GYNECOLOGY

Opioid use after laparoscopic hysterectomy: prescriptions, patient use, and a predictive calculator

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BACKGROUND: In the setting of America's opioid epidemic, judicious postoperative opioid prescribing is important. Gynecologists lack standard guidelines about postoperative opioid prescriptions.

OBJECTIVES: The objectives of the study were to describe opioid prescribing practices by a group of minimally invasive gynecologic surgeons, to measure postoperative opioid use after minimally invasive hysterectomy, and to identify preoperative factors that could predict whether a patient will be a low or high postoperative opioid user.

STUDY DESIGN: This was a prospective survey-based study including 125 women undergoing laparoscopic hysterectomy for benign indications at 2 community teaching hospitals. Patients were preoperatively surveyed about demographics, past medical history, and current and expected pain scores and were screened for anxiety, depression, and pain catastrophizing. At 1 and 2 weeks after surgery, patients were surveyed about their pain and pain medication use.

RESULTS: Ninety-eight percent of patients were prescribed an opioid for acute postoperative pain. The median opioid prescription was for 150 morphine milligram equivalents, equivalent to 20 tablets of oxycodone 5 mg, while median patient postoperative use was 37.5 morphine milligram equivalents, equivalent to 5 tablets of oxycodone 5 mg. Ninety percent of patients had leftover opioids at 2 weeks after surgery, and most leftover opioids were stored in an unsecure location. Preoperative factors that were most strongly correlated with postoperative opioid use included a history of chronic pelvic pain or endometriosis, preoperative opioid use, anxiety, depression, pain catastrophizing, preoperative pain score, anticipated postoperative pain score, and anticipated postoperative pain medication needs. A predictive calculator was developed based on these factors to help identify patients who are likely to be a high opioid user (defined as taking greater than 112.5 morphine milligram equivalents) or a low opioid user (defined as taking 37.5 morphine milligram equivalents or less).

CONCLUSION: On average, surgeons prescribed 4 times the amount of opioids than was needed for patients undergoing laparoscopic hysterectomy for acute postoperative pain control. Individualizing patients' opioid prescriptions based on preoperative risk factors could help reduce excess prescription opioids.

Key words: hysterectomy, laparoscopy, leftover, minimally invasive surgery, opioid, pain, postoperative, postsurgical, prescription

The United States is in the midst of an opioid epidemic. According to the Centers for Disease Control and Prevention, 115 Americans die each day from opioid overdoses. Opioid overdose deaths quintupled between 1999 and 2016.[1] Although most opioid overdose deaths are from heroin and illicit fentanyl abuse, the majority of new heroin users (79.5%) have a history of prior misuse of a prescription pain medication.[2]

Prescription opioids are a mainstay of pain management after surgery. Hysterectomies are one of the most common surgeries performed, with more than 400,000 done each year in inpatient and outpatient settings.[3–5] Hysterectomies are increasingly performed with a minimally invasive approach.[6] This helps to minimize postoperative pain,[7] but nonetheless, minimally invasive hysterectomy patients are routinely prescribed postoperative opioids.

Prior studies demonstrate that postoperative gynecological patients are usually prescribed more pain medication than they use[8,9] and that leftover postoperative prescription opioids are left in unsecure locations.[8] Excess opioids and opioids not kept securely can potentially be misused by patients. Although the risk of long-term ongoing opioid use in opioid-naïve hysterectomy patients is low,[10] there is a risk of patients' family and friends accessing unlocked leftover opioid medications. Most people misusing prescription opioids use opioids stolen or purchased from friends or family.[11]

Ideally, surgeons would prescribe the right amount of opioids. Given current trends, this means giving fewer opioid pills to the average patient while prescribing more opioids to select patients who may have more postoperative pain. This approach would minimize leftover opioids and opioid refills while ensuring patients have adequate pain management. However, it can be challenging to preoperatively identify patients who will have higher pain medication needs.

Prior research has investigated whether a patient's postoperative pain can be predicted before surgery. In gynecology, hysterectomy patients' opioid use was correlated with increased fibromyalgia survey scores,[12] a history of endometriosis,[12] and pain anxiety.[13] Work in other disciplines has identified self-rated pain sensitivity,[14] electrical pain threshold,[15] thermal pain threshold,[16] preoperative pain,[17–21] preoperative opioid use,[21,22] expected postoperative pain,[18,20,21] younger age,[23] fear of surgery,[20] anxiety,[17,24] depression,[17], and pain catastrophizing (a patient's exaggerated negative orientation toward actual or anticipated pain experiences[25])[20,24,26] as risk factors for increased acute postoperative pain.

In this study, our primary objectives were to describe opioid prescribing practices by a group of minimally invasive gynecological surgeons and to

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AJOG at a Glance

Why was this study conducted?

To describe the quantity of opioids prescribed for and taken after laparoscopic hysterectomy and to identify preoperative factors that could predict whether a patient will be a low or high postoperative opioid user.

Key findings

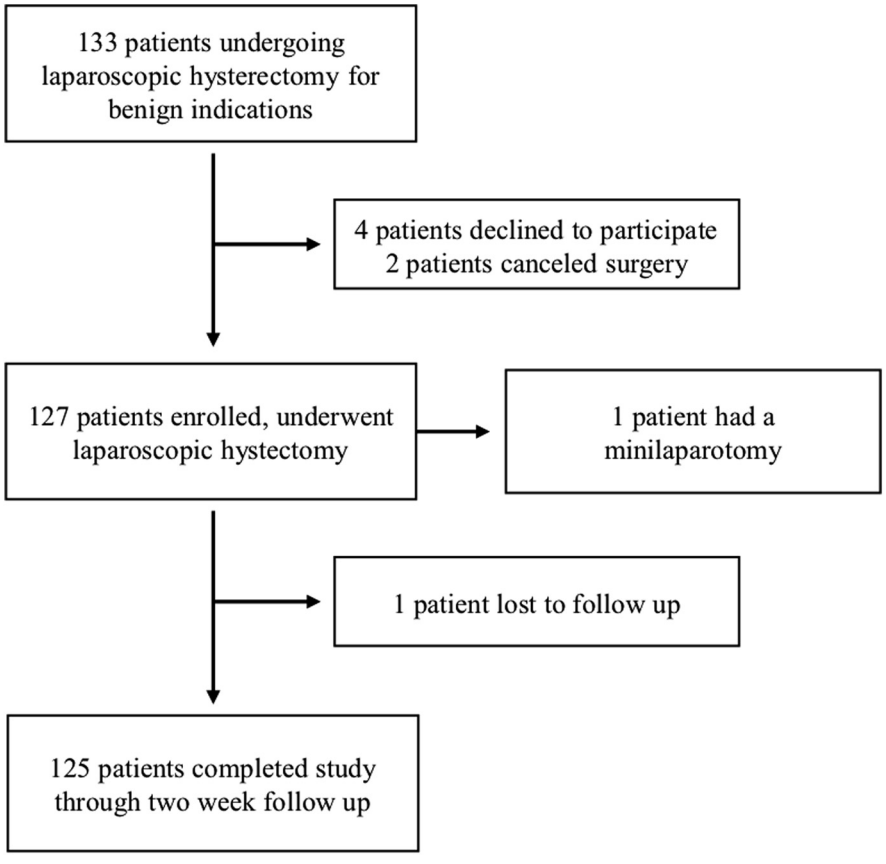
Surgeons prescribed 4 times more opioids than laparoscopic hysterectomy patients used. Preoperative factors that were most correlated with postoperative opioid use included a history of chronic pelvic pain or endometriosis, preoperative opioid use, anxiety, depression, pain catastrophizing, preoperative pain score, anticipated postoperative pain score, and anticipated postoperative pain medication needs.

What does this add to what is known?

This paper reaffirms that laparoscopic hysterectomy patients are routinely prescribed more opioids than they use and identifies several preoperative factors that could help surgeons titrate opioid prescriptions.

measure postoperative opioid use after minimally invasive hysterectomy. A secondary objective was to identify preoperative factors that could predict whether a patient would be a low or high postoperative opioid user.

FIGURE 1
Patient enrollment and study completion diagram



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Materials and Methods

This was a prospective, survey-based study at 2 community teaching hospitals, Newton-Wellesley Hospital (Newton, MA) and Lahey Hospital and Medical Center (Burlington, MA). The institutional review boards at both hospitals approved this study.

Beginning on March 14, 2017, at Newton-Wellesley Hospital and April 1, 2017, at Lahey Hospital, all consecutive patients undergoing laparoscopic hysterectomy for benign indications within the minimally invasive gynecological surgery departments were approached to participate in the study.

Two non-English speakers were included and consented and completed all surveys with an interpreter. Patients were excluded if they had a preoperative diagnosis of cancer, if they were scheduled for any concurrent procedure such as a urogynecological procedure or abdominoplasty, or if a laparotomy was planned for intact specimen removal. Patients who had significant opioid use preoperatively, including those who used opioids on a daily basis, were included.

All patients who met the study criteria were initially recruited during their new patient visit or by mail. Patients who agreed to participate gave informed consent during their preoperative visit. During their preoperative visit, patients were counseled to use standing acetaminophen and ibuprofen after surgery, with opioid pain medication as needed for breakthrough pain. At the conclusion of their preoperative visit and after signing study consents, patients completed a preoperative survey. Surveys were conducted with RedCAP, a secure web application.[27]

The preoperative survey included questions about demographic information, including age, race, education, and marital status. It also asked questions about patients' past medical and surgical history, preoperative pain medication use, and baseline pain and expected pain after surgery (on a 0−10 numeric scale). Patients completed a National Institute of Drug Abuse drug screening tool.[28] Lastly, all patients completed 3 validated instruments to measure

TABLE 1
Patient preoperative demographics, past medical history, and baseline characteristics

Patient information	All patients (n = 125)
Age, y	46.5 ± 6.7 y (30–76)
Race	
White	105 (84%)
Hispanic/Latino	7 (5.6%)
Asian/Pacific Islander	7 (5.6%)
Black	4 (3.2%)
Multiracial	2 (1.6%)
BMI	28.9 ± 6.7 (18.4–58)
Education	
Less than high school	1 (0.8%)
High school graduate or equivalency	12 (9.6%)
Some college, no degree	17 (13.6%)
Associate's degree	9 (7.2%)
Bachelor's degree	46 (36.8%)
Graduate or professional degree	40 (32%)
Marital status	
Single	13 (10.4%)
Long-term relationship	5 (4%)
Married	82 (65.6%)
Separated	0 (0%)
Widowed	5 (4%)
Divorced	20 (16%)
Smoker	10 (8%)
Parous	91 (72.8%)
ASA class	
ASA 1	32 (25.6%)
ASA 2	82 (65.6%)
ASA 3	11 (8.8%)
Preoperative pain medication use	
Any pain medication (including opioid)	53 (42.4%)
Opioid	10 (8%)
PRN opioid	5 (4%)
Daily opioid	5 (4%), (5–160)
Past medical history	
Anxiety	37 (29.6%)
Migraines	31 (24.8%)
Chronic pelvic pain	28 (22.4%)
Endometriosis	26 (20.8%)
Depression	19 (15.2%)

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depression (Patient Health Questionnaire [PHQ-9]),[29] anxiety (Generalized Anxiety Disorder 7 item scale [GAD-7]),[30] and pain castrophizing (Pain Castastrophizing Scale [PCS]).[31]

During their preoperative visit or in the preoperative area on the day of surgery, patients were given a prescription for opioid pain medication to use for acute postoperative pain. Surgeons were instructed to make no changes to their usual preoperative-counseling or opiate-prescribing practices while participating in the study.

At the surgeon's discretion, some patients on chronic opioids were seen in the pain clinic for preoperative consultation and postoperative pain management planning, including opioid-prescribing recommendations. Following surgery, using a standardized RedCAP form, members of the surgical team (A.V., M.W., and K.W.) collected data from the electronic medical record about details of the surgical case, opioid prescriptions, in-hospital pain medication use, indications for surgery, and pathology results.

Intraoperative complications were defined as injury to any structures, conversion to laparotomy, and intraoperative blood transfusion. All the cases were done by one of the minimally invasive gynecological surgeons (K.I., M.L., S.M., A.V., K.W.) with either a fellow or resident assistant. Greater than 90% of the cases at both hospitals were planned as outpatient procedures.

After surgery, all patients were surveyed at approximately 1 and 2 weeks after surgery. A phone call was made to all patients between postoperative days 4 and 7, with 88% of patients reached on either postoperative day 6 or 7. Following a script, patients were asked by a study investigator (A.V., M.W., K.W.) about their pain scores and pain medication use since discharge from the hospital.

At their 2 week postoperative visit, patients filled out RedCAP surveys detailing their pain scores and pain medication use since surgery, and, if applicable, their plans for any left-over opioid pain medication. There were 9 patients who brought their

TABLE 1
Patient preoperative demographics, past medical history, and baseline characteristics *(continued)*

Patient information	All patients (n = 125)
Arthritis	13 (10.4%)
Chronic back pain	11 (8.8%)
Fibromyalgia	7 (5.6%)
Past surgical history	
Any prior abdominal surgery	84 (67.2%)
Prior laparoscopic surgery	49 (39.2%), (1–10)
Prior open surgery	54 (43.2%), (1–5)

Data are mean ± SD (range) or n (percentage). Any pain medication includes any over-the-counter or prescription pain medications. The range of morphine milligram equivalents taken in 24 hours by daily opioid users is included in parentheses under Preoperative pain medication use, Daily opioid. The value of 5–160 MME is equivalent to 0.7 of a pill to 21.3 pills of oxycodone 5 mg. The range of number of prior surgeries is included in parentheses under Past surgical history.

ASA, American Society of Anesthesiologists; *BMI*, body mass index; *PRN*, as needed.

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TABLE 2
Patient surgical data

Surgical characteristics	All patients (n = 125)
Indication for hysterectomy	
Abnormal uterine bleeding	83 (66.4%)
Fibroids	73 (58.4%)
Pelvic pain or endometriosis	46 (36.8%)
Adenomyosis	15 (12%)
Recurrent postmenopausal bleeding	7 (5.6%)
Lynch syndrome	3 (2.4%)
History of cervical dysplasia	3 (2.4%)
Endometrial hyperplasia	2 (1.6%)
Endometrial intraepithelial neoplasia	1 (0.8%)
Premenstrual dysphoric disorder	1 (0.8%)
Type of laparoscopic hysterectomy	
Total laparoscopic hysterectomy	122 (97.6%)
Laparoscopic supracervical hysterectomy	3 (2.4%)
Additional surgical procedures	
Bilateral salpingectomy	95 (76%)
Unilateral salpingectomy	5 (4%)
Bilateral salpingo-oophorectomy	20 (16%)
Unilateral salpingo-oophorectomy	8 (6.4%)
Ovarian cystectomy	3 (2.4%)
Lysis of adhesions	30 (24%)
Resection of endometriosis	12 (9.6%)
Ablation/fulguration of endometriosis	1 (0.8%)
Cystoscopy	53 (42.4%)

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leftover opioids to their follow-up visit, and these were counted to confirm patients' self-reported opioid use. All patients completed their 2 week postoperative follow-up visits by Jan. 20, 2018.

Primary outcomes were the opioid prescriptions given by the surgeons and the amount of acute postoperative opioids used by patients in the 2 weeks following surgery. All opioid prescriptions and opioids used postoperatively were converted into morphine milligram equivalents (MMEs) using the Centers for Disease Control and Prevention guidelines.[32]

Acute postoperative opioid use was defined as all opioids used by a patient after leaving the postanesthesia care unit (PACU) after surgery through their 2 week follow-up visit. For patients using chronic opioids prior to surgery, we counted only the opioids that were taken in addition to their chronic opioids. If patients were admitted to the hospital after surgery, their acute postoperative opioid use included any opioids taken on the hospital floor after leaving the PACU as well as the opioids used at home after discharge through their 2 week postoperative visit.

To test whether preoperative factors were significantly associated with acute postoperative opioid use, nonparametric statistical methods (Spearman correlation coefficient or Wilcoxon rank-sum test) were used. The preoperative factors that were most strongly correlated with patients' acute postoperative opioid use were then used to create a postoperative opioid use predictor calculator.

Results

Patient enrollment

One hundred thirty-three patients had laparoscopic hysterectomies during the enrollment period and were eligible for the study. Four patients declined to participate. Two patients were enrolled but then decided not to proceed with surgery. One patient was enrolled, but during her surgery she had a small serosal defect of the small bowel that was repaired through a minilaparotomy, so she was excluded. One patient was

TABLE 2
Patient surgical data *(continued)*

Surgical characteristics	All patients (n = 125)
Number of trocars	
4	124 (99.2%)
5	1 (0.8%)
Local anesthesia with trocar placement	80 (64%)
Morcellation of uterine specimen	
Any morcellation	56 (44.8%)
Vaginal	48 (38.4%)
Suprapubic	7 (5.6%)
Umbilical	1 (0.8%)
Length of procedure, min	94.3 ± 54.2 (33–344)
Estimated blood loss, mL	48.4 ± 87.2 (0–800)
Uterine specimen weight, g	321 ± 305.0 (21–1500)
Pathology findings	
Fibroids	102 (81.6%)
Adenomyosis	39 (31.2%)
Endometriosis	20 (16%)
Endometrial or endocervical polyp	6 (4.8%)
Simple cystadenoma	3 (2.4%)
Dermoid	2 (1.6%)
Mucinous cystadenoma	1 (0.8%)
Endometrial intraepithelial neoplasia	2 (1.6%)
Cervical intraepithelial neoplasia	2 (1.6%)
Leiomyosarcoma	1 (0.8%)
Carcinoid tumor within a dermoid cyst	1 (0.8%)
No abnormal pathology	9 (7.2%)
Intraoperative complications	One cystotomy in the setting of stage IV endometriosis, repaired intraoperatively; 1 intraoperative blood transfusion in the setting of severe preoperative anemia (Hct 14)
Admission to hospital after surgery	16 (12.8%)

Data are mean ± SD (range) or median (interquartile range) or n (percentage). For preoperative diagnosis and pathology findings, patients could have more than 1 diagnosis. For specimens morcellated umbilically or suprapubically, laparoscopic incisions were extended to 2–3 cm. For uterine specimen weight, 1 pathology report did not include a specimen weight. Data shown are for the other 124 patients.

Hct, hematocrit.

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enrolled, had her surgery, but was lost to follow-up. A total of 125 patients completed the study through their 2 week postoperative visit. Of those enrolled in the study, there was a 99.2% follow-up and study completion rate (Figure 1).

Patient baseline characteristics and surgical findings

Demographic details about the 125 patients who completed the study are detailed in Table 1. Specifics about the 125 surgeries are detailed in Table 2. Patients were also surveyed preoperatively about their current and predicted pain and were screened for depression, anxiety, and pain castrophizing (Table 3).

Opioid prescribing practices

A total of 98.4% of patients were given an opioid prescription. Surgeons prescribed a median of 150 MME (interquartile range [IQR], 150–160, range, 0–720 MME) for acute postoperative pain, equivalent to 20 tablets of oxycodone 5 mg. Two patients were prescribed no opioids at their request, and 2 other patients received opioid prescriptions but did not fill them. Eight patients (6.4%) were prescribed more than 20 opioid tablets; 5 of these patients were on opioids for baseline chronic pain and 1 had a contraindication to nonsteroidal antiinflammatory drugs. Oxycodone was the most commonly prescribed opioid (65.6%), followed by hydrocodone (21.6%), hydromorphone (10.4%), and morphine (0.08%).

Postoperative opioid use

Median patient postoperative opioid use for acute pain in the 2 weeks after surgery was 37.5 MME (IQR, 7.5–90; MME, range, 0–960 MME), equivalent to 5 tablets of oxycodone 5 mg (Figure 2). Twenty-five patients (20%) used no opioids after discharge from the PACU. 52% of all patients used 37.5 MME (equivalent to 5 tablets of oxycodone 5 mg) or less, and 80.8% of all patients used 112.5 MME (equivalent to 15 tablets of oxycodone 5 mg) or less (Figure 2). Nine patients required refills for their prescriptions for persistent acute postoperative pain. Only 1 of those 9 patients was taking any opioids preoperatively. Although they did not require a refill, an additional 9 patients used all the opioids they were prescribed. Overall, median initial opioid prescriptions were 4 times higher than median opioid use (Figure 3).

Mean duration of opioid use was 3.3 days (SD, 3.2 days). One hundred twenty-three patients (98.4%) used no opioids for acute postoperative pain after their 2 week follow-up visit. The 2 patients who were still using opioids after their 2 week visit both stopped using opioids by 3 weeks after surgery. Sixteen

TABLE 3
Preoperative survey question results

Preoperative survey item	All patients (n = 125) Mean	Median	Range
Pain questions			
Average preoperative pain	2.5 ± 2.7	2 (0–4)	0–9
Expected postoperative pain	5.7 ± 2.2	5 (5–7)	0–10
Pain score when patient would request pain medication	6.2 ± 1.9	6 (5–8)	1–10
Expected pain medication requirements	5.2 ± 2.5	5 (3–7)	0–10
Depression screen, PHQ-9	4.1 ± 5.0	2 (1–5)	0–20
Anxiety screen, GAD-7	3.5 ± 4.4	2 (0–5)	0–19
Pain Catastrophizing Scale, PCS	11.7 ± 12.0	8 (3–17)	0–51

Data are mean ± SD or median (interquartile range). For the pain questions, all responses were on a scale from 0 to 10. For the first 3 items, the values were as follows: 0, no pain; 10, worst pain imaginable. For the fourth item, the values were as follows: 0, no pain medication needed; 10, highest possible amount of pain medication needed. Maximum possible scores on the PHQ-9, GAD-7, and PCS are 27, 21, and 52, respectively.

GAD, Generalized Anxiety Disorder; *PCS*, Pain Catastrophizing Scale; *PHQ*, Patient Health Questionnaire.

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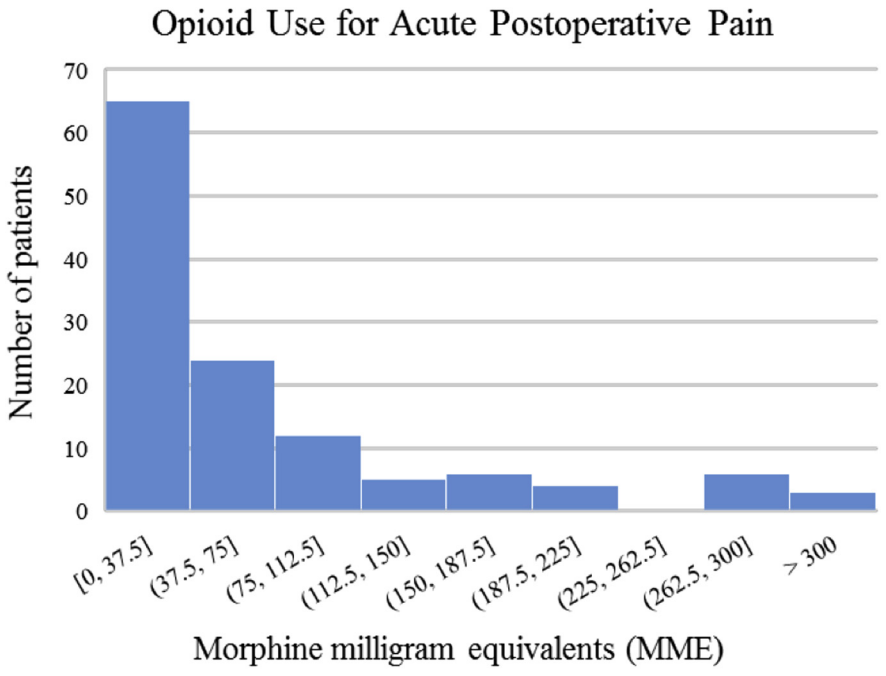
FIGURE 2
Histogram of opioid use for acute postoperative pain



Histogram of opioid use for acute postoperative pain over the first 2 weeks after laparoscopic hysterectomy. Each bar represents an interval of 37.5 MME, which is equal to 5 tablets of oxycodone 5 mg.

MME, morphine milligram equivalent.

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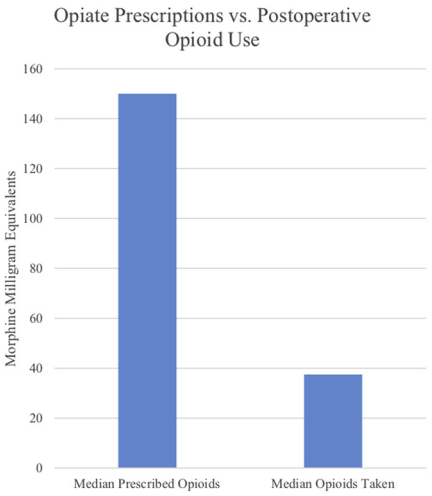
FIGURE 3
Median opioid prescriptions compared with median opioid use



Prescribed opioids are the quantity of opioids given as an initial prescription before surgery, converted to MMEs (150 MME is equivalent to 20 tablets of oxycodone 5 mg). Opioids taken is the total amount of opioids taken for acute postoperative pain after discharge from the PACU through the first 2 weeks after surgery, converted to MMEs (37.5 MME is equivalent to 5 tablets of oxycodone 5 mg).

MME, morphine milligram equivalent; *PACU*, postanesthesia care unit.

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patients were admitted to the hospital after surgery. Only 3 of those patients required any intravenous opioid pain medication while admitted. Five of the 16 admitted patients (31%) used no opioids on the floor after surgery.

Leftover opioids

One hundred twenty-one patients were prescribed opioids and filled their prescription. One hundred nine of those patients (90%) had leftover opioid medication. Leftover opioids ranged from none to 200 MME, with a median of 120 MME (IQR, 75–142.5), equivalent to 16 tablets of oxycodone 5 mg. Ten patients had disposed of their excess opioids by their 2 week postoperative visit. The remaining 99 patients had their opioids in their home. A total of 73.4% of those patients were storing their opioids in an unlocked location in their home. Patients with leftover opioids

were surveyed about their plans for the leftover pills; 44% were unsure or planned to keep their opioid pills.

Patient pain and satisfaction scores after surgery

At 1 week after surgery, the mean current pain score was 1.9 (SD, 1.9, range, 0−8) on a 0−10 scale (0, no pain, 10, worst pain imaginable). Patients also reported their highest pain score after surgery. The mean highest pain score was 6.5 (SD, 2.5, range, 1−10). At 2 weeks after surgery, median current pain score was 0 (IQR, 0, 2). Average patient satisfaction with their pain control after surgery on a 0−10 scale (0, totally unsatisfied, 10, totally satisfied) was 9.1 (SD, 1.9) at both 1 and 2 weeks after surgery.

Preoperative factors that predict postoperative opioid use

A summary of factors that were and were not correlated with acute opioid use are noted in Table 4. Younger patients, smokers, and patients with a history of chronic pain, anxiety, or depression were all at increased risk of using more opioids for acute postoperative pain.

Patients who were taking any pain medication before surgery and particularly those using opioids before surgery tended to use more opioids postoperatively. Those with higher preoperative pain scores and those who anticipated having more pain and requiring more pain medication after surgery also used more postoperative opioids. Higher depression, anxiety, and pain catastrophizing scores on the PHQ-9, GAD-7, and PCS were all significantly correlated with increased postoperative opioid use. All individual questions on the GAD-7, PHQ-9, and PCS were also independently correlated with opioid use except for the final 2 questions of the PHQ-9.

Designing a calculator to predict high and low opioid use

Based on the findings described in the previous text, we collected the factors that were most strongly correlated with opioid use. In our patient population, we defined a high opioid user as someone who used more than 112.5 MME (equivalent to more than 15 tablets of oxycodone 5 mg). These 24 patients comprised the top 20% of opioid users.

Fifteen tablets of oxycodone 5 mg has also been suggested as a recommended postoperative prescription for those undergoing laparoscopic hysterectomy.[33] We defined a low opioid user as someone who used 37.5 MME or less

TABLE 4
Preoperative factors and their associations with postoperative opioid use

Variables	Not correlated with postoperative opioid use	Correlated with postoperative opioid use
Demographic information		
	BMI	Age[a]
	Parity	Smoking[b]
	ASA class	
	Employment	
	Race	
Past medical history		
	Prior abdominal surgery	Total number of prior abdominal surgeries[b]
	History of arthritis	History of chronic pelvic pain[a]
		History of endometriosis[a]
		History of migraines[b]
		History of fibromyalgia[a]
		History of chronic back pain[b]
		History of anxiety[a]
		History of depression[b]
Preoperative pain		
		Any preoperative pain medication use[a]
		Preoperative opioid use[a]
		Preoperative pain score[a]
		Expected postoperative pain score[a]
		Expected pain medication requirements[a]
Depression, anxiety, and pain catastrophizing		
		Depression (PHQ-9)[a]
		Anxiety (GAD-7)[a]
		Pain catastrophizing (PCS)[a]
Preoperative diagnosis		
		Pain or endometriosis[a]
		Abnormal uterine bleeding[b]
		Fibroids[b]

For discrete and continuous variables, a Spearman's correlation was calculated. For categorical variables, a Wilcoxon rank-sum test was done. Race was defined as white vs nonwhite/multiracial. Depression, anxiety, and pain catastrophizing were defined as a patient's total score on the PHQ-9, GAD-7, or PCS.

ASA, American Society of Anesthesiologists; *BMI*, body mass index; *GAD*, Generalized Anxiety Disorder; *PCS*, Pain Catastrophizing Scale; *PHQ*, Patient Health Questionnaire.

[a] $P < .001$; [b] $P < .05$.

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FIGURE 4
Predictive calculator for opioid use after laparoscopic hysterectomy

1. Do you have a history of chronic pelvic pain?	No (0)	Yes (10)			
2. Do you have a history of endometriosis?	No (0)	Yes (10)			
3. Do you currently use any opioid pain medication regularly?	No (0)	Yes (10)			
4. On an average day, how much pain do you experience on a scale of 0 to 10? (0= no pain, 10= worst pain imaginable)	0 1 2 3 4 5 6 7 8 9 10 No pain — Worst pain imaginable				
5. How much pain do you expect to experience after your surgery on a scale from 0 to 10? (0= no pain, 10= worst pain imaginable)	0 1 2 3 4 5 6 7 8 9 10 No pain — Worst pain imaginable				
6. What do you expect your pain medication requirements will be after surgery? (0= no pain medication needed, 10= highest possible amount of pain medication needed)	0 1 2 3 4 5 6 7 8 9 10 No pain medication needed — Highest possible amount of pain medication needed				
7. Over the past 2 weeks, how often have you been bothered by little interest or pleasure in doing things?	0 Not at all	2 Several days	4 More than half the days	6 Nearly every day	
8. Over the past two weeks, how often have you been bothered by worrying too much about different things?	0 Not at all	2 Several days	4 More than half the days	6 Nearly every day	
9. To what degree do you have these thoughts and feelings when you are experiencing pain:. When I am in pain, it's awful and I feel that it overwhelms me	0 Not at all	2 To a slight degree	4 To a moderate degree	6 To a great degree	8 All the time
Total _____					

How to interpret score:
Score 33 or above: Increased risk of using over 112.5 morphine milligram equivalents (equivalent to 15 tabs of oxycodone 5 mg) for acute postoperative pain
Score 12 or less: Likely to use 37.5 MME or less (equivalent to 5 tabs of oxycodone 5 mg) for acute postoperative pain

Questions 4, 5, and 6 were developed by Carvalho et al.[21] Question 7 is the first question on the PHQ-9. Question 8 is the third question on the GAD-7. Question 9 is the fourth question on the PCS.
GAD, Generalized Anxiety Disorder; *PCS*, Pain Catastrophizing Scale; *PHQ*, Patient Health Questionnaire.
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(equivalent to 5 tablets of oxycodone 5 mg or less). These 65 patients comprised 52% of all patients.

There are 9 components to the calculator we have labeled Postoperative Opioid Calculator for Hysterectomy (POOCH) (Figure 4). All components can be assessed preoperatively, thus providing clinicians with information they can use to predict and prescribe appropriate, individualized amounts of pain medication.

There are 3 questions on past medical history, 1 question each from the PHQ-9, GAD-7, and PCS, and 3 questions about current and predicted pain. Possible scores on the calculator range from 0 to 80. The calculator can be used both to predict higher opioid users and lower opioid users (Figure 5). Those scoring 33 points or higher were more likely to use more than 112.5 MME, with a positive predictive value of 83.3%, negative predictive value of 96%, sensitivity of 83.3%, and specificity of 96.0%. Those scoring 12 points or less were more likely to use 37.5 MME or less, with a positive predictive value of 83.7%, negative predictive value of 35.4%, sensitivity of 55.4%, and specificity of 88.3%.

In our cohort of 125 patients, 29 patients scored 33 points or higher on the calculator. Twenty of those patients used more than 112.5 MME. Average postoperative opioid use in this predicted high opioid use group was 210.0 MME. Forty-three patients scored 12 points or lower on the calculator. Thirty-six of those patients used 37.5 MME or less. Average postoperative opioid use in this predicted low opioid use group was 22.7 MME.

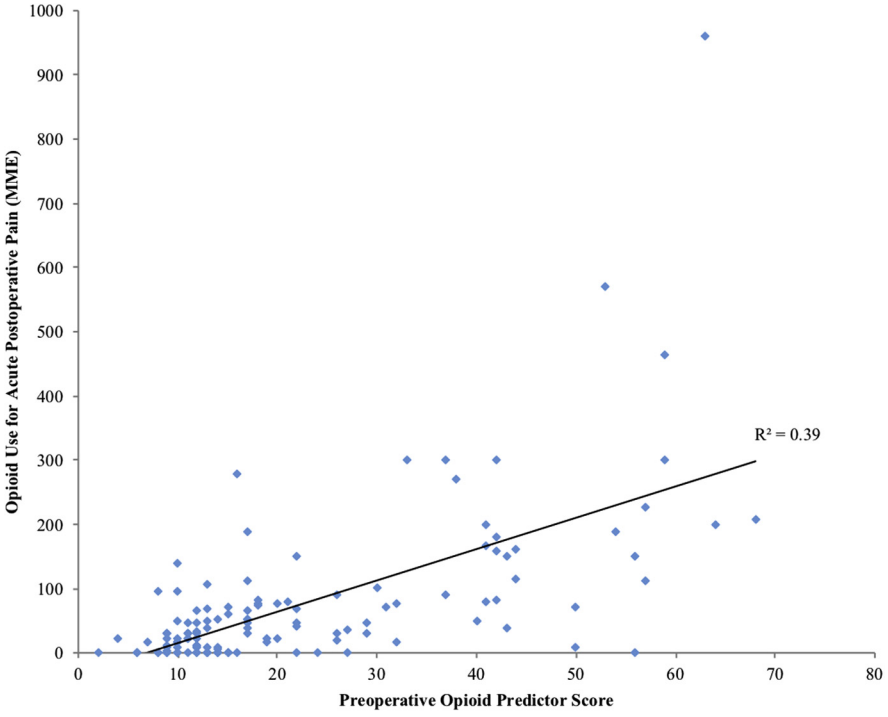
Comment

In this study, patients undergoing laparoscopic hysterectomy were prescribed 4 times more opioid medication than they used. Eighty percent of patients had leftover opioid pain medication. These findings are congruent with previous research[34,35] that has demonstrated that gynecologists,[9,12,36] obstetricians,[37] general surgeons,[38] plastic surgeons,[39] orthopedic surgeons,[40] dermatologists,[41] and urologists[42] routinely prescribe more opioids than patients require. We hope that this study adds to this body of literature and encourages surgeons to decrease the standard quantity of opioids they typically prescribe.

The majority of leftover opioids were stored in unlocked locations in patients' homes, showing the need for improved patient education about appropriate, prompt opioid disposal. After completing all study surveys, patients were given handouts about appropriate opioid disposal techniques and locations. At 1 of our sites, a secure medication dropbox was installed in the lobby.

This study identified multiple preoperative factors that were significantly associated with postoperative opioid use. The difference in opioid use based on a single factor could be dramatic (Table 5). For example, patients with a history of chronic pelvic pain used a median of 113.25 MME of postoperative opioids,

FIGURE 5
Scatter plot of opioid predictor scores and postoperative opioid use



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compared with 30 MME in patients with no history of chronic pelvic pain. Overall, a self-reported history of chronic pelvic pain or endometriosis, higher scores on depression, anxiety, and pain catastrophizing surveys, preoperative opioid use, and higher baseline and expected pain and anticipated pain medication requirements were all significantly correlated with opioid use after surgery.

We incorporated these 9 factors into a calculator to try to stratify patients at risk of needing more or less than the average amount of postoperative opioids. We set our cutoff scores for the high-user group to maximize sensitivity because our goal was to capture the majority of patients at increased risk of needing high opioids postoperatively. In the low-user group, our goal was to optimize the tool's positive predictive value, to identify only low users.

TABLE 5
Median postoperative opioid use based on nine top predictive factors

Variables	No	Yes
History of chronic pelvic pain	30	113.25
History of endometriosis	26.25	114
Preoperative opioid use	30	200
Preoperative pain score 5 or greater	26.25	160
Expected postoperative pain score 7 or greater	22.5	90
Expected pain medication requirement score 6 or greater	26.25	90
PHQ-9 question 1 answer several days or more	26.25	114
GAD-7 question 3 answer several days or more	30	57.5
PCS question 4 answer to a moderate degree or more	22.5	112.5

All data are in morphine milligram equivalents. A value of 7.5 MME is equivalent to 1 5 mg tablet of oxycodone.

GAD, Generalized Anxiety Disorder; *PCS*, Pain Catastrophizing Scale; *PHQ*, Patient Health Questionnaire.

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To our knowledge, this is the first calculator designed to help predict a patient's postoperative opioid requirements after laparoscopic hysterectomy. We plan to continue this work with a prospective follow-up study to validate and simplify this calculator so that it can be used clinically for laparoscopic hysterectomy patients.

We support the Michigan Opioid Prescribing Engagement Network recommendation for prescribing the MME equivalent of 15 tablets of oxycodone 5 mg to the average laparoscopic hysterectomy patient.[33] With the use of preoperative screening with questions such as those included in POOCH, opioid prescriptions can then be further individualized for patients. For patients anticipated to be low opioid users, we believe surgeons should consider prescribing the MME equivalent of 5–10 tablets of oxycodone 5 mg.

Theoretical downsides to decreasing postoperative opioid prescriptions include decreased patient satisfaction and increased need for opioid refills. Satisfaction with pain control was high at 1 and 2 weeks after surgery in this study. There could be concern that patient satisfaction rates might drop if patients are prescribed less opioid medication; however, a recent study showed no decrease in patient satisfaction with fewer prescribed postoperative opioids.[39] Another concern with decreasing opioid prescription quantity is that patients may require more refills, but research in general surgery has shown no increase in refills when fewer opioids were prescribed after surgery.[37]

This study had several strengths, including excellent follow-up rates with patients after surgery. It had the benefit of being a prospective study. We intentionally limited the exclusion criteria and included patients regardless of their

prior substance use or preoperative opioid use.

However, this study had some important limitations. This was an observational study, so the preoperative factors correlated with acute postoperative opioid use identified in this study are not necessarily causal. However, the preoperative factors identified here are consistent with prior research. By working with 5 high-volume minimally invasive gynecological surgery surgeons, this study had the advantage of enrolling a relatively large number of patients during the study period, but it is possible that these findings may not be directly applicable to all surgeons. For example, lower-volume surgeons could have patients with lower rates of endometriosis and less baseline pain.

In addition, the majority of opioid use was self-reported by our patients. We believe that the prospective nature of the study and surveying patients at 1 and 2 weeks after surgery minimize the risk of recall bias. We tried to minimize response bias by having patients fill out their 2 week postoperative surveys anonymously through REDCap rather than with a study provider.

Lastly, although we had excellent participation and study completion rates, this was a relatively homogenous group of predominantly college-educated white patients in 1 geographic region. Future research with a more diverse patient population will be important. Although we believe POOCH holds promise, it will require validation in these future studies before clinical implementation.

In summary, tackling the opioid epidemic will require an approach from different angles. It is essential to help minimize patients' pain; taking a minimally invasive approach, providing excellent preoperative counseling, utilizing multimodal pain control, and following enhanced recovery after surgery pathways may be helpful.[43,44] This study highlights 3 methods that gynecologists can use to decrease the amount of excess opioids after laparoscopic hysterectomy: decreasing the default quantity of opioids prescribed to the average patient, personalizing opioid prescriptions to identify those patients likely to need more or less opioids than the default prescription, and educating patients about safe disposal of their leftover opioids. We believe that these tenets are applicable to all surgical specialties. ■

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