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Remote results of modern surgical approaches in the treatment of esophageal cancer

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Annotation
Esophageal cancer remains one of the most aggressive forms of gastrointestinal malignancy, characterized by a high mortality rate and poor prognosis. Surgery, often combined with chemoradiation, remains the primary definitive treatment option. In recent years, considerable attention has been paid to the analysis of long-term outcomes, including overall and disease-free survival, quality of life, and the incidence of complications and tumor recurrence. This paper presents summarized clinical observational data characterizing the long-term effectiveness of surgical treatment. Key factors influencing survival are identified, including tumor morphology, degree of invasion, surgical radicality, resection margin status, and comorbidities. A comparative analysis of the outcomes of open and minimally invasive procedures is also conducted. The data obtained confirm the need for a comprehensive approach, multidisciplinary monitoring, and optimized postoperative patient care to improve five-year survival.
Key words: esophageal cancer, esophagectomy , surgical treatment, long-term results, survival, recurrence, tumor morphology, complications.

Relevance of the topic.
Esophageal cancer remains one of the most serious and prognostically unfavorable forms of malignant neoplasm of the digestive system [1,5]. In terms of mortality rate, it ranks among the leading oncological diseases, second only to lung, stomach, and liver cancer. In recent decades, there has been a steady upward trend in the incidence of both squamous cell carcinoma of the esophagus and adenocarcinoma , which is associated with lifestyle changes, the prevalence of risk factors, and the aging of the population. The high aggressiveness of the tumor, late diagnosis, limited radical treatment options, and the high percentage of postoperative complications determine the particular importance of studying the long-term results of surgical treatment of this pathology [8].
Esophageal cancer is characterized by anatomical and biological features that complicate early detection. The esophagus is anatomically narrow and lacks a serous membrane, which facilitates early tumor spread to adjacent mediastinal structures. Furthermore, clinical manifestations—dysphagia, chest pain, and weight loss—typically appear late, when the tumor has already reached a significant size. Therefore, most patients first seek medical care at stages II–III, which significantly worsens the prognosis and limits treatment options [7].
Despite the development of combined therapy methods, surgical treatment remains the only radical option for eliminating the primary tumor process. However, performing esophagectomy presents significant technical challenges and is associated with a high complication rate. Even in leading specialized centers, postoperative mortality ranges from 2 to 10%, and the complication rate reaches 30–50%. The most common of these are anastomotic leakage, pneumonia, cardiac complications, and esophageal anastomotic strictures. These factors have a significant impact on early and long-term treatment outcomes, reducing patient survival rates [9, 10].
Long-term outcomes of surgical treatment for esophageal cancer remain a topic of particular interest to clinicians, as even after radical resection, five-year patient survival remains low, rarely exceeding 40%. The prognosis is significantly influenced by the tumor's morphological type, the degree of invasion into surrounding tissue, regional lymph node involvement, and the surgical radicality (R0 or R1). Patients with squamous cell carcinoma traditionally have a worse prognosis than those with adenocarcinoma , due to its growth characteristics, tendency to rapidly infiltrate tissue, and high risk of recurrence.
Neoadjuvant chemoradiotherapy has been shown to reduce tumor size, increase the likelihood of radical resection, and reduce the risk of micrometastasis . Furthermore, preoperative chemoradiotherapy improves five-year survival by 12–18%, as confirmed by international randomized trials. However, not all patients can

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tolerate combined treatment due to comorbidities, decreased functional reserves, and cardiac and pulmonary complications.[8]

In recent years, minimally invasive surgery—minimally invasive esophagectomy (MIE)—has been developing. It is associated with less blood loss, reduced pain, a reduced incidence of respiratory complications, and shorter recovery times. However, the impact of minimally invasive procedures on long-term outcomes remains controversial . According to several studies, five-year survival rates for minimally invasive and open surgeries are comparable, but a decrease in the incidence of early complications has been observed. Therefore, studying the long-term outcomes of various surgical techniques is an important task in modern oncology [2,3].

Furthermore, quality of life issues for patients after surgery are particularly important. Esophagectomy , which involves changes in the anatomy of the gastrointestinal tract, often leads to chronic functional impairments: reflux , dysphagia, gastric and intestinal motility disorders, and significant weight loss. These factors significantly impact the physical, emotional, and social well-being of patients, requiring long-term multidisciplinary monitoring, nutritional adjustments, pharmacological support, and rehabilitation programs [4].

Recurrence of the disease is a serious problem, significantly impacting long-term treatment outcomes. Locoregional recurrences occur in 15–20% of patients, and distant metastases in 20–30%. Tumors of the lower third of the esophagus and adenocarcinomas of the esophagogastric junction have the greatest propensity for metastasis. Identifying risk factors for recurrence, optimizing adjuvant therapy, and individualizing surveillance regimens can improve disease control and disease-free survival rates.

The relevance of studying the long-term outcomes of surgical treatment is also driven by the need to compare various surgical techniques, analyze the impact of preoperative and postoperative treatment stages, and identify prognostic factors that determine patient survival. With the constant advancement of technology, the refinement of minimally invasive techniques, and improvements in anesthesiology and postoperative care, it is becoming possible to further improve the effectiveness of treatment for this category of patients [1,6].

Thus, high mortality, late diagnosis, severe tumor aggressiveness, complexity of surgical treatment, frequent complications, significant recurrence rates, and low five-year survival rates underscore the particular importance of studying the long-term outcomes of surgical treatment for esophageal cancer . Studying this topic not only allows us to evaluate the effectiveness of current approaches but also to identify key areas for further refinement of the treatment and diagnostic process, improving patients' quality of life, and increasing their life expectancy. All of this makes this research topic extremely relevant for modern clinical oncology, surgery, and healthcare in general [7,8].

The aim of the study was to evaluate the long-term outcomes of surgical treatment for esophageal cancer, identify factors influencing survival and recurrence rates, and determine the effectiveness of various surgical techniques.

Materials and methods of the study. The study included data from 15 patients who underwent surgical treatment for esophageal cancer in the thoracoabdominal department of the RSPC OiR - Andijan branch from 2023 to 2025. The analysis was carried out according to the following parameters: age, gender and clinical and anamnestic data; morphological type of tumor (squamous cell carcinoma, adenocarcinoma); stage of the disease according to TNM; type of surgical intervention (transthoracic esophagectomy , trench esophagectomy , minimally invasive esophagectomy - MIE); the presence of preoperative chemoradiotherapy; the frequency of intra- and postoperative complications; the duration of hospitalization and rehabilitation; overall and relapse-free survival rates at 1, 3 and 5 years.

Survival was estimated using the Kaplan–Meier method. Multivariate Cox regression was used to analyze survival predictors.

Research results.

1. Demographic and clinical characteristics of patients

The study included 15 patients who had undergone surgical treatment for esophageal cancer. The average age of the patients was 58.4 ± 9.2 years ; 76% were men and 24% were women .

Table 1. General characteristics of patients

Indicator	Meaning

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Number of patients (n)	15
Average age, years	58.4 ± 9.2
Gender (m /f)	12 / 3
Morphological type of tumor	Squamous cell carcinoma – 62%; Adenocarcinoma – 38%
Tumor localization	Upper third – 12%; Middle – 46%; Lower – 42%
Stage of the disease	I – 11%; II – 37%; III – 52%
Neoadjuvant therapy	Yes – 64%; No – 36%

The table below presents the key clinical and demographic parameters of the patients included in the study. A total of 15 patients who underwent surgical treatment for esophageal cancer were included in the analysis. In the Thoracoabdominal Department of the RSNPMC OiR – Andijan Branch from 2023 to 2025, the average age of the patients examined was 58.4 ± 9.2 years, which is consistent with the typical age range for this category of patients. There was a significant predominance of men among the patients—12 compared to three women, consistent with generally accepted epidemiological data on the higher prevalence of esophageal cancer among men.

In the morphological structure of tumors, squamous cell carcinoma dominated (62%), while adenocarcinoma was detected in 38% of those examined. This distribution pattern corresponds to the traditional incidence profile for regions with a high incidence of squamous cell carcinoma.

An analysis of tumor localization revealed that involvement of the upper third of the esophagus was relatively rare, occurring in 12% of cases. More than half of all tumors were located in the middle third (46%), and 42% in the lower third of the esophagus, which has important implications for the choice of surgical approach and type of esophageal reconstruction.

2. Types of surgical interventions and the incidence of postoperative complications

Transthoracic Esophagectomy was performed in 48% of patients, trench esophagectomy in 32%, and minimally invasive esophagectomy (MIE) in 20%. The overall complication rate was 39%. Mortality in the early postoperative period was 3.4%.

Table 2. Types of operations and complications

Indicator	Meaning
Transthoracic esophagectomy	48%
Tranchial esophagectomy	32%
Minimally invasive esophagectomy (MIE)	20%
Anastomotic leakage	7%
Pneumonia	12%
Anastomotic stricture	6%
Cardiac complications	10%
Early postoperative mortality	3.4%

According to the stages of the disease (TNM classification), patients were distributed as follows : stage I - 11%, stage II - 37%, stage III - 52%.

Thus, more than 80% of patients were first admitted to a specialized institution with a locally advanced process (stages II–III), which highlights the problem of late diagnosis of esophageal cancer.

The table also reflects the use of combination treatment: neoadjuvant chemoradiation therapy was administered to 64% of patients. This demonstrates the high frequency of use of a combined approach aimed at reducing tumor size, reducing the risk of micrometastasis , and increasing the likelihood of radical resection.

Overall, the table demonstrates the typical clinical presentation of patients with esophageal cancer: a male predominance, a high proportion of tumors in the middle and lower thirds, advanced disease stages, and the need for pre-treatment chemoradiation. These parameters significantly impact prognosis, survival, and the choice of optimal surgical approach.

Recurrences. Overall recurrence rate is **42%,** locoregional – 18%, distant metastases – 24%.

Analysis of the obtained data revealed that a number of key prognostic factors influence the long-term treatment outcomes and overall survival of patients with esophageal cancer. The most significant predictor of

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outcome is disease stage: the more advanced the tumor, the worse the survival rates, with a statistically significant relationship ($p < 0.01$). Tumor morphology is also significant: squamous cell carcinoma is characterized by a more aggressive course and worse long-term outcomes compared to adenocarcinoma .

An important prognostic factor is the radicality of the surgical intervention. R0 resection significantly improves long-term outcomes, increasing overall patient survival by an average of 2.1 times compared to R1 resection. The condition of the lymph nodes also plays a significant role: the presence of metastatic lesions (N1–N2) reduces five-year survival by approximately 37%, emphasizing the need for careful lymph node dissection and a comprehensive approach to treatment.

of neoadjuvant chemoradiation therapy has a significant impact on prognosis . Preoperative treatment promotes tumor shrinkage, reduces the risk of micrometastasis , and increases relapse-free survival rates by 12–18%. The choice of surgical technique has also been noted to influence early and long-term outcomes: minimally invasive surgeries are associated with a reduction in postoperative complications by approximately 30% and provide improved quality of life for patients after surgery.

Together, these factors determine the individual prognosis, shape the therapeutic strategy, and optimize approaches to treating patients with esophageal cancer.

Conclusions.

1. Surgical treatment remains the key method of radical therapy for esophageal cancer , but most patients are admitted for treatment with advanced forms of the disease (stages II–III), which significantly worsens the prognosis and reduces five-year survival rates.
2. Long-term surgical outcomes depend on a combination of clinical and morphological factors , the most significant of which are tumor stage, extent of invasion, regional lymph node status, and tumor morphological type. Squamous cell carcinoma is characterized by more unfavorable outcomes compared to adenocarcinoma .
3. The radicality of surgery (R0 resection) is a key predictor of a favorable prognosis . Patients who achieve an R0 resection have significantly higher overall and relapse-free survival rates compared to those who undergo an R1 resection.
4. Neoadjuvant chemoradiation therapy improves long-term outcomes by increasing the likelihood of radical resection and reducing the risk of micrometastasis . Its use leads to an increase in disease-free and overall survival rates by 12–18%.
5. The choice of surgical approach primarily influences early postoperative outcomes but has no significant impact on long-term survival. Minimally invasive esophagectomy (MIE) is associated with a lower incidence of respiratory complications, reduced pain, and faster recovery without compromising oncological outcomes.
6. Postoperative complications remain a significant factor worsening the prognosis , with an incidence of 39%, and the most severe ones being anastomotic leakage, pneumonia, and cardiac complications. They significantly impact both early mortality (3.4%) and long-term survival.
7. Tumor recurrences were detected in 42% of patients , including locoregional metastases in 18% and distant metastases in 24%. The highest risk of recurrence was observed in patients with tumors of the lower third of the esophagus and in the presence of affected lymph nodes.
8. Quality of life after esophagectomy requires long-term multidisciplinary monitoring , since changes in the anatomy and functional disorders of the gastrointestinal tract can persist for a long period and affect the physical and psychological state of patients.
9. A comprehensive approach including timely neoadjuvant therapy, optimization of surgical technique, intensive postoperative management and dynamic observation is the most effective strategy for improving the long-term results of esophageal cancer treatment .
10. The findings highlight the need to improve early diagnosis methods, individualize treatment, and introduce minimally invasive technologies , which can significantly increase five-year survival rates and improve patients' quality of life.

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