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Caudal Dexmedetomidine versus Fentanyl with Bupivacaine in Decreasing Post-Operative Pain in Pediatric Inguinoscrotal Surgery : A Comparative Study

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ABSTRACT

Introduction

Despite various advancements in postoperative analgesia in children, about half of post-surgical children still experience pain. Opioids like fentanyl are used as an adjunct leading to a lower dose of caudal local anesthetics but have many side effects. Administration of caudal dexmedetomidine with local anesthetics was shown to prolong postoperative analgesia and sedation in children. This study was conducted to compare the effects of caudally administered fentanyl and dexmedetomidine in children undergoing inguinoscrotal surgery.

Methods

This was a comparative clinical study in which 152 patients were included. Patients were divided into two groups to receive a caudal block, each having 76 cases. Group A and Group B received single-dose caudal analgesia using fentanyl (1mcg/kg) and dexmedetomidine (1mcg/kg) with 0.25% bupivacaine(0.75ml/kg), respectively. The analgesic effect of the caudal block was evaluated using the FLACC score and sedation using the RSS score. The statistical significance was evaluated using independent t test using confidence interval of 95% (p value<0.05).

Results

The study showed no statistical significance in the demographic and operative variables between the two groups. The duration of analgesia (p value<0.001) and both the FLACC (p value=0.001) and RSS score (p value=0.004) only at 30 min postoperative values were statistically significant between the groups. The only side effect that showed statistical significance was vomiting (p value=0.03) seen in fentanyl group.

Conclusion

Dexmedetomidine can thus be used safely in children along with bupivacaine in routine inguinoscrotal surgery with additional benefits of prolonged analgesia and decreased side effects.

Keywords

Bupivacaine; fentanyl; dexmedetomidine; postoperative analgesia

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INTRODUCTION

Caudal anaesthesia is used in varieties of paediatric surgeries allowing rapid recovery and providing postoperative analgesia. However, the mean duration of analgesia provided is limited, therefore a single shot caudal is indicated for surgeries less than 90 mins.[1] In order to overcome this issue, many drugs have been added to local anaesthetic solutions to prolong the duration of caudal anaesthesia.

Opioids like fentanyl have been used as an adjunct to caudal local anaesthetics to achieve the desired anaesthetic effect.[2] Addition of opioids lead to decreased doses of local anaesthetics and improve the quality of analgesia but there are chances of increased incidence of pruritis,urinary retention, nausea, vomiting and respiratory depression.[3,4] Dexmedetomidine is a potent and highly selective α-2 adrenergic agonist that has a sedative, sympatholytic and analgesic effect. Its remarkable lack of side effects and combinative effects with local anaesthetics had drawn attention of researchers.[5]

Despite various advances for postoperative analgesia in children, about half of post-surgical children still experience some form of pain.6Caudal analgesia has been proved as a straightforward technique in children but has a major disadvantage of short duration of action.[1] Studies suggest administration of dexmedetomidine with caudal local anesthetics prolong postoperative analgesia and sedation in children. If its use has a prolonged time of sedation and fewer adverse effects its routine use could prove rewarding.

The general objective of the study was to find the comparative effects of caudal dexmedetomidine versus fentanyl added to bupivacaine in pediatric inguinoscrotal surgery. The specific objectives were to compare the postoperative analgesic efficacy and postoperative sedation between dexmedetomidine and fentanyl administered caudally.

METHODS

This was a prospective comparative clinical study conducted from April 2021 to September 2021 in the department of Paediatric Anesthesia at Kanti Childrens' Hospital.

After ethical approval from Institutional Review Committee (IRB-46/2020-021), 152 pediatric patients, scheduled for routine inguinoscrotal surgery at Kanti Childrens' Hospital, Nepal were included. The inclusion criteria for our study were; age 2-7 years and those with The American Society of Anesthesiologists (ASA) physical status I or II.[7,8] The exclusion criteria were; refusal by parents, history of mental retardation or delayed development, in patients in whom a caudal block is contraindicated (infection at the site of block, bleeding disorders, pre-existing neurological or spinal disease or congenital anomalies such as cardiac or sacral anomalies, known or suspected coagulopathy) and history of known allergy to the study drugs.

Written informed consent was obtained from parents or guardians of the patient scheduled for surgery as per the inclusion criterion. Group allocation was done after arrival of the patients in the patient holding area of the operation theatre. The patients were divided into two equal groups: group A patients (n = 76) received single-dose caudal analgesia using fentanyl (1mcg/kg) with 0.25% bupivacaine (0.75ml/kg) and group B patients (n = 76) received single-dose caudal analgesia using dexmedetomidine (1mcg/ kg) with 0.25% bupivacaine(0.75ml/kg).Patients were kept under fast as stated by ASA guidelines for water 2 h, breastmilk 4 h, and infantile formula or light meals for 6 h. In the operation theater, standard monitoring devices like noninvasive blood pressure, electrocardiography and pulse oximetry were attached and then 22-24-gauge cannula was inserted in an available peripheral vein.

Patients were placed in supine position, then general anesthesia was induced using sevoflurane in oxygen/air mixture and propofol 2ml/kg was given intravenously and appropriate sized laryngeal mask airway was inserted with patient kept under spontaneous ventilation. Patients were then placed in lateral decubitus position with hips flexed to 90°, and then a single dose caudal block was performed

Table 1. FLACC Score

Category	Score		
	0	1	2
Face	Disinterested	Occasional grimace, withdrawn	Frequent frown, clenched jaws
Legs	No position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
Activity	Normal Position	Squirming, tense	Arched, rigid or jerking
Cry	No crying	Moans, whimpers	Constant crying, screams or sobs
Consolability	Content, relaxed	Distractable	Inconsolable

Table 2. RSS Score

Score	Level of sedation
1	Patient is anxious and agitated or restless or both
2	Patient is co-operative, oriented and tranquil
3	Patient responds to commands only
4	Patient exhibits brisk response to light tactile stimuli or loud auditory stimulus
5	Patient exhibits sluggish response to light tactile stimuli or loud auditory stimulus
6	Patient exhibits no response

with 23-gauge needle using the standard loss of resistance technique under all aseptic precautions. The patients received their medications as per their allocated groups. Intra operatively paracetamol (15mg/kg) as an analgesic was given to all patients.

After completion of the operation, patients were taken to the recovery room and observed for 30 minutes. Then the patients were discharged to the ward and were observed for another 24 hours.The analgesic effect was evaluated using the FLACC score (Table 1) and sedation using the RSS (Ramsay Sedation Score) score (Table 2).[9,10] Duration of analgesia (time from caudal block to time at which FLACC score is 4 or more) along with heart rate, blood pressure, ECG, oxygen saturation, respiratory rate and side effects (hypotension, bradycardia, respiratory depression, vomiting) were also assessed. Data was collected by a consultant or a resident, who were blinded to the drug administered.

Assessment of FLACC and RSS score was done first in the recovery room as soon as the patient was shifted there and subsequently at 15 minutes and 30 minutes in the same place. In the ward, assessment was done 1, 2, 6, 12 and 24 hours after the operation.

Data was analyzed using computer statistical software system SPSS version 25. The data was expressed as mean, standard deviation and proportion where appropriate. The statistical significance was evaluated using independent t test and chi square test using confidence interval of 95% (p value<0.05) and power 80 %.

RESULTS

The demographic and intraoperative variables of this study are as depicted in Table 3. This study showed no statistical significance in the demographic and operative variables like age, gender, body weight, duration of anesthesia and types of surgery between the two groups.

Our study however, showed statistical significance between the duration of analgesia (p value<0.001) and both the 30-minute postoperative FLACC (p value=0.0014) and the 30-minute postoperative RSS score (p value=0.0035) between group A and group B (Table 4). The only side effect which showed statistical significance was vomiting (p value=0.03) (Table 4).

No statistical significance was observed in the RSS score and the FLACC score as soon as the

Table 3. Comparison of patient baseline characteristics (n=152)

Parameters	Group		p-value
	Fentanyl (n=76)	Dexmedetomidine (n=76)	
Age (years)	4.381 ± 1.34	4.631 ±1.32	0.25
Gender (Male:Female)	74:2	74: 2	1.00
Body Weight (kilograms)	15.48 ±2.74	16.14 ±2.59	0.13
Duration of anaesthesia (minutes)	62.27 ±6.72	64.13 ±7.85	0.12
Type of surgery			
Inguinal hernia	58	54	0.46
Hydrocele	8	6	0.58
Circumcision	10	16	0.20

Table 4. Comparison regarding study variables (n=152)

Parameters	Group		p-value
	Fentanyl (n=76)	Dexmedetomidine (n=76)	
Duration of analgesia in minutes	418 ± 35.63	501.42 ± 31.77	<0.001*
FLACC score at 30 minutes	1.24 ± 0.677	0.92 ± 0.523	0.001*
RSS score at 30 minutes	2.12 ± 0.542	2.40 ± 0.618	0.006*
Side effects			
Hypotension	3 (3.94%)	4 (5.26%)	0.77
Bradycardia	6 (7.89%)	7 (9.4%)	0.74
Respiratory depression	8 (10.52%)	4 (5.26%)	0.23
Vomiting	12 (15.78%)	4 (5.26%)	0.03*

**statistically significant*

patient was transferred to the recovery room and at 15 minutes. Similarly, both the scores were also insignificant in the ward at 1, 2, 6, 12 and 24 hours after the operation. Although the incidence of respiratory depression was higher in group A than B it failed to show statistical significance. There were no observed side effects in both the groups that required emergency intervention. Other side effects including hypotension and bradycardia also did not show statistical significance in the two groups.

Hemodynamic parameters viz heart rate, blood pressure, mean arterial pressure, ECG, blood oxygen saturation and respiratory rate were observed to be similar between the two groups both intraoperatively and postoperatively.

DISCUSSION

The present study compared the effects of caudal dexmedetomidine and fentanyl added to bupivacaine in pediatric inguinoscrotal surgery in a tertiary hospital in Nepal. Caudal epidural analgesia is a long established technique in children undergoing infra umbilical surgeries and various adjuncts have been used to increase its effect.[11] In the last decade alone, the use of adjuncts in caudal anaesthesia have increased by 58%,especially like ketamine and clonidine, while addition of opioids has decreased from 36% to 18% owing to higher incidence of side-effects as nausea and vomiting, itching and respiratory depression specially in children.[12]

The demographic and operative profile in our study were comparable with other similar studies and did not show any significant difference on statistical comparison. The conspicuous difference in the duration of analgesia with dexmedetomidine as an adjunct accompanied by the decreased incidence of vomiting was noted in the present study.

Similar to the findings of our study Neogi et al. in 2010 found that administration of dexmedetomidine to caudal analgesics remarkably increased the analgesic time.[13] Bajwa et al. in 2011 found that caudal dexmedetomidine is better to fentanyl as it provided hemodynamic stability, early onset and increased duration of post-op analgesia and improved sedation levels. This study also reported the side effect vomiting to be significant with patients receiving fentanyl.[14]

Although this study was not done in pediatric patient and had more study variables than our study the effects of dexmedetomidine were similar. In the year 2014 both Elham et al. and Hossam and Mohamed conducted studies in pediatric patients comparing the effects of caudal dexmedetomidine to morphine and fentanyl,respectively.[15,16] Akin to the findings of our study they concluded that the use of dexmedetomidine not only prolongs the duration of post-operative analgesia with improved pain scores but also has fewer side effects then morphine and fentanyl.Side effects in the postoperative period were seen with caudal morphine and fentanyl injection as compared to dexmedetomidine. Elfawal et al. compared caudal dexmedetomidine and fentanyl as adjuncts to levobupivacaine in pediatric patients and found dexmedetomidine provided better postoperative analgesia, sedation profile with comparable hemodynamics and fewer side effects than fentanyl.[17]

Although not a comparative study Wang et al. in 2019 performed a metanalysis and systematic review of caudal dexmedetomidine in pediatric patients, some of the findings of which were like this study namely significantly increased duration of analgesia.[18]. Other findings showed that dexmedetomidine can significantly prolong the time to first rescue pain medication, which is in line with the results of previous meta-analysis.Further non comparative studies on dexmedetomidine were conducted in 2020 in children by Vljay et al. and Gautam et al that

stated that caudal dexmedetomidine (2 µg/kg) as a additive for pediatric lower abdominal surgeries provided longer duration of postoperative pain relief which lead to better quality of sleep and a longer period of arousable sedation with comparable adverse events among the groups.[19,20]

Contrary to the findings of our study Elham et al showed fentanyl to have significant side effect of respiratory depression when used in the same dose as in this study.[15] The number of patients with respiratory depression in fentanyl group was observed to be higher in our study but the result did not come out to be statistically significant. Another contradictory finding to our study in relation to dexmedetomidine was given by Wang et al. in his systematic analysis stating the incidence of bradycardia to be significant side effect.[18] Bradycardia, caused by both increased vagal tone resulting from central stimulation of parasympathetic outflow, and reduced sympathetic drive is a significant side effect of dexmedetomidine.[21] Similarly,increased incidence of bradycardia and hypotension was observed in a study in pediatric cardiac surgery with caudal dexmedetomidine which also contraindicated our findings.[22] The incidence of bradycardia between the two groups in our study were almost comparable and failed to show significance.

Dexmedetomidine (1mcg/kg) with 0.25% bupivacaine (0.75ml/kg) therefore proved to be a better adjunct than fentanyl for pediatric patients undergoing inguinoscrotal surgery in this study.

The exact equivalent dose of dexmedetomidine for fentanyl is not known which could be a potential limitation of this study. As the incidence of pediatric females requiring inguinoscrotal surgeries are significantly lower, our study had only a total of 4 females in the two groups. Gender biased perception to pain if present in pediatric patients couldn't be assessed.

CONCLUSION

Dexmedetomidine can thus be used safely in children along with bupivacaine in routine inguinoscrotal surgeries with additional benefits of prolonged analgesia and decreased side effects in comparison to opioid additives

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

REFERENCES

1. Giaufré E. Single shot caudal block. In: Saint-Maurice C,Schulte-Steinberg O, eds. Regional Anaesthesia in Children.Fribourg: Mediglobe, 1990; 81–87
2. Benzon HT, Wong HY, Belavic AM Jr, et al. A randomized double blind comparison of epidural fentanyl infusion versus patient controlled analgesia with morphine for postthoracotomy pain. Anesth Analg1993;76:316 22.
3. Salomaki TE, Laitinen JO, Nuutinen LS. A randomized doubleblind comparison of epidural versus intravenous fentanyl infusion for analgesia after thoracotomy. Anesthesiology 1991;75:790 5.
4. Lorenzini C, Moreira LB, Ferreira MB. Efficacy of ropivacainecompared with ropivacaine plus sufentanil for postoperative analgesia after major knee surgery. Anaesthesia 2002;57:424 8.
5. Talke P, Richardson CA, Scheinin M,et al. Postoperative pharmacokinetics and sympatholytic effects of dexmedetomidine. Anesth Analg. 1997;85:1136–42
6. Kozlowski LJ, Kost-Byerly S, Colantuoni E,et al. Pain prevalence, intensity, assessment and management in a hospitalized pediatric population. Pain Manag Nurs. 2014;15:22–35.
7. Katrina Williams, Denise Thomson, Iva Seto,et al.Standard 6: Age Groups for Pediatric Trials.Pediatrics June 2012, 129 (Supplement 3) S153-S160
8. Alexandra Beltramini, MD; Kolia Milojevic, MD; and Dominique Pateron, PhD.Pain assessment in newborn,infants and children. Pediatr Ann. 2017;46(10):e387-e395
9. Merkel SI, Voepel-Lewis T, Shayevitz JR,et al. The FLACC: A behavioral scale for scoring postoperative pain in young children. Pediatr Nurs. 1997;23:293–7.
10. MA, Savege TM, Simpson BR,et al. Controlled Sedation with alphaxalone-alphadolone. Br Med J. 1974;2(5920): 656-659
11. Peutrell JM, Mather SJ. Oxford: oxford university press; 1997. Regional anesthesia for babies and children; pp. 187–233.
12. Menzies R, Congreve K, Herodes V,et al. A survey of pediatric caudal extradural anesthesia practice. Paediatr Anaesth. 2009;19:829–36.
13. Neogi, Mausumi; Bhattacharjee, Dhurjoti Prosad; Dawn, Satrajit;et al. A Comparative Study Between Clonidine and Dexmedetomidine used as Adjuncts to Ropivacaine for Caudal Analgesia in Paediatric Patients. Journal of Anaesthesiology Clinical Pharmacology 26(2) Apr–Jun 2010: 149-152.
14. Bajwa, Sukhminder Jit Singh, et al. "Comparative evaluation of dexmedetomidine and fentanyl for epidural analgesia in lower limb orthopedic surgeries." Saudi journal of anaesthesia 5.4 (2011): 365.
15. El-Feky, Elham M., and Ahmed A. Abd El Aziz. "Fentanyl, dexmedetomidine, dexamethasone as adjuvant to local anesthetics in caudal analgesia in pediatrics: A comparative study." Egyptian journal of anaesthesia 31.2 (2015): 175-180.
16. El Shamaa, Hossam A., and Mohamed Ibrahim. "A comparative study of the effect of caudal dexmedetomidine versus morphine added to bupivacaine in pediatric infra-umbilical surgery." Saudi Journal of Anaesthesia 8.2 (2014): 155.
17. Elfawal, S. M., W. A. Abdelaal, and M. R. Hosny. "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 10.4 (2016): 423.
18. Wang, Xian-xue, et al. "Caudal dexmedetomidine in pediatric caudal anesthesia: A systematic review and meta-analysis of randomized controlled trials." Medicine 99.31 (2020).
19. Anand, Vijay G., et al. "Effects of dexmedetomidine added to caudal ropivacaine in paediatric lower abdominal surgeries." Indian journal of anaesthesia 55.4 (2011): 340.

20. Gautam, B., B. Piya, and D. Karki. "Study of Dexmedetomidine in Caudal Block for Children Undergoing Inguino-scrotal Surgery." Kathmandu University Medical Journal 18.1 (2020): 68-73.
21. Talke P, Chen R, Thomas B,et al. The hemodynamic and adrenergic effects of perioperative dexmedetomidine infusion after vascular surgery. Anesth Analg. 2000 Apr;90(4):834-9.
22. Nasr, Dalia Abdelhamid, and Hadeel Magdy Abdelhamid. "The efficacy of caudal dexmedetomidine on stress response and postoperative pain in pediatric cardiac surgery." Annals of cardiac anaesthesia 16.2 (2013): 109.