



Surgery

UNIVERSITY OF TORONTO

Enhanced Recovery after Surgery: ERAS for All

A Clinical Practice Guideline developed by the
University of Toronto's Best Practice in Surgery

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Contents

- Section 1: General information**
- Section 2: Guideline recommendations**
- Section 3: Supporting evidence**
- Section 4: External review**
- Section 5: Implementation strategies**

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Section 1. General information

Aim

The aim of this guideline is to make recommendations for pre-, intra- and post-operative care which will optimize recovery of patients undergoing surgery.

Outcomes of interest

Improved recovery, decreased complications and length of hospital stay, and increased patient satisfaction.

Target population

These recommendations apply to patients undergoing elective surgery.

Intended users

This guideline is intended for use by health care providers involved in the management and care of surgical patients including surgeons, anesthesiologists, nurses, dietitians, physiotherapists and trainees.

Rationale

The rationale for developing a procedure agnostic ERAS guideline which is applicable to patients undergoing most surgical procedures stemmed from the success of the development and implementation of an ERAS guideline for elective colorectal surgery that was developed by the Best Practice in Surgery (then Best Practice in General Surgery) in 2011. Following provincial implementation of the ERAS guideline for elective colorectal surgery patients, several hospitals asked for guideline recommendations to support the uptake of ERAS by other surgical specialities. In addition, several small, rural hospitals were interested in implementing an ERAS guideline, but required it to be more applicable to the wider surgical population.

Overview of process

A review of existing guidelines for Enhanced Recovery after Surgery was conducted to obtain a comprehensive list of all interventions recommended in published guidelines for all surgical procedures. This review was conducted using MEDLINE as well as searching guideline clearinghouses and the grey literature. Based on these guideline recommendations, a master list of interventions was created to determine similarities and differences amongst guidelines for the same surgical procedures as well as across different procedures. Once a comprehensive list of interventions was determined, a review of each individual ERAS intervention was undertaken by searching MEDLINE for relevant supporting evidence. After gathering and summarizing the evidence, the Best Practice in Surgery committee with representation from all surgical specialties, anesthesiologists and nurses, met to discuss the evidence and finalize recommendations. The evidence was assessed in adherence to GRADE recommendations (<http://www.gradeworkinggroup.org/>).

Section 2. Guideline recommendations

1. Preoperative recommendations

- 1.1 Patients and their families should receive education about the surgery and expected recovery prior to their operation (Level of evidence: Low)
 - 1.1.1 Patients and their families should receive information on: expected length of stay assuming there are no complications; length of preoperative fasting; pain control; early ambulation and feeding; and smoking cessation prior to surgery
 - 1.1.2 Patients should be assessed for history of gastroesophageal reflux disease, dysphagia symptoms, or other gastrointestinal motility disorders preoperatively. If present, patients may require individual recommendations for perioperative fasting
- 1.2 Patients should be allowed to eat solid foods until midnight the night before surgery (Level of evidence: Low)
- 1.3 Patients should be encouraged to drink clear fluids up to 2 hours before anesthesia administration. Clear fluids include coffee and tea (without milk), and drinks that are high in carbohydrates (i.e. apple juice and pulp-free orange juice) (Level of evidence: High)
- 1.4 Infants can consume breast milk up to 4 hours prior to anesthesia administration (Level of evidence: Low)

2. Intraoperative recommendations

- 2.1 Perioperative pain control should be multimodal (Level of evidence: Moderate)
 - 2.1.1 Multimodal opioid-sparing analgesia should be considered for all patients. This should include considering acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), gabapentinoids, ketamine, lidocaine, epidurals and regional anesthesia
 - 2.1.2 Analgesia should be customized to enable the earliest possible transition to oral medications including early removal of patient controlled analgesia (PCA) if used
- 2.2 Prophylactic use of nasogastric (NG) tubes for decompression should be avoided. (Level of evidence: High)
 - 2.2.1 NG tubes may be used in patients having gastric or pancreatic surgery as per the surgeon's clinical judgement
- 2.3 See guideline recommendations for surgical site infection prevention

3. Postoperative recommendations

- 3.1 Patients should be encouraged to participate in early mobilization once extubated with the exception of patients having spine surgery who should be assessed individually (Level of evidence: Moderate)
 - 3.1.1. Patients should be encouraged to dangle on the side of their bed, walk, or sit in a chair on postoperative day (POD) 0
 - 3.1.2. Patients should be encouraged to walk at least twice on POD1 and everyday until discharge
 - 3.1.3. Patients should be encouraged to sit up in a chair while awake during the day
- 3.2 Patients should resume eating and drinking as soon as possible after surgery (Level of evidence: Moderate)
 - 3.2.1. Patients should be offered clear fluids 2 hours postoperatively provided they are awake, alert and capable of swallowing
 - 3.2.2. Patients should be offered solid food beginning POD1
 - 3.2.3. Patients should be encouraged to chew gum 3x/day for 5 minutes until they are tolerating solid food
- 3.3 The routine use of Foley catheters should be avoided with the exception of patients undergoing urologic or pelvic surgery, there is an anticipated prolonged duration of surgery, patient is anticipated to receive large volume infusions of fluid or diuretics, or the patient requires monitoring
 - 3.3.1 If used, the Foley catheter should be removed within 24 hours except if the patient underwent rectal or urologic surgery

- 3.3.2 For patients who undergo rectal surgery the catheter should be removed at or before 48 hours
- 3.3.4 For patients who undergo urologic surgery the catheter should be removed at the discretion of the treating urologist based on the nature of the surgery

Section 3. Supporting evidence

1. Preoperative Recommendations

1.1 Patients and their families should receive education about the surgery and expected recovery prior to their operation. (Level of evidence: Low)

1.1.1 Patients and their families should receive information on: expected length of stay assuming there are no complications; length of preoperative fasting; pain control; early ambulation and feeding; and smoking cessation (if applicable) prior to surgery

1.1.2 Patients should be assessed for history of gastroesophageal reflux disease, dysphagia symptoms, or other gastrointestinal motility disorders preoperatively. If present, patients may require individual recommendations for perioperative fasting

Despite the limited evidence, it is widely believed that preoperative patient education is an essential component of ERAS programs. Appropriate preoperative education has been shown to decrease patients' anxiety and fears about surgery, reduce postoperative complications, as well as lessen the use of postoperative analgesia and leads to shorter hospital stays¹⁻⁴. Many patients view surgery as a threatening experience with many stressful components which elicit strong emotional responses^{3,4}. These responses including fear, distress, and anxiety and can have negative repercussions for the patient in the postoperative period^{2,3}. Research, although limited, has shown that preoperative psychosocial interventions have positive effects on postoperative psychological and physical functioning³⁻⁵. Additionally, it has been suggested that patient education should address the patient, the patient's spouse or partner, and the patient-partner relationship³.

There is limited information available on the effect of preoperative education on patient outcomes, particularly within an ERAS program. However, a few qualitative studies have been conducted to determine patients' needs and satisfaction within an ERAS program. Sibbern et al (2016) conducted a qualitative systematic review and meta-synthesis to better understand patient experiences while in an ERAS program. This review included 11 studies (9 interviews and 2 focus groups).⁶ The studies included patients who underwent colorectal surgery (n=7), hip replacement (n=3), hip or knee replacement (n=1). With regards to preoperative counselling, this study found that both written and verbal information was essential for making patients feel prepared for surgery. Ideally, patients should receive written information prior to their pre-admission visit to better prepare for the appointment and be able to have questions ready. It was noted that many times patients received different information including between written and verbal instructions and from different healthcare providers. It is essential that patients receive a consistent message from all healthcare providers as well as standardized messaging in all written materials. Additionally, this study found that it was beneficial to patients to have a family member present during the preadmission visit. These findings are consistent with the recommendations set forth in ERAS protocols^{1,2}. The European ERAS Society suggests that providing patients with clear expectations of what will occur during hospitalization leads increased adherence to the guideline recommendations and allows for early recovery and discharge^{1,7,8}. Additionally, the ERAS literature strongly recommends that patients should be given clear tasks including milestones for such interventions as food intake and mobilization^{1,2,8,9}.

With regards to preoperative education outside of an ERAS program, two Cochrane reviews have been conducted. One review looks at the impact of preoperative education for patients undergoing total hip or knee replacement and the impact on postoperative outcomes.¹⁰ Overall, 18 trials were included in the review with a total of 1463 participants. The quality of evidence was very low as only 6 studies used an adequate method of allocation concealment; only two trials blinded participants and only a few trials reported data on patient centered outcomes including pain, function, quality of life, and postoperative anxiety). The educational interventions also differed significantly between groups. Six trials included

patients receiving written information and one or more educational sessions. Written information alone was studied in one trial. Five trials included an audio-video component in addition to either written and/or in-person education sessions. All patients in the control groups did receive some type of written information prior to surgery. Overall, this review found that preoperative education may not improve pain, function, health-related quality of life and postoperative anxiety as compared to usual care. The other Cochrane review looked at preoperative education for patients undergoing laparoscopic cholecystectomy.¹¹ The review included four trials with 431 participants randomized to formal preoperative education including verbal education, multimedia DVD, computer-based multimedia, and PowerPoint presentations (n=215) compared to standard care (n=216). Due to the included studies having a high risk of bias, the authors of this review were unable to comment on the effect on pain scores, patient knowledge, patient satisfaction, or patient anxiety associated with education. None of the trials reported surgical complications, quality of life, length of hospital stay, return to work or number of unplanned visits to the doctor. Thus, there is inconclusive evidence on the impact of preoperative education on clinical outcomes.

While there are no controlled trials that assess the impact of preoperative assessment for gastroesophageal reflux disease, dysphagia symptoms, or other gastrointestinal motility disorders, the American Society of Anesthesiologists strongly suggests that this assessment should be performed as part of the patients' preoperative evaluation.¹² This recommendation is based on these patients having an increased risk for reflux and aspiration.

1.2 Patients should be allowed to eat solid foods until midnight the night before surgery (Level of evidence: Low)

There is very little evidence available that allows an evidence based recommendation for solid intake. The current guidelines all support a fast of 6 hours following a light meal. This recommendation is based on the estimated physiologic gastric emptying time for healthy patients. An ultrasonographic study by Soreide et al. showed that 4 hours of fasting was required to guarantee complete emptying of solid particles after a light breakfast.¹³ Factors such as smoking, functional dyspepsia, psychological stress and female hormones may further prolong gastric emptying times for solids.^{14,15} Combining this set of information, and allowing a sufficient margin of safety, all of the international and national guidelines recommended that the fasting period after intake of solids should not be less than 6 hours.^{12, 16-18,}

From a 2003 Cochrane review on preoperative fasting, the only available data that were reviewed on shortened solid fast compared to a standard fast were two trials that were conducted in 1983.¹⁹ The participants randomized to the treatment group received a small preoperative breakfast (mean of 249min or 199min prior to induction). In both trials, there was no difference in the intervention groups compared to the groups who received a standard fast of midnight before surgery in regards to gastric residual volume or gastric pH values. These trials had very small sample sizes, and thus, very little can be concluded from these results.

1.3 Patients should be encouraged to drink clear fluids up to 2 hours before anesthesia administration. Clear fluids include coffee and tea (without milk), and drinks that are high in carbohydrates (i.e. apple juice and pulp-free orange juice) (Level of evidence: High)

Early research in the role of preoperative fasting determined that for passive regurgitation and pulmonary aspiration to occur during anaesthesia, a certain gastric volume must be present. It has been assumed that a minimum of 200 mL of residual volume is required for regurgitation.^{20,21} Numerous studies have reported that in most patients, the preoperative mean gastric fluid volume is in the range of 10-30 mL and 120 mL is rarely exceeded irrespective of intake of clear fluids.^{22,23} With this in mind, many trials have been performed to confirm this observation. A Cochrane Review on preoperative fasting for adults to prevent perioperative complications has provided the most thorough compilation of work and has

served as justification for many of the modern day fasting guidelines.¹⁹ The review was undertaken in 2003 and included 22 individual randomized controlled trials with a total of 2270 participants.

With regards to optimum duration of fast for fluids, none of the trials that were included in the Cochrane Review noted an increased occurrence of aspiration or regurgitation in any of the investigational groups. Individual trials examined gastric content by measuring gastric residual volume and pH as surrogate markers. They compared a standard fast with a fast that allowed some fluid intake up to 90min, between 120-180min or 180min or longer preoperatively. The volume of allowed fluid that was compared was 150 mL or between 300-450 mL. They noted no differences in gastric content or pH values between those having a standard fast or a shortened fast. In regards to thirst, all groups that received fluids preoperatively recorded a reduction in thirst and dryness of mouth; however, postoperatively there was no difference in thirst among the groups. There were also no significant differences in regards to preoperative hunger, nausea, or vomiting between any of the groups.

The Cochrane Review also assessed the impact of different volumes of fluid classifying them into low (≤ 150 mL), high (> 150 mL), and unlimited volumes. There were no reported differences in the rates of aspiration or regurgitation nor gastric content volume or pH levels. They did note that participants who received a high volume of fluid reported a decrease in thirst in the preoperative period but not in the postoperative period. In addition, patients in the trials that allowed unlimited fluids preoperatively had significantly less thirst both preoperatively and postoperatively. None of the clinical practice guidelines that were reviewed specify the amount of fluid that patients may consume preoperatively. However, ASPEN suggests "an unlimited amount of water".¹⁶

The Cochrane Review also assessed the impact of different types of liquid and included trials that compared 1) water to the standard fast; 2) coffee to the standard fast, and 3) water, pulp-free orange juice, apple juice, carbohydrate drink, coffee or tea to the standard fast. The trials that examined only water found a statistically significantly lower volume of intraoperative gastric contents in the participants permitted preoperative water ($p=0.02$) compared to standard fast. However, this difference was not considered clinically significant. In regards to the other 2 interventions (comparing coffee to standard fast and water, pulp-free orange juice, apple juice, carbohydrate drink, coffee or tea to the standard fast), there was no difference in the volume of gastric contents between the treatment and the standard fasting groups. Of note, all guidelines that were reviewed broadly define clear liquids as water, pulp-free juices, tea, coffee, carbonated drinks and clear carbohydrate-rich drinks^{12, 16-18}.

The European Society of Anesthesiology Guidelines provide support for encouraging the consumption of a clear fluid (water, pulp-free juice, and coffee and tea without milk) prior to surgery as they believe this practice is not only safe, but that a prolonged fast is in fact inappropriate in preparing patients for the stress of Surgery¹⁸. Thus, they encourage patients, especially children and the elderly, to keep drinking until 2 hours prior to surgery.

All reviewed CPGs support this recommendation for adults, as well as children, infants, and neonates. Additionally, a Cochrane Review was conducted in 2010 to assess the effects of different fasting regimens on the impact of perioperative complications on children and included 25 studies with 47 randomized controlled comparisons involving 2543 children who were at normal risk of regurgitation or aspiration. These studies compared a shortened fast of differing times to a standard fast (nil-by-mouth-from-midnight). Overall, the authors found that children who were permitted fluids up to 2 hours preoperatively, regardless of the volume, did not experience higher gastric volumes or lower gastric pH levels than those who fasted. The authors did note that children who were permitted fluids were less thirsty and hungry, better behaved and more comfortable than those who fasted. Thus, due to the safety of reduced fast with no increased complications, and increased patient comfort and satisfaction, the recommendations are deemed applicable to children²⁴.

The rationale for encouraging patients to consume drinks high in carbohydrates (CHO) is to enhance the patient's outcome by minimizing the adverse effects of starvation and decreasing the effects of surgical stress. Additionally, it has been hypothesised that CHO drinks may reduce insulin resistance and glycogen depletion and may attenuate loss of muscle mass, hunger, thirst, anxiety, nausea as well as surgical complications leading to reduced length of hospital stay.

There is broad support for the consumption of clear, carbohydrate rich drinks as both the Canadian Anesthesiologists Society and the American Society of Anesthesiology recently published clinical practice guidelines that support the intake of clear fluid intake (including CHO drinks) two hours prior to induction^{12,17}. Additionally, the Canadian Agency for Drugs and Technologies in Health (CADTH) reviewed 5 systematic reviews and seven evidence-based guidelines on the clinical effectiveness of preoperative CHO loading in patients undergoing surgery under general anesthetic²⁵. Overall, the majority of the evidence showed no benefit with preoperative carbohydrate drinks but some studies showed modest effects for reduced length of stay, postoperative insulin resistance, return to GI function, and patient wellbeing. As well, these studies did find that use of CHO was safe as it did not increase the risk of postoperative complication such as aspiration. Thus, they concluded that while there is no strong evidence to support its use in terms of improved surgical outcomes, there is no evidence for potential postoperative complications, and this, CHO drink may be encouraged as it may improve the tolerability of fasting in the pre-surgical period.

Smith et al completed a Cochrane Review to assess the effects of preoperative CHO loading on postoperative recovery and insulin resistance in adult patients undergoing elective surgery²⁶. Twenty-seven trials involving 1976 participants were included in the review. The trials included patients undergoing abdominal surgery (18), orthopedic surgery (4), cardiac surgery (4), and thyroidectomy (1). Overall, the consumption of preoperative CHO drinks as compared to fasting or a placebo was associated with a modest reduction in length of stay (MD - 0.30 days, 95%CI -0.56 to -.04). However, these results should be interpreted with caution as heterogeneity was high, except for patients undergoing abdominal surgery. Patients undergoing abdominal surgery tended to have overall longer lengths of hospital, showed a larger decrease in LOS (MD -1.66 days, 95%CI -2.97 to -0.34). With regards to postoperative complications, 14 studies (913 participants) with low heterogeneity contributed to the analysis. The ingestion of CHO drinks did not affect the rate of postoperative complications (RR 0.98, 95%CI 0.86 to 1.11). Thirteen studies (n=789) reported on aspiration pneumonitis and there no instances of this reported. No evidence for insulin resistance was reported (MD -1.59, 95%CI -3.35 to 0.17). However, preoperative CHO treatment was associated with postoperative increased insulin sensitivity (MD 0.76 mL/kg/min, 95%CI 0.24-1.29). No evidence of treatment effect was found for postoperative nausea at 24 hours (MD -1.69, 95%CI -4.12 to 0.74) or postoperative vomiting (RR 1.25, 95%CI 0.77 to 2.04). With respect to return of bowel function, two studies found a reduction in mean time of 0.39 days (95%CI -0.70 to -0.07) however there was no effect for time to first bowel movement (MD -0.28 days, 95%CI -0.62 to 0.05). In sum, this review found that the intake of CHO treatment prior to surgery may lead to a small reduction in length of hospital. However, its use does not appear to have an effect on other postoperative outcomes.

There is much debate regarding carbohydrate loading in diabetic patients. Unfortunately, there is limited evidence available to support or refute a recommendation on this. To date, only one study has assessed preoperative carbohydrate loading in type-2 diabetes patients. This study was of low quality, compared 25 patients with diabetes to 10 health controls²⁷. The patients in the experimental group were given a carbohydrate-rich drink (400 ml, 12.5% with 1.5g of paracetamol) that is not currently available in Canada. The authors found that peak glucose was higher in diabetic patients (13.4 +/- 0.5 vs. 7.6 +/- 0.5 mM; P<0.01), however glucose concentrations were back to baseline at 180 minutes for diabetic patients compared to 120 min in the control group (P<0.01). Gastric half-emptying time (T50) was also significantly different with it occurring at 49.8 +/- 2.2 min in diabetics compared to 58.6 +/- 3.7 min in the control (P<0.05). Despite these difference, the authors concluded that type 2 diabetic patients showed no signs of delayed gastric emptying suggesting that the use of carbohydrate drinks may be

safely administered prior to surgery. Most guidelines reviewed, as well as the European Enhanced Recovery After Surgery Guidelines, do not support providing CHO beverages to diabetic patients. However, the European Anesthesiology Guidelines recommend that "It is safe for patients (including diabetics) to drink carbohydrate-rich drinks up to 2 hours before elective surgery)¹⁸. At the University of Toronto affiliated hospitals, consensus has been reached that patients with diabetes should be able to tolerate the carbohydrate-rich drinks. However, due to limited evidence, the recommendation for carbohydrate loading does not include diabetic patients.

In summary, there is strong evidence that favours reducing preoperative fasting times and is supported by numerous worldwide guidelines. Reducing the fasting time to 2 hours for clear fluids and 6 hours for solids does not increase the risk of regurgitation or pulmonary complications in patients who are otherwise healthy. As such, adopting these practices should become the standard of care.

1.4 Infants can consume breast milk up to 4 hours prior to anesthesia administration (Level of evidence: Low)

Similarly, there is limited evidence on the impact of ingesting breast milk prior to surgery. The ASA made its recommendation based on observational findings that suggested equivocal findings of gastric volumes and pH levels when healthy neonates and toddlers ingested breast milk 4 hours prior to surgery¹². There is insufficient evidence to comment on the incidence of emesis/reflux or pulmonary aspiration. Thus, this recommendation is largely based on consensus from the ASA.

2. Intraoperative recommendations

2.1 Perioperative pain control should be multimodal (Level of evidence: Moderate)

2.1.1 Multimodal opioid-sparing analgesia should be considered for all patients. This should include considering acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), gabapentinoids, ketamine, lidocaine, epidurals and regional anesthesia

In 2016, the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee and Administrative Council released a clinical practice guideline on the management of postoperative pain.²⁸ The group recommends multimodal analgesia for the treatment of postoperative pain in both adults and children. They define multimodal analgesia as the "use of a variety of analgesic medication and techniques that target different mechanisms of action in the peripheral and/or central nervous system". Multimodal analgesia is highly recommended as it is perceived to provide more effective pain control when compared to single modalities. They also recommend that clinicians try to incorporate non-opioid analgesics and nonpharmacological treatments into their modalities and try to avoid opioids when possible. Citing two randomized controlled trials, this CPG suggests that the use of two or more medications leads to superior pain relief in addition to reduced opioid consumption. The authors do note that there is limited high-quality evidence to support which exact medications should be used together. However, the authors provide suggestions for common procedures.

2.2.2 Analgesia should be customized to enable the earliest possible transition to oral medications including early removal of patient controlled analgesia (PCA) if used

The American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee and Administrative Council CPG also made recommendations for oral rather than IV administration of opioids postoperatively. As well, the group recommends that IV PCA be used when the parental route is needed for management of ileus, aspiration risk or after surgeries that affect the ability to take medications orally.²⁸

2.2 Prophylactic use of nasogastric tubes for decompression of the GI tract should be avoided. (Level of evidence: High)

The Cochrane Collaboration originally published a review article titled "Prophylactic nasogastric decompression after abdominal surgery" in 2004, which has subsequently undergone two additional updates in 2007 and 2010.²⁹ The review examined randomized controlled trials that compared individuals with and without routine prophylactic use of NG tube gastric decompression. The population consisted of adults over the age of 18 who had any type of abdominal operation. Included in this review were colorectal, gastroduodenal, biliary, esophageal, and hepatic surgeries. Furthermore, the results from each individual trial were in agreement with the conclusions of the Cochrane review. The review examined 5 major outcomes, including:

- a) Time to Flatus: of the studies analyzed, it was shown that there is no benefit to NG suction in accelerating the return of gastrointestinal function as measured by time to flatus. Specifically, amongst the patients having colon surgery there was an earlier return of bowel function seen in patients without a tube.
- b) Pulmonary Complications (pneumonia and atelectasis): non-routine NG suction conferred a benefit (OR=1.45, CI=1.10-1.92). A subgroup analysis was done and found no difference in outcome amongst those who had colon surgery and a lower rate of complications amongst those who had upper gastrointestinal surgery and did not receive a NG tube (OR=1.49, CI=1.01-2.21)
- c) Wound Infection & Anastomotic leak: all studies that reported wound infections and/or anastomotic leak failed to show a difference between the groups
- d) Length of Stay: the majority of the studies reported a lower mean length of stay for the group without a tube, although statistical significance was not reached (OR=0.53, CI=-0.39-1.46)
- e) Gastric Upset: a total of 25 studies reported vomiting in the postoperative period of which the majority of trials showed more vomiting in the group without the tube (OR=0.64, CI=0.46-0.90)

A recent study by Kerger et al assessed the incidence of postoperative vomiting amongst those who did or did not receive an NG tube. The findings of this comparative study showed that intraoperative use of an NG tube was not associated with a reduction in nausea (OR=1.23, p=0.14), vomiting (OR=0.92, p=0.64), or postoperative nausea and vomiting (OR=1.22, p=0.16). The 24 hour postoperative nausea and vomiting incidence was 44.4% in patients with an intraoperative NG tube and 41.5% amongst those without a NG tube.³⁰

In summary, the evidence indicates that the original rationale for using prophylactic NG intubation, such as a reduction in wound infections, anastomotic leak, shorter length of stay, and pulmonary complications (pneumonia, atelectasis), are no longer valid reasons to use such therapy. As such, its use should be avoided as a prophylactic measure after surgery.

2.3 See guideline recommendations for surgical site infection prevention strategies

3. Postoperative recommendations

3.1 Patients should be encouraged to participate in early mobilization once extubated (Level of evidence: Moderate)

3.1.1. Patients should be encouraged to dangle on the side of their bed, walk, or sit in a chair on POD0.

3.1.2 Patients should be encouraged to walk at least twice on POD1 and everyday until discharge

3.1.3. Patients should be encouraged to sit up in a chair while awake during the day

There is very limited evidence on the effectiveness of postoperative mobilization for most surgical procedures with the exception of orthopedic operations. There is however evidence that suggests that extended bed rest has negative consequences. Additionally, there is some evidence supporting early mobilization within a multimodal program although the timing and frequency differ among protocols.

Castelino et al conducted a systematic review to assess the impact of early mobilization on postoperative outcomes on patients undergoing abdominal and thoracic surgery.³¹ Four studies included patients undergoing abdominal surgery (3 RCTs and 1 prospective observational study; 225 patients) and four studies included patients having thoracic surgery (3 RCTs and 1 retrospective observational study; 283 patients). There was significant variation between mobilization protocols with some including only sitting and walking while others included strengthening and/or aerobic activities and some included the assistance of healthcare providers while others did not. Overall, none of the studies reported significant differences between the two groups with respect to outcome. While all studies reported on length of stay, only one study found a significant reduction. Similarly, functional status was reported in 3 studies with only one finding a significant difference between the groups.

Early ambulation has mostly been studied in combination with other strategies including a multi-modal approach to surgical care. As such, the evidence presented must be taken in context along with the other included interventions. Khoo et al reported that individually ERAS interventions appear to improve outcome, but the degree of improvement is small; however, in combination, the improvements to the rate of recovery appear to be strong.³² The first trial to evaluate ambulation in the context of a multimodal ERAS approach was completed by Bardram et al. The trial studied 9 consecutive patients who underwent elective colonic resection. Patients received a thoracic epidural catheter, normal oral food intake immediately after surgery, and sat or walked for a median of 6 hours on the 1st day and 8 hours on the 2nd day. Of the 9 patients, 6 patients went home on postoperative day (POD) 2 and at 1 month postoperatively, all the patients had returned to their baseline function.³³

A recent study by Lee et al. looked at the effect a rehabilitation program with early mobilization and diet has on recovery rate. They randomized 100 patients, who had laparoscopic colon surgery, into a rehabilitation group with early mobilization and diet or to a conventional care group. They measured recovery time by including: 1) tolerance of diet for at least 24 hours (defined as eating one third or more of their meal), 2) analgesia free, 3) safe ambulation (defined as ambulation 600 meters without assistance), 4) afebrile status without major complications. They found that a rehabilitation program resulted in improved recovery after laparoscopic colon surgery (median (interquartile range), 4(3-5) days in the rehabilitation group compared to 6 (5-7) days, $p < 0.0001$) with no adverse effect on pain scores, complications, quality of life, or readmission. The observed improvements in recovery variables (diet tolerance, ambulation, and absence of pain and major complications) were strong in the rehabilitation group.³⁴

The final study was a novel approach to identify if early mobilization has an effect on the duration of postoperative ileus.³⁵ The rationale for this study was that the back and forth motion of a rocking chair might reduce intestinal gas accumulation, abdominal distention, and pain associated with postoperative ileus after abdominal surgery. This study adds to the current body of literature due to the fact that part of the early mobilization initiative was to get the patient out of bed and into a chair as soon as possible. A total of 66 patients, who underwent abdominal surgery for gastrointestinal cancers, were evaluated. The control and intervention groups received the same care, with the exception of the type of early mobilization. The control group's mobilization included walking and sitting in a non-rocking chair beginning on POD 1, whereas the intervention group received care that included walking and rocking in a rocking chair beginning on POD 1. The authors found that the rocking group passed flatus on average 0.7 days (16.8 hours) earlier than the non-rocking group ($p = 0.001$). There was a trend towards a greater amount of pain medication received in the non-rocking group as compared with the rocking group; however, this was not significant. Finally, time to discharge, total laps ambulated, and total amount of

time spent in a chair (rocking or not) were similar in the two groups. Although this study needs to be replicated in a larger trial before any recommendation can be made, it suggests that early mobilization as well as specific types of mobilization may be important.

With regards to orthopedic procedures, Guerra et al conducted a systematic review of the effect of early mobilization in patients who had a hip or knee joint replacement.³⁶ The authors included 5 randomized controlled trials encompassing 622 patients who underwent total hip arthroplasties (114), total knee arthroplasties (300), unicompartmental hemiarthroplasty (45), or total hip or knee arthroplasties (163). In four of the trials, the experimental groups were mobilized on the day of surgery (sitting out of bed or walking), while in the fifth, patients were mobilized on POD1. The controls groups usually started mobilizing on POD2. Otherwise care was similar in the two groups and in all the trials, the patients followed predetermined care plans. Most trials were of high quality (4 out of 5). The meta-analysis revealed a reduced length of stay of 1.8 days (95%CI 1.1-2.6) in the early ambulation group. There was less impairment (range of motion, gait, balance and muscle strength) in the experimental group although this was mainly due to the results of two of the trials. Additionally, activity outcomes (Oxford knee assessment score and visual analog score) were also better in the experimental groups (three trials). Lastly, patient satisfaction scale was similar and no significant differences in adverse events were reported. Thus, the authors concluded that there is moderate evidence that early mobilization, starting in the first 24 hours after surgery, is effective in reducing the length of stay without an increase in negative outcomes (i.e. adverse events). In addition, Stowers et al published an Enhanced Recovery after Surgery protocol for total hip and knee arthroplasty based on a systematic review of the evidence. The authors included 22 studies that met their inclusion criteria for enhanced recovery pathways or recommendations for total hip and knee arthroplasties. The authors found strong evidence to support early mobilization within 24 hours. The authors found that early mobilization led to fewer complications, including DVT and PE, as well as reduced hospital stay.³⁷

Overall, the available literature on postoperative mobilization is quite scarce outside of the orthopaedic literature and of the available literature, most is of poor quality. Thus, the recommendations are largely based on the literature that shows the detrimental effects of bedrest after surgery. Additionally, the evidence that does support the role of early mobilization after surgery provides evidence that there are multiple postoperative benefits, including a reduction in VTEs and an earlier removal of bladder catheters. Its effect on overall recovery must be taken in conjunction with the other modalities that it is commonly combined with. Furthermore, combining early mobilization with early enteral feeding and balanced analgesia, along with a minimal surgical approach, appear to provide a synergistic benefit to the patient and is slowly being adopted amongst enhanced recovery programs around the world.

3.2 Patients should resume eating and drinking as soon as possible after surgery. (Level of evidence: Moderate)

3.2.1. Patients should be offered clear fluids 2 hours postoperatively provided they are awake, alert and capable of swallowing

3.2.2. Patients should be offered solid food beginning POD1

3.2.3. Patients should be encouraged to chew gum 3x/day for 5 minutes until they are tolerating solid food

In 2015, the American Society for Parenteral and Enteral Nutrition released a clinical practice and perioperative fasting guideline.¹⁶ The authors systematically reviewed current guidelines containing pre- and post-operative fasting recommendations in Medline, CINAHL as well as several guideline databases. The authors found 19 relevant clinical practice guidelines to include in their review. All guidelines were assessed using the AGREE tool. The authors consolidated the 20 different recommendations, including recommendations on specific surgical populations, into 10 recommendations, with three pertaining to the postoperative period. The postoperative recommendations are as follows:

1. Generally, it is unnecessary to interrupt nutrition intake after surgery (Grading level: A)

2. In patients without complications, oral food and fluids should be recommenced as soon as possible (Grading level: B), according to patients' tolerance (Grading level: E), preferably within 24 hours of surgery (Grading level: A), or ideally within 4 hours following surgery (Grading level: A-B)
3. Where indicated or in patients in whom early oral nutrition cannot be initiated, nutritional support should be commenced as soon as possible after surgery via enteral route if possible (A-E) or parental route (B-E) and ideally within 24 or 48 hours after surgery (Grading level: A).

The authors concluded that based on the strength of the evidence supporting the recommendations, that postoperative nutrition (both fluid and solids) should be recommenced as soon as possible.

With respect to the gastrointestinal (GI) surgical patients specifically, the Cochrane Collaboration reviewed all the relevant randomized controlled trials regarding early enteral feeding for colorectal surgical patients until August 2006.³⁸ They included trials that compared early enteral feeding or supplemented oral feeding with no food (placebo). Their objective was to determine if early feeding following GI surgery is of clinical benefit. They reported on 7 different outcomes including: wound infection, intra-abdominal abscess, anastomotic dehiscence, post surgical pneumonia, mortality, length of stay, and adverse effects. The composite findings regarding wound infection (RR=0.77, CI=0.48-1.22), intra-abdominal abscess (RR=0.87, CI=0.31-2.42), anastomotic dehiscence (RR=0.69, CI=0.36-1.32), and post surgical pneumonia (RR=0.76, CI=0.36-1.58) failed to reach conventional levels of statistical significance but the direction of the effect indicated a likely benefit. Evaluating mortality as an outcome resulted in a significant reduction (RR=0.41, CI=0.18-0.93) amongst the patients who were randomized to the early EN group. Although it was difficult to determine the relationship between early feeding and mortality reduction, the majority of deaths in the control population were secondary to conditions that could benefit from nutrition (cardiac dysfunction, anastomotic leak or sepsis). The length of stay displayed a tendency towards a shorter length of stay for the treatment group with an overall reduction that corresponded to approximately one day. In regards to adverse effects, there was a significant increase in the relative risk of vomiting amongst patients who were fed early (RR=1.27, CI=1.01-1.61, p=0.04).

Since the Cochrane Review was released, several new trials have been published that add to this body of literature. A study by Han-Geurts et al³⁹ assessed the effects of an early oral diet on GI function and quality of life in patients undergoing elective open colorectal (n=50 in control group, n=46 in 'free diet' group) or abdominal vascular surgery (n=17 in control group and n=15 in 'free diet' group). Patients in the 'free diet' group were able to eat whatever and whenever they wanted. The conventional diet group received water only on POD 0-1, liquid diet (water, tea, coffee, lemonade) on POD 2-3, easily digestible diet on POD 4 and normal diet on POD 5. They found no difference between groups in regards to return of bowel function, postoperative complication rate, length of stay, and quality of life scores. They found that patients in the free diet group tolerated a diet containing solid foods a median of 2 days after surgery. Their study indicates that oral feeding is tolerated independent of the presence of a postoperative ileus.

El Nakeeb et al⁴⁰ randomized patients (n=120) to either an early feeding group (n=60) that began fluids on the first postoperative day or to a regular feeding group (n=60) that was managed as "nil per os" until the ileus resolved. The majority of their patients tolerated early feeding (75%), although vomiting occurred more frequently in the early feed group (25% vs. 10%, p=0.05). Both time to flatus (3.3 +/- 0.9 compared to 4.2 +/- 1.2, p=0.04) and time to first defecation (4.1 +/- 1.2 compared to 4.9 +/- 1.2, p=0.005) occurred sooner in the early feeding group. Similarly, the postoperative stay was shorter in the early feeding group (6.2 +/-0.2) vs. 6.9 +/-0.5 days, p=0.05). They did not find a difference in the frequency of wound complications, anastomotic leakage, or abnormalities in serum electrolytes.

The Cochrane Collaboration also conducted a review to assess the effect of early vs delayed oral intake of fluids and solids after major abdominal gynecological surgery in 2014.⁴¹ The authors included 5 RCTS totaling 631 patients. Early feeding was defined as starting within 24 hours after surgery while the control

group started oral intake after 24 hours and only after signs of postoperative ileus resolution. The authors found that early feeding was associated with shorter time to return of bowel sounds (MD -0.32 days, 95%CI -0.61—0.03, $p=0.03$) and flatulence (MD -0.21, 95%CI -0.40- -0.01, $p=0.04$). There was no difference between the groups with respect to passage of first stool (MD -0.25 days, 95%CI -0.58—0.09, $p=0.15$). The early feeding group had a significantly shorter hospital stay (MD -0.92 days, 95%CI -1.53 to - 0.31, $p=0.003$) and significantly reduced rate of infectious complications (RR 0.20, 95%CI 0.05 to 0.73, $p=0.02$). The authors found that the rate of developing postoperative ileus was comparable between the experimental and control groups (RR 1.03, 95%CI 0.64-1.67, $p=0.90$). Similarly, the rates between the groups for nausea and vomiting, abdominal distension or need for a postoperative NG tube were not significantly different. Thus, the authors concluded that early postoperative feeding appears to be safe without increasing negative outcomes.

In summary, the evidence indicates that early feeding results in a small decrease in length of stay compared with the traditional method of “nil per os” until bowel function resumes. Early feeding may lead to an increased chance of vomiting but otherwise there appears to be no adverse effects. In particular, early enteral feeding does not increase the rate of wound infection, infectious complications, or anastomosis dehiscence.

With regards to gum chewing, this recommendation comes from the colorectal literature. The first trial to evaluate the use of chewing gum following gastrointestinal surgery was completed by Asao et al⁴² They found that in those who received chewing gum, the time to passage of first flatus and defecation was significantly shorter. Since this initial study, several randomized controlled trials have been published. Currently, 4 separate systematic reviews and meta-analysis that has been published on this subject. The first review was completed by Chan et al.⁴³ who included 5 trials from patients who underwent colorectal resection. In total, 158 patients were randomized to either standard care therapy or to receive the intervention. They found that all patients tolerated the gum without any side-effects. In regards to intestinal motility, they found that patients in the gum chewing group passed flatus 24.3% earlier (weighted mean difference of -20.8 hours, $p=0.0006$) and had a bowel movement 32.7% earlier (weighted mean difference of -33.3 hours, $p=0.0002$). The patients in the gum chewing group were discharged 17.6% earlier (weighted mean difference of -2.4 days, $p<0.00001$) and did not differ in regards to postoperative complication rates, and readmission or reoperation rates. Parnaby et al conducted a similar review on 6 randomized controlled trials that contained a total of 256 patients.⁴⁴ They found similar results in regards to a significant reduction in time to flatus and time to bowel movement; however, they did not note a significant reduction in length of stay. Interestingly, the authors urge the reader to use caution with the results as the studies included had different techniques for randomization, 5 trials lacked blinding, and no allocation concealment was completed. In addition, study heterogeneity existed secondary to differing colorectal pathology, operative technique and postoperative analgesia, and oral intake requirements. Furthermore, only one trial examined the effect of gum chewing on bowel motility within an enhanced recovery program. The next review published was by Noble et al. who included 9 trials for a total 437 patients.⁴⁵ They found a mean reduction of time to flatus of 14 hours (95% CI -20 to -8h, $p<0.001$) and time to bowel movement of 23 hours (95% CI: -31 to -15, $p<0.001$). In addition, they found a mean reduction in length of stay of 1.1 days (-1.9, -0.2, $p=0.016$). Of note, the trial by Kouba et al dominated the results; however, the trial itself was not conducted in a randomized manner.⁴⁶ In addition, the authors also included one trial that investigated undefined gastrointestinal surgery solely on children.⁴⁷ As such; the results from this systematic review are difficult to interpret considering the trials that were included. The final review was conducted by Fitzgerald et al who included seven randomized controlled trials with 272 adult patients who had undergone elective open or laparoscopic gastrointestinal surgery for any indication.⁴⁸ In regards to bowel motility, the time to first flatus favored treatment with a 12.6 hour (17%) reduction (95% CI -21.49 to -3.72, $p=0.005$) and time to first bowel movement favored treatment with a 23.11 hour (22%) reduction in time to first bowel movement (95% CI -34.32 to -11.91, $p<0.0001$). The authors showed a non-statistically significant trend towards lower length of stay in the treatment group, with a 23.88 hour (12%) reduction (95% CI -53.19 to +5.53, $p=0.11$). Finally, the authors found no statistically significant differences between laparoscopic or open surgery groups.

In summary, the preliminary data tends to favor the use of chewing gum for the reduction of a postoperative ileus. The main advantage to using chewing gum is that it is inexpensive, well tolerated, and widely available. Furthermore, the use of chewing gum should not substitute for previously proven methods that are included in the enhanced recovery protocols; rather, it may be of benefit as either an add on therapy or in patients who are unable to tolerate early enteral feeds.

3.3 The routine use of Foley catheters should be avoided with the exception of patients undergoing urologic or pelvic surgery, there is an anticipated prolonged duration of surgery, patient is anticipated to receive large volume infusions of fluid or diuretics, or the patient requires monitoring.

3.3.1 If used, the Foley catheter should be removed within 24 hours except if the patient underwent rectal or urologic surgery

3.3.2 For patients who undergo rectal surgery the catheter should be removed at or before 48 hours

3.3.4 For patients who undergo urologic surgery the catheter should be removed at the discretion of the treating urologist based on the nature of the surgery

There is overwhelming agreement that urinary catheters should be avoided perioperatively unless they are absolutely necessary. Urinary tract infections are the most common type of hospitalize acquired infection, in both medical and surgical patients and the biggest risk factor for developing a urinary tract infection is indwelling urinary catheters.⁴⁹

Wald and colleagues reported on a cohort of 35,904 Medicare patients who had major cardiovascular, orthopaedic or gastrointestinal surgery in 2001.⁵⁰ Because of the data source, many of these patients were older and had significant comorbidities. In patients having gastrointestinal surgery, 80.3% of patients had a urinary catheter in place for more than 2 days with a mean duration of 5.1 days. Overall the risk of having a UTI in this group was 4% but increased from 4.5% to 9.4% in patients having a catheter for more than 2 days ($p=0.004$) compared to patients having a catheter for 2 days or shorter. Using a Cox Proportional Hazards Model, catheter duration of more than 2 days remained a significant predictor of time to developing a UTI and discharge to another facility rather than home.

Similarly, Trickey and colleagues, analyzed outcomes in 8,801 surgical patients in whom NSQIP data were collected.⁵¹ They also found that in patients having colonic and rectal surgery, 66% of patients who had UTIs had catheters in place for more than 2 post-operative days compared to only 43% of those who did not have a UTI ($p<0.001$).

The recommendations provided by the Centres for Disease Control and Prevention (CDC) apply to all hospitalized patients.⁵² The recommendations are not specific to surgery. However, they are applicable equally to medical or surgical patients with regards to risk of UTI. They are supported by other guidelines and are considered to be the gold standard for preventing catheter-related urinary tract infections. Our recommendations mirror those presented in the CDC guideline. The CDCs recommendations for use of an indwelling urinary catheter are as follows:

- Use urinary catheters in operative patients only as necessary, rather than routinely. (Category IB)
- For operative patients who have an indication for an indwelling catheter, remove the catheter as soon as possible postoperatively, preferably within 24 hours, unless there are appropriate indications for continued use. (Category IB)

The CDC also provides examples of appropriate indications for indwelling catheter use including:

- acute urinary retention or bladder outlet obstruction,
- need for accurate measurements of urinary output in critically ill patients,
- to assist in healing of open sacral or perineal wounds in incontinent patients;
- for patients that require prolonged immobilization (e.g., potentially unstable thoracic or lumbar spine, multiple traumatic injuries such as pelvic fractures)

With regards to the perioperative use of catheters, they specify their use in:

- Patients undergoing urologic surgery or other surgery on contiguous structures of the genitourinary tract
- Anticipated prolonged duration of surgery (catheters inserted for this reason should be removed in PACU)
- Patients anticipated to receive large-volume infusions or diuretics during surgery
- Need for intraoperative monitoring of urinary output

In patients having bladder/prostate surgery and other pelvic surgery (eg: rectal resection), urinary catheters are often left in situ for longer duration to allow for healing (bladder anastomoses) or because of perceived difficulty with voiding (rectal resections).

Zmora and colleagues performed a randomized controlled trial which included patients who had a dissection of the rectum and in whom the catheter was removed on post-operative day 1, 3, or 5.⁵³ They found that urinary retention rates did not correlate with the duration the catheter was left in although the overall retention rates were higher (14.6% to 5.3% to 10.5%) than others have observed.

There also is a belief that patients who have a thoracic epidural analgesia need to have the urinary catheter in place until the epidural catheter. Basse et al reported on a single arm prospective cohort study which followed 100 patients who had a thoracic epidural in place.⁵⁴ Of these, 96 had a transurethral catheter in place. All patients had their urinary catheter removed 16-20 hours after surgery while the epidural catheter was removed on post-operative day two (approximately 44 hours post-operatively). Nine per cent of patients required recatheterization.

Zaouter et al conducted a randomized controlled trial in selected patients having thoracic, gastrointestinal or urological surgery.⁵⁵ In one group, the urinary catheter was removed on average 17 hours after the surgery compared to 107 hours in the other group. The epidural catheter was said to be left in situ on average 3-5 days. These investigators found no statistically significant difference in the need for recatheterization between the two groups although 10.5% (11/105) of patients in the early removal group required in-out, intermittent or in situ bladder catheterization compared with 1.9% (2/110) in the standard group. They also observed a significantly lower rate of UTIs (2% vs 14%) in the group with early removal of the catheter.

Section 4. External review

After the guideline was finalized by the Best Practice in Surgery Committee, it was sent electronically to all staff surgeons, surgical fellows and surgical residents at the University of Toronto for review. There was no feedback to address.

Section 5. Implementation strategies

Implementation of an ERAS guideline requires several implementation strategies to be employed simultaneously. Based on the available literature, as well as our experience, we developed an implementation toolkit that may be used to assist with implementation. The toolkit and other implementation resources can be found at www.bestpracticeinsurgery.ca. Below are the necessary steps to take when implementing ERAS.

Step 1: Identify Champions

Identify at least one Surgeon, Anesthesia and Nurse Champion. Ideally, each surgical specialty and corresponding hospital unit will have its own ERAS champion(s).

Step 2: Get support from administration and other stakeholders

The Champions should communicate with administration about the program to ensure that they have the support required for implementation. See the readiness assessment checklist for suggested members of administration to contact.

Step 3: Stakeholder engagement, agreement and buy-in

Once administration has signed on, it is important to get buy in from all members of the perioperative team who will be affected the changes presented in the ERAS guideline. It is important to discuss the ERAS recommendations and ensure that there is agreement and local consensus. All departments should receive information and education on the ERAS guideline and all stakeholders should feel part of the implementation process. Multidisciplinary ground rounds are an excellent way to educate all members of the perioperative team and provide a forum for different departments to learn about and discuss the program together. Rounds for each department may also be helpful.

Step 4: Develop local implementation strategies

As a group, the Champions should discuss which implementation strategies may be most beneficial for their staff and develop a local implementation plan. This may include rounds and in-services, dissemination of guidelines, development of strategies for disseminating and collecting the patient education booklet, and creating local care pathways and other tools such as posters. As well, during this stage, order sets should be modified to reflect the ERAS guideline recommendations and other processes should be put in place, such as identifying ERAS patients.

Step 5: Collect data and process for feedback

It is important to collect data. Collecting baseline data is essential to be able to assess progress. Thus, it is suggested to start collecting ERAS data as soon as possible.

Step 6: Identify a start date

It is important to determine a start date so that the healthcare professionals are aware of when implementation will start. A good start date is when the standardized orders have been modified.

Step 7: Monitor implementation

Once ERAS has launched, it is important to maintain interest and active implementation of the recommendations. Having regularly scheduled meetings with the Champions is essential to regularly review data, address gaps in care and develop strategies to overcome them. As well, it is important to provide continuous re-education for the staff as well as provide regular updates on the progress and lessons learned.

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