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Original Research Article

A Comparative Evaluation of Dexamethasone (4 Mg) and $MgSO_4$ (150 Mg) as an Adjuvant to Bupivacaine (0.25%) in Tap Block for Postoperative Analgesia in Patients Undergoing Elective LSCS, A Triple Blinded Randomised Controlled Trial

D Sushma Reddy[1], Kiran Kumar Suggala[2], T Anusha[3]

[1]Post Graduate Resident, Department of Anaesthesia, Mamata Medical College, Khammam, Telangana, India

[2]Professor and HOD, Department of Anaesthesia, Mamata Medical College, Khammam, Telangana, India

[3]Associate Professor, Department of Anaesthesia, Mamata Medical College, Khammam, Telangana, India

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Corresponding Author: Dr. Kiran Kumar Suggala

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Abstract:

Introduction: Adequate postoperative analgesia is critical following lower segment cesarean section (LSCS) to support early recovery, facilitate breastfeeding, and enhance maternal-infant bonding. The transversus abdominis plane (TAP) block has proven effective for postoperative pain management in abdominal surgeries. This study compares dexamethasone (4 mg) and magnesium sulphate ($MgSO_4$) (150 mg) as adjuvants to bupivacaine (0.25%) in TAP blocks for postoperative analgesia in LSCS.

Materials and Methods: This triple-blinded randomised controlled trial included 60 patients undergoing elective LSCS, divided into Group D (bupivacaine + dexamethasone) and Group M (bupivacaine + $MgSO_4$). Both groups received bilateral ultrasound-guided TAP blocks following spinal anaesthesia. Pain intensity was assessed using the visual analogue scale (VAS), time to first analgesic request, total rescue analgesia required, hemodynamic stability, patient satisfaction, and side effects over 24 hours. Statistical analyses were performed using SPSS version 26.0.

Results: Group D demonstrated a significantly longer time to the first analgesic request (800 ± 60 vs. 620 ± 55 minutes, $p < 0.001$) and reduced tramadol consumption (1.0 ± 0.4 vs. 1.8 ± 0.6 doses, $p < 0.001$). VAS scores at rest and movement were consistently lower in Group D at all time intervals ($p < 0.01$). Hemodynamic parameters remained stable in both groups, with minimal side effects. Patient satisfaction was higher in Group D (86.7% "highly satisfied" vs. 63.3%).

Conclusion: Dexamethasone as an adjuvant to bupivacaine in TAP blocks offers superior postoperative pain control, reduced analgesic requirements, and higher patient satisfaction than $MgSO_4$, with a comparable safety profile.

Keywords: TAP block, dexamethasone, magnesium sulphate, postoperative analgesia, cesarean section.

Introduction

Adequate postoperative analgesia is essential following lower segment cesarean section (LSCS) to promote early recovery, facilitate breastfeeding, and enhance maternal-infant bonding. [1] [2] Poorly managed postoperative pain can lead to complications such as thromboembolic events, delayed ambulation, and prolonged hospital stays. [3] A multimodal analgesic approach, combining systemic and regional techniques, is recommended to assure optimal pain control while minimising drug-related side effects. [4] The transversus abdominis plane (TAP) block has emerged as a valuable local analgesic technique for abdominal surgeries, including LSCS. [5] The TAP block involves administering a local anaesthetic into the fascial layer between the internal oblique and transversus abdominis muscles, aiming to block the sensory nerves that provide innervation to the anterolateral abdominal wall. [6] Ultrasound guidance has significantly improved the accuracy, safety, and effectiveness of the TAP block. [7] Bupivacaine, a long-acting local anaesthetic [8], is commonly used in TAP blocks due to its prolonged analgesic effect. [9] However, its duration of action is limited, necessitating the use of adjuvants to enhance and extend postoperative pain relief. Dexamethasone, a potent glucocorticoid, has demonstrated analgesic-prolonging effects through anti-inflammatory action, inhibition of nociceptive C-fiber transmission, and local vasoconstriction. [10] [11] similarly, magnesium sulphate (MgSO4), an N-methyl-D-aspartate (NMDA) receptor antagonist, provides antinociceptive effects by modulating pain transmission and reducing central sensitisation. [12]

Despite promising evidence, limited studies have directly compared the analgesic efficacy of dexamethasone and $MgSO_4$ as adjuvants to bupivacaine in TAP blocks for LSCS. This randomised, triple-blinded, controlled trial aims to evaluate and compare the postoperative analgesic effects of adding dexamethasone (4 mg) or $MgSO_4$ (150 mg) to bupivacaine (0.25%) in ultrasound-guided TAP blocks in patients undergoing elective LSCS. The main objective is to evaluate the pain score at rest and during movement, while secondary objectives involve assessing hemodynamic parameters.

Materials and Methods

This triple-blind, randomised, controlled trial was carried out in the Department of Anaesthesia at Mamata Medical College, Khammam, Telangana, from July 2023 to July 2024. A total of 60 patients scheduled for elective lower segment cesarean section (LSCS) under spinal anaesthesia were enrolled. Participants aged 18 to 40 years, classified as ASA physical status I or II, and were randomly divided into two groups of 30 each using a computer-generated randomisation method.

Group D received 20 mL of 0.25% bupivacaine and 4 mg of dexamethasone, while Group M received 20 mL of 0.25% bupivacaine mixed with 150 mg of magnesium sulfate ($MgSO_4$). To maintain blinding, an independent anaesthetist prepared the drug solutions, and identical syringes were used for administration to ensure allocation concealment. Following written informed consent, bilateral ultrasound-guided transversus abdominis plane (TAP) blocks were administered after LSCS under spinal anaesthesia. Standardised anaesthesia included 10 mg of 0.5% hyperbaric bupivacaine. A linear ultrasound transducer was used to identify the fascial plane between the internal oblique and transversus abdominis muscles. Correct needle placement was confirmed through hydro-dissection before injecting the study drugs. Postoperative monitoring involved assessing the time to the first analgesic request, pain intensity using the visual analogue scale (VAS), and total rescue analgesic consumption within 24 hours. Intravenous tramadol (50 mg) was given as rescue analgesia when VAS ≥ 3.

Hemodynamic parameters, patient satisfaction, and side effects, including nausea or neurotoxicity, were recorded at predefined intervals (2, 6, 12, 18, and 24 hours). Statistical analysis was performed using SPSS version 26.0, with independent t-tests and chi-square tests applied as appropriate. A p-value < 0.05 was considered statistically significant. The trial adhered to ethical guidelines with approval from the institutional ethics committee.

Results

The demographic variables such as age, weight, and duration of surgery were similar between the two groups, with no statistically significant differences (Table 1). Regarding the primary outcome, Group D exhibited a significantly longer duration before the first analgesic request (800 ± 60 minutes) compared to Group M (620 ± 55 minutes; p < 0.001).

Additionally, total tramadol consumption within 24 hours was notably lower in Group D (1.0 ± 0.4 doses) compared to Group M (1.8 ± 0.6 doses; p < 0.001), indicating superior analgesic efficacy in Group D.

Table 1: Patient Demographics and Surgical Characteristics

Variable	**Group D (n = 30) (Dexamethasone)**	**Group M (n = 30) (Magnesium sulphate)**	**p-value**
Age (years)	30.8 ± 4.5	31.3 ± 3.9	0.54
Weight (kg)	66.2 ± 6.4	65.8 ± 7.0	0.68
Surgical Duration (min)	58.0 ± 5.8	59.2 ± 6.0	0.41

Pain intensity measured by the VAS score at rest and during movement was notably lower in Group D than in Group M at all recorded intervals (Table 2).

At the 6-hour mark, the average VAS score at rest was 2.0 ± 0.6 for Group D and 3.5 ± 0.7 for Group M. By 24 hours, these scores were 1.5 ± 0.5 and 3.0 ± 0.5, respectively. Likewise, VAS scores during movement were consistently reduced in Group D.

Hemodynamic indicators, such as heart rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP), remained stable in both groups, with no significant clinical differences detected (Table 3).

Table 2: VAS Scores at Rest and Movement

Time (hours)	Rest - Group D	Rest - Group M	Movement - Group D	Movement - Group M	p-value
2	1.0 ± 0.4	1.2 ± 0.5	1.2 ± 0.5	1.4 ± 0.6	0.15
6	2.0 ± 0.6	3.5 ± 0.7	2.8 ± 0.7	4.2 ± 0.8	0.002
12	2.5 ± 0.6	3.8 ± 0.8	3.2 ± 0.8	4.5 ± 0.7	0.001
18	2.0 ± 0.5	3.2 ± 0.7	2.5 ± 0.6	4.0 ± 0.7	0.001
24	1.5 ± 0.5	3.0 ± 0.5	2.2 ± 0.6	3.8 ± 0.6	0.001

Table 3: Hemodynamic Parameters (Heart Rate, SBP, DBP)

Time (hours)	Group D (n = 30) (Dexamethasone)			Group M (n = 30) (Magnesium sulphate)		
	Heart Rate	**SBP**	**DBP**	**Heart Rate**	**SBP**	**DBP**
Baseline	78.2 ± 5.2	118.6 ± 7.5	76.3 ± 4.7	79.1 ± 6.6	119.3 ± 8.3	77.2 ± 5.3
2	80.5 ± 6.7	120.3 ± 6.1	78.4 ± 5.7	82.5 ± 7.4	121.5 ± 7.7	79.7 ± 6.9
6	82.3 ± 6.3	122.8 ± 5.7	80.1 ± 5.4	84.2 ± 8.1	124.9 ± 6.2	81.1 ± 6.1
12	84.1 ± 7.4	123.7 ± 6.2	81.2 ± 4.2	86.7 ± 8.8	125.0 ± 7.5	83.4 ± 5.8
24	80.7 ± 5.1	120.1 ± 6.3	78.4 ± 5.4	81.5 ± 6.3	121.1 ± 7.4	79.9 ± 6.3

Patient satisfaction scores were significantly higher in Group D, with 86.7% of participants reporting being "highly satisfied," compared to 63.3% in Group M. Minimal side effects were observed, with mild nausea reported in three patients from Group M and one from Group D. These findings underscore the superior analgesic efficacy and safety profile of dexamethasone as an adjuvant to bupivacaine in TAP blocks.

Discussion

In the present study, the mean age of patients was lower (30.8 ± 4.5 years in Group D and 31.3 ± 3.9 years in Group M) compared to Shambhavi T et al.'s [13] older patient groups (51.32 ± 9.49 years in Group BD (Bupivacaine + Dexamethasone) and 46.6 ± 11.60 years in Group BM (Bupivacaine + Magnesium sulphate). This age variation suggests a younger patient population in the current study. Both studies reported similar averages regarding weight. The present study documented 66.2 ± 6.4 kg (Group D) and 65.8 ± 7.0 kg (Group M). At the same time, Shambhavi T et al. [13] observed slightly lower weights of 65.35 ± 8.67 kg (Group BD) and 62.90 ± 9.44 kg (Group BM), indicating comparable nutritional statuses.

Surgical duration differed significantly. In the present study, average surgical times were 58.0 ± 5.8 minutes (Group D) and 59.2 ± 6.0 minutes (Group M), whereas Shambhavi T et al. [13] reported longer durations of 69 ± 9.82 minutes (Group BD) and 74 ± 12.81 minutes (Group BM). This suggests more complex or prolonged procedures in Shambhavi T et al.'s [13] study, possibly due to different surgical types or techniques. Overall, the present study involved a younger population with shorter surgical times, while Shambhavi T et al. included older patients undergoing more prolonged procedures, reflecting differences in patient selection and surgical context.

For clinical practice, these findings suggest that healthcare providers should carefully consider patient age when selecting between dexamethasone and magnesium sulfate, as the effectiveness and side effect profiles might vary between younger and older populations. Additionally, the expected surgical duration should factor into the decision-making process, as longer procedures might require different drug dosing strategies or additional considerations for maintaining therapeutic effects throughout the operation. The similar weight distributions across both studies suggest that weight-based dosing protocols might be reliably applied across different patient populations, though always with careful consideration of individual patient factors.

In the present study, comparing VAS scores at rest and during movement between Group D and Group M reveals significant differences over time. At 2 hours, VAS scores for rest and movement were comparable, with no statistically significant difference (p=0.15). However, as time progressed, Group D consistently demonstrated lower pain scores than Group M at rest and during movement. These differences became statistically significant by 6, 12, 18, and 24 hours (p<0.01), indicating better pain control in Group D. Similarly, Shambhavi T et al. [13] reported lower VAS scores in Group BD compared to Group BM. At rest, Group BD maintained lower scores throughout the 24 hours, with the maximum difference observed at 8 hours. Group BD also showed consistently lower scores during movement, with the most notable disparity at 8 and 10 hours. Overall, both studies indicate superior analgesic efficacy in Group D or BD compared to Group M or BM, with statistically significant differences emerging after the initial postoperative hours. This suggests that Group D/BD provides more effective and sustained pain relief at rest and during movement.

Dexamethasone is more effective than magnesium sulfate as an adjuvant to bupivacaine in TAP blocks. This conclusion is supported by significantly longer time to first analgesic request (800 ± 60 vs 620 ± 55 minutes, $p<0.001$), lower tramadol consumption (1.0 ± 0.4 vs 1.8 ± 0.6 doses, $p<0.001$), and consistently lower VAS pain scores throughout the 24-hour period. While both groups maintained stable hemodynamics, the dexamethasone group achieved higher patient satisfaction (86.7% vs 63.3% "highly satisfied") with fewer reported side effects. The present study provides compelling evidence that dexamethasone is the preferred adjuvant for TAP blocks. It offers enhanced post-operative pain control, reduced analgesic requirements, and improved patient satisfaction while maintaining a favourable safety profile.

Conclusion

When used as an adjuvant to bupivacaine in TAP blocks, dexamethasone provides better postoperative pain relief compared to magnesium sulfate. It prolongs the duration of analgesia, decreases the requirement for supplemental pain medication, and results in lower pain scores both at rest and during movement.

Hemodynamic parameters remained stable in both groups, with minimal side effects observed. Patients in the dexamethasone group reported significantly higher satisfaction, highlighting its efficacy and safety in improving postoperative pain management.

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