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ORIGINAL ARTICLE

Implementation of Enhanced Recovery after Surgery Guidelines in Colorectal Operations in Tehran Hospitals, Iran

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ABSTRACT

Background: Enhanced Recovery after Surgery (ERAS) protocols are designed to improve perioperative care and postoperative recovery; however, implementation varies across hospitals. Data on ERAS use in colorectal surgery in Tehran hospitals are limited. This study evaluated ERAS implementation in colorectal surgery, focusing on nutrition, surgery, and anesthesia-related components.

Methods: This observational cross-sectional study was conducted in Tehran hospitals from June 2024 to February 2025. Patients undergoing colorectal surgery were included. Using a questionnaire based on the latest ERAS protocols, designated hospital staff assessed protocol implementation from admission to discharge. Completed questionnaires were included in the final analysis.

Results: Low anterior resection (LAR) was the most frequent procedure (25.5%), while abdominoperineal resection (APR) was the least common method. Significant differences were observed between public and private hospitals in 9 of 24 items including patient introduction to ERAS protocols (74.2%), admission timing (74.3%), preadmission counseling (100% private), regional anesthesia use (0% private), preferred analgesia route (74.8%), initiation of oral fluids (100% private), oral diet (100% private), early mobilization (100% private), and urinary catheter removal timing (73.6%). The remaining 15 items showed no significant differences. Eight ERAS elements, including fasting duration modification, carbohydrate loading, preoperative pain control, intrathecal analgesia, gum chewing, intraoperative temperature monitoring, chronic pain prevention, and ileus prevention, were absent in all hospitals.

Conclusion: This study provided a comprehensive evaluation of ERAS protocol implementation in colorectal surgeries in Tehran, revealing substantial gaps. Disparities between public and private sectors highlight the need for targeted interventions to improve adherence.

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Introduction

Colorectal cancer is one of the most common malignancies worldwide and remains a major public health problem (1). According to recent global estimates, colorectal cancer was the third most commonly diagnosed cancer and the second leading cause of cancer-related death worldwide in 2022 (2). Its incidence has been increasing in many regions, particularly in Asia, partly because of population aging, lifestyle changes, dietary patterns, obesity, physical inactivity, and improved detection through screening programs (2-4). The treatment of colorectal cancer depends on tumor location, disease stage, molecular characteristics, and the patient's general condition (5). Current treatment strategies may include surgery, chemotherapy, radiotherapy, targeted therapy, and immunotherapy, either alone or as part of a multimodal treatment plan (6-8).

Despite advances in oncological and perioperative management, surgical resection remains the mainstay of treatment for localized colorectal cancer and is also an important component of treatment in selected patients with advanced disease (6, 7, 9). However, colorectal surgery is associated with considerable postoperative morbidity, with reported complication rates of approximately 20-30%, leading to prolonged hospital stay, increased healthcare costs, delayed recovery, and reduced quality of life (10-12). To reduce postoperative complications and improve surgical outcomes, the Enhanced Recovery after Surgery (ERAS) concept was developed as a multimodal, evidence-based perioperative care pathway (13).

ERAS protocols include several coordinated preoperative, intraoperative, and postoperative interventions, such as preoperative counseling, optimization of nutrition, avoidance of prolonged fasting, carbohydrate loading, standardized anesthesia and analgesia, prevention of nausea and vomiting, optimal fluid management, early oral feeding, early mobilization, and early removal of tubes and catheters (13-15). These components require close collaboration among surgeons, anesthesiologists, nutritionists, nurses, and other healthcare professionals. In colorectal surgery, ERAS guidelines have been shown to improve physiological recovery, accelerate return of bowel function, decrease postoperative complications, shorten hospital stay, and reduce healthcare costs without increasing readmission rates (14, 16, 17). Recent guidelines continue to emphasize ERAS as a standard approach for improving perioperative care in colorectal cancer surgery (14, 18).

Despite the established benefits of ERAS, its implementation remains variable across hospitals and countries. Introducing new evidence-based clinical pathways into routine practice can be challenging because it requires multidisciplinary coordination, institutional support, staff training, auditing, and adaptation to local resources. Therefore, before designing interventional programs, it is important to assess the current status of ERAS implementation and identify gaps between recommended guidelines and actual clinical practice. Such baseline evaluation can help hospitals recognize areas requiring improvement and provide a foundation for future quality-improvement interventions (13, 14, 18).

No reports have been published regarding the implementation of ERAS guidelines in colorectal surgery in private and public hospitals in Middle Eastern countries or low- and middle-income countries. In Iran, where colorectal surgery represents an important part of surgical oncology practice, knowledge regarding the current level of ERAS implementation remains limited. Moreover, the exact extent to which hospitals follow ERAS components in nutrition, surgery, and anesthesia is unclear. So the aim of this study was to determine the utilization of ERAS guidelines in colorectal surgery and to evaluate the variation in implementation of common ERAS components among hospitals in Tehran, Iran.

Materials and Methods

This observational cross-sectional study was conducted from June 2024 to February 2025 in 6 hospitals, including three public and three private ones, in Tehran, Iran, in accordance with the principles of the Declaration of Helsinki. The protocol was reviewed and approved by the Institutional Review Board and Ethics Committee of Tehran University of Medical Sciences, Tehran, Iran, with the institutional ethical approval code of IR.TUMS.IKHC.REC.1401.115. The included patients were those who underwent various colorectal surgeries during the study period. The study aimed to collect information about the implementation of ERAS guidelines.

A questionnaire was used to collect the information, and it was completed by the project colleagues. The questionnaire was developed based on the latest ERAS protocols in colorectal surgery as described before (14, 19).

According to global ERAS protocols, the implementation of these guidelines starts from the patient's admission to the hospital and continues until the day of discharge (14, 19). In this study, the designated individuals, including the surgeon, anesthesiologist, and nutritionist of each hospital,

reviewed the implementation or non-implementation of the relevant protocols in their respective specialties. They assessed the protocols from the time the patient was admitted to the colorectal surgery department until the time of discharge, and provided the necessary information in the prepared questionnaire. The exclusion criteria were patient transfer to the intensive care unit (ICU), and unavailability of required information in the questionnaire. Once the questionnaires were completed, data were collected in each hospital according to the determined sample size.

The sample size was calculated according to the type of study (20). The study estimated the number of colorectal surgeries performed in the past year in the six participating hospitals (3 private and 3 public hospitals) as Sina: 152, Firuzgar: 152, Imam Khomeini: 300, Jam: 100, Bahman: 255, and Kasra: 205. In total, 1164 surgeries were performed across these six hospitals in the past year. The coefficient of 0.28 was obtained by dividing 326 by 1164. This coefficient was then multiplied by the number of surgeries in each hospital to determine the sample size for that hospital within 6 months. For example, the sample size for Sina Hospital was determined to be 42, Firuzgar 43, Imam Khomeini 84, Jam 28, Bahman 70, and Kasra 59.

The statistical analysis of the data was performed using SPSS software (Version 24, Chicago, IL, USA). Categorical variables, including hospital type, type of colorectal surgery, and responses to ERAS-related questionnaire items, were reported as frequencies and percentages. Comparisons between public and private hospitals were performed using the Chi-Square test. Fisher's exact test was applied when the expected cell counts were small. A *p* value less than 0.05 was considered statistically significant.

Results

Responses were obtained from 6 hospitals [Public: 169 (51.8%) and private: 157 (48.2%)]. Responses in 8 types of colorectal surgeries (right hemicolectomy (RHC), left hemicolectomy (LHC), sigmoid colectomy, very low anterior resection (VLAR), low anterior resection (LAR), abdomino-perineal resection (APR), and total proctocolectomy (TC)) were evaluated during 6 months. During this period, the highest rate of surgery was LAR with 25.5% and the lowest rate was APR (Table 1).

From the 24 questions of the questionnaire, a significant difference was seen in 9 questions of "is the ERAS protocol introduced to the patients in your hospital?" [242 (74.2%)]; "When are patients usually admitted to your hospital before surgery?" (74.3% B+C); "Is preadmission counseling performed?" [Private: 157 (100%)]; "Is regional anesthesia used?" [Private: 0 (100%)]; "What is the preferred route of analgesia following colorectal surgery?" (74.8% C); "When do you start oral liquid intake"? (Private: 100% B); "When do you start oral food intake?" (Private: B+D); "When do patients start walking after colorectal surgery?" [Private: A (100%)]; "When is the urinary catheter removed following colorectal surgery?" [103 (73.6%) B] based on the type of public and private hospital.

No significant difference was seen in the rest of the questions. Of the remaining 15 of the ERAS protocols, 8 of protocols were not performed in any hospital that included the duration of fasting, carbohydrate loading, preoperative pain control, intrathecal injection for analgesia, chewing gum, checking the temperature during surgery, taking medication to prevent chronic pain, and specific measures to prevent ileus. Seven ERAS protocols that included assessment the nutrition status, antibiotic prophylaxis, DVT prophylaxis, antiemetic prophylaxis, bowel preparation, general anesthesia, and intraoperative fluid management were implemented and there was no significant difference between private and public hospitals (Tables 2-5).

In this study, we investigated the implementation of ERAS protocols in both private and public hospitals for the first time in Iran, and we reached three categories of results. The first one was elements that had significantly different implementation rates between these two types of hospitals. The second category consisted of elements that were not implemented in any hospital. The third category involved elements that were implemented in both types of hospitals and showed no significant differences. We further elaborated on these findings.

Table 1: Characteristics of the study population.

Type of Hospital/Type of Surgery	No. (%)
Public hospital	169 (51.8)
Private hospital	157 (48.2)
Total	326 (100)
APR	5 (1.5)
LAR	83 (25.5)
LHC	34 (10.4)
RHC	50 (15.3)
Sigmo	70 (21.5)
VLAR	61 (18.7)
TC	23 (7.1)
Total	326 (100)

APR: Abdominoperineal resection; LAR: Low anterior resection; LHC: Left hemicolectomy; RHC: Right hemicolectomy; Sigmo: Sigmoidectomy; VLAR: Very low anterior resection; TC: Total colectomy. Data were presented as no. (%).

Table 2: Implementation of preoperative ERAS protocol for colorectal surgery.

Question	Answer /Type of hospital				*P* value
	A Public/private	B Public/private	C Public/private	D Public/private	
	No. (%)				
Q1	242 (74.2) 85/157	-	84 (25.8) 84	-	0.01
Q2	-	202 (62) 70/132	40 (12.3) 15/25	84 (25.8) 84	0.01
Q3	242 (74.2) 85/157	-	84 (25.8) 84	-	0.01
Q4	326 (100) 169/157	-	-	-	-
Q5	-	326 (100) 169/157	-	-	-
Q6	-	326 (100) 169/157	-	-	-
Q7	300 (92) 159/141	26 (8) 10/16	-	-	0.15
Q8	326 (100)	-	-	-	-
Q9	326 (100) 169/157	-	-	-	-

ERAS: Enhanced Recovery after Surgery, Q: Question.

Table 3: Implementation of intraoperative ERAS protocol for colorectal surgery.

Question	Answer /Type of hospital				*P* value
	A Public/private	B Public/private	C Public/private	D Public/private	
	No. (%)				
Q10	-	326 (100) 169/157	-	-	-
Q11	326 (100) 169/157	-	-	-	-
Q12	-	242 (74.2) 85/157	84 (25.8) 84	-	0.01
Q13	326 (100) 169/157	-	-	-	-
Q14	326 (100) 169/157	-	-	-	-
Q15	-	326 (100) 169/157	-	-	-
Q22	-	326 (100) 169/157	-	-	-

ERAS: Enhanced Recovery after Surgery, Q: Question.

The elements that had significantly different implementation rates between these two types of hospitals were determined. In private hospitals, patients were admitted either 24 hours before surgeries or on the morning of the day of operations. For 25.8% of patients in public hospitals, the admission time before the operation was unspecified. Preadmission counseling (A preoperative discussion of milestones and discharge criteria typically took place with the patient before surgery. This included ileostomy education and counseling on dehydration avoidance) was available for all patients in private hospitals, whereas about half of the patients in public hospitals had unclear responses to this question.

Regional anesthesia was entirely unused in private hospitals. Among all patients, 74.8% followed a combination route of analgesia (intramuscular and intravenous) after the operation, with the majority in private hospitals opting for this approach. After any colorectal surgery, patients in private hospitals began fluid intake 12 hours after being admitted to the ward. In contrast, 84 patients in public hospitals started receiving fluids 48 hours afterward admission. The start time for solid food was unspecified for 48

Table 4: Implementation of postoperative ERAS protocol for colorectal surgery.

Question	Answer /Type of hospital				*P* value
	A Public/private	B Public/private	C Public/private	D Public/private	
	No. (%)				
Q16	82 (25.2) 30/52	-	244 (74.8) 139/105	-	0.01
Q17	-	242 (74.2) 85/157	-	84 (25.8) 84	0.01
Q18	-	119 (36.5) 43/76	84 (25.8) 84	123 (37.7) 42/81	0.01
Q19	-	326 (100) 169/157	-	-	-
Q20	242 (74.2) 85/157	84 (25.8) 84	-	-	0.01
Q21	40 (12.3) 15/25	240 (73.6) 137/103	46 (14.1) 17/29	-	0.01
Q23	-	326 (100) 169/157	-	-	-
Q24	-	-	-	326 (100) 169/157	-

ERAS: Enhanced Recovery after Surgery, Q: Question.

Table 5: Implementation of ERAS protocol in our study.

ERAS component	Complete	Not complete	Not done
Preoperative	Assessment the nutrition status/Antibiotic prophylaxis/ DVT prophylaxis/Antiemetic prophylaxis/Bowel preparation	Preadmission counseling	Duration of fasting/ Carbohydrate loading/ Preoperative pain control
Intraoperative	General anesthesia/ Intraoperative fluid management	Regional anesthesia	Intrathecal injection for analgesia/Checking the temperature during surgery
Postoperative	-	Oral liquid intake oral food intake/Walking after colorectal surgery/Urinary catheter removed	Chewing gum/Specific measures to prevent ileus/ Taking medication to prevent chronic pain
Total	7 components	6 components	8 components

ERAS: Enhanced Recovery after Surgery.

hours for 84 patients in public hospitals, 24 hours for 76 patients in private hospitals, and the time of initiation after the operation was unclear for 81 patients. All patients in private hospitals commenced walking in the evening following the operation, whereas 84 patients in public hospitals began walking the day after their operations. In private hospitals, the catheter was removed for the majority of individuals the day after surgery, with 14.1% of patients experiencing removal 48 hours post-surgery. There were elements that were not implemented in any hospital. Eight protocols were not performed in any hospital that included the duration of fasting, carbohydrate loading, preoperative pain control, intrathecal injection for analgesia, chewing gum, checking the temperature during surgery, taking medication to prevent chronic pain, and specific measures to prevent ileus.

Discussion

The colorectal ERAS protocol includes preoperative, intraoperative, and postoperative components such as patient education, nutritional assessment and support, bowel preparation, carbohydrate loading, shortened fasting, thromboprophylaxis, antibiotic prophylaxis, standard anesthesia, nausea and vomiting prevention, laparoscopic surgery, fluid management, hypothermia prevention, wound care, analgesia, glucose control, early mobilization, oral intake, and nutritional supplementation (21-23). ERAS is a multimodal approach, and no single component alone can accelerate recovery. A meta-analysis by Azhar *et al.* showed that ERAS significantly reduced time to bowel movement, hospital stay, ambulation, and first fluid intake compared with traditional care in colorectal surgery (24).

However, implementing new medical methods is

slow and challenging (25). Although the first large ERAS implementation program in the Netherlands reduced hospital stay after colon resection from 9 to 6 days, later follow-ups showed increased length of stay due to reduced compliance, mainly from insufficient training, auditing, and feedback (21). Therefore, collecting pre-ERAS baseline data is essential before implementing ERAS programs. Previous studies revealed limited and variable ERAS implementation. Pujic *et al.* reported that ERAS protocols were formally used in only 24% of Serbian hospitals performing cesarean sections (26). Jeo *et al.* found that greater adherence to ERAS components in colorectal surgery was associated with shorter hospital stay (27). A 2023 systematic review of 337 studies from 39 countries demonstrated similar numbers of implemented ERAS elements between high-income and low- and middle-income countries, but hospital stay was shorter in high-income settings, indicating substantial variation in ERAS outcomes across healthcare systems (28).

The differences in our findings underscore the impact of hospital type on protocol adherence, emphasizing the need for tailored strategies to standardize practices across various healthcare settings. This prompts essential questions about the root causes of these differences and the barriers that may impede the comprehensive adoption of ERAS protocols in clinical practice. The disparity between recommended ERAS practices and their actual implementation leads to inquiries about the factors contributing to these obstacles. Potential barriers may include institutional resources, staff training, and systemic challenges in healthcare environments. Overcrowding in our public hospitals, prolonged patient queues, the shortage of functional diagnostic and treatment tools, and insufficient medical staff relative to patient numbers are significant hurdles obstructing the implementation of these protocols. Identifying and addressing these potential obstacles can offer crucial insights into the barriers that need to be overcome to promote more comprehensive adherence to the protocol.

There were elements that were not implemented in any hospital. It can be said that general resistance to change, lack of time, insufficient manpower, and weaknesses in communication, collaboration, and coordination between departments are among the reasons for the non-implementation of these protocols. For example, the reason for not implementing a 2-hour fasting period for liquids and an 8-hour fasting period for solids before surgery was the fear of aspirating patients. Or, for example, due to financial problems, the drug Alvimopan was not available in our country, and there was still strong resistance to initiating a regular regimen after surgery to reduce the incidence of ileus in our country.

It seems that the lack of approved national guidelines for implementing these ERAS protocols may be among the reasons for their non-implementation. The availability of local research and evidence supporting the effectiveness and safety of ERAS protocols can influence their acceptance. In LMICs where limited local research on ERAS outcomes existed or where evidence seemed insufficient, there may be doubts regarding the implementation of the protocols (2, 3). Of course, the acceptance of ERAS protocols is a gradual process that requires collaboration among healthcare providers, policymakers, and hospital managers. Efforts to address the mentioned obstacles, along with enhancing education, increasing awareness, and securing necessary resources, can facilitate the widespread implementation of ERAS protocols (29).

Acquaintance and training of treatment team would be very effective in implementing these protocols. For example, Agdgomelashvili and colleagues in 2021 in an observational study examined the impact of ERAS protocols on postoperative outcomes compared to traditional protocols in 87 patients undergoing colorectal surgery. Initially, all team members, including surgeons, anesthesiologists, and nurses, underwent two months of training in the principles of the ERAS guidelines, followed by the active implementation process. The 87 patients requiring colorectal surgery were actively treated according to the ERAS protocol and were placed in the experimental group. At the same time, they began retrospectively collecting data on selected colorectal surgical cases from the past two years and examined them based on preoperative, intraoperative, postoperative pain, and various complications. The study group showed a significant reduction in hospital stay days, with an average of 5 days. In comparison with the traditional care group, the occurrences of respiratory complications, postoperative nausea and vomiting (PONV: 6.9%), postoperative ileus (5.7%), deep venous thrombosis (0%), urinary retention (0%), readmission rate (0%), and surgical site infection (3.4%) were lower (29).

The elements that were implemented in both types of hospitals and showed no significant differences were determined in our study. Seven ERAS protocols that included assessment the nutrition status, antibiotic prophylaxis, DVT prophylaxis, antiemetic prophylaxis, bowel preparation, general anesthesia, and intraoperative fluid management were implemented and there was no significant difference between private and

public hospitals. These indicated a level of global acceptance and integration of the specific protocols, which highlighted the potential areas of success in standardizing some aspects of ERAS guidelines. It may also be due to previous studies conducted in Iran on these protocols (30, 31). Examining the successful implementation of these specific ERAS protocols in public and private hospitals can provide valuable lessons for implementing other elements. This may include discussions on best practices, success factors, and potential strategies for extending this level of compatibility to other areas of protocol implementation (32, 33).

There were some limitations in our study. This study was limited to referral hospitals in Tehran, which may restrict generalizability to other provinces. We assessed ERAS implementation but did not evaluate postoperative outcomes/complications or analyze results by surgery type and hospital characteristics. Future multicenter studies across Iran should link ERAS adherence to clinical outcomes.

Conclusion

ERAS implementation in Tehran hospitals was shown to be incomplete and variable. Developing nationally adapted ERAS guidelines with multidisciplinary training, strong management support, and audit-and-feedback systems are needed to improve adherence and postoperative recovery in colorectal surgery.

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Authors' Contribution

RH: Conception, design, data curation, writing original draft preparation, analysis and interpretation of data, drafting the manuscript, and visualization. HAA: Conception, design and data curation. JR: Data acquisition and management. BB: Conception and design. MA: Conception and design. RKH: Conception, design, analysis and interpretation of data, and revising manuscript for intellectual content.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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