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ORIGINAL ARTICLE

Posterior spinal fusion for adolescent idiopathic scoliosis and the impact of postoperative intravenous dexamethasone supplementation

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Abstract

Postoperative care pathways for adolescent idiopathic scoliosis patients undergoing posterior spinal fusion have demonstrated decreases in postoperative opioid consumption, improved pain control, and lead to decreased lengths of stay. Our objective was to implement postoperative steroids to reduce acute postoperative opioid consumption, pain scores, and length of stay. Dosing consisted of intravenous dexamethasone 0.1 mg/kg up to 4 mg per dose for a total of three doses at 8, 16, and 24 h postoperatively. As part of a quality initiative, we compared three cohorts of patients. The initial retrospective epidural cohort (EPI) ($n = 59$) had surgeon placed epidural catheters with infusion of ropivacaine 0.1% postoperatively for 18–24 h. Following an institutional change in postoperative care, epidural use was discontinued. A second cohort ($n = 149$), with prospectively collected data, received a surgeon placed erector spinae plane block and wound infiltration with a combination of liposomal and plain bupivacaine (LB). A third cohort ($n = 168$) was evaluated prospectively. This cohort received a surgeon placed erector spinae plane block and wound infiltration with liposomal and plain bupivacaine and additionally received postoperative dexamethasone for three doses (LB + D). Compared to the LB cohort, the LB + D cohort demonstrated statistically significant decreases in oral milligram morphine equivalents per kilogram at 0–24, 24–48, and 48–72 h. There was a statistically significant difference in median pain scores at 24–48 and 48–72 h in LB + D versus LB. The LB + D cohort's median length of stay in hours was significantly less compared to the LB cohort (52 h vs. 70 h, $p < 0.0001$). Postoperative intravenous dexamethasone was added to an established postoperative care pathway for patients undergoing posterior spinal fusion for idiopathic scoliosis resulting in decreased VAS pain scores, opioid consumption, and shorter length of stay.

KEYWORDS
adolescent idiopathic scoliosis, dexamethasone, opioid reduction, posterior spinal fusion, postoperative pain control, quality improvement

1 | INTRODUCTION

Over the last few years, there have been several standardized postoperative care pathways published for patients undergoing posterior spinal fusion (PSF) for adolescent idiopathic scoliosis (AIS).[1–7] Many of these pain pathways involve several nonopioid analgesic medications, including gabapentinoids, acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), and diazepam (for muscle spasms) are given in combination with opioid medications. This approach allows for earlier mobilization and ambulation as well as decreased length of stay (LOS). However, with the ongoing opioid epidemic there is motivation for hospitals to focus on implementing postoperative care pathways that minimize the use of opioids and enhance quality of recovery.

Liposomal bupivacaine is a long-lasting encapsulated local anesthetic that releases bupivacaine over several days. The single-dose infiltration multivesicular liposome formulation has gained FDA approval in the pediatric population.[8] In a previous quality initiative (QI) performed at our institution on AIS patients undergoing a PSF, it was reported that liposomal bupivacaine was associated with less total consumption of postoperative morphine equivalents during the inpatient postoperative admission compared to a similar cohort of patients that had an epidural for postoperative analgesia.[9] Since implementing the change from epidurals to liposomal bupivacaine at our institution, there has been more focus on further decreasing VAS pain scores, LOS, and opioid consumption. A recent study published by Fletcher et al., studying PSF in AIS patients, reported that there was a 40% decrease in the use of opioids when patients were given a short course of postoperative steroids.[10] A 2015 study found that adolescent patients who were given an opioid prescription by 12th grade are 33% more likely to misuse opioids after high school than those who have no prescription history.[11] Furthermore, retrospective analysis of privately insured adolescents aged 11–17 years in the United States showed a rate of 1 in 1600 previously opioid naive patients will suffer some form of opioid overdose a median of 1.75 years later.[12] Even legitimate opioid use for pain, such as in the postoperative setting, can translate into misuse potential in adolescents. Therefore, our institution enhanced the postoperative care pathway for AIS patients with a goal of further reductions of postoperative opioid consumption.[13]

This QI project focused on the enhancement of patient standardized postoperative care pathway for AIS patients undergoing PSF. The aims of this QI were to (1) minimize opioid usage, (2) decrease pain scores, and (3) decrease length of stay below our previously reported results. The initial retrospective cohort, ($n = 59$), had surgeon placed epidural catheters with infusion of ropivacaine 0.1% at 0.1 mL/kg postoperatively for 18–24 h. Epidural catheters were placed at the midpoint to lower one-third of the incision and placed at 5 cm in the epidural space. Following an institutional wide change in postoperative care, epidurals were no longer placed. A second cohort ($n = 149$), with prospectively collected data, received a surgeon placed erector spinae plane block and wound infiltration with a combination of liposomal and plain bupivacaine. Following a plan-do-study-act cycle, a third cohort ($n = 168$) was evaluated prospectively. This third cohort received surgeon placed erector spinae plane block and wound infiltration with a combination of liposomal and plain bupivacaine and postoperative dexamethasone for three doses.

2 | METHODS

The UT Southwestern Human Research Protection Program (HRPP) reviewed the project and determined that it does not meet the definition of research under 45 CFR 46.102 and therefore does not require IRB approval or oversight. A multidisciplinary team (pediatric orthopedic surgeon, pediatric anesthesiologist, electronic medical record (EMR) analyst, and director of quality improvement) was assembled, and surgical data collection was built into the electronic medical record. EMR data from three cohorts of AIS patients that underwent PSF at a single academic institution were extracted and compared. Data were retrospectively collected for the first cohort consisting of surgeon placed epidural catheters. The second and third cohort consisted of prospectively collected data. The records of patients 12–20 years old who had undergone a PSF for the treatment of AIS were reviewed. Non-English speaking was not an exclusion criterion. The exclusion criteria were any previous spine surgery including growth sparing instrumentation.

The variables collected included sex, age, preoperative major Cobb angle, weight in kilograms, body mass index, ethnicity, and visual analog scale (VAS) from 0 to 5 in intensity. VAS scores at rest were collected at 0–24, 24–48, 48–72 h, length of stay hours (beginning from admission time to the postoperative anesthesia care unit (PACU) until hospital discharge). Postoperative pain scores were assessed every 15 min in the PACU. On the postoperative wards, a pain reassessment occurred 15 min after an intravenous (IV) agent and 45 min after an oral agent was administered. Opioids administered in PACU through the first 72 h of the patients stay were collected (measured as oral morphine milligram equivalents (oMME)). Additionally, diazepam doses were recorded at intervals of 0–24, 24–48, and 48–72 h. Anti-emetic drug doses including ondansetron and aprepitant were collected at similar time points.

We compared three sequential cohorts of AIS patients that underwent PSF between 2019 and 2022. The first cohort had an epidural catheter placed by the surgeon prior to wound closure. Ropivacaine 0.1% was infused for 18–24 h postoperatively. The next sequential two cohorts were administered a mixture of liposomal bupivacaine, bupivacaine HCl, and normal saline via an open erector spinae plane (ESP) block approach. The mixture was injected into the fascial and subcutaneous layers of the incision prior to wound closure. Ideally, 30 mL of solution would be infiltrated for every 2.5 cm of incision. Two-thirds of the solution was injected into the fascial layer and one-third into the subcutaneous layer. Patients less than 60 kg received a mixture of 4 mg/kg liposomal bupivacaine and 2 mg/kg of 0.25% bupivacaine, while patients that were greater than 60 kg received 266 mg of liposomal bupivacaine, 125 mg of 0.25% bupivacaine. Normal saline was added for volume expansion per manufacturer's recommendation for a minimum liposomal bupivacaine

concentration of 0.89 mg/mL. This added dilution with normal saline allowed for injection as close to 30 mL of solution/2.5 cm of incision as possible. All three cohorts also received 0.1 mg/kg of IV dexamethasone for a maximum of 4 mg dose intraoperatively to help control postoperative nausea and vomiting.

The third cohort had an open ESP block and wound infiltration with liposomal bupivacaine, bupivacaine, and saline and received three doses of postoperative IV dexamethasone (0.1 mg/kg up to 4 mg) every 8 h. Otherwise, the cohorts received the same multimodal postoperative pain control protocol. This consisted of IV opioid (hydromorphone) with transition to oral opioid (oxycodone at a dose of 0.15 mg/kg every 4 h as needed) within the first 24 h postoperatively, as well as dexmedetomidine, acetaminophen, ketorolac, and diazepam. Intranasal dexmedetomidine was given at 20:00 and 02:00 the first evening after surgery at a dose of 1.5 mcg/kg as an adjunctive analgesic and sedative for the first night after surgery. Intravenous ketorolac (0.5 mg/kg up to 30 mg) was given every 6 h for 24 h with transition to oral ibuprofen (10 mg/kg every 6 h). Intravenous acetaminophen (15 mg/kg up to 1 g) was also given every 6 h for 24 h with transition to oral acetaminophen (15 mg/kg up to 1 g). Oral diazepam (0.1 mg/kg) was available as needed for muscle spasms.

A chi-square test was performed to compare patient sex, and a Fisher's exact test was performed to compare ethnicity. A Shapiro's normality test was conducted for continuous variables, followed by a parametric or nonparametric test for the comparison of continuous variables. For the variables with a *p*-value of Shapiro's normality test less than 0.05, we adopted the nonparametric test, and for the variable with a *p*-value of Shapiro's normality test greater than 0.05, we adopted the parametric test. A parametric ANOVA with Tukey HSD multiple comparisons was used to compare normally distributed variables and nonparametric Kruskal test with Dunn's multiple comparisons for non-normally distributed variables. Analysis was conducted with R version 4.1.3.

3 | RESULTS

Altogether, 376 AIS patients underwent PSF. There were no preoperative statistically significant differences between the Epidural (EPI) cohort ($n=59$), Liposomal Bupivacaine (LB) cohort ($n=149$), and the Liposomal Bupivacaine + Dexamethasone (LB + D) cohort ($n=168$) when comparing sex and ethnicity (Table 1).

Among the three groups, there were no preoperative statistically significant differences weight, BMI, and major preoperative Cobb angles (Table 2). There were minor differences in age and number of levels fused between the three groups (Table 2).

The postoperative length of stay in the LB group was a median of 70 h [50–72] versus 52 h [48–69] in the LB + D, $p<0.0001$. When comparing the baseline historical cohort EPI versus the most current cohort, LB + D, the median length of stay has decreased by 17 h (Table 3).

The median number of pain scores documented from 0 to 24 h decreased from 19 [16–21.5] in the EPI group to 14.5 [10.75–19], $p=0.0001$ in LB + D. A similar downward trend in the number of pain scores documented occurred during the 24–48 h period and the 48–72 h period after surgery (Table 3). Regarding resting pain score intensity, there was no statistically significant difference between pain scores in all three groups during the 0–24 h period. There was a statistically significant difference in each cohort studied at 24–48 h (Table 3). There was also a statistically significant difference in the median pain scores and IQR of the 48–72 h period in the LB + D group, 2 [1, 2] when compared to the LB group, 2 [1.5–2.5], $p=0.0237$.

Oral morphine consumption was reported with milligram values and milligram per kilogram values for 0–24, 24–48, and 48–72 h. There was no statistically significant difference in oMME at 0–24 h between EPI and LB groups. The LB group had a median value of 36 mg [27–46] versus 27 mg [21.5–37.25] in LB + D, $p<0.0001$, a 25% decrease in median oMME at 0–24 h following the transition from LB to LB + D. Results at 0–24 h were similar when evaluated on an oMME/kg basis (Table 3). The median oMME from 24 to 48 h decreased by 5 mg during the transition from EPI to LB, and an additional 5 mg when transitioning from LB to LB + D. With the addition of IV dexamethasone to the postoperative multimodal pain management regimen, among patients still hospitalized, opioid consumption decreased during 0–72 h by an additional 32 oral morphine milligram equivalents. This led to an overall 39% reduction in hospital opioid consumption from 2019 to 2022 (Figure 1).

TABLE 1 Sex and ethnicity.

Patient demographics		EPI ($N=59$)	LB ($N=149$)	LB + D ($N=168$)	*p*-Value
Sex	Female	42 (71.19%)	119 (79.87%)	125 (74.40%)	0.3316
	Male	17 (28.81%)	30 (20.13%)	43 (25.60%)	
Ethnicity	White	35 (59.32%)	98 (65.77%)	100 (59.52%)	0.2198
	Black/African American	18 (30.51%)	27 (18.12%)	42 (25.00%)	
	Asian	3 (5.08%)	9 (6.04%)	5 (2.98%)	
	Indian	0 (0.00%)	3 (2.01%)	1 (0.60%)	
	Native American	1 (1.69%)	2 (1.34%)	1 (0.60%)	
	Other	2 (3.39%)	10 (6.71%)	19 (11.31%)	

Abbreviations: EPI, epidural group; LB, liposomal bupivacaine group; LB + D, liposomal bupivacaine + dexamethasone.

TABLE 2 Additional demographics.

	EPI (N = 59)	LB (N = 149)	LB + D (N = 168)	p-value			
				Kruskal test	EPI versus LB	EPI versus LB + D	LB versus LB + D
Age (years)	15 [13.5–17]	14 [13–16]	14 [12–16]	0.0325	0.175	<0.0001	<0.0001
Weight (kg)	53 [48.5–58.5]	55 [46–62]	52.5 [46–64]	0.9556	-	-	-
BMI (kg/m^2)	20 [18–21]	21 [18–24]	21 [18–24.25]	0.3242	-	-	-
Pre-op major cobb (degrees)	59 [54–65.5]	58 [53–67]	60 [54–66]	0.6594	-	-	-
Levels fused	11 [11–12]	12 [10–13]	12 [11–14]	0.0231	0.0248	0.0233	0.7614

Note: Results reported as median value with 25%–75% IQR as values in [] for non-normally distributed variables.
Abbreviations: EPI, epidural group; LB, liposomal bupivacaine group; LB + D, liposomal bupivacaine + dexamethasone.

Along with decreases in opioid usage, patients required less antispasmodic agents that are commonly required with a long segment posterior spinal fusion (Table 4). Median diazepam doses from 24 to 48 h dropped from 2 [1–3] in LB to 1 [0–2] in the LB + D, $p = 0.0016$. By 48–72 h, median diazepam doses were 1 [0–2] in LB compared to 0 [0–1] in LB + D, $p = 0.0001$.

Nausea and vomiting severity were assessed by studying anti-emetic usage (Table 4). Ondansetron doses were low overall. The EPI group showed lower usage 0–24 h when compared to both LB and LB + D. At 24–48 h, the LB group had a median number of doses at 0 [0–1] compared to 0 [0–0.25], $p < 0.0001$ in the LB + D group. The rescue anti-emetic of choice at this institution is aprepitant, and usage was overall very low during the hospitalization of patients in all groups.

No acute surgical site infection (SSI) occurred in the EPI group or LB + D group but 2 acute SSIs occurred in the LB cohort (1.3%). All patients received a prescription of 40 doses of opioid upon discharge from the hospital. Additionally, only 16 patients (4.26%) overall required a single refill prescription for opioid pain medication. This occurred within the month following surgery. There was no statistically significant difference in refill rates among the three cohorts.

4 | DISCUSSION

With the addition of three doses of postoperative intravenous dexamethasone every 8 hours at a dose of 0.1 mg/kg (maximum 4 mg) to an established postoperative care pathway for patients with adolescent idiopathic scoliosis undergoing posterior spinal fusion, our local patient population experienced decreased VAS pain scores, opioid consumption, and shorter length of stay. The initial cohort received postoperative analgesia from a surgeon placed epidural catheter with infusion of ropivacaine 0.1% on the first postoperative night. A practice change moved toward open erector spinae plane block with liposomal bupivacaine in lieu of epidural catheter for primary means of postoperative analgesia.[9] The open erector spinae plane block group consumed similar median oral morphine milligram equivalents during the initial 24 h when compared to the epidural cohort [35 mg vs. 36 mg] ($p = 0.6738$) but less at 24–48 h [40 mg vs. 35 mg] ($p = 0.031$), and 48–72 h [34 mg vs. 28 mg] ($p < 0.0001$). When a third cohort was prospectively studied that received the addition of postoperative dexamethasone, LB + D, oral morphine milligram equivalents dropped by an additional 32% in the postoperative setting compared to the LB group.

There was no statistically significant difference between the median pain scores in all three groups during the 0–24 h period. The difference in median pain scores was most apparent at 24–48 h and beyond. The pain scores in the 24–48 h period did have a statistically significant difference in each successive cohort studied. The median and IQR for pain scores in the 48–72 h period in the LB + D group were 2 [1, 2] when compared to the LB group 2 [1.5–2.5], $p = 0.0237$. The initial postoperative steroid dose is not administered until 8 h after the beginning of surgery. This could potentially explain

TABLE 3 Postoperative length of stay, pain scores, and opioid usage.

				p-value			
	EPI	LB	LB + D	Kruskal test	EPI versus LB	EPI versus LB + D	LB versus LB + D
Median postoperative length of stay in hours	*N* = 59 69 [67–71]	*N* = 149 70 [50–72]	*N* = 168 52 [48–69]	<0.0001	0.1578	<0.0001	<0.0001
Number of pain scores documented							
0–24 h	*N* = 59 19 [16–21.5]	*N* = 149 18 [15–22]	*N* = 168 14.5 [10.75–19]	<0.0001	0.5763	0.0001	<0.0001
24–48 h	*N* = 59 17 [14–20.5]	*N* = 149 16 [13–19]	*N* = 168 13 [9–16]	<0.0001	0.0537	<0.0001	<0.0001
48–72 h	*N* = 57 12 [10–15]	*N* = 117 13 [8–16]	*N* = 99 7 [3–12]	<0.0001	0.7603	<0.0001	<0.0001
Median pain score (0–5)							
0–24 h	*N* = 59 2 [1–2]	*N* = 149 2 [1–2.5]	*N* = 168 2 [1–2]	0.5227	–	–	–
24–48 h	*N* = 59 2 [1.75–2]	*N* = 149 2 [2–2.5]	*N* = 168 2 [1–2]	0.0004	0.5323	0.0393	0.0004
48–72 h	*N* = 57 2 [2–2]	*N* = 117 2 [1.5–2.5]	*N* = 99 2 [1–2]	0.0293	0.2998	0.3601	0.0237
Oral morphine milligram equivalents							
0–24 h	*N* = 59 35 [28–47.5]	*N* = 149 36 [27–46]	*N* = 168 27 [21–37.25]	<0.0001	0.6738	0.0001	<0.0001
24–48 h	*N* = 59 40 [35–47.5]	*N* = 149 35 [28–45]	*N* = 168 30 [20–38]	<0.0001	0.0089	<0.0001	<0.0001
48–72 h	*N* = 58 34 [25–40]	*N* = 123 28 [15–39]	*N* = 119 10 [5–23]	<0.0001	0.1266	<0.0001	<0.0001
Oral milligram morphine equivalent per kilogram							
0–24 h[a]	*N* = 59 0.69 (0.63–0.74)	*N* = 149 0.67 (0.63–0.71)	*N* = 168 0.54 (0.5–0.57)	0.116	0.5877	<0.0001	<0.0001
24–48 h	*N* = 59 0.75 [0.62–0.84]	*N* = 149 0.66 [0.54–0.77]	*N* = 168 0.54 [0.36–0.65]	<0.0001	0.0092	<0.0001	<0.0001
48–72 h	*N* = 58 0.61 [0.44–0.73]	*N* = 123 0.53 [0.29–0.70]	*N* = 119 0.23 [0.09–0.46]	<0.0001	0.1746	<0.0001	<0.0001

Note: Results reported as median value with 25%–75% IQR as values in [] for non-normally distributed variables.

Abbreviations: EPI, epidural group; LB, liposomal bupivacaine group; LB + D, liposomal bupivacaine + dexamethasone.

[a]Results for 0–24 h oral morphine equivalents per kilogram were normally distributed and reported as mean with 95% confidence intervals in ().

the apparent lack of difference in VAS scores in the 0–24 h period. Additionally, our institution records VAS scores at rest and we do not have information regarding VAS scores with movement which would provide a more complete assessment of pain. The organization is also transitioning to a more common pain scale of 0–10 which could also allow for better detection of differences in median pain scores in the future.

Our institution was aware that dexamethasone had been added to a postoperative care pathway by Fletcher et al. for idiopathic scoliosis patients and neuromuscular scoliosis patients. Results were published in a 2020 study by Fletcher et al. that reviewed 113 AIS patients who underwent PSF from 2015 to 2018 at a single institution. The institution's standard pain control protocol consisted of IV diazepam and gabapentin on day of surgery, postsurgery patient-controlled analgesia (PCA) pump, ketorolac, and oral diazepam. In this study, 48 of the AIS patients received three postoperative doses of dexamethasone, while the other 65 received the standard protocol. Fletcher et al. reported a 39.6% decrease in total MMEs in the steroid group as compared to the no steroid group (49.5 mg vs 82.0 mg, $p=0.001$). Also, there was a statistically significant decrease in the median LOS of the steroid group compared to the no steroid (46.5 h vs 49.2 h, $p<0.001$). While the study did not report pain scores per day, there was no significant difference between the pain scores at discharge of the two cohorts (3 vs. 4, $p=0.215$). Our institution reports similar statistics in the reduction of morphine equivalents when IV steroids are given in conjunction with a standardized pain protocol.

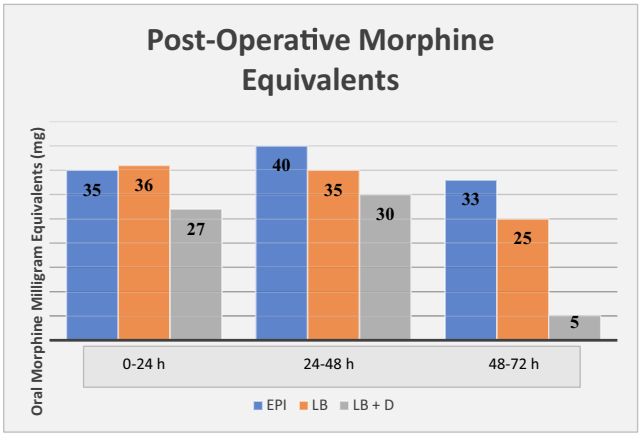

FIGURE 1 Median oral morphine milligram equivalents. EPI, epidural group; LB, liposomal bupivacaine group; LB + D, liposomal bupivacaine + dexamethasone. Comparison of oral morphine milligram consumption between the three study groups at time points 0–24 h postoperatively, 24–48 h postoperatively, and 48–72 h postoperatively.

Interestingly, our quality improvement project reveals a statistically significant difference in pain scores with liposomal bupivacaine open erector spinae plane block and steroid supplementation whereas Fletcher's study shows no difference. This difference could be due to the intraoperative liposomal bupivacaine administered in our project that was not utilized in Fletcher's study. Additionally, the effectiveness of local anesthetics has been shown to be enhanced further when steroids are co-administered with regional anesthetic nerve blocks.[14] However, it should be noted that Fletcher's study uses a 0–10 pain scale, whereas our institution uses the VAS 0–5 scale.

A confounder in both our project and the Fletcher article is that length of stay was decreased with the addition of IV dexamethasone to the AIS postoperative multimodal pain management

TABLE 4 Postoperative antispasmodic medication usage and anti-emetic medication usage.

				p-value			
	EPI	LB	LB + D	Kruskal test	EPI versus LB	EPI versus LB + D	LB versus LB + D
Diazepam doses							
0–24 h	*N* = 59 1 [1–1]	*N* = 149 1 [0–2]	*N* = 168 1 [0–1]	0.0046	0.3359	0.2200	0.0033
24–48 h	*N* = 59 2 [1–3]	*N* = 149 2 [1–3]	*N* = 168 1 [0–2]	<0.0001	0.0521	<0.0001	0.0016
48–72 h	*N* = 58 1 [0–2]	*N* = 122 1 [0–2]	*N* = 118 0 [0–1]	<0.0001	0.6889	0.0003	0.0001
Ondansetron doses							
0–24 h	*N* = 59 0 [0–1]	*N* = 149 1 [1–2]	*N* = 168 1 [1–1]	<0.0001	<0.0001	<0.0001	<0.0001
24–48 h	*N* = 59 1 [0–1]	*N* = 149 0 [0–1]	*N* = 168 0 [0–0.25]	<0.0001	0.2508	<0.0001	<0.0001
48–72 h	*N* = 58 0 [0–0]	*N* = 123 0 [0–0]	*N* = 119 0 [0–0]	0.9312	–	–	–
Aprepitant doses	*N* = 59 0 [0–0]	*N* = 149 0 [0–0]	*N* = 168 0 [0–0]	0.0001	0.6934	0.0132	0.0001

Note: Results reported as median value with 25%–75% IQR as values in [] for non-normally distributed variables.

Abbreviations: EPI, epidural group; LB, liposomal bupivacaine group; LB + D, liposomal bupivacaine + dexamethasone.

regimen. Our patients discharged home 7.7 h sooner. Opioid consumption was not recorded after discharge. Therefore, it is possible that opioid consumption was equivalent between the cohorts at 48–72 h and beyond, but it occurred in the home setting. Additionally, length of stay could potentially be decreased due to turnover in staff orthopedic surgeons. During the data collection period from 2019 to 2022, four of seven orthopedic surgeons remained the same. Three senior staff surgeons were replaced by junior staff surgeons during the data collection time. All surgeons received a detailed video-based training on proper technique for the open erector spinae plane block. However, staff turnover remains as a confounder.

A primary discussion in Fletcher's study was to evaluate wound or infection complications with the addition of postoperative steroids. We had no infections (0/59) in the EPI cohort, 1.3% (2/149) acute SSI rate in the LB cohort and no infections (0/168) with the addition with a short IV course of postoperative steroids in the LB + D cohort. Therefore, no relationship between steroids and infection could be established in this small series of patients.

Currently, all seven orthopedic spine surgeons at our institution follow a standardized pain protocol. Future modifications to the protocol might include a prospective cohort of patients that receive preincisional ultrasound guided erector spinae plane blocks as opposed to surgeon placed open erector spinae plane block.[15,16] Additionally, more data collection in the form of patient reported outcomes could describe patient's overall recovery beyond what is gleaned from pain scores and opioid requirements. Our institution has worked to standardize opioid prescriptions at discharge, but accounting for total usage postoperatively has not been studied and this would strengthen future investigations.

5 | CONCLUSION

The addition of IV dexamethasone to the use of liposomal bupivacaine administered in a surgeon placed open erector spinae block led to the improved recovery of AIS patients. We demonstrated decreased VAS pain scores, opioid consumption, and shorter length of stay when liposomal bupivacaine was combined with IV dexamethasone postoperatively.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest with regard to this manuscript.

DATA AVAILABILITY STATEMENT

Anonymized data are available from the corresponding author upon reasonable request.

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REFERENCES

1. Oetgen ME, Martin BD, Gordish-Dressman H, Cronin J, Pestieau SR. Effectiveness and sustainability of a standardized care pathway developed with use of lean process mapping for the treatment of patients undergoing posterior spinal fusion for adolescent idiopathic scoliosis. *J Bone Joint Surg Am*. 2018;100(21):1864-1870. doi:10.2106/JBJS.18.00079
2. Sanders AE, Andras LM, Sousa T, Kissinger C, Cucchiaro G, Skaggs DL. Accelerated discharge protocol for posterior spinal fusion patients with adolescent idiopathic scoliosis decreases hospital postoperative charges 22. *Spine (Phila Pa 1976)*. 2017;42(2):92-97. doi:10.1097/BRS.0000000000001666
3. Gornitzky AL, Flynn JM, Muhly WT, Sankar WN. A rapid recovery pathway for adolescent idiopathic scoliosis that improves pain control and reduces time to inpatient recovery after posterior spinal fusion. *Spine Deform*. 2016;4(4):288-295. doi:10.1016/j.jspd.2016.01.001
4. Yang J, Skaggs DL, Chan P, et al. High satisfaction in adolescent idiopathic scoliosis patients on enhanced discharge pathway. *J Pediatr Orthop*. 2020;40(3):e166-e170. doi:10.1097/BPO.0000000000001436
5. Temby SE, Palmer GM, Penrose SP, Peachey DM, Johnson MB. Implementation of an enhanced recovery pathway in Australia after posterior spinal fusion for adolescent idiopathic scoliosis delivers improved outcomes. *Spine Deform*. 2021;9(5):1371-1377. doi:10.1007/s43390-021-00340-4
6. Fletcher ND, Shourbaji N, Mitchell PM, Oswald TS, Devito DP, Bruce RW. Clinical and economic implications of early discharge following posterior spinal fusion for adolescent idiopathic scoliosis. *J Child Orthop*. 2014;8(3):257-263. doi:10.1007/s11832-014-0587-y
7. Dietz N, Sharma M, Adams S, et al. Enhanced recovery after surgery (ERAS) for spine surgery: a systematic review. *World Neurosurg*. 2019;130:415-426. doi:10.1016/j.wneu.2019.06.181
8. Tirotta CF, de Armendi AJ, Horn ND, et al. A multicenter study to evaluate the pharmacokinetics and safety of liposomal bupivacaine for postsurgical analgesia in pediatric patients aged 6 to less than 17 years (PLAY). *J Clin Anesthesia*. 2021;75(3):110503.
9. McIntosh AL, McLeod C. Local infiltration anesthesia with liposomal bupivacaine decreases postoperative narcotic consumption in AIS: Quality, safety and value (QSVI). *JPOSNA*. 2022;4(2):1-6. doi:10.55275/JPOSNA-2022-0024
10. Fletcher ND, Ruska T, Austin TM, Guisse NF, Murphy JS, Bruce RW. Postoperative dexamethasone following posterior spinal fusion for adolescent idiopathic scoliosis. *J Bone Joint Surg Am*. 2020;102(20):1807-1813. doi:10.2106/JBJS.20.00259
11. Palamar JJ, Shearston JA, Dawson EW, Mateu-Gelabert P, Ompad DC. Nonmedical opioid use and heroin use in a nationally representative sample of us high school seniors. *Drug Alcohol Depend*. 2016;158:132-138. doi:10.1016/j.drugalcdep.2015.11.005
12. Groenewald CB, Zhou C, Palermo TM, Van Cleve WC. Associations between opioid prescribing patterns and overdose among privately insured adolescents. *Pediatrics*. 2019;144(5):e20184070. doi:10.1542/peds.2018-4070
13. Groenewald CB. Opioid-prescribing patterns for pediatric patients in the United States. *Clin J Pain*. 2019;35(6):515-520. doi:10.1097/AJP.0000000000000707
14. Pehora C, Pearson AM, Kaushal A, Crawford MW, Johnston B. Dexamethasone as an adjuvant to peripheral nerve block. *Cochrane Database Syst Rev*. 2017;11:CD011770.

15. Chin KJ, Dinsmore MJ, Lewis S, Chan V. Opioid-sparing multimodal analgesia with bilateral bi-level erector spinae plane blocks in scoliosis surgery: a case report of two patients. *Eur Spine J*. 2020;29(Suppl 2):138-144. doi:10.1007/s00586-019-06133-8
16. Wittayapairoj A, Wittayapairoj K, Vechvitvarakul M. Effect of bilateral ultrasound-guided erector spinae plane block on postoperative pain after open lumbar spinal surgery: a double-blind, randomized controlled trial. *Eur Spine J*. 2022;32:420-427. doi:10.1007/s00586-022-07494-3

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