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Case series

Dexmedetomidine as an adjuvant with bupivacaine 0.5% for pediatric spinal anaesthesia in infraumbilical surgeries -A case series

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Abstract

Introduction: *In adults, dexmedetomidine has widely been used as an adjuvant in spinal anaesthesia in doses from 5 to 15mcg. The use of Inj Dexmeditomedine in pediatric spinal anaesthesia as an adjuvant to bupivacaine heavy is not studied well.*

Aims and objectives*: To report case series of paediatric spinal anaesthesia with dexmedetomidine as an adjuvant together with bupivacaine for infraumbilical surgeries in paediatric population.*

Materials and methods: *This case series was conducted at Pravara medical rural hospital, loni. We randomly selected patients between age group of 2 to 12 years*

Result: *We present a case series of 5 paediatric patients who underwent infraumbilical surgeries. All patients were given 0.5% bupivacaine heavy as per their body weight and dexmedetomidine 1 mcg was added as an adjuvant to it. All patients were sedated with Inj Midazolam, Inj Ketamine and Inj Glycopyrrolate as premedication as per our protocol. All patients were given oxygen at 2L/min via a face mask with spontaneous ventilation. we found prolonged sensory and motor block in these patients and none of the our patients needed rescue analgesic in postoperative period. There were no reported hemodynamic and respiratory adverse effects.*

Conclusion: *Spinal anaesthesia has several advantages like reduced respiratory complications, hemodynamic stability, short recovery time, avoidance of systemic medication. But the duration of anaesthesia is limited which in paediatric population can be overcome by addition of an alpha2 agonist dexmedetomidine to the intrathecally administered drug 0.5% bupivacaine heavy with no hemodynamic and respiratory adverse events.*

Key words: *anesthesia, caudal, dexmedetomedine, pediatric*

INTRODUCTION

Pediatric spinal anesthesia has become a valuable technique in managing pain and sedation for children undergoing lower abdominal and lower limb surgeries. This approach offers several benefits over general anesthesia, including faster recovery, reduced respiratory complications, and minimized postoperative pain, making it especially useful for children with specific health conditions.[1,2] However, the primary limitation of spinal anesthesia in children is its relatively short duration of action due to increased cerebrospinal fluid (CSF) volume, a higher rate of CSF turnover, and increased absorption of the injected local anesthetic, which often necessitates the addition of adjuvants to extend analgesic effects and enhance comfort.[3-5]

Adjuvants are essential in pediatric spinal anesthesia, as they extend the duration of analgesia and reduce the required dosage of local anesthetics, leading to safer, more effective anesthesia with fewer side effects. Commonly used adjuvants include opioids, clonidine, and dexamethasone, each providing distinct advantages in prolonging anesthesia duration and improving the quality of pain management. [6-8] Among the recent developments, dexmedetomidine, a selective α2-adrenergic agonist, has emerged as a promising adjuvant due to its sedative, analgesic, and anxiolytic effects with minimal respiratory depression. [9,10]

.MATERIAL AND METHODS:

We randomly selected patients between age group of 2 to 12years of age, weight between 10 to 30 kg, ASA grade 1and 2 of any gender undergoing any infraumblilical surgery admited in surgery ward. We excluded children with any congenital anomaly like spina bifida,Sacral bone variation,heart disease . Patients with localized infection ,coagulopathy,bleedingdisorder,mental retardation were excluded from study.

CASE REPORTS:

Case 1:

10 year old male posted for meatal stenosis surgery weighing 28 kg ASA I patient underwent surgery under spinal Anesthesia with dexmedtomidine as an adjuvant with 0.5% heavy bupivaciane.Pateint was premeditated with Inj.Glycopyrolate 10 mcg/kg ,Inj.Midazolam 0.04mg/kg and Inj.Ketamine 1 mg/kg. All standard Anesthesia monitoring devices were attached.Baseline parameters of Heart rate , SpO2 and Blood pressure were observed and recorded.patient was given oxygen via face mask at the rate of 2lit/min until the end of surgery.

Patient was put in lateral decubitus position and intrathecal injection of 0.5% heavy bupivacaine 0.4mg/kg along with Inj.dexmedtomidine 1mcg (2.2ml of 0.5% heavy bupivaciane With 1mcg of dexmedtomidine) was given by 25 G spinal needle utilizing free CSF flow technique by expert anaesthesiologist. After the spinal heart rate, SpO2 and MAP was measured at intervals of 5 min till end of surgery.

Onset time to T10 sensory loss was 1 min 20 sec, Time to complete motor block was 5 min 10 sec. Intraoperatively, Patient was stable and surgery was uneventful. Surgery was completed without any complications in 40 min. Urine was drained after the surgery. Patient was shifted to post operative recovery area and monitored. Time to complete sensory recovery was 3 hr 30 min, Time to complete motor recovery was 4 hr.

Case 2:

9 year old male posted for hypospadias repair surgery weighing 26 kg ASA I patient underwent surgery under spinal Anesthesia with dexmedtomidine as an adjuvant with 0.5% heavy bupivaciane. Patient was premeditated with Inj.Glycopyrolate 10 mcg/kg ,Inj.Midazolam 0.04mg/kg and Inj.Ketamine 1 mg/kg.All standard Anesthesia monitoring devices were attached. Baseline parameters of Heart rate , SpO2 and Blood pressure were observed and recorded. Patient was given oxygen via face mask at the rate of 2lit/min until the end of surgery.

Patient was put in lateral decubitus position and intrathecal injection of 0.5% heavy bupivacaine 0.4mg/kg along with Inj.dexmedtomidine 1mcg ((2ml of 0.5% heavy bupivaciane with 1mcg of dexmedtomidine) was given by 25 G spinal needle utilizing free CSF flow technique by expert anaesthesiologist. After the spinal heart rate, SpO2 and MAP was measured at intervals of 5 min till end of surgery. Onset time to T10 sensory loss was 1 min 30 sec, Time to complete motor block was 5 min 50 sec. Intraoperative Patient was stable and surgery was uneventful. Surgery was completed without any complications in 1 hr 30 min. Urine was drained after the surgery. Patient was shifted to post operative recovery area and monitored. Time to complete sensory recovery was 2 hr 45 min, Time to complete motor recovery was 3 hr 20 min.

Case 3:

11-year-old male posted for hypospadias repair surgery weighing 28 kg ASA I patient underwent surgery under spinal Anesthesia with dexmedtomidine as an adjuvant with 0.5% heavy bupivacciane. Patient was premeditated with Inj.Glycopyrolate 10 mcg/kg ,Inj.Midazolam 0.04mg/kg and Inj.Ketamine 1 mg/kg .All standard Anesthesia monitoring devices were attached. Baseline parameters of Heart rate ,SpO2 and Blood pressure were observed and recorded. Patient was given oxygen via face mask at the rate of 2lit/min until the end of surgery.

Patient was put in lateral decubitus position and intrathecal injection of 0.5% heavy bupivaccaine 0.4mg/kg along with Inj.dexmedtomidine 1mcg (2.2ml of 0.5% heavy bupivaciane with 1mcg of dexmedtomidine) was given by 25 G spinal needle utilising free CSF flow technique by expert anaesthesiologist. After the spinal heart rate, SpO2 and MAP was measured at intervals of 5 min till end of surgery. Onset time to T10 sensory loss was 1 min 40 sec, Time to complete motor block was 5 min 20 sec Intraoperative Patient was stable and surgery was uneventful. Surgery was completed without any complications in 1 hr 50 min. Urine was drained after the surgery. Patient was shifted to post operative recovery area. Time to complete sensory recovery was 2 hr 40 min, Time to complete motor recovery was 3hr 30 min.

Case 4:

6-year-old male posted for right inguinal hernia repair surgery weighing 18 kg ASA I patient underwent surgery under spinal Anesthesia with dexmedtomidine as an adjuvant with 0.5% heavy bupivacciane. Patient was premeditated with Inj.Glycopyrolate 10 mcg/kg, Inj.Midazolam 0.04mg/kg and Inj.Ketamine 1 mg/kg. All standard Anesthesia monitoring devices were attached. Baseline parameters of Heart rate ,SpO2 and Blood pressure were observed and recorded. Patient was given oxygen via face mask at the rate of 2lit/min until the end of surgery.

Patient was put in lateral decubitus position and intrathecal injection of 0.5% heavy bupivaccaine 0.4mg/kg along with Inj.dexmedtomidine 1mcg (1.4 ml of 0.5% heavy bupivaciane with 1mcg of dexmedtomidine) was given by 25 G spinal needle utilizing free CSF flow technique by expert anaesthesiologist. After the spinal heart rate, SpO2 and MAP was measured at intervals of 5 min till end of surgery. Onset time to T10 sensory loss was 1 min 50 sec, Time to complete motor block was 6 min. Intraoperative Patient was stable and surgery was uneventful. Surgery was completed without any complications in 40 min. Urine was drained after the surgery. Patient was shifted to post operative recovery area. Time to complete sensory recovery was 3 hr 45 min, Time to complete motor recovery was 4 hr 10 min

Case 5:

12 year old female posted for right inguinal hernia repair surgery weighing 27kg ASA I patient underwent surgery under spinal Anesthesia with dexmedtomidine as an adjuvant with 0.5% heavy bupivacciane.Patient was premeditated with Inj.Glycopyrolate 10 mcg/kg ,Inj.Midazolam 0.04mg/kg and Inj.Ketamine 1 mg/kg .All standard Anesthesia monitoring devices were attached. Baseline parameters of Heart rate ,SpO2 and Blood pressure were observed and recorded. Patient was given oxygen via face mask at the rate of 2lit/min until the end of surgery.

Patient was put in lateral decubitus position and intrathecal injection of 0.5% heavy bupivaccaine 0.4mg/kg along with Inj.dexmedtomidine 1mcg(2 ml of 0.5% heavy bupivaciane with 1mcg of dexmedtomidine) was given by 25 G spinal needle utilizing free CSF flow technique by expert anaesthesiologist. After the spinal heart rate, SpO2 and MAP was measured at intervals of 5 min till end of surgery. Onset time to T10 sensory loss was 1 min 25 sec, Time to complete motor block was 6 min. Introperative Patient was stable and surgery was uneventful. Surgery was completed without any complications in 50 min. Urine was drained after the surgery. Patient was shifted to post operative recovery area. Time to complete sensory recovery was 4 hr 05 min ,Time to complete motor recovery was 4 hr 40 min.

DISCUSSION:

Dexmedetomidine is an alpha2 adrenergic agonist, originally approved by the FDA in 1999 for up to 24 hours administration to adults on ventilator in ICU. In 2008 the drug was approved for adult sedation outside ICU setting. Although dexmedetomidine is not currently approved for paediatric use, it has been successfully used by intravenous, subcutaneous, buccal, caudal and epidural routes. [1,3,6,9]

In adult spinal anesthesia, dexmedetomidine has demonstrated efficacy in enhancing analgesic duration and improving patient satisfaction, making it a popular choice as a spinal adjuvant . The drug has also been successfully used via intramuscular route in paediatric population.[11,12] Uusalo P et al studied pharmacokinetics and sedative effects of intranasal dexmedtomidine in ambulatory paediatric patients[12]. Its use in pediatric populations, however, is relatively new and has been studied through various administration routes, including intravenous (IV), intramuscular (IM), intranasal, oral, caudal, and epidural methods. These routes have shown dexmedetomidine's versatility and safety, providing effective sedation and analgesia across various pediatric procedures. [12-15]

Despite its demonstrated efficacy across various routes, the spinal (intrathecal) administration of dexmedetomidine in children remains minimally studied. Only a few articles have addressed this approach, highlighting the need for further investigation into its safety and effectiveness in this specific setting. [7,16] As pediatric spinal anesthesia becomes more common, understanding the full potential of dexmedetomidine as a spinal adjuvant could offer significant benefits, especially in reducing the need for multiple anesthetic agents and providing a more seamless recovery for young patients. [15] To address this gap in the literature, we conducted a case series to examine the effectiveness and safety of dexmedetomidine as an adjuvant to spinal anesthesia in children.

Khaled Mohamed Fares et al. investigated the analgesic effects of intrathecal Fentanyl versus Dexmedetomidine as adjuvants to bupivacaine in pediatric patients undergoing abdominal cancer surgery. The study demonstrated that both Dexmedetomidine and Fentanyl, when added to intrathecal Bupivacaine, significantly enhance postoperative pain relief. However, Dexmedetomidine provided superior overall analgesic efficacy compared to Fentanyl. [17]

Liu Liu et al. used dexmedetomidine 5 ug along with 0.5% hyperbaric bupivacaine in the sub-arachnoid block, proving that it prolonged sensory and motor blocks and delayed first analgesic requisite postoperatively. [18]

Jagtap and Bhure revealed that dexmedetomidine has a longer duration of action with effective postoperative

analgesia and fewer side effects when compared to fentanyl. [19] Mohammed et al revealed that 5ug dexmedetomidine is the suitable additive to prolong sensory and motor blocks and extend analgesia compared to fentanyl 25 ug. [20] This case series was aimed to expand on these findings, exploring the potential of dexmedetomidine in pediatric spinal anesthesia and providing new insights into its role as a spinal adjuvant in children.

Mohamed et al, Shaikh et al, Kataria et al, studied effects of addition of low dose dexmedetomidine to intrathecal local anaesthetic significantly prolonged the action, and prevented the need for postoperative analgesia as well as rescue analgesia. So, as a means to overcome the duration of spinal anaesthesia in paediatric population, we used dexmedetomidine as an adjuvant to 0.5% bupivacaine heavy and we found prolonged sensory and motor block in these patients and none of the our patients needed rescue analgesic in postoperative period. Dexmedetomidine acts by binding to alpha-2 receptors in the central and peripheral nervous systems, which leads to decreased sympathetic outflow and enhanced analgesia. When used in spinal anesthesia, dexmedetomidine's action on the spinal cord's dorsal horn modulates pain perception by inhibiting the release of excitatory neurotransmitters. This mechanism results in prolonged sensory and motor block durations without impacting the safety profile significantly, making it an ideal adjuvant for pediatric patients.

Benefits of Dexmedetomidine in Pediatric Spinal Anesthesia:

1. Prolonged Block Duration: Dexmedetomidine, when added to local anesthetics like bupivacaine, significantly extends the duration of both sensory and motor blocks. This is particularly useful in pediatric patients, as spinal anesthesia in children typically has a shorter duration compared to adults, and dexmedetomidine helps overcome this limitation.
2. Reduced Need for Systemic Analgesics: By enhancing the quality of the spinal block, dexmedetomidine reduces postoperative pain and the need for systemic analgesics, which is beneficial in children, as it minimizes drug exposure and reduces the likelihood of side effects.
3. Stable Hemodynamic Profile: Unlike other sedatives, dexmedetomidine generally preserves cardiovascular stability by maintaining a steady heart rate and blood pressure. This is especially advantageous in children, as they have a more reactive cardiovascular system and are more prone to hemodynamic changes during surgery.
4. Reduced Risk of Respiratory Depression: One of the key advantages of dexmedetomidine is that it provides effective sedation and analgesia with minimal risk of respiratory depression, making it safer in pediatric populations, particularly neonates and young children who have a greater sensitivity to respiratory depressant effects.
5. Improved Postoperative Comfort: Dexmedetomidine's sedative effects help children remain calm postoperatively, reducing agitation and discomfort as the block wears off. Its smooth recovery profile helps children wake up comfortably, which is reassuring for both the child and caregivers.

While dexmedetomidine has a favorable safety profile in pediatrics, potential side effects include:

- Bradycardia: Dexmedetomidine's sympatholytic effect may cause a slower heart rate, which generally remains within safe limits but should be monitored, especially in neonates and infants.
- Hypotension: While rare, some children may experience mild hypotension, which typically does not require intervention but warrants close monitoring during and after surgery.
- Sedation: Although a benefit, the sedative effect can be too profound in higher doses. Careful dosing is needed to avoid oversedation.

CONCLUSION:

Spinal Anesthesia is proven safe, efficious, cost effective in paucity of facilities in periphery health center. The limited duration of bupivaciane spinal Anaesthesia block in setting of paediatric surgery can thus be insufficient for slow operative process or bilateral hernia repair is planned, so by adding dexmedtomidine to intrathecal bupivacaine we can prolong duration of surgical Anesthesia as well as analgesia.There were no reported hemodynamic and respiratory adverse effects.

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