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SPECTRUM OF PAP SMEAR CYTOLOGY IN WOMEN PRESENTING IN A TERTIARY CARE CENTER

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Abstract

Background: ervical cancer remains a significant public health problem, particularly in low- and middle-income countries where organized screening programs are limited. The Papanicolaou (Pap) smear is a simple, cost-effective screening tool for early detection of cervical epithelial abnormalities. Evaluating the spectrum of Pap smear cytology in tertiary care settings helps understand disease patterns and optimize opportunistic screening strategies.

Objectives: To assess the spectrum of cervical cytological findings on Pap smear examination among women attending a tertiary care center and to analyze the association of epithelial cell abnormalities with demographic, clinical, and cytological factors.

Methods:A retrospective, descriptive, cross-sectional study was conducted over six months in a tertiary care teaching hospital. Records of 1490 women who underwent Pap smear examination were reviewed. Smears were collected using Ayre's spatula, stained by the conventional Papanicolaou method, and reported according to The Bethesda System 2014. Data on age, clinical indications, smear adequacy, transformation zone representation, cytological diagnosis, and infective findings were analyzed using descriptive statistics and appropriate inferential tests.

Results: Most women were aged 21–50 years (70.7%). Pap smears were predominantly performed for symptom-based indications, while routine screening accounted for 19.9% of cases. Satisfactory smears constituted 95.0%, and the transformation zone was represented in 73.0%. The majority of smears were reported as negative for intraepithelial lesion or malignancy (98.7%). Epithelial cell abnormalities were detected in 12.3%, mainly ASC-US (0.3%) and ASC-H (0.6%). Adenocarcinoma was identified in 0.1% of cases. Significant associations were observed between epithelial cell abnormalities and postmenopausal bleeding, inflammatory smears, and adequate transformation zone representation.

Conclusion: Pap smear cytology remains an effective screening tool for detecting cervical epithelial abnormalities in tertiary care settings. Strengthening opportunistic screening and ensuring optimal sampling of the transformation zone may enhance early detection and contribute to cervical cancer prevention.

Keywords: Cervical cancer; Pap smear; Cervical cytology; Bethesda system; Epithelial cell abnormality; Tertiary care hospital

Introduction

Cervical cancer continues to be a major public health concern worldwide and remains one of the leading causes of cancer-related morbidity and mortality among women, particularly in low- and middle-income countries [1]. Despite being largely preventable, the burden of cervical cancer persists due to inadequate screening coverage and delayed diagnosis in many regions. Effective screening and early detection of precancerous lesions have been shown to significantly reduce both the incidence and mortality associated with cervical cancer [2].

The Papanicolaou (Pap) smear is a simple, cost-effective, and widely accepted screening tool for the early detection of cervical epithelial abnormalities [3]. Since its introduction, the Pap smear has played a pivotal role in identifying a spectrum of cytological changes ranging from benign reactive and inflammatory conditions to premalignant lesions and invasive carcinoma [4]. Organized cervical screening programs using Pap smear cytology have resulted in a substantial decline in cervical cancer incidence in several developed countries [5].

The Bethesda System for Reporting Cervical Cytology provides a standardized terminology for reporting Pap smear findings, enabling uniform interpretation, effective communication between pathologists and clinicians, and appropriate patient management [6]. This system classifies cervical cytology into categories such as negative for intraepithelial lesion or malignancy, atypical squamous and glandular cell abnormalities, squamous intraepithelial lesions, and invasive carcinoma, facilitating comparison across studies and healthcare settings [7].

Women attending tertiary care centers constitute a diverse population, including both asymptomatic individuals undergoing routine screening and symptomatic women referred for evaluation of gynecological complaints such as abnormal uterine bleeding, postcoital bleeding, persistent vaginal discharge, or suspicious cervical lesions on clinical examination [8]. Due to referral bias and the availability of advanced diagnostic facilities, tertiary care hospitals often encounter a wider spectrum and higher prevalence of premalignant and malignant cervical lesions compared to primary or secondary healthcare facilities [9].

Evaluating the spectrum of Pap smear cytological findings in women presenting to tertiary care centers is crucial for understanding disease patterns, assessing the effectiveness of opportunistic screening programs, and identifying high-risk groups requiring targeted interventions [8]. Such hospital-based studies are particularly relevant in developing countries where organized population-based screening programs are limited. Analysis of cytological patterns also aids in strengthening cervical cancer prevention strategies, optimizing resource allocation, and reinforcing the importance of routine cervical cytology screening. The present study aims to assess the spectrum of Pap smear cytological findings in women presenting to a tertiary care center, thereby emphasizing the role of cervical cytology in early detection and prevention of cervical cancer.

Methodology: Study Design, Duration and Setting : The study was conducted as a retrospective, descriptive, cross-sectional study to evaluate the spectrum of cervical cytological findings on Pap smear examination. It was carried out in the Department of Obstetrics and Gynaecology and the Cytology/Pathology Laboratory of a tertiary care teaching hospital that provided routine and diagnostic cervical cancer screening services. The study was conducted over a six-month, and the study population consisted of women who had undergone Pap smear examination during this time. A total of **1490 Pap smear slides** were collected and analyzed.

Inclusion Criteria

- Women of any age who had undergone Pap smear examination during the study period were included.
- Pap smears processed and reported in the hospital cytology laboratory were included.
- Smears reported according to The Bethesda System (2014) were included.
- Records with complete demographic and cytological details were included.

Exclusion Criteria

- Unsatisfactory or inadequate Pap smear slides were excluded.
- Duplicate Pap smear reports were excluded, and only the first smear was considered.
- Records with incomplete or missing information were excluded.

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- Pap smears collected or reported outside the study institution were excluded.

Sample Size

All eligible Pap smear records during the study period were included, and the final sample size consisted of **1490 Pap smear slides.**

Data Collection

- Data were collected retrospectively from cytology laboratory registers, hospital medical records, and electronic databases.
- A structured data extraction proforma was used.
- Demographic details such as age and parity were recorded.
- Clinical indications for Pap smear examination were documented.
- Smear adequacy and final cytological diagnosis were recorded.

Pap Smear Collection and Processing

- Cervical samples had been collected using Ayre's spatula during speculum examination.
- The smears had been immediately fixed in 95% ethyl alcohol.
- Slides had been stained using the conventional Papanicolaou staining technique.

Cytological Interpretation: Epithelial cell abnormality (ECA) was defined as the presence of atypical squamous or glandular epithelial changes, including ASC-US, ASC-H, atypical glandular cells, and malignant lesions, as per the Bethesda System 2014.

- The stained slides were examined under light microscopy by experienced cytopathologists.
- Reporting had been done according to The Bethesda System (2014).
- Cytological findings were categorized as:
  - Negative for Intraepithelial Lesion or Malignancy (NILM)
  - Inflammatory and infective lesions
  - Epithelial cell abnormalities (ASC-US, ASC-H, LSIL, HSIL)
  - Malignant lesions (squamous cell carcinoma and adenocarcinoma)

Data Analysis: The collected data were entered into Microsoft Excel, and descriptive statistical analysis was performed. The results were expressed as frequencies and percentages, and the findings were presented using tables and charts

Ethical Considerations: Approval for the study was obtained from the Institutional Human Ethics Committee. The study was retrospective and non-interventional in nature, and no direct patient contact or intervention was involved. Patient confidentiality was maintained by anonymizing all records, and the data were used exclusively for academic and research purposes.

RESULTS

Table 1: Age-wise distribution of women undergoing Pap smear examination (n = 1490)

Age group (years)	Frequency (n)	Percentage (%)
21–30	308	20.7
31–40	387	26.0
41–50	358	24.0
51–60	278	18.7
>60	159	10.6
Total	1490	100.0

Table 1 shows the age-wise distribution of women who underwent Pap smear examination during the study period (n = 1490). The highest proportion of participants belonged to the 31–40 years age group (26.0%), followed by women aged 41–50 years (24.0%). Women aged 21–30 years constituted 20.7% of the study population, while 18.7% were in the 51–60 years age group. Participants aged above 60 years formed the smallest proportion (10.6%). Overall, most women screened were between 21 and 50 y ears of age.

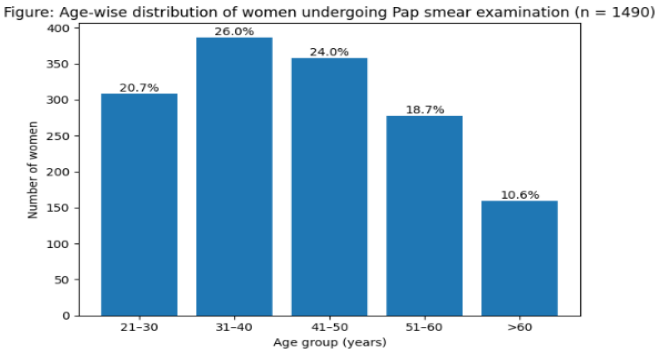

Figure 1-Age-wise distribution of women undergoing Pap smear examination (n = 1490)

Clinical indication	Frequency (n)	Percentage (%)
Routine screening	296	19.9
White discharge per vaginum	171	11.5
Intermenstrual bleeding	194	13.0
Post-coital bleeding	172	11.5
Postmenopausal bleeding	182	12.2
Abdominal pain	262	17.6
Infertility	211	14.2
Antenatal screening	2	0.1
Total	1490	100.0

Table 2: Distribution of women according to clinical indication for Pap smear examination (n = 1490)

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Table 2 presents the distribution of women according to the clinical indications for which Pap smear examination was performed (**n = 1490**). Abdominal pain was the most common indication (17.6%), followed by infertility (14.0%). Routine screening and intermenstrual bleeding each accounted for 19.9% of cases. Postmenopausal bleeding was reported in 11.7% of women, while white discharge per vaginum and post-coital bleeding were noted in 11.0% each. Antenatal screening constituted 01% of the study population. Overall, Pap smear examinations were undertaken for both routine screening and symptom-based indications, reflecting a wide range of outpatient clinical presentations.

Table 3A: Smear adequacy (n = 1490)

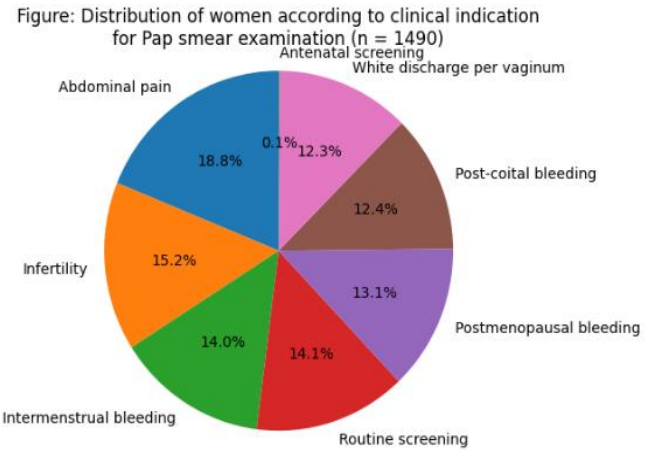

Figure 2-Distribution of women according to clinical indication for Pap smear examination (n = 1490)

Smear adequacy	Frequency (n)	Percentage (%)
Satisfactory	1415	95.0
Unsatisfactory	75	5.0
Total	1490	100.0

Table 3A summarizes the adequacy of Pap smear samples evaluated in the study. The majority of smears were reported as satisfactory, accounting for **95.0%** of cases, indicating adequate cellularity and preservation for reliable cytological interpretation. Unsatisfactory smears constituted **5.0%** of the total samples, representing a small proportion of cases in which evaluation was limited due to factors such as insufficient cellular material or obscuring elements. Overall, the high rate of satisfactory smears reflects good sampling quality and supports the reliability of cytological assessment during the study period.

Table 3B: Transformation zone component (n = 1490)

Transformation zone component	Frequency (n)	Percentage (%)
Present	1088	73.0
Absent	402	27.0
Total	1490	100.0

Table 3B shows the distribution of Pap smears according to the presence of the transformation zone component. The transformation zone was adequately represented in 73.0% of the smears, indicating that the majority of samples included the area most relevant for detecting cervical epithelial abnormalities. In 27.0% of cases, the transformation zone component was absent. Overall, the substantial proportion of smears with transformation zone representation supports the diagnostic adequacy and reliability of the cytological evaluation performed in this study.

Table 4: Spectrum of Pap smear cytological findings based on the Bethesda System 2014 (n = 1490)

Cytological diagnosis	Frequency (n)	Percentage (%)
Negative for intraepithelial lesion or malignancy (NILM)	1470	98.7
ASC-US	5	0.3
ASC-H	9	0.6
LSIL	0	0.0
HSIL	0	0.0
Squamous cell carcinoma	0	0.0
Atypical glandular cells (AGUS)	4	0.3
Adenocarcinoma	2	0.1
Total	1490	100.0

Table 4 depicts the spectrum of cytological findings on Pap smear examination based on the Bethesda System 2014. The majority of smears were reported as negative for intraepithelial lesion or malignancy (98.7%). Epithelial cell abnormalities were detected in a small proportion of women, predominantly in the form of borderline lesions such as ASC-US (0.3%) and ASC-H (0.6%). Glandular cell abnormalities were uncommon, with atypical glandular cells observed in 0.3% of cases and adenocarcinoma detected in 0.1% of women. No cases of LSIL, HSIL, or squamous cell carcinoma were identified in the present study.

Table 5: Distribution of non-neoplastic findings on Pap smear (multiple responses) (n = 1490)

Non-neoplastic finding	Frequency (n)	Percentage (%)
Inflammation	750	50.3
Candida spp.	224	16.1
Bacterial vaginosis	298	21.4
Trichomonas vaginalis	75	5.4
Actinomyces-like organisms	45	3.2

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Table 5 outlines the distribution of non-neoplastic findings observed on Pap smear examination. Inflammatory changes were the most frequently identified finding, present in 50.3% of smears. Bacterial vaginosis was noted in 21.4% of cases, while fungal elements consistent with Candida species were observed in 16.1%. Trichomonas vaginalis was identified in 5.4% of smears, and Actinomyces-like organisms were detected in 3.2% of cases. As multiple non-neoplastic findings could coexist in a single smear, the total percentage exceeds 100%. Overall, these findings highlight the substantial burden of inflammatory and infective conditions detected during routine cytological evaluation.

Table 6: Association between age group and epithelial cell abnormality (ECA) (n = 1490)

Age group	ECA present n (%)	No ECA n (%)	Total	χ^2, p-value, df
≤45 years	119 (11.6)	906 (88.4)	1025	$\chi^2 = 0.42$, df = 1; p = 0.51
>45 years	65 (14.0)	400 (86.0)	465	
Total	184 (12.3)	1306 (87.7)	1490	

Statistical test: Chi-square; $\chi^2 = 0.42$, df = 1.

Table 6 shows the association between age group and epithelial cell abnormality (ECA) among women undergoing Pap smear examination (n = 1490). Epithelial cell abnormalities were detected in 11.6% of women aged ≤45 years and in 14.0% of women aged >45 years. Although a slightly higher proportion of abnormalities was observed in women above 45 years of age, this difference was not statistically significant ($\chi^2 = 0.42$, df = 1; p = 0.51), indicating no significant association between age group and the occurrence of epithelial cell abnormality. For analytical purposes, epithelial cell abnormality (ECA) was considered as a composite variable including atypical epithelial changes identified on cytology.

Table 7: Association between clinical presentation and epithelial cell abnormality (ECA) (n = 1490)

Clinical presentation	ECA present n (%)	No ECA n (%)	Total	χ^2, p-value, df
Routine screening	20 (10.6)	169 (89.4)	189	$\chi^2 = 0.18$, df = 1; p = 0.67
Symptomatic women	164 (12.6)	1137 (87.4)	1301	
Total	184 (12.3)	1306 (87.7)	1490	

Table 7 depicts the association between clinical presentation and epithelial cell abnormality (ECA) on Pap smear examination. Epithelial cell abnormalities were observed in 10.6% of women undergoing routine screening and in 12.6% of symptomatic women. Although the proportion of abnormalities was slightly higher among symptomatic women, the association was not statistically significant ($\chi^2 = 0.18$, df = 1; p = 0.67).

Table 8: Comparison of clinicocytomorphological features with smear adequacy (n = 1490)

Clinical feature	Category	Satisfactory n	Unsatisfactory n	Fisher's exact test p-value
White discharge per vaginum	Yes	144	20	0.61
	No	1193	133	
Postmenopausal bleeding	Yes	134	40	0.018
	No	1203	113	
Abdominal pain	Yes	224	25	0.74
	No	1113	128	
Antenatal screening	Yes	2	0	1.00
	No	1413	72	

$p < 0.05$ considered statistically significant.

Table 8 compares selected clinicocytomorphological features with Pap smear adequacy among the study population (n = 1490). Smear adequacy did not differ significantly among women presenting with white discharge per vaginum or abdominal pain, as comparable proportions of satisfactory and unsatisfactory smears were observed ($p > 0.05$). In contrast, a statistically significant association was noted between postmenopausal bleeding and smear adequacy, with a higher proportion of unsatisfactory smears among women presenting with postmenopausal bleeding ($p = 0.018$). Among antenatal women, only two Pap smears were performed, both of which were satisfactory, and no statistically significant association was observed between antenatal screening and smear adequacy (Fisher's exact test, p = 1.00).

Table 9: Association between clinical features and epithelial cell abnormality (ECA) (n = 1490)

Clinical feature	Category	ECA present n	No ECA n	Fisher's exact test p-value
White discharge per vaginum	Yes	30	134	0.44
	No	154	1172	
Postmenopausal bleeding	Yes	40	134	0.031
	No	144	1172	
Intermenstrual bleeding	Yes	30	159	0.62
	No	154	1147	
Post-coital bleeding	Yes	35	129	0.08
	No	149	1177	

$p < 0.05$ considered statistically significant.

Table 9 shows the association between selected clinical features and epithelial cell abnormality (ECA) among women undergoing Pap smear examination (n = 1490). Epithelial cell abnormalities were significantly more frequent in women presenting with postmenopausal bleeding ($p = 0.031$). No statistically significant association was observed between ECA and white discharge per vaginum, intermenstrual bleeding, or post-coital bleeding, although a higher proportion of abnormalities was noted among women with post-coital bleeding.

Table 10: Association between infection/inflammation and epithelial cell abnormality (ECA) (n = 1490)

Cytological finding	Category	ECA present n	No ECA n	Fisher's exact test p-value
Inflammation	Yes	124	626	0.021
	No	60	680	
Candida spp.	Yes	20	204	0.77
	No	164	1102	
Bacterial vaginosis	Yes	15	283	0.18
	No	169	1023	
Trichomonas vaginalis	Yes	5	70	1.00
	No	179	1236	

$p < 0.05$ considered statistically significant.

Table 10 presents the association between infective or inflammatory cytological findings and epithelial cell abnormality (ECA) among women undergoing Pap smear examination (n = 1490). A statistically significant association was observed between inflammatory smears and epithelial

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cell abnormality (p = 0.021). In contrast, no significant association was found between ECA and specific infections such as *Candida* species, bacterial vaginosis, or *Trichomonas vaginalis* (p > 0.05).

Table 11: Association between transformation zone component and epithelial cell abnormality (ECA) (n = 1490)

Transformation zone component	ECA present n (%)	No ECA n (%)	Total	p-value
Present	167 (15.3)	921 (84.7)	1088	0.012
Absent	17 (4.2)	385 (95.8)	402	
Total	184 (12.3)	1306 (87.7)	1490	

Table 11 shows the association between transformation zone representation and epithelial cell abnormality (ECA) among women undergoing Pap smear examination (n = 1490). Epithelial cell abnormalities were significantly more frequent in smears with transformation zone representation compared to those without transformation zone component (p = 0.012).

DISCUSSION

The present study evaluated cervical cytological findings among 1490 women attending a tertiary care hospital using the Bethesda System 2014. Most women belonged to the reproductive and perimenopausal age groups, with 70.7% of participants between 21 and 50 years of age. Pap smear examination was predominantly undertaken for symptom-based indications, with abdominal pain (16.7%) and infertility (14.0%) being the most common, while routine screening accounted for only 12.8% of cases. A high level of technical quality was observed, with 95.0% of smears reported as satisfactory and transformation zone representation in 73.0% of samples. Cytologically, the vast majority of smears were reported as negative for intraepithelial lesion or malignancy (98.7%), while epithelial cell abnormalities were detected in 12.3% of women. Borderline epithelial abnormalities such as ASC-US and ASC-H predominated, while invasive malignancies were uncommon. Significant associations with epithelial cell abnormality were observed for postmenopausal bleeding, inflammatory smears, and adequate transformation zone representation, whereas age group and overall clinical presentation did not show statistically significant associations.

The age distribution and cytological spectrum observed in the present study are consistent with findings reported in several recent hospital-based studies. **Ranjit et al.** reported that women aged 30–50 years constituted the largest proportion of those undergoing Pap smear examination, reflecting increased healthcare utilization during the reproductive and perimenopausal periods.[10] Similarly, **Kashyap et al.** observed that most Pap smears in tertiary care settings are performed for symptomatic indications rather than routine screening, underscoring the opportunistic nature of cervical cancer screening in low-resource settings.[11] The high smear adequacy rate of 95.0% in the present study compares favorably with the findings of **Singh et al.**, who reported adequacy rates above 90% and emphasized the role of standardized sampling techniques and trained personnel in improving cytological quality.[12]

With respect to cytological diagnoses, NILM constituted the predominant category in the present study, which is comparable to the observations of **Bhatla et al.**, who reported that the majority of cervical smears in hospital-based studies show benign or reactive changes.[13] The prevalence of epithelial cell abnormality (12.3%) observed in this study is similar to that reported by **Patel et al.**, who documented epithelial abnormalities in approximately 10–15% of women undergoing Pap smear examination.[14] Borderline abnormalities such as ASC-US and ASC-H were more frequent than high-grade lesions, a pattern also described by **Davey et al.**, who noted an increase in ASC reporting following the adoption of the Bethesda 2014 system due to improved recognition of subtle epithelial changes.[15]

An important clinicocytological correlation identified in the present study was the significant association between postmenopausal bleeding and epithelial cell abnormality. This finding is in agreement with the observations of **Verma et al.**, who reported that postmenopausal bleeding is frequently associated with premalignant and malignant cervical lesions and warrants careful cytological evaluation.[16] In contrast, symptoms such as white discharge per vaginum, intermenstrual bleeding, and post-coital bleeding did not show statistically significant associations with epithelial abnormalities, findings that are consistent with those reported by **Sharma et al.**, who noted that these symptoms are more commonly linked to inflammatory or reactive cytological changes.[17]

The present study also demonstrated a statistically significant association between inflammatory smears and epithelial cell abnormality. Similar findings have been reported by **Gupta et al.**, who highlighted that chronic inflammation may coexist with epithelial atypia or obscure dysplastic cells, emphasizing the importance of repeat cytology after treatment of inflammation.[18] Furthermore, the significantly higher detection of epithelial abnormalities in smears with adequate transformation zone representation observed in this study supports the conclusions of **Arbyn et al.**, who emphasized that sampling of the transformation zone is critical for improving the sensitivity of cervical cytology and reducing false-negative results.[19]

Figure 3-: Cervical cytology showing normal squamous epithelial cells (NILM) on Papanicolaou stain [7]

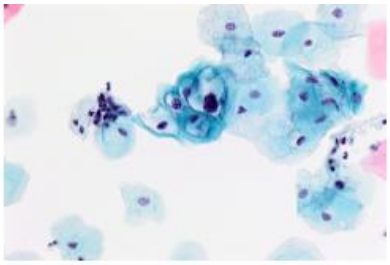


Figure 4: Low-grade squamous intraepithelial lesion (LSIL)[7]

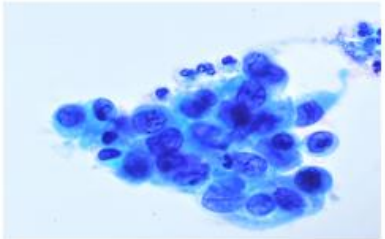
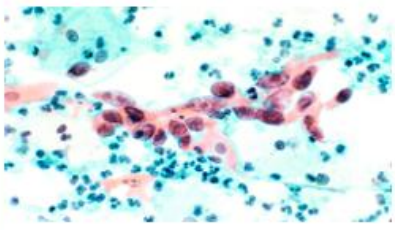


Figure 5:High-grade squamous intraepithelial lesion (HSIL)[8]



-Figure 6: Squamous cell carcinoma of cervix on Pap smear [7]

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Strengths and Limitations

The strengths of the present study include its large sample size, use of a standardized reporting system, high smear adequacy, and detailed assessment of clinicocytological associations. However, certain limitations must be acknowledged. The retrospective design limited the availability of detailed behavioral and reproductive risk factors, and histopathological or HPV DNA correlation could not be performed. As a single-center, hospital-based study, the findings may not be fully generalizable to the wider community.

Despite these limitations, the findings have important clinical implications. Strengthening opportunistic screening, ensuring optimal sampling of the transformation zone, and maintaining careful evaluation of women presenting with postmenopausal bleeding or inflammatory smears may enhance early detection of cervical epithelial abnormalities. Integration of cytology-based screening with HPV testing, where feasible, may further improve diagnostic accuracy.

conclusion

The present study demonstrates that Pap smear cytology remains an effective and reliable screening tool for the detection of cervical epithelial abnormalities in routine clinical practice. Although most smears were benign, a clinically meaningful proportion of epithelial abnormalities was identified, particularly among women with postmenopausal bleeding, inflammatory changes, and adequate transformation zone sampling. Continued emphasis on quality sampling and timely follow-up can contribute significantly to cervical cancer prevention efforts.

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