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International Journal of Medical and Scientific Research 2023; 1 (1); 18-23.

Original Research Article

Comparative study of dexmedetomidine and clonidine as an adjuvant with 0.25% Ropivacaine in children undergoing hypospadias repair surgery under caudal block

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Received: 16-03-2023 / Revised: 29-03-2023 / Accepted: 1-05-2023
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Conflict of interest: Nil

Abstract

Background: Caudal analgesia is a common technique used to provide perioperative analgesia for infraumbilical surgeries in pediatric patients but with the disadvantage of the short duration of action after a single injection. Many additives were combined with local anesthetics in the caudal block to prolong post-operative analgesia.

Aim and Objectives: To compare the safety and analgesic efficacy of dexmedetomidine and clonidine added to ropivacaine in pediatric patients undergoing hypospadias repair surgeries under the caudal block.

Materials and Methods: A study was conducted among 30 pediatric patients undergoing hypospadias repair surgeries under the caudal block. A total of 30 American Society of Anesthesiologists (ASA) status I and II pediatric patients below 8 years of age were enrolled in this study. The caudal block was administered with inj. ropivacaine 0.25% with clonidine 2 µg/kg (group RC) and inj. ropivacaine 0.2% with dexmedetomidine 2 µg/kg (group RD) after induction with general anesthesia. Hemodynamic parameters were observed before, during, and after the surgical procedure. Post-operative analgesic duration, the total dose of rescue analgesia, pain scores, and any side effects were looked for and recorded.

Results: Adding dexmedetomidine or clonidine to caudal ropivacaine significantly increases the time to rescue analgesia. The mean time for rescue analgesia postoperatively was significantly ($p<0.001$) longer among patients receiving dexmedetomidine (706.73+107.42 min) than clonidine (504.33+97.57 min). No significant difference was observed in the incidence of hemodynamic changes or side effects.

Conclusions: Adding dexmedetomidine to ropivacaine significantly prolongs the time to rescue analgesia for post-operative pain relief in children undergoing hypospadias repair surgery under the caudal block without increasing adverse effects.

Keywords: Caudal analgesia, clonidine, dexmedetomidine

Introduction

Pediatric pain sensation often goes misunderstood, unrecognized or neglected, underdiagnosed, and

undertreated/untreated medical problems, particularly in children. Pediatric pain assessment and management are among the most challenging factors while treating such children in routine practice.[1] Caudal epidural block is safe, effective, reliable, and most popular since its introduction in routine pediatric analgesia practice; having disadvantages of the short duration of action and requirement of repeated doses.[2] To overcome these demerits, the addition of various adjuvants, such as ketamine, opioid, epinephrine, and alpha 2 agonists, leads to the prolongation of caudal analgesia using the single shot technique.[3] It provides rapid and smooth recovery, a better quality of post-operative analgesia, and reduces the other anesthetic agent's requirement in supra and infra umbilical pediatric procedures.[4]

Clonidine is a selective α2 adrenergic receptor agonist and action similar to local anesthetic action. It works by various mechanisms explained earlier, blocking A-delta and C fibers, local vasoconstriction, and intensifying spinal local anesthetic action.[5] Addition of clonidine to ropivacaine significantly prolongs analgesia and reduces the requirement of analgesia during the first 24 hours postoperatively after infra umbilical surgeries in children.[6]

Dexmedetomidine, a highly selective α2 adrenergic receptor agonist, has an eight-fold greater affinity for α2 adrenergic receptors than clonidine. Fewer α1 effects account for more significant analgesic and hypnotic effects than clonidine.[7] Additionally, dexmedetomidine possesses anxiolytic, sedative, sympatholytic, and analgesic properties without respiratory depressant effects.[8]

This study was conducted to study the comparative analgesic effects and side effects of dexmedetomidine and clonidine when added to ropivacaine in children undergoing hypospadias repair surgery under the caudal block.

Material and Methods

The present cross-sectional comparative study was conducted on pediatric patients undergoing hypospadias repair surgery 60 American Society of Anesthesiologists (ASA) status I and II patients, aged below 8 years, whose parents or guardians gave informed consent. The exclusion criteria include a history of developmental delay and mental retardation, drug allergy, local site infection, coexisting neurological or coagulation-related medical illness, anatomical abnormalities of the spine/sacrum, and failed single-shot caudal block.

After obtaining written informed consent and detained pre-anesthetic evaluation, the chit system randomly allocated the patients into two groups. All healthcare personnel providing direct patient care, the subjects, and their parents or guardians were blinded to caudal medications administered. Group A patients received 0.25% ropivacaine 1 ml/kg with 2 µg/kg dexmedetomidine in 0.5 ml volume, while group B received 1 ml/kg of 0.25% ropivacaine with 1 µg/kg of clonidine in 0.5 ml volume.

As a pre-anesthetic medication, intravenous glycopyrrolate 0.01mg/kg, intravenous midazolam 0.1 mg/kg, and intravenous ketamine 3mg/kg were administered according to body weight before shifting patients to the operating room to all the patients in both groups. Anesthesia was induced using an inhaled technique of sevoflurane in oxygen via a pediatric circuit system, and spontaneous ventilation was maintained throughout the surgical procedure maintaining a MAC value of 1. The caudal block was given under general anesthesia in a prone, semi-prone, or lateral position. Hemodynamic parameters, respiratory rate, end-tidal CO2 concentration, and SpO2 were recorded before induction, after intubation, after caudal anesthesia, and at 10 min intervals.

The mean arterial blood pressure, pulse rate, oxygen saturation, pain scores, and sedation scores were recorded at 10 min intervals after extubation and then at intervals of 1, 2, 4, 6, 8, 12, 18, and 24 hours. Pain score was assessed using the FLACC scale. The pain score decided the necessity for rescue medicine. Rescue medication was administered when the FLACC score was≥ 4. In bradycardia (< 20 % of baseline value), intravenous atropine 0.04mg/kg and in hypotension (< 20 % of baseline value), intravenous ephedrine 0.1mg/kg was given. Propofol (1mg/kg) was used as an adjuvant drug for sedation. The total amount of analgesic dose and any complications or side effects were looked for and recorded. All the patients were observed for the next 24 hours in the special room, and all parameters were recorded.

SPSS software 12.1 was used for statistical analysis. Data are presented as mean and standard deviation (SD). To estimate differences in normally distributed continuous outcome variables, the student's t-test for independent samples was used. A P-value of <0.05 was considered statistically significant.

Results

We enrolled 30 pediatric patients (15 children in each group) in our study profile. No difference could be detected from the data of 30 children regarding the patient profile. Patients' demographic data were collected, and no significant difference was found in the groups regarding age, body weight, gender, and duration of surgery.

As shown in Table 1, the mean pulse rate in the dexmedetomidine group was 116.68±11.0 per min, while in the clonidine group, it was 125.3±10.23 per min without any statistically significant difference (p>0.05).

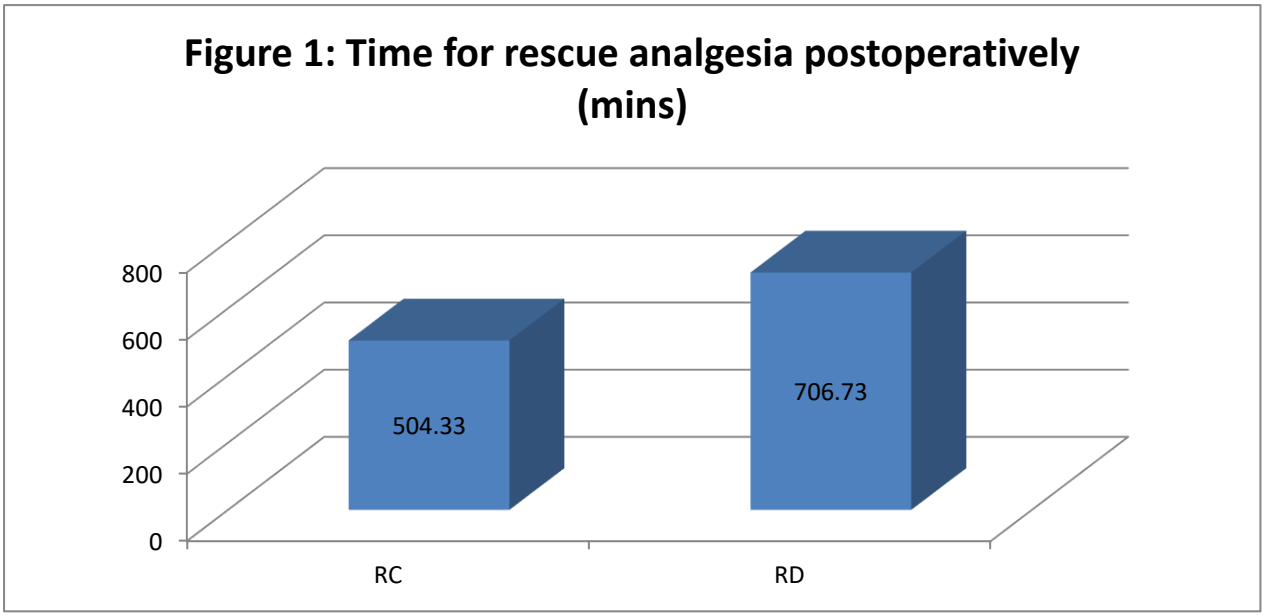
Similarly, the mean arterial pressure in both groups was comparable, and no significant difference between the two groups was found statistically (p>0.05).

No post-operative complications were found in the dexmedetomidine group, whereas in the clonidine group, 3.8% of the patients had post-operative complications (p>0.05).

Table 1: Mean HR, MAP, post-OP complications, and time for rescue analgesia

Parameters	RD	RC	P value
Mean Heart Rate (per min)	116.68±11.0	125.3±10.23	>0.05
Mean Arterial Pressure (mmHg)	60±1.56	65.5±1.5	>0.05
Post-operative complications	0.0%	3.8%	0.309
Time for rescue analgesia	706.73±73	504.33±97.53	<0.001

The mean time for rescue analgesia postoperatively (min) was significantly (p<0.001) longer among patients receiving dexmedetomidine (706.73+107.42 min) than clonidine (504.33+97.57 min).



Discussion

Ropivacaine, in comparison to bupivacaine, has a wider margin of safety, less motor blockade, less cardiovascular or neurological toxicity, and a similar duration of analgesia. It can be safely used for regional anesthesia and analgesia in the ambulatory setting in pediatrics.[9, 10]

The successful use of epidural clonidine in adults led to its evaluation in the pediatric caudal block. The resulting studies have consistently shown caudal clonidine to increase the duration of post-operative analgesia.[11] On the other hand, dexmedetomidine also enhances the effects of local anesthetics without increasing the incidence of side effects.[12] Dexmedetomidine, compared to clonidine, is a much more selective α2-adrenoceptor agonist, which might permit its application in relatively high doses for sedation and analgesia without the unwanted vascular effects from activation of α1-receptors. In addition, dexmedetomidine is a shorter-acting drug than clonidine, and it is unique in that its sedative effect can be reversed by atipamezole.[13] These properties render dexmedetomidine suitable for sedation and analgesia during perioperative. Nevertheless, there are still some concerns regarding its safety.[14]

We found that a caudal bolus injection of a combination of ropivacaine 0.25% with dexmedetomidine 2 µg/kg provides better post-operative analgesia than ropivacaine 0.25% with clonidine 1 µg/kg. Gupta et al. studied the effectiveness and safety of caudal clonidine in comparison with dexmedetomidine in potentiating the post-operative analgesic effect. They found that in pediatric patients who underwent elective lower abdominal surgeries, the addition of dexmedetomidine 2 µg/kg to ropivacaine 0.2% significantly prolonged the median duration of analgesia and reduced the total dose of post-operative analgesic compared with clonidine 2 µg/kg and ropivacaine 0.2% ($P < 0.05$).5 The findings of our study are almost similar to the observations of Gupta et al.[5], as post-operative analgesia was significantly prolonged in the patients receiving dexmedetomidine compared to the clonidine group as an adjuvant to ropivacaine.

Both supraspinal and spinal mechanisms mediate the analgesic activity of alpha 2 agonist dexmedetomidine. It is assumed that central alpha 2 adrenoceptors in the

locus cerulus (a supraspinal) and the spinal cord's dorsal horn are involved in this activity.[15] After adding dexmedetomidine 2 μg/kg to caudal ropivacaine, the magnitudes of hemodynamic changes between the groups were similar.

Our study found no significant differences in mean pulse rate, mean arterial blood pressure, and post-operative complications statistically ($p>0.05$). Similar observations were reported in a study conducted by Gupta et al.[5]

The mean time for rescue analgesia was 504.33+97.53 mins in the dexmedetomidine group, while in the clonidine group, 504.33+97.53 mins were observed. The prolongation of the duration of analgesia was significantly higher in the dexmedetomidine groups compared to the clonidine group.

Another study by El-Hennawy et al.[16] administered dexmedetomidine and clonidine at 2 μg/kg as an adjuvant with 0.25% bupivacaine caudally. They found that the duration of analgesia was significantly higher in the group receiving a bupivacaine–dexmedetomidine mixture [median (95% CI): 16 hours (14–18)] or bupivacaine–clonidine mixture [median (95% CI): 12 hours (3–21)] than the group receiving bupivacaine alone [median (95% CI): 5 hours (4–6)]. Neogi et al.[17] compared clonidine 1 μg/kg and dexmedetomidine 1 μ/kg as adjuncts to ropivacaine 0.25% for caudal analgesia in pediatric patients and concluded that the addition of both clonidine and dexmedetomidine with ropivacaine administered caudally significantly increases the duration of analgesia.

Conclusion

In conclusion, we found that a single caudal injection of dexmedetomidine 2 μg/kg as an adjuvant to ropivacaine 0.2% provides an advantage of prolonged analgesia over clonidine 2 μg/kg added to ropivacaine 0.2% for post-operative pain relief in children undergoing hypospadias repair surgery under the caudal block, without increasing the incidence of adverse effects.

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