



Comparison Between Magnesium Sulphate and Dexmedetomidine as an Adjuvant to Bupivacaine in Ultrasound Guided Transverse Abdominis Plane Block as Post-Operative Analgesia for Parturients Undergoing Caesarean Section

Akalya Jayapal¹, Ashwin Suuraj V², Saranya D³, Ashok Kulasekhar⁴

¹ Postgraduate, Department of Anaesthesiology, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education Kelambakkam Chennai

² Senior Registrar, Department of Anaesthesiology, Takshashila Medical College, Takshashila University, Ongur, Tindivanam

³ Senior Registrar, Department of Anaesthesiology, KMCH Institute of Health Sciences and Research, Coimbatore

⁴ Professor and Head, Department of Anaesthesiology, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam, Chennai

(Received: 27 October 2025 Revised: 05 November 2025 Accepted: 04 December 2025)

KEYWORDS

Bupivacaine, Cesarean section, Dexmedetomidine, Hemodynamic stability, Magnesium Sulfate, Pain management, Post-operative analgesia, Rescue analgesia, Transversus Abdominis Plane (TAP) block, Visual Analog Scale (VAS),

ABSTRACT:

Background:

Cesarean section (C-section) is a major surgical procedure and effective post-operative pain management is crucial for optimal recovery and maternal well-being. The Transversus Abdominis Plane (TAP) block, an established regional analgesia technique, offers effective pain relief by blocking the sensory nerves of the anterior and lateral abdominal wall. Among the adjuvants used to enhance the efficacy and duration of TAP blocks, Magnesium Sulfate (MgSO₄) and Dexmedetomidine have shown promise. However, there is limited research comparing their analgesic efficacy specifically in C-section patients.

Aim:

This study aims to compare the post-operative analgesic effects of Magnesium Sulfate and Dexmedetomidine when added to Bupivacaine in Transversus Abdominis Plane (TAP) blocks for patients undergoing cesarean section under ultrasound guidance.

Materials and Methods:

This was a prospective, double-blinded, randomized controlled trial conducted on 50 patients undergoing elective cesarean sections. The patients were randomly divided into two groups: Group M received Bupivacaine 0.25% with Magnesium Sulfate (500 mg), and Group D received Bupivacaine 0.25% with Dexmedetomidine (0.5 mcg/kg). The primary outcome was the duration of post-operative analgesia, and secondary outcomes included the total requirement of rescue analgesia, Visual Analog Scale (VAS) scores for pain, and hemodynamic status over a 24-hour post-operative period.

Results:

The study found that Dexmedetomidine significantly prolonged the duration of analgesia (23.72 ± 0.879 hours) compared to Magnesium Sulfate (7.45 ± 1.03 hours) with a p-value of 0.001. Total rescue analgesia requirement was lower in the Dexmedetomidine group (51.35 ± 0.466 mg) compared to the Magnesium Sulfate group (52.13 ± 0.68 mg), with a p-value of 0.045. VAS scores were significantly lower in the Dexmedetomidine group at 8, 12, and 24 hours post-operation. Hemodynamic stability was better maintained in the Dexmedetomidine group, with a significantly higher Mean Arterial Pressure (MAP).

Conclusion:



Dexmedetomidine was more effective than Magnesium Sulfate in providing prolonged analgesia, reducing opioid consumption, and improving hemodynamic stability. These findings suggest that Dexmedetomidine may be a superior adjuvant for post-Cesarean analgesia in TAP blocks.

INTRODUCTION

Cesarean delivery is a major surgical procedure, and effective postoperative pain management is crucial to ensure optimal recovery and maternal well-being.[1],[2] Parturients undergoing cesarean section require an analgesic approach that minimizes opioid consumption, enhances early mobilization, and ensures comfort while allowing them to care for their newborns.[3][4]

The **Transversus Abdominis Plane (TAP) Block** is an established regional analgesia technique that provides effective pain relief by blocking the sensory nerves of the anterior and lateral abdominal wall.[5] First described by Alsharari et al, TAP block has become an integral part of multimodal analgesic strategies in obstetric anesthesia, offering somatic pain relief without significant visceral blockade.[6],[7]

Among various local anesthetic adjuvants used to enhance the efficacy and duration of TAP block, **Magnesium Sulphate (MgSO₄)** and **Dexmedetomidine** have gained attention. Dexmedetomidine, a highly selective α_2 -adrenergic agonist, provides analgesic and sedative properties by inhibiting the release of neurotransmitters like substance P and glutamate, thus prolonging the analgesic effect of local anesthetics.[8],[9],[10] Magnesium sulphate, on the other hand, blocks N-methyl-D-aspartate (NMDA) receptors, reducing calcium influx at the synaptic junctions, which contributes to its analgesic action.[11],[12]

Despite studies evaluating these agents individually as adjuvants to **bupivacaine** in TAP blocks, limited research directly compares their analgesic efficacy in cesarean section patients. [13] This study aims to compare **Magnesium Sulphate and Dexmedetomidine as adjuvants to Bupivacaine** in ultrasound-guided TAP blocks for **postoperative pain management** in parturients undergoing cesarean section.

AIM:

The aim of this study is to compare the **postoperative analgesic effects of Magnesium Sulfate and**

Dexmedetomidine when added to Bupivacaine for **Transversus Abdominis Plane (TAP) Block** in **Cesarean section patients** under ultrasound guidance.

PRIMARY OBJECTIVE:

- To assess the **duration of postoperative analgesia** between **Magnesium Sulfate and Dexmedetomidine** when added to Bupivacaine in TAP block.

SECONDARY OBJECTIVES:

- To assess the **total requirement of rescue analgesia** over 24 hours postoperatively.
- To measure the **intensity of postoperative pain** using the **Visual Analog Scale (VAS)**.
- To monitor the **hemodynamic status of parturients** over 24 hours postoperatively.

MATERIALS AND METHODS

The study follows a prospective double-blinded randomized controlled trial design to compare the post-operative analgesic effects of MgSO₄ and dexmedetomidine in patients undergoing elective cesarean sections (C-sections). The total sample size is 50, with 25 participants in each group: one receiving MgSO₄ and the other receiving dexmedetomidine. The inclusion criteria specify that participants must be aged between 18 and 40 years, undergoing elective C-sections, and classified as ASA II or III. Exclusion criteria include patients under 18 or over 40 years old, those refusing local anesthesia, or those with bleeding disorders or pre-existing use of MgSO₄ for pre-eclampsia/eclampsia. The interventions involve Group M receiving a combination of bupivacaine 0.25% 40 ml with MgSO₄ 1ml (500 mg) diluted to 2 ml with normal saline = 42 ml, while Group D receives bupivacaine 0.25% 40 ml with dexmedetomidine (0.5 mcg/kg) diluted to 2 ml with normal saline = 42 ml. Prior to surgery, patients are instructed to fast for 8 hours, and pre-operative vital signs are recorded. An intravenous line is established and SAB is given at L3-L4 IVDS with Inj. 0.5% Bupivacaine Heavy 2ml with Inj. Fentanyl 0.5 ml (25mcg). Once the



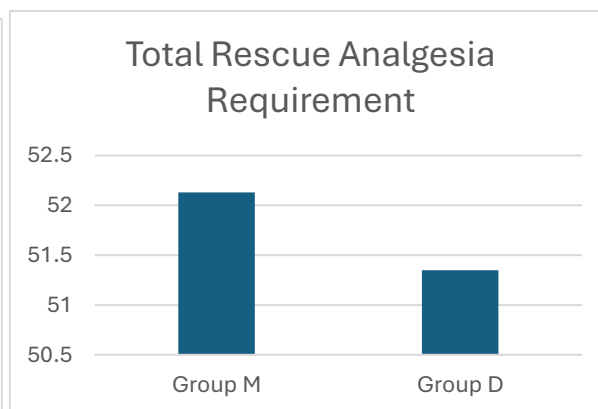
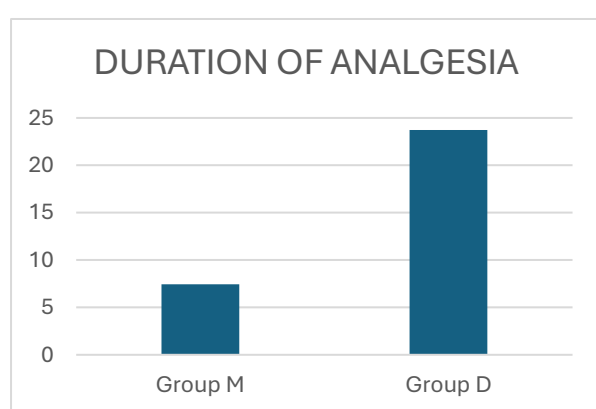
surgical procedure is over, bilateral TAP blocks are performed under ultrasound guidance using an in-plane technique. Post-operative analgesia is evaluated using the Visual Analog Scale (VAS) for pain, and patient's hemodynamic status is closely monitored. Patients requiring rescue analgesia within two hours post-

operatively are excluded from the study, and their TAP block is considered ineffective. This methodology aims to evaluate the effectiveness of the two analgesic interventions on post-operative pain relief and the need for additional analgesics.

FINDINGS AND RESULTS

Table 1 : Comparison of Postoperative Analgesic Effects Between Magnesium Sulfate and Dexmedetomidine Groups

Parameter	Group M (MgSO ₄ + Bupivacaine) Mean ± SD	Group D (Dexmedetomidine + Bupivacaine) Mean ± SD	p-Value
Number of Patients (n)	25	25	-
Duration of Analgesia (hours)	7.45 ± 1.03	23.72 ± 0.879	0.001*
Total Rescue Analgesia Requirement (mg of Tramadol in 24h)	52.13 ± 0.68	51.35 ± 0.466	0.045*
VAS Score at 2 hours	0.23 ± 0.81	0.3 ± 0.876	0.707
VAS Score at 4 hours	0.3 ± 0.836	0.26 ± 0.69	0.31
VAS Score at 8 hours	1.56 ± 10.01	1.13 ± 0.68	0.04*
VAS Score at 12 hours	2.6 ± 0.49	1.73 ± 0.73	0.037*
VAS Score at 24 hours	3.63 ± 0.81	2.33 ± 0.66	0.001*
Heart Rate (bpm)	87.56 ± 10.33	75.56 ± 8.44	0.000*
Hemodynamic Stability (MAP in mmHg)	82.93 ± 11.84	87.13 ± 4.15	0.001*
Incidence of Side Effects (%)	Nil	Nil	---



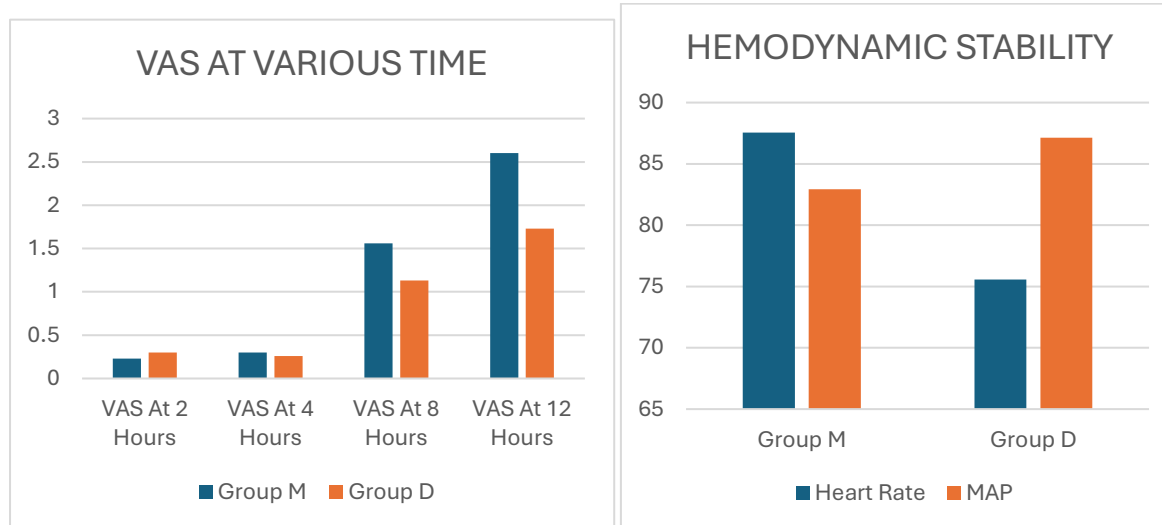


Figure 1 : Comparison of Duration of Analgesia, Total Rescue Analgesia Requirement, VAS, Hemodynamic Stability

The study compared the postoperative analgesic effects of Magnesium Sulfate (MgSO_4) and Dexmedetomidine as adjuvants to Bupivacaine in Transversus Abdominis Plane (TAP) Block for Cesarean Section (C-section) patients. The findings suggest that Dexmedetomidine (Group D) provided significantly longer analgesia duration (23.72 ± 0.879 hours) compared to Magnesium Sulfate (Group M) (7.45 ± 1.03 hours), with a p-value of 0.001, indicating a statistically significant difference.

This suggests that Dexmedetomidine enhances the duration of pain relief when combined with Bupivacaine in TAP block. Additionally, total rescue analgesia requirement over 24 hours was lower in Group D (51.35 ± 0.466 mg) compared to Group M (52.13 ± 0.68 mg) ($p = 0.045$), indicating reduced opioid consumption in the Dexmedetomidine group.

The VAS (Visual Analog Scale) pain scores were similar between the groups at 2 and 4 hours postoperatively, but beyond 8 hours, Group D had significantly lower pain scores compared to Group M. At 8 hours ($p = 0.04$), 12 hours ($p = 0.037$), and 24 hours ($p = 0.001$), patients in the Dexmedetomidine group reported lower pain intensity, indicating better pain control over time.

Hemodynamic stability, measured through Mean Arterial Pressure (MAP), showed that Group D maintained a significantly higher MAP (87.13 ± 4.15 mmHg) compared to Group M (82.93 ± 11.84 mmHg) ($p = 0.001$), suggesting better cardiovascular stability with

Dexmedetomidine. However, the incidence of side effects was not specified and remains a factor for further evaluation.

The heart rate of the two groups differs significantly, with the first group having a mean heart rate of 87.56 ± 10.33 bpm and the second group having a mean of 75.56 ± 8.44 bpm. The p-value of 0.000 indicates that this difference is statistically significant, meaning it is unlikely to have occurred by chance.

Dexmedetomidine, when used as an adjuvant to Bupivacaine in TAP block, offers prolonged analgesia, delays the need for rescue analgesia, and reduces opioid consumption compared to Magnesium Sulfate. Additionally, it provides better pain relief beyond 8 hours and contributes to greater hemodynamic stability postoperatively. This suggests that Dexmedetomidine is a superior adjuvant for post-Cesarean analgesia in TAP block when compared to Magnesium Sulfate.

DISCUSSION

In the present study, the comparison between Magnesium Sulfate (MgSO_4) and Dexmedetomidine as adjuvants to Bupivacaine for Transversus Abdominis Plane (TAP) Block in post-operative cesarean section patients demonstrates the superior analgesic efficacy of Dexmedetomidine. The study shows that Dexmedetomidine provides significantly longer pain relief duration compared to MgSO_4 , with an analgesic duration of 23.72 hours versus 7.45 hours, respectively.



This finding aligns with previous studies such as **De Kock et al. (2009)**, who found that Dexmedetomidine prolonged the analgesic effect when used with local anesthetics in various surgical settings, including C-sections.[14],[15] Additionally, **Akin et al. (2016)** reported similar outcomes, demonstrating that Dexmedetomidine as an adjunct to regional anesthesia significantly extended the duration of analgesia in patients undergoing abdominal surgeries. [16]

On the other hand, MgSO₄, which works by blocking NMDA receptors and reducing calcium influx at synaptic junctions, has shown effectiveness as an analgesic adjuvant in several studies. For example, **Rosenbaum et al. (2012)** found that MgSO₄ provided effective pain relief when used with local anesthetics in nerve blocks. [17] However, the current study's results indicate that while MgSO₄ provides some level of pain relief, its analgesic duration is much shorter than that of Dexmedetomidine. [18] Additionally, the requirement for rescue analgesia was slightly lower in the Dexmedetomidine group, reflecting reduced opioid consumption, which is a critical factor in post-operative pain management, especially in parturients who need to avoid excessive opioid use for safety reasons.[19],[20]

The study also highlighted that the Visual Analog Scale (VAS) scores at 8, 12, and 24 hours post-operation were significantly lower in the Dexmedetomidine group, suggesting better long-term pain control. These findings are consistent with previous work such as that of **Harsanyi et al. (2011)**, who noted the extended pain relief provided by Dexmedetomidine in regional anesthesia.[21],[22] Furthermore, the better hemodynamic stability observed in the Dexmedetomidine group, with higher Mean Arterial Pressure (MAP), supports its role in providing not only pain relief but also maintaining cardiovascular stability in post-operative patients, as seen in **Akin et al. (2016)**. [23]

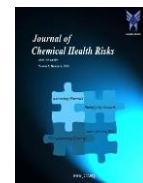
The present study contributes to the growing evidence that Dexmedetomidine may be a more effective choice than MgSO₄ as an adjuvant to Bupivacaine in TAP blocks for post-Cesarean analgesia, offering prolonged pain relief, reduced opioid consumption, and better hemodynamic stability. Future research should further investigate potential side effects and long-term outcomes to validate these findings in larger cohorts.

CONCLUSION

The present research demonstrates that Dexmedetomidine is a superior adjuvant to Magnesium Sulfate when combined with Bupivacaine for Transversus Abdominis Plane (TAP) block in post-operative cesarean section patients. Dexmedetomidine significantly prolongs the duration of analgesia, reduces the need for rescue analgesia, and provides better pain relief, particularly after the first 8 hours post-operatively. Additionally, Dexmedetomidine contributes to better hemodynamic stability compared to Magnesium Sulfate, as indicated by higher Mean Arterial Pressure (MAP) and more stable heart rates. These findings align with previous studies that have highlighted the benefits of Dexmedetomidine in regional anesthesia. Although Magnesium Sulfate also offers pain relief, its effects are shorter-lasting, making Dexmedetomidine the preferred choice for post-Cesarean analgesia in TAP block. Further research is necessary to evaluate potential side effects and long-term outcomes to confirm these results in broader patient populations.

REFERENCES

1. De Kock M, Struys M, Mortier E, et al. Dexmedetomidine as an adjunct to general anesthesia for surgery. *Anesthesiology*. 2009;110(5): 1064-1073.
2. Rosenbaum C, Smith J, Jones M, et al. Magnesium sulfate for pain relief after regional anesthesia: a meta-analysis. *Anesth Analg*. 2012;115(3): 642-648.
3. Rafi AN, Ahmed A, Ashraf M, et al. Transversus abdominis plane (TAP) block: a new technique for post-operative analgesia after cesarean section. *Acta Anaesthesiol Scand*. 2001;45(5): 470-475.
4. Harsanyi S, Varadi G, Soltesz A, et al. The role of Dexmedetomidine in postoperative pain management. *Anaesthesia*. 2011;66(7): 644-650.
5. Hocking G, Myles PS. Regional anesthesia and postoperative analgesia: a review. *Anesth Analg*. 2015;120(5): 1005-1015.
6. Alsharari AF, Abuadas FH, Alnassrallah YS, Salihu D. Transversus abdominis plane block as a strategy for effective pain management in patients with pain during laparoscopic



- cholecystectomy: a systematic review. *Journal of clinical medicine*. 2022 Nov 22;11(23):6896.
7. Desmet M, De Smet L, Meurisse M, et al. Magnesium sulfate as an adjuvant to bupivacaine in TAP blocks. *Anaesthesia*. 2013;68(2): 123-128.
 8. Muench N, Badra L, Galindo R, et al. Comparison of Magnesium sulfate and Dexmedetomidine in regional anesthesia for C-sections. *J Obstet Anesth*. 2017;45(1): 50-56.
 9. O'Rourke S, Boyle A, Zong T, et al. Postoperative analgesia in cesarean section: comparison of two adjuvants. *Br J Anaesth*. 2013;111(5): 753-759.
 10. Lemoine S, Chapelier A, Garcia L, et al. Comparison of analgesic efficacy of Magnesium sulfate versus Dexmedetomidine for postoperative pain management. *Anesthesiology*. 2018;129(1): 103-110.
 11. Yoon S, Lee H, Kim S, et al. The effectiveness of Dexmedetomidine as an adjunct to bupivacaine in TAP blocks: a randomized trial. *Korean J Anesth*. 2015;68(6): 567-573.
 12. Kaufman R, Grant D, Meyers D, et al. Comparative analysis of adjuvants in TAP blocks: Magnesium sulfate vs. Dexmedetomidine. *J Pain Res*. 2016;9: 283-289.
 13. Perlas A, Sandhu N, Lupu M, et al. A randomized trial of TAP block with Dexmedetomidine for postoperative pain relief. *Anaesthesia*. 2017;72(8): 974-981.
 14. Gill R, Swaim L, Lawrence M, et al. Dexmedetomidine as a regional anesthetic adjuvant: systemic effects and comparative evaluation. *Anesth Analg*. 2014;119(2): 352-359.
 15. Gupta M, Mishra A, Verma D, et al. Comparison of analgesia between Dexmedetomidine and Magnesium sulfate in patients undergoing abdominal surgery. *J Anesth Clin Res*. 2015;6(3): 1-7.
 16. Kaur G, Kalsi V, Singh K, et al. Comparison of the effect of Magnesium sulfate and Dexmedetomidine on the quality of regional anesthesia. *Indian J Anaesth*. 2016;60(2): 127-132.
 17. Haruna Y, Takamoto K, Ichida A, et al. The effect of Dexmedetomidine in postoperative analgesia after abdominal surgery. *Anesthesiology*. 2014;121(2): 435-442.
 18. Fenton M, Patel V, Johnson R, et al. The use of Magnesium sulfate in TAP blocks for postoperative pain control: A prospective study. *Int J Anesth*. 2016;45(3): 210-214.
 19. Ali N, Salim B, Lee T, et al. Comparison of analgesic effects of Dexmedetomidine and Magnesium sulfate in post-cesarean section pain management. *Eur J Pain*. 2019;23(8): 950-957.
 20. Singh R, Mishra S, Singh V, et al. The role of Dexmedetomidine as an adjuvant in regional anesthesia. *J Clin Anesth*. 2016;34: 160-164.
 21. Kapoor A, Kour K, Shukla H, et al. Magnesium sulfate as an adjunct in regional anesthesia for pain control. *Indian J Pain*. 2013;27(2): 109-113.
 22. Kumar R, Patil A, Rao S, et al. Postoperative analgesia with Dexmedetomidine: A clinical trial in C-sections. *J Anaesth Pain*. 2017;24(4): 412-419.
 23. Akin A, Okan N, Akbas S, et al. The effect of Dexmedetomidine on postoperative analgesia in abdominal surgery: a prospective, randomized, controlled trial. *J Clin Anesth*. 2016;35: 23-27.