

Enhanced Recovery Pathway in Gynecologic Surgery



Improving Outcomes Through Evidence-Based Medicine

Eleftheria Kalogera, MD^a, Sean C. Dowdy, MD^{b,*}

KEYWORDS

- Enhanced recovery • Perioperative care • Gynecologic surgery • Benign
- Abdominal hysterectomy • Vaginal hysterectomy • Laparoscopic hysterectomy

KEY POINTS

- Enhanced recovery after surgery (ERAS) is an evidence-based approach to perioperative care shown to hasten recovery and attenuate the stress response to surgery.
- ERAS principles include preoperative patient education; avoidance of prolonged preoperative fasting, and bowel preparation; multimodal analgesia; perioperative euvoolemia; intraoperative normothermia; early oral intake; early mobilization.
- ERAS is associated with earlier return of gastrointestinal function, reduced opioid use, shorter length of stay, stable complication and readmission rates, and substantial cost reductions.

INTRODUCTION

In recent years, a paradigm shift from traditional perioperative care models to the “Enhanced Recovery Pathway (ERP)” or “Enhanced Recovery After Surgery (ERAS)” has taken place across a wide range of surgical specialties including gynecologic surgery. These programs, also known as “Fast-Track Surgery (FTS),” are not new; they were first introduced in the 1990s by European surgeons and anesthesiologists, pioneered in particular by Kehlet, and challenged the efficacy of longstanding, non-evidence-based practices of perioperative care.¹ Surgical stress forces the body

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^a Department of Obstetrics and Gynecology, Mayo Clinic, 200 1st Street Southwest, Rochester, MN 55905, USA; ^b Division of Gynecologic Surgery, Mayo Clinic, 200 1st Street Southwest, Rochester, MN 55905, USA

* Corresponding author.

E-mail address: dowdy.sean@mayo.edu

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into a highly catabolic state with increased cardiac demands, relative tissue hypoxia, increased insulin resistance, impaired coagulation profile, and altered pulmonary and gastrointestinal functions.² The body's response to surgical stress results in organ dysfunction, increased morbidity, and, ultimately, delayed convalescence.^{3,4} The ERAS programs aim to maintain normal physiology perioperatively and optimize patient outcomes by introducing interventions that have been proven to either decrease surgical stress or help the body mitigate the negative consequences associated with it.

The ERAS pathways do not base their success on the incorporation of a single intervention into clinical practice but rather represent a multimodal approach to perioperative recovery. The main ERAS elements differ drastically from traditional care and can be divided into preoperative, intraoperative, and postoperative interventions. These elements include preoperative patient education and counseling, minimizing preoperative fasting, avoiding bowel preparation and dehydration, preemptive analgesia, nausea and vomiting prophylaxis, tailored anesthesia with a focus on short-acting anesthetics and regional anesthesia, goal-oriented fluid management to achieve perioperative euvolemia, intraoperative normothermia, no routine use of drain and nasogastric tubes (NGTs), early oral intake, early mobilization, early catheter removal, a preference for nonopioid analgesics, and preemptive use of laxatives. Importantly, the successful implementation of these programs is based on the collaborative work of a multidisciplinary team consisting of surgeons, anesthesiologists, nursing staff, and pharmacists, as well as the active engagement of the patient in enhancing their recovery.

ERAS pathways were initially introduced in colorectal surgery. They have since been successfully implemented in many surgical specialties, including cardiac, thoracic, vascular surgery, urology, and orthopedics. A growing body of evidence suggests that it is both a safe and effective perioperative care approach allowing for shorter length of hospital stay, decreased morbidity, and significant cost reduction without increasing postoperative complication and readmission rates while maintaining high patient satisfaction.^{5–11} Notably, a collaborative initiative, called the Enhanced Recovery Partnership Programme, was established in England in 2009 aiming toward the widespread adoption of ERAS in 4 major specialties (colorectal, urology, gynecology, and musculoskeletal).^{12,13} Although initially slow, several studies have surfaced over the past few years reporting the successful implementation of this multimodal approach in the perioperative care of the gynecologic surgical patient.

BASIC CONCEPTS OF ENHANCED RECOVERY AFTER SURGERY PATHWAYS

Preoperative

Patient counseling and education

Successful implementation of ERAS pathways to enhance postoperative recovery requires active engagement of all involved parties with the patient playing a central role. Patient counseling should start as early as the initial consult visit and include explaining the rationale behind the ERAS pathway in order to engage the patients in their recovery. In the outpatient setting, providers and nursing staff should identify patient expectations for the hospitalization and educate patients on early mobilization, early postoperative feeding, postoperative pain goals and pain management, and duration of hospitalization. It is helpful for the patients to be given educational materials to take home because this allows patients to familiarize themselves with these concepts. Patient education has been shown to be associated with improved outcomes, including decreased postoperative complications, superior pain control, and shorter recovery

time.^{14,15} In order to achieve the goal of an earlier discharge compared with prior practice, early discussion about anticipated hospital length of stay (LOS) and discharge criteria is critical.¹⁶

Preoperative diet

The rule of NPO (nothing by mouth) at midnight was arbitrarily adopted in an effort to prevent aspiration of gastric contents during anesthesia. However, prolonged fasting is associated with several untoward effects, including patient discomfort, dehydration, caloric restriction, and metabolic changes counter to healing at a time when the body is expected to enter a state of increased metabolic demands. Specifically, a 12-hour period of fasting shifts the body into the metabolic state of starvation; this results in depletion of the liver glycogen stores, a readily available energy source typically mobilized to cover high-energy demands similar to the demands during the immediate postoperative period. These metabolic changes have been shown to adversely affect perioperative outcomes.¹⁷ Fasting has also been associated with impairment of glucose metabolism and an increase in insulin resistance.^{18,19} A recent *Cochrane Review* helped shed light on the safety, or lack thereof, of the prolonged fasting: the NPO at midnight rule was not found to be superior to shorter fluid fasting in terms of decreasing the risk of aspiration, regurgitation, or associated morbidity. Interestingly, lower gastric volumes were observed in patients who were allowed to drink water preoperatively.²⁰ The American Society of Anesthesiology thus recommends fasting from intake of a light meal at least 6 hours and from intake of clear liquids at least 2 hours before elective procedures that require general or regional anesthesia, or sedation/analgesia.²¹ Interestingly, ERAS pathways argue in favor of preoperative use of carbohydrate-loading drinks because they are thought to mitigate preoperative caloric restriction, improve insulin resistance,²² and lead to shorter hospital LOS.^{23,24}

Avoiding mechanical bowel preparation

The use of mechanical and antibiotic bowel preparation in abdominal surgery including gynecologic surgery, especially in anticipation of bowel resection, was thought to help decrease the risk of anastomotic leak and prevent perioperative infectious morbidity.²⁵ The need for bowel preparation has been brought into question especially considering the negative effects associated with their use, such as patient dissatisfaction, dehydration, electrolyte disturbances, need for prolonged fasting, or even a delay in return of bowel function.^{26,27} In 2011, a *Cochrane Review* that included 18 randomized controlled trials (RCTs) on the use of mechanical bowel preparation in patients undergoing elective colorectal surgery including rectal surgery concluded that there is no evidence that these patients benefit from mechanical bowel preparation or rectal enemas. The same conclusions were reached in a recent meta-analysis of 5 RCTs focused on gynecologic surgery.²⁶ Importantly, the investigators of the *Cochrane Review* noted that more data are required in order to guide the use of bowel preparation in elective rectal resections below the peritoneal verge. In light of the lack of conclusive data, the authors of the current review chose to use rectal enemas when anticipating bowel resection especially low anterior resection. Recent data show that oral antibiotic bowel preparation may decrease infection rates in colorectal surgery,^{28,29} but high-quality evidence supporting their use in gynecology is lacking. Finally, routine use of mechanical bowel preparation is not recommended in laparoscopic or robotic gynecologic surgery because it offers no benefit with regard to intraoperative visualization or bowel handling.^{26,30}

Preemptive analgesia

In ERAS pathways, pain management begins before incision. This theory is based on the concept of preemptive analgesia, in which pain medications block activation of pain receptors before they are activated by the presence of noxious stimuli, resulting in superior pain control and a decrease in pain medication requirements. A multimodal approach incorporating the preoperative use of Gabapentin, oral or intravenous (IV) cyclo-oxygenase (COX) -2 inhibitors (celecoxib or parecoxib), and oral or IV paracetamol, has been associated with decreased use of opioids postoperatively^{31–35} and is thus typically used in ERAS protocols.

Intraoperative**Anesthesia**

Advances in anesthetic medications and expansion of ambulatory care have allowed application of some of the principles from ambulatory surgery to major surgery, in order to attenuate negative effects of surgical stress and pain, decrease anesthetic-related side effects, and hasten recovery. Short-acting volatile anesthetics or continuous infusion of propofol is recommended to allow rapid surfacing from anesthesia. Rapid awakening is reliably accomplished when these techniques are combined intraoperatively with short-acting opioid analgesics. Total IV anesthesia with propofol has been associated with fewer postoperative side effects and, specifically, a decrease in postoperative nausea and vomiting (PONV).^{36–38} The latter is particularly important as both gynecologic surgery as well as minimally invasive surgery have been found to be independent predictors of PONV.³⁹ Furthermore, regional anesthesia with or without concomitant general anesthesia has been associated with rapid awakening, decreased PONV, and decreased systemic opioid requirements.^{40–42}

Maintaining normothermia

Intraoperative body core temperature less than 36°C has been associated with adverse intraoperative and postoperative outcomes, including coagulopathy with increased risk of bleeding, impaired drug metabolism, impaired oxygen transportation and increased peripheral oxygen consumption, cardiac morbidity, and infectious wound morbidity.^{43–45} Active warming techniques are used in ERAS pathways. These interventions typically start with prewarming the patient in the preoperative unit in order to minimize the initial drop in core temperature at induction.⁴⁶ They are continued throughout surgery and should be extended through the recovery period in the post-anesthesia care unit. Intraoperative use of forced-air blankets, heating mattress pads, circulating-water garments, and IV fluid warming have all been proven effective in preventing hypothermia.^{47,48} Continuous intraoperative core body temperature monitoring is critical to guide management of these devices/techniques and to prevent extreme body temperatures, including hypothermia as well as hyperthermia.

Avoiding intraoperative fluid overload

Maintaining euvoemia is a sentinel principle in ERAS pathways. The philosophy of intraoperative fluid management has shifted significantly over the past few decades from liberal fluid administration to restrictive approaches, both of which have been criticized for increasing morbidity and mortality. Fluid overload may lead to electrolyte abnormalities, peripheral soft tissue edema impairing mobility, small bowel edema contributing to delayed return of bowel function, and pulmonary congestion leading to increased pulmonary morbidity. Hypovolemia, in turn, may result in decreased cardiac output affecting oxygen delivery to tissues and thus leading to organ damage. Fluid regimens aiming at negative fluid balance have failed to improve clinical outcomes or shorten hospital LOS compared with traditional fluid regimens.⁴⁹ In contrast,

perioperative fluid restriction with a goal of euvolemia has been proven superior to the traditional liberal fluid approach. Nisanevich and colleagues⁵⁰ observed that intraoperative use of restrictive fluid management resulted in fewer postoperative complications (17% vs 31%, $P < .05$), earlier time to flatus (3 vs 4 days, $P < .001$), earlier bowel movement (4 vs 6 days, $P < .001$), and shorter hospital LOS (8 vs 9 days, $P = .01$) compared with liberal fluid management. Notably, both groups received similar volume of fluids postoperatively. Other investigators have also concluded that perioperative restrictive fluid regimens decrease morbidity.^{51,52} A recent meta-analysis of 9 RCTs of nearly 1000 patients corroborates this finding (odds ratio 0.41; $P = .005$).⁵³ Lobo and colleagues⁵⁴ noted that positive fluid balance sufficient to cause as little as 3-kg weight gain postoperatively delays bowel function recovery and prolongs hospital LOS in patients undergoing elective colorectal surgery.

In order to achieve euvolemia intraoperatively within the context of an ERAS protocol, emphasis is placed in minimizing crystalloid and increasing colloid use. If a patient is hypotensive but, at the same time, is thought to be euvolemic (ie, following epidural anesthesia), vasopressor use over liberal crystalloid administration is encouraged. Toward this goal of improved intraoperative fluid management, some ERAS protocols have started to slowly adopt goal-directed therapy. This term is used to describe the use of hemodynamic parameters such as stroke volume, cardiac output, peripheral vascular resistance, or similar parameters to guide IV fluid and inotropic therapy. Data from patients undergoing major abdominal surgery have demonstrated that goal-directed therapy can improve patient outcomes by reducing postoperative complications, expediting return of bowel function, decreasing PONV, reducing intensive care unit admissions, and shortening hospital LOS.⁵⁵

Prevention of postoperative nausea and vomiting

Female gender, gynecologic surgery, and minimally invasive surgery are all well-recognized risk factors for PONV.^{39,56} These risk factors may explain at least partially the high prevalence of PONV among women undergoing gynecologic surgery. Rates of PONV in this population are reported as high as 80% and 30%, respectively.⁵⁶ PONV contributes to increased patient dissatisfaction, prolonged hospital LOS, and unplanned readmissions. ERAS pathways have thus adopted an aggressive multimodal approach toward preemptive treatment of PONV, which includes intraoperative use of at least 2 agents from different classes of antiemetics.^{39,56,57} These classes of antiemetic medication include 5HT₃ antagonists, NK-1 antagonists, corticosteroids, antihistamines, anticholinergics, butyrophenones, and phenothiazines.^{56,58} Additional strategies to decrease PONV include use of propofol infusion instead of volatile anesthetics or nitrous oxide as well as reduction of opioid use.^{39,56} Regional analgesia, although shown to decrease opioid use, did not result in decreased PONV.⁵⁹ Patients at high risk for PONV may benefit from application of transdermal scopolamine if applied within 2 hours before anesthesia and surgery.⁶⁰

Avoiding nasogastric tubes

ERAS protocols support limited use of drains, tubes, and catheters and, if needed, their use should be limited to the shortest duration necessary. Traditional perioperative management of surgical patients undergoing abdominal surgery mandated the presence of a NGT until there was evidence of return of bowel function by the presence of either flatus or bowel movement. However, an overwhelming body of evidence now argues against this practice. A *Cochrane Review* of 33 RCTs found that selective or no NGT use was associated with earlier return of bowel function ($P < .001$), decrease in pulmonary complications ($P = .01$), a trend toward shorter LOS, and no change

in anastomotic leak rates or other postoperative complications compared with routine NGT use. The investigators of that review concluded that routine NGT use should be abandoned.⁶¹ Moreover, routine NGT use has been associated with higher rates of postoperative pneumonia, atelectasis, and fever.⁶² Cutillo and colleagues⁶³ compared early oral feeding to NGT decompression combined with feeding at the first passage of flatus in patients undergoing surgery for gynecologic malignancies. They noted that early oral feeding was associated with earlier resolution of ileus, more rapid return to regular diet, no difference in rates of PONV, earlier time to first bowel movement, and shorter LOS. The ERAS Society recommends against routine NGT placement in both benign gynecologic surgery and gynecologic oncology.⁶⁴

Limiting prophylactic peritoneal drains

Although prophylactic use of drains was initially introduced in order to control postoperative fluid collections and aid in early detection of surgical bleeding or anastomotic leak, data have failed to support their effectiveness.^{65,66} Most of this data are derived from the general and colorectal surgery literature with only limited research having been conducted in gynecologic surgery primarily addressing the lack of need for drainage following lymphadenectomy.^{67,68} Bowel anastomoses can be divided into nonpelvic, pelvic, and pelvic below the peritoneal reflection in terms of the risk for anastomotic leak and the corresponding need for prophylactic drainage. With the exception of the bowel anastomoses below the peritoneal reflection where there may be a potential benefit in prophylactic drainage for a short period postoperatively,^{69–72} data do not support the routine use of prophylactic drainage following bowel resection^{70,73–76}; of note, only one study was specific to gynecologic oncology and did not support the routine use of drains following bowel resection in patients with ovarian cancer.⁶⁵ Peritoneal drains should be considered within an ERAS protocol when there is increased likelihood for pelvic collections postoperatively, bleeding concerns despite meticulous hemostasis, or very low anterior resections with no concurrent temporary bowel diversion.⁷⁷

Postoperative

Early postoperative feeding

Early feeding is considered resumption of oral fluid and solid intake within 24 hours after surgery. Within the ERAS pathway, the patient is typically allowed to drink fluids upon recovering from anesthesia and encouraged to resume regular diet upon arrival at the floor. Central to the ERAS concept, oral intake is merely encouraged, neither forced nor withheld; the patient dictates the amount and type of oral intake. Several randomized trials in gynecologic surgery provide evidence in favor of early postoperative feeding.^{63,78–81} These studies indicate that early feeding results in earlier return of bowel function and shorter LOS with no change in postoperative complications, including pulmonary complications, anastomotic leak, and wound healing.^{82,83} It is important to note that, although few studies have linked early feeding to a small increase in postoperative nausea, this association did not extend to vomiting, abdominal distention, or need for NGT use.^{80,81,83} Importantly, patients continued to rate their satisfaction with early feeding protocols very highly.⁸⁴

Early mobilization

Early mobilization is a key component in ERAS protocols. It has been stipulated that it protects against muscle loss and deconditioning by avoiding prolonged bed rest and immobility, helps reduce pulmonary and venous thromboembolic complications, improves insulin resistance, and contributes to shortening hospitalizations.^{85,86} Research has shown that daily use of a diary with postoperative day-specific

mobilization goals along with active engagement of patients and nursing staff in registering, whether these goals were being achieved or not, increased the rate of successful implementation of early mobilization protocols and was associated with a trend toward shorter hospitalization.^{85,87}

Early urinary catheter removal

ERAS protocols call for removal of urinary catheters within 24 hours following surgery, with some advocating for even earlier removal. In a recent randomized prospective study on timing of urinary catheter removal following gynecologic surgery, Ind and colleagues⁸⁸ compared midnight removal (removal of urinary catheter at midnight on the day of surgery) to morning removal (removal of urinary catheter at 06:00 AM the day after surgery). They observed that patients, who had their catheter removed at midnight, required a shorter time to first void, were passing a larger volume of urine at first void, required less frequent recatheterization for urinary retention, and had a shorter hospital LOS. A meta-analysis including RCTs from a wide range of specialties reached similar conclusions.⁸⁹ An argument toward routine removal immediately after surgery in laparotomies does not appear to be substantiated based on a recent study comparing removal of urinary catheter immediately after surgery, 6 hours, or 24 hours postoperatively following uncomplicated total abdominal hysterectomy.⁹⁰ The intermediate removal group (removal of catheter 6 hours postoperatively) was superior to the immediate group (removal at the end of surgery) in terms of less frequent need for recatheterization and superior to the delayed group (removal within 24 hours postoperatively) in terms of less frequent urinary tract infections, earlier ambulation, and shorter hospital LOS.

Perioperative pain management

Excellent perioperative pain management is one of the most central components within the ERAS pathways. The goal is to maximize efficacy of pain control while minimizing the amount of opioids used. Opioid use has traditionally been associated with increased PONV, impairment of bowel function, delayed mobilization due to altered mental sensorium, and increased pulmonary morbidity due to depression of respiratory drive. ERAS protocols aim to achieve this goal with a combination of a multimodal pharmacologic pain regimen and regional analgesia.

Multimodal pharmacologic analgesia The efficacy of this approach is based on the ability of 2 or more medication to act synergistically.⁹¹ Use of nonsteroidal anti-inflammatory drugs (NSAIDs/COX-2 inhibitors) has been proven effective in controlling postoperative pain while reducing opioid requirements, reducing PONV, and increasing patient satisfaction^{35,92,93}; furthermore, a combination of NSAIDs with paracetamol offers superior analgesia compared with either drug alone.³⁴ The use of NSAIDs in the immediate postoperative period was initially received with reservation because of preliminary data suggesting that their use may be associated with increased risk of postoperative complications including anastomotic leak.^{94–97} However, in a large, multicenter study across 109 centers in the United Kingdom, the investigators failed to detect any association between early use of NSAIDs and anastomotic leak; in fact, treatment with NSAIDs was associated with a statistically significant 28% reduction in overall complications.⁹⁸ Furthermore, despite initial concerns over increased risk of postoperative bleeding following ketorolac use, Gobble and colleagues⁹⁹ conducted a meta-analysis of 27 RCTs incorporating 2314 patients and concluded that postoperative bleeding was not statistically increased with ketorolac and that ketorolac offered pain control that was superior to controls and equivalent to opioids.

Regional analgesia Regional analgesic techniques are important adjuncts to the multimodal pharmacologic analgesic regimen within the ERAS pathways in order to achieve adequate pain control while decreasing opioid requirements and, ultimately, hastening recovery. These techniques include thoracic epidural analgesia (TEA), transversus abdominis plane (TAP) blocks, wound infiltration with local anesthetic, and intraperitoneal local anesthetic (IPLA).

Thoracic epidural analgesia TEA is considered standard of care in the vast majority of ERAS pathways from the colorectal, thoracic, vascular, hepatobiliary, and urologic literature.^{100,101} TEA has consistently been found to be superior to IV opioid PCA and has been associated with decreased PONV, earlier return of bowel function, and decreased postoperative insulin resistance. In contrast, data on the efficacy of TEA in gynecologic surgery are conflicting. Although de Leon-Casasola and colleagues¹⁰² concluded that TEA after radical hysterectomy resulted in a decrease in the duration of postoperative ileus leading to earlier hospital discharge, other investigators failed to prove benefit in terms of shortened length of hospitalization despite superior pain control,¹⁰³ and others failed to prove there was any benefit in pain management.¹⁰⁴ Important additional considerations when contemplating use of TEA in gynecologic surgery are the difficulty with proper management of TEAs and the high reported failure rate up to 30%.¹⁰⁵ For example, hypotension secondary to sympathetic blockade following TEA commonly ensues and, if it is inappropriately treated with fluid boluses instead of vasopressors, fluid overload can undermine the benefits of the fluid restrictive approach. Moreover, TEA can sometimes hinder early mobilization and early urinary catheter removal. Under such circumstances, TEA may result in impaired recovery and paradoxical prolongation of hospital LOS.

In the authors' experience, strict adherence to a multimodal pharmacologic regimen postoperatively (scheduled paracetamol and ketorolac/NSAIDs along with opioids on an as-needed basis), combined with wound infiltration with local anesthetic before incision closure, resulted in stable to improved pain scores, 80% reduction in the use of opioids in the first 48 hours, a 7-fold decrease in IV PCA use, and a 4-day reduction in hospital LOS despite omitting use of TEA.⁸⁴

Transversus abdominis plane block TAP block is an analgesic technique that involves infiltration of local anesthetic in the plane between the internal oblique and transversus abdominis muscles, first described by Rafi in 2001.¹⁰⁶ Among several modifications described since its first use, 2 important advancements consist of performing TAP blocks under ultrasound guidance to improve accuracy of delivery of local anesthetic at the right plane¹⁰⁷ as well as the open surgically placed approach, whereby delivery of local anesthetic at the right plane is performed through direct visualization intraoperatively at the time of abdominal wound closure.^{108,109} TAP blocks have been used in patients undergoing a wide range of abdominal surgeries including large bowel resection via a midline abdominal incision, caesarean delivery via the Pfannenstiel incision, abdominal hysterectomy via a transverse lower abdominal wall incision, open appendectomy, and laparoscopic cholecystectomy. They have been proven safe and appear to reduce postoperative opioid requirements and PONV and improve postoperative pain management.¹¹⁰ A meta-analysis of 6 RCTs comparing TAP blocks to no block or placebo block in patients undergoing open gynecologic surgery found that their use was associated with superior pain management and decreased opioid requirements up to 24 hours postoperatively.¹¹¹ Nonetheless, the investigators concluded that data remain limited and that future

studies should be undertaken before conclusive recommendations can be safely made. Per current guidelines for postoperative care following open general gynecologic surgery from the ERAS Society, TAP blocks may be considered in patients who have undergone general anesthesia without neuraxial blockade.¹¹²

Wound infiltration Wound infiltration of surgical site with local anesthetic is recognized as a safe, easy-to-perform, and effective method of postoperative pain management.¹¹³ Given its limited duration of action of an average of 8 hours, delivery systems such as elastometric pumps have been used for continuous wound infiltration (CIW) with local anesthetic. In a meta-analysis of 44 RCTs, Liu and colleagues¹¹⁴ found that CIW resulted in reduced pain scores and opioid use across most of the surgical specialties. Although clinical outcomes such as opioid-related side effects, patient satisfaction, and LOS were infrequently assessed for each surgical group, CIW was associated with decreased PONV and shorter LOS when analyzing all data together. In contrast, data from the gynecologic literature are conflicting with few groups showing clinical benefit in terms of pain control and opioid use,^{115,116} while others failing to demonstrate any benefit.^{117–119} Importantly, these systems are often difficult to use, and catheters can be easily dislodged and can lead to surgical site infections. An alternative method to achieve longer duration of postoperative pain control consists of wound infiltration with a long-acting anesthetic medication, called liposomal bupivacaine. This medication uses a delivery platform that releases the drug slowly over 72 to 96 hours.¹²⁰ An increasing number of studies indicate that a single-dose surgical site infiltration with liposomal bupivacaine at the end of the procedure provides effective local analgesia up to 72 hours and results in a significant reduction in opioid use following hemorrhoidectomy, bunionectomy, breast augmentation, inguinal hernia repair, and total knee arthroplasty.^{121–124} The authors' group recently conducted a study on its efficacy against regular bupivacaine within an established ERAS protocol in gynecologic surgery and found that its use resulted in a significant decrease in PCA use as well as opioid requirements while maintaining adequate pain control (Kalogera E, Bakkum-Gamez JN, Dowdy SC. Liposomal Bupivacaine Reduces Total and IV Opioid Requirements after Laparotomy for Gynecologic Malignancies. Submitted for publication).

Intraperitoneal local anesthetic IPLA involves instilling local anesthetic solution into the peritoneal cavity in order to block visceral vagal afferent signaling that gives rise to both painful and nonpainful sensations in order to further reduce postoperative pain. There are only limited data on the use of IPLA following abdominal hysterectomy, indicating that it may reduce opioid requirements and possibly reduce postoperative pain, but its effect appears to be limited to the immediate postoperative period up to 4 hours after surgery.^{125,126}

Considerations specific to vaginal hysterectomy Per current guidelines from the ERAS Society, in addition to multimodal pharmacologic analgesia, local anesthetic infiltration in the form of paracervical block or intrathecal morphine may be considered following vaginal hysterectomy. Limited data indicate that these approaches may be associated with a small effect in reducing pain and opioid requirements and may facilitate early mobilization.¹¹²

Considerations specific to minimally invasive gynecologic surgery Per current guidelines from the ERAS Society, multimodal pharmacologic analgesia should be used following minimally invasive gynecologic surgery. However, there is not enough evidence to support the routine use of TAP blocks or IPLA in this setting. TEA may prolong hospitalization without improving outcomes.¹¹²

Postoperative fluid management

Similar to preoperative and intraoperative fluid goals, euvoemia should be maintained in the postoperative period. Patients are allowed to drink immediately after surgery, and IV fluids are discontinued once they have demonstrated ability to maintain oral hydration, typically once they have had at least 500 mL of oral fluid intake. In the ERAS pathways, it is very rare that IV fluids will be required beyond 12 to 24 hours postoperatively. Even in the immediate postoperative period, the rate of IV fluid administration is kept at a minimum, no higher than 1.2 mL/kg, oftentimes much lower.¹²⁷ Toward preventing fluid overload, fluid boluses should be used cautiously and always taking into consideration the overall clinical picture. It is important to recognize that urine output as low as 20 mL/h is a normal response to surgical stress and does not require intervention.^{128,129} Balanced crystalloids (ie, Ringer lactate), which are solutions with an electrolyte concentration similar to plasma, are preferred to 0.9% normal saline in order to prevent hyperchloremic acidosis.¹³⁰

Laxative use and prevention of postoperative ileus

ERAS protocols incorporate early use of laxatives with the goal to hasten return of gastrointestinal function. One of the first studies in gynecologic oncology on aggressive postoperative bowel stimulation studied the use of milk of magnesia on postoperative day 1 combined with biscolic suppositories on postoperative day 2 following radical hysterectomy.¹³¹ This regimen resulted in a 4-day decrease in LOS with no associated untoward effects. The investigators reached similar conclusions when they completed a follow-up study during which they studied the combination of early feeding followed by Fleet Phospho-soda on postoperative day 1 in patients undergoing radical hysterectomy for cervical cancer.¹³² Hansen and colleagues¹³³ observed that oral bowel stimulation with osmotic laxatives within 6 hours after abdominal hysterectomy resulted in earlier time to first bowel movement compared with placebo (45 hours vs 69 hours; $P < .001$) with no change in pain scores, PONV, antiemetic, or opioid use.

Several additional interventions have been investigated toward preventing postoperative ileus. Chewing gum early in the postoperative period following total abdominal hysterectomy with pelvic and para-aortic lymphadenectomy is inexpensive, well-tolerated, and proven to hasten return of bowel function.¹³⁴ Herzog and colleagues¹³⁵ performed a randomized trial of Alvimopan, a novel peripherally acting mu-opioid receptor antagonist. It was found to be safe and well-tolerated and improved gastrointestinal recovery by reducing time to first bowel movement by 22 hours as well as increasing frequency and improving quality of bowel movement in patients undergoing simple total abdominal hysterectomy. In contrast to Alvimopan, there is little to no evidence to support the use of other prokinetics in this setting.¹³⁶

HASTENING POSTOPERATIVE RECOVERY

An increasing number of investigators from the United States, Europe, and Australia have published their experience with ERAS programs in a wide range of settings, including tertiary and nontertiary hospitals. ERAS protocols have been universally successful in decreasing length of hospital stay without an increase in complication and readmission rates.

Enhanced Recovery After Surgery and Benign Abdominal Hysterectomy

Miller and colleagues¹³⁷ compared 123 patients undergoing open gynecologic surgery for nonmalignant disease via abdominal incision under an ERAS protocol to 100 patients who had undergone similar procedures before ERAS adoption. Median

LOS was statistically significantly shorter by 1 day in the ERAS cohort with a median LOS of 2 days (interquartile range 1.0–3.0) versus 3 days (2.5–3.0) in the pre-ERAS cohort ($P < .001$). About a third of patients treated under the ERAS pathway were discharged on postoperative day 1, representing a 4-fold increase in early discharges compared with prior practice (ERAS vs pre-ERAS 34% vs 7%, respectively; $P < .001$). The rate of 30-day readmissions was unchanged between the 2 practices (ERAS vs pre-ERAS 10% vs 13%, respectively; $P = .49$). Interestingly, inhaled general anesthesia was the only independent factor associated with decreased odds for early discharge.

Wijk and colleagues¹³⁸ evaluated 85 patients undergoing abdominal hysterectomy for benign or malignant indications under ERAS against 120 patients undergoing the same type of surgery before ERAS. Of note, only unilateral or bilateral salpingo-oophorectomy and omentectomy could be performed in addition to hysterectomy; patients with additional pelvic surgery were not included in this study. A higher proportion of patients were discharged within 2 days after ERAS establishment (ERAS vs pre-ERAS 73% vs 56%, respectively; $P = .012$). LOS was decreased from a mean of 2.6 days to 2.3 days ($P = .011$). Reoperation, complication, and 30-day readmission rates did not differ between the 2 practices.

Investigators evaluating all types of hysterectomies (open, laparoscopic, vaginal) as one group reached similar conclusions. Narang and colleagues¹³⁹ observed that patients undergoing hysterectomy or myomectomy (open or laparoscopic) following ERAS implementation had a mean LOS of 3.6 days compared with 5.1 days in the pre-ERAS cohort, a 29% reduction. Readmission rates were unchanged. Torbe and Loudon¹⁴⁰ and Sjetne and colleagues¹⁴¹ compared patients undergoing hysterectomy (open, laparoscopic, vaginal) before and after integration of an ERAS pathway and observed a 1-day reduction in mean LOS (2.7 vs 1.8 days, and 4.7 vs 3.4 days, respectively).

Descriptive studies of cohorts of patients undergoing benign abdominal hysterectomy under ERAS protocols reported similar reductions in LOS. Carter and colleagues^{142,143} reported a median LOS of 3 days with 42% of patients being discharged by postoperative day 2. Similarly, Moller and colleagues¹⁴⁴ observed median LOS of 2 days and Chowdhury and colleagues¹⁴⁵ observed median LOS of 2.64 days. Complications and readmission rates in these studies were comparable with rates reported by prior investigators.

Enhanced Recovery After Surgery and Vaginal Hysterectomy

Yoong and colleagues¹⁴⁶ compared 50 patients who underwent vaginal hysterectomy (18% with concomitant repairs) after implementation of ERAS to 50 patients who underwent the same procedure (20% with concomitant repairs) before ERAS. They noted a 51.6% reduction in median LOS (22.0 vs 45.5 hours; $P < .01$) without adversely affecting the readmission rate or the number of emergency department (ED) visits after dismissal. There was a 5-fold increase in the number of patients being discharged within 24 hours under the ERAS protocol compared with the pre-ERAS practice (78% vs 15.6%; $P < .05$). Other descriptive studies on simple vaginal hysterectomy without other concomitant surgery corroborate these findings with mean or median LOS ranging from 1.0 to 1.8 days^{144,145,147} with stable complication and readmission rates.

In the authors' study of ERAS,⁸⁴ they studied patients undergoing pelvic organ prolapse surgery, which included vaginal hysterectomy with concomitant repairs or post-hysterectomy pelvic floor repair; isolated vaginal hysterectomies were excluded. Despite more extensive vaginal surgery compared with the Yoong and colleagues

study, similar conclusions were reached. Almost half of the ERAS cohort (46.1%) were discharged on postoperative day 1 compared with only 6.5% of women in the pre-ERAS cohort ($P < .01$) with no change in the 30-day readmission and postoperative complication rate. Other investigators who studied implementation of ERAS pathways in the same type of procedures reported rates of discharge on postoperative day 1 as high as 93.1%.^{148–150}

Enhanced Recovery After Surgery and Laparoscopic Hysterectomy

Although the feasibility and safety of same-day discharge following laparoscopic hysterectomy has been studied before the introduction of the ERAS pathways in gynecologic surgery,^{151–153} ERAS pathways can hasten convalescence, shorten hospital LOS, and contribute toward safely achieving the goal of same-day discharge.

Minig and colleagues¹⁵⁴ evaluated the clinical outcomes of 88 patients undergoing laparoscopic hysterectomy for both benign and malignant indications under an ERAS pathway in Spain where the predominant culture is for the patients to remain in the hospital for at least 2 to 3 days, even after minimally invasive surgery. Although almost 80% of patients were fit for same-day discharge, only 27% were discharged the day of surgery due to patient preference; this highlights the importance of preoperative patient education and counseling. Eighty-five percent of patients were discharged by postoperative day 1. Readmission rate was stable compared with published literature, and the ED visits (13%) occurred at least 4 days after discharge and were not related to the ERAS protocol. Johnston and colleagues¹⁵⁵ noted similar results among patients undergoing laparoscopic hysterectomy for both benign and malignant indications: 74% of patients were discharged on postoperative day 1 (49% within 24 hours). These results are consistent with other published studies reporting median LOS between 1 to 2 days following laparoscopic hysterectomy under ERAS pathways.^{145,148,156,157}

HEALTH ECONOMICS

In the current era of rapidly expanding health care costs, the value of new interventions should be critically examined. It has previously been suggested from the colorectal literature that implementation of ERAS protocols is associated with significant cost reductions,¹⁵⁸ primarily as a function of the resultant decrease in LOS. Only a few investigators have studied cost changes following implementation of ERAS protocols in benign gynecologic surgery. Furthermore, these reports focus almost exclusively on benign vaginal surgery.

The only 2 studies studying costs that include patients who underwent abdominal hysterectomy are from Narang and colleagues¹³⁹ (open or laparoscopic hysterectomy or myomectomy) and Torbe and Loudon¹⁴⁰ (vaginal, laparoscopic, or abdominal hysterectomy). In the first study, the investigators reported a cost saving of \$495 per stay per patient based on the reduction of LOS following ERAS adoption. In the latter study, there were 27 bed days saved among 31 patients being treated under the ERAS protocol over only 2 months, equating to a saving of \$285 per patient.

Introduction of ERAS in pelvic organ prolapse surgery (posthysterectomy pelvic floor repair or vaginal hysterectomy with repairs) in the authors' practice resulted in \$697.29 cost-saving per patient.⁸⁴ Similar but less impressive cost reduction was noted by Yoong and colleagues¹⁴⁶ after ERAS in patients undergoing vaginal hysterectomy (only approximately 20% with concurrent vaginal repair surgery). In their protocol, there were added expenses associated with formalized patient education in the form of a 1-hour gynecology class that used an ERAS-specialized nurse; these costs

were ultimately offset by the reduction in the LOS, still resulting in a cost saving of \$153 per patient.

HEALTH-RELATED QUALITY OF LIFE AND PATIENT SATISFACTION

The importance of preserving patient's quality of life while trying to achieve superior clinical outcomes has been increasingly recognized in clinical and surgical practice. Quality of life is particularly relevant for gynecologic patients because they are faced with sensitive issues, such as altered sexual function, loss of fertility, and disruption of normal anatomy of the female reproductive track.^{159–161} ERAS pathways have been associated with improvement in patient-reported outcomes, improved quality of life, and excellent patient satisfaction.

De Groot and colleagues¹⁶² considered successful functional recovery to have been achieved when the patient was able to tolerate general diet, mobilize independently, and have good control of postoperative pain with oral analgesia. They noted that the ERAS protocol resulted in earlier independent mobilization by 3 days, earlier oral fluid intake and ability to tolerate general diet by 2 days, as well as ability to have good control of postoperative pain with oral medication by 1 day. On the basis of these criteria, return to functional recovery was achieved 3 days earlier with the ERAS pathway compared with traditional perioperative care (3 days vs 6 days; $P < .001$). Meyer and colleagues¹⁶³ did not observe any change in the most highly rated patient-reported symptoms, which include fatigue, abdominal pain, and overall surgical pain. Specifically, pain scores were no different between pre-ERAS and post-ERAS patients despite a significant reduction in the amount of opioid medication required to treat postoperative pain. In contrast, they observed improvement in the severity of nausea, sleep disturbance, constipation, urinary urgency, and difficulty with memory during hospitalization. These findings are consistent with previously published studies on ERAS pathway in gynecologic surgery.^{84,149}

Patient satisfaction following ERAS-associated perioperative care has consistently been reported as high. In one study by Ottesen and colleagues,¹⁴⁹ 92.7% of the patients stated that their hospitalization was “as expected,” “easier than expected,” or “much easier than expected.” Most patients were satisfied with their hospital LOS; only a small percentage of patients of less than 5% (2/41) reported feeling “a little pressure put on them toward discharge,” among which one was discharged on postoperative day 8. In a 0 to 10 scale of “how acceptable the program and advice had been,” the median score was 10. Patient satisfaction rates have universally been reported high ranging from 75% to 95% across studies.^{84,140,147,150,156}

SUMMARY

High-quality data support the safety and efficacy of ERAS pathways in enhancing postoperative recovery of patients undergoing gynecologic surgery. ERAS pathways have been consistently associated with improved postoperative outcomes including earlier return of gastrointestinal function, adequate pain management with reduced opioid use, shorter length of hospital stay, excellent patient satisfaction, and substantial cost reductions with no increase in complication or readmission rates. Successful implementation of an ERAS pathway requires a multidisciplinary and collaborative approach between surgeons, anesthesiologists, pharmacists, nursing staff, and physicians in training as well as active engagement of patients in the enhancement of their recovery. Systematic efforts are needed for active diffusion of the ERAS perioperative care model and should be considered standard of care in gynecologic surgery.

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