



## Review Article

## Enhanced recovery after surgery (ERAS) for the anaesthesiologist

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## ABSTRACT

Enhanced recovery after surgery (ERAS) protocol consists of entire spectrum of pre, intra and post-operative designed to enhance patient outcomes. Since its first introduction for major abdominal surgery in the 1990's, ERAS protocols have been successfully used extensively in many countries in several major surgical procedures. When effectively implemented, ERAS resulted in reduction in hospitalization, improvement in satisfaction of the patients, and reduction in complication rate without an increase in re-admissions. Implementation of ERAS in India has also positively affected the patient experience and led to efficient utilization of valuable hospital resources.

Many of the ERAS components are linked to the anaesthesia team. Anaesthesiologists help in preparing anaesthesia, they also ascertain the fasting regime in preoperative period, assess premedication, and introduce prophylaxis for post-operative nausea and vomiting (PONV). Intraoperatively, they introduce low sodium fluid therapy, help in preventing hypothermia, and utilize short acting drugs. They also help in important decision making during postoperative analgesia. An anaesthesiologist role is foremost important in the implementation of ERAS protocol. The article aims to discuss the various components of ERAS and the role of anaesthesiologist in implementing them.

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## 1. Introduction

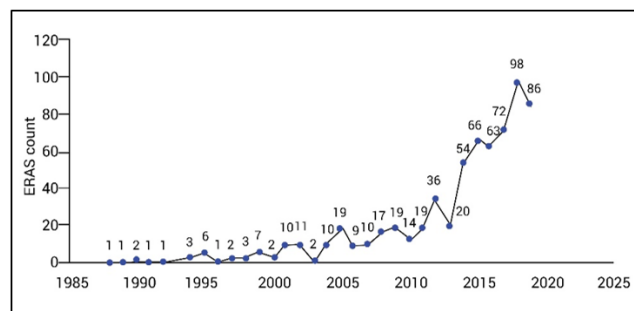
Enhanced Recovery After Surgery (ERAS) protocols help in lowering the stress response and maintain organ function thereby achieving early recovery post-surgery.<sup>1,2</sup> ERAS has

led to a shift from conventional patient care in surgical wards to a more evidence-based approach. This has further lowered recovery time and postoperative complication rates thereby being cost-effective.<sup>1</sup> There has been a growing interest in ERAS, especially within the last five years suggesting improved patient outcomes with ERAS protocols across different surgical settings (Figure 1). Since

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the initial introduction in the late 1980's, the publications on ERAS has expanded with more than 1300 articles published in the last 5 years.<sup>3</sup>



**Fig. 1:** ERAS count from 1988-2019

### 1.1. ERAS protocol-an overview

Adapted from Motwani SK, Yadav VK and Jhanwar S. Enhanced Recovery After Cardiac Surgery - A Single Tertiary Care Centre Experience in India. *E-Cronicon Anaesthesia*. 2019;5(4): 97-105.

Brown JK, Singh K, Dumitru R, Chan E, Kim MP. The Benefits of Enhanced Recovery After Surgery Programs and Their Application in Cardiothoracic Surgery. *Methodist Debakey Cardiovasc J*. 2018 Apr-Jun;14(2):77-88.

The ERAS protocol comprises of entire spectrum of pre, intra and post-operative care to enhance patient outcomes (Figure 2). These protocols reduce hospitalization, lower complication rate and promote faster recovery of the patient's preoperative functional state to return to their daily activities, including work, more quickly.<sup>4,5</sup>

A recent meta-analysis indicated that implementation of ERAS protocols reduced hospitalization by approximately 2.3 days and the complication rates by approximately 40%.<sup>5</sup> In an international, multicentre randomized trial, ERAS protocol patient mobility in ICU as well as increased the functional independence upon discharged.<sup>6</sup> ERAS protocols significantly reduced the burden of perioperative opioid usage.<sup>2</sup> The ERAS protocol promotes use of multimodal anaesthesia care such as use of regional anaesthesia, local anaesthetics, or as well nonopioids such as nonsteroidal anti-inflammatory drugs (NSAIDs), gabapentin and ketamine.<sup>7</sup>

Since its first introduction for major abdominal surgery by Henrik Kehlet in the 1990's, ERAS protocols have been successfully used extensively in many countries in several major surgical procedures (Figure 3).<sup>8</sup>

### 1.2. ERAS - The Indian perspective

Few studies in India have evaluated the impact of ERAS protocols on patient outcomes. In cardiac surgery, ERAS protocol reduced ICU stay and length of hospitalization,

without any increase in readmission or complication rates. This positively affected the patient experience and led to efficient utilization of valuable hospital resources.<sup>4</sup> Following hepatopancreatic-biliary surgery, ERAS protocols significantly reduced the length of postoperative stay without compromising patient safety.<sup>9</sup> In valve surgery, early extubation according to ERAS protocol proved to be beneficial for faster recovery, shorter ICU and hospital stay without any significant impact on postoperative patient outcomes compared to traditional methods.<sup>10</sup>

Many components of the protocol are directly connected to the activities of the anaesthesia team. Anaesthesiologists play an important role in anaesthesia preparation, determining the fasting regime during preoperative period, introduction of post-operative nausea and vomiting (PONV) prophylaxis and assessing the premedication. During the intraoperative period, the anaesthesiologists make use of low sodium fluid therapy, use short acting drugs and prevent hypothermia. Moreover, they also are involved in important decisions regarding intra- and postoperative analgesia (i.e., epidural anaesthesia and non-opioid analgesics).<sup>11,12</sup>

## 2. Anaesthesiologist and the Pre-Operative Period

### 2.1. Peri-operative patient assessment and risk stratification

A preoperative multidisciplinary evaluation is done, to assess and optimize functional, and nutritional status and mitigate comorbid conditions, through screening tests and questionnaires.<sup>5</sup>

The American Society of Anaesthesiologists (ASA) Physical Status Classification System has been in use for over 60 years, to assess and communicate a patient's pre-anaesthesia medical co-morbidities. The final assignment of Physical Status classification must be made on the day of anaesthesia care by the anaesthesiologist after evaluating the patient. While the classification system alone does not predict the perioperative risks, when used in combination with other factors, such as type of surgery, frailty, level of deconditioning, etc, it can be helpful in predicting perioperative risks and surgical outcomes.<sup>13</sup> These assessment will also the patient participation in shared decision-making to understand if the surgery represents their best treatment option.<sup>14</sup>

### 2.2. Framework for perioperative risk prediction

The American College of Cardiology/American Heart Association (ACC/AHA) and the European Society of Cardiology/European Society of Anaesthesiology (ESC/ESA) have provided a conceptual model which will help in assessing preoperative cardiac risk by classifying patients into risk groups with the help of patient demographics, comorbidities and functional capacity as discriminators.<sup>15,16</sup> Figure 4 provides a conceptual model

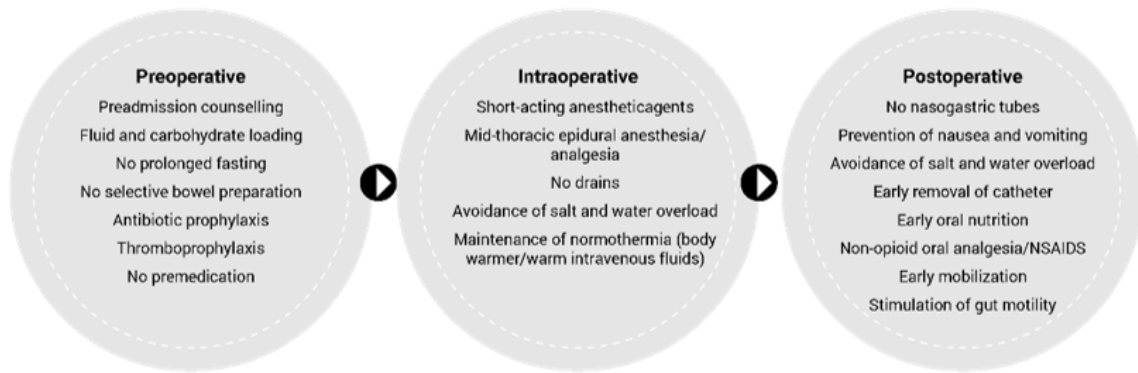


Fig. 2: Outline of ERAS protocol

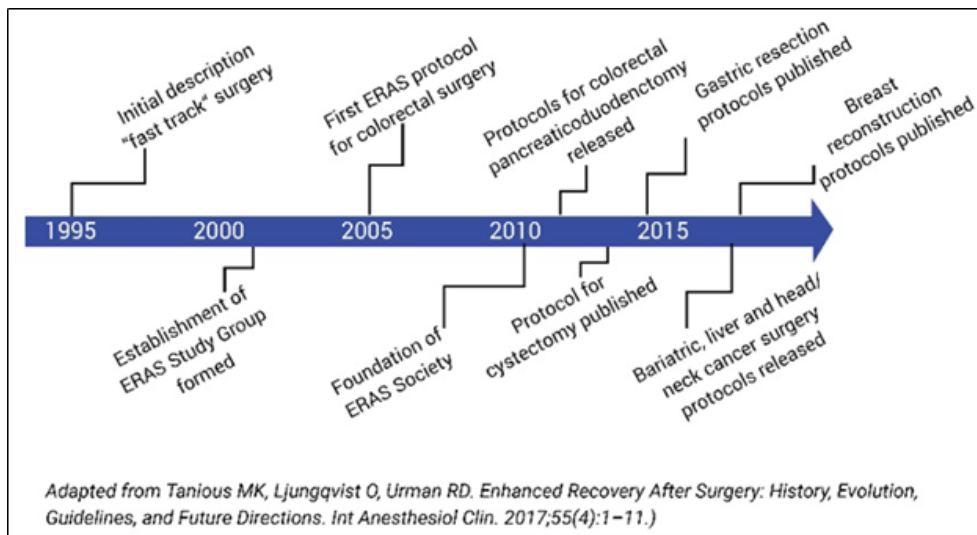


Fig. 3: Timeline of development of bundled perioperative care processes

for outcome after surgery.<sup>14</sup>

### 2.3. General fitness and cardiopulmonary exercise

A large study utilising data from the National Surgical Quality Improvement Program (NSQIP), showed that decreasing physiological and functional reserve before the surgery, increases rates of complications, 30-day mortality, and duration of hospital stay.<sup>17</sup>

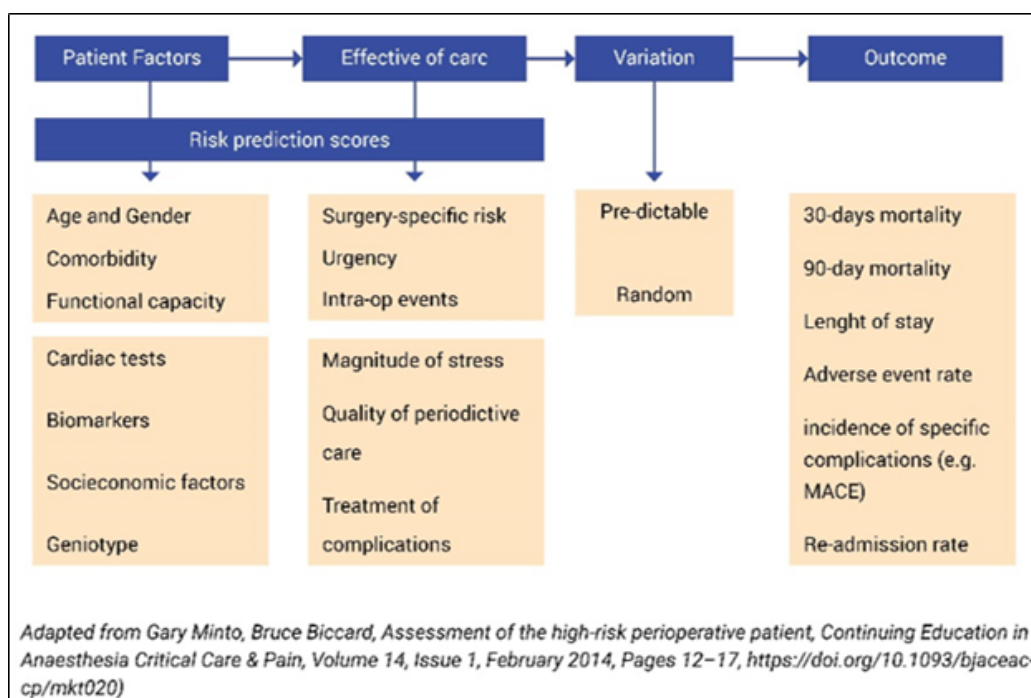
For ideal perioperative management of patients undergoing cardiac surgery, preoperative exercise helps in strengthening the functional capacity of patients by decreasing sympathetic over-reactivity, enhancing insulin sensitivity, and improving lean body mass to body fat ratio.<sup>18</sup> Another systematic review which investigated the extent to which preoperative conditioning (PREHAB) improves physiologic function and thereby surgical outcomes, showed that preoperative exercise improves inspiratory muscle endurance, functional mobility, and

quality of life and there is a reduction in postoperative pain scores and anxiety.<sup>19</sup>

Prehabilitation protocols are gaining increasing acceptance in ERAS. Prehabilitation using education, nutritional optimization, psychological preparation and exercise training, have successfully demonstrated significant benefits.<sup>5</sup>

### 2.4. Consumption of clear liquids and carbohydrate loading

According to numerous evidences, intake of clear liquids until 2 to 4 hours preoperatively is an important part of ERAS protocols especially in noncardiac surgeries.<sup>18</sup> Intake of carbohydrate-rich drink 2 to 3 hours before surgery is believed to place patients in a metabolically fed state, which in turn reduces postoperative nitrogen and protein losses. This helps to maintain lean body mass and muscle strength and decreases insulin resistance, helps with tissue



**Fig. 4:** A conceptual model for predicting outcome after surgery grey shaded area represents variables included in many risk predictions scores. MACE, major adverse cardiac events

glycosylation as well as return of gut function. Carbohydrate treatment also reduces preoperative thirst, hunger, and anxiety.<sup>20,21</sup>

ERAS guidelines recommend 800 mL of a 12.5% carbohydrate-containing clear drink with a proven safety profile the night before surgery and 400 mL, 2 hours before surgery.<sup>5</sup>

### 2.5. Premedication

ERAS protocols have successfully incorporated the management of surgical site infection (SSI) and thromboembolic/deep vein thrombosis (DVT). By using standard practices such as use intravenous antibiotics prior to incision, bowel preparation with antibiotics, glove/instrument change as well as antibiotic irrigation prior to closure and use of chlorhexidine-alcohol skin wipes pre-incision, there has been a 34% reduction in SSIs. Such protocols also improve postoperative immune function and reduce perioperative inflammatory markers. Use of DVT prophylaxis has reduced the incidence of perioperative DVT from 0.8% to 0% in ERAS patient population.<sup>2</sup>

### 2.6. Anemia

Preoperative anaemia predicts not only postoperative complications but also mortality.<sup>21</sup> A retrospective cohort study of > 200,000 patients, indicated that mild preoperative anemia enhances the 30-day non-cardiac morbidity and

mortality risk in both men and women across all age groups.<sup>5</sup> Increased risk of hospital-associated infection, increased duration of hospitalization, higher probability of re-hospitalization, renal impairment and higher risk of thrombosis have also been attributed to low haemoglobin levels.<sup>22</sup>

Correction of haemoglobin levels with supplements such as vitamin B12, iron and/or erythropoietin preoperatively is mandatory.<sup>21</sup> In patients with severe anemia or patients undergoing a major surgery, preoperative blood transfusion may correct haemoglobin levels rapidly and effectively; however, it carries the risk increased mortality and morbidity due to infection, stroke or myocardial infarction.<sup>5,21,22</sup>

Implementation of such protocols will not only reduce and even avoid transfusions, but also help obtain the best clinical results, improve postoperative recovery, reduce re-hospitalizations, and lower costs.<sup>21,22</sup>

## 3. Anaesthesiologist and Intra-Operative Period

### 3.1. Choice of anaesthetic drugs

Anaesthetic care involves delivery of anaesthesia as well as managing postoperative pain.<sup>12</sup> ERAS protocols are used to lower the effect of anaesthetic techniques on organs, hasten recovery of gastrointestinal and motor functions. Therefore, special attention should be given to the type of anaesthetic agents and monitoring of vitals.<sup>21</sup>

In ERAS, administration of epidural anaesthesia is an important element.<sup>12</sup> It not only restores bowel motor activities but also has a range of beneficial effects such as limiting metabolic response, reducing postoperative insulin resistance, which not only shortens hospital stay but also decreases metabolic complications.<sup>23</sup> A thoracic epidural catheter is recommended to be inserted which helps provide analgesia with a local anaesthetic, thus not needing the opioids.<sup>12</sup>

### 3.2. Multimodal analgesia

Use of preventive analgesia is an important element of pain management. To obtain this effect, analgesics from various categories are employed, regional analgesia techniques are used and drugs inhibiting development of central nervous system sensitisation are administered.<sup>12</sup>

According to the Polish guidelines, pre-emptive analgesia is required to modify nociception and multimodal analgesia, which is thereby beneficial in relief of pain, reducing the doses as well as the risks of adverse side effects.<sup>12</sup>

Sometimes for effective control of postoperative pain, more than one analgesic modality is required.<sup>24</sup> Multimodal analgesic protocol is an important component of ERAS pathways.<sup>25</sup>

Multimodal analgesia involves use of non-opioid analgesics such as nonsteroidal anti-inflammatory drugs, gabapentinoids, acetaminophen, alpha-2 agonists, ketamine along with procedures such as neuraxial and/or peripheral neural blockade techniques which will help in decreasing opioid dose and its side-effects. They are designed in a way to maximize physiologic and pharmacologic benefits as well as promote quick recovery and return to patients' vitals to baseline function.<sup>25</sup>

Multimodal nonopioid analgesia is known to decrease perioperative need of opioids, thereby lowering proportion of patients needing an opioid prescription after discharge.<sup>5</sup>

Opioids have been the foundation of postoperative analgesia for moderate to severe pain. As many patients suffer from chronic pain, prescription of long-term opioid affects the central and peripheral sensitization, thereby impacting development of abnormally heightened sensitivity to pain. Hence, the effort has been made to modify multimodal regimens in ERAS protocols that reduce the demand for opioids, thereby reducing its side effects.<sup>24</sup>

A multimodal analgesic protocol encompasses a combination of acetaminophen, an NSAID, and a gabapentanoid given preoperatively.

Intraoperatively, use of regional anaesthesia or analgesics as well as an opioid-sparing anaesthetic is encouraged. While postoperatively, regional analgesic technique is preferred. For prevention of breakthrough pain, tramadol preceded by opioids can be given. This pathway is used

in major surgeries (Figure 5). When used during colorectal surgery, liver resection, and cystectomy, a reduction in hospital stay by 1- to 2-day, reduction in cost, and improvement in the patient satisfaction and a decrease in complications was observed. Utilization of multimodal analgesia in liver resection was associated with pain score improvements.<sup>25</sup>

Adapted from Wick EC, Grant MC, Wu CL. Postoperative Multimodal Analgesia Pain Management With Nonopioid Analgesics and Techniques: A Review. *JAMA Surg.* 2017 Jul 1;152(7):691-697.

### 3.3. Fluid management

The main aim of intraoperative fluid management is maintaining central euolemia whilst avoiding salt and water overload.<sup>26,27</sup> This, not only renal and pulmonary complications but also helps in return of bowel function, lowers urinary tract infections and surgical site infections. The role of fluid management has been a controversial component of ERAS.<sup>2</sup>

There has been a debate on whether restrictive or liberal fluid therapy is appropriate for different procedures. Numerous evidences suggest that the liberal fluid therapy plays a role in many postoperative complications.<sup>2,12</sup>

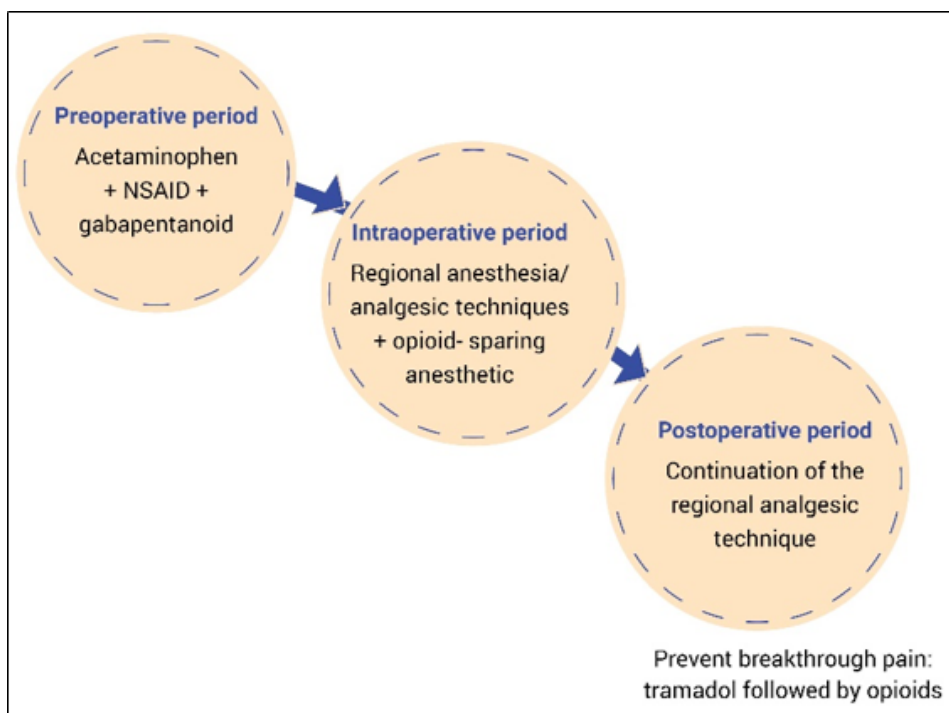
When there is an overload of fluid, the risk of tissue oedema increases, hindering the healing of intestinal anastomoses which further delays intestinal motor functions, leading to paralytic ileus. Surgical patients with sodium-low fluid therapy between < 2000 mL of fluids and < 77 mmol of sodium per day, demonstrated a shortened hospitalization from 9 to 6 days and a shortened paralytic ileus from 6.5 to 4 days.<sup>12</sup>

According to a meta-analysis, goal directed fluid therapy (GDFT) reduces postoperative morbidity and hospitalization in high-risk patients with limited physiologic reserve, severe cardiopulmonary illness, aortic vascular disease, renal impairment, and planned extensive surgery. When GDFT is compared with evidence-based fluid regimens, no benefits have been demonstrated when compared with more traditional liberal fluid administration. Moreover, when comparing GDFT with a zero-balance strategy, there was no benefit as well as harm in ERAS patients.<sup>5</sup> Within an ERAS protocol, surgery patients are less fluid responsive after anaesthesia induction.<sup>26</sup>

A combination of fluids and inotropes are used during intraoperative GDFT which helps in optimizing perfusion thereby improving tissue oxygen delivery.<sup>27</sup> Assessment of volume status can be performed measurement of HR, BP, laboratory test, pulmonary artery catheterization, arterial waveform-based analysis, thoracic bioimpedance-based technologies, and echocardiography.<sup>28</sup>

Despite this controversy, the American Society of Colon and Rectal Surgeons and the Society of American Gastrointestinal and Endoscopic Surgeons recommends





**Fig. 5:** Regime for multimodal analgesia

GDFT in an ERAS protocol, as it is believed to decrease complications as well as mortality.<sup>5</sup>

### 3.4. Prevention of hypothermia

The incidence of inadvertent intraoperative hypothermia (core temperature  $<36^{\circ}\text{C}$ ) ranges from 6% to 90%. The risk increases with extended surgery, higher age, massive burns, lower preoperative temperature, severe trauma, and major intraoperative fluid shifts.<sup>29</sup> Prevention of hypothermia can reduce cardiac complications, wound infections, bleeding and transfusion requirements, and may improve immune function, recovery and overall survival.<sup>21</sup>

Impairment of normal physiologic temperature regulation can be caused by both Both general and neuraxial anaesthesia.<sup>30</sup> Supplementation with analgesics, sedatives, or general anaesthesia further impairs thermoregulation.<sup>29</sup> Under general anaesthesia, the core temperature is reduced by 0.5–1.5°C in the first 30 min, causing an internal redistribution of body heat.<sup>21</sup>

Hypothermia not only extends action of anaesthetic drugs but even in mild severity, it adversely affects the myocardial outcomes by three-folds.<sup>29</sup>

In up to 40% patients especially in younger age group and those with low core temperature, postanesthetic shivering occur, which leads to 100% increase in oxygen consumption, raised intraocular and intracranial pressures, surgical incision causing wound pain, and morbid myocardial outcomes. The risk of postanesthetic shivering

can be reduced by maintaining strict normothermia, skin surface warming, treatment with meperidine, clonidine, dexmedetomidine, ketanserin, magnesium sulfate, tramadol, physostigmine, and nefopam.<sup>29</sup>

According to the National Institute for Health and Clinical Excellence (NICE) guideline, the patients should be assessed for risk of developing perioperative hypothermia before transfer to the operation theatre. Use fluid warming device to warm IV fluids and blood products at  $37^{\circ}\text{C}$ . For preventing perioperative hypothermia forced air warmers are recommended.<sup>29</sup>

## 4. Anaesthesiologist and Postoperative Period

### 4.1. Postoperative nutrition

The European Society for Clinical Nutrition and Metabolism (ESPEN) guideline focusses on nutritional aspects of patients undergoing major surgery, and those with severe complications despite best perioperative care.<sup>31</sup>

The key aspects of perioperative nutrition care include:<sup>31</sup>

1. Integrating nutrition in overall patient care
2. Initializing oral feeding as early as possible
3. Starting nutritional therapy when the risk becomes apparent
4. Control of metabolic parameters such as blood glucose
5. Lowering stress-related catabolism or impairment of gastrointestinal function

6. Minimized time on paralytic agents for ventilator management in the postoperative period
7. Early mobilisation

The American Society for Enhanced Recovery and Perioperative Quality Initiative Joint Consensus Statement on Nutrition Screening and Therapy recommends a high-protein diet (via diet or high-protein oral nutritional supplement) be initiated on the day of surgery in most cases, with exception of patients without bowel in continuity, with bowel ischemia, or persistent bowel obstruction. The consensus statement also suggests that reaching an overall protein intake goal is more important than total calorie intake in the postoperative period.<sup>32</sup>

In patients who are malnourished as well as those who cannot meet nutritional goals (>50% of protein/kcal) via oral feeds are recommended for enteral and parenteral nutrition.<sup>32</sup>

#### 4.2. Early mobilization

In many surgical specialities, early mobilisation forms an important part of ERAS protocol. Bed rest following surgery is associated with increased cases of muscle wasting, thromboembolism, physical deconditioning, and pneumonia.<sup>33</sup>

Therefore, early mobilisation after major elective surgery not only lowers respiratory complications but also thromboembolic events, improving functional capacity. Up to 85% of patients undergoing liver resection may be ambulatory by post-operative day 3. According to Yip et al, sitting out of bed by post-operative day 1 ( $P < 0.03$ ), walking by post-operative day 3 ( $P = 0.03$ ) and removal of urinary catheter by post-operative day 3 ( $P < 0.01$ ) were independently associated with successful hospital discharge within 6 days after surgery.<sup>32</sup>

Early ambulation can be promoted by preoperative counselling of the patient, as well as effective stepwise, multimodal analgesia regimens that limit reliance on systemic opiates.<sup>34</sup> When the epidural analgesia is extended to the lumbar nerve roots, during thoracic or open abdominal surgery, postoperative hypotension and lower limb weakness is caused. For such scenarios use of epidural systems which lowers interference with ambulation is favored.<sup>21</sup>

Regardless of risk, all patients should be commenced with postoperative thromboprophylaxis along with early ambulation, intermittent pneumatic compression and the use of well-fitted compression stockings and may incorporate low-molecular-weight heparin.<sup>35</sup>

Most of the ERAS guidelines recommend enforced early mobilization within the first 24 hours after surgery without any specification of duration, intensity, target or frequency of mobilization.<sup>36</sup>

#### 4.3. Removal of catheter

Surgical drains should be removed quickly after surgery. Its routine use hinders mobilization, increases morbidity, and prolongs hospital stay.<sup>35</sup>

Continuous use of urinary catheters is associated with a risk of catheter-associated urinary tract infection (CAUTI) by 5% per day; moreover, 3.6% of those who develop a CAUTI further develop urosepsis, thereby increasing hospitalization, morbidity as well as mortality.<sup>5</sup>

Occurrence of CAUTI can be prevented by limiting the use and duration of urinary catheters (< 24-48 hours irrespective of epidural analgesia) and using proper aseptic technique for catheter insertion.<sup>5</sup> Therefore, urinary catheter should be removed within the first 24 hours in colonic and upper rectal surgeries, and 48 hours in mid-rectal or lower rectal surgeries and patients at risk of retention.<sup>36</sup> Zaouter et al. demonstrated catheter removal on postoperative day 1 even with epidural analgesia had lower urinary infection rate and similar re-catheterization rates.<sup>34</sup> According to a recent meta-analysis, implementation of ERAS pathways on hospital-associated infections reduced postoperative UTIs along with decrease in lung infections and surgical site infections.<sup>5</sup>

#### 4.4. Postoperative ileus

Postoperative ileus disrupts the normal peristaltic motion of the gut.<sup>26</sup> It is the single most factor which prolongs hospitalization and increases risk of complications.<sup>21</sup> The major contributing factors include surgical stress, secretion of inflammatory mediators, inhaled anesthetics, fluids, endogenous opioids in GI tract, and electrolyte balance and use of opioids for postoperative analgesia.<sup>26</sup>

Therefore, prevention of postoperative ileus and promotion of bowel motility is one of the main goals of ERAS practices.<sup>36</sup> Probiotics, pentoxifylline, early feeding in combination with multimodal regimens, valdecoxib, clonidine, ropivacaine, flurbiprofen, ketorolac, lidocaine as well as spinal analgesia accelerate recovery of GI motility. Reduced gut motility is a well-known side effect of opioids, hence its use is restricted during the postoperative phase. NSAID such as flurbiprofen and ketorolac might be helpful in restricting opioid use.<sup>37</sup> Additionally, several studies have revealed that chewing sugar free gums may facilitate early restoring of gut mobility. Despite the poor quality of these studies, American and French ERAS guidelines for colorectal surgery recommends chewing gums for its limited risk and potential benefits.<sup>36</sup>

#### 4.5. PONV

Postsurgery, the incidence of PONV ranges between 20–30%. On the contrary, it increases upto 70% in high-risk patients. The most commonly known factors causing PONV are female gender, smoking status, a history of motion

sickness and the use of postoperative opioids. In ERAS, a multimodal approach is followed wherein antiemetics are used along with IV propofol instead of inhalational agents.

Other factors influencing PONV prevalence are carbohydrate-loading, reduction of preoperative fasting, adequate hydration and high inspired oxygen concentrations. Moreover, NSAID use and regional anaesthetic may also have an indirect influence on the prevalence of PONV. Efficacy of antiemetics such as dopaminergic, cholinergic, histaminergic and serotonergic have shown to be superior in PONV prevention. Combinations of antiemetic demonstrate better effective than monotherapy. In high-risk patients, 2–3 antiemetics combinations along with propofol shows highest possibility of reducing PONV.<sup>21</sup>

#### 4.6. Postoperative pain management

Pain interrupts recovery milestones and delays discharge after surgery, hence optimal management of acute postsurgical pain is an important component of ERAS.<sup>38</sup> According to the ERAS Society multimodal oral analgesia is recommended for postoperative pain management. It consists of combining acetaminophen with NSAIDs unless contraindicated.<sup>39</sup>

NSAIDs are not only effective in controlling postoperative pain but also reducing opioid requirements. Although there are some concerns regarding safety of NSAIDs with respect to risk for anastomotic leak and bleeding, evidence suggest an overall reduction in postoperative complications with no increased risk for anastomotic leak or bleeding.<sup>39</sup>

Opioids are very effective against severe pain; but their side-effects include increase in hospitalization from dose-related side effects including urinary retention, respiratory depression, PONV, sedation and ileus. Opioids may not always be effective in controlling postoperative pain, as they provide an initial analgesic effect but subsequently cause rapid development of tolerance and a reduction in pain threshold (i.e., opioid-induced hyperalgesia).<sup>38</sup> Opioids, if required, should be used only as adjuncts and limited to the lowest dose and for the shortest duration possible.<sup>39</sup>

### 5. Difficulties in ERAS Implementation

Numerous evidence has proven the success of ERAS protocol by demonstrating decreased recovery times, reduced hospitalization, and increased patient satisfaction. A single centre study showed that 50-90% increase in compliance rate decreased complication rates by 20% and the length of stay by 4 days. A large-scale ERAS Compliance Group in 2015, demonstrated that increasing compliance to ERAS lowers complication rate. During intraoperative period the rate of ERAS compliance ranges between 60-90%. Even in cases of lower compliance

(< 70%), implementation of ERAS protocol is beneficial and improves short-term outcomes. According to a study conducted by Roulin et al., non-compliance is usually observed in postoperative period and in almost 80% cases, they are medically justified. Successful implementation of ERAS protocol requires a multidisciplinary team, distributing patient educational materials, and modifying the postoperative ward into a patient friendly rehabilitation centre.<sup>40</sup>

Conventional intraoperative practices, such as overnight fasting prior to surgery, mechanical bowel preparation and routine use of, nasogastric tubes, catheters and drains and, yet continue to be followed across India. Some surgeons have adopted the ERAS principles, but these have not become an institutional policy. Among those who follow ERAS protocol, only some components are implemented, while other are avoided.<sup>41</sup>

Data on implementation of ERAS protocols in Indian medical institutions are limited to a few observational studies utilizing only a few ERAS care elements. Earlier studies from India demonstrated a significant early tolerance to feeds and mobilization with ERAS in patients undergoing open elective bowel anastomosis. Similarly, early discharge was reported for patients undergoing colostomy closure, colorectal surgery, and gastrectomy.<sup>41,42</sup> A study carried out in a government tertiary hospital from India, demonstrated that most of ERAS protocols were followed in elective general surgeries, thereby leading to early patient discharge with a very low rate of complication and morbidity. However, there is still a long way to go for its full implementation.<sup>41</sup>

In the Indian context, the commonly identified barriers to ERAS are lack of awareness, lack of importance given to perioperative care, initiative lacking from healthcare providers, and lack of interdepartmental coordination. Once these barriers are defeated, ERAS can be successfully implemented in Indian scenario.<sup>41</sup> The promising trend in the studies reported from India will lead to a successful and wider implementation of ERAS pathways in India as in the West. This will in turn translate into real-life cost savings and improvement in quality, both for the patient and the health-care system, which is of utmost importance in developing nations.<sup>42</sup>

A multi-disciplinary team is required for the implementing of ERAS. The central ERAS team consists of doctors from surgical, anaesthesia, and nursing care along with other members such as nutritionists, physicians from various specialties, occupational and physical therapists and social workers.<sup>43</sup> Implementation must involve equal participation of all the relevant stakeholders. However, surgeon and anaesthesiologist usually participate actively in-patient management.<sup>44</sup> This team should be responsible for reviewing available literature and formulating the ERAS program to be implemented at their institute. Individual



components should be tailored to match locally available expertise and facilities. The formulated ERAS protocols should be made available to all those involved in the team. Provision for feedback should be provided within the program. Feedback from individual staff members must be made available to the multidisciplinary team at subsequent team meetings. Along with regular audits, feedbacks help in improving the process of the program. Along with regular internal quality checks, external audit may even be organized. After the changes are done, the entire cycle must be again be initiated.<sup>43</sup>

For the success of ERAS, an active participation of the patient is required. The role of family can be used as an advantage. Early family involvement will not only reduce total cost but also improve satisfaction of the patient. Moreover, the patient can be further motivated with wireless connectivity and wearable devices, thus causing early discharge from hospital.<sup>45</sup>

## 6. Conclusion

The ERAS protocol incorporates new modalities in surgery, anaesthesia and nutrition, enforces early mobilization and feeding, and emphasizes reduction of the surgical stress response. When effectively implemented, ERAS paves a way towards reduced hospitalization, improvement in satisfaction of the patient satisfaction, as well as reduction in complication rate without hospital re-admissions. Moreover, ERAS significantly increased understanding of peri-operative physiology and how to modulate it to improve outcomes. An anaesthesiologist is the most important ally of the surgeon in the formulation and implementation of this protocol at an institutional level. Until ERAS becomes a routine practice, all personnel involved in the peri-operative care of the surgical patient should be familiar with ERAS and its principles. ERAS in the coming years will hopefully see a wider implementation due to its benefits.

## 7. Source of Funding

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## 8. Conflict of Interest

The authors have declared and confirmed that there is no conflict of interest with respect to this authored publication. The views expressed and stated in this article are the independent views of the authors and not of Abbott India Ltd.

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