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Comparative study between Nalbuphine and Dexmedetomidine as an adjuvant to Ropivacaine for Caudal Block in children undergoing infra umbilical surgeries

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Abstract

Background and Aims: The quality of caudal blocks can be improved by adding adjuvants to the local anaesthetic. Adjuvants prolong analgesia and decrease the adverse effects encountered with single high dose local anaesthetic. The objective of this study was to compare caudal nalbuphine and dexmedetomidine combined with ropivacaine to provide postoperative analgesia in children undergoing infra-umbilical surgeries.
Material and Methods: This was a randomised, prospective double blinded study. A total of 60 children aged 1-12 years were randomly allocated into 2 groups: Group A received caudal block with 0.2% ropivacaine 1ml/kg with 0.2mg/kg nalbuphine and Group B received caudal block with 0.2% ropivacaine 1ml/kg with dexmedetomidine 2 µg/kg. Duration of analgesia, haemodynamic changes and adverse effects were compared. Percentage analysis and independent sample t-test were used. Chi square analysis was used for categorical variables.
Results: Group A recorded duration of analgesia of 5.8± 0.88 hours, compared to 9.1 ±0.89 hours in group B and this was statistically significant. All 30 patients in group B had lower pain scores at 4^{th}, 5^{th} and 9^{th} hours.
Conclusion: caudal ropivacaine 0.2% (1ml/kg) with dexmedetomidine 2 µg/kg resulted in prolongation of duration of analgesia and better quality of analgesia compared with ropivacaine 0.2% (1ml/kg) with nalbuphine 0.2mg/kg without any significant difference in the haemodynamic parameters.
Keywords: Nalbuphine, dexmedetomidine, ropivacaine.

1. Introduction

Research into paediatric pain management has shown that parents, care takers and medical personnel often underestimate the pain experienced by children and also over estimate the adverse effects of pain medications. [1,2] Presently, caudal anaesthesia remains one of the most common and widely used regional anaesthetics in paediatric anaesthesia.

Adjuvants have been added to single-shot caudal blocks to increase the duration of caudal blocks.[3] Ropivacaine has become a commonly used local anaesthetic in paediatric patients, with onset times similar to bupivacaine, without the side effects encountered with bupivacaine. [4]

Nalbuphine is a synthetic, agonist- antagonist opioid drug equivalent to morphine, with a 'ceiling effect'.[5] Dexmedetomidine is a selective alpha 2 receptor agonist with analgesic and anaesthetic sparing effects. [6]

This study was undertaken to compare ropivacaine 0.2% (1ml/kg) with nalbuphine 0.2mg/kg and Ropivacaine 0.2% (1 ml/kg) with dexmedetomidine 2µg/kg as a single shot caudal block in infra-umbilical surgeries in children in terms of duration and quality of post-operative analgesia, haemodynamic changes (HR-heart rate, SBP-systolic blood pressure & DBP-diastolic blood pressure) and also adverse effects if any like post operative nausea and vomiting, respiratory depression, urinary retention, pruritus, hypotension and bradycardia.

2. Methods

This prospective, double-blinded, randomised study was conducted on 60 children aged 1-12 years old undergoing elective infra-umbilical surgeries belonging to American Society of Anaesthesiologists (ASA) Physical Status I and II, randomly allocated to two groups (Group A & Group B) as per a computer generated randomisation table. Exclusion criteria included Patient/ guardian refusal for consent, ASA grade III and IV, infection at the site of injection, coagulopathy or anticoagulation therapy, congenital abnormalities of lower spine and meninges, active central nervous system disease, history of allergy to the drugs used in the study and surgeries longer than 2 hours in duration. The sample size was calculated with confidence interval 95% and power of the study as 80% and significance level of 0.05. A pilot study to determine the sample size yielded a minimum of 14 in each group, which was finally rounded off to 30.

All the children underwent pre-anaesthetic evaluation which included clinical history and physical examination, with routine laboratory investigations. Routine nil per oral protocols were followed as per age. Patients were premedicated with oral midazolam 0.5 mg/kg, 1 hour prior to induction. Intravenous cannula was secured and Ringers Lactate fluid was started according to paediatric fluid guidelines and maintained with standard monitoring i.e. pulse oximetry (SpO_2), non invasive blood pressure, End tidal capnography and electrocardiography monitoring. After administration of Inj. Atropine 15 mcg/kg pre oxygenation was done for 3 min. Anaesthesia induced with thiopentone 3-5 mg/kg i.v and intubated with appropriate Endotracheal tube using Inj. Vecuronium 0.1 mg/kg. Anaesthesia was maintained on oxygen-nitrous oxide (40:60)-sevoflurane and positioned for administration of caudal block. With all aseptic precautions caudal block was performed in lateral decubitus position. Group A received caudal block with 0.2% ropivacaine 1m1/kg with 0.2mg/kg nalbuphine and group B received caudal block with 0.2% ropivacaine 1ml/kg with dexmedetomidine 2 µg/kg.

The study drugs were prepared by an Anaesthesiologist who was not part of the study. The Anaesthesiologist performing the block was unaware of the drug preparations and the intraoperative monitoring and postoperative assessment was done by him. At the end of the procedure, child was extubated and monitored in the post-operative unit for 2 hours. Assessment was done hourly for 10 hours, then at 12th hour.

Duration of analgesia was defined as the time interval between the administration of block and the first requirement of supplementary analgesia for the patient. Post operative analgesia was assessed by Objective Pain Scale (OPS) score (Figure 1).

Figure 1: Objective pain scale

Day			
Time			
Crying			
0: Not crying			
1: Crying but responds to tender loving care (TLC)			
2: Crying and does not respond to TLC			
Moving			
0: None			
1: Restless			
2: Thrashing			
Agitation			
0: Patient asleep or calm			
1: Mild			
2: Hysterical			
Verbal Evaluation or body language			
0: Patient asleep or states no pain			
1: Mild pain (cannot localise)			
2: Moderate pain (can localise) verbally or by pointing or adopts position with legs drawn up to trunk, fists clenched, and moves hand to painful area, or tries to protect it			
Blood Pressure			
0: ± 10 % Pre-Op			
1: 10 to 20% Pre-Op			
2: 20 to 30% Pre-Op			
Total score			

Rescue analgesia was administered if OPS score was ≥4 with iv Paracetamol 10mg/kg over 10 minutes 6 hourly, if OPS score was >4 in 30 minutes, iv Tramadol 1mg/kg 8 hourly was used as second rescue analgesic. These assessments were made at hourly intervals. Quality of analgesia was graded as: 1 to 3- no or minimal pain, 4 to 6- moderate pain and 7 to 10- severe pain.

Patients were monitored for heart rate, oxygen saturation and blood pressure after administration of caudal block at 0,5,15,30,45,60 and 120 minutes and in post operative period and the values were recorded. On extubation patients were monitored for smooth recovery or any agitation; smooth-calm and asleep/ arousable, Agitated - restless, responds to tender loving care and turbulent - thrashing on bed, not responding to tender care. Side effects were noted and recorded with appropriate interventions: Bradycardia- defined as the decrease in the heart rate of more than 20% of the baseline value. It was subsequently treated with Inj. Atropine 0.01mg/kg. Hypotension was defined as a decrease of systolic pressure to <70 mm Hg plus twice the age in years. It was treated with rapid infusion of IV fluids and Inj. Mephentermine. Respiratory depression- defined as a decrease in the SpO2 of <90% that required administration of supplemental oxygen via face mask. Sedation: 1- awake and alert, 2- awake but drowsy, 3- drowsy but arousable, responding to physical stimulus and 4- unarousable, not responding to physical stimulus. Nausea and vomiting, urinary retention, shivering and pruritis were also noted.

SPSS version 20.0 computer software was used for statistical analysis. Variables were expressed as mean ± standard deviation (mean ± SD). Percentage analysis was carried out to find out the demographical information of patients.

Descriptive statistical measures were carried out in each variable. Chi-square analysis was used to find the association between categorical variables. P<0.05 was considered statistically significant.

3. Results

The mean duration of analgesia in group A was 5.8± 0.88 hours, whereas mean duration of analgesia in group B was 9.1 ±0.89 hours. This difference between the two groups was found to be statistically significant (p <0.05) (Table 1).

Table 1: Mean Duration of analgesia

Duration of analgesia	Groups (Mean±SD)		p-value
	Group A (Hours)	Group B (Hours)	
	5.8± 0.88	9.1±0.89	0.001

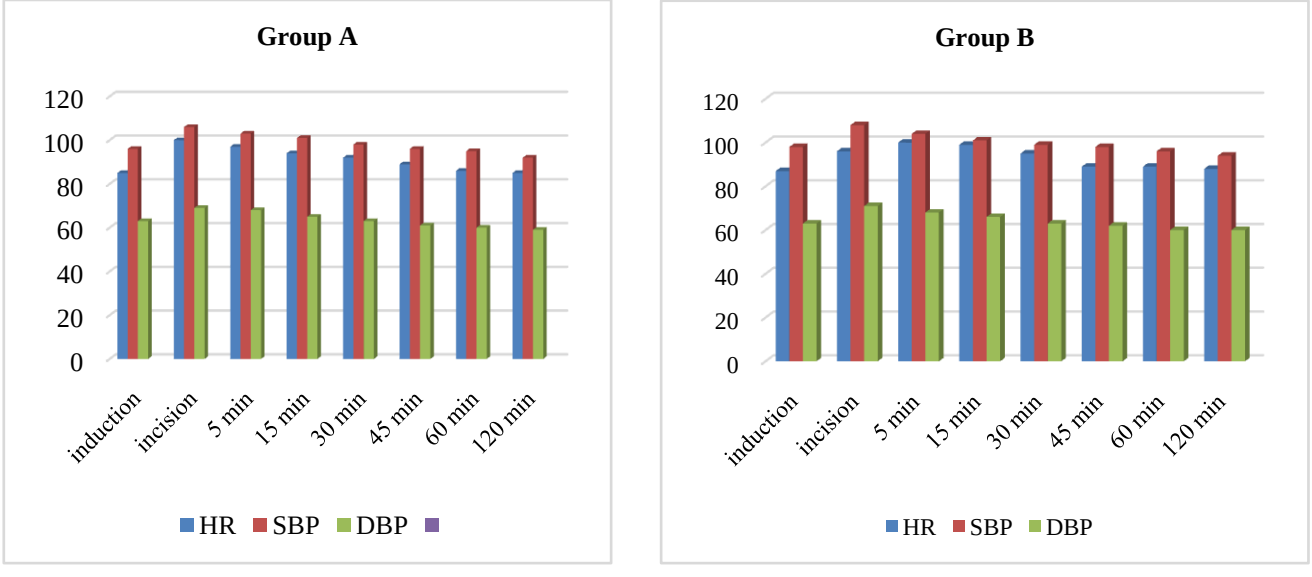
All the patients in both the groups had good analgesia until 4 hours, but 25 patients in group A had good analgesia at the end of 5 hours, where as all 30 patients had good analgesia in group B at the end of 5 hours. This was found to be statistically significant. At the end of the 9th hour only 14 patients of group B continued to have good analgesia. This was found to be statistically significant (Table 2).

Table 2: Quality of analgesia

Quality of analgesia	Groups	Mild/good	P value
4th hour	A	30	0
	B	30	
5th hour	A	25	0.019
	B	30	
9th hour	A	00	0
	B	14	

In group A 25 patients had smooth recovery whereas in group B it was 26 patients. Nausea/ vomiting were noted in 3 patients in Group A and in 2 patients in Group B, no other side effects were noted in both study groups. There were no statistically significant differences in the incidence of side effects in both groups. The perioperative haemodynamic changes were comparable in both groups and not statistically significant (Figure 2).

Figure 2: Haemodynamic changes in both groups



4. Discussion

Post operative pain in children is often an under reported condition. The reported rate of moderate to severe acute post-surgical pain is (APSP) 15-60%.[7] Various options are being used for APSP management. [8] Pain assessment in children is difficult, with different charts and tools in practice, for e.g. OPS.[9]

Caudal block is the most common regional anaesthetic block in children. [10] It offers advantages like early extubation, ambulation, and decreased risk of chest infections, decreased post operative analgesic requirements and early discharge. Most commonly in practice a single shot caudal block with a long acting local anaesthetic is used. Hence the caudal block is limited by the concentration of the local anaesthetic used. Catheters to repeat doses or start infusions in the caudal epidural space are not used frequently because of infection risks. [11]

We may use high dose of local anaesthetics to get around this problem, but this can lead to local anaesthetic toxicity, hypotension and respiratory depression.[12] The use of multimodal analgesia by which two or more drugs of different classes are used in lower concentrations to provide better and longer analgesia while minimizing the risk of either of the drugs adverse effects. [13] Addition of adjuvants to caudal block can achieve longer duration of analgesia without any or minimal side effects. Of late

opioids are being used less as adjuvants due to the various adverse effects (nausea and vomiting, pruritus, respiratory depression).

Ropivacaine is an amide local anaesthetic with less cardio toxic effects and similar analgesic action, compared to the much more common Bupivacaine.[14] There have been few studies with Caudal Ropivacaine with caudal opioids. These studies have shown that opioids added to caudal ropivacaine significantly prolong the duration of post operative analgesia as compared to ropivacaine alone. [15,16]

Nalbuphine is a synthetic agonist-antagonist opioid with less risk of opioid adverse effects due to its kappa receptor activity. Its safety and efficacy has been established in the clinical field. [5,17,18] Dexmedetomidine is a highly alpha 2 agonist which acts by stimulating the pre and post synaptic alpha 2 receptors in the spinal cord which inhibits the release of nociceptive neurotransmitters. It also enhances the effect of local anaesthetics with minimal side effects.[16,19-21] In our study the mean duration of analgesia was 5.8± 0.88 hours in Group A and 9.1±0.89 hours in Group B (Table 1). *Miller* compared caudal 0.25% levobupivacaine 1 ml/kg and caudal levobupivacaine 1ml/kg plus 0.2mg/kg nalbuphine. Group with caudal nalbuphine had a significantly longer duration of analgesia, 6.4 hours vs. 3.36 hours.[22] Thus our study had a similar duration of analgesia with caudal nalbuphine at 0.2mg /kg.

Another study compared caudal 0.25% bupivacaine 1 ml/kg with 2 µg/kg dexmedetomidine and nalbuphine 0.2 mg/kg. The nalbuphine group showed a mean duration of analgesia of 6.70±0.38 hour.[23] In our study it was 5.8± 0.88 hours. This is comparable to the above study. One more study compared bupivacaine 0.25% 1 ml/kg with nalbuphine 0.1 mg/kg. The nalbuphine group had prolonged analgesia (10.1 hours vs. 6.2 hours). This study noted that caudal nalbuphine prolonged the duration of analgesia.[24]

Dexmedetomidine 2µg/kg in combination with ropivacaine 0.2% was compared with fentanyl 2µg/kg by *Gupta and Pratap*. Duration of analgesia was significantly longer with dexmedetomidine (714±149 min vs. 384±71.80 min).[15]

In a previously quoted study, the time for first postoperative analgesic requirement was significantly longer in BD group (16.89±0.74 hours), BN group (6.70±0.38 hours) and B group (4.84±0.70 hours).[23] This study supports our own study findings where dexmedetomidine showed lower pain scores and had longer duration of analgesia.

Gupta and Sharma compared caudal dexmedetomidine (2 µg/kg) with 0.25% ropivacaine (1 ml/kg) for paediatric lower abdominal surgeries and achieved significant postoperative pain relief that resulted in less incidence of emergence agitation following sevoflurane anaesthesia.[25] In our study 4 patients in Dexmedetomidine group were agitated at extubation compared to 5 in nalbuphine group. Alpha 2 agonists are known to facilitate smooth conduction of anaesthesia with their effects extending to post operative period resulting in better recovery without any emergence agitation or deep sedation. Nalbuphine is known to reduce the anxiety and excitation following anaesthesia without prolonging the awakening time. [26-28]

Both nalbuphine and dexmedetomidine groups showed no significant difference with respect to haemodynamics in our study as was the case in the above quoted studies (Figure 3).

5. Conclusion

The present study demonstrated that caudal Ropivacaine 0.2% with Dexmedetomidine 2 µg/kg resulted in prolongation of duration of analgesia and better quality of analgesia compared with Ropivacaine 0.2% with Nalbuphine 0.2mg/kg without any significant difference in the haemodynamic parameters or increase in the incidence of side effects in children undergoing infra umbilical surgeries. Dexmedetomidine offers a significant advantage over Nalbuphine as regards to the duration and quality of analgesia.

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