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Clinical Study

Preoperative multimodal analgesia decreases 24-hour postoperative narcotic consumption in elective spinal fusion patients

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Abstract

BACKGROUND CONTEXT: Effective postoperative pain management in patients undergoing elective spinal fusion surgery has been associated with shorter hospital stays, reduced rates of hospital readmissions due to pain, and decreased cost of care. Furthermore, preoperative multimodal analgesia regimens have been shown to decrease postoperative subjective pain measurements and narcotic consumption in patients undergoing spinal fusion and total arthroplasty surgeries.

PURPOSE: Compare the difference in effects on 24-hour postoperative narcotic consumption, reported pain, and early mobility with administration of preoperative celecoxib plus gabapentin, gabapentin alone, and a nonstandardized analgesia regimen in patients undergoing elective spinal fusion surgery involving ≤5 levels.

STUDY DESIGN: Retrospective review, Level of Evidence III.

PATIENT SAMPLE: A total of 185 adult patients undergoing elective spinal fusion surgery involving ≤5 levels from 2013 to 2017 at one academic institution. Patients were excluded if the surgery was nonelective, for oncological purposes, or the patient was younger than 17 years old.

OUTCOME MEASURES: Twenty-four-hour postoperative morphine equivalent consumption, 24-hour postoperative visual analogue scale (VAS) pain scores, postoperative day to ambulate, and postoperative day to clear physical therapy.

METHODS: A single-institution retrospective chart review was conducted. Patients meeting inclusion criteria were grouped by whether they had received preoperative celecoxib plus gabapentin, gabapentin alone, or neither of these medications. Opioid medication intake for the first 24 hours after the surgery end time was tabulated and converted to morphine equivalents. Visual analogue scale (VAS) pain scores were also averaged over the first 24 hours. Finally, physical therapy notes were reviewed to determine the time taken for the patient to first ambulate and to clear physical therapy. No external funding was procured for this research and the authors' conflicts of interest are not pertinent to the present work.

RESULTS: Twenty-four-hour postoperative morphine equivalent consumption was significantly lower in the celecoxib plus gabapentin group compared with control (p=.004). Patients in the celecoxib plus gabapentin group had significantly lower mean VAS scores (p=.002) and had earlier mobility postoperatively (p=.012) than those in the control group. Early mobility and time to physical therapy clearance did differ between the celecoxib + gabapentin group compared with the gabapentin alone group. The gabapentin group had a significantly higher 24-hour morphine dose equivalent (p=.013) and a significantly higher VAS average (p=.009) compared with the celecoxib + gabapentin

FDA device/drug status: Not applicable.

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group. Gabapentin given alone compared with control did not show statistically significant improved outcomes in postoperative morphine equivalent consumption, pain scores or physical therapy goals.
CONCLUSIONS: This study demonstrates that administering a selective COX-2 inhibitor and GABA-analogue preoperatively can significantly decrease 24-hour postoperative opioid consumption, VAS pain scores, and elapsed time to postoperative mobility in patients undergoing elective spine fusion surgery of ≤5 levels. Optimal standardized dosing and drug combination for preoperative multimodal analgesia remains to be elucidated.

Keywords: Elective spine surgery; Multimodal analgesia; Opioid use; Postoperative pain management; Postoperative physical therapy; Spinal fusion

Introduction

Spinal fusion surgery patients are subjected to significant postoperative pain and large amounts of opioid consumption. Effective postoperative pain management has been associated with shorter hospital stays, reduced rates of hospital readmissions due to pain, and a decreased cost of care [1–4]. With the rates of spinal fusion surgery significantly increasing in recent years, it is important to find optimal pain management protocols [5,6].

Opioid medications have been the basis for pain management in spinal fusion cases due to its proven effectiveness in managing acute postoperative pain [7–9]. Although effective, opioids have significant multisystem adverse side effects and recently have come under scrutiny due to potential for abuse. [10] Additionally, the sedative side effects in particular can decrease early postoperative mobility which is associated with increased morbidity and complications [11].

The implications of opioid use and a greater understanding of the physiological mechanisms of pain have led to investigating multimodal pain therapy. Multimodal analgesia targets various mechanisms of pain at different levels of the central and peripheral nervous systems to accomplish synergistic analgesia [12]. Preoperative COX-2 inhibitors in conjunction with opioids have been shown to be superior in reducing postoperative narcotic consumption and visual analogue scale (VAS) pain scores when compared with opioids alone in the setting of total knee arthroplasty [13–16]. Preoperative gabaminergic medications have also been shown to decrease postoperative opioid consumption when compared with opioids alone in total knee arthroplasty and spinal fusion surgery [17,18]. However, COX-2 inhibitors have been used cautiously for concerns over their potential adverse effects on bone healing and bleeding. To date there is conflicting evidence over these concerns within orthopedic literature [19–21].

Our study aimed to compare the efficacy of administering a preoperative COX-2 inhibitor plus a GABA-analogue compared with a GABA-analogue agent alone, compared with a nonstandardized regimen in adult patients undergoing elective spinal fusion involving ≤5 levels. We hypothesize that the postintervention groups would have significantly lower narcotic consumption and VAS pain scores within the first 24 hours postoperatively. Secondary mobility outcomes were also assessed, including time taken to ambulate and discharge from physical therapy.

Methods

Patients

This was a multisurgeon, retrospective review of all adult patients undergoing elective spinal fusion surgery at any level from January 2013 to July 2017 at one academic institution. All surgeries were fusions and did not include decompressions alone or surgeries *via* minimally invasive approaches. Cervical and lumbar fusions were included. The percentage of lumbar versus cervical fusions and anterior versus posterior approaches was analyzed for each treatment group. Patients were excluded if (1) they were younger than 17 years old, (2) their surgery involved greater than five vertebral levels, (3) they were having nonelective surgery, (4) we were unable to accurately assess narcotic consumption due to lack of recording this information in the electronic medical record, or (5) they were undergoing surgery for oncological purposes. There were a total of 185 patients that were included in the study. The patient characteristics are outlined in Table 1. Patients underwent posterior spinal fusion with instrumentation for spondylolisthesis and/or spinal stenosis causing pain with neurologic symptoms. The mean number of levels fused was 3 with a median of 3, and a range of 2–5. There were no external funding sources or conflicts of interest to report.

Intervention groups and outcome measures

Sixty-three patients received celecoxib and gabapentin, 61 received gabapentin only and 61 received neither medication. The dosing of each medication varied by surgeon but was predominantly celecoxib 400 mg PO (mean = 377 mg) and gabapentin 900 mg PO (mean = 824 mg), given one time before induction of anesthesia. Between each group we compared morphine dose equivalents taken by each patient within the first 24 hours. Patients were managed postoperatively with a nonstandardized multimodal pain medication regimen which included a combination of oral, transdermal, and intravenous opioids that were

Table 1
Patient baseline characteristics by group

	Control (n=61)	Celebrex + Gabapentin (n=63)	Gabapentin (n=61)	Year	p Value Celebrex + Gabapentin vs. control	p Value Gabapentin vs. control	p Value Gabapentin vs. Celebrex + Gabapentin
Age (Years)					.638	.910	.647
N	22	12	7	41			
Mean (SD)	61.8 (14.2)	59.5 (11.6)	62.4 (13.2)	61.2 (13)			
Median (Range)	63 (22–78)	62 (38–77)	58 (46–82)	63 (22–82)			
Gender (n, %)					.469	.717	.860
Male	27 (44.3%)	33 (52.4%)	30 (49.2%)	90 (48.6%)			
Female	34 (55.7%)	30 (47.6%)	31 (50.8%)	95 (51.4%)			

converted to standard morphine equivalents. The average VAS pain scores (0–10 scale) over the first 24 hours were compared between the groups. Physical therapy outcomes included postoperative day **on** which the patient was able to ambulate and the postoperative day the patient was cleared for discharge by physical therapy. Patients were considered ambulatory if they were able to ambulate independently or with the assistance of a front-wheeled walker.

Statistical analysis

Age was compared between groups using analysis of variance. The proportions of male and female subjects were compared between groups using chi-square tests. Surgical characteristics and outcomes were compared between groups using linear mixed-effects models including a random intercept for surgeon. All response variables except VAS were log transformed before analysis. Two models were fitted for each outcome, one with group as the only fixed effect in the model and one including group, number of levels instrumented, and estimated blood loss (EBL). Analysis of opioid consumption and postoperative day of mobility was performed to control for potential confounding of increased opioid consumption leading to increased mobility.

Analyses were conducted using the statistical software environment R, version 3.3.3 (R Core Team, 2017). Linear mixed effects modeling was conducted using the R package nlme, version 3.1-131.

Results

Table 1 summarizes patient characteristics by group. Table 2 shows surgical characteristics by group. There was an even distribution of lumbar versus cervical fusion cases. Lumbar surgeries accounted for 82%, 78%, and 85% of the control group, celecoxib + gabapentin group, and gabapentin alone group spinal fusions, respectively, with the others being cervical fusions. Despite slight variance, the difference between groups was not a statistically significant.

Additionally, there was an even distribution of anterior versus posterior approaches for the spinal fusion surgeries. Posterior approaches accounted for 79%, 72%, and 77% of the control group, celecoxib + gabapentin group, and gabapentin alone group for the spinal fusion approach, respectively, with the others being anterior approaches. There was not a significantly statistical difference.

24-hour postoperative morphine equivalent consumption

Table 3 shows outcomes by group before adjusting for EBL and number of levels instrumented. Patients in the celecoxib + gabapentin group had a significantly lower 24-hour postoperative morphine dose equivalent (p=.005) compared with the control group. Patients in the gabapentin group had a significantly higher 24-hour postoperative morphine dose equivalent (p=.017)) compared with the celecoxib + gabapentin group. Figure 1 shows 24-hour postoperative morphine equivalent doses by group. Table 4 shows results between groups after adjusting for number of levels instrumented and EBL. After adjusting for these variables, the results were unchanged. Celecoxib + gabapentin group had a significantly lower 24-hour postoperative morphine dose equivalent (p=.004) compared with the control group. The gabapentin group had a significantly higher 24-hour postoperative morphine dose equivalent (p=.013) compared with the celecoxib + gabapentin group.

Physical therapy outcomes

The time taken to ambulate after surgery was significantly shorter for the celecoxib + gabapentin group compared with control (p=.012) (Table 3). When the model is adjusted for number of levels instrumented and EBL (Table 4), this conclusion remained unchanged (p=.012). Early mobility and time to physical therapy clearance did differ between the celecoxib + gabapentin group compared with the gabapentin alone group. The time taken to clear physical therapy was not significantly different between any of the groups. Figure 2 shows postoperative day to ambulate by group. Figure 3 shows postoperative day to clear physical therapy by group. One patient from the control group did not have information on their physical therapy progress notes or discharge recorded in the electronic medical record. There was no difference in overall opioid consumption and postoperative mobility timing (Supplementary Figure 1).

Table 2
Surgery characteristics by group

	Control (n=35)	Celebrex + Gabapentin (n=26)	Gabapentin (n=25)	All patients (n=86)	Celebrex + Gabapentin vs. control		Gabapentin vs. control		Gabapentin vs. Celebrex + Gabapentin	
					Geometric mean ratio (95% CI)	p Value	Geometric mean ratio (95% CI)	p Value	Geometric mean ratio (95% CI)	p Value
Number of levels instrumented					0.98 (0.87, 1.11)	.731	1.01 (0.91, 1.13)	.814	1.04 (0.90, 1.18)	.613
N	61	63	61	185						
Mean (SD)	3 (1)	2.9 (.9)	3.1 (.9)	3 (.9)						
Median (Range)	3 (2–5)	3 (2–5)	3 (2–5)	3 (2–5)						
EBL (mL)					1.17 (0.79, 1.73)	.433	0.96 (0.65, 1.43)	.843	0.82 (0.56, 1.22)	.326
N	61	63	61	185						
Mean (SD)	523.8 (542.5)	511.3 (437.2)	454.8 (370.7)	496.8 (453.9)						
Median (Range)	350 (10–3000)	400 (10–2500)	350 (20–1400)	350 (10–3000)						
Intraoperative time (minutes)					1.11 (0.98, 1.26)	.092	0.96 (0.85, 1.09)	.547	**0.87 (0.77, 0.98)**	**.022**
N	61	63	61	185						
Mean (SD)	274.7 (115.6)	291.4 (80.1)	256.7 (93.7)	274.4 (97.9)						
Median (Range)	257 (93–687)	283 (137–522)	241 (119–697)	267 (93–697)						

EBL, estimated blood loss.
*Geometric mean ratios, confidence intervals, and p values are from linear mixed effects models including a fixed effect for group and a random intercept for surgeon.

24-hour postoperative VAS pain scores

Patients in the celecoxib + gabapentin group had a significantly lower VAS average (p=.002) compared with the control group. Patients in the gabapentin group had significantly higher VAS average (p=.014) than the celecoxib + gabapentin group. After adjusting for EBL and number of levels fused these conclusions remained unchanged (p=.002;p=.009). Figure 4 shows average VAS score by group.

Surgery characteristics

EBL and number of levels instrumented did not significantly differ between any of the groups (Figs. 5 and 6). The only difference noted was patients in the gabapentin group had significantly shorter intraoperative time than patients in the celecoxib + gabapentin group (p=.022; Fig. 7).

Discussion

In our study, patients who received celecoxib and gabapentin before elective spinal fusion involving ≤5 levels required less morphine equivalents during the first 24 hours, had decreased VAS pain scores, and ambulated sooner during the postoperative period. These represent not only statistically significant results but clinically significant as well. For example, as described by Myles et al. in 2017, the minimum clinically important difference for VAS pain scores in 204 patient undergoing various general, orthopedic and other surgical subspecialty procedures to be 9.9 mm or 1 point on 1-10 VAS pain score scale [22]. The patients in the celecoxib + gabapentin treatment group had less pain and hence were more likely to mobilize sooner.

There have been multiple publications on the use of multimodal pain regimens containing nonsteroidal anti-inflammatory drugs (NSAIDs) in postspine surgery pain management in recent years. A randomized controlled trial published by Jirarattanaphochai et al. in 2008 found the addition of a COX-2 inhibitor to morphine preoperatively and postoperatively decreased the amount of morphine required within the first 48 hours postoperatively by 39% in 120 patients undergoing lumbar discectomy, decompression or fusion [23]. Additionally, in 2013 Mathiesen et al. conducted a retrospective review of 85 patients that reported a decrease in narcotic consumption along with improvements in postoperative mobilization with a preoperative multimodal analgesic regimen consisting of intravenous Tylenol, orally administered gabapentin and celecoxib in patients undergoing multilevel spinal fusion [13]. Lastly, in 2016 Kim et al. conducted a randomized controlled trial comparing the use of celecoxib, pregabalin, oxycodone, and acetaminophen preoperatively versus postoperative intravenous morphine in 80 patients undergoing L4–L5 posterior lumbar interbody fusion which showed decreased VAS pain scores and improved functional outcome scores [19]. Our study provides further evidence supporting the implementation of a

Table 3
Outcomes by group

	Control (n=35)	Celebrex + Gabapentin (n=26)	Gabapentin (n=25)	All patients (n=86)	Celebrex + Gabapentin vs. control		Gabapentin vs. control		Gabapentin vs. Celebrex + Gabapentin	
					Geometric mean ratio* (95% CI)	p Value	Geometric mean ratio* (95% CI)	p Value	Geometric mean ratio* (95% CI)	p Value
24-hour morphine dose equivalent					**0.55 (0.36, 0.83)**	**.005**	0.95 (0.66, 1.39)	.801	**1.74 (1.11, 2.74)**	**.017**
N	61	63	61	185						
Mean (SD)	181.2 (121.7)	150.3 (126.9)	185 (154.9)	171.9 (135.4)						
Median (Range)	166 (15.5−551.5)	125 (0−558)	123 (8−745)	141.5 (0−745)						
VAS average					**−1.08 (−1.76, −0.39)**	**.002**	−0.22 (−0.91, 0.47)	.529	**0.86 (0.17, 1.54)**	**.014**
N	61	63	61	185						
Mean (SD)	(	4.9 (2.2)	5.8 (1.9)	5.6 (2)						
Median (Range)	6 (1.2−9.8)	5 (0−8.4)	5.9 (0−10)	5.8 (0−10)						
Mobility POD					**0.79 (0.66, 0.95)**	**.012**	0.88 (0.73, 1.06)	.162	1.11 (0.92, 1.33)	.266
N	60	63	61	184						
Mean (SD)	2 (1.4)	1.5 (1)	1.7 (1.2)	1.7 (1.2)						
Median (Range)	2 (1−8)	1 (1−5)	1 (1−8)	1 (1−8)						
Cleared POD					0.86 (0.72, 1.02)	.090	0.90 (0.75, 1.07)	.233	1.05 (0.88, 1.25)	.616
N	60	63	61	184						
Mean (SD)	3.8 (2)	3.3 (2)	3.3 (1.6)	3.5 (1.9)						
Median (Range)	4 (1−14)	3 (1−12)	3 (1−10)	3 (1−14)						

POD, postoperative day.

* Geometric mean ratios, confidence intervals, and p values are from linear mixed effects models including a fixed effect for group and a random intercept for surgeon. For VAS average, which was not analyzed on the log scale, the estimated difference in means is reported instead of the geometric mean ratio.

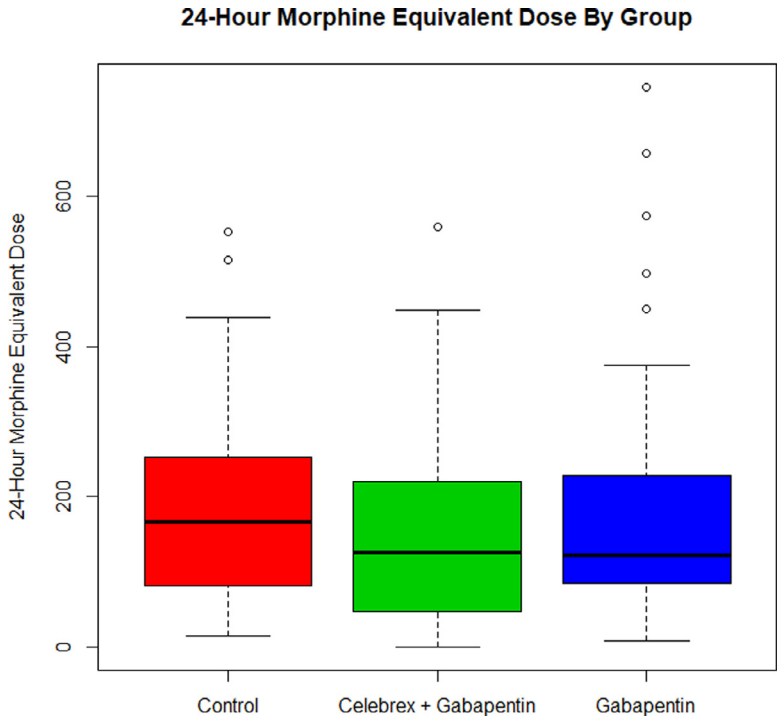

Fig. 1. Shows 24-hour morphine equivalent doses by group. The solid line in the middle of the box represents the group median, the lower and upper box edges represent the 25th and 75th percentiles, respectively, and the lower and upper whiskers represent the smallest and largest observations lying within 1.5 interquartile ranges (IQR) from the box edges, respectively. Observations lying more than 1.5 IQR from the box edges, if any, are represented by circles.

preoperative opioid-sparing multimodal pain regimen that focuses on reducing pain scores with decreased opioid consumption resulting in increased postoperative mobilization in a generalizable, heterogenous population of spinal fusion patients.

However, the impact on bone healing and blood loss using COX inhibitors must be considered. Animal and human studies have demonstrated higher rates of nonunion in fracture healing [24–26]. A rodent study from 2007 by Gerstenfeld et al. assessed fracture healing at 21 and 35 days after receiving 7 or 21 days of celecoxib [26]. They found a significant increase in the rate of nonunion by 21 days postoperative with celecoxib administration which was no longer significant by postoperative day 35. However, evidence suggests that this effect on bone healing is dose and duration of therapy-dependent [27]. We hypothesize that the relatively small preoperative dose used in most multimodal pain protocols will not have a significant impact on bone healing. There is little evidence to support or oppose the risks related to blood loss with the use of small doses of COX-2 inhibitors preoperatively in spine surgery. In the aforementioned study by Kim et al., there were no differences found in operative blood loss, postoperative hemovac drain output, or nonunion rate in 80 patients

Table 4
Outcomes by group

Models adjusted for number of levels instrumented and EBL						
	Celebrex + Gabapentin vs. control		Gabapentin vs. control		Gabapentin vs. Celebrex + Gabapentin	
	Geometric mean ratio* (95% CI)	p Value	Geometric mean ratio* (95% CI)	p Value	Geometric mean ratio* (95% CI)	p Value
24-hour morphine dose equivalent	**0.54 (0.35, 0.82)**	**.004**	0.96 (0.66, 1.41)	.847	**1.79 (1.13, 2.84)**	**.013**
VAS average	**−1.11 (−1.80, −0.43)**	**.002**	−0.19 (−0.88, 0.51)	.598	**0.93 (0.23, 1.62)**	**.009**
Mobility POD	**0.79 (0.66, 0.95)**	**.012**	0.88 (0.73, 1.06)	.190	1.12 (0.93, 1.35)	.233
Cleared POD	0.85 (0.71, 1.01)	.065	0.93 (0.78, 1.10)	.391	1.09 (0.91, 1.32)	.330

POD, postoperative day; VAS, visual analogue scale.

* Geometric mean ratios, confidence intervals, and p values are from linear mixed effects models including fixed effects for group, number of levels instrumented, and EBL, and a random intercept for surgeon. For VAS average, which was not analyzed on the log scale, the estimated difference in means is reported instead of the geometric mean ratio.

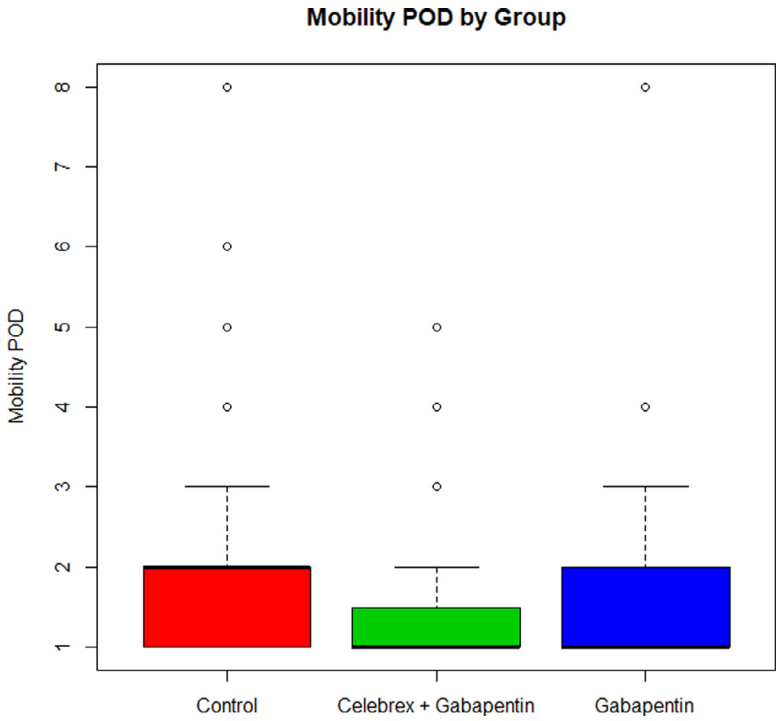

Fig. 2. Shows POD to ambulate by group. The solid line in the middle of the box represents the group median, the lower and upper box edges represent the 25th and 75th percentiles, respectively, and the lower and upper whiskers represent the smallest and largest observations lying within 1.5 interquartile ranges (IQR) from the box edges, respectively. Observations lying more than 1.5 IQR from the box edges, if any, are represented by circles.

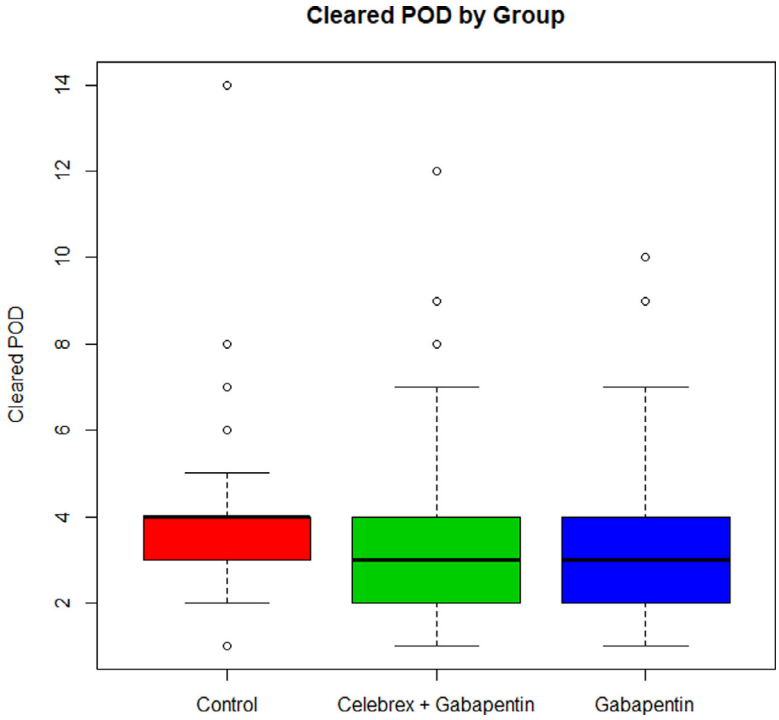

Fig. 3. Shows POD to clear physical therapy by group. The solid line in the middle of the box represents the group median, the lower and upper box edges represent the 25th and 75th percentiles, respectively, and the lower and upper whiskers represent the smallest and largest observations lying within 1.5 interquartile ranges (IQR) from the box edges, respectively. Observations lying more than 1.5 IQR from the box edges, if any, are represented by circles.

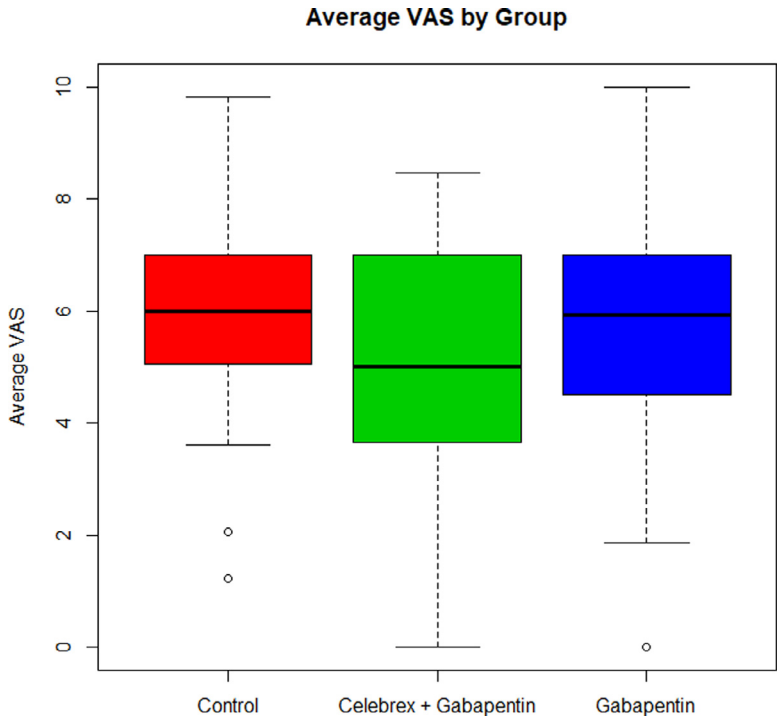

Fig. 4. Shows average VAS score by group. The solid line in the middle of the box represents the group median, the lower and upper box edges represent the 25th and 75th percentiles, respectively, and the lower and upper whiskers represent the smallest and largest observations lying within 1.5 interquartile ranges (IQR) from the box edges, respectively. Observations lying more than 1.5 IQR from the box edges, if any, are represented by circles.

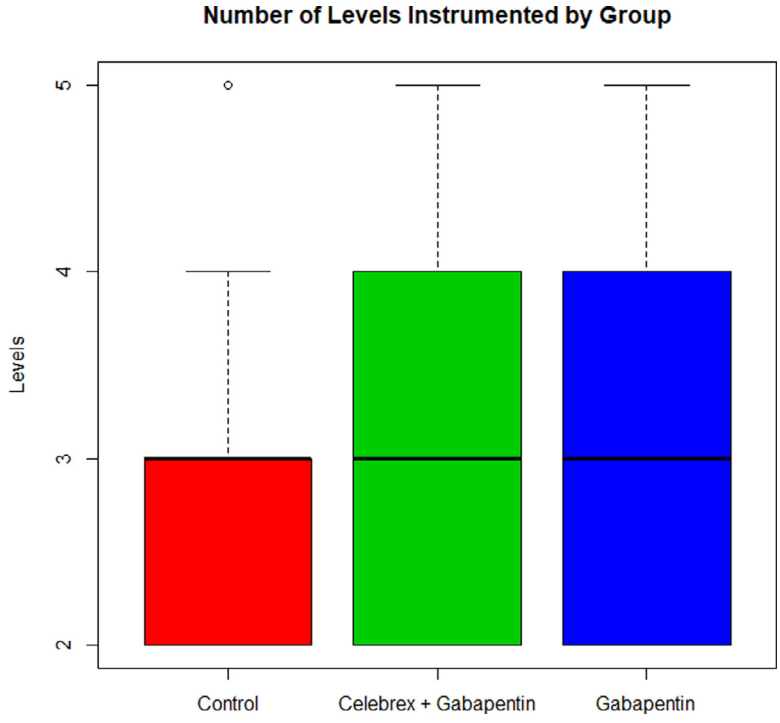

Fig. 5. Shows the number of levels instrumented by group. The solid line in the middle of the box represents the group median, the lower and upper box edges represent the 25th and 75th percentiles, respectively, and the lower and upper whiskers represent the smallest and largest observations lying within 1.5 interquartile ranges (IQR) from the box edges, respectively. Observations lying more than 1.5 IQR from the box edges, if any, are represented by circles.

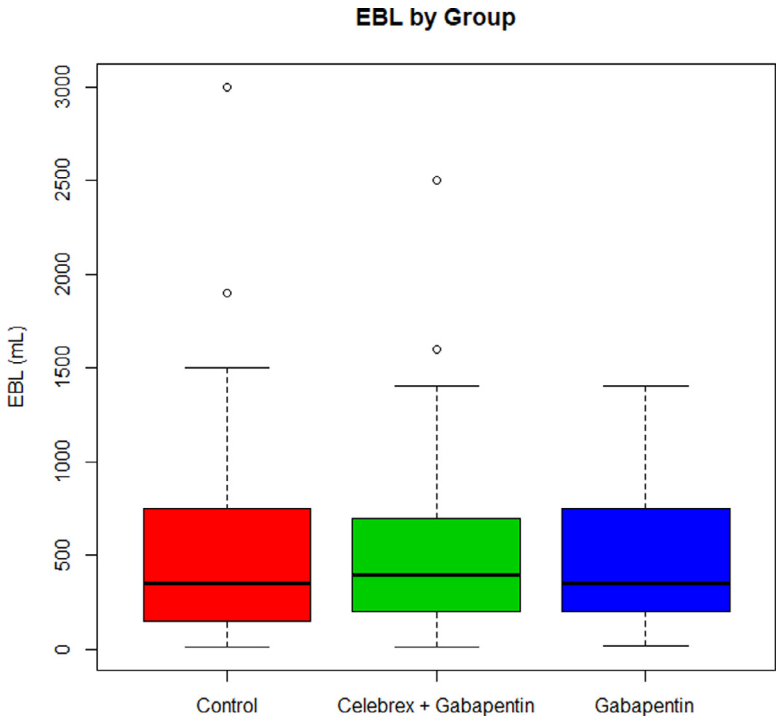

Fig. 6. Shows EBL by group. The solid line in the middle of the box represents the group median, the lower and upper box edges represent the 25th and 75th percentiles, respectively, and the lower and upper whiskers represent the smallest and largest observations lying within 1.5 interquartile ranges (IQR) from the box edges, respectively. Observations lying more than 1.5 IQR from the box edges, if any, are represented by circles.

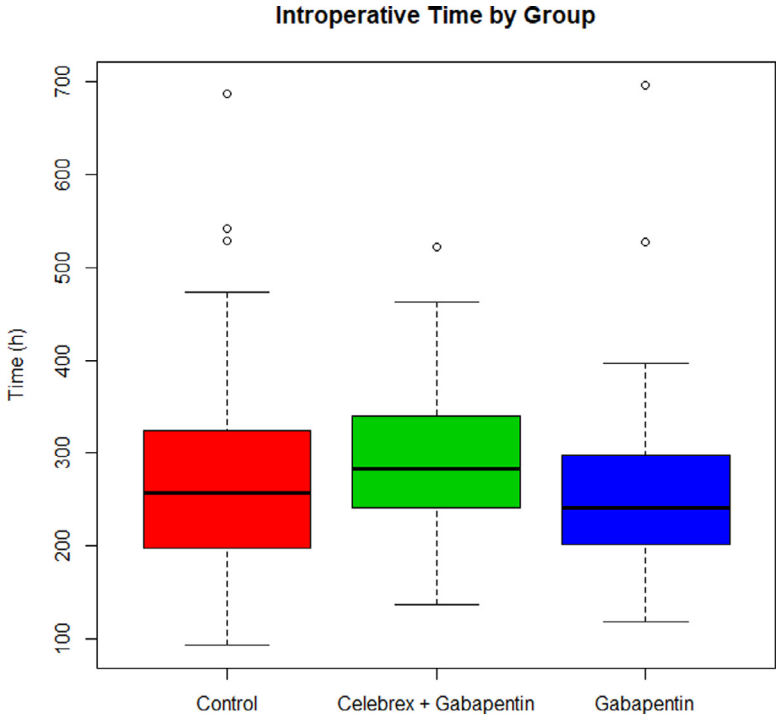

Fig. 7. Shows intraoperative time by group. The solid line in the middle of the box represents the group median, the lower and upper box edges represent the 25th and 75th percentiles, respectively, and the lower and upper whiskers represent the smallest and largest observations lying within 1.5 interquartile ranges (IQR) from the box edges, respectively. Observations lying more than 1.5 IQR from the box edges, if any, are represented by circles.

undergoing spinal fusion surgery with a preoperative multimodal pain regimen that contained a selective COX-2 inhibitor [19]. In support of the findings in other studies, our investigation demonstrated no significant increase in EBL in the celecoxib and gabapentin group compared with control. Although the lack of statistically significant differences in blood loss during and after operation may indeed have been unrelated in *any way* to the medication regimen used, it is also quite possible as seen in other studies that the use of a selective COX-2 inhibitor administered as a one-time preoperative dose does not affect patient blood loss.

Interestingly, our results did not show a significant difference in 24-hour morphine consumption, physical therapy measures, or VAS pain scores between those receiving gabapentin only and our control group. In 2004, Turan et al. conducted a study with 25 patients receiving 1200 mg of preoperative gabapentin before elective lumbar discectomy or spinal fusion surgery and found a significant decrease in 24-hour morphine consumption as well as decreased pain scores [18]. The difference in results may suggest a dose-dependent effect of gabapentin given that our gabapentin study population received between 300 and 900 mg preoperatively.

The celecoxib and gabapentin group was also significantly faster to ambulate postoperatively compared with the control and gabapentin groups. Early postoperative mobilization has led to decreased length of hospital stay and decreased costs of spine surgery [28]. The possibility to improve early operative mobility from improved analgesia protocols adds additional incentive to continued research in this topic.

Finding a standard multimodal pain regimen is a work in progress. Outside of NSAIDs and neurolytics, systemic steroids have been shown to be effective in decreasing postoperative analgesia in total knee and hip arthroplasty patients [29–31]. A meta-analysis done in 2012 by De Oliveira et al. found a single dose of perioperative systemic glucocorticoids decreased postoperative morphine consumption in the 11 studies that were included in its meta-analysis [29]. Unfortunately, there was only one orthopedic study included in the analysis. Future studies are needed to determine the role of glucocorticoids in combination with NSAIDs and/or neurolytics in the setting of spine surgery. Although the administration of glucocorticoids must be monitored cautiously as it may also interfere with bone healing and adversely affect infection rates.

The study does have limitations with respect to retrospective design and sample size. Additionally, the lack of standardized dosing prescribed by each surgeon introduces mild variability in our results as does the variability of each surgeon's technique. Although it is possible each patient's postoperative pain regimen differed slightly, our institution has a standard postoperative pain protocol that would have been followed unless there were changes made secondary to patient tolerance, preference, or pharmacy availability. During the time frame of this study our postoperative rehab protocol remained standardized as administered by our physical therapy colleagues and was not impacted by the operating surgeon's preference. Ideally, preoperative opioid consumption should have been completely and accurately quantified in our study. However, due to the retrospective nature of this study and omissions in the presurgical documentation of medication history, accurate daily opiate consumption was not always recorded. This may introduce the opportunity for confounding variables in total opiate consumption, however, we assume that these patients would have been evenly distributed between the treatment groups. In a perfectly controlled, randomized study precisely equal preoperative narcotic administration might be feasible. However, given the wide variety of patient demographics and primary physician prescribed opiate regimens, some variability in preoperative opiate requirement will remain.

The strengths of this study include the exclusion of a strict selection bias based on patient characteristics or planned procedure. This inclusive approach allows for general application of a multimodal analgesia protocol. Further, we were able to measure subjective pain and opioid use which correlated with our short-term functional measurements and outcomes. In addition, we were able to account for potential operative confounders. As a result of this study, we have now incorporated a standardized preoperative multimodal analgesia regimen consisting of a selective COX-2 inhibitor and GABA-analogue.

Conclusions

Our study supports the use of selective COX-2 inhibitors and GABA-analogues in multimodal pain regimens to decrease postoperative opioid consumption, VAS pain scores, and time to postoperative mobility for patients undergoing elective spinal fusion surgery. This study is a timely addition to the body of literature aimed at reduction of opiate consumption facilitated by standardized, multimodal nonopiate analgesic medications administered before spine surgery. Future research is needed to compare different combinations of the aforementioned analgesia medications within randomized trials and assessment of long-term ramifications of implementation.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.spinee.2019.07.005.

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