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Screening of Cervical Carcinoma using Smart Scope Artificial Intelligence

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Abstract

Background: Artificial intelligence (AI) for cervical cancer screening and diagnosis offers promising advantages over traditional methods like Pap smear and visual inspection. AI-based medical diagnostic applications provide improved accuracy by analysing data with precision, potentially reducing errors compared to subjective human interpretation. This technology automates the screening process, enhancing efficiency and decreasing the time needed for analysis and result delivery.

Aim: To Screen cervical carcinoma using smart scope AI.

Objectives: To compare the diagnostic accuracy of Smart scope AI, pap smear and HPE when available and categorise the patients using the images taken by smart scope and to compare the reports of smart scope with Pap smear.

Materials and Methods: All subjects underwent Pap smear with smart scope imaging and HPE when indicated.

Statistical analysis: The data were analysed using SPSS (Statistical Package for the Social Sciences) version 20.0 software. As applicable for qualitative data, tests like the chi-square test were used for comparison of variables used in the study.

Results: The impression of Pap smear was abnormal only in 4 (3.25%), smart scope was abnormal in 86 (69.9%), Out of 4 histopathology that were done, all reported with abnormal findings.

Conclusion: According to our study pap smear is a better screening tool to detect cervical cancer compared to smart scope.

Keywords: Pap smear, Smart scope, HPE – histopathology.

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INTRODUCTION

Cervical cancer remains a significant global health burden, responsible for approximately 604,000 new cases and 342,000 deaths annually worldwide (WHO, 2021). Despite the availability of effective screening tools such as Pap smears and HPV testing, disparities in access to healthcare services and limitations in diagnostic accuracy persist, particularly in low-resource settings. These challenges underscore the urgent need for innovative approaches to improve early detection and reduce cervical cancer mortality. Artificial intelligence (AI) technologies, particularly those integrating machine learning algorithms, have demonstrated potential in transforming cancer screening paradigms.

Smart Scope AI represents a novel advancement in this domain, utilizing AI-driven analysis of digital colposcopy images to enhance diagnostic precision in cervical cancer screening. By analysing high-resolution images of the cervix in real-time, Smart Scope AI aims to detect subtle abnormalities indicative of precancerous lesions or early-stage cancers that may be missed by conventional visual inspection methods. The promise of Smart Scope AI lies in its ability to assist healthcare providers in making accurate and timely diagnostic decisions, thereby potentially reducing unnecessary biopsies and improving patient outcomes. This technology has the potential to address key challenges in cervical cancer screening, including variability in clinician expertise and access to specialized healthcare services, especially in underserved regions. The integration of Smart Scope AI into routine clinical practice requires rigorous evaluation of its diagnostic performance, cost-effectiveness, and feasibility across diverse healthcare settings. [1]

This article aims to explore the current landscape of cervical cancer screening methods, highlight the development and potential applications of Smart Scope AI technology, and discuss its implications for enhancing global efforts in cervical cancer prevention. By critically examining the role of AI in improving screening accuracy and accessibility, this study seeks to contribute valuable insights to on-going discussions on leveraging technological innovations to achieve equitable and effective cervical cancer control strategies worldwide.[2,3]

MATERIALS AND METHODS

This study is conducted in the Department of Obstetrics and gynaecology in a tertiary care hospital in Pune. It is a prospective observational study conducted to evaluate the role of smart scope AI as a screening for cervical cancer during the period from June 2022 to December 2023 matching the inclusion & exclusion criteria.

Women of age group 30 to 60 years are included in the study. Exclusion Criteria were pregnant women, woman with active genital infections, known case of cervical carcinomaand woman who underwent any cervical procedures in last 8 weeks.

Written consent was obtained from women matching the inclusion and exclusion criteria to participate in the study. A thorough history according to predetermined proforma which includes complaint at presentation, menstrual history including intermenstrual bleeding, obstetric history, age of menopause, and bleeding after menopause was taken. Proper clinical evaluation which includes general and systemic examination was done. Local examination with speculum was done in women who will come under this study as per inclusion criteria. Pap smear was taken and results were interpreted as per Bethesda classification. All women underwent smart scope examination and reports were obtained using smart scope AI.Biopsy was taken in indicated cases. Treatment was administered and follow-up of patients was done according to clinical guidelines.

Pap testreporting: Bethesda classification is usedin the presentstudy tointerpret Pap test results as given below: (organization, 2001)

- NILM – Negative for intraepithelial lesion or malignancy.
- A typical squamous cells of undetermined significance (ASCUS)
- A typical squamous cells cannot exclude HSIL (ASC-H)
- Low-grades quamous intraepithelial lesion (LSIL)
- High grade squamous intraepithelial lesion (HSIL)
- Suspicious of invasion
- Squamous cell carcinoma
- A typical glandul arendocervical, endometrial cells (NOS - Not otherwise specified)
- A typical endocervical cells, favor neoplastic
- A typical glandular cells, favor neoplastic
- Endocervical adenocarcinoma in situ
- Adenocarcinoma

SMART SCOPE

The images were group into the following groups based on the software saved in the device.

- Green which indicates a healthy cervix or nebothian cysts.
- Amber which indicates polyp, infection, inflammation, cervicitis or squamous metaplasia.
- High-risk amber indicates high risk changes, probable low-grade CIN lesion.
- Red indicates probability of high-grade CIN lesion or carcinoma.

RESULTS

A total of 123 participants who were willing for screening and participation were included in the study.

There were 86 of 123 patients with symptoms, only 37 were without symptoms. The most common symptom was pv white discharge observed in 39 (45.34%) patients, followed by lower abdominal pain in 22 (25.58%), abnormal menstrual bleeding in 14 (16.27%), and vaginal pruritus in 7 (8.13%). Among other symptoms reported were postcoital, post menopausal bleeding etc.

The Pap smear findings according to Bethesda classification are: NILM is considered normal-comprising 119 (96.74%) of cases. Abnormal papsmears are ASCUS 1(0.81%), LSIL 2(1.62%), HSIL 1(0.81%).

Smart scope was performed in all 123 participants, the report was normal among 37 (30.08%) while remaining reported abnormal.

Out of 123 participants his topathology was done in 4 (3.25%) patients. Among these, cervical intra epithelial neoplasia (CIN) type I was reported prevalently among 2 (50%), cervical intraepithelial neoplasia (CIN) type II in 1 (25%), squamous cell carcinoma (SCC) in 1 (25%).

Table 1: Effectiveness of smart scope against Pap smear

		Frequency	Percentage
Smart Scope	Abnormal	86	69.9
	Normal	37	30.08
Pap Smear	Abnormal	4	3.25
	Normal	119	96.74

When findings of smart scope and Pap smear were compared, there was no fair agreement between the findings of smart scope and Pap smear findings, with p value of 0.182 (not significant).

For smart scope the sensitivity was 31.1% with specificity of 100%. The positive and negative predictive values were 100% and 4.65%, with accuracy of 33.3% in comparison to Pap smear.

Effectiveness of smart scope agains this to pathology

Among 4 patients who were evaluated by histopathology, smart scope, and Pap smear as well, the effectiveness of smart scope and Pap smear was assessed considering histopathology as gold standard.

1. For smart scope the sensitivity was 31.1% with specificity of 100%. The positive and negative predictive values were 100% and 4.65%, with accuracy of 33.3% in comparison to histopathology. The 2x2 table for impressions of smart scope and histopathology is shown in table 2.
2. When findings of smart scope and histopathology were compared, there was no fair agreement between the findings of smart scope and histopathology findings, with p value of 0.182 (not significant).

Table 2: Findings of Smart scope vs. Histopathology

	Histopathology report							
Smart scope	**CC**	**CIN I**	**CIN II**	**CIN III**	**CIS**	**SCC**	**Adeno CA**	**Total**
Green	00	00	00	00	00	00	00	00
Abnormal (amber)	00	01	00	00	00	00	00	01
Abnormal (High amber)	00	00	00	00	00	00	00	00

	Histopathology report							
Abnormal (Red)	00	01	01	00	00	01	00	03
Total	00	01	01	01	00	01	00	04

Effectiveness of Pap smear agains this to pathology

For Pap smear, the sensitivity was 100% with specificity of 100%. The positive and negative predictive values were 100% and 100%, with accuracy of 100% in comparison to histopathology.

Table 3: Correlation between Pap smear and Histopathological diagnosis

	Histopathology report							
Pap smear	**CC**	**CIN I**	**CIN II**	**CIN III**	**CIS**	**SCC**	**Adeno CA**	**Total**
NILM	00	00	00	00	00	00	00	00
LSIL	00	01	01	00	00	00	00	02
HSIL	00	00	00	00	00	01	00	01
ASCUS	00	01	00	00	00	00	00	01
Total	0	2	01	00	00	01	00	4

When findings of Pap smear and histopathology was compared (table 3), there was fair agreement between the findings of Pap smear and histopathology findings with p value of <0.001 (significant).

DISCUSSION

In this study, 80(65%) of 123 woman are in the age group of 30-45 years and mean age group is 43 years. 43(34.14%) of these woman were post-menopausal.

There were 86 of 123 patients with some gynecological symptoms, 37 were without symptoms. The most common symptom was white discharge per vagina, followed by lower abdominal pain, abnormal PV bleeding.

The most frequent symptom, according to Sachan PL is white vaginal discharge, which is followed by abdominal pain, an irregular menstrual cycle, post coital bleeding, and postmenopausal bleeding.[4]

Inpresent study Pap smear wasperformed on all 123 women; the results of the smear were normal (NILM) in the 119 (96.7%) and abnormal in only 4 (3.25%) - these include 1(0.81%) ASCUS, 2(1.62%) LSIL, HSIL in 1(0.81%).

According to Hend.S.Saleh, Acetic acid test was positive in 24/200 (12%) participants and Pap smear was abnormal in 8 (4%). There were 5 LSIL, 2 HSIL and one with cells suspicious of malignancy.[5]

According to Rahatgaonkar V, out of 509 participants, Pap test could detect 1 HSIL and 8 LSIL. Maximum number of women, (300/509; 58.9%), were reported to have normal cytology followed by 169 (33.2%) with inflammatory smears. On NE test, 141 were screen-positive (27.7%), and 367 were screen-negative (72.1%). SS test identified pre-cancerous lesions in 94 (18.5%) and cancerous lesions in 2 (0.4%) women.[6]

In the present study smart scope findings were normal in 37 (30.08%) patients and abnormal in 86 (69.9%) out of 123 patients.

Histopathology is the gold standard for detection of premalignant and malignant cervical lesions. It requires taking biopsy from the lesion site which can be taken in a single sitting while doing colposcopy also knownas “Colposcopy directed biopsy”. In our study, patients were advised excisional biopsy via Loop electrode in cases of colposcopy detected significant lesions and disparity in Pap smear & colposcopy.

According to Bae SN, 1547 patients had undergone digital cervicography, cervical pathology and Pap smear. The results showed 74.2% CIN, 13.9% cervical cancer, and 11.9% cervicitis. The most prevalent interpretation of cervicography was atypical (53.9%) followed by “compatible with CIN 1” (23.1%). The cervical cytology reported 568 women (36.7%) with high-grade squamous intraepithelial lesion (HSIL) and 520 women (33.6%) with atypical cytology.[7]

Total 4 patients underwent biopsy in our study

and 4 were reported abnormal. Among abnormal findings, cervical intraepithelial neoplasia (CIN) I was reported as prevalently occurring in 2 (50%) of cases, followed by CIN II (25%) and, one was reported as SCC (25%).

Out of 119 patients having normal pap smear findings i.e. NILM/NILM with inflammation, smart scope showed normal (green) finding in 37 patients, benign changes (amber) in 49 patients, high risk changes (high amber) observed in 24 patients and suspect HSIL (red) in 9 patients.4 patients underwent biopsy. Among them 2 patients had CIN I, one patient had SCC and the other patient had CIN II.

There were 4 patients having abnormal pap smear findings ASCUS (1), LSIL (2), HSIL (1). The patient with ASCUS on Pap smear was reported as suspect HSIL on smart scope and was reported as CIN 1 on histopathology. Out of the 2 patients with LSIL on Pap smear, one was reported as benign change (amber) in smart scope and CIN1 in histopathology and the other was reported as suspect HSIL (red) on smart scope and CIN II on histopathology. The patient with HSIL on Pap smear was reported as suspect HSIL (red) on smart scope and squamous cell carcinoma on histopathology. When the findings of smart scope and Pap smear were compared statistically, there was the no agreement between the findings (p value of 0.182).

We advised histopathology in patients with abnormal Pap smear beyond LSIL & smart scope with amber, high amber and red. Total 4 patients underwent biopsy and rest ware lost for follow up. There was 1 case of CIN II, 2 cases of CIN I, 1case of SCC diagnosed on HPE.

The case showing chronic cervicitis, Pap smear showed low grade lesion (LSIL); smart scope reported as suspect HSIL (red). Out of 2 patients with CINI, Pap smear showed low grade lesion (LSIL) in 1 case and ASCUS in another case; smart scope showed benign change (amber) in 1 case & suspect HSIL (red) in another. The case which was reported as SCC, Pap smear showed high grade lesion (HSIL), smart scope showed suspect HSIL (red).

Out of 37 cases which were reported as normal on smart scope (green), all were reported as normal on Pap smear and no patient underwent biopsy. Out of 50 cases that were reported as benign changes on smart scope (amber), one was reported as LSIL on Pap smear and as CIN 1 on histopathology; the remaining 49 were reported as normal on Pap smear and did not undergo biopsy. Out of 24 cases reported as high risk change on smart scope (high amber), all reported as normal on Pap smear and none underwent biopsy.

Out of 12 cases reported as suspect HSIL (red) on smart scope, one was reported as LSIL, one as ASCUS, one as HSIL on Pap smear and reported as CIN II, CIN 1, SCC respectively on histopathology and the rest 9 were reported as normal on Pap smear.

According to Rahatgaonkar V, Sensitivity, specificity, PPV, NPV were determined for the naked eye test, smart scope and Pap smear. Smart scope test was found to have a sensitivity and NPV of 100% each, PPV of 45.4% and a specificity of 36.8%. Sensitivity and specificity of Naked eye test was 90% and 39.5% respectively, PPV was 43.9% and NPV was 88.2%. Pap smear test had a sensitivity of 25% and specificity of 84.2%, PPV of 45.5% and NPV of 68.08%.[6]

CONCLUSION

Sequential screening is needed for diagnosing cervical precancerous lesions. Sensitivity and specificity of Pap smear & smart scope in our study are not at par. Smart scope can be used as a basic screening test in peripheral centres as smart scope can detect high grade cervical lesions and timely referral to higher centres where abnormality is reported.

According to our study pap smear is a better screening tool to detect cervical cancer compared to smart scope. Over diagnosis is anacceptable tradeoffas the prevalence ofcancer cervix is high in our country.

Conflict of interest: Nil

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