Journal of Clinical Anesthesia 61 (2020) 109679

Contents lists available at ScienceDirect

Journal of Clinical Anesthesia

journal homepage: www.elsevier.com/locate/jclinane

Correspondence

Oral multimodal preemptive analgesia improves postoperative pain control and decreases opioid utilization in spinal fusion patients

Spinal fusion procedures in the United States have increased at a dramatic rate over the past 20 years; from 2004 to 2015 there was a 63% increase in the number of elective lumbar fusions alone [1]. These major spine procedures are often associated with significant postoperative pain, high levels of opioid consumption, longer hospital lengths of stay, and difficulty with postoperative mobilization [2]. Inadequate pain control has been demonstrated to be a barrier to early postoperative mobilization and rehabilitation efforts, increasing hospital length of stay and leading to significant increases in the cost of care [3].

Oral multi-modal preemptive analgesia (OMPA) has been demonstrated to be superior to opioid-based regimens alone in addressing some of these postoperative challenges [4]. The aim of this study was to determine if the implementation of a standardized OMPA protocol as the first phase in the development of a Perioperative Surgical Home Model (PSHM) for spinal fusion procedures would result in improved postoperative pain control and reduce opioid utilization.

After institutional review board approval at St. Joseph Mercy Oakland Hospital, the medical records of 100 patients undergoing cervical and lumbar fusion were retrospectively reviewed. They were convenience sampled and grouped by the date of surgery before and after the implementation of the OMPA protocol to produce 4 cohorts (n = 25 for each) Cervical_Before, Lumbar_Before, Cervical_After and Lumbar_After. The data for the before and after groups were obtained from patient charts from Oct 2015 to June 2016 and Oct 2016 to June 2017, respectively. A three month grace period was used in between sample groups to ensure that our OMPA protocol had been fully implemented in the hospital. The “Before” cohorts received general anesthesia including intravenous opioid given by the anesthesia provider, and postoperative opioid management was guided by each individual surgeon. The “After” cohorts were given the standardized OMPA (which included concurrent administration of gabapentin (300 mg), celecoxib (200 mg), acetaminophen (1 g), and oxycodone (10 mg) unless contraindicated by patient allergy or intolerance), received general anesthesia with intravenous opioid, and postoperative opioid management was again guided by each individual surgeon.

Patient demographics including age, gender, weight, height, BMI, and ASA classification were analyzed to ensure similitude between compared cohorts. Both preoperative and postoperative (6Hr, 12Hr and 24Hr) verbal analog pain scores (VAS; 0, no pain to 10, worst pain imaginable), along with perioperative opioid consumption totals were collected for each patient from the electronic medical record. In cases that for a time period multiple pain scores were assessed the mean value of those assessments was reported as the pain score for that time period.

OMPA implementation resulted in statistically significant reduction in postoperative pain scores (6 and 12 h) and postoperative total opioid consumption (oral morphine equivalents, http://www.globalrph.com/narcotic.cgi) in the first 24 h after surgery stay in the hospital; there was also a significant reduction in the incidence of the administration of the antiemetic therapy (percentage of the patients) in the combined cervical and lumbar groups. There was no significant difference in the 24 h postoperative pain score. Pre-operative pain score was used as a positive control. See Table 1.

Our results show that OMPA can reduce postoperative pain in the first 12 h and decrease total opioid utilization in patients undergoing anterior cervical and posterior lumbar fusion. It is encouraging to observe both a decrease in postoperative pain and opioid consumption in these patients, especially given their increased risk for chronic pain and opioid dependence [5]. OMPA protocols can be a valuable component of multimodal clinical pathways for patients undergoing spinal fusion, and may have a positive impact upon quality and value in the development of a PSHM for spine surgery.

Declaration of competing interest

No grants, no sponsors, and no funding sources provided direct or indirect financial support to the research work contained in the manuscript. The authors have no conflict of interest to report.

https://doi.org/10.1016/j.jclinane.2019.109679
Received 13 September 2019; Received in revised form 25 October 2019; Accepted 29 November 2019
0952-8180/ © 2019 Elsevier Inc. All rights reserved.

Table 1
Primary outcome data.

	Cerv.(B)	Cerv.(A)	Lumb.(B)	Lumb.(A)	Comb.(B)	Comb.(A)
	N = 25 (M = 14, F = 11)	N = 25 (M = 16, F = 9)	N = 25 (M = 7, F = 18)	N = 25 (M = 8, F = 17)	N = 50 (M = 21, F = 29)	N = 50 (M = 24, F = 26)
Pre-op pain score						
All	4.6 ± 0.6	4.7 ± 0.4	4.7 ± 0.6	4.8 ± 0.6	4.7 ± 0.4	4.7 ± 0.4
Male	4.2 ± 0.8	4.9 ± 0.5	4.1 ± 1.6	4.6 ± 1.2	4.2 ± 0.7	4.8 ± 0.5
Female	5.2 ± 0.8	4.2 ± 0.9	4.9 ± 0.6	4.8 ± 0.7	5.0 ± 0.5	4.6 ± 0.6
6Hrs-post-op avg. pain score						
All	4.9 ± 0.4	3.5 ± 0.5[a]	5.4 ± 0.6	4.3 ± 0.6[b]	5.2 ± 0.4	3.9 ± 0.4[a]
Male	4.8 ± 0.5	3.8 ± 0.5	4.7 ± 1.3	3.0 ± 1.0	4.8 ± 0.5	3.5 ± 0.5
Female	5.1 ± 0.6	3.1 ± 1.0	5.7 ± 0.8	4.9 ± 0.7	5.5 ± 0.5	4.3 ± 0.6
12Hrs-post-op avg. pain score						
All	5.2 ± 0.5	3.4 ± 0.5[a]	5.7 ± 0.5	3.8 ± 0.7[a]	5.5 ± 0.4	3.4 ± 0.4[a]
Male	5.3 ± 0.6	3.0 ± 0.6	5.7 ± 1.0	2.1 ± 1.2	5.4 ± 0.5	2.7 ± 0.5
Female	5.2 ± 0.8	4.0 ± 1.1	5.7 ± 0.6	4.2 ± 0.9	5.5 ± 0.5	4.1 ± 0.7
24Hr-post-op avg. pain score						
All	4.7 ± 0.4	4.4 ± 0.6	5.3 ± 0.6	5.3 ± 0.4	5.0 ± 0.4	4.8 ± 0.4
Male	4.6 ± 0.4	4.2 ± 0.7	6.0 ± 1.1	5.5 ± 1.0	5.1 ± 0.5	4.6 ± 0.6
Female	4.8 ± 0.7	4.8 ± 1.1	5.0 ± 0.8	5.2 ± 0.5	4.9 ± 0.4	5.1 ± 0.5
24Hr-total opioid-oral morphine equivalent (mg)						
All	109 ± 12	92 ± 21[a]	132 ± 15	98 ± 14[a]	120 ± 9.0	95 ± 12[a]
Male	111 ± 17	111 ± 31	107 ± 25	103 ± 23	110 ± 13	108 ± 21
Female	105 ± 18	59 ± 18	141 ± 18	96 ± 18	127 ± 13	83 ± 13

Values are mean ± SD or Number (% of patients); ANOVA was used for statistical analysis. Cerv. = cervical; Lumb. = lumbar; Comb. = combined; B = before; A = after; M = male; F = female.

[a] Indicates significant difference between Before and After groups for each category (p-value < 0.05).

[b] Indicates a trend (0.05 < p-value < 0.1 significant change in a one-tail test).

References

[1] Martin B, Mirza S, Spina N, et al. Trends in lumbar fusion procedure rates and associated hospital costs for degenerative spinal diseases in the United States, 2004 to 2015. Spine 2019;44(5):369–76.

[2] Goz V, Weinreb J, McCarthy I, et al. Perioperative complications and mortality after spinal fusions. Spine 2013;38(22):1970–6.

[3] Dahl J, Gordon D, Ward S, et al. Institutionalizing pain management: the post-operative pain management quality improvement project. J Pain 2003;4:361–71.

[4] Mathiesen O, Dahl B, Thomsen B, et al. A comprehensive multimodal pain treatment reduces opioid consumption after multilevel spine surgery. Eur Spine J 2013;22(9):2089–96.

[5] Connolly J, Javed Z, Raji M, et al. Predictors of long-term opioid use following lumbar fusion surgery. Spine 2017;42(18):1405–11.

Kaveh Nabavighadi (MD)[a,b,*], Carter Batista (MD)[a,b,1], Farhad Ghoddoussi (PhD)[a,2], Nakul Kumar (MD)[c,3], Alec Aiello (BS)[a,4], Brady Reeves (BS)[a,4], Sandeep Krishnan (MD)[a,b,1], Terry Ellis II (MD)[a,d,5]

[a] *Department of Anesthesiology, Wayne State University School of Medicine, Detroit, MI, USA*

[b] *Department of Anesthesiology, St. Joseph Mercy Oakland Hospital, Pontiac, MI, USA*

[c] *Department of Anesthesiology, Cleveland Clinic, Cleveland, OH, USA*

[d] *Department of Anesthesiology, Henry Ford Allegiance Health, Jackson, MI, USA*

E-mail addresses: knabavig@med.wayne.edu (K. Nabavighadi), gl2257@wayn04e.edu (C. Batista), fghoddoussi@med.wayne.edu (F. Ghoddoussi), kumarn6@ccf.org (N. Kumar), aaiello@med.wayne.edu (A. Aiello), brady.reeves2@med.wayne.edu (B. Reeves), sakrishna@med.wayne.edu (S. Krishnan), tellis@med.wayne.edu (T. Ellis).

[*] Corresponding author at: Department of Anesthesiology, Wayne State University School of Medicine, St. Joseph Mercy Oakland Medical Office Building, 44555 Woodward Avenue, Suite 308, Pontiac, MI 48341, USA.

[1] Department of Anesthesiology, St. Joseph Mercy Oakland Hospital, St. Joseph Mercy Oakland Medical Office Building, 44555 Woodward Avenue, Suite 308, Pontiac, MI 48341, USA.

[2] Department of Anesthesiology, Wayne State University School of Medicine, University Health Center (UHC) Bldg., Section 4J, Room #28, Detroit, MI 48201, USA.

[3] Department of Anesthesiology, Center for Critical Care, Cleveland Clinic, 9500 Euclid Avenue, Cleveland, OH 44195, USA.

[4] School of Medicine, Wayne State University, 540 East Canfield, Detroit, MI 48201, USA.

[5] Department of Anesthesiology, Henry Ford Allegiance Health, 205 N East Ave, Jackson, MI 49201, USA.

Journal of Clinical Anesthesia 61 (2020) 109692

Contents lists available at ScienceDirect

Journal of Clinical Anesthesia

journal homepage: www.elsevier.com/locate/jclinane

Correspondence

Ultrasound-guided out-of-plane (OOP) adductor canal continuous catheter placement compared to in-plane (IP) placement in total knee arthroplasty: Arandomized, single blinded, pilot clinical trial

Adductor canal continuous catheters (ACCCs) have largely supplanted femoral nerve continuous catheters (FNCCs) for providing postoperative analgesia after total knee arthroplasty (TKA). They have been shown to provide similar analgesic efficacy to FNCCs, while facilitating mobility more quickly through sparing of quadriceps muscle strength [1–3]. Kurtz et al. studied the epidemiology of TKA in the United States and predicted that TKA annual volume will reach 1.37 million by 2020 and 3.48 million by 2030 [4]. As more perineural catheters are used to provide analgesia for these procedures, it is imperative that placement techniques providing superior analgesia are isolated.

In ACCC placement as with FNCC, there are two primary techniques used to perform the procedure. The saphenous nerve is most often imaged in the short axis (cross-section) because studies have shown that femoral nerve block placement takes longer when imaging in the long axis [5]; however, the provider must decide whether to use an in-plane (IP) or out-of-plane (OOP) needle-probe alignment technique. In this

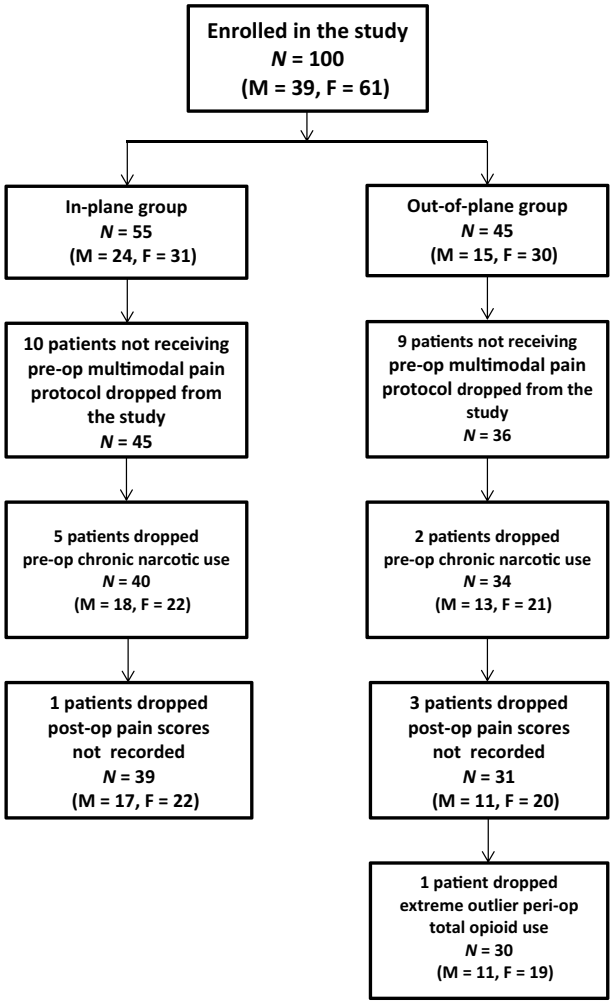

Fig. 1. Consolidated Standards of Reporting Trials (CONSORT) diagram for this study.

https://doi.org/10.1016/j.jclinane.2019.109692
Received 27 October 2019; Received in revised form 17 November 2019; Accepted 1 December 2019
0952-8180/ © 2019 Elsevier Inc. All rights reserved.

Table 1
Patient outcome and medication use.

	In-Plane (IP) $n = 39$	Out-of-Plane (OOP) $n = 30$	p-Values
Length of stay (days)			
All	1.4 ± 0.8	1.5 ± 0.7	0.649
Male	1.4 ± 0.7	1.3 ± 0.7	0.763
Female	1.4 ± 0.8	1.6 ± 0.8	0.493
Pain score (pre-Op)			
All	1.4 ± 2.0	1.5 ± 2.0	0.823
Male	1.7 ± 2.1	1.4 ± 2.6	0.755
Female	1.1 ± 1.8	1.5 ± 1.7	0.481
Pain score (post-Op, Avg)			
All	4.1 ± 1.3	1.5 ± 2.0	0.823
Male	4.0 ± 1.3	1.4 ± 2.6	0.755
Female	4.2 ± 1.3	1.5 ± 1.7	0.481
Incidence of anti-emetic drug administration			
All	35(90)	26(87)	0.720
Male	15(88)	8(72)	0.353
Female	20(91)	18(95)	1.000
Total opioid oral morphine equivalent (mg)			
All	36.1 ± 33.8	36.3 ± 36.0	0.978
Male	34.9 ± 31.4	28.6 ± 23.5	0.577
Female	37.0 ± 36.3	40.8 ± 41.5	0.759
Total acetaminophen (mg)			
All	1840 ± 1686	1714 ± 1511	0.748
Male	1691 ± 1578	1484 ± 1143	0.711
Female	1956 ± 1792	1847 ± 1703	0.844
Total Ondansetron (mg)			
All	5.0 ± 3.1	4.7 ± 2.6	0.614
Male	4.5 ± 2.4	3.6 ± 2.8	0.408
	5.5 ± 3.6	5.3 ± 2.3	0.844

Values are mean ± SD. or number (% of patients).
p value $< .05$ is considered statistically significant.
p value $0.05 < p < .1$ significant in one-tail test.

single-center, randomized, parallel-group, single-blinded trial, we compared the IP and OOP approaches for ACCC placement. We compared average post-operative pain scores, total opioid use (oral morphine equivalents), hospital length of stay (LOS), total acetaminophen administration, and incidence of anti-emetic administration.

After institutional review board approval at St. Joseph Mercy Oakland Hospital, written informed consent was obtained from 100 consecutive subjects (IP($n = 55$) and OOP($n = 45$)) undergoing TKA with ACCCs between November 2018 and August 2019. Data for 31 patients were excluded (IP($n = 39$) and OOP($n = 30$)); 19 patients were excluded for not receiving the pre-operative multimodal pain protocol (MPP), 9 were excluded for pre-operative chronic opioid use, 4 were excluded for not having recorded VAS pain scores, and 1 was excluded for excessive use of opioid analgesics post-operatively (extreme outlier for total opioid use) (See Fig. 1). Patients received four pre-operative medications as part of our institutional MPP: oral gabapentin (300 mg), oral celecoxib (200 mg), oral acetaminophen (1 g), and oral oxycodone (10 mg). Intraoperatively, spinal anesthesia with 15 mg (2 mL 0.75%) of hyperbaric bupivacaine was used as the primary anesthetic and was combined with monitored anesthesia care (propofol infusion). The patients were not given opioids during the intraoperative period. ACCCs were placed under ultrasound guidance and dosed with 30 mL of 0.25% bupivacaine and 4 mg of dexamethasone.

Patient demographics including gender, age, BMI, and ASA classification were analyzed to ensure similitude between the two groups.

The primary outcomes of the investigation were hospital length of stay (LOS), total opioid consumption (oral morphine equivalents), and average post-operative pain score. Secondary outcomes included total ondansetron consumption, total acetaminophen consumption, and incidence (percentage of patients) of anti-emetic drug use. The pre-operative pain score was used as a positive control for the study. All outcomes were analyzed as continuous variables except for the incidence of administration of anti-emetic drugs, which was treated as a categorical variable.

Our analysis showed no statistically significant difference between the IP and OOP groups for average pre-operative pain score, average post-operative pain score, total opioid consumption, total acetaminophen usage, LOS, and total ondansetron administration. There, also, was no significant association between the type of treatment patients received and the incidence of anti-emetic drug administration (Table 1).

This randomized trial found no evidence to support the superiority of either IP or OOP perineural catheter placement technique for TKA. While each technique has advantages and disadvantages, the results of this study suggest that practitioners can comfortably use whichever technique they are most familiar with or which optimally suits each clinical situation. Further research can be done to determine if the time necessary to perform the approaches differ, as well to determine if a specific method of securing perineural catheters leads to improved analgesia.

Declaration of competing interest

No grants, no sponsors, and no funding sources provided direct or indirect financial support to the research work contained in the manuscript. The authors have no conflict of interest to report.

References

[1] Shah N, Jain N. Is continuous adductor canal block better than continuous femoral nerve block after total knee arthroplasty? Effect on ambulation ability, early functional recovery and pain control: a randomized controlled trial. J Arthroplasty 2014;29(11):2224–9.
[2] Hanson N, Allen C, Hostetter L, et al. Continuous ultrasound-guided adductor canal clock for total knee arthroplasty: a randomized, double-blind trial. Anesthesia & Analgesia 2014;118:1370–7.
[3] Ellis T, Hammoud H, Dela Merced P, et al. Multimodal clinical pathway with adductor canal block decreases hospital length of stay, improves pain control, and reduces opioid consumption in total knee arthroplasty patients: a retrospective review. J Arthroplasty 2018;33:2440–8.
[4] Kurtz S, Ong K, Lau E, et al. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am 2007;89(4):780–5. Apr.
[5] Mariano E, Kim E, Funck N, et al. A randomized comparison of long-and short-axis imaging for in-plane ultrasound-guided femoral perineural catheter insertion. J Ultrasound in Med 2013;32:149–56.

Carter Battista[a,b], Elliot Harmon[a,b], Samir Patel[a,b], Farhad Ghoddoussi[a], Brendan Lynch[a], Kaveh Nabavighadi[a,b], Sandeep Krishnan[a,b,*]
[a] *Department of Anesthesiology, Wayne State University School of Medicine, Detroit, MI, USA*
[b] *Department of Anesthesiology, St. Joseph Mercy Oakland Hospital, Pontiac, MI, USA*
E-mail address: sakrishna@med.wayne.edu (S. Krishnan).

* Corresponding author at: St. Joseph Mercy Oakland Medical Office Building, 44555 Woodward Avenue, Suite 308, Pontiac, MI 48341, USA.