Section: Pathology

Original Research Article

HISTOPATHOLOGICAL SPECTRUM OF CERVICAL LESIONS IN WOMEN WITH ABNORMAL PAP SMEARS: A CORRELATION STUDY IN A TERTIARY CARE CENTER IN INDIA

Manoj Kumar Bind[1], Archana Singh[2], Arun Kumar Yadav[3], Dhananjay Kumar Singh[4]

[1]*Associate Professor, Department of Pathology, Maharshi Vishwamitra Autonomous State Medical College Ghazipur, Uttar Pradesh, India.*
[2]*Associate Professor, Department of Pathology, Rajarshi Dasharath Autonomous State Medical College, Ayodhya, Uttar Pradesh, India.*
[3]*Assistant Professor, Department of Pathology, Madhav Prasad Tripathi Autonomous State Medical College Siddharthnagar, Uttar Pradesh, India.*
[4]*Professor & Head, Department of Community Medicine,Maharshi Vishwamitra Autonomous State Medical College, Ghazipur, Uttar Pradesh, India.*

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Corresponding Author:
Dr. Arun Kumar Yadav,
Assistant Professor, Department of Pathology, Madhav Prasad Tripathi Autonomous State Medical College Siddharthnagar, Uttar Pradesh, India..
Email: arunyadava01@gmail.com

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ABSTRACT

Background: Cervical carcinoma continues to be one of the major causes of cancer morbidity and mortality in Indian women. Although Pap smear is the most common method for detecting early cervicitis histopathology is still the reference standard for accurate diagnoses. The purpose of this study was to determine his-topathological spectrum of cervical lesions of women with abnormal Pap smears and to find out concordance between cytological and histopathological findings.

Materials and Methods: A cross-sectional analytical study was conducted over two years at a tertiary care hospital in India. A total of 60 women with abnormal Pap smear results were enrolled. Cytological findings were classified using the 2014 Bethesda system. All participants underwent colposcopy-guided cervical biopsies, which were histopathologically examined. The correlation between cytological and histological diagnoses was analyzed, and the sensitivity, specificity, and accuracy of the Pap smear in detecting high-grade lesions (CIN II and above) were calculated.

Results: The most affected age group was 35–44 years. Cytologically, high-grade squamous intraepithelial lesion (HSIL) was the most common abnormality (33.3%). Histopathology revealed CIN I in 26.7%, CIN II/III in 33.3%, and carcinoma in 16.6% of cases. The overall diagnostic accuracy of the Pap smear in detecting CIN II and above was 81.7%, with a sensitivity of 86.2%, specificity of 78.6%, and kappa agreement of 0.63. Concordance was highest for HSIL (85%) and lowest for ASC-US (50%).

Conclusion: Pap smear remains a valuable tool for cervical cancer screening, particularly for high-grade lesions. However, histopathological confirmation is essential, especially in low-grade or ambiguous cytological findings. Strengthening cytology-biopsy correlation can improve early detection and prevent progression to invasive cervical cancer.

Keywords: Pap smear, Cervical lesions, Cytology-histology correlation, CIN, Cervical cancer screening, Histopathology, Bethesda system.

INTRODUCTION

Cervical cancer is a common public health problem worldwide particularly in low and middle income countries. It is the fourth most frequent cancer among women all over the world and 90% of these women die in low resource settings.[1] Cervical cancer is the second most prevalent cancer among women in India next to breast cancer, comprising about 18.3% of all female cancers.[2] Although there are effective methods of screening patients, a delayed presentation

and limited access to diagnostic services result in a high morbidity and mortality in the country.

The Papanicolaou (Pap) smear test is an established, cost-effective screening method for identifying precancerous and cancerous cervical neoplasms. It allows for prompt intervention and greatly decreases incidence of invasive cervical cancer.[3] Pap smear, however, has some degree of sensitivity and specificity but further confirmation to establish disease progression, especially for high-grade lesions is required histopathologically.[4]

The histopathological assessment of cervical biopsies is accepted as the gold standard for diagnosing cervical intraepithelial neoplasia (CIN) and carcinoma. The correlation of cytologic results with histopathologic findings serves not only to confirm the accuracy of Pap smear screening but also benefits in the comprehension of the entire spectrum of cervical pathology.[5] Such an association is particularly pertinent in India, where mass screening is not uniformly practiced and a large number of women come with advanced disease because of ignorance, and inaccessibility.

Earlier Indian studies have reported variable concordance rates between Pap smear and biopsy and His cytology-histology correlation should be continued to be assessed for better diagnostic precision and better patient management.[6,7] Hence, the current study was conducted on the histopathological spectrum of cervical lesions in women attending a tertiary care setup in India with abnormal Pap smear results and to correlate the cytological and histological diagnoses.

MATERIALS AND METHODS

This was a hospital based cross-sectional analytical study done over a period of two years (July 2023 to June 2025) in the Departments of Pathology and Obstetrics & Gynecology in a tertiary care teaching hospital of India. Sixty women who were presented with abnormal Pap smear findings and their ages ranged between 25 and 65 years were enrolled in this study. The subjects were women with abnormal cytological findings of ASC-US, LSIL, HSIL, ASC-H, or AGC by the Bethesda system who were visiting outpatient gynecology clinics and referred for colposcopy-guided cervical biopsies.

Pregnant and menstruating women at the time of assessment, those who had ever undergone hysterectomy, and those who had incomplete clinical records were excluded. Written informed consent was obtained, and a detailed history of demographics and clinical was documented. Pap smears were obtained with Ayre's spatula and cytobrush, stained by Papanicolaou method, and reported as per the 2014 Bethesda system.

Each of the eligible patients had a colposcopic examination and guided cervical biopsies. Histopathological analysis was performed on H E (hematoxylin and eosin)-stained formalin-fixed paraffin-embedded tissue sections. The results of histology were classified as chronic cervicitis, cervical intraepithelial neoplasia (CIN I, II, III), carcinoma in situ and invasive carcinoma. The associations between cytological and histopathological results and the sensitivity, specificity and concordance rate of Pap smear for cervical lesions were investigated.

Data were analyzed using Microsoft Excel and SPSS version 25.0. Categorical variables were expressed as frequencies and percentages. Diagnostic performance of Pap smear was evaluated using cross-tabulation, and the level of agreement was assessed using Cohen's kappa statistic. A p-value <0.05 was considered statistically significant.

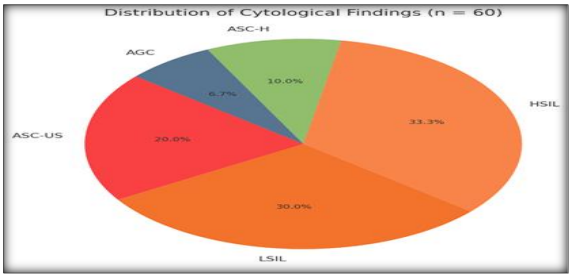
RESULTS

Sixty women with abnormal Paps were involved in the study. The age of the participants varied from 25 to 65 years and a substantial number (36.7%) was reported in the 35–44-year age bracket. The most common cytological findings in the Bethesda system were HSIL (33.3%), LSIL and ASC-US. All patients had colposcopy-directed cervical biopsy and the subsequent histopathological examination showed lesions from chronic cervicitis to invasive carcinoma. The cytological and histopathological findings were compared to determine the diagnostic accuracy of Pap smear.

Table 1: Age-Wise Distribution of Study Participants (n = 60)

Age Group (Years)	Number of Patients	Percentage (%)
25–34	15	25.0%
35–44	22	36.7%
45–54	16	26.7%
≥55	7	11.6%
Total	**60**	**100%**

The 60 cases with abnormal Pap smear findings were distributed among various age groups and are presented in Table 1. Most (n = 40, 36.7%) women were aged between 35 and 44 years. The 25–34 year age group made up the highest percentage (25.0%) of cases, and the smallest (11.6%) was in the ≥55 years age group. This pattern of distribution signals that atypical cervical cytological results were more likely be found among 35 to 44-year-old women.



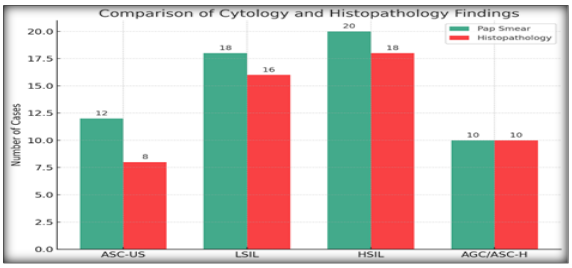
Graph 1: Pie Chart – Distribution of Cytological Findings (Bethesda Classification)

Graph 1: pie chart showing distribution of cytological findings according to Bethesda system and the range of abnormal pap stain result among the participants. The pattern of most frequent abnormalities detected were HSIL, 33.3%, followed by LSIL 30.0% and ASC-US 20.0%. Less common were atypical squamous cells – cannot exclude HSIL (ASC-H) and atypical glandular cells (AGC) accounting for 10.0% and 6.7% of results, respectively.

Table 2: Histopathological Diagnosis of Cervical Biopsies

Histological Diagnosis	Number of Cases	Percentage (%)
Chronic cervicitis	14	23.3%
CIN I	16	26.7%
CIN II	12	20.0%
CIN III	8	13.3%
Carcinoma in situ	5	8.3%
Invasive carcinoma	5	8.3%
Total	**60**	**100%**

The histopathological diagnoses on cervical biopsies in the 60 women with abnormal Pap smears are summarized in Table 2. The most frequent diagnosis was CIN I (26.7%), then chronic cervicitis (23.3%), and CIN II (20.0%). Histopathology showed a higher grade lesion (CIN III, carcinoma in situ and invasive carcinoma) in 13.3%, 8.3%, and 8.3% of the women, respectively. This spectrum of lesions indicates a relatively high burden of both low-grade and high-grade cervical pathology among women with cytological abnormalities, thus underling the need for histopathological confirmation for the correct diagnosis and further clinical management.



Graph 2: Bar Chart – Comparison of Cytology and Histopathology Findings

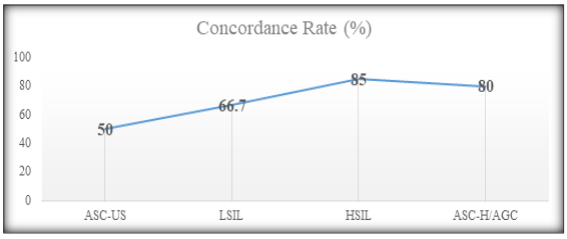
Graph 2 is a bar chart on comparison between cytological and histopathological findings and shows degree of agreement of two methods of diagnosis in male and female in different lesion categories. Even in cases diagnosed by Pap smear as ASC-US, histopathology most frequently showed the presence of benign lesions (chronic cervicitis and low-grade dysplasia) and only few of them were high-grade ones. In the category LSIL, CIN I was proved by histology in most of the patients and higher-grade lesions were diagnosed in a low number, thus demonstrating moderate concordance. The cases cytologically diagnosed as HSIL exhibited good correlation and they were histopathologically correlating with CIN II, CIN III or carcinoma showing a good predictive accuracy. Likewise, the AGC/ASC-H category presented a broad histopathological spectrum including benign changes and invasive cancer. In general, the bar graph demonstrates the variable concordance by Pap smear for low-grade lesions but considerable reliability in the prediction of high-grade cervical disease.

Table 3: Cytology–Histopathology Correlation Matrix

Pap Smear Category	Histology-Negative (e.g., Chronic Cervicitis)	CIN I	CIN II/III	Carcinoma (CIS/Invasive)	Total
ASC-US (n = 12)	5	4	2	1	12
LSIL (n = 18)	3	10	4	1	18
HSIL (n = 20)	1	2	11	6	20
ASC-H / AGC (n = 10)	2	0	3	5	10
Total	**11**	**16**	**20**	**13**	**60**

The association of cytological results with histopathological diagnoses is shown in Table 3. Among the 12 ASC-US cases by Pap smear, histopathology showed that 5 cases were non, 4 were CIN I, 2 were CIN 2/3, 1 was carcinoma. In the LSIL group, 10 cases were proven as CIN I, and 3 cases as negative, 4 as CIN II/III, and 1 as carcinoma, suggesting a certain lower limit of underdiagnosis at cytological level. Among HSIL lesions, histopathology confirmed high-grade lesions in the majority of these (11 were diagnosed as CIN II/III and 6 as carcinoma), again consistent with a high correlation. There were only 3 HSIL cases with lower-grade or non-diagnostic findings. Of the 10

cases with ASC-H/AGC, 5 were carcinoma, 3 were CIN II/III, and 2 negative on histology, again emphasizing that atypical glandular and high-grade cytology findings frequently can be associated with significant underlying disease. This matrix confirms the need for histological verification, especially in the presence of high-grade or abnormal cytological results.



Graph 3: Line Graph – Concordance Rate by Cytology Grade

The line graph depicts the trend of diagnostic agreement between Pap smear diagnosis and subsequent histopathological diagnosis. The lowest concordance was found for cases of ASC-US with 50% of lesions present on biopsy. Concordance of LSIL was slightly better at 66.7% (moderate agreement). The joint highest appeals were in HSIL case"s, which provided histopathological confirmation in 85% of cases as CIN II, CIN III or carcinoma, suggesting diagnostic reliability. ASC-H/AGC category also showed a good concordance rate of 80%, which could further support the predicting significance of atypical or glandular cells on cytology. This pattern further reinforced that the sensitivity of Pap smear increased with the increasing of cytological atypia, which indicating the useful of Pap smear method as a screening while still remind of biopsy required for further diagnosis.

Table 4: Diagnostic Accuracy of Pap Smear in Detecting CIN II and Above

Parameter	Value (%)
Sensitivity	86.2
Specificity	78.6
Positive Predictive Value (PPV)	76.3
Negative Predictive Value (NPV)	87.8
Diagnostic Accuracy	81.7
Kappa Value (agreement)	0.63 (Substantial agreement)

The diagnostic value of the Pap smear in diagnosing CIN II+ is presented in Table 4. This implies that the pap smear was positive in most of the diagnosed patients, thus the sensitivity of pap smear was 86.2%. The specificity was 78.6% which indicates that in those women without CIN II or more it can reliably exclude disease. PPV was 76.3, and NPV was 87.8, leading to the result that a negative pap smear result has a higher value in ruling out high grade lesions. Sensitivity, specificity, and the overall accuracy of the diagnosis were 71.6%, 83.6%, and 81.7%, respectively, and the ink value (0.63) indicated substantial agreement between the cytological and histopathological diagnosis. The findings support the Pap smear as an effective reliable screening test, especially for high-grade cervical lesions, and the value of histopathological validation in positive cases.

DISCUSSION

This study aimed at evaluating the histopathological spectrum findings of cervical lesions in women with abnormal Pap smears, and, to assess the proportion of cytology–histopathology correlation in a tertiary care hospital. The results validate the diagnostic clinical value of Pap smear as a screening method in addition to supporting the role of histopathology as a confirmative examination for the diagnosis and grading of cervical lesions.

Our findings were similar to other Indian studies,[8] wherein peak age group affected was 35–44 years followed by 45–54 years, indicating that women in reproductive, premenopausal age group are more vulnerable to cervical epithelial abnormality. Cyto-logically, HSIL was the most frequent lesion (33.3%), followed by LSIL and ASC-US. This distribution is in concordance with that reported by Pimple et al who observed a similar high proportion of HSIL in women who attended opportunistic screening in India.[9]

Histopathological examination showed a variety of cervicitic lesions that ranged from chronic cervicitis to invasive cancer with the most common being CIN I. These results are in line with data reported by Mishra et al. and Gandhi et al that described CIN I being the more frequent histological abnormality in women with cytological changes.[10,11] The finding of carcinoma in situ and invasive carcinoma in a significant percentage of cases (8.3% in each category) emphasizes the critical need for appropriate follow-up and biopsy when cytologically suspicious specimens are examined.

Sensitivity, specificity and overall diagnostic accuracy of the Pap smear were moderate to substantial, which were 86.2%, 78.6% and 81.7%, respectively. These findings are similar to those of Gupta et al., who found Pap smear sensitivity to be between 70%–90%, depending on lesion grade and interpreter experience.[12] The kappa value of 0.63 in our case is an indication of significant agreement between cytology and histopathology, as also reported by Singh et al. who reported kappa values between 0.6 and 0.7 in large cervical screening studies.[13]

Consistent with previous studies, the agreement rate of Pap smear and histopathology was the highest in HSIL cases (85%) and the lowest in ASC-US (50\%),

reflecting that more severe cytological abnormalities are more likely to be associated with significant histopathological diagnosis. These results are in line with the known limitations of the Pap smear in identifying low-grade lesions and they emphasize the necessity of a biopsy check for the borderline or atypical cases.[14]

Although Pap smear has high diagnostic value, its limitations include interobserver variations, sampling errors, and false-negatives, particularly in glandular or endocervical lesions. Thus, a combination of cytological screening with colposcopy and histopathology (our recommendation) not only increases the diagnostic sensitivity, but also allows rapid intervention.[15]

The present study underscores the importance of the conventional Pap smear test that is still practically relevant in resource-poor settings such as India, for which HPV testing facilities are not readily available. Nevertheless, our results also favour the step wise introduction of molecular assays and visual inspection methods for a more complete cervical cancer screening programme.[16-20]

CONCLUSION

The present study shows good concordance between pap smear cytology and cervical lesion histopathology. High-grade cytological abnormalities (HSIL and ASC-H/AGC) were most concordant with underlying CIN II, CIN III and carcinoma, whereas low-grade cytological lesions (ASC-US, LSIL) were less concordant upon histopathological interpretation. The sensitivity and negative predictive value of Pap smear (86.2% and 87.8%) for CIN II and above indicated its significance as a primary screening strategy in resource-poor settings. But the variability of agreement for lower grade lesions highlights the need for histopathological verification in biopsy. These findings underscore the on-going significance of cervical cytology, as well as the need for efficient coordination of cytological screening with prompt histological workup to provide prompt detection, accurate diagnosis, and prevention of progression to cervical cancer.

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