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ORIGINAL ARTICLE

Effect of Caudal Dexmedetomidine on Emergence Agitation after Infra Umbilical Pediatric Surgeries

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ABSTRACT

Background: Intravenous dexmedetomidine could reduce the incidence of postoperative agitation. However, it could also delay discharge from the hospital and increase the incidence of hypotension. This study aimed to evaluate the effect of caudal dexmedetomidine on the emergence of agitation in pediatrics after infra-umbilical surgeries.

Methods: This Prospective randomized controlled clinical trial included 104 pediatric patients with age group from 2 to 6 years undergoing elective infra umbilical surgeries, categorized into two equal groups (52 each): Control group (C): patients who received caudal block using 2 mg /kg of 0.25% bupivacaine diluted in saline. Dexmedetomidine group (D): patients who received caudal block using 2 mg/kg of 0.25% bupivacaine and 0.5 µg/kg dexmedetomidine. Incidence and severity of emergence Agitation (EA), hemodynamics, sedation level, duration of the caudal block, and adverse events were evaluated.

Results: The control group had a higher incidence of agitation than the dexmedetomidine group ($p<0.05$), denoting that caudal dexmedetomidine effectively decreased the incidence of emergence agitation. The Dexmedetomidine group had a longer post-anesthesia care unit (PACU) stay duration than the Control group ($P=<0.001$). The control group had a significantly higher FLACC Pain Score than the dexmedetomidine group during the next 6-24 hours at the ward ($p=<0.001$).

Conclusion: The addition of 0.5 µg/kg dexmedetomidine 0.5 to the local anesthetic 2 mg/kg of 0.25% bupivacaine in a single-shot caudal block could decrease the incidence of emergence agitation, prolong the duration of the block, and postoperative analgesia and also reduce postoperative analgesic requirements without significant hemodynamic instability or postoperative complications. Therefore, dexmedetomidine may be the drug of choice to be given as an additive to local anesthetics in the caudal block.

Keywords: Caudal Dexmedetomidine, Emergence Agitation, Infra Umbilical, Pediatric Surgeries

INTRODUCTION

Anxieties, cries, screams, confusion, and non-purposeful restlessness are symptoms of emergence agitation, a detached state of consciousness that can affect as many as 80% of pediatric patients after surgery [1]. Several factors can cause EA. These include things like being too alert upon waking up in a strange place, painful events like surgical wounds, agitation during induction, airway obstructions, how long the anesthesia lasts, extreme heat or cold, the type and location of the operation, any premedication, inhaled or intravenous anesthetics, and the technique of administration [2].

Patients experiencing endotracheal asphyxia may unknowingly remove their stomach and endotracheal tubes, leading to hypoxia, incision dehiscence, and hemorrhage. Furthermore, individuals with EA

frequently encounter sympathetic stimulation and circulatory instability, which can be particularly risky for patients with preexisting cardiovascular and cerebrovascular disorders [3].

While opioids have shown promise in reducing EA rates in children, the risk of major side effects, such as respiratory depression, limits their usage in this age range [4]. The efficacy of midazolam in preventing emergence agitation in pediatric patients is inconsistent [2]. Propofol and magnesium sulfate are other medications that help lessen the occurrence and severity of EA; however, these medications require continuous infusion [5]. In contrast, ketamine and dexmedetomidine administration can reduce the severity of EA [6].

Dexmedetomidine is an agonist for α2-adrenoreceptors that is both powerful and very selective. As a sedative-hypnotic, it also reduces anxiety and pain, and it acts as an anesthetic and sympatholytic [7]. One positive side effect of intravenous dexmedetomidine is that it reduces postoperative agitation; nevertheless, there is a negative side effect that it increases the risk of hypotension and delays hospital discharge [8]. Several administration methods are available, including intravenous, transnasal, oral, inhalation, and caudal block [9].

Because of its safety, simplicity, high success rate, and decreased incidence of EA compared to intravenous medications, the caudal block is a frequently utilized regional block for pediatric infra-umbilical operations for intraoperative and postoperative analgesia [2]. However, the short-acting nature of the caudal block is its primary drawback. This is why the caudal block has several adjuncts that make it last longer as an analgesic after surgery [9]. Postoperative analgesia with reduced pain can be prolonged with the use of dexmedetomidine when administered caudally [10].

So, we aimed in this study to evaluate the effect of caudal dexmedetomidine on the emergence of agitation in pediatrics after infra-umbilical surgeries.

METHODS

This Prospective randomized controlled clinical trial was done on 104 pediatric patients undergoing infra umbilical surgeries at Zagazig University Hospitals from May 2023 to December 2023.

After the Zagazig University Faculty of Medicine Research Ethics Committee (IRB#10496/7-3-2023), All parents or caregivers of participants were asked to sign an informed consent. Human subjects research adhered to the guidelines set in the Declaration of Helsinki, which is part of the World Medical Association's Code of Ethics.

Inclusion criteria: The study included 104 patients of both sexes aged 2–6 years, with body mass index (BMI) equal to 5%: 85% of BMI (kg/ m2) of the same age and sex, American Society of Anesthesiologists (ASA) classes I and II, who were scheduled for elective infra umbilical surgeries.

In this study, 110 patients were enrolled to undergo infra umbilical surgery; 6 patients were excluded as two did not meet the inclusion criteria, and four refused to participate. Two equal groups were randomly selected from among the 104 patients who were enrolled in the study (Figure 1).

Exclusion criteria: Patients who were excluded from the study were those who had known allergies, sensitivity to dexmedetomidine or bupivacaine, chest infection within two weeks, contradictions to caudal block, such as infection at the site of injection, coagulopathy, increased intracranial tension, preexisting neurological deficits, and demyelinating lesions. Also, patients with operations lasting more than 2 hours were excluded from the study.

Complete medical history was obtained from the parents or caregivers, and physical examinations and laboratory investigations were performed on all study participants. These investigations included complete blood count (CBC), random blood glucose, kidney function test, liver function test, and coagulation profile. Patient weight was determined in kilograms, then the volume to be injected in the caudal block in the form of used drugs according to each group and normal saline prepared in syringes provided that the calculated dose of bupivacaine is below the toxic dose (2.5 mg /kg). All children were fasting for 2 hours for clear fluid and 6 hours for light meals.

Intraoperative

An appropriately sized peripheral intravenous line was placed. Patients had non-invasive blood pressure (NIBP), electrocardiogram (ECG), and pulse oximetry (SpO2) monitors attached to them so that baseline values of mean arterial pressure (MAP), heart rate (HR), and SpO2 could be recorded and tracked every 5 minutes throughout the procedure. General anesthesia was induced by intravenous injection of 2 mg/kg Propofol and 2 mcg/kg fentanyl. Tracheal intubation was facilitated by an intravenous injection of 0.5 mg/kg atracurorium, and controlled ventilation was started with the adjustment of tidal volume and respiratory rate to maintain EtCO2 35-40 mmHg. Anesthesia was maintained with 1.5% isoflurane in pure oxygen and muscle relaxant

atracurorium 0.2mg/kg at fixed time intervals. The analgesic dose for all patients was 15 mg/kg of intravenous paracetamol.

Before recovery from anesthesia, Patients in both groups were placed in the lateral decubitus position and under completely sterile conditions, sacral hiatus identified by the non-dominant hand, and a single-dose caudal block was performed according to the group using the standard loss of resistance technique. After locating the sacral hiatus, the area immediately above it was thoroughly cleaned with an antiseptic solution. A 22-gauge needle was inserted at a slight angle to the skin, positioned at approximately 90 degrees, and continued to be inserted until a "click" was heard, indicating the piercing of the sacrococcygeal ligament, as per the group's protocol for a single-dose caudal block. Next, the needle was cautiously guided in a cephalad direction, making an angle close to the spinal canal's long axis. A "whoosh test" with two to three milliliters of air or saline and a stethoscope can verify the needle's proper insertion. Due to the child's dura being located at or below the S2 level, great care was exercised to prevent the needle from being inserted too deeply. An aspiration test is performed to rule out cerebrospinal fluid or blood [11].

Patients were randomly allocated in two groups using computer-generated randomization tables; the randomization sequence was concealed in sealed envelopes. Randomization assignments were kept in sealed envelopes until the day of surgery, and then they were opened by the research anesthesiologist immediately prior to the operation. The drugs used in the research and control drug bear the same shape and size and are placed in syringes of the same shape and size. The data of patients were collected by an anesthesia resident (blind observer) who was not part of the study team.

Group C (Control group): Patients received a caudal block using 2 mg /kg of 0.25% bupivacaine diluted in saline for a total volume of 1 ml/kg.

Group D (Dexmedetomidine group) **(n= 52):** Patients received caudal block using 2 mg/kg of 0.25% bupivacaine and 0.5 µg/kg dexmedetomidine diluted in saline with a total volume of 1 ml/kg.

The prepared volume was injected slowly at a rate < 10 ml / 30 seconds; muscle relaxant was reversed with a mixture of 0.05 mg/kg of neostigmine and 0.01 mg/kg of atropine after inhalational anesthesia was discontinued. Extubation was done following the patient's awakening, and they were moved to the PACU. Primary outcome: Incidence of emergence agitation. Secondary outcomes: Severity of emergence agitation, Duration of PACU stay, Incidence of post-operative side effects, Duration of caudal analgesia.

Postoperative:

The following parameters were monitored: HR, MAP, respiratory rate, and SpO_2.The incidence and severity of EA were evaluated upon admission to the PACU, after 5 min, after 15 min, and after 30 min using Aono's four-point scale [12]: 1 in case of calm, 2 for those who were not calm but could be easily calmed, 3 for those who were moderately agitated or restless, and 4 for those who were exited or disorient. The duration of the caudal block was assessed using the pediatric observational Face, Legs, Activity, Cry, Consolability (FLACC) pain scale after surgery. The FLACC pain scale, 0 = Relaxed and comfortable, 1-3 = Mild discomfort, 4-6 = Moderate pain, 7-10 = Severe discomfort/pain [13]. The Ramsay sedation scale (RSS) was used to measure the degree of sedation [14]. The RSS values were recorded at intervals of 1 hour during the first 24 hours postoperative; Ramsay sedation scale (RSS) 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. Excessive sedation was defined as RSS value > 4.

The adverse events were recorded and managed**.** When the modified Aldrete score reached more than 9, the patient was discharged from PACU [15].

Data collection:

Vital parameters HR, MAP, and SPo2 were recorded on arrival to the operating room as baseline values and at a 5-minute time interval during the operation. They were monitored post-operative at PACU at time intervals of 5 minutes till discharge and at the ward at 0,2,4,6,12,24 hours. Extubation time, incidence, and severity of emergence agitation: upon admission to PACU 0, 5, 15, 30 min postoperatively using Aono's four-point scale, Duration of caudal block analgesia: done every 2 hours for 24 hours and the total rescue dose of fentanyl was recorded; the pain managed by rescue dose of fentanyl 1 ug/kg when FLACC score became equal or more than 4, Level of sedation: assessed using RSS, duration of PACU stay: The time from arrival to the PACU until discharge from it.

Sample size: Assuming the frequency of postoperative agitation was 2.5%. Vs. 22.5% in the Dexmedetomidine group Vs. Control group. At 80% power and 95% CI, the estimated sample was 104

Cases, with 52 Cases in each group. (OpenEpi, Version 3).

STATISTICAL ANALYSIS

IBM's statistical analysis software, SPSS, version 27.0, was used to process the data. Normality was tested using the Shapiro–Wilk test and the Kolmogorov-Smirnov Normality Test. An Independent sample t-test was used to compare the continuous data between both groups. Categorical data were represented as events and percentages. Comparison between both groups regarding categorical data was performed using the Chi-square (x2) test or Fisher Exact test. Repeated measurements for continuous data were evaluated using a General linear model adjusted with Bonferonni or a mixed linear model adjusted with Bonferonni in the presence of missing values. The significance level was considered when the p-value was <.0.05.

RESULTS

The mean age of the patients in the control group was 4.6 years old and 4.9 years old in the Dexmedetomidine group. Most of the patients included in both groups were males; non-statistically significant differences were found between both groups regarding demographic characteristics, ASA physical status, operation time, and extubation time (**Table 1**).

Repeated measurements of HR, mean arterial pressure and peripheral oxygen saturation (%) at PACU and the ward revealed non-statistically significant differences (**Figure 2**).

The control group had a higher incidence of agitation than the dexmedetomidine group ($p<0.05$), denoting that caudal dexmedetomidine was effective in decreasing the incidence of emergence agitation **(Table 2**).

The Dexmedetomidine group had a longer PACU stay duration than the Control group (P=<0.001). Also, the duration of the caudal block was longer in the Dexmedetomidine group than in the Control group (P<0.001) (**Table 3**).

The FLACC Pain Score was higher in the control group than in the dexmedetomidine group during the next 6-24 hours at the ward (p=<0.001); regarding the degree of sedation, the RSS Score was higher in the dexmedetomidine group than in the control group during the first 5 hours in the ward (p=<0.001) (**Table 4**).

Non-statistically significant differences were found between both groups regarding the adverse events: respiratory depression, Hypoxia, Hypotension, and Bradycardia ($p>0.05$) (**Table 5**).

Table 1: Demographic data, Operation time, and Extubation time of both groups.

	control group (N=52)	Dexmedetomidine group (N=52)	Test value	P value
Age(years)	4.6±0.9	4.9±0.8	T=0.3	0.07
BMI(kg/m^2)	14.35±1.78	14.33±1.67	T=0.02	0.95
Gender (event (%)				
male	36(69.2%)	32(61.5%)	X^2 = 0.67	0.410
female	16(30.8%)	20(38.5%)		
ASA (event (%)				
Grade I	31(59.6%)	23(44.2%)	X^2 = 2.46	0.116
Grade II	21(40.4%)	29(55.8%)		
time (min) Operation	52.6±9.77	52.12±10.01	T=0.48	0.80
time (min) Extubation	7.73±1.72	7.75±1.72	T=-0.02	0.95

Data are represented as mean± standard deviation or number and percentage (%), categorical data as event and percentage, T=independent sample t-test, and X^2=Chi square test. BMI: Body Mass Index, N: Number, ASA: American Society of Anesthesiologists, P: statistically significant if P value < 0.05

Table 1: Repeated measurements for Aono's four-point scale at PACU and incidence of agitation in both groups

Aono's four-point scale	Control group (N=52)	Dexmedetomidine group (N=52)	Test value	P value
0 minutes	2.192±0.1	1.73±0.1	MD= 0.462	**0.002**
5 minutes	1.865±0.09	1.35±0.09	MD= 0.506	**<0.001**
15 minutes	1.635±0.077	1.25±0.08	MD= 0.385	**0.001**
Agitation	13(25.0%)	2(3.8%)	X^2= 9.42	**0.002**

Data are represented as mean± standard deviation or number and percentage (%), mixed model adjusted with Bonferonni. P: statistically significant if P value < 0.05, MD: mean difference, X2: chi-square test

Table 3: Duration of PACU stay and caudal block in both groups

	Control group	Dexmedetomidine group	Mean difference	t	P value
PACU stay (min)	15.44±1.75	17.05±1.79	-1.615	-4.63	**<0.001**
Duration of caudal block (hr)	5.17±0.76	9.56±0.50	-4.39	**-34.73**	**<0.001**

Data are represented as mean± standard deviation, independent sample-t-test, PACU post-anesthesia care unit, P: statistically significant if P value < 0.05

Table 4: FLACC Pain Score and Ramsay sedation scale (RSS) at the ward in both groups at different time points

FLACC Pain Score at ward	Control group	Dexmedetomidine group	Mean difference	P value
0 hour	0.48±0.07	0.5±0.07	-0.02	0.846
2 hours	1.08±0.05	1.17±0.05	-0.10	0.141
4 hours	1.08±0.04	1.1±0.04	-0.02	0.730
6 hours	1.44±0.07	1.02±0.07	0.42	**<0.001**
8 hours	3.33±0.09	1.48±0.09	1.85	**<0.001**
10 hours	4.56±0.07	3.5±0.07	1.86	**<0.001**
12 hours	5.19±0.14	3.29±0.14	1.90	**<0.001**
24 hours	7.44±0.16	5.4±0.16	2.04	**<0.001**
RSS at ward	**Control group**	**Dexmedetomidine group**	**Mean difference**	**P value**
0 hour	2.17±0.11	3.04±0.11	-0.87	**<0.001**
1 hour	2.21±0.11	3.12±0.11	-0.90	**<0.001**
2 hours	2.1±0.12	2.77±0.12	-0.67	**<0.001**
3 hours	2.13±0.12	3.02±0.12	-0.88	**<0.001**
4 hours	2.04±0.11	2.46±0.11	-0.42	**0.008**
5 hours	1.83±0.08	2.12±0.08	-0.29	**0.03**
6 hours	2.10±0.07	2.10±0.07	0.00	0.99
7 hours	1.96±0.08	2.12±0.08	-0.15	0.197
8 hours	1.98±0.08	2.1±0.08	-0.12	0.321
9 hours	1.96±0.07	2.1±0.07	-0.13	0.146
10 hours	2±0.04	2.1±0.04	-0.10	0.130
11 hours	2.02±0.04	2.1±0.04	-0.08	0.202

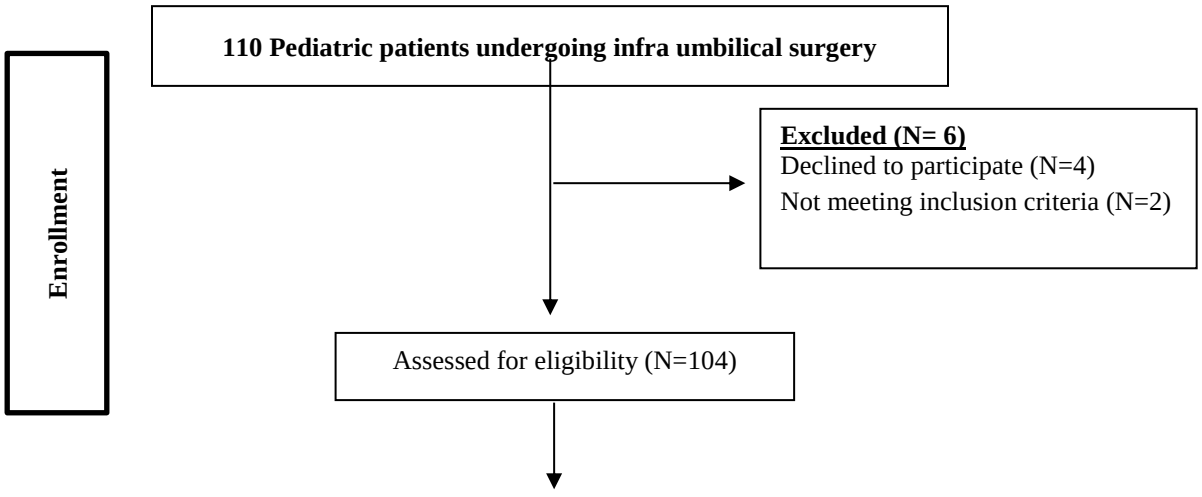
RSS at ward	Control group	Dexmedetomidine group	Mean difference	P value
12 hours	2±0.04	2.1±0.04	-0.10	0.130
13 hours	2.02±0.04	2.1±0.04	-0.08	0.202
14 hours	2.02±0.04	2.1±0.04	-0.08	0.202
15 hours	2.02±0.04	2.1±0.04	-0.08	0.202
16 hours	2.02±0.04	2.1±0.04	-0.08	0.202
17 hours	2.02±0.04	2.1±0.04	-0.08	0.202
18 hours	2.02±0.04	2.1±0.04	-0.08	0.202
19 hours	2.02±0.04	2.1±0.04	-0.08	0.202
20 hours	2.02±0.04	2.1±0.04	-0.08	0.202
21 hours	2.02±0.04	2.1±0.04	-0.08	0.202
22 hours	2.02±0.04	2.1±0.04	-0.08	0.202
23 hours	2.02±0.04	2.1±0.04	-0.08	0.47
24 hours	2.06±0.04	2.1±0.04	-0.04	0.467

Data are represented as mean± standard error, General linear model adjusted with Bonferonni.FLACC: F=face, L=leg, A=activity, C=cry, C= Consolability: statistically significant if P value < 0.05

Table 2: Incidence of adverse effects in both groups.

Adverse effects	Control group (N=52) Number (%)	Dexmedetomidine group (N=52) Number (%)	P value
Respiratory depression	0 (0%)	0 (0%)	0.999
Hypoxia	0 (0%)	0 (0%)	0.999
Hypotension	2(3.8%)	1(1.9)	0.89
Bradycardia	1(1.9%)	4(7.7%)	0.363

Data were represented by number and percentage (%), cross-tabulation, and the Fisher exact test. N: Number, P: statistically significant if P value < 0.05.



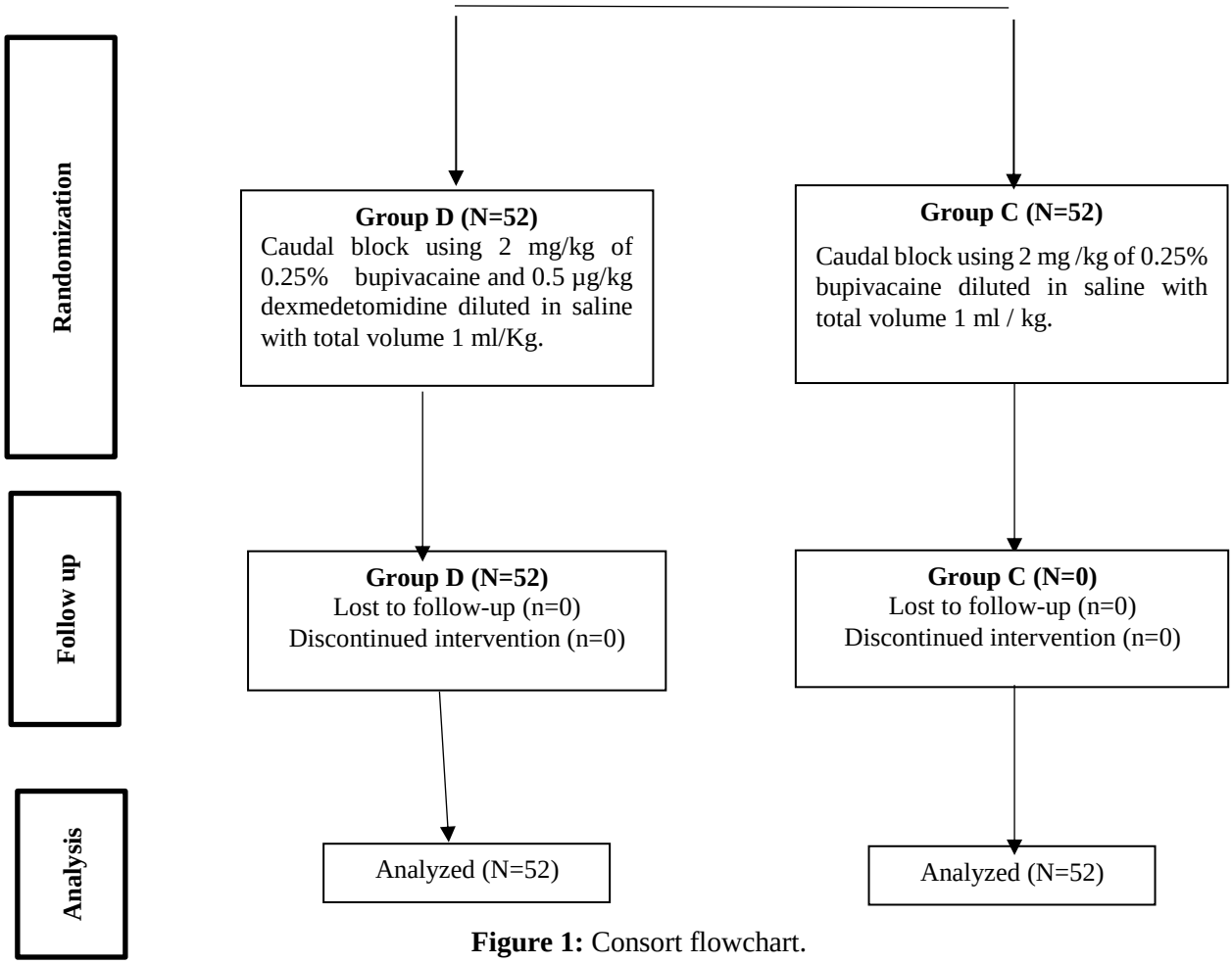
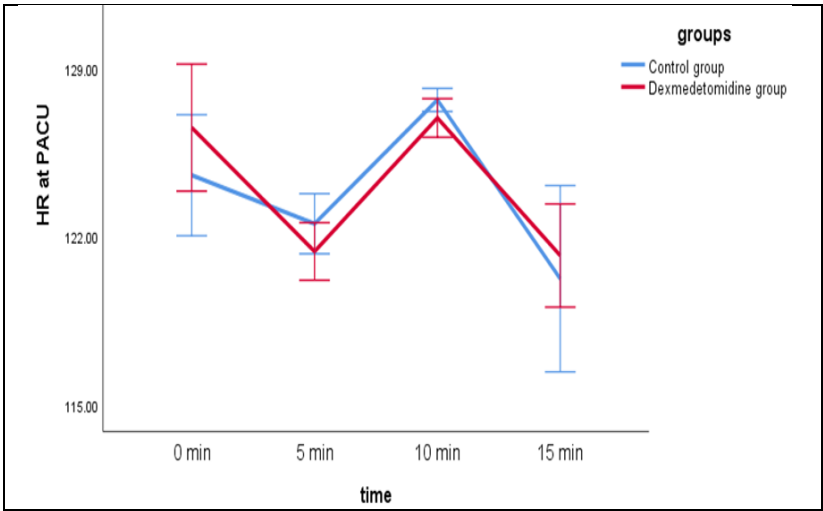
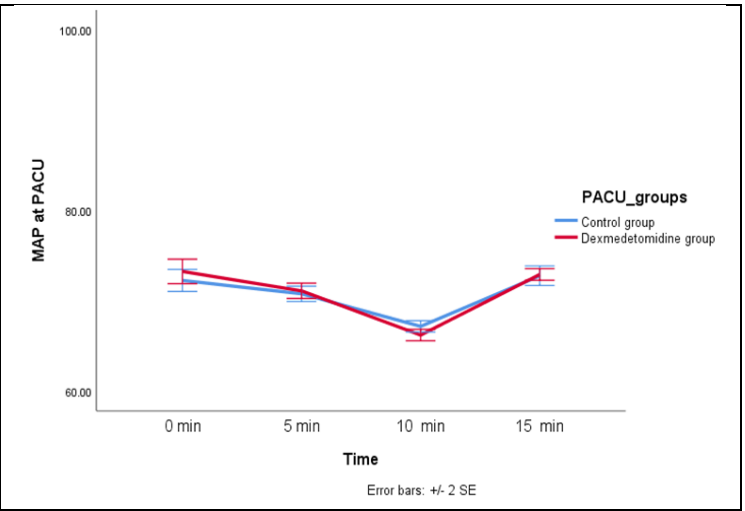


Figure 1: Consort flowchart.



(A)



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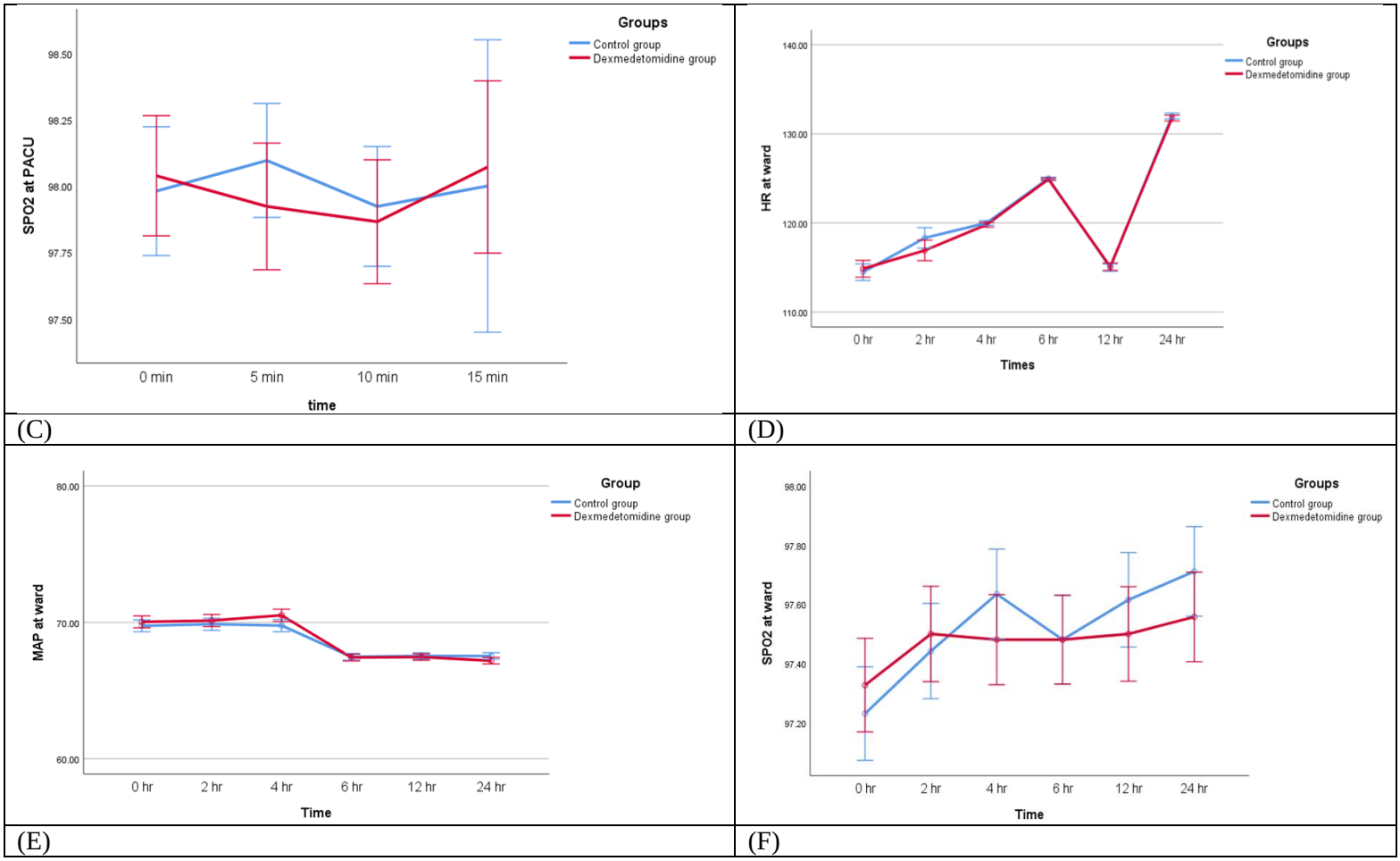

Figure 2: Line charts comparing (A) heart rate (beat/min) between both groups at PACU at different time points, (B) mean arterial pressure (mmHg) between both groups at PACU at different time points, (C) peripheral oxygen saturation (%) between both groups at PACU at different time points, (D): heart rate between both groups at ward at different time points, (E): mean arterial pressure (mmHg) between both groups at ward at different time points, (F): peripheral oxygen saturation (%) between both groups at ward at different time points

DISCUSSION

When administering regional anesthesia to children, caudal block is among the most popular methods. Despite the use of long-acting drugs like bupivacaine, the procedure's primary drawback is the relatively brief duration of action, even though it is safe and uncomplicated [16].

At present, we aim to evaluate the effect of caudal dexmedetomidine on the emergence of agitation in pediatrics after infra-umbilical surgeries.

The present study showed that caudal dexmedetomidine significantly decreased the incidence of postoperative agitation among children who had undergone infra umbilical surgeries; this could be explained by its activation of α2-A receptors in locus ceruleus, which induces drowsiness, analgesia, and a centrally mediated sympatholytic action by inhibiting norepinephrine release from presynaptic neurons [17].

It is suggested that the physiologic effects of dexmedetomidine delivered via the caudal epidural route may be amplified in the sacral area due to the higher concentration of α2-AR there compared to the thoracic and lumbar regions [18].

These results were in accordance with the result of Zhu et al. [19], who conducted a randomized controlled study investigating the effects of caudal dexmedetomidine for preventing postoperative agitation in children undergoing urethroplasty. Group D, consisting of 80 children, received 0.2 percent Ropivacaine in addition to 0.5 µg/kg dexmedetomidine for caudal block; group C, consisting of 40 instances in total, received 0.2 percent Ropivacaine alone. According to the study, pediatric patients experienced less postoperative

agitation when 0.5 µg/kg of caudal dexmedetomidine was administered.

Contrary to our study, Ham et al. [20] investigated the impact of a single dose of dexmedetomidine on emergence agitation in patients undergoing orthognathic surgery. Seventy patients, aged twenty-five to forty-five, were randomly divided into two groups: one group was given intravenous dexmedetomidine at a dose of 1 µg/kg (Dex group). In contrast, the other group was given normal saline (control group). Perhaps because of differences in age and administration method, dexmedetomidine was not able to considerably lessen emergence agitation.

The present study showed no statistically significant differences between the groups regarding postoperative hemodynamics HR, MAP, and SPO2 at PACU and ward. These results agreed with Xiang et al. [21], who studied 100 children aged 2–10 years undergoing elective infra-umbilical surgeries. The children who were going to have inguinal hernia repairs were split into two groups. One group received 1 ml/kg of 0.25 percent bupivacaine and 1 ml of normal saline. In contrast, the other group got 1 ml/kg of 0.25 percent bupivacaine and 1 µg/kg of dexmedetomidine in 1 ml of normal saline. The researchers discovered that combining caudal bupivacaine and dexmedetomidine decreased the hemodynamic response to hernial sac pressure. After numerous assessments in the post-anesthesia care unit, however, the dexmedetomidine group's hemodynamics were not significantly different from the control group.

This is in line with the findings of Karuppiah et al. [22], who examined the effects of bupivacaine and two dosages of dexmedetomidine (1 µg/kg and 2 µg/kg) on caudal analgesia during juvenile infra umbilical operations. The study included 90 children and found that both doses of dexmedetomidine were effective as adjuvants to bupivacaine. Still, the 1 µg/kg dose had a better safety profile with non-significant differences in the mean blood pressures and heart rates between the groups at any time interval.

Contrary to the present study, Refaee et al. [23] performed research on 36 children ranging in age from one to seven who were going to have orthopedic surgery on their lower limbs. The caudal block was supplemented with general anesthesia for the patients. Three groups of patients were formed. In the first group, 12 participants were given 0.5 mL/Kg of bupivacaine in addition to 2 mcg/Kg of dexmedetomidine; in the second group, 50 mg of magnesium was given with the same amount of bupivacaine; and in the third group, 12 participants were given 0.5 mL/Kg of bupivacaine in addition to normal saline. Results showed that dexmedetomidine was associated with a worse hemodynamic profile and a greater sedation score; however, the limited sample size and high dosage may have contributed to these findings.

The present study showed that the Dexmedetomidine group had a longer PACU stay duration than the Control group ($P<0.001$). These results agreed with Zhu et al. [19], who analyzed the effectiveness of caudal dexmedetomidine in reducing agitation following urethroplasty in a randomized controlled trial. Researchers discovered that patients given dexmedetomidine took more time to leave the PACU than those given a placebo.

Also, Abdel-Rahman et al. [24] carried out a study with 90 pediatric patients having strabismus surgery to find the optimal dosage of dexmedetomidine to reduce the occurrence of emerging agitation. Ninety-nine patients were divided into three equal groups and given different doses of dexmedetomidine: 0.5 µg.kg−1 in the high Dex group, 0.25 µg.kg−1 in the low Dex group, or normal saline in the placebo group. The study discovered that the high Dex group had a significantly longer time to PACU discharge with an Aldrete score of 9 or 10 than the other two groups.

Contrary to our study, Alansary et al. [25] compared the effects of caudal midazolam with caudal dexmedetomidine in reducing emerging delirium in pediatric patients undergoing sevoflurane anesthesia. Following the induction of general anesthesia, 75 children ranging in age from 2 to 6 years' old who were undergoing lower abdomen or perineal procedures were randomly assigned to one of three groups; each group was given a single-shot caudal epidural block. The group given dexmedetomidine was given a mixture of 1.5 µg/Kg dexmedetomidine in normal saline and 0.25 percent bupivacaine (1 ml/Kg). The group given midazolam had a mixture of 30 µg/kg of midazolam and 0.25 percent bupivacaine (1 ml/Kg). The control group was administered 1 ml/Kg of normal saline containing 0.25 percent bupivacaine, and it was discovered that the control group's PACU stay was significantly longer than the dexmedetomidine group**.** This could be attributed to the IV dexmedetomidine that was used postoperatively as a rescue medication to treat emergency agitation in the control group, resulting in over-sedation and prolonged PACU stay.

Regarding the analgesic profile, the duration of caudal block, and the FLACC Pain Score, our study found that the duration of caudal block was significantly longer in the Dexmedetomidine group. Concerning the FLACC Pain Score, there was no statistically significant difference between both groups at the ward during the first 4 hours, and then the FLACC Pain Score was significantly higher in the control group than the Dexmedetomidine group during 6-24 hours at the ward.

These results agreed with a study by Mohan et al. [26], in which the researchers randomly assigned 135 children, ranging in age from 2 to 8, to one of three groups. One group, RD, received 1 mL/kg of 0.2% Ropivacaine mixed with one εg/kg of dexmedetomidine. Another group, RM, received 1 mL/kg of 0.2% Ropivacaine mixed with 30 µg/kg of midazolam. Finally, group R received 1 mL/kg of 0.2% Ropivacaine mixed with 1 mL of normal saline. The research showed that the analgesic effect was prolonged more effectively and for a longer period when Dexmedetomidine and Ropivacaine were administered together.

Regarding postoperative sedation, according to the RSS score, this study showed that the RSS Score was significantly higher in the dexmedetomidine group than in the control group during the first 5 hours at the ward. Then, there was no statistically significant difference between both groups regarding RSS at the ward for 6-24 hours.

These results agreed with a study by Singh et al. [27]. The participants in this study were 80 children, ranging in age from 1 to 12, with an ASA grade of I or II, who were going to have elective infra-umbilical procedures under general anesthesia. The patients were split evenly into two groups. Group A was given a 1 mL/kg body weight dosage of 0.25 percent levobupivacaine in 0.5 mL of normal saline, and Group B got a 1 mL/kg body weight dose of 0.25 percent levobupivacaine in 0.5 mL of normal saline with dexmedetomidine 1 µg/kg as a caudal drug mixture. Dexmedetomidine was associated with a statistically significant increase in the mean RSS score compared to the control group at 0, 2, and 4 hours postoperatively. However, after 4 hours, the two groups had no significant difference.

This agrees with Zhu et al. [19], who performed a randomized controlled trial to see whether caudal dexmedetomidine effectively reduced agitation in children after urethroplasty surgery. Two groups were formed from the 80 children who were randomly assigned: one group received 0.2 percent Ropivacaine plus 0.5 µg/kg dexmedetomidine for the caudal block, and the other group received 0.2 percent Ropivacaine alone. as compared to the control group, those given dexmedetomidine had a greater RSS in the first four hours following surgery. Then, a similar pattern emerges between four- and twenty-four-hours following surgery.

Regarding post-operative side effects, this study showed that statistically significant differences were found between both groups as regards the adverse events: Respiratory depression, Hypoxia, Hypotension, and Bradycardia ($p>0.05$). These results agreed with a study by Anand et al. [28], who analyzed the outcomes of lower abdominal surgeries in children with a combination of caudal dexmedetomidine and 0.25 percent Ropivacaine (1 ml/kg). The research included 60 kids divided into two groups. One group, Group RD, got 0.25 percent Ropivacaine 1 ml/kg with 2 µg/kg of Dexmedetomidine. The other group, Group R, got only 0.25 percent Ropivacaine 1 ml/kg of Dexmedetomidine. The researchers noted that problems like postoperative nausea and vomiting, respiratory depression, urinary retention, hypotension, and bradycardia could be side effects of caudal dexmedetomidine. However, they didn't detect any notable differences in these complications between the two groups.

It is also in line with the findings of a study by Goyal et al. [29] that examined 100 children ranging in age from 2 to 10 who had elective infra-umbilical operations. They split into two categories. Group A made up of one milliliter of normal saline and 0.25 percent bupivacaine per kilogram. The results showed that the inclusion of dexmedetomidine did not raise the occurrence of adverse effects when compared to bupivacaine alone in Group B, which consisted of 0.25 percent bupivacaine (1 ml/kg) plus 1 µg/kg dexmedetomidine in 1 ml of normal saline.

In contrast to our findings, Refaee et al. [23] examined 36 infants, ranging in age from 1 to 7, who were due to have orthopedic surgery on their lower limbs. Along with the caudal block, patients also received general anesthesia. Three groups were formed from the patients. Twelve subjects were randomly assigned to one of three groups: one received 0.5 mL/Kg bupivacaine + 2 mcg/Kg dexmedetomidine; another received 0.5 mL/Kg bupivacaine + 50 mg magnesium; and twelve subjects were randomly assigned to one of three control groups: twelve subjects each received 0.5 mL/Kg bupivacaine + normal saline. The unfavorable hemodynamic profile and increased

sedation score observed with Dexmedetomidine administration may result from the greater dosage.

Limitations:

The current study had some limitations. First, the sample size might be relatively small, with 56 subjects. Because of this, the results may not apply to a broader population. Second, since the study was conducted in a specific hospital, there was a potential for selection bias. The patient population might not fully represent the diversity and characteristics of all individuals with Infra Umbilical Pediatric Surgeries, which could affect the external validity of the study.

CONCLUSION

The addition of 0.5 µg/kg dexmedetomidine 0.5 to the local anesthetic 2 mg/kg of 0.25% bupivacaine in a single-shot caudal block could decrease the incidence of emergence agitation, prolong the duration of the block, and postoperative analgesia. It also reduces postoperative analgesic requirements without significant hemodynamic instability or postoperative complications. Therefore, dexmedetomidine may be the drug of choice to be given as an additive to local anesthetics in the caudal block.

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