

Immunohistochemical and Morphological Changes in Cervical Neoplasia

Jumaeva D.R.

Asia International University, Bukhara, Uzbekistan

Abstract: Cervical neoplasia is one of the most common precancerous and cancerous diseases affecting women's reproductive health. It involves abnormal proliferation of epithelial cells in the cervix, ranging from dysplasia to invasive carcinoma. The main etiological factor is persistent infection with high-risk human papillomavirus (HPV) types. Despite advances in prevention and treatment, cervical neoplasia continues to pose a global health problem, especially in developing countries. This article discusses its epidemiology, etiology, pathogenesis, classification, diagnosis, treatment, and preventive measures.

Keywords: Cervical neoplasia, screening programs, HPV infection, carcinoma, immunohistochemistry.

Introduction. Cervical neoplasia represents a progressive process of abnormal cellular changes occurring in the cervical epithelium. It is considered a precursor to cervical cancer, which ranks as the fourth most common cancer among women worldwide.

According to recent WHO data, more than 600,000 new cases and 340,000 deaths occur annually due to cervical cancer. The disease is strongly associated with infection by oncogenic strains of human papillomavirus (HPV). The cervix, as part of the lower reproductive tract, is especially vulnerable to viral infections and hormonal influences. Early identification and management of precancerous changes are crucial for preventing invasive carcinoma.

Modern medicine emphasizes screening programs, vaccination, and educational measures to reduce the incidence and mortality associated with cervical neoplasia. Epidemiology Cervical neoplasia affects women across the globe, but its incidence varies greatly by region. The highest rates are found in Sub-Saharan Africa, Southeast Asia, and parts of Latin America, while developed countries show lower rates due to effective screening programs.

Most cases occur between the ages of 30 and 50, although HPV infection often begins soon after the onset of sexual activity. Socioeconomic status, limited access to healthcare, and lack of awareness are significant risk factors contributing to delayed diagnosis and poor outcomes.

The introduction of HPV vaccination has led to a gradual decline in incidence rates in countries with strong public health systems. Etiology and Pathogenesis Persistent infection with high-risk HPV types (especially HPV-16 and HPV-18) is the primary cause of cervical neoplasia. These viruses integrate into the host genome and produce oncoproteins E6 and E7, which disrupt the function of tumor suppressor genes p53 and Rb. This leads to uncontrolled cell proliferation and accumulation of genetic mutations.

However, HPV infection alone is not sufficient to cause neoplasia. Additional risk factors play a major role, including early onset of sexual activity, multiple sexual partners, smoking, long-term use of oral contraceptives, immunodeficiency (including HIV infection), and chronic inflammation of the cervix.

The progression from infection to invasive carcinoma usually takes several years, providing a valuable opportunity for screening and early intervention. Classification and Stages Cervical neoplasia is classified histologically as Cervical Intraepithelial Neoplasia (CIN) and clinically as Invasive Cervical Cancer.

- CIN I (Mild Dysplasia): Abnormal cells confined to the lower one-third of the epithelium.
- CIN II (Moderate Dysplasia): Involvement of up to two-thirds of epithelial thickness.

- CIN III (Severe Dysplasia / Carcinoma in situ): Full-thickness abnormal changes but without invasion.

If untreated, CIN III may progress to invasive carcinoma, which is staged according to the FIGO system:

- Stage I: Tumor confined to the cervix.
- Stage II: Spread beyond the uterus but not to the pelvic wall.
- Stage III: Extension to the pelvic wall or lower third of the vagina.
- Stage IV: Invasion of bladder, rectum, or distant metastasis.

Diagnosis Early diagnosis of cervical neoplasia is vital for successful treatment. The cornerstone of screening is the Pap smear test, which detects cytological abnormalities. HPV DNA testing has become an important complementary method, allowing identification of high-risk viral types even before cellular changes occur. When screening results are abnormal, further investigations include colposcopy, biopsy, and histopathological analysis.

In certain cases, immunohistochemistry and molecular studies help evaluate the aggressiveness of lesions. Imaging techniques such as ultrasound, MRI, or CT scans are used for staging invasive cancers. **Treatment** Treatment of cervical neoplasia depends on the stage and severity of the disease. CIN I is often managed conservatively with observation and follow-up, as spontaneous regression is common. CIN II–III require surgical excision through procedures such as LEEP (Loop Electrosurgical Excision Procedure), cryotherapy, or cold knife conization. Invasive cancer is managed with a combination of surgery, radiation therapy, and chemotherapy.

Radical hysterectomy and pelvic lymphadenectomy are standard for early-stage invasive cancer. Newer therapies, including targeted molecular treatments and immunotherapy, are being developed to improve outcomes and reduce recurrence. Psychosocial support is also crucial, as diagnosis and treatment can affect mental and reproductive health.

Prevention is the most effective strategy against cervical neoplasia. It includes:

- Primary prevention: HPV vaccination for girls and young women before sexual activity. Vaccines such as Gardasil and Cervarix have shown high efficacy.

- Secondary prevention: Regular screening with Pap smears and HPV testing for early detection.
- Tertiary prevention: Proper treatment and follow-up to prevent recurrence or progression.

Public education about sexual health, avoidance of smoking, and timely medical consultation play significant roles in prevention. Implementing national screening and vaccination programs has already reduced cervical cancer incidence in many countries.

Conclusion. Cervical neoplasia continues to be a major challenge in women's health, yet it is one of the most preventable cancers. Persistent HPV infection remains the key causative factor, and widespread vaccination can drastically reduce the disease burden. Early detection through screening and appropriate management of precancerous lesions ensure a favorable prognosis. Healthcare systems should focus on expanding screening coverage, improving access to vaccination, and increasing awareness among women. With global cooperation and continued research, the elimination of cervical cancer as a public health threat is an achievable goal.

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