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Modified ERAS protocol and length of stay in obstructive colorectal cancer: A study at Saiful Anwar general hospital, Malang

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Abstract
Enhanced Recovery After Surgery (ERAS) protocols have been widely applied in elective colorectal procedures, demonstrating reductions in complications and hospital length of stay (LOS). However, application in emergency settings such as obstructive colorectal cancer (OCRC) is still underexplored. This retrospective analytical observational study examined the correlation between modified ERAS protocol implementation and LOS in OCRC patients at Saiful Anwar General Hospital, Malang, between January 2022 and January 2024. A total of 45 patients undergoing emergency colorectal resection surgery were categorized based on ERAS adherence. Data were analyzed using Spearman correlation and independent t-test. A significant negative correlation was observed between ERAS adherence and LOS ($r = -0.304$; $p = 0.042$), particularly in postoperative components ($r = -0.389$; $p = 0.009$). The mean LOS for patients undergoing resection with anastomosis was 7.83 ± 4.53 days, while those with stoma had 7.30 ± 3.63 days ($p = 0.751$). These results support the potential benefit of applying ERAS in emergency colorectal cancer surgeries to enhance recovery and optimize hospital resources even with different surgical procedures.

Keywords: Enhanced Recovery After Surgery (ERAS), obstructive colorectal cancer, length of stay, emergency surgery, modified protocol

Introduction
Colorectal cancer (CRC) is a significant contributor to cancer-related morbidity worldwide. In Indonesia, it ranks fourth among the most common malignancies (Makhlouf *et al*., 2021) [1]. Obstruction is the most frequent emergency presentation in CRC, accounting for 8-10% of cases (Kemenkes RI, 2019) [2]. Emergency colorectal surgeries carry increased risks of complications and prolonged hospitalization due to the acute physiological stress response (Oodit *et al*., 2018) [3].

The ERAS protocol, developed to mitigate surgical stress, has been shown to improve recovery in elective colorectal surgeries (Smith *et al*., 2020) [4]. Modifications for emergency settings have been proposed (Lohsiriwat & Jitmungngan, 2019) [5], but data on their effectiveness, especially in Indonesia, remain limited. This study explores the implementation of modified ERAS in OCRC and its association with LOS at Saiful Anwar General Hospital, Malang.

Methods
This retrospective observational analytical study was conducted at Saiful Anwar General Hospital, Malang. Data were collected from January 2022 to January 2024 from 45 patients who underwent resection emergency surgery for obstructive colorectal cancer. ERAS adherence was evaluated using a 15-component checklist **(**Figure 1) and categorized into adherence (Full adherence) and non-adherence groups (Partial adherence). Statistical analysis included descriptive statistics, Spearman correlation test to assess the relationship between ERAS adherence and LOS, and independent t-test to evaluate differences in LOS between surgical methods. A p-value of <0.05 was considered statistically significant.

Study Population and Sampling
The study population consisted of all patients diagnosed with obstructive colorectal cancer who underwent emergency laparotomy with tumor resection during the study period.

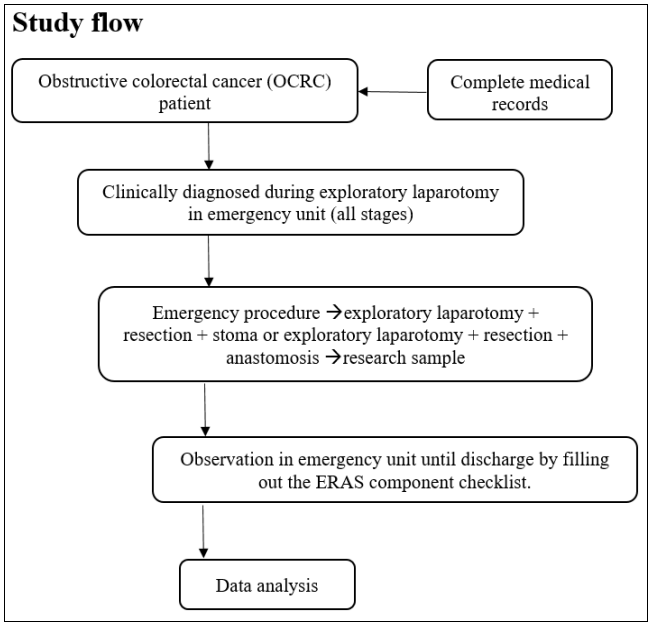

Chart 1: The study flow

Inclusion criteria

1. Adults and elderly patients with obstructive colorectal cancer who required emergency surgery.
2. Patients diagnosed clinically in the emergency unit and underwent exploratory laparotomy with resection (either with stoma or anastomosis).
3. Surgery was performed within 24 hours of emergency admission.
4. Patients who received modified ERAS interventions either completely or partially.
5. Complete medical records

Exclusion criteria

1. Patients with colorectal cancer and clinical peritonitis.
2. Patients with a history of other malignancies.
3. Patients who received neoadjuvant therapy.
4. Recurrent colorectal cancer cases.
5. Patients who did not undergo tumor resection.
6. Patients who died before discharge.
7. Patients with administrative discharge delays (non-clinical prolongation of LOS).

Sampling used consecutive sampling to include all eligible patients meeting inclusion criteria during the study period.

ERAS item	Recommendation
Preoperative phase	
Education and detailed counseling	Patients should routinely receive concise and practical preoperative education including stoma counseling
Medical optimization	Preoperative risk stratification and "targeted" optimization of general conditions are recommended
Glycemic control	Perioperative blood glucose should be maintained between 140 and 180 mg/dL
Intraoperative phase	
Use of epidural analgesia	Thoracic epidural analgesia may be used in patients with stable hemodynamic and no bleeding tendency
GDFT	GDFT may be beneficial in patients with high-predicted postoperative mortality
Prevention of hypothermia	All measures should be done to prevent or reverse intraoperative hypothermia
PONV	A multimodal prophylaxis of PONV should be used in all patients based on their risk factors for PONV
Minimally invasive surgery	Laparoscopy may be performed in selected patients by experienced surgeons
Avoidance of intraperitoneal drains	Intraabdominal and pelvic drains should not be used routinely
Postoperative phase	
Multimodal analgesia	Opioid-sparing multimodal analgesia should be tailored to the individual and the operation involved
Early removal of NGT	NGT can be removed safely on postoperative day 1-2 unless paralytic ileus is evident
Early feeding	Oral intake can resume in stabilized patients and should progress moderately if patients can tolerate
Early removal of urinary catheter	Urinary catheter can be removed safely on postoperative day 1-2
Breathing and coughing exercise	Patients are encouraged to have sessions of deep breathing and coughing exercise postoperatively
Early mobilization	Patients are encouraged to have early independent mobilization as a part of physiotherapy and rehabilitation program

ERAS: Enhanced recovery after surgery; GDFT: Goal-directed fluid therapy; PONV: Postoperative nausea and vomiting; NGT: Nasogastric tube.

Fig 1: Modified ERAS Protocol and Recommendation (Lohsiwirat, V and Jitmungngan R, 2019) [14]

Each patient was given a checklist. If a component was fulfilled, it was marked "Yes" (score = 1); if not fulfilled, it was marked "No" (score = 0). The maximum possible score per patient was 15. Patients were categorized as: Adherent: Score = 15 (100% adherence), Non-adherent: Score < 15.

Data Collection Procedure

1. Medical records were reviewed for each patient from emergency admission to discharge.
2. ERAS component adherence was evaluated using a standardized checklist.
3. Demographic data (age, sex), tumor location, type of surgery, and length of stay (LOS) were recorded.
4. LOS was defined as the number of days from ER admission to hospital discharge.

Results

Table 1: Patient Demographics by Age

Age Group	Number of Patients
21-30 years	5
31-40 years	5
41-50 years	6
51-60 years	10
61-70 years	12
71-80 years	5
81-90 years	2
Rate±SD	54.53±16.31

Table 2: Patient Characteristics (Gender, Tumor Location, Surgery Type, ERAS Adherence)

Characteristic	N	%
Male	23	51.11
Female	22	48.89
Caecum	9	20
Ascenden	8	17.78
Transversum	12	26.67
Descenden	14	31.11
Sigmoid	1	2.22
Rectosigmoid	1	2.22
Stoma	39	86.67
End to End Anastomosis	6	13.33
Full Adherence	6	13.33
Non-Adherence	39	86.67

The majority of patients were aged 60 years and above. The youngest patient in this research sample was found at 20 years old while the oldest was found at 81 years old. The subjects of this study had an average age and SD of 54.53±16.31 years.

This Table 2 shows, almost equal distribution between males (51.11%) and females (48.89%). Most lesions were found in the descending colon (31.11%), followed by the transverse colon (26.67%). Rare locations included sigmoid and recto sigmoid regions. Stoma creation was the dominant procedure (86.67%), compared to primary anastomosis (13.33%), due to emergency settings. Only 13.33% of patients had full (100%) adherence to the ERAS protocol, while the majority (86.67%) had partial adherence.

Table 3: Percentage of Modified ERAS Component Adherence

ERAS Component Phase	Adherent (%)	Non-Adherent (%)
Preoperative	92.59	7.41
Intraoperative	92.96	7.04
Postoperative	81.48	18.52

This table 3 categorizes ERAS adherence into three phases: Preoperative phase: 92.59% adherence. Intraoperative phase: 92.96% adherence. Postoperative phase: 81.48% adherence. The postoperative phase had the lowest compliance, suggesting more challenges in executing recovery measures such as multimodal pain control, early feeding, catheter removal, and mobilization after surgery.

Table 4: Correlation between ERAS Adherence and Length of Stay

Variable	R	P
ERAS Adherence	-0.304	0.042

This table 4 shows a significant inverse correlation between total ERAS adherence and length of hospital stay (r=-0.304, P=0.042). This means that higher adherence to ERAS protocol was associated with a shorter hospitalization period for colorectal cancer patients undergoing emergency surgery.

Table 5: Correlation between ERAS component phases and length of stay

ERAS Component	R	P
Preoperative	-0.08	0.6
Intraoperative	0.208	0.171
Postoperative	-0.389	0.009

Spearman's analysis for each ERAS phase revealed: Pre-operative: r=-0.080, P=0.600 → not significant. Intra-operative: r=0.208, P=0.171 → not significant. Post-operative: r=-0.389, P=0.009 → statistically significant inverse correlation. This confirms that only the postoperative ERAS components (e.g., early feeding, mobilization) were significantly related to shorter hospital stay.

Table 6: Comparison of length of stay based on surgery type

Group	Mean Los (Days)	P-Value
End to End Anastomosis (EEA)	7.83±4.53	
Stoma	7.30±3.63	0.751

This table compares LOS between two surgery types: End-to-End Anastomosis (EEA): 7.83±4.53 days. Stoma creation: 7.30±3.63 days. The difference was not statistically significant (P=0.751), suggesting that surgical method did not affect LOS when ERAS protocols were applied consistently.

Discussion

This study found that most patients with obstructive colorectal cancer treated at Saiful Anwar General Hospital were over the age of 50, with a mean age of 54.5 years. This aligns with global trends showing increased colorectal cancer incidence after age 50 (Brunicardi, 2019; Jorjani *et al*., 2024) [7, 13]. Nonetheless, a considerable portion of the patients (37.78%) were under 50 years old, with the youngest being 20 years old. This supports recent projections indicating a growing number of younger patients (ages 2049) will be diagnosed with colorectal cancer in the coming decade (Agung *et al*., 2021; Kemenkes RI, 2019; Makhlouf *et al*., 2021) [6, 1, 2].

Regarding sex distribution, this study observed an equal number of male and female patients, differing from previous literature which showed a higher incidence in men (Roshandel *et al*., 2024) [13]. The equal gender distribution may be due to the relatively small sample size or the specific demographics of the hospitals patient population.

The most common tumor location was the descending colon (31.11%), consistent with prior findings that obstructive lesions are more frequently found on the left side of the colon (Shida *et al*., 2019; Shang *et al*., 2018) [10, 11]. Left-sided tumors, especially in the descending colon, sigmoid, and rectum, are more likely to cause luminal narrowing and obstruction. This is supported by previous reports from the same hospital showing similar patterns over the 2010-2015 period (Sasmitahe & Mustika, 2017; Varut Lohsiriwat, 2019) [14].

The implementation of the modified ERAS protocol in this study showed a high level of adherence in both the preoperative (92.59%) and intraoperative (92.96%) phases. However, postoperative adherence was lower (81.48%). The reduced compliance in the postoperative phase was mainly due to

delayed urinary catheter removal and mobilization, often because patients were returned to the high care unit post-surgery. Prolonged catheterization and delayed mobilization can contribute to prolonged hospital stays and higher complication rates (Dimitrov, 2021) [12].

This study demonstrated a statistically significant negative correlation between total ERAS adherence and hospital length of stay ($r = 0.304$, $p = 0.042$). Among ERAS phases, only the postoperative phase showed a significant correlation with reduced length of stay ($r = 0.389$, $p = 0.009$). This highlights the critical role of postoperative interventions such as multimodal analgesia, early enteral nutrition, catheter removal, and early mobilization in expediting recovery and discharge.

This study did not find a significant difference in hospital stay between patients undergoing resection with anastomosis and those with a stoma ($p = 0.751$), suggesting that surgical method did not affect LOS when ERAS protocols were applied consistently. Previous literature did not report consistent differences in length of stay between these groups when ERAS protocols were applied (Lohsiriwat *et al*., 2020; Lazar *et al*., 2024) [14, 15].

External studies support these findings. Lazar *et al*. (2024) [15] reported that emergency colorectal cancer patients in Romania who followed ERAS protocols had a mean hospital stay of 7.4 days versus 10.8 days in non-ERAS patients. Similarly, Lohsiriwat *et al*. (2020) [14] found that ERAS implementation reduced hospital stay by approximately three days compared to conventional care, along with lower postoperative complication rates. Another study by Wisely *et al*. (2016) [16] in Australia confirmed that ERAS significantly reduced complications such as urinary tract infections and pulmonary infections during the postoperative period, although mortality and readmission rates remained unchanged.

Overall, these findings strengthen the evidence that modified ERAS protocols especially focused on postoperative care—are feasible and effective in emergency settings such as obstructive colorectal cancer. Multimodal pain control, early feeding, and early mobilization are essential components in accelerating recovery, minimizing complications, and reducing healthcare costs.

Study Limitation

First, the study did not explore the factors influencing adherence to the implementation of modified ERAS components in cases of obstructive colorectal cancer. As a result, it provides limited insight into potential barriers that may affect its application. Second, the study did not analyze the long-term impacts of implementing the modified ERAS protocol, such as patient survival rates, postoperative quality of life, or cost-effectiveness of care. Therefore, it is difficult to comprehensively assess the programs benefits for patients with this condition. Finally, this study was limited to a single center, making it difficult to draw general conclusions that could be applied across various hospitals. A multicenter study would be needed to better compare the effectiveness of modified ERAS implementation in different contexts and resource settings.

Conclusion

This study concluded that patients with obstructive colorectal cancer at Dr. Saiful Anwar General Hospital Malang had an average age of 54 years, with a balanced distribution of male and female patients. The most frequent tumor location was in the descending colon, and most patients belonged to the group that did not fully adhere to the modified ERAS protocol. The overall adherence to ERAS components was high in the preoperative (92.59%) and intraoperative (92.96%) phases, while the postoperative phase showed lower adherence (81.48%). A statistically significant inverse correlation was found between total ERAS adherence and length of hospital stay, indicating that greater adherence led to shorter recovery time. Among the ERAS components, only the postoperative phase demonstrated a significant correlation with reduced hospitalization duration. Furthermore, there was no statistically significant difference in length of stay between patients who underwent resection with end-to-end anastomosis and those who underwent resection with stoma formation.

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