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Perioperative Pathways: Enhanced Recovery After Surgery

ABSTRACT: Gynecologic surgery is very common: hysterectomy alone is one of the most frequently performed operating room procedures each year. It is well known that surgical stress induces a catabolic state that leads to increased cardiac demand, relative tissue hypoxia, increased insulin resistance, impaired coagulation profiles, and altered pulmonary and gastrointestinal function. Enhanced Recovery After Surgery (ERAS) pathways were developed with the goal of maintaining normal physiology in the perioperative period, thus optimizing patient outcomes without increasing postoperative complications or readmissions. The basic principles of ERAS include attention to the following: preoperative counseling and nutritional strategies, including avoidance of prolonged perioperative fasting; perioperative considerations, including a focus on regional anesthetic and nonopioid analgesic approaches, fluid balance, and maintenance of normothermia; and promotion of postoperative recovery strategies, including early mobilization and appropriate thromboprophylaxis. Benefits of ERAS pathways include shorter length of stay, decreased postoperative pain and need for analgesia, more rapid return of bowel function, decreased complication and readmission rates, and increased patient satisfaction. Implementation of ERAS protocols has not been shown to increase readmission, mortality, or reoperation rates. These benefits have been replicated across the spectrum of gynecologic surgeries, including open and minimally invasive approaches and benign and oncologic surgeries. The implementation of the ERAS program requires collaboration from all members of the surgical team. Enhanced Recovery After Surgery is a comprehensive program, and data demonstrate success when multiple components of the ERAS pathway are implemented together. Successful ERAS pathway implementation across the spectrum of gynecologic care has the potential to improve patient care and health care delivery systems.

Recommendations and Conclusions

The American College of Obstetricians and Gynecologists makes the following recommendations and conclusions regarding the implementation of Enhanced Recovery After Surgery (ERAS) pathways:

- Enhanced Recovery After Surgery pathways were developed with the goal of maintaining normal physiology in the perioperative period, thus optimizing patient outcomes without increasing postoperative complications or readmissions.
- The goals of decreasing surgical stress and helping the body mitigate the consequences of such stress with ERAS pathways is achieved by the implementation of a combination of multiple elements, which when bundled together, form a comprehensive perioperative management program.
- The basic principles of ERAS include attention to the following: preoperative counseling and nutritional strategies, including avoidance of prolonged perioperative fasting; perioperative considerations, including a focus on regional anesthetic and nonopioid analgesic approaches, fluid balance, and maintenance of normothermia; and promotion of postoperative recovery strategies, including early mobilization and appropriate thromboprophylaxis.

- Benefits of ERAS pathways include shorter length of stay, decreased postoperative pain and need for analgesia, more rapid return of bowel function, decreased complication and readmission rates, and increased patient satisfaction. Implementation of ERAS protocols has not been shown to increase readmission, mortality, or reoperation rates.
- Institutions considering adoption of ERAS programs should carefully examine their own infrastructure and patient flow through the preoperative and postoperative phases of care.
- In order for an ERAS program to be sustainable, it should be embedded as a standard model of care in a health care delivery system.
- Enhanced Recovery After Surgery is a comprehensive program, and data demonstrate success when multiple components of the ERAS pathway are implemented together.
- The use of ERAS pathways should be strongly encouraged within institutions.

Introduction

Gynecologic surgery is very common—hysterectomy alone is one of the most frequently performed operating room procedures each year (1). By using evidence-based protocols for perioperative and postoperative care, surgical stress can be reduced, healing optimized, and the patient experience improved. Traditional components of perioperative care include bowel preparation, cessation of oral intake after midnight, liberal use of narcotics, patient-controlled analgesia use, prolonged bowel and bed rest, the use of nasogastric tubes or drains, and gradual reintroduction of feeding. However, many of these commonly implemented interventions are not evidence-based, and their use frequently does not promote healing and recovery (2). With this in mind, ERAS pathways were developed with the goal of optimizing patient outcomes by introducing interventions that are data supported and have been proved either to decrease surgical stress or help the body mitigate the negative consequences of such stress (2). The basic principles of ERAS include attention to the following:

- Preoperative counseling and nutritional strategies, including avoidance of prolonged perioperative fasting
- Perioperative considerations, including a focus on regional anesthetic and nonopioid analgesic approaches, fluid balance, and maintenance of normothermia
- Promotion of postoperative recovery strategies, including early mobilization and appropriate thromboprophylaxis (Table 1)

The purpose of this document is to provide education and recommendations regarding perioperative pathways for these ERAS or "fast track" programs in gynecologic surgery.

Background

It is well known that surgical stress induces a catabolic state that leads to increased cardiac demand, relative tissue hypoxia, increased insulin resistance, impaired coagulation profiles, and altered pulmonary and gastrointestinal function (3). This response can lead to organ dysfunction with increased morbidity and delayed surgical recovery (4). The consequences of delayed postoperative recovery may include nosocomial infections, development of venous thromboembolism (VTE), long term diminishment of quality of life (5), and increased health care costs.

Enhanced Recovery After Surgery pathways were developed with the goal of maintaining normal physiology in the perioperative period, thus optimizing patient outcomes without increasing postoperative complications or readmissions. The goals of decreasing surgical stress and helping the body mitigate the consequences of such stress with ERAS pathways are achieved by the implementation of a combination of multiple elements, which when bundled together, form a comprehensive perioperative management program. Enhanced Recovery After Surgery is a comprehensive program, and data demonstrate success when multiple components of the ERAS pathway are implemented together. A meta-analysis of six randomized controlled trials demonstrated that implementation of at least 4 of the 17 possible components of the ERAS pathway in patients undergoing colorectal surgery resulted in reductions in length of hospital stay (by more than 2 days) and complication rates (by nearly 50%) (6–12).

Colorectal surgery was the first subspecialty to implement ERAS programs. When ERAS pathways have been implemented for benign gynecologic and gynecologic oncology surgeries (using open and minimally invasive approaches), results have been encouraging (13–19). Benefits of ERAS pathways include shorter length of stay (16, 20, 21), decreased postoperative pain and need for analgesia, more rapid return of bowel function, decreased complication and readmission rates, and increased patient satisfaction (22). Implementation of ERAS protocols has not been shown to increase readmission, mortality, or reoperation rates (20, 21).

Multiple studies also have demonstrated significant cost-savings associated with implementation of ERAS pathways. In one cohort study of 50 patients undergoing vaginal hysterectomy for benign indications with the use of ERAS pathways (as compared with 50 patients who underwent vaginal hysterectomy before ERAS implementation), length of stay decreased by more than 50% and the percentage of patients discharged within 24 hours increased fivefold (17). Notably, in this study, preoperative patient education was delivered by a structured "gynecology school" in which patients attended an hour-long teaching session (with a maximum of 10 participants) that incorporated audiovisual materials and question-and-answer sessions before surgery.

Table 1. Components Which May Be Considered in the Design and Implementation of an Enhanced Recovery After Surgery Program*

Surgical Phase	Intervention
	Preoperative Components
Education	• Dedicated preoperative counseling
Optimization	• Recommend tobacco cessation (ideally at least 4 weeks before surgery) • Recommend alcohol cessation for hazardous drinkers • Active identification and correction of anemia
Fasting guidelines	• May ingest light meal up to 6 hours before procedure; may drink clear liquids up to 2 hours before procedure; fasting 2 hours before procedure (except indicated preoperative medications) • Day of surgery: Commercially available carbohydrate loading drink (to be completed at 2 hours before planned procedure start time) • Eliminate oral mechanical bowel prep
	Intraoperative Components
Analgesia	• Before OR entry: consideration of celecoxib 400 mg orally, acetaminophen 1,000 mg orally, and gabapentin 600 mg orally • Regional anesthesia • Opioids IV at discretion of the surgical team, supplemented with ketamine, or ketorolac, or both • Consideration of transversus abdominis plane block versus local wound infiltration depending on surgical incision • For pelvic organ prolapse surgery: Spinal block containing bupivacaine plus hydromorphone (40–100 micrograms); sedation versus light general anesthetic at discretion of the surgical team
Prophylaxis for nausea and vomiting	• Before incision (± 30 min): consideration of transdermal scopolamine 1.5 mg patch for patients at high risk of postoperative nausea or vomiting • Intraoperative: consideration of dexamethasone 8 mg IV at induction, ondansetron 4 mg IV before emergence • Alternative or additional regimens at discretion of anesthesiologist and surgical team
Fluid optimization	• Decrease crystalloid administration • Increase colloid administration if needed
Thromboprophylaxis	• Sequential compression devices • Consideration of heparin or low-molecular-weight heparin for high-risk patients
Antimicrobial therapy	• First-generation cephalosporin or amoxicillin-clavulanic acid within 60 minutes before skin incisions • Increase prophylactic antibiotic dosage in obese patients (BMI [calculated as weight in kilograms divided by height in meters squared] greater than or equal to 30) • Additional intraoperative doses if heavy blood loss (>1,500 mL) or for lengthy procedures • Skin cleansing: Use an alcohol-based agent unless contraindicated • Vaginal cleansing: Use either 4% chlorhexidine gluconate or povidone-iodine • Hair clipping (rather than shaving)
Drains/packs	• Avoidance of drains and vaginal packs
Temperature	• Maintenance of normothermia
	Postoperative Considerations
Activity	• Evening of surgery: OOB more than 2 hours (including one or more walks and sitting in chair) • Day after surgery until discharge: OOB more than 8 hours (including four or more walks and sitting in chair) • Up in chair for all meals

(*continued*)

Table 1. Components Which May Be Considered in the Design and Implementation of an Enhanced Recovery After Surgery Program* (*continued*)

Surgical Phase	Intervention
Diet	• No NG tube (remove at extubation if placed) • Start regular diet and chewing gum 4 hours after procedure • Day of surgery: one box liquid nutritional supplement; oral intake at least 800 mL fluid but no more than 2,000 mL by midnight • Day after surgery until discharge: two boxes liquid nutritional supplement; encourage daily oral intake of 1,500–2,000 mL fluids • Osmotic diuretics: Senna and docusate sodium; magnesium oxide; magnesium hydroxide as needed • Maintain blood glucose levels (180–200 mg/dL)
Analgesia	• Stepwise, multimodal pain management strategy to minimize opioid administration • Scheduled ketorolac or scheduled NSAIDs (if unable to take NSAIDs: scheduled tramadol) • Scheduled acetaminophen (for patients without severe hepatic disease) • Scheduled gabapentin • Oral opioids if needed; breakthrough pain: hydromorphone • IV and PCA regimens only for continued pain despite titration of oral regimen
Fluid optimization	• OR fluids discontinued on floor arrival • Fluids 40 mL/hour until 8 am day after surgery, then discontinued • Peripheral lock IV at 600 mL oral intake or 8 am day after surgery (whichever first)
Catheters	• Removal of urinary catheter within 24 hours • Assess for removal of drains and vaginal packs
Discharge	• Defined discharge pathways (eg, full mobilization, ability to tolerate solids without nausea or vomiting, oral analgesia)

Abbreviations: BMI, body mass index; IV, intravenous; NG, nasogastric; NSAIDS, nonsteroidal antiinflammatory drugs; OOB, out of bed; OR, operating room; PCA, patient-controlled analgesia.

*These are suggested considerations only. Discussion and implementation of hospital- and surgery-specific protocols should be discussed.

Data from Nelson G, Altman AD, Nick A, Meyer LA, Ramirez PT, Achtari C, et al. Guidelines for pre- and intra-operative care in gynecologic/oncology surgery: Enhanced Recovery After Surgery (ERAS[R]) Society recommendations—Part I. Gynecol Oncol 2016;140:313–22; Nelson G, Altman AD, Nick A, Meyer LA, Ramirez PT, Achtari C, et al. Guidelines for postoperative care in gynecologic/oncology surgery: Enhanced Recovery After Surgery (ERAS[R]) society recommendations—Part II. Gynecol Oncol 2016;140:323–32; Myers K, Hajek P, Hinds C, McRobbie H. Stopping smoking shortly before surgery and postoperative complications: a systematic review and meta-analysis. Arch Intern Med 2011;171:983–9; Oppedal K, Møller AM, Pedersen B, Tønnesen H. Preoperative alcohol cessation prior to elective surgery. Cochrane Database of Systematic Reviews 2012, Issue 7. Art. No.: CD008343; Chapman JS, Roddy E, Ueda S, Brooks R, Chen LL, Chen LM. Enhanced recovery pathways for improving outcomes after minimally invasive gynecologic oncology surgery. Obstet Gynecol 2016;128:138–44; Kalogera E, Bakkum-Gamez JN, Jankowski CJ, Trabuco E, Lovely JK, Dhanorker S, et al. Enhanced recovery in gynecologic surgery. Obstet Gynecol 2013;122:319–28; *and* Kalogera E, Dowdy SC. Enhanced recovery pathway in gynecologic surgery: improving outcomes through evidence-based medicine. Obstet Gynecol Clin North Am 2016;43:551–73.

Even with the addition of a formal teaching session and a newly hired specialist "Enhanced Recovery" nurse, the ERAS protocol was associated with a cost savings of nearly 10% (17). However, differences exist between ERAS protocols among institutions performing gynecologic surgery; thus, there is a need to develop standardized, evidence-based and specialty-specific guidelines (16, 23).

Preoperative Enhanced Recovery After Surgery Components

Preoperative Management Planning and Risk Assessment

Patient involvement and engagement are key, and patient education is associated with improved outcomes (6). Counseling should start as early as the initial preoperative visit, with an explanation of the rationale behind ERAS and a discussion of patient expectations. Patient-tailored handouts may be helpful in communicating the goals of ERAS and helping patients understand the active role they may play in their care. Preoperative risk assessment should include identification of tobacco and alcohol use, overweight status and obesity, anemia, and sleep apnea. These factors should be considered when choosing the appropriate preoperative and postoperative care. The perioperative period is a critical window of opportunity for surgeons to influence behavior and encourage smoking cessation. Smoking-related impairment in wound healing decreases and pulmonary function improves within 4–8 weeks of smoking cessation (24). Although the benefits of smoking cessation increase proportionally with the length of cessation, and there has been concern about short-term smoking cessation immediately before surgery, emerging research suggests that shorter-term perioperative smoking cessation does not cause harm (25–27). The data

regarding hazardous drinking is sparser but suggests that patients who consume 3–4 drinks per day (considered "hazardous alcohol intake") may have up to 50% higher complication rates (including bleeding, cardiac arrhythmias, impaired wound healing, and intensive care unit admissions) when compared with patients who consume 0–2 drinks per day. Complication rates increase to 200–400% for those who have five or more drinks per day (28). A 2012 Cochrane Review suggested that intensive preoperative alcohol cessation interventions could significantly reduce complication rates (29).

A discussion regarding planned length of stay is crucial to ensuring availability of appropriate support and managing patient expectations. Patients should be provided the opportunity to discuss surgical planning and pain control with the surgical team and the anesthesia team as desired. Designated nurses specializing in ERAS care may be helpful (30). A key strategy for successful implementation of an ERAS program is the active engagement of all parties. In addition to partnering with the patient, a central component of a successful program is the cooperation of an interdisciplinary team, including the surgeon, preoperative nurse, anesthesiologist, office nurses, and other important staff (Fig. 1).

Appropriate risk stratification is an important component of enhancing surgical recovery. The Caprini VTE risk assessment model and the Rogers score may be used to provide individual risk assessment, although more extensively validated models for specific patient populations are needed (31, 32). Systemic hormone therapy and oral contraceptive use have been associated with increased risk of VTE; however, the overall risk remains quite low. No trials exist to demonstrate a reduction in postsurgical VTE with preoperative discontinuation of hormone therapy, and this practice should not be routinely recommended. In women using combined oral contraception, prothrombotic clotting factor changes persist 4–6 weeks after discontinuation, and risks associated with stopping oral contraception a month or more before major surgery should be balanced with the very real risk of unintended pregnancy. It is not considered necessary to discontinue combination oral contraceptives before laparoscopic tubal sterilization or other brief surgical procedures. In current users of oral contraceptives who have additional risk factors for VTE having major surgical procedures, heparin prophylaxis should be considered (33). Lastly, preoperative anemia is associated with postoperative morbidity and mortality and should be actively identified and corrected (21).

Diet and Bowel Preparation

The goal of the preoperative phase of ERAS is for patients to obtain the energy necessary for the body to accommodate the high metabolic demands imposed by surgery. The traditional fasting requirements of surgery deplete liver glycogen and are associated with impaired glucose metabolism and increased insulin resistance, which have been shown to adversely affect perioperative outcomes. In contrast with traditional "nothing by mouth" strategies, ERAS pathways avoid dehydration by reducing the preoperative starvation period and utilizing complex carbohydrate drinks in nondiabetic patients. This strategy has been shown to reduce preoperative thirst and anxiety and reduce postoperative insulin resistance in colorectal surgery, ultimately reducing length of stay and improving patient satisfaction (30, 34, 35). Data from the anesthesia literature have demonstrated that intake of clear fluids up until 2 hours before surgery does not increase gastric content, reduce gastric fluid pH, or increase complication rates (23). Thus, clear fluids should be allowed up to 2 hours before induction of anesthesia and solids up to 6 hours prior. Integration of a multidisciplinary approach is important to ensure buy-in and compliance with these guidelines from all members of the surgical team.

Evidence that preoperative mechanical cleansing of the bowel improves surgical outcomes is limited. A 2011 Cochrane review of 20 randomized trials with 5,805 participants undergoing elective colorectal surgery demonstrated no difference in wound infections or anastomotic leakage rates between groups of participants who received or did not receive mechanical bowel preparation (36). Although some studies showed that the combination of oral antibiotics with a mechanical bowel preparation regimen reduces rates of infection and anastomotic leakage (37–39), other data have not demonstrated a significant difference (40). Mechanical bowel preparation also has been proposed as a method of enhancing visualization of the surgical field during laparoscopic surgery. However, a randomized controlled trial of 146 women assigned to laparoscopic hysterectomy either with or without mechanical bowel preparation showed no difference in surgeries rated as "good" or "excellent" visualization (41). Additionally, mechanical bowel preparation is time-consuming, expensive, and unpleasant for patients. Institutions may individualize their approach; data support that in cases of well-defined location and size of the lesion, shared decision-making between the obstetrician–gynecologist and the patient is the recommended approach (36).

Perioperative Enhanced Recovery After Surgery Components

Minimizing Infection Risk

Minimally invasive approaches should be undertaken whenever possible and incisions kept as small as possible (30). Patients undergoing hysterectomy, which is classified as a clean contaminated surgery, should receive broad-spectrum antibiotics to cover skin, vaginal, and enteric bacteria (23, 42). For laparoscopic surgeries that do not involve genitourinary or digestive contamination, no antibiotic prophylaxis is necessary (23). Intravenous antibiotics should be administered within 60 minutes before skin incision. Amoxicillin–clavulanic acid and

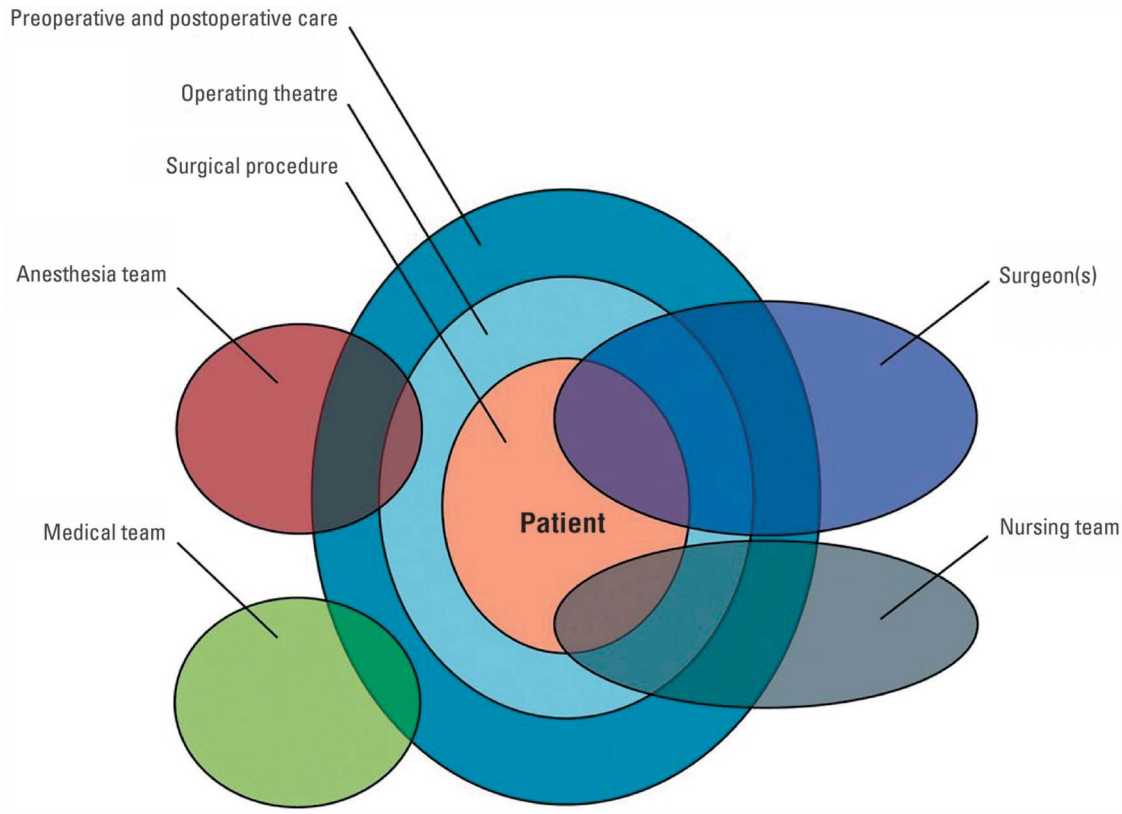

Figure 1. The complex surgical environment. (Modified from Ergina PL, Cook JA, Blazeby JM, Boutron I, Clavien PA, Reeves BC, et al. Challenges in evaluating surgical innovation. Lancet 2009;374:1097–104.)

cefazolin provide appropriate antibiotic coverage against the microbes frequently involved in postoperative infections, although amoxicillin–clavulanic acid is more effective against anaerobes (43). Patients with a severe β−lactam allergy may be given a combination of clindamycin and gentamycin or a quinolone such as ciprofloxacin (23). Health care providers should consult their institutional antibiograms to confirm local susceptibility rates to the chosen coverage regimen. For lengthy procedures, additional intraoperative doses of the chosen antibiotic, given at intervals of two times the half-life of the drug (measured from the initiation of the preoperative dose, not from the onset of surgery), are recommended to maintain adequate levels throughout the operation (44). Prophylactic antibiotic dosage should be increased in obese patients (BMI [calculated as weight in kilograms divided by height in meters squared] greater than or equal to 30) and, in surgical cases with excessive blood loss, a second dose of the prophylactic antibiotic may be appropriate (44). Although most guidelines do not specifically define "excessive," data suggest an additional dose of cefazolin when blood loss exceeds 1,500 mL (44).

Perform preoperative surgical site skin preparation with an alcohol-based agent unless contraindicated (45). Chlorhexidine-alcohol is an appropriate choice. Skin antiseptics should be used in accordance with their manufacturer's instructions. Scrub time (gentle, repeated back-and-forth strokes) for chlorhexidine-alcohol preparations should last for 2 minutes for moist sites (inguinal fold and vulva) and 30 seconds for dry sites (abdomen), and allowed to dry for 3 minutes (46). However, if using povidone-iodine scrubs for abdominal preparation, recommended scrub time can be as long as 5 minutes (47). The solution should then be removed with a towel and the surgical site painted with a topical povidone-iodine solution, which should be allowed to dry for 2 minutes before draping (47). Vaginal cleansing with either 4% chlorhexidine gluconate or povidone-iodine should be performed before hysterectomy or vaginal surgery (44). Although currently only povidone-iodine preparations are U.S. Food and Drug Administration-approved for vaginal surgical-site antisepsis, solutions of chlorhexidine gluconate with low concentrations of alcohol (eg, 4%) are safe and effective for off-label use as vaginal surgical preparations and may be used as an alternative to iodine-based preparations in cases of allergy or when preferred by the surgeon. If hair removal is needed, electric clipping is preferred to shaving (23). Any necessary hair removal should be done immediately before the operation (44).

Pain Management

Opioid use is associated with postoperative nausea and vomiting, impairment of bowel function, delayed mobilization, and increased pulmonary morbidity, all of which can delay recovery and negatively affect patients' perception of the surgical experience. Although there are situations in which the judicious use of opioids is appropriate to achieve postoperative pain control, the epidemic of opioid use disorder and drug diversion has focused increased attention on development of alternative, stepwise and multimodal, and nonopiate pain management strategies. As an alternative to the administration of opioids, ketorolac is effective in controlling postoperative pain and does not increase postoperative bleeding (48). Preemptive medication strategies (eg, medications given to the patient before surgery), including paracetamol and acetaminophen, gabapentin, nonsteroidal antiinflammatory drugs, and COX-2 inhibitors, have been shown to decrease total narcotic requirements and improve postoperative pain and satisfaction scores in women undergoing total abdominal hysterectomy (49). Intraoperatively, epidural and spinal anesthesia strategies, when compared with general anesthesia, decrease overall mortality and postoperative complications, including VTE, blood loss, pneumonia and respiratory depression, myocardial infection, and renal failure (50), although such strategies limit mobilization. However, epidural and spinal anesthesia strategies are not feasible or appropriate for all surgical procedures. The transversus abdominis plane block (commonly referred to as a TAP block), which involves injection of local anesthetic into the transversus abdominis fascial plane, also has been shown to be effective in some studies for reduction of postoperative opioid use in patients undergoing laparoscopic surgery, as well as women undergoing total abdominal hysterectomy (51, 52). However, other trials have yielded less promising results. In one randomized controlled trial of women undergoing gynecologic laparoscopy, transversus abdominis plane block did not provide statistically significant differences in mean postoperative pain scores (53).

The strategy of postoperative minimization of opioid use reduces nausea and vomiting, impairment of bowel function, delayed mobilization, and pulmonary morbidity (54). Regimens designed to minimize postoperative opioid use also may include the use of scheduled acetaminophen, gabapentin, and nonsteroidal antiinflammatory drugs. For vaginal hysterectomy, paracervical nerve blocks or intrathecal morphine may be useful. For open general gynecologic surgery, spinal analgesia or thoracic epidural analgesia can be used postoperatively. Wound infiltration with liposomal bupivacaine, a long-acting anesthetic medication effective over 72–96 hours, also has been proposed as an alternative approach (2); although more data are needed on the benefit of its use. Antiemetics should be incorporated to combat postoperative nausea and vomiting.

Intraoperative Fluid Balance and Prevention of Hypothermia

Careful attention to intraoperative euvolemia and prevention of hypothermia are important, and close collaboration between the anesthesia and surgical teams is imperative in order to achieve this goal. Fluid overload may lead to electrolyte abnormalities, peripheral edema and impaired mobility, delayed return of bowel function, and pulmonary congestion, whereas hypovolemia may result in decreased cardiac output and oxygen delivery. Moreover, even mild hypothermia (a decrease of 1°C from core temperature) stimulates adrenal steroid and catecholamine production and results in increased incidence of wound infections, cardiac arrhythmias, and blood loss (4).

Use of Tubes and Drains

Surgical drains should be removed as early as possible after surgery. The routine use of nasogastric, abdominal, and vaginal drains hinders mobilization, increases morbidity, and prolongs hospital stay with limited evidence of benefit (55). Vaginal packing may cause discomfort and limit ambulation, which is important for prevention of VTE (30). The judicious use of nasogastric tubes during surgery (avoiding their use whenever possible) does not increase anastomotic leaks and, in fact, is associated with decreased pulmonary complications and a trend toward shorter length of stay (30). Removal of the urinary catheter, if used, within 24 hours also shortens hospital length of stay by decreasing infection risk (30). Importantly, women who undergo pelvic surgical procedures such as a total laparoscopic hysterectomy or other long laparoscopic procedures are at risk of postoperative voiding difficulty and should be monitored with postvoid residual checks after discharge, if clinically indicated (30).

Postoperative Enhanced Recovery After Surgery Components

Early Mobilization and Thromboprophylaxis

Postoperatively, early ambulation (a concept with varying definitions but typically encompassing time spent out of bed as early as the day of surgery) is a mainstay of management. Mobilization protects against deconditioning, reduces thromboembolic complications, reduces insulin resistance and overall results in shorter hospital stays (2). Early ambulation can be promoted by preoperative counseling of the patient, as well as effective stepwise, multimodal analgesia regimens that limit reliance on systemic opiates. For patients at risk of VTE, the Caprini score or Rogers score may be used to provide further risk stratification (Table 2). Regardless of risk, postoperative thromboprophylaxis in all patients should include, in addition to early ambulation, intermittent pneumatic compression and the use of well-fitted compression stockings and also may incorporate low-molecular-weight heparin. For women undergoing

laparotomy for abdominal or pelvic malignancies, extended (28 day) prophylaxis should be provided (54).

Nutrition and Fluid Balance

Protocols that emphasize early feeding (a return to regular diet within 24 hours), with use of laxatives as needed, promote the earlier return of bowel function and improve patient satisfaction. Postoperative oral fluid intake and feeding should begin on the day of surgery, if possible. Chewing gum reduces the incidence of postoperative ileus and its use should be considered (54). Intravenous fluids should be discontinued within 24 hours after surgery because they are rarely needed in patients able to sustain oral intake. High energy protein drinks may be added to the dietary regimen to ensure protein and calorie intake while oral intake is building. If intravenous fluids must be maintained, total hourly volume should be kept no higher than 1.2 mL/kg to prevent volume overload. Balanced crystalloid solutions, such as Ringer's lactate, are preferred. The risk of hyperchloremic metabolic acidosis increases with the administration of large volumes of 0.9% normal saline (54).

A patient's blood glucose levels should be maintained between 180 mg/dL and 200 mg/dL (54). Perioperative hyperglycemia, or blood glucose levels greater than 180–200 mg/dL, is associated with poor clinical outcomes, including infection, increased length of stay, and postoperative mortality (56). However, the ideal target range remains controversial because of potential adverse events related to hypoglycemia, which itself may lead to morbidity (including seizures, brain damage, and cardiac arrhythmia). Stricter control may be considered in select patients because maintenance of postoperative blood glucose levels less than 139 mg/dL has been shown to lower the surgical site infection rate by 35% in women with diabetes mellitus and postoperative hyperglycemia (56). Levels above this range should be managed with insulin and regular blood glucose monitoring (54). There are various protocols to achieve glycemic control, but the data are too limited to recommend one specific protocol over another.

Hospital Discharge

Hospital discharge should be criteria-based and include assessment for ambulation, adequate pain control with oral analgesics, and tolerance of diet. Written information should be provided, including guidelines to notify the surgical team, recovery advice, and emergency contact information. Flatus is not necessary before discharge. Specific guidelines for patients undergoing same-day discharge should be made available. Patients with obstructed sleep apnea also warrant specific attention and discharge guidelines given their increased risk of postoperative complications (31). Notably, implementation of an ERAS program has not been shown to increase readmission rate or work for the primary care provider (30).

Implementation of Enhanced Recovery After Surgery Principles

Enhanced Recovery After Surgery programs represent a comprehensive bundle of interventions, and successful implementation depends on adaptation of multiple ERAS principles. The implementation of an ERAS program may require major changes to clinical interventions and supporting clinical systems. Institutions considering adoption of ERAS programs should carefully examine their own infrastructure and patient flow through the preoperative and postoperative phases of care. In order for an ERAS program to be sustainable, it should be embedded as a standard model of care in a healthcare delivery system. Factors critical for success include the following:

Table 2. Risk Stratification for Venous Thromboembolism

	Patients Undergoing Major General, Thoracic, or Vascular Surgery		Patients Undergoing General Surgery, Including GI, Urological, Vascular, Breast, and Thyroid Procedures	
VTE Risk Category	Rogers Score	Observed Risk of Symptomatic VTE %	Caprini Score	Observed Risk of Symptomatic VTE %
Very low	<7	0.1	0	0
Low	7–10	0.4	1–2	0.7
Moderate	>10	1.5	3–4	1.0
High	N/A	N/A	≥5	1.9

Abbreviations: GI, gastrointestinal; VTE, venous thromboembolism.

Modified from Gould MK, Garcia DA, Wren SM, Karanicolas PJ, Arcelus JI, Heit JA, et al. Prevention of VTE in nonorthopedic surgical patients: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines [published erratum appears in Chest 2012; 141:1369]. Chest 2012;141 suppl:e227S–77S. Available at: http://journal.chestnet.org/article/S0012-3692(12)60125–1/abstract. Retrieved April 12, 2018.

- Measurement of outcomes and refinement of interventions based on internal data
- Involved, engaged clinical leadership at a senior level
- Mutual respect and effective teamwork among members of the clinical team who should view patients as partners in their care
- An organizational culture that emphasizes safety and quality without fear of risk or blame (30)

Conclusion

The ERAS principles represent an evidence-based approach to surgical management that challenges traditional surgical management paradigms. The use of ERAS pathways has resulted in more rapid surgical recovery, shorter length of stay, greater patient satisfaction, and decreased costs when compared with traditional approaches. These benefits have been replicated across the spectrum of gynecologic surgeries, including open and minimally invasive approaches and benign and oncologic surgeries. The implementation of the ERAS program requires collaboration from all members of the surgical team. Successful ERAS pathway implementation across the spectrum of gynecologic care has the potential to improve patient care and health care delivery systems, and the use of ERAS pathways should be strongly encouraged within institutions.

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