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A COMPARATIVE STUDY BETWEEN DEXAMETHASONE AND MAGNESIUM AS AN ADJUVANT TO ROPIVACAINE IN CAUDAL ANALGESIA IN PEDIATRIC PATIENTS UNDERGOING INFRAUMBILICAL SURGERIES

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ABSTRACT **BACKGROUND:** Caudal analgesia is the most commonly used technique for intraoperative and postoperative analgesia. Adjuvants are the one which prolong analgesia and free of side effects. **OBJECTIVE:** We compared the analgesic effects and side-effects of dexamethasone and magnesium added to ropivacaine for caudal analgesia in pediatric patients undergoing infraumbilical surgeries. **MATERIALS AND METHODS** The comparative study was conducted after obtaining approval from ethical committee. Written informed consent was obtained from parents of patients on day before the surgery.The comparative study was conducted on 75 patients with ASA class I and II, aged between 3-8 yrs scheduled for infraumbilical surgeries were included in this study.Study has been done under three groups with each group containing25 patients. Group 1(control) 0.5ml/kg of injection ropivacaine 0.2% alone. Group 2: 0.5ml/kg of injection ropivacaine 0.2% and magnesium 50mg. Group3:0.5ml/kg of injection ropivacaine 0.2% and dexamethasone 0.1mg/kg. P value <0.05 was considered statistically significant. **RESULTS:** There was a significant prolongation of duration of analgesia in study groups who received dexamethasone and magnesium as compared to ropivacaine alone. Regarding the intensity and duration of analgesia there was a statistically significant difference between two groups, dexamethasone provides longer duration of analgesia when compared to magnesium. None of the adjuvants results in either prolonged or excess sedation. No side effects were encountered in either group. **CONCLUSION:** When compared to magnesium, dexamethasone added to ropivaciane provide longer duration of caudal analgesia without any side effects.

KEYWORDS : DEXAMETHASONE, MAGNESIUM, ADJUVANT , ROPIVACAINE , CAUDAL ANALGESIA

INTRODUCTION

The caudal block is the most commonly performed regional block in paediatric anaesthesia.

Single-shot blocks may not last long and would still depend on the dose, volume, and concentration.

It may not always be feasible to prolong the duration by placing continuous catheters.

Adjuvant added to local anesthetics, bridge the gap by prolonging the duration of single shot blocks Prolongation of caudal analgesia using a "single-shot" technique has been achieved by the addition of various adjuvants such as opioids, ketamine, clonidine and dexmedetomidine. However, their use has been limited by adverse effects in children. Opioids carry risk of postoperative respiratory depression, nausea, vomiting and ketamine has the potential of neurotoxicity if inadvertently injected intrathecally1.To analyze the efficacy of non-opioid adjuvants like dexamethasone2, and magnesium as an adjuvant to ropivacaine in caudal analgesia in pediatric patients undergoing infraumbilical surgeries in terms of duration of postoperative analgesia, postoperative sedation, and postoperative side effects.

AIM OF THE STUDY

To analyze the efficacy of non-opioid adjuvants like dexamethasone, and magnesium as an adjuvant to ropivacaine in caudal analgesia in pediatric patients undergoing infraumbilical surgeries in terms of duration of postoperative analgesia, postoperative sedation, and postoperative side effects1.

MATERIALS AND METHODS

This comparative study was conducted over a period of 1 year from July 2021 to March 2022 among 75 children aged between 3 to 8 years, ASA class I and II posted for infra umbilical surgeries in Government General Hospital attached to Rangaraya Medical College, Kakinada. After obtaining institutional ethics committee approval and informed consent from the parents/guardians of children,this computer generated study population is divided into three groups.

Group 1: (control)0.5ml/kg of injection ropivacaine 0.2% alone

Group 2: 0.5ml/kg of injection ropivacaine 0.2% and magnesium 50mg

Group3: 0.5ml/kg of injection ropivacaine 0.2% and dexamethasone 0.1mg/kg.

Inclusion criteria:

A. Children aged between 3 to 8 years.
B. ASA grade I and II.
C. Cases posted for infra umbilical surgeries.

Exclusion criteria:

A. Contraindication to caudal anesthesia
B. Cardiovascular diseases
C. Drug allergy
D. Coagulation disorders
E. Those who did not given valid informed consent

PROCEDURE

The patient was shifted to operating room, the standard monitors including pulse oximetry, electrocardiogram, and noninvasive blood pressure were attached. Standard general anesthesia technique was followed in all patients using injection fentanyl 2 µg/kg and injection propofol 3 mg/kg as induction agent, airway was secured by insertion of appropriate sized endotracheal tube, facilitated by injection atracurium 0.5 mg/kg. Anesthesia maintained by O2+N2O+sevoflurane 1.0–2.0+intermittent doses of atracurium.

After completion of surgery, Caudal anesthesia was performed in lateral decubitus position using, a 5 cm short beveled 22 G needle. After identifying the space using the loss of resistance technique with saline, the study solutions were injected slowly with repetitive intermittent aspiration.

Study has been done under three groups, with each group containing 25 patients

1. Group I (control) - 0.5 ml/kg of injection ropivacaine 0.2% alone
2. Group II - 0.5 ml/kg of injection ropivacaine 0.2% + Dexamethasone 0.1mg/kg
3. Group III - 0.5 ml/kg of injection ropivacaine 0.2% + Magnesium 50mg

Patient was extubated and shifted to postoperative care unit.

The demographic data (age, weight, ASA status, type, and duration of surgery) and the following parameters were recorded: HR and MAP at baseline, after caudal block, and immediate postoperatively.

In the postoperative anesthesia care unit (PACU), the Modified Objective Pain Score (MOPS) and Ramsay sedation score(RSS) is assessed at 30 min, 1, 2, 3, 6, and 12 h.

Patients were observed for any adverse effects

Modified objective pain score

Table 1: Modified Objective Pain Score

Criteria	0	1	2
Crying	None	Consolable	Nonconsolable
Movements	None	Restless	Thrashing
Agitation	Asleep or calm	Mild	Hysterical
Posture	Normal	Flexed	Holds injury site
Verbal	Asleep or not complaint	Complaint but cannot localized	Complaint but can localize

Ramsay sedation score

Table 2: Ramsay Sedation Score

Score	Clinical response
1	Anxiety and completely awake
2	Completely awake
3	Awake but drowsy
4	Asleep but responsive to verbal commands
5	Asleep but responsive to tactile stimulus
6	Asleep and not responsive to any stimulus

If modified objective pain score was >4, the patients will receive supplementary paracetamol IV injection in a dose of 15mg/kg as rescue analgesia. The time from caudal block to the first time to injection of paracetamol was noted and considered as duration of analgesia.

RESULTS

MODIFIED OBJECTIVE PAIN SCORE:

MOPS	CONTROL	DEXAMETHASONE	MAGNESIUM SULPHATE	P VALUE
30min	3.0	1.0	2.0	0.312
1hr	3.0	1.0	2.0	0.359
2hr	4.0	1.0	2.0	0.954
3hr	4.0	1.0	2.0	0.102
6hr	4.0	1.0	2.0	<0.01
12hr	4.0	1.0	2.0	<0.05

RAMSAY SEDATION SCORE

RSS	CONTROL	DEXAMETHASONE	MAGNESIUM SULPHTE	P VALUE
30min	2.0(2-2)	2.0 (2- 2)	2.0 (1- 2.75)	0.306
1hr	2.0(2-2)	2.0 (2- 2)	2.0 (1- 2)	0.118
2hr	2.0(1-2)	2.0 (1- 2)	2.0 (1- 2)	0.621
3hr	1.5(1-2)	2.0 (1- 2)	2.0 (1- 2)	0.319
6hr	1.0(1-2)	2.0 (1- 2)	2.0 (1- 2)	0.111
12hr	2.0(1-2)	2.0 (1- 2)	1.5(1- 2)	0.971

DURATION OF ANALGESIA

RESCUE TIME(min)	CONTROL	DEXAMETHASONE	MAGNESIUM SULPHATE	P VALUE
Mean+/-SD	280.49+/-57.28	460.25+/-76.20	406.00+/-47.59	<0.001

No adverse effects such as hypotension, bradycardia and respiratory depression were noted in none of the groups studied.

The hemodynamic parameters such as HR and systolic, diastolic, and mean blood pressure were similar among the groups studied.

DISCUSSION

All the adjuvants used in the current study prolonged the duration of caudal analgesia compared to ropivacaine alone. The addition of adjuvants was not associated with increased sedation5. Each adjuvant is unique in its mechanism of action and is considered safe and is efficient in prolonging the duration of analgesia.Many studies suggested that epidurally administered magnesium as an adjuvant could reduce the postoperative pain in adults. But few studies are available about the use of magnesium as an adjuvant in caudal block for postoperative analgesia in pediatrics. On the contrary, dexamethasone has been successfully administered epidurally for postoperative analgesia in adults6. Nevertheless, there are still some concerns regarding its route of administration whether regional or systemic and its additive analgesic effects if administrated as adjuvant. In this study, we found that the duration of adequate caudal analgesia without the need for rescue pethidine is significantly higher in the groups receiving ropivacaine-magnesium or ropivacaine–dexamethasone than the group receiving ropivacaine alone[3]. However, there was statistically significant difference between dexamethasone and magnesium as regards the analgesia duration. Also, rescue oral paracetamol was lower and the time to first oral paracetamol administration was significantly longer with the addition of dexamethasone or magnesium compared with caudal ropivacaine alone7 with improved emergence behavior score and no increased incidence of side effects.Magnesium is known to be an NMDA receptor antagonist. NMDA receptors have been implicated in the development of central sensitivity after noxious peripheral stimulation. Magnesium prevents this central sensitization and whatever the route of administration, the true site of action of magnesium is at the spinal cord NMDA receptors[8,9]. Whereas, Arcioni et al proved that combined intrathecal and epidural MgSO4 supplementation reduce the postoperative analgesic requirements. Farouk found that the continuous epidural magnesium started before anesthesia provided preemptive analgesia and analgesic sparing effect that improved postoperative analgesia. Also, Bilir et al. showed that the time to first analgesia requirement was slightly longer with significant reduction in fentanyl consumption after starting epidural MgSO4 infusion postoperatively. Asokumar et al., found that addition of MgSO4 prolonged the median duration of analgesia after intrathecal drug administration. Birbicer et al., who compared ropivacaine 0.25% plus 50 mg magnesium to ropivacaine 0.25% alone for caudal anesthesia in children. They concluded that that addition of magnesium as an adjuvant agent to local anesthetics for caudal analgesia has no effect on postoperative pain and analgesic need. On the contrary, Ko et al. found that perioperative intravenous administration of magnesium sulfate 50 mg/kg does not reduce postoperative analgesic requirements which could be attributed to the finding that the perioperative intravenous administration of MgSO4 did not increase cerebrospinal fluid magnesium concentration due to inability to cross blood brain barrier.

The effects of systemic dexamethasone in reducing postoperative pain and morbidity have been studied in children. Results have been conflicting; some studies demonstrating benefit and others not. Hong et al. concluded that an intravenous dexamethasone in combination with a caudal block with ropivacaine reduces the intensity of postoperative pain and prolongs analgesic duration after paediatric orchiopexy. The exact mechanism of dexamethasone analgesic effect is not fully understood. Systemic administration of steroids has been found to suppress tissue levels of bradykinin and the release of neuropeptides from nerve endings, both of which can enhance nociception in inflamed tissue. Dexamethasone inhibits the synthesis of the cyclooxygenase isoform-2 in peripheral tissues and in the central nervous system resulting in reduction in prostaglandin production which might contribute to analgesia Dexamethasone has direct membrane stabilizing action on nerves and is believed to have a local anesthetic effect and by regulating nuclear factor kappa B inhibits central sensitization after surgery and potentiates analgesia of the caudal block without any significant adverse effect.Magnesium, a noncompetitive N-methyl-D-aspartate antagonist, extends analgesia primarily based on the regulation of calcium influx into the cell when used caudally.NMDA receptors have been implicated in the development of central sensitivity after noxious peripheral stimulation. Magnesium prevents this central sensitization by inhibiting NMDA receptors.

CONCLUSION

The caudal adjuvants used in the current study, dexamethasone 0.1 mg/kg, and magnesium 50 mg added to 0.2% ropivacaine, prolong the postoperative analgesia in pediatric infra-umbilical surgeries without undue and adverse effects.

When compared to magnesium, dexamethasone added to ropivaciane provides better analgesia and longer duration of caudal analgesia.

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