CAS 2025

Resident Competition Abstracts

Contents

Anesthesia workforce forecasting in rural Canada: a prospective survey of Canadian anesthesia trainees

Submission ID

22

AUTHORS

Pierik, August; Lapierre, Danielle

Department of Anesthesiology, Northern Ontario School of Medicine University/Health Sciences North, Sudbury, ON, Canada

INTRODUCTION

Over the last few decades, Canadians' access to rural surgical and obstetrical care has declined, in part due to a lack of recruitment and retention of health care providers to rural, remote and Northern Canada. Anesthesiologists, an essential resource in rural surgical services, are currently experiencing a country-wide shortage that is expected to worsen as the current workforce ages and retires,[1] with rural and remote communities most acutely affected through concurrent centralization of surgical services to urban areas.[2,3] This study aims to characterize the incoming anesthesia workforce in terms of geographical distribution and to identify factors that impact anesthesia trainees' decisions to practice outside of major city centres.

METHODS

Study design:

- We conducted a prospective quality improvement survey study which was distributed to all Canadian anesthesia trainees in the Fellow of the Royal College of Physicians of Canada (FRCPC) and Family Practice Anesthesia (FPA) programs in the 2022/2023 academic year. Resident responses were collected over a period of 6 months.

Primary outcome

- Current trainees' intention to incorporate rural practice into their future careers was directly assessed in the survey.

Associated factors

- Trainee demographics were also surveyed, which included identifying the population size of the city/town in which trainees grew up and whether it was remote or Northern. Trainees were also asked if they had experience living in a rural/remote/Northern location for greater than 1 consecutive year.
- Exposure to rural clinical experiences in medical school and residency training was also assessed.

- Motivators and deterrents pertaining to incorporating rural anesthesia practice into future career plans were elicited.

Statistical analysis

- Outcomes' associations were assessed using a series of ranked pairwise comparison tests and Chi squared tests.

RESULTS

Ninety anesthesia residents completed the survey; a response rate of 12%. Trainees who grew up in large cities (defined as a population size of > 500,000) were significantly less likely to consider incorporating non-urban work into their future practice when compared to trainees from communities of less than 20,000 (0% [confidence interval (CI), 0 to 9%] *vs* 63% [CI, 47 to 76%]; $P = 0.0002$). Family Practice Anesthesia and Northern Ontario School of Medicine (NOSM) trainees were more likely to select rural, remote, or Northern settings as their desired future practice locations compared to residents from other programs, with 91% of FPA residents intending to practice rurally (CI, 62 to 98%; $P < 0.00001$) and 81% of NOSM residents with rural practice plans (CI, 57 to 93.4%; $P = 0.00008$). The top motivating factor for rural practice among residents was rural lifestyle and the number one deterrent from rural practice identified was distance from family.

DISCUSSION

Rural, remote, and Northern Canadian settings were more likely to be selected as anticipated future practice locations by FPA and NOSM residents. Trainees who grew up in smaller communities were more likely to consider incorporating non-urban practice into their future career plans. Geographical motivators and deterrents amongst anesthesia trainees have implications for future sustainable rural anesthesia workforce planning. This study has potentially demonstrated the Canadian residency programs currently training the majority of the future Canadian rural, remote, and Northern anesthesia workforce.

REFERENCES

1. *Canadian Anesthesiologists' Society.* Shortage of anesthesiologists impacts delivery of surgical, acute and chronic pain services; 2019. Available from URL: https://www.newswire.ca/news-releases/shortage-of-anesthesiologists-impacts-delivery-of-surgical-acute-and-chronic-pain-services-872753250.html (accessed May 2025).
2. *Orser BA, Wilson CR, Rotstein AJ, et al*. Improving access to safe anesthetic care in rural and remote communities in affluent countries. Anesth Analg 2019; 129: 294–300. https://doi.org/10.1213/ane.0000000000004083
3. *Orser BA, Wilson CR, Bainbridge D*. Improving anesthesia care and pain medicine in rural Canada: nothing about us without us. Can J Anesth 2021; 68: 1731–7. https://doi.org/10.1007/s12630-021-02098-9

Development, validation, and comparison of a logistic regression model with a machine learning algorithm to predict postoperative delirium in the elderly

Submission ID

137

AUTHORS

Riviere, Raphael;[1] Niazi, Ahtsham;[1] Matava, Clyde;[1] Vazquez-Montes, Maria[2]

[1]Deptartment of Anesthesiology & Pain Medicine, University of Toronto, Toronto, ON, Canada; [2]Deptartment of Primary Health Care Sciences, University of Oxford, Oxford, UK

INTRODUCTION

Postoperative delirium (POD) complicates 20–45% of elderly patients' recovery after non-cardiac surgery, with studies suggesting up to 40% may be preventable.[1] Accurate prediction and effective treatment are essential to alleviate POD's impact and reduce expenses. Logistic regression (LR) and machine learning (ML) techniques like the Least Absolute Shrinkage Selection Operator (LASSO) and random forest (RF) offer different approaches to binary outcome prediction in large datasets.[2] Many current prediction models were built on specialty specific populations, limiting generalizability across surgical patients. Furthermore, many existing tools are cumbersome with many variables—the current American College of Surgeons Risk Calculator uses 20 predictors for 19 different outcomes (excluding delirium). Clinicians, for whom this model is intended, often find models with too many variables impractical, especially in fast-paced perioperative settings where decisions are needed in seconds. Thus, a parsimonious prediction modelling tool for POD is essential.

METHODS

A retrospective cohort study was conducted using data sourced from 685 hospitals in 2021, of North American surgical patients aged ≥ 75 (n = 61,313), who were assessed for delirium. All patients included in this study had the following criteria: had a major surgery, an anesthetic (general anesthetic, neuraxial or monitored anesthetic care), a formal assessment of delirium, and were ≥ 75 yr old. All patients under the age of 18, minor cases, cases designated as American Society of Anesthesiologists (ASA) Physical Status VI, trauma cases, transplant cases, cases involving hyperthermic intraperitoneal chemotherapy, cases requiring a return to the operating room that is related to an occurrence or complication of a prior procedure were not included. All three models were built using 10 pre-specified predictors, including age, sex, cognitive impairment, anesthetic type, and surgical factors. Adhering to EQUATOR guidelines, complete case analysis helped address missing data.[3,4] For internal validation LR and LASSO models underwent 10-fold cross-validation; the RF model was trained on 80% and tested on

20% of the 2021 data. All three models were externally validated on a separate 2022 cohort. Discrimination was evaluated using the C-statistic and calibration, graphically.

RESULTS

At model derivation there were 8,170 patients out of 61,313 diagnosed with delirium and eligible for inclusion while at validation, there were 7,394 out of 66,987. The LASSO model retained age, ASA Physical Status class, cognitive impairment, infection, operative time and case urgency as prognostic variables, generating a C-statistic of 0.77 (95% confidence interval, 0.76 to 0.78) at external validation. It also demonstrated superior calibration graphically. Calibration values regarding the slope, and calibration-in-the-large appeared most impressive for the logistic regression model although the O:E Ratio was better for the LASSO model at 0.90 (0.88 to 0.92). The LASSO model and LR model had the best C-statistic, and were identical at external validation 0.77 (0.77 to 0.78) and 0.77 (0.76 to 0.78) respectively (see Supplementary Material).

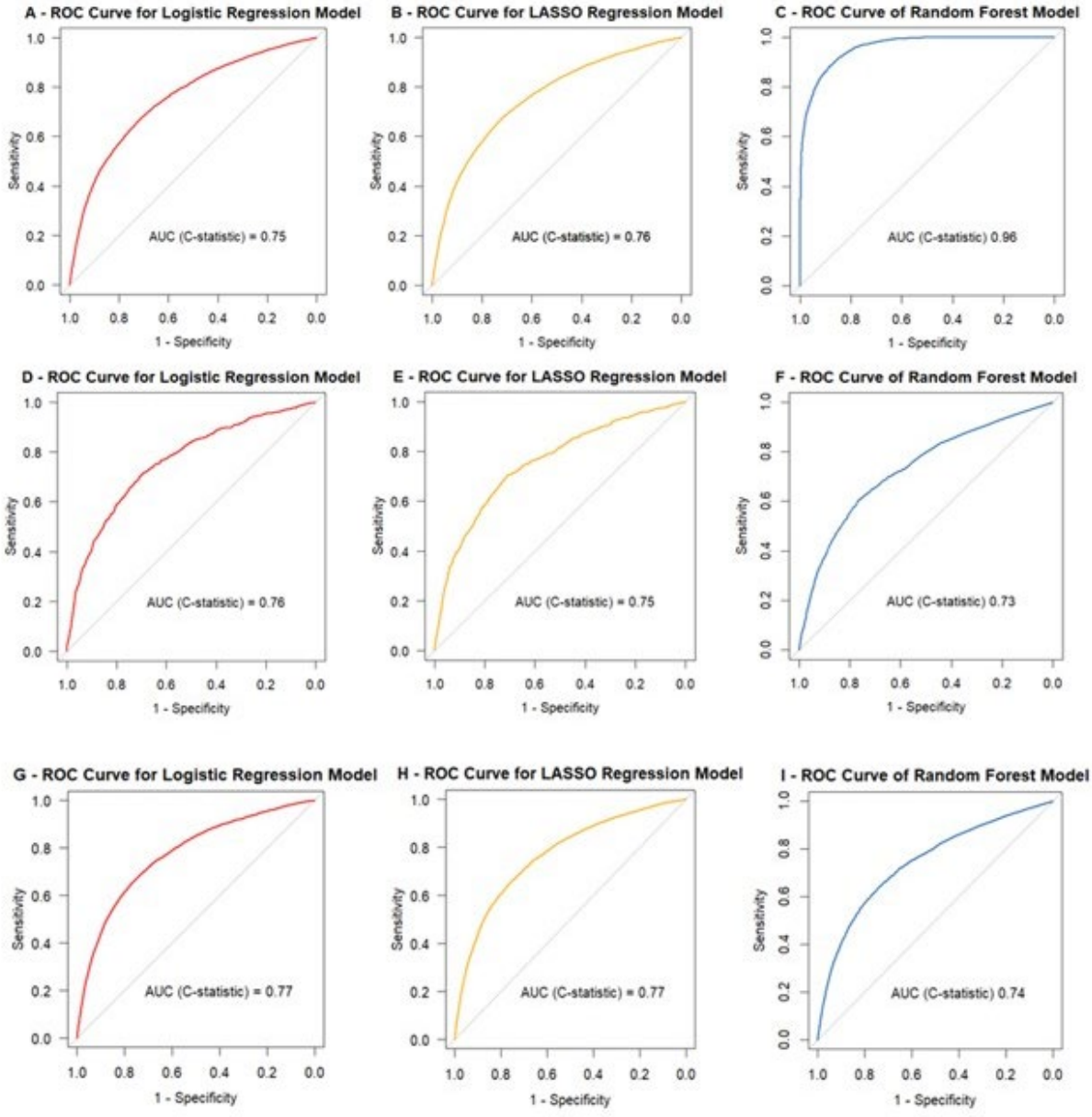
DISCUSSION

Fitting the LASSO confirms the validity of previously identified risk factors thought to have prognostic potential to predict postoperative delirium: pre-existing cognitive impairment, age, infection and markers of more severe disease. Operative duration was statistically significant given the large sample size but its contribution effectively null. Anesthetic type in most new inferential studies has not been found to be significant with logistic regression modelling. Although not designed for inference, LASSO did not retain any of the anesthetic type categories for prediction which suggests that anesthetic technique may be less important to the development of postoperative delirium, compared to other perioperative factors.

REFERENCES

1. *Bramley P, McArthur K, Blayney A, McCullagh I.* Risk factors for postoperative delirium: an umbrella review of systematic reviews. Int J Surg 2021; 93: 106063. https://doi.org/10.1016/j.ijsu.2021.106063
2. *Friedman J, Hastie T, Tibshirani R, et al.* glmnet: Lasso and Elastic-Net Regularized Generalized Linear Models. R package version 4.1-8. Available from URL: https://glmnet.stanford.edu (accessed May 2025).
3. *Collins GS, Dhiman P, Ma J, et al*. Evaluation of clinical prediction models (part 1): from development to external validation. BMJ 2024; 384: e074819. https://doi.org/10.1136/bmj-2023-074819
4. *Steyerberg EW, Vergouwe Y.* Towards better clinical prediction models: seven steps for development and an ABCD for validation. Eur Heart J 2014; 35: 1925–31. https://doi.org/10.1093/eurheartj/ehu207

Figure Receiver operator characteristic curves of all 3 models at apparent performance (Curves A, B, C) and after internal validation (Curves D, E, F), and after external validation (Curves G, H, I)



LASSO = least absolute shrinkage selection operator; ROC = receiver operator characteristic

Left upper lobectomy prior to contralateral lung surgery

Submission ID

43

AUTHORS

Poulakos, Nickolas;[1] Couture, Etienne;[2] Provencher, Steeve;[3] Gingras, Michel;[4] Michael, Stéphane;[5] Laliberté, Anne-Sophie;[6] Bussières, Jean[2]

[1]Anesthesia Department, Quebec City, Université Laval, QC, Canada; [2]Department of Anesthesiology, Quebec Heart and Lung Institute, Quebec City, QC, Canada; [3]Pulmonary Department, Quebec Heart and Lung Institute, Quebec City, QC, Canada; [4]Radiological Department, Quebec Heart and Lung Institute, QC, Canada; [5]Radiological Department, Université Laval, Quebec City, QC, Canada; [6]Thoracic Surgery Department, Quebec Heart and Lung Institute, Quebec City, QC Canada

INTRODUCTION

Following a left upper lobectomy (LUL) (Figure) for neoplasia, the discovery of a suspicious nodule in the contralateral (right) lung may justify performing a right lung surgery. This procedure requires lung isolation, most often achieved with a left double-lumen tube (L-DLT). The prior LUL causes anatomical changes in the residual left tracheobronchial tree, which can occasionally complicate the use of a L-DLT during subsequent right lung surgery. The primary objective is to evaluate the incidence of successful placement of a L-DLT for right lung surgery in patient who already had a LUL. Secondary objective is to evaluate the association between radiological measurements and occurrence of failures during L-DLT insertion following LUL.[1]

METHODS

A retrospective observational study was conducted after approval by the local ethics and research board. Patients were included if they had undergone LUL prior to right lung surgery. Success in L-DLT placement was defined as effective positioning of the L-DLT allowing adequate lung isolation to perform surgery. Failure was defined as the absence of adequate lung isolation or left lung ventilation after insertion of a L-DLT. Consequently, it was necessary to modify lung isolation technique using either right double-lumen tube[2] (R-DLT) or right bronchial blocker[3] (BB). In a subgroup of patients where a computed tomography (CT) scan preceded the right lung surgery, we performed radiological measurements of the residual tracheobronchial tree following the previous LUL. These measurements include the left tracheobronchial angle, the length of the left main bronchus, and the angle formed by the junction between the left main bronchus and the left lower lobe bronchus. In this subgroup, tracheobronchial measurements were compared between patient who had a success or failure in L-DLT placement.

Statistical analysis: The mean and standard deviation were used to describe all variables. Student's *t* test was used for comparison between the two groups: success and failure. Results were considered significant when the significance thresholds (*P* values) were ≤ 0.05.

RESULTS

Sixty patients were included and analyzed between 2000 and 2023. Success was documented in 47/60 (78%) patients and failure in 4/60 (7%) patients. In 9/60 (15%) patients, a R-DLT or BB was placed in first intention. In the subgroup of 36 patients with CT scans, there was no statistically significant difference between proposed radiological measurements between the patient who experienced success or failure in L-DLT placement.

DISCUSSION

The success rate of L-DLT placement for right lung surgery in patient who already had a LUL was 78%. None of the analyzed radiological parameters were associated with failure in L-DLT placement. In cases of failure to use a L-DLT, the right main bronchus must be instrumented by using a R-DLT or a BB.

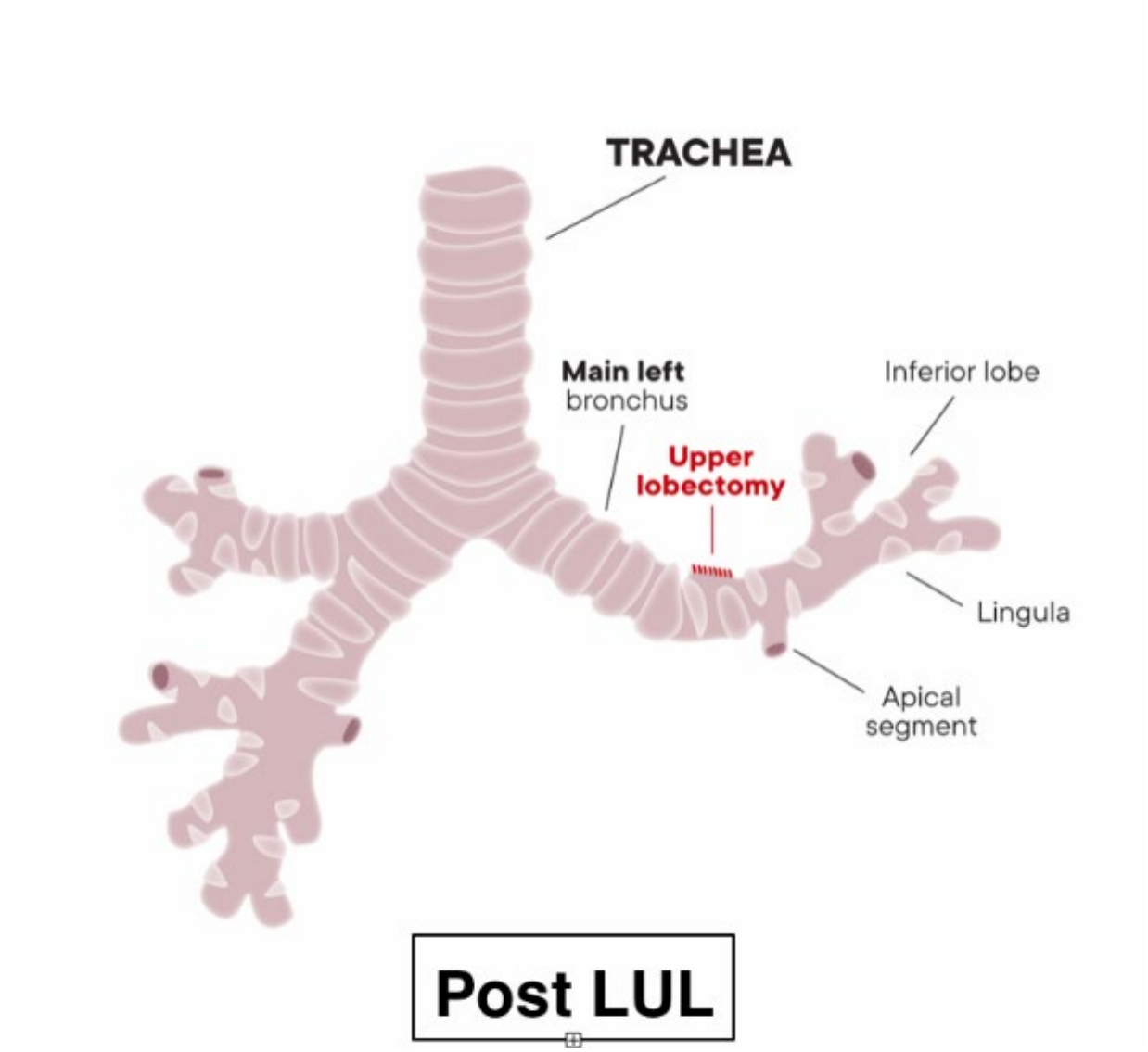
REFERENCES

1. *Kawagoe I, Hayashida M, Suzuki K, et al*. Anesthetic management of patients undergoing right lung surgery after left upper lobectomy: selection of tubes for one-lung ventilation (OLV) and oxygenation during OLV. J Cardiothorac Vasc Anesth 2016; 30: 961–6. https://doi.org/10.1053/j.jvca.2015.10.004

2. *Campos JH, Massa FC*. Is there a better right-sided tube for one-lung ventilation? A comparison of the right-sided double-lumen tube with the single-lumen tube with right-sided enclosed bronchial blocker. Anesth Analg 1998; 86: 696–700. https://doi.org/10.1097/00000539-199804000-00003

3. *Ren S, Che J, Yan H, Liu Z*. Accidental transection of bronchial blocker during thoracoscopic radical resection of lung cancer in two cases. Can J Anesth 2024; 71: 679–80. https://doi.org/10.1007/s12630-024-02712-6

Figure Tracheobronchial tree after left upper lobectomy



LUL = left upper lobectomy

Postoperative opioid consumption and pain scores after pericapsular nerve block in elective hip procedures

Submission ID

90

AUTHORS

Cojocaru, Alex;[1] Walker, Andrew;[1] Fifen, Abraham O;[2] Endersby, Ryan V. W.;[1] Fifen, Joanna J.[1*]

[1]Department of Anesthesiology, Perioperative and Pain Medicine, Cumming School of Medicine, University of Calgary, South Health Campus, Calgary, AB, Canada; [2]Department of Infection, Prevention and Control, Alberta Health Services, Calgary, AB, Canada

*Principal investigator

INTRODUCTION

In 2018–2019, over 62,000 hip replacements were performed in Canada in patients ≥ 65 yr of age with 99% of these patients requiring at least an overnight stay in hospital.[1] There are multiple regional anesthetic techniques to aid in multi-modal analgesia to reduce opioid consumption and postoperative pain in this patient population. Specifically, the pericapsular nerve group (PENG) block targets sensory branches of the obturator, accessory obturator, and femoral nerves in the anterior capsule of the hip and is thought to provide more complete analgesia by depositing local anesthetic within the myofascial plane of psoas muscle and superior pubic ramus.[2] The primary objective of our retrospective study was to examine whether PENG block reduces total opioid consumption to 48 hr after elective hip arthroplasty, hip arthroplasty revisions and Birmingham hip resurfacing procedures. We further explored if a PENG block reduced postoperative pain scores at rest and on movement.

METHODS

Ethics approval was obtained from our local research ethics board prior to chart review. This was a historical, non-blinded cohort review of patients (≥ 18 yr of age, American Society of Anesthesiologists [ASA] Physical Status score ≤ III) requiring elective hip arthroplasty (including revisions) and elective Birmingham hip resurfacing between 1 January 2018 and 30 November 2021. Patients received either PENG block preoperatively or no PENG block. All patients received spinal anesthesia for surgery. Exclusion criteria were ASA Physical Status score ≥ IV, contraindication to regional anesthesia, allergy to local anesthetics, other nerve blocks given in addition to PENG, postoperative epidural, postoperative nerve block, or bilateral procedures during the same surgery. Opioid consumption in oral morphine equivalents (mmeq) and numerical rating scale pain at rest and on movement were extracted at 6-, 12-, 24-, and 48-hr following surgery. We used linear mixed models to assess the association between PENG block intervention and cumulative opioid consumption, pain at rest and on movement to 48 hr post-

surgery. We completed two sensitivity analyses; propensity score matching using 1:1 without replacement greedy nearest neighbour matching and entropy balance weighting. Propensity scores and entropy weights were incorporated into weighted linear mixed models. Results are presented as median (IQR [min–max]) and effect size (95% confidence interval).

RESULTS

One-hundred and seventy-four and 944 procedures had a PENG or no PENG block. Of these, 120 (69.0%) and 780 (82.6%) were primary hip arthroplasties, respectively. Cumulative opioid consumption to 48 hr was 72 (44–114 [0–555]) mmeq and 60 (26–79 [0–683]) mmeq in PENG and no PENG block groups, respectively ($P < 0.001$). No difference in cumulative consumption was noted to 12 hr post-surgery. After 12 hr, there was an increase in opioid consumption in PENG block patients with significant interactions of time with intervention required at 24 ($P = 0.005$) and 48 ($P < 0.001$) hr post-surgery. Pain at rest and on movement was −0.57 − 0.91 to −0.24; $P < 0.001$) and −0.67 (−1.1 to −0.24; $P < 0.001$) points lower at 6 hr post-surgery in PENG block patients. After 6 hr, there was a relative increase in pain in PENG block patients. Results were similar with propensity score matching and entropy balance weighting.

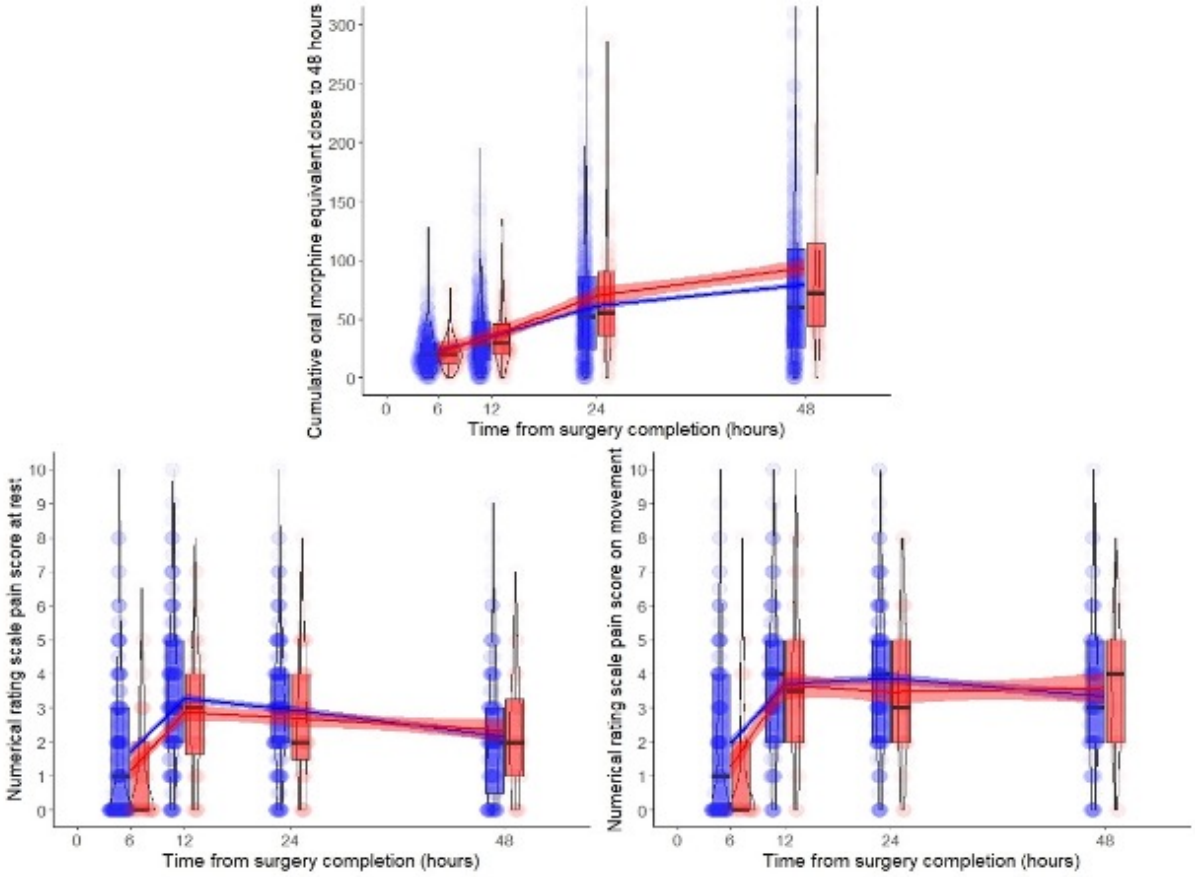
DISCUSSION

The PENG block was originally developed to provide analgesia for hip fractures.[2] Our study further expands its application to include total hip arthroplasties, hip arthroplasty revisions and Birmingham hip resurfacing. A recent systematic review and meta-analysis showed that significant reductions in pain with PENG block were restricted to < 6 hr post-surgery compared to fascia iliaca compartment blocks.[3] We show comparable results with similar pain scores between groups beyond 6 hr post-surgery. Additionally, we found increased opioid consumption beyond 12 hr post-surgery in PENG block patients. This suggests that the analgesia effect of PENG diminishes 6–12 hr post-surgery.

REFERENCES

1. *Canadian Joint Replacement Registry.* CJRR annual report: hip and knee replacements in Canada, 2018–2019; 2020. Available from URL: https://www.cihi.ca/en/cjrr-annual-report-hip-and-knee-replacements-in-canada-2018-2019 (accessed May 2025).
2. *Girón-Arango L, Peng PW, Chin KJ, Brull R, Perlas A*. Pericapsular nerve group (PENG) block for hip fracture. Reg Anesth Pain Med 2018; 43: 859–63. https://doi.org/10.1097/aap.0000000000000847
3. *Farag A, Hendi NI, Diab RA*. Does pericapsular nerve group block have limited analgesia at the initial post-operative period? Systematic review and meta-analysis. J Anesth 2023; 37: 138–53. https://doi.org/10.1007/s00540-022-03129-5

Figure Cumulative opioid consumption in oral morphine equivalents, pain at rest, and pain on movements to 48 hr post-surgery in PENG block (red) and no PENG (blue) in hip arthroplasty revisions and Birmingham hip resurfacing patients



The METEOR study: a population-based comparative effectiveness analysis of clinical and health system outcomes associated with extended-release opioid prescription after total joint arthroplasty

Submission ID

57

AUTHORS

Malone, Janna;[1] Tierney, Sarah;[1,2] McGinn, Ryan;[1] McIsaac, Daniel I.[1–4]

[1]Department of Anesthesiology and Pain Medicine, The Ottawa Hospital, Ottawa, ON, Canada; [2]Faculty of Medicine, University of Ottawa, Ottawa, ON, Canada; [3]Institute for Clinical Evaluative Sciences, Ottawa, ON, Canada; [4]Ottawa Hospital Research Institute, Ottawa, ON, Canada

INTRODUCTION

Extended-release opioids (EROs) are approved for chronic pain management but are increasingly used in acute pain settings despite documented risks, including persistent postoperative opioid use (PPOU) and opioid overdose.[1,2] Because of these potential risks, most guidelines advise against the use of EROs for acute pain. However, data describing outcomes related to ERO use by surgical patients is lacking.[3] In particular, long-term outcomes attributable to ERO use in postoperative and acute pain contexts are poorly described.[4] To advance our understanding of long-term outcomes associated with ERO prescribing, we conducted a population-based cohort study of patients undergoing hip and knee arthroplasty. Our specific objectives were to estimate the association of new post operative ERO prescription receipt with subsequent development of persistent postoperative opioid use, and other health system and clinical outcomes.

METHODS

Research ethics review was waived per provincial legislation. We conducted a population-based, historical observational cohort study in Ontario, Canada. A protocol was prespecified and registered. We identified all residents aged > 18 who underwent their first inpatient, elective total hip or knee arthroplasty (THA or TKA) from January 2013 to March 2022. Participants were excluded if they filled a prescription for an ERO or mixed opioid agonist/antagonist in the six months prior to surgery. The analytic data set was constructed from patient-level deterministic linkage of the Discharge Abstract Database (to identify surgeries), the Narcotics Monitoring System (to identify all opioid prescriptions), and others. The primary exposure was receipt of a new ERO prescription within seven days post-discharge. The primary outcome was PPOU using a consensus definition that accounted for preoperative immediate release opioid use. An alternative definition was ascertained for sensitivity analysis (PPOU1/PPOU2). Secondary outcomes were days alive at home (DAH) and total health system costs (at 365 days);

readmissions and emergency department (ED) visits at 90-days. Exposure-outcomes associations were estimated using propensity score (PS) overlap weights to adjust for postulated confounders (clustering by hospital, demographics, comorbidities, preoperative use of controlled substances, surgical and hospitalization variables). A two-sided alpha =0.05 was used.

RESULTS

An ERO prescription was filled by 31,224 (12.1%) of 258,624 total THA or TKA patients. After PS adjustment, all measured confounders were balanced (standardized difference < 0.1) between groups.

Prior to adjustment, ERO receipt was associated with greater odds of PPOU (6.0% *vs* 5.2%; odds ratio [OR], 1.16; 95% confidence interval [CI], 1.10 to 1.22); after adjustment, the association was attenuated but still significant (OR, 1.08; 95% CI, 1.01 to 1.15). The secondary PPOU definition was also associated with ERO receipt (adj-OR, 1.15; 95% CI, 1.08 to 1.22); see Table 1 for full report of primary and secondary associations.

After PS-adjustment, ERO receipt was significantly associated with higher readmission rates (adj-OR, 1.09; 95% CI, 1.02 to 1.17) and ED visits (adj-OR, 1.16; 95% CI, 1.12 to 1.21). In contrast, ERO receipt was associated with improved total health system costs (ratio of means [RoM], 0.87; 95% CI, 0.85 to 0.89) and DAH (RoM, 1.002; 95% CI, 1.0004 to 1.003).

DISCUSSION

Approximately 5% of THA and TKA patients who receive an ERO prescription after discharge develop PPOU; ERO receipt is associated with small, but consistent and statistically significant increases in PPOU. Those receiving an ERO prescription also had adjusted increases in readmission rates and ED visits, however improved health system costs and DAH were associated with ERO receipt. These complex and contrasting results suggest neither substantial harm, nor benefits, from ERO prescriptions at the patient-level. However, lacking clear associations with benefit, ERO prescribing should be carefully considered given potential impacts on the opioid ecosystem,[5] especially the pool of opioids in the community.

REFERENCES

1. *Miller M, Barber CW, Leatherman S, et al*. Prescription opioid duration of action and the risk of unintentional overdose among patients receiving opioid therapy. JAMA Intern Med 2015; 175: 608–15. https://doi.org/10.1001/jamainternmed.2014.8071

2. *Shah A, Hayes CJ, Martin BC*. Characteristics of initial prescription episodes and likelihood of long-term opioid use—United States, 2006–2015. MMWR Morb Mortal Wkly Rep 2017; 66: 265–9. https://doi.org/10.15585/mmwr.mm6610a1

3. *Clarke HA, Manoo V, Pearsall EA, et al.* Consensus statement for the prescription of pain medication at discharge after elective adult surgery. Can J Pain 2020; 4: 67–85. https://doi.org/10.1080/24740527.2020.1724775

4. *Deyo RA, Hallvik SE, Hildebran C, et al*. Association between initial opioid prescribing patterns and subsequent long term use among opioid-naïve patients: a statewide retrospective cohort study. J Gen Intern Med 2017; 32: 21–7. https://doi.org/10.1007/s11606-016-3810-3

5. *Kharasch ED, Clark JD, Adams JM*. Opioids and public health: the prescription opioid ecosystem and need for improved management. Anesthesiology 2022; 136: 10–30. https://doi.org/10.1097/aln.0000000000004065

Figure Clinical and health system outcomes with and without extended-release opioid prescription after total hip arthroplasty or total knee arthroplasty

Outcome	ERO n=31,224	No ERO n=227,400	Unadjusted relative effect* 95%CI	Adjusted relative effect* 95%CI	Adjusted absolute effect** 95%CI
PPOU 1	n=1,860 6.0%	n=11,804 5.2%	1.16 1.10 to 1.22	1.08 1.006 to 1.15	0.4% 0.03 to 0.76
PPOU 2	n=2,434 7.8%	n=15,125 6.7%	1.19 1.13 to 1.24	1.15 1.08 to 1.22	1.0% 0.55 to 1.4
DAH Mean	n=361 SD=21	n=360 SD=26	1.004 1.0032 to 1.0047	1.002 1.0004 to 1.003	53.6% 17.4 to 89.7
Costs	n=8,865 SD=14,104	n=10,454 SD=17,968	0.85 0.83 to 0.86	0.87 0.85 to 0.89	-1,381 -1,631 to -1,131
Readmission	n=1,675 5.4%	n=13,152 5.8%	0.92 0.88 to 0.97	1.09 1.02 to 1.17	0.5% 0.11 to 0.83
ED visit	n=6,421 20.6%	n=48,567 21.4%	0.95 0.93 to 0.98	1.16 1.12 to 1.20	2.4% 1.8 to 3.0

*Odds ratio: PPOU, Readmission, ED visit (logistic); ratio of means DAH (negative binomial), costs (log gamma)
**Risk difference: PPOU, Readmission, ED visit; geometric mean difference: DAH, costs

DAH = days alive at home; ED = emergency department; ERO = extended release opioid; PPOU = persistent postoperative opioid use