



The 2024 Korean Enhanced Recovery After Surgery (ERAS) guidelines for colorectal cancer: a secondary publication

Kil-yong Lee¹ , Soo Young Lee² , Miyoung Choi³ , Moonjin Kim⁴ , Ji Hong Kim⁵ , Ju Myung Song⁴ ,
Seung Yoon Yang⁵ , In Jun Yang⁶ , Moon Suk Choi⁷ , Seung Rim Han⁸ , Eon Chul Han⁹ ,
Sang Hyun Hong¹⁰ , Do Joong Park^{11,12} , Sang-Jae Park¹³ ; the Korean Enhanced Recovery After Surgery (ERAS) Committee within the Korean Society of Surgical Metabolism and Nutrition

¹Department of Surgery, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Uijeongbu, Korea

²Department of Surgery, Chonnam National University Hwasun Hospital, Chonnam National University Medical School, Hwasun, Korea

³National Evidence-based Healthcare Collaborating Agency, Seoul, Korea

⁴Department of Surgery, Incheon St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Incheon, Korea

⁵Department of Surgery, Yonsei University College of Medicine, Seoul, Korea

⁶Department of Surgery, Chungnam National University Hospital, Daejeon, Korea

⁷Department of Surgery, Inha University Hospital, Inha University School of Medicine, Incheon, Korea

⁸Ain Hospital, Incheon, Korea

⁹Department of Surgery, Dongnam Institute of Radiological and Medical Sciences, Busan, Korea

¹⁰Department of Anesthesiology and Pain Medicine, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea

¹¹Department of Surgery, Seoul National University Hospital, Seoul National University College of Medicine, Seoul, Korea

¹²Seoul National University Cancer Research Institute, Seoul, Korea

¹³Center for Liver and Pancreatobiliary Cancer, National Cancer Center Hospital, Goyang, Korea

The Korean Enhanced Recovery After Surgery (ERAS) Committee within the Korean Society of Surgical Metabolism and Nutrition was established to develop ERAS guidelines tailored to the Korean context. This guideline focuses on creating the most current evidence-based practice guidelines for ERAS purposes, based on systematic reviews. All key questions targeted randomized controlled trials exclusively, and if fewer than 2 were available, studies employing propensity score matching were also included. Recommendations for each key question were marked with strength of recommendation and level of evidence following internal and external review processes by the committee.

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Correspondence to: Soo Young Lee, MD, PhD

Department of Surgery, Chonnam National University Hwasun Hospital, Chonnam National University Medical School, 322 Seoyang-ro, Hwasun 58128, Korea

Email: syleecrs@gmail.com

Co-correspondence to: Sang-Jae Park, MD, PhD

Center for Liver and Pancreatobiliary Cancer, National Cancer Center, 323 Ilsan-ro, Ilsandong-gu, Goyang 10408, Korea

Email: spark@ncc.re.kr

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INTRODUCTION

With advancements in minimal invasive surgery for colorectal cancer, rapid postoperative recovery and reintegration into daily life have become essential aspects. Although existing Enhanced Recovery After Surgery (ERAS) guidelines are available [1, 2], there is a growing need to develop ERAS guidelines that are appropriate for Korean healthcare context. Consequently, the Korean Society of Surgical Metabolism and Nutrition has established an ERAS committee to formulate evidence-based practice guidelines. The primary objective is to assist frontline physicians treating colorectal cancer by providing evidence-based recommendations with clear levels of evidence and benefits for the application of ERAS protocols in postoperative recovery. This aims to facilitate safer and more effective clinical decision-making. Furthermore, it seeks to enhance the understanding of policymakers and patients desiring treatment.

METHODS

The guidelines were developed using a *de novo* approach. The systematic review conducted for the development followed the methodology proposed by the Cochrane Collaboration [3]. The assessment of the quality of evidence and the determination of the strength of recommendations were based on the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) methodology [4]. To enhance applicability within the Korean context, supplementary local studies were identified and incorporated.

Formulating key questions

The committee examined existing ERAS guidelines [1, 2] to identify pivotal yet debatable issues needing evidence. After thorough discussions, they prioritized and finalized 13 key questions (KQs).

Literature search

The literature search was conducted by deriving primary search terms through discussions between the methodology expert and the development committee members responsible for each KQ, and search strategies were established using MEDLINE (PubMed). The databases utilized were MEDLINE, Embase, Cochrane, and KoreaMed. Studies were collected without restrictions on publication year or language to ensure comprehensiveness, reproducibility, and homogeneity through a consistent approach for all KQs. The search was performed on August 15, 2023. At least 3 individuals, including the methodology

expert, the committee member responsible for each KQ, and the committee chair, participated in all stages of the search process to eliminate subjective judgment. The finalized search strategies are included in [Supplementary Material 1](#).

Selection of literature

The process of selecting evidence was carried out by assigning at least 2 reviewers to each KQ, ensuring no overlap, and reported following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram ([Supplementary Fig. 1](#)) [5]. Inclusion and exclusion criteria for each KQ were formulated and applied using the PICOS (population, intervention, comparison, outcomes, study design) framework. All KQs targeted randomized controlled trials (RCTs) exclusively, and if fewer than 2 were available, studies employing propensity score matching were also included.

Assessment of risk of bias

The quality assessment of the literature was conducted separately according to individual study designs (RCTs, Cochrane risk-of-bias tool for randomized trials [RoB 2] [6]; nonrandomized studies, ROBINS-I [risk of bias in nonrandomized studies of intervention] [7]). The quality assessment of literature was independently performed by the designated committee member for each KQ, and any discrepancies in assessment results were resolved through consensus among the committee members ([Supplementary Fig. 2](#)).

Summation of estimates (meta-analysis)

Meta-analysis was conducted if there was no unexplained heterogeneity and multiple outcomes were available. Duplicate study results were managed by selecting the most recent or largest sample size. A fixed-effect model was used, and both statistical (I^2 statistic) and clinical heterogeneity were evaluated. The analysis covered all relevant outcomes of the intervention.

Level of evidence

The assessment of the level of evidence followed the grading criteria provided by the GRADE Working Group ([Table 1](#)). Each level of evidence was assigned based on outcome measures, and when randomized and nonrandomized studies provided evidence for the same outcome measure, the level of evidence from randomized studies was used as the reference value. The assigned level of evidence for recommendations was based on the level of evidence for the most critical primary outcome associated with each recommendation.

Strength of recommendation

The members for each KQ developed a preliminary recommendation and recommendation grade based on the level of evidence, considering various strengths and limitations of the evidence, the balance between benefits and harms, the size of benefits and harms, patient values and preferences, barriers for implementation by healthcare providers, financial considerations, and applicability within the specific healthcare institution. The strength of recommendation was defined based on evidence, evaluating the balance of benefits and harms for each intervention through the committee's blind voting process (Table 2).

Recommendation consensus

The draft recommendations underwent evaluation through a blind vote if participation from at least 70% of all internal committee members was achieved. Eleven members of the internal committee within the development committee participated in the recommendation grading process. If individual items received over 70% approval in the vote, with over 70% in favor, the committee considered it a consensus decision. If fewer than 70% of the votes were in favor, the development committee members considered amendments, and a second vote was conducted.

External expert review

The selection of relevant experts was conducted to evaluate the content of the guidelines for the purpose of enhancing their quality. A total of 18 individuals were selected, recommended through the Korean Society of Coloproctology (KSCP), from among colorectal surgeons specializing in primary to tertiary hospital, who had experience conducting systematic reviews or had experience in developing other clinical guidelines. These individuals were surveyed for their opinions on the pros and cons of the recommendations and the validity of outcome indicators related to benefits and harms.

Guideline update plan

The guidelines are planned to be revised on a 3-year cycle, with the addition of new recommendations or modifications and enhancements to existing recommendations when high-quality evidence regarding new diagnostic methods, medications, or treatments is reported. The revision process for the guidelines follows the principles of new development, applying the same methods as those used in the original guideline development. However, for subsequently developed recommendations, evidence searching will be conducted only for newly added evidence after August 15, 2023.

Table 1. Level of evidence

Level	Definition
High	Evidence from a well-conducted RCT/meta-analysis with low risk of bias in study design and conduct, or from an observational study with no bias in study design or conduct and an effect size rated as very large.
Moderate	Evidence derived from RCT or meta-analysis with bias in study design and conduct, or from an observational study without bias in study design or conduct and a large effect size.
Low	Evidence resulting from RCT or meta-analysis with biases reported in 2 or more aspects of study design and conduct, or from an observational study without biases in study design and conduct.
Very low	Evidence from observational studies, case reports, or inadequately conducted observational studies with biases in study design and conduct.

RCT, randomized controlled trial.

Table 2. The definition of the strength of recommendation

Strength of recommendation	Strength	Direction	Definition
Strong recommendation	Strong	For	When the benefits of treatment or testing clearly outweigh the associated risks, burdens, and costs
Conditional recommendation	Conditional	For	When the benefits of treatment or testing potentially exceed the associated risks, burdens, and costs but remain uncertain
Conditional against	Conditional	Against	When the risks, burdens, and costs of treatment or testing potentially exceed the benefits but remain uncertain
Strong against	Strong	Against	When the risks, burdens, and costs of treatment or testing clearly outweigh the benefits

RESULTS

Recommendation	Strength	Level of evidence
KQ 1. Is prehabilitation effective for patients scheduled for elective surgery for colorectal cancer? Prehabilitation is recommended for patients scheduled to undergo surgery for colorectal cancer.	Conditional for	Moderate
KQ 2. Is preoperative oral nutritional supplement effective for patients scheduled for elective surgery for colorectal cancer? Preoperative nutritional support using oral nutritional supplements is recommended for patients scheduled for colorectal cancer surgery.	Conditional for	Moderate
KQ 3. What are the appropriate methods to prevent postoperative nausea and vomiting in patients scheduled for elective surgery for colorectal cancer? The use of dexamethasone in combination with a serotonin receptor antagonist rather than monotherapy is recommended for the prevention of postoperative nausea and vomiting in patients scheduled for colorectal cancer surgery.	Strong for	High
KQ 4. Is the use of oral antibiotics in combination with mechanical bowel preparation effective for patients scheduled for elective colorectal cancer surgery? The use of oral antibiotics in conjunction with mechanical bowel preparation is recommended for patients scheduled for colorectal cancer surgery.	Conditional for	High
KQ 5. Is preoperative oral carbohydrate loading effective for patients scheduled for elective colorectal cancer surgery? Oral carbohydrate loading up to 2 hours before colorectal cancer surgery is recommended.	Conditional for	Moderate
KQ 6. Is goal-directed fluid therapy beneficial during elective surgery for colorectal cancer? Goal-directed fluid therapy during surgery may be considered for high-risk patients undergoing colorectal cancer surgery.	Conditional for	Moderate
KQ 7. Is the insertion of an intra-abdominal drain necessary during elective surgery for colorectal cancer? It is suggested not to insert an intra-abdominal drain during surgery for colorectal cancer.	Conditional against	Moderate
KQ 8. During elective surgery for colorectal cancer, does the insertion of a nasogastric tube aid in the patient's recovery? It is suggested not to insert a nasogastric tube during surgery for colorectal cancer.	Conditional against	Low
KQ 9. Is transverse abdominis plane block effective for postoperative pain control following elective surgery for colorectal cancer? Transverse abdominis plane block may be considered for pain control during surgery for colorectal cancer.	Conditional for	Moderate
KQ 10. Is thromboprophylaxis necessary for patients scheduled for elective surgery for colorectal cancer? Preoperative pharmacologic thromboprophylaxis is recommended for patients scheduled for colorectal cancer surgery.	Conditional for	Moderate
KQ 11. How long should urinary catheters be maintained after elective surgery for colorectal cancer? It is recommended to remove urinary catheters the day after colorectal cancer surgery.	Conditional for	Moderate
KQ 12. Is early feeding effective following elective surgery for colorectal cancer? Early feeding is recommended to start from the day after surgery for colorectal cancer.	Conditional for	Moderate
KQ 13. Is early ambulation effective following elective surgery for colorectal cancer? Early ambulation is recommended to commence on the day after surgery for colorectal cancer.	Conditional for	Moderate

KQ 1. Is prehabilitation effective for patients scheduled for elective surgery for colorectal cancer?**Population (P):** Adult colorectal cancer patients undergoing elective surgery**Intervention (I):** Implementation of preoperative prehabilitation**Comparison (C):** Non-implementation of preoperative prehabilitation**Outcomes (O):** Complication rate, readmission rate, length of hospital stay, mortality rate**Recommendation 1.**

Prehabilitation is recommended for patients scheduled to undergo surgery for colorectal cancer.

*Strength of the recommendation: Conditional for**Level of evidence: Moderate*

Prehabilitation primarily consists of increasing physical activity, improving nutritional status, and stabilizing mental well-being. Prehabilitation through exercise consists of aerobic/anaerobic exercise sessions, lasting approximately 1 hour, 3 to 4 times per week over a period of 3 to 6 weeks. Prehabilitation has been shown to improve postoperative outcomes by enhancing baseline physical condition and mental functional capacity prior to surgery. The incidence rate of postoperative complications (Clavien-Dindo classification grades I, II) was assessed after analyzing a total of 9 studies [8–16]. Among the analyzed studies, several demonstrated significant differences between the 2 groups, indicating that patients who underwent preoperative prehabilitation had a statistically significant reduction in postoperative complication rates (Clavien-Dindo classification grades I, II) compared to those who did not undergo prehabilitation (odds ratio [OR], 0.70; 95% confidence interval [CI], 0.51 to 0.97) (Supplementary Fig. 3A). However, no significant differences were observed between the 2 groups in terms of postoperative complications (Clavien-Dindo classification grades $\geq$ III), length of hospital stay, readmission rate, and mortality (Supplement Fig. 3B–F).

However, reflecting the situation in Korea, although there may be variations between institutions, it is generally assumed that if surgery for colorectal cancer is typically performed within 3 weeks of diagnosis, preoperative rehabilitation may not be feasible. Additionally, as previously mentioned, if patients prefer to undergo surgery shortly after diagnosis, the implementation of prehabilitation may be challenging. Furthermore, as described above, the introduction of comprehensive prehabilitation requires resources from various fields, including exercise, but it should be considered that it may not be feasible for all medical institutions to provide these resources within limited means.

Recommendation consensus meeting results

Ninety percent of the attending members (9 of 10) endorsed the proposal. However, there were discussions on whether it is appropriate to allocate limited resources to prehabilitation, the practical feasibility of implementing several weeks of prehabilitation within the context of Korea, and which patient groups should be conditionally recommended for prehabilitation.

External expert review results

The external experts' opinions on the recommendation strength of the guideline revealed a relatively lower agreement rate (7–9 points) of 72% (13 of 18). However, there was a high level of concordance (17 of 18, 94%) for the response of "conditional for" regarding the appropriate recommendation level. Consequently, the committee confirmed the recommendation level as "conditional for" without dissent.

KQ 2. Is preoperative oral nutritional supplement effective for patients scheduled for elective surgery for colorectal cancer?**Population (P):** Adult colorectal cancer patients undergoing elective surgery**Intervention (I):** Preoperative oral nutritional supplementation therapy**Comparison (C):** Standard preoperative diet**Outcomes (O):** Postoperative complication rate, total length of hospital stay, mortality rate**Recommendation 2.**

Preoperative nutritional support using oral nutritional supplements is recommended for patients scheduled for colorectal cancer surgery.

*Strength of the recommendation: Conditional for**Level of evidence: Moderate*

It is well established that patients at nutritional risk have a higher incidence of postoperative complications and prolonged hospital stays [17, 18]. Specifically, in colorectal cancer, symptoms such as loss of appetite, diarrhea, and bowel obstruction can increase the vulnerability of patients to malnutrition [18]. Consequently, perioperative nutritional supplementation is essential for appropriate recovery in these patients. In cases where adequate nutritional intake through oral consumption is challenging, the use of oral nutritional supplements prior to surgery is recommended. Immunonutrition, which includes arginine, ω -3 fatty acids, nucleotides, and high concentrations of protein, is preferred [19].

The meta-analysis of postoperative complications encompassed a total of 8 studies [20–27]. While 6 studies did not demonstrate significant differences between the intervention and

control groups [21, 22, 24–27], some reported that preoperative oral nutritional supplementation reduced postoperative complications [20, 23]. Furthermore, the results revealed a significant association between preoperative oral nutritional supplementation and decreased postoperative complications (OR, 0.74; 95% CI, 0.55 to 0.98) (Supplementary Fig. 4A). Analysis regarding the length of hospital stay included 5 studies with results on this outcome [21, 24–27]. While Xu et al. [27] demonstrated a significant association between the intervention and control groups in terms of hospital stay, a meta-analysis of the 5 studies did not confirm this significance (mean difference [MD], –0.30; 95% CI, –0.95 to 0.36) (Supplementary Fig. 4B). Regarding mortality, no patients were reported to have died within 30 days postoperatively in any of the 8 included studies.

Recommendation consensus meeting results

Ninety percent of the attending members (9 of 10) supported the proposal. The final recommendation was subsequently decided without dissent through consensus.

External expert review results

Seventy-two percent of the external experts (17 of 18) endorsed the recommendation strength and direction of the guideline, with scores ranging from 7 to 9. Additionally, 94% (17 of 18) responded with "conditional for" to the question regarding the appropriate recommendation strength. Consequently, the committee confirmed the recommendation strength as "conditional for" without dissent.

KQ 3. What are the appropriate methods to prevent postoperative nausea and vomiting in patients scheduled for elective surgery for colorectal cancer?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Serotonin receptor antagonist (5-HT₃ antagonist) and dexamethasone combination therapy

Comparison (C): Serotonin receptor antagonist monotherapy

Outcomes (O): Nausea and vomiting incidence within 24 hours postoperatively, adverse effects

Recommendation 3.

The use of dexamethasone in combination with a serotonin receptor antagonist rather than monotherapy is recommended for the prevention of postoperative nausea and vomiting in patients scheduled for colorectal cancer surgery.

*Strength of the recommendation: Strong for
Level of evidence: High*

most common postoperative complications, causing patient dissatisfaction and discomfort. These symptoms can also lead to increased healthcare costs, prolonged hospital stays, or unexpected readmissions [28–31]. Given the complexity and diversity of antiemetic therapies for PONV, a comprehensive review of all available methods poses practical limitations. Thus, our committee has decided to establish a key question and systematically review the efficacy of steroid combination therapy with serotonin receptor antagonists (5-HT₃ antagonists), which are among the most widely used and evidence-supported options, to enhance PONV prevention.

Meta-analysis of 7 studies investigating early PONV within 6 hours revealed that the combination of a serotonin receptor antagonist and dexamethasone significantly lowered the incidence compared to other treatments (OR, 0.48; 95% CI, 0.31 to 0.76) (Supplementary Fig. 5A) [32–38]. Additionally, a meta-analysis of 14 studies examining PONV within 24 hours showed that the combination therapy had a significantly lower incidence rate compared to serotonin receptor antagonist monotherapy (OR, 0.43; 95% CI, 0.33 to 0.56) (Supplementary Fig. 5B) [33, 35, 36, 38–48].

Common side effects of serotonin receptor antagonists and dexamethasone include headache, dizziness, fatigue, diarrhea, and pruritus. However, the most frequently reported side effects in the majority of studies were headache and dizziness. A meta-analysis of 4 studies reporting overall side effects found no significant difference between combination therapy and monotherapy (OR, 0.93; 95% CI, 0.60 to 1.44) (Supplementary Fig. 5C) [33, 35, 41, 46]. Additionally, meta-analyses of 6 studies specifically analyzing headache (OR, 1.00; 95% CI, 0.55 to 1.82) and dizziness (OR, 0.77; 95% CI, 0.38 to 1.57) also showed no significant differences between combination therapy and monotherapy (Supplementary Fig. 5D, E) [33, 35, 41, 43, 46, 47].

The committee conducted a review of commonly used pharmacological agents and their clinical outcomes, in addition to those specified in the KQs. A summary of the types and doses of various agents used for the prevention of PONV is presented in Supplementary Table 1. Among neurokinin-1 (NK-1) receptor antagonists, aprepitant, which is available domestically, shows comparable efficacy in preventing postoperative vomiting with an oral dose of 40 mg to intravenous palonosetron of 0.075 mg [49]. Dexamethasone monotherapy has also been used for several years and is well-known for its effectiveness in PONV prevention. It is generally recommended in doses ranging from 4 to 10 mg, although recent reports have highlighted the efficacy of 8 mg or higher [50–52]. Among antidopaminergic

Postoperative nausea and vomiting (PONV) are among the

gic agents, droperidol and haloperidol have shown efficacy in preventing PONV; however, there is a concern regarding QT interval prolongation [28]. Metoclopramide, at doses of 25 and 50 mg, is also effective in PONV prevention but carries a risk of extrapyramidal symptoms as a side effect. Additionally, there are reports on the antiemetic efficacy of anticholinergic agents [53], and various combination therapies, as addressed in this study.

Recommendation consensus meeting results

Ninety-one percent of the attending members (10 of 11) supported the recommendation strength and direction for the use of a combination of serotonin receptor antagonists and dexamethasone to prevent nausea and vomiting after elective colorectal surgery. Although there were concerns about a strong recommendation level, the committee reached consensus that the high level of evidence and the clear benefits of nausea and vomiting prevention provided by the combination therapy outweighed any minor side effects, thus justifying a strong recommendation.

External expert review results

The proportion of external experts who supported the recommendation strength for this key question was 61% (11 of 18), which is relatively low. When asked about the appropriate recommendation strength, 50% (9 of 18) favored a strong recommendation, while a significant number of experts chose "conditional for" (5 of 18, 28%) or "conditional against" (4 of 18, 22%). As mentioned, there are various methods for preventing nausea and vomiting. This guideline does not mandate the use of a combination of serotonin receptor antagonists and dexamethasone but rather strongly recommends the combination therapy over serotonin receptor antagonists alone. The choice of method for preventing nausea and vomiting should be at the discretion of the clinician, and various alternatives are detailed. After the discussion, the committee reached a consensus that a "strong recommendation" was appropriate and confirmed it as the final recommendation.

KQ 4. Is the use of oral antibiotics in combination with mechanical bowel preparation effective for patients scheduled for elective colorectal cancer surgery?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Preoperative mechanical bowel preparation with oral antibiotic administration

Comparison (C): Preoperative mechanical bowel preparation

Outcomes (O): Surgical site infection, readmission rate

Recommendation 4.

The use of oral antibiotics in conjunction with mechanical bowel preparation is recommended for patients scheduled for colorectal cancer surgery.

*Strength of the recommendation: Conditional for
Level of evidence: High*

Regarding bowel preparation methods to reduce surgical site infections (SSIs), previous guideline suggested that mechanical bowel preparation (MBP) provided no clinical benefit and thus was not recommended for colorectal cancer surgeries [54]. However, recent network meta-analyses investigating the optimal combination of MBP and oral antibiotic prophylaxis (OAP) have reported that combining MBP with OAP is more effective in reducing SSIs than using either method alone [55, 56]. Based on these findings, we determined that there is sufficient evidence to support the combined use of both MBP and OAP. To further elucidate its benefits, a systematic review was conducted to compare the effectiveness of this combined approach with MBP alone.

The incidence of SSIs was analyzed across 8 studies [57–64]. Several studies demonstrated significant differences between the groups, showing that the combination of preoperative MBP and oral antibiotic administration significantly reduced the incidence of SSIs compared to MBP alone (OR, 0.51; 95% CI, 0.39 to 0.66) (Supplementary Fig. 6A). However, there were no significant differences between the groups concerning organ-space SSIs [57–63], including anastomotic leaks (Supplementary Fig. 6B), or the readmission rate within 30 days (Supplementary Fig. 6C) [57–60].

Recommendation consensus meeting results

Ninety percent of the attending members (9 of 10) supported the recommendation strength and direction for this key question. There were concerns about whether recommending MBP and oral antibiotics for both colon and rectal cancer might be excessive, considering the resources required and patient discomfort. However, after reviewing the current evidence, it was determined that the benefits clearly outweigh the risks. Therefore, it was

agreed to recommend the approach with a “conditional for” recommendation strength.

External expert review results

Sixty-one percent of the external experts (11 of 18) supported the recommendation strength (scoring 7–9 points), with 6 experts providing a score of 6. Most experts (17 of 18, 94%) provided scores of 6 or higher. When asked about the appropriate recommendation strength, 72% (13 of 18) selected “conditional for.” Consequently, the committee integrated the results from the consensus meeting with the external experts' opinions and confirmed “conditional for” as the final recommendation strength.

KQ 5. Is preoperative oral carbohydrate loading effective for patients scheduled for elective colorectal cancer surgery?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Oral carbohydrate preparation (administered up to 2 hours before surgery)

Comparison (C): Fasting (or placebo)

Outcomes (O): Complication rate, time to bowel motility recovery, length of hospital stay

Recommendation 5.

Oral carbohydrate loading up to 2 hours before colorectal cancer surgery is recommended.

Strength of the recommendation: Conditional for

Level of evidence: Moderate

The stress associated with surgery can induce peripheral insulin resistance, leading to hyperglycemia, which may increase the risk of postoperative complications and delay recovery [65]. Therefore, it can be hypothesized that preoperative oral carbohydrate loading may reduce insulin resistance and thereby decrease postoperative complications. The incidence of postoperative complications was assessed in 7 studies [66–72]. Most studies reported no significant differences between the groups, and meta-analysis also failed to demonstrate a significant correlation between preoperative oral carbohydrate supplementation and the incidence of postoperative complications (OR, 0.77; 95% CI, 0.49 to 1.19) (Supplementary Fig. 7A). Similarly, there were no significant differences between the groups in terms of individual complications such as surgical site infection [66–69, 71, 72] and prolonged postoperative ileus [66–72]. However, the time to first flatus was significantly shorter in the oral carbohydrate group (MD, –0.52; 95% CI, –0.76 to –0.28) [66, 69–71, 73], and the length of hospital stay was also shorter in the oral carbohydrate group (MD, –1.03; 95% CI, –1.39 to –0.68) (Supplementary Fig. 7B–E) [67–71, 74, 75].

Preoperative fasting induces psychological stress in patients, and reducing the duration of fasting as much as possible has been shown to be effective for patients' psychological well-being in several studies [76]. Rizvanović et al. [74] reported that the intake of oral carbohydrate solutions before colorectal surgery positively affects patients' subjective feelings.

Recommendation consensus meeting results

Ninety-one percent of the attending members (10 of 11) supported the recommendation strength and direction for prescribing oral carbohydrate supplements in elective colorectal surgery. While there were concerns that intake might be restricted in patients with bowel obstruction, it was agreed by the majority that since the guideline is limited to elective surgery, there would likely be few patients unable to take oral carbohydrate supplements due to bowel obstruction.

External expert review results

Eighty-nine percent (16 of 18) of the external experts provided a support score of 7 or higher for a “conditional for” recommendation. Additionally, 67% (12 of 18) of the external experts endorsed the recommendation strength as “conditional for.” Although 4 external experts (22%) suggested that a “strong recommendation” might be more appropriate, the consensus was that a strong recommendation would be unsuitable due to potential difficulties in taking oral carbohydrate supplements for patients with diabetes or bowel obstruction. Consequently, the development committee confirmed “conditional for” as the final recommendation strength.

KQ 6. Is goal-directed fluid therapy beneficial during elective surgery for colorectal cancer?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Goal-directed fluid therapy

Comparison (C): Conventional fluid management

Outcomes (O): Complication rate, surgical site infection, anastomotic leak, postoperative ileus, length of hospital stay, mortality rate

Recommendation 6.

Goal-directed fluid therapy during surgery may be considered for high-risk patients undergoing colorectal cancer surgery.

Strength of the recommendation: Conditional for

Level of evidence: Moderate

In relation to the ERAS protocol, restrictive fluid therapy or zero-balance fluid management has been introduced and widely

studied to prevent weight gain due to postoperative fluid retention [1]. This approach can accelerate the recovery of gastrointestinal motility post-surgery and potentially reduce the length of hospital stay. However, excessive restriction of fluids requires caution as it may lead to acute kidney dysfunction [1, 77].

Goal-directed fluid therapy (GDFT) refers to the adjustment of fluid administration based on the monitoring of various hemodynamic parameters [78]. There is no standardized criterion for what to target in GDFT, but it commonly involves the monitoring of cardiac output and stroke volume using transesophageal echocardiography, central venous pressure via a central venous catheter, and stroke volume variation through arterial waveform analysis. Additionally, various bioimpedance analyses are employed. The group receiving GDFT demonstrated a trend toward a lower incidence of overall postoperative complications compared to the control group, though this did not reach statistical significance (OR, 0.78; 95% CI, 0.60 to 1.01) (Supplementary Fig. 8A) [79–88]. However, the incidence of SSIs was significantly reduced in the GDFT group (OR, 0.54; 95% CI, 0.30 to 0.97) (Supplementary Fig. 8B) [79, 85, 86, 88–90]. There were no significant differences between the groups concerning the frequency of anastomotic leaks (Supplementary Fig. 8C) [79, 82, 85–91], prolonged postoperative ileus (Supplementary Fig. 8D) [79, 82, 84–86, 88, 90], or mortality within postoperative 30 days (Supplementary Fig. 8E) [79–82, 84, 85, 87, 88, 90–92]. Importantly, the length of hospital stay was significantly shorter in the GDFT group (MD, –0.30; 95% CI, –0.45 to –0.14) (Supplementary Fig. 8F) [79–91, 93].

According to previous studies, GDFT has been reported to be effective in high-risk patients [1, 78]. A previous meta-analysis of patients undergoing abdominal surgery reported no benefit from implementing GDFT for all patients [94]. Specifically, with the application of the ERAS protocol, preoperative fasting and MBP are minimized, thereby reducing preoperative fluid deficit to a minimum, suggesting that zero-balance fluid management may be sufficient. Therefore, it is essential to select and apply GDFT to high-risk patients. While the definition of high-risk varies, it generally includes patients with severe cardiopulmonary disease, patients over 70 years old with poor general health, and surgeries expected to last longer than 8 hours [1]. By applying GDFT to high-risk patients in medical institutions equipped with monitoring devices, a faster recovery for patients can be achieved.

As stated above, this recommendation is limited to high-risk patients. In actual clinical practice, performing medical procedures such as transesophageal echocardiography for GDFT in non-high-risk patients would lead to a waste of medical resources and should be avoided. For non-high-risk patients, zero-balance fluid therapy (administration of 1–4 mL/kg/hr of crystalloid solu-

tion excluding blood loss) as described in other guidelines is considered sufficient [1, 2].

Recommendation consensus meeting results

The recommendation strength and direction for the use of GDFT during colorectal surgery were unanimously supported by all attending members (11 of 11). However, it was emphasized that GDFT should be selectively applied only to high-risk patients, as its benefits do not extend to all patients. Consequently, the guideline specifies that GDFT should be considered only for high-risk patients.

External expert review results

In the external review conducted by the 18 external experts, 89% of the reviewers (16 of 18) provided a support score of 7 or higher for a “conditional for” recommendation. Additionally, 89% of the reviewers (16 of 18) endorsed the same recommendation strength as “conditional for,” indicating overall support for the recommendation. The final review by the development committee also confirmed this decision without dissent.

KQ 7. Is the insertion of intra-abdominal drain necessary during elective surgery for colorectal cancer?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Insertion of a drainage tube during surgery

Comparison (C): No insertion of a drainage tube during surgery

Outcomes (O): Complication rate, anastomotic leak, postoperative pelvic inflammation and sepsis, bowel obstruction, reoperation rate

Recommendation 7.

It is suggested not to insert an intra-abdominal drain during surgery for colorectal cancer.

Strength of the recommendation: Conditional against

Level of evidence: Moderate

Prophylactic drainage is believed to have several benefits [95]: (1) it can reduce the incidence of anastomotic leakage by removing blood and serous fluids, which, if infected, may cause abscess formation and potentially lead to the abscess rupturing into the anastomosis [96]; (2) it helps in mitigating the severity of such complications by allowing for earlier detection [97]; and (3) it aids in identifying intraperitoneal bleeding [96]. However, surgeons who argue against the use of drainage suggest the following: (1) it might actually promote the production of serous fluid [98]; (2) it could introduce infections from external sources [99, 100]; (3) it might increase the risk of leakage by hindering the movement of the omentum and nearby organs, which otherwise help seal the

anastomotic site [99, 101], or by causing leaks through mechanical erosion of the anastomosis [102]; and (4) it is typically enclosed quickly by the body [103].

The meta-analysis revealed that drain placement did not significantly impact the overall complication rates across the studies analyzed (OR, 0.86; 95% CI, 0.62 to 1.19) (Supplementary Fig. 9A) [95, 104–107]. There was no significant difference in the incidence of anastomotic leakage associated with drain placement (OR, 0.93; 95% CI, 0.69 to 1.24) (Supplementary Fig. 9B) [95, 104–108]. Additionally, no significant differences were observed between the groups regarding the incidence of pelvic fluid collection and sepsis (OR, 0.96; 95% CI, 0.7 to 1.33) [95, 104, 106–108], intestinal obstruction (OR, 0.66; 95% CI, 0.42 to 1.05) [95, 104, 106, 108], or the reoperation rate (OR, 1.00; 95% CI, 0.67 to 1.5) (Supplementary Fig. 9C–E) [95, 106, 108]. While not statistically significant, the tendency was towards a lower incidence of each complication, except for the reoperation rate, in the group without drain placement (Supplementary Fig. 9E).

Recommendation consensus meeting results

Seventy percent of the attending members (7 of 10) supported the recommendation strength and direction for not using a drainage catheter during colorectal surgery. There were concerns that there might be insufficient evidence to deviate from traditional practices, as some felt that not using a drainage catheter did not provide clear benefits or avoid risks. However, the consensus was that given the absence of clear benefits and considering patient discomfort and the potential for earlier discharge, recommending not using a drainage catheter was justified.

External expert review results

In the external review conducted by the 18 external experts, only 39% of the reviewers (7 of 18) provided a support score of 7 or higher for “conditional against.” Additionally, only 44% of the reviewers (8 of 18) endorsed the same recommendation strength as “conditional against,” while 33% of the reviewers (6 of 18) suggested “conditional for” as the appropriate recommendation strength. A significant number of clinicians use drainage catheters during colorectal surgeries, especially rectal surgeries, primarily due to concerns about anastomotic leakage. The review results from the external experts reflects this reality. Although there may be some discrepancy with actual clinical practice, the guideline is evidence-based and, considering the essence of the ERAS guidelines, the development committee agreed that a recommendation against using drainage catheters was appropriate. Consequently, the final recommendation strength was confirmed as “conditional against.”

KQ 8. During elective surgery for colorectal cancer, does the insertion of a nasogastric tube aid in the patient's recovery?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Insertion of a nasogastric tube during surgery

Comparison (C): No insertion of a nasogastric tube during surgery

Outcomes (O): Complication rate, time to bowel motility recovery, length of hospital stay

Recommendation 8.

It is suggested not to insert a nasogastric tube during surgery for colorectal cancer.

Strength of the recommendation: Conditional against

Level of evidence: Low

The necessity of nasogastric tube insertion during surgery has been widely researched in abdominal surgeries over the years. A Cochrane review published in 2007 concluded that routine insertion of nasogastric tubes for decompression purposes in all patients undergoing abdominal surgery is unnecessary [109]. Our meta-analysis also revealed results consistent with those of similar studies. No statistically significant differences were observed between the 2 groups regarding anastomotic leakage (Supplementary Fig. 10A), time to bowel movement (Supplementary Fig. 10B), gas passage (Supplementary Fig. 10C), SSIs (Supplementary Fig. 10D), or length of hospital stay (Supplementary Fig. 10F) [110, 111]. However, Venara et al. [111] reported a significantly higher incidence of respiratory infections in patients with nasogastric tube insertion compared to those without (3.0% vs. 0.4%, $P < 0.001$), which was corroborated by the meta-analysis (OR, 7.12; 95% CI, 2.48 to 20.47) [110, 111] (Supplementary Fig. 10E).

Recommendation consensus meeting results

Ninety percent of the attending members (9 of 10) supported the recommendation strength and direction regarding the use of nasogastric tubes during elective colorectal surgery. Although it has long been known that there are no benefits to nasogastric tube insertion, some suggested that the recommendation strength should be “strongly against.” However, it was agreed that the evidence level is insufficient to justify a strong recommendation. Therefore, the consensus was to recommend against the use of nasogastric tubes, but not at a strong level.

External expert review results

In the external review conducted by the 18 external experts, 67% (12 of 18) provided a support score of 7 or higher for “conditional against.” However, only 39% of the reviewers (7 of 18) deemed

“conditional against” as the appropriate recommendation strength, which was a relatively low proportion. A significant number of reviewers (8 of 18, 44%) suggested “strongly against” as the appropriate recommendation strength. This aligns with the opinions expressed during the development committee’s consensus meetings. Considering the level of evidence, the final decision was to confirm the recommendation strength as “conditional against” through the final meeting.

KQ 9. Is transverse abdominis plane block effective for postoperative pain control following elective surgery for colorectal cancer?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Transverse abdominis plane block

Comparison (C): Conventional pain management

Outcomes (O): Postoperative pain, opioid consumption, nausea and vomiting, postoperative ileus, length of hospital stay

Recommendation 9.

Transverse abdominis plane block may be considered for pain control during surgery for colorectal cancer.

*Strength of the recommendation: Conditional for
Level of evidence: Moderate*

Effective pain management following colorectal cancer surgery is a key component of ERAS protocols, as it can aid in facilitating rapid patient recovery and early discharge from the hospital. Opioid-based patient-controlled analgesia has been widely used due to its ease of use, simplicity, and effectiveness in pain management [112]. However, opioids can cause side effects such as nausea and vomiting, and reduce gastrointestinal motility, which can slow recovery [1, 112]. Therefore, the most crucial aspect emphasized in other ERAS guidelines for postoperative pain management is to avoid opioids and apply multimodal analgesia, which combines 2 or more pain control methods [1, 2].

There are many options available for multimodal analgesia. Among nonopioids, the most easily prescribed medications are acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs). These are the easiest alternatives to opioids as they do not require special equipment or procedures. However, caution is needed with nonselective NSAIDs like diclofenac due to reports of increased anastomotic leaks. Ketorolac or COX-2 selective NSAIDs are relatively recommended instead [1, 113]. Other medications such as gabapentinoids (e.g., gabapentin, pregabalin) and ketamine can also be used, but their analgesic effects are debated and side effects must be considered [1].

Thoracic epidural analgesia has been proven effective for open surgery but is not recommended for minimally invasive colorec-

tal cancer surgery due to a lack of evidence of superiority over other analgesic methods and potential side effects [1]. The use of continuous wound infiltration with local anesthetics via catheter is becoming more widespread, and new local pain control methods, such as the use of thermosensitive hydrogels for local anesthetic delivery, are being developed [1, 114]. Additionally, nerve blocks such as the transverse abdominis plane (TAP) block and rectus sheath block have been reported to reduce opioid use and hospital stay duration, making them viable options for multimodal analgesia. The selection of methods to be combined for multimodal analgesia should be determined based on the available resources and the preferences of the medical staff at each hospital. This guideline establishes KQs and conducts a systematic review on the TAP block, which has been widely studied in colorectal surgery.

This meta-analysis compared the effectiveness and side effects of TAP block with other pain management methods (placebo using saline solution, local anesthetic-based pain control, or traditional opioid analgesia) during colorectal surgery. The analysis of postoperative pain using the visual analog scale indicated significantly lower pain scores in the TAP block group compared to the control group at both postoperative 2 hours (MD, -1.31; 95% CI, -1.41 to -1.21) (Supplementary Fig. 11A) [115–126] and postoperative 24 hours (MD, -1.04; 95% CI, -1.14 to -0.94) (Supplementary Fig. 11B) [115, 117–126]. Additionally, the TAP block group had a significantly shorter hospital stay compared to the control group (MD, -0.38 days; 95% CI, -0.53 to -0.22) (Supplementary Fig. 11C) [115–118, 120, 122, 123, 125–128]. While variability in reporting standards and units posed challenges for aggregating opioid consumption data, several studies consistently demonstrated reduced opioid requirements in the TAP block group relative to the control group [116, 117, 122, 123, 127–129]. A meta-analysis by Liu et al. [130], utilizing standardized MD, further confirmed the reduction in postoperative opioid use in the TAP block group compared to the control group (standardized MD, -0.26; 95% CI, -0.47 to -0.05).

The incidence of PONV was significantly lower in the TAP block group compared to the control group (OR, 0.51; 95% CI, 0.36 to 0.72) (Supplementary Fig. 11D) [115–118, 120–122, 125, 126, 128, 129, 131]. However, there was no statistically significant difference between the 2 groups concerning the incidence of postoperative ileus (Supplementary Fig. 11E) [115–118, 120, 123, 126, 128, 129, 131].

As described above, there are many methods for postoperative pain management. Instead of relying on a single method, combining multiple techniques in a multimodal analgesia approach is more effective for pain control. TAP block should also be used as

part of this multimodal analgesia. The ultimate goal is to minimize the use of opioids.

Recommendation consensus meeting results

The recommendation strength and direction for the use of TAP block during colorectal surgery were unanimously supported by all attending members (11 of 11), with no dissenting opinions regarding the recommendation.

External expert review results

The external review of this key question by the external experts showed that the proportion of those who supported the recommendation strength (7–9 points) was 50% (9 of 18), which was not high. However, 89% of the reviewers (16 of 18) indicated “conditional for” when asked about the appropriate recommendation strength. It is believed that this survey result reflects the fact that various pain control methods can be included in multimodal analgesia. As mentioned earlier, the TAP block, as an element of multimodal analgesia, was ultimately agreed to be “conditional for,” and the recommendation strength was confirmed.

KQ 10. Is thromboprophylaxis necessary for patients scheduled for elective surgery for colorectal cancer?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Preoperative pharmacologic thromboprophylaxis
Comparison (C): No preoperative pharmacologic thromboprophylaxis

Outcomes (O): Occurrence of deep vein thrombosis or pulmonary embolism postoperatively

Recommendation 10.

Preoperative pharmacologic thromboprophylaxis is recommended for patients scheduled for colorectal cancer surgery.

Strength of the recommendation: Conditional for
Level of evidence: Moderate

For preoperative thromboprophylaxis, clinical methods include mechanical prophylaxis (such as compression stockings or intermittent pneumatic compression) and pharmacologic prophylaxis. Mechanical prophylaxis has been proven effective and is used in clinical practice [132, 133]. However, the use of pharmacologic prophylaxis remains less established. Therefore, this analysis evaluated RCTs comparing preoperative pharmacologic thromboprophylaxis with placebo or intermittent pneumatic compression.

The incidence of postoperative deep vein thrombosis or pulmonary embolism was analyzed in 2 studies included in the analysis [134, 135]. Both studies reported a significantly lower incidence

in the group that received preoperative pharmacologic thromboprophylaxis. Consequently, the meta-analysis results also demonstrated a significant association between preoperative pharmacologic thromboprophylaxis and reduced rates of postoperative deep vein thrombosis or pulmonary embolism (OR, 0.45; 95% CI, 0.20 to 0.99) (Supplementary Fig. 12A).

Preoperative pharmacologic thromboprophylaxis carries a potential risk of postoperative bleeding. Both studies included in the analysis reported on major bleeding requiring transfusion and minor bleeding not requiring transfusion [134, 135]. When combined, the studies confirmed that preoperative pharmacologic thromboprophylaxis was not associated with major bleeding (OR, 4.04; 95% CI, 0.45 to 36.29) or minor bleeding (OR, 2.48; 95% CI, 0.92 to 6.68) (Supplementary Fig. 12B, C).

However, the limited number of RCTs supporting preoperative pharmacologic thromboprophylaxis in colorectal surgery specifically targeting Korean populations, presents a significant barrier. A prospective study conducted on a Korean cohort found no significant difference in the incidence of thrombotic complications between patients who received preoperative pharmacologic thromboprophylaxis and those who did not [136], which could hinder the implementation of such measures.

As an alternative, it may be practical to selectively administer preoperative pharmacologic thromboprophylaxis to patients at high risk for thromboembolic events. For example, patients with obesity or multiple underlying conditions, who are at a higher risk for thrombotic complications [137–140], might benefit more from targeted prophylactic interventions. If nomograms for identifying patients at high risk for thrombosis are developed, they could serve as valuable tools for deciding whether to implement preoperative pharmacologic thromboprophylaxis.

Recommendation consensus meeting results

Ninety percent of the attending members (9 of 10) supported the recommendation strength and direction for implementing preoperative pharmacologic thromboprophylaxis in patients scheduled for elective colorectal cancer surgery. While there was an opinion in the consensus meeting that the recommendation strength should be “strongly recommended,” the view that the level of evidence should be considered and that the decision should be made selectively based on the individual patient’s condition gained traction. Consequently, the consensus was to classify it as “conditional for.”

External expert review results

Among the external experts, the proportion of those who provided a support score of 7 or higher for a “conditional for” recom-

mentation was 44% (8 of 18), which is relatively low. However, 78% of the external experts endorsed “conditional for” as the appropriate recommendation strength. Conversely, 3 experts (17%) suggested that “conditional against” was more suitable. After reviewing the consensus meeting results, external expert reviews, and meta-analysis outcomes, the final recommendation strength was confirmed as “conditional for.”

KQ 11. How long should urinary catheters be maintained after elective surgery for colorectal cancer?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Early urinary catheter removal (postoperative day 1)

Comparison (C): Catheter removal after postoperative day 3

Outcomes (O): Acute urinary retention, urinary tract infection

Recommendation 11.

It is recommended to remove urinary catheters the day after colorectal cancer surgery.

Strength of the recommendation: Conditional for
Level of evidence: Moderate

Early removal of urinary catheters postoperatively has been reported to reduce the time to first ambulation [141–145] and decrease the length of hospital stay in numerous studies [141, 142, 144, 146, 147]. However, the benefits of reducing urinary tract infections (UTIs) through early catheter removal must be weighed against the risks of acute urinary retention that can occur following early removal. The 2 studies included in the meta-analysis showed a trend toward a reduction in UTIs, but this trend was not statistically significant [148, 149]. However, 2 other studies with relatively larger sample sizes demonstrated a statistically significant reduction in UTIs [150, 151]. Therefore, the meta-analysis confirmed that early catheter removal could reduce the incidence of UTIs (OR, 0.36; 95% CI, 0.20 to 0.67) (Supplementary Fig. 13A).

There is potential for catheter reinsertion due to acute urinary retention following early catheter removal. This is particularly relevant in rectal cancer surgeries, where the risk of damaging the lateral pelvic nerves during pelvic surgery must be considered. In the present analysis, 4 studies on colorectal surgeries involving the pelvic region were included [148–151]. The meta-analysis revealed that early catheter removal is associated with an increased risk of acute urinary retention following pelvic surgery (OR, 2.16; 95% CI, 1.20 to 3.89) (Supplementary Fig. 13B).

Clean intermittent catheterization has been reported not to increase the frequency of UTIs compared to indwelling catheters

[152]. Therefore, after removing the catheter on postoperative day 1, in cases where acute urinary retention occurs, the decision whether to reinsert the catheter for prolonged use based on bladder volume expansion ($>600\text{ cm}^3$), or to implement clean intermittent catheterization, can be determined [153].

Considering different protocols for colon cancer and rectal cancer surgeries is also warranted. A meta-analysis of colorectal surgeries, including pelvic surgeries conducted in 2019 [154], analyzed 3 prospective RCTs [148, 150, 151] and 2 retrospective cohort studies [155, 156], confirming no significant difference in the frequency of UTIs or acute urinary retention between postoperative day 1 and 3. Therefore, considering catheter removal on postoperative day 2 for rectal cancer surgeries is also worth considering.

Additionally, in patients with urinary retention issues due to benign prostatic hyperplasia, there have been reports indicating an increased incidence of acute urinary retention following early catheter removal [157–159]. Therefore, early catheter removal should be approached with caution, and the use of medications such as alpha blockers should be considered prior to removal [160].

Recommendation consensus meeting results

Regarding the recommendation strength and direction for early removal of urinary catheters following elective surgery for colorectal cancer, 90% of the attending members (9 out of 10) supported the recommendation strength. There was a suggestion to create separate guidelines for colon cancer and rectal cancer. However, the meta-analysis included studies that covered both colon and rectal cancers, and there were no prospective randomized studies solely on early catheter removal for colon cancer. This limitation makes it impractical to create separate guidelines based solely on the current evidence.

External expert review results

The external review by 18 experts showed that 78% (14 of 18) provided a support score of 7 or higher for a “conditional for.” Additionally, all 18 experts unanimously agreed that “conditional for” was the appropriate recommendation strength. Consequently, the final review by the development committee confirmed “conditional for” as the recommendation strength without dissent.

KQ 12. Is early feeding effective following elective surgery for colorectal cancer?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Early feeding (within postoperative 24 hours)

Comparison (C): Feeding after postoperative day 2

Outcomes (O): Complication rate, time to bowel motility recovery, length of hospital stay, mortality rate

Recommendation 12.

Early feeding is recommended to start from the day after surgery for colorectal cancer.

*Strength of the recommendation: Conditional for
Level of evidence: Moderate*

Early feeding was defined as the introduction of a liquid diet or more substantial nutrition within postoperative 24 hours, and a systematic review of the literature was conducted accordingly. The majority of studies included in the meta-analysis did not demonstrate significant differences in complications between patients who initiated a liquid diet within 24 hours and those who commenced the diet after 24 hours [161–169]. However, Zhou et al.'s study [170], which enrolled the largest number of patients, reported statistically significant reduction in complications with early dietary advancement, leading to a significant association between early dietary advancement and reduced total postoperative complications in the meta-analysis (OR, 0.50; 95% CI, 0.38 to 0.65) (Supplementary Fig. 14A). Although individual studies did not individually demonstrate statistical significance in anastomotic leakage [161–163, 165–171], when pooled together, a significant association between early dietary advancement and reduced anastomotic leakage was observed (OR, 0.40; 95% CI, 0.19 to 0.83) (Supplementary Fig. 14B). Time to first flatus was significantly shorter in the early dietary advancement group (MD, –0.87; 95% CI, –1.00 to –0.74) (Supplementary Fig. 14C) [161–164, 168, 170, 171], and hospital stay was also shorter in the early dietary advancement group (MD, –0.76; 95% CI, –0.89 to –0.64) (Supplementary Fig. 14D) [161–170, 172, 173]. However, there was no significant difference in mortality rates between the 2 groups (OR, 0.54; 95% CI, 0.15 to 2.01) (Supplementary Fig. 14E) [161–163, 165–168, 171].

Early dietary advancement is associated with concerns about inducing ileus or vomiting before complete bowel recovery. A comprehensive analysis of 9 papers reporting postoperative vomiting revealed a significantly higher incidence of postoperative vomiting in the early dietary advancement group (OR, 1.58; 95% CI, 1.11–2.26) (Supplementary Fig. 14F) [163–165, 167–169, 171–173]. Postoperative nasogastric tube insertion was more fre-

quently performed in the early dietary advancement group, although statistical significance was not reached (OR, 1.49; 95% CI, 0.96–2.31) (Supplementary Fig. 14G) [162–165, 167, 168, 170–172].

Recommendation consensus meeting results

The recommendation strength and direction for early postoperative feeding after elective surgery for colorectal cancer were unanimously supported by all attending members (10 of 10). There were no dissenting opinions regarding the recommendation.

External expert review results

In the external review conducted by 18 experts, 78% (14 of 18) provided a support score of 7 or higher for a “conditional for” recommendation (on a scale of 1 to 9). Additionally, 94% of the experts (17 of 18) endorsed the recommendation strength as “conditional for.” This overall agreement indicates strong support for the recommendation strength. The development committee also confirmed the “conditional for” recommendation strength without dissent during the final review.

KQ 13. Is early ambulation effective following elective surgery for colorectal cancer?

Population (P): Adult colorectal cancer patients undergoing elective surgery

Intervention (I): Early ambulation

Comparison (C): No early ambulation

Outcomes (O): Complication rate

Recommendation 13.

Early ambulation is recommended to commence on the day after surgery for colorectal cancer.

*Strength of the recommendation: Conditional for
Level of evidence: Moderate*

Postoperative early ambulation is believed to prevent intestinal paralysis and pulmonary complications. Both of the 2 studies included in the analysis showed no overall difference in complications, and the meta-analysis result also indicated no significant difference in the occurrence rates of complications between the 2 groups (Supplementary Fig. 15) [174, 175]. Specific complications could not be analyzed due to a lack of comparable data provided by both studies. However, 1 study reported a decrease in hospitalization period with early ambulation [175].

Although early ambulation is considered to be clinically beneficial, meta-analysis results showed insufficient evidence regarding its benefits and harms. Other systematic reviews did not report the advantages of early ambulation, consistent with our findings

[176]. The heterogeneity and design of the studies likely influenced these results. Additionally, there are very few RCTs focusing solely on early ambulation, and most studies included early ambulation as part of the ERAS protocol, making it difficult to synthesize the evidence.

Although this meta-analysis did not clearly establish the benefits of early ambulation, its potential advantages as a component of the ERAS protocol cannot be ruled out, and it can be implemented to some extent without a formal program. Based on this, the committee suggests initiating early ambulation from the day after surgery, considering that its potential benefits likely outweigh the risks.

Recommendation consensus meeting results

The recommendation strength and direction for early ambulation after colorectal cancer surgery were unanimously supported by all attending members (10 of 10), with no dissenting opinions on the recommendation.

External expert review results

The external review by 18 experts showed that 89% of reviewers (16 of 18) provided a support score of 7 or higher for a “conditional for” on a scale from 1 to 9. Sixty-one percent of the reviewers (11 of 18) endorsed “conditional for” as the appropriate recommendation strength. The remaining 39% of reviewers (7 of 18) suggested that a “strong recommendation” might be more appropriate. Despite this, considering the low level of evidence and the fact that some patients may have difficulties with mobility, the consensus was that a strong recommendation would not be suitable. Consequently, the development committee confirmed “conditional for” as the final recommendation strength.

CONCLUSION

This guideline outlines a comprehensive protocol aimed at facilitating early recovery in patients undergoing colorectal cancer surgery, covering recommendations from preoperative to postoperative care. Prehabilitation is advised for patients scheduled for colorectal cancer surgery. Preoperative nutritional support with oral nutritional supplements is recommended. For the prevention of PONV, a combination of dexamethasone and a serotonin receptor antagonist is preferred over monotherapy. Oral antibiotics alongside MBP are recommended. Oral carbohydrate loading up to 2 hours before surgery is advised. GDFT may be considered for high-risk patients. Avoidance of intra-abdominal drain placement is suggested. Nasogastric tube insertion is also suggested to be avoided. A TAP block may be considered for intraoperative pain

control. Preoperative pharmacologic thromboprophylaxis is recommended. Urinary catheters should ideally be removed on the first postoperative day. Early postoperative feeding is recommended to commence the day after surgery. Early ambulation should begin on the first postoperative day.

ARTICLE INFORMATION

Conflict of interest

Soo Young Lee is an editorial board member of this journal, but was not involved in the peer reviewer selection, evaluation, or decision process of this article. No other potential conflict of interest relevant to this article was reported.

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Author contributions

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Supplementary materials

Supplementary Material 1. Literature search terms for each key questions (KQs).

Supplementary Table 1. Multiple pharmacological options for preventing postoperative nausea and vomiting

Supplementary Fig. 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart for each key questions (KQs).

Supplementary Fig. 2. Risk of bias assessment for each key questions (KQs) using ROBINS-I (Risk of Bias in Nonrandomized Studies of Intervention), and Cochrane RoB 2 (Risk-of-Bias Tool for Randomized Trials 2).

Supplementary Fig. 3. Forest plots of (A) postoperative complication (Clavien-Dindo classification grades I, II), (B) postoperative complication (Clavien-Dindo classification grades $\geq$ III), (C) hospital stay, (D) readmission within 30 days, (E) readmission

within 90 days and (F) postoperative mortality based on prehabilitation.

Supplementary Fig. 4. Forest Plots comparing oral nutritional supplement for (A) total postoperative Complications and (B) length of Hospital Stay

Supplementary Fig. 5. Forest plots of (A) nausea and vomiting (within 6 hours), (B) nausea and vomiting (within 24 hours), (C) overall side effects, (D) headache and (E) dizziness between combination therapy and monotherapy

Supplementary Fig. 6. Forest Plots of (A) surgical site infection, (B) organ-space surgical site infection and (C) readmission rate (within 30 days) in the combination of mechanical bowel preparation and oral antibiotic prophylaxis versus mechanical bowel preparation alone.

Supplementary Fig. 7. Forest plots of (A) postoperative complication, (B) surgical site infection, (C) prolonged postoperative ileus, (D) time to flatus and (E) hospital stay based on preoperative oral carbohydrate loading.

Supplementary Fig. 8. Forest plots of (A) postoperative complication, (B) surgical site infection, (C) anastomotic leakage, (D) prolonged postoperative ileus, (E) mortality and (F) hospital stay based on goal-directed fluid therapy.

Supplementary Fig. 9. Forest plots of (A) total postoperative complication, (B) anastomotic leakage, (C) pelvic fluid collection and sepsis, (D) intestinal obstruction and (E) reoperation based on drain insertion.

Supplementary Fig. 10. Forest plots of (A) anastomotic leakage, (B) Time to first bowel movement, (C) time to first flatus, (D) surgical site infection, (E) respiratory infection and (F) hospital stay based on nasogastric tube insertion.

Supplementary Fig. 11. Forest plots of (A) postoperative pain using the visual analog scale (within 2 hours), (B) postoperative pain using the visual analog scale (within 24 hours), (C) hospital stay, (D) postoperative nausea and vomit and (E) prolonged postoperative ileus in transversus abdominis plane block versus conventional pain control method.

Supplementary Fig. 12. Forest plots of (A) venous thromboembolism, (B) major bleeding and (C) minor bleeding based on preoperative pharmacologic thromboprophylaxis.

Supplementary Fig. 13. Forest plots of (A) urinary infection and (B) acute urinary retention comparing early versus late urinary catheter removal.

Supplementary Fig. 14. Forest plots of (A) total postoperative complication, (B) anastomotic leakage, (C) time to flatus, (D) hospital stay, (E) mortality, (F) postoperative vomit and (G) postoperative nasogastric tube insertion comparing early versus late feeding.

Supplementary Fig. 15. Forest plots of total postoperative complication comparing early versus late mobilization.

Supplementary materials are available from <https://doi.org/10.3393/ac.2024.00836.0119>.

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