Section: Pathology

Original Research Article

SPECTRUM OF PAP SMEAR CYTOLOGY IN A TERTIARY CARE HOSPITAL

Pamelle Yadav[1], Sonal Agarwal[2], Sumaiya Siddiqui[3]

[1]Professor, Department of Pathology, IRPGIMSR and associated Northern Railway Central Hospital, New Delhi, India.
[2]Assistant Professor, Department of Pathology, IRPGIMSR and associated Northern Railway Central Hospital, New Delhi, India.
[3]Assistant Professor, Department of Pathology, IRPGIMSR and associated Northern Railway Central Hospital, New Delhi, India.

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Corresponding Author:
Dr. Sumaiya Siddiqui,
Email: virgo.asiya@gmail.com

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ABSTRACT

Background: Cervical cancer continues to be a major public health concern among women, particularly in low- and middle-income countries. In India, delayed diagnosis and limited screening coverage contribute significantly to disease burden. Since cervical cancer evolves through identifiable premalignant stages, cytological screening using the Papanicolaou smear plays a vital role in early detection. **Aim:** To assess the utility of Pap smear screening in identifying non-neoplastic, premalignant, and malignant cervical lesions in a tertiary care hospital, Northern Railway Central Hospital, New Delhi. **Materials and Methods:** A retrospective analysis of 1,296 cervical cytology smears received in the Department of Pathology, Northern Railway Central Hospital, New Delhi, from January 2023 to December 2024 was conducted. Women aged more than 21 years, visiting the gynaecological OPD, either for any complaints, or for routine screening were included. Smears were interpreted using the 2014 Bethesda System. **Results:** 1,132 cases (87.3%) were labelled as Negative for Intraepithelial Lesions or Malignancy (NILM), and these included the 90 cases (6.9%) showing Bacterial Vaginosis, which was added as an additional finding. Epithelial abnormalities included Atypical Squamous Cells of Undetermined Significance (ASCUS) in 4 cases, Atypical Squamous Cells—Cannot Exclude High-Grade Lesion (ASC-H) in 15 cases, Low-Grade Squamous Intraepithelial Lesions (LSIL) in 8 cases, High-Grade Squamous Intraepithelial Lesion (HSIL) in 1 case, and Squamous Cell Carcinoma (SCC) in 1 case. Atypical Glandular Cells of Undetermined Significance (AGUS) were identified in 10 cases. **Conclusion:** Pap smear screening remains an effective, low-cost, and minimally invasive method for early detection of cervical epithelial abnormalities. Strengthening screening programs can substantially reduce cervical cancer burden.

INTRODUCTION

Cervical cancer is the fourth most common cancer worldwide in terms of both incidence and mortality in women, with an estimated 660,000 new cases and 350,000 deaths worldwide in 2022.[1] In India, cervical cancer is the second most common cause of cancer mortality with 127526 new cases and 79906 deaths reported in 2022.[2] These figures show that cervical cancer remains a significant public health challenge especially in India, necessitating robust screening of all women at risk.

Cervical cancer is characterised by a long lead time due to its prolonged asymptomatic premalignant state. Therefore, when diagnosed early, it can be treated successfully. Despite the advent of newer molecular testing methods, Papanicolaou (PAP) smear examination continues to be the cornerstone of cervical cancer screening regimens, also covering the women who have received HPV vaccination. This is a specific, easy, and minimally-invasive outpatient procedure. Conventional PAP smear cytology shows a sensitivity of 30–87% and a specificity of 86–100% in detection of cervical pathologies, while the sensitivity and specificity of the liquid-based cytology have been found to be 61–95% and 78–82%, respectively.[3,4]

Though PAP smear examination is primarily aimed at detecting the premalignant conditions of cervix, it is also helpful in diagnosing various infective and non-infective benign lesions of cervix, and therefore aiding in the clinical management of these conditions as well.

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In this retrospective study, we aimed to evaluate the spectrum of cervical pathologies through conventional PAP smears examination, amongst women who attended Gynaecology OPD at Northern Railway Central Hospital, New Delhi from Jan 2023 to Dec 2024. This study also includes data from the routine health check-up camps conducted routinely for the railway beneficiaries in collaboration with Department of Gynaecology.

The results were reported according to the latest Bethesda system (2014) for reporting cervical cytology and categorized as Negative for intraepithelial lesion or malignancy (NILM) or Epithelial cell abnormalities along with their further subtyping while identifying the age predilection for each category. With these results, we aim to quantify the burden of benign, premalignant, and malignant cervical lesions, and to refine the working protocol of the PAP smear clinic.

MATERIALS AND METHODS

A retrospective observational study was carried out in the Department of Pathology at Northern Railway Central Hospital, New Delhi, over a two-year period from January 2023 to December 2024. All cervical cytology specimens received during this interval for routine screening were included for evaluation.

The collected smears were prepared by the conventional Pap smear method, immediately labelled, and fixed in 95% ethyl alcohol. Papanicolaou staining was performed by trained technologists. The stained slides were examined under light microscopy and independently interpreted by experienced pathologists.

Inclusion Criteria: Women aged more than 21 years attending the Gynaecology Outpatient Department for routine screening, or presenting with clinical complaints such as vaginal discharge, abnormal uterine bleeding, postmenopausal bleeding, lower abdominal pain, menstrual irregularities, or symptoms suggestive of genital prolapse, and who consented to undergo Pap smear examination, were included in the study.

Exclusion Criteria: Smears considered unsatisfactory due to poor fixation, inadequate cellularity, excessive lubricant use, or having obscured morphology due to blood, mucus, or inflammatory exudate were not included in the final analysis.

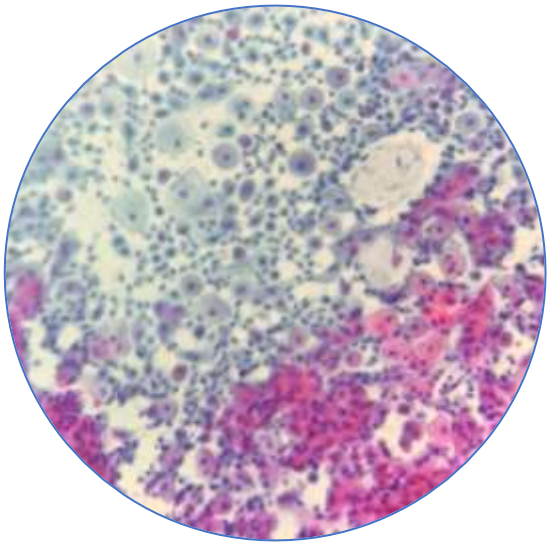
Cytological Evaluation: Assessment of smear adequacy and cytological reporting were performed in accordance with the 2014 Bethesda System. Relevant clinical information was retrieved from patient medical records.

Statistical Analysis: All data were entered into Microsoft Excel and analysed using descriptive statistical techniques. Results were expressed in terms of frequencies and percentages.

RESULTS

A total of 1,296 cervical cytology samples collected over two years and were analysed retrospectively. The cytological findings are summarized in the table below.

Normal cytology (NILM) was observed in 1,132 cases (87.3%). Infectious and inflammatory changes were identified in 90 cases (6.94%), with bacterial vaginosis being the most common infection. Atrophic changes were noted in 122 cases (9.41%), predominantly among women above 50 years of age.



Atrophic Smear

Endometrial cells were detected in 3cases (0.23%). Epithelial abnormalities were present in 39 cases (3%), which included Atypical Squamous Cells of Undetermined Significance (ASCUS) in 4 cases (0.31%), Atypical Squamous Cells—cannot exclude HSIL (ASC-H) in 15 cases (1.16%), Low-Grade Squamous Intraepithelial Lesion (LSIL) in 8 cases (0.62%), High-Grade Squamous Intraepithelial Lesion (HSIL) in 1case (0.08%), carcinoma in 1 case (0.08%), and Atypical Glandular Cells of Undetermined Significance (AGUS) in 10 cases (0.77%).

Table 1

Age Group (years)	NILM	Microbes	Atrophic	Endometrial Cells	ASCUS	ASC-H	LSIL	HSIL	SCC	AGUS	Total
≤30	92	11	0	0	0	1	0	0	0	0	104
31–40	277	27	1	1	0	3	4	0	0	1	314
41–50	323	27	10	1	1	0	2	0	0	5	369
51–60	245	18	71	1	1	6	1	0	0	2	345
≥60	105	7	40	0	1	5	1	1	1	2	162
Total	**1,042**	**90**	**122**	**3**	**4**	**15**	**8**	**1**	**1**	**10**	**1,296**

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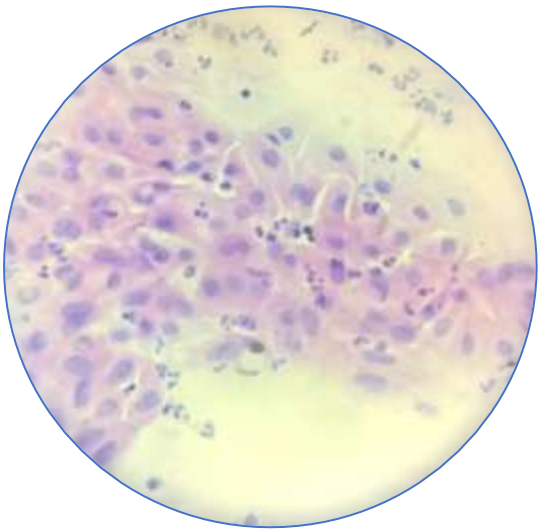
The highest proportion of NILM cases was observed in the 41–50-year age group, while atrophic changes were most prevalent in women aged 51 years and above. Normal cytology predominated in women aged 31–50 years, with infections observed across all age groups but slightly more common in younger women under 40 years.

Atrophic changes increased substantially in women aged 51 years and above, correlating with postmenopausal status. Premalignant lesions such as ASC-H and LSIL were mostly seen in women aged 31–60 years, while high-grade lesions and carcinoma were detected primarily in women aged 60 years and older.

DISCUSSION

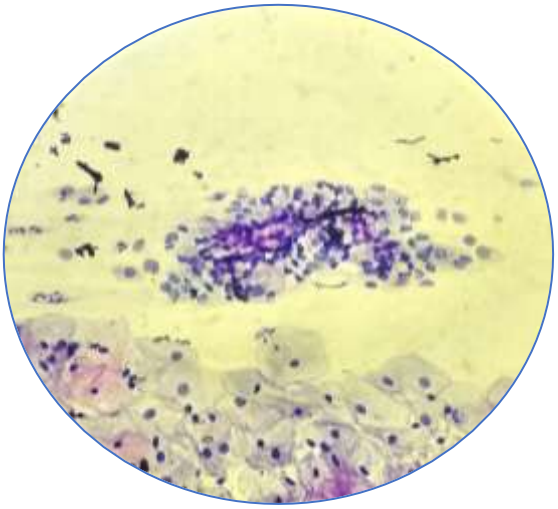
Cervical cancer continues to pose a formidable public health challenge in India, ranking as the second most common cancer among women, with an estimated 123,907 new cases and 77,348 deaths in 2022 alone, according to GLOBOCAN data.[1] Cytological screening via the Pap smear remains a cornerstone for early detection of premalignant and malignant cervical lesions, offering a cost-effective means to curb this burden in resource-limited settings. In our retrospective analysis of 1,296 Pap smears from women attending the Gynaecology Outpatient Department at NRCH, New Delhi, over 2023–2024, the majority—1,132 cases (87.3%)—were reported as negative for intraepithelial lesion or malignancy (NILM). This high NILM rate aligns closely with patterns observed in other Indian cohorts, where benign cytology predominates due to the widespread prevalence of low-risk profiles in screened populations.



Low grade squamous intraepithelial lesion (LSIL)

Non-neoplastic abnormalities, primarily infectious and inflammatory changes, were identified in 90 cases (6.9%). Bacterial vaginosis emerged as the most common etiology, followed by non-specific inflammatory smears, Candida spp., and Trichomonas vaginalis infections. These findings mirror those from prior Indian studies, which report infection-related changes in 5–10% of smears, often linked to poor genital hygiene, multiparity, and limited access to preventive care in low-socioeconomic groups.[5,6] Such observations highlight the Pap smear's dual utility: not only for neoplastic screening but also for identifying treatable infections that could otherwise predispose to persistent high-risk human papillomavirus (HPV) infections.

Among epithelial abnormalities, detected in 39 cases (3%), the distribution included atypical squamous cells of undetermined significance (ASCUS; 3 cases, 0.23%), atypical squamous cells, cannot exclude high-grade squamous intraepithelial lesion (ASC-H; 15 cases, 1.16%), low-grade squamous intraepithelial lesion (LSIL; 8 cases, 0.62%), high-grade squamous intraepithelial lesion (HSIL; 2 cases, 0.15%), squamous cell carcinoma (1 case, 0.08%), and atypical glandular cells of undetermined significance (AGUS; 10 cases, 0.77%).



Atypical Glandular Cells of Undetermined Significance (AGUS)

LSIL constituted the most frequent premalignant lesion (0.62%), predominantly affecting women aged 31–50 years, comparable to rates reported in other Indian studies, where LSIL prevalence ranges from 0.5–1%. Age-stratified analysis revealed LSIL peaking in women aged 31–50 years, a reproductive-age group often exposed to new sexual partners or multiparity. In contrast, HSIL, carcinoma, and ASC-H were disproportionately seen in women over 50 years (prevalence up to 2.5% in this subgroup), underscoring the progressive nature of high-grade lesions in perimenopausal and postmenopausal women, where hormonal changes may exacerbate persistent HPV-driven dysplasia. These trends corroborate age-specific data from multiple Indian studies.[5,6,7,9] The relatively higher proportion of ASC-H compared to ASCUS may reflect conservative cytological interpretation in a tertiary-

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care referral setting, prioritising sensitivity for high-grade lesions.

Physiological changes further enriched the age-wise insights: atrophic smears and benign endometrial cells predominated in women ≥51 years, reflecting oestrogen decline and postmenopausal epithelial thinning. Notably, endometrial cells in women over 45 years warrant heightened scrutiny, as they may signal endometrial hyperplasia or carcinoma—a valuable incidental screening benefit of Pap cytology, with reported detection rates of 0.5–1% in postmenopausal smears.

Clinically, nearly half (48%) of patients with epithelial abnormalities presented with a normal-appearing cervix on speculum examination, while the rest showed non-specific signs like cervical congestion or erosion. This discrepancy emphasizes that macroscopic inspection alone is inadequate for detecting subclinical lesions, reinforcing cytology's role in uncovering occult pathology.[5,8]

The 3% prevalence of epithelial abnormalities in our study falls squarely within the 2–9% range reported across Indian populations, where LSIL accounts for 50–70% of atypia and high-grade lesions or invasive carcinoma remains rare (<1%), reflecting effective triage in opportunistic screening programs.[5,6,7,9]

As a minimally invasive, rapid (results in 1–2 days), and low-cost tool, the Pap smear excels in high-volume settings like ours. It not only facilitates early intervention—such as colposcopy and loop electrosurgical excision procedure (LEEP) for HSIL—to avert progression to invasive disease but also serves as a sentinel for evaluating national HPV vaccination initiatives, like India's 2023 rollout targeting girls aged 9–14. Routine screening is particularly advocated for women aged 30–60 years, who are at higher risk of premalignant changes, potentially reducing cervical cancer incidence by 60–90% with 3-yearly intervals, as evidenced by global trials adapted to Indian contexts.

In summary, our findings affirm the Pap smear's enduring value in India's healthcare landscape, advocating for its integration with emerging strategies like HPV DNA testing to enhance sensitivity and equity in cervical cancer control, where early detection allows timely intervention, preventing progression to invasive carcinoma.

CONCLUSION

Pap smear screening is a reliable and effective method for early detection of cervical epithelial abnormalities. In this study, although the majority of smears were normal, a small but significant proportion exhibited premalignant or malignant changes, predominantly among women aged 31–60 years. LSIL was the most frequent premalignant lesion, while HSIL and carcinoma were less common but mostly observed in women above 50 years. Integration of Pap smear programs with public health initiatives, HPV vaccination, and awareness campaigns therefore reinforces the continued relevance of cervical cytology in tertiary-care settings.

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