ORIGINAL ARTICLE

Caudal Dexmedetomidine and Fentanyl as Adjuvants to Levobupivacaine in Paediatric Infraumbilical Surgeries for Perioperative Pain Management: A Comparative Study

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Abstract

Background: Postoperative pain control is an essential component of anaesthesia care. Preemptive caudal analgesia is one strategy for managing perioperative pain in paediatric patients. In caudal block, dexmedetomidine and fentanyl are useful adjuvants to levobupivacaine that offer better and longer-lasting postoperative analgesia. In this study, the effects of preemptive administration of caudal levobupivacaine with either fentanyl or dexmedetomidine were compared in terms of perioperative haemodynamic stability, pain intensity, and duration of postoperative analgesia, the number of patients who needed rescue analgesics, sedation level, and adverse events.

Methods: This study was carried out in the Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University after obtaining approval from the institutional review board (IRB). Preemptive caudal block was used for perioperative analgesia in 60 children, aged 1-6 years, who were undergoing infraumbilical surgeries under general anaesthesia with ASA grade I–II. Children were divided into two groups: Group FL (control) received levobupivacaine 0.25% with 1 µg/kg of fentanyl diluted with distilled water to make total volume 0.75 ml/kg. Group DL received levobupivacaine 0.25% with 0.8 mcg/kg of dexmedetomidine diluted with distilled water to make total volume 0.75 ml/kg. Perioperative haemodynamic parameters, the face, leg, activity, cry and consolability (FLACC) pain scale, the sedation score, duration of analgesia and adverse effects were noted after the medications were administered. The data was recorded on a predesigned data collection sheet.

Results: In this study, demographic characteristics showed no significant differences. The findings revealed that the mean heart rate was lower in the dexmedetomidine group (Group DL) compared to the fentanyl group (Group FL) throughout the perioperative period but significant at 30 and 60 minutes after block as p-value was < 0. 001. The FLACC scores for both groups were measured at various postoperative time points. Significant differences were found between the groups at the 4-to-6 hour time point after surgery with mean FLACC scores of 3.02±0.49 in Group DL versus 3.42±0.41 in Group FL at 4 hours ($p = 0.001$) and 3.12 ± 0.12 in Group DL compared to 5.30 ± 0.18 in Group FL at 6 hours ($p < 0.001$). A statistically significant higher RSS score in Group DL compared to Group FL at various time points up to 4 hours after surgery ($P < 0.001$) suggests better sedation in Group DL. The mean time to first rescue analgesic requirement was significantly longer in Group DL (480.63 ± 5.39 minutes) as opposed to Group FL (360.20 ± 3.35 minutes, $P < 0.001$).There is no significant adverse event between the group with more parental satisfaction in DL group compared to the FL group.

Conclusion: Dexmedetomidine is a better adjuvant to levobupivacaine compared to fentanyl in preemptive caudal block as it maintains better perioperative haemodynamic stability, perioperative analgesia and better sedation without an increase in adverse event in children undergoing infraumbilical surgeries.

Keywords: Caudal, Dexmedetomidine, Fentanyl, Levobupivacaine, Paediatric Surgery, Pain Management

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Introduction

Pain is an unpleasant subjective sensation that children only experience and cannot express fully. Children's pain expression is difficult because they are dependent on caregivers for their well-being. Postoperative pain control is an essential component of anaesthetic care. The use of an analgesic before the onset of painful stimuli is known as preemptive analgesia. Inhibition of the initial neural cascade could eliminate the hypersensitivity that noxious stimuli produce. The frequency and severity of wound pain following surgery may be reduced by preemptive analgesia[1]. Uncontrolled postoperative pain may produce detrimental acute and chronic effects. Effective pain management promotes early mobilization, lower postoperative complications, and early hospital discharge. To decrease post-operative pain, and systemic analgesic requirements and improve the quality of analgesia, various regional anesthetic techniques have been available[2].

Preemptive caudal block is one of the techniques used to prevent postoperative pain in children. It is a commonly performed, simple, and safe neuroaxial technique for paediatric patients undergoing infraumbilical surgeries[3]. Campbell first introduced the caudal block in 1933[4] and performed the the block in the left lateral position. Then, a landmark-based blind technique was used under general anesthesia by controlled ventilation with endotracheal intubation after securing the airway. It decreased the requirement of volatile agents and opioids when combined with general anesthesia[4]. The primary drawback of single-shot caudal block is still it's very short duration of analgesia, even with the use of long-acting local anesthetics[5].

A repeated dose of local anesthetic solution is not preferred for caudal block due to the high risk of infection[6]. Levobupivacaine is a commonly used long-acting agent for caudal blockade. Levobupivacaine is a member of the amide local anesthetic, which is an S-enantiomer of bupivacaine. Both levobupivacaine and bupivacaine have the same efficacy and equivalent analgesia. It is safer than bupivacaine because of its faster protein binding capacity and lower cardiovascular and central nervous system toxicity[4]. It reduces unwanted motor blocks[7]. In low doses, levobupivacaine produces more sensory block and less toxicity[4].

Additives like opioid, clonidine, dexmedetomidine, epinephrine and neostigmine have been used with the single-shot caudal block technique to make caudal anesthesia longer[8,9], especially with ketamine and clonidine, but the use of opioids is decreased due to the higher incidence of side effects in children[10,11]. Fentanyl is the most common additive to local anesthetics[12] and among the opioids, is the least likely to cause respiratory depression when administered extradurally[5].

Compared to clonidine, dexmedetomidine is a more selective α-2 adrenergic receptor agonist that can improve the effects of local anesthetics without causing side effects[13]. It has sedative, analgesic and sympatholytic effects[14,15]. It has some side effects like hypotension and bradycardia, which are manageable with intravenous fluid and atropine (0.02 mg/kg). During caudal block, dexmedetomidine prolongs analgesia and reduces the local anesthetic concentration of levobupivacaine[15]. Dexmedetomidine appears to be a better alternative to fentanyl as an epidural adjuvant in adults because it provides comparable stable hemodynamics, early onset, sensory anesthesia, prolonged postoperative analgesia, and much better sedation levels[16].

From the previous studies, it was found that both dexmedetomidine and fentanyl are promising adjuncts to provide excellent and prolonged postoperative caudal analgesia. There is very limited study with the adjuncts dexmedetomidine and fentanyl with levobupivacaine in pediatric infra-umbilical surgeries. Therefore, the purpose of this study was to evaluate the effectiveness of dexmedetomidine or fentanyl as an adjuvant to levobupivacaine in preemptive analgesia by caudal block in terms of perioperative haemodynamic stability, pain intensity, duration of analgesia, sedation and adverse events.

Methods

This prospective comparative study was conducted at paediatric operation theatre under supervision of Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University, Dhaka. The patients aged between 1 to 6 years, with

American Society of Anesthesiologists physical status I-II, who were scheduled to undergo infraumblical surgeries eg. Inguinal herniotomy, orchidopexy and hypospadias under general anaesthesia were selected for this study. A total of 60 patients were alternatively assigned into two equal groups. Group-FL (30): Patients received levobupivacaine 0.25% combined with fentanyl 1 µg/kg diluted with distilled water to a total volume of 0.75ml/kg. Group-DL (30): Patients received levobupivacaine 0.25% combined with dexmedetomidine 0.8µg/kg diluted with distilled water to total volume of 0.75 ml/kg.

Study Procedures

Following receiving approval from the institutional review board and obtaining informed written consent from the parents of each individual, 60 patients were enrolled in this study who scheduled for infraumbilical surgeries. Preoperative assessment was completed by taking a history from parents, performing a physical examination, an airway assessment, determining the ASA grade, and reviewing the patient's medications. Participants were selected by purposing sampling and categorized alternatively into Group FL and Group DL, with 30 participants in each group to receive general anesthesia with control ventilation with endotracheal intubation.

Anesthetics technique

All patients were fasted according to fasting guideline. No premedication was given. Upon arrival at the operating room, routine anesthesia monitoring was established. Anaesthesia was induced with isoflurane in 100% oxygen (6 L/min) through a facemask. After loss of consciousness, a peripheral vein cannulated with 22/24G intravenous cannula and isotonic crystalloid (Hartman solution) was given by the Holliday-Segar formula. The patients were induced with inj. fentanyl 2 µg/kg and inj. propofol 2 mg/kg followed by inj. succinylcholine 1.5mg/kg IV to facilitate tracheal intubation with endotracheal tube of appropriate size was inserted for the maintenance of the airway. Anaesthesia was maintained with O_2 and nitrous oxide at a 33% to 66% ratio and halothane at 0.9 vol% on controlled ventilation by Jackson Rees circuit. Then the children were placed in a left lateral position with the hips fully flexed position. After identifying caudal space, a previously prepared solution was given slowly and check for any resistance and subcutaneous swelling. After caudal injection, patients were placed in the supine position. If there was an increase in heart rate (HR) or mean arterial blood pressure of more than 20% of the baseline value after skin incision, then it was considered as block failure and these patients were excluded from the study. No other analgesics and antiemetic were used intraoperatively. At the end of the surgical procedure, inhalational anesthesia was discontinued and reversal was done. After extubating the patients were transferred to the recovery room with a patient airway and spontaneous respiration was confirmed, where they received O_2 via a face mask to maintain oxygen saturation above 95%.

Follow-up and outcome measures: Hemodynamic parameters were recorded together with pain assessment using the FLACC pain scale immediately following complete regaining of consciousness. In the post anesthesia care unit, patient monitoring was resumed hourly for the first 2 hours, then 2 hourly for 8 hours, then at 12 hours and 24 hours. Pain was assessed using the FLACC pain scale. Mild discomfort (FLACC score ≤4) was treated routinely with intravenous paracetamol (15 mg/kg). Moderate to severe pain was treated with rescue analgesic (Diclofenac suppositories 1mg/kg). Number of patients who received rescue analgesic and the time of the first rescue analgesic requirement were noted. The Ramsay sedation scale was used to measure sedation. Perioperative complications were noted and hypotension and bradycardia treated with intravenous fluid and atropine (0.02) mg/kg respectively. Parents were permitted to accompany the child while they were in PACU. All children were kept under constant observation from PACU to the ward. Parent satisfaction was noted using the Likert scale.

All information was recorded in the data collection sheet and compared. Our primary outcome was the postoperative pain intensity scores using FLACC, secondary outcomes measures were hemodynamic stability (HR, MAP, SpO_2), sedation by Ramsay sedation scale, time of first rescue analgesic requirement and number of patients received rescue analgesic.

Study measures

FLACC Scale: Pain is measured by face, leg, activity, cry and consolability scale. Score range (0-10)[17].

- 0 = Relaxed and comfortable
- 1-<4 = Mild discomfort
- ≥4-6 = Moderate pain
- 7-10 = Severe discomfort/pain.

Ramsay sedation score: Sedation was measured by Ramsay sedation score[18]. Total score= 6.

Parent satisfaction: Assessment of the level of parental satisfaction on the anaesthetic and analgesic care of the patient on a 1 - 5 Likert scale. (Very dissatisfied-1, not satisfied-2, neutral-3, satisfied-4, very satisfied-5)[19].

Mean Arterial Pressure (MAP): The average arterial pressure throughout one cardiac cycle, systole and diastole. MAP=DP+1/3(SP-DP). Bradycardia: Decrease of heart rate below 20% of base line. Tachycardia: Increase of heart rate above 20% of base line.

Preemptive analgesia: The use of an analgesic before the onset of painful stimuli is known as preemptive analgesia. Duration of analgesia/time of first rescue analgesic requirement: Duration of surgery plus when first rescue analgesic given.

Statistical analysis:
Statistical analysis were carried out using the Statistical Package for Social Sciences version 23.0 for Windows (SPSS Inc., Chicago, Illinois, USA). A descriptive analysis was performed for all data. The mean values were calculated for continuous variables. Frequencies and percentages indicated the quantitative observations. Unpaired Student's t-test was used to compare continuous variables. Chi-square test was used to compare categorical data. A p-value of <0.05 was considered statistically significant.

Results

A total of 60 patients were included in the study. Hemodynamic parameters (HR, MAP, SpO_2) were assessed before and after giving caudal block. The patients were compared with each other with respect to age, ASA class, weight, gender and duration of surgery. The patients were also compared in aspect of hemodynamic parameters like HR, MAP and SpO_2. At post anaesthesia care unit FLACC and Ramsay sedation scale were recorded and compared between the groups. Time of first rescue analgesic requirement and number of patients received rescue analgesic were recorded. Any perioperative complications were also noted in the data sheet.

Table I: Demographic Characteristics of Patients in Group DL and Group FL (n=60)

Variables	Group DL (n=30)	Group FL (n=30)	p value
Age in years (Mean ±S.D.)	4.72±0.44	4.79±0.52	0.577
Gender			
Male	18 (60.0%)	17 (56.7%)	0.793
Female	12 (40.0%)	13 (43.3%)	
Weight in kg (Mean ± S.D.)	15.90±3.31	16.56±3.34	0.443

Data presented in Mean ± SD and absolute number, within parenthesis percentages over column total.

Table I showed the demographic characteristics of the patients. The mean age of patients in both groups were similar, with no statistically significant difference between Group DL (4.72 ± 0.44 years) and Group FL (4.79 ± 0.52 years). Gender distribution shows a nearly equal proportion of males and females across both groups (p = 0.793). The mean weight was also comparable between the groups, with p = 0.443.

Table II: Clinical Characteristics of Patients in Group DL and Group FL (n=60)

Variables	Group DL (n=30)	Group FL (n=30)	p value
ASA status			0.688
ASA I	26(86.7%)	27(90.0%)	
ASA II	4(13.3%)	3(10.0%)	
Types of surgery			0.693
Herniotomy	18 (60.0%)	16 (53.3%)	
	8 (26.7%)	11 (36.7%)	
Hypospadias	4 (13.3%)	3 (10.0%)	
Orchidopexy			
Duration of surgery in minute (Mean ± S.D.)	65.70±7.55	64.35±7.60	0.495

Data presented in Mean ± SD and absolute number, within parenthesis percentages over column total.

Table II compares the clinical characteristics of patients in two groups. Most patients in both groups were classified as ASA I, with no significant difference observed between the groups (p = 0.688). The types of surgery performed, including herniotomy, hypospadias, and orchidopexy, were similarly distributed between the groups (p = 0.693). The duration of surgery was almost similar, with no statistically significant difference (p = 0.495).

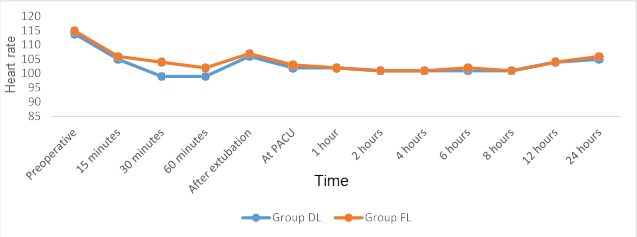

Figure 1: Trends of heart rate (HR) at different time points in Group DL and Group FL

Figure 1 illustrates the heart rate trends at various time points for Group DL (levobupivacaine with dexmedetomidine) and Group FL (levobupivacaine with fentanyl). It was observed that mean heart rate was comparatively lower in group DL than group FL during the whole follow up time. No significant differences in heart rate were observed between the groups at most time points, with p value > 0.05. However, 30 and 60 minutes after the caudal block, Group FL had significantly higher heart rates than Group DL. At 30 minutes after caudal block heart rate was found 99.54±1.44 beat/min in Group DL and 104.60±1.71 beat/min in Group FL. Difference was statistically significant with p<0.001.At 60 minutes after caudal block heart rate was found 98.90±1.21 beat/min in Group DL and 102.60±1.71 beat/min in Group FL. Difference was statistically significant with p<0.001.

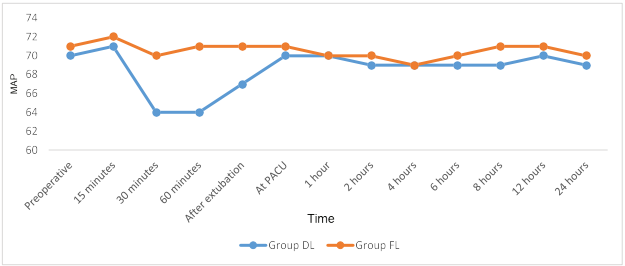

Figure 2: Trends of mean arterial pressure (MAP) at different time points in the studied groups

Figure 2 shows the trends of MAP in Group DL (levobupivacaine with dexmedetomidine) and Group FL (levobupivacaine with fentanyl) over time. Significant differences in MAP were observed 30 minutes after the caudal block to after extubation with Group DL having a lower MAP than Group FL ($p \leq 0.001$). At other time points, including preoperative, PACU, and postoperative measurements up to 24 hours, no statistically significant differences were found between the groups ($p > 0.05$).

There were no statistically significant differences in SpO2 between the two groups at any time point, as all p value were greater than 0.05, indicating that both treatments maintained comparable oxygen saturation levels throughout the study period.

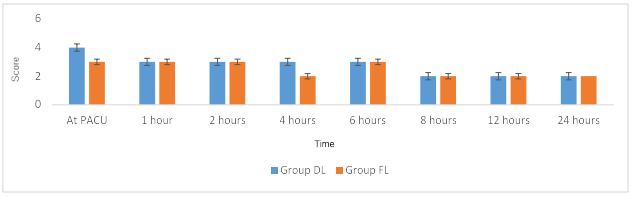

Figure 3: Pain intensity using FLACC scale at different time points in both groups

Evaluation of pain sensation using the FLACC scale at various time points for Group DL and Group FL was shown in Figure 3. Patients in the group-FL had higher FLACC compared with the group-DL in between groups. The differences in FLACC scale between group DL and group FL were non-significant up to 2 hours. However at 4 to 6 hours' time point after surgery, pain relief was better in DL group than FL group, which was statistically significant, with mean FLACC scores of 3.02±0.49 in Group DL versus 3.42±0.41 in Group FL at 4 hours ($p = 0.001$) and 3.12 ± 0.12 in Group DL compared to 5.30 ± 0.18 in Group FL at 6 hours ($p < 0.001$) At other time points (0, 1, 2, 8, 12, and 24 hours), the differences were not statistically significant ($p > 0.05$). The mean FLACC scale was lower in group DL than FL in 24 24-hour period indicating a trend towards more effective pain control in the dexmedetomidine group compared to fentanyl group. The uphill trend of FLACC Score was observed in both groups with the progression of time, but significantly higher in FL group.

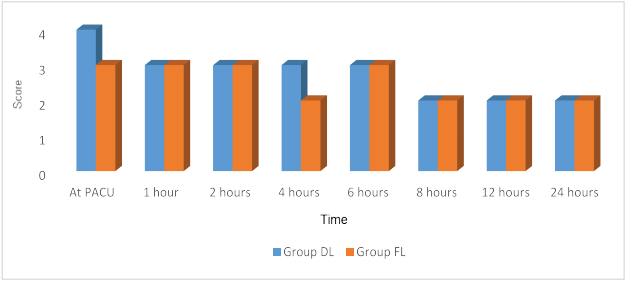

Figure 4: Ramsay Sedation Scale (RSS) scores at different time points in the studied groups

Ramsay Sedation Scale (RSS) scores at various time points for Group DL and Group FL were illustrated in Figure 4. At 4 hours after surgery, mean sedation

score was found 3.37±0.49 score in group DL and 2.57±0.50 score in group FL. Difference was statistically significant (p< 0.001). From 6 hours after surgery, mean sedation score between groups were non-significant and was found 2.70±0.53 score in group DL and 2.53±0.57 score in group FL. After 8 hours, mean sedation score between groups were non-significant and was found 2.47±0.51 score in group DL and 2.23±0.43 score in group FL. At 24th hours after surgery, mean sedation score were 2.17±0.38 score in group DL and 2.10±0.31 score in group FL.

Table III: Time of first rescue analgesic and number of patients received rescue analgesic (n=60)

Variables	Group DL (n=30)	Group FL (n=30)	p Value
Time of first rescue analgesic requirement (minutes)	480.63±5.39	360.20±3.35	0.001
Patients received rescue analgesic	9(30.0%)	20(66.7%)	0.013

Data presented in Mean ± SD and absolute number, within parenthesis percentages over column total.

Table III presents the time to first rescue analgesic requirement and the number of patients receiving rescue analgesic. Group DL required analgesics later, with a mean time of 480.63 ± 5.39 minutes compared to 360.20 ± 3.35 minutes for Group FL which was statistically significant. Additionally, a higher proportion of patients in Group FL received rescue analgesic, with 20 patients (66.7%) compared to 9 patients (30.0%) in Group DL which was statistically significant as p= 0.013.

The frequency of adverse events were lower in Group DL 10 (33.3%) compared to Group FL 11 (36.7%), while the majority of patients in both groups experienced no adverse events (66.7% in Group DL vs. 63.3% in Group FL). However, the difference in adverse event rates between the two groups is not statistically significant.

Table IV: Parent satisfaction following treatment evaluated by Likert scale (n=60)

Impression	Group DL (n=30)	Group FL (n=30)	p Value
Satisfied (Very satisfied +Somewhat satisfied)	25 (83.3%)	17 (56.7%)	0.024
Dissatisfied (Neutral + Somewhat dissatisfied+Very dissatisfied)	5 (16.7%)	13 (43.3%)	

Data presented in absolute number, within parenthesis percentages over column total. P Values reached from chi-square test.

Parent satisfaction following treatment, evaluated using a Likert scale, showed a statistically significant difference between the two groups as (p = 0.024) (table IV). A higher proportion of parents in Group DL (83.3%) were "Very satisfied" or "Somewhat satisfied" compared to Group FL (56.7%), while dissatisfaction ("Neutral," "Somewhat dissatisfied," or "Very dissatisfied") was more prevalent in Group FL (43.3%) than in Group DL (16.7%).

Discussion

Postoperative analgesia is crucial following surgical procedures, not only to patient comfort and reduce the length of hospital stays but also to prevent complications. Caudal epidural block is one of the most popular, reliable, and safe techniques in pediatric patients that can provide analgesia for a variety of supra and infra-umbilical surgical procedures. Its main disadvantage remains the short duration of analgesia. Adjuvants can prolong the duration of analgesia. Therefore, this study used two different additives, including dexmedetomidine or fentanyl in order to evaluate and compare the effectiveness of dexmedetomidine and fentanyl as an adjuvant to levobupivacaine in preemptive analgesia by caudal block in terms of perioperative hemodynamic stability, pain intensity, duration of analgesia, number of patients required rescue analgesic and level of sedation in pediatric patients undergoing infraumbilical surgery.
In this study, patients were alternatively assigned into two groups: Group FL(control) and Group DL(intervention). Group FL received levobupivacaine 0.25% combined with fentanyl at a dosage of 1 µg/kg with distilled water for a total volume of 0.75 ml/kg. In contrast, Group DL received levobupivacaine 0.25% combined with dexmedetomidine at a dosage of 0.8 µg/kg with distilled water for a total volume of 0.75 ml/kg.

In the current study, there was no statistical difference observed between the two groups regarding demographic characteristics (age, gender, weight, ASA classification, type of surgery and mean duration of surgery). The findings were consistent with other studies[5,20].

In this study, the differences in heart rate (HR), mean arterial pressure (MAP) and SpO_2 between Group DL and Group FL were non-significant at most time points. However, it was noted that the mean heart rate and mean arterial pressure were lower in Group DL compared to Group FL. Specifically, 30 minutes and 60 minutes after block, the result was statistically significant as ($p < 0.05$). Findings were similar to the study of Elfawal et al. (2016)[2]. They were found significantly lower HR (15 to 60 minutes after caudal block) and MAP (15 to 90 minutes after caudal block) in LD than LF group. Oxygen saturation (SpO_2) between Group DL and Group FL were not statistically significant differences at any time point, as the p value was greater than 0.05, indicating that both treatments maintained optimal oxygen saturation throughout the study period. Another study found that MAP, HR, and SpO_2 showed statistically significant differences between the two groups[14].

In the present study, the differences in FLACC scale between group DL and group FL were non-significant up to 2 hours. But at the 4 to 6 hour time point after surgery, pain relief was better in the DL group than the FL group, which was statistically significant ($p < 0.001$). At the 8th hour and onward, most patients reported moderate pain which was statistically non-significant ($p = 0.081$). Overall, the findings suggest that the preemptive use of levobupivacaine combined with either fentanyl or dexmedetomidine effectively reduces postoperative pain, particularly with dexmedetomidine even in a reduced dose (0.8 µg/kg) compared to other studies in the early hours following surgery. Observations were similar to the studies done by Dutt et al. (2014)[20] who compared caudal dexmedetomidine or fentanyl with ropivacaine in pediatric patients undergoing lower abdomen and limb surgeries and concluded that in the dexmedetomidine group, the pain score was decreased. Elfawal et al. (2016)[2] also demonstrated a similar outcome with dexmedetomidine dose 1 mcg/kg and compared caudal dexmedetomidine or fentanyl with levobupivacaine in paediatric patients undergoing lower limb surgery.

Sedation was measured by Ramsay Sedation Scale (RSS). In this study, statistical differences were observed at all-time points up to 4 hours after surgery, with Group DL exhibiting higher RSS scores compared to Group FL ($p < 0.001$). No significant differences were found at 6, 8, 12, and 24 hours after surgery. The quality of pleasant and adequate sedation varied between groups and it was maintained properly in group DL than group FL up to 4 hours. So precise control of the depth of sedation is managed by group DL rather than FL group. This suggests that patients in group DL experienced greater sedation during the initial postoperative phase. This finding was consistent with the results of research carried out by Chauhan and Sharma[22]. The mean RSS was significantly greater in the group levobupivacaine with dexmedetomidine (up to 4 hours) as compared to levobupivacaine alone and levobupivacaine with fentanyl group (2 hours). Similar results were observed in the study done by Paul et al. (2022)[23], where the dexmedetomidine group had higher sedation scores than fentanyl when added to epidural bupivacaine. So dexmedetomidine can be considered a suitable adjuvant to levobupivacaine for caudal block as it produces sedation.

In this study, Group DL required rescue analgesics later, with a mean time of 480.63 ± 5.39 minutes compared to 360.20 ± 3.35 minutes for Group FL ($p < 0.001$). When FLACC score ≥ 4, rescue analgesia was given. A higher proportion of patients in Group FL received rescue analgesic, with 20 patients (66.7%) compared to 9 patients (30.0%) in Group DL ($p = 0.013$). Bajwa et al. 2011[16] evaluated the addition of dexmedetomidine or fentanyl to epidural ropivacaine in patients undergoing lower limb orthopedic surgeries and found that the dexmedetomidine group prolonged the postoperative analgesia duration. Elfawal et al. (2016)[2] observed similar results. Here the duration of analgesia (min) 330.4 ± 14.7 in FL group 490.4 ± 13.6 in DL group and patient requiring rescue analgesia 15 (50%) and 9 (32.1%), respectively.

In this study, the incidence of hypotension and bradycardia was higher in the DL than in the FL group. Nausea and vomiting were lower in group DL than Group FL, the occurrence of adverse events was higher in Group DL (33.3%) compared to Group FL (36.7%), while the majority of patients in both groups experienced no adverse events (66.7% in Group DL

vs. 63.3% in Group FL). This result is consistent with the results of other studies[16,24].

The current study used a five-point Likert scale to assess parent satisfaction and found that parents of patients who received caudal dexmedetomidine were more satisfied than those who received fentanyl. They discovered that the children were peaceful and quiet, and the level of anxiety was limited, with minimal postoperative adverse effects, giving them more trust about their children's safety. Parent satisfaction following treatment showed a statistically significant difference between the two groups ($p = 0.024$). A higher proportion of parents in Group DL (83.3%) were "Very satisfied" or "Somewhat satisfied" compared to Group FL (56.7%), while dissatisfaction ("Neutral," "Somewhat dissatisfied," or "Very dissatisfied") was more prevalent in Group FL (43.3%) than in Group DL (16.7%). Yao et al. (2022)[24] concluded that improving parental satisfaction promotes a positive relationship between patients and doctors, leading to more empathetic medical services.

Conclusion

Dexmedetomidine added to levobupivacaine in preemptive caudal block provided better perioperative haemodynamic stability, analgesia, increased the duration of postoperative analgesia,better sedation and minimal side effects with more parental satisfaction in pediatric patients.

Declaration

Ethics approval

The study was approved by the Institutional Review Board of Bangladesh Medical University (Registration No: 4662, BMU/2023/13221).

Author contributions

Conception and development of the idea MMR, AKMA
Writing MMR, SN
Data analysis MSI, AF, MMR
Data collection MMR, MHM, MNA
Review and Editing MMK, DKB

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Conflict of interests: None

References

1 Hasani A, Ahmeti H, Llullaku S, Soljakova M. Preemptive Analgesia in Children with Caudal Blocks. Acta Inform Med. 2011; 19(1): 37-39.

2 Elfawal SM, Abdelaal WA, Hosny MR. A comparative study of dexmedetomidine and fentanyl as adjuvants to levobupivacaine for caudal analgesia in children undergoing lower limb orthopedic surgery. Saudi journal of anaesthesia. 2016; 10(4): 423–427.

3 Gawe ZA, Isa HM, Almashaur MM, Haider F, Almulla K. The Effect of Caudal Anesthesia Block on Perioperative Pain Control and Reduction of the Anesthetic Agent in Pediatric Infraumbilical Surgery: A Prospective Randomized Trial Study. Anesthesia, essays and researches. 2022; 16(3): 301–306.

4 Singh A, Gupta KK, Kaur A, Kaur H. Analgesic efficacy and safety of dexmedetomidine as an adjuvant to caudal levobupivacaine for infraumbilical surgeries in children. JARSS. 2021; 29(4):263-9.

5 Kanazi GE, Aouad MT, Jabbour-Khoury SI, Al Jazzar MD, Alameddine MM, Al-Yaman R, Bulbul M, Baraka AS. Effect of low-dose dexmedetomidine or clonidine on the characteristics of bupivacaine spinal block. Acta anaesthesiologica Scandinavica. 2006; 50(2): 222–227.

6 Bhowmick DK, Akhtaruzzaman AKM, Ahmed N, Islam MS, Hossain MM, Islam MM. Postoperatve pain relief in children after subumbilical surgeries-a comparison between caudal bupivacaine and bupivacaineclonidine. Mymensingh medical journal. 2011; 20(1): 93–97.

7 Aziz MMA, Abdelfatah AM, Hamid HMA. Ultrasound-guided caudal analgesia using fentanyl versus dexmedetomidine as an adjuvant for levobupivacaine in infraumbilical pediatric surgeries. Ain-Shams Journal of Anaesthesiology. 2016; 9:542–548.

8 Attri JP, Kaur G, Kaur S, Kaur R, Mohan B, Kashyap K. Comparison of levobupivacaine and levobupivacaine with fentanyl in infraumbilical surgeries under spinal anaesthesia. Anesthesia, essays and researches 2015; 9(2): 178–184.

9 Menzies R, Congreve K, Herodes V, Berg S, Mason DG. A survey of pediatric caudal extradural Anaesthesia practice. Paediatr Anaesth. 2009; 19:829–36.

10 Lönnqvist PA, Ivani G, Moriarty T. Use of caudal-epidural opioids in children: still state of the art or the beginning of the end? Paediatric anaesthesia. 2002; 12(9):747–749.

11 Lönnqvist PA. Adjuncts to caudal block in children. Br J Anaesth.2005; 95:431–3.

12 Shukla U, Prabhakar T, Malhotra K. Postoperative analgesia in children when using clonidine or fentanyl with ropivacaine given caudally. Journal of anaesthesiology, clinical pharmacology 2011; 27(2):205–210.

13 Yoshitomi T, Kohjitani A, Maeda S, Higuchi H, Shimada M, Miyawaki T. Dexmedetomidine enhances the local anesthetic action of lidocaine via an alpha-2A adrenoceptor. Anesthesia and analgesia. 2008; 107(1): 96–101.

14 El Shamaa HA, Ibrahim M. A comparative study of the effect of caudal dexmedetomidine versus morphine added to bupivacaine in pediatric infra-umbilical surgery. Saudi journal of anaesthesia. 2014; 8(2): 155–160.

15 She YJ, Xie GT, Tan YH, Kuang XH, Yu GF, Lian GH, Song XR. A prospective study comparing the onset and analgesic efficacy of different concentrations of levobupivacaine with/without dexmedetomidine in young children undergoing caudal blockade. Journal of clinical anesthesia. 2015; 27(1): 17–22.

16 Bajwa SJ, Arora V, Kaur J, Singh A, Parmar SS. Comparative evaluation of dexmedetomidine and fentanyl for epidural analgesia in lower limb orthopedic surgeries. Saudi journal of anaesthesia. 2011; 5(4): 365–370.

17 Merkel SI, Voepel-Lewis T, Shayevitz JR, Malviya S. The FLACC: a behavioral scale for scoring postoperative pain in young children. Pediatric nursing. 1997; 23(3): 293–297.

18 Ramsay MA, Savege TM, Simpson BR, Goodwin R. Controlled sedation with alphaxalone-alphadolone. British medical journal. 1974; 2(5920): 656–659.

19 Alkharusi H. A descriptive analysis and interpretation of data from likert scales in educational and psychological research. Indian Journal of Psychology and Education. 2022; 12(2): 13-16.

20 Dutt B, Parmar NK, Shrivastava M, Dhama V, Tyagi V, Asad M. Comparison of caudal dexmedetomidine and fentanyl for postoperative analgesia: a randomized double blinded study. J Adv Res Biol Sci. 2014; 6:51-7.

21 Chauhan K, Sharma R. A study to compare caudal dexmedetomidine versus fentanyl as adjuvant to 0.25% levobupivacaine for postoperative sedation in paediatric patients undergoing infraumblical surgeries under General Anaesthesia. International Journal of Medical and Biomedical Studies. 2019; 3(4):225.

22 Paul A, Nathroy A, Thakurdas P. A Comparative Study of Dexmedetomidine and Fentanyl as an Adjuvant to Epidural Bupivacaine in Lower Limb Surgery. J Med Sci. 2017; 37(6): 221-226.

23 Sethi C, Gaur S, Verma M, Krishna L, Gaur AC. Comparative study of dexmedetomidine and fantanyl as adjuvants to ropivacaine for epidural anaesthesiain orthopedic replacement surgeries. International Journal of Contemporary Medical Research. 2022; 9(1): A5-A9.

24 Yao J, Gong H, Zhao X, Peng Q, Zhao H, Yu S. Parental presence and intranasal dexmedetomidine for the prevention of anxiety during anesthesia induction in children undergoing tonsillectomy and/or adenoidectomy surgery: A randomized controlled trial. Frontiers in Pharmacology. 2022; 13: 1015357.