Comparative Evaluation of Dexmedetomidine and Bupivacaine Combination versus Bupivacaine Alone on the Analgesic Effect of Ilioinguinal Nerve Block in Pediatric Patients Undergoing Inguinal Herniorrhaphy

Sedighe Shahhosseini[1], Alireza Mahdavi[1*]

[1]Anesthesiology Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran

*Address for Corresponder: Dr. Alireza Mahdavi, Anesthesiology Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran (e-mail: alirezamahdavi78@yahoo.com)

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Abstract

Introduction: Elective inguinal herniorrhaphy is one of the most prevalent surgical procedures in pediatric age group. |Postoperative pain is prevalent in children undergoing inguinal hernia repair. This study was aimed to compare the analgesic effect of dexmedetomidine with bupivacaine combination versus bupivacaine alone for ilioinguinal nerve block in children undergoing inguinal herniorrhaphy.

Materials and Methods: In this prospective randomized study, we studied 60 ASA class I and II patients with the age between 6 months to 6 years scheduled for unilateral inguinal herniorrhaphy. With the help of a computer-generated list, our patients were assigned randomly to two groups of 30 patients. Group A, received 5cc bupivacaine 0.25%, and group B received 5cc bupivacaine 0.25% with dexmedetomidine 0.3 µg/kg. Statistical analysis was performed using SPSS. The t-student and Mann-Whitney tests were used to compare the variables between groups. The values were considered significant if $P < 0.05$.

Results: There was no significant difference in blood pressure (systolic or diastolic) and heart rate between the two groups (P=0.624, P=0.784 and P=0.167, respectively). Analgesia duration was significantly longer in bupivacaine with dexmedetomidine group in comparison to bupivacaine alone group (P=0.008). However, there were no significant difference in frequency of analgesic consumption (P = 0.175) and total dose of analgesic

Keywords

- Dexmedetomidine
- Bupivacaine
- Herniorrhaphy
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consumption (P = 0.634) in the first 24 h between the two groups. One patient in group B developed bradycardia.

Conclusion: The use of dexmedetomidine, as an adjuvant to bupivacaine prolongs the length and the analgesic efficacy of the ilioinguinal nerve block after inguinal herniorrhaphy in pediatric age group.

Introduction

Elective inguinal herniorrhaphy is amongst the most common surgical procedures in children.[1] This surgery can cause severe post-operative pain. Unfortunately, pain is often under treated in the pediatric age group.2 Aasvang EK et al. showed that 12.4% of pediatric patients experienced persistent post herniorrhaphy pain. Chronic pain occurs in 5% to 10% of patients who have had inguinal herniorrhaphy.[2]

Suboptimal pain control can result in increased blood pressure, tachycardia, insomnia and behavioral disorders.[2,3] Today, different methods are used for perioperative pain management in children including: single shot caudal block, wound infiltration with local anesthetics, transverse abdominal plane block, oral or intravenous analgesics.[3] These methods have different efficacy and side effects. Ilioinguinal/Iliohypogastric (II/IH) nerve block is used as a choice technique in many pediatric surgical centers because it has good effect on post-operative pain with minimal risk, and low cost.[4] II/IH nerve block could be achieved by ultrasound guided techniques or by anatomical landmarks.[5-8] II/IH nerve block is as effective as a caudal block.[9]

Local anesthetics, such as bupivacaine and rupivacaine, are used for peripheral nerve block, sympathetic nerve block, local infiltration, epidural and caudal blocks.[6,7] Combination of epinephrine, clonidine or dexmedetomidine with bupivacaine or rupivacaine is used for prolongation of their analgesic effect.[10-14] Dexmedetomidine is a strong α2 adrenergic agonist which has a sympatholytic, sedative, analgesic effect and has been defined to be effective in many anesthetic and analgesic techniques.[6,14-16] Wound infiltration with combination of dexmedetomidine and rupivacaine reduces post-operative pain after inguinal herniorrhaphy.[12, 13, 16, 17]

We hypothesized that the addition of dexmedetomidine to bupivacaine improves the analgesic efficacy of II/IH nerve block and reduces the need of pain relief drugs. Therefore, this study was aimed to compare the analgesic effect of dexmedetomidine with bupivacaine combination versus bupivacaine alone for II/IH nerve block in pediatrics undergoing unilateral inguinal herniorrhaphy.

Materials and Methods

In this prospective randomized study, 60 ASA class I and II patients with ages between 6 months to 6 years, scheduled for unilateral inguinal herniorrhaphy, were included. Patients with known drug allergy to the drugs used in our study, coagulopathy, heart and neurological diseases and history of developmental delay were excluded. The study was performed according to Helsinki principals and was approved by the ethical committee of Shahid Beheshti University of Medical Sciences. The parents of our patients signed a written informed consent. They were informed that during the surgery day they would be contacted via a phone call to assess presence of pain. Using a computer a randomization list of two groups of 30 patients was created.

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In operating room, children were monitored for heart rate (HR), ECG also pulse oximetry (SpO2) and noninvasive blood pressure (MAP) was carried out and values were recorded. Anesthesia induction was achieved by inhaled sevoflurane at increasing concentrations from 1% to 8% in 100% O^2. An intravenous catheter was inserted for administration of fentanyl and atracurium. Then laryngeal mask airway proportionate to body weight was inserted. If the child had an IV line then induction of anesthesia was achieved by propofol. Maintenance of general anesthesia was done with isoflurane delivered in oxygen with a concentration that would not change hemodynamics more than 30% of the baseline values. No other drug for anesthesia was administered intraoperatively.

Group A, received 5cc bupivacaine 0.25%, and group B received 5cc bupivacaine 0.25% with dexmedetomidine 0.3 µg/ kg. At the end of surgery and before extubation, ilioinguinal block was performed under ultrasound guidance.[1, 2] For children with less than 10 kg weight, we used 3 cc of solution. Then the reversing agent was administered, and after full awaking the patient was extubated and transferred to PACU. Using the FLACC pain scale18 **Table 1** the severity of our patient's pain was assessed upon arrival in PACU and at the time of discharge from the PACU. Until the patient was hospitalized the pain monitoring was performed hourly. After the discharge from the hospital pain monitoring was performed by parents. Any time the pain score was assessed to be 4 or more, paracetamol or NSAIDs was administered so that the score would become 3 or less. Duration of adequate ilioinguinal analgesia (from the time of injection to the first analgesic drug consumption) and total dose of analgesic consumption during the first 24 hours was recorded.

Table 1: FLACC pain scale

Categories	Score		
	0	1	2
Face	No particular expression or smile; disinterested	Occasional grimace of frown, withdrawn	Frequent to constant frown, clenched jaw, quivering chin
Legs	No position or relaxed	Uneasy, restless, tense	Kicking, or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid, or jerking
Cry	No crying (awake or sleep)	Moans or whimpers, occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging, or talking to, distractible	Difficult to console or comfort

The statistical analysis was performed using SPSS version 21. The quantitative data were demonstrated as Mean ± SD and the qualitative variables were demonstrated as Frequency and percent. The t-student and Mann-Whitney tests were used to compare the variables between groups. The values were significant at $P < 0.05$.

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Results

There were no significant difference regarding age (P = 0.632) and weight (P = 0.823) between group A (bupivacaine) and group B (bupivacaine + dexmedetomidine) in our study. **Table 2** shows the demographic characteristics of the two groups of patients.

Table 2: Demographic Parameters in two Groups of Patients

	Group A (n = 30)	Group B (n =30)	P value
Age (month)	38.33±18.05	41.80±22.79	0.632
Weight (kg)	15.48±5.08	14.67±3.79	0.823
Heart Rate (BPM)	113.03±9.96	108.93±1.627	0.098
Systolic Blood Pressure (mmHg)	93.67±10.00	94.83±11.44	0.784
Diastolic Blood Pressure (mmHg)	50.67±7.12	52.83±6.58	0.167

As shown in Table 2 there was no significant difference in systolic blood pressure and diastolic blood pressure and heart rate between two groups (P = 0.784, P = 0.167 and P=0.098 respectively).

The duration of analgesia was significantly longer in bupivacaine with dexmedetomidine group in comparison to bupivacaine alone group (P = 0.008). Moreover, there were no significant difference in frequency of analgesic consumption in the first 24 h (P = 0.175) and total dose of analgesic consumption (P = 0.634) between two groups **Table 3**.

One patient in group B developed bradycardia (HR= 60/min) 10 minutes after II/IH nerve block, fortunately it didn't need to interfere.

Table 3: Analgesia Duration and the Analgesic Administration Postoperatively

	Group A (n = 30)	Group B (n =30)	P value
Duration of analgesia (hours)	8.68±3.70	11.14±3.26	0.008
Frequency of analgesic consumption in the first 24 h	1.40±0.93	1.70±0.88	0.175
Total dose of analgesic consumption	267.67±235.41	277.50±220.93	0.634

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Discussion

In the present study the effect of dexmedetomidine as an adjuvant to bupivacaine was compared with bupivacaine alone on analgesic efficacy of ilioinguinal nerve block in children undergoing inguinal herniorrhaphy. There was no significant difference in age, weight, systolic and diastolic blood pressure and heart rate of patients in the two groups.

In the present study it was determined that the duration of analgesia is significantly higher in the group which received bupivacaine with dexmedetomidine in comparison to the group which received bupivacaine alone. However, the frequency of analgesic consumption in the first 24 h and total dose of analgesic consumption showed no significant difference in the two groups. These results are similar to the study of Xiang et al. which was performed on sixty children with the age range of 12 to 72 months who underwent unilateral inguinal herniorrhaphy. In that study it was revealed that using dexmedetomidine in addition to bupivacaine reduced the hernia sac traction response and increased the analgesia time postoperatively.[19] Lundblad et al. demonstrated that in children undergoing inguinal herniorrhaphy, dexmedetomidine with rupivacaine prolonged the period of first analgesia demand compared to rupivacaine alone.[16]

The study of El-Hennawy et al. showed that adding dexmedetomidine to bupivacaine critically increased the analgesia time in children after lower abdominal surgeries.[14] In another study in Egypt on 60 children, with ASA class I and II, who were scheduled for inguinoscrotal surgeries, the group which received dexmedetomidine and bupivacaine showed longer analgesia time than the group which received ketamine and bupivacaine ($P = < 0.001$).[20] In Chatrath et al study on 100 patients undergoing elective infraumbilical surgeries under spinal anesthesia, adding the dexmedetomidine to bupivacaine caused early onset of sensory and motor block with elongated period, and patients were pain free for a longer time ($P = < 0.001$).[21] Al-Zaben et al. performed a study on ninety one children undergoing infra-umbilical surgery and found that the dexmedetomidine and bupivacaine group had a better postoperative sedation score than the bupivacaine alone group ($P < 0.001$).[22] In another study on 120 patients undergoing laparoscopic cholecystectomy it was found that visual analogue score (VAS) was far lower in dexmedetomidine and bupivacaine group (1.80 ± 0.36) than tramadol and bupivacaine (3.01 ± 0.48) and plain bupivacaine group (4.5 ± 0.92) ($P = 0.000$).[23] Fares et al. studied the effect of the mixture of dexmedetomidine and bupivacaine on forty children who had undergone abdominal cancer surgeries and showed that it reduced postoperative pain significantly up to 19 hrs and increased the duration of sedation.[24]

Conclusion

According to the results of the present study the use of dexmedetomidine, as an adjuvant to bupivacaine, prolongs the length of postoperative analgesia following inguinal herniorrhaphy in children compared to bupivacaine alone. Dexmedetomidine along with bupivacaine increases the analgesic efficacy of the ilioinguinal nerve block. Since using dexmedetomidine with bupivacaine is convenient and cost effective, it is recommended that it can be used for anesthesia in pediatrics.

Ethical Consideration

This study was approved by 38 session of Ethics Committees in Biomedical Research of Shahid Beheshti University of Medical Sciences with Ethical Code Number of "IR.SBMU.RETECH.REC.1396.315" on 96.06.05.

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Conflict of interests

There is no conflict of interests.

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