

Efficacy of Intrathecal Morphine Administration in Pediatric Patients Undergoing Selective Dorsal Rhizotomy

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Background

- Cerebral palsy (CP) is a neuromotor disorder that disrupts normal motor and postural development in children. The improper development of or damage to the developing brain impacts the child's ability to perform precise and effective motor functions.
- The current treatment for CP includes physical therapy and rehabilitation, orthotic devices, and surgery. Selective dorsal rhizotomy (SDR) is a neurosurgical procedure that treats the spasticity associated with CP. SDR involves separating the dorsal and ventral roots, stimulating the dorsal nerve roots, and monitoring the response from target muscles.
- Early studies on SDR in children have proven that epidural administration of morphine in the post-operative period allows for better pain control as compared to oral pain medications. The more recent use of intrathecal morphine has now allowed for prolonged periods of pain control and less use of narcotics in the immediate post-operative period.

Purpose

The purpose of this study was to evaluate the effectiveness of intrathecal morphine following selective dorsal rhizotomy in pediatric patients previously diagnosed with cerebral palsy. Retrospective study evaluated the post-operative narcotic usage in patients who underwent a multi-level laminectomy for SDR in those who received intrathecal morphine intraoperatively compared to those who did not. These data were collected over a four-year period.

Methods

Patient Selection

Patients who underwent multilevel laminectomies for SDR at Akron Children's Hospital, performed by a single surgeon during the study period of June 1, 2015, and June 30, 2019 (n = 15). The control group consisted of patients who did not receive intrathecal morphine. Study patients received a dose of 5 mcg/kg of intrathecal morphine given by the surgeon at the time of dural closure.

Data Collection

Patients were initially captured by a search from Current Procedural Technology (CPT) codes for this procedure (63185, 63190, 63295) through EMR from June 2015-July 2019.

Once patients were identified:

- Length of stay (LOS, which is expressed by the time on neurosurgery service prior to transition to the inpatient rehabilitation service)
- Days on PCA and number of doses administered
- Doses of oral narcotic administered during the hospital stay
- Doses of other oral narcotics administered while in inpatient rehabilitation were reviewed.

Study Variables

Demographic variables: age, weight, and gender

Variables included in the analysis were:

- Time in operating room
- Extent of surgical exploration (based on level and percentage of roots cut and total amount of narcotic used post-operatively at 96 hours as measured by total dose of hydromorphone administered on PCA)
- Number of days on PCA
- Cumulative dose of oral narcotics (oxycodone)
- Number of days on oral narcotics, and number of doses taken.
- Other pain medication including gabapentin, diazepam, and ketorolac that was received within the 96-hour post-operative period was also included within the analysis

Surgical Technique

- Peacock technique using multilevel laminectomy for bony exposure, typically levels L2–L5. All patients underwent the same technique performed by the same surgeon at a single institution. Laminectomies were performed from L2–L5 using an ultrasonic bone scalpel. Using intraoperative neuromonitoring and concurrent functional exam, each level from L2 through S1 was worked through systematically. Sensory nerve rootlets were selected and isolated while motor nerves were protected. If there was an abnormal electrical or motor response, the rootlet was cut. Per side, 20–40% of rootlets per level were targeted.
- For the cohort group, intrathecal morphine at 5 mcg/kg was injected into the subarachnoid space just prior to tying the last dural stitch.
- Patients were then kept flat for 48 hours, allowing for prone, supine, or lateral positioning. On post-operative day two, patients were allowed to sit up and start to mobilize with the help of physical therapy

Statistical Analysis

To identify any statistical difference between the demographics of the two groups, non-parametric descriptive statistics were used in the analysis.

Wilcoxon Rank Sum tests were conducted for age and weight, and Fisher's exact test was conducted to assess any association with gender.

For the variable analysis, the Wilcoxon Rank Sum test was used to compare outcomes between the study group and the control group by incorporating the variables identified. A p-value <0.05 was used to note any significant difference in variables between the groups.

Outcomes

- Fifteen patients were identified who met the inclusion criteria.
- Seven patients received intrathecal morphine, and eight patients did not receive intrathecal morphine intraoperatively
- The group demographics between the study group and the control group did not show any statistical significance with regard to gender, age at time of surgery, or weight at time of surgery. Incidentally, 75% of the control group were female as compared to only 29% of the study group (Table 1)

Table 1. Baseline Demographics

	Intrathecal Morphine		mean difference (95%CI)	p value
	No, n = 8	Yes, n = 7		
Gender, n(%)				
	F 6(75)	2(28.6)		0.132
	M 2(25)	5(71.4)		
Age at time of surgery				0.088
	Mean (SD)	6.1(1.8)	1.9(-0.03; 3.7)	
Ordered observations	5,7,7,8,9,9,9,10	4,5,5,5,8,8,8		
Weight, kg				0.127
	Mean (SD)	20.2(3.6)	7.6(-2.6; 17.9)	
Ordered observations	18.7, 20.4, 22.5, 22.5, 23.8, 25.2, 34, 55.3	14.7, 18.7, 18.8, 19.8, 20, 22.9, 26.2		

While results did not achieve statistical significance, a trend of less narcotic use in total was noted in the cohort group when compared to the control group.

As an example, the total PCA dose for the study group was 3243 mcg while the total for the control group was 4378 mcg, a difference of 1135 mcg. The same tendency was seen in weight-based dosing as well: 163 mcg/kg in the study group vs. 171 mcg/kg in the control group. Although the mean total number of days on oral narcotics was greater in the study group (2.6) vs. the control group (1.8), the total oral narcotic dose was greater in the control group (17.9 mg) vs. the study group (14.1 mg). An even greater difference was seen when examining the median value for this measure, with 20.1 mg in the control group and 10.4 mg in the study group.

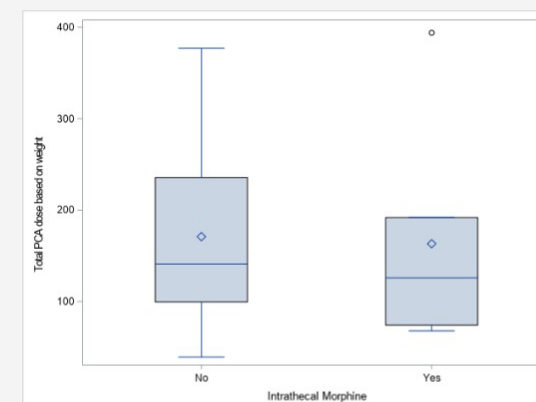


Figure 1: PCA Dose based on weight

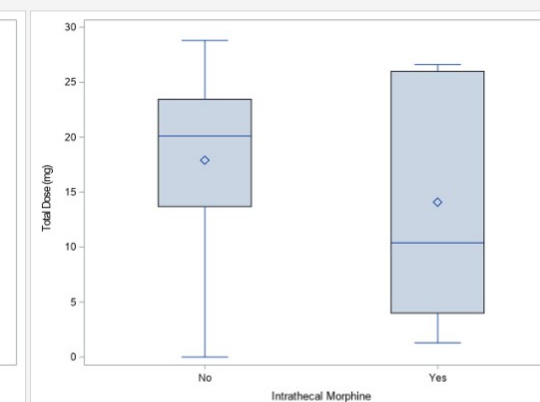


Figure 2: Total Dose of Narcotic

At our institution, ketorolac is commonly given after 12 hours from surgery, barring any contraindication. The median amount of ketorolac given during the first 96 hours post-operatively was 34.4 mg in the control group and 14.4 mg in the study group.

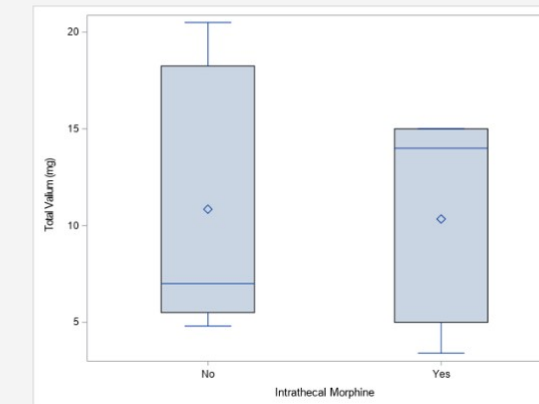


Fig. 3. Total valium dose. Diamond indicates mean; line indicates median.

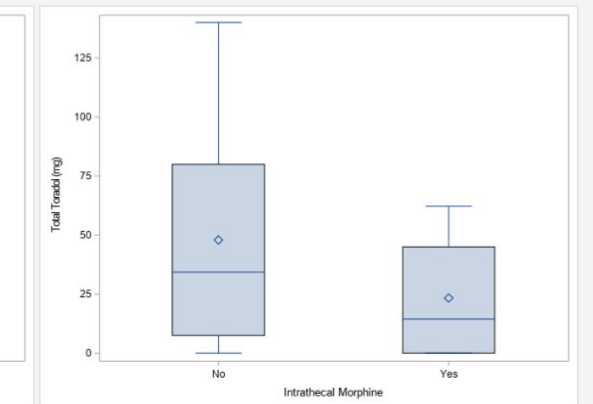


Fig. 4. Total ketorolac dose. Diamond indicates mean; line indicates median.

Another measure that revealed an inverse relationship was the total dose of gabapentin within the first 96 hours post-operatively with 605.6 mg in the control group and 804.3 mg in the study group.

Discussion

Based on the data, it was shown that the use of intrathecal morphine intraoperatively clinically reduced the opiate need in the first 96 hours post-operatively. Although the data did not show statistical significance amongst the variables selected, there did appear to be a tendency to have less overall narcotic use when intrathecal morphine was given in the operating room.

Other positive outcomes from this study included less total dose of oral narcotics, less total dose of diazepam, and less total dose of ketorolac in the immediate post-operative period.

Limitations

- Small population size.
- The cohort groups were not randomized as the decision to begin using intrathecal morphine on all patients was decided halfway through the study period based on the growing body of literature and success of this procedure.
- Furthermore, differing measures of pain validation could be used in the future to assess postoperative pain status.

Conclusion and Future Opportunities

Use of intrathecal morphine has shown some benefits in terms of post-operative pain control for patients undergoing multi-level laminectomy for SDR. This confirmed data from prior studies showing that the use of intrathecal morphine lessens the need for post-operative narcotics in the immediate post-operative period. (2,3)

Moving forward, a prospective randomized study of SDR patients utilizing the single level laminectomy technique and pre-operative gabapentin, with the protocolized postoperative pathway may show clinically significant results.

In the spirit of reducing post-operative narcotic use and enhancing recovery after surgery, the community should consider the utilization of "unconventional" ideas such as long-lasting local anesthetic, nerve blocks, or subcutaneous anesthetic medication administration.

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