

# Retrospective Study Comparing the Efficacy of Epidural Analgesia to Perineural Nerve Catheter Analgesia for Postoperative Pain Management in Pediatric Patients Following a Unilateral Lower Limb Surgery



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## Introduction

Postoperative pain is a common complication for patients that undergo surgery. Multimodal analgesia centers on managing patients' pain while also aiming to reduce patient exposure to opioids. Two methods of multimodal analgesia include epidural catheter infusions and peripheral nerve block infusions.

Besides an epidural infusion delivering global paralysis of both lower extremities, its potential adverse effects include infection, urinary retention, hypotension, pruritus, nausea/vomiting, headaches, backaches, and respiratory depression. Peripheral nerve blocks only act on the local area and the sensory function of nerves is inhibited prior to the motor function. By doing so, with the careful dosing of a peripheral catheter infusion, analgesia is targeted to the intended area while motor mobility is maintained and systemic effects are avoided. The use and extent of multimodal analgesia can vary greatly amongst surgeons (i.e., a single shot nerve block or spinal v. an infusion).

As providers are more judicious with opioid use postoperatively and multimodal analgesia has become more prevalent, it is important to compare multimodal analgesia methods to help determine which method offers the most acceptable combination of both adequate analgesia and a low side effect profile for specific procedures. The primary aim of this study is to determine if peripheral nerve catheterization offers a better analgesic alternative than an epidural catheter in patients who undergo a unilateral lower limb surgery.

## Methods

This was a retrospective study, with PCH IRB approval, that looked at 65 overall patients (epidural: n = 52, continuous peripheral nerve block: n = 13) between the ages of 5-15 years who underwent a unilateral lower limb surgery at Phoenix Children's Hospital from 2014 to 2016. The primary aim of this study was to examine the efficacy of peripheral nerve infusion compared to epidural catheterization.

Inclusion criteria: 5-15 years of age, underwent a unilateral lower limb surgery at Phoenix Children's Hospital, received an epidural or peripheral nerve catheter

Exclusion criteria: history of chronic pain, any previous surgery on extremity, previous surgery on surgical extremity, mental delay or non-verbal or migration of catheter before proper removal

Data gathered included: gender, age, height, diagnosis, surgery information (date of surgery, length of surgery, type of surgery, amount of morphine given), epidural information (placement, medication, length of use), daily morphine usage (all opioids were converted to morphine equivalent), need for analgesic rescue (PCA or other adjunct pain therapies) and adverse events (infection, pruritus, nausea/vomiting, urinary retention, constipation, escalation of care, overdose or compartment syndrome).

Outcomes assessed: opioid consumption (normalized to patient weight and morphine equivalents), pain scores, need for analgesic rescue, length of stay, time to ambulation and the incidence of adverse events. The epidural exposure group was used as the control group.

Wilson Rank Sum was used to compare continuous variable. Fisher's Exact was used to compare categorical variables. Linear Mixed Model was used to ascertain differences in morphine outcomes over time between epidural and perineural block adjusting for age, gender, height, weight, longitudinal time points, length of stay, intraoperative morphine, and length of anesthesia. Generalized Estimating Equation was used to ascertain the likelihood of adverse events over time between epidural and perineural block catheterization adjusting for age, gender, height, weight, longitudinal time points, length of stay, intraoperative morphine, and length of anesthesia.

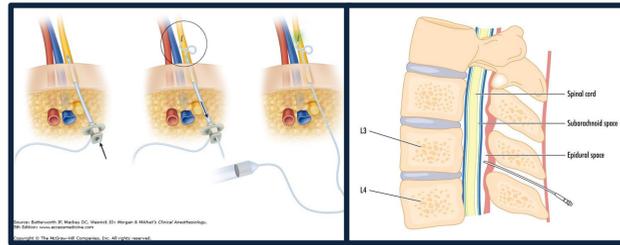


Illustration 1. Peripheral nerve catheter (left) v. epidural catheter (right)

## Results

Demographics				
Variables	Overall N=65	Epidural N=52	Peripheral Block N=13	P-value
Age, years (mean, SD)	11.1 (3.05)	11.1 (3.17)	11.0 (2.61)	0.72
Sex (male, %)	29 (44.6)	22 (42.3)	7 (53.9)	0.54
Height, cm (mean, SD)	144.2 (20.4)	144.4 (20.9)	143.4 (19.1)	0.81
Weight, kg (mean, SD)	44.3 (22.8)	43.7 (22.9)	46.7 (22.6)	0.63
Length of Stay, days (mean, SD)	1.58 (1.81)	4.69 (1.77)	4.15 (1.95)	0.13
Intra-operative Morphine (mean, SD)	8.41 (6.91)	8.63 (7.32)	7.57 (5.16)	0.89
Length of Anesthesia, min (mean, SD)	305.1 (115.8)	296.8 (112.9)	338.2 (125.6)	0.82
Nerve Block (yes, %)	15 (24.2)	2 (4.08)	13 (100.0)	<0.001
Length of Epidural Use, hours (mean, SD)	41.5 (10.9)	41.5 (10.9)	N/A	N/A
Epidural Restarted (yes, %)	1 (2.00)	1 (1.92)	N/A	N/A
Length of PNC use, hours (mean, SD)	44.3 (15.1)	N/A	44.3 (15.1)	N/A
PNC restarted (yes, %)	1 (7.14)	N/A	1 (7.69)	N/A

Table 1. Demographics of the enrolled patients

Differences in morphine			
Outcomes	Epidural vs Peripheral Block Ln (Beta (95% CI))	Epidural vs Peripheral Block exp(Beta (95% CI))	P-value <sup>1</sup>
Pain Score	0.36 (-1.11, 0.39)	1.43 (0.33, 1.47)	0.35
POD continuous Morphine	-4.18 (-0.39, -0.09)	0.02 (0.68, 0.91)	0.001
POD continuous Clonidine	-2.71 (-3.35, -2.08)	0.07 (0.03, 0.12)	<0.001
POD PRN Morphine	-0.36 (-1.12, 0.39)	0.69 (0.33, 1.47)	0.34
POD Total	-0.38 (-1.27, 0.51)	0.68 (0.28, 1.67)	0.39
POD mg/kg Total	-0.28 (-1.03, 0.46)	0.76 (0.36, 1.58)	0.47
POD PCA	-1.11 (-2.23, -0.004)	0.32 (0.11, 0.99)	0.049
Epidural vs Peripheral Block OR (95% CI)			P-value <sup>2</sup>
Adverse Events	0.70 (0.28, 1.74)	N/A	0.45

Table 2. Epidural (control) group vs. Peripheral continuous infusions

Change over time			
Outcomes	Over Time Overall Ln (Beta (95% CI)) <sup>1</sup>	exp(Beta (95% CI))	P-value
Pain Score	-0.005 (-0.03, 0.02)	0.995 (0.97, 1.02)	0.70
POD continuous Morphine	-0.15 (-0.39, 0.09)	0.86 (0.68, 1.09)	0.23
POD continuous Clonidine	0.72 (0.08, 1.35)	2.05 (1.08, 3.86)	0.025
POD PRN Morphine	-0.10 (-0.19, -0.10)	0.90 (0.83, 0.90)	0.024
POD Total	-0.15 (-0.25, -0.048)	0.86 (0.78, 0.95)	0.004
POD mg/kg Total	-0.07 (-0.14, 0.007)	0.93 (0.87, 1.01)	0.09
POD PCA	-1.25 (-1.70, -0.81)	0.28 (0.18, 0.44)	<0.001
OR (95% CI) <sup>2</sup>			P-value
Adverse Events	0.81 (0.68, 0.96)	N/A	0.018

Table 3. Change in time for enrolled patients

## Discussion

- Both groups had similar breakdowns in demographics.
- Patients in the peripheral group had operations that were approximately forty minutes longer (p = 0.82) and received less morphine equivalents intraoperatively (7.57 v. 8.63 [p = 0.89]).
  - The peripheral infusion group had a shorter length of stay in the hospital (4.15 v. 4.69 days [p = 0.13]), which suggests a less eventful recovery and quicker progress to warrant safe discharges after undergoing similarly invasive procedures.
- Patients with peripheral infusions had pain scores that were 43% higher (p = 0.35)
  - However, the peripheral group actually received 98% less (p = 0.001) continuous morphine equivalents in their infusions, required 31% less (p = 0.34) PRN ["as needed"] morphine equivalents, had 68% less (p = 0.049) PCA [patient controlled analgesia] usage rates, and received 32% less (p = 0.39) total morphine equivalents.
  - One explanation is that a more localized analgesia modality allows patients to engage in physical activity and rehabilitation sooner than a patient who received the more global effects of an epidural infusion.
- Patients that received a peripheral nerve block encountered less adverse events than the epidural group, odds ratio of 0.70 (p = 0.45).
  - Epidural infusions are broad and include systemic effects that are well known
- Patients of both groups did well once their infusions were stopped, but one patient in each the peripheral and epidural group required to have their infusions restarted, respectively, due to inadequate pain control.
- All 65 patients' data was analyzed to determine how outcomes changed over time in the postoperative window. The data analysis was not broken down into subset groups of peripheral v. epidural since there was not enough data to trend the change for the groups separately.
  - Patients' pain scores only decreased by 0.5% on average (p = 0.70) for interval averages taken at every 12 hours during hospital courses.
  - Patients received less total and PRN morphine equivalents over time, 14% (p = 0.004) and 10% (p = 0.024), respectively.
  - Patient usage of PCA pumps decreased by 72% (p < 0.001) over time.
  - Although pain scores did not decrease markedly, the significant decreases for total morphine, PRN morphine, and PCA usage indicates that patients may have had acceptable pain control as they were less dependent on treating pain the further they were removed from the time of surgery.
- Limitations of study include:
  - retrospective in design,
  - sample size of 65, while offered valuable insights, was not large enough to provide significant data findings for most or all of the measured outcomes, and
  - the inability to account for surgeons' preferences to either use or not use multimodal analgesia and to what extent (i.e., a single shot spinal or peripheral nerve block v. a running infusion on the floor).

## Conclusions

Patients that received a peripheral continuous block in comparison to the epidural infusion group experienced less adverse effects, had shorter hospital stays, had a similar length of catheter use, and while they had higher pain scores, they also had significantly less exposure to opioids via infusions, PCA pumps, scheduled PO, and PRN PO. Continuous peripheral infusions are a valid alternative to epidural infusions for pediatric patients that undergo a unilateral lower limb surgery and should be considered as part of the therapeutic plan for these patients.

A randomized control trial with an adequate sample size would better elucidate the benefits that various forms of multimodal analgesia, such as epidural and peripheral catheter infusions, would offer in delivering analgesia post-operatively for patients that undergo various procedures. A future study can also compare patients that received an infusion, either peripheral or epidural, to those that only received a single shot peripheral or spinal block. Also, randomly assigning patients to treatment groups would account for surgeons' individual preferences, and would also account for variables involving patient demographics.

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