Modern approaches to early diagnosis of cervical dysplasia

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Relevance of the topic

Cervical dysplasia, or cervical intraepithelial neoplasia (CIN), is a precancerous condition that, if not diagnosed and treated in a timely manner, can progress to invasive cancer. The main etiological factor in the development of dysplasia is infection with oncogenic types of human papillomavirus (HPV). According to the WHO, cervical cancer ranks fourth among malignant neoplasms in women worldwide, but it is one of the few types of cancer that can be effectively prevented through organized screening. The relevance of the topic is due to the need to improve existing programs for the early detection of precancerous changes in the cervix, the transition to more sensitive and standardized molecular diagnostic methods, and the need to adapt current international recommendations to national practice.

Research objective

The objective of the study is to analyze current approaches to early diagnosis of cervical dysplasia based on a review of scientific literature from recent years, to determine the effectiveness of various screening and triage methods, their advantages and limitations, and to outline the prospects for introducing the latest technologies into clinical practice.

Materials and methods

For the review, scientific publications, systematic reviews, meta-analyses, and clinical guidelines published in 2019–2025 in the PubMed, Google Scholar, and Cochrane Library databases, as well as official documents from the WHO, ASCCP, and ACOG, were analyzed. Keywords used: cervical dysplasia, early diagnosis, HPV testing, colposcopy, p16/Ki-67, methylation markers, self-sampling. More than 40 sources were selected that contain data on the effectiveness of cytological screening, primary HPV testing, combined methods, self-sampling, and the use of molecular biomarkers for patient triage. The methodological basis of the review was a comparative analysis of the results of different approaches to the diagnosis of cervical dysplasia.

Research results

Analysis of the literature showed that primary HPV DNA testing has significantly higher sensitivity in detecting cervical intraepithelial neoplasia II–III (CIN2+, CIN3+) compared to traditional cytology. Co-testing (combining cytology and HPV testing) increases diagnostic accuracy but is less cost-effective for mass screening programs. A promising direction is the use of biomarkers, in particular p16/Ki-67 and DNA methylation tests (e.g., FAM19A4/miR124-2), which allow for effective triage of HPV-positive women and reduce the number of unnecessary invasive procedures. An important tool for increasing the accessibility of screening is self-sampling for HPV testing, which demonstrates comparable diagnostic accuracy to physician sampling and promotes coverage of women who rarely undergo preventive examinations. Colposcopy and targeted biopsy remain the gold standard for confirming the diagnosis, but require standardization and highly qualified specialists.

Discussion

The results of the analysis confirm that modern screening programs should be based on primary HPV testing, which is in line with the updated recommendations of the WHO (2021) and ASCCP (2019). The combination of molecular and cytological methods provides an optimal balance between sensitivity and specificity of diagnosis. At the same time, the use of the latest biomarkers, such as p16/Ki-67 and methylation tests, opens up prospects for a personalized approach to assessing the risk of dysplasia progression. In countries with limited resources, an important direction is the introduction of self-sampling technologies, which can significantly increase screening coverage. In Ukraine, the urgent task remains the adaptation of modern diagnostic methods to national conditions, the updating of regulatory documents, and the provision of a laboratory base for the introduction of HPV testing and molecular triage methods.

Conclusions

Early diagnosis of cervical dysplasia is a key factor in preventing invasive cancer. Primary HPV testing is the most effective screening method, providing high sensitivity and the possibility of extending the intervals between examinations. The use of triage tests, such as p16/Ki-67 and methylation markers, increases diagnostic accuracy and reduces the need for invasive procedures. Self-collection of material for HPV testing expands the accessibility of prevention programs. The introduction of these modern approaches into the healthcare system will significantly improve the effectiveness of detecting precancerous conditions of the cervix and contribute to reducing the incidence and mortality from cervical cancer.