

A novel opioid-sparing method for post-laparotomy pain management in gynaecologic oncology patients

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Dear Editor,

Midline laparotomy incisions often result in significant postoperative pain due to nociceptive stimulation of the skin, musculo-fascial layers and peritoneum. This pain can lead to tachycardia, tachypnoea, decreased intestinal motility, and stress responses such as hyperglycaemia and increased cortisol production.¹ Poor pain control contributes to prolonged hospitalisation, increased emergency visits, readmissions and reduced patient satisfaction.²

Opioids remain the cornerstone of postoperative pain management but are associated with side effects like respiratory depression, nausea, vomiting, urinary retention and paralytic ileus.³ These complications can prolong recovery, increase patient discomfort and raise healthcare costs due to delayed discharge and increased nursing care.⁴

To mitigate these challenges, multimodal analgesia—combining opioids, non-opioid drugs, and nerve blocks—has gained popularity. While single-dose nerve blocks provide limited relief, continuous local anaesthetic infusion via wound catheters has shown efficacy in multiple surgical disciplines. A systematic review of over 2000 patients demonstrated reduced pain scores and opioid use across various surgical disciplines, with decreased postoperative nausea, improved satisfaction and shorter hospital stays.⁵ In gynaecologic oncology, few studies with small cohorts have found continuous wound infusion to be effective for postoperative pain relief, with decreased opioid requirements following benign gynaecological procedures.⁶

We conducted a study to investigate whether the use of elastomeric pumps infusing peri-wound ropivacaine via preperitoneally inserted catheters helps reduce postoperative patient-controlled analgesia (PCA) opioid requirements in patients who had undergone midline laparotomy. Secondary objectives studied included evaluating opioid-related side effects, postoperative recovery parameters and

catheter-related complications. Ethics approval was granted by National Healthcare Group Domain Specific Review Board (DSRB 2019/00355).

A retrospective review was conducted on women undergoing gynaecologic oncologic surgeries via midline laparotomies at National University Hospital in Singapore from February 2017 to February 2022. Two groups were compared: 119 patients with only intravenous (IV) PCA before the introduction of preperitoneal wound catheters (PPWC) (pre-2017) and 133 patients receiving PPWC with or without PCA (2018 onwards). Ropivacaine was chosen as the local anaesthetic due to its greater safety margin, and reduced cardiac and central nervous system toxicity compared to bupivacaine.⁷ The amount and side effects of opioid usage, daily pain score, duration to ambulation, oral intake and bowel output were compared. Data analysis was performed using software R version 4.4.2 (R Foundation for Statistical Computing, Vienna, Austria).

The PPWC setup consisted of 2 Baxter Infusor (Baxter Healthcare Corporation, Illinois, US) elastomeric pumps connected to 20-gauge epidural catheters. Catheters were inserted preperitoneally on both sides of the midline incision before rectus sheath closure, using Tuohy needles placed laterally and directed towards the anterior superior iliac spine. A ropivacaine bolus (3 mg/kg, diluted to 20 mL per side) was administered, followed by continuous infusion at 5, 7 or 12 mL/hour based on clinical needs. The system remained in place until infusion completion, with top-ups if necessary. Routine oral painkillers were prescribed per pain team's and surgeon's discretion. PPWC removal involved gentle traction on the catheters.

Overall, we observed no significant differences in age, weight, ethnicity, type of surgery or cancer diagnosis between PCA and PPWC groups (Table 1). Ovarian cancer was the most common diagnosis, with hysterectomy and pelvic lymph node dissection being

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the most frequent procedure. The most common anaesthesia used in both groups were morphine, followed by fentanyl then oxycodone. All opioid dosages were converted into morphine equivalents based on World Health Organization guidelines.⁸

Mean PCA usage duration was shorter in the PPWC compared to the PCA group (1.8 versus [vs] 2.7 days). The PPWC group had a mean catheter use of 3.4 days with a 7 mL/hour infusion rate. All historical patients received IV PCA, whereas 17.3% of PPWC patients did not, and opioid consumption among PCA users was comparable between both groups in terms of milligrams per kilogram of body weight each day after surgery for the first 72 hours postoperatively. In spite of that, pain scores at rest and during movement were similar, confirming PPWC's non-inferiority to PCA. No catheter-related complications were reported.

A multivariate regression model confirmed that those with PPWC required lower opioid doses, similar to existing literature. Older patients required more

opioids, consistent with previous studies reporting prolonged pain and opioid needs in this population, likely due to prolonged tissue damage, slower wound healing, hyperalgesia and inflammation in older individuals.⁹ This finding suggests that older patients may benefit from combining IV PCA and PPWC for improved pain control.

In terms of postoperative recovery, there were no significant differences in time to ambulation and bowel function. Opioid-related side effects such as nausea, vomiting and ileus were also similar (27–31%). This is likely due to Enhanced Recovery After Surgery protocol applied to all our gynaecology oncology patients. Routine post-laparotomy care included routine antiemetic medications, and ambulatory and chest physiotherapy, standardising the time to ambulation. However, PPWC patients had longer times to oral intake (1.78 vs 1.40 days; $P=0.002$) and hospital stays (5.74 vs 4.89 days; $P=0.01$). Further analysis is necessary to clarify these findings. Possible

Table 1. Demographics of patients who received PPWC versus PCA only.

Demographics	PPWC (n=133)	PCA only (n=119)	P value
Median age (range), years	60 (28–90)	56 (25–84)	0.14
Median weight (range), kg	59 (35–126)	59 (30–93)	0.70
Ethnicity, no. (%)			
Chinese	88 (66.2)	71 (59.7)	0.30
Malay	17 (12.8)	19 (16.0)	
Indian	10 (0.08)	5 (0.04)	
Others	18 (0.14)	24 (20.2)	
Diagnosis, no. (%)			
Ovarian cancer	95 (71.4)	81 (68.1)	0.18
Endometrial cancer	23 (12.3)	19 (16.0)	
Cervical cancer	3 (0.02)	10 (0.08)	
Others	12 (0.09)	9 (0.08)	
Type of surgery, no. (%)			
THBSO +/- PLND	105 (78.9)	102 (85.7)	0.32
THBSO + PLND + bowel resection	21 (15.8)	14 (11.8)	
THBSO + PLND + other organ resection	7 (0.05)	3 (0.03)	
Mean duration of surgery (range), hour	3.9 (1.92–8.73)	3.3 (1.3–9.8)	1.2×10^{-5}
Previous abdominal surgery, no. (%)	31 (23.3)	25 (21.0)	0.77

PCA: patient-controlled analgesia; PLND: pelvic lymph node dissection; PPWC: preperitoneal wound catheters; THBSO: total abdominal hysterectomy and bilateral salpingo-oophorectomy
P values were obtained with chi-square test for all variables.

selection bias exists, as surgeons might have used PPWC in more complex surgeries or adopted more conservative postoperative care for such cases.

To our knowledge, our study is the first local investigation of PPWC for local anaesthesia infusion in gynaecologic oncology cases, describing its unique system. The PPWC system is a continuous wound instillation system, providing uninterrupted analgesia compared to single-dose injections or PCA systems, which deliver local anaesthesia only on demand. The PPWC setup is easy to use and portable. The Baxter Infusor elastomeric pumps are disposable, allow for adjustable infusion rates and have a capacity of 300 mL, and are thus not only lightweight but sufficient for approximately 2 days, covering the peak postoperative pain period. Removal is simple, and complications were minimal. Accurate preperitoneal catheter placement is ensured before closing the rectus sheath, which allows for effective analgesia by blocking afferent nerve transmission, which is potentially superior to subcutaneous placement.¹⁰ However, our study limitations include its retrospective design, potential selection bias and uniform infusion rates not reflecting individualised pain needs.

In conclusion, PPWC is a novel, effective method for postoperative pain relief in gynaecologic oncology patients undergoing midline laparotomy. It reduces opioid use, and is also safe, cost-effective and easy to administer. Prospective studies comparing PPWC to IV PCA are recommended to validate these findings.

Ethics statement

Ethics approval was granted by National Healthcare Group Domain Specific Review Board (DSRB 2019/00355).

Declaration

The authors declare they have no affiliations or financial involvement with any commercial organisation with a direct financial interest in the subject or materials discussed in the manuscript.

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