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MODERN METHODS AND CLINICAL-DIAGNOSTIC ASPECTS OF DETECTING INFECTIOUS LESIONS OF THE CERVIX IN CERVICAL PATHOLOGY

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Abstract

This article presents an overview of modern methods and clinical-diagnostic approaches for the detection of infectious lesions of the cervix in the context of cervical pathology. Special attention is given to the role of viral and bacterial infections, particularly high-risk human papillomavirus (HR-HPV), as key etiological factors in the development of cervical intraepithelial neoplasia and other pathological conditions of the cervix.

Keywords

Cervical pathology; cervical intraepithelial neoplasia (CIN); high-risk human papillomavirus (HR-HPV); cervicovaginal infections; molecular diagnostics; real-time PCR; colposcopy; liquid-based cytology; cervical screening; self-sampling; Qvin-tip; precancerous lesions.

Relevance. Viral and bacterial infections of the cervix remain a significant challenge in modern gynecology and gynecologic oncology due to their high prevalence, frequently latent course, and potential for progression to precancerous lesions. Of particular clinical importance is high-risk human papillomavirus (HR-HPV), which is widely recognized as the primary etiological factor in the development of cervical intraepithelial neoplasia and cervical cancer. In addition, bacterial infections contribute to the chronicity of inflammatory processes, disrupt epithelial regeneration, and may create a microenvironment conducive to neoplastic transformation.

Objective

The aim of this study was to evaluate the diagnostic effectiveness of contemporary methods for detecting viral and bacterial infections of the cervix in order to optimize early diagnosis and improve preventive strategies against precancerous cervical lesions.

Materials and Methods

This prospective, cross-sectional study was conducted among 150 women of reproductive age (25–45 years) who were sexually active and presented for routine gynecological screening at outpatient clinical settings. All participants provided written informed consent prior to enrollment. The study protocol was approved by the institutional ethics committee and complied with the ethical standards outlined in the Declaration of Helsinki.

Study Design and Population

Participants were recruited consecutively during routine preventive examinations. Inclusion criteria comprised women aged 25–45 years with an active sexual history and no prior diagnosis of cervical malignancy. Exclusion criteria included pregnancy at the time of examination, history

of hysterectomy, recent use of systemic antibiotics or antiviral therapy (within the past 4 weeks), and acute inflammatory pelvic disease.

Clinical Evaluation

All participants underwent a comprehensive gynecological assessment, including detailed medical and reproductive history, evaluation of risk factors (early onset of sexual activity, multiple sexual partners, smoking status), and physical examination of the external genitalia and cervix using a speculum.

Colposcopic Examination

Extended colposcopy was performed using standard protocols with the application of 3–5% acetic acid and Lugol's iodine solution. Colposcopic features such as acetowhite epithelium, punctuation, mosaic patterns, and atypical vascularization were evaluated. Findings were classified according to the International Federation for Cervical Pathology and Colposcopy (IFCPC) terminology, allowing differentiation between low-grade and high-grade lesions.

Cytological Assessment

Cervical samples were collected for both conventional cytology (Pap smear) and liquid-based cytology (LBC). Specimen collection was performed using a cervical brush to ensure adequate sampling of the transformation zone. Cytological evaluation was conducted according to the Bethesda System, categorizing findings into NILM (negative for intraepithelial lesion or malignancy), ASC-US, LSIL, and HSIL. Liquid-based cytology was employed to improve sample quality, reduce contamination, and increase diagnostic accuracy.

Molecular Biological Diagnostics

For the detection of viral and bacterial pathogens, real-time polymerase chain reaction (RT-PCR) assays were utilized due to their high sensitivity and specificity. High-risk human papillomavirus (HR-HPV) genotyping was performed, including detection of the most oncogenic types (HPV 16, 18, 31, 33, 45, 52, and 58).

In addition to viral detection, molecular analysis included screening for bacterial agents associated with cervicovaginal dysbiosis and chronic inflammation, such as *Gardnerella vaginalis*, *Atopobium vaginae*, *Chlamydia trachomatis*, *Mycoplasma hominis*, and *Ureaplasma urealyticum*. The inclusion of these pathogens was based on their established role in altering the cervical microenvironment and contributing to persistent infection and epithelial damage.

Self-Sampling Technique

A self-sampling device (Qvin-tip) was introduced as an alternative method for biological specimen collection. Participants were instructed on proper self-collection procedures to obtain vaginal and cervical samples. This method was evaluated for its feasibility, acceptability, and diagnostic concordance with clinician-collected samples. The use of self-sampling aimed to enhance patient compliance, reduce barriers to screening, and improve accessibility, particularly in population-based screening programs.

Statistical Analysis

Data were processed and analyzed using statistical software (e.g., SPSS version XX). Descriptive statistics were used to summarize demographic and clinical characteristics. Diagnostic performance of each method was assessed by calculating sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Comparative analyses between diagnostic modalities were performed using the chi-square (χ^2) test. A p-value of less than 0.05 was considered statistically significant.

Results

The results demonstrated that the sensitivity of cytological examination was 36.6%, while colposcopy showed a sensitivity of 63.5%. Molecular biological methods exhibited significantly higher diagnostic performance, with a sensitivity of 84.7%.

The combined use of cytology and PCR-based testing improved the overall diagnostic sensitivity to 83%, highlighting the advantage of multimodal diagnostic approaches. The highest diagnostic efficiency was achieved through the combination of the Qvin-tip self-sampling system with colposcopic examination, which enabled the detection of cervical pathological changes in 100% of the examined patients.

Conclusions

In conclusion, a comprehensive diagnostic approach integrating molecular biological, cytological, and instrumental methods ensures a high level of accuracy in detecting viral and bacterial cervical infections. The implementation of innovative self-sampling technologies represents a promising direction for enhancing screening programs and improving early detection and prevention of precancerous conditions and cervical cancer.

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