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Prevalence of Caudal Block and Duration of Analgesia of Caudal Dexmedetomidine Adjunct in Pediatric Lower Abdominal Surgery

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ABSTRACT

Background: Caudal block is a commonly used method of postoperative pain management in children. However, single shot caudal block has shorter duration of analgesia that can be extended by addition of adjuncts like opioids, clonidine, and dexmedetomidine along with local anesthetics. Recently, dexmedetomidine has been used as an adjunct for prolonging the duration of analgesia. This study aimed to find out prevalence of the caudal block and the duration of analgesia with dexmedetomidine adjunct among children undergoing lower abdominal surgeries.

Methods: A cross-sectional, observational study was conducted among the children admitted to the tertiary care children hospital of Nepal during the period of six months. Children of age 2 to 7 years, who had undergone lower abdominal surgeries under general anesthesia were enrolled in the study. We observed the prevalence of the caudal block and duration of analgesia of caudal dexmedetomidine with ropivacaine

Results: Throughout the study period, 449 children were posted for lower abdominal surgeries. Out of which 226 children (50.03%) received caudal block. Among the caudal block, 51 children (22.56%)) were administered ropivacaine with dexmedetomidine, 45 children (19.91%) received ropivacaine alone, 43 children (19.02%) were given bupivacaine alone, 46 children (20.35%) received a combination of bupivacaine and fentanyl, and 41 children (18.14%) received bupivacaine and dexmedetomidine. Dexmedetomidine with ropivacaine provides 840.35±14.97 minutes of postoperative pain relief.

Conclusions: The prevalence of the caudal block was 50.03%, and the combination of Dexmedetomidine with ropivacaine provides longer duration of postoperative analgesia.

Keywords: Analgesia; caudal block; children; prevalence.

INTRODUCTION

Caudal block is an effective, widely accepted and relatively safe technique, used for postoperative pain management in children. It provides smooth recovery, enhances the early restoration of body function, prevents the development of fear and anxiety and allows early hospital discharge. [1-2] However, the main disadvantage of the single shot caudal block is being its short duration of action with local anesthetics only. So, various adjuncts like Fentanyl, morphine, and clonidine have been used to prolong the duration of analgesia but have detrimental effects.[3,4] The use of Dexmedetomidine have described in literature as an adjunct, to prolong the duration of analgesia in the caudal block.[5] Hence we aimed to find out the prevalence of caudal block and duration of analgesia with dexmedetomidine as an adjunct to ropivacaine among the children undergoing lower abdominal surgeries.

METHODS

A descriptive, cross-sectional, observational study, was conducted among the children admitted to the Kanti Children Hospital, Kathmandu, Nepal during the period of six months in 2023. Ethical approval was obtained from the Institutional Review Committee (IRC no 1221). The children aged 2 to 7 years, scheduled for lower

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abdominal surgeries undergoing general anesthesia were eligible for enrollment in the study. Children with history of neuromuscular disease, coagulation disorders, skin lesion at the site of injection, spine deformity, history of developmental delay, and allergy to study drugs were excluded. The written informed consent was obtained from the parent.

The attending Anesthesiologist, who was not involved in the study, did the preanesthetic evaluation and provided general anesthesia with appropriate-sized laryngeal mask airway (LMA) to the children. Details of the eligible children, including their age, gender, type of surgery, and duration of surgery, was documented on a structured proforma.

Further details of the children who received single-dose caudal block, after general anesthesia, were recorded. It included drugs used for caudal block (i.e. local anesthetics 0.25% bupivacaine or ropivacaine at the dose of 1ml/kg, with or without Adjunct Dexmedetomidine or fentanyl at 1µg/kg), duration of postoperative analgesia and any complications during the first 24 hours of the postoperative period. Those with incomplete data were excluded from the study. Confidentiality of the children's information was maintained during the collection of the data.

The rFLACC (revised face, legs, activity, cry, and consolability) score which is a valid, objective and reliable method of pain assessment in children between 2 months to 7 years old, was used to assess the pain.[6, 7]

The duration of analgesia was defined as the time period between the administrations of caudal block to the first need of rescue analgesia i e when the time of rFLACC score reached ≥4. Adverse events such as nausea, vomiting, bradycardia, respiratory depression and urinary retention were monitored for 24 hours.

The prevalence of caudal block was calculated by dividing the number of children who received caudal block by the total number of child undergone lower abdominal surgeries.

The primary outcome of this study was to find out the prevalence of caudal block among the children with lower abdominal surgeries and secondary outcome was to observe the duration of analgesia in different type drugs administered for caudal block.

The collected data were entered and analyzed using IBM-SPSS Statistics version 21.0 The Age, weight, duration of surgery was expressed as mean ±SD. The significance of mean duration of analgesia was analyzed by Welch's unpaired T test. Statistical significance was defined as $p<0.05$

RESULTS

A total of 449 children who met the inclusion criteria were enrolled in the study and among them, 226 children received a caudal block. So, the prevalence of caudal block is 50.03%. The remaining children received an illioinguinal and iliohypigastric nerve block, along with opioids and NSAIDs for managing post-operative pain. Hence our analysis focused on 226 children.

There were 136(60.17%) males and 90 (39.82%) were female children. The mean age of the children was 4.92±2.54 years. The mean weight of the children was 15.93±5.73 kg (Table 1).

Table 1. Demographic details of study population.

SN	Variables	Mean (±SD)
1	Age (years)	4.92±2.54
2	Weight (kg)	15.93±5.73
3	Duration of lower abdominal surgery (min)	54.22±22.3

Among the lower abdominal surgeries, the most common procedure was the inguinal hernia repair, which was noted in 90 (39.82%) children, shown in Table 2.

Table 2. Types of surgery.

SN	Type of surgery	No of children (n=226)
1	Herniotomy	90 (39.82%)
2	Urethroplasty	40 (17.69%)
3	Circumcision	30 (13.27%)
4	Orchidopexy	26(11.50%)
5	Colostomy	20(8.84%)
6	Colostomy closure	7 (3.09%)
7	Others	13 (5.75%)

Table 3. Duration of post-operative Analgesia with different drugs used in caudal block.			
SN	**Drugs used for caudal block**	**No. of patients (n=226)**	**Duration of analgesia (minutes) (Mean ± SD)**
1	Dexmedetomidine and Ropivacaine	51(22.56%)	840.35 ± 14.97
2	Ropivacaine	45 (19.91%)	412.90 ± 93.46
3	Bupivacaine	43 (19.02%)	294.78 ± 65.84
4	Fentanyl and Bupivacaine	46 (20.35%)	356.14±48.28
5	Dexmedetomidine and Bupivacaine	41 (18.14%)	466.87 ±49.99

During the study period, 226 children received caudal block for postoperative analgesia. Different groups of local anesthetics drugs, both alone and in conjunction with adjunct were used for caudal block. Among the 226 caudal blocks, 51 children (22.56%)) were administered ropivacaine with dexmedetomidine, while 45 children (19.91%) received ropivacaine alone, 43 children (19.02%)were given bupivacaine alone, 46 children (20.35%) received a combination of bupivacaine and fentanyl, and 41 children (18.14%) received a combination of bupivacaine and dexmedetomidine for caudal block, details shown in table:3.

Table 4. Comparison of duration of analgesia with different drugs used in caudal block.			
SN	Comparison of Drugs used for caudal block	Mean difference (minutes)	Adjusted p value (Bonferroni correction)
1	Dexmedetomidine and ropivacaine vs Ropivacaine	427.45	<0.001*
2	Dexmedetomidine and ropivacaine vs Bupivacaine	545.57	<0.001*
3	Dexmedetomidine and ropivacaine vs Fentanyl and Bupivacaine	484.21	<0.001*
4	Dexmedetomidine and ropivacaine vs Bupivacaine and Dexmedetomidine	373.48	<0.001*

*Welch's unpaired T test

Among the study drugs, dexmedetomidine with ropivacaine combination provided pain relief for 840.35±14.97 minutes followed by 466.87 ± 49.99 minutes with dexmedetomidine and bupivacaine, 412.90 ± 93.46 minutes with ropivacaine alone, 356.14±48.28 minutes with a combination of fentanyl and bupivacaine, and 294.78 ± 65.84 minutes with bupivacaine alone and was statistically significant (p<0.001). The Comparison of duration of analgesia with different drugs combinations used in caudal block were done and details shown in table: 3and 4.

None of the children had bradycardia, nausea, vomiting, respiratory depression and urinary retention.

DISCUSSION

Children have significant pain following surgery. Most of the time, it is undermanaged. Poorly controlled post-operative pain increases the morbidity. So, postoperative pain management is an essential component of pediatric postoperative care. Adequate pain control after surgery permits early mobilization, reduces the postoperative complication, to prevent development of fear and anxiety and allows early hospital discharge.

The concept of postoperative pain management in children has improved dramatically in the recent years. Till date, various methods have been used to

manage the post-operative pain in pediatric patients. The conventional methods of post-operative pain management following surgery are opioid administration, NSAIDs, paracetamol and local anaesthesia infiltration. All these drugs have their own adverse effect and causes delayed hospital discharge. Recent literatures revealed that multimodal analgesia technique has been used to enhance the analgesic effect.[1]

The Caudal block is one of the components of multimodal analgesia. It provides excellent analgesia, reduces intraoperative anesthetics drug requirements, ensures pain free recovery from anesthesia, decrease stress response and avoids deleterious adverse effects of narcotic drugs.[2] However, the main disadvantage of caudal block is being its short duration of action with sole local anesthetics. The use of dexmedetomidine with local anesthetic in caudal block has been described in literature. It is a selective α2-adrenoceptor agonist and has analgesic and sedative effects.[3] So this study was conducted to find out the prevalence of the caudal block among children undergoing lower abdominal surgeries and was focused on the duration of analgesia in different type drugs administered for caudal block.

The prevalence of caudal block was found to be 50.03% in this study. Caudal block is frequently used in pediatric anesthesia, with reported prevalence rates ranging from approximately 34% to 40% in various surgical procedures involving children. Various Studies have documented its widespread utilization and efficacy in pediatric patients undergoing various surgeries.[8,9] We observed a higher prevalence rate of caudal block, which might be due to the difference in age group of children enrolled, preferences of attending anesthesiologist for caudal versus other blocks and the nature of surgery.

In present study the duration of analgesia with caudal ropivacaine alone was 412.90 ± 93.46 minutes. In a study done by Kamal M and colleague, the median duration of pain relief with caudal ropivacaine alone was found to be 390 (414.95-483.05) minutes with 95% confidence interval.[11] Similarly, a study by Anand VG and colleagues recorded a median duration of pain relief was 5.5 (4.97–6.03) hours with 95% confidence interval in patients receiving ropivacaine alone.[10] Our findings are comparable with these studies.

In the present study the mean duration of analgesia with caudal Bupivacaine alone was 294.78 ± 65.84 minutes and with dexmedetomidine adjunct was 466.87 ±49.99 minutes. A study conducted by Gautama B and colleagues revealed that, the mean duration of analgesia with caudal bupivacaine was 204±40 minutes and with dexmedetomidine adjunct was 413±101minutes.[13] This finding was further confirmed by our study.

In this study, the mean duration of postoperative analgesia in children receiving caudal dexmedetomidine as an adjunct with ropivacaine was found to be 840.35±149.97 min. Various studies have described the use of dexmedetomidine in caudal blocks to prolong the duration of analgesia. The study by Anand VG and colleagues found that, the median duration of pain relief with the addition of dexmedetomidine to ropivacaine was 14.5(13.90–15.09) hours with 95% confidence interval.[10] Kamal M and colleagues observed the median duration of analgesia of 750 (771.08-926.92) minutes with 95% confidence interval.[11] Jain K et al also reported mean duration of analgesia of 797.00 ± 59.20 with ropivacaine and dexmedetomidine in their studies. Our findings are comparable with these above mentioned studies. [12]

However, in our study, we observed that the addition of dexmedetomidine as an adjuvant to caudal ropivacaine extended the analgesic effect to 840.35±149.97 min and with Bupivacaine to 466.87 ±49.99 minutes. This prolonged duration of pain relief could be attributed to the addition of dexmedetomidine in the caudal block.

None of the patients had clinically significant respiratory depression, bradycardia and urinary retention. Jain k and colleague in their study also did not report bradycardia, hypotension and respiratory depression in any of the patients in the study group. [12]

Kamal M et al in their study found that there was significant hypotension in 6.66% in both study groups. However the incidence of hypotension was not statistically significant (p=0.897).[11] The findings of the above-mentioned studies supports the result of the present study.

After caudal administration, dexmedetomidine rapidly diffuses into the cerebrospinal fluid and reaches binding sites in the spinal cord because of its lipophilicity. Within the spinal cord, it stimulates the α2-receptors, situated in the substantia gelatinosa of the dorsal horn. This stimulation leads to the inhibition of nociceptive neuron firing and the suppression of substance P release, resulting in analgesic effects. When administered through epidural or caudal routes, dexmedetomidine's analgesic effect is up to five times greater compared with systemic administration. Dexmedetomidine also causes local vasoconstriction and hyperpolarization,

delaying the absorption of local anaesthetics and leading to prolonged analgesic effects of local anaesthetics. Another possible mechanism described in the literature is its central analgesic effect through spinal and supraspinal actions, inhibiting the activation of spinal astrocytes and microglia, decreasing the release of nociceptive substances, and regulating nociceptive transmission.[14-15]

Limitation of this study was the lack of observation of total analgesics consumption and sedation level within the initial 24 hours following surgery.

CONCLUSIONS

From this study, it was found that the prevalence of the caudal block was 50.03% among the lower abdominal surgeries and administration of dexmedetomidine as an adjunct to Ropivacaine in single shot caudal block provides analgesia for 840.35±149.97 minutes.

Thus, Dexmedetomidine enhances the effects of local anesthetics and can be used as an adjunct for prolonging the duration of analgesia.

CONFLICT OF INTEREST:

None.

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