Multimodal opioid-sparing postoperative pain regimen compared with the standard postoperative pain regimen in vaginal pelvic reconstructive surgery: a multicenter randomized controlled trial

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BACKGROUND: Postoperative pain control after urogynecological surgery has traditionally been opioid centered with frequent narcotic administration. Few studies have addressed optimal pain control strategies for vaginal pelvic reconstructive surgery that limit opioid use.

OBJECTIVE: The objective of the study was to determine whether, ice packs, Tylenol, and Toradol, a novel opioid-sparing multimodal postoperative pain regimen has improved pain control compared with the standard postoperative pain regimen in patients undergoing inpatient vaginal pelvic reconstructive surgery.

STUDY DESIGN: This was a multicenter randomized controlled trial of women undergoing vaginal pelvic reconstructive surgery. Patients were randomized to the ice packs, Tylenol, and Toradol postoperative pain regimen or the standard regimen. The ice packs, Tylenol, and Toradol regimen consists of around-the-clock ice packs, around-the-clock oral acetaminophen, around-the-clock intravenous ketorolac, and intravenous hydromorphone for breakthrough pain. The standard regimen consists of as-needed ibuprofen, as-needed acetaminophen/oxycodone, and intravenous hydromorphone for breakthrough pain. The primary outcome was postoperative day 1 pain evaluated the morning after surgery using a visual analog scale. Secondary outcomes included the validated Quality of Recovery Questionnaire, satisfaction scores, inpatient narcotic consumption, outpatient pain medication consumption, and visual analog scale scores at other time intervals. In all, 27 patients in each arm were required to detect a mean difference of 25 mm on a 100 mm visual analog scale (90% power).

RESULTS: Thirty patients were randomized to ice packs, Tylenol, and Toradol and 33 to the standard therapy. Patient and surgical demographics were similar. The median morning visual analog scale pain score was lower in the ice packs, Tylenol, and Toradol group (20 mm vs 40 mm, $P = .03$). Numerical median pain scores were lower at the 96 hour phone call in the ice packs, Tylenol, and Toradol group (2 vs 3, $P = .04$). Patients randomized to the ICE-T regimen received fewer narcotics (expressed in oral morphine equivalents) from the postanesthesia care unit exit to discharge (2.9 vs 20.4, $P < .001$) and received fewer narcotics during the entire hospitalization (55.7 vs 91.2, $P < .001$). At 96 hour follow up, patients in the ice packs, Tylenol, and Toradol group used 4.9 ketorolac tablets compared with 4.6 oxycodone/acetaminophen tablets in the standard group ($P = .81$); however, ice packs, Tylenol, and Toradol patients required more acetaminophen than ibuprofen by patients in the standard arm (10.7 vs 6.2 tablets, $P = .012$). There were no differences in Quality of Recovery Questionnaire or satisfaction scores either in the morning after surgery or at 96 hour follow up.

CONCLUSION: The ice packs, Tylenol, and Toradol multimodal pain regimen offers improved pain control the morning after surgery and 96 hours postoperatively compared with the standard regimen with no differences in patient satisfaction and quality of recovery. Ice packs, Tylenol, and Toradol can significantly limit postoperative inpatient narcotic use and eliminate outpatient narcotic use in patients undergoing vaginal pelvic reconstructive surgery.

Key words: multimodal pain control, opioid sparing, urogynecology, vaginal surgery

As the US population ages, the demand for health care for pelvic floor disorders is estimated to increase up to 40% over the next 30 years.[1,2] Despite the increased demand, there is a paucity of data on postoperative pain control specific to female pelvic medicine and reconstructive surgery (FPMRS).

Mitigation of postoperative pain is important in patients' perception of quality of recovery and influences patient satisfaction.[3] Traditionally, postoperative pain control after pelvic floor surgery has relied primarily on opioids. To date, only 1 study has evaluated postoperative pain control after vaginal reconstructive surgery and it utilized opioid-centric therapies.[4,5]

The United States is currently facing an opioid crisis in which opioid overdose is a leading case of accidental death.[6] In an effort to combat narcotic use in gynecologic surgery and FPMRS, multimodal therapy has been gaining momentum to achieve improved pain control and decreased opioid requirements.[7–9] Ice packs, ketorolac (Toradol), and acetaminophen (Tylenol) have all been studied to accomplish these goals in a variety of surgeries.

Ice packs have been shown to be effective in the treatment of postoperative pain after abdominal midline incisions.[10] A Cochrane Review of 1825 patients utilizing post–vaginal delivery perineal cooling included 10 randomized controlled trials with evidence that

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AJOG at a Glance

Why was this study conducted?

The study was conducted to determine whether a multimodal opioid-sparing pain regimen composed of ice packs, Tylenol, and Toradol (ICE-T) has improved pain control compared with the standard pain regimen in patients undergoing inpatient vaginal pelvic reconstructive surgery.

Key findings

Pain scores were lower the morning after surgery and 96 hours postoperatively in the ICE-T group. ICE-T patients received fewer narcotics throughout their entire hospitalization and did not require any additional narcotics once discharged home.

What does this add to what is known?

This multicenter randomized controlled trial further demonstrates that multimodal opioid-sparing pain regimens achieve satisfactory postoperative pain control, can limit narcotic use for postoperative pain control, and can eliminate outpatient narcotic prescriptions in patients undergoing vaginal pelvic reconstructive surgery.

local cooling in the form of ice packs and cold gel packs and may be effective in pain relief.[11]

Ketorolac has been extensively studied in a multitude of surgeries including spinal, obstetric, orthopedic, urologic, and gynecologic and has been administered preemptively, intraoperatively, and postoperatively for pain control. Results from these studies suggest that ketorolac decreases postoperative subjective pain scores and lowers narcotic use.[12–14]

Acetaminophen is a mainstay for postoperative pain control that complements other opioid-sparing medications in many surgeries, including abdominal hysterectomy, with few reported side effects.[15,16]

The purpose of this study was to determine whether a novel multimodal postoperative pain regimen composed of ice packs, Toradol (ketorolac), and Tylenol (acetaminophen) (ICE-T) provides improved pain control, increased patient satisfaction, and decreased opioid intake compared with the Standard postoperative pain regimen in patients undergoing vaginal pelvic reconstructive surgery (VPRS).

TABLE 1
ICE-T and standard postoperative pain regimens

ICE-T	Standard
• At the end of surgery, patients receive 30 mg of IV ketorolac. Once out of PACU, patients receive: • Ice packs applied to the perineum Q2 h for 20 min ATC until discharge • Ketorolac 30 mg IV Q6 h ATC until discharge • Acetaminophen 1 g PO Q6 h ATC until discharge • Hydromorphone 0.2 mg IV Q3 h PRN for breakthrough pain • Patients are discharged home with: 1. Acetaminophen 1 g PO every 6 h for PRN pain 1–5, #60 2. Ketorolac 10 mg PO every 6 h PRN for pain, #6–10, #16	• At the end of surgery, patients receive 30 mg of IV ketorolac. Once out of PACU, patients receive: • Ibuprofen 600 mg PO Q4 h PRN for pain 1–3 • Acetaminophen/oxycodone 5 mg/325 mg 1 tablet PO Q4–6 h PRN for pain 4–6 • Acetaminophen/oxycodone 5 mg/325 mg 2 tablets PO Q4–6 h PRN for pain 7–10 • Hydromorphone 0.2 mg IV Q3 h PRN for breakthrough pain • Patients are discharged home with: 1. Ibuprofen 600 mg PO Q8 h PRN for pain 1–5, #60 2. Acetaminophen/oxycodone 5 mg/325 mg 1–2 tablets Q4-6 h PRN pain 6–10, #16

ATC, around the clock; *IV*, intravenous; *PO*, by mouth; *Q*, every day; *PRN*, as needed.

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Materials and Methods

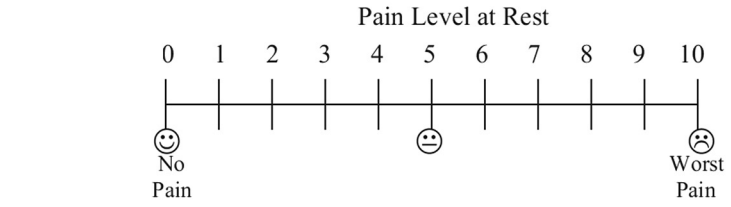
This was an investigator-initiated, multicenter, randomized controlled clinical trial at 2 tertiary medical centers. This study was registered with ClinicalTrials.gov (ID: NCT03052816) and institutional review board approval was obtained at both sites. Consolidated Standards of Reporting Trials guidelines were adhered to for study reporting.[17] All recruited patients were from the Division of FPMRS at the respective institution.

Patients were enrolled in the study if they consented to study participation, were English speaking, were at least 18 years of age, were able to read and understand visual analog scales (VAS), and were admitted overnight after undergoing VPRS. Patients were excluded if they did not meet all inclusion criteria; chose not to participate; had a history of chronic pelvic pain or illicit drug use, liver disease, renal disease, or cardiac disease; suffered from dementia; had an allergy to any of the study medications; had nonsteroidal antiinflammatory drug intolerance; were currently using daily analgesics or sedatives; or had a planned or unplanned abdominal or laparoscopic procedure.

Once patients were deemed appropriate candidates, they were consented for study participation on the day of their preoperative visit or in the preoperative suite the day of surgery. Once enrolled, a preoperative pain VAS score was obtained. Patients were randomized at the end of surgery using sequentially numbered opaque sealed envelopes. A statistician developed the 1:1 mixed block randomization sequence using a random number generator; only the statistician was aware of the sequence.

Patients were randomized to 1 of 2 postoperative pain regimens: ICE-T

FIGURE 1
VAS pain scale



VAS pain scale for preoperative score, PACU score, and POD at number 1 morning score are shown.

PACU, postanesthesia care unit; *POD*, postoperative day; *VAS*, visual analog scale.

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opioid-sparing regimen or the Standard regimen. Patients were recruited in a consecutive fashion that did not depend on the site of recruitment: randomization was not blocked by site. Both hospitals were part of the same fellowship with similar patient populations.

Intraoperatively, all patients received general anesthesia and were managed per anesthesiology routine practice. Fellowship-trained FPMRS surgeons and FPMRS fellows performed all surgeries. Postanesthesia care unit (PACU) orders were under the discretion of the anesthesiology provider. The study investigators obtained a VAS score prior to the patient's exit from the PACU.

Outside the study protocol, both institutions had a VAS threshold prior to discharge from the PACU. Once discharged from the PACU, the nursing staff administered either the ICE-T regimen or the Standard regimen until discharge as per the protocol listed in Table 1. Two 8 oz premade ice packs were applied to the perineum every 2 hours for 20 minutes at a time around the clock until discharge home. Patients could opt out of applying ice to the perineum but none did.

All patients had a clear liquid diet the day of surgery and a regular diet the following morning. Ondansetron was ordered for postoperative nausea as needed. Voiding trials were performed using a retrograde fill. An independent data and safety monitoring physician in the Department of Obstetrics and Gynecology at both institutions oversaw the progress of the study.

The primary outcome was postoperative day 1 pain as measured using a VAS the morning after surgery. Patients completed a VAS score between 7 AM and 8 AM the morning after surgery. The VAS is a 100 mm scale with a score of no pain on the left of the scale, indicating a score of 0, and a score of worst pain on the right, indicating a score of 10 (Figure 1).

Secondary outcomes included all other VAS scores, verbal pain, and satisfaction scores, Quality of Recovery-40 scores (QoR-40), narcotic consumption in oral morphine equivalents, time to first bowel movement, urinary retention, medication side effects, operating and postoperative hospitalization times, differences in demographics and intraoperative variables, hemoglobin differences, and posthospital discharge medication consumption.

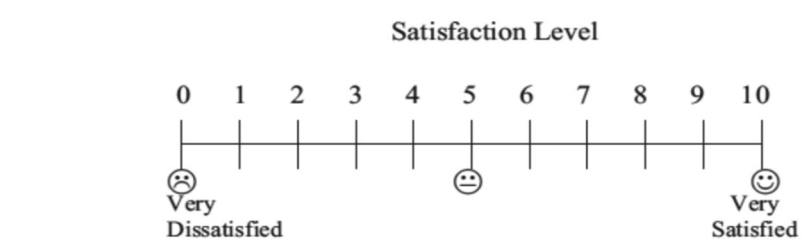
Study investigators asked patients to mark the pain scale corresponding to their level of pain at rest the morning after surgery. Patients were also asked to mark their level of satisfaction with their pain control using a satisfaction-specific VAS scale, with a score of 0 indicating the patient was very dissatisfied and a score of 10 indicating the patient was very satisfied (Figure 2).

Once the VAS scales were completed, patients were asked to complete a validated quality of recovery questionnaire, the QoR-40. The minimum score for the QoR-40 of 40 indicates a poor quality of recovery, while the maximum score of 200 indicates excellent quality of recovery.[18–20]

Prior to hospital discharge, patients were informed that they would be contacted 4 days after surgery by telephone. This phone call was used to gather information for the QoR-40, assess the numerical pain scale score and verbal satisfaction with pain control scores from 0 to 10, and ask whether the patient had her first bowel movement after surgery. Patients were also asked to count how many pain medication tablets (ketorolac and acetaminophen for the ICE-T arm or ibuprofen and acetaminophen/oxycodone for the Standard arm) they had consumed and how many tablets remained.

Twenty-seven patients in each arm would be needed to achieve 90% power

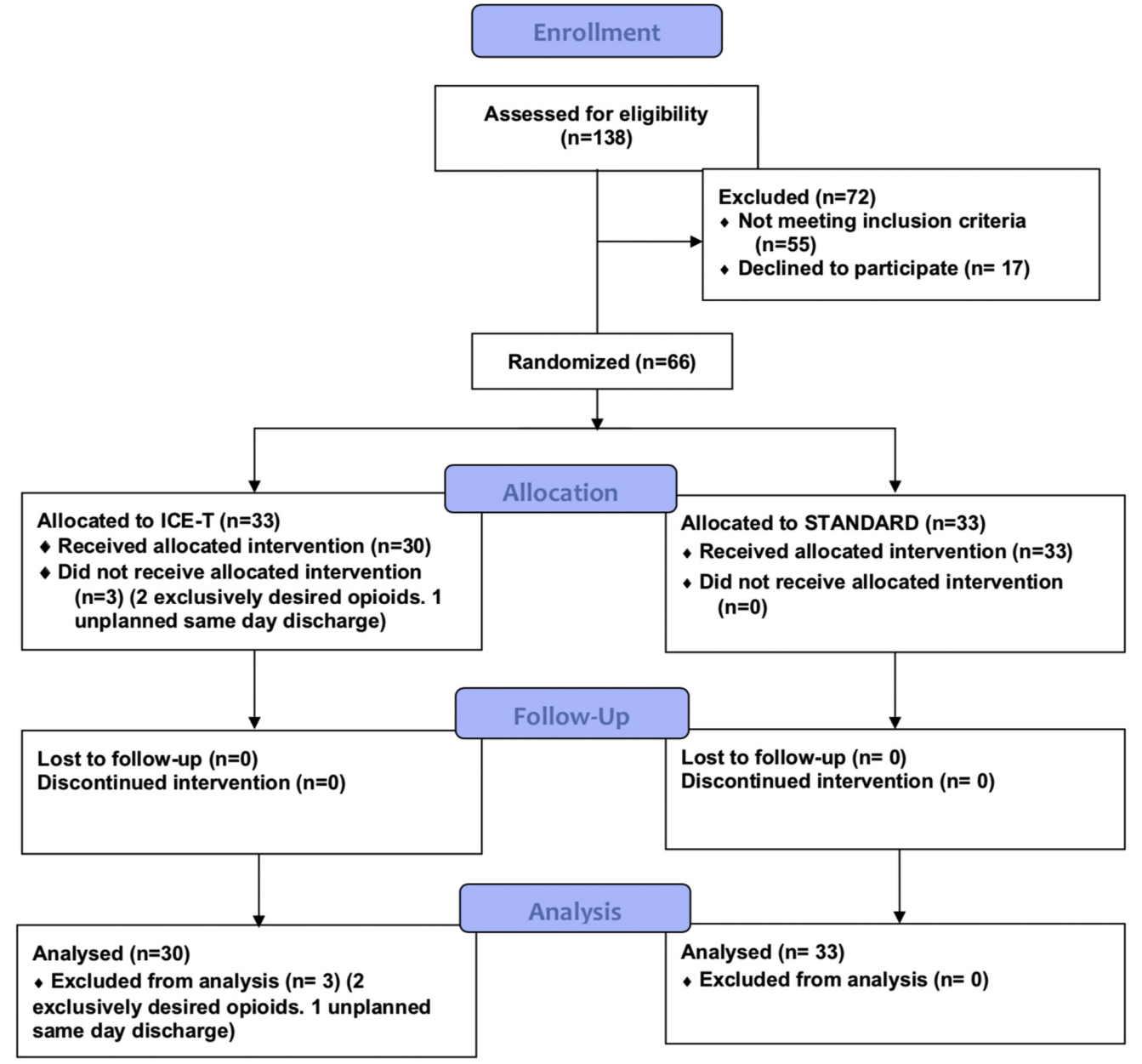
FIGURE 2
VAS satisfaction score for postoperative day 1 morning score



VAS, visual analog scale.

Petrikovets et al. ICE-T pain regimen in vaginal pelvic surgery. Am J Obstet Gynecol 2019.

FIGURE 3
Flow diagram



Petrikovets et al. ICE-T pain regimen in vaginal pelvic surgery. Am J Obstet Gynecol 2019.

to detect a mean difference of approximately 25 mm on a 100 mm VAS scale for a significance level of 0.05. This difference was selected based on multiple articles stating that a VAS pain score difference between 20 mm and 30 mm is significant for most patients.[5,21,22] We added 20% to account for loss to follow-up and enrolled 66 patients with 33 in each arm.

Statistical analysis was performed using Stata version 11.2 (StataCorp LP, College Station, TX). All opioids were converted to doses of oral morphine equivalents using the equianalgesic dosage conversion calculator provided by clincalc.com. Data were assessed for normality of distribution. Continuous variables were analyzed using a Student *t* test for normally distributed variables and the Mann-Whitney test for nonparametric variables.

Categorical variables were analyzed using a χ^2 test. Spearman's correlation coefficient was used to measure correlations. Data were stratified by post-anesthesia unit VAS scores using pairwise analysis. All results yielding $P < .05$ were deemed statistically significant.

Results

Between April 2017 and April 2018, 138 women who were scheduled for vaginal pelvic reconstructive surgery were assessed for eligibility. Seventy-two patients were excluded; 55 patients did not meet inclusion criteria and 17 patients chose not to participate after the study was explained to them.

Sixty-six patients were randomized to the ICE-T or Standard protocols. Of the 33 patients who were randomized to the ICE-T regimen, 3 were excluded after randomization. One of the excluded patients was discharged home the same day from the postanesthesia care unit as per her request. The other 2 patients decided not to participate prior to transfer out of the PACU prior to the initiation of ICE-T or standard postoperative pain regimens and prior to collection of PACU VAS scores. None of the patients in the Standard arm were excluded. Ultimately, 30 patients in the ICE-T arm and 33 patients in the Standard arm were analyzed (Figure 3).

Patient demographics, which are presented in Table 2, did not demonstrate statistically significant differences between groups. The preoperative diagnoses for all patients included pelvic organ prolapse and/or stress urinary incontinence. One patient had a sling performed with a concomitant total vaginal hysterectomy with McCall culdoplasty for cervical dysplasia and was randomized to the ICE-T group. All other patients who had slings performed for stress urinary incontinence had pelvic organ prolapse as a concomitant diagnosis.

Surgical demographics are presented in Table 3. There were no statistically significant differences between the 2 arms and no conversions to laparoscopy or laparotomy. At no time were any of the surgeries listed performed separately; all procedures were bundled (eg, a transvaginal hysterectomy with uterosacral ligament suspension, bilateral salpingectomy, posterior colporrhaphy, perineorrhaphy, and a sling).

In the ICE-T arm, 93% of patients had an apical suspension (sacrospinous ligament fixation, uterosacral ligament fixation, or colpocleisis) as the primary procedure along with other additional procedures. Similarly, 85% of patients in the Standard group had an apical suspension as the primary procedure with other additional procedures.

Postoperative VAS, QoR-40, and satisfaction scores are shown in Table 4. Preoperatively, VAS pain scores were 0 in both groups. Postoperatively, pain scores were generally low. Prior to PACU exit, patients in the ICE-T regimen had a VAS score of 35 mm vs 50 mm for patients in the Standard arm ($P = .13$). Patients randomized to the ICE-T regimen had lower median morning VAS pain scores (primary outcome) compared with patients in the Standard arm (20 mm vs 40 mm, $P = .03$). Lower median pain scores persisted through the 96 hour follow-up.

Both groups reported high median QoR-40 scores, with no differences the morning after surgery or at the 96 hour follow-up, and patients were very satisfied with both pain control regimens. Table 5 demonstrates postoperative VAS, QoR-40, and satisfaction scores stratified into high PACU VAS and low PACU VAS scores.

Patients were stratified by those having a VAS score above or below the median (50 mm). In the high PACU VAS group, there were 32 patients; in the low PACU VAS group, there were 31 patients. Upon stratification, there were no differences in any of the outcome measures including the primary outcome.

Hospitalization times, postoperative complications, and morning complaints are presented in Table 6. There were no statistically significant differences in time spent in the PACU, the time from the end of surgery to the morning VAS scores, or the hospitalization time. All patients were admitted as 23 hour extended

TABLE 2
Patient demographics

Characteristics	ICE-T (n = 30)	Standard (n = 33)	*P* value
Age	61.8 ± 10.1	59.8 ± 12.7	.49
BMI, kg/m^2	29.2 ± 6.0	31.6 ± 6.5	.14
Parity	2.9 ± 1.5	2.6 ± 1.3	.41
Smoking, % never smoker	21 (70.0)	18 (54.5)	.18
Anxiety, % yes	5 (16.7)	4 (12.1)	.61
Depression, % yes	5 (16.7)	7 (21.2)	.65
Charlson Comorbidity Index	2.1 ± 1.3	2.1 ± 1.7	.95
Race			
White	20 (66.7)	28 (84.8)	.09
African American	7 (23.3)	5 (15.2)	.41
Hispanic	3 (10.0)	0 (0.0)	.06
Preoperative diagnosis			
Pelvic organ prolapse	29 (96.7)	33 (100.0)	.29
Stress urinary incontinence	14 (46.7)	13 (39.4)	.56
Abnormal uterine bleeding	1 (3.3)	3 (9.1)	.36
Cervical dysplasia	1 (3.3)	0 (0.0)	.30
Hospital distribution			.93
MetroHealth Medical Center	23 (76.7)	25 (75.8)	—
University Hospitals Cleveland Medical Center	7 (23.3)	8 (24.2)	—

Data are n (percentage), mean ± standard deviation unless otherwise mentioned. *BMI*, body mass index; *ICE-T*, ICE-T postoperative multimodal pain regimen of ice packs, Toradol (ketorolac), and Tylenol (acetaminophen).

Petrikovets et al. ICE-T pain regimen in vaginal pelvic surgery. Am J Obstet Gynecol 2019.

TABLE 3
Surgical demographics

Surgical variables	ICE-T (n=30)	Standard (n=33)	*P* value
Duration of surgery, min	104.6 ± 46.5	90.4 ± 36.0	.18
Duration of anesthesia, min	145.9 ± 49.3	140.2 ± 40.9	.62
Estimated blood loss, mL	34.5 ± 29.9	50.6 ± 32.2	.41
Intraoperative complications[a]	2 (6.7)	1 (3.0)	.51
Ketorolac given at end of surgery, % yes	29 (96.7)	28 (84.8)	.11
Preoperative hemoglobin, g/dL	13.4 ± 1.3	12.9 ± 13.4	.14
Postoperative hemoglobin, g/dL	11.5 ± 1.1	11.9 ± 1.3	.17
Surgery performed			
Vaginal hysterectomy	20 (66.7)	18 (54.5)	.33
Trachelectomy	0 (0.0)	1 (3.0)	.34
Sacrospinous ligament fixation, after hysterectomy apical suspension	7 (23.3)	6 (18.2)	.62
Uterosacral ligament suspension	19 (63.3)	19 (57.6)	.64
Colpocleisis	2 (6.7)	3 (9.1)	.72
Retropubic midurethral sling	16 (53.3)	14 (42.4)	.39
Anterior colporrhaphy	8 (26.7)	10 (30.3)	.75
Posterior colporrhaphy	10 (33.3)	15 (45.5)	.33
Perineorrhaphy	12 (40.0)	16 (48.5)	.51
McCall culdoplasty	13 (43.3)	16 (48.5)	.69
Bilateral salpingectomy	15 (50.0)	16 (48.5)	.91
Bilateral salpingoophorectomy	4 (13.3)	1 (3.0)	.13
Cystoscopy	30 (100)	32 (97.0)	.34

Data are n (percentage) or mean ± standard deviation unless otherwise mentioned.

ICE-T, ICE-T postoperative multimodal pain regimen of ice packs, Toradol (ketorolac), and Tylenol (acetaminophen).

[a] All intraoperative complications were bladder perforations from retropubic slings.

Petrikovets et al. ICE-T pain regimen in vaginal pelvic surgery. Am J Obstet Gynecol 2019.

observations. Overall, postoperative complications were low. One patient in the Standard group was hospitalized for 47 hours because of postoperative febrile morbidity from atelectasis.

There were no significant differences in common complaints the morning after surgery except that more patients in the Standard group complained of dizziness compared with ICE-T. Although there were no specific untoward effects of ice measured, the morning after surgery patients were queried regarding medication side effects and were asked an open-ended question in regard to whether there were any other questions/concerns that they would like to address, none of which pertained to the application of ice packs.

Table 7 shows narcotic use in oral morphine equivalents. From PACU exit to discharge, ICE-T patients were administered 2.9 oral morphine equivalents compared with 20.4 for Standard patients ($P < .001$). This remained significant during the entire postoperative course in which ICE-T patients were administered 17 oral morphine equivalents compared with 37.6 for Standard patients ($P < .001$). The total opioid use during the entire hospitalization (intraoperative to discharge) was 55.7 oral morphine equivalents compared with 91.2 in the Standard group ($P < .001$).

Similarly, patients randomized to ICE-T required significantly fewer narcotics than the Standard patients for postoperative course (PACU to discharge). Table 8 demonstrates that upon stratification into high and low PACU VAS scores, there was no difference in intraoperative and PACU exit to discharge consumption of narcotics. Furthermore, 41.9% of the patients with a low PACU VAS score required 0 narcotics compared with 18.1% of those with a high PACU VAS score.

Table 9 presents all the 96 hour follow-up data except for QoR-40 scores and satisfaction (shown in Table 5). One patient in the ICE-T group presented to the emergency department 3 days after discharge for constipation. Regardless of group, the number of pain tablets taken was low. At no point did patients in the ICE-T arm request any prescriptions for narcotics. Close monitoring of nursing phone calls and electronic medical records indicated that none of the patients called for extra prescriptions of pain medications.

Additional analysis was performed to evaluate for any associations between variables of interest. Morning VAS scores were positively correlated with 96 hour numerical pain levels ($\rho = 0.5710$, $P < .00001$). The amount of acetaminophen/oxycodone or ketorolac tablets taken at 96 hours was positively correlated with 96 hour numerical pain levels ($\rho = 0.343$, $P = .007$). There were otherwise no significant correlations between morning VAS scores and surgical time, intraoperative narcotic administration, or PACU narcotic administration.

Comment

The current opioid crisis and patterns of postoperative prescription narcotic use in the United States warrant a closer look at postsurgical pain control. Although growing, there is limited prospective data in FPMRS focusing on not only postsurgical pain control requirements but also pain control regimens that would limit narcotic use. The goal of this study was to determine whether the ICE-T postoperative pain control regimen had improved postsurgical pain control, satisfaction, quality of recovery, and decreased narcotic consumption compared with the Standard pain control regimen in the patients undergoing VPRS.

The main findings of this trial indicate that patients who were randomized to ICE-T compared with the Standard regimen experienced significantly less pain the morning after surgery and had persistently less pain at the time of the 96 hour follow-up. Although the 1 point difference at the 96 hour follow-up was statistically significant, it is likely not clinically significant as previously stated in the sample size calculation. ICE-T patients required significantly fewer narcotics from the time of PACU exit to discharge.

During the study period, the narcotic dose that was required by ICE-T patients was one tenth of that used by patients in the Standard regimen. Seventy percent of the ICE-T patients did not require any narcotics after discharge from the PACU to discharge from the hospital compared with 12% of Standard patients. This difference may be due to the scheduled administration of ICE-T medications compared with the PRN administration in the standard regimen, requiring patients to have pain escalation prior to receiving pain medications. This may also be attributed to the inherently lower pain demands of patients undergoing VPRS.[1,23]

We were also able to characterize the short-term outpatient pain medication use and add to the growing body of literature regarding how much pain medication we should be prescribing. Whether randomized to the ICE-T or Standard arm, patients used on average just more than 4 tablets of ketorolac or acetaminophen/oxycodone. Furthermore, in the ICE-T arm, patients required approximately 11 tablets of acetaminophen compared with only 6 tablets of ibuprofen in the Standard arm. This may indicate improved pain control with nonsteroidal antiinflammatory drugs after VPRS.

This study demonstrates the plausibility of eliminating outpatient narcotic administration in patients undergoing VPRS. These findings have multiple implications, most notably the ability to mitigate some of the risks associated with unused opioid tablets and the associated hazards, including prescription painkiller abuse in the household and community, and a reduced need to inform patients on proper procedures for disposing or returning unused opioids.[24–26]

Although other multimodal pain regimens following FPMRS have decreased perioperative opioid requirements, ICE-T eliminates narcotics entirely from the outpatient regimen. While the Joint Commission has indicated an inverse

TABLE 4
Visual analog pain scores, satisfaction scores, and quality of recovery scores across all time points

Variables	ICE-T (n = 30)	Standard (n = 33)	*P* value
Pain scores			
Preoperative VAS pain score, mm	0	0	1.00
PACU VAS pain score, mm	35 (0–70)	50 (30–80)	.13
Morning VAS pain score, mm	20 (10–20)	40 (20–50)	.03[a]
Difference in VAS (PACU and morning), mm	10 (−5 − 40)	10 (0–40)	.99
96 hour numerical pain score	2 (0–3)	3 (1.5–5)	.04[a]
QoR-40			
Morning QoR-40	182 (158–189)	173 (164–182)	.26
96 hour QoR-40	187 (178–190)	184 (166–192)	.29
Satisfaction scores			
Morning satisfaction	10 (8–10)	10 (8–10)	.59
96 hour numerical satisfaction	10 (8.5–10)	9 (8–10)	.18

Data are median (interquartile range) unless otherwise mentioned.

ICE-T, postoperative multimodal pain regimen of ice packs, Toradol (ketorolac), and Tylenol (acetaminophen); *PACU*, post anesthesia care unit; *QoR-40*, Quality of Recovery-40 Questionnaire; *VAS*, Visual Analog Scale.

[a] Statistically significant ($P<.05$).

Petrikovets et al. ICE-T pain regimen in vaginal pelvic surgery. Am J Obstet Gynecol 2019.

TABLE 5
Visual Analog Scale pain scores, satisfaction scores, and quality of recovery scores across all time points stratified by postanesthesia care unit VAS scores

Variables	High PACU VAS[a] (n = 32)	Low PACU VAS (n = 31)	*P* value
Pain scores			
Morning VAS pain score, mm	30 (20–55)	30 (5–50)	.18
96 hour numerical pain Score	30 (15–50)	20 (0–30)	.05
QoR-40			
Morning QoR-40	175 (159–186)	178 (165–190)	.10
96 Hour QoR-40	183 (161–191)	187 (181–190)	.11
Satisfaction scores			
Morning satisfaction	10 (8–10)	10 (9–10)	.43
96 hour numerical satisfaction	9 (7–10)	10 (9–10)	.19

Data are median (interquartile range) unless otherwise mentioned.

ICE-T, postoperative multimodal pain regimen of ice packs, Toradol (ketorolac), and Tylenol (acetaminophen); *PACU*, post anesthesia care unit; *QoR-40*, Quality of Recovery-40 Questionnaire; *VAS*, Visual Analog Scale.

[a] VAS >50 mm.

Petrikovets et al. ICE-T pain regimen in vaginal pelvic surgery. Am J Obstet Gynecol 2019.

TABLE 6
Hospitalization times, complications, and morning complaints

Variables	ICE-T (n = 30)	Standard (n = 33)	*P* value
Hospitalization times			
Time in PACU, min	124.5 ± 67.6	117.9 ± 48.2	.65
Time from surgery end to morning VAS score, h	19.05 ± 2 h	18.73 ± 2.3h	.57
Hospitalization time (PACU to discharge), h	24.1 ± 3.1 h	24.1 ± 5.4 h	.98
Postoperative complications (postoperating room to discharge)			
Atelectasis	1 (3.3)	3 (9.1)	.51
Urinary retention requiring Foley upon discharge (not related to bladder injury)	5 (16.7)	7 (21.2)	.65
Morning complaints			
Itching	0 (0.0)	2 (6.1)	.17
Drowsiness	0 (0.0)	1 (3.0)	.34
Blurred vision	0 (0.0)	0 (0.0)	—
Nausea/vomiting	14 (46.7)	18 (54.5)	.54
Dizziness	4 (13.3)	12 (36.4)	.03[a]
Headache	6 (20.0)	7 (21.2)	.91
Chest pain	0 (0.0)	0 (0.0)	—
Shortness of breath	0 (0.0)	0 (0.0)	—

Data are n (percentage) or mean ± standard deviation unless otherwise mentioned.

ICE-T, postoperative multimodal pain regimen of ice packs, Toradol (ketorolac), and Tylenol (acetaminophen); *PACU*, post-anesthesia care unit; *VAS*, Visual Analog Scale.

[a] Statistically significant ($P<.05$).

Petrikovets et al. ICE-T pain regimen in vaginal pelvic surgery. Am J Obstet Gynecol 2019.

TABLE 7
Narcotic use in oral morphine equivalents

Variables	ICE-T (n = 30)	Standard (n = 33)	*P* value
Intraoperative	48.9 ± 18.6	53.7 ± 27.1	.11
PACU	14.1 ± 3.5	17.2 ± 5.3	.42
PACU exit to discharge	2.9 ± 1.2	20.4 ± 7.6	< .001[a]
Total opioid use during postoperative course (PACU to discharge)	17.0 ± 6.4	37.6 ± 16.2	< .001[a]
Total inpatient opioid use (intraoperative to discharge)	55.7 ± 31.2	91.2 ± 38.9	< .001[a]
Patients requiring 0 narcotics (PACU exit to discharge)	21 (70%)	4 (12%)	< .001[a]

Data are n (percentage) or mean ± standard deviation unless otherwise mentioned.

ICE-T, postoperative multimodal pain regimen of ice packs, Toradol (ketorolac), and Tylenol (acetaminophen); *PACU*, post-anesthesia care unit.

[a] Statistically significant ($P<.05$).

Petrikovets et al. ICE-T pain regimen in vaginal pelvic surgery. Am J Obstet Gynecol 2019.

relationship between narcotic use and patient satisfaction, we did not see this trend as satisfaction was high in both groups.[27] Similarly, both groups had high global QoR-40 scores, with no significant score differences at each time interval. These findings are likely attributed to overall low pain scores, a favorable side effect profile, and a low complication rate associated with VPRS.

Although there is limited literature on pain control after VPRS, the findings in our study advance currently available data and suggest reforming the postoperative pain management approach. Swenson et al[28] determined that in patients without chronic pain who undergo minimally invasive urogynecologic surgery (including both vaginal and robotic modalities), the median number of opioids used within the first 2 weeks of surgery was 13 tablets of acetaminophen/oxycodone, with low inpatient and outpatient pain scores.

A survey study from Mt Auburn Hospital (Cambridge, MA) that evaluated patients undergoing a variety of urogynecological surgical modalities (vaginal, abdominal, laparoscopic, and sacral neuromodulation) at a 2 week postoperative visit indicated that the median number of opioid tablets used was less than 10.[29] In a randomized, double-blind, placebo-controlled trial injecting 0.25% bupivacaine into the sacrospinous ligament for sacrospinous ligament fixations, Ferrando and Walters[23] observed VAS scores of 30-40 mm the day after surgery. In this trial, patients used about six to eight narcotic tablets 1 week after surgery, regardless of group, results that largely coincide with the low number of pain medications used in our study.

Additionally, Reagan et al[9] used a multimodal, narcotic-sparing pain regimen in a randomized trial of patients undergoing FPMRS surgery of varying modalities (vaginal, laparoscopic, and abdominal) and found that median postoperative day 1 pain scores were between 3 and 4, with no differences between the 2 pain control regimens. In the study by Reagan et al, patients were discharged home with 50 5 mg oxycodone tablets and used approximately 30 of these tablets after 1 week.[9]

Overall, the available literature largely coincides with our findings of low pain scores with limited outpatient pain medication use. In each of the aforementioned studies, patients were discharged home with narcotics, whereas the ICE-T regimen is unique in that it not only significantly limits inpatient narcotic administration but also eliminates outpatient narcotic prescriptions.

The strengths of this study include its multicenter randomized design, limiting bias and confounding. Five fellowship-trained FPMRS attending physicians and 3 FPMRS fellows assisted in performing all of the procedures at both sites. All pain regimens were standardized with minimal missing data. Furthermore, the use of validated VAS scores and QoR-40 questionnaires bolster the outcomes. This was the first study to prospectively examine a multimodal, narcotic-sparing pain control regimen in strictly vaginal reconstructive surgeries without confounding from other modalities including laparoscopic, robotic, and/or abdominal approaches.

The results of this study must be interpreted with the following limitations in mind. First, the lack of blinding introduced potential bias. Furthermore, the VAS scores, surveys, and follow-up phone calls were performed by research coordinators and a medical student. Although they were not informed about which regimen the patients received, they were also not blinded from accessing this information. During the consent process, patients were counseled in an unbiased manner and were informed that they would receive 1 of 2 postoperative pain regimens with medications and/or ice packs that are commonly used to manage patients' postsurgical pain. The nursing staff was notified that patients were in a pain control study and were asked to administer medications as per study protocols.

The generalizability of this study is limited by the inclusion and criteria. Therefore, we cannot comment on the efficacy of ICE-T for other minimally invasive modalities including the laparoscopic or robotic approach.

TABLE 8
Narcotic use in oral morphine equivalents stratified by postanesthesia care unit VAS scores

Variables	High PACU VAS[a] (n = 32)	Low PACU VAS (n = 31)	*P* value
Intraoperative	51.3 ± 27.3	41.5 ± 20.3	.11
PACU exit to discharge	21.6 ± 14.3	13.7 ± 9.8	.09
Patients requiring 0 narcotics (PACU exit to discharge)	6 (18.1)	13 (41.9)	< .001

Data are n (percentage) or mean ± standard deviation unless otherwise mentioned.

ICE-T, postoperative multimodal pain regimen of ice packs, Toradol (ketorolac), and Tylenol (acetaminophen); *PACU*, postanesthesia care unit.

[a] VAS >50 mm.

Petrikovets et al. ICE-T pain regimen in vaginal pelvic surgery. Am J Obstet Gynecol 2019.

Multiple VPRS operations were included, which may have different pain profiles. However, based on recent literature, it appears that patients undergoing various vaginal surgeries generally have similar pain scores. In a randomized setting with no significant differences between the arms, we do not believe this has a notable impact on our findings.

Also, because of the multimodal nature of ICE-T, it is difficult to identify which component of the regimen has the greatest impact on pain control. We speculate that the greatest impact on pain control may be the use of ketorolac with ice packs along with the around the clock administration of the ICE-T regimen.

Finally, this study had a short outpatient follow-up period of 96 hours to minimize patient dropout and missing data. Although patients continue to use pain medications after 96 hours after surgery, this limitation may have little impact because none of the patients requested more tablets, indicating that the prescription quantities were likely sufficient. At the 96 hour follow-up, patients were asked how many pain tablets were taken in addition to how many tablets were remaining to ensure accountability and limit recall bias.

In conclusion, the ICE-T multimodal pain regimen offers improved pain control the morning after surgery and 96 hours postoperatively compared with the standard regimen with no differences in patient satisfaction and quality of recovery. Outside anesthesiology-monitored pain control, the ICE-T regimen can significantly limit postoperative inpatient narcotic use and eliminate outpatient narcotic use in patients undergoing VPRS. ■

TABLE 9
Ninety-six hour follow-up

Variables	ICE-T (n = 29)	Standard (n = 32)	*P* value
Emergency department visit, % no	1 (3.4)	0 (0.0)	.93
Bowel movement since surgery, % yes	25 (86.2)	28 (87.5)	.86
Ketorolac or acetaminophen/oxycodone taken, n	4.9 ± 3.5	4.6 ± 5.7	.81
Acetaminophen or ibuprofen taken, n	10.7 ± 7.6	6.2 ± 5.89	.012[a]

Data are n (percentage) or mean ± standard deviation unless otherwise mentioned.

ICE-T, postoperative multimodal pain regimen of ice packs, Toradol (ketorolac), and Tylenol (acetaminophen).

[a] Statistically significant (*P*<.05).

Petrikovets et al. ICE-T pain regimen in vaginal pelvic surgery. Am J Obstet Gynecol 2019.

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