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Guideline

The 2024 Korean Enhanced Recovery After Surgery guidelines for hepatobiliary and pancreatic surgery

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Abstract

Purpose: The Korean Enhanced Recovery After Surgery (ERAS) Committee within the Korean Society of Surgical Metabolism and Nutrition has developed comprehensive guidelines for hepatobiliary and pancreatic (HBP) surgery by adapting established international protocols. These guidelines provide evidence-based recommendations specifically tailored to the Korean healthcare system and address perioperative management for both pancreatoduodenectomy and hepatectomy.

Methods: The HBP subcommittee reviewed existing international ERAS guidelines and conducted an adaptation process. Key questions were identified based on national survey results from Korean HBP surgeons and were prioritized according to clinical relevance. The committee focused on elements supported by moderate- to high-quality evidence with strong recommendation grades. Literature searches were conducted through January 2025, and evidence quality was evaluated using GRADE methodology. Four key questions underwent formal assessment, and eight additional questions were adapted from international guidelines.

Results: Twelve key questions were selected and addressed, covering critical perioperative care domains: prehabilitation, preoperative nutritional assessment and support, anti-thrombotic prophylaxis, prophylactic abdominal drainage, preoperative biliary drainage, smoking and alcohol cessation, pre-anesthetic medication, minimally invasive surgical approaches, prophylactic nasogastric intubation, postoperative glycemic control, perianastomotic drainage management, and early mobilization protocols. Each recommendation was assigned specific evidence levels and graded for strength. High-quality evidence supported strong recommendations for the routine avoidance of prophylactic drainage in uncomplicated hepatectomy, early drain removal after pancreatoduodenectomy in low-risk patients, elimination of routine nasogastric decompression, and the implementation of early mobilization strategies.

Conclusion: These Korean-adapted ERAS guidelines for HBP surgery are expected to standardize perioperative care, reduce postoperative complications, shorten hospital stays, and enhance overall patient outcomes across Korean healthcare institutions.

Keywords: Clinical relevance; Enhanced Recovery After Surgery; Hepatectomy; Pancreatoduodenectomy; Perioperative care

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Introduction

Background

Despite major advancements in hepatobiliary and pancreatic (HBP) surgery, achieving early postoperative recovery and a timely return to daily life remains a significant challenge, particularly for complex procedures such as pancreatoduodenectomy and hepatectomy [1]. Although international Enhanced Recovery After Surgery (ERAS) guidelines have been developed and updated for these operations, there is increasing recognition of the need to adapt these protocols to the specific clinical environment and healthcare delivery system in Korea [2-5].

Objectives

In response, the Korean Society of Surgical Metabolism and Nutrition established an ERAS committee to develop Korean guidelines for HBP surgery. The primary objective of these guidelines is to support physicians by providing evidence-based recommendations that are both feasible and appropriate within Korean clinical practice. The guidelines seek to facilitate informed perioperative decision-making and to enhance the expectations and value perceived by both healthcare professionals and patients.

Methods

Ethics statement

Because this work did not involve human participants, neither institutional review board approval nor informed consent was required.

Assessment through adaptation by the committee

These guidelines were developed with an emphasis on practical clinical implementation. Unlike other surgical fields such as colorectal or gastric surgery, HBP surgery already has well-established and recently updated international guidelines. Therefore, the HBP subcommittee of the Korean ERAS Committee, under the Korean Society of Surgical Metabolism and Nutrition, elected to omit potentially redundant processes such as de novo literature searches and meta-analyses. Instead, the committee selected key elements considered most essential for implementation based on the results of a national survey. For all elements not included among these predefined priorities, the committee conducted evaluation through an adaptation process.

Review of existing guidelines

The head committee reviewed existing ERAS guidelines to identify common elements and areas of ongoing debate [2-7]. As a result, the head committee categorized the elements into two groups: common elements and other field-specific elements (Table 1). The HBP committee then examined the field-specific elements in international guidelines and assessed the degree of dissension associated with each.

Key question development

The HBP committee was subdivided into two groups, one focusing on hepatectomy and the other on pancreatoduodenectomy. Each subdivision identified pivotal but debated elements based on Korean survey findings [8]. In addition, another relevant survey conducted by the Korean Association of Liver Surgery (KALIS), though not yet published, also informed the process. Initially, the committee categorized all elements outside the common international elements according to whether their evidence level was at least moderate and their recommendation grade was strong. Through detailed discussions, the HBP committee then prioritized and finalized four key questions (KQs) for formal assessment and eight additional KQs to be adapted from international guidelines (Table 2).

Literature search and study selection

The authors met in August 2023 to agree upon the elements to be included and to assign responsibilities. A principal literature search was conducted through January 2025. All co-authors screened web-based databases and their personal archives for relevant articles. A non-systematic emphasis was placed on more recent publications and those demonstrating higher methodological quality.

Quality assessment and grading

The assessment of evidence levels followed the grading criteria established by the GRADE working group [9,10]. Assignment

Table 1. Common Enhanced Recovery After Surgery elements across surgical fields

Enhanced Recovery After Surgery items
Preoperative counseling
Preoperative fasting and treatment with carbohydrates
Epidural analgesia
Postoperative intravenous and oral analgesia
Wound catheter and transversus abdominis plane block
Postoperative nausea and vomiting prophylaxis
Avoiding hypothermia
Fluid balance
Postoperative artificial nutrition
Audit

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Table 2. Key questions

	Key questions
Assessed	Prehabilitation (PD)
	Preoperative nutrition (PD)
	Anti-thrombotic prophylaxis (L)
	Prophylactic abdominal drainage (L)
Adapted	Preoperative biliary drainage
	Preoperative smoking and alcohol cessation
	Pre-anesthetic medication
	Minimally invasive surgery
	Prophylactic nasogastric intubation
	Postoperative glycemic control
	Perianastomotic drainage
	Early and scheduled mobilization

PD, pancreatoduodenectomy; L, liver surgery.

of each level of evidence was based on outcome measures. When randomized and non-randomized studies contributed evidence for the same outcome measure, the evidence level derived from randomized studies was used as the reference. The final level of evidence assigned to each recommendation was determined by the evidence supporting the most critical primary outcome associated with that recommendation.

Results

KQ 1. Prehabilitation in pancreatoduodenectomy

A prehabilitation program consisting of moderate aerobic exercise and resistance training for 60 minutes per session, at least three times per week at home without supervision, has been recommended. This intervention has been associated with decreases in the incidence of severe bile leakage and reductions in the average length of hospital stay [11]. A recent systematic review on prehabilitation for pancreatic surgery also demonstrated improvements in patients' physical fitness and nutritional status, accompanied by reductions in postoperative complications and duration of hospitalization [12]. These findings support the integration of individualized prehabilitation programs, incorporating multidisciplinary components such as physical exercise, nutritional support, and psychological counseling, into the perioperative care pathway for pancreatic surgery.

Summary and recommendation: Prehabilitation for pancreatic surgery reduces postoperative complications, shortens the length of hospital stay, and supports overall patient recovery. (Evidence level: high, Grade of recommendation: conditionally in favor)

KQ 2. Preoperative nutrition in pancreatoduodenectomy

Appropriate patient selection and comprehensive nutritional assessment are fundamental to effective preoperative nutritional management. Early identification of patients at risk for malnutrition enables timely intervention and supports postoperative recovery. Assessment methods include anthropometric measurements (e.g., body weight, body mass index, waist circumference, body fat composition, and recent weight changes), laboratory parameters (e.g., serum albumin, transferrin, electrolytes, and vitamin levels), and validated screening tools such as the Malnutrition Universal Screening Tool (MUST), Nutrition Risk Screening 2002 (NRS-2002), and Patient-Generated Subjective Global Assessment (PG-SGA) [13-16]. Ideally, nutritional therapy should begin at least 7 days before surgery, particularly for patients with signs of or risk factors for malnutrition. Early intervention helps prevent acute nutritional deterioration and reduces postoperative complications such as infection, impaired wound healing, and muscle loss [13,17]. For patients with adequate oral intake and preserved gastrointestinal function, consumption of high-calorie, high-protein meals and oral nutritional supplements should be encouraged to optimize energy and nutrient intake. When oral intake is insufficient, enteral nutrition (EN) administered via feeding tubes is preferred to ensure delivery of nutrient-rich formulas tailored to the patient's metabolic requirements [18]. If EN cannot be implemented, parenteral nutrition (PN) should be considered, providing a complete intravenous nutritional solution that includes calories, amino acids, lipids, vitamins, and minerals [19]. Selection between EN and PN should be guided by the patient's clinical condition and gastrointestinal functional status. Early and adequate nutritional intervention is essential for optimizing surgical outcomes and postoperative recovery.

Summary and recommendation: Patients undergoing pancreatoduodenectomy should receive a thorough preoperative nutritional assessment. Preoperative nutritional support, through enteral or parenteral routes as appropriate, contributes to reduced postoperative complications and shorter hospital stays. (Evidence level: high, Grade of recommendation: conditionally in favor)

KQ 3. Anti-thrombotic prophylaxis in liver surgery

The use of pharmacological thromboprophylaxis in liver surgery is well established, and chemical prophylaxis with low-molecular-weight heparin (LMWH) or unfractionated heparin (UFH) has been shown to significantly reduce the incidence of postoperative venous thromboembolism

(VTE) without meaningfully increasing bleeding risk [20]. Comparative studies have further demonstrated that LMWH and UFH are similarly effective in lowering VTE rates, with no significant differences in bleeding complications [21]. A large Korean national study also reported lower overall VTE rates in Asian populations compared with Western populations, underscoring the need for individualized prophylaxis strategies [22]. Updated recommendations from the Asian Venous Thrombosis Forum emphasize the use of mechanical prophylaxis, such as intermittent pneumatic compression devices, particularly for patients with elevated bleeding risk. Combined use of pharmacologic and mechanical prophylaxis is recommended for individuals at high risk for VTE to achieve optimal outcomes [23].

Summary and recommendation: Postoperative administration of LMWH or UFH is recommended unless contraindicated. Intermittent pneumatic compression devices should also be used to minimize the risk of thromboembolic events. (Evidence level: moderate, Grade of recommendation: strong)

KQ 4. Prophylactic abdominal drainage in liver surgery

Abdominal drainage has traditionally been used following hepatic resections; however, emerging evidence has increasingly challenged its routine application. A 2022 meta-analysis of seven randomized controlled trials (RCTs) involving 1,064 patients reported that routine abdominal drainage after hepatectomy was associated with significantly higher rates of overall and wound-related complications. Importantly, no significant differences were observed between drainage and no-drainage groups with respect to bile leakage, intra-abdominal collections, or length of hospital stay [24]. Similarly, a systematic review and meta-analysis including 5,050 patients demonstrated that prophylactic drainage after major hepatectomy was associated with increased bile leakage, a higher need for interventional drainage, more postoperative complications, and longer hospitalization [25]. Although routine prophylactic drainage is unnecessary for most patients undergoing elective hepatectomy, selective drainage may benefit patients at high risk of bile leakage, including those undergoing biliary tract reconstruction or those with substantial liver damage [26].

The current consensus indicates that routine prophylactic abdominal drainage after hepatic resection offers no advantage in reducing bile leakage or intra-abdominal infections and may instead increase postoperative morbidity. Therefore, decisions regarding abdominal drain placement should be individualized based on surgical complexity and patient-specific risk factors.

Summary and recommendation: Routine abdominal drainage is not recommended in patients undergoing hepatectomy without biliary reconstruction. (Evidence level: high, Grade of recommendation: strong)

KQ 5. Preoperative biliary drainage

Prolonged preoperative jaundice is associated with increased postoperative morbidity, largely because severe cholestasis induces hepatic dysfunction [27,28]. To mitigate these risks, preoperative biliary drainage is often considered, particularly in patients with cholangitis, malnutrition, or coagulopathy [29]. However, biliary drainage also carries potential complications, including pancreatitis, biliary tract infection, and surgical site contamination.

Current evidence suggests that percutaneous transhepatic biliary drainage (PTBD) may be more effective than endoscopic biliary drainage (EBD) in achieving biliary decompression and reducing rates of post-procedural pancreatitis and infection among patients with perihilar cholangiocarcinoma [30,31]. In contrast, EBD has demonstrated superiority over PTBD with regard to minimizing seeding metastasis and improving overall survival in patients with resectable perihilar cholangiocarcinoma [32]. Most clinical guidelines recommend delaying surgery until serum bilirubin levels decrease to below 2–3 mg/dL [27,30,32,33].

For pancreatoduodenectomy, several meta-analyses have shown that preoperative biliary drainage is associated with increased postoperative complications and does not significantly affect mortality [27,34-36]. Neither percutaneous nor endoscopic techniques, including placement of plastic or metallic stents, appear to effectively mitigate this increased risk [35].

Summary and recommendation: For liver surgery, preoperative biliary drainage is recommended in patients with cholestatic liver disease (bilirubin >2–3 mg/dL). In perihilar cholangiocarcinoma, PTBD is preferred over EBD. Elective surgery should be postponed until bilirubin levels decrease to below 2–3 mg/dL. (Evidence level: moderate, Grade of recommendation: strong)

Summary and recommendation: For pancreatoduodenectomy, preoperative biliary drainage should be avoided unless clinically unavoidable (e.g., bilirubin >250 μmol/L, cholangitis, intractable pruritus, or prior to neoadjuvant therapy). (Evidence level: high, Grade of recommendation: strong)

KQ 6. Preoperative smoking and alcohol cessation

Cigarette smoking is an independent risk factor for postoperative complications following liver surgery, including respiratory and infectious complications [37-39]. Evidence from randomized trials and meta-analyses indicates that smoking cessation for at least 4 weeks prior to surgery significantly reduces pulmonary complications and promotes improved wound healing [38,40]. Similarly, chronic alcohol consumption negatively affects liver function and increases the risk of perioperative complications. Alcohol-induced hepatic inflammation and immune dysregulation contribute to higher postoperative infection rates and poorer surgical outcomes [41,42].

Summary and recommendation: Smoking cessation should begin at least 4 weeks before hepatic resection. Patients with high alcohol intake (>24 g/day for women, >36 g/day for men) should abstain for at least 4–8 weeks prior to surgery. (Evidence level: high, Grade of recommendation: strong)

KQ7. Pre-anesthetic medication

The routine use of nonsteroidal anti-inflammatory drugs (NSAIDs) in the preoperative period is not recommended due to the risk of acute kidney injury (AKI). NSAIDs may compromise renal perfusion and exacerbate kidney injury, particularly under physiological stress during major surgery. This risk is especially relevant in patients with preexisting renal impairment or other comorbidities [43-45]. Emerging evidence suggests that certain sedatives and antiemetics may offer protective effects against perioperative AKI. For example, dexmedetomidine possesses anti-inflammatory and antioxidant properties that may reduce the incidence of AKI. However, use of these agents should be individualized based on patient-specific profiles and potential contraindications [44,46].

Summary and recommendation: Routine preoperative NSAID use should be avoided due to concerns regarding renal function. Long-acting anxiolytics are discouraged, particularly in elderly patients. Transdermal scopolamine may be used for nausea prevention, but should be administered with caution in older adults. (Evidence level: moderate, Grade of recommendation: strong)

KQ 8. Minimally invasive approaches

Minimally invasive techniques, particularly laparoscopy, have advanced considerably in HBP surgery and demonstrate advantages such as reduced intraoperative blood loss, decreased morbidity, and shorter postoperative recovery. Numerous high-volume centers have reported favorable outcomes with laparoscopic HBP procedures. Although robust RCT evidence for robotic HBP surgery remains limited, emerging data support its feasibility and suggest that both laparoscopic and robotic approaches can expand the indications for minimally invasive HBP surgery [47-52].

Summary and recommendation: Laparoscopic liver resection and laparoscopic distal pancreatectomy are recommended when technically feasible, as they are associated with shorter hospital stays and fewer complications. Laparoscopic pancreatoduodenectomy should be performed only in high-volume centers with substantial expertise and within strict institutional protocols, given persistent concerns regarding its safety. (Evidence level: moderate, Grade of recommendation: strong)

KQ 9. Prophylactic nasogastric intubation

Historically, nasogastric tube (NGT) decompression has been used postoperatively to prevent ileus and aspiration. However, an RCT evaluating routine NGT use after elective hepatectomy found no significant differences in overall morbidity, pulmonary complications, postoperative emesis, time to oral intake, or hospital length of stay between patients with and without NGT placement. Importantly, patients in the NGT group reported greater discomfort [53]. A meta-analysis assessing routine nasogastric decompression (NGD) after pancreatoduodenectomy showed associations with increased delayed gastric emptying, higher rates of major complications, and prolonged hospitalization [54]. These findings indicate that routine NGD provides no clear clinical benefit and may instead contribute to adverse outcomes. Routine NGD after elective liver or pancreatic surgery does not improve postoperative recovery and may increase complications and patient discomfort. Current protocols therefore support early oral feeding and recommend selective NGT placement only in cases involving postoperative complications such as significant gastric distension or prolonged ileus.

Summary and recommendation: Routine postoperative NGT is not recommended. (Evidence level: high, Grade of recommendation: strong)

KQ 10. Postoperative glycemic control

Perioperative hyperglycemia is associated with an in-

creased risk of infections, reoperative interventions, and in-hospital mortality, regardless of whether patients have diabetes [55]. Surgical stress induces transient insulin resistance, which contributes to hyperglycemia and can impair immune function and wound healing. Maintaining normoglycemia through appropriate insulin therapy has been shown to reduce infection risk and support postoperative recovery [56]. Continuous glucose monitoring and individualized insulin regimens should be considered integral components of perioperative management in HBP surgery to optimize glycemic control [56,57].

Summary and recommendation: In pancreatoduodenectomy, elevated perioperative blood glucose levels are associated with adverse outcomes in both diabetic and non-diabetic patients, although the optimal perioperative glycemic target has yet to be clearly defined. In liver surgery, insulin therapy should be employed to maintain blood glucose levels below 150 mg/dL. (Evidence level: high, Grade of recommendation: strong)

KQ 11. Perianastomotic drainage in pancreatoduodenectomy

The utility of routine intra-abdominal drainage following pancreatoduodenectomy remains an area of debate. Multiple RCTs have reported conflicting results, with some demonstrating increased complications in patients with drains and others indicating higher morbidity in the no-drain groups [58-61]. The development of the Fistula Risk Score (FRS) has enabled a more refined, risk-stratified approach. Evidence suggests that routine drainage may be unnecessary—or potentially harmful—in low-risk patients, while offering possible benefit in those with moderate or high risk. Additionally, early drain removal (postoperative day 3) in patients with low drain amylase levels (<5,000 U/L on postoperative day 1) has been associated with lower complication rates [62-66]. Accordingly, a selective strategy based on FRS and early drain amylase levels is recommended, whereas routine omission of drains remains a matter of debate.

Summary and recommendation: In patients with a low FRS and drain amylase <5,000 U/L on postoperative day 1, early perianastomotic drain removal at 72 hours is recommended. (Evidence level: high, Grade of recommendation: strong)

KQ 12. Early and scheduled mobilization

Early postoperative mobilization is a core component of enhanced recovery pathways and offers benefits such as reduced pulmonary complications, prevention of VTE, and improved gastrointestinal function. Studies have shown that mobilizing patients within the first 24 hours after surgery accelerates gastrointestinal recovery and shortens hospital stays [67,68]. Although the ideal frequency and duration of mobilization remain undefined, structured ambulation programs should be incorporated into routine postoperative care.

Summary and recommendation: Patients should be encouraged to ambulate as early as the day of surgery to reduce postoperative complications. No specific recommendations can be made regarding the optimal duration or frequency of mobilization. (Evidence level: moderate, Grade of recommendation: strong)

Conclusion

These Korean ERAS guidelines for HBP surgery provide evidence-based, contextually adapted recommendations covering 12 essential perioperative elements. Implementation of these protocols is expected to standardize care, reduce postoperative complications, shorten hospital stays, and ultimately improve patient outcomes across Korean healthcare institutions performing major HBP procedures.

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Authors' contribution

Conceptualization: all authors. Data curation: all authors. Formal analysis: KH, DWH. Funding acquisition: DJP, SJP. Investigation: all authors. Methodology: KH, HK, HSK, DWH. Project administration: DWH, SJP. Resources: SJP. Supervision: DWH, DJP, SJP. Visualization: all authors. Writing–original draft: all authors. Writing–review & editing: all authors. All authors read and approved the final manuscript.

Conflict of interest

The authors of this manuscript have no conflicts of interest to disclose.

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Data availability

Not applicable.

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Supplementary materials

None.

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