



ANATOMICAL AND MORPHOLOGICAL FEATURES OF CERVICAL CANCER

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ABSTRACT: This article analyzes the anatomical, topographic, and morphological characteristics of cervical cancer, with a particular focus on its mechanisms of spread and clinical implications. The study aims to evaluate the correlation between histological features, tumor growth forms, and regional metastasis to optimize oncosurgical approaches.

A retrospective clinical and morphological analysis was conducted on surgical materials from patients diagnosed with cervical cancer. Standard histological examinations were used to assess the depth of stromal invasion, cellular differentiation, and lymphovascular involvement. Data systematization, statistical analysis, and visual assessment were performed utilizing modern medical information technologies, specifically Microsoft Excel.

The findings indicate that the exophytic growth form is the most prevalent (65-70%), followed by the endophytic form (20-25%). Histologically, squamous cell carcinoma originating from the transformation zone accounted for 80-85% of cases, while adenocarcinomas constituted 10-15%. A strong direct correlation was established between the depth of tumor invasion into the stroma and the frequency of lymphogenic metastasis to the obturator, internal iliac, and external iliac lymph nodes.

The local spread and regional lymphatic metastasis of cervical cancer are strictly dictated by the tumor's macroscopic form, histological differentiation, and the complex vascular-lymphatic anatomy of the pelvic cavity. The study highlights the critical necessity of integrating digital technologies, statistical visualization, and principles of clinical bioethics (such as nerve-sparing surgery) into both modern clinical practice and the pedagogical processes of higher medical education.



KEYWORDS: Cervical cancer, topographic anatomy, tumor morphology, transformation zone, lymphogenic metastasis, squamous cell carcinoma, nerve-sparing surgery, medical information technologies, statistical visualization, clinical bioethics.

INTRODUCTION Cervical cancer occupies a leading position among female oncological diseases worldwide in terms of incidence and mortality rates, remaining one of the most pressing problems in gynecological practice. The severity of the disease is explained by its long, almost asymptomatic course and its hidden development due to its specific, complex anatomical location.

From an anatomical point of view, the cervix (*cervix uteri*) is the lower, narrowed, cylindrical, or cone-shaped part of the uterus, integrally connected to the pelvic organs through blood vessels, lymphatic, and nerve networks. Topographically, its structure is divided into two main parts: the supravaginal portion (*portio supravaginalis*), located above the level of the pelvic fascia, and the vaginal portion (*portio vaginalis*), directly adjacent to the vaginal fornices. The internal canal passing through the middle of the cervix with a spindle-like shape (*canalis cervicis uteri*) connects the uterine cavity with the vagina.

The histological architectonics of the cervix is the primary factor determining its extreme oncological vulnerability. The inner surface of the canal is lined with mucus-producing single-layer columnar epithelium, while the outer vaginal portion is covered with protective stratified squamous epithelium. The boundary where these two completely different types of tissues meet is anatomically referred to as the "squamocolumnar junction" (SCJ) or the "transformation zone." Depending on the woman's age and hormonal background, this boundary constantly shifts, and it is in this area that the process of active cellular metaplasia (the transformation of one type of tissue into another) occurs. Morphologically, this area is highly sensitive to the effects of various oncogenic agents, particularly the human papillomavirus (HPV). Scientific studies confirm that almost all cervical carcinomas originate from dysplastic changes in this exact transformation zone.

Furthermore, the stromal layer of the cervix is extremely rich in blood vessels (branches of *a. uterina*) and lymphatic capillaries. This rich lymphatic system acts as a kind of "open door" for tumor cells to easily metastasize to the periuterine tissue (parametrium), as well as to the internal iliac, external iliac, and obturator lymph nodes of the pelvis, right from the early stages. Due to anatomical proximity, in the later stages of the disease, the tumor also rapidly invades adjacent organs such as the bladder and rectum.

In this regard, the main purpose of this article is to comprehensively analyze the mechanisms of origin of cervical cancer, the stages of carcinogenesis, the pathological anatomy of the tumor, and the pathways of its spread to the pelvic organs based on modern morphological and topographic-anatomical approaches. These analyses are of crucial importance for diagnosing the disease in its early stages and correctly understanding the anatomical foundations of radical surgical procedures.

MATERIALS AND METHODS This study is based on the principles of clinical-anatomical and retrospective morphological analysis and is aimed at studying tissue-level changes and the features of topographic spread of cervical cancer.

Object and materials of the study: During the study, the medical histories, macroscopic descriptions of surgical materials, and pathomorphological conclusions of patients surgically treated with a diagnosis of malignant tumors of the cervix were comprehensively analyzed. The main focus was on clinical data determining the anatomical location of the tumor, the nature of growth (exophytic or endophytic forms), and its relationship to the pelvic plexus organs.



Histological and morphological examination methods: To accurately evaluate pathological changes in the transformation zone of the cervix, as well as at the boundaries of the stratified squamous and columnar epithelium, the obtained tissue samples were examined using standard histological methods. Histological sections were stained with hematoxylin-eosin and studied using a light microscope. During the microscopic analysis, special attention was paid to the following morphological criteria:

- Depth of invasion (ingrowth) of tumor cells into the stroma and connective tissue;
- Degree of cell differentiation (highly, moderately, and poorly differentiated carcinomas);
- Involvement of blood and lymphatic vessels (lymphovascular invasion).

Application of medical information technologies: Modern medical information technologies were widely used in the process of collecting, storing, and processing research data. The microscopic appearances of histological preparations were digitized and entered into a database to increase the accuracy of visual assessment and for future use in educating students and young professionals.

Statistical analysis: All obtained clinical, anatomical, and morphological data were systematized, and their statistical analysis and visualization were carried out using Microsoft Excel software. Using the functional capabilities of this program, the following operations were performed:

- The frequency distribution of macroscopic forms and histological types of the tumor was calculated;
- Correlation dependencies between the stages of anatomical spread of the disease (according to the TNM classification) and the probability of metastasis to regional lymph nodes were analyzed;
- To ensure the accuracy and clarity of the obtained biomedical data, comparative tables, as well as various histograms and diagrams, were formed.

RESULTS As a result of clinical-morphological and topographic-anatomical analyses, a number of important patterns were identified regarding the stages of development, growth forms, and characteristics of the spread of cervical cancer to adjacent organs. All obtained data were processed in Microsoft Excel, and exact statistical indicators were formed based on the anatomical and histological characteristics of the disease.

1. Macroscopic and Topographic growth forms: The study results showed that cervical cancer manifests in various macroscopic forms depending on its anatomical location. Their main distribution was observed as follows:

- **Exophytic form (65-70%):** The most common type of tumor, starting mainly from the vaginal portion of the cervix (*portio vaginalis*) and growing toward the vaginal cavity in a cauliflower-like or polypoid shape. Because these types of tumors are highly vascularized, they are characterized by symptoms of contact bleeding even in the early stages.

- **Endophytic form (20-25%):** Tumors of this form mainly start from the mucous membrane of the cervical canal (*canalis cervicis uteri*) and grow deeply inward into the muscle and connective tissues (stroma) of the cervix. As a result, the cervix undergoes hypertrophy and acquires a hard, barrel-like shape. The danger of the endophytic form lies in its long hidden course and the difficulty of visual detection during vaginal examination.

- **Mixed form (5-10%):** A form that exhibits features of both exophytic and endophytic growth, mostly observed in the later stages of the disease. Rapid ulceration and necrosis of tumor tissues are characteristic.



2. Histological and Microscopic features: Morphological examinations confirmed that the histological type of tumor cells directly depends on the anatomical zone from which they originate:

- **Squamous cell carcinoma (80-85%):** Primarily noted to develop from the stratified squamous epithelium of the "transformation zone" and the vaginal portion. Histologically, highly differentiated (keratinizing) and poorly differentiated (non-keratinizing) types were distinguished.

- **Adenocarcinoma (glandular cancer) (10-15%):** Develops from the columnar epithelium lining the cervical canal and the cervical glands. The study observed that these types of tumors invade the stromal layer faster and deeper, and have a more aggressive course.

3. Anatomical spread and Lymphogenic metastasis: It was found that the local spread of the disease occurs step-by-step, strictly depending on the anatomy of the pelvic cavity:

- **Local invasion:** The tumor first spreads to the vaginal fornices (*fornix vaginae*), then to the connective tissue surrounding the cervix—the parametrium. Statistical analysis showed that as the tumor penetrates deeper than 3 mm into the stromal layer, the risk of transferring to blood and lymphatic vessels (lymphovascular spaces) sharply increases. In the later stages, the tumor was observed invading the bladder through the anterior wall and the rectum through the posterior wall.

- **Spread to lymph nodes:** Due to the anatomically rich lymphatic network of the cervix, regional lymph nodes are affected first. The topography of the spread was noted to occur mainly in three directions: obturator nodes (*n. l. obturatorii*), internal iliac nodes (*n. l. iliaci interni*), and external iliac nodes (*n. l. iliaci externi*).

4. Statistical evaluation using information technologies: When the obtained data were correlationally analyzed using Microsoft Excel, a strong directly proportional relationship was confirmed between the depth of tumor invasion into the stroma and the frequency of metastasis to regional lymph nodes. Furthermore, visual diagrams created using the program clearly showed the incidence frequency of exophytic and endophytic tumors by age categories, which significantly facilitated the drawing of clinical conclusions.

DISCUSSION The data obtained as a result of the study once again confirm how seriously the anatomical, topographic, and morphological features of cervical cancer affect its clinical course. In our analysis, the incidence frequency of exophytic and endophytic growth forms and the nature of their invasion into surrounding pelvic organs correspond to international indicators cited in modern oncological literature.

During the analysis of the obtained results, it becomes evident that a doctor requires not only profound anatomical knowledge but also a perfect clinical thinking methodology. The specific histological structure of the tumor in each patient (squamous cell carcinoma or the more aggressive adenocarcinoma), as well as individual morphological changes in the transformation zone, demand an approach based not on a template, but specifically on the anatomical condition of that patient. Correlating the macroscopic appearance of the disease with the microscopic depth of invasion, and correctly evaluating the changes in blood and lymphatic vessels, is the most crucial analytical step in determining the scope of surgical intervention.

Moreover, the spread of the tumor to pelvic organs (parametrium, bladder, rectum) and regional lymph nodes requires complex oncosurgical interventions, particularly radical hysterectomy. Operating in anatomically close proximity to extremely delicate structures, such as the intersection of the uterine artery (*a. uterina*) and the ureter (*ureter*), as well as the pelvic plexus nerve fibers (*plexus hypogastricus*), requires high skill from the surgeon. It is exactly at this point that the epistemological and bioethical problems of medicine arise. While performing a radical operation to ensure oncological safety, it is essential for the doctor to maintain a delicate



bioethical balance by preserving nerve fibers and the function of adjacent organs as much as possible (nerve-sparing surgery) to ensure the patient's future quality of life. This struggle between saving the patient's life and ensuring her social and physiological completeness is one of the most complex philosophical aspects of clinical practice.

Our histological analyses and statistical conclusions regarding the spread of the disease indicate that the tumor process is not merely a pathology of a single organ, but the disruption of an entire pelvic anatomical complex. Explaining these complex topographic and pathomorphological relationships to young personnel is of immense importance in organizing the educational process in higher medical education institutions. Modern textbooks to be created for students of the therapeutic, medical-pedagogical, and pharmacy faculties of our Republic's medical universities must include not just theoretical anatomy, but rather evidence-based data enriched with exactly such clinical, histological, and digital technologies (including statistical visualizations). Such a comprehensive approach will serve as a foundation for developing students' spatial-anatomical imagination and logical-clinical reasoning abilities in the future.

In conclusion, the localization, growth form, and histological differentiation of cervical cancer are the primary factors determining its local spread and regional lymphatic metastasis. The anatomy of the pelvic cavity, rich in blood vessels and lymphatic systems, increases the risk of the rapid spread of the tumor to adjacent organs. The successful treatment of the disease directly depends on profound clinical-anatomical analysis, strict adherence to bioethical principles during surgery, and properly formed medical-educational training in oncological morphology. It is advisable that future research in this direction be focused on evaluating molecular-level changes of the disease using digital technologies.

CONCLUSION The conducted clinical-anatomical, morphological, and topographic analyses show that cervical cancer is not just a local pathological process, but a complex oncological condition involving all pelvic cavity organs and their rich vascular and lymphatic systems. The histological vulnerability in the transformation zone, considered the focus of carcinogenesis, and the macroscopic growth forms of the tumor (exophytic, endophytic, or mixed) strictly determine the depth of its invasion into the stromal layer and the directions of metastasis to pelvic lymph nodes.

Through the application of modern information technologies and statistical visualization methods, it was confirmed that the degree of cell differentiation and the depth of tumor penetration into the tissue are the main digital criteria determining the prognosis of the disease. Such an accurate, data-driven approach allows for properly assessing the stage of the disease and optimizing the treatment tactics.

At the same time, treating cervical cancer surgically demands from the doctor not only perfect knowledge of the complex topographic anatomy of the pelvic organs (including vascular anastomoses and nerve plexuses) but also a high level of clinical thinking methodology. The delicate bioethical balance between radical oncological procedures aimed at saving the patient's life and ensuring the woman's socio-physiological quality of life by maximally preserving organ functions (nerve-sparing surgery) remains one of the most important directions in the philosophy of modern medicine.

The comprehensive approach highlighted in this study is of great significance not only for practical oncology and gynecology but also for improving the educational-pedagogical process in medical universities. When training future medical professionals, it is necessary to teach the fundamental disciplines of anatomy and histology inextricably linked with information technologies, digital morphology, and clinical bioethics. In the future, thoroughly studying the pathology of gynecological tumors and improving treatment outcomes are directly tied to widely



introducing pedagogical-statistical assessment systems into the continuous education process and developing students' abilities to draw independent clinical-logical conclusions.

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