Implementation of a urogynecology-specific enhanced recovery after surgery (ERAS) pathway

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OBJECTIVE: Enhanced recovery after surgery protocols were developed for colorectal surgery to hasten postoperative recovery. Variations of the protocol are being adopted for gynecological procedures despite limited population and procedure-specific outcome data. Our objective was to evaluate whether implementation of an enhanced recovery after surgery pathway would facilitate reduced length of admission in a urogynecology population.

MATERIALS AND METHODS: In this retrospective analysis of patients undergoing pelvic floor reconstructive surgery by 7 female pelvic medicine and reconstructive surgeons, we compared same-day discharge, length of admission and postoperative complications before and after implementation of an enhanced recovery after surgery pathway at a tertiary care hospital. Groups were compared using χ^2 and Student *t* tests. Candidate variables that could have an impact on patient outcomes with $P < .2$ were included in multivariable logistic regression models. Satisfaction with surgical experience was assessed using a phone-administered questionnaire the day after discharge.

RESULTS: Mean age and body mass index of 258 women (137 before enhanced recovery after surgery and 121 enhanced recovery after surgery) were 65.5 ± 11.3 years and 28.2 ± 5.0 kg/m^2. The most common diagnosis was pelvic organ prolapse (n = 242, 93.8%) including stage III pelvic organ prolapse (n = 61, 65.1%). Apical suspension procedures included 58 transvaginal (25.1%), 112 laparoscopic/robotic (48.8%), and 61 obliterative (26.4%). Hysterectomy was performed in 57.4% of women. Demographic and surgical procedures were similar in both groups. Compared with before enhanced recovery after surgery, the enhanced recovery after surgery group had a higher proportion of same-day discharge (25.9% vs 91.7%, $P < .001$) and a 13.8 hour shorter duration of stay (25.9 ± 13.5 vs 12.1 ± 11.2 hours, $P < .001$). Operative and postsurgical recovery room times were similar (2.6 ± 0.8 vs 2.6 ± 0.9 hours, $P = .955$; 3.7 ± 2.1 vs 3.6 ± 2.2 hours, $P = .879$). Women in the enhanced recovery after surgery group were more likely to be discharged using a urethral catheter (57.9% enhanced recovery after surgery vs 25.4% before enhanced recovery after surgery, $P = .005$). There were no group differences in total 30 day postoperative complications overall and for the following categories: urinary tract infections, emergency room visits, unanticipated office visits, and return to the operating room. However, enhanced recovery after surgery patients had higher 30 day hospital readmission rates (n = 8, 6.7% vs n = 2, 1.5%, $P = .048$). Patients before enhanced recovery after surgery were readmitted for myocardial infarction and chest pain. Enhanced recovery after surgery patients were admitted for weakness, chest pain, hyponatremia, wound complications, nausea/ileus, and ureteral obstruction. Three enhanced recovery after surgery patients returned to the operating room for ureteral obstruction (n = 1), incisional hernia (n = 1), and vaginal cuff bleeding (n = 1). Enhanced recovery after surgery patients also had more postoperative nursing phone notes (2.6 ± 1.7 vs 2.1 ± 1.4, $P = .030$). On multivariable logistic regressions adjusting for age and operative time, same-day discharge was more likely in the enhanced recovery after surgery group (odds ratio, 32.73, 95% confidence interval [15.23–70.12]), while the odds of postoperative complications and emergency room visits were no different. After adjusting for age, operative time, and type of prolapse surgery, readmission was more likely in the enhanced recovery after surgery group (odds ratio, 32.5, 95% confidence interval [1.1–28.1]). In the enhanced recovery after surgery group, patient satisfaction (n = 77 of 121) was reported as very good or excellent by 86.7% for pain control, 89.6% for surgery preparedness, and 93.5% for overall surgical experience; 89.6% did not recall any postoperative nausea during recovery.

CONCLUSION: Enhanced recovery after surgery implementation in a urogynecology population resulted in a greater proportion of same-day discharge and high patient satisfaction but with slightly increased hospital readmissions within 30 days.

Key words: enhanced recover after surgery, pelvic floor reconstructive surgery, pelvic organ prolapse, same-day discharge

Enhanced recovery after surgery (ERAS), a multidisciplinary care pathway composed of evidence-based interventions, has challenged the traditional perioperative care paradigm with a goal of enhancing recovery and improving perioperative outcomes.[1] Central to ERAS are the core components of patient education, preoperative optimization, avoidance of preoperative fasting, carbohydrate loading, intraoperative euvolemia, standardized opioid-sparing anesthesia, prevention of postoperative pain and nausea, and early mobilization.[1,2]

The first pathway was developed in Europe for colorectal surgery and has since been adapted for other surgical specialties, including gynecology.[3,4] The most studied population in gynecology are oncology patients undergoing laparotomies with hospitalizations longer than 2 days.[5,6] After ERAS implementation these patients experienced decreased length of admission, hastened return of bowel function, and decreased narcotic use, resulting in better postoperative pain control, and high patient satisfaction.[1,7,8]

The benefits of ERAS are less clear in older patients undergoing prolapse procedures who are routinely admitted for a 23 hour observation and experience low postoperative morbidity compared with gynecological oncology patients. We hypothesized that adopting an ERAS

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AJOG at a Glance

Why was this study conducted?

This study aims to determine the clinical implications of adopting a urogynecology-specific enhanced recovery after surgery (ERAS) pathway.

Key findings

ERAS implementation reduced length of admission by 13.8 hours and increased same-day discharge from 25.9% to 91.7%, while 30-day complications were unchanged.

What does this add to what is known?

ERAS outcomes in this population have yet to be reported and add to the limited literature on ERAS after pelvic floor reconstructive surgery.

protocol for the urogynecology service would lead to a reduced length of stay and ultimately increase day-of-surgery discharges. While same-day discharge has gained popularity for hysterectomy alone, it has yet to be adopted in women undergoing major pelvic organ prolapse (POP) procedures. Studies examining the effects of ERAS after POP surgeries fail to demonstrate a reduced length of admission to less than 1 day.[1,9]

The objective of this study was to evaluate whether the implementation of a unique urogynecology ERAS pathway is associated with a reduction in the length of admission and increased same-day discharge (SDD) after pelvic floor reconstructive surgery.

Materials and Methods

We conducted a retrospective, observational cohort study of women who underwent elective major surgery by 7 surgeons of the urogynecology teaching service at Magee-Womens Hospital of the University of Pittsburgh Medical Center, a tertiary care institution, before and after implementation of an urogynecology-specific ERAS pathway.

Over a 1 year period, a multidisciplinary team within our health care system worked to create the ERAS pathway. Because of the scarcity of existing urogynecology or minimally invasive gynecologic surgery ERAS protocols at the time our protocol was developed, we created our own protocol adapted from colorectal surgery, urology, and gynecological oncology data along with experiences of our ERAS leaders.

The core components of our ERAS protocol are listed in Table 1. Patients attended a preoperative office visit or phone call 1−3 weeks before surgery. A physician's assistant, fellow, surgeon, or nurse conducted these individual appointments. The overarching goal of the visit was to engage patients in their recovery process, provide education on preoperative optimization, review the goals of ERAS including SDD, and identify patients' postoperative expectations.

Avoidance of preoperative fasting is a principal component of ERAS and one of the largest changes in practice for our institution.[10,11] In our ERAS pathway, we adopted a liberalized fluid policy following the American Society of Anesthesiology recommendations of clear liquids up until 3 hours before surgery.[12] In addition, we encouraged carbohydrate loading the day before and day of surgery to prevent insulin resistance seen with fasting.[13,14]

Patients were advised to consume 20−40 ounces of an electrolyte-supplemented sports drink with 45 g of carbohydrates the day before surgery and 20 ounces of a sports drink up to 3 hours prior to surgery. Patients were also encouraged to ambulate for 30 minutes daily. At the end of each visit, patients were provided with an institutionally authored brochure outlining the principles of ERAS.

The cohort was created by merging 2 deidentified preexisting databases that contained women who had surgery prior to and after implementation of the ERAS pathway. The pre-ERAS database included all consecutive patients who had elective major procedures by 7 surgeons board certified in female pelvic medicine and reconstructive surgery from Jan. 1, 2016 through June 31, 2016.

Eligibility criteria were major pelvic floor reconstructive surgery including an apical suspension procedure or obliterative procedure and/or hysterectomy during the specified timeframe. Exclusion criteria were minor procedures, such as isolated anterior or posterior colporrhaphies, isolated incontinence procedures, or minor laparoscopic procedures such as salpingectomy or excision of endometriosis.

Data were collected retrospectively in a previous study. Women were identified from the surgical services calendar, and data were extracted from the electronic medical record clinic notes, operative reports, anesthesia records, admission records, and emergency department records by chart review. The timeframe for data collection was from baseline preoperative appointment through 30 days postoperatively. Variables collected were demographic factors, medical history, baseline examination findings, operative procedures, anesthesia, perioperative medications, postoperative complications, unplanned visits, postoperative nursing calls, and pain scores.

The 8 month period preceding ERAS implementation was excluded because of potential crossover influences due to ERAS planning meetings and the initiation of ERAS protocols for 2 other gynecological surgery services (gynecologic oncology and minimally invasive gynecologic surgery) prior to urogynecology.

The post-ERAS implementation database included all consecutive patients who had elective major gynecological surgery by 1 of 5 female pelvic medicine and reconstructive surgery surgeons from Feb. 2, 2017, to July 31, 2017. Data were collected prospectively as part of a quality improvement initiative within our division to track outcomes after implementation of ERAS.

Data collected were similar to the pre-ERAS database and were extracted from the electronic medical record. In addition, 2 unique, nonvalidated,

study-specific instruments were administered prospectively in this group. The first was a patient-completed paper questionnaire administered in the preoperative area the day of surgery to identify compliance with preoperative ERAS education and specific preadmission ERAS recommendations, such as exercise, hydration, nutrition, bowel preparation, and fasting. The second questionnaire was administered by office nurses at the time of the standard postoperative call, typically the day after discharge, to assess satisfaction with the surgical experience and their recollection of nausea and pain control while in the hospital. The postoperative questionnaire was developed 2 months after initiation of ERAS as part of a quality improvement initiative.

We hypothesized that ERAS implementation would increase the proportion of patients discharged on the day of surgery by 18% and 30 day complications would not increase by more than 10%. To be discharged from the postanesthesia care unit, patients had to meet all of the following criteria: pain <3, tolerate juice and crackers, have no nausea or emesis, ambulate independently, spontaneously void or with a catheter plan, and have a WAKE score ≥9. WAKE score is a standardized scoring system for PACU discharge readiness that became popular with the shift to same day discharge in orthopedic patients. The 5 indicators of readiness are movement, blood pressure, level of consciousness, respiratory effort and oxygen saturation, which are combined for a maximum score of 10.[15]

The primary outcome was length of admission, which was measured in 2 ways. First, it was measured as a continuous variable comparing admission length in hours pre- and post-ERAS implementation. Then it was measured as a binary variable, overnight admission, comparing proportions of patients admitted overnight after surgery before and after the ERAS implementation.

We also assessed 30 day complication rates before and after the ERAS implementation. Total 30 day complications were a composite of intraoperative complications, hospital complications, postoperative complications, emergency department visits, unanticipated office visits, readmission to the hospital, urinary tract infection, and reoperation within 30 days of the index surgery. Complications were defined as any aberration from the standard recovery course. Other important secondary outcomes were spontaneous void at discharge and patient postoperative calls.

We performed a multivariable regression for the following dependent variables to control for potential confounding variables: postoperative recovery unit time, length of admission, overnight admission, 30 day postdischarge complications, 30 day emergency visits, and 30 day readmission. Lastly, we assessed patient outcomes including satisfaction, pain control, and postoperative nausea in the patients after ERAS implementation.

We hypothesized that ERAS would improve SDD rates, increasing the

TABLE 1
ERAS components

Preoperative optimization	
Assessment	Preoperative office visit or phone call Screen for chronic conditions and assess optimization for surgery Screen for tobacco and alcohol abuse Assess for weight loss and malnutrition Assess postoperative nausea and vomiting risk using simplified Apfel criteria
Education	Tobacco and alcohol cessation 4–6 weeks prior to surgery ERAS pathway Perioperative expectations, reinforcing the patient's role in their own recovery Provide ERAS brochure and nutrition patient information
Exercise	30 minutes of walking daily until surgery
Diet	Protein and carbohydrate-rich foods 1 week prior to surgery Regular diet until midnight the night before surgery Clear liquids until 3 hours prior to surgery Clear liquids include water, black coffee or clear tea, carbonated beverages, fruit juice without pulp, or Gatorade Patients with diabetes should avoid sugar-containing liquids
Verification	Preoperative phone call the day prior to surgery Nothing by mouth instructions reviewed Medications reviewed Shower with soap the night before surgery
Day of surgery	
Preoperative	Multimodal pain management: Celecoxib 400 mg PO (200 mg if age >65 y); omit if GFR <60 Acetaminophen 1000 mg PO (omit if hepatic dysfunction) Morphine sulfate ER 30 mg PO (15 mg if age >65 y) Postoperative nausea and vomiting prevention: Perphenazine 8 mg PO Anesthesia can add scopolamine patch if age <65 y Antibiotic prophylaxis Cefotetan 2 g IV within 60 minutes of incision No routine fluid administration No IV opioid premedication

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TABLE 1
ERAS components *(continued)*

Day of surgery	
Intraoperative	Induction: Propofol (1−2 mg/kg or titrate to amnesia and anesthesia) Ketamine 20 mg (20, 21) Lidocaine 100−200 mg bolus Muscle relaxant (no opioids) Dexamethasone 4−5 mg IV (avoid if diabetes) Maintenance: Ketamine 10 mg q 1 hour (avoid in final hour) Lidocaine boluses q 1 hour (1 mg/kg) Avoid opioids intraoperatively unless patient c/o pain at emergence Avoid routine use of NGT Fluid management: Goal is euvolemia Laparoscopic and vaginal cases: 2 mL/kg per hour Boluses for MAP <60 mm Hg or 20% of baseline Emergence: Propofol titration Ondansetron 4 mg IV No IV ketorolac (unless celecoxib not given preoperatively) No IV acetaminophen (unless not given preoperatively)
Postoperative	Transition from IV to PO opioids for rescue pain management Avoid patient controlled anesthesia Ketorolac and acetaminophen scheduled Start ice chips/sips of clear liquids as tolerated IV fluids at 40 mL/h until tolerating oral fluids
Discharge checklist	Tolerating oral fluids without nausea and emesis Pain controlled (pain score <5) Voiding trial complete Independent ambulation No signs of delirium (oriented to person, place, time, current events)
Postoperative follow-up	
Assessment POD 1	Phone call from office nurses Home health if required (urinary retention, DVT prophylaxis)

DVT, deep vein thrombosis; *ER*, extended release; *GFR*, glomerular filtration rate; *IV*, intravenous; *MAP*, mean arterial pressure; *NGT*, nasogastric tube; *PO*, per os; *POD*, postoperative day; *q*, every day.

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proportion of women discharged the day of surgery by 18% in the ERAS group. In November 2016 the overnight admission rate within our division was 63.1%. Therefore, multiple estimates were created based on the range of pre-ERAS proportions. Using the most conservative estimates, we estimated 97 women were required in each group to detect a decrease in overnight admission from 63.1% to 48.0% with 80% power at a 2-sided alpha of 0.05.

Results are presented as means ± SD for continuous, normally distributed variables, medians (interquartile range) for nonnormal data, and frequencies (percentages) for categorical variables. Continuous variables were analyzed using a Student *t* test for normally distributed data and Wilcoxon's rank sum test for nonparametric data. Categorical variables were analyzed using χ^2 or Fisher exact test, as appropriate.

For both multivariable logistic and linear regression analyses candidate covariates tested were determined a priori because of their potential to have an impact on or confound the outcomes. These variables included type of prolapse procedure, concomitant hysterectomy, length of surgery, age, medical comorbidities, and case order. Regression models were fit with backward removal and confirmed with forward addition techniques.

Results are presented as beta coefficients with *P* values and odds ratios with 95% confidence intervals for linear and logistic regressions, respectively. Strengthening the reporting of the observational studies in epidemiology (STROBE) guidelines were strictly followed.

This study was approved by the University of Pittsburgh Institutional Review Board September 1, 2017). Analyses were performed using SAS version 9.3 (Cary, SC).

Results

During the study period, 258 women met inclusion criteria. There were 137 women before ERAS (53%) and 121 after ERAS implementation (47%). Mean age and body mass index were 65 ± 11 years and 28.2 ± 5.0 kg/m^2, respectively. Most were menopausal (n = 224, 86.8%), nonsmoking (n = 239, 92.6%), and white (n = 248, 96.1%).

Women before ERAS were more likely to have cardiac disease, anxiety, and previous pelvic surgery (all $P < .05$) and less likely to have diabetes (5.8% vs 18.2%, $P = .003$). The most common indication for surgery was stage III POP (n = 168, 65.1%) followed by stage II POP (n = 52, 20.2%). Baseline characteristics for the pre- and post-ERAS groups are listed in Table 2.

Most patients (n = 242, 93.8%) underwent major prolapse procedures, and a concomitant hysterectomy was performed in 135 (55.8%). The most common procedure was a laparoscopic or robotic sacrocolpopexy followed by transvaginal obliterative procedures. Fourteen (5.4%) underwent a hysterectomy with minor POP procedures and 13 (5.0%) hysterectomy alone. There

TABLE 2
Baseline characteristics and surgical factors

Characteristics	Before ERAS (n = 137)	ERAS (n = 121)	*P* value
Age, y	66.6 ± 11.2	64.4 ± 11.4	.084[a]
Race			.001[a]
White	137 (100%)	112 (92.6%)	
African American	0	9 (7.4%)	
Current smoker	14 (10.2%)	5 (4.1%)	.135
Postmenopausal	122 (89.1%)	102 (84.3%)	.521
Medical comorbidity[b]	77 (56.2%)	67 (55.4%)	.893
History of diabetes	8 (5.8%)	22 (18.2%)	.003[a]
History of cardiac disease	20 (14.6%)	7 (5.8%)	.025[a]
History of abdominal surgery	95 (69.3%)	76 (62.8%)	.268
Body mass index, kg/m^2	28.1 ± 5.0	28.4 ± 5.0	.560
Prolapse organ prolapse stage			.258
0	3 (2.9%)	8 (6.6%)	
I	0	1 (.83%)	
II	30 (21.9%)	22 (18.2%)	
III	88 (64.2%)	80 (66.1%)	
IV	16 (11.7%)	10 (8.3%)	
Anesthesia type			.037[a]
General	114 (83.2%)	113 (93.4%)	
Spinal	22 (16.1%)	8 (6.6%)	
Sedation	1 (0.7%)	0	
Local anesthetic infiltration	97 (70.8%)	92 (76.0%)	.344
Intravenous fluids, mL	1871.5 ± 638.5	1774.9 ± 558.4	.319
Estimated blood loss, mL	64.1 ± 60.1	78.4 ± 77.6	.354
Hysterectomy type			.442
Vaginal	38 (27.7%)	26 (21.5%)	
Supracervical	30 (21.9%)	34 (28.1%)	
Total hysterectomy	11 (8.0%)	8 (6.6%)	
LAVH	0	1 (0.83%)	
No hysterectomy	58 (42.3%)	52 (43.0%)	
Prolapse procedures			.532
Abdominal[c]	60 (46.2%)	52 (51.5%)	
Vaginal[d]	32 (24.6%)	26 (25.7%)	
Obliterative[e]	38 (29.2%)	23 (22.8%)	
Minor prolapse procedures			
Anterior colporrhaphy	19 (19.2%)	21 (21.4%)	.696
Posterior colporrhaphy	29 (29.2%)	33 (33.7%)	.508
Levator myorrhaphy	11 (8.02%)	21 (17.35%)	.050[a]
Perineorrhaphy	23 (23.2%)	32 (32.6%)	.141

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TABLE 2
Baseline characteristics and surgical factors *(continued)*

Characteristics	Before ERAS (n = 137)	ERAS (n = 121)	*P* value
Incontinence procedures[f]	4 (2.9%)	3 (2.5%)	.436
Intraoperative complications[g]	3 (2.2%)	0	.250
Operative time, h	2.6 ± 0.8	2.6 ± 0.9	.955
Total operating room time, h	3.3 ± 0.9	3.3 ± 1.0	.813

Data are n (percentage) or mean ± SD.

LAVH, laparoscopic-assisted vaginal hysterectomy.

[a] Statistically significant; [b] Medical comorbidity is a composite variable for any of the following conditions: hypertension, diabetes, chronic obstructive airway, obstructive sleep apnea, cardiac disease, and vascular disease; [c] Abdominal prolapse procedures include laparoscopic and robotic mesh–augmented procedures and uterosacral ligament suspensions; [d] Vaginal procedures include transvaginal mesh–augmented procedures and native tissue apical suspension via uterosacral ligament suspensions and sacrospinous ligament fixations; [e] Obliterative prolapse procedures include colpocleisis and colpectomy; [f] Incontinence procedures include midurethral slings and periurethral bulking procedures; [g] Intraoperative complications include cystotomy and ureteral injury.

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were no group differences in procedures performed, except for levator myorrhaphy, which was more commonly performed in the ERAS group (Table 2). More patients in the ERAS group had general anesthesia (93.4% vs 83.2%, $P = .037$).

Other surgical variables including operative and total procedure times, estimate blood loss, intravenous fluids, local anesthetic used for wound infiltration, and intraoperative complications were similar between groups (Table 2).

ERAS implementation significantly decreased length of hospital admission. Prior to ERAS, 25.9% of the women (n = 35) were discharged the day of surgery compared with 91.7% (n = 111) after ERAS implementation ($P < .001$). The length of admission measured as the time from intake assessment to discharge decreased by 46.7% after ERAS implementation (12.1 ± 11.2 vs 25.9 ± 13.5 hours, Δ, −13.8 hours, $P < .001$).

Total 30 day complications were similar before and after ERAS implementation (Table 3). After analyzing each complication separately, we found urinary tract infection, emergency department visits, unplanned office visits, and reoperation rates were unchanged after ERAS implementation. Postdischarge complications, which reflected any aberrations from normal postoperative recovery were not different after ERAS (17 [14.3%] vs 12 [8.8%], $P = .164$). These included voiding dysfunction (n = 7), wound complications (n = 10), angina/cardiac arrhythmias (n = 3), postoperative nausea/ileus (n = 10), hematoma (n = 3), vertigo (n = 1), and ureteral obstruction (n = 1).

More women in the ERAS group were readmitted to the hospital within 30 days of surgery (8 [6.7%] vs 2 [1.5%], $P = .030$). Pre-ERAS patients were readmitted for a myocardial infarction and chest pain. ERAS patients were admitted for weakness, chest pain, hyponatremia, wound complications (n = 3), postoperative nausea/ileus, and ureteral obstruction. Three of the patients readmitted in the ERAS group returned to the operating room for ureteral obstruction (n = 1), incisional hernia (n = 1), and vaginal cuff bleeding (n = 1).

In addition, ERAS women were more likely to have urinary retention at the time of discharge (42.1% vs 23.6%, $P = .005$). When compared with the pre-ERAS group, the ERAS patients were more likely to have transient urinary retention at discharge managed with an indwelling catheter as opposed to clean-intermittent self-catheterization, (17.7% vs 42.3%, $P = .017$).

Multivariable regressions were performed to determine which covariates had an impact on postoperative outcomes. We found after adjusting for age and operative time, same-day discharge was more likely after ERAS implementation (odds ratio, 32.73, 95% confidence interval [CI; 15.23–70.12]; Table 4). In the regression for length of stay when we adjusted for age, body mass index, medical comorbidities and total operative time, ERAS implementation decreased length of admission by 13.62 hours (95% CI [−16.6 to −.61]; Table 5). In another model that adjusted for age, operative time, and type of prolapse surgery, readmission was more likely after ERAS implementation (OR, 5.7, 95% CI [1.1–28.1]; Table 6). The odds of postoperative complications and emergency room visits were no different in the adjusted models.

Groups differed in the timing and frequency of postoperative nursing calls. The median day of the call was postoperative day 2 (interquartile range, 2) in the pre-ERAS group and postoperative day 1 (interquartile range, 1) in the ERAS group ($P < .001$), which reflects our standard practice of calling patients the day after discharge from the hospital. Mean patient reported pain scores at the postoperative call were similar between groups (3.63 ± 1.85 before ERAS vs 3.37 ± 2.01 ERAS, $P = .301$).

A questionnaire of patient perception regarding their surgical experience was administered to ERAS patients during the postoperative call. Because of the delay in development, it was administered to 77 of the ERAS group (63.6%). Most women reported very good or

TABLE 3
Length of stay, same-day discharge, and 30 day complication outcomes after ERAS implementation

Variables	Before ERAS	ERAS	*P* value
Length of admission, h	25.9 ± 13.5[a]	12.1 ± 11.2[a]	< .001[a]
Same-day discharge	35 (25.9%)[a]	111 (91.7%)[a]	< .001[a]
Total 30 day complications[b]	43 (31.4%)	43 (35.5%)	.480
Intraoperative complications[c]	3 (2.2%)	0 (0.0%)	.250
Hospital complications[d]	7 (5.1%)	5 (4.1%)	.775
Postdischarge complications[e]	12 (8.8%)	17 (14.3%)	.164
Unplanned postdischarge office visits	29 (21.2%)	22 (19.0%)	.761
Emergency department visits	11 (8.0%)	16 (13.5%)	.159
Readmission[f]	2 (1.5%)[a]	8 (6.7%)[a]	.030[a]
Return to operating room	1 (0.7%)	4 (3.4%)	.187
Urinary tract infection	9 (6.6%)	13 (10.9%)	.265

Data are n (percentage) or mean ± SD.

[a] Statistically significant; [b] Total 30 day complication is a composite variable of intraoperative, hospital, and postoperative complications; [c] Intraoperative complications included cystotomy and ureteral injury; [d] Hospital complications included hypoxia, chest pain/arrhythmia, hyponatremia, uncontrolled pain, oliguria, nausea/ileus, and wound complications; [e] Postdischarge complications included voiding dysfunction, wound complications, angina/cardiac arrhythmias, nausea/ileus, hematoma, vertigo, and ureteral obstruction; [f] Readmission indications included myocardial infarction, chest pain/arrhythmia, weakness, hyponatremia, wound complications, nausea/ileus, and ureteral obstruction.

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excellent overall surgical experience (n = 72 of 75, 93.5%), very good or excellent pain control (n = 65 of 75, 86.7%), and feeling prepared for their surgery (n = 69 of 77, 89.6%). Approximately 90% of women (n = 69 of 77) did not recall experiencing any nausea during their postoperative recovery.

Comment

In the current study, we found implementation of a urogynecology-specific ERAS protocol reduced the duration of our surgical admissions by 13.8 hours. This reduction contributed to a commensurate increase in day-of-surgery discharge from 25.9% to 91.7%, an improvement well beyond the 18% hypothesized. Prior to our institutional launch of ERAS, it was routine for patients undergoing major POP procedures to have an overnight admission.

Our urogynecology ERAS pathway is unique from others reported in literature in that 1 goal was to decrease length of admission to less than 1 day. In our review of ERAS, no study had demonstrated ERAS could meaningfully reduce the length of stay in women undergoing POP repairs. Kalogera et al[6] analyzed a subset of patients undergoing vaginal prolapse repair surgery. They reported a 0.5 day reduction in the length of stay after ERAS implementation; however, total length of admission remained longer than 2 days, which exceeded our pre-ERAS statistics. In a study by Modesitt et al,[9] the authors found there was no decrease in the 1 day length of admission after ERAS implementation in women undergoing a minimally invasive hysterectomy.

We attribute the significant decrease in length of stay in our study to the universal adoption of all ERAS components by nursing, anesthesia, pharmacy, surgeon, and support staff in conjunction with an ongoing departmental quality initiative to reduce surgically associated morbidity and costs by increasing minimal access surgery and reducing laparotomies.[16-20]

The year-long development of our ERAS pathways occurred in parallel with a quality improvement initiative to reduce length of stay. During that time, gynecological surgeons identified nausea, somnolence, and urinary retention in the immediate recovery period as barriers to earlier discharge. ERAS, which included presurgical education and patient optimization, euvolemia, and avoidance of opioids through the use of multimodal pain interventions, was viewed as a potential solution to the hurdles challenging same-day discharge.[1] Although other studies of ERAS in urogynecology patients observed modest reductions in length of stay, none reported a goal of same-day discharge.

From the first discussion with patients regarding surgery, we presented prolapse repairs as outpatient surgery. This expectation was reiterated at preoperative appointments and reinforced the day of surgery to the patient, their family, and the anesthesia staff. Adoption of ERAS changed the model of perioperative care delivered within our institution by integrating all services. This change

TABLE 4
Multivariable logistic regression for variables having an impact on same-day discharge after ERAS implementation

Variables	Unadjusted OR	95% CI	Adjusted OR	95% CI
After ERAS Implementation	32.35[a]	15.24–68.65[a]	32.73[a]	15.23–70.12[a]
Age	0.97[a]	0.95–0.99[a]	0.97[a]	0.94–0.99[a]
Total operative time	0.97	0.72–1.30	0.85	0.57–1.28

Data are unadjusted and adjusted odds ratios with 95% confidence intervals.

CI, confidence interval; *OR*, odds ratio.

[a] Statistically significant.

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TABLE 5
Multivariable linear regression for variables having an impact on length of stay after ERAS implementation, hours

Variables	Unadjusted Beta	*P* value	Adjusted Beta	*P* value
After ERAS implementation	−13.78[a]	< .0001[a]	−13.62[a]	< .0001[a]
Age	0.14	.07	0.10	.188
BMI	0.12	.48	0.22	.151
Medical comorbidity	3.58[a]	.04[a]	3.10	.059
Total operative time	2.27[a]	.03[a]	2.93[a]	.002[a]

Data are unadjusted and adjusted beta coefficients with *P* values.

BMI, body mass index.

[a] Statistically significant.

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cannot be attributed to a single component or intervention but rather the universal and comprehensive adoption of ERAS at every level of care in the patient's surgical experience from the time when surgery was introduced to the 4 week postsurgical office visit. Changing patient expectations along with the change in perioperative care worked concomitantly as part of the same intervention, resulting in a significant decrease in length of stay.

The most important determinant of successful ERAS implementation was the leadership, teamwork, and universal willingness to change established practices along with institutional support. The leadership team had previously implemented a successful colorectal ERAS pathway at a sister hospital. We used their expertise along with insights from our group of local stakeholders in nursing, pharmacy, home health, and social work to develop a subspecialty-specific ERAS.

To operationalize ERAS, we staggered launches for the various surgical specialties to allow for small, incremental changes to be made. The institution's staged approach provided opportunity for refinement, which dampened the learning curve for each subsequent service brought onto ERAS. In addition, synergistic programs such as the delivery of medications to patients prior to discharge and reliable home health service the day after discharge provided patient convenience and safety nets. These complemented preoperative education and establishment of expectations.

After ERAS implementation, we found 90% of the women believed their preparation for surgery was very good or excellent based on the information they received from our office. A Cochrane meta-analysis found that there may be benefit to preoperative formal education on postoperative outcomes of pain, length of stay, and recovery.[21] Unfortunately, we do not have data on preparedness from the pre-ERAS group for comparison. Our results are similar to those found by Kalogera et al[6], who also found high rates of preparedness after receiving ERAS education preoperatively.

Avoidance of preoperative fasting and carbohydrate loading are principal components of ERAS.[1] This was a radical change at our institution which mandated fasting starting at midnight the night before surgery. Our group comparisons are reassuring in that they did not identify any cases of aspiration pneumonia, the basis for the fasting mandate. This is consistent with a systematic review that found that fasting did not decrease aspiration, regurgitation, or any other morbidities after elective surgery.[11] In addition, preoperative carbohydrate loading increased insulin sensitivity, slightly decreased hospital stay, and decreased time to flatus while rates of complications were unchanged.[14]

ERAS was not associated with an increase in 30 day complications. However, we report 30% of women experienced at least 1 complication, which is higher than reported in the literature.[6,9] This may reflect our broad definition of adverse events, which included unplanned postdischarge outpatient visits. We found 1 in 5 women returned to the office for an appointment other than their scheduled postoperative visit. Many studies report on emergency department visits and readmissions, but data are lacking on office visits. We included these because they result in an increased burden to the health care system and patients. Efforts are ongoing to better characterize the indications for extra visits and associated patient characteristics to inform on strategies to reduce this burden.

While length of admission decreased, readmissions increased by an additional 6 patients from 1.5% to 6.7% after implementation of ERAS. The rate of

TABLE 6
Multivariable logistic regression for variables impacting 30-day readmission after ERAS implementation

Variables	Unadjusted OR	95% CI	Adjusted OR	95% CI
After ERAS implementation	4.87[a]	1.01–23.38[a]	5.68[a]	1.15–28.13[a]
Age	1.00	0.94–1.05	0.96	0.89–1.03
Vaginal prolapse procedure	1.19	0.21–6.67	1.76	0.28–11.19
Obliterative prolapse procedure	2.33	0.56–9.66	6.34	0.78–51.81

Data are unadjusted and adjusted odds ration with 95% confidence intervals.

CI, confidence interval; *OR*, odds ratio.

[a] Statistically significant.

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readmission is low and consistent with a similarly sized cohort of ERAS women undergoing minimally invasive gynecological surgery after ERAS implementation, which reported 6.8%.[9]

Our small data set precludes our ability to assign attribution to specific components of ERAS, the abbreviated hospital admission, or other factors not accounted for in this observational study design. The indications for reoperation in 3 women cannot plausibly be related to ERAS. Further prospective research is needed using more robust data to identify patients who do not benefit from ERAS or are at greater risk for readmissions or reoperation after ERAS.

Our study is limited by its retrospective, observational design. As we mentioned, one of the main goals for implementing ERAS at our institution was to enable more women to experience the benefits of shorter hospitalizations after elective surgery. We achieved this through a broad culture shift in perioperative care. In addition to the ample nursing, pharmacy, and social work resources, our practice instituted mandatory preoperative appointments and preemptive phone calls after discharge. We recognize that this level of nursing support may not be available in some offices. Future cost-effectiveness analyses may provide compelling support for broader adoption of these resources. We are unable to discretely account for the contributing influence of a concurrent department-wide initiative to decrease length of stay. Nor can we distinguish among all the ERAS elements how much the establishment of patient expectations influenced our outcomes.

Also, inherent to this design is the inability to distinguish correlation from the association between the outcome and intervention. However, a randomized trial with the intervention being ERAS, a group of interventions vs traditional care would be expensive and difficult because the benefits of ERAS are being widely reported and are likely influencing care. To control for selection bias, we included consecutive patients in each cohort and performed adjusted multivariable analyses.

Lastly, we were not powered to detect small differences in secondary outcomes such as adverse events or perioperative morbidity.

In conclusion, we found that implementation of a urogynecology-specific ERAS pathway was associated with decreased length of admission, increase in the day of surgery discharge with high patient satisfaction, and preparedness among older women undergoing pelvic floor reconstructive surgery. Although we did not detect a difference in 30 day complications after implementation of ERAS, our observed increase in 30 day hospital readmissions in our small sample size warrants further scrutiny. We continue our surveillance of adverse sequelae in a quality improvement program to further assess potential risks of ERAS and same-day discharge in our urogynecology population. ■

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