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Immediate results of gastrectomy depending on the method of Esophagojejunal Anastomosis reconstruction

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Relevance: At present, the issue of selecting the optimal reconstruction option after gastrectomy and the method of forming the esophagojejunal anastomosis acceptable to all surgeons remains unresolved.

Materials and methods: From 1980 to 2025, the immediate results of gastrectomy were analyzed in 4,108 patients with gastric cancer depending on the method of forming the esophagojejunal anastomosis (EJA). According to the type of reconstruction and time period, the patients were divided into 3 groups:

- EJA per Gilyarovich: 1980–2000 (n = 1217)
- EJA per Gilyarovich–Shalimov: 2001–2006 (n = 489)
- EJA per the authors' own technique: 2007–2025 (n = 2412)

Results: Anastomotic leakage with reconstruction per Gilyarovich was 7.3%. With the Shalimov modification — 5.1%, and with the authors' own technique — 0.24%. Reflux esophagitis of varying degrees was 62.2%, 49.0%, and 2.7%, respectively, by technique.

Anastomositis — 48.8%, 39.3%, and 18.9%.

Anastomotic stricture, also by reconstruction type, was 35.7%, 27.0%, and 9.0%.

Conclusion: Optimization of EJA formation should be based on a differentiated approach aimed at reducing complication rates and improving the functional results of treatment after gastrectomy.

Key words: Gastric cancer, esophagojeunoanastomosis, reconstruction, type of anastomosis, anastomotic leakage, reflux esophagitis, anastomositis.

Ключевые слова: Рак желудка, эзофагоеюноанастомоз, реконструкция, тип анастомоза, несостоятельность анастомоза, рефлюкс-эзофагит, анастомозит.

Kalit so‘zlar: Me'da saratoni, ezofagoeyunoanastomoz, rekonstruksiya, anastomoz turi, anastomoz yetishmovchiligi, reflyuks-ezofagit, anastomozit.

Relevance

At present, the issue of selecting a reconstruction option after gastrectomy and a method of forming the esophagojejunal anastomosis acceptable to all surgeons remains unresolved. A large number of reconstruction techniques after gastrectomy exist. All their diversity can presently be reduced to four main ones (1):

- esophagoduodenostomy;
- esophagojejunoduodenoplasty;
- esophagojejunal anastomosis on a long loop with a Braun inter-intestinal anastomosis;
- esophagojejunal anastomosis per Roux.

Most authors consider esophagoduodenostomy unacceptable, as this option is associated with the highest number of cases of anastomotic leakage and a higher incidence of reflux esophagitis. However, some surgeons still prefer this reconstruction method. (2)

Variants of esophagus-to-jejunum anastomosis on a long loop with a Braun inter-intestinal anastomosis are most often used to restore digestive tract continuity after gastrectomy. With all its

positive qualities, this method carries the risk of developing "afferent loop obstruction syndrome" with risk of wall necrosis and peritonitis. Attention is drawn to the role of technical aspects of anastomosis formation in the development of "afferent loop obstruction syndrome": possible kinking of the afferent loop near the ligament of Treitz, its excessive length, and probability of strangulation in the mesocolic window. (3, 8)

Many domestic and foreign surgeons prefer the C. Roux technique when restoring the continuity of the digestive tract after gastrectomy (Chernousov A.F., 1999). The main reason is the low incidence of reflux esophagitis in the late period after surgery and the simplicity of reconstruction (Famyl D.Ch. et al., 2002). A drawback of the method is the possibility of developing a specific complication called "Roux stasis syndrome" (Zherlov G.K., Zykov D.V., Baranov A.I., 2002).

The problem of esophageal anastomotic leakage after gastrectomy remains in the field of view of surgeons dealing with gastric cancer treatment, since this formidable complication is one of the main causes of death in the postoperative period and largely determines mortality rates after surgery. According to numerous authors (6, 7, 9, 12), this complication currently develops in 1.5–8.5% of operated patients. It presents the greatest danger in the first days after surgery, when adhesions delimiting the anastomotic region from adjacent tissues and serous cavities have not yet formed. The earlier the leakage occurs, the more severely it progresses and the greater the threat to the patient's life. The size of the defect in esophagoenteric anastomotic leakage varies from punctate to complete dehiscence of the edges of the sutured organs. A direct dependence of the complication's prognosis on the size of the defect formed is evident here. (10, 14)

The cause of this complication consists of a number of factors that can be divided into several groups. (4)

1. Features of the organs being sutured: absence of a serous layer of the esophagus and the associated apposition of the intestinal serous layer suture with the muscular layer of the esophagus; structural features of the distal esophagus — predominance of longitudinal muscle fibers over circular ones, which reduces tissue regenerative capacity and increases the risk of suture cut-through;
2. Factors related to the main and concomitant diseases: unfavorable metabolic changes of alimentary and tumor origin;
3. Iatrogenic causes: tension on the organs being sutured; rough handling of tissues; excessive mobilization of the esophagus or small intestine; traumatization of the pancreas and consequently development of pancreatitis or pancreatic necrosis; excessive or insufficient tightening of knots;

We naturally do not exclude that some of these complications may have been associated with the technical development of the technique and incomplete refinement of pre-, intra-, and postoperative patient management.

The second important complication, of a functional nature, was reflux esophagitis. (11, 13) This type of complication in our observations was encountered with varying intensity in 48% of patients. Conservative correction of reflux esophagitis after gastrectomy was practically absent. The agents available in the early 1990s were of low effectivenes

Literature review, Materials and methods

A.F. Chernousov et al. (2011) formulated the primary requirements for esophagoenteric anastomosis (EEA) that must be strictly followed during its creation to prevent complications. These requirements include technical simplicity, ease of execution, leak-proof airtightness (competence), and the overall reliability of the anastomosis.

C.S. Gong et al. (2017) analyzed the incidence of early and late complications in 687 patients following laparoscopic gastrectomy utilizing intra- and extracorporeal linear and circular staplers. (The anastomotic leakage rate was 5.6% when circular staplers were used, compared to 3.5% with linear staplers; anastomotic stricture occurred in 1.13% and 0.48% of cases, respectively).

The majority of Russian and domestic surgeons prefer hand-sewn techniques, which significantly reduces the cost of the surgical procedure and allows for more adequate lymphadenectomy via an open approach. According to **S.V. Volkov (2012)** and **S.A. Polikarpov et al.**, the rate of anastomotic leakage ranged from 1.2% to 2.1%, reflux esophagitis occurred in 18.4% and 21.4% of cases, and anastomotic stricture developed in 16.4% and 23.5% of patients, respectively.

From 1980 to 2025, the immediate results of gastrectomy were analyzed in 4,108 patients with gastric cancer depending on the method of forming the esophagojejunal anastomosis (EJA). This work is retrospective and includes 40 years of experience of the Department of Abdominal Surgery of the RSSPMCOR. The evolution of gastric cancer surgery and, depending on the type of EJA formation, in our practice is divided into 3 large groups:

4. Stage of EJA formation per Gilyarovich: 1980–2000 (n = 1217).
5. Stage of EJA formation per Gilyarovich and Shalimov: 2001–2006 (n = 489).
6. Stage of EJA formation per the authors' own technique: from 2007 to 2025 (n = 2412). (Patent for invention NJAP 04468 dated 13.05.2010.)

Over 20 years, EJA was formed using the Gilyarovich technique and its modification in 1,217 (98.8%) patients. Of these, 590 (48.9%) operations were standard, with D1 lymphadenectomy, and 627 (51.5%) were standard radical operations with D2 lymphadenectomy. Combined gastrectomy accounted for 184 (15.2%) patients.

From 2001, over 6 years, we formed EJA using the Gilyarovich–Shalimov technique in 489 (11.9%) patients with gastric cancer after gastrectomy. Of these, standard gastrectomy was performed in 181 (37%) patients, radical-standard gastrectomy in 248 (50.7%), and palliative gastrectomy in 60 (12.3%) patients. Combined and extended-combined gastrectomy accounted for 132 (41.9%) patients of the total.

From 2007, in order to eliminate the shortcomings in EJA formation per Gilyarovich and Gilyarovich–Shalimov, we developed and introduced into clinical practice our own modifications of EJA formation. To eliminate the above-mentioned shortcomings, we first abandoned the application of fixating lateral esophagojejunal anastomoses, which creates a more mobile anastomosing end of the esophagus — essential, especially when forming the second layer. We limit ourselves to placing only three sero-muscular sutures between the anterior wall of the efferent loop and the posterior wall of the esophagus at least 4–5 cm above the line of esophageal resection (Fig. 1 A). This technique is necessary for the invaginating suture of the posterior esophageal wall into the lumen of the intestine.

The second distinctive feature when forming the second layer of the anastomosis is the avoidance of a defect in the muscular layer. Next, a total of 8 sutures are placed to create the esophagojejunal anastomosis through all layers: 3 sutures posteriorly, 3 anteriorly, and 1 on each side (Fig. 1 B).

Initially, two sero-muscular sutures are placed covering the left and right corners of the intestine; subsequently, sutures are passed through the muscular layer of the esophagus and catch the edge of the esophageal hiatus of the diaphragm. Three more such sutures are placed between the left and right corners (Fig. 1 C). The placement of such sutures, firstly, prevents the appearance of a defect in the muscular layer of the esophagus, and secondly, when the suture is tightened, it pulls the esophageal walls to the level of the diaphragm, thereby creating invagination of the esophagus into the intestinal lumen (Fig. 1 D).

During cuff formation using the afferent loop of the intestine, the upper edge of the intestine was additionally fixed to the edges of the esophageal hiatus of the diaphragm, as was provided in the Gilyarovich–Shalimov modification (Fig. 1 E and F).

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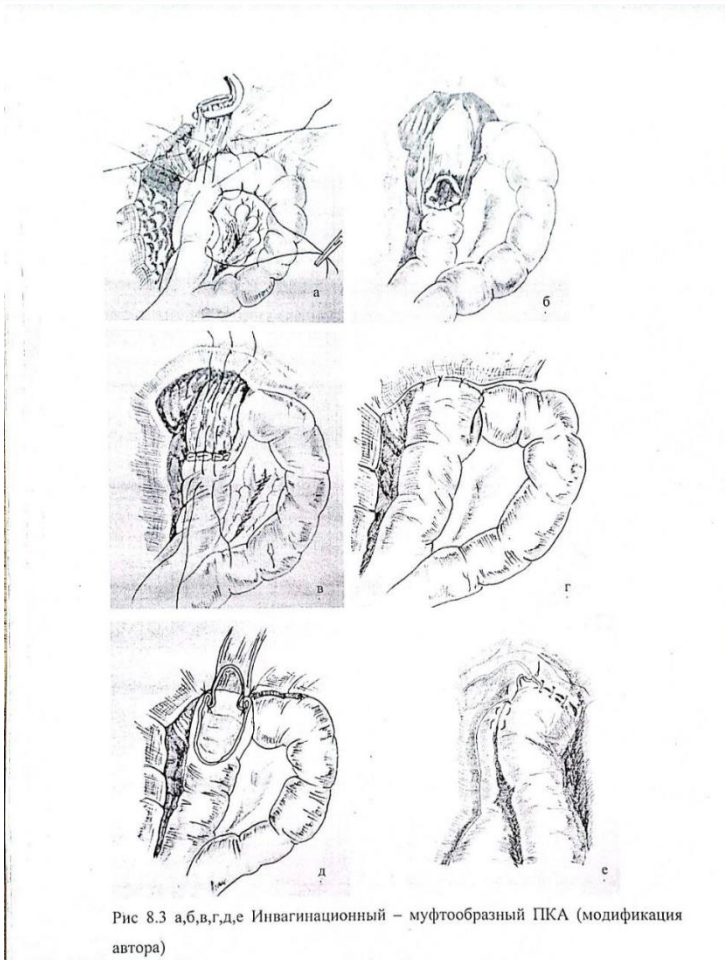


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Fig. 1. Stages of the authors' technique of esophagojejunal anastomosis formation (A–F).

Analysis of clinical material by the type of operation showed that out of 2,412 gastrectomies, 106 (4.4%) operations were of a standard nature, 2,170 (90%) were standard-radical gastrectomies (D2 lymphadenectomy), 46 (1.9%) were extended-radical gastrectomies (D3 lymphadenectomy), and 90 (3.7%) patients underwent palliative gastrectomy. Out of 2,412 gastrectomies performed, 490 (20.3%) operations were of a combined nature.

Results

Analysis of the immediate results of gastrectomy depending on the type of reconstruction (Table 1) shows that the most critical and formidable complication — esophagojejunal anastomotic leakage — was observed significantly most often with the Gilyarovich reconstruction and amounted to 7.3%, of which 82.0% of leakage cases were early and resulted in death, while only 18.0% (16 cases) were late leakage.

With the Gilyarovich–Shalimov modification, the leakage rate was 5.1%, which is 1.5 times less than with the previous reconstruction type — evidence of simplification of some weak points of the anastomosis components in the Shalimov modification. Unlike before, the frequencies of early and late leakage were practically balanced — 52% and 48% respectively — which caused mortality in only 83.3% (10 patients) out of 12 with late leakage.

Frequency and nature of postoperative complications in gastrectomy depending on the type of EJA reconstruction.

Table 1.

Complication	Gilyarovich EJA (n=1217)	Gilyarovich–Shalimov EJA (n=489)	Authors' own EJA technique (n=2412)
1. Anastomotic leakage	**89 (7.3%)**	**25 (5.1%)**	**6 (0.24%)**
a) early	73 (82.0%)	13 (52.0%)	—
b) late	16 (18.0%)	12 (48.0%)	6 (100.0%)
2. Reflux esophagitis	**935 (78.5%)**	**240 (49.0%)**	**65 (2.7%)**
Grade A	460 (37.8%)	102 (42.5%)	65 (100.0%)
Grade B	725 (59.6%)	132 (55.5%)	—
Grade C	32 (2.6%)	6 (2.5%)	—
Grade D	—	—	—
3. Anastomositis	**594 (48.8%)**	**192 (39.3%)**	**455 (18.9%)**
4. EJA luminal stenosis	**435 (35.7%)**	**132 (27.0%)**	**215 (9.0%)**

With EJA formation per the authors' own technique, the overall leakage rate was 0.24% (6 out of 2,412 operated patients), i.e. 1 case per 402 patients, of which almost all were diagnosed late, owing to which it was possible to save the lives of 5 patients and only 1 died of multiple organ failure.

Another very important complication, which significantly depends on the type of EJA formation, is reflux esophagitis. As can be seen from the table, reflux esophagitis of varying degrees was observed most often with Gilyarovich reconstruction — in 78.3% of patients, of which moderate and severe cases amounted to 62.2%. This complication with the Shalimov modification was 49.0% of patients, with moderate and severe degrees at 38.0%. With EJA formation per the authors' own technique, reflux esophagitis was observed in only 2.7% of patients, all of mild degree. (P1-3 and P2-3 < 0.05)

Anastomositis at 3 years was observed in 48.8% of patients with Gilyarovich, 39.3% with the Shalimov modification, and significantly lower with the authors' own technique — 18.9%.

One of the unpleasant complications is anastomotic stenosis of varying degrees.

According to the data presented, the early form of this complication occurred in 35.7% of patients with Gilyarovich reconstruction, 27.0% with the Shalimov modification, and a much lower 9.0% with EJA formation per the authors' own technique. (P1-3 < 0.05; P2-3 < 0.05)

Discussion

The formation of the esophagoenteric anastomosis is one of the most critical stages of reconstructive surgery in gastric cancer. The choice of the optimal technique aims to address the primary objective: ensuring leak-proof airtightness (competence) and establishing a reliable anti-reflux barrier to protect the esophageal mucosa.

Despite the advancements in modern surgery, esophagoenteric anastomotic leakage remains the leading cause of mortality following gastrectomy. According to various authors, the rate of this formidable complication ranges from 0.8% to 20%.

The primary factor contributing to the occurrence of esophagoenteric anastomotic leakage is the unfavorable anatomical and physiological characteristics of the esophagus. Iatrogenic factors also lead to leakage, including tension on the sutured organs, excessive mobilization of the esophagus, insufficient knot tightening, among others.

Despite the existence of more than 100 different methods and modifications of esophagoenteric anastomosis, there is currently no single technique that satisfies all surgeons, which highlights the lack of a universal approach. The search for more reliable methods to ensure the airtightness of the esophagoenteric anastomosis—providing not only satisfactory immediate but also long-term outcomes—remains a subject of ongoing debate.

Conclusion

Optimization of EJA formation should be based on a differentiated approach aimed at reducing complication rates and improving the functional results of treatment after gastrectomy.

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