

Cytomorphological Spectrum of Cervical Lesions Detected by Pap Smear Screening: A Retrospective Study

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Abstract:

Background: Cervical cancer remains an important health concern among women, and Pap smear cytology provides a simple and effective method for detecting cervical epithelial abnormalities at an early stage.

Aim: To evaluate the cytomorphological spectrum of cervical lesions detected by conventional Pap smear screening and assess their age-wise distribution using the 2014 Bethesda System.

Methodology: A retrospective descriptive study was conducted in Department of Obstetrics and Gynaecology, Nalanda Medical College and Hospital, Patna, Bihar, India, over one year from January 2024 to December 2024. Medical records of 80 women aged >21 years who underwent conventional Pap smear examination for gynecological symptoms or routine screening were reviewed. Cytological findings were categorized according to the 2014 Bethesda System and analyzed using SPSS version 20.0.

Results: NILM with inflammatory/reactive changes was the predominant finding, observed in 48 (60.0%) cases, while epithelial cell abnormalities were detected in 32 (40.0%). Among abnormal smears, ASC-US constituted 10 (31.25%), LSIL 9 (28.13%), HSIL 6 (18.75%), ASC-H 4 (12.50%), and SCC 3 (9.37%). Higher-grade abnormalities were predominantly observed among women aged ≥41 years.

Conclusion: Pap smear screening effectively identified a broad spectrum of cervical cytological abnormalities and may facilitate early detection and timely management of significant cervical lesions.

Keywords: Cervical cytology, Pap smear, Bethesda system, cervical lesions, ASC-US, LSIL, HSIL, cervical cancer.

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Introduction

Despite all this, cervical cancer is a major public health problem and is one of the significant causes of cancer mortality and morbidity in women especially in LMIC countries. It is a significant cause of female cancers worldwide and India makes a significant contribution to the burden of this disease. Cancer of the cervix is a disease that remains important in terms of effective prevention and early detection: in 2020 there were approximately 604,000 new cases and 342,000 deaths globally [1]. Cervical cancer remains one of the top five cancer sites in women with a significant number of women being diagnosed at the locally advanced stage, highlighting the urgent need for accessible screening and early diagnosis in India. Additionally, there are geographic disparities within the country regarding the burden of disease, screening coverage, socioeconomic, healthcare accessibility and awareness, all of which

affect the identification of cervical abnormalities. Cervical cancer offers an important opportunity for prevention because the development of invasive malignancy typically follows a sequence of premalignant epithelial changes, which can last for many years before epithelial malignancy develops. High-risk human papillomavirus (HPV) infection is known to be a necessary cause of cervical cancer, and other co-factors such as smoking, multiple sexual partners, sexually transmitted infections, high parity and prolonged use of oral contraceptives have been suggested to be involved in the development and progression of the disease [2]. The opportunity to identify abnormalities in the cervical epithelium during the pre-cancerous stage can therefore be used to take proper precautionary measures to ensure adequate surveillance and treatment that will prevent the development of invasive cancer.

Screening is therefore an integral part of cervical cancer prevention programmes. Papanicolaou (Pap) smear is a simple, relatively inexpensive, minimally invasive, cytological examination that allows for the evaluation of exfoliated cervical epithelial cells for inflammatory, infectious, pre-malignant and malignant changes. The technique was developed as a result of the pioneering work of George Papanicolaou and eventually became one of the most widely used methods for cervical cancer screening. In populations with organized screening programs that have been successfully implemented, conventional cervical cytology has been a key factor in helping to lower the incidence and mortality of cervical cancer. Whilst HPV testing is now also an important primary screening tool, the importance of cytology as a means of the detection and characterization of cell abnormalities has an important role in many clinical and screening contexts. In addition, the World Health Organization's (WHO) 2021 recommendations highlighted the growing importance of HPV-based primary screening, while acknowledging that cytology is an established cervical screening method [3].

In the past, variations in terminology and classification by cytopathologists led to problems in conveying the information of cervical cytology to the clinician. The Bethesda System for Reporting Cervical Cytology was developed in 1988 to provide standardized terminology that is reproducible. Later revisions in 1991, 2001, and 2014 added to the knowledge of cervical neoplasia, as well as updates to cytomorphologic criteria. The Bethesda System has made the interpretation of cervical cytology more uniform and has helped to communicate between the pathologist and the treating clinician [4]. The latest Bethesda System for cervical cytology categorizes the test into five groups: specimen adequacy, negative for intraepithelial lesion or malignancy (NILM), epithelial cell abnormalities, and other findings. These abnormalities of the epithelium are atypical squamous cells of undetermined significance (ASC-US), atypical squamous cells cannot exclude HSIL (ASC-H), low-grade squamous intraepithelial lesion (LSIL), high-grade squamous intraepithelial lesion (HSIL), squamous cell carcinoma, and glandular abnormalities.

In 2014, the Bethesda System underwent relatively minor changes in terminology, but additions were made in the areas of morphologic criteria and reporting guidelines. A significant recommendation is for reporting benign appearing endometrial cells, which differ depending on age and menopausal state [5]. Uniform reporting is especially critical for retrospective cytology research so that the cytology patterns and rates of abnormality can be compared between different populations and institutions. Cervical Pap smears can present with a wide cytomorphological spectrum which ranges from inflammatory

and reactive changes to obvious premalignant or malignant changes. In addition, changes that occur with bacterial vaginosis and infectious organisms such as *Trichomonas vaginalis* and *Candida* may also be detected by cytologic examination. In a Puducherry retrospective study, 1,650 conventional Pap smears were analyzed based on the Bethesda System of 2014 and NILM was the most common result while epithelial cell abnormalities were detected in lesser number of cases and abnormal Pap findings were associated with older age groups. The prevalence and distribution of inflammatory changes, ASC-US, LSIL, HSIL and malignant changes have also been shown to vary significantly in studies conducted in other parts of India, which is related to differences in the study population and screening practices [6]. Analysis of age-wise cytological patterns is of particular relevance since the occurrence of cervical epithelial abnormalities is not the same in all age groups. The age range where inflammatory, premalignant and malignant abnormalities are more common can help to inform target populations for screening. Previous Indian studies have shown that abnormal epithelial changes can be focused on specific age groups and benign inflammatory and infectious changes are common among younger and middle-aged women [7]. Demographic characterization may be helpful in planning the screening strategy and enhancing participation in preventative health care.

Therefore, the present retrospective study was conducted in Patna, Bihar, India, to explore the cytomorphological spectrum of cervical lesions identified by the conventional Pap smear screening using the 2014 Bethesda System for Reporting Cervical Cytology. To evaluate the distribution of the cervical cytological results, to describe the clinical and demographic characteristics of women who present for screening, to determine the age-wise distribution of the various abnormal cytological findings, and to ascertain the prevalence of abnormal Pap smear result in the population studied. Similarly, the analysis of these patterns could be useful in identifying the groups at higher risk of cytological abnormalities in the cervix and could be used as local evidence for improving cervical cancer screening and early detection activities in Patna.

Methodology

Study Design: The present study was conducted as a retrospective descriptive study to evaluate the cytomorphological spectrum of cervical lesions detected through conventional Pap smear screening. Previously recorded clinical, demographic, examination, and cervical cytology data of eligible women were retrospectively reviewed. Cervical cytological findings were classified according to the 2014 Bethesda System for Reporting Cervical Cytology (TBSRC 2014).

Study Area: The study was conducted in Department of Obstetrics and Gynaecology, Nalanda Medical College and Hospital, Patna, Bihar, India. The study population comprised women attending the outpatient department (OPD) with various gynecological complaints as well as women presenting for routine cervical cancer screening.

Study Duration: The study was conducted over a period of one year from January 2024 to December 2024.

Sample Size: A total of 80 women (N = 80) fulfilling the predefined inclusion and exclusion criteria were included in the present study. Only records containing adequate information regarding the participant's clinical profile and Pap smear findings were considered for analysis.

Sample Population: The study population consisted of women aged more than 21 years who attended the gynecology OPD with various gynecological symptoms or presented for routine cervical cancer screening and underwent conventional Pap smear examination. The study included women whose available medical records contained relevant clinical and cytological information required for evaluation.

Data Collection: Data were collected retrospectively from the available medical records of the study participants. Relevant demographic and clinical information, including age, presenting complaints, personal history, marital history, and per-speculum examination findings of the cervix, was recorded. The corresponding conventional Pap smear reports were reviewed for cytological findings. The cytological findings were subsequently categorized according to the 2014 Bethesda System for Reporting Cervical Cytology. Particular attention was given to the presence of inflammatory/reactive changes, negative for intraepithelial lesion or malignancy (NILM), and epithelial cell abnormalities.

Inclusion Criteria

- Women more than 21 years of age.
- Women attending the gynecology OPD with various gynecological symptoms.
- Women presenting for routine cervical cancer screening.
- Women who had undergone a conventional Pap smear examination.
- Medical records contain sufficient clinical and cytological information for analysis.

Exclusion Criteria

- Pregnant women.

- Women with a known history of epithelial cell abnormality.
- Women who had previously been treated for cervical epithelial abnormalities or cervical cancer.
- Unmarried women.
- Records with incomplete or insufficient clinical/cytological information were also excluded from the final analysis.

Procedure: Conventional Pap smear samples obtained from eligible women were reviewed from the available medical records. The clinical history and per-speculum examination findings were correlated with the corresponding cytological reports. Cervical smears were evaluated and categorized according to the 2014 Bethesda System for Reporting Cervical Cytology (TBSRC 2014). Reactive cellular changes associated with inflammation and atrophy were included under Negative for Intraepithelial Lesion or Malignancy (NILM). Epithelial cell abnormalities (ECA) were categorized into Atypical Squamous Cells of Undetermined Significance (ASC-US), Atypical Squamous Cells cannot exclude High-Grade Squamous Intraepithelial Lesion (ASC-H), Low-Grade Squamous Intraepithelial Lesion (LSIL), High-Grade Squamous Intraepithelial Lesion (HSIL), and Squamous Cell Carcinoma (SCC). The distribution of cytological findings was subsequently assessed in relation to the demographic and clinical characteristics of the study population.

Statistical Analysis: The collected data were systematically entered, tabulated, and analyzed using Statistical Package for the Social Sciences (SPSS), version 20.0. Descriptive statistical methods were used to summarize the study findings. Categorical variables, including different Pap smear categories and epithelial abnormalities, were expressed as frequencies and percentages. Age-wise and category-wise distributions of cytological findings were also evaluated to determine the pattern and prevalence of cervical cytological abnormalities within the study population”.

Result

Table 1 shows the age-wise distribution of the 80 women included in the study. The highest proportion of participants belonged to the 31–40 years age group, comprising 24 (30.0%) cases, followed by the 41–50 years group with 20 (25.0%) cases and the 21–30 years group with 18 (22.5%) cases. A total of 12 (15.0%) women were aged 51–60 years, while only 6 (7.5%) participants were above 60 years of age. Thus, the study population was predominantly composed of women between 31 and 50 years of age.

Table 1: Age-wise Distribution of Study Participants (N=80)

Age Group (years)	Number of Cases (n)	Percentage (%)
21–30	18	22.5
31–40	24	30
41–50	20	25
51–60	12	15
>60	6	7.5
Total	80	100

Table 2 demonstrates the cytological findings of all 80 Pap smear samples according to the 2014 Bethesda System. Negative for Intraepithelial Lesion or Malignancy (NILM) with inflammatory/reactive changes was the most frequently observed finding, accounting for 48 (60.0%) cases. Among epithelial cell abnormalities, ASC-US was the most common finding, detected in 10 (12.5%) cases, followed by

LSIL in 9 (11.25%) cases. HSIL was identified in 6 (7.5%) cases, while ASC-H was observed in 4 (5.0%) cases. Squamous cell carcinoma was detected in 3 (3.75%) cases. Overall, the findings demonstrated a broad cytomorphological spectrum ranging from benign inflammatory changes to high-grade lesions and invasive malignancy.

Table 2: Distribution of Pap Smear Findings According to the 2014 Bethesda System (N=80)

Cytological Finding	Number of Cases (n)	Percentage (%)
NILM – Inflammatory/Reactive changes	48	60
ASC-US	10	12.5
ASC-H	4	5
LSIL	9	11.25
HSIL	6	7.5
Squamous Cell Carcinoma (SCC)	3	3.75
Total	80	100

Table 3 presents the relationship between age and different cervical cytological findings. NILM was the predominant finding in all age groups, particularly among women aged 31–40 years, where 16 of 24 cases showed NILM. ASC-US was most frequently observed in the 31–40 years age group, with 4 cases. LSIL was distributed mainly among women

aged 31–50 years. Higher-grade abnormalities, including HSIL and SCC, were predominantly observed among women aged 41 years and above. The presence of HSIL and SCC in older age groups indicates an increasing occurrence of clinically significant epithelial abnormalities with advancing age in the study population.

Table 3: Age-wise Distribution of Cytological Findings

Age Group (years)	NILM	ASC-US	ASC-H	LSIL	HSIL	SCC	Total
21–30	15	2	0	1	0	0	18
31–40	16	4	1	3	0	0	24
41–50	10	3	1	3	2	1	20
51–60	5	1	1	1	3	1	12
>60	2	0	1	1	1	1	6
Total	48	10	4	9	6	3	80

Table 4 shows the overall prevalence of epithelial cell abnormalities among the study participants. Of the 80 women screened, 48 (60.0%) had NILM, whereas 32 (40.0%) demonstrated epithelial cell abnormalities. Thus, although benign or inflammatory/reactive cytological findings constituted the majority, a considerable proportion of women

showed abnormal epithelial changes requiring further clinical assessment and appropriate follow-up. The findings emphasize the usefulness of Pap smear screening in identifying cervical epithelial abnormalities among women attending the gynecology OPD or presenting for routine screening.

Table 4: Distribution of Women According to Presence or Absence of Epithelial Cell Abnormality

Cytological Category	Number of Cases (n)	Percentage (%)
NILM	48	60
Epithelial Cell Abnormality (ECA)	32	40
Total	80	100

Table 5 describes the detailed distribution of the 32 cases categorized as epithelial cell abnormalities. ASC-US was the most frequent abnormality, accounting for 10 (31.25%) cases, followed closely by LSIL with 9 (28.13%) cases. HSIL was identified in 6 (18.75%) cases, while ASC-H was observed in 4 (12.50%) cases. Squamous cell carcinoma

represented 3 (9.37%) cases. Therefore, low-grade or indeterminate abnormalities constituted the larger proportion of epithelial abnormalities, although the detection of HSIL and SCC in 9 cases (28.12%) highlights the presence of clinically significant cervical lesions within the screened population.

Table 5: Distribution of Epithelial Cell Abnormalities According to Bethesda Categories (n=32)		
Epithelial Cell Abnormality	Number of Cases (n)	Percentage among ECA (%)
ASC-US	10	31.25
ASC-H	4	12.5
LSIL	9	28.13
HSIL	6	18.75
SCC	3	9.37
Total	32	100

Discussion

Cervical cancer is still a major health problem in India, especially since a significant number of women may fail to have regular screening despite the availability of relatively simple and inexpensive screening techniques. The conventional Pap smear still plays an important role in the detection of epithelial abnormalities of the cervix and inflammatory/reactive changes prior to the development of invasive disease. Eighty women who were enrolled for Pap smear screening were assessed in the current study according to the Bethesda System 2014. The majority of NILM (60.0%) and identification of epithelial abnormalities in 40.0% of women showed the value of cytological evaluation for characterization of the spectrum of the cervical lesions in the study population. In the same manner, other studies have highlighted that Pap smear is a simple, economic and effective tool for the detection of non-neoplastic and neoplastic cervical lesions especially in an outpatient and resource-limited environment [8].

Women in the 31-40 years age group had the highest number of cases (30.0%) followed by the 41-50 age group with 25.0%. Therefore, 55.0% of the study population were aged 31-50 years. This was similar to the study done in northern India by Priyanka et al., where the age group 31-40 years was the highest (32.72%) for women who underwent Pap smear examination followed by 41-50 years [9]. In the same context, the study conducted in western Uttar Pradesh indicated that 40.37% women in the study were from 30-39 years age group. The higher number of screening participants in the reproductive and early perimenopausal age groups may relate to the higher prevalence of gynecological complaints and health care utilization in these age groups. Our cytological spectrum revealed that NILM with inflammatory/reactive changes were the most common findings and were seen in 48 (60.0%) women. This is in keeping with various Indian studies that showed that majority of cervical smears were either benign inflammatory or reactive changes.

Omhare et al. reported benign and inflammatory lesions in 95.48% of the satisfactory smears and Sreelatha et al. reported inflammatory smears in 69.22% of cases in South India [10]. Gidwani et al. reported inflammatory lesions in 63.78% of the cases examined in another retrospective study. The relatively high incidence of inflammatory changes in our study may be due to the fact that women were studied who were attending the gynecology OPD with symptoms as well as those women who were attending for routine screening. This study, with 32 women (40.0%) with epithelial cell abnormalities, shows a significantly higher percentage than several larger retrospective studies. In a study of 9,330 cervical smears, Sreedevi et al. found only 1.70% cases with epithelial abnormalities, and Gupta et al. found 6.9% cases with epithelial cell abnormalities out of 450 pap smears [11]. Likewise, a big study from Puducherry found abnormal cells in 2.3% of 1,650 Pap tests done using the conventional method.

We, however, have a higher proportion in our study which should be interpreted with caution as we studied only 80 women and have included women who were in the gynecology OPD with symptoms. The prevalence of abnormal cytology will vary widely, depending on sample size, referral patterns, screening practices and populations studied. Epithelial abnormalities in our study were the most common group with ASC-US in 10 (31.25%) cases, and LSIL in 9 (28.13%) cases. ASC-H, HSIL and SCC were observed in 4 (12.5%), 6 (18.75%) and 3 (9.37%) cases, respectively. ASC-US is the most common abnormal smear seen and this is similar to what was reported by Lakshmy et al. who reported ASC-US to be the most common epithelial abnormality with 1.38% of all the smears screened [12]. Likewise, Sharma et al., conducted a study in North India, that found ASC-US to be an important part of epithelial abnormalities. But, in other studies LSIL has been the most common epithelial abnormality. In one Indian study of 7127 pap tests, for instance, LSIL was

the most frequently observed epithelial change, followed by HSIL and SCC.

In the present study, age-wise analysis revealed that the incidence of higher grades of abnormalities increased among the women with age 41 years and above. Most of the women with HSIL were in the 41-50 years and 51-60 age groups, with all three cases of SCC being in women 41 years and older. The present finding is similar to the study conducted by Sreedevi et al., which showed that women with epithelial abnormalities range from 31 to 70 years of age with the highest number of women in the 41-50 years age group. Priyadharisini et al. also found that nearly all the changes of the epithelium were found in women over 44 years old [13]. These results confirm the need for screening to continue after the younger childbearing age range, as clinically important cervical lesions may present at that time. The present study also showed that out of 32 epithelial abnormalities 9 were HSIL or SCC showing 28.12% high grade or malignant cytological change in abnormal smears. The proportion of this is very small (on a relatively small sample), however, it is clinically significant as finding such lesions during screening allows timely confirmatory evaluation and management. Comparatively, the study by Sharma et al. in North India had 8 malignant cases out of 450 smears and the study by Malpani et al. in central India also showed the utility of Pap smear in picking up low-grade, high-grade and malignant lesions for further evaluation [14].

The current study shows a wide spectrum of cytomorphological changes, including inflammatory/reactive NILM changes, ASC-US, ASC-H, LSIL, HSIL and SCC. The predominance of patients in the age group 31-40 years, the high prevalence of NILM with inflammatory changes and the higher prevalence of clinically significant epithelial changes in the older age groups are broadly similar to what is reported in other Indian population. The variation in prevalence of epithelial abnormalities among studies illustrates study design, population characteristics and sample size. The current results support the importance of traditional pap smear testing and uniform Bethesda reporting to detect women who need additional clinical evaluation and follow up.

Conclusion

The present retrospective study showed that the spectrum of different cervical lesions in females who had Pap smear screening in Patna, Bihar was wide ranging with majority of them being NILM and inflammatory/reactive changes (60.0%), while 40.0% of the study population had epithelial cell abnormalities. Among abnormal smears, ASC-US was the most frequent category (31.25%), followed by LSIL (28.13%), HSIL (18.75%), ASC-H (12.50%), and SCC (9.37%). The high-grade abnormalities and malignant lesions occurred mainly in the age group

of women 41 and older, which highlights the need to continue screening in this age group. The results demonstrate the value of traditional Pap smear cytology and the standardized reporting system of 2014 Bethesda System in identifying various cervical disease types, including clinically significant premalignant and malignant diseases. The regular cervical cytological screening, especially in the proper age group and women with gynecological symptoms, can help to detect the disease in an early stage and can help to manage it accordingly thereby playing a role in preventing cervical cancer.

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