Original Research Article

EFFECT OF DEXMEDETOMIDINE AND BUPIVACAINE AT CAUDAL REGION IN PAEDIATRICS AGE GROUP:A HOSPITAL STUDY

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Abstract

Introduction: Caudal epidural analgesia is one of the most commonly performed regional blocks in paediatric anaesthesia for intra and post-operative analgesia. However, the mean duration of analgesia provided by local anaesthetics alone is limited .Dexmedetomidine, an α2 agonist, is known for its analgesic effects with lesser side effects. Hence, this study was conducted to know the efficacy and safety of addition of dexmedetomidine to bupivacaine in a single shot caudal block in children.

Methods: This study was conducted at Department of Anaesthesia, Naraina Medical College & Reserch Centre, Kanpur (Dec 2021 to Aug 2022). Among 60 children in the age group of 2 – 10 years coming for various elective infraumbilical surgical procedures. They were divided into two groups of 30 each. Group A received caudal 0.25% bupivacaine (1ml/kg) and group B received caudal 0.25% bupivacaine (1ml/kg) with dexmedetomidine (1µg/kg). Pain assessment was done at the 1st, 2nd, 3rd, 4th, 8th, 12th and 24th hour after the surgery.

Results: A total number of 60 children in the age group of 2 – 10 years belonging to ASA grade I and II were enrolled in this study. They were divided into two groups of 30 each. Children in group A received caudal bupivacaine 0.25% (1ml/kg). Children in group B received caudal bupivacaine 0.25% (1ml/kg) with dexmedetomidine (1µg/kg)

Conclusion: This study showed that the addition of dexmedetomidine in the dose of 1µg/kg to 0.25% bupivacaine (1ml/kg) improved the analgesic duration and efficacy after a single shot caudal block with minimal side effects in children.

Key words: Caudal; bupivacaine; dexmedetomidine; children

Introduction

The International Association for the Study of Pain defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage"[1]. In children, even the definition of pain has been debated.[2] Pain is a complex constellation of unpleasant sensory, perceptual, and emotional experiences and certain associated autonomic, psychological, emotional, and behavioral responses. In many newborns or infants, as well as others who have mental retardation, pain cannot be described in such self report terms. In fact, pain experienced by infants and children often goes unrecognized, even neglected, because of the operational definition of pain that requires self-report [2,3] . Pain management is an essential component of care provided by paediatric anesthesiologists. Most obvious, of course, is the integration of a pain management plan into the overall peri-operative plan. For many years, it has been recognized that paediatric patients are more likely to have pain treated less aggressively than their adult counterparts.[4,5,6] Unfortunately, one can argue that this has led to a considerable amount of unnecessary suffering on the part of these patients. Pain perception does begin before birth, and potent analgesics alter the stress response to surgery, even in premature infants. The landmark article published by Anand and Hickey in 1987 clearly addressed the issue that newborns and infants do in fact experience pain. It is important to understand that pain due to surgical procedures not only results in an immediate nociceptive response but also results in changes in the nociceptive activation pathways that lead to hypersensitivity, hyperalgesia, and allodynia[7]. The use of regional anaesthetic techniques in infants and children has become increasingly accepted as standard of care during final decades of twentieth century. Regional anaesthetic techniques reduce the overall intra-operative requirement of both inhaled and intravenous anaesthetic agents and allow more rapid return of the conscious pre-operative state while providing effective post-operative pain relief with minimal sedation[8]. Caudal analgesia is one of the most popular regional anaesthetic technique employed in children. It is a relatively simple technique with a predictable level of blockade, and is by far the most common regional technique used in paediatric surgery for lower abdominal, urological, and lower limb operations. Gradual offset usually provides analgesia beyond the duration of surgery, with a smooth recovery period and good postoperative pain control. This benefit is especially important in ambulatory and same-day surgery patients because it reduces analgesic requirements and facilitates early discharge[9].

Material and Methods:

This study was conducted at Department of Anaesthesia, Naraina Medical College & Reserch Centre, Kanpur (Dec 2021 to Aug 2022). Among 60 children in the age group of 2 – 10 years coming for various elective infraumbilical surgical procedures. They were divided into two groups of 30 each. Group A received caudal 0.25% bupivacaine (1ml/kg) and group B received caudal 0.25% bupivacaine (1ml/kg) with dexmedetomidine (1µg/kg). Pain assessment was done at the 1st, 2nd, 3rd, 4th, 8th, 12th and 24th hour after the surgery.

Results

A total number of 60 children in the age group of 2 – 10 years belonging to ASA grade I and II were enrolled in this study. They were divided into two groups of 30 each. Children in group A received caudal bupivacaine 0.25% (1ml/kg). Children in group B received caudal bupivacaine 0.25% (1ml/kg) with dexmedetomidine (1µg/kg)

Table 1: Mean Age of Patients

Group	**No of patients**	**Mean age (yrs) ± SD**	**Mean difference**	**P value**
Group A	30	5.77 ±1.63	0.10	0.812
Group B	30	5.87 ±1.61		

The mean age in group A was 5.77 ± 1.63 years and in group was 5.87 ± 1.61 years. The two groups did not differ significantly (p = 0.812) with respect to their age, which is depicted in graph 1.

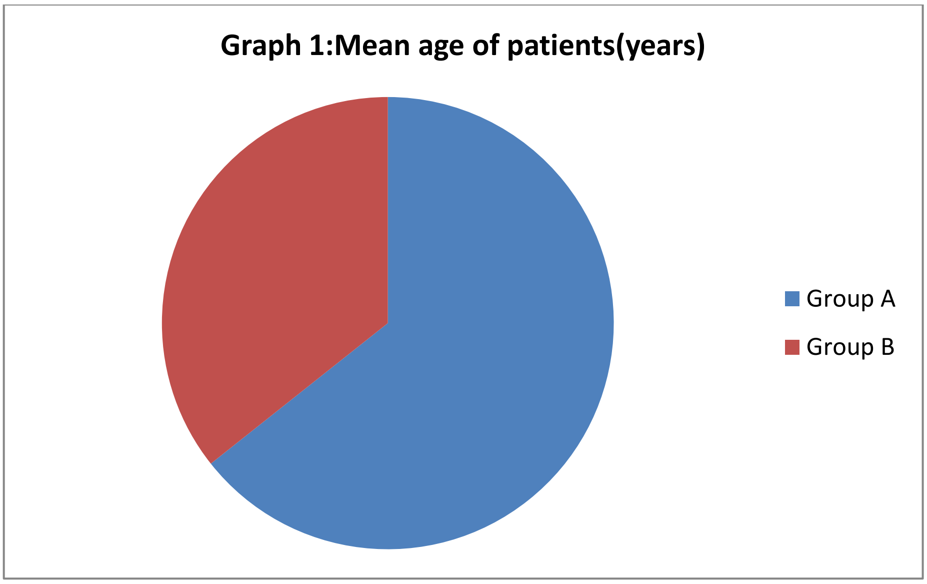


Table 2: Sex wise distribution

Gender	**Group A (n%)**	**Group B (n%)**
Male	27	27
Female	3	3
Total	**30**	**30**

In group A there were 27(90%) males and 3 (10%) females. Group B had 27 (90%) males and 03(10%) females. The groups were comparable with respect to sex as shown in the table 4 and depicted in graph 2.

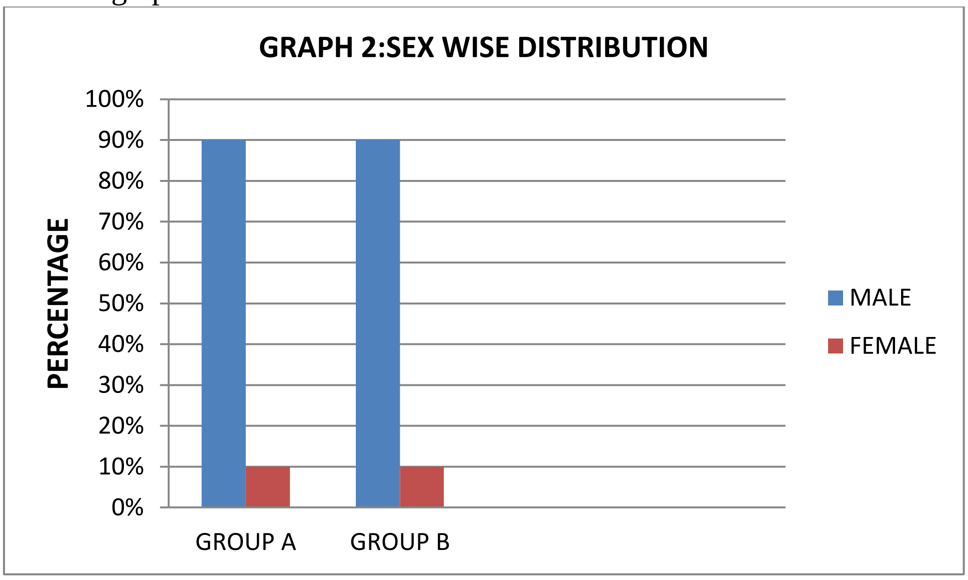
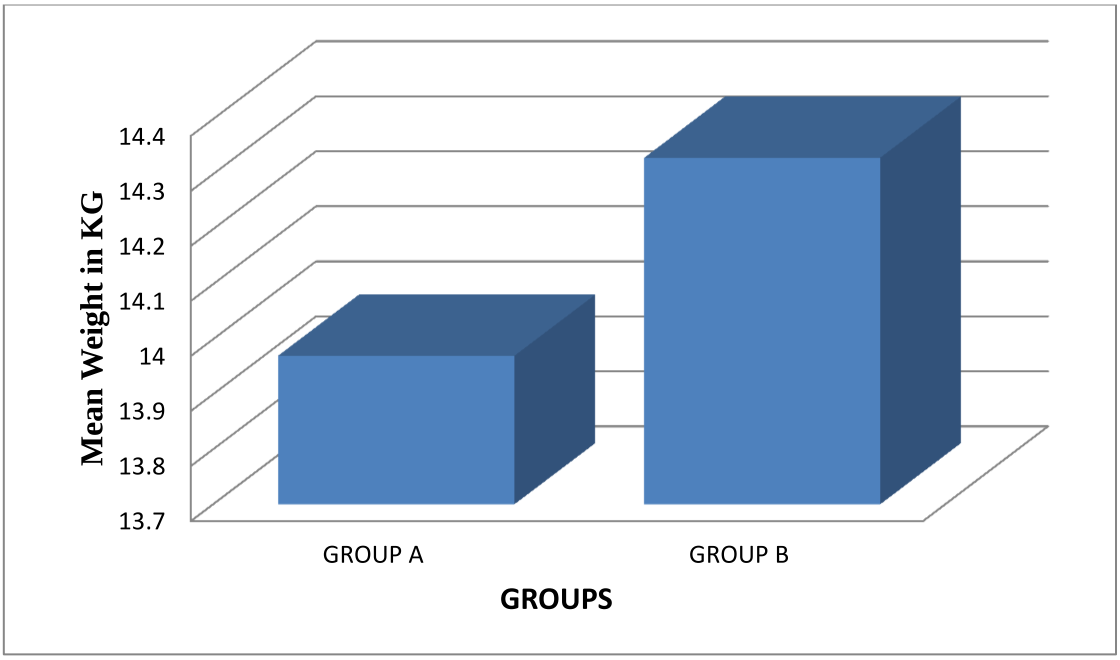


Table 3: Mean weight of the patients

Weight(kg)	**Group A**	**Group B**	**Mean difference**	**P value**
Mean Weight ± SD	13.97±3.14	14.33±3.4	0.36	0.67
Range	10-22	10-20		

The weight of the children in group A ranged from 10 to 22 kg with a mean weight of 13.97 ± 3.14 kg. In group B the weight ranged from 10 to 20 kg with a mean of 14.33 ± 3.4 kg. The two groups did not differ significantly with respect to weight (p = 0.67).



Graph 3: Mean weight of patients

Table 4: Types of Surgical Procedures

Types of surgery	**Group A(n)**	**Group B(n)**
Herniotomy	12(40)	13(43)
Circumcision	8(27)	5(17)
Orchidopexy	2(7)	2(7)
Lower limb surgeries	6(20)	6(20)
Others	2(6)	4(13)
Total	**30**	**30**

The different surgical procedures performed during the study in the two groups are shown in table 6 and graph 4. In our study, herniotomy accounted for around 50% of cases, 12 (40%) in group A and 13(43%) in group B. Circumcision was done in 8(27%) and 5(17%) cases in group A and B respectively, lower limb surgeries accounted for 6(20%) and 6(20%) in group A and B respectively, while orchidopexy accounted for 2(7%) cases in both the groups. Other surgeries included urethroplasty, incision and drainage, hypospadias surgery, implant removal and skin grafting which accounted for 2(6%) in group A and 4(13%) in group B.

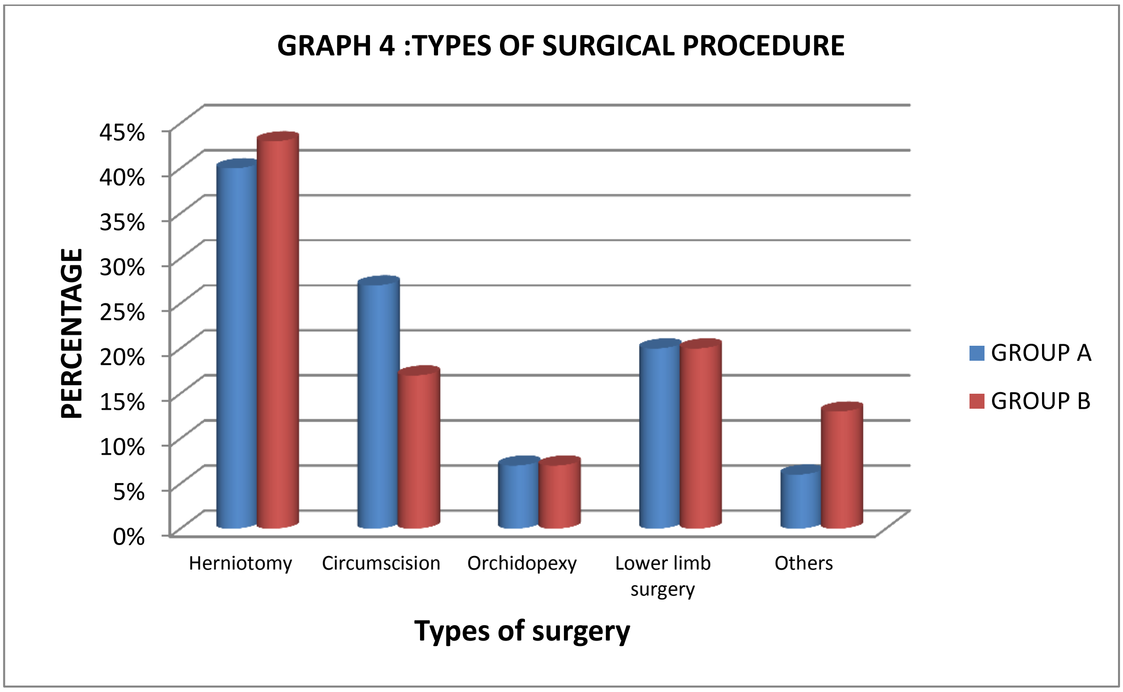


Table 5: Pain Score at Various Time Intervals

Time interval (hours)	Group A n (%)	Group B n (%)	P* Value	X^2 value
1	0	0	-	-
2	0	0	-	-
3	1(3)	0	1	0
4	14(47)	1(3)	<0.01	12.8
8	13(43)	19(63)	0.2	1.6
12	9(30)	9(30)		
24	13(43)	11(33)	0.8	0.06

The distribution of subjects in the two study groups according to pain score ≥6 at various monitoring intervals are shown. The Paediatric Objective Pain Score was below 6 at the end of first and second hour in both the groups and did not require any analgesia. At the end of third hour, 1(3%) of the patients in group A had a pain score of ≥6 whereas none of the patients had a score of ≥6 in group B, which was found to be statistically insignificant ($p > 0.05$). At the end of fourth hour, 14(47%) of patients in group A had a pain score of ≥6 and only 1(3%) in group B had a similar pain score. It was statistically highly significant ($p < 0.01$). The pain score was ≥6 in 13(43%) of patients in group A and 19(63%) in group B by the end of eight hour which was not statistically significant. At the end of 12th and 24th hour, group A had 9(30%) and 13(43%) patients with pain score of ≥6 and group B had 9(30%) and 11(33%) with similar pain score respectively. The differences were found statistically insignificant. The subjects with a pain score of ≥6 were significantly lower in group B compared to group A at the end of 3rd and 4th hour.

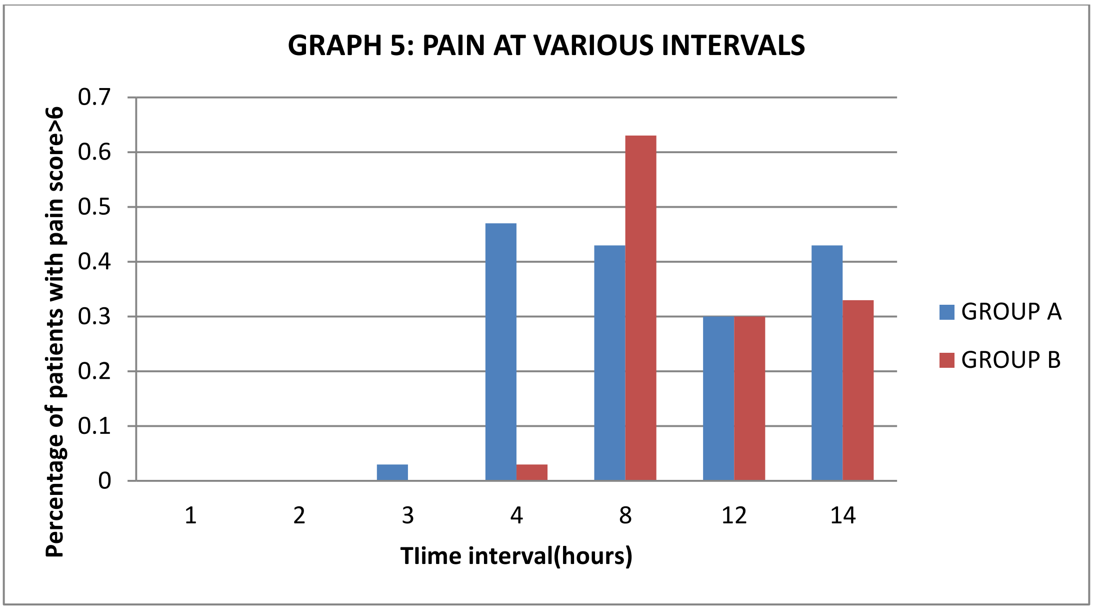
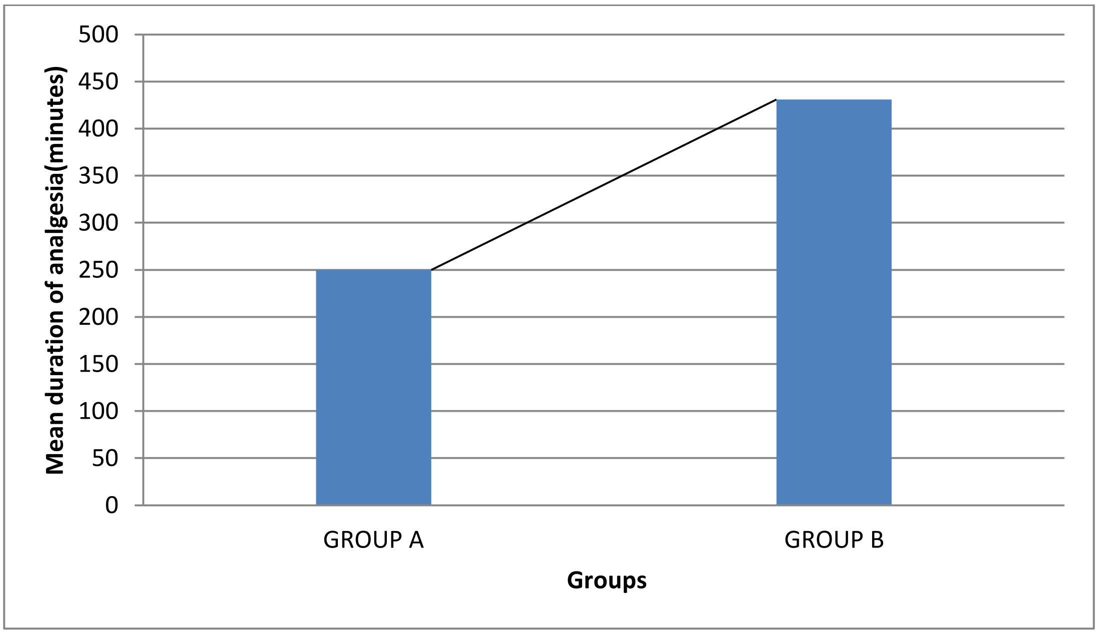


Table 6: Duration of Analgesia

Duration of analgesia (min)	Group A	Group B
Mean duration ± SD	250±39	431±63.7
Range	190-360	265-530

p < 0.01, student's unpaired 't' test

The mean duration of analgesia was 250.39 ± 39min in group A with a range of 190 to 360 min. In group B, the mean duration of analgesia was 431 ± 63.7min with a range of 265 to 530 min. The difference in the mean duration of analgesia was statistically highly significant (p<0.001).

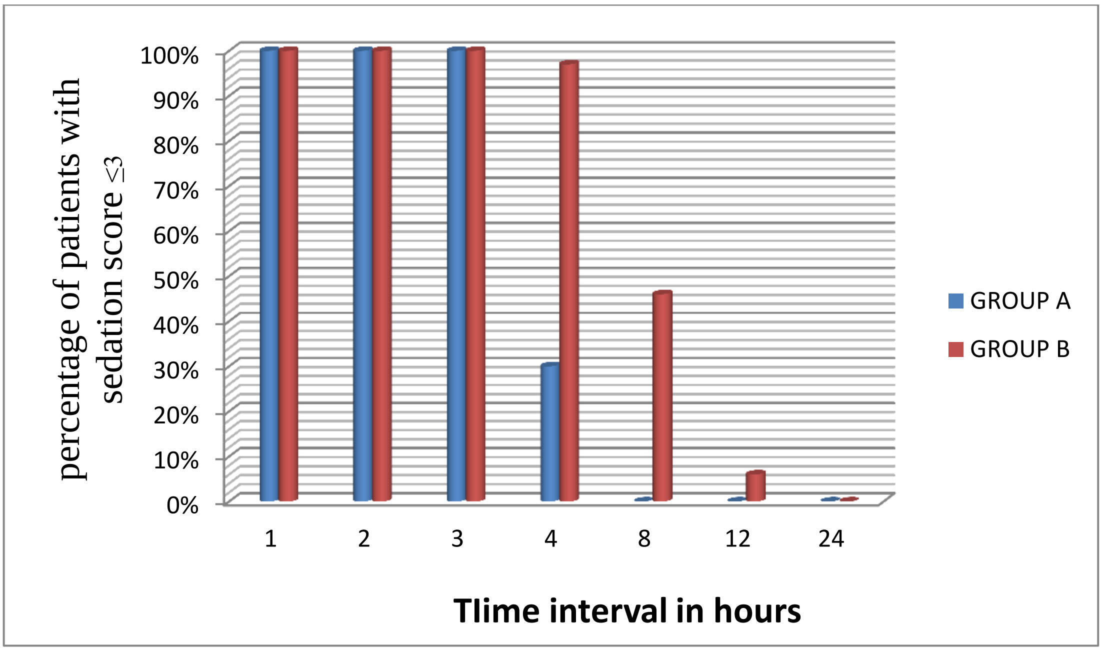


Graph 6 : Mean Duration of Analgesia

Table 7: Sedation Score at Various Time Interval

Time interval (hours)	**Group A n (%)**	**Group B n (%)**	**p* value**	X^2 value
1	30(100)	30(100)	-	-
2	30(100)	30(100)	-	-
3	30(100)	30(100)	-	-
4	9(30)	29(97)	<0.001	25.9
8	0	14(46)	<0.01	15.7
12	0	2(6)	0.47	0.51
24	0	0	-	-

The distribution of subjects in the two study groups according to sedation score ≤3 at various monitoring interval. The sedation score at the end of first, second and third hour was less than 3 in both the groups and the children were drowsy but responding to verbal commands. At the end of fourth and eight hour 9(30%) and 0(0%) of patients in group A and 29(97%) and 14(46%) of patients in group B respectively had a score of ≤3, indicating a significant difference in the sedation score between the groups at that time. At the end of 12th and 24th hour, all the patients in group A were awake and alert. In group B 2(6%) had a score of 3 at the 12th hour and all were awake by the end of 24th hour. There was no significant difference between the two groups at this time.



Graph 7: Sedation Scores at Various Time Interval

Discussion

The past decade has witnessed many advances in the understanding and treatment of pain in children. Caudal epidural blockade is one of the most popular regional blocks used in paediatric anaesthesia. This reliable and safe technique is used widely for many surgical procedures in combination with general anaesthesia. It allows rapid recovery from anaesthesia with effective post-operative analgesia. The main disadvantage of this technique is the short duration of action following single shot caudal using only local anaesthetic. To avoid extradural catheter placement, which carries the risk of infection, and yet prolong the duration of single-shot caudal anaesthesia, various additives to local anaesthetic solutions have been used.[9.10.]. Hence, recently several studies have reported caudal use of opioids and other drugs in children to improve postoperative analgesia. Though the use of caudal opioids did prolong the duration of analgesia, it was associated with side-effects like respiratory depression, pruritis, urinary retention, nausea and vomiting. Hence, other drugs like clonidine and dexmedetomidine have been administered to improve analgesia in the postoperative period while avoiding the side-effects associated with opioid use.[11] In this study, caudal epidural block using bupivacaine alone and bupivacaine with dexmedetomidine combination was conducted in 60 children in the age group of 2 to 10 years of ASA grade I and II coming for various elective infra-umbilical surgeries.

Age, sex and weight :

In the present study, there was no significant difference in the two groups with regard to age, weight and sex. The mean age was 5.77 ± 1.63 years in group A and 5.87 ± 1.61 years in group B. The mean weight was 13.97 ± 3.14 kg in group A and 14.33 ± 3.4 kg in group B. In both the groups males were more (> 80%). This could be due to inclusion of surgeries like herniotomy, orchidopexy and circumcision in our study. Ying-jun she [12]studied the effect of caudal analgesia in paediatric patients undergoing only hydrocoel, hence all the cases were male (100%). The patients were induced with oxygen- nitrous oxide (50% - 50%) and halothane (in increasing concentration) and caudal block was performed using the same technique and same type of needle in all the patients.

Concentration and dosage of the drug:

Gunter JB et al[13] have reported that 0.175% bupivacaine offered the best combination of effectiveness and rapid recovery and discharge for paediatric surgical outpatients. Armitage[14] has recommended 0.25% bupivacaine in a dose of 0.5 ml/kg lumbosacral, 1 ml/kg for thoraco-lumbar 1.25 ml/kg for mid-thoracic level of block and the plasma bupivacaine levels were always below 1.2μg/ml, which was below toxic levels. However Cook B et al[15] used 0.25% bupivacaine (1ml/kg) for paediatric herniotomy and orchidopexy respectively, as a single shot caudal block. In our study also, we have used a single dose of 0.25% bupivacaine (1ml/kg). Higher concentration can produce motor blockade in the immediate post-operative period and delay discharge. Since all the patients are monitored for 24 hours postoperatively in our hospital, 0.25% bupivacaine was used for post-operative analgesia.A number of papers on the use of caudal dexmedetomidine have been published over the past 10 years focusing primarily on the quality of analgesia obtained with local anaesthetics. Saadawy IBoker A and colleagues found that the mean duration of post-operative analgesia with caudal bupivacaine 0.25% (1ml/kg) was significantly increased by addition of dexmedetomidine 1μg/kg compared with plain bupivacaine.[16] Ghada Foud El-Baradey [17] used dexmedetomidine (2μg/kg) with bupivacaine 0.25% (1ml/kg) caudally in children aged 1-9 years for inguinal herniotomy surgeries.caudal dexmedetomidine was very effective adjunct to bupivacaine as it prolongs duration of post operative analgesia and sedation. Xiang Q,Huang DY,Zhao YL,Wang GH[18] demonstrated that in small children (1-3 yrs) undergoing hernia repair, the addition of dexmedetomidine 1μg/kg to bupivacaine 0.25% (1 ml/kg) significantly prolonged the mean duration of analgesia and reduced the post-operative analgesic requirement within the first 24 hours. In our study, we chose 0.25% bupivacaine which provides better quality of analgesia when compared to lower concentrations and dexmedetomidine 1μg/kg which prolongs the duration of analgesia significantly while avoiding the side effects like excessive sedation associated with higher doses.

Conclusion

The present study demonstrated that caudal administration of bupivacaine 0.25% (1ml/kg) with dexmedetomidine (1 µg/kg) resulted in superior analgesia with longer duration of action compared with 0.25% bupivacaine (1 ml/kg) alone as a single shot caudal block in children.Sixty children of ASA grade I and II in the age group of 2-10 years coming for various elective infra-umbilical surgeries were included in the study.

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