cancer in 41.7 to 56% of cases [13,14].

This study demonstrated excellent diagnostic performance of LBC, with 100% sensitivity and negative predictive value for detecting abnormal cytology. The high concordance between conventional Pap smear and LBC in detecting HSIL and SCC indicates that both methods reliably identify high-grade lesions; however, LBC outperformed VIA and VILI in overall diagnostic accuracy. The cytological patterns observed in this study are comparable to those reported by Naidu NP et al. (2019), who observed inflammatory changes in 77.5% of HIV-positive women and precancerous lesions including ASCUS (4%), LSIL (1.5%), HSIL (0.5%), and SCC (0.5%) [12]. Similarly, Jeyakumar AM et al. (2019) reported the highest diagnostic accuracy for LBC (100%), followed by VIA and VILI [13]. Shrestha B et al. (2020) also demonstrated superior sensitivity and specificity for LBC compared to VIA, further confirming the diagnostic superiority of LBC in HIV-infected women [14]. Although VIA and VILI are useful low-cost screening tools in resource-limited settings, LBC remains the most precise method for cervical lesion detection and should be preferred wherever feasible. Cervical cancer screening in HIV-positive women is recommended at the time of HIV diagnosis, irrespective of age, with a repeat screening at 12 months followed by screening every three years.

In addition to screening evaluation, the present study assessed risk factors associated with abnormal cervical cytology. Age between 30-49 years, late menopause, higher parity, presence of white vaginal discharge, and CD4 counts below 500 cells/mm³ were significantly associated with abnormal cytology ($p<0.05$). These findings suggest that immunosuppression and reproductive factors play crucial roles in cervical carcinogenesis among HIV-positive women.

Risk factors		Normal (n=225)		Abnormal (n=25)		p value
		Frequency	%	Frequency	%	
Age (years)	20-29	41	18.2	1	4	0.04
	30-39	103	45.8	8	32	
	40-49	57	25.3	9	36	
	50-59	17	7.6	5	20	
	≥ 60	7	3.1	2	8	
Occupation	Housewife	218	96.9	25	100.0	0.67
	Labourer	4	1.8	0	0	
	Maid	3	1.3	0	0	
SES	Lower middle	7	3.1	0	0	0.43
	Upper lower	165	73.3	21	84.0	
	Lower	53	23.6	4	16.0	
Age at menarche (years)	11-13	119	52.9	12	48.0	0.22
	14-16	106	47.1	13	52.0	
Age at menopause (years)	<45	4	1.8	3	12.0	0.001
	46-50	17	7.6	10	40.0	
	51-55	5	2.2	0	0	
	Not attained	199	88.4	12	48.0	
Age at marriage (years)	≤18	10	4.4	0	0	0.07
	18-20	95	42.2	18	72.0	
	21-25	107	47.6	6	24.0	
	26-30	10	4.4	1	4.0	
	>30	3	1.3	0	0	
Age at first pregnancy	≤18	1	.4	1	4.0	0.28
	18-20	47	20.9	8	32.0	
	21-25	152	67.6	15	60.0	
	26-30	16	7.1	1	4.0	
	>30	2	.9	0	0	
	Nulligravida	7	3.1	0	0	
Parity	0	15	6.7	0	0	0.007
	1	59	26.2	3	12.0	
	2	89	39.6	8	32.0	
	3	37	16.4	5	20.0	
	≥4	25	11.1	9	36.0	
History of abortions	No	220	97.8	0	0	0.45
	Yes	5	2.2	25	100.0	
History of blood transfusion	No	219	97.3	23	92.0	0.85
	Yes	6	2.7	2	8.0	
History of multiple sex partner	No	158	70.2	17	68.0	0.12
	No history given by patient	67	29.8	8	32.0	
Husband HIV status	Negative	31	13.8	3	12.0	0.81
	Positive	194	86.2	22	88.0	
History of HIV in family	No	221	98.2	24	96.0	0.45
	Yes (Child)	4	1.8	1	4.0	
Duration of ART	<1 year	31	13.8	5	20.0	0.81
	1-2 years	18	8.0	2	8.0	
	2-5 years	97	43.1	8	32.0	
	6-10 years	60	26.7	7	28.0	
	>10 years	19	8.4	3	12.0	
CD4	<200	3	1.3	6	24.0	0.001
	200-500	11	4.9	13	52.0	
	>500	211	93.8	6	24.0	
Symptoms of participant	No symptoms	210	93.3%	03	12%	<0.001
	White discharge	3	1.3%	21	28%	
	Lower abdominal pain	11	4.8%	01	04%	
	Recurrent genital ulcer	1	0.44%	00	00	

Awareness of cervical cancer screening	Yes	8	3.5%	00	00	1.0
	No	217	96.4%	25	100%	

[Table/Fig-7]: Distribution according to risk factors associated with abnormal cytology.

Similar observations were reported by Stanley MA et al. (2014), who identified immunosuppression, multiparity, smoking, and high-risk sexual behaviour as major determinants of HPV infection [15]. Chambuso RS et al. (2017) also reported HIV infection and age above 30 years as significant risk factors for cervical cancer [16]. Chakravarty J et al. (2017) identified low CD4 counts, younger age, low literacy, and rural residence as predictors of HPV infection [17].Boddu A et al. (2021) further highlighted educational status, CD4 count, and age at first coitus as important predictors of cervical lesions [10].

Limitation(s)

Although abnormal cytology serves as an important indication for colposcopy-guided biopsy, enabling early detection and improved outcomes, the absence of histopathological confirmation remains a key limitation of this study. A substantial number of patients were lost to follow-up for colposcopy and biopsy due to the COVID-19 pandemic, which disrupted healthcare services and restricted patient visits. Consequently, histopathological correlation could not be established for all abnormal cytology cases.

CONCLUSION(S)

In the present study, cervical dysplasia was detected in 9.6% of HIV-positive women, highlighting a significant burden of pre-invasive cervical lesions in this high-risk population. Since cervical abnormalities can be detected at an early, asymptomatic stage, timely screening using Pap smear, Liquid-Based Cytology, VIA, and VILI plays a pivotal role in cervical cancer prevention. It is imperative that all HIV-positive women are educated about the importance of cervical screening and encouraged to undergo regular screening. Strengthening awareness and integrating cervical cancer screening into routine HIV care can substantially reduce the morbidity and mortality associated with HPV-related cervical disease.

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PARTICULARS OF CONTRIBUTORS:

1. Consultant, Department of Obstetrics and Gynaecology, Private Clinic, Bangalore, Karnataka, India.
2. Professor, Department of Obstetrics and Gynaecology, Gandhi Medical College, Bhopal, Madhya Pradesh, India.
3. Associate. Professor, Department of Obstetrics and Gynaecology, RKMCHRC, Bhopal, Madhya Pradesh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Sushruta Shrivastava,
E6/105, Arera Colony Behind Seven Hills School, Bhopal, Madhya Pradesh, India.
E-mail: vikrantsush18@gmail.com

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