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Chapter

Enhanced Recovery after Surgery

Navin Kumar, Rohik Anjum, Dhiraj Mallik, Farhanul Huda, Bibek Karki and Somprakas Basu

Abstract

Enhanced recovery after surgery (ERAS) protocols are specialized perioperative care guidelines. The protocol was first published in 2005. Since then, it has been associated with improved perioperative outcomes. This multimodal peri-operative protocols standardize the perioperative care to minimize the surgical stress response and post-operative pain, reduce complications, improve post-operative outcomes, expedite recovery and decrease the length of hospital stay. It initially started with colorectal surgery, but now it is used in hepatobiliary, upper gastrointestinal system, urology, gynecology, vascular surgery, bariatric, and non-gastro intestinal specialties. Its role is well established in elective surgery. Now there are enough evidence suggesting its role in emergency surgeries as well. There are 24 elements of the ERAS bundle. However, only some critical elements of the ERAS bundle are feasible to be used in emergency surgery. Postoperative pain management is one of the significant elements in the ERAS bundle. Multimodal analgesia is the optimal modality for pain control. It facilitates early ambulation and rehabilitation. Current evidence recommends the ERAS protocol. However, each item within the protocol constantly changes over time, depending upon the evidence.

Keywords: ERAS, length of hospital stay, postoperative pain, perioperative care, protocol, multimodal analgesia

1. Introduction

There are various challenges in the care of a patient in his surgical journey, which starts from preadmission, preoperative, and intraoperative care till postoperative recovery. Each unit has its focus, affecting the one to follow. The same surgery may have different outcomes because the surgical outcome depends on the perioperative management rather than the actual operation. Patients require hospital care after major abdominal surgery because of the need for parenteral analgesia for persistent pain and intravenous fluid because of bowel dysfunction and postoperative complications. The length of hospital stay may vary in different parts of the world because of the variation in perioperative care. Henrik Kehlet showed that a patient could be discharged in 2 days after the open sigmoid resections [1]. The length of stay after these operations was ten days in most countries; thus, he pioneered fast-track surgery [2].

In earlier days, postoperative care was different among different centers because of the lack of specific protocols for specific organ-based surgeries. It was decided to promote the change in practice in the care of surgical patients. The Enhanced

Recovery After Surgery (ERAS) study group was formed in 2001 in Europe to combat this problem. Professor Ken Fearon, University of Edinburgh, UK, and Professor Olle Ljungqvist, Karolinska Institute, Sweden, assembled in 2001 to develop ideas about ERAS with the surgical department or Universities of three other northern European Countries (Denmark, Norway, and The Netherlands) [3]. They found a discrepancy between the actual practices and evidence-based best practices. Much published evidence suggests that perioperative care differs in different parts of the world, and there is a minimum adherence to evidence-based practice [4].

The aim of the ERAS study group (<http://www.erassociety.org>) was to find out the ways for quality surgical recovery rather than speed. The study group met several times to reach a consensus on a protocol to improve the quality of surgical recovery. These were called ERAS protocols. These are procedure-specific guidelines. The group focused on enhancing recovery and reducing complications by modifying the metabolic response to surgical insult rather than limiting the length of stay. They found that early mobilization and enteral nutrition are beneficial in the postoperative period, leading to rapid hospital discharge [5]. The first guideline was published in 2005 for colorectal surgery [3]. In 2012 the guidelines were divided into colonic and rectal surgery, but in 2018 these two surgical specialties guidelines were combined [6–8]. The Dutch group led the implementation of the first guidelines and showed improvements in recovery time [9]. They showed that the guidelines could be implemented in a structured way. ERAS protocol, when implemented in a structured way, showed a significant reduction in postoperative morbidity (48%) and length of hospital stay (2.5 days) in colorectal surgery when compared with traditional perioperative care [10, 11]. The ERAS society was registered in Sweden in 2010 (www.erassociety.org). This is an international non-profit medical academic society whose members are from different professions involved in surgical care [5].

Current evidence recommends the ERAS protocol as a whole (all elements) and not as a single element. However, each element within the protocol constantly changes over time, depending upon the evidence. Now, these protocols have been adapted for the upper gastrointestinal system, urology, gynecology, vascular surgery, hepato-pancreatico-biliary, esophageal, bariatric, and non-gastrointestinal specialties [12, 13]. The ERAS guideline has changed over the years since its inception. The first ERAS guideline was based on expert opinion and literature review, but the recent guideline is based on evidence-based grading.

2. Components of ERAS

There are 24 components of ERAS that are used by different surgical specialties of the hospital for different patients (**Table 1**) [8].

2.1 Preadmission

2.1.1 Preadmission information, education, and counseling

It is recommended that proper preoperative counseling should be done as it not only takes out the fear of surgery but also helps in pain control to a reasonable amount which ultimately will lead to an early discharge for the patient [14–18]. Patient education via leaflets, drawings, and multimedia (like various videos) of the surgical

ERAS item	
1	Preadmission information, education, and counseling
2	Preoperative optimization
3	Prehabilitation
4	Preoperative nutritional care
5	Management of anemia
6	Prevention of nausea and vomiting
7	Pre-anesthetic medication
8	Antimicrobial prophylaxis and skin preparation
9	Bowel preparation
10	Preoperative fluid and electrolyte therapy
11	Preoperative fasting and carbohydrate loading
12	Standard anesthetic protocol
13	Intraoperative fluid and electrolyte therapy
14	Preventing intraoperative hypothermia
15	Surgical access (open and minimally invasive surgery including laparoscopic, robotic, and trans-anal approaches)
16	Drainage of peritoneal cavity and pelvis
17	Nasogastric intubation
18	Postoperative analgesia
19	thromboprophylaxis
20	Postoperative fluid and electrolyte therapy
21	Urinary drainage
22	Prevention of postoperative ileus
23	Postoperative glycaemic control
24	Postoperative nutritional care

Table 1.
 ERAS guidelines 2018 for colorectal surgery (<http://www.erasociety.org>) [8].

procedures also improves pain and anxiety after surgery. Patients should always be designated a particular role post-surgery, including proper nutrition and mobilization [14, 19, 20]. The grade of recommendation is strong.

2.1.2 Preoperative optimization: (risk assessment, abstinence of smoking and alcohol)

Preoperative risk assessment of the patient should be done along with optimization of heart, lung, and kidney diseases, diabetes, hypertension, anemia, malnutrition, and cessation of excessive alcohol and smoking. Smokers have an increased risk of intraoperative and postoperative complications [21]. Counseling and nicotine replacement are very effective methods in preoperative smoking cessation [22]. At least 4–8 weeks of abstinence is required to reduce respiratory and wound healing complications [23, 24]. Alcohol abuse increases postoperative morbidity but not mortality. At least four weeks of abstinence is required [25]. The grade of recommendation for preoperative optimization is strong.

2.1.3 Prehabilitation

Prehabilitation is the period between diagnosis and the beginning of acute treatment. It is done to improve the physical and psychological health of the patient. Poor preoperative physical health is a risk factor for postoperative complications. Its grade of recommendation is weak.

2.1.4 Preoperative nutritional care

A preoperative nutritional assessment should be done to detect malnutrition. In malnourished patients, enteral or additional parenteral nutrition should be added 7–10 days preoperatively. It reduces infectious complications and anastomotic leaks [26]. Its grade of recommendation is strong.

2.1.5 Management of anemia

Anemia is the risk factor for morbidity and mortality, and blood transfusion also increases complications. A 60–100 g/L of Hb should be maintained before surgery [27]. Its grade of recommendation is strong.

2.2 Preoperative items

2.2.1 Postoperative nausea and vomiting

Postoperative nausea and vomiting (PONV) are important causes of patient dissatisfaction. PONV affects 30–50% of patients [28]. The etiology of PONV is multifactorial. Prophylactic treatment should be given to prevent postoperative nausea and vomiting. There are several scoring systems for predicting a risk factor for PONV. Koivuranta and Apfel's scoring system is most commonly used [29–31]. A multimodal approach should be considered to prevent PONV. Patients with 1–2 risk factors should be given a two-drug combination as prophylactic antiemetics, whereas 2–3 antiemetics should be given in patients with >2 risk factors. Its grade of recommendation is strong.

2.2.2 Pre-anesthetic medication

A high level of anxiety occurs in the perioperative period, which increases the analgesic requirements and postoperative complications. Anxiolytic should be given to decrease the psychological stress, which subsequently decreases the perioperative analgesic requirement [32]. Its grade of recommendation is strong.

2.2.3 Antimicrobial and skin preparation

Intravenous antibiotic prophylaxis should be given 60 minutes prior to the incision. There is a reduction in surgical site infection (SSI) after oral and systemic antibiotics, along with mechanical bowel preparation in colorectal surgery. The SSI rate further decreases after skin decontamination with chlorhexidine. Although preoperative hair removal does not decrease SSI incidence, it should preferably be performed using clippers [33]. The grade of recommendation is strong for intravenous antibiotic prophylaxis and skin decontamination by chlorhexidine.

2.2.4 Preoperative fluid and electrolyte therapy

Preoperative fluid and electrolyte deficits should be corrected before the patient reaches the operating room. Its grade of recommendation is strong.

2.2.5 Preoperative fasting and carbohydrate loading

Old school thought of prolonged fasting before major surgeries are being taken out of recommendations. Nowadays, light meals can be taken 6 hours prior to induction while clear liquids, specifically carbohydrate drinks (a 12-ounce clear beverage or a 24-g complex carbohydrate beverage), 2 hours prior to induction [34]. Evidence shows that it decreases dehydration and hypotension intraoperatively and also decreases insulin resistance, thus enhancing postoperative metabolism [35]. The grade of recommendation is strong.

2.3 Intraoperative components

2.3.1 Standard anesthetic protocol

Benzodiazepines should be avoided, and short-acting anesthetic agents should be used. Propofol should be used for induction of anesthesia. It can be combined with short-acting opioids such as fentanyl, alfentanil, sufentanil or remifentanil infusions. This minimizes residual effects at the end of anesthesia. This will allow rapid reversal [8]. Cerebral monitoring should be done to reduce the risk of delirium.

2.3.2 Intraoperative fluid and electrolyte therapy

Fluid management is crucial to maintaining intravascular volume, cardiac output, and tissue perfusion. The main aim is to reduce the hydrostatic pressure in pulmonary capillaries. Before ERAS, there was a restriction in fluid management where the rate for maintenance fluid was 1-2 ml/kg/hr., with perioperative fluid being <1500 ml or 20 ml/kg/24 hrs. In ERAS protocol, it is always a goal-directed therapy (GTD) for fluids, which reduces postoperative morbidity and decreases the length of stay in the hospital. Now balanced crystalloids at a rate of 1-4 ml/kg/hour are the fluid of choice over 0.9% normal saline (NS) but should be discontinued postoperatively. Again, liberal fluid management can also harm the patient postoperatively by intestinal edema and delayed return of bowel movements [36].

2.3.3 Preventing intraoperative hypothermia

Normothermia should be maintained throughout the surgery. This can be done by warming and humidifying anesthetic gases and warming intravenous and irrigation fluids.

2.3.4 Drainage of the peritoneal cavity and pelvis

Many published studies do not support the use of the intraperitoneal drain. It has no effect on clinical outcomes and should not be used routinely. The grade of recommendation is strong.

2.4 Postoperative items

2.4.1 Nasogastric intubation

Its aim was to reduce postoperative gastric distension and vomiting. A Cochrane meta-analysis does not support it. It should be used sparingly. If inserted intraoperatively, it should be removed before anesthesia reversal [37, 38].

2.4.2 Anesthesia and pain relief

In line with ERAS protocol, pain relief is a multimodal approach that uses regional anesthesia. It avoids the use of opioids. Relief from postoperative pain decreases immediate risks of hypoxemia, hypercarbia, increased myocardial work, arrhythmias, and ischemia. Therefore, enhanced recovery pathways must combine multimodal enteral and parenteral analgesia with regional analgesia or local anesthetic techniques. It should also be kept in mind that the impact of an anesthetic agent on organ function should be minimum. Depth of anesthesia should be appropriate to avoid an overdose. It is better to use short-acting agents than total intravenous anesthesia.

Postoperative pain is one of the most important reasons for immobilization, delayed oral intake, and prolonged hospital stay. Therefore, to avoid these, the protective role of epidural analgesia has become an essential element in ERAS protocol. It mainly reduces stress hormones secretion and insulin resistance. Usually, an epidural catheter is inserted just before the induction or during surgery; either a continuous infusion (4–10 ml/hr) or intermittent top-up of a local anesthetic agent (bupivacaine 0.1%) can be given along with a low dose of opioid (to avoid opioid related systemic side effects) via the epidural catheter. Usually, the catheter is kept for two days. No other mode of analgesia is required during this duration, and using another analgesic during those two days is not recommended.

Apart from this, there are other modalities for pain relief, such as paravertebral block, serratus anterior plane block, rectus abdominis block, and transversus abdominis block. However, all these are less proven for pain relief than epidural analgesia [39].

The surgical aspect of ERAS in pain relief is equally important for a better postoperative recovery. Prolonged and open surgeries hamper postoperative mobilization, pain control, and oral intake and even increase the length of hospital stay. Thus, minimally invasive approaches are recommended for their effectiveness in reducing postoperative complications, including hospital stays. It is seen that less tissue handling during surgery improves postoperative recovery [40].

Apart from epidural analgesia, enteral analgesics are also recommended to reduce pain, postoperative nausea, vomiting, and the start of oral feeds. Enteral analgesics that can be used are acetaminophen (most commonly) and NSAIDs (avoided in renal failure, Diabetic patients, and old age patients) [35]. For the facilitation of pain management protocol in ERAS, a PROSPECT (PROcedure-SPECific Postoperative Pain Management) working group was constituted. This collaboration provides evidence-based, procedure-specific pain management recommendations (www.postoppain.org) [41, 42]. This approach improved compliance with pain management recommendations in an ERAS bundle.

2.4.3 Thromboprophylaxis

Mechanical thromboprophylaxis and compression stockings or intermittent pneumatic compression should be advised to all high-risk surgical patients undergoing major surgery (malignancy, hypercoagulable state, steroid use, advanced age, and obesity) [43–45]. Mechanical thromboprophylaxis should be continued until discharge.

2.4.4 Postoperative fluid and electrolyte therapy

ERAS states that it should be neither restrictive nor liberal in giving fluid therapy both intraoperatively and postoperatively. Maintenance fluid should always be given according to the body weight, with supplementing electrolytes over 24 hrs. Too much fluid might lead to intestinal edema, resulting in decreased bowel movement and delayed oral intake. Thus increasing postoperative complications and increased length of hospital stay [46]. The patient should be encouraged to oral liquids when they are awake.

2.4.5 Urinary drainage

Urinary catheterization can cause urinary tract infection (UTI), which is directly related to the duration of catheterization. So, the duration of catheterization should be individualized based on the risk factor of urinary retention (male gender, epidural anesthesia, pelvic surgery). In low-risk cases catheter should be removed on the first day of surgery, whereas in high risk, it should be kept for up to 3 days.

2.4.6 Prevention of postoperative ileus

It is a significant cause of postoperative discomfort and length of hospital stay. The ERAS items, like limiting the use of opioids and encouraging the use of multimodal analgesia, minimally invasive surgery, avoiding routine nasogastric tube insertion, and maintaining goal-directed fluid therapy, can limit the postoperative ileus [6].

2.4.7 Postoperative glycaemic control

The physiological response to surgical injury is insulin resistance which can persist for several weeks after elective surgery [47]. Hyperglycaemia is a risk factor for surgery. This can be prevented in the ERAS pathway by giving preoperative oral carbohydrate loading, laparoscopic surgery, and epidural analgesia.

2.4.8 Postoperative nutritional care

Early oral feeds are another essential element in ERAS protocol that reduces postoperative complications (postoperative ileus) and length of hospital stay. It also helps reduce any in-hospital infection. Studies have shown that there is no advantage in keeping nil by mouth for patients undergoing major surgeries, which instead hampers fast recovery. However, patients with early oral feeds are also at risk of nausea and vomiting. To prevent this, a targeted strategy should be planned. Use of anti-emetic drugs to be adopted and emetogenic drugs (opioids) should be avoided [48].

2.4.9 Early mobilization

Postoperatively patient has to mobilize as early as possible to avoid pulmonary complications, reduced muscle strength, risk of thromboembolism, insulin resistance, delayed bowel movements, and prolonged hospital stay [19].

3. ERAS in emergency surgery

This has been proven that ERAS has a defined role in elective surgery [49]. However, the effectiveness of these protocols in emergency abdominal surgeries has been nominally studied. The protocols that have been clearly defined for elective surgeries were not fully applicable in emergency surgeries, and there would be difficulty in compliance with the set protocols. However, some elements of the ERAS bundle can be included in emergency surgeries. The recent evidence showed a reduced length of stay and postoperative complications on implementing even tailored ERAS protocols in emergency abdominal surgeries [50]. Tailoring of the ERAS protocol can be done to include only critical items which can facilitate program implementation in emergency surgery. This has shown better outcomes and a reduction in the cost of care in emergency surgery. Recent studies have shown that 70% of the ERAS bundle is required to get the beneficial effects [51–53].

4. Impact of ERAS

ERAS is described as an intention to treat analysis. The compliance rate of ERAS may vary which depends on different surgical approaches and diseases. Minimally invasive surgery with minimal tubes and drains is considered a standard of care.

Postoperative pain management is one of the major elements in the ERAS bundle. It facilitates early ambulation and rehabilitation, ultimately reducing length of hospital stay [41, 54]. Inadequate postoperative pain relief may lead to chronic pain development and ultimately increase the readmission rate [54, 55]. The ERAS protocols reduce the length of hospital stay (3–5 days) as well as a significant reduction in overall morbidity (Relative Risk of 0.6, 95% CI 0.46–0.76), without any higher readmission rate [56]. In addition to reduced length of hospital stay and morbidity, there is enhanced recovery, including reduced duration of ileus, preservation of lean body mass, and a more active lifestyle [57].

5. Conclusion

Enhanced recovery after surgery (ERAS) are specially designed multimodal perioperative care pathways for a speedy recovery. ERAS pathways are the standard of care, but their widespread dissemination is still challenging. Some elements of the ERAS bundle, like minimally invasive surgery and limiting tubes and drains, are standard of care and are being followed in most of the centers. However, the other elements of the ERAS bundle, like preoperative carbohydrate loading and postoperative early ambulation, still need to be implemented in routine clinical practice. There is considerable difficulty in adherence to the complete ERAS bundle. Postoperative pain management is one of the major elements in the ERAS bundle. Multimodal

analgesia is the optimal modality for pain control. It facilitates early ambulation and rehabilitation. It also decreases the duration of ileus and morbidity, ultimately reducing the hospital stay and readmission rate. Current evidence recommends ERAS protocol as a whole and not as a few elements within it. However, each item within the protocol constantly changes over time, depending upon the evidence.

Conflict of interest

The authors declare no conflict of interest.


Author details

Navin Kumar*, Rohik Anjum, Dhiraj Mallik, Farhanul Huda, Bibek Karki
and Somprakas Basu

Department of Surgery, All India Institute of Medical Sciences, Rishikesh, India

*Address all correspondence to: navin.surg@aiimsrishikesh.edu.in

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References

- [1] Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. *British Journal of Anaesthesia*. 1997;**78**:606-617
- [2] Kehlet H, Mogensen T. Hospital stay of 2 days after open sigmoidectomy with a multimodal rehabilitation programme. *The British Journal of Surgery*. 1999;**86**:227-230
- [3] Fearon KC, Ljungqvist O, Von Meyenfeldt M, et al. Enhanced recovery after surgery: A consensus review of clinical care for patients undergoing colonic resection. *Clinical Nutrition*. 2005;**24**(3):466-477
- [4] Lassen K, Hannemann P, Ljungqvist O, et al. Enhanced recovery after surgery group. Patterns in current perioperative practice: Survey of colorectal surgeons in five northern European countries. *BMJ*. 2005;**330**(7505):1420-1421
- [5] Ljungqvist O, Young-Fadok T, Demartines N. The history of enhanced recovery after surgery and the ERAS society. *Journal of Laparoendoscopic & Advanced Surgical Techniques. Part A*. 2017;**27**:860-862
- [6] Gustafsson UO, Scott MJ, Schwenk W, et al. Guidelines for perioperative care in elective colonic surgery: Enhanced recovery after surgery (ERAS[®]) society recommendations. *World Journal of Surgery*. 2013;**37**:259-284
- [7] Nygren J, Thacker J, Carli F, et al. Guidelines for perioperative care in elective rectal/pelvic surgery: Enhanced recovery after surgery (ERAS[®]) society recommendations. *World Journal of Surgery*. 2013;**37**:285-305
- [8] Gustafsson UO, Scott MJ, Hubner M, et al. Guidelines for perioperative Care in Elective Colorectal Surgery: Enhanced recovery after surgery (ERAS[®]) society recommendations: 2018. *World Journal of Surgery*. 2019;**43**(3):659-695
- [9] Gillissen F, Hoff C, Maessen JM, et al. Structured synchronous implementation of an enhanced recovery program in elective colonic surgery in 33 hospitals in the Netherlands. *World Journal of Surgery*. 2013;**37**:1082-1093
- [10] Spanjersberg WR, Reurings J, Keus F, et al. Fast track surgery versus conventional recovery strategies for colorectal surgery. *Cochrane Database of Systematic Reviews*. 2011;**16**(2):CD007635
- [11] Varadhan KK, Lobo DN. A meta-analysis of randomized controlled trials of intravenous fluid therapy in major elective open abdominal surgery: Getting the balance right. *The Proceedings of the Nutrition Society*. 2010;**69**(4):488-498
- [12] Pisarska M, Malczak P, Major P, et al. Enhanced recovery after surgery protocol in oesophageal cancer surgery: Systematic review and meta-analysis. *PLoS One*. 2017;**12**(3):1-14
- [13] De Groot JJA, Ament SMC, Maessen JMC, et al. Enhanced recovery pathways in abdominal gynecologic surgery: A systematic review and meta-analysis. *Acta Obstetrica et Gynecologica Scandinavica*. 2016;**95**(4):382-395
- [14] Ayyadhah AA. Reducing anxiety in preoperative patients: A systematic review. *The British Journal of Nursing*. 2014;**23**:387-393

- [15] Gan TJ, Habib AS, Miller TE, et al. Incidence, patient satisfaction, and perceptions of post-surgical pain: Results from a US national survey. *Current Medical Research and Opinion*. 2014;**30**:149-160
- [16] Hounsome J, Lee A, Greenhalgh J, et al. A systematic review of information format and timing before scheduled adult surgery for peri-operative anxiety. *Anaesthesia*. 2017;**72**:1265-1272
- [17] Wilson CJ, Mitchelson AJ, Tzeng TH, et al. Caring for the surgically anxious patient: A review of the interventions and a guide to optimizing surgical outcomes. *American Journal of Surgery*. 2016;**212**:151-159
- [18] Ziehm S, Rosendahl J, Barth J, et al. Psychological interventions for acute pain after open heart surgery. *Cochrane Database of Systematic Reviews*. 2017;**7**:CD009984
- [19] Dort JC, Farwell DG, Findlay M, et al. Optimal perioperative Care in Major Head and Neck Cancer Surgery with Free Flap Reconstruction: A consensus review and recommendations from the enhanced recovery after surgery society. *JAMA Otolaryngology. Head & Neck Surgery*. 2017;**143**(3):292-303
- [20] Bekelis K, Calnan D, Simmons N, et al. Effect of an immersive preoperative virtual reality experience on patient reported outcomes: A randomized controlled trial. *Annals of Surgery*. 2017;**265**:1068-1073
- [21] Bluman LG, Mosca L, Newman N, et al. Preoperative smoking habits and postoperative pulmonary complications. *Chest*. 1998;**113**:883-889
- [22] Thomsen T, Villebro N, Moller AM. Interventions for preoperative smoking cessation. *Cochrane Database of Systematic Reviews*. 2014;**2014**(3):CD002294
- [23] Mills E, Eyawo O, Lockhart I, et al. Smoking cessation reduces postoperative complications: A systematic review and meta-analysis. *The American Journal of Medicine*. 2011;**124**(2):144-154
- [24] Wong J, Lam DP, Abrishami A, et al. Short-term preoperative smoking cessation and postoperative complications: A systematic review and meta-analysis. *Canadian Journal of Anaesthesia*. 2012;**59**:268-279
- [25] Shabanzadeh DM, Sorensen LT. Alcohol consumption increases post-operative infection but not mortality: A systematic review and meta-analysis. *Surgical Infections*. 2015;**16**:657-668
- [26] Waitzberg DL, Saito H, Plank LD, et al. Postsurgical infections are reduced with specialized nutrition support. *World Journal of Surgery*. 2006;**30**:1592-1604
- [27] American Society of Anesthesiologists Task Force on Perioperative Blood Management. Practice guidelines for perioperative blood management: An updated report by the American Society of Anesthesiologists Task Force on perioperative blood management. *Anesthesiology*. 2015;**122**:241-275
- [28] Gan TJ, Diemunsch P, Habib AS, et al. Consensus guidelines for the management of postoperative nausea and vomiting. *Anesthesia and Analgesia*. 2014;**118**:85-113
- [29] Apfel CC, Kranke P, Eberhart LH, et al. Comparison of predictive models for postoperative nausea and vomiting. *British Journal of Anaesthesia*. 2002;**88**:234-240

- [30] Kappen TH, Moons KG, van Wolfswinkel L, et al. Impact of risk assessments on prophylactic antiemetic prescription and the incidence of postoperative nausea and vomiting: A cluster-randomized trial. *Anesthesiology*. 2014;**120**:343-354
- [31] Kappen TH, Vergouwe Y, van Wolfswinkel L, et al. Impact of adding therapeutic recommendations to risk assessments from a prediction model for postoperative nausea and vomiting. *British Journal of Anaesthesia*. 2015;**114**:252-260
- [32] Ip HY, Abrishami A, Peng PW, et al. Predictors of postoperative pain and analgesic consumption: A qualitative systematic review. *Anesthesiology*. 2009;**111**:657-677
- [33] Tanner J, Norrie P, Melen K. Preoperative hair removal to reduce surgical site infection. *Cochrane Database of Systematic Reviews*. 2011;**9**(11):CD004122
- [34] Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: Application to healthy patients undergoing elective procedures: An updated report by the American Society of Anesthesiologists Task Force on preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration. *Anesthesiology*. 2017;**126**:376-393
- [35] Engelman DT, Ben Ali W, Williams JB, et al. Guidelines for perioperative Care in Cardiac Surgery: Enhanced recovery after surgery society recommendations. *JAMA Surgery*. 2019;**154**(8):755-766
- [36] Medbery RL, Fernandez FG, Khullar OV. ERAS and patient reported outcomes in thoracic surgery: A review of current data. *Journal of Thoracic Disease*. 2019;**11**(Suppl. 7):S976-S986
- [37] Rao W, Zhang X, Zhang J, et al. The role of nasogastric tube in decompression after elective colon and rectum surgery: A meta-analysis. *International Journal of Colorectal Disease*. 2011;**26**:423-429
- [38] Nelson R, Edwards S, Tse B. Prophylactic nasogastric decompression after abdominal surgery. *Cochrane Database System*. 2007;**2007**(3):CD004929
- [39] Kaibori M, Iida H, Ishizaki M, et al. Objective and quantitative assessment of postoperative pain in digestive surgery. In: Kaibori RFM, editor. *Enhanced Recovery after Surgery*. Singapore: Springer nature; 2018. pp. 29-42
- [40] Gregory AJ, Grant MC, Manning MW, et al. Enhanced recovery after cardiac surgery (ERAS cardiac) recommendations: An important first step-but there is much work to Be done. *Journal of Cardiothoracic and Vascular Anesthesia*. 2020;**34**(1):39-47
- [41] Joshi GP, Schug SA, Kehlet H. Procedure-specific pain management and outcome strategies. *Best Practice & Research. Clinical Anaesthesiology*. 2014;**28**:191-201
- [42] Lee B, Schug SA, Joshi GP, et al. Procedure-specific pain management (PROSPECT): An update. *Best Practise & Research Anaestheisiology*. 2018;**32**:101-111
- [43] Hill J, Treasure T. Decreasing the venous thromboembolism risk summary of the NICE guidelines. *Praxis (Bern 1994)*. 2010;**99**:977-980
- [44] Kakkos SK, Caprini JA, Geroulakos G, et al. Combined intermittent pneumatic leg compression and pharmacological

prophylaxis for prevention of venous thromboembolism. Cochrane Database of Systematic Reviews. 2016, 2016;**9**:CD005258

[45] Sachdeva A, Dalton M, Lees T. Graduated compression stockings for prevention of deep vein thrombosis. Cochrane Database of Systematic Reviews. 2018;**11**(11):CD001484

[46] Ljungqvist O, Scott M, Fearon KC. Enhanced recovery after surgery: A review. *JAMA Surgery*. 2017;**152**(3):292-298

[47] Thorell A, Efendic S, Gutniak M, et al. Insulin resistance after abdominal surgery. *The British Journal of Surgery*. 1994;**81**:59-63

[48] Moningi S, Patki A, Padhy N, et al. Enhanced recovery after surgery: An anesthesiologist's perspective. *Journal of Anaesthesiology Clinical Pharmacology*. 2019;**35**(Suppl 1):S5-S13

[49] Wisely JC, Barclay KL. Effects of an enhanced recovery after surgery programme on emergency surgical patients. *ANZ Journal of Surgery*. 2016;**86**(11):883-888

[50] Sharma J, Kumar N, Huda F, et al. Enhanced recovery after surgery protocol in emergency laparotomy: A randomized control study. *Surgery Journal (N Y)*. 2021;**7**(2):e92-e99

[51] Gotlib Conn L, McKenzie M, Pearsall EA, et al. Successful implementation of an enhanced recovery after surgery programme for elective colorectal surgery: A process evaluation of champions' experiences. *Implementation Science*. 2015;**10**:99

[52] Gustafsson UO, Hausel J, Thorell A. Adherence to the enhanced recovery after surgery protocol and outcomes after

colorectal cancer surgery. *Archives of Surgery*. 2011;**146**:571-577

[53] ERAS Compliance Group. The impact of enhanced recovery protocol compliance on elective colorectal cancer resection: Results from an international registry. *Annals of Surgery*. 2015;**261**:1153-1159

[54] Glare P, Aubrey KR, Myles PS. Transition from acute to chronic pain after surgery. *Lancet*. 2019;**393**(10180):1537-1546

[55] Rosero E, Joshi GP. Hospital readmission after ambulatory laparoscopic cholecystectomy: Incidence and predictors. *The Journal of Surgical Research*. 2017;**219**:108-115

[56] Greco M, Capretti G, Beretta L, et al. Enhanced recovery program in colorectal surgery: A meta-analysis of randomized controlled trials. *World Journal of Surgery*. 2014;**38**(6):1531-1541

[57] Basse L, Madsen JL, Kehlet H. Normal gastrointestinal transit after colonic resection using epidural analgesia, enforced oral nutrition and laxative. *The British Journal of Surgery*. 2001;**88**(11):1498-1500