Journal of Clinical Anesthesia 52 (2019) 105–110

Contents lists available at ScienceDirect

Journal of Clinical Anesthesia

journal homepage: www.elsevier.com/locate/jclinane

Original contribution

Comparison of caudal epidural block with paravertebral block for renal surgeries in pediatric patients: A prospective randomised, blinded clinical trial

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ARTICLE INFO

Keywords:
Analgesia
Child
Regional
Ultrasound
Single-shot
Pyeloplasty

ABSTRACT

Study objective: This study was undertaken to compare the analgesic efficacy of ultrasound-guided single-shot caudal block with ultrasound-guided single-shot paravertebral block in children undergoing renal surgeries.
Design: Randomised, interventional, blinded clinical trial.
Setting: Operating rooms of All India Institute of Medical Sciences, New Delhi, India.
Patients: 50 children aged 2–10 years, of ASA status I/II, posted for elective renal surgeries.
Interventions: The children were randomised into two groups (Group C-caudal block, Group P-paravertebral block). After induction of general anesthesia, single-shot caudal or paravertebral block was performed under ultrasound guidance, with 0.2% ropivacaine with 1:200000 adrenaline.
Measurements: Time to first rescue analgesia, time to perform blocks, intraoperative and post-operative hemodynamics, post-operative FLACC scores, incidence of complications, parental satisfaction scores were recorded.
Main results: Children in Group P had significantly longer duration of analgesia ($p < 0.0004$) than Group C. Post-operative FLACC scores ($p < 0.005$) and analgesic requirements ($p < 0.0004$) were lower in Group P. The mean fentanyl requirement over 24 h in group P was 0.56 ± 0.82 μg/kg, compared to 1.8 ± 1.2 μg/kg in group C. Parents in Group P reported greater satisfaction ($p < 0.02$). No complications were seen in either of the groups.
Conclusion: This study showed superior analgesia and parental satisfaction with single-shot paravertebral block in comparison to single-shot caudal block for renal surgeries in children. However, the block performance in children requires adequate expertise and practice.

1. Introduction

Renal surgeries, one of the common surgical procedures performed in children, are associated with significant post-operative pain. Good post-operative analgesia is essential to allow effective coughing and early mobilisation to reduce the occurrence of post-operative respiratory complications. In pediatric patients, caudal epidural block, via landmark approach, remains the most commonly performed regional anesthetic technique [1]. The use of ultrasound has facilitated the correct placement of the block, even in children with sacral anomalies [2]. The use of peripheral nerve blocks in children is on the rise with the advent of ultrasound and nerve stimulators, which assist in better identification of fascial planes.

Paravertebral block has been used for post-operative analgesia in children since 1992 [3]. The main advantages include localised pain control and the ability to avoid large volumes of local anesthetic [4]. It is a promising alternative to caudal analgesia [5]. The use of ultrasound in pediatric regional analgesia has great utility because these are often performed under deep sedation or general anesthesia. Ultrasound guidance offers a qualitative anatomic end-point, provides the ability to observe local anesthetic spread during injection, and can be used to identify abnormal anatomy [6]. This study was undertaken to compare

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https://doi.org/10.1016/j.jclinane.2018.09.007
Received 3 May 2018; Received in revised form 22 August 2018; Accepted 8 September 2018
0952-8180/

the analgesic efficacy of ultrasound-guided caudal epidural block with ultrasound-guided single-shot paravertebral block in children undergoing renal surgeries, namely pyeloplasties.

2. Materials & methods

2.1. Study design and participants

This prospective randomised single blind interventional study was conducted at the All India Institute of Medical Sciences after receiving Institutional Review Board approval (Reg. No. CTRI/006688), in accordance with the CONSORT guidelines.

Informed written consent was taken from the guardians of the children who were enrolled in the study. The routine anesthetic practice at our institute for Anderson-Hynes pyeloplasty is the administration of single-shot caudal block after induction of general anesthesia or local infiltration of the surgical wound. In this study, single-shot caudal block was compared with single-shot paravertebral block. Fifty children, aged 2–10 years, of ASA physical status I/II planned for Anderson-Hynes pyeloplasty were randomised into two groups: Group C (caudal block) and Group P (paravertebral block), using sealed envelopes. Exclusion criteria included contraindications to regional analgesic procedures, neurological/cardiac disease, developmental delay, spine or chest wall deformity, history of previous renal surgeries and history of sensitivity to drugs used in the study. All the children were followed up for 24 h post-operatively, by an anesthesiologist who was blinded to the block given. The primary outcome was the time to first analgesic requirement in the 24 h follow-up period. The secondary outcomes were the time required to perform the blocks, FLACC scores in the 24 h post-operative period, analgesic requirement in each group, incidence of block-related complications and the parental satisfaction scores.

The primary outcome in our study was time to first rescue analgesia. On the basis of previous available literature, the time to first rescue analgesia after a caudal block in pyeloplasty was expected at 287.63 ± 68 min [7]. Assuming 20% increase in time to first rescue analgesia in the paravertebral block group at the rate of 5% level of significance to achieve 80% power of the study, we required 24 samples in each group.

2.2. Study protocol

The perioperative anesthetic management was standardised. The children were induced either inhalationally or intravenously, along with fentanyl 2 μg/kg and atracurium 0.5 mg/kg. Airway was secured with an appropriate size endotracheal tube. Thereafter, anesthesia was maintained with O_2/N_2O (1:1) and isoflurane. The baseline hemodynamic parameters were noted and the children were positioned either for caudal block or paravertebral block. The time to perform the block was noted. Any change in the intra-operative hemodynamic parameters by > 20% was considered as inadequate analgesia and treated with 1 μg/kg fentanyl boluses. The hemodynamic parameters and the number of fentanyl boluses were recorded. Towards the end of the surgery, all the children received intravenous ondansetron 0.1 mg/kg as anti-emetic prophylaxis, and intravenous paracetamol 15 mg/kg, which was continued 6th hourly post-operatively. After the extubation of trachea, all the children were shifted to PACU where the hemodynamic parameters and FLACC scores were recorded at 0, ½, 1st, 2nd, 3rd, 6th, 12th and 24th hours. If FLACC score of > 3 was recorded, the child was first managed by non-pharmacologic means (tactile stimulation, change of position, warming/cooling, etc.) in order to make the child comfortable again. If the child did not settle down, rescue analgesia with fentanyl 1 μg/kg was administered. In cases where rescue analgesia was needed within first 2 h, the block was considered a failure. The time to first rescue analgesia, number of fentanyl boluses, total amount of fentanyl required and the parental satisfaction scores were recorded.

2.3. Ultrasound-guided block: procedure

The blocks were administered by an anesthesiologist who is familiar with the use of ultrasound-guided blocks for post-operative analgesia, both in adults and children.

2.3.1. Caudal block

Children in group C were turned to lateral decubitus position for ultrasound-guided caudal block. After cleaning and draping, a high-frequency 38 mm linear transducer was placed transversely over the sacral cornu to get the 'frog-eye' appearance. The probe was then turned longitudinally to obtain a sagittal view of the caudal space. Using 5 cm, 22 G needle, caudal block was given with 1.25 ml/kg of 0.2% ropivacaine with 1:200000 adrenaline, by in-plane approach.

2.3.2. Paravertebral block

Children in group P were turned to lateral decubitus position for ultrasound-guided paravertebral block at T10 level. After cleaning and draping, a high-frequency 38 mm linear transducer was placed longitudinally to identify the spinous processes of T9-T10. The probe was then moved laterally till the respective transverse processes and the corresponding paravertebral spaces were seen. The probe was then turned obliquely, and using in-plane approach, 0.5 ml/kg of 0.2% ropivacaine with 1:200000 adrenaline was injected at the T10 paravertebral space with 19 G Touhy needle.

2.4. Statistical analysis

The data were analysed using STATA 14.0 and SPSS 20.0. Continuous measurements were presented as mean ± SD, median (IQR) and categorical variables were presented as numbers. Chi-square/Fisher exact test was used to find the significance of study parameters on a categorical scale between the two groups. Unpaired sample *t*-test was used to find the significance of study parameters on continuous scale between two groups. The comparison between the two groups, when the variables were not normally distributed, was done by Mann-Whitney *U* test. $p < 0.05$ was considered significant.

3. Results

As shown in Table 1, the baseline characteristics were comparable between both the groups, except for the time taken to perform the block. The time taken to administer the block was 288.1 ± 146 s (CI: 227.8–348.4) in group P compared to 114.7 ± 68.1 s (CI: 86.6–142.8) in group C ($p < 0.0001$).

There was no statistically significant difference in the heart rate ($p = 0.34$) and mean arterial pressures ($p = 0.29$) amongst the two groups, recorded every 5 min intraoperatively (Figs. 1 & 2).

The requirement of fentanyl boluses intraoperatively was comparable between both the groups ($p = 0.46$). 12 children in group C and 9

Table 1
Demography and patient characteristics (data expressed as mean ± SD, median (IQR) or proportions as applicable).

Variable	Group C ($n = 25$)	Group P ($n = 25$)	*p* value
Age (yrs)	5.1 ± 2.6	6.0 ± 2.6	0.23[a]
Weight (kg)	17.1 ± 6.0	19.5 ± 6.1	0.16[a]
Sex (male/female)	20/5	19/6	0.99[c]
ASA I/II	22/3	25/0	0.23[c]
Time to give the block (s)	114.7 ± 68.1	288.1 ± 146	0.0001[b]
Duration of surgery (min)	99.6 ± 20.7	98.2 ± 22.8	0.82[a]

[a] *t*-Test.
[b] Mann-Whitney test.
[c] Fisher's exact.