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Evaluation of analgesia by epidural Fentanyl and MgSO₄ with Fentanyl for postoperative analgesia in patients of lower abdominal surgeries: A comparative study

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Abstract--Background: The addition of Magnesium sulphate (MgSO₄) to postoperative Fentanyl Epidural infusions has been demonstrated to reduce the requirement for Fentanyl. Methodology: Group I (38 patients) got Epidural Fentanyl 50 mg (1 cc) diluted and made up to 6 cc with normal saline, whereas Group II (38 patients) received Epidural Fentanyl 50 µg (1 cc) + MgSO₄ 50 mg (4 units in insulin syringe of 50% solution) diluted and made up to 6 cc with normal saline. The effects of analgesia on pulse rate and blood pressure were measured as well as the duration of analgesia. Results: In this study, an average age of the study population was 41.25 ± 3.25 years in Group I and 42.14 ± 4.42 years in Group II. The pulse rate in Group-I increased significantly from 105 minutes compared to Group-II, whereas it remained steady in Group-II throughout the research duration. Systolic BP increased significantly in Group-I after 90 minutes compared to Group-II, but remained steady in Group-II. SPO₂ and respiratory rates did not differ significantly. Conclusion: Adding

magnesium sulphate to fentanyl in epidural analgesia increased the duration of analgesia while maintaining hemodynamic stability.

Keywords---fentanyl, magnesium sulphate, epidural anaesthesia, hemodynamics.

Introduction

The treatment of postoperative pain is a key problem for treating physicians [1]. Poorly treated acute pain, such as that experienced after surgery, can trigger pathophysiologic processes in the peripheral and central nervous systems, which can lead to chronicity [2]. To prolong the duration of analgesia, the continuous spinal epidural (CSE) block combines the rapidity, density, and dependability of a subarachnoid block with the flexibility of a continuous epidural block. The CSE approach is increasingly used in major orthopaedic surgery and obstetrics [3]. Epidural anaesthesia is thought to be an efficient treatment for surgical pain because it suppresses endocrine, autonomic, and somatic reactions, which may be especially useful in the perioperative care of the elderly [4]. Over the years, a variety of opioid and non-opioid adjuvants have been introduced to increase neuraxial analgesia; nevertheless, researchers are still looking for better adjuvants with fewer side effects. Opioids, GABA agonists, adrenergic agonists, NMDA (N-methyl-D-aspartate) antagonists, COX inhibitors, and Ach-esterase inhibitors are all examples of adjuvants [5, 6]. For postoperative analgesia, epidural opioids have been shown to be particularly effective.

When opioids like fentanyl are used as epidural anaesthetic adjuvants, they provide better analgesia but come with a higher risk of pruritus, urine retention, nausea, vomiting, and respiratory depression [7]. Fentanyl has a higher lipophilic character, which makes it better for epidural analgesia. Fentanyl is rapidly absorbed by the bloodstream from the epidural region and distributes less rostrally than other regularly used opioids [8]. It may also undergo uptake into Epidural fat or diffusion across the dura into the cerebrospinal fluid (CSF). The rapidity of analgesic effect of Epidural Fentanyl administration and the relatively short duration of action makes it the drug of choice for postoperative acute pain [8]. Magnesium, a divalent cation, has antinociceptive properties via blocking the NMDA receptor in a noncompetitive manner, resulting in calcium antagonism. It has been used as an adjuvant in various dosages and through various routes, including intravenous, epidural, and intrathecal [9]. The current study aims at assessment of the efficiency of epidural fentanyl and fentanyl with magnesium sulphate (MgSO_4) on hemodynamic stability in patients undergoing elective lower limb and lower abdominal surgeries.

Material and Methods

After obtaining informed written consents and approval of the ethical committee of the anesthesia department, Government Medical College and Government general hospital, Nizamabad, Telangana, India (Duration of study was April 2021 to January 2022). A total of 68 (ASA I/II) patients scheduled to undergo elective lower limb and lower abdominal surgeries were selected for the study and

allocated into one of the two groups: Group -I (34 patients): received Epidural Fentanyl 50 µg (1cc) diluted and made up to 6cc with normal saline. Group-II (34 patients): received Epidural Fentanyl 50 µg (1cc) pulse MgSO₄ 50mg (4 units in insulin syringe of 50% solution) diluted and made up to 6cc with normal saline.

Inclusion criteria

Patients aged between 32 to 52 years of age of either sex, posted for elective lower limb and lower abdominal surgeries, ASA grade I/II

Exclusion criteria

Patient's refusal, morbidly obese patients and patients with coagulopathies, Patients with vertebral column defects, local sepsis or significant neurological deficits, and ASA grade III/IV/V. The visual analogue scale (VAS) for pain was chosen as the tool for pain evaluation prior to the operation, and all patients were taught how to respond to the scale. All patients were given 10 ml/kg Ringer's acetate solution as a preload in the preparation room after being cannulated with an 18 gauge venous cannula. Non-invasive blood pressure, pulse oximetry, and ECG were used to keep track of the patients. Following the induction of anaesthesia, a capnogram was introduced. Routine investigations were performed on all patients before to surgery. By employing a midline approach with a 16 gauge Tuohy's needle and a loss of resistance method, the epidural space was discovered at L2-L3 or L3-L4. Following that, an 18 G Epidural catheter was placed into the epidural space. All patients had their pulse rate, blood pressure, oxygen saturation, and respiratory rate monitored intra-operatively, and the following values were recorded. Patients in Group-I got 50 g of Fentanyl while patients in Group-II received 50 g of Fentanyl + 50 mg Magnesium sulphate after regression of sensory block (confirmed by pin prick) to L1. The duration of analgesia, haemodynamic changes, respiratory rate, SpO₂ (oxygen saturation), and adverse effects were all observed. Patients were transported to the postoperative ward after 30 minutes of monitoring in the PACU (post-anesthesia care unit). The first time a patient needed analgesia was documented. For 24 hours, adverse events connected to the medication and the Epidural catheter was monitored.

Data collected

- Peri and intraoperative hemodynamics in the form of HR (heart rate) and MAP (mean arterial pressure): baseline, 20 min after epidural activation, every 15 min after start of the surgery and till skin closure, once reaching recovery room and every hour for six hours.
- Time taken to achieve complete sensory and motor block.
- Post-operative assessment of pain every hour for six hours using the Visual Analogue Scale where 0 = no pain and 10 = worst possible pain [10, 11].
- Number of patients suffering from postoperative nausea, vomiting, itching and urine retention.

Statistical analysis

Data were coded and entered using the statistical package Origin Pro 8.5 and Epi-Info software's were used for the analysis of the data. Student t-test (two tailed, independent) was used to find the significance of study parameters on continuous scale between two groups Chi-square/ Fisher Exact test were used to find the significance of study parameters on categorical scale between two or more groups. A P value < 0.05 was considered statistically significant.

Results

While 76 patients qualified for the study only 68 completed the study and were randomized among the two groups. In present study, the mean age of study population in group-I was 41.25 ± 3.25 years and in Group-II it was 42.14 ± 4.42 years. The association of two groups with age was statistically not significant (P value>0.05). There was no statistically significant difference in the ratio of males to females in both the study groups. Femur fracture cases were more in both the study groups as compared to other fracture types but there was no statistically significant difference between two groups with the type of fractures the P value>0.05 (Table 1).

Table 1
Comparison of Sociodemographic parameters

Parameter	Group-I (n= 38)	Group-II (n=38)
Age (years): Mean age	41.25 ± 3.25	42.14 ± 4.42
Sex		
Male	29 (76.32 %)	30 (78.94 %)
Female	09 (23.68 %)	08 (21.06 %)
Types of cases		
Fracture femur	16 (42.10 %)	16(42.10 %)
Hysterectomy	08 (21.05 %)	09 (23.68 %)
Fracture tibia and fibula	11(28.95 %)	10 (26.31 %)
Inguinal hernia	03(7.90 %)	03 (7.90 %)

As regards sensory and motor blocks there were statistically significant differences between the two groups ($p < 0.001$), both were faster in group-II in comparison to groups -I as shown in Table 2.

Table 2
Motor and sensory block

	Group-I	Group-II	P-value
Motor block (min)	19.42 ± 1.83	$13.25 \pm 2.12^{**}$	<0.001*
Sensory block (min)	17.23 ± 1.45	$12.03 \pm 0.96^{**}$	<0.001*

Data are expressed as mean $\pm$ SD. *statistically significant difference between the two groups (p-value<0.05).

There was a significant increase in the pulse rate from 105 min in Group-I compared to Group II, but it was stable in Group-II during the study period (fig-1).

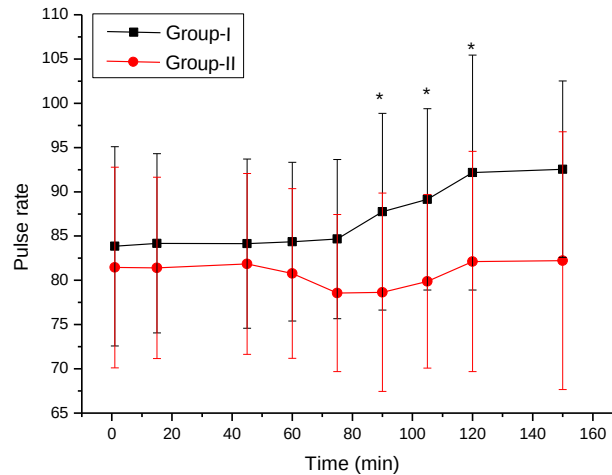


Fig 1. Comparison between the two groups as regards pulse rate. *denotes statistically significant difference between the two groups (p-value<0.05)

There was significant increase in Systolic BP from 90 min in Group-I compared to Group-II and it was stable in Group-II (fig-2).

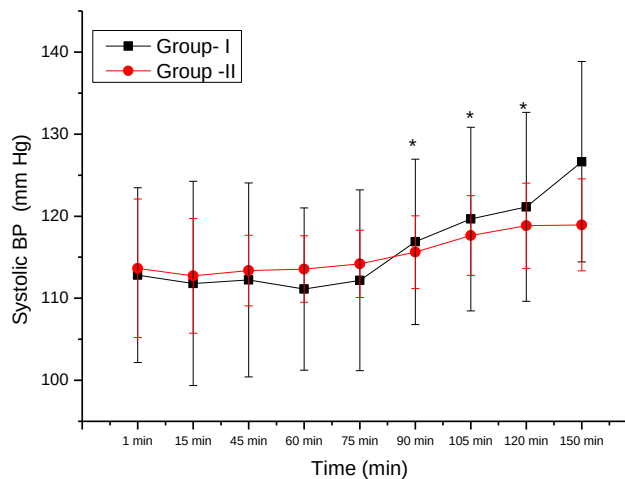


Fig. 2. Comparison between the two groups as regards Systolic BP. *denotes statistically significant difference between the two groups (p-value<0.05).

There was no significant variation in Diastolic BP among the two groups (fig-3).

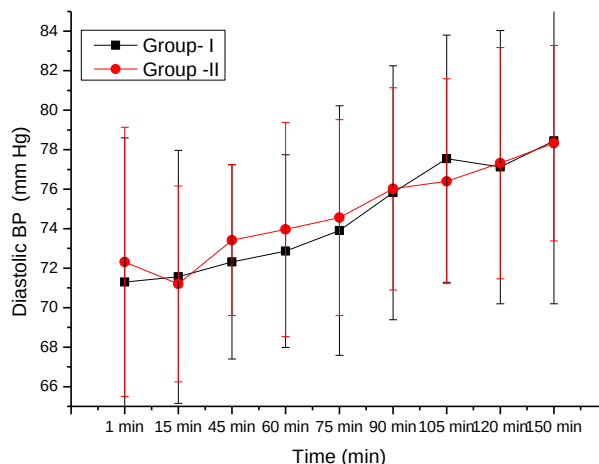


Fig 3. Comparison between the two groups as regards Diastolic BP. *denotes statistically significant difference between the two groups (p -value <0.05)

Mean of arterial pressure was stable throughout in both the groups and it was comparable. The results were shown in fig-4.

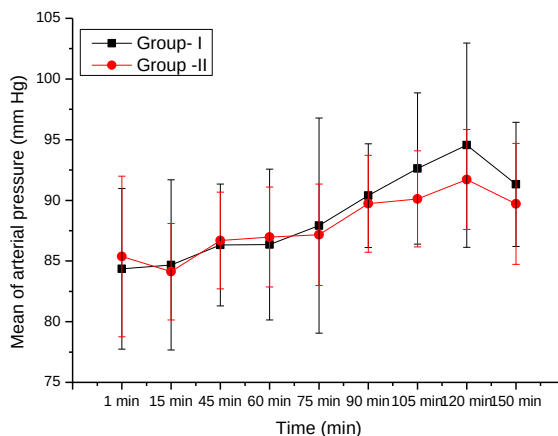


Fig 4. Comparison between the two groups as regards arterial pressure. *denotes statistically significant difference between the two groups (p -value <0.05)

No significant variation in SpO_2 and respiratory rates. One patient from group-I had nausea/vomiting, whereas two patients had nausea/vomiting from group-II. One patient from group-II had urinary retention but none of the patient had urinary retention from group-I. There was no significant difference in incidence of adverse effects like nausea /vomiting, pruritus, urinary retention and others in the two groups.

Discussion

Postoperative pain may produce a range of detrimental effects and if not treated effectively may lead on to chronic postsurgical pain [12]. The study used a combined spinal epidural block, which combines the speed, density, and dependability of a subarachnoid block with the flexibility of a continuous epidural block to lengthen analgesia duration. In addition to reducing pain, epidural anaesthesia and analgesia has been shown to lower the incidence and severity of perioperative physiologic derangements. Adjuvants like opioids and magnesium can prolong and increase the quality of post-operative analgesia. Because of its quick onset of analgesia and short duration of action, epidural Fentanyl has been the medication of choice for acute postoperative pain. Inadequate analgesia in the elderly has been linked to longer hospital stays, greater complications, frequent readmissions, and poor patient outcomes in several studies [13].

The current study indicated that a single epidural dosage of 50-100µg of fentanyl is efficacious, with a quick onset of analgesia in 5-10 minutes and a shorter duration of action (2-4 hr). In our study, both groups had similar baseline characteristics such as age, gender distribution, and the types of patients that were scheduled for surgery. Because the duration of surgery and the time to regression of sensory block to L1 were statistically similar in both groups, the time between regression to L1, when test drug was given, and the patient's first complaint of pain more accurately represents the duration of analgesia due to test drugs with minimal bias associated with spinal block and surgery. While 76 patients qualified for the study only 68 completed the study and were randomized among the two groups. In present study, the mean age of study population in group-I was 41.25 ± 3.25 years and in Group-II it was 42.14 ± 4.42 years. The association of two groups with age was statistically not significant (P value >0.05).

Neurotransmitters are released in response to noxious stimulus and bind to several subclasses of excitatory amino acid receptors, including NMDA receptors. The duration of acute pain may be determined by NMDA receptor signaling [14]. As a result, NMDA receptor antagonists may be useful in the treatment and prevention of post-injury pain. Magnesium inhibits calcium influx and antagonises NMDA receptor channels in a noncompetitive manner [15]. When administered alone, magnesium can reduce pain, but it has also been proven to highlight the analgesic benefits of opioids [16]. Magnesium in combination with Fentanyl may extend Fentanyl analgesia in this way. Fentanyl PCEA with 50 mg bolus Mg and continuous Mg infusion Epidurally was used in Group-I and Fentanyl PCEA with 50 mg bolus Mg and continuous Mg infusion Epidurally was used in Group-II by Bilir *et al* [17]. There were statistically significant differences between the two groups (p 0.001) in terms of sensory and motor blocks; both were quicker in group II than in group I.

There was 25% reduction in Fentanyl consumption in Group-II at the end of 24 hr compared to Group-I. Thus, addition of Mg allowed lesser requirement of Fentanyl in the post-operative period due to its NMDA receptor antagonist action and potentiation of opioid analgesic effects. This is comparable to the results of the present study wherein adding Mg (50 mg) to Fentanyl (50 µg) Epidurally as a single dose markedly increased duration of Fentanyl analgesia in group II

compared to group I. In the study conducted by Arcioni et al [18] using Epidural Mg infusion and morphine for postoperative analgesia, postoperative morphine requirements assessed for 36 hrs were less in Epidural Magnesium group (24.0 mg) compared to control group (38.96 mg).

Mean morphine requirement was reduced by 38%. This was attributed to NMDA receptor antagonism of Mg and pain modulation and its potentiation of opioid analgesia. The pulse rate in Group-I increased significantly from 105 minutes compared to Group II, whereas it remained steady in Group-II throughout the research duration. Systolic BP increased significantly in Group-I after 90 minutes compared to Group-II, but remained steady in Group-II. Diastolic blood pressure did not differ significantly between the two groups. The mean arterial pressure in both groups was consistent and equal throughout. SPO₂ and respiratory rates did not differ significantly. One patient from group-I had nausea/vomiting, whereas two patients had nausea/vomiting from group-II. One patient from group-II had urinary retention but none of the patient had urinary retention from group-I. There was no significant difference in incidence of adverse effects like nausea/vomiting, pruritus, urinary retention and others in the two groups. The findings are similar to those of the current study in that they showed that preoperative use of epidural magnesium followed by infusion resulted in better postoperative analgesia and less analgesic consumption, but they differ in the study population, as Kogler *et al.*[19] included elderly patients, co-administered drugs, and postoperative epidural analgesia.

Conclusion

In comparison to both Fentanyl and Magnesium Sulphate pulse Fentanyl, we can conclude that using magnesium sulphate as an additive to epidural Fentanyl infusion that started before the operation and continued until the end of the surgery provides good analgesia without side effects. It also proved to fasten the epidural block. The addition of magnesium sulphate to fentanyl in epidural analgesia increased the duration of analgesia while maintaining hemodynamic stability, according to the current study.

References

1. Arcioni R, Palmisani S, Tigano S, Santorsola C, Sauli V, Romano S, Mercieri M, Masciangelo R, De Blasi RA, Pinto G. Combined intrathecal and epidural magnesium sulfate supplementation of spinal anesthesia to reduce post-operative analgesic requirements: a prospective, randomized, double-blind, controlled trial in patients undergoing major orthopedic surgery. *Acta anaesthesiologica scandinavica*. 2007;51(4):482-9.
2. Begon S, Pickering G, Eschalier A, Dubray C. Magnesium increases morphine analgesic effect in different experimental models of pain. *The Journal of the American Society of Anesthesiologists*. 2002;96(3):627-32.
3. Bilir AY, Gulec S, Erkan A, Ozcelik AB. Epidural magnesium reduces postoperative analgesic requirement. *British journal of anaesthesia*. 2007;98(4):519-23.
4. Buvanendran A, Kroin JS. Useful adjuvants for postoperative pain management. *Best practice & research Clinical anaesthesiology*.

- 2007;21(1):31-49.
5. Dubé L, Granry JC. The therapeutic use of magnesium in anesthesiology, intensive care and emergency medicine: a review. *Canadian journal of anaesthesia*. 2003 ;50(7):732-46.
6. Garg R, Banwait S, Pawar M, Sharma S, Sood R. Evaluation of single epidural bolus dose of magnesium as an adjuvant to epidural fentanyl for postoperative analgesia: a prospective, randomized, double-blind study. *Saudi J Anaesth* 2012; 6: 273-8.
7. Garimella V, Cellini C. Postoperative pain control. *Clinics in colon and rectal surgery*. 2013;26(03):191-6.
8. Ghatak T, Chandra G, Malik A, Singh D, Bhatia VK. Evaluation of the effect of magnesium sulphate vs. clonidine as adjunct to epidural bupivacaine. *Indian journal of anaesthesia*. 2010;54(4):308.
9. Ginosar Y, Riley ET, Angst MS. The site of action of epidural fentanyl in humans: the difference between infusion and bolus administration. *Anesthesia & Analgesia*. 2003;97(5):1428-38.
10. Joshi GP, Ogunnaike BO. Consequences of inadequate postoperative pain relief and chronic persistent postoperative pain. *Anesthesiology Clinics of North America*. 2005;23(1):21-36.
11. Katz J, Melzack R. Measurement of pain. *Surgical Clinics of North America*. 1999;79(2):231-52.
12. Kogler J, Karaman-Ilić M, Hrabač P, Perić M, Bekavac-Mišak V. Effects of epidural magnesium sulphate on intraoperative sufentanil and postoperative analgesic requirements in thoracic surgery patients. *Signa vitae: journal for intensive care and emergency medicine*. 2016;11(1):56-73.
13. McKeown JL. Pain management issues for the geriatric surgical patient. *Anesthesiology Clinics*. 2015;33(3):563-76.
14. Pinard AM, Donati F, Martineau R, Denault AY, Taillefer J, Carrier M. Magnesium potentiates neuromuscular blockade with cisatracurium during cardiac surgery. *Canadian journal of anaesthesia*. 2003;50(2):172-8.
15. Qian M, Gao F, Liu J, Xu P. Dexmedetomidine versus fentanyl as adjuvants to ropivacaine for epidural anaesthesia: a systematic review and meta-analysis. *International Journal of Clinical Practice*. 2021;75(5):e13772.
16. Rawal N, Holmström B, Crowhurst JA, Van Zundert A. The combined spinal-epidural technique. *Anesthesiology Clinics of North America*. 2000;18(2):267-95.
17. Riker RR, Picard JT, Fraser GL. Prospective evaluation of the Sedation-Agitation Scale for adult critically ill patients. *Critical care medicine*. 1999;27(7):1325-9.
18. Santhisree M, Krishnaprasad P, Sowbhagyalakshmi B, Babji SN. Evaluation of single epidural bolus dose of magnesium sulphate as an adjuvant to fentanyl for postoperative analgesia in orthopaedic hip surgeries. *Journal of evolution of medical and dental sciences*. 2014;3(27):7581-8.
19. Shevchuk, V., Vlasova, O., Zaika, V., Morgun, V., & Kaliuzhna, Y. (2022). Psychological and pedagogical support for the quality of life of persons with disabilities. *International Journal of Health Sciences*, 6(2), 1108–1122. <https://doi.org/10.53730/ijhs.v6n2.11330>
20. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). Health and treatment of diabetes mellitus. *International Journal of Health Sciences*, 5(1), i-v. <https://doi.org/10.53730/ijhs.v5n1.2864>

21. Widana, I. K., Sumetri, N. W., & Sutapa, I. K. (2018). Effect of improvement on work attitudes and work environment on decreasing occupational pain. *International Journal of Life Sciences*, 2(3), 86–97. <https://doi.org/10.29332/ijls.v2n3.209>
22. Woolf CJ, Thompson SW. The induction and maintenance of central sensitization is dependent on N-methyl-D-aspartic acid receptor activation; implications for the treatment of post-injury pain hypersensitivity states. *Pain*. 1991;44(3):293-9.