Effect Intravenous Dexamethasone as an Adjuvant to Caudal Block on post operative analgesia: Prospective Cohort study design

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Abstract

Introduction

Caudal block is by far the most commonly employed regional anesthetic techniques to maintain postoperative analgesia in pediatric urogenital surgeries. However, its short duration of action can be prolonged by adding Adjuvants. The aim of this study was to compare the efficacy of dexamethasone administered through intravenous on post-operative analgesia in pediatric patients who underwent infra umbilical surgeries.

Method

In this prospective study, sixty American Society of Anesthesiologists Physical Status I and II patients aged 1–7 years were randomly allocated into two groups of thirty each. Both groups were compared for the duration of postoperative analgesia and analgesic requirement. Severity of postoperative pain was measured by FLACC score. Mann –Whitney U test was used to compare the pain severity and total analgesic consumption. Independent sample t test was used for analgesia duration as well as Chi-square test was used to analyze independent categorical variables between two groups and a p-value of less than 0.05 was considered as statistically significant.

Result

Analgesia duration was significantly prolonged in caudal block with IV dexamethasone group than caudal block with bupivacaine alone group ($P < 0.001$). Total analgesia consumption was significantly lower ($P < 0.001$) in caudal block with IV dexamethasone compared to with bupivacaine alone group. Postoperative severity of pain was significantly lower in caudal block with IV dexamethasone group at 4 th , 6 th and 12 th hours ($P < 0.001$, $P < 0.001$ and $P < 0.003$) respectively.

Conclusion

Addition of intravenous dexamethasone as an adjuvant to caudal block with 0.25% Bupivacaine significantly reduced the intensity of post-operative pain and prolonged the duration of post-operative analgesia.

Introduction

A caudal block is a popular reliable and safe technique for pediatric pain management after infraumbilical surgical procedures. It is by far the most commonly used regional anesthesia technique. It is a good, reliable and easy method to provide perioperative analgesia in a variety of pediatric surgery [1–3]. However, it has the disadvantage of short duration of action and a significant proportion of patients, despite face moderate to severe pain as the block resolves[1].

Many additives were used in combination with local anesthetics in caudal block to prolong the duration of action of bupivacaine in caudal anesthesia[4]. Dexamethasone is a well-known corticosteroid used as an analgesic and antiemetic perioperatively[5]. When it is combined with local anesthetics caudally, it prolongs the postoperative analgesia [6,7]

Bupivacaine is a long-acting reliable local anesthetic agent that is used as a caudal analgesic, but different auxiliary agents need to be co-administered to improve its analgesic efficient[8,9]. Single shots of a combination of local anesthetics, such as Ketamine, midazolam, neostigmine, adrenaline, opioids, clonidine and, recently, dexmedetomidine, have been used[10].

Significant number of children still suffer from moderate to severe pain in the postoperative period. Pain after surgery is usually most severe in the first 24–72 h but may persist for several days or weeks. 1.5% of all surgical procedures results in chronic pain. Postoperative pain management is a very important in pediatric patient for satisfied and better coherent parents, early rehabilitation, and a reduced chance of progression to chronic pain. regional techniques combined with general anesthetic reduce consumption of intraoperative analgesics and volatile anesthetics, reduce the stress response to surgery and encourage fast and painless recovery from surgery[11,12]. We conducted this study to determine the analgesic effect of dexamethasone as an adjuvant to caudal block when given intravenously.

Materials And Methods

Prospective Cohort study design employed at Black Lion specialized hospital from January 2019 to March 2019. All pediatric surgical patients scheduled for infraumbilical surgery were source population where as all elective pediatric surgical patients scheduled for infra umbilical procedures under general anesthesia with caudal block at Black Lion Specialized Hospital and those who fulfill the inclusion criteria from January 2019 to March 2019 were study population.

Children having any contraindication for caudal blocks such as known allergy to local anesthetic agents, coagulation disorders, preexisting neurological disorders, any systemic or local infection, and anatomical abnormalities of spine were excluded from the study. Similarly, children having any others comorbidities such as cardiovascular or respiratory problems, history of convulsions, psychiatric disorders, and mental retardation and failed caudal block were excluded from the study.

Comparison of mean for two independent equal sample sizes was determined based on mean pain score among. The group where n_1 = sample for CB (caudal block) with bupivacaine alone group, n_2 = sample for CB with bupivacaine and IV dexamethasone group. The study was designed with type I error of $\alpha = 0.05$, which is 1.96, type II error of $\beta = 0.2$ and power of 80%, which is 0.84. Since there is no previous study done in our country result adopted from literature was used to calculate sample size.

Previous study on 2015 in Malaysia, showed that the mean pain score was 1.9 ± 2.0 , 3.5 ± 2.2 in CB with bupivacaine and IV dexamethasone and CB with bupivacaine alone group respectively in the first

postoperative days. The required sample size shows that 95% likelihood of the mean pain score difference between two groups was calculated as:

$$n = \frac{(S_1)^2 + (S_2)^2}{(x_1 - x_2)^2} (a + b)^2$$

$$(x_1 - x_2)^2$$

$$n = 27.1$$

Structured checklists and questionnaires were prepared in English which included socio-demographic, perioperative data, the severity of pain, and duration of analgesia and total analgesia consumption. On arrival of the patient to the operating room, all standard monitors were attached, and baseline heart rate [HR], mean arterial pressure (MAP) and oxygen saturation [SpO₂] were recorded. IV line was secured with appropriate size cannula and Normal saline or Ringer's lactate was started at the rate of 4 ml/kg/hr. Patients who were premedicated with IV atropine 0.01 mg/K and midazolam 0.05 mg/Kg and patients who were induced with halothane 2% in oxygen with fresh gas flow of 3–4 L/min and the patients who were placed in left lateral decubitus position, and under aseptic precautions, single-dose caudal block was performed using a 23-gauge short-beveled hypodermic needle were included

Patients in Group I received caudal Bupivacaine 0.15% (1.5 ml/kg) alone while patients in group II received caudal Bupivacaine 0.15% (1.5 ml/kg) with IV dexamethasone of 0.5 mg/kg. The time of caudal block was recorded and the surgery was started 10 min after caudal injection. Vital signs were recorded on admission to PACU and then every 20 minute till the patient was discharged to the ward. FLACC scale was used to assess postoperative pain. Score ≥ 4 indicated pain so those children were given rescue analgesia. Patients were observed by trained nurses and pain score was documented at PACU, 2nd, 4th, 6th, 12th and 24th postoperative hour. Pain score, analgesia duration and total analgesia consumption were obtained from patients charts.

Data collectors were trained and pretest was done on 10% of sample patients. During data collection, regular supervision and follow up was made appropriately. Each data was cross-checked for completeness and consistency every day. All materials used for data collection were arranged sequentially and store in safe and secure place. Vital parameters were recorded intraoperatively every 5 min till the end of surgery. Patients were shifted to postoperative room after awakening and vital parameters were monitored along with oxygen supplementation for 1–2 h. Postoperative pain was assessed by Wong-Baker faces scale[13], on a scale from 1 to 10, 1 indicating no pain and 10 indicating maximum pain(Figure 1).

FLACC scale is a measurement used to assess pain of children ages from two month to seven years or individual that is unable to communicate their pain. Each category is scored on the 0–2 scale, which results in a total score of 0–10. 0 represents relaxed and comfortable, 1–3 represents mild discomfort, 4–6 represents moderate pain and 7–10 represents severe discomfort or pain or both.

Data were checked and cleaned manually for completeness and then coded and entered in to SPSS version 25 computer program for analysis. Descriptive statistics were summarized with tables and figures reported as means $\pm$ SD for continuous variables, and numbers or percentages for quantitative variables. Normality of distribution for continuous variable was tested by Shapiro-Wilk test and parametric variables were analyzed by independent t-test and Mann-Whitney for nonparametric test as needed, while chi-square test was used for hypotension. Association was measured by 95% confidence interval and $p < 0.05$ was considered as statistically significant.

In this study, postoperative pain is defined as any pain that occur within 24 hours in the postoperative period. The time required for first rescue analgesia was recorded as the duration of postoperative analgesia; total dose of analgesics given in mg within the first 24 hours after end of surgery is referred as total analgesia consumption.

The primary outcome of this study was the meantime to first rescue analgesic (time interval between a caudal block to the recording of VAS score ≥ 4) was recorded[14]. Rescue analgesia was provided with IV paracetamol (15 mg/kg). Secondary outcomes measured were total doses of rescue analgesia and severity of postoperative pain.

Ethical approval and consent

Ethical clearance and approval was obtained from ethical review committee of college of health science and official letter was obtained from anesthesia department, Addis Ababa University. Informed written consent was obtained from the children's parent. Confidentiality and anonymity of information were ensured

Results

Demographic and Perioperative Characteristics

A total of 60 patients were finally involved for analysis of this cohort study the patient's age, sex, weight, baseline V/S, type of surgery, duration of surgery and duration of anesthesia were homogenous with no significance difference between the group (Table 1).

Table 1. Demographic and perioperative characteristics of pediatric patients undergone elective infra-umbilical surgery at TASH from January 1-march 30, 2019

Variables		CB with dexamethasone + bupivacaine	CB with bupivacaine alone	P value
Sex				
Female		8(26.7%)	9(30%)	0.774
Male		22(73.3%)	21(70%)	
ASA I		25(83.3%)	24(80%)	0.739
ASA II		5(16.7%)	6(20%)	
Weight **		13.9±3.89	13.63±3.37	0.778
Baseline V/S				
HR		130.8±17.33	131.8±18.13	0.817
BP (MAP)		67.7±5.7	68.3±6.5	0.704
Type of surgery	lower abdominal	12(40%)	13(43.3%)	0.959
	Urologic	12(40%)	11(36.7%)	
	Orthopedics	6(20%)	6(20%)	
Induction agent	Propofol	15(50%)	15(50%)	0.924
	Ketamine	10(33.3%)	11(36.7%)	
	Halothane	5(16.7%)	4(13.3%)	
Duration of surgery*		80(60-100)	85(60-120)	0.795
Duration of anesthesia*		95(75-115)	95(73-140)	0.894

NB*=median (interquartile range) **=mean ±standard deviation

Result is presented as Mean ±SD: independent t test, median (IQR): mann-whitneyU test and number (percentage): chi square test was used, p value < 0.05 was considered statistically significant.

Comparison of duration of analgesia between the groups

As result of independent sample t test revealed there is difference in duration of analgesia between the groups with p<0.001 which is statistically significant (Table 2).

Table 2. Comparison of analgesia duration between CB with bupivacaine and IV dexamethasone versus CB with bupivacaine alone groups in pediatric patients undergone elective infra-umbilical surgery at

Variables	CB with dexamethasone + bupivacaine	CB with bupivacaine alone	P value
Duration of analgesia	699.3±57.55	347.4 ±40.53	<0.001

Analgesia consumption in 24 hours

According to result of mann-whitney U test total analgesics consumption and analgesia request frequency in 24 hours was significantly different between the groups with $p < 0.001$ (Table 3).

Table 3. Comparison of total analgesia consumption, frequency of analgesia request in pediatric patients had undergone elective infra-umbilical surgery at TASH, 2019.

Variables	CB with dexamethasone + bupivacaine	CB with bupivacaine alone	P value
Proportion of patient took analgesia in 24 hours	26(86.7%)	30(100%)	0.038
Total dose of analgesia given in mg	255(250-375)	510(390-525)	<0.001
Type of analgesia given	250(250-375)	500(375-625)	<0.001
Paracetamol	0(0-2.5)	0(0-25)	0.041
Tramadol			
Frequency of analgesia request	1(1-2)	2(2-3)	<0.001

NB Result is presented as Median (IQR): number (percent): mann-whitney U test and chi square was used, p value < 0.05 was considered statistically significant.

Comparison of postoperative pain severity

Result of mann-whitney U test indicated that severity of postoperative pain was not statistically significant difference at PACU at 2nd and 24th hours, with $p = (0.736, 0.923 \text{ and } 0.816)$. But there is statistically significant difference at 4, 6 and 12 hours.

Table 3. Severity of postoperative pain in pediatric patient's undergone elective infra-umbilical surgery at TASH, 2019.

Variables	CB with dexamethasone + bupivacaine	CB with bupivacaine alone	P value
FLACC score at PACU	0(0-1)	0(0-1)	0.736
FLACC score at 2 nd hr.	1(0-1)	1(0-1)	0.923
FLACC score at 4 th hr.	1.5(1-2.25)	3(2-3)	<0.001
FLACC score at 6 th hr.	3(2-3)	6(4.75-6)	<0.001
FLACC score at 12 th hr.	6(5-6)	6(6-8)	0.003
FLACC score at 24 th hr.	2(1-3)	2(1-3.25)	0.816

NB: Result is presented as Median (IQR): mann-whitney U test was used, p value < 0.05 was considered statistically significant.

Discussion

This study found that the median FLACC score was lower in CB with IV dexamethasone group at 4th, 6th and 12th hours which is statistically significant with p value of (<0.001,<0.001and 0.003) respectively. The finding of this study is comparable with study done on a new look on adding dexamethasone as an adjuvant to caudal bupivacaine; efficacy on postoperative pain and vomiting in pediatric patients[15,16]. The findings of our study also demonstrated that the addition of dexamethasone could significantly prolong the mean time to first rescue analgesia which is in line with other several studies [17–19]. This is because adding adjuvant to caudal block can significantly reduce the post-operative pain by prolonging the duration of analgesia with significantly lesser analgesic consumption.

According the finding of this study, there is a significant difference in duration of analgesia consumption between CB with IV dexamethasone group and CB alone group with mean value of 699.7 ±57.55 versus 347.4±40.53 min respectively which agrees with other similar studies[11,20]. Another study also found that analgesia duration is significantly prolonged in patients who took IV dexamethasone with CB group with mean duration of 646versus 430 min,800 versus 520 min,10.3± 2.9versus 3.6 ±1.3 hours respectively[16].The reason for difference between result is might be due dexamethasone has direct action on the nerve membrane that causing local anesthetic effect which enhances the action of bupivacaine and prolongs its duration and this effect may explain the analgesic effect of caudal dexamethasone.

The finding of this study showed that total dose of analgesia given in mg of patients who took IV dexamethasone reduced amount of paracetamol in 24hours than CB alone group with median value of

255mg versus 510mg respectively with $p < 0.001$. Similarly, the study conducted in Egypt shows total paracetamol consumption is significantly reduced in IV dexamethasone group with 440 ± 244.8 versus 842.5 ± 357.7 in CB alone group which is consistent with our result[15,21]. Other study also found that analgesia consumption was lower in dexamethasone group than CB with bupivacaine alone group[22].

Conclusion

We concluded that the addition of IV dexamethasone to bupivacaine as an adjuvant to caudal block reduces the intensity of postoperative pain and considerably prolong the mean time to first rescue analgesia as compared to caudal block with bupivacaine alone.

Abbreviations

AAU- Addis Ababa University; *ASA*-American Association of Anesthesiologists; *CB*- Caudal block; *IV*- Intravenous; *LA*-Local Anesthetics; *PACU*-Post anesthesia care unit; *POP*-Postoperative Pain; *RA*- Regional anesthesia; *V/S*-Vital sign

Declarations

Funding: Addis Ababa University

Competing interests

We declared that we had no competing interests

Author's contribution: TG initiated the research, wrote the research proposal, conducted the search, did data entry and analysis and wrote the manuscript. MA and MS Initiated the research, wrote the research proposal, conducted the research, did data entry and analysis and wrote the manuscript. All authors read and approve the final manuscript.

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Figure

Figure 1 was not provided with this version.