ORIGINAL ARTICLE

Comparative Evaluation of Magnesium and Dexmedetomidine as Adjuvants to Ropivacaine in Caudal Block in Children - A Randomized Control Trial

Megha Gandotra, Smriti Gulati, Naine Bhadrala,Rajesh Mahajan,Shruti Gupta,Shipra Guptaa

Abstract

Background and aims: Children often receive inadequate analgesia because of the fear of adverse effects of analgesic drugs and also because of difficulty in assessment of pain in children. Caudal block is one of the safe armamentarium used for perioperative anaesthesia and analgesia in children. **Objectives :** Our aim is to compare duration of post operative analgesia and sedation score between dexmedetomidine and magnesium when used as adjuvants to ropivacine in caudal block in pediatric age groups in lower abdominal surgeries.**Materials & Methods** : This randomized clinical study included 90 patients of ASA group I or II in the age group of 2-10 years undergoing lower abdominal surgeries under general anesthesia with caudal block supplementation. They were divided in three groups as Group C received 1 ml of normal saline Group M received magnesium Sulphate (50?mg) in 1 ml normal saline and Group D received dexmedetomidine 1µg/kg in 1?ml normal saline in addition to 0.2% ropivacaine in a dose of 1ml/kg to all participants.**Results :** There was no significant difference demographic and surgical characters among the three groups (p>0.05). However, there was a decrease in mean heart rate of 10-15 % in Group D as compared to the other two groups. The duration of post operative analgesia was significantly prolonged in Groups M and D, with an increase in sedation seen in Group D as compared to other groups.

Conclusion : Dexmedetomidine and magnesium significantly increased the duration of post-operative analgesia when given as adjuvants to ropivacaine in caudal block in children undergoing lower abdominal surgeries.

Keywords

Dexmedetomidine, Ropivacaine, Magnesium, Caudal block, Paediatric

Introduction

The provision of adequate analgesia is necessary during and after any surgery, and it is especially important in children. Inadequate pain relief in children is usually associated with restlessness, excitability and increased oxygen consumption which may lead to hypoxia, post-operative nausea and vomiting and delayed discharge from the hospital. Caudal analgesia reduces the need for inhaled and intravenous anaesthetic requirement, reduces the stress response to surgery and facilitates good post-operative analgesia with early ambulation.[1] Several drugs for caudal analgesia have been investigated including local anaesthetics and adjuvants like midazolam, neostigmine, clonidine, dexmedetomidine etc. The current study was undertaken to compare the relative safety and efficacy of commonly used adjuvants like magnesium and dexmedetomidine for ropivacaine in terms of prolongation and potential analgesia in the intra-operative and post-

PG Department of Anesthesia and Critical Care , Government Medical College, Jammu, Jammu and Kashmir, India

Correspondence to: Dr. Samriti Gulati,Former Professor and Head, Department of Anesthesia , Government Medical College, Jammu (J&K)

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operative period in caudal block in children.

Materials & Methods

This was a randomized clinical trial done after obtaining approval from hospital ethical committee. After written parental informed consent was obtained from 90 participants of ASA classification I or II children in the age group of 2-10 years, of either sex, undergoing elective lower abdominal surgeries under general anaesthesia with caudal block supplementation.

Exclusion criteria : ASA III or more, Weight > 30 kgs, Parental refusal, History of known allergy to study drugs, Coagulation disorders, Any contraindication to neuraxial anaesthesia, Any need for pre-operative sedation or analgesia.

Group allocation : After randomization, 90 participants were allocated into one of the three study groups. The principal component of the mixture injected caudally is ropivacaine 0.2% in a dose of 1?ml/kg to all participants. The adjuvant were added as follows:

"Group C : 1 ml of normal saline as placebo.

"Group M : magnesium Sulphate (50?mg) in 1 ml normal saline.

"Group D : dexmedetomidine 1µg/kg in 1?ml normal saline.

After shifting the child to operation table, monitors were attached. Intravenous line secured with appropriate size intravenous cannula and I/v infusion started. Inj. ondansetron 0.1 mg/kg i/v inj. tramadol 1mg/kg i/v given to all children as premedication. Induction done with inj. propofol 2-2.5 mg/kg and inj. suxamethonium chloride 1.5 mg/kg by i/v route. Intubation done with appropriate size PVC endotracheal tube. Maintenance with O2: N2O, halothane 0.5 to 1% and injection atracurium besylate 0.5 mg/kg as muscle relaxant and then 1/5th stat dose of atracurium as top up dose. Controlled ventilation started. The child was put in left lateral position and received caudal block with a 22 gauge intravenous cannula. Intraoperatively, the efficacy of analgesia was observed through hemodynamic, and with the increase of ? 20% in systolic blood pressure (SBP) or heart rate (HR) above the pre-incision values, the patient was withdrawn from the study and given intravenous 20 mg/kg paracetamol as rescue analgesia. The surgical incision was allowed 10 minutes after the caudal block. Muscle relaxation was reversed at the end of surgery by injection neostigmine (50µg/kg) and injection glycopyrolate (10µg/kg). The following parameters were assessed :

"Duration of analgesia using observer pain scale (OPS) [given by Attia J *et al.*[2] in which laughing, euphoric child is give a score of 1, happy contented child score 2, calm or asleep child score 3, grimacing restless child but can be distracted with toys or parental presence score 4 and inconsolable screaming child score 5. Rescue analgesia was given with OPS score of 4 or more with intravenous paracetamol 20 mg/kg for the first 24 hours.

"Sedation using 5 point sedation score (given by Dsida RM *et al.*[3] in which asleep not readily arousable child is given a score of 1, asleep child responds slowly to verbal commands score 2, drowsy child readily responds to verbal commands score 3, awake calm and quiet child score 4, awake and active child score 5.

Statistical analysis :

was done using statistical package for social sciences (SPSS) for Windows, version 21.0. Categorical variables was presented in number and continuous variables was presented as mean ± SD. Normality of data was tested by Kolmogorov-Smirnov test. Quantitative variables were compared using unpaired t-test/Mann-Whitney test whereas qualitative variables were compared using Chi-square test/Fisher's exact test. A P value of <0.05 was considered statistically significant.

Results

There was no significant difference in age, weight and duration of surgery between three groups (p>0.05). Intergroup comparison of mean systolic BP between all three groups was comparable (*Fig. 1*) and statistically non-significant (P > 0.05). The mean heart rate comparison among group C & D and group M & D showed statistically significant variation at 10, 20 and 30 mins (P < 0.05). There was decrease in mean heart rate of about 10-15 % below baseline at 10, 20 and 30 minutes (*Table 1*) in Group D after administration of caudal block.

Table.1 Group Comparison for Heart Rate (beats/min.)

Time interval	Mean ± Standard Deviation		
	Group C	Group M	Group D
0 minutes	93.30 ± 4.78	91.65 ± 5.36	91.45 ± 5.73
10 minutes	92.75 ± 4.19	91.00 ± 6.33	83.55 ± 7.26
20 minutes	91.50 ± 4.25	89.90 ± 6.11	75.50 ± 9.12
30 minutes	90.20 ± 4.49	89.20 ± 6.16	75.45 ± 8.20
60 minutes	89.10 ± 4.17	88.95 ± 5.70	87.05 ± 5.06
90 minutes	88.80 ± 4.37	88.45 ± 5.32	86.90 ± 4.03
Grand Mean	90.94 ± 3.82	89.86 ± 5.51	83.72 ± 6.57

Table 2. Mean Table for Observer Pain Scale

Group	Observer Pain scale	No. of patients and time duration						
		30 min	1 hr	3 hrs	6 hrs	8 hrs	12 hrs	24 hrs
	1	0	0	0	0	0	0	0
	2	3	10	10	4	0	5	11
C	3	17	10	10	13	13	15	9
	4	0	0	0	3	7	0	0
	5	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0
	2	2	8	12	13	3	0	11
M	3	18	12	8	7	17	13	9
	4	0	0	0	0	0	7	0
	5	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0
	2	0	11	11	12	7	4	10
D	3	20	9	9	8	13	16	10
	4	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0

In our current study, duration of analgesia is defined as the time from the administration of caudal epidural block to the time when first rescue analgesia was needed by the patient. In Group C children who received plain ropivacaine started perceiving pain in between 6 to 8 hours and after receiving rescue analgesia, none had a OPS 4 thereafter (*Table 2*). In Group M children who received ropivacaine plus magnesium perceived pain after 12 hours and after receiving rescue analgesia had OPS ? 4 thereafter (*Table 2*). Mean duration of analgesia in Group C was 7.15 ± 0.71 hours, Group M was 13.01 ± 0.27 and Group D was 15.03 ± 0.25 hours (*Table 3*). Mean sedation score in Group C was 4.33 ± 0.29 hours, Group M was 4.21 ± 0.22 and Group D was 3.84 ± 0.29 hours (*Table 4*) which was statistically significant. Two patients complained of nausea and vomiting each in group C, M and D which was statistically non significant (P > 0.05).

Discussion

The search for ideal drug combinations for caudal epidural anaesthesia in pediatric population is unending, but the quest to use safer drugs relatively in lower concentration is growing day by day. Ropivacaine is one such drug that has a long safety profile in paediatric regional anaesthesia.[4] Its decreased propensity for motor block is useful for rapid patient mobilization in the post-operative period.[5] Magnesium antinociceptive effects are primarily based upon the regulation of calcium influx into the cell.[6] Recent studies conducted by Shahi V[7] and Shruthi *et al*.[8] have successfully demonstrated the anti-nociceptive benefits of epidurally administered magnesium as adjuvant for post-operative analgesia in both adults and children.

In our study we carried out a comparative evaluation of

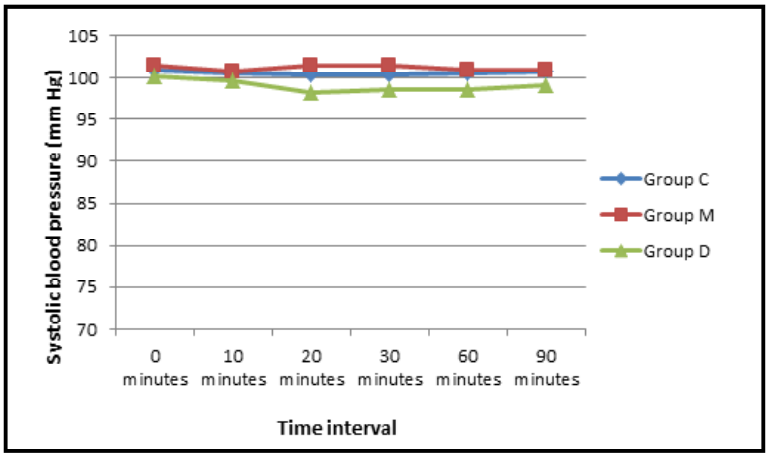
Table 3. Group Comparison for Duration of Analgesia (hrs)

Groups	Duration of post-operative analgesia (hrs) Mean ± Standard Deviation	p-value	Remarks
Group C & M			
Group C	7.15 ± 0.71	0.01	S
Group M	13.01 ± 0.27		
Group C & D			
Group C	7.15 ± 0.71	0.01	S
Group D	15.03 ± 0.25		
Group M & D			
Group M	13.01 ± 0.27	0.01	S
Group D	15.03 ± 0.25		

Table 4. Mean for 5 Point Sedation Score

Groups	5 point sedation score (Mean ± SD)	p-value	Remarks
Group C & M			
Group C	4.33 ± 0.29	0.02	S
Group M	4.21 ± 0.22		
Group C & D			
Group C	4.33 ± 0.29	0.01	S
Group D	3.84 ± 0.29		
Group M & D			
Group M	4.21 ± 0.22	0.01	S
Group D	3.84 ± 0.29		

Fig 1 . Group Comparison for Systolic Blood Pressure (mm Hg)



dexmedetomidine and magnesium as adjuvants to ropivacaine in caudal block in children. There was no significant difference in mean systolic blood pressure between the three groups, but there was a 10-15% decrease in mean heart rate below baseline at 10, 20 and 30 minutes after caudal block with 0.2% ropivacaine + 1 µg/kg dexmedetomidine. This observation was in confirmity with the study done by Nasreen *et al.*[9] who also reported statistically significant decrease in heart rate and mean arterial pressure starting 15 min after caudal block which continued throughout intraoperative period extending up till 1 h postoperatively in dexmedetomidine

(1 µg/kg) plus 0.125% levobupivacaine (0.75 ml/kg) group as compared to the control group consisting of plain 0.25% levobupivacaine group (0.75 ml/kg). In our current study however, the heart rate returned to baseline at 60 and 90 minutes in dexmedetomidine group and thus at 0, 60 and 90 minutes in all three groups the mean heart rate was comparable. This was in contrast to the study done by Sayed *et al*.[10] who reported MAP values were significantly lower in the groups which received dexmedetomidine compared to control group with no statistically significant differences in heart rates between dexmedetomidine plus ropivacaine group & magnesium plus ropivacaine group and all values were within accepted ranges. However, a meta-analysis by Wu *et al*.[11] depicted increased risk of bradycardia (P =0.02) with no increased risk of hypotension with the use of neuraxial dexmedetomidine (administered as 1 µg/kg plus 0.25% bupivacaine in a dose of 1ml/kg) as compared to the control group.

Dexmedetomidine is an alpha 2 adrenergic receptor agonist. The presence of alpha 2 adrenergic receptors in the presynaptic and postsynaptic terminals contributes to its sedative and analgesic properties. It also reduces the volatile anaesthetic, sedative and analgesic requirements of the patients without causing significant respiratory depression.[12] The activation of the presynaptic terminal leads to decreased transmission of pain signals, and activation of the postsynaptic terminal inhibits the sympathetic nervous system, elucidating its hypotensive and bradycardic effects.[13,14]

The observation of prolongation of duration of analgesia in our study with ropivacaine and magnesium (13.01 ± 0.27 hours) combination in caudal epidural block is in agreement with the study done by Sridhar *et al*.[15] who concluded that the addition of adjuvants to ropivacaine prolong duration of caudal analgesia dexmedetomidine (406.2 ± 45.5 min), dexamethasone (450.0 ± 72.6 min), and magnesium (325.0 ± 45.8 min) as compared to ropivacaine (285.9 ± 52.7 min) without any prolonged sedation or significant side effects. El-Hennawy *et al*.[16] administered dexmedetomidine and clonidine, both in a dose of 2 microg/kg as adjuvant with 0.25% bupivacaine caudally and found that the duration of analgesia to be 16 hrs in bupivacaine-dexmedetomidine group, 12 hrs in bupivacaine-clonidine group and 5 hrs in group receiving bupivacaine alone. In our study children receiving ropivacaine with dexmedetomidine as adjuvant started perceiving pain after about 15 hours & after getting rescue analgesia again, the OPS became less than 4. This finding is in agreement with the study done by Saadawy *et al*.[17] They observed the duration of analgesia was significantly longer (upto 18 hours) with the consumption of rescue analgesic significantly lower in dexmedetomidine (1µg/kg) plus 0.25% bupivacaine (1 ml/kg) group as compared to plain bupivacaine group (P < 0.01) without much adverse effects in pediatric patients.

Intergroup comparison in our study reflected that number of the children who received ropivacaine with dexmedetomidine were more sedated in the early post operative period as compared to those who received plain ropivacaine or ropivacaine with magnesium. This is in accordance with the study conducted by Sayed *et al*.[10] who found higher Ramsay sedation scale in study groups which received dexmedetomidine as compared to plain ropivacaine. Although the sedative effect of dexmedetomidine was easily reversed with verbal or physical stimuli with the child returning to sleep when not stimulated. Similar results were reported by Saadawy *et al*.[17] who demonstrated in their study that dexmedetomidine administration in caudal route not only significantly prolongs the duration of analgesia but also produces better quality of sleep and a prolonged sedation. In our study two patients complained of nausea and vomiting each in group C, M and D. The difference was statistically non-significant (P > 0.05). No other complications or side effects like hypotension, bradycardia, urinary retention or motor weakness were reported. This finding of our study is consistent with finding in study conducted by Wang *et al*.[18] and Neogi *et al*.[19] who reported post operative nausea and vomiting as the most common adverse effect with statistically insignificant difference after caudal block

in pediatric patients.

Conclusion

We conclude that addition of magnesium or dexmedetomidine as adjuvants to 0.2% ropivacaine in caudal epidural block in children undergoing infra-umbilical surgery significantly prolongs the duration and quality of post operative analgesia. Dexmedetomidine induces a better quality of sleep leading to a calm arousable state in post operative period. Also there is major benefit of dexmedetomidine over magnesium in terms of prolonged duration of analgesia without any unwanted complications.

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Nil.

Conflicts of Interest
There are no conflicts of interest.

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