

Early Oral Feeding in Patients Undergoing Upper Gastrointestinal Surgery: A Propensity Score-matching Study

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Abstract. *Background/Aim:* Enhanced recovery after surgery (ERAS) protocol is adopted in clinical practice worldwide, but a lack of evidence for measurable benefits after upper gastrointestinal (GI) surgeries can be detected especially regarding early oral feeding. *Patients and Methods:* A propensity score-matching study was conducted at the Department of Surgery of the University of Pécs between January 2020 and December 2023. The study included patients who underwent upper GI cancer surgery and were treated according to an early oral feeding protocol (EOF). Investigational and control groups were analyzed and compared from prospectively collected datasets. *Results:* We enrolled 72 patients, 36 in the EOF group, and 36 case-matched patients in the traditional late oral feeding (LOF) group. Oral feeding in the EOF group started on an average of 1.94 days postoperatively, while in the LOF group, it began on an average of 5.72 days postoperatively. EOF could reduce the average length of hospital stay. Statistically significant decreases were observed in the EOF group concerning the time until the first bowel movements, and the length of postoperative intravenous fluid therapy. No significant differences were detected regarding mortality, anastomosis insufficiency, inflammation and stricture or seroma formation. *Conclusion:* Early oral nutritional support

positively impacts the recovery of patients following upper GI surgery without increasing mortality or anastomosis insufficiency rates compared to traditional protocols. Significant improvements were observed in quality of life indicators for patients in the early oral feeding group. This approach aligns with ERAS goals and suggests a valuable strategy for postoperative care in upper GI cancer surgeries.

It is crucial to assess the preoperative nutritional and physical status of patients suffering from malignant diseases, especially in upper gastrointestinal (UGI) malignancies, as these tumors can cause swallowing difficulties, easily leading to a catabolic state before the operation (1). Upper gastrointestinal cancer has a major impact on healthcare worldwide, with the incidence of esophagogastric cancer rising globally. According to the World Health Organization, in 2018 there were approximately 456,000 new cases of esophageal cancer and 923,000 new cases of gastric cancer worldwide (2). In 2018, 2923 new cases of esophagogastric cancer occurred in Hungary (3). Risk factors for these types of cancer include tobacco use, alcohol consumption, poor diet, and infection with certain strains of bacteria or viruses, namely *Helicobacter pylori* and human papilloma virus (HPV). HPV infection is a prognostic factor, for example, in oropharyngeal squamous cell carcinomas (SCC), where a changed miRNA expression pattern was found in tumor tissues and the surrounding mucosa. Prevention strategies include quitting smoking, reducing alcohol intake, maintaining a healthy diet, and getting vaccinated against HPV infection (4, 5).

One of the principles of patients' recovery is nutritional therapy, which includes important components such as prehabilitation before surgery and the initiation of early nutrition after surgery.

Prehabilitation is becoming progressively important in modern healthcare. It refers to the process of optimizing the patient's physical, mental and emotional well-being before undergoing a surgical procedure. Prehabilitation can involve nutritional counseling and interventions to optimize a

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patient's nutritional and physical status before surgery. Improved nutrition can support the healing process and reduce the risk of complications.

After esophago-gastric resections, the fear of anastomosis insufficiency used to be the main reason for the delayed start of oral feeding. However, today's approach favors the patient's enhanced recovery and better quality of life, which has surpassed the fear. The timely initiation of enteral feeding is crucial for patients undergoing UGI surgery.

The aim of this study was to examine the effect of early oral feeding in patients who have undergone surgical intervention for upper GI tumors.

Patients and Methods

A propensity score-matching study was conducted at the Department of Surgery at the University of Pécs between January 2020 and December 2023. The study protocol was approved by the Hungarian Scientific and Research Ethics Committee of the Medical Research Council (registration number: BM/3049/2023). The procedures followed were in accordance with the ethical standards of the Helsinki Declaration of the World Medical Association. This method was chosen, as it is considered to be superior over a simple retrospective study because it assesses the effectiveness of certain treatments and improves the comparability of the intervention and control groups. The study included patients with upper GI cancer surgery with esophageal anastomosis, who were enrolled in the early postoperative feeding (EOF) protocol and were compared to a control group (late oral feeding, LOF), who were on a "nil per os" feeding method for 5-7 days postoperatively. We performed minimally invasive techniques in approximately equal proportions in both groups. The majority of patients in both groups received detailed information about the importance of physical and dietetic prehabilitation before the surgery and were referred to specialists for this reason. Additionally, all members of these groups received special carbohydrate-loading supplements in the 24 hours before the surgery (Preop, Nutricia Danone, Nutricia Limited, London, UK).

In case of a swallowing complaint early oral feeding was suspended: further examinations, such as a swallow test, were performed, and oral feeding was resumed only after negative results were obtained. In the traditional feeding group oral feeding was delayed up to 5-7 days after the operation.

The protocol of early postoperative feeding was as follows: 1st day: per os 2 dl water + parenteral nutrition (2,000 kcal, 95 g protein). 2nd day: per os 5 dl water, nutritional starter (700 kcal, 29 g protein) + parenteral feeding (1,300 kcal, 58 g protein). 3rd day: nutritional starter, yoghurt, soup (2,000 kcal, 11 g protein). From the 4th day: soft diet.

Results

In our study 72 patients were enrolled, 36 in the EOF group and 36 case-matched patients in the traditional oral feeding group. The median age in the EOF group was 60.6 years (range=21-79 years). The start of the oral feeding was on the 1.94th (average) postoperative day in the EOF, and on the 5.72nd (average) day in the LOF group.

Table I. Patient demographics and postoperative data.

	EOF	LOF	p-Value
Gastric cancer	25	25	
Esophageal cancer	11	11	
Median age	60.6	60.5	
Male	27	29	
Female	9	7	
Postop.first oral intake (day)	1.94	5.72	0.00000001
Postop. emission (days)	8.53	12.03	0.0008
First bowel movement (day)	4.19	5.56	0.0127
Last i.v. fluid therapy (days)	4.89	8.65	0.000013

EOF: Early oral feeding protocol; LOF: late oral feeding.

Table II. Comparison of the study groups with respect to the complications.

Morbidity	EOF	LOF	p-Value
Anastomosis insufficiency	4*	2	0.39
Anastomosis inflammation	1	0	0.314
Anastomosis stricture	1	1	1
Pneumonia	4	3	0.69
Hydrothorax	3	3	1
Reoperation	2	3	0.64
Seroma	1	1	1
ARDS	0	1	0.32
Atelectasia	0	1	0.314
Fever	1	3	0.303
Dysphagia	0	1	0.314
Death	2	2	1

EOF: Early oral feeding protocol; LOF: late oral feeding. *Out of the four patients with anastomosis insufficiency, one had subclinical anastomotic insufficiency, and the other had a previous unsuccessful reconstruction at another institution; a repeat reconstruction was performed at our institution.

The median postoperative hospital stay was 8.53 days in the EOF group and 12.03 days in the LOF ($p>0.05$, $t=-3.3004$). Statistically significant decreases were observed in the time until the first bowel movement (4.19 days in the EOF group vs. 5.56 days in the LOF group, $p>0.05$, $t=-2.2818$), length of postoperative intravenous fluid therapy (4.89 days in the EOF group vs. 8.65 days in the LOF group, $p>0.05$, $t=-4.64$) (Table I).

There were no significant differences in mortality ($p>0.05$), anastomosis insufficiency ($p>0.05$), anastomosis inflammation ($p>0.05$), anastomosis stricture ($p>0.05$), seroma formation ($p>0.05$), atelectasis ($p>0.05$) or ARDS ($p>0.05$) (Table II).

Discussion

Nutrition is a cardinal factor in the recovery and healing process after cancer resections. Therefore, it is important to recognize the presence of malnutrition before the operation, as it can have a significant impact on the surgical outcome. Malnutrition can affect a person's ability to tolerate surgery and anesthesia and can increase the risk of complications, such as infections and poor wound healing. In addition, surgery inflicts a significant amount of metabolic stress on the body, and appropriate nutrition can improve the body's healing process, the function of the immune system, and curtail the risk of complications. After a surgical procedure, the body requires more nutrients than usual to repair tissue and to restore organ function (6).

In the past, oral intake was forbidden for 5-7 days after UGI resections to aid healing, but this led to nutritional deficiencies and complications like muscle loss and infections. Total parenteral nutrition, providing essential nutrients intravenously, became popular in the 1970s and 1980s. However, due to complications, such as liver dysfunction, infections, and metabolic disturbances, it became an option mainly for patients unable to tolerate enteral feeding (7-9).

Early enteral nutrition emerged in the 1990s and gained popularity in the early 2000s, promoting early feeding after UGI surgery. Initially, feeding tubes were placed in the stomach, but concerns about aspiration led to the use of post-pyloric feeding with nasojejunal or jejunostomy tubes, which reduced the risk by feeding directly into the jejunum (10).

In the recent years, the implementation of Enhanced Recovery After Surgery (ERAS) protocols has had a significant impact on GI surgery and it has significantly influenced postoperative feeding techniques. This complex bundle of care was designed for the early recovery of patients after major surgery (11, 12).

ERAS is a multimodal approach to perioperative care that aims to optimize patient outcomes by reducing complications and speeding up recovery. It focuses on various aspects of the perioperative period, including nutrition, to alleviate surgical stress and maintain physiological functions. Established in 2003 in Stockholm, the ERAS Study Group developed protocols to improve care quality and patient quality of life (13). Studies have shown that the use of ERAS protocols can lead to less pain, fewer complications, faster recovery, shorter hospital stays, improved immune function, quality of life and mortality outcomes (14, 15).

According to ERAS guidelines, early oral feeding is generally recommended but should be individualized to each patient's needs. The use of ERAS is widespread in patients with colorectal cancer but less so in patients with UGI cancer, where traditional methods delay oral feeding for 5-7 days or more. In UGI surgery, ERAS protocols include preoperative counseling, minimally invasive surgery, early oral feeding, multimodal pain management, and early mobilization (12).

A multicenter meta-analysis of six studies with 454 patients who underwent gastrectomy for cancer found no significant differences in postoperative complications, oral tolerability, hospital readmissions, or anastomosis insufficiency. However, a shorter hospital stay and time to first flatus were observed. These results were confirmed in our study (16).

In 2022, He *et al.* analyzed data from 1,087 patients with gastric cancer undergoing surgery across nine studies. They found that early oral feeding reduced hospital stay and costs without increasing postoperative complications or feeding intolerance, similar to our findings (17). Other relevant literature data also highlight the safety and cost-effectiveness of EOF as a preferred approach in UGI surgery (18-20). Our research was initiated to validate this statement, further underscoring the safety of EOF as a preferred approach in UGI surgery.

In our view, another crucial aspect is saliva production, which ranges from 0.5 to 1.5 liters per day in adults, varying based on age, diet, hydration, medications, and health. Proper hydration supports healthy saliva production, preventing thick saliva that complicates swallowing and speech. Thick saliva may also contain more active proteins compared to thinner saliva (21).

This daily saliva production information is pertinent when considering early postoperative feeding. Swallowing saliva after UGI surgery is inevitable and generally does not cause complications. This underpins the hypothesis that if swallowing saliva poses no issues, then minimal oral fluid intake might not lead to anastomotic insufficiency.

We also introduced prehabilitation by referring the patients to a dietitian and a physiotherapist, and were provided with dietary supplements, and received oral carbohydrate-loading before surgery. Another important factor that could contribute to faster patient recovery is the application of minimal invasive procedures, which lead to a shorter hospital stay, as well as faster recovery. Their benefits over traditional open surgery, including less postoperative pain, quicker recovery, reduced blood loss, and reduced risk of complications made them popular in the recent years. Although minimally invasive esophagectomy is well supported by evidence, minimally invasive total gastrectomy is still undergoing trials to prove its benefits and safety (22-26).

Despite the application of the above-mentioned techniques and procedures, the postoperative period after UGI surgery is still associated with a high morbidity and mortality rate, therefore the proper nutritional support became an essential aspect of postoperative care (27, 28).

In our view, early oral feeding is one of the most important components of the ERAS protocol, and our study confirmed that early oral feeding is highly beneficial after UGI surgery. In our study, the average start of oral feeding was on the 1.94th postoperative day in the EOF group, compared to the 5.72nd day in the LOF group. The median postoperative hospital stay was 8.53 days in the EOF group and 12.03 days in the LOF

group. Statistically significant decreases were observed in the time until the first bowel movement (4.19 days in the EOF group vs. 5.56 days in the LOF group) and in the length of postoperative intravenous fluid therapy (4.89 days in the EOF group vs. 8.65 days in the LOF group). There were no significant differences in mortality, anastomosis insufficiency, anastomosis inflammation, anastomosis stricture, seroma formation, atelectasis, or ARDS. In conclusion, our results are consistent with experiences reported worldwide.

Study limitations. The study was not randomized and had a relatively small sample size. Further multicenter studies with larger cohorts and long-term follow-ups are required to confirm the safety and efficiency of an EOF protocol in patients after UGI surgery.

Conclusion

As a summary, early oral nutrition favorably influences the recovery of patients after UGI surgery. It is also a very important observation that the mortality rate and anastomosis insufficiency rate do not increase compared to the traditional protocol. The earlier recovery of the patients shortens the length of their hospital stay and contributes to their quality of life, and well-being.

In conclusion, while the present study has confirmed the positive effects of EOF, we believe that multiple, large-scale, prospective randomized studies are needed to generalize the protocol of early oral feeding after UGI surgeries.

Conflicts of Interest

The Authors have no conflicts of interest to declare in relation to this study.

Authors' Contributions

Csenge Papp M.D. conducted examinations, wrote the manuscript, and collected data. Dóra Lili Sindler M.D. conducted examinations. András Palkovics M.D. PhD. edited the manuscript. Balázs Németh M.D. PhD. edited the manuscript. Armad Csonotos M.D. processed the test documentation, prepared tables, edited the manuscript. Zoltán Sándor M.D. edited the manuscript. András Vereczkei M.D., PhD, DSc conducted the investigation. András Papp M.D., PhD. developed the hypothesis, conducted the investigation.

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