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Original Research Article

EVALUATION OF DEXMEDETOMIDINE EFFICACY VERSUS MAGNESIUM SULFATE AS AN ADJUVANT TO ROPIVACAINE IN ULTRASOUND GUIDED BILATERAL TRANSVERSUS ABDOMINIS PLANE BLOCK [US-TAP] IN LOWER ABDOMINAL SURGERIES IN PAEDIATRIC PATIENTS: A RANDOMIZED CONTROLLED STUDY

Vishwanath Meti[1], Swathi Rajshekar[2], Mohan[3], Ashwini D.M[4]

[1]Professor, Department of Anesthesiology and Critical Care, Navodaya Medical College Hospital & Research Centre, Mantralayam Road, Navodaya Nagar, Raichur, Karnataka, India.
[2]Assistant Professor, Department of Anatomy, Navodaya Medical College Hospital & Research Centre, Mantralayam Road, Navodaya Nagar, Raichur, Karnataka, India.
[3]Professor, Department of Anesthesiology and Critical Care, Navodaya Medical College Hospital & Research Centre, Mantralayam Road, Navodaya Nagar, Raichur, Karnataka, India.
[4]Postgraduate, Department of Anesthesiology and Critical Care, Navodaya Medical College Hospital & Research Centre, Mantralayam Road, Navodaya Nagar, Raichur, Karnataka, India.

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Corresponding Author:
Dr. Vishwanath Meti,
Professor, Department of Anesthesiology and Critical Care, Navodaya Medical College Hospital & Research Centre, Mantralayam Road, Navodaya Nagar, Raichur, Karnataka, India.

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ABSTRACT

Background: The ultrasound-guided transversus abdominis plane (US-TAP) block provides effective somatic analgesia to the anterior abdominal wall and reduces opioid requirements. Ropivacaine is commonly used for TAP blocks due to its favourable safety profile; however, the duration of analgesia from a single-shot block is limited. Therefore, adjuvants such as dexmedetomidine, an α2-adrenergic agonist, and magnesium sulfate, an NMDA receptor antagonist, are added to local anaesthetics to prolong analgesia and improve postoperative pain control. The objective is to evaluate and compare the efficacy of dexmedetomidine and magnesium sulfate as adjuvant to ropivacaine in US-TAP block for postoperative analgesia in paediatric patients undergoing lower abdominal surgeries.

Materials and Methods: This prospective randomized double-blind controlled study was conducted in paediatric patients aged 6–12 years undergoing elective lower abdominal surgeries under general anaesthesia. A total of 58 patients were randomly allocated into two groups of 30 each. Group D: Received US-TAP block with ropivacaine 0.2% combined with dexmedetomidine. Group M: Received US-TAP block with ropivacaine 0.2% combined with magnesium sulfate. Postoperative pain was assessed using the Visual Analogue Scale (VAS) at predetermined time intervals. The primary outcome measured was the duration of postoperative analgesia. Secondary outcomes included time to first rescue analgesic requirement, total rescue analgesic consumption in the first 12 postoperative hours, and incidence of adverse effects.

Results: The addition of dexmedetomidine to ropivacaine in US-TAP block resulted in a longer duration of postoperative analgesia compared with magnesium sulfate. Patients in the dexmedetomidine group demonstrated lower postoperative pain scores and delayed requirement for rescue analgesia. Total rescue analgesic consumption in the first 12 postoperative hours was also reduced in the dexmedetomidine group. Hemodynamic parameters remained stable in both groups, with no significant adverse effects observed.

Conclusion: Dexmedetomidine is a more effective adjuvant than magnesium sulfate when added to ropivacaine for US-TAP block in paediatric patients

undergoing lower abdominal surgeries. It significantly prolongs the duration of postoperative analgesia, reduces pain scores, and decreases the need for rescue analgesics without producing significant side effects.
Keywords: Dexmedetomidine, Magnesium sulfate, Ropivacaine, Ultrasound-guided TAP block, Paediatric postoperative analgesia, Rescue anaesthesia.

INTRODUCTION

Effective postoperative analgesia for paediatrics lower abdominal surgery reduces opioid consumption, improves recovery, and decreases postoperative behavioral disturbances and hospital stay. The ultrasound-guided transversus abdominis plane (US-TAP) block provides targeted somatic analgesia to the anterior abdominal wall and has become an established option for lower abdominal procedures in paediatric practice.[1] Paediatric dosing recommendations for ropivacaine and safety limits for truncal blocks emphasize weight-based volumes and concentrations (for example, typical single-shot TAP volumes in children range approximately 0.2–0.5 $mL \cdot kg^{-1}$ at low concentrations), and clinicians must balance the need for adequate spread with the risk of local anaesthetic systemic toxicity (LAST).[2] Evidence of additives prolonging the TAP block is growing in paediatric patients, and randomized studies have demonstrated prolonged analgesia and reduced rescue analgesic use when dexmedetomidine is combined with ropivacaine for abdominal wall blocks.[3] Similarly, systematic reviews and randomized trials suggest magnesium can extend sensory and motor block duration and reduce postoperative opioid consumption when added to local anesthetics. The data are heterogeneous with respect to dose, route (intravenous vs perineural), and block type, and high-quality evidence specifically in paediatric TAP blocks remains limited, making direct comparisons to agents such as dexmedetomidine.[4]

The current study was designed to evaluate efficacy (duration of analgesia, pain scores, postoperative opioid requirement) and safety (hemodynamic changes, sedation, adverse events) of dexmedetomidine versus magnesium sulfate as adjuvants to ropivacaine for bilateral US-TAP blocks in paediatrics lower abdominal surgery.

MATERIALS AND METHODS

After obtaining Institutional Ethical Committee approval, written informed consent was obtained from parents or legal guardians. Eligible patients aged 6–12 years, ASA I and II, scheduled for elective lower abdominal surgeries were included. All patients underwent a detailed pre-anaesthetic evaluation including history, physical examination, and routine investigations. Patients were kept nil per orally for 6–8 hours. Standard monitoring was applied in the operating room. Patients were randomly allocated into two groups: Group D: Ropivacaine 0.2% (1–2 mg/kg) + Dexmedetomidine 0.75–1 µg/kg. Group M: Ropivacaine 0.2% (1–2 mg/kg) + Magnesium sulfate 1–2 mg/kg. The adjuvant drug was diluted to 1 mL with normal saline in both groups. All drugs were prepared by an anesthesiologist not involved in patient assessment. The prepared syringes were labelled identically to maintain blinding. Strict aseptic precautions were followed during preparation and administration of drugs.

After completion of surgery, bilateral US-TAP block was performed with the patient in supine position. Under aseptic precautions, the linear ultrasound probe was placed in the mid-axillary line between the costal margin and iliac crest. The needle was advanced in-plane until the plane between the internal oblique and transversus abdominis muscles is identified. After negative aspiration, the study drug was injected and correct spread of local anaesthetic was confirmed sonographically. The procedure was repeated on the contralateral side. Postoperatively, patients were assessed at 2, 4, 6, 8, and 12 hours using the Visual Analogue Scale (VAS). Time to first rescue analgesic and total analgesic consumption was recorded.

The collected data was coded and entered into a computer for statistical analysis. Statistical analysis was performed using SPSS software. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were summarized as frequencies and percentages. Associations between categorical variables was analyzed using the Chi-square test. A p-value < 0.05 was considered statistically significant at a 95% confidence level. The analyzed results were presented in the form of tables and graphs for appropriate interpretation.

RESULTS

The demographic profile was comparable, with mean age 8.73 ± 2.08 years in Group D and 9.33 ± 1.95 years in Group M, and similar ASA grade distribution (ASA I: 86.7% in both groups). Hemodynamic parameters such as heart rate, SBP, DBP, and SpO2 remained stable in both groups throughout the postoperative period ($p > 0.05$). Overall analgesic efficacy was better in Group D compared to Group M. Pain scores (VAS) were comparable in the early postoperative period but were significantly lower in Group D at 8 and 12 hours as shown in [Table 1] and [Figure 1], indicating better postoperative analgesia in Group D.

Table 1: Comparison of VAS Scores Between Group D and Group M

Time after surgery	Group D (Mean ± SD)	Group M (Mean ± SD)	P value
1st hour	0.00 ± 0.00	0.00 ± 0.00	1.00
2nd hr	0.00 ± 0.00	0.00 ± 0.00	1.00
4th hr	0.03 ± 0.18	0.00 ± 0.00	0.32
8th hr	0.53 ± 1.02	1.17 ± 1.43	0.04
12th hr	1.90 ± 2.28	4.37 ± 2.61	<0.001

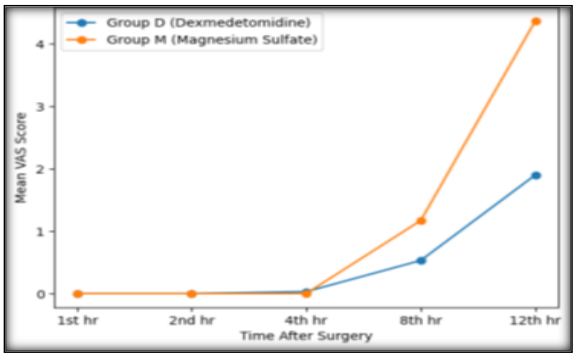

Figure 1: Line graph showing the Comparison of VAS Scores Between Group D and Group M

The mean duration to first rescue analgesia was 645.00 ± 92.40 minutes in Group D and 492.30 ± 108.50 minutes in Group M. The time ranged from 480–720 minutes in Group D and 360–660 minutes in Group M. The duration was significantly longer in Group D ($p < 0.001$), indicating prolonged postoperative analgesia with dexmedetomidine compared to magnesium sulfate. Rescue analgesia was required in 4 patients (13.3%) in Group D and 11 patients (36.7%) in Group M, while it was not required in 26 (86.7%) and 19 (63.3%) patients, respectively. The requirement of rescue analgesia was significantly lower in Group D compared to Group M ($p = 0.036$), indicating better postoperative analgesic efficacy with dexmedetomidine. Overall, Dexmedetomidine provided better quality and prolonged postoperative pain relief in paediatric patients undergoing lower abdominal surgeries.

DISCUSSION

In our study, the demographic profile of all the patients was matching. And haemodynamic stability was maintained in all patients of both the groups which is supported by available literature.[5] In our study dexmedetomidine provided better quality and prolonged postoperative pain relief in paediatric patients undergoing lower abdominal surgeries.

Elyazed MMA et al. demonstrated that dexmedetomidine provided superior and prolonged postoperative analgesia compared with magnesium sulfate when used as an anesthetic adjuvant in regional anestrhesia.[6] Similarly, in the present study, rescue analgesia was required in only 13.3% of patients in Group D compared with 36.7% in Group M. The present study also showed better overall analgesic efficacy with dexmedetomidine, as evidenced by lower VAS scores and longer duration of analgesia. This positive effect of dexmedetomidine is supported by Yadav BL et al.[7]

Studies on neuraxial techniques also support our findings. Gupta et al. reported that caudal ropivacaine with dexmedetomidine significantly prolonged the duration of postoperative analgesia in paediatric patients undergoing lower abdominal surgeries.[8] Similarly, the present study demonstrated a significantly longer time to first rescue analgesia in Group D (645 ± 92 minutes) compared with Group M (492 ± 108 minutes), indicating prolonged analgesic effect with dexmedetomidine in regional blocks. Shahi V et al. observed that postoperative pain scores were significantly lower in patients receiving epidural dexmedetomidine compared to magnesium sulfate.[9] In accordance with this finding, the present study also showed significantly lower VAS scores in Group D at the 8th and 12th postoperative hours.

CONCLUSION

Our findings suggest that dexmedetomidine as an adjuvant to US-TAP block provides better postoperative analgesia compared to magnesium sulfate. It effectively reduces postoperative pain scores, prolongs the duration of analgesia, and decreases the need for additional analgesic medications. Therefore, dexmedetomidine can be considered a more effective adjuvant for postoperative pain management compared to magnesium sulfate. Its ability to provide prolonged analgesia without causing significant hemodynamic instability makes it a valuable option in clinical practice for improving postoperative pain control and patient outcomes.

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