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Enhanced Recovery after Surgery (ERAS)

LESSON 3
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Enhanced Recovery after Surgery (ERAS)

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LESSON OBJECTIVES
Upon completion of this lesson, the reader should be able to:
1. Explain the importance of improving patient outcomes in colorectal surgery.
2. Discuss the goals of the ERAS pathway.
3. Identify the preoperative components of ERAS.
4. Discuss the intraoperative components of ERAS.
5. Describe the postoperative components of ERAS.
6. Identify the benefits of ERAS pathways.
7. Explain the literature regarding the efficacy of ERAS.
8. Understand the financial implications of ERAS.
9. Discuss the barriers to implementation of ERAS.
10. Discuss the future goals of ERAS.

Introduction
In the early 1990s, Danish Professor Henrik Kehlet first envisioned enhanced recovery or “fast-track” protocols with the goal of providing patients with safe and painless surgeries and shorter hospital stays. In stark contrast to many deep-rooted traditional surgical tenets, this new approach to patient care management was very slow to gain acceptance. Two decades later, enhanced recovery after surgery (ERAs) strategies are finally catching the wave of popularity in the United States, in particular for those patients undergoing major abdominal, thoracic and urological surgeries.

These guidelines, published by the recently formed Enhanced Recovery After Surgery (ERAS®) Society, provide care teams with comprehensive and evidence-based approaches for the perioperative management of surgical patients. Considering that every aspect was born from existing evidence gathered from the perioperative medicine literature, ERAS guidelines simply integrate these concepts into a unified pathway approach to clinical patient care. Given that standardization of medical care has been associated with improved outcomes and lower health care costs, these protocols were designed to reduce psychologic and physiologic stress with the final goal of lessening complication rates, enhancing functional recovery, and reducing length of stay.
2020 costs for colorectal cancer treatment in its initial, continuing, and final stages is predicted to total $5.19 billion, $3.57 billion, and $5.27 billion, respectively, for a total cost approaching $15 billion.

Despite the substantial body of evidence demonstrating that ERAS protocols lead to improved outcomes, they challenge traditional surgical dogma. Not only do these protocols force the re-examination of traditional perioperative practices with early feeding, early mobilization and early goal-directed physical activities, they are also comprehensive in scope, covering all areas of the patient’s journey through the surgical process. Fast-track protocols with multidisciplinary teams are a paradigm shift in the customary approach to the surgical care of patients, and as such ERAS has been a challenge to implement universally.

In this lesson, we will focus on the components of ERAS that are common to every guideline. In addition, because the colorectal pathway has been the most validated, we will also present components unique to those guidelines.


Goals of ERAS

The key factors that keep patients in the hospital after surgery include pain control requiring parenteral analgesia, slow return of bowel function necessitating intravenous fluids, and impaired mobility requiring bed rest. The central elements of the ERAS pathway address these key factors, recognizing that each aspect interacts with the other to affect overall patient recovery. Additionally, ERAS pathways provide direction to all perioperative care partners, guiding everyone to work as a well-coordinated team to provide the best patient care.

The goals of ERAS are to establish standardized guidelines for perioperative care interventions to improve patient outcomes. Using a multidisciplinary approach, ERAS is focused on decreasing hospital length of stay, reducing complication rates and improving the return of functionality, with subsequent reduction in overall health care costs. This is accomplished by following anesthesia and analgesia plans even for minimally invasive techniques, use of goal-directed fluid therapy to avoid bowel edema, early nutrition with the prevention of nausea and ileus, and considering thromboembolic prophylaxis to be early mobilization.

As ERAS pathways have been utilized extensively in Europe, studies have shown that adherence to them can reduce care time by more than 30% and reduce postoperative complications by up to 50%.
Common Components of ERAS Protocols (Figure 2)

While each of the current ERAS protocols for the different types of surgery have certain variations, they are all derived from evidence-based practices. Each protocol shares a multidisciplinary approach aiming to optimize conditions before, during and after surgery to reduce the length of hospital stay for patients after surgery.

Preoperative Phase

During the preoperative phase, attention is focused on preparation of the patient both in the weeks leading to the surgery as well as on the day of surgery (prior to entering the operating room). This helps to alleviate psychologic stress and optimize co-morbidities.

Patients should routinely receive dedicated preoperative counseling and education, not only focusing on the surgical aspects of their care (including the potential need for an ostomy), but should also include a thorough discussion regarding expectations and goals for discharge. While the evidence level is specifically low for this component, ERAS strongly recommends this as it improves patient satisfaction.

Preoperative optimization of co-morbidities and organ function is important to ensure the safest and smoothest course possible. This includes smoking and alcohol cessation, ideally 4 if not 8 weeks prior to surgery. Maintaining ideal glucose and blood pressure control prior to major surgery is also paramount as well as ensuring proper nutrition to avoid tissue catabolism. Patients are also kept warm during all phases of care, including the time they are in the hospital awaiting their surgery. Additionally, oral mechanical bowel preparation is not recommended since it has not been shown to have any proven benefit.

These guidelines utilize a multidisciplinary approach to optimize patient outcomes by targeting interventions during the pre-, intra-, and postoperative phases.

On the day of surgery, specific preoperative interventions include the avoidance of prolonged starvation times as well as providing carbohydrate loading (Table 1). As such, ERAS protocols encourage clear fluids for all patients up to 2 hours prior to surgery, advocating for a shorter 6 hour interval between last solid intake and surgery, and recommending oral carbohydrate loading in the preoperative holding area for those not prone to hyperglycemia.

Table: Estimated New Cases* and Estimated Deaths

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prostate</strong></td>
<td>220,800 (25%)</td>
</tr>
<tr>
<td><strong>Lung &amp; bronchus</strong></td>
<td>115,610 (14%)</td>
</tr>
<tr>
<td><strong>Colon &amp; rectum</strong></td>
<td>69,090 (8%)</td>
</tr>
<tr>
<td><strong>Urinary bladder</strong></td>
<td>6,320 (7%)</td>
</tr>
<tr>
<td><strong>Melanoma of the skin</strong></td>
<td>42,570 (5%)</td>
</tr>
<tr>
<td><strong>Non-Hodgkin lymphoma</strong></td>
<td>39,850 (5%)</td>
</tr>
<tr>
<td><strong>Kidney &amp; renal pelvis</strong></td>
<td>28,270 (5%)</td>
</tr>
<tr>
<td><strong>Oral cavity &amp; pharynx</strong></td>
<td>5,360 (6%)</td>
</tr>
<tr>
<td><strong>Leukemia</strong></td>
<td>30,900 (4%)</td>
</tr>
<tr>
<td><strong>Liver &amp; intrahepatic bile duct</strong></td>
<td>25,510 (3%)</td>
</tr>
<tr>
<td><strong>All sites</strong></td>
<td>848,200 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lung &amp; bronchus</strong></td>
<td>85,360 (28%)</td>
</tr>
<tr>
<td><strong>Prostate</strong></td>
<td>22,540 (9%)</td>
</tr>
<tr>
<td><strong>Colon &amp; rectum</strong></td>
<td>25,100 (8%)</td>
</tr>
<tr>
<td><strong>Pancreas</strong></td>
<td>20,710 (7%)</td>
</tr>
<tr>
<td><strong>Liver &amp; intrahepatic bile duct</strong></td>
<td>17,030 (5%)</td>
</tr>
<tr>
<td><strong>Thyroid</strong></td>
<td>47,230 (6%)</td>
</tr>
<tr>
<td><strong>Ovary</strong></td>
<td>12,600 (4%)</td>
</tr>
<tr>
<td><strong>Uterine corpus</strong></td>
<td>11,510 (4%)</td>
</tr>
<tr>
<td><strong>Non-Hodgkin lymphoma</strong></td>
<td>11,480 (4%)</td>
</tr>
<tr>
<td><strong>Kidney &amp; renal pelvis</strong></td>
<td>9,070 (3%)</td>
</tr>
<tr>
<td><strong>Brain &amp; other nervous system</strong></td>
<td>312,150 (100%)</td>
</tr>
</tbody>
</table>

*Excludes basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder.

©2015, American Cancer Society, Inc., Surveillance Research (www.cancer.org/research/cancerfactsstatistics/)

Figure 1. Leading Sites of New Cancer Cases and Deaths – 2025 Estimates
Avoidance of pre-anesthetic anxiolysis or analgesic medications is also endorsed as sedating pre-medications can lead to delayed postoperative recovery of psychomotor function. Of course chronic pain patients should be encouraged to continue their pain regimens through the preoperative period to avoid withdrawal and poor pain control. However, short-acting sedating medications, including midazolam and fentanyl, are appropriate to facilitate the placement of preoperative regional anesthesia blocks.

Intraoperative Phase

During the intraoperative phase, ERAS is focused on both specific intraoperative management, as well as optimization of pain and fluid management, in preparation for postoperative recovery.

Routine recommendations such as antimicrobial and antithrombotic medications are included in the ERAS guidelines. The initial dose of antimicrobial prophylaxis should occur before incision, and may need to be re-dosed. There is a specific focus in ERAS on antithrombotic prophylaxis. Heparin or low molecular weight heparin are recommended 2-12 hours before surgery and should be continued until patient mobilization and potentially for an additional 4 weeks. Importantly, because of the recommendation of routine epidural use for open abdominal surgery (to be discussed below), the timing of anti-thrombotic prophylaxis is crucial to limit the risk of epidural hematoma. The American Society of Regional Anesthesia has produced guidelines regarding the timing of anti-coagulation medications and neuraxial anesthesia, which are beyond the scope of this lesson; we have included recommendations adapted from UCSF/ASRA guidelines for commonly used agents (Table 2).

Routine use of epidural anesthesia is one of the key components of ERAS. It has been shown to be superior to patient-controlled analgesia (PCA) in re-

### Table 1: Preoperative NPO Guidelines

<table>
<thead>
<tr>
<th></th>
<th>ASA Guidelines</th>
<th>ERAS Comment/Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Liquids</td>
<td>2 hours</td>
<td>• Encourage clears up in 2 hours</td>
</tr>
<tr>
<td>Breast Milk</td>
<td>4 hours</td>
<td>• Optimize nutrition and fluid status</td>
</tr>
<tr>
<td>Infant Formula</td>
<td>6 hours</td>
<td>• Reduce starvation states</td>
</tr>
<tr>
<td>Light Meal</td>
<td>6 hours</td>
<td>• Avoid/minimize bowel preps</td>
</tr>
<tr>
<td>Regular Meal</td>
<td>8 hours</td>
<td>• Carbohydrate loading</td>
</tr>
</tbody>
</table>
ieving pain when the catheter is properly positioned (Table 3). In addition, it is also associated with decreased stress response, improvement in pulmonary function, decreased risk of postoperative pneumonia, and reduced insulin resistance. However, evidence is conflicting regarding whether epidural analgesia increases or diminishes the length of stay.

To ensure the efficacy of epidurals, they should be tested prior to the induction of general anesthesia since a significant percentage do not function adequately. They should be activated before surgery and continued for 48 hours while transitioning to oral multimodal analgesia.

While epidurals are recommended for laparoscopic surgeries, they have not been proven superior to spinals or PCA. However, epidural administration of local anesthetic leads to a lower rate of ileus in laparoscopic procedures. Specifically, in laparoscopic

<table>
<thead>
<tr>
<th>Medication</th>
<th>Minimum time between last dose and neuraxial shot/catheter placement</th>
<th>Minimum time between neuraxial shot/catheter removal and next dose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANTICOAGULANTS FOR VENOUS THROMBOEMBOLISM PROPHYLAXIS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dalteparin (Fragmin) 5000 units SQ daily</td>
<td>12 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Enoxaparin (Lovenox) 40 mg SQ daily, 30 mg SQ BID</td>
<td>12 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Fondaparinux (Arixtra) 2.5 mg SQ daily</td>
<td>48 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Heparin 5000 units SQ BID</td>
<td>May be given; no time restrictions</td>
<td></td>
</tr>
<tr>
<td>Heparin 5000 units SQ TID</td>
<td>4 hours</td>
<td>2 hours</td>
</tr>
<tr>
<td>Rivaroxaban (Xarelto) 10 mg PO daily</td>
<td>48 hours</td>
<td>6 hours</td>
</tr>
<tr>
<td><strong>ANTICOAGULANTS AT THERAPEUTIC DOSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apixiban (Eliquis) 2.5-5mg PO BID</td>
<td>72 hours</td>
<td>6 hours</td>
</tr>
<tr>
<td>Dabigatran (Pradaxa)</td>
<td>4 days or TT or aPTT or normal</td>
<td>6 hours</td>
</tr>
<tr>
<td>Dalteparin (Fragmin) 100 units/kg SQ q12h</td>
<td>24 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Dalteparin (Fragmin) 200 units/kg SQ 12h</td>
<td>24 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Enoxaparin (Lovenox) 1 mg/kg SQ BID</td>
<td>36 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Enoxaparin (Lovenox) 1.5 mg/kg SQ daily</td>
<td>72 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Fondaparinux (Arixtra) 5-10 mg SQ daily</td>
<td>48 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Heparin: full dose IV</td>
<td>When aPTT &lt; 40</td>
<td>2 hours</td>
</tr>
<tr>
<td>Rivaroxaban (Xarelto) 20-30 mg PO daily</td>
<td>5 days &amp; INR &lt; 1.5</td>
<td>2 hours (no consensus)</td>
</tr>
<tr>
<td>Warfarin (Coumadin)</td>
<td>5 days &amp; INR &lt; 1.5</td>
<td>2 hours (no consensus)</td>
</tr>
<tr>
<td><strong>ORAL ANTIPLATELET AGENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirin/NSAIDS/COX inhibitors/ dipyridamole</td>
<td>May be given; no time restrictions</td>
<td></td>
</tr>
<tr>
<td>Clopidogrel (Plavix)</td>
<td>7 days</td>
<td>2 hours</td>
</tr>
<tr>
<td>Prasugrel (Effient)</td>
<td>9 days</td>
<td>6 hours</td>
</tr>
<tr>
<td>Ticagrelor (Brilinta)</td>
<td>5 days</td>
<td>6 hours</td>
</tr>
<tr>
<td>Ticlopidine (Ticlid)</td>
<td>14 days</td>
<td>2 hours</td>
</tr>
<tr>
<td><strong>DIRECT THROMBIN INHIBITORS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argatroban/bivalirudin (Angiomax)</td>
<td>When TT is normal</td>
<td>2 hours</td>
</tr>
<tr>
<td><strong>GP IIb/IIIa INHIBITORS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abciximab (Reopro)</td>
<td>48 hours</td>
<td>2 hours</td>
</tr>
<tr>
<td>Eptifibatide (Integrillin)/ Tirofiban (Aggrastat)</td>
<td>8 hours</td>
<td>2 hours</td>
</tr>
<tr>
<td><strong>THROMBOLYTIC AGENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alteplase (TPA) Full dose for stroke, MI, etc</td>
<td>10 days</td>
<td>10 days</td>
</tr>
</tbody>
</table>
colorectal resections undergoing the ERAS program, there was no difference in return of GI function and length of hospital stay between thoracic epidural and continuous IV lidocaine infusion. In general, intravenous lidocaine is known for its analgesic, anti-inflammatory, and anti-hyperalgesic properties, and is moderately recommended in the ERAS pathway.

ERAS provides few recommendations with regard to intraoperative anesthetic management. These include using short-acting medications, such as induction agents, opioids, and muscle relaxants, and titrating anesthetic needs to the bispectral index (BIS), especially in the elderly population to avoid oversedation. A strong recommendation is for low tidal-volume ventilation to decrease baro- and volutrauma and their associated postoperative morbidity.

Given the importance of decreasing the length of stay as a goal of the ERAS pathway, and that up to 70% of patients undergoing major abdominal surgery have postoperative nausea and vomiting (PONV) which can delay discharge, the prevention of PONV is naturally an important focus of ERAS. PONV should be treated using a multimodal approach both prophylactically and if present after surgery; risk stratification using a PONV scoring system can aid in a tailored approach. Antiemetics may be cholinergic, dopaminergic, serotonergic, histaminergic, or a neurokinin-1 receptor antagonist. Avoiding inhaled anesthetics, utilizing regional anesthetic techniques to minimize the need for opioids, and prophylactically treating with antiemetics are part of this multimodal approach (Figure 3). If PONV is present despite prior prophylaxis, consider choosing an agent from another therapeutic class. While dexamethasone has antiemetic effects, its immunosuppressive effects on oncology patients is still unknown.

<table>
<thead>
<tr>
<th>Type/Location of Surgery</th>
<th>Level Placed by Bony Landmarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoracic</td>
<td>T4-T6</td>
</tr>
<tr>
<td>Upper Abdominal/Flank</td>
<td>T6-T8</td>
</tr>
<tr>
<td>Mastectomy/Tram</td>
<td>T8-T10</td>
</tr>
<tr>
<td>Colorectal/Mid-Abdomen</td>
<td>T9-T10</td>
</tr>
<tr>
<td>Gynecological/Low-Abdomen</td>
<td>T9-T11</td>
</tr>
<tr>
<td>Lower Extremity</td>
<td>L2-L3</td>
</tr>
</tbody>
</table>

Table 3: Epidural Placement for Specific Surgical Sites

Figure 3. PONV Management Options
Additional measures to enhance outcomes include temperature management, fluid management, and glycemic control. Avoiding intraoperative hypothermia leads to decreased rates of wound infections, cardiac complications, bleeding and transfusion requirements and post-anesthetic recovery times. Cutaneous warming systems such as forced-air or circulating-water garment systems are highly recommended. Strict attention to fluid balance and avoiding sodium overload has also been shown to improve outcomes. This can be attained by providing balanced crystalloid (preferred over normal saline) solutions, and high-risk patients may benefit from doppler-guided fluid management (Figure 4). Care should be taken to avoid interpreting epidural-induced hypotension as hypovolemia; vasopressors may be more appropriate in this setting.

Preoperative interventions include education and counseling, optimizing preoperative fluid balance by avoiding bowel preparation, and drinking fluids up to 2 hours prior to surgery.

Ideally, by adhering to the other components of ERAS, postoperative glycemic control can be optimized by decreasing insulin resistance that can occur after major surgery even in patients without diabetes. These measures include avoiding preoperative fasting and oral bowel preparations, using oral carbohydrate treatment, reducing the stress response with epidural anesthesia, and optimizing fluids and avoiding systemic opioids to affect the early return of gut function. Setting a limit of 215 mg/dL given its correspondence to glucosuria is reasonable to avoid hyperglycemia without introducing the risk of hypoglycemia.

Intraoperative interventions include thromboprophylaxis, antibiotic prophylaxis, normothermia, avoiding nasogastric tubes and surgical drains, fluid optimization, and minimally invasive surgical approaches when appropriate.

Postoperative Phase
Focusing on preoperative and intraoperative management aims to ensure a smooth postoperative course. Accordingly, there are few specific postoperative recommendations (Figure 5).

By using a multi-modal approach for PONV and adhering to excellent fluid balance, ileus should be a minor problem postoperatively. However, ERAS strongly recommends avoiding nasogastric decompression, while laxatives and chewing gum are weakly recommended to accelerate gastrointestinal transit.

Urinary drainage after surgery should be accomplished with transurethral catheters, which can be removed safely on POD1 even with a thoracic epidural in place. This leads to lower infection rates without an increased rate of re-

Figure 4. Doppler-guided fluid management waveform displaying Stroke Distance, Peak Velocity, Mean Acceleration and Flow Time measurements. Any change in the left ventricular output will cause a proportional change in the size and shape of the waveform, affecting the area under the curve.
catheterization (compared with removal on POD3-5). If urinary drainage is required for more than 4 days, suprapubic catheterization is probably superior.

Early and scheduled mobilization is strongly recommended, even though the evidence level for this is very low. This should occur on the morning of POD1 with detailed daily postoperative targets. Ensuring adequate analgesia using epidurals and optimal pain management permits movement. Coordination with physical therapists and occupational therapists is crucial to ensure safe and early mobilization.

**Postoperative interventions include gut mobilization, opioid-sparing analgesia, multimodal antiemetic regimens, early removal of urinary catheters, and early mobilization.**

**Interventions Specific to Colorectal Surgery**

In addition to common recommendations for all surgeries covered by the ERAS protocols, there are some interventions that are specific to colorectal surgery, which still accounts for the majority of surgeries that currently follow the ERAS guidelines.

Laparoscopy is highly recommended over open surgery since it is associated with shorter length of stay and lower morbidity. **Perhaps laparoscopy can be considered to be the key intervention in the ERAS pathway since many studies point to laparoscopy alone as a cause of a shorter length of stay.** However, when compared to laparoscopy and conventional therapy, ERAS with laparoscopy was still associated with shorter length of stay.

In general, tubes and drains are avoided in ERAS. Specifically, nasogastric intubation should not be used routinely. In addition, drainage of the peritoneal cavity after colonic anastomosis should be avoided, as there is no proven benefit and it can impair early mobilization.

**Postoperative analgesia is extremely important, and needs to provide adequate analgesia allowing for early mobilization while minimizing complications such as delayed return of gut function and feeding.** Within all the ERAS guidelines, **avoidance of systemic opioids is strongly recommended for improved outcomes.** Techniques utilized to decrease requirements of systemic opioids include regional techniques such as epidurals, spinalis, transversus abdominusplane (TAP) blocks, intravenous infusions of lidocaine, and utilization of NSAIDs (Figure 6). Specifically for laparoscopic surgery, mid-thoracic epidurals were found to be associated with earlier return of GI function and tolerance of an oral diet when compared with systemic opioids. There is ongoing investigation about the use of spinal anesthesia, and TAP techniques for laparoscopic surgery.

**Outcomes of ERAS Protocols**

Because ERAS is a relatively new concept, there is limited evidence regarding its efficacy; what evidence exists is focused primarily on elective colorectal surgeries. The existing evidence points to overall improved patient care, especially in decreasing the length of stay, without an increase in complications.
or re-admission rates. The most recent meta-analysis (Zhuang et al.) of 13 RCTs of 1,910 participants concluded that ERAS was associated with decreased lengths of stay by 2.5 days, and decreased total complications (relative risk 0.71). Another meta-analysis (Lv et al.) of 7 RCTs showed similar results with decreased lengths of stay by 1.9 days, and an overall decreased rate of complications (RR 0.69). In 2011, a Cochrane Review of 4 RCTs assessed the effectiveness and safety of the ERAS multimodal strategy compared to conventional care surgery; it also found that length of stay was significantly reduced by almost 3 days, with decreased complication rates with no difference in readmission rates.

Implementation may be difficult, as it requires involvement by surgeons, anesthetists, nurses, physical therapists, nutritionists, social workers, and potentially a dramatic shift in clinical workflow.

While some critics argue that part of the benefit of the ERAS pathway can be attributed to patient selection with relatively healthier patients and a younger population, there have been several studies that have shown that ERAS is also safe in an older patient population. Furthermore, the average age in most ERAS trials has been over 60.

Postoperative recovery is confounded by pre- and intraoperative measures; therefore, it is difficult to measure the unique benefits of the postoperative components of ERAS. Previous data has shown that early mobilization and initiation of oral diet are associated with shortened lengths of stay; however, they could be signals of improvement of recovery after surgery due to pre- and intraoperative factors.

**Implementation**

A multidisciplinary approach to fast track surgery requires a multidisciplinary team; in addition to the surgeon, anesthesia provider, and nurses, physical therapists, enterostomal therapists, nutritionists, and social workers are all part of the team and should be trained in fast-track surgery principles. Making changes within so many different units and shifting existing clinical routines requires significant dedication from all involved parties. Further support personnel may be required to collect and maintain data.

Within the ERAS guidelines, there are approximately 20 listed puzzle pieces; this can be overwhelming to launch (Table 4). In addition the relative contribution of each intervention remains un-
certain. As such, there may be only modest enthusiasm by a particular institution.

There is also a lack of general knowledge about the efficacy of ERAS and its improved outcomes. As always, there is a delay between dissemination of information and implementation of evidence-based medicine.

Future Outcomes

ERAS programs are not widely accepted in the United States. This may be due to the fact that most of the initial studies and institutions involved are in Europe. Given that there are also multiple team members and interventions to implement within the protocol, it may be difficult to implement as previously discussed. Ongoing investigations concern utilizing only a subset of 4 interventions (RAPID) that may lead to improved adherence. With the recent establishment of the American Enhanced Recovery Society, more United States institutions may begin to utilize ERAS. In addition, there is ongoing investigation regarding alternatives to epidural, especially in laparoscopic surgery.

**Teamwork and mutual understanding of the ERAS guidelines is the key to success.**

**Summary**

ERAS protocols were initially described and validated for open colorectal surgeries, but have since been studied in a variety of other surgical specialties, including thoracic and urologic surgeries. Although growing evidence from several randomized controlled trials, systematic reviews and meta-analyses suggest substantial benefits with adherence to ERAS pathways, there are still colossal struggles when introducing these evidence-based guidelines into routine daily practice. Namely, a multidisciplinary team is required, with all team members being familiar with ERAS philosophies and being motivated to carry out the protocols. To do so, all must overcome traditional concepts, teaching and attitudes toward perioperative care. In light of such compelling evidence, the evidence-based environments in which we practice demands a review of this perioperative approach to patients requiring major surgeries so that we may alter our practice accordingly.

**Bibliography**


Thoha M. Pham, MD

Dr. Pham completed residency training in Anesthesiology & Perioperative Care at the University of California at San Francisco (UCSF) and subsequently continued training as a Pain Medicine Fellow at UCSF thereafter. Dr. Pham remains at UCSF as an Associate Clinical Professor in the Department of Anesthesiology with time split between the operating room and the Pain Management Clinic. Additional interests include spending time with family while exploring and enjoying the outdoors through travel.

Ann Cai Shah, MD

Dr. Shah completed medical school at Harvard Medical School, and is currently a resident in anesthesiology at the University of California at San Francisco. Additional interests include chamber music, travel, rueda dance, and international cuisine.

Tips for your Clinical Practice: Key Points

- ERAS guidelines utilize a multidisciplinary approach targeting pre-, intra-, and postoperative phases.
- ERAS force the re-examination of traditional surgical practices (e.g., it espouses minimally invasive techniques).
- The goals of ERAS focus on decreasing hospital length of stay, improving the return of functionality, and reducing complications. This should result in decreased healthcare costs.
- Since up to 70% of patients experience PONV after major abdominal surgery (which can delay discharge), the use of a multimodal approach to prevent PONV is an important focus of ERAS.
- The control of postoperative pain is also an important aspect of ERAS. Since some analgesics can cause PONV, a multimodal approach to analgesia is essential to provide patient comfort and early discharge.

Monte Lichtiger, MD
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**DESIGNATION OF SPECIFIC CONTENT AREAS:**

Current Reviews for Nurse Anesthetists (CRNA) is designed to meet the standards and criteria of the American Association of Nurse Anesthetists (AANA) for the prior-approved continuing medical education activity, Provider-Directed Independent Study, also known as home study. CRNA is an approved program provider.

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POST-STUDY QUESTIONS

1. Goals of ERAS include:
   □ A. Minimizing personnel involved by engaging only the surgical team.
   □ B. Standardization of medical care.
   □ C. Providing optimal patient outcomes without considering cost.
   □ D. Delaying mobilization until patient is fully healed.

2. Which surgical procedure accounts for the majority of surgeries that currently follow the ERAS guidelines?
   □ A. Radical cystectomy for bladder cancer.
   □ B. Pancreaticoduodenectomy.
   □ C. Pelvic surgery.
   □ D. Colorectal surgery.

3. A major barrier to implementing ERAS is:
   □ A. It requires the cooperation of a multidisciplinary group of health care providers.
   □ B. ERAS protocols do not change traditional surgical practices.
   □ C. There is no medical-based evidence to support ERAS.
   □ D. ERAS increases the incidence of postoperative infections.

4. Preoperative fasting guidelines include:
   □ A. 6 hours for fried or fatty foods or meat.
   □ B. 4 hours for tea and toast.
   □ C. 4 hours for juice with pulp.
   □ D. 2 hours for clear liquids.

5. Recommended preoperative interventions include:
   □ A. Mechanical bowel preparation.
   □ B. Avoiding carbohydrate loading.
   □ C. Premedication for anxiolysis.
   □ D. Continuation of chronic pain medications.

6. Recommended intraoperative surgical interventions include:
   □ A. Aggressive fluid resuscitation.
   □ B. Placement of nasogastric tubes.
   □ C. Minimally invasive surgical techniques.
   □ D. Placement of surgical drains.

7. Recommended intraoperative anesthetic interventions include:
   □ A. Warming.
   □ B. Aggressive fluid administration.
   □ C. Opioid infusion.
   □ D. Ketamine infusion.

8. Recommended postoperative interventions include:
   □ A. Opioid-sparing analgesia.
   □ B. Continuing urinary catheter for at least two days post-op.
   □ C. Continuing NPO diet until first bowel movement.
   □ D. Avoidance of polypharmacy by utilizing only one class of antiemetic medication.

9. Adherence to ERAS protocols is associated with the following outcomes:
   □ A. Increased readmission rates.
   □ B. Decreased length of stay.
   □ C. No change in complication rates.
   □ D. Increased morbidity.

10. Implementation of ERAS:
    □ A. Requires the engagement of a multidisciplinary team.
    □ B. Does not require any changes within existing clinical routines.
    □ C. Has been widely adopted in the United States.
    □ D. Has been easy because of the "recipe" of 20 listed interventions.

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