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The effect of anesthesia choice on post-operative outcomes in women undergoing exploratory laparotomy for a suspected gynecologic malignancy☆

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Abstract

Objective—To determine how anesthesia choice in women undergoing laparotomy for gynecologic malignancy affects pain control and narcotic use.

Methods—This is a retrospective study of women who underwent laparotomy for suspected gynecologic malignancy from May 2012 to January 2013. Patients were categorized into one of three groups: 1) patient controlled analgesia (PCA); 2) PCA + transversus abdominis plane block (TAP); and 3) patient-controlled epidural analgesia (PCEA). Mean narcotic use and patient reported pain scores were compared.

Results—The analysis includes 112 women (44 PCA, 30 TAP, 38 PCEA). Intraoperative factors were not different between groups with the exception of a significant difference in the rate of intra-operative complications ($p = 0.020$), with lower rates in the PCEA group. The groups differed in intravenous narcotic use in each of the first three postoperative days (day 0: $p = 0.014$; day 1: $p < 0.0001$; day 2: $p = 0.048$), with patients in the TAP group using the least on day 0 and those in the PCEA group using less on postoperative days 1 and 2. In addition, the PCEA group reported lower pain scores on postoperative days 1 and 2 (day 1: $p = 0.046$; day 2: $p = 0.008$).

Conclusions—The use of patient controlled epidural anesthesia after laparotomy for gynecologic malignancy is associated with decreased IV and PO narcotic use and improved pain control without increasing complications or length of hospital stay. Further investigation with prospective randomized trials is warranted to elucidate the optimal post-operative pain management technique.

Keywords

Regional anesthesia; TAP blocks; Pain control; Laparotomy

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Introduction

Optimizing postoperative pain control has been shown to improve surgical outcomes [1,2]. Traditional use of systemic opioids provides effective pain relief but is associated with undesired side effects including nausea and delayed recovery of bowel function which are detrimental to global recovery. Recent reports suggest that regional anesthetic techniques such as the epidural and transversus abdominus plane (TAP) blocks may provide effective analgesia without the deleterious systemic effects of narcotic medications. Several meta-analyses of epidural use suggest its superiority to traditional intravenous opioid administration in terms of post-operative analgesia for patients undergoing a laparotomy or thoracotomy [3,4]. Whether these findings can be extrapolated to the gynecologic cancer population, whose surgical complexity and baseline physiologic characteristics may be less favorable to rapid recovery, remains uncertain with data to date demonstrating conflicting results with regard to pain control and return of bowel function [5–7].

TAP blocks, which act distal to the central nervous system but proximal to the surgical wound, were first described in 2001 and have been shown to be effective in many surgical settings [8]. The TAP block is performed by injection of a long acting local anesthetic into the neurovascular plane of the abdominal musculature. A recent meta-analysis showed that the use of TAP blocks resulted in decreased morphine use after 24 h and increased time to first request for additional analgesia in a wide variety of surgeries including laparoscopic cholecystectomy, cesarean section through a Pfannenstiel incision, total abdominal hysterectomy and large bowel resection through a vertical midline incision [9]. However, two randomized controlled trials showed no improvement in pain scores or narcotic use with the use of TAP block or On-Q local anesthetic pump in gynecologic oncology patients [10,11]. The goal of the current study is to compare pain control in women undergoing laparotomy for potential gynecologic malignancy using three different modes of postoperative analgesia.

Materials and methods

We performed a retrospective chart review of gynecologic oncology patients at the University of Minnesota Medical Center. Institutional Review Board approval was obtained prior to data collection. All patients undergoing laparotomy via a vertical midline abdominal incision for a known or suspected gynecologic malignancy were identified using the surgical database for the gynecologic oncology department from May 2012 to January 2013. This time frame was used due to the introduction and wide use of TAP blocks during this period. Patients were categorized into one of three groups based on the type of analgesia used in the postoperative setting: 1) patient-controlled intravenous analgesia alone (PCA group) with a basal rate only for those on chronic opioids and demand dosesasneeded;2) patient-controlled intravenous analgesia + transversus abdominus pain block (TAP group); and 3) patient-controlled epidural anesthesia (PCEA group). Patients were grouped according to the first analgesia method used post-operatively, even if it was later determined to be non-functional and/or had to be changed. All epidural catheters and TAP blocks were placed by a dedicated regional anesthesia team in the pre-operative area. This same team was responsible for the management and subsequent removal of all indwelling catheters in the post-operative

period. Based on the half-life of liposomal bupivacaine the TAP blocks are estimated to last approximately 55–72 h. For PCA management it is our practice to order a basal rate for any patient who is on opiates long term. For those patients who are opiate naïve it is not standard to order a basal rate for a PCA. Our dedicated regional anesthesia team uses 0.125% or 0.0625% bupivacaine with dilaudid 3–6 mcg/ml in the epidural and this is titrated up or down as appropriate based on patient side effects and pain scores, however there could be some variation based on patient medical history.

Medical records were reviewed for demographic data, surgical information, prior narcotic use, postoperative pain scores, postoperative narcotic use and any complications. Surgical procedures were classified into 1 of 4 groups based on type of surgery performed 1) <TAH:no hysterectomy or debulking (e.g. adnexal procedure),2) TAH: hysterectomy +/− adnexal procedure, 3) Debulking: any staging (omentectomy, lymph node dissection, peritoneal biopsies) or tumor debulking beyond hysterectomy/salpingo-oophorectomy, excluding bowel surgery, and 4) Bowel surgery: any small or large bowel procedure. Pain scores and narcotic use during hospitalization were the primary outcomes of interest. Pain scores were recorded multiple times each day and mean pain score was calculated for each postoperative day. Pain scores are recorded with vital signs which are standardly recorded every 2 h for two readings, then every 4 h for two more readings and then every shift for the remainder of their hospital stay pending any changes due to patient status. Narcotic use was calculated from any systemic (intravenous or oral) narcotics that were utilized by the patients but did not include any narcotics given through the epidural.

Demographic and clinical characteristics were summarized by group using descriptive statistics. The relationship between pain management method and intra-operative complications (yes/no) was assessed using Chi-squared and Fisher's exact tests as appropriate. The effect of pain management method on systemic narcotic use (morphine equivalents in milligrams), average reported pain score for postoperative days 0, 1 and2 (0–10 on the visual analog scale) along with the length of the surgery (minutes) was analyzed using Wilcoxon two-sample two-sided tests. The effect of pain management method on the length of the post-surgical hospital stay (number of days) was assessed using Poisson regression, adjusting for over-dispersion. Experience of intra- or post-operative complications and age at time of surgery were also considered in regression models. All statistical analyses were performed using SAS 9.3 (SAS Institute, Cary, NC) and p-values of <0.05 were considered statistically significant. Analysis was by intention to treat.

Results

A total of 112 patients met the inclusion criteria. Group distribution by primary post-operative pain control method was 44 (39.3%) PCA, 30 (26.8%) TAP and 38 (33.9%) PCEA. Ten patients (26%) in the PCEA group were unable to achieve adequate pain control and were thus switched to a PCA; per intention to treat analysis, these patients were analyzed in the PCEA group. None of the patients in the PCA or TAP groups subsequently had epidurals placed. Patients in all three groups had high rates of the expected medical co-morbidities of the gynecologic oncology population including diabetes, hypertension, and obesity, with a mean BMI of 30.4 kg/m^2 for the entire study population. Groups were

generally well balanced for studied baseline factors with no statistically significant differences in age, body mass index (BMI), rates of pre-operative narcotic use, diabetes, obstructive sleep apnea or final surgical pathology (benign or malignant) between the three groups (Table 1). There were more patients with hypertension in the PCA group ($p = 0.018$).

Surgical procedures, length of surgery and estimated blood loss were similar across the groups. Eighty five percent of the laparotomy incisions extended above the umbilicus, and this was not statistically significantly different between groups. There were 6 patients in the PCA group, 4 patients in the TAP group and 2 patients in the PCEA group for which it is unknown if their incision extended above the umbilicus. We recorded any intra-operative complications that occurred, however there were only urinary tract injuries and transfusions that occurred. In-traoperative complication rates were significantly different by group (Table 2). In particular, the PCEA group did not require any blood transfusions whereas 13.6% and 10% of those in the PCA and TAP groups, respectively, were transfused at least one unit of packed red blood cells ($p = 0.043$). There were no complications attributed to the placement of the epidural catheters or TAP blocks.

On postoperative day 0 (day of surgery), use of systemic narcotic pain medication (morphine equivalents in milligrams) was significantly different by group ($p = 0.014$), with those in the TAP group using less than those in the PCA and PCEA groups, though all three reported similar pain scores (Table 3). On postoperative days 1 and 2 there were also significant differences in pain ($p = 0.046$ and $p = 0.008$) and systemic narcotic pain medication use ($p < 0.0001$, $p = 0.048$) by group, with those in the PCEA group reporting lower pain scores and using less systemic narcotic pain medication.

The proportion of patients experiencing postoperative complications was not significantly different between groups (Table 4). Only one patient developed hypotension in the PCA group, compared to none in the TAP or PCEA groups. The fact that 46% of patients in the PCEA group were hypertensive at baseline could account for the lack of postoperative hypotension seen in this group. We also find that hypotension is avoided in this patient population due to the responsiveness of our dedicated regional anesthesia team. There was no difference in the rates of postoperative ileus or urinary retention. After adjusting for age and complications arising both intra- and post-operatively, there was a borderline significant difference in length of hospital stay by group ($p = 0.071$), with those in the TAP group having the longest stay and those in the PCA group having the shortest (TAP 5.7 days, PCEA 5.0 days, PCA 4.1 days).

Discussion

In our study, PCEA for postoperative pain management after laparotomy was associated with decreased patient reported pain scores as well as total narcotic use on postoperative days 1 and 2 without leading to increased complications or increased hospital stay. The finding of improved pain control with PCEA is consistent with other published studies in gynecologic oncology [12,13]. In contrast, a prospective cohort study in gynecologic oncology patients found no difference in pain control between PCEA and intravenous analgesia and showed that PCEA users required more supplemental pain medications and

were also more likely to receive a blood transfusion [7]. These discrepant findings could be due to the fact that in this study a statistically significantly higher proportion of patients undergoing cancer staging or debulking surgery used PCEA (57%) compared to patients undergoing benign gynecologic surgery (36%).

In our study, 13.4% of patients developed a postoperative ileus, with no difference in postoperative ileus rates in the PCEA or TAP groups compared to the PCA group. A randomized-controlled trial of 153 patients also showed no difference in postoperative nausea or ileus rate between the PCEA and PCA groups [6]. With ileus rates of only 10–15%, it is difficult to determine if the lack of a difference is due to the more radical nature of gynecologic oncology surgery compared to benign surgical procedures or if these studies just lack the power to detect a difference. Two meta-analyses have concluded that regional epidural anesthetic provides superior pain control compared to systemic opioids with decreased nausea and vomiting in at least some subgroups of patients [3,4]. A prospective study of 68 patients undergoing hysterectomy for cancer showed a faster return of bowel function in patients receiving PCEA, measured by time to removal of routinely-placed nasogastric tube and time to tolerance of solid food, however, no difference in rate of postoperative ileus [5].

In our study, TAP block with PCA reduced narcotic pain medication use only on postoperative day 0, with no difference in mean pain score. Our data supports the conclusion of two previous randomized controlled trials of gynecologic oncology patients which showed no decrease in pain scores or narcotic use with the addition of TAP blocks to traditional postoperative pain management [10,11]. Further, the addition of TAP blocks in our study was associated with a trend toward a longer length of stay. Possible explanations for the discrepancy of our findings with outcomes in the current literature include the nature of the surgical incision and extent of surgery. The studies in the gynecologic literature which have shown decreased opioid use and shorter hospital stays are studies of patients undergoing hysterectomy for benign indications [14–16]. The patients in these studies had either a low-transverse incision or laparoscopic surgery, while all of the patients in our study had a vertical midline abdominal incision, most of them extending above the umbilicus. With a vertical incision, the baseline pain management requirements and the number of affected neural units are likely different and possibly inadequately addressed with TAP blockade. This hypothesis is supported by the lack of improved pain control reported by Griffiths et al., in which most patients had surgery via a vertical midline abdominal incision [10].

To date there is one small retrospective study comparing TAP blocks to epidurals [17]. This study of 30 patients showed no difference in pain scores and increased IV fentanyl use in the TAP group. Our retrospective study showed similar results, with decreased narcotic use in the PCEA group compared to the TAP group. We were also able to demonstrate improved pain scores postoperative days 1 and 2 in the PCEA group compared to both the PCA and TAP groups.

This is one of the first studies to compare three different modalities of postoperative analgesia in the gynecologic oncology population. Our study includes a representative

sample of the types of patients and conditions treated by a university based gynecologic oncology practice. The limitations of our study are typical of retrospective studies. There was no randomization or stratification of patients and postoperative pain regimen was chosen by the patient with influence from the surgeon and the anesthesia team, potentially biasing the results. We were not able to control for the combination of drugs or infusion rates used within each of the modalities and this may influence the results. We did find a statistically significant difference in the rate of intraoperative complications between groups, with the lowest rate of complications in the PCEA group. This may indicate increased complexity of the surgical procedures in the TAP and PCA groups, which may also contribute to the higher systemic narcotic use in these groups. Additionally, the small number of patients in each group precludes the ability to detect subtle differences in efficacy between the treatments.

In conclusion, our study shows a decrease in systemic narcotic use on the day of surgery when the TAP block is added to PCA, however, this does not continue into the next two postoperative days. Review of the literature shows that this may be due to a difference in the type of surgical incision. While our data does not support the use of TAP blocks in patients undergoing laparotomy via a vertical midline abdominal incision, this method of pain management could be further explored for gynecologic oncology patients undergoing laparoscopic surgery. Compared to PCA with or without a TAP block, pain control on postoperative days 1 and 2 is improved with the use of PCEA, with decreased pain scores and decreased systemic narcotic use in gynecologic oncology patients undergoing laparotomy. The ease of which we are able to utilize both the TAP blocks and the epidurals has to do with our dedicated regional anesthesia team that helps to coordinate both the placement and the management of them on the floors. The use of a PCEA is also in line with rapid recovery programs that attempt to limit systemic opioid use to reduce associated complications and thus lead to quicker recovery times and shorter hospital stays. Based on the results from our study, we believe that the PCEA should be the preferred method of postoperative pain control in this population. Given the increased complexity of management of PCEA compared to PCA, further investigation with a prospective randomized trial is needed to determine which patient and surgical factors are associated with the greatest PCEA benefit in the gynecologic oncology patient population. Further investigation with a prospective randomized trial is needed to confirm superiority of PCEA compared to PCA in the gynecologic oncology patient population.

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Highlights

- PCEA in gynecologic oncology patients undergoing laparotomy is associated with decreased narcotic use and pain scores.
- TAP blocks are associated with decreased narcotic use on the day of surgery, but not on posmiddle days 2–3.

Table 1

Patient demographic and clinical characteristics at time of surgery.

Variable	Overall (N = 112)	PCA (N = 44)	TAP (N = 30)	PCEA (N = 38)	P-value
	n (%)	n (%)	n (%)	n (%)	
Narcotic use prior to surgery					0.192
No	89 (79.5)	31 (70.5)	26 (86.7)	32 (84.2)	
Yes	23 (20.5)	13 (29.6)	4 (13.3)	6 (15.8)	
Diabetes					0.865
No	90 (81.1)	36 (81.8)	25 (83.3)	29 (78.4)	
Yes	21 (18.9)	8 (18.2)	5 (16.7)	8 (21.6)	
Missing	*1(0.9)*	*0 (0.0)*	*0 (0.0)*	*1 (2.6)*	
Hypertension					**0.018**
No	55 (49.6)	15 (34.1)	20 (66.7)	20 (54.1)	
Yes	56 (50.5)	29 (65.9)	10 (33.3)	17 (46.0)	
Missing	*1 (0.9)*	*0 (0.0)*	*0 (0.0)*	*1 (2.6)*	
Obstructive sleep apnea					0.520
No	106 (95.5)	43 (97.7)	29 (96.7)	34 (91.9)	
Yes	5 (4.5)	1 (2.3)	1 (3.3)	3 (8.1)	
Missing	*1 (0.9)*	*0 (0.0)*	*0 (0.0)*	*1 (2.6)*	
Type of Surgery[a]					0.190
<TAH	11 (9.8)	5 (11.4)	5 (16.7)	1 (2.6)	
TAH	17 (15.2)	6 (13.6)	5 (16.7)	6 (15.8)	
Debulking	77 (68.8)	31 (70.5)	16 (53.3)	30 (79.0)	
Bowel surgery	7 (6.3)	2 (4.6)	4 (13.3)	1 (2.6)	
Disease type					0.699
Benign	28 (25.0)	11 (25.0)	9 (30.0)	8 (21.1)	
Malignant	84 (75.0)	33 (75.0)	21 (70.0)	30 (79.0)	
Lymph node dissection					0.478
No	80 (71.4)	30 (68.2)	24 (80.0)	26 (68.4)	
Yes	32 (28.6)	14 (31.8)	6 (20.0)	12 (31.6)	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	

Variable	Overall (N = 112)	PCA (N = 44)	TAP (N = 30)	PCEA (N = 38)	P-value
	n (%)	n (%)	n (%)	n (%)	
Age	57.8 (14.2)	59.1 (12.4)	53.9 (16.3)	59.5 (14.1)	0.201
BMI	30.4 (8.6)	31.3 (10.0)	30.1 (6.5)	29.6 (8.7)	0.652

The bold show the significant results. The italicized data reflect missing data.

1) <TAH: No hysterectomy or debulking.

2) TAH: Hysterectomy +/− adnexal procedure.

3) Debulking: Any staging (omentectomy, lymph node dissection, peritoneal biopsies) or tumor debulking beyond hysterectomy/salpingo-oophorectomy, excluding bowel surgery.

4) Bowel surgery: Any small or large bowel procedure.

[a]Patients were categorized into 4 groups based on type of surgery.

Table 2

Surgical variables.

Variable	Overall (N = 112) n (%)	PCA (N = 44) n (%)	TAP (N = 30) n (%)	PCEA (N = 38) n (%)	P-value
Complications					
Any intra-op complication	16 (14.3)	8 (18.2)	7 (23.3)	1 (2.6)	**0.020**
Transfusions	9 (8.0)	6 (13.6)	3 (10)	0 (0)	**0.043**
Urinary tract injury	2 (1.8)	1 (2.3)	0 (0)	1 (2.6)	1.00
	Median (range)	Median (range)	Median (range)	Median (range)	
Length of surgery (minutes)	218 (105–420)	224 (119–370)	208 (120–420)	223 (105–334)	0.653
Estimated blood loss	265 (20–6000)	300 (20–6000)	265 (25–1800)	250 (25–3000)	0.998

Bold data reflect significant results.

Table 3

Posmiddleerative pain scores and narcotic use.

Variable	Overall (N = 112) Median (range)	PCA (N = 44) Median (range)	TAP (N = 30) Median (range)	PCEA (N = 38) Median (range)	P-value
Day 0					
Pain score	4.8 (0–8.9)	5.1 (0–8.3)	4.9 (2.8–8.1)	4.2 (1.0–8.9)	0.292
Narcotic use[a] (mg)	11.3 (0–99)	15.3 (1–46)	6.5 (0–35)	11 (0–99)	**0.014**
Day 1					
Pain score	3.9 (1.0–9.2)	4.1 (1.0–9.2)	4.5 (1.4–7.4)	3.3 (1.4–7.4)	**0.046**
Narcotic use[a] (mg)	6.1 (0–223)	13.3 (0.3–108)	9.7 (0.3–223)	1.0 (0–47.5)	**<0.0001**
Day 2					
Pain score	4.0 (1.0–8.3)	4.0 (2.0–7.9)	4.2 (1.0–8.3)	3.0 (1.0–7.4)	**0.008**
Narcotic use[a] (mg)	2.2 (0–204)	3.3 (0–76)	3.3 (0–204)	1.2 (0–33)	**0.048**

Bold data reflect significant results.

[a]Systemic narcotic use converted to morphine-equivalents in milligrams.

Table 4

Number of patients with post-operative complications by group.

Complication	PCA N = 44 n (%)	TAP block + PCA N = 30 n (%)	PCEA N = 38 n (%)	P-value
Any complication	7 (15.9)	11 (36.7)	15 (39.3)	0.034
Ileus	4 (9.1)	5 (16.7)	6 (15.8)	0.604
Pneumonia	2 (4.5)	0 (0.0)	1 (2.6)	0.780
Stroke	1 (2.3)	0 (0.0)	1 (2.6)	1.00
Infectious	1 (2.3)	1 (3.3)	1 (2.6)	1.00
Wound complications	3 (6.8)	0 (0.0)	2 (5.3)	0.434
Hypotension	1 (2.3)	0 (0.0)	0 (0.0)	1.00
Respiratory depression	0 (0.0)	2 (6.7)	0 (0.0)	0.070
Acute renal failure	2 (4.5)	1 (3.3)	0 (0.0)	0.487
VTE	0 (0.0)	1 (3.3)	0 (0.0)	0.268
Bleeding	1 (2.3)	0 (0.0)	1 (2.6)	1.00
Narcotic overdose	0 (0.0)	0 (0.0)	1 (2.6)	0.607
Urinary retention	0 (0.0)	1 (3.3)	1 (2.6)	0.519
Epidural headache	0 (0.0)	0 (0.0)	1 (2.6)	0.607