International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Efficacy of High Thoracic (T2) Erector Spinae Plane Block with Mgso4 as an Adjuvant to Ropivacaine for Postoperative Analgesia in Shoulder Arthroscopy

Dr. Neha Khullar[1], Dr. Nusrat Jehan[2], Dr. Mubasher Ahmed[3], Dr. Vishal Kant[4]

[1]Senior Resident, Department of Anesthesia and Critical Care, Government Medical College and Hospital, Jammu, J&K, India
[2]Associate Professor, Department of Anesthesia and Critical Care, Government. Medical College and Hospital, Srinagar, J&K, India
[3]Associate Professor, Department of Anesthesia and Critical Care, Government. Medical College and Hospital, Srinagar, J&K, India
[4]Assistant Professor, Department of Anesthesia and Critical Care, Govt. Medical College and Hospital, Udhampur, J&K, India

OPEN ACCESS

Corresponding Author:

Dr. Vishal Kant
Assistant Professor, Department of Anesthesia and Critical Care, Govt. Medical College and Hospital, Udhampur, J&K, India
Email: *vishalkant3708@gmail.com*

Received: 20-03-2026
Accepted: 15-04-2026
Available online: 30-04-2026

ABSTRACT

Background: More than 50% of patients undergoing shoulder arthroscopy experience severe postoperative pain, which increases morbidity, adversely impacts outcomes and prolongs recovery time. ESPB at high thoracic level has emerged as promising technique for analgesia in these patients. This prospective observational study was undertaken with Aim of assessing post operative analgesic efficacy of MgSO4 as an adjuvant to Ropivacaine [0.2%] in high thoracic erector spinae plane block for shoulder arthroscopy. Methodology: In this study ultrasound guided erector spinae plane block was given at T2 with 0.2% ropivacaine with MgSO4 200 mg (2 ml) after which surgery was done under general anesthesia. Postoperative pain assessment done using VAS score and rescue analgesia given if VAS≥4. Results: mean time to first rescue analgesia was 10 hrs. 0,1 and 2 doses of analgesia was required in 62%, 32% and 6% patients,respectively. VAS at rest and VAS at movement showed increasing trend from immediate postop period upto 24 hrs (p value<0.001). **Conclusion**: Addition of MgSO4 in ESPB produces better analgesic profile with reduced consumption of opioids with stable hemodynamics.

Keywords: *ESPB, MgSO4, analgesia, arthroscopy, ropivacaine.*

INTRODUCTION:

Shoulder arthroscopy is a common orthopedic procedure used to treat conditions such as rotator cuff tears, instability, and stiffness. Around 54% of patients experience severe postoperative pain, which can delay recovery, impair rehabilitation, and increase the risk of readmission. Therefore, effective pain management is essential to promote early mobilization, enhance rehabilitation outcomes, and improve overall patient satisfaction [1].

Pain following shoulder arthroscopy is multifactorial, resulting from soft tissue handling, bone resection, capsular distension, and local inflammatory responses. Referred pain due to diaphragmatic irritation via the phrenic nerve can further add to discomfort, commonly radiating to the neck or arm. Owing to these varied mechanisms, effective analgesia requires a multimodal and targeted approach [2]

Conventional perioperative pain control for shoulder surgery relies on systemic agents—primarily opioids and nonsteroidal anti-inflammatory drugs—and regional techniques such as interscalene and suprascapular nerve blocks. Despite their effectiveness, these approaches carry notable risks, including unintended phrenic nerve involvement, hemidiaphragmatic paralysis, and potential pneumothorax.[3] Because of these drawbacks, attention has shifted toward newer options like the erector spinae plane block (ESPB), which can offer broad pain relief while preserving

motor function and minimizing impact on respiration.[4] This technique is increasingly favored because it is relatively simple to perform with ultrasound guidance, carries a low risk of complications, and spares the phrenic nerve. Emerging evidence from case reports and small studies suggests that ESPB is effective for managing both acute postoperative and chronic shoulder pain.[5]

Incorporating magnesium sulfate ($MgSO_4$) into regional anesthesia can provide added benefits. It helps extend the duration of analgesia by stabilizing nerve membranes and enhancing the action of local anesthetics, thereby prolonging both sensory and motor blockade [6]. Other benefits include: Opioid-Sparing Effects [7]; Enhanced pain control with $MgSO_4$ contributes to better postoperative recovery, improved patient satisfaction, and faster rehabilitation [8].

Aims and Objectives:
To assess post operative analgesic efficacy of MgSO4 as an adjuvant to Ropivacaine[0.2%]

- Primary Objective: To determine postoperative pain scores upto 24 hours; To observe time to request for Ist rescue analgesia in postoperative period, and Total Post operative opioid consumption (up to 24 hours after surgery).
- Secondary Objective: To determine patient satisfaction, and to observe any adverse event.

METHODOLOGY
Study Design: Prospective Observational Study
Study Setting: Hospital based study carried out in a bone and joint tertiary care hospital.
Study duration: 20 months.
The participants for the study were selected based on the following inclusion and exclusion criteria:

Inclusion Criteria: Patients aged between 18 to 65 years of either gender having a body weight of 40–80 kg who were classified as American Society of Anesthesiologists (ASA) physical status I or II, scheduled for elective arthroscopic shoulder surgery who provided informed consent for participation in study

Exclusion Criteria: Patients with a known allergy to ropivacaine, $MgSO_4$ and Tramadol; Patients classified as ASA III or IV; Patients with a history of chronic opioid use; Patients with coagulopathy or bleeding disorders; and Patients with skin infections or lesions at the planned injection Site.

Ethical Approval And Consent To Participate: This study accorded approval from Institutional Review Board with reference number: IRBGMC/ANESTH173 dated: July 20, 2023. Written informed consent was obtained from patients and study was conducted in accordance with Declaration of Helsinki.

Study Procedure: The study procedure consisted of the following steps:

Preoperative Preparation: Patients scheduled for surgery were evaluated during the preoperative visit. Informed consent was obtained, and baseline parameters, including demographic data, body weight, and ASA classification, were recorded. Patients were instructed to fast for at least 6 to 8 hours prior to the procedure.

Intervention: On the day of surgery, participants were shifted to the operation theater, and standard monitors (non-invasive blood pressure, electrocardiogram, and pulse oximetry) were applied. Intravenous access was established, and patients were premedicated with 0.02 mg/kg midazolam.

Preoperatively, an ultrasound-guided ESPB was performed in the sitting position. A high- frequency linear transducer was used to visualize the T2 spinous process by counting down anatomically from the vertebra prominens (C7), and the T2 transverse process was visualized by counting down from the first rib. The erector spinae muscle was visualized above the T2 transverse process. An 18-20G needle was inserted in a caudal-to-cranial orientation using an in-plane technique. The needle tip was advanced to the plane between the erector spinae muscle and the transverse process. A small volume of saline was injected to confirm proper needle placement within the fascial plane. Once the plane was identified, the local anesthetic was injected in 5 ml increments with aspiration after every 5 ml to prevent intravascular injection. A total of 22ml of 0.2% Ropivacaine (20ml) and 200mg (2ml) of Mgso4 is injected, allowing for cranial and caudal spread. Visual analogue score (VAS) for Pain was used which is numerical representation of patients subjective experience of pain. Pain scores ranging from 0 to 10 was recorded where 0 is no pain and 10 is the worst pain imaginable. VAS was recorded preoperatively just after giving block (at rest and during shoulder movement) and postoperatively at rest and with movement at various time intervals (recovery, 2hr, 4hr, 8hr, 16hr and 24hr).

After giving block, General anesthesia was given. Patient was induced with propofol (2 mg/kg), fentanyl (2μg/kg), and Atracurim (0.5mg/kg) to facilitate endotracheal intubation. Anesthesia was maintained with sevoflurane (1.5–2% end-tidal concentration) and oxygen/nitrous oxide mixture. Postoperative Care: At the end of surgery, patients were

extubated after meeting extubation criteria and transferred to the postoperative care unit (PACU). Pain scores were assessed using the VAS scale at predetermined intervals. Rescue analgesia was provided as IV tramadol (1-2mg/kg) if the patient requested and if VAS score was ≥4. Total opioid consumption in 24hrs and time to request for first rescue analgesia was also recorded.

Study Parameters: The following parameters we rerecorded and analyzed:

Primary Parameters: Postoperative pain scores measured using the Visual Analogue Scale (VAS) at rest and with shoulder movement at specific intervals (recovery, 2, 4, 8, 16, and 24 hours postoperatively); Time to request for first rescue analgesia and Total opioid consumption in the first 24 hours postoperatively.

Secondary Parameters: Occurrence of adverse events, including nausea, vomiting, itching, respiratory depression and block failure (defined as incomplete or ineffective action of a regional anesthesia technique, where the expected sensory or motor block is partially achieved or not achieved at all).

Study Data Collection: The following data points were recorded: Base line demographic information (age, gender, weight, ASA status). Intraoperative parameters (BP, HR, SPO2) including duration of surgery. Postoperative VAS scores at recovery, 2, 4, 8, 16, and 24 hours at rest and with movement. Time to first request for rescue analgesia. Total opioid consumption in the first 24 hours. Patient satisfaction scores and adverse events (eg; nausea, vomiting, itching, respiratory depression and block failure).

Statistical Analysis:
Data was entered in a Microsoft Excel spread sheet and analysed using Stata18. Frequency tables were used to summarise categorical variables. Continuous variables were summarized as mean and SD in the absence of extreme values. Median and Inter-quartile range was used to summarise ordinal variables and continuous variables with non-normal distribution. Repeated-measures ANOVA was used to analyze the change in HR, SBP, DBP, and SpO2 during the intraoperative and postoperative periods; Friedman test was used to analyze VAS scores. Two-sided p-values were reported and $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

The 50 evaluable patients underwent study as per protocol (Fig.1); these patients displayed demographic characteristics typical of an ambulatory shoulder-arthroscopy population. Patients were mainly aged 40–49 years (34%), followed by 30–39 years (26%), and 20–29 and 50–59 years (16% each), with a mean age of 41.7±11.5 years. Males predominated females (58% vs 42%) (Table 1). Median weight was 71.5 kg (IQR 66–78). Balanced demographics reduce bias, suggesting lower tramadol use reflects true block efficacy rather than patient variation.

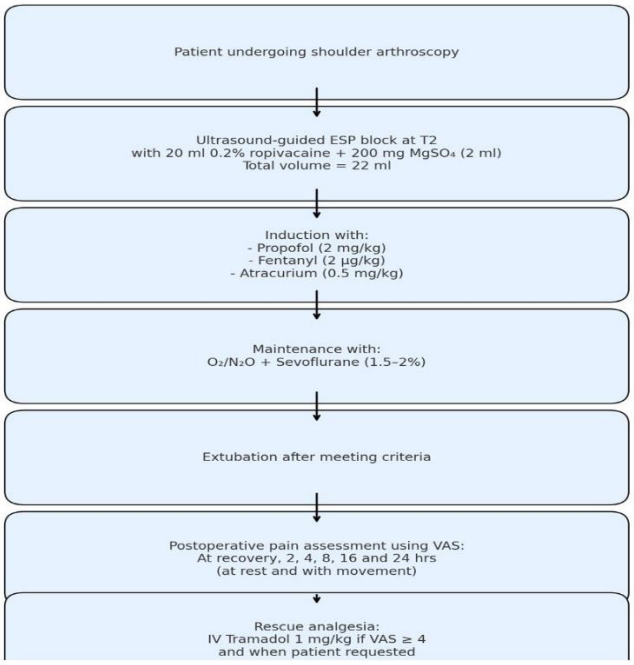

Figure 1. Flow diagram of study

Most patients were ASA I (64%), with the rest ASA II, forming a relatively homogenous, low-risk group (Table 1).

This minimizes confounding from comorbidities, ensuring more reliable assessment of postoperative pain and pharmacodynamic effects of regional anesthesia techniques like ESPB..

Table 1. Demographic distribution of data showing Age and Gender distribution, ASA status, Comorbidity status and type of surgery

Age-wise distribution of study patients

Age (years)	Percentage (%)
20–29	16.0
30–39	26.0
40–49	34.0
50–59	16.0
60–65	8.0

Gender-wise distribution of study patients

Gender	Percentage (%)
Male	58.0
Female	42.0

ASA (American Society of Anesthesiologist) status of study patients

ASA Status	Percentage (%)
ASA I	64.0
ASA II	36.0

Comorbidities among the study population

Comorbidities	Percentage (%)
No Medical Comorbidity (NMC)	64.0
Hypertension (controlled)	8.0
Type-2 diabetes	8.0
Smoker	8.0
Hypothyroid	6.0
Hypertension / Hypothyroid	4.0

Hypertension / Type-2 diabetes	2.0

Type of surgery

Type of Surgery	Percentage (%)
Rotator-cuff repair	48.0
Sub-acromial decompression	28.0
Bankart stabilisation	20.0
Labral debridement	4.0

Most patients (64%) had no comorbidities, while 36% had associated conditions. Controlled hypertension, type 2 diabetes, and smoking were each present in 8% of patients, hypothyroidism in 6%, and combined comorbidities (hypertension with hypothyroidism or diabetes) in a small proportion (Table 1). These findings are comparable to similar ESPB studies. Abdelhaleem (2022) reported 62.5% ASA I and 37.5% ASA II patients.[9] Studies by Selvi et al. (2018) and Diwan & Nair (2020) also included patients with low-to-moderate comorbidity burdens, mainly controlled hypertension and diabetes.[10,11] Overall, ESPB appears safe even in patients with comorbidities due to minimal respiratory and systemic complications.

In this study, 48% of patients underwent rotator cuff repair, 28% subacromial decompression, 20% Bankart stabilization, and 4% labral debridement (Table 1), similar to Ciftci (2021) [12]. Comparable surgical profiles were reported by Selvi et al (2018) and Diwan & Nair (2020), with rotator cuff and decompression procedures predominating.[10,11] These surgeries typically cause moderate to severe postoperative pain, making them ideal for evaluating ESPB efficacy.

The mean surgical duration was 91.82 minutes (IQR 73.75–110), comparable to Abdelhaleem (2022) [9] and shorter than Ciftci (2021) [12]. Notably, surgeries ≥90 minutes required minimal tramadol, indicating prolonged analgesia with 200 mg $MgSO_4$.

Preoperative parameters showed patients were hemodynamically stable before induction and administration of the erector spinae plane block (ESPB), with baseline vitals comparable to earlier studies. Normal preoperative SpO_2 supports the suitability of ESPB in patients requiring respiratory preservation, highlighting its phrenic-sparing advantage over interscalene block (Table 2).

Intraoperatively, heart rate remained stable (78.88–80.45 bpm) from 10 to 120 minutes. Although a statistically significant change was noted at 10 minutes (p=0.004), it was clinically insignificant. No episodes of bradycardia or tachycardia occurred, confirming the hemodynamic neutrality of ESPB, even with $MgSO_4$. Postoperatively, heart rate remained stable over 24 hours (81.46–82.52 bpm) with no significant variation, indicating effective analgesia and minimal sympathetic activation (Table 2).

Table 2. Table showing preoperative, intraoperative and postoperative hemodynamic vitals

Time Point	Preoperative				Intraoperative				Postoperative			
	HR (bpm)	SBP (mmHg)	DBP (mmHg)	SpO_2 (%)	HR (bpm)	SBP (mmHg)	DBP (mmHg)	SpO_2 (%)	HR (bpm)	SBP (mmHg)	DBP (mmHg)	SpO_2 (%)
Baseline	80.38± 5.56	123.90± 7.77	77.32± 4.35	98.02± 0.55	—	—	—	—	—	—	—	—

0 hr / 10 min	—	—	—	—	78.94± 5.46	120.38± 7.28	74.84± 4.01	98.62± 0.67	82.14± 5.31	122.74± 6.08	75.70± 5.34	98.28± 0.45
2 hr / 30 min	—	—	—	—	79.82± 5.68	120.08± 7.30	75.92± 5.93	98.56± 0.50	81.74± 6.35	122.12± 9.21	75.08± 5.06	98.14± 0.57
4 hr / 60 min	—	—	—	—	78.88± 5.64	121.88± 7.72	75.44± 4.99	98.58± 0.50	81.82± 5.70	122.80± 9.72	76.88± 6.13	98.30± 0.46
8 hr / 90 min	—	—	—	—	80.45± 6.31	120.59± 8.41	75.90± 3.02	98.48± 0.51	82.26± 8.66	124.54± 8.39	78.60± 4.39	98.06± 0.24
16 hr / 120 min	—	—	—	—	80.13± 4.73	128.13± 4.52	75.88± 4.85	99.00± 0.00	81.46± 7.50	122.50± 7.10	77.46± 5.41	98.00± 0.73
24 hr	—	—	—	—	—	—	—	—	82.52± 6.64	122.14± 6.59	76.80± 4.92	97.96± 0.20
Overall p-value	—	—	—	—	**0.004**	**<0.001**	**0.008**	**0.273**	**0.627**	**0.103**	**<0.001**	**0.273**

Blood pressure trends were similarly stable. Intraoperative systolic BP ranged from 120.08 to 128.13 mmHg and diastolic BP from 74.84 to 75.88 mmHg. Minor statistically significant variations at 10 minutes were clinically insignificant. Postoperatively, SBP (122.12–124.54 mmHg) and DBP (75.08–78.60 mmHg) remained within normal limits. SpO_2 remained consistently high intra- and postoperatively without significant variation, with no desaturation episodes (Table 2). This confirms that ESPB with $MgSO_4$ preserves respiratory function, supports early mobilization, and maintains stable hemodynamics.

In our study, the preoperative VAS score immediately after block placement was low, with a mean of 2.1 (IQR 1–2) at rest and 2.6 (IQR 2–3) on movement (Table 3). Postoperatively, VAS at rest showed a gradual increase from the immediate period up to 24 hours, likely due to the peak effect of the block early on, followed by a gradual decline in its analgesic effect over time. These changes across time intervals were statistically significant ($p<0.001$) (Fig. 2). VAS scores with movement followed a similar trend and were consistently slightly higher than those at rest at all time points (0, 2, 4, 8, and 16 hours), reflecting increased pain with activity (Fig. 3). Despite this, overall VAS scores remained low, indicating effective analgesia, reduced opioid requirement, delayed need for rescue analgesia, and good patient satisfaction. These findings align with Abdelhaleem et al (2022) [9], who reported higher pain scores with movement in suprascapular block compared to high thoracic ESPB. Similarly, Ciftci et al (2021) demonstrated significantly lower VAS scores in the ESPB group compared to controls up to 48 hours postoperatively.[12]

Postoperative total 24-hour opioid (tramadol) consumption was significantly low, reinforcing improved block quality with magnesium as an adjuvant in ESPB for shoulder surgeries (Table 3). Abdelhaleem et al (2022) similarly reported a significant reduction in rescue analgesia (morphine) in the ESPB group compared to controls ($p<0.001$).[9] Likewise, Ciftci et al (2021) demonstrated a significantly lower need for rescue analgesia in the ESPB group versus the sham block group. Postoperative fentanyl consumption was also significantly reduced in the ESPB group ($p=0.009$).[12] These consistent findings across studies support the enhanced analgesic efficacy of ESPB, particularly with magnesium, in minimizing postoperative opioid requirements and improving overall pain management outcomes.

The average time to first rescue analgesia was significantly prolonged, with a median of 10 hours (IQR 7–12 hours). Only 2% of patients required analgesia at 0 hours, while 6% requested it at 14 hours, indicating sustained analgesic effect (Table 3). These findings are consistent with previous studies. Lee AR et al (2011) demonstrated a significantly longer duration of analgesia in the magnesium group (664 minutes) compared to saline (553 minutes; $p=0.017$).[13]

Similarly, Abdelhaleem et al. (2022) reported a markedly prolonged time to first rescue analgesia in the ESPB group (281 minutes) compared to the placebo group (23 minutes; $p<0.001$), supporting enhanced analgesic efficacy.[9]

Table 3. Table showing Preoperative VAS (Visual Analogue Score) just after giving block, Postoperative opioid consumption, Time to ist rescue analgesia, patient satisfaction score and Adverse effects

Preoprative VAS (just after block)	Median	IQR	Mean
At rest	2	1–2	2.1
With movement	3	2–3	2.6

Opioid consumption (tramadol) in 24 hours

Rescue analgesia (no. of doses)	Percentage (%)
0 doses	62.0
1 dose	32.0
2 doses	6.0

Time to first rescue analgesia (in hours)

Time interval	Frequency (%)
0 hour	1 (2.0%)
1 hour	3 (6.0%)
7 hour	2 (4.0%)
8 hour	2 (4.0%)
10 hour	3 (6.0%)
12 hour	6 (12.0%)
14 hour	3 (6.0%)

Patient satisfaction score

Score	Percentage (%)
1 — Very dissatisfied	0.0
2 — Somewhat dissatisfied	6.0
3 — Neutral	10.0
4 — Satisfied	34.0

5 — Very satisfied	50.0

Adverse effects

Adverse effect	Percentage (%)
Nausea	14.0
Vomiting	6.0
Block failure	4.0
Itching	0.0
Respiratory depression	0.0

At 24 hours, patient satisfaction scores indicated high acceptance of the block. Most patients were very satisfied (score 5: 50%), followed by satisfied (score 4: 34%). A smaller proportion reported neutral (10%) or somewhat dissatisfied (6%) responses, while none were very dissatisfied. Overall, 84% of patients were satisfied or very satisfied with the analgesia provided (Table 3). The high satisfaction rates can be attributed to effective pain control achieved with ESPB at the T2 level. The addition of magnesium sulfate likely enhanced and prolonged analgesic duration, reducing the need for rescue analgesia and improving overall patient comfort in the postoperative period.

In our study, among adverse effects noted, nausea was the most common complication (14%), followed by vomiting (6%) and block failure (4%) (Table 3). These findings are consistent with Abdelhaleem et al (2022), who also reported nausea, vomiting, and constipation as common side effects, with no cases of respiratory depression.[9] Similar to our results, Ahmed et al (2022) observed complications such as nausea, vomiting, pruritus, and shivering, without serious adverse events like pneumothorax.[14] Notably, no incidence of itching was observed in our study, unlike other reports showing 12% and 8% incidence in different ESPB groups. Three cases of block failure required multiple rescue analgesic doses for adequate pain control. Although ESPB is considered a safe and effective regional technique, it is not entirely free from failure or incomplete analgesia. Selvi et al (2018) reported a case series where one out of three patients experienced inadequate postoperative pain relief, highlighting the possibility of variability in block efficacy.[10]

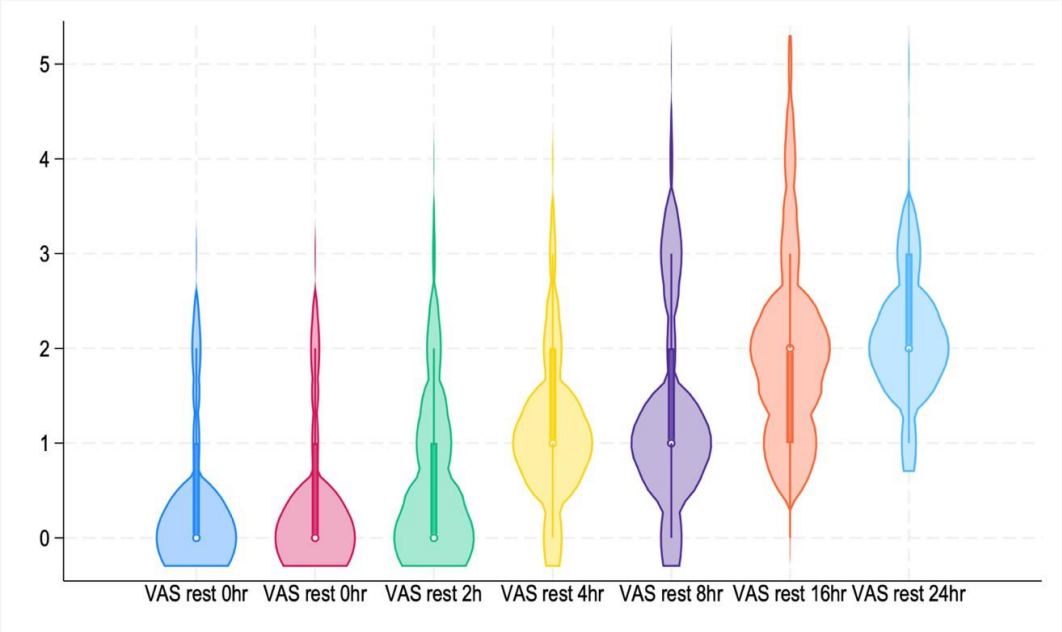

Figure 2. Violin plot showing VAS at Rest at different time intervals postoperatively

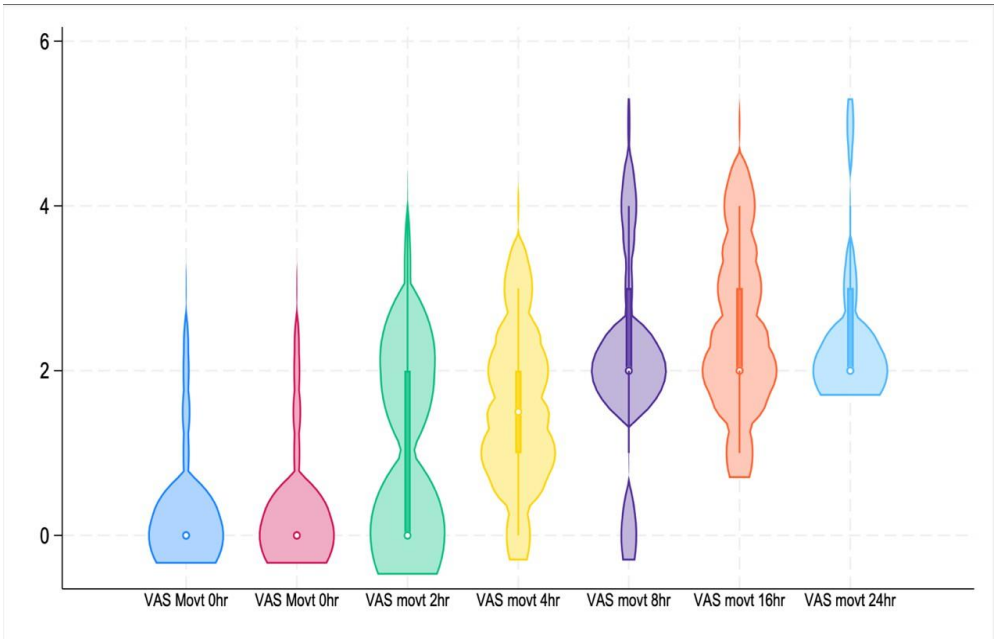

Figure 3. Violin plot showing VAS at movement at different time intervals postoperatively

CONCLUSION

Addition of MgSo4 to a low dose ropivacaine solution for high thoracic erector spinae plane block produced better analgesic profile in terms of statistically significantly low VAS Score upto 24 hrs both at rest and with movement. It showed reduced consumption of opioids in postoperative period, significantly prolonged time to rescue analgesia, better patient satisfaction score profile and stable hemodynamics profile in both intraoperative and postoperative period with insignificant adverse effects.

Limitations

Since this study was a prospective observational study with no comparison or control group, so comparison could only be made between different time intervals of same patient; and also it was localized to one hospital only and sample size was quite less also. A better picture of results could be carved with extrapolation of this study with polycentric, randomisation, double blinding, and adding comparison group while taking large sample size. Also, we used 20 mL of 0.2% bupivacaine with 200 mg MgSO4, further studies may be needed to evaluate the efficacy of different concentrations of local anesthetics as well as different doses of MgSO4. In our study block failure occurred in 3 patients, which can be considered a technical limitation of the procedure, which can be due to anatomical variation, inadequate volume or concentration of local anesthetic or operator dependant technique.

Source(s) of support: Nil
Acknowledgement: we thanks all the faculty and anesthesia team for their individual help in this study
Conflicts of Interest Statement of each author: No conflict of interest

REFERENCES:

1. Treuting R. Minimally invasive orthopedic surgery: arthroscopy. Ochsner Journal. 2000 Jul 1;2(3):158-63.
2. Hughes M, Matava M, Wright R, Brophy R, Smith MV. Interscalene brachial plexus block for arthroscopic shoulder surgery: A systematic review. J Bone Joint Surg Am. 2013;95(14):1318-24. doi:10.2106/JBJS.L.01116.
3. Bayot ML, Nassereddin A, Varacallo M. Anatomy, shoulder and upper limb, brachial plexus.
4. Walker-Bone K, van der Windt DAWM. Shoulder pain—where are we now? Curr Treat Options Rheumatol. 2021;7(1):1-22. doi:10.1007/s40674-021-00184-z.
5. S, Krishnan & Cascella, Marco. (2019). Erector Spinae Plane Block.
6. Nadri S, Mahmoudvand H, Vahabi S.Effect of magnesium sulfate on morphine activity retention to control pain after herniorrhaphy. Pain Manag.2017;7(2):119-125. doi:10.2217/pmt- 2016-0038.
7. Alkhazraji YF, Sahib HA, Saleh MM. A Comparison Study of Adding Magnesium Sulfate to Local Anesthetics During Spinal Anesthesia for Cesarean Section. Indian J Forensic Med Toxicol. 2021;15(4):17139. doi:10.37506/ijfmt.v15i4.17139.
8. Elyazed MMA, Mogahed M. Comparison of Magnesium Sulfate and Dexmedetomidine as an Adjuvant to 0.5% Ropivacaine in Infraclavicular Brachial Plexus Block. Anesth Essays Res. 2018;12:109-115. doi:10.4103/aer.AER_70_17.
9. Abdelhaleem NF, Abdelatiff SE, AbdelNaby SM. Comparison of Erector Spinae Plane Block at the Level of

the Second Thoracic Vertebra With Suprascapular Nerve Block for Postoperative Analgesia in Arthroscopic Shoulder Surgery. Pain Physician. 2022 Nov;25(8):577-585
10. Selvi O, Tulgar S, Ozer Z. Case report presentation of ultrasound-guided erector spinae plane block in shoulder surgery: Three patients and two different results. Cureus 2018;10(11):e3538.
11. Nair A, Diwan S. Erector spinae block as a phrenic nerve sparing block for shoulder surgeries.
12. RegAnesthPainMed2020;45(9):751–2.
13. Ciftci B, Ekinci M, Go¨ lboyu BE et al. High Thoracic Erector Spinae Plane Block for Arthroscopic Shoulder Surgery: A Randomized Prospective Double-Blind Study. Pain Medicine, 2021; 22(4):776–783
14. Lee AR, Yi HW, Chung IS, Ko JS, Ahn HJ et al. Magnesium added to bupivacaine prolongs the duration of analgesia after interscalene nerve block. Can J Anesth/ J Can Anesth (2012)59:21– 2727. Jebali C, Kahloul M, Hassine MI, Jaouadi MA
15. Ahmed SA, Magdy AA, Abduallah MA et al. The Effect of Erector Spinae Plane Block With and Without Addition of Magnesium on Relief of Pain from Post- herpetic Neuralgia. Pain Physician 2022; 25:365-372