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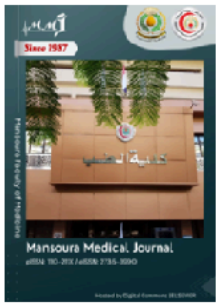

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The effect of adding magnesium sulphate versus dexmedetomidine as an adjuvant to bupivacaine in ultrasound rectus sheath block on postoperative analgesia in patients undergoing abdominal aortic surgery

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ORIGINAL STUDY

The Effect of Adding Magnesium Sulfate Versus Dexmedetomidine as an Adjuvant to Bupivacaine in Ultrasound Rectus Sheath Block on Postoperative Analgesia in Patients Undergoing Abdominal Aortic Surgery

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Abstract

Background: **With significant advancements in the area, postoperative pain management after abdominal procedures has garnered attention lately. Despite these developments, postoperative pain is still difficult to manage and is sometimes not sufficiently addressed, which causes worry, tension, and discontent in the patient. In addition to having negative medical impacts, inadequate pain management may also have negative psychological, economic, and societal repercussions.**

Aim and objectives: **To assess the analgesic impacts of dexmedetomidine against magnesium sulfate when used as a bupivacaine adjuvant during ultrasound-guided bilateral rectus sheath block during abdominal aortic surgery.**

Patients and methods: **Over the course of 5 months, 40 research participants were split into two groups and the study was conducted at the Vascular Surgery Center at Mansoura University using a prospective, randomized, double-blind methodology.**

Results: **Regarding baseline data and problems, there were no statistically substantial variations between the two groups under study. The two groups under study differed significantly as regards the length of operation, sensory perception, motor block, and visual analog scale score.**

Conclusion: **When magnesium sulfate or dexamethasone is added to bupivacaine 0.5 % in ultrasound rectus sheath block for patients undergoing abdominal aortic surgery, the effects are more rapid in terms of onset, duration, postoperative analgesia, and reduction in the need for rescue analgesia − all without raising the risk of side impacts. Dexamethasone demonstrated superior outcomes in this regard.**

Keywords: Abdominal aortic surgery, Dexmedetomidine, Magnesium sulfate, Postoperative analgesia

1. Introduction

With significant advancements in the area, postoperative pain management after abdominal procedures has garnered attention lately. Despite these developments, postoperative pain is still difficult to manage and is sometimes not sufficiently addressed, which causes worry, tension, and discontent in the patient. Inadequate pain management may have negative physiological consequences in addition to negative psychological, economic, and societal repercussions (Kehlet, 2004; White and Kehlet, 2010).

Severe stomach discomfort after major abdominal procedures involving incisions in the abdomen may result in atelectasis, retention of secretions, shallow breathing, and resistance to physiotherapy if the condition is not well-managed (Apfelbaum et al., 2003). This causes a delay in recovery and raises the risk of postoperative morbidity. Many procedures,

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such as epidural catheter analgesia, transverse abdominus plane block, local wound infiltration, patient-controlled analgesia, and peripheral nerve blocks, were utilized to minimize this severe post-operative pain in addition to the systemic use of NSAIDS or opioids (Lassen et al., 2009).

One of these localized methods after abdominal surgery analgesia is the rectus sheath block (Azmati and Khosravi, 2005).

For both intraoperative and postoperative analgesia, magnesium sulfate has been utilized as an adjuvant to local analgesics and anesthetic drugs. Numerous studies have shown the effectiveness of magnesium infusions at a modest dose for reducing the need for postoperative analgesics during surgery and in the recovery phase. Furthermore, it impedes the release of presynaptic acetylcholine and competes with calcium ions at synaptic connections, extending the duration of neuromuscular blocker drugs' actions (Jee et al., 2009).

A highly selective a2-adrenoceptor agonist dexmedetomidine was only recently used in anesthesia. It causes anxiolysis, dose-dependent sedation, and analgesia (including the supraspinal and spinal sites) without depressing breathing (Virtanen et al., 1988).

This research compared the analgesic impacts of dexmedetomidine and magnesium sulfate when used as an adjuvant to bupivacaine during ultrasound-guided bilateral rectus sheath block during abdominal aortic surgery.

2. Patients and methods

This was a 5-month prospective randomized, double-blind research conducted at the Vascular Surgery Center at Mansoura University. The 40 study participants were split into two groups. Group D: 20 patients were administered with 20 ml of isobaric bupivacaine 0.25 % + 1 μg/kg of dexmedetomidine, followed by 5 ml of normal saline. Group M: 20 patients got 500 mg of magnesium sulfate and 20 ml of isobaric bupivacaine 0.25 %.

Publication ethical statement: all patients gave their informed consent for inclusion before they participated in this study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by IRB (MS. R.22.08.1784 at 28/09/2022).

Inclusion criteria: individuals between the ages of 20 and 60 who are scheduled for general anesthesia for abdominal aortic surgery (ASA I–II).

Exclusion criteria: individuals who have had prior abdominal surgery, uncontrolled diabetes or hypertension, significant cardiac disease, mental illness, or allergy to study medications.

2.1. Randomization

By choosing sealed envelopes at random, patients will be split into two groups. Every group was made up of patients. Our trial was blind as no one in the operating room knew the randomization code. Group D: patients will get 5 ml of normal saline along with 20 ml of isobaric buprocaine 0.25 % + 1 μg/kg and 5 ml of dexmedetomidine (Fares et al., 2015). Group M: patients were given 500 mg of magnesium sulfate and 20 ml of isobaric buprocaine (0.25 %) (Jee et al., 2009).

2.2. Technique

The patients were taken to the operating room on the day of the procedure, when a peripheral cannula was placed in an appropriate forearm vein. To reduce their anxiousness, all patients got 5 mg of midazolam intravenously. Frequent hemodynamic monitoring has been associated with heartbeat, noninvasive blood pressure, pulse oximetry, and ECG.

The short-axis in-plane approach was used to complete the rectus sheath block. In a transverse plane, the high-frequency linear probe was positioned lateral to the rectus abdominus muscle's lateral border. The local anesthetic injection site was superficial to the rectus sheath and deep to the rectus abdominus muscle. A 22-G spinal needle was used to provide a single injection to both sides. The needle was progressed from the lateral to the medial after being implanted 3–8 cm lateral to the probe's outer border. The needle entered the rectus abdominus muscle after passing through the lateral b order of the linea semilunaris. The needle continued to advance until it reached the posterior portion of the rectus sheath and the deep surface of rectus abdominus muscle.

Here, a 1–5-ml injection of local anesthetic was given to ensure that the needle was inserted in the proper location by looking for an anechoic fluid collection. The anechoic fluid collection became larger when 20 ml of the drug was administered. In order to verify spreading inside the posterior rectus sheath compartment, the transducer was repositioned in a cephalad-to caudad position after injection.

Intravenous propofol 1–2 mg/kg, fentanyl 1–2 mg/kg, and atracurium 0.5 mg/kg were utilized to initiate general anesthesia. A minimum alveolar concentration of 2 % was maintained in anesthesia with the use of sevoflurane inhalation. Hemodynamics were continuously monitored throughout the whole process. After baseline, heart rate and

mean arterial pressure were determined every 15 min until the procedure was completed. Systolic blood pressure that fell by 20 % or more of the baseline value was known as hypotension, and it was managed with i.v. ephedrine (0.1 mg/kg) and crystalloid infusion (5 ml/kg). Additionally, i.v. atropine (0.2–0.5 mg) was utilized to treat bradycardia, which is known as a heart rate below 50 bpm.

The hospital pharmacy would produce the tested medications in a sterile syringe and provide them to the anesthetist, who was blind to the medicines' identities. Following surgery, patients were sent to the PACU and subsequently the internal ward, where they were closely observed and evaluated. For 2 h after surgery, mean arterial pressure and heart rates were also measured every 15 min. They were asked to use the visual analog scale (VAS), where 10 represented the worst pain they had ever felt and 0 represented no discomfort at all. After surgery, these readings were taken in the PACU, then every 2 h for the first 12 h, and subsequently at 16 and 24 h. i.v. fentanyl (20–30 μg) was started if the patient reported a VAS of four or higher. The whole amount of opioids used after surgery was computed and noted. Any adverse effects linked with opioids, such as vomiting, nausea, and respiratory depression, were noted and documented. Metoclopramide (10 mg) intravenously was used to treat the last two symptoms.

2.3. Statistical analysis

The computer was given data, and IBM SPSS software package, version 20.0, was utilized for analysis (IBM Corp., Armonk, New York, USA). Numbers and percentages were utilized to describe the qualitative data. The dispersion normality was confirmed utilizing the Kolmogorov–Smirnov test. Quantitative variables were described utilizing the words range (minimum and maximum), average, SD, median, and interquartile range. The findings were deemed significant at the 5 % level. The tests that were utilized were the Mann–Whitney (U), Student t test, and χ^2 test.

3. Results

There was no statistical substantial variation between the two researched groups as regards baseline data (Table 1).

There was a high statistically substantial variation between the two studied groups regarding duration of surgery (Table 2).

Table 1. Comparison between studied cases as regards baseline data.

	Group D ($N = 20$)	Group M ($N = 20$)	Test of significance	P
Age				
Range	58–78	57–79	$t = 0.403$	0.689
Mean ± SD	67.3 ± 6.74	68.1 ± 5.77		
Sex	n (%)	n (%)		
Female	3 (15.0)	5 (25.0)	$\chi^2 = 0.625$	0.429
Male	17 (85.0)	15 (75.0)		
Presentation				
Elective	13 (65.0)	16 (80.0)	$\chi^2 = 1.129$	0.288
Emergency	7 (35.0)	4 (20.0)		
BMI				
Range	21.1–29.2	20.4–29.8	$t = 0.560$	0.579
Mean ± SD	25.18 ± 2.47	25.68 ± 3.14		
Aneurysm diameter				
Range	4.8–7.8	5.1–7.8	$t = 0.309$	0.759
Mean ± SD	6.26 ± 0.79	6.34 ± 0.85		

There were high statistical substantial variations between the two researched groups as regards sensory and motor block (Table 3, Figs. 1 and 2).

There was no statistical substantial variation between the two researched groups as regards complications (Table 4).

There was high statistically substantial variation between the two researched groups regarding VAS score (Table 5).

4. Discussion

These days, a useful method to extend the duration and strength of the block and accelerate its onset is to apply local anesthetics in conjunction with many adjuvants. The use of adjuvants seeks to reduce the overall dose of local anesthetic while achieving excellent block and extending the analgesic effect without generating systemic adverse effects. Adjuncts such as dexamethasone, bicarbonate, magnesium sulfate, clonidine, neostigmine, and opioids have been attempted (Kogler, 2009).

In the present investigation, there was a highly statistically substantial variation in the length of the motor block (h), the duration of the sensory block (h), and the beginning of the block (min) between the two analyzed groups.

Our findings were similar to Xu et al. (2017) who investigated the impact of bupivacaine and dexmedetomidine during rectus sheath block and

Table 2. Comparison between researched cases as regards duration of surgery.

	Group D ($N = 20$)	Group M ($N = 20$)	t	P
Duration of surgery (h)				
Range	2–5	2–5	0.887	0.381
Mean ± SD	3.65 ± 1.14	3.95 ± 1		

Table 3. Comparison between researched cases according to sensory and motor block.

Laboratory investigations	Group D ($N = 20$)	Group M ($N = 20$)	Test of significance	P
Onset of sensory block (min)				
Range	11–15	13–16	$t = 4.320$	<0.001*
Mean ± SD	13.55 ± 1.05	14.95 ± 1		
Onset of motor block (min)				
Range	13–18	18–20	$t = 9.579$	<0.001*
Mean ± SD	15.55 ± 1.57	19.25 ± 0.72		
Duration of sensory block (h)				
Range	15–19	11–18	$t = 3.912$	<0.001*
Mean ± SD	17.3 ± 1.26	15.15 ± 2.11		
Duration of motor block (h)				
Range	13–17	8–13	$t = 10.685$	<0.001*
Mean ± SD	15.3 ± 1.38	10.8 ± 1.28		
Timing of analgesia (h)				
Range	15–19	11–18	$t = 3.912$	<0.001*
Mean ± SD	17.3 ± 1.26	15.15 ± 2.11		
Number of rescue analgesia	n (%)	n (%)		
1	17 (85.0)	0	$\chi^2 = 30.0$	<0.001*
2	3 (15.0)	15 (75.0)		
3	0	4 (20.0)		
4	0	1 (5.0)		

* Means that significance between two groups <0.005.

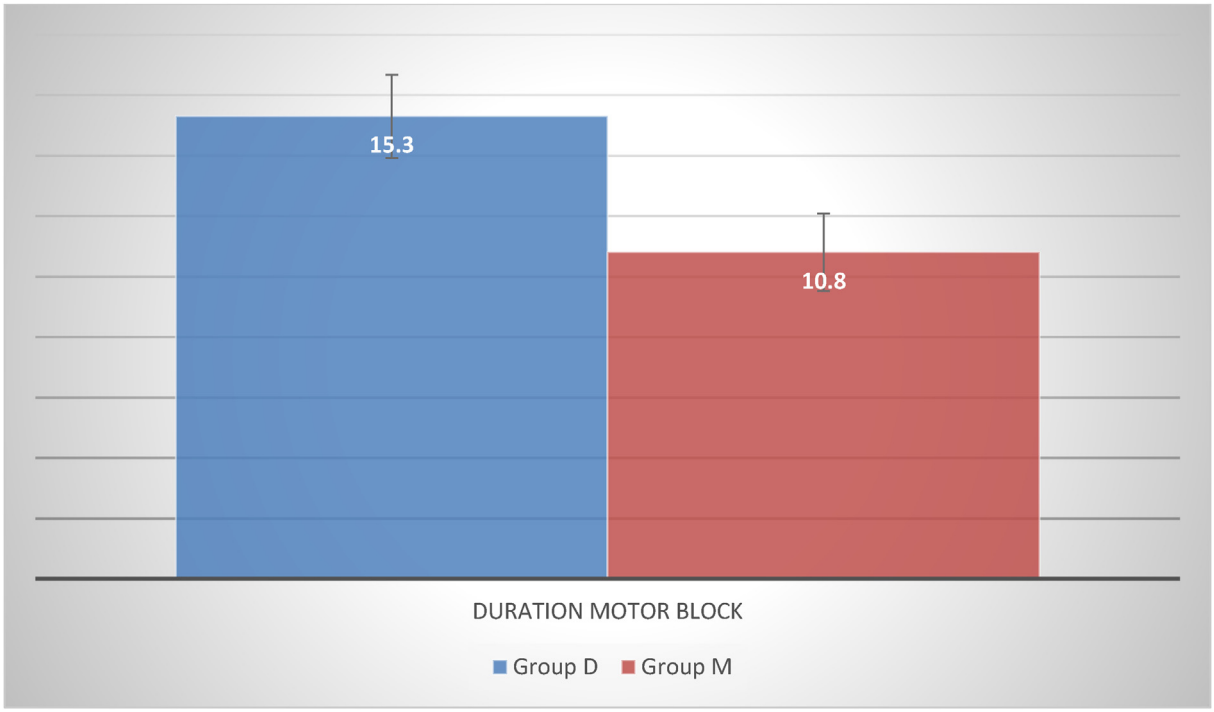

Fig. 1. Comparison between researched cases according to duration of motor block.

transverse abdominus plane block in senior patients undergoing emergency abdominal surgery. Dexmedetomidine delayed the need for rescue analgesia and extended the duration of the sensory blockade.

Similarly, Yousef et al. (2021) found that as regards the start of sensory and motor blocks, the D group was substantially shorter ($P < 0.05$) than the M group and control group. Additionally, the D group had a substantially longer ($P < 0.05$) duration of sensory and motor blocks as well as the time of initial analgesia than the M group or control group.

Between the two groups under study, there was a strongly statistically substantial variation in the number of rescue analgesics and the timing of analgesia in hours.

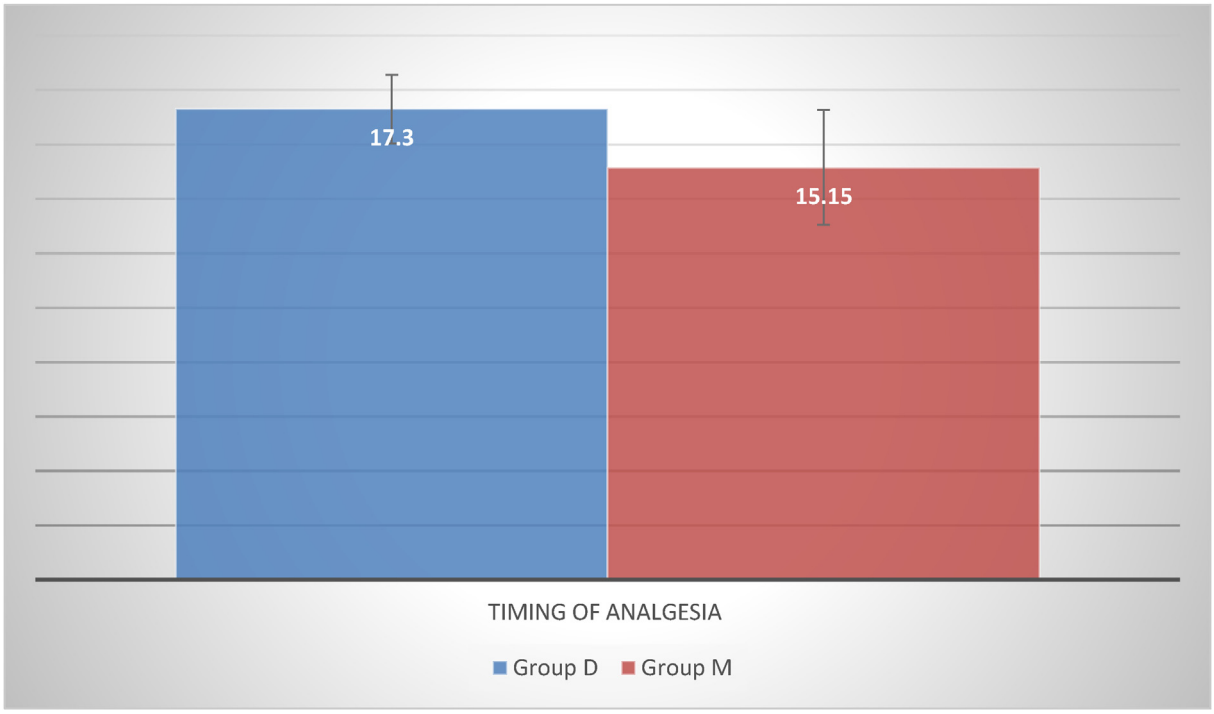

Fig. 2. Comparison between researched cases according to timing of analgesia.

Table 4. Comparison between researched cases as regards complications.

Postoperative ventilation beyond 24 h	Group D ($N = 20$) *n* (%)	Group M ($N = 20$) *n* (%)	Test of significance	*P*
No	7 (35.0)	11 (55.0)	$\chi^2 = 1.616$	0.204
Yes	13 (65.0)	9 (45.0)		
Postoperative ICU stay				
Range	1–5	1–4	$U = 187.5$	0.738
Median (IQR)	2 (2–3)	2 (2–3)		

IQR, interquartile range.

Table 5. Comparison between researched cases as regards visual analog scale score.

VAS score	Group D ($N = 20$)	Group M ($N = 20$)	*U*	*P*
30 min	0 (0–0)	0 (0–0)	–	–
60 min	0 (0–0)	0 (0–0)	–	–
90 min	0 (0–0)	0 (0–0)	–	–
2 h	0 (0–0)	0 (0–0)	–	–
4 h	0 (0–0)	0 (0–0)	–	–
6 h	0 (0–0)	0 (0–0)	–	–
8 h	0 (0–0)	25 (15–30)	0.0	<0.001*
12 h	0 (0–5)	35 (25–40)	0.500	<0.001*
16 h	25 (19–25)	30 (19–36)	136.500	<0.001*
20 h	20 (20–25)	35 (30–40)	10.500	<0.001*
24 h	30 (25–35)	40 (40–45)	52.500	<0.001*

Data are presented as median (IQR).
IQR, interquartile range; VAS, visual analog scale.
* Means that significance between two groups <0.005.

Our findings were in accordance with Luan et al. (2017) who showed that when used in conjunction with local anesthetics, perineural dexmedetomidine extends the duration of peripheral nerve blocks and offers effective postsurgical analgesia.

Similarly, Yousef et al. (2021) found that group D had considerably lower total rescue analgesia and number of rescue analgesia ($P < 0.05$) than M group and control group.

In a research done by Raghavan and Ashraf (2017), the study found that dexamethasone was superior when compared with magnesium sulfate when utilized as additives to local anesthetics in supraclavicular brachial plexus blocks. Three equal groups of ninety patients were created: the control group (S) got 30 ml of local anesthetic solution and

2 ml of normal saline, the dexamethasone group (SD) got the same local anesthetic solution plus 8 mg of dexamethasone, and the magnesium sulfate group (SM) got 30 ml of local anesthetic solution plus 150 mg of magnesium sulfate added to it, bringing the volume of the other groups to the same level. The group that received dexamethasone (SD) had the longest duration of analgesia, followed by group SM and group S.

Regarding complications, there were no statistical substantial variations between the two groups under investigation.

Our findings were supported by Yousef et al. (2021) who found that regarding problems such as pneumothorax, Horner's syndrome, or systemic toxicity from local anesthetics, none of the patients in either group had encountered any adverse effects or complications related to the anesthetic procedure or the medications administered.

Furthermore, Abd Al-Salam et al. (2018) previously cited research revealed no issues across the study groups.

Regarding the displayed VAS score, there was a substantial statistically important variance among the two analyzed groups.

Similarly, Yousef et al. (2021) found that VAS was comparable until the seventh hour, when it began to rise, particularly in the control group, where it was substantially greater than in the other groups, with the M group following. Finally, the D group considerably outperformed the M group and the control group at 20 and 24 h.

4.1. Conclusion

In patients undergoing abdominal aortic surgery, the addition of either dexamethasone or magnesium sulfate to bupivacaine 0.5 % in ultrasound rectus sheath block shortened the time it took for sensory and motor blocks to occur, raised postoperative analgesia, and reduced the need for rescue analgesia – all without raising the risk of side impacts. Dexamethasone demonstrated superior outcomes.

Conflict of interest

The author declare herby that the study did not receive any form of financial support but as the study was done in vascular surgery center Faculty of medicine and all equipment from this center.

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Registration number: This paper was registered in Institutional Research Board (IRB) with a number R.22.08.1784 at 28/09/2022.

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