Comparison of pre- vs. post-incisional caudal bupivacaine for postoperative analgesia in unilateral pediatric herniorrhaphy: A double-blind randomized clinical trial

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ABSTRACT

Introduction: This study was designed to evaluate the pre- vs. post-incisional analgesic efficacy of bupivacaine administered caudally in children undergoing unilateral hernia repair. **Methods:** Fifty children aged 6 months to 6 years were included in the study. Children were divided blindly between the two groups to receive pre- vs. post-incisional caudal bupivacaine. The preincisional group received 1 ml/kg of 0.125% bupivacaine caudally after induction of anesthesia and the postincisional group received the same dose caudally at the end of surgery. Heart rate, SaO_2, end tidal CO_2, and noninvasive arterial blood pressure were recorded every 10 min. The duration of surgery, extubation time, and duration of recovery period were also recorded. The pain scores were measured with using an Oucher chart in the recovery room, 2, 4, 6, 12, and 24 h after surgery. Time to first analgesia, numbers of supplementary analgesics required by each child in a 24-h period and total analgesic consumptions were recorded. Any local and systemic complications were recorded. Quantitative data were compared using a two-tailed *t*-test. Sex distribution and frequency of acetaminophen consumption were measured using χ^2 test. $P < 0.05$ was considered statistically significant. **Results:** The Oucher pain scale at 4, 6, 12, and 24 h after surgery, the total analgesic consumption and the numbers of demand for supplemental acetaminophen were lower statistically in preincisional group ($P < 0.05$). Extubation time and duration were higher in preincisional group ($P < 0.05$). Mean changes of heart rates were statistically lower during the anesthesia period and recovery time in preincisional group ($P < 0.05$). **Conclusion:** Preincisional caudal analgesia with a single injection of 0.125% bupivacaine is more effective than the postincisional one for postoperative pain relief and analgesic consumption in unilateral pediatric herniorrhaphy.

Key words: *Bupivacaine, caudal analgesia, herniorrhaphy, postoperative pain*

INTRODUCTION

Tissue injuries cause an increase in the excitability of dorsal neurons in the central nervous system, which is a normal physiologic response, and contribute to pain in the postoperative pain.[1] This excitability can be prevented or reduced pharmacologically by the administration of analgesic before injury, which was defined as preemptive analgesia.[2] Then in preemptive analgesia antinociceptive treatment is doing with preventing the establishment of central processing of afferent input, which reduced postoperative pain.[3-6] Afferent noxious stimulus could be interrupted at the periphery, afferent input in sensory axons, and central neurons.[7] Previous clinical studies are controversial about superiority of preemptive or preventive analgesia to reduce postoperative pain.[1,8,9]

Clinical trial studies have documented that caudal blocks performed at the end of hernia repair in children produce effective postoperative analgesia.[10-12] Whether the preincisional caudal block are more effective than caudal block, when performed at the end of surgery in managing postoperative pain in pediatric herniorrhaphy remains controversial. This study was designed to evaluate the pre- vs. postincisional analgesic efficacy of bupivacaine

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administered caudally in children undergoing unilateral hernia repair.

METHODS

After approval of local Ethic Research Committee, all children ASA physical status I or II, aged 6 months to 6 years, who candidate for unilateral hernia repair at the Al-Zahra Medical Center were candidates for inclusion in the study. A written consent was obtained from the parents of all children recruited for the study. They were not admitted to the study if any of the following criteria were present: (1) musculoskeletal diseases, (2) local infection in the site of injection, and (3) aspirin ingestion during the previous week and bleeding diathesis. Children were randomly allocated between the two groups according to parents' selection of closed envelope to receive either preincisional caudal bupivacaine or postincisional caudal bupivacaine. We were describing for parents child about the two methods and blindness of the study and then asked them to select one envelop from a box. The code was revealed to the researchers, who were responsible for the recruitment and data collection, once statistical analyses were completed. In the premedication room, all children received intravenous midazolam 0.1 mg/kg and then they transferred to the operating room. The baseline heart rate, systolic and diastolic blood pressure, and SaO_2 were recorded. Heart rate, SaO_2, and end tidal CO_2 were monitored during the entire anesthesia period and also recorded every 10 min. Noninvasive arterial blood pressure was measured and recorded every 10 min.

Induction of anesthesia was carried out with Na thiopental 5 mg/kg, fentanyl 1 μ/kg, and atracurium 0.6 mg/kg, and then, trachea was intubated. Maintenance of anesthesia was performed with 66% N_2O in 33% O_2 and 1.2 MAC isoflurane with controlled ventilation. In the preincisional group, patients received 1 ml/kg of 0.125% bupivacaine caudally in the lateral position after induction of anesthesia and intubation of trachea. This dose was selected to perform higher volume, lower concentration of bupivacaine injection, and inhibit of bupivacaine toxicity.[13,14] Skin incision was performed 10 min later. In the postincisional group, the same dose of the bupivacaine was injected caudally, at the end of surgery, with the same position before the reversal of residual neuromuscular paralysis. All caudal blocks were performed in the lateral position, under aseptic conditions, by the same anesthesiologist. The anal sphincter tone was tested at the end of surgery by a blinded anesthesiologist for accuracy of block performance. The patient was excluded from the study if the patient had a tight sphincter.[13] At the end of surgery, the residual neuromuscular block was reversed with a mixture of 0.02 mg/kg atropine and 0.05 mg/kg of neostigmine. Duration of surgery, extubation time (from discontinuation of inhalation agents until extubation) and duration of recovery period (from extubation until discharge from a postanesthesia care unit) were recorded. We compared the Asian version of the Oucher pain intensity scale with children faces by one of the anesthesiologists who was blinded to the patient's groups. Each poster consisted of six color photographs of children's faces, ranging from "no hurt at all" (scored as 0) to the "biggest hurt" (scored as 100).[15] Acetaminophen was administered 30 mg/kg rectally, if pain score was more than 20. Rectal acetaminophen is a usual method of analgesia in our pediatric surgical wards.

In the current study, we tested the hypothesis that the preincisional caudal block with 0.125% bupivacaine is superior to the postincisional caudal block with 0.125% bupivacaine to reduce postoperative pain and analgesic consumption after unilateral hernia repair in children. The pain score recorded in the recovery room, 2, 4, 6, 12 and 24 h after surgery, by an anesthesiologist blinded to the treatment groups. The time to first analgesia was calculated from the tracheal extubation until the first dose of acetaminophen consumption. The numbers of supplementary analgesics required by each child in a 24-h period and total acetaminophen consumptions were recorded. Any local and systemic complications contain seizure, arrhythmia, bradicardia, laryngospasm, re-intubation, delay voiding, and shivering were recorded.

To have an 95% chance of detecting as significant (at the two sided 5% level), a 40 point difference between the two groups in the Oucher pain scale, with an assumed 25 children (50 in total) in each group, was required for study.[16]

Collected data entered into a computer and analyzed by SPSS version 18 software data such as age, weight, anesthesia time, extubation time, recovery time, mean of pain score, mean of acetaminophen consumption, and mean time to first analgesia requirement were compared with using a two-tailed *t*-test. Sex distribution and frequency of acetaminophen consumption were measured by using χ^2-test. The trend and change of heart rate, systolic blood pressure, and diastolic blood pressure during point times were analyzed by repeated measures of the ANOVA test. $P < 0.05$ was considered statistically significant.

RESULTS

The two groups were comparable for sex, age, weight, and duration of surgery [Table 1]. The Oucher pain scale

was statistically lower at 4, 6, 12 and 24 h after surgery in the preincisional group [Table 2]. Extubation time was statistically higher in the preincisional group [Table 3]. The total acetaminophen consumption during the 24 h after surgery was lower significantly in the preincisional group [Table 3]. The numbers of demand for supplemental acetaminophen were significantly lower in the preincisional group [Table 3]. Time to first analgesia was not significant between the two groups [Table 3]. According to repeated measures ANOVA, mean changes of heart rates during the anesthesia period and recovery time in the preincisional group were lower than the postincisional group ($P < 0.001$) [Figure 1 and Table 4]. The comparison of systolic and diastolic blood pressure between the two groups was not statistically significant ($P > 0.05$) [Tables 5 and 6]. In addition, the trend of systolic and diastolic blood pressure was shown in Figures 2 and 3.

SaO_2 and end tidal CO_2 were comparable between the two groups during the anesthesia period. The incidences of postoperative complications were very low: 2 and 3 shivering, respectively, and then the statistical analysis were not possible.

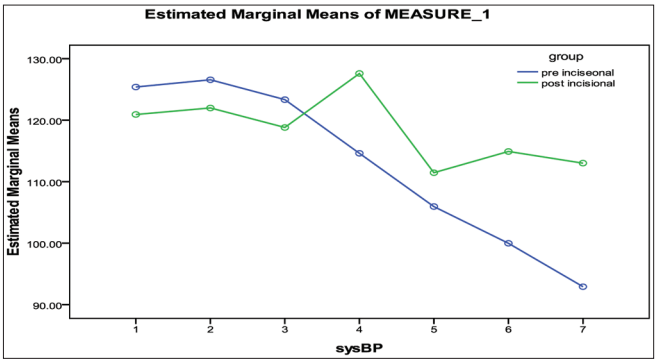

Figure 1: Trend of HR between the two groups

DISCUSSION

This study showed that preincisional caudal analgesia with bupivacaine is superior to the postoperative caudal block for reducing pain intensity, reducing analgesic consumption and a number of demands for supplemental acetaminophen. Mean changes of heart rates were statistically lower during the anesthesia period and recovery time in the preincisional group, which may revealed to lower pain during surgery because of the preincisional block in this group. Previous studies were not in accordance with results for comparing pre- and post-incisional caudal analgesia for postoperative pain relief and analgesic consumption in pediatric patients. Kundra and coworkers compared preemptive caudal bupivacaine with postincisional caudal bupivacaine in

Table 1: Demographic data of the two groups

Variable	Preincisional	Postincisional	*P* value
Age (months)	26 ± 17.5	35.8 ± 22	0.096
Weight (kg)	12 ± 3.6	13 ± 4	0.53
Sex (M/F)	21/4	20/5	1
Duration of surgery (min)	30.2 ± 7.6	31.9 ± 5.5	0.54

Values are mean ± SD. Or number (*n*%)

Table 2: The Oucher pain score, all time measurements are from the extubation time

Variable	Preincisional	Postincisional	*P* value
PACU	18.4 ± 18	20.6 ± 8.7	0.584
2 h	34.8 ± 10	41 ± 21.6	0.188
4 h	22.2 ± 10.4	31 ± 12.5	0.009*
6 h	17 ± 5.6	39.2 ± 13.9	0.000*
12 h	18 ± 2.8	23 ± 10.6	0.000*
24 h	0.000	4.4 ± 7	0.005*

Values are mean ± SD. *Significant values ($P > 0.05$)

Table 3: Extubation time, recovery time, time to first analgesia and acetaminophen requirement of the two groups

Variable	Preincisional	Postincisional	*P* value
Extubation time (min)	46.4 ± 21	24.8 ± 11	0.000*
Recovery time (min)	32.8 ± 15.7	28.5 ± 15	0.325
Total acetaminophen consumption (mg/kg)	38 ± 73	135 ± 101	0.000*
Number of supplementary doses (%)	6 (24)	18 (72)	0.002*
Time to first analgesia (h)	2.2 ± 0.93	3.1 ± 1.6	0.109

Data are presented as mean ± standard deviation or number (*n*%). *Significant values ($P > 0.05$)

Table 4: Mean changes of heart rate over time between the two groups

Time	Groups		
	Preincisional	Postincisional	Mean differences
Before induction of anesthesia	101.12 ± 7.5	106 ± 6.96	4.88 ± 2.48
10 min after induction of anesthesia	104.59 ± 5.8	107.24 ± 9.1	2.64 ± 2.61
20 min after induction of anesthesia	95.41 ± 6.88	101.65 ± 21.1	6.23 ± 5.39
30 min after induction of anesthesia	85.35 ± 8.4	99.59 ± 20.4	14.24 ± 5.36
40 min after induction of anesthesia	79.29 ± 9.2	100.32 ± 22.6	21.1 ± 5.9
Extubation time	77.76 ± 7.48	100.47 ± 22.61	22.7 ± 5.78
Recovery	84.41 ± 8.62	101 ± 23.1	16.59 ± 5.98

$P < 0.001$

Table 5: Mean changes of systolic blood pressure over time between the two groups

Time	Groups		
	Preincisional	Postincisional	Mean differences
Before induction of anesthesia	125.4 ± 26.1	120.9 ± 27.2	4.47
10 min after induction of anesthesia	126.59 ± 24	122 ± 16.79	4.58
20 min after induction of anesthesia	123.35 ± 18.94	118.8 ± 15.48	4.53
30 min after induction of anesthesia	114.63 ± 24	127.6 ± 45	−13
40 min after induction of anesthesia	106 ± 20.6	11.5 ± 15.7	-5.5
Extubation time	92.93 ± 30	113 ± 31	−20.1
Recovery	100 ± 25.4	114.9 ± 26.4	−14.9

P = 0.42

Table 6: Mean changes of diastolic blood pressure over time between the two groups

Time	Groups		
	Preincisional	Postincisional	Mean differences
Before induction of anesthesia	79.1 ± 11	86.5 ± 12.7	11
10 min after induction. of anesthesia	77.5 ± 12	80.8 ± 21.6	12
20 min after induction of anesthesia	79.4 ± 8.5	64.1 ± 32.2	8.5
30 min after induction of anesthesia	80.5 ± 9.1	79.9 ± 15.8	9.1
40 min after induction of anesthesia	80.6 ± 10.8	75.4 ± 17.5	10.8
Extubation time	79.8 ± 12	76.8 ± 13.1	12
Recovery	81.3 ± 12.6	78.4 ± 16.2	12.57

P = 0.54

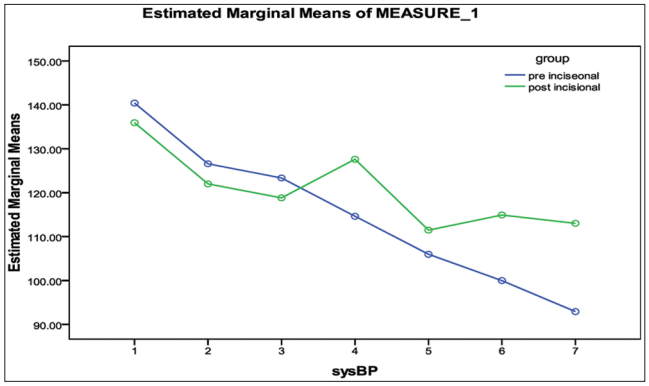

Figure 2: Trend of systolic blood pressure between the two groups

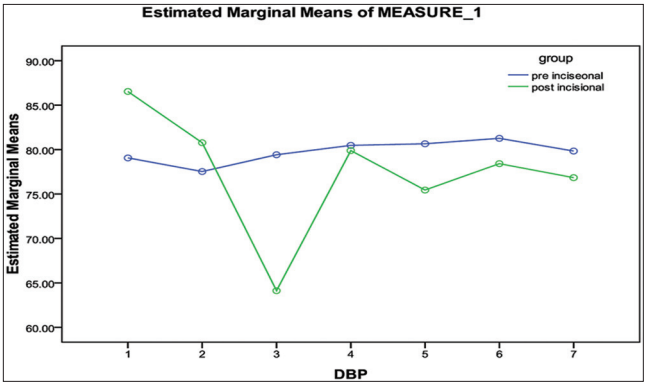

Figure 3: Trend of diastolic blood pressure between the two groups

combination with morphine for reducing postoperative pain of hernia repair.[7] They concluded that the preemptive use of bupivacaine and morphine is superior for reducing postoperative pain and morphine requirement. In addition, time to first analgesia requirement was statistically longer in the preemptive group in their study. Finding of this study is in accordance with our study. Although Kundra used morphine in their study, probably a bigger volume of bupivacaine in our study demonstrates nearly the same results for both studies (1 ml/kg of 0.125% bupivacaine in our study vs. 0.66 ml of 0.25% bupivacaine in Kundra study).[17] Goodarzi evaluated the effect of preincisional and postincisional caudal analgesia on postoperative pain of club foot repair in children.[2] He did not find any significant differences in postoperative analgesic requirement and time to first analgesic administration between the two groups. Rice and coworkers evaluated the timing of caudal placement on postoperative analgesic requirement in pediatric patients.[9] They used 0.5 ml/kg of bupivacaine 0.25% before the onset of surgery and at the end of surgery. They did not find statistically significant differences between the two groups with regard to postoperative pain/discomfort scores and the need for postoperative narcotic analgesia. Ozcengiz *et al.* were compared the quality and duration of postoperative analgesia and the effect on perioperative sevoflurane requirement after preemptive caudal tramadol or morphine in comparison with postsurgical caudal morphine. They concluded that presurgical or postsurgical caudal morphine did not make any difference to postoperative analgesia.[10]

Our study demonstrated a statistically lower heart rate during the surgery and recovery period in the preincisional group in comparison with the postincisional group. Administration of preincisional local anesthetic may be useful to reduce or stop peripheral sensory inflow in nerves and cells in the CNS during surgical intervention. In our study, extubation time (from discontinuation of

inhalation anesthetic until extubation) was statistically more prolonging in the preincisional group than the postincisional group. The same level of anesthesia could explain this deference as in the preincision group block could be associated with a good analgesia, so IV analgesia and sedation could be heavy. In the Rice study, discharge time was longer in the postoperative caudal block group.

CONCLUSIONS

Preincisional analgesia with a single caudal injection of 0.125% bupivacaine is more effective than the postincisional one for postoperative pain relief and analgesic consumption until 24 h.

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