

Research Report

Enhanced recovery Pathways in gynecologic surgery: Are they safe and effective in the elderly? ☆

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ABSTRACT

Objective: To compare perioperative outcomes of the elderly versus non-elderly patients on ERPs undergoing laparotomy for gynecologic surgery.**Methods:** From January 2016 to June 2017, patients undergoing elective laparotomies for gynecologic surgery were enrolled in a perioperative ERP protocol. Outcomes were compared between the elderly (age ≥ 70 years) and the non-elderly (age ≤ 69 years). Primary outcomes were length of stay and perioperative complication rates. Comparisons were performed using chi-squared tests or Fisher's exact tests for categorical data and Student's *t*-test or Wilcoxon rank-sum tests for continuous variables, with $p < 0.05$ for significance.**Results:** One hundred eighty-nine patients were enrolled in the study, including 16 patients ≥ 70 years old. The median age was 75 years for the elderly and 45 years for the non-elderly. Elderly patients were more likely to have more complex surgery and longer operative times (absolute median difference of 39 min). Despite the increasing complexity of surgical procedures for elderly patients, there were no statistically significant differences in serious inpatient complications (Clavien-Dindo score 3A or greater), pain and nausea scores, 30-day complications and readmission rates. Elderly patients had a longer median length of stay compared to non-elderly patients by one day ($p < 0.001$), however, this was not statistically significant on multivariate analysis. **Conclusion:** In our series, elderly patients on the ERP had similar rates of complications and readmission when compared to non-elderly patients, despite undergoing more complex surgeries. This suggests that ERP may be feasible and safe in the elderly population undergoing elective gynecologic laparotomy.

1. Introduction

Enhanced Recovery Pathways (ERPs) challenge traditional perioperative care by optimizing the stress response associated with surgery. Initially introduced in colorectal literature, various ERPs have been implemented in gynecologic surgery. ERPs include preoperative patient counseling, reduction of preoperative fasting and bowel prep, perioperative normovolemia, limited nasogastric tubes and drains, early removal of urinary catheters, multimodal pain control to minimize opiate consumption, early postoperative mobilization, and enteral

nutrition (Kalogera et al., 2013; Barber and Van Le, 2015; Committee on Gynecologic, 2018; Carey and Moulder, 2018). Similar to those in colorectal surgery, ERPs in gynecologic surgery have been shown to decrease post-operative opioid consumption, reduce the length of stay, and increase patient satisfaction (Kalogera et al., 2013; Committee on Gynecologic, 2018; Nelson et al., 2014; Wijk et al., 2014). A recent committee opinion by American College of Obstetrics and Gynecologists encourages the implementation of ERP as the standard model of care in a health delivery system (Committee on Gynecologic, 2018).

Surgery in elderly patients is associated with an increased risk of

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postoperative complications, longer hospital stays, and greater readmission rates. This increased perioperative risk profile is a function of a variety of factors: elderly patients are likely to present with more advanced stages of diseases well as more comorbid conditions including diabetes, hypertension, pulmonary disease, and cerebrovascular disease. They are also more likely to undergo surgery in the setting of an emergency, and thus less likely surgery with curative intent (Simmonds et al., 2000). ERPs require the active participation by the patient and their families (i.e., early mobilization) and may be perceived as “aggressive” in the care of the older patients. A recent study of colorectal cancer patients on an ERP showed that there was similar adherence to the protocol between older and younger patients, with similar postoperative outcomes, although older patients tended to stay longer in the hospital (Sliker et al., 2017). Another systematic review of the colorectal surgery literature showed that ERP was feasible in the elderly with reduction in morbidity with the implementation of ERP (Launay-Savary et al., 2017). However, there are currently limited data on safety or the efficacy of ERP in elderly patients in gynecologic literature. Our objective was to compare perioperative outcomes in elderly and non-elderly patients on an ERP for elective gynecologic laparotomy.

2. Materials and Methods

This was a prospective study evaluating the use of an ERP for patients undergoing elective laparotomy. Our ERP protocol was developed by a multidisciplinary team of gynecologic oncologists, anesthesiologists, pain management specialists, surgical coordinators, nursing managers, and floor managers. We employed a four-step process of research and protocol development accounting for the current literature, protocol design, initiation of protocol, and modification of protocol. This study was approved by our institutional review board. Fig. 1 describes our protocol.

All consecutive patients undergoing scheduled laparotomies for all gynecological indications at our institution from January 1, 2016 to June 30, 2017 were enrolled in the ERP, and all of these patients were included on our study. All patients adhered to the pathway during this study period. Exclusion criteria were patients undergoing minimally invasive surgery or unscheduled emergent laparotomy. Patients from

both the benign gynecology and the gynecologic oncology services were included.

Demographics, intraoperative parameters, and perioperative outcomes were collected prospectively via chart review. Primary perioperative outcomes were length of stay, complication rates, and readmission rates. Demographics included patient age, race, insurance, and body mass index (BMI). American Society of Anesthesiologists (ASA) class, and Charlson Comorbidity Index (CCI), a validated metric for 10-year predictive morbidity were recorded (Charlson et al., 1987). Pain scores were calculated by the average of each patient’s subjective reports of pain on a scale of 0–10. For length of stay, day of surgery was defined as postoperative day 0. Total length of stay was calculated as the number of days until discharge from day of surgery. Opioid use was quantified using oral mean morphine equivalents (MME) per day; intraoperative and immediate postoperative breakthrough analgesia in the recovery room were not included in this calculation. Nausea scores were reported by patients as none, mild, moderate, or severe. Perioperative outcomes included estimated blood loss (EBL) and operative time in minutes. Differences in creatinine and hemoglobin were measured from the most recent preoperative value to the value on postoperative day one.

Intraoperative complications were classified as intraoperative transfusions, anesthesia complications, or structural damage. Inpatient postoperative complications were assessed during the hospital stay prior to discharge, and thirty-day postoperative complications were defined as those after the day of discharge and until 30 days after the day of surgery. These complications were classified according to the Clavien-Dindo classification system of surgical complications; serious complications were classified as those with grade 3 or above (Clavien et al., 2009; Katayama et al., 2016).

Elderly status was defined as greater than or equal to 70 years of age. Though the definition of the elderly vary across various societies, age 70 was chosen as the cutoff based on the NRG CC-002 study, which aims to characterize a preoperative model for postoperative complications for elderly women undergoing surgery for ovarian, fallopian tube, primary peritoneal and advanced stage uterine cancer (Ahmed et al., 2018). Prior studies in colorectal literature assessing the feasibility of the ERP on the elderly also used age 70 as a definition for the elderly (Sliker et al.,

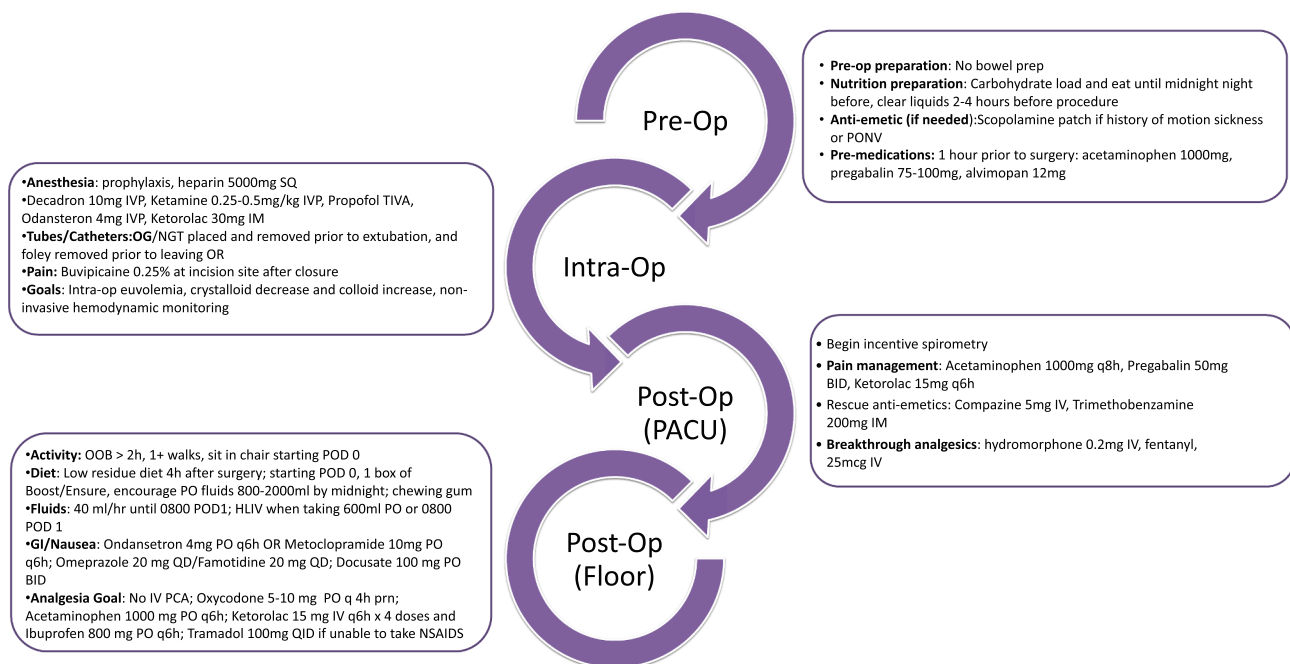


Fig. 1. Enhanced Recovery Pathway protocol. Our institutional ERP protocol was designed by a multidisciplinary team, with goals of euvoolemia, pain control with opioid minimization, and early mobilization.

2017). Elderly and nonelderly patients were compared across demographics and perioperative outcomes using Student's t-tests or Wilcoxon rank sum test for non-parametric continuous data and chi-square and Fisher's exact tests for categorical data. Univariate and multivariate logistic regression was used to assess clinical factors associated with increased length of stay. P values of < 0.05 were considered statistically significant. SPSS version 23 was used for statistical analysis.

3. Results

One hundred eighty-nine patients underwent scheduled laparotomies during the study period at our institutions and all were placed on the ERP. Of those, 16 (8.5%) were age 70 or older, and 173 (91.5%) were ages 69 and younger. The median age for the elderly group was 75 (range 70–89), and for the non-elderly was 45 (range 23–69). Demographics are described in Table 1. There were no differences in race between the elderly and the non-elderly; unsurprisingly, the elderly were more likely to have enrolled in Medicare insurance. Elderly patients had higher CCI (4 vs 0, $p < 0.001$). All elderly patients underwent surgery by gynecologic oncologists vs. 55% of non-elderly patients; elderly patients were more likely to have a preoperative diagnosis of suspected malignancy (100% vs. 38%, $p < 0.001$).

Table 1
Demographic characteristics of patients enrolled in the ERP pathway.

	All (N = 189)	Elderly (N = 16)	Non-elderly (N = 173)	P-value
Median age, years (range)	47 (23–89)	75 (70–89)	45 (23–69)	<0.001
BMI, kg/m² (median, range)	26.4 (17.0–51.9)	24.6 (19.1–35.7)	26.5 (17.0–51.9)	0.433
ASA class (median, range)	2 (1–4)	2 (2–3)	2 (1–4)	0.011
CCI (median, range)	0 (0–7)	4 (3–7)	0 (0–7)	<0.001
Race, n (%)				0.841
White	81 (42.9)	72 (41.6)	9 (56.3)	
Black	63 (33.3)	4 (25.0)	59 (34.1)	
Asian/ Pacific Islander	16 (8.5)	2 (12.5)	14 (8.1)	
American Indian/ Native American	1 (0.5)	0 (0.0)	1 (0.6)	
Hispanic	10 (5.3)	0 (0.0)	10 (5.8)	
Two or more	2 (1.1)	0 (0.0)	2 (1.2)	
Other	16 (8.5)	1 (6.3)	15 (8.7)	
Insurance, n (%)				<0.001
Medicare	25 (13.4)	11 (68.8)	14 (8.2)	
Medicaid	5 (2.7)	0 (0.0)	5 (2.9)	
Private	152 (81.3)	5 (3.3)	147 (86.0)	
Self-pay	4 (2.1)	0 (0.0)	4 (2.3)	
Uninsured	1 (1.0)	0 (0.0)	1 (0.6)	
Admitting service, n (%)				<0.001
Benign gynecology	85 (45.0)	0 (0.0)	85 (49.1)	
Gynecologic oncology	104 (55.0)	16 (100.0)	88 (50.9)	
Preoperative diagnosis, n (%)				<0.001
Benign	107 (56.6)	0 (0.0)	107 (61.8)	
Malignant or suspected malignant	82 (43.4)	16 (100.0)	66 (38.2)	

BMI: body mass index, ASA: American Society of Anesthesiologists class, CCI: Charlson Comorbidity Index

Perioperative outcomes are summarized in Table 2. Elderly patients had a longer median stay compared to nonelderly patients (3 days vs. 2 days, $p < 0.001$). Elderly patients had a longer operative time by 39 min (225 min vs. 186 min, $p = 0.021$). Eight of 16 elderly patients (50%) underwent lymph node dissection (LND) or tumor debulking compared to 26 of 176 (15%) non-elderly. The majority of non-elderly patients underwent a myomectomy (33.5%) or simple hysterectomy with bilateral salpingectomy (23.7%). There were no differences in the EBL or intraoperative transfusions between the elderly and the non-elderly. Elderly patients tended to have a higher likelihood of malignant final pathology compared to non-elderly patients (81.3% vs 20.5%, $p < 0.001$).

Postoperative pain reports are shown in Fig. 2. There were no significant differences between the elderly and the non-elderly in patients' subjective reports of postoperative pain. On a scale of 0–10, mean patient-reported pain scores four-hours postoperatively were 3.35 for the elderly and 3.74 for the non-elderly ($p = 0.931$). The postoperative pain scores decreased each day for both the elderly and the non-elderly, with mean pain scores of 2.65 vs 3.14 ($p = 0.998$) for postoperative day 1, 2.28 vs 2.73 ($p = 0.606$) for postoperative day 2, and 1.22 vs 2.72 ($p = 0.100$) for postoperative day 3, respectively. Mean morphine equivalents (MME) were also not statistically significantly different between

Table 2
Perioperative outcomes of patients on ERP pathway.

	All n (%)	Elderly n (%)	Non-elderly n (%)	P-value
Median (range) length of stay, days	2 (0–8)	3 (1–8)	2 (0–7)	<0.011
Median (range) estimated blood loss, mL	350 (25–2500)	300 (50–1200)	350 (25–2500)	0.950
Median (range) operative time, minutes	240.5 (119–571)	271.5 (152–449)	232.5 (119–571)	0.191
Procedure type				<0.001
Myomectomy	58 (30.7)	0 (0.0)	58 (33.5)	
Hysterectomy and BS	41 (21.7)	0 (0.0)	41 (23.7)	
Hysterectomy and BSO/USO	44 (23.3)	6 (37.5)	38 (22.0)	
Hysterectomy and BSO/USO and LND	25 (13.2)	5 (31.3)	20 (11.6)	
BSO/USO and LND	5 (2.6)	0 (0.0)	5 (2.9)	
BSO/USO	10 (5.3)	2 (12.5)	8 (4.6)	
Ovarian cystectomy	2 (1.1)	0 (0.0)	2 (1.2)	
Other debulking	4 (2.1)	3 (18.8)	1 (0.6)	
Final pathology				<0.001
Benign	125 (66.1)	3 (18.8)	122 (70.5)	
Malignant	64 (33.9)	13 (81.3)	51 (20.5)	
Types of malignancy				0.084
Uterus	17 (26.6)	2 (15.4)	15 (29.4)	
Ovary/ fallopian tube/ primary peritoneal	39 (60.9)	8 (61.5)	31 (60.8)	
Cervix	1 (1.6)	0 (0.0)	1 (2.0)	
Other	1 (1.6)	1 (7.7)	0 (0.0)	
Synchronous	3 (4.7)	2 (15.4)	1 (2.0)	
Metastatic	3 (4.7)	0 (0.0)	3 (5.9)	
Hemoglobin difference*	2.13 ± 1.51	1.93 ± 1.41	2.15 ± 1.52	0.575
Creatinine difference*	0.03 ± 0.12	-0.01 ± 0.19	0.04 ± 0.11	0.187

BS: bilateral salpingectomy; BSO: bilateral salpingo-oophorectomy; USO: unilateral salpingo-oophorectomy; LND: lymph node dissection.

* Differences in lab values calculated from admission values to postoperative day one.

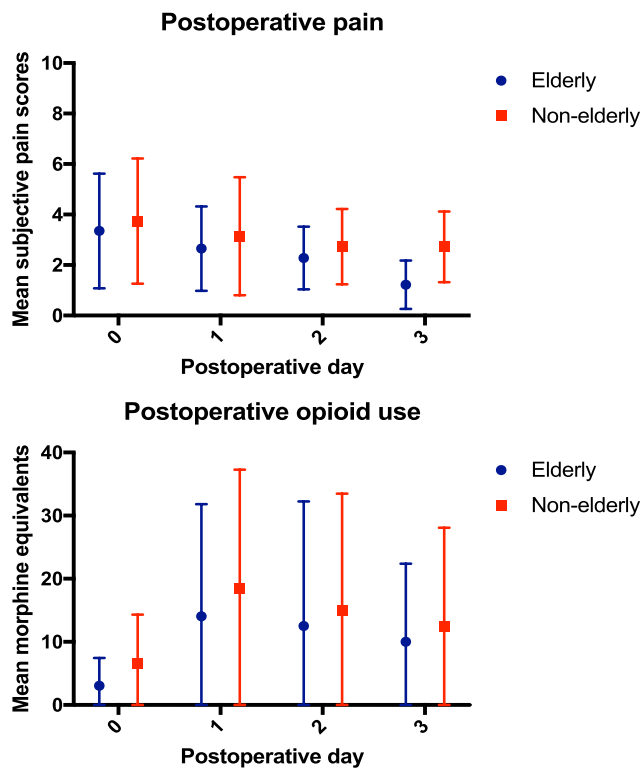


Fig. 2. Postoperative pain and opioid use. There was parity in outcomes of subjective patient-reported pain and opioid use.

the elderly and the non-elderly. There were no differences in reported postoperative nausea between the two groups (data not shown).

Complication rates are summarized in Table 3A and 3B. There were no differences in the postoperative complication rates between the elderly vs. the non-elderly ($p = 0.051$); there were no differences in serious inpatient complications, defined by grade 3A or above on the Clavien-Dindo scale (12% vs. 4.6%, respectively; $p = 0.203$). There were no differences in the 30-day complications, serious 30-day complications, or 30-day readmissions. Complications are listed in Table 3B. There were no deaths in either group.

Regression results are shown in Table 4A. On univariate analysis, elderly status, CCI, ASA, admitting service (benign vs. gynecologic oncology), preoperative diagnosis of presumed malignancy, intraoperative and postoperative complications were all associated with an increased risk of length of stay of greater than or equal to 2 days. These variables were assessed for collinearity and then used to construct a multivariate logistic model to predict the length of stay of greater than or equal to 2 days. In this analysis, ASA class (OR 2.69, 95% CI 1.25–5.76, $p = 0.011$) and inpatient postoperative complications (OR 16.6, 95% CI 4.50–61.26, $p < 0.001$) were associated with length of stay; elderly status was not independently associated with a length of stay greater than 2 days after adjusting for these factors.

A subanalysis of patients who underwent surgery by the gynecologic oncology division was performed, and 104 patients were included. In this group, 16 (15.4%) were 70 or older, and 88 (84.6%) were ages 69 and younger. There were no differences in perioperative outcomes (e.g., transfusions, EBL, operative time, readmissions, 30-day postoperative complications) between the elderly and the non-elderly in this cohort undergoing surgery by a gynecologic oncologist. However, the elderly had a median longer length of stay of 3 vs 2 days ($p = 0.025$). In the multivariate regression analysis, elderly status was not associated with increased length of stay; only postoperative complications were associated with an increased length of stay of greater than 2 days (Table 4B).

Table 3A

Intraoperative, postoperative, and 30-day complications of patients on ERP pathway.

	All	Elderly (n = 16)	Non-elderly (n = 173)	P-value
Intraoperative complications				0.675
None	171 (90.5)	14 (87.5)	157 (90.8)	
Intraoperative transfusion	13 (6.9)	1 (6.3)	12 (6.9)	
Anesthesia complication	1 (0.5)	0 (0.0)	1 (0.6)	
Structural damage	4 (2.1)	1 (6.3)	3 (1.7)	
Postoperative inpatient complications				0.051
Complications by grade*				
None	141 (76.9)	8 (50.0)	133 (76.9)	
Grade 1	23 (12.2)	3 (18.8)	20 (11.6)	
Grade 2	16 (8.5)	3 (18.8)	13 (7.5)	
Grade 3A	5 (2.6)	2 (12.5)	3 (1.7)	
Grade 3B	1 (0.5)	0 (0.0)	1 (0.6)	
Grade 4A	3 (1.6)	0 (0.0)	3 (1.7)	
Serious postoperative complications**	9 (4.8)	2 (12.5)	7 (4.0)	0.170
30-day postoperative complications				0.708
Complications by grade*				
None	177 (93.7)	15 (93.8)	162 (93.6)	
Grade 1	1 (0.5)	0 (0.0)	1 (0.6)	
Grade 2	4 (2.1)	1 (6.3)	3 (1.7)	
Grade 3A	4 (2.1)	0 (0.0)	4 (2.3)	
Grade 3B	3 (1.6)	0 (0.0)	3 (1.7)	
Grade 4A	0 (0.0)	0 (0.0)	0 (0.0)	
Serious 30-day complications**	7 (3.7)	0 (0.0)	7 (4.0)	1
30-day readmissions	9 (4.8)	0 (0.0)	9 (5.2)	1

Interpretation of results (12)

Clavien-Dindo grade	Definition	Examples
1	Any deviation from normal postoperative course without need for pharmacological, surgical, endoscopic or radiological interventions	Bedside paracentesis Wound irrigation at bedside Foley catheter replacement
2	Pharmacological treatment with drugs, including blood transfusion, total parental nutrition	Antibiotics Diuretics
3A	Surgical, endoscopic or radiologic intervention not under general anesthesia	Naso-gastric tube placement Image-guided drain placement
3B	Surgical, endoscopic, radiologic intervention under general anesthesia	Exploratory laparotomy
4A	Life-threatening complications requiring ICU management, single organ dysfunction	Dialysis Intubation
4B	Life-threatening complications requiring ICU management, multi-organ dysfunction	
5	Death of patient	

* Classified by Clavien-Dindo scale, see interpretation of results.

** Serious complications defined by class 3A or above.

4. Discussion

In this study comparing the perioperative outcomes of patients undergoing elective gynecologic laparotomies on the ERP, elderly patients were more likely to have preoperative risk factors and more complex surgery, but achieved parity in perioperative outcomes. Our findings suggest that ERPs may be appropriate for and tolerated by elderly

Table 3B
Postoperative complications by type of complication.

	All	Elderly	Non-elderly
Inpatient postoperative complications			
Acute kidney injury	3	1	2
Urinary retention	2	0	2
Acute blood loss anemia	19	5	14
Poor pain control	10	1	9
Ileus/SBO	12	3	9
STEMI	1	0	1
Urinary tract infection	3	2	1
Re-operation	1	0	1
Transient hypoxia	2	0	2
Persistent hypotension	1	0	1
Nerve compression	1	0	1
ICU admission	2	0	2
Electrolyte imbalance	2	0	2
Pneumothorax	1	0	1
Delirium	1	1	0
Total number of complications	61	13	48
30-day postoperative complications			
SBO, conservative management	2	0	2
SBO requiring reoperation	2	0	2
Enterocutaneous fistula	1	0	1
Wound infection	4	0	4
Deep vein thrombosis	1	1	0
Fascial dehiscence	1	0	1
Urinary tract infection	1	0	1
Pelvic abscess	1	0	1
Acute blood loss anemia	1	0	1
Total number of complications	14	1	13

SBO: small bowel obstruction; STEMI: ST elevation myocardial infarction; ICU: intensive care unit.

patients undergoing elective laparotomy. Elderly patients also were more likely to have more preoperative risk factors and more complex surgical procedures. There were no statistically significant differences in postoperative pain scores, opioid use, and postoperative nausea. Elderly and non-elderly patients had similar perioperative outcomes, including intraoperative blood loss, rates of intraoperative or postoperative complications, and readmission rates.

Despite the growing evidence that ERPs can be safely instituted in elderly patients, we cannot ignore the physiologic, psychologic, and social differences in the pain management of the elderly. In addition, the relationship between age and perioperative outcomes can be confounded by more advanced disease at presentation, preexisting comorbidities, and type of treatment received, as elderly patients were less likely to undergo curative resection (Simmonds et al., 2000). The elderly may have atypical presentations of disease and may have

different sensitivity to pain (Kaye et al., 2010). A systematic review by Lautenbacher et al. suggests that both superficial (e.g., heat-related nociceptors) and visceral pain thresholds are dulled by increasing age (Lautenbacher et al., 2017). The elderly may also be at increased risk for adverse reactions from analgesia due to physiologic changes such as reduced renal and hepatic metabolism. The elderly also have increased fat mass, decreased muscle mass, and decreased total body water, which may affect drug distribution and elimination. For instance, the mean elimination half-life of morphine is 4.5 h for older patients, which is longer than the half-life of 2.9 h in younger patients; thus, the elderly are more sensitive to equivalent doses of morphine (Aubrun and Marmion, 2007). The elderly also have increased sensitivity to centrally acting drugs (e.g., benzodiazepines, opioids) while having decreased sensitivity to the adrenergic and cholinergic drugs, (e.g., beta blockers). There is also an increased concern of potentiating effects of medications given polypharmacy and multiple medical comorbidities (Kaye et al., 2010; Chau et al., 2008). Other challenges in assessing the elderly include a lack of consistent definitions of the elderly in literature. Further, these definitions may continue to change as the population continues to grow older. The elderly are also under-represented in clinical trials, which can sometimes pose challenges in application of the “standard of care” to a vulnerable segment of the population.

ERPs are increasingly becoming the standard of care for laparotomies. To individualize care for the elderly or the frail, modifications of the ERP may be appropriate, and continues to be an area for future directions. Although parity in pain control was achieved in our study, liposomal bupivacaine might be considered at time of surgery to improve acute postoperative pain control. A Cochrane review showed that liposomal bupivacaine did show a reduction in postoperative pain and reduced use of postoperative opioids compared to placebo (Hamilton et al., 2017). Interventional modalities of pain treatment may help alleviate the need for heavy reliance on opioids.

To help improve early postoperative mobility, early consult to inpatient physical therapy, occupational therapy, and integrative health may be appropriate, although access to such consultative services may be limited based on care settings. A recent review of alternative therapies showed that although many practices are not widely accepted and at times viewed as incompatible with the standards of medicine, integrative therapies may be used as complements to mainstream medicine to address pain and reduce opioid use and are gaining increased acceptance in the United States (Lin et al., 2017). Johnson et al. showed that for patients admitted with cardiovascular disease, adjunctive integrative medicine therapies were associated with significantly less pain and anxiety; and while women had a higher likelihood of receiving integrative medicine therapy, older patients had reduced odds of receiving therapy (Johnson et al., 2014). A systematic review showed

Table 4A
Logistic regression analysis of factors associated with length of stay greater than 2 days, all cohort.

	Univariate OR	95% CI	P-Value	Multivariate OR	95% CI	P-Value
Elderly	5.88	1.29–26.67	0.022	0.35	0.04–3.07	0.341
CCI	2.01	1.50–2.68	<0.001	1.64	1.03–2.63	0.038
ASA	3.67	1.98–6.78	<0.001	2.73	1.30–5.74	0.008
Preoperative diagnosis	5.69	2.94411.00	<0.001	1.56	0.59–4.13	0.37
Postop complications	18.57	5.51–62.59	<0.001	17.14	4.72–62.32	<0.001

Table 4B
Logistic regression analysis of factors associated with length of stay greater than 2 days, gynecologic oncology cohort only.

	Univariate OR	95% CI	P-Value	Multivariate OR	95% CI	P-Value
Elderly	2.94	0.62–13.84	0.174	0.46	0.05–4.32	0.497
CCI	1.65	1.19–2.29	0.003	1.46	0.87–2.47	0.153
ASA	3.72	1.469.48	0.006	2.49	0.80–7.77	0.116
Postop complications	24.3	3.14.188.02	0.002	16.56	2.03–134.93	0.009

CCI: Charles Comorbidity Index; ASA: American Society of Anesthesiologists class.

that while prehabilitation programs are feasible in gynecologic surgery, the integration of these programs into ERPs has not yet been well established (Schneider et al., 2020). Though physical and occupational therapy may increase the likelihood of early postoperative mobility, especially in the elderly, currently, evidence is lacking in gynecologic ERAS literature and remains a future area of study.

Our findings are consistent with prior studies in literature. Safety of gynecologic surgery in elderly patients—despite these patients having more preoperative risk factors and more complex procedures—was shown in a study by Madden et al., though this study focused on patients undergoing minimally-invasive robotic surgery not on the ERP (Madden et al., 2019). Kim et al. compared elderly patients undergoing minimally invasive surgery; patients ages 80–93 were compared across perioperative outcomes to patients ages 65–79, and there were no differences in surgical outcomes (Kim et al., 2019). Recently, De Nonneville et al. showed that ERPs for elderly patients were safe in gynecologic oncology surgery, though age greater or equal to 70 years was associated with a longer length of stay. This finding was not significant when controlling for surgical method (e.g., minimally invasive vs. open) or ASA scores greater than or equal to 3. This study also had only 17% patients of patients undergoing laparotomy, describing a different population than our cohort of elective laparotomy patients (de Nonneville et al., 2018). Prior studies in colorectal literature have also shown that elderly patients stayed longer in the hospital. In a study by Sliker et al., despite the fact that older patients were found to have more co-morbidities at time of presentation, there were no differences in mobilization, oral intake, or postoperative complications for patients undergoing ERPs. They again did note that the elderly tended to stay longer in the hospital by one postoperative day compared to non-elderly patients (Sliker et al., 2017). In a systematic review of colorectal cancer literature, elderly patients were more likely to have longer lengths of stay, more likely to have postoperative cardiovascular, thromboembolic, and respiratory complications, and were found to have increased rates of postoperative mortality. However, there was considerable variation in the surgical selection of patients, and in the quality of, and the protocols for, preoperative and postoperative care (Simmonds et al., 2000).

This study was prospective in design, which is a strength of the study. All patients undergoing laparotomies during the study period were enrolled and included in the analysis. Both benign gynecology and gynecologic oncology services were included. This is a single institution study, which may limit its generalizability to other institutions. Additional studies are needed to characterize the effect of the implementation of ERP by comparing the pre- vs post-implementation of ERP for the elderly patients. This study also describes the implementation of a standardized and uniform approach to ERP for all patients. Elderly patients and other patients with limited performance status may benefit from a modified approach, including early access to physical and occupational therapy. Such modifications were not explicitly evaluated in our study and remain a limitation and an area for future study.

As demographics change and our elderly population grows, we need to address the differences in pain manifestation in the elderly. In this population, the enhanced recovery pathway may not only be appropriate, but also safe as a method of addressing pain control given its focus on non-opioid analgesia for pain control. While the elderly may need additional adjunctive therapies for pain, more studies need to be done to best characterize the optimal modalities in this patient population.

CRedit authorship contribution statement

Sarah S. Lee: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Jing-Yi Chern:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. **Melissa K. Frey:** Conceptualization, Data curation,

Formal analysis, Writing – review & editing. **Ashley Comfort:** Conceptualization, Methodology, Data curation, Writing – review & editing. **Jessica Lee:** Conceptualization, Methodology, Data curation, Writing – review & editing. **Nicole Roselli:** Conceptualization, Methodology, Data curation, Writing – review & editing. **Leslie R. Boyd:** Conceptualization, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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