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Variation in prescribing for the prevention of postoperative nausea, vomiting, and pain following abdominal surgery: A retrospective study

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Abstract

Background and Aims: Adequate postoperative analgesia and prevention of post-op nausea and vomiting (PONV) are core components of modern day anaesthesia and peri-operative care. As well as contributing to overall morbidity, postoperative pain and PONV are frequently cited as one of the most unpleasant and distressing aspects of surgery for patients. Variation in healthcare delivery is known to exist but has often been poorly described. A first step to understanding the consequences of variation is to describe the extent of variation. We aimed to assess variation in pharmacological strategies to prevent postoperative pain, nausea and vomiting in patients undergoing elective major abdominal surgery at a tertiary hospital in Perth, Western Australia, over a three-month period.

Methods: Retrospective cross-sectional study.

Results: We observed considerable variation in prescribing of postoperative analgesia and PONV prophylaxis and suggest that despite adequate evidence based guidelines, they are often overlooked in practice.

Conclusion: Measurement of the consequences of variation requires randomised clinical trials that evaluate differences in outcome and cost, associated with the strategies that exist within the spectrum of variation.

KEYWORDS

anesthesia, critical care medicine, healthcare management, surgery

1 | INTRODUCTION

The provision of optimal perioperative care can reasonably be expected to improve patient outcomes, including speed of recovery, and reduce hospital length of stay and cost. Adequate analgesia and prevention of postoperative nausea and vomiting (PONV) are important aspects of perioperative care and are considered to be patient-centered outcomes after surgery.[1] Hospital administrators report that these issues are among the most common complaints received from patients.[2]

Healthcare variation is defined by the Australian Commission on Safety and Quality in Health Care as a difference in healthcare processes or outcomes, compared to peers or to a gold standard such as an evidence-based guideline recommendation.[3] Many practice guidelines on analgesia and the prevention and treatment of PONV exist, including

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procedure-specific recommendations.[4] Measuring variation in healthcare is important because variation either reflects the lack of implementation of evidence-based guidelines or deficiency of evidence, or both. Where there is variation in care, in the absence of evidence, the documentation of variation serves to identify the need for the generation of high-quality evidence, with trials evaluating different options from within the spectrum of standard care.

Our primary objective was to assess variation in the prescribing of postoperative analgesia and PONV treatments in patients undergoing elective major abdominal surgery at a tertiary private hospital in Perth, Western Australia. A secondary objective was to determine if the variation was occurring in the presence or absence of sufficient evidence to guide practice.

2 | METHODS

A retrospective, cross-sectional study was conducted. Ethical approval was granted by the St John of God Healthcare Human Research Ethics Committee (Reference #1770). The study was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (*STROBE*) Statement: *guidelines* for reporting observational studies. Operating theater lists of all elective major abdominal surgery cases performed at St John of God Subiaco Hospital between September 1, 2020 and November 30, 2020 were generated by the hospital's computer system (WebPAS), including general and colorectal surgery, gynecology, gynecological oncology, and urology cases. Study inclusion criteria were age over 18 years, and elective abdominal laparoscopy or laparotomy lasting greater than 60 min. Patients undergoing emergency or day-case surgery, or with a pre-existing chronic pain syndrome and/or chronic opioid use, were excluded.

Data were extracted from medical records by two resident medical officers (S. M. K. and M. Q.) and recorded in a Microsoft Excel 2010 spreadsheet. Participants were assigned a unique number and the data collected were stored with the unique number. No participant identifiers were held. Data were analyzed using SPSS V25 (IBM Corp.). Continuous scale variables were described using mean, median, and standard deviation, and categorical variables were described using frequency and percent. Ninety-five percent confidence intervals for proportions were derived using the online calculator Epitools (reference: Sergeant, ESG, 2018. Epitools Epidemiological Calculators. Ausvet; available at: http://epitools.ausvet.com.au.) All authors have read and approved the final version of the manuscript. The first and senior authors (S. M. K. and P. A. C.) had full access to all the data in this study and take complete responsibility for the integrity of the data and the accuracy of the data analysis.

3 | RESULTS

During the study period, 450 participants underwent elective major abdominal surgery and met the inclusion criteria. The mean age was 54 years (SD: 15.6). Eighty-nine percent of patients had at least one comorbidity with 82.6% having an ASA (American Society of Anesthesiology) score of 2 or 3 (Table 1). Three-hundred forty-four surgeries were minimally invasive (76.4%). The three most common procedures performed were laparoscopic total hysterectomies (14.9%), laparoscopic sleeve gastrectomies (14.9%), and robotic radical prostatectomies (17.8%).

3.1 | Intraoperative analgesic regimen

All patients had a multimodal intraoperative analgesic regimen comprising simple analgesics and opioid-based analgesics (Table 2). Regional anesthesia was less common with 55 patients undergoing regional nerve block (12%), 13 patients undergoing spinal block (2.9%), and only 9 patients receiving an epidural (2%). There was considerable variation in those who received nonsteroidal anti-inflammatory drugs (NSAIDs) (59%) intraoperatively and those who received paracetamol (65%). Further, 26% of patients received ketamine and 43% received morphine. Notably, 14% of patients received a lignocaine infusion.

3.2 | Intraoperative antiemetic regimen

Table 2 shows that 374 patients (82%) had dexamethasone at induction and 156 (34.7%) patients had propofol total intravenous anesthesia (TIVA). Table 2 shows that 374 patients (82%) had dexamethasone at induction and 156 (34.7%) patients had propofol TIVA. The remaining patients were anesthetized with gas. The number and combination of antiemetics given intraoperatively varied considerably with 9% of patients receiving no antiemetic and 35% receiving granisetron (Table 2).

3.3 | Postoperative analgesia

Approximately one-third of patients were prescribed one regular analgesic, one-third were prescribed two regular analgesics, and 27% were prescribed three regular analgesics (Table 3). Sixty-seven percent of patients were prescribed two “as-required” (prn) analgesics, in addition to other methods such as patient-controlled analgesia, ketamine infusions, or regional anesthesia (Table 4). Table 4 shows marked variation in the prescribing of NSAIDs (48% prescribed) and tapentadol (32% prescribed).

3.4 | Postoperative antiemetic regimen

Table 4 shows that ondansetron was the most common antiemetic prescribed postoperatively (89% of patients), followed by cyclizine (68% of patients) and finally droperidol (49% of patients). It was noted that where multiple antiemetics were prescribed postoperatively, there was seldom any instruction to ward staff in what order to administer these medications when required.

TABLE 1 Characteristics of 450 participants undergoing elective major abdominal surgery at SJOG Subiaco Hospital between September 1, 2020 and November 30, 2020.

Continuous scale variables	Mean (SD)	Median (IQR)	Minimum	Maximum
Age	54.0 (15.6)	55 (24)	20	94
BMI	30.1 (7.7)	28.3 (8)	18	69
Procedure duration (min)	122.3 (56.6)	104 (82)	61	355
Length of hospital stay (days)	2.9 (3.3)	2 (2)	0	47
Categorical variables				***n* (%)**
ASA score				
1				65 (14.4)
2				226 (50.2)
3				146 (32.4)
4				12 (2.7)
Not recorded				1 (0.2)
Total				450 (100.0)
Comorbidity				401 (89.1)
Surgical procedure				
Hysterectomy				79 (17.6)
Sacrocolpopexy ± vaginal repair				6 (1.3)
Excision of endometriosis				16 (3.6)
Gynecologic laparoscopy				14 (3.1)
Staging for gynecologic cancer				4 (0.9)
Radical hysterectomy				2 (0.4)
Mesh incisional hernia repair				20 (4.4)
Hiatus hernia repair				15 (3.3)
Cholecystectomy				32 (7.1)
Sleeve gastrectomy				69 (15.3)
Gastric bypass				8 (1.8)
Small bowel resection				5 (1.1)
Right hemicolectomy				8 (1.8)
Formation of ileostomy				5 (1.1)
Removal of gastric band				5 (1.1)
Drainage of seroma				1 (0.2)
Partial hepatectomy				2 (0.4)
Laparostomy and bypass				2 (0.4)
Closure of ileostomy				2 (0.4)
Inguinal hernia repair				34 (7.6)
Left hemicolectomy				1 (0.2)
Anterior resection				9 (2.0)
Abdominoperineal resection				4 (0.9)
Rectopexy				1 (0.2)
Nephrectomy				16 (3.6)
Robotic-assisted prostatectomy				80 (17.8)
Other urologic procedures				10 (0.2)
Total				450 (100)
Surgical modality				
Minimally invasive				344 (76.4)
Laparotomy				106 (23.6)
Total				450 (100%)

Abbreviations: ASA, American Society of Anesthesiology; BMI, body mass index; IQR, interquartile range; SJOG, St John of God Subiaco Hospital.

3.5 | Subgroup analyses by type of procedure

We investigated prescribing of postoperative analgesia and PONV prophylaxis in patients undergoing total hysterectomy, sleeve gastrectomy, and robotic-assisted radical prostatectomy—the three most prevalent procedures. Marked variation in prescribing analgesia and antiemetics was demonstrated within each procedure (Supporting Information: Tables 1–12).

4 | DISCUSSION

We observed significant variation in the prescribing of analgesia and antiemetics among patients undergoing elective major abdominal surgery at our institution. The greatest variation found was in the prescribing of NSAIDS, paracetamol, morphine, ketamine, propofol TIVA, and the number of medications/combinations in the postop analgesia and antiemetic regimens. This large variation in prescribing practices was also seen when specific procedures were examined, such as laparoscopic hysterectomies/sleeve gastrectomies and robotic prostatectomies (Supporting Information: Tables). Therefore, procedure-related variation does not provide an explanation for the large variation seen. Many high-quality, evidence-based guidelines exist to aid decision-making when choosing perioperative analgesia and antiemetic regimens.[5,6] It is, therefore, a pertinent question as to why such variation was observed and what are the potential consequences, if any?

Variation in prescribing practices has been previously demonstrated. The LapCoGesic study examined patients undergoing elective colorectal surgery and noted significant variation in the modalities used to prevent postoperative pain.[7] A United States-based study that included 11,821 participants examined postoperative opioid prescribing practices following urologic surgery.

TABLE 2 Intraoperative analgesia and antiemetics: Whole cohort.

	n (%) [95% CI]
Intraoperative analgesia	
NSAID	264 (58.7) [54.1–63.1]
Paracetamol	293 (65.1) [60.6–69.4]
Tramadol	88 (19.6) [16.2–23.5]
Oxycodone	2 (0.4) [0.1–1.6]
Fentanyl	424 (94.2) [91.7–96.0]
Remifentanil	61 (13.6) [10.7–17.0]
Alfentanil	83 (18.4) [15.1– 2.3]
Hydromorphone/morphine	192 (42.7) [38.2–47.3]
Ketamine	118 (26.2) [22.4–30.5]
Spinal/intrathecal morphine or diamorphine	12 (2.7) [1.5–4.6]
Spinal fentanyl + bupivacaine	1 (0.2) [0.00–1.20]
Epidural	9 (2.0) [1.1–3.8]
Regional nerve block	
Transversus abdominus plane	27 (6.0) [4.2–8.6]
Ilioinguinal	14 (3.1) [1.9–5.2]
Intercostal	13 (2.9) [1.7–4.9]
Pudendal	1 (0.2) [0.00–1.20]
Lignocaine infusion	62 (13.8) [10.9–17.3]
Lignocaine bolus	71 (15.8) [12.7–19.4]
Magnesium	33 (7.3) [5.3–10.1]
Nitrous oxide	31 (6.9) [4.9–9.6]
Pethidine	2 (0.4) [0.1–1.6]
Intraoperative antiemetics	
No antiemetic	40 (8.9) [6.6–11.9]
Ondansetron	68 (15.1) [12.1–18.7]
Cyclizine	1 (0.2) [0.00–1.20]
Droperidol	32 (7.1) [5.1–9.9]
Granisetron	157 (34.9) [30.6–39.4]
Tropisetron	2 (0.4) [0.1–1.6]
Ondansetron and droperidol	37 (8.2) [6.0–11.1]
Droperidol and granisetron	42 (9.3) [7.0–12.4]
Two other antiemetics in combination	34 (7.6) [5.5–10.4]
Total	450 (100.0)
Dexamethasone at induction	371 (82.4) (78.7–85.7)
Total intravenous anesthesia with propofol	156 (34.7) (30.4–39.2)

Abbreviation: CI, confidence interval; NSAID, nonsteroidal anti-inflammatory drug.

TABLE 3 Numbers of regular and prn analgesics prescribed to postoperative patients: Whole cohort.

	n (%) [CI]
Number of regular postop analgesics prescribed	
0	6 (1.3) [0.6–2.9]
1	153 (34.0) [29.8–38.5]
2	155 (34.4) [30.2–38.9]
3	120 (26.7) [22.8–30.9]
4	15 (3.3) [2.0 –5.4]
5	1 (0.2) [0.00–1.20]
Total	450 (100)
Number of prn postop analgesics prescribed	
0	3 (0.7) [0.2–1.9]
1	46 (10.2) [7.8–13.4]
2	303 (67.3) [62.9–71.5]
3	81 (18.0) [14.7–21.8]
4	17 (3.8) [2.4–6.0]
5	0 (0.0) [0.0–0.8]
Total	450 (100.0)

Abbreviations: CI, confidence interval; prn, as-required.

This revealed that 78% of patients were prescribed opioids on discharge and it also demonstrated significant variation in prescribing patterns within and across surgical procedures. The authors concluded that there is a great need for the development of standardized opioid prescribing to safeguard against the current opioid epidemic.[8]

A combined approach is often taken when tackling PONV. Antiemetics with different mechanisms of action can be used such as antihistamines, 5-HT3 antagonists, and NK1 receptor antagonists. Other strategies include maintaining adequate hydration and avoiding opioids/inhaled anesthetics. One study among anesthesiologists in California noted considerable variation in prescribing practices for prophylaxis of PONV. It postulated that the variation observed may reflect uncertainty about the efficacy of available interventions, or differences in practitioners' clinical judgment and personal experiences about how to treat PONV given their different training backgrounds.[9]

It is recommended that institutions should have PONV management protocols that clearly outline an individuals' risk of PONV, to identify high-risk patients who may require additional prophylaxis.[10] The algorithm should also take into account the patient's choice, cost-effectiveness of the treatment at the institution, and patient's pre-existing conditions (e.g., risk of prolonged QT interval). This would allow the risks associated with antiemetic administration to be

TABLE 4 Postoperative analgesia and antiemetics prescribed: Whole cohort.

	n (%) [CI]
Postoperative analgesia	
Rectus sheath catheters	22 (4.9) [3.3–7.3]
Fentanyl PCA	92 (20.4) [17.0–24.4]
Hydromorphone PCA	11 (2.4) [1.4–4.3]
Ketamine infusion	21 (4.7) [3.1–7.0]
Paracetamol	436 (96.9) [94.8–98.1]
NSAIDs	214 (47.6) [43.0–52.2]
Tapentadol SR	143 (31.8) (27.6–36.2)
Tramadol	5 (1.1) [0.5–2.6]
Buprenorphine	13 (2.9) [1.7–4.9]
Oxycodone	12 (2.7) [1.5–4.6]
Gabapentin	1 (0.2) [0.00–1.20]
Pregabalin	41 (9.1) [6.8–12.1]
Amitriptyline	3 (0.7) [0.2–1.9]
Postoperative antiemetics	
Ondansetron	399 (88.7) [85.4–91.3]
Cyclizine	307 (68.2) [63.8–72.4]
Droperidol	219 (48.7) [44.1–53.3]
Metoclopramide	107 (23.8) [20.1–27.9]
Prochlorperazine	26 (5.8) [4.0–8.3]
Granisetron	11 (2.4) [1.4–4.3]
Dexamethasone	6 (1.3) [0.6–2.9]
Promethazine	2 (0.4) [0.1–1.6]
Domperidone	1 (0.2) [0.0–1.2]

Abbreviations: CI, confidence interval; NSAID, nonsteroidal anti-inflammatory drug; PCA, patient-controlled analgesia; SR, sustained release.

minimized while ensuring adequate treatment for high-risk patients; it likely to be the most cost-effective strategy.[11] However, recent publications concluded that there is remarkably low adherence to PONV prophylaxis guidelines, with less than half of medium-to-high-risk patients receiving the appropriate prophylaxis.[12,13] It is, therefore, not only important to ensure that protocols are implemented but also audited to ensure adherence to evidence-based guidelines.

In our study, we observed wide variation in the use of intraoperative prophylactic antiemetics and postoperative antiemetics. It was discovered that no hospital guidelines existed and no instructions were given to ward staff on which antiemetic to administer postoperatively, where multiple options were prescribed. One suggestion to tackle this problem would be to create an electronic risk stratification system that would prompt the anesthetist to record the level of risk of nausea and vomiting preoperatively and implement a decision support tool, which suggests the most appropriate antiemetic/combination. However, this system would work best where electronic medical records are widely available, which excludes Western Australia.

The reasons for the observed variation can only be subject to speculation. The hospital conducting the study is a totally specialist-delivered service that may have played a role. We postulate that the most likely reason for the variation observed is the absence of local hospital guidelines/decision support tools, meaning that practitioners may choose pharmacological agents based on availability and their own particular preferences and experiences, rather than adhering to the most recent evidence-based guidelines.

The consequences of the variation in prescribing practices observed in this study are uncertain. If all treatment options are equally effective and have equal cost, then it is reasonable to presume that there are no consequences. The consequences of the documented variation can only be established by the conduct of trials that evaluated the comparative effectiveness and cost-effectiveness of alternative strategies. It is certainly plausible that the documented variation in care is associated with markedly different patient experiences, speed and completeness of recovery, surgical and preoperative complications, duration of hospital admission and frequency of readmission, and of long-term consequences including chronic pain and opiate dependence. Even if all treatment strategies were effective, the variation is highly likely to result in differences in cost and healthcare efficiency.

Strengths of our study include the accuracy of case ascertainment from the hospital's electronic operating theater database, and data extraction of standardized variables by two clinicians. Our study has important limitations that should be acknowledged including its retrospective cross-sectional design that has a risk of selection bias and only allows assessment of prevalence. A further limitation is that the study was conducted in a single private hospital, with a limited number of anesthetists prescribing most of the medications, which may limit the generalizability of its findings. However, our results were consistent across different surgical specialities and types of abdominal procedures.

In summary, we observed substantial variation in strategies to prevent postoperative pain, nausea, and vomiting in patients undergoing elective major abdominal surgery at a private tertiary hospital in Perth, Western Australia. We suggest that further studies need to be done to discover whether such variation comes with an added morbidity and cost. We also suggest that to reduce variation in prescribing patterns and to promote adherence to guidelines that decision-based tools should be implemented to identify patients who are at high risk of postoperative nausea, vomiting, and pain, and aid procedure-specific perioperative management.

AUTHOR CONTRIBUTIONS

Sarah M. Kelly: Data curation; formal analysis; investigation; methodology; writing—original draft; writing—review and editing. **Miranda Quenby**: Data curation; investigation. **Tiranda Corcoran**: Formal analysis; visualization; writing—original draft; writing—review and editing.

Siranda Webb: Conceptualization; formal analysis; supervision; visualization; writing—original draft; writing—review and editing. **Paul A. Cohen**: Conceptualization; formal analysis; methodology; software; supervision; visualization; writing—original draft; writing—review and editing.

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CONFLICT OF INTEREST STATEMENT

P. A. Cohen declares honoraria from Seqirus and Astra Zeneca unrelated to the submitted work. The remaining authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

TRANSPARENCY STATEMENT

The senior author P. A. Cohen affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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