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A Study on Hemodynamic Changes in Dexamethasone 0.1 mg/kg When Combined with 0.15% Ropivacaine for Caudal Analgesia in Children

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Abstract

Introduction: The efficacy of dexamethasone in prolonging the effect of local anesthetic has not been extensively studied when compared to other adjuvants. So, in our study we evaluated the analgesic efficacy of caudally administered dexamethasone along with dilute concentration of local anesthetics in children undergoing infra umbilical surgeries.

Methodology: 60 children between the age group 1–5 years of ASA-PS I and II posted for elective infraumbilical surgeries were randomly grouped into two equal groups using shuffled sealed opaque envelope technique. Pre anesthetic evaluation was done and informed consent was obtained from the parents after explaining about the procedure and the drugs being used.The two groups were Group R (control group) and Group D (study group). Group R received 1 ml/kg of 0.15% ropivacaine with normal saline (1ml) and Group D received 1 ml/kg of 0.15% ropivacaine with dexamethasone 0.1 mg/kg in saline to make a total volume 1ml in the caudal epidural space.

Results: No significant variation was noticed in either of the groups with respect to heart rate. The p values at all the various time intervals was >0.05.

Conclusion: There is no difference which is statistically significant between the diastolic blood pressures of the two groups.

Keywords: Hemodynamic changes, Caudal analgesia, Children.

Introduction

Single shot caudal epidural block is one of the most commonly performed neuraxial blockade in children. The developmental anatomy of the caudal space in children enables easy and precise placement of the needle for providing analgesia for infra umbilical surgeries.[1]

The caudal blockade provides extended hours of analgesia postoperatively, improving patient comfort and reducing the risk of possible harmful effects of untreated severe pain. It decreases the undesirable cardiovascular effects such as tachycardia, hypertension, increased peripheral vascular resistance and neurobehavioral changes associated with inadequately treated pain.[2]

It also reduces the intraoperative requirements of anesthetic agents such as opioids and volatile agents thereby allowing a more rapid and smooth recovery following anesthesia. Providing postoperative pain relief with minimal sedation is important in pediatric patient, as overtly sedated children may be unable to protect the airway.[3]

Understanding the pharmacology and pharmacodynamic properties of local anesthetic agents and adjuvant drugs have enabled us to

modify post operative pain management improving patient comfort. The use of local anesthetics such as lignocaine, bupivacaine, ropivacaine etc., in isolation provide only a limited duration of analgesia. Addition of adjuvants such as pethidine, clonidine, dexmedetomidine, magnesium, neostigmine, glucocorticoids, and ketamine to the local anesthetic have been studied extensively in children to maximize analgesia.[4]

The efficacy of dexamethasone in prolonging the effect of local anesthetic has not been extensively studied when compared to other adjuvants. So, in our study we evaluated the analgesic efficacy of caudally administered dexamethasone along with dilute concentration of local anesthetics in children undergoing infra umbilical surgeries.[5]

As with other local anaesthetics, Ropivacaine has the potential to induce CNS and cardiovascular toxicity at high plasma concentrations such as those occurring after large doses or inadvertent intravascular administration. Ropivacaine is less lipophilic than Bupivacaine and that, together with its stereo selective properties, contributes to Ropivacaine having a significantly higher threshold for cardiovascular and CNS toxicity than Bupivacaine in animals and healthy volunteers. The lower lipophilicity of Ropivacaine versus Bupivacaine correlated with the lesser cardio depressant effects of both Ropivacaine isomers than of the Bupivacaine isomer in animal studies. The CNS effects occurred earlier than cardiotoxic symptoms during an intravenous infusion of local anaesthetic (10 mg of Ropivacaine and Bupivacaine) in human volunteers and the infusion was stopped at this point. Significant changes in cardiac function involving the contractility, conduction time and QRS width was found to be significantly smaller with Ropivacaine than with Bupivacaine.[6]

Methodology

60 children between the age group 1–5 years of ASA-PS I and II posted for elective infraumbilical surgeries were randomly grouped into two equal groups using shuffled sealed opaque envelope technique. Pre anesthetic evaluation was done and informed consent was obtained from the parents after explaining about the procedure and the drugs being used. The two groups were Group R (control group) and Group D (study group).Group R received 1 ml/kg of 0.15% ropivacaine with normal saline (1ml) and Group D received 1 ml/kg of 0.15% ropivacaine with dexamethasone 0.1 mg/kg in saline to make a total volume 1ml in the caudal epidural space.

Study Design: It is a prospective, randomized, controlled, double blinded study.

Sample Size: To calculate the sample size to get a statistically significant difference in postoperative analgesia a power analysis of α=0.05 and power 80%, the following formula was used N= 2[(α+β)]2/(μ1−μ2)2=2[(1.96+0.84)2×202]/152=2×13.93= 28 assuming a difference of means to be detected in time of first rescue analgesic requirement in ropivacaine plain group and ropivacaine with dexamethasone of 15min with expected standard deviation 20 min.

Based on a previous study done by Santhi sree et al and using the above formula the minimum number of patients in each group was 25 considering the number of dropouts a sample size of 30 patients in each group was selected 60 children aged between 1 year to 5 years of age undergoing elective infraumbilical surgeries under general anesthesia were enrolled for the study after institutional ethics committee clearance.

Inclusion Criteria:

1. Age 1 year to 5 years
2. ASA PS I and II
3. Children scheduled for elective infraumbilical surgeries

Exclusion Criteria:

1. All contraindications for caudal analgesia like:
   a. Infection at the site of caudal injection
   b. Any sacral bone abnormalities
   c. Bleeding diathesis
2. Parental refusal to give consent
3. Allergy to local anaesthetics/dexamethasone

Results

Table 1: Heart Rates at different time intervals in the two groups.

	Group			
	D		R	
	Mean	SD	Mean	SD
HRBI	124.0	11.7	125.7	14.8
HRAI	137.0	11.9	137.9	13.3
HR1MIN	133.0	13.8	133.9	14.2
HR5MIN	130.2	12.9	132.7	14.4
HR10MIN	129.2	12.0	129.7	14.1
HR15MIN	127.7	12.8	129.5	13.3
HR20MIN	127.4	12.1	128.2	13.7

HR30MIN	126.2	12.3	126.7	13.8
HR40MIN	124.9	12.0	125.7	12.7
HR50MIN	124.2	11.7	125.3	11.4
HR60MIN	121.8	15.7	122.4	15.5

No significant variation was noticed in either of the groups with respect to heart rate. The p values at all the various time intervals was>0.05.(Table 1)

Table 2: Systolic blood pressure variation at different time intervals.

	Group			
	D		R	
	Mean	SD	Mean	SD
SBPBI	106.1	9.2	105.1	7.1
SBPAI	115.9	11.8	113.3	8.8
SBP1MIN	105.8	12.5	105.9	9.8
SBP5MIN	104.0	10.0	104.4	7.9
SBP10MIN	105.4	10.1	104.3	7.8
SBP15MIN	104.9	10.7	104.8	8.7
SBP20MIN	104.8	11.1	102.4	8.0
SBP30MIN	104.0	9.8	102.8	7.7
SBP40MIN	104.8	9.4	102.5	7.3
SBP50MIN	104.1	9.5	102.8	7.4
SBP60MIN	101.3	10.5	102.6	8.4

There is no significant statistical difference between the systolic blood pressure between the two groups.(Table 2)

Table 3: Diastolic Pressure Variation at different time intervals.

	Group			
	D		R	
	Mean	SD	Mean	SD
DBPBI	67.1	10.2	64.9	9.5
DBPAI	78.4	13.7	72.8	9.2
DBP1MIN	71.7	15.4	63.3	8.7
DBP5MIN	70.2	10.4	65.0	9.6
DBP10MIN	67.2	11.9	63.6	8.4
DBP15MIN	65.7	14.0	61.3	9.3
DBP20MIN	63.7	16.5	60.2	7.3
DBP30MIN	65.0	9.9	62.4	7.5
DBP40MIN	65.4	10.7	62.6	7.6
DBP50MIN	64.4	11.8	62.8	5.4
DBP60MIN	65.0	10.6	60.4	9.5

There is no difference which is statistically significant between the diastolic blood pressures of the two groups.(Table 3)

Discussion

The search for alternatives to bupivacaine (1butyl-2′,6′ pipecoloxylidide) which is extensively used for providing caudal anaesthesia, has led to development of relatively new amide local anaesthetic, ropivacaine (N-n propyl2′,6′-pipecoloxylidide) which was first registered for use in 1996.Ropivacaine was introduced in India only in 2009.

Ropivacaine is produced as a pure 'S' enantiomer with lower lipid solubility. Apart from reduced cardiovascular system toxicity, ropivacaine also showed easier reversibility after inadvertent intravascular injection, significant reduction incentral nervous system toxicity, lesser motor block and greater differentiation of sensory to motor block.[7,8]

It is used widely for caudal epidural analgesia in children because of its long duration of action and beneficial ratio of sensory to motor block. Based on a study done by Hong JY et al Ropivacaine 0.15% is the optimum concentration for this purpose, providing equivalent postoperative analgesia to ropivacaine 0.20% (4–6 hrs).[9] Hence in our study 0.15% ropivacaine was used.

Since even long acting local anesthetics like ropivacaine have a limited duration of analgesia of about 4–6 hours, several adjuvants have been used to prolong the duration of analgesia of caudal block. Extended duration of analgesia can be achieved by using caudal additives, however an ideal agent is still not available, alpha–2 agonists, ketamine and midazolam are some of the commonly used drugs as additives.[10]

Recently dexamethasone has been used as an adjuvant for caudal analgesia and has been found to be effective in prolonging the post operative analgesia.[8] The advantage of dexamethasone over other adjuvants is it doesn't produce any respiratory depression, PONV, pruritus, urinary retention and increased sedation. Hence in our study we considered dexamethasone to be the adjuvant along with 0.15% ropivacaine.

Dexamethasone as an adjuvant to local anaesthetic for peripheral nerve/ neuraxial block has various mechanisms of actions like direct membrane action in unmyelinated fibres, vaso constriction, action on potassium channels and suppression of other inflammatory mediators.

Many of the authors who have used dexamethasone as caudal adjuvant have used 0.1mg/kg of the drug.[9] Hence in our study we selected dexamethasone dose to be 0.1mg/kg.

In a previous study regarding the analgesic effect of epidural dexamethasone in adults which showed that effective analgesia was provided by 5 mg of epidural dexamethasone but not 5 mg of i.v. dexamethasone in patients undergoing laparoscopic cholesystectomy, which implied that

epidural dexamethasone has greater analgesic efficacy than i.v. dexamethasone at the same dose.

FLACC scale was used in the study to evaluate pain postoperatively. The FLACC scale can be applied to a wide range of ages including children in the neonatal intensive care unit, preverbal children and children with cognitive impairment, as well as for pediatric postoperative pain. It has been validated and is easy to use.

Motor function was assessed using the following scale: 0, no motor block; 1, able to move legs; 2, unable to move legs.

Demographic criteria and surgical parametres were comparable between the two groups.

There was no significant decrease in heart rate and blood pressure from the base line with the use of dexamethasone with ropivacaine in caudal epidural analgesia, and all patients maintained hemodynamic stability with no episodes of hypotension or bradycardia being reported in our study.

There was no incidence of PONV and no cases of motor block after surgery in the two groups.

Unlike other adjuvants to caudal block investigated in previous studies, no adverse events were observed with dexamethasone during postoperative recovery.

Like, use of caudal opioids (has been associated with adverse effects like respiratory depression, pruritus, nausea, vomiting and urine retention and use of Alpha agonists as adjuvants have been associated with sedation, hypotension, bradycardia.

Conclusion

The haemodynamic parameters like pulse rate, blood pressure, respiratory rate were comparable and statistically non significant. No adverse effects were observed in any of the groups

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