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Original Article

Caudal Ketamine for Post-operative Analgesia in Pediatric Lower Abdominal Surgeries

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Abstract

Background: Caudal anesthesia is one of the most common regional anesthetic techniques used for lower abdominal and lower extremities surgery in pediatric group of patients. Various drugs other than local anesthetics have been tried for prolonging the duration of post-operative analgesia and also to enhance the quality of block. We aimed to study and compare the effect of ketamine and bupivacaine in caudal epidural block in pediatric patient.

Materials and Methods: This prospective, randomized, double–blind, and controlled study include 60 pediatric patient aged 2–12 years with ASA Grade I and II scheduled for lower abdominal surgery. The patient was randomly allocated to three groups of 20 each. The patient in Group K1 received caudal ketamine 0.5 mg/kg made up to 0.75 ml/kg. The patient in Group K2 received ketamine 1 mg/kg made up to 0.75 ml/kg. The patient in Group B received caudal bupivacaine (0.25%) with epinephrine 1:200,000 in a dose of 1.8 mg/kg made up to 0.75 ml/kg. Vital parameter including heart rate, blood pressure, respiratory rate, sedation score as well as the pain score of the patient was monitored hourly up to the 8th h postoperatively and compared between the groups.

Results: Ketamine and bupivacaine have practically, when given caudally have, no effect on vitals parameter. Bupivacaine (0.25%) and ketamine in doses of 1 mg/kg are better analgesic than ketamine 0.5 mg/kg ($P < 0.05$). There was no significant difference in between groups in sedation score.

Conclusion: In our study, it is concluded that ketamine in doses of 1 mg/kg made up to 0.75 ml/kg afford comparable analgesia to 0.25% bupivacaine when administered caudally in pediatric patient for lower abdominal surgery.

Key words: Bupivacaine, Caudal, Ketamine

INTRODUCTION

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage. During surgery, it occurs as result of direct tissue trauma and further aggravated by reflex muscular spasm or visceral distention.

Post-operative pain is likely to bring a term of unavoidable complications jeopardizing patient's recovery. Prolonged immobilization caused by pain can lead to deep vein thrombosis, bedsores, muscle wasting, hypostatic pneumonia, reduced functional residual capacity, inability for sputum clearance, and many other problems. Thus, the requirement of postoperative pain relief is more for therapeutic than for humanitarian reasons.

Parenteral administration of narcotics remains the most conventional method of post-operative pain relief. The larger dose requirement as compared to modern methods is associated with several side effects such as nausea, vomiting, itching, and respiratory depression early or delayed. When used for prolonged periods, the problems of tolerance and addiction cannot be ignored.

Extradural sacral block is one of the methods in conduction analgesia and provides differential spinal block. It has all

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the advantages of low spinal block and is outside theca. This method scores heavily on grounds of efficiency and largely avoids dangers of vomiting.

Caudal anesthesia has become widespread in pediatric surgery in recent years; especially for operations below the umbilicus since the "First pediatric report" in 1933. Several studies have described the indication for pediatric caudal block, the level of analgesia, recommended doses, and pharmacokinetics of local analgesics and anesthetics used in caudal anesthesia.[1-4]

The ketamine molecule (2-0-chloro-phenyl-2-methylaminocyclohexanone), which structurally resembles phencyclidine and cyclohexylamine, has a molecular weight of 238. Water soluble has a pka of 7.5 and contains a chiral center producing two optical isomers or enantiomers. The racemic mixture contains equal amounts of the two ketamine isomers.[5]

"Dissociative" anesthetic state which has been described as a functional and electrophysiological dissociation between the thalamoneocortical and limbic systems; catalepsy in which the eyes remain open with a slow nystagmic gaze while corneal and light reflexes remain intact, varying degree of hypertonus and occasional non-purposeful movements unrelated to painful stimuli; depression of thalamoneocortical pathways (producing hypersynchronous delta waves), and concomitant activation of limbic system.

Massopust *et al.*[6] showed that ketamine produces a selective depressant effect on the medial thalamic nuclei. This observation was supported by the work of Sparks *et al.*[7] who demonstrated that ketamine blocks afferent signals associated with the affective emotional components of pain perception (spinoreticular tracts) without significantly impairing conduction of signals related to localization of somatic stimuli (e.g., spinothalamic tracts). There are also evidence to suggest that ketamine binds stereospecifically to opiate receptors possibly competing with narcotic analgesics and endogenous morphine such as compounds for central nervous system and spinal cord receptors sites.[8]

Possible systemic toxicity after intravascular injection of local anesthetics or possible respiratory depression after spinal opioid administrations has been the motivation for caudal or epidural administration of ketamine.

It was assumed that ketamine exerts analgesic effects after epidural, caudal, or intrathecal administration because of its interaction with antinociceptive spinal receptors. Because the administration through epidural route would bring the drug closure to "the target organ," the effective doses can be reduced, thus decreasing possible adverse effects. Although some studies have shown sufficient analgesic effectiveness of epidural ketamine,[9] other study did not confirm these results. Hence, this study was conducted to document measurable analgesic effect of caudal epidural administered ketamine in varying doses.

Aims and Objectives

The objectives of the study were as follows:

1. To study the efficacy of caudal epidural administered ketamine as a post-operative analgesic
2. To study the efficacy of caudal epidural administered bupivacaine as a postoperative analgesic
3. To study the effects of caudal epidural administered bupivacaine and ketamine on cardiovascular and respiratory dynamics
4. To study the side effects of bupivacaine and ketamine

MATERIALS AND METHODS

This study was carried out on 60 children of either sex in the age group from 2 years to 12 years. The cases were selected from the routine operative list of pediatric surgery which were below umbilicus in N.S.C.B. Medical College and Hospital, Jabalpur. The duration of study was from 2000 to 2001.

The cases were chosen at random (ASA I and II) from different communities and status. They were examined to rule out any cardiorespiratory or systemic illness a day before surgery. Patients with a history of bleeding diathesis, pre-existing neurological and spinal diseases, or allergic tendencies were excluded from the study. The entire procedure was explained to the patients parents to gain confidence and written informed consent was taken.

Baseline parameters were recorded, that is, blood pressure, heart rate, and respiratory rate. All routine investigations were done and all patients were weighted preoperatively to calculate the dose of caudally administered drug to be given. The study comprised three groups.

- Group K1 consists of 20 patients of the either sex, who received caudal ketamine 0.5 mg/kg made up to 0.75 ml/kg
- Group K2 consists of 20 patients of either sex, who received caudal ketamine 1 mg/kg made up to 0.75 ml/kg
- Group B consists of 20 patients of either sex, who received caudal bupivacaine (0.25%) with epinephrine 1:200,000 made up to 0.75 ml/kg.

A patent vein was secured and patients pre-medicated by injection atropine in dose of 0.03 mg/kg. No narcotic was given. Then, the patients were induced with intravenous

thiopentone (2.5%) 4–7 mg/kg and intubation facilitated with succinylcholine. Anesthesia was maintained with 1–1.5% halothane and O_2, gas mixture (30:70). Muscle relaxation with atracurium and ventilation provided with JR modification of Ayre's T piece or Bain's circuit. An Isolyte P solution was infused at a rate of 5–10 ml/kg/h.

The anesthetized patient was placed in either right or left lateral position with the hip and knees flexed on abdomen with slight flexion of neck. All aseptic precautions were taken. The skin over the sacral hiatus was stretched with the left hand to facilitate puncture. Aspiration for blood and cerebrospinal fluid was done; if negative a test dose of 2 ml of selected drug was injected. The patient was watched for 5 min to detect any untoward effect. The total requisite dose of the drug was then slowly injected.

Immediately after injection of drug, the patient was turned supine. Vitals were obtained after induction of general anesthesia, immediately after caudal injection, and every 5 min thereafter during operation. Skin incision was allowed 15 min after caudal injection. At the beginning, of skin closure, anesthesia was discontinued.

When the surgery was over, the patient was shifted to recovery room and vitals along with sedation score and pain score were recorded before discharging the patient to surgical ward. On arrival to the surgical ward, the patient was observed until 8 h, after the caudal injection.

The efficacy of post-operative analgesia was documented by an observation pain/discomfort scale (OPS) and duration of analgesia after caudal block. Objective behavioral variables are as follows.

- Crying
- Facial expression
- Position of the torso
- Position of legs
- Motor restlessness.

Each variable was scored on a three point scale.

- 1 = None
- 2 = Moderate
- 3 = Severe.

Duration of analgesia was defined as the time between caudal injection of drug and first intravenous injection of paracetamol. If intravenous injection of paracetamol was not necessary within 6 h of observation period, the duration of analgesia was counted as 360 min. A four-point patient sedation score was assigned as follows —

- 1 = Asleep (not arousable by verbal contact)
- 2 = Asleep (Arousable by verbal contact)
- 3 = Drowsy (not sleepy)
- 4 = Alert, awake

Patient was observed closely for complications such as nausea, vomiting. itching, respiratory depression, retention of urine, bradycardia, and convulsion up to 8 h.

OBSERVATIONS AND RESULTS

Maximum number of children were in the age range of 5–8 years in Group B and age range 9–12 years in Groups K_1 and K_2. There was no significant difference between the three groups ($P > 0.05$).

Table 3 shows that children in all three groups had weight ranging from 5 to 28 kg. Difference between the three groups was statistically insignificant ($P > 0.05$).

The main indication of this block is to provide post-operative pain relief in operations below umbilicus. In this study, maximum number of cases were herniotomy (66.66%).

The mean heart rate decreased in all the three groups and there was no significant difference in heart rate among the groups after injection of drug ($P > 0.05$).

Although there was an increase in blood pressure after injection of drug in all the three groups, the difference

Table 1: Distribution of group

S. No.	Group	No. of cases	Drug for caudal epidural	Dose	Volume
1.	B	20	Bupivacaine	1.8 mg/kg	0.75 m1/kg
2.	K1	20	Ketamine	0.5 mg/kg	0.75 m1/kg
3.	K2	20	Ketamine	1.0 mg/kg	0.75 ml/kg

Table 2: Age-wise distribution of the patients

S. No.	Age in years	Group B (*n*=20)		Group K_1 (*n*=20)		Group K_2 (*n*=20)	
		Male	Female	Male	Female	Male	Female
1.	2–4	5	2	6	1	4	2
2.	5–8	7	2	4	2	4	1
3.	9–12	3	1	5	2	7	2
Total		15	5	15	5	15	5
Mean age±S.D.		6.25±2.78		6.6±3.37		7.8±3.39	

between groups was statistically insignificant ($P > 0.05$). The *Z*-test was applied to compare all three groups.

The change in respiratory rate at different hours in each group was found to be statistically insignificant ($P > 0.05$).

Table 8 shows four point sedation score. There was no significant difference between the three groups in mean hourly sedation score. *Z*-test applied to compare all three groups ($P > 0.05$).

Total duration of post-operative pain was observed using OPS. There were more patients requiring additional analgesic immediately after surgery in Group K1 compared with other two groups. In Group B, pain score significantly increased after 7 h. In Group K1, OPS was significantly increased after 4 h of observation. In Group K2, OPS was significantly increased after 5 h of observation. Mean OPS in Group B was significantly lower as compared with K1 ($P < 0.05$).

Table 10 shows mean duration of analgesia in three groups. In Group B, it was 5.10 ± 1.38 h. In Group K1, it was 3.21 ± 1.56 h, and in Group K2, it was 4.35 ± 2.01 h. Mean duration of analgesia for those patients who left the recovery area without first requiring addition analgesia did not differ significantly between groups ($P > 0.05$).

DISCUSSION

Caudal epidural analgesia has become wide spread in pediatric surgery in recent years, especially for pain management within the distribution of the T10–S5 dermatomes, covering the lower abdomen, perineum, and lower extremities. It is evident from various studies that intrathecal and epidural administration of local anesthetic drug and narcotic is a novel method for providing pain relief.

Discovery of caudal epidural space by Corning in 1885 started a new era of pain relief but did not achieve any success till the first successful attempt was done by Cathlein and Sicard (1901), to achieve pain relief by extradural administration of local anesthetic.

Although administration of bupivacaine in caudal epidural space has been the standard method for providing post-operative analgesia for below umblicus surgery; a single injection may have only a relatively short duration of action.

To obviate the need of narcotics, it was decided to determine if caudal ketamine could provide effective, long-lasting analgesia. Each group contains 20 patients posted for repair of inguinal hernia surgery; was given caudal epidural block to evaluate clinically the efficacy of ketamine by this route in children for the purpose of post-operative pain relief.

Group B contains 20 cases for caudal epidural bupivacaine in dose of 1.8 mg/kg, in volume of 0.75 ml/kg diluted with normal saline. Group K1 contains 20 cases for caudal epidural for ketamine in dose of 0.5 mg/kg in volume of 0.75 ml/kg diluted with normal saline and Group K2 contains 20 cases receiving ketamine in dose of 1 mg/kg in volume of 0.75 ml/kg diluted with normal saline.

In this study, 45 patients were male and 15 were female. The mean age of patients in this study was 6.25 ± 2.78 years in Group B, Group K1 was 6.6 ± 3.37 years, and Group K2 was 7.8 ± 3.39 years. The main indications of this block were inguinal herniotomy (66.66%) and herniorrhaphy (33.33%).

Mean weight of patients in Group B was 17.84 ± 5.30 kg, in Group K1 was 17.65 ± 6.28 kg, and in Group K2 was 20.15 ± 7.09 kg. Maximum number of patients were in weight range of 14–18 kg in Group B and weight range of 24–28 kg in Groups K1 and K2. The difference in mean weight of patients of three groups was found to be statistically insignificant.

In this study, patients were premedicated with injection atropine 0.03 mg/kg. After premedication, the patient was induced with intravenous thiopentone (2.5%) 4–7 mg/kg. Tracheal intubation was facilitated with succinylcholine 1–2 mg/kg and intraoperative muscle relaxation achieved using atracurium 0.5 mg/kg. Anesthesia was maintained with oxygen nitrous oxide mixture (30:70) + Halothane (0.5–1%). Patients were ventilated intraoperatively through J.R. modification of Ayre's T Piece or Bain's circuit. Patients received randomly one of the three solutions caudally, diluted with 0.9% saline as necessary so that volume injected into the caudal epidural space was 0.75 ml/kg.

Crighton *et al.*[10] studied 38 patients, the anatomy of the sacral extradural (caudal) space using magnetic resonance imaging. The sacrococcygeal membrane could not be detected in 10.8% of patients. In our study also, the sacral hiatus could not be felt in three children. These patients were excluded from the study.

After the patients were intubated and 15 min before the surgery was started, patients were given caudal block with the predetermined drug. Vital parameters including heart rate, blood pressure, and respiratory rate were observed preoperatively and hourly postoperatively for 8 hrs. Similarly, sedation score was also counted at an hourly interval postoperatively.

Table 3: Weight-wise distribution of the patients

S. No.	Wt. in kg	Group B (*n*=20)		Group K1 (*n*=20)		Group K2 (*n*=20)	
		n	%	*n*	%	*n*	%
1.	5-8	1	5	0	0	0	0
2.	9-13	2	10	6	30	6	30
3.	14-18	10	50	5	25	3	15
4.	19-23	3	15	3	15	2	10
5.	24-28	4	20	6	30	9	45
Mean ± S.D.		17.84±5.30		17.65±6.28		20.15±7.09	

Table 4: Indication of caudal epidural block

S. No.	Name of operation	No. of cases	Percentage
1	Herniotomy	40	66.66
2	Herniorrhaphy	20	33.34

Table 5: Mean heart rate

Time in hours	Group B (HR/min)±SD	Group K1 (HR/min±SD	Group K2 (HR/min)±SD
Pre-operative	102.3±16.64	113.5±16.93	112.1±11.04
0–1	107.7±12.72	108.1±11.15	97.1±11.76
1–2	104.7±7.17	106.4±10.43	98.4±11.38
2–3	103.9±7.44	105.3±10.34	98.3±10.86
3–4	99.2±7.95	104.8±9.87	98.9±9.34
4–5	98.8±5.99	104.6±10.28	99.1±8.49
5–6	98.6±6.77	103.8±10.3	99.5±8.04
6–7	98.9±7.93	103.2±9.58	100.6±7.42
7–8	98.1±7.41	102.9±10.23	99.7±6.90

Table 6: Mean blood pressure

Time in hours	Group B (mm Hg)±SD	Group K1 (mmHg)±SD	Group K2 (mmHg)±SD
Before injection	107.2±8.01	108.2±8.51	109.2±8.42
0–1	106.0±8.18	106.15±7.29	107.2±7.09
1–2	107.84±5.68	106.745±.38	110.325±0.00
2–3	108.11±5.61	109.79±6.29	111.0±4.01
3–4	108.84±4.72	111.89±5.52	111.793±0.39
4–5	108.51±4.80	110.63±4.95	112.214±0.05
5–6	110.11±4.14	111.26±5.34	112.63±2.98
6–7	110.47±4.45	110.47±4.45	112.0±3.46
7–8	110.71±3.22	111.71±3.22	113.16±2.24

Table 7: Mean respiratory rate per minute

Time in hours	Group B (RR/min) ±SD	Group K1 (RR/min) ±SD	Group K2 (RR/min) ±SD
Pre-operative	21.05±2.58	19.6±1.90	18.65±2.56
0–1	20.75±1.55	19.1±1.77	18.6±2.34
1–2	20.85±1.56	18.8±1.64	19.05±1.98
2–3	21.10±1.58	18.2±1.57	19.2+1.88
3–4	20.15±1.38	18.9±1.99	19.4±1.60
4–5	18.9±1.20	19±1.65	19.3±1.62
5–6	21.3±1.28	19±1.65	19.5±1.57
6–7	18.1±1.37	18.9±1.77	19.8±1.57
7–8	18.4±2.21	19.3±1.62	19.2±1.25

Mean heart rate decreased in all the three groups after injection of drug and there was no significant difference in heart rate among the groups. To compare these results, *Z*-test statistics was applied and it was observed that the difference among the three groups was statistically insignificant ($P > 0.05$). Similarly, blood pressure was recorded before injection and postoperatively. Blood pressure at different periods was slightly higher in all the three groups but the difference was statistically insignificant on each occasion ($P > 0.05$).

The findings of this study are consistent with those of Naguib *et al.*[11] They clearly demonstrate that both drugs are devoid of disturbances in circulatory parameters. Another reason for the stability of cardiovascular system from above may be due to less sympathetic activity due to good quality of pain relief.

Respiratory rate was closely observed preoperatively and 1 hourly in post-operative period. Mean respiratory rate before caudal block was 21.05 ± 2.58 per minute in Group B, Group K1 was 19.6 ± 1.90 per minute, and Group K2 was 18.65 ± 2.56 per minute. The change in

Table 8: Sedation score of the study group

Time in hours	Group B (Sedation score)±SD	Group K1 (Sedation score) ±SD	Group K2 (Sedation score)±SD
0–1	1.25±0.44	1.10±0.31	1.15±0.36
1–2	1.25±0.44	1.1±0.31	1.15±0.36
2–3	1.10±0.31	1.15±0.36	1.25±0.44
3–4	1.05±0.22	1.35±0.58	1.25±0.44
4–5	1.05±0.22	1.5±0.68	1.3±0.47
5–6	1.15±0.36	1.70±0.73	1.35±0.48
6–7	1.15±0.50	1.80±0.69	1.35±0.48
7–8	1.45±0.68	1.9±0.64	1.45±0.51

Table 9: Pain score of the study group

Time in hours	Group B (Mean pain score)±SD	Group K1 (Mean pain score)±SD	Group K2 (Mean pain score)±SD
0–1	1.3±0.57	1.3±0.47	1.2±0.41
1–2	1.1±0.31	1.5±0.60	1.35±0.58
2–3	1.15±0.37	1.75±0.71	1.45±0.68
3–4	1.15±0.37	2.4±0.72	1.5±0.76
4–5	1.45±0.60	2.85±0.67	1.85±0.93
5–6	1.6±0.68	3.0±0.85	2.0±0.73
6–7	1.8±0.77	3.1±0.91	2.1±0.79
7–8	2.55±0.69	3.25±0.72	2.2±0.77

Table 10: Mean duration of analgesia

Group	No. of cases	Mean duration of analgesia (hours) ±SD
B	20	5.10±1.38
K1	20	3.21±1.56
K2	20	4.35±2.01

Table 11: Complications

S. No.	Complication	Group B		Group K1		Group K2	
		n	%	*n*	%	*n*	%
1.	Flushing	4	20	4	20	4	20
2.	Pruritus	-	-	2	10	-	-
3.	Emesis	2	10	2	10	2	10
4.	Respiratory depression	-	-	-	-	-	-
5.	Retention of urine	-	-	-	-	-	-
6.	Convulsion	-	-	-	-	-	-
7.	Pain at puncture site	1	5	-	-	2	10

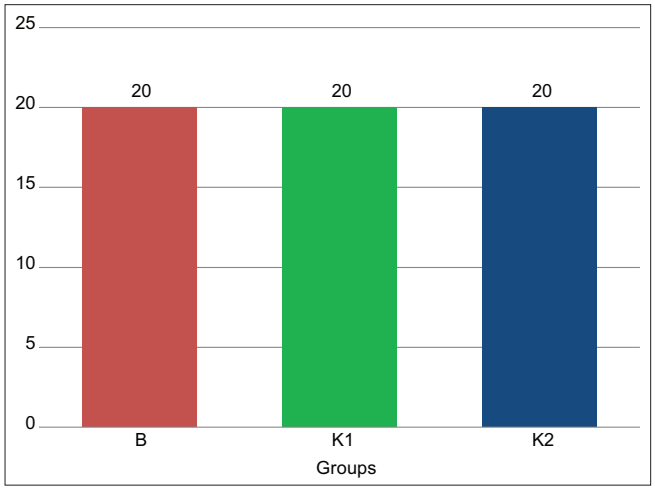

Chart 1: Distribution of group

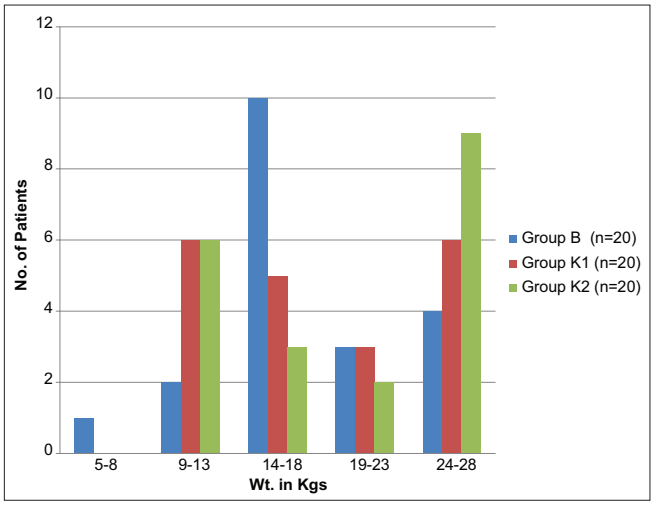

Chart 2: Weight-wise distribution of the patients

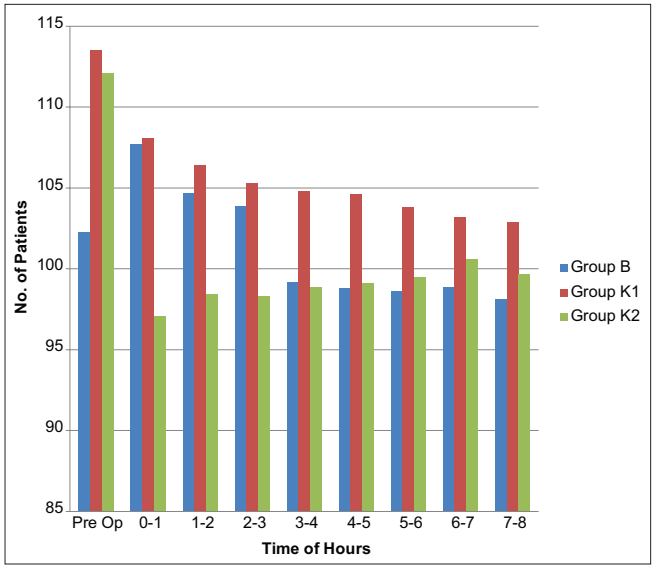

Chart 3: Mean heart rate per minute

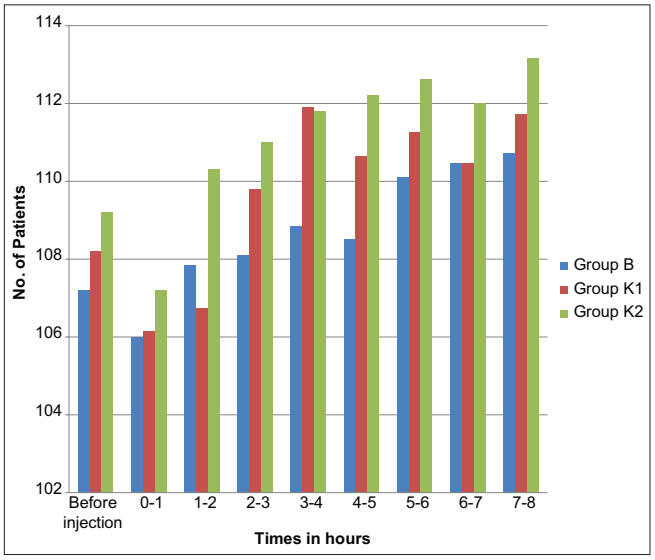

Chart 4: Average blood pressure

respiratory rate at different hours in each group was found to be statistically insignificant ($P > 0.05$). These findings were consistent with the finding of other workers like Marhofer *et al.*[12]

A four-point sedation score was also measured postoperatively at an hourly interval to the study the sedative property of drug. The score was slightly low in all the three groups. There was no significant difference between the three groups in mean hourly sedation score. Similar results were obtained by Marhofer *et al.*[12] The efficacy of post-operative analgesia was documented by an observational pain discomfort scale (OPS). We used the OPS to assess objective, behavioral variables (crying, facial

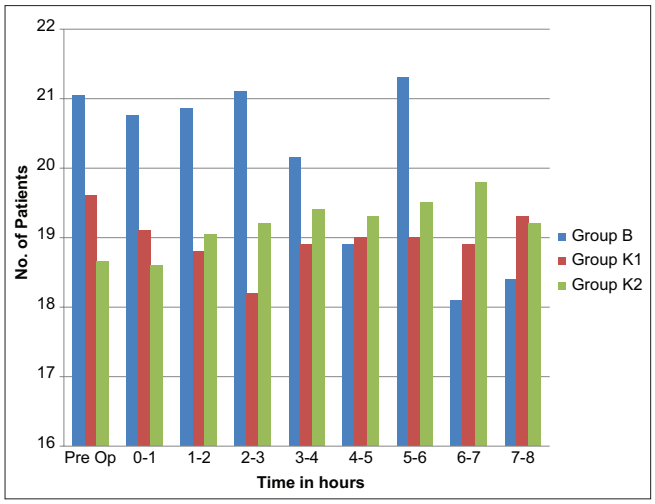

Chart 5: Mean respiratory rate per minute

expression, position of torso, position of legs, and motor restlessness). Each variable was scored on a 3-point scale.

1 = none, 2 = moderate, 3 = severe.

Marhofer *et al.*[12] also used the same pain score in their study. A pain score >11 in two subsequent measurement was considered as termination of pain relief and the patient was administered oral paracetamol 30 mg per kg. There were more patients who required additional analgesia in the recovery room immediately after surgery in Group K1 compared with other Groups B and K2. In Group B, pain score was significantly increased after 7 h. In Group K1, OPS was significantly increased after 4 h of observation. In Group K2, OPS was significantly increased after 5 h of observation. OPS in Group B was lower when compared with Group K2. However, the difference did not attain statistical significance ($P > 0.05$). These results are similar to that obtained Marhofer *et al.*[12]

The duration of analgesic action was taken as the time from caudal injection to first administration of supplementary analgesia. If by 8 h, no additional analgesia had been required, we assumed for sake of comparison that the duration of analgesia was 8 h. Although it is possible that useful analgesia may have continued for longer duration.

However, logistical problems dictated that further observations were impracticable and after 8 h observations were complete, there was a tendency for prophylactic paracetamol analgesia to be given by ward nurses to any patients, who were still awake. All patients were managed successfully with paracetamol alone after this time.

Mean duration of analgesia for those patients who left the recovery area without first requiring additional analgesia did not differ significantly between groups. The mean duration of analgesia in Group B was 5.10 ± 1.38 h, in Group K1 was 3.21 ± 1.56 h, and Group K2 was 4.35 ± 2.01 h.

Dhasmana *et al.*[13] reported duration of analgesia to be 273 ± 123 min. The study conducted by Marhofer *et al.*[14] with same drug ketamine and bupivacaine in pediatric patients for hernia repair, when given caudal epidurally demonstrated that the mean duration of analgesia in bupivacaine group was 300 ± 96 min, in ketamine Group K1 was 203 ± 117 min, and Group K2 was 273 ± 123 min. The dose used was similar to that of our study but the duration of analgesia in our study in Group B was 5.10 ± 1.38 h, in Group K1 was 3.21 ± 1.56 h, and in Group K2 was 4.35 ± 2.01 h.

There is a variation in duration of analgesia observed by different workers. This discrepancy is difficult to explain. Some explanation may be offered on the basis of methods of measurements of pain, type of surgery, individual reaction to pain, overall psyche of patients, and intelligence do have a definite influence, especially in our class of patients. All most all the patients in our study were from lower socioeconomic group and were illiterate. Their reaction was not like the patients from the affluent class. A higher mean pain score in Group K1 in early post-operative period demonstrate a slow set of action through ketamine N-methyl-D-asparate receptor antagonism (NMDA) receptors although it produces good quality of analgesia for an average 3.21 ± 1.56 h. If the operation was longer, adding ketamine to our usual dose of bupivacaine solves the purpose of enhancing the total analgesic period.

Ketamine, a derivative of phencyclidine, has a chemical structure similar to that of bupivacaine and therefore has local anesthetic effects. These local anesthetic effects are also caused by (NMDA receptors are in the substantia gelatinosa in spinal cord), opioid receptor agonism, and the voltage sensitive sodium channel interaction.

The incidence of side effects such as nausea, vomiting, pruritus, flushing, and others, if any, was recorded in post-operative period. Although incidence of facial flushing exceeded 20% in all the three groups, it was not obviously distressing to the individuals affected. No patient in any group had numbness, convulsion, or respiratory depression. Two patients complained of pain at the site of the puncture postoperatively. The pain was mild in nature and occurred in patients in whom manipulation was done to locate the sacral canal. The pain disappeared after 3–4 days.

Nausea and vomiting occurred in all three groups. The patterns of vomiting were similar. This did not appear to cause distress and no treatment was given. The difference was statistically insignificant.

SUMMARY AND CONCLUSION

The present study included a series of 60 patients of ASA Grade I and II of age ranging from 2 to 12 years who were selected randomly posted for operations below umbilicus.

Patients were premedicated with intravenous atropine (0.03 mg/kg), anesthesia was induced with thiopentone (2.5%) 4–7 mg/kg and tracheal intubation facilitated with succinylcholine 1–2 mg/kg. Anesthesia was maintained with oxygen nitrous oxide (30:70) + halothane (0.5–1%) + muscle relaxation achieved by atracurium. Patient received one of the three solutions diluted with normal saline as necessary to ensure a comparable volume of 0.75 ml/kg.

Group B received bupivacaine 1.87 mg/kg. Group K1 received ketamine 0.5 mg/kg and Group K2 received ketamine 1 mg/kg.

The vital parameters (respiratory rate, blood pressure, and heart rate) of the all patients in all the groups were observed preoperatively, during operation and in the post-operative period up to period of 8 hrs. The vital parameters remained stable throughout the operative and post-operative period in all patients of all the groups.

From the present study, it is concluded that:-

1. Ketamine 1 mg/kg, when given caudally in pediatric patients produces analgesia in post-operative period with a mean duration of 4.35 ± 2.01 h
2. Ketamine and bupivacaine both have practically no effect on vital parameter, that is, respiratory rate, heart rate, and blood pressure
3. Caudal ketamine has slow onset of action in Group K1
4. There was no significance difference between groups in sedation score
5. There is no cardiotoxicity associate with in advertent intravascular injection of ketamine when compared to bupivacaine
6. Bupivacaine and ketamine 1 mg/kg is better than ketamine 0.5 mg/kg for post-operative analgesia
7. There was no statistically significant difference in incidence of pain at puncture site and facial flushing (side effect)

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