

Comparison Between Magnesium Sulphate and Morphine as an Adjuvant to Bupivacaine in Ultrasound Guided Transversus Abdominis Plane Block

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ABSTRACT

Objective: To compare analgesic efficacy of magnesium sulphate (MgSO₄) and morphine as adjuvant to bupivacaine solution in transversus abdominis plane (TAP) block in patients undergoing abdominal surgeries.

Study Design: Quasi-Experimental Study.

Place and Duration of Study: Combined Military Hospital Rawalpindi, Pakistan from Aug to Oct 2022.

Methodology: A total of 80 patients undergoing abdominal surgeries under general anesthesia were enrolled in the study after non-probability consecutive sampling and divided into two groups receiving localized morphine (Group-A) and receiving MgSO₄ (Group-B) as adjuvants to TAP block. The primary goal was to determine mean total consumption of analgesia post-operatively in the two groups. Additionally, determining variables were mean postoperative pain scores at 6, 12 and 24 hours and time to requesting first analgesia.

Results: The mean age of participants was 37.14±11.5 years. Increased dosage of injection nalbuphine (26.44±1.64 mg vs 20.07±1.36 mg, p -value<0.001) were consumed in Group-A as compared to Group-B respectively. There was a significantly prolonged time before patients requested first analgesic dose in Group-B as compared to Group-A (161.90±19.94 minutes vs 242.77±63.01 minutes (p <0.001))

Conclusion: Magnesium sulphate not only serves as better adjuvant to bupivacaine in TAP block due to its better analgesic potential in terms of post-operative pain scores and reduced post-operative analgesic requirement, it also has a better side effect profile as compared to morphine.

Keywords: Anesthesia, Analgesia, Bupivacaine, Morphine.

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INTRODUCTION

Post-operative pain is one of the main complaints of patients following abdominal surgeries.^{1,2} A big component of this post-operative pain is somatic and derived from the abdominal wall incision. The anterior abdominal wall is supplied by nerves that traverse the plane between internal oblique muscle and transversus abdominis muscle and fascia. This is known as transversus abdominis plane (TAP). Several key nerves travel through it.³

TAP block involves administration of local anaesthetic into the TAP plane to block the somatic pain component of the post-operative/per-operative pain. Rafi *et al.* used a landmark guided technique to introduce local anaesthetic solution in the TA plane. He inserted the needle over the iliac crest at level of L3-L4 intervertebral space at the base of lumbar “triangle of petit” over the lateral border of latissimus

dorsi muscle. He advanced the needle until a definite pop sensation was felt after which local anaesthetic was injected in TA plane after negative aspiration.^{4,5}

Nowadays, ultrasound guided TAP blocks are considered gold standards as they result in lesser complications and lesser iatrogenic injuries as a direct result of TAP block.^{6,7,9} There are generally four approaches of the ultrasound guided TAP block: Subcostal, Oblique Subcostal, Lateral and Posterior approach.^{3,6,8} The approach used by the anesthesiologist depends upon the site and size of incision and upon the anesthesiologist's experience. Sometimes, a dual approach is utilized, which includes subcostal with lateral/posterior approach for better spread local anaesthetic in TAP plane.

Various adjuncts such as magnesium sulphate and morphine have been used with local anaesthetic solution to improve the quality and duration of post-operative analgesia with good effect.¹⁰ In our study we wanted to explore this avenue and compare their basic side effect profile.

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METHODOLOGY

This quasi-experimental study was conducted at Combined Military Hospital Rawalpindi, Pakistan, after approval from the Institutional Ethical Review Board (vide letter no. 277) over a period of 03 months from August to October 2022.

Inclusion Criteria: Patients of either gender, undergoing any abdominal surgery with American society of Anesthesiologists status 1 and 2, between the ages of 16 and 60 years with hemodynamic stability were included.

Exclusion Criteria: Patients with respiratory diseases, pre-operative hypotension, pre-operative bradycardia, patients on ionotropic support and those with contraindications and allergy to morphine and magnesium sulphate were excluded.

Sample size was calculated using the World Health Organization (WHO) sample size calculator taking a mean difference of 5.4 mg in mean postoperative use morphine in the first 24 hours.¹¹ The estimated sample size came out to be 54 patients. With non-probability consecutive sampling the 80 subjects were equally divided into two groups, i.e. Group-A (morphine group) and Group-B (magnesium sulphate group), as seen in Figure.

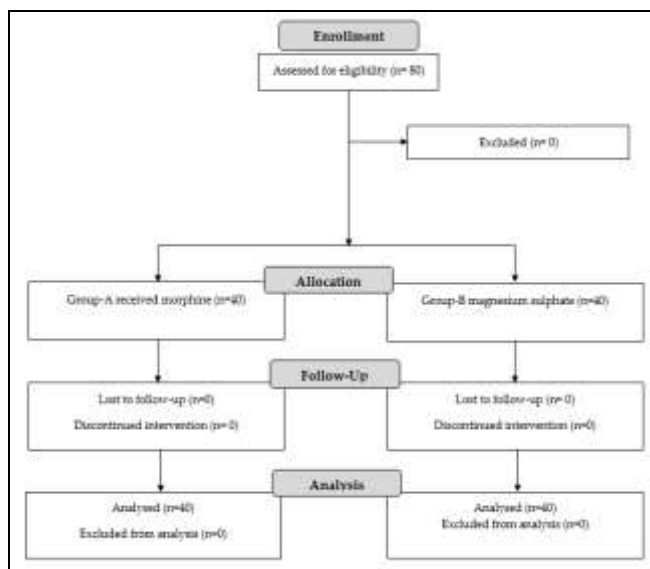


Figure: Patient Flow Diagram (n=80)

To determine the patients' suitability for the study, a thorough interview was done with them before undergoing to surgery. They were given a thorough explanation of the study's goals and methodology, and their informed consent was

obtained after they were given satisfactory answers to all their pertinent questions.

Complete pre-anaesthesia assessment was done as per institutional protocols and patients were optimized accordingly. They were reassessed by a consultant anaesthesiologist before going to the operating room (OR). All patients were given general anaesthesia with injection propofol (2mgkg⁻¹) as the sedative and injection atracurim (0.5mgkg⁻¹). Injection nalbuphine (0.1mgkg⁻¹) and injection paracetamol (15mgkg⁻¹) were given as per-operative analgesic agents. Anaesthesia plane was maintained with 1.5% Isoflurane inhalation with fresh gas flow.

After induction of general anaesthesia, both groups were given a TAP block with the help of ultrasound guidance with a 22-gauge spinal needle under ultrasound guidance with 0.25% bupivacaine solution (2mgkg⁻¹) using the lateral approach after preparing the skin with 2% chlorhexidine solution for antisepsis. Again, negative aspiration was first done to avoid an intravascular injection. However, morphine (0.05mgkg⁻¹) was added as an adjunct to bupivacaine solution in Group-A, and MgSO₄ (3mgkg⁻¹) was added to bupivacaine solution in Group-B. Pain was assessed using Visual Analog Scale (VAS) at 6 hours, 12hours and 24 hours postoperatively. Injection Nalbuphine was used post-operatively for patients complaining of post-operative pain.

Data was entered and analyzed by Statistical Package for Social Sciences (SPSS) version 23. Descriptive statistics for categorical variable were presented as frequency and percentage, while mean and standard deviation were reported for continuous variables. The categorical groups were compared by using the Chi-square test, while mean values were compared using independent samples t-test among groups. A *p*-value of ≤0.05 was considered significant.

RESULTS

A total of 80 patients were included in the study. The mean age of participants of the study was 37.14±11.5 years with a mean BMI of 25.14±4.36 kgm⁻². A total of 39(48.8%) males and 41(51.2%) females were included in this study. The distribution of age, gender, BMI and ASA status was generally uniform and no statistical significance seemed to exist between the groups as far as demographic data of the patients included in this study were concerned (Table-I).

Post-operative analgesic markers are described in Table-II. Patients in Group-B (MgSO₄) consumed

lesser quantity of nalbuphine ($p < 0.001$), waited a greater amount of time to request for analgesia (p -value < 0.001) and lesser number of patients requested analgesia to begin with (p -value 0.012) as compared to Group-A (Morphine).

Table-I: Patient Demographics and Clinical Data (n=80)

Parameters	Study Groups		p-value
	Group-A n=40 n (%)	Group-B n=40 n (%)	
Age in years Mean $\pm$ SD	39.15 $\pm$ 11.04	35.13 $\pm$ 11.73	0.118
BMI in kgm-2 Mean $\pm$ SD	25.38 $\pm$ 3.75	24.90 $\pm$ 4.93	0.622
Gender	Males	20(51.3%)	0.823
	Females	20(48.8%)	
American Society of Anesthesiologists (ASA) Status	ASA-1	22(55.0%)	0.263
	ASA-2	18(45.0%)	

Table-II: Post-Operative Analgesia (n=80)

Parameters	Study Groups		p-value
	Group-A n=40 n (%)	Group-B n=40 n (%)	
Nalbuphine Mean $\pm$ SD	26.44 $\pm$ 1.64	20.07 $\pm$ 1.36	< 0.001
Time to 1 st analgesic request, mins Mean $\pm$ SD	161.90 $\pm$ 19.94	242.77 $\pm$ 63.01	< 0.001
Number of patients requesting analgesia,	21 (52.5%)	10 (25.0%)	0.012

Table-III tabulates mean post-operative pain scores as per Visual Analog Scale at 6, 12 and 24 hours. In all three instances patients exhibited significantly lesser pain scores in Group-B (MgSO₄) with p -values of 0.004, 0.013 and 0.008 respectively.

Table-III: Post-Operative Pain Scores (n=80)

Parameters	Study Groups		p-value
	Group-A n=40 Mean $\pm$ SD	Group-B n=40 Mean $\pm$ SD	
VAS 6 Hours	4.58 $\pm$ 1.58	3.04 $\pm$ 1.82	0.004
VAS 12 Hours	3.90 $\pm$ 1.54	2.95 $\pm$ 1.76	0.013
VAS 24 Hours	3.88 $\pm$ 1.52	2.88 $\pm$ 1.74	0.008

*VAS: Visual Analog Scale

Table-IV describes the side effect profile of both drugs. 16(40.0%) patients had nausea vomiting in Group-A as compared to 5(12.5%) patients in Group-B (p -value 0.005). Group-A also showed significantly greater frequency of itching and hypotension as compared to Group-B.

DISCUSSION

The question our study has tried to answer is that among morphine and MgSO₄, which one serves as a better adjuvant to bupivacaine solution to prolong the post-operative analgesia and improve the quality and

depth of analgesia. Our study revealed significant improvement in pain reduction as well as side effect profile with MgSO₄ compared to morphine.

Table-IV: Side Effects of Study Drugs (n=80)

Side Effects	Study Groups		p-value
	Group-A n=40 n (%)	Group-B n=40 n (%)	
Nausea/Vomiting,	16(40.0%)	5(12.5%)	0.005
Itching,	14(35.0%)	4(10.0%)	0.007
Hypotension,	7(17.5%)	1(2.5%)	0.025
Bradycardia,	1(2.5%)	0 (0.0%)	0.314

Various adjuvants have been added to local anaesthetic solutions both in local infiltration and in regional blocks to prolong their action, decrease their onset and to decrease pain upon injection among other reasons.^{12,13} MgSO₄ is a common adjuvant added to bupivacaine for transversus abdominis plane and other field blocks. It exerts its anti-nociceptive action by blocking the voltage gated calcium channels and by its antagonistic actions of N-methyl-D-aspartate (NDMA) receptors.¹⁴

Benevides *et al.* found that even systemic intravenous magnesium reduces the postoperative operative pains scores in patients who had undergone abdominal hysterectomy.¹⁵ Adding MgSO₄ to bupivacaine local anaesthetic solution significantly reduces the dose of MgSO₄ utilized thereby potentially preventing side effects and toxicity of the MgSO₄. Abd-Elsalam *et al.* added MgSO₄ to 0.25% bupivacaine solution as an adjuvant in TAP block and found that addition of MgSO₄ to the local anaesthetic solution significantly reduced the time to first analgesia and significantly reduced the morphine consumption over the first 24 hours (7.63 $\pm$ 2.93 mg vs 16.20 $\pm$ 3.24mg, $p < 0.001$) after total abdominal hysterectomy.¹⁰

Another study showed that addition of MgSO₄ and adenosine to local anaesthetic solution reduced pain scores on Visual Analog Scale and also that the duration of analgesia was significantly longer than in adenosine and magnesium as compared to control groups however, the duration of analgesia was significantly longer in MgSO₄ group as compared to adenosine group (401 vs. 447 vs. 320 minutes in adenosine, magnesium and control groups, respectively; $p = 0.003$).¹⁶

Morphine as an adjunct to TAP block has also been studied in some clinical trials. A study conducted

by Abdel-Ghaffar *et al.* showed that addition of morphine to a single shot subcostal TAP block significantly reduced pain scores post-operatively in patients undergoing upper abdominal surgery.¹⁷ Addition of morphine adjuvant also decreased post-operative opioid consumption and increased the time to 1st request of analgesia in a dose dependent manner whereas the side effect profile was similar both with and without morphine. Study conducted by El Sherif *et al.* shows similar results with nausea being more common in patients who were given morphine adjuvants with TAP block which was consistent with the results of our study.¹¹ Another study added sufentanyl to bupivacaine solution for TAP block and showed that it reduced post-operative morphine consumption.¹⁸ Other adjuvants (clonidine, dexamethasone, dexmedetomidine) have been added to local anaesthetic solutions to TAP block, with varying results as far as post-operative analgesia and side effect profile is concerned.^{17,18}

LIMITATIONS OF STUDY

We could not do long term follow-ups of the patients included in the trial due to limited duration of study to check for incidences and differences of chronic pain syndromes in both groups. Our study was also limited by the fact that we could not compare other adjuvants to the adjuvants included in our group. This could leave avenues for exploration in further studies.

CONCLUSION

Magnesium sulphate not only serves as better adjuvant to bupivacaine than morphine in TAP block due to its better analgesic potential in terms of post-operative pain scores and reduced post-operative analgesic requirement, it also has a potentially better side effect profile as compared to morphine.

Conflict of Interest: None.

Discolure:

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

OM & KB: Data acquisition, data analysis, critical review, approval of the final version to be published.

SS & MHS: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

TAK & MH: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity

of any part of the work are appropriately investigated and resolved.

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Comparison between Magnesium Sulphate

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