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Original Article

Anaesthesia Section

Effects of Magnesium Sulphate, Dexmedetomidine and Lignocaine on Perioperative Haemodynamic and Postoperative Analgesia in Patients undergoing Laparoscopic Abdominal Surgeries: A Randomised Clinical Study

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ABSTRACT

Introduction: Laparoscopic surgeries currently represent the mainstay of surgical modalities. Pneumoperitoneum imposes significant intraoperative haemodynamic alterations, which are more pronounced in elderly patients and those with co-morbid conditions. Inadequate pain relief in the perioperative period may result in various physiological and psychological traumas.

Aim: To investigate the effects of magnesium sulphate, dexmedetomidine, and lignocaine on the haemodynamic responses and postoperative analgesia in patients undergoing laparoscopic abdominal surgeries.

Materials and Methods: This double-blinded, randomised clinical study was conducted in the general surgery operation theatre, Post-anaesthetic Care Unit (PACU), and the male and female surgery ward of RG Kar Medical College and Hospital, Kolkata, West Bengal, India from March 1, 2021, to March 1, 2022. The study involved 105 subjects assigned to Group-L, who received an injection of lignocaine as a loading dose of 1.5 mg/kg intravenously over 2-4 minutes before induction, followed by a continuous infusion of 2 mg/kg/hour throughout the surgery. Group-M received a loading dose of $MgSO_4$ at 30 mg/kg over 15 minutes before induction, followed by 15 mg/kg/hour throughout the surgery, and Group-D received a loading dose of dexmedetomidine at 1 mcg/kg over 10 minutes before induction, followed by a continuous infusion of 0.5 mcg/kg/min throughout the surgery. Data on Heart Rate (HR), Mean Arterial Pressure (MAP), and the total dose of rescue analgesic administered in the postoperative 24 hours were recorded and analysed using Analysis of Variance (ANOVA) and Tukey's Honestly Significant Difference (HSD) test, as well as the Chi-square test where applicable. A p-value of less than 0.05 was considered statistically significant.

Results: The groups were comparable in terms of demographic variables and baseline haemodynamic status. The average age in Group-D was 39.13±9.48 years, in Group-M was 37.30±8.14 years, and in Group-L was 36.5±7.2 years (p=0.26). Group-D had 60% males, Group-M had 57% males, and Group-L had 60% males. The mean Body Mass Index (BMI) of Group-D was 25.9±2.03 (kg/m^2), Group-L (Lignocaine) was 24.7±2.7, and Group-M (Magnesium Sulphate) was 23.8±3.2. Dexmedetomidine was found to be superior in maintaining haemodynamic stability throughout the perioperative period (Preinduction HR: Group-D=79.43, Group-L=79.06, Group-M=82.09; Postinduction HR: Group-D=86.49, Group-M=65.91, Group-L=72.69). There was a significant decrease in postintubation MAP, most pronounced in the Magnesium Sulphate and Dexmedetomidine groups. Post-pneumoperitoneum, the surge in MAP was most effectively prevented by Dexmedetomidine. The lowest amount of rescue analgesic (injection Diclofenac in mg) was used in the Dexmedetomidine group (55.86±5.05), followed by the Lignocaine group (126.43±17.69). Patients in the Magnesium group required the highest amount of rescue analgesic (156.43±7.91). The number of patients receiving rescue analgesia was significantly higher in the Lignocaine and Magnesium Sulphate groups (Group-D: 6.5±3.14565, Group-L: 14.75±7.36, Group-M: 18.25±8.057).

Conclusion: Dexmedetomidine was more effective in maintaining haemodynamic stability throughout the perioperative period and exhibited superior postoperative analgesic properties. Magnesium Sulphate and lignocaine were more effective in preventing postintubation surges.

Keywords: Cardiovascular response, Elderly, Laryngoscopy, Pneumoperitoneum, Tracheal intubation

INTRODUCTION

Although laparoscopic abdominal surgeries offer significant advantages, such as reduced trauma and quicker recovery, managing pneumoperitoneum-induced haemodynamic changes, such as a sudden increase in arterial blood pressure and Systemic Vascular Resistance (SVR), remains challenging for anaesthesiologists during surgery [1,2]. These haemodynamic alterations are triggered by elevated levels of vasopressin, catecholamines, renin, and angiotensin produced due to increased intra-abdominal pressure during pneumoperitoneum, and can substantially impact the patient's perioperative cardiovascular status, particularly in those with pre-existing cardiovascular conditions [3-6]. Conversely, postoperative pain plays a crucial role in postoperative recovery. Insufficient pain relief during the perioperative period can lead to various physiological and psychological traumas, prolonging hospital stays, and thus necessitates effective management [7,8]. Therefore, it is crucial to implement safe and effective strategies to uphold haemodynamic stability and manage postoperative pain

during abdominal laparoscopic surgeries [7,8]. Various drugs have been explored for mitigating the haemodynamic response induced by pneumoperitoneum, including alpha$_2$ agonists, inhalation agents, opioids, beta-blockers, and Glyceryl Trinitrate (GTN) [9].

Lignocaine, an amide-type local anaesthetic, blunts the cardiovascular response to laryngoscopy and tracheal intubation [5]. Perioperative lignocaine infusion has shown to alleviate postoperative pain in various open abdominal and laparoscopic procedures [10]. Magnesium sulphate, a non competitive N-Methyl-D-Aspartate (NMDA) receptor blocker, inhibits the release of catecholamines and vasopressin and directly affects blood vessels, dampening the vasopressor response triggered by intubation [11]. Studies have indicated that magnesium administration significantly reduces fentanyl consumption in the perioperative and postoperative periods [11-13]. Dexmedetomidine, a full adrenoceptor agonist, enhances intraoperative haemodynamic stability, attenuates sympathoadrenal responses to laryngoscopy and tracheal intubation, reduces the intraoperative requirement of anaesthetic agents, and alleviates postoperative pain [14,15]. However, limited research has directly compared all three drugs. Some studies have compared the intraoperative effects of two out of these three drugs on haemodynamic changes induced by pneumoperitoneum with varying outcomes [3,5,8]. Therefore, considering the perioperative haemodynamic effects and analgesic properties of the test drugs Dexmedetomidine, Magnesium sulphate, and Lignocaine as evidenced in previous studies [3,5,7,8], the authors aimed to compare the effectiveness of these drugs on the haemodynamic profile and postoperative analgesia in patients undergoing laparoscopic abdominal surgeries under general anaesthesia.

MATERIALS AND METHODS

This double-blinded, randomised clinical study was conducted in the general surgery operation theatre, Post-anaesthetic Care Unit (PACU), and the male and female surgery ward of RG Kar Medical College and Hospital, Kolkata, West Bengal, India, from March 1, 2021, to March 1, 2022. Patients were included in the study only after receiving clearance from the Institutional Ethical Committee (RKC/296, Date: 21.02.2021) and obtaining written informed consent from patients who were fully briefed on the study procedure. However, participants were not informed about the group distribution or which drug would be administered to them.

The primary objective of the present study was to observe and compare the changes in haemodynamic parameters perioperatively with the administration of different test drugs within the assigned groups. The secondary objectives were to evaluate and compare the effectiveness of the test drug in reducing postoperative analgesic requirements and to record the incidence of any perioperative adverse effects.

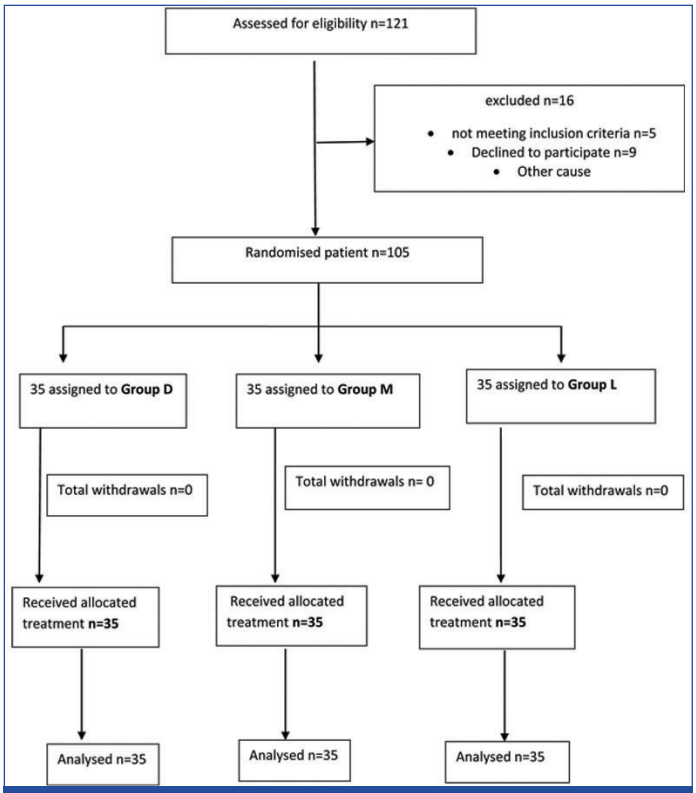
Sample size calculation: Based on a previously published study by Ismail MA et al., with HR as the primary outcome, the Standard Deviation (SD) used was 6.5, and the size of the difference obtained was 4.46 [3]. Assuming a p-value less than 0.05 to be significant and considering the effect to be two-sided, we obtained Z_α=1.96. Assuming a power of the present study to be 80%, we obtained $Z_{1-\beta}$=0.84. We determined the sample size using the formula:

$$n=\frac{2*(Z_\alpha+Z_{1-\beta})^2*SD^2}{D^2}=\frac{2*(1.96+0.84)^2*6.5^2}{4.46^2}=33.3.$$

Thus, the authors obtained n=33, and therefore, we enrolled 35 patients in each group.

Inclusion criteria: Patients classified as American Society of Anesthesiologists (ASA) grade I and II, aged between 18 and 60 years, undergoing elective laparoscopic surgery under general anaesthesia.

Exclusion criteria: Patients with uncontrolled hypertension, diabetes mellitus, hepatic/renal/cardiovascular diseases (including cardiac conduction defects), morbid obesity, pregnancy, anticipated major blood losses and fluid shifts, those regularly taking beta blockers, α_2 adrenergic agonists, sedatives, psychoactive medications, or with allergies to any of the study drugs. A total of 105 patients meeting the inclusion criteria were enrolled in the study and randomly allocated to one of the three study groups (Group-L, Group-M, and Group-D) using a computer-generated randomisation table, with 35 patients in each group. Nine patients were excluded from the study [Table/Fig-1].



[Table/Fig-1]: Trial Profile {Consolidated Standards of Reporting Trials (CONSORT)}.

Study Procedure

Group-L received a loading dose of Lignocaine 1.5 mg/kg slow i.v. over 2-4 minutes before induction, followed by 2 mg/kg/hour throughout the surgery [6]. Group-M received a loading dose of $MgSO_4$ 30 mg/kg over 15 minutes before induction, followed by 15 mg/kg/hour throughout the surgery [16]. Group-D received a loading dose of Dexmedetomidine 1 mcg/kg over 10 minutes before induction, followed by 0.5 mcg/kg/min throughout the surgery [17].

Patients were taken into the operation theatre and monitored according to American Society of Anaesthesiologists (ASA) standard monitoring guidelines. Baseline Electrocardiogram (ECG), Saturation of Peripheral Oxygen (SpO_2), HR, and MAP values were recorded. Loading doses of the test drugs were administered accordingly. After preoxygenating the patients for three minutes with 100% O_2, injection Fentanyl citrate 1 µg/kg Intravenous (i.v.) was given. Anaesthesia was induced by injection Propofol 1-2 mg/kg. Endotracheal intubation was facilitated by injection Rocuronium (1.2 mg/kg). Anaesthesia was maintained by Air+Oxygen (50%+50%) along with a Propofol infusion started at a rate of 10 mg/kg/hour. Maintenance doses of the test drug infusion were initiated. Muscle relaxation was achieved by intermittent bolus doses of injection Rocuronium (0.15 mg/kg). Pneumoperitoneum with CO_2 was established and maintained at a pressure of 12 mmHg throughout the laparoscopic surgery using an automatic insufflation unit. Ventilation was mechanically controlled. A tidal volume of 6-8 ml/kg lean body weight and positive end-expiratory pressure of 4-6 mmHg were set to maintain an end-tidal carbon dioxide tension of 30-35 mmHg. Active and passive warming strategies were used to keep patients normothermic. Neuromuscular blockade was reversed by injection Neostigmine (0.05 mg/kg) Glycopyrrolate (0.02 mg/kg), and tracheal extubation was performed. After extubation, the test drug infusion was stopped.

Following the operation, patients were transferred to the recovery room, and physiological recovery from anaesthesia was evaluated every five minutes using the modified Aldrete score until ready for discharge (score of 9 or more) from the recovery room. Whenever the Visual Analogue Scale (VAS) score was more than 4 or the patient requested analgesia, the rescue analgesic drug injection Diclofenac Sodium aqueous 75 mg was administered i.v. over a period of 15-20 minutes. Bradycardia (if HR persisted <40 beats/minute) was treated with injection Atropine (1 mg), hypotension (MAP <20% of the baseline) was managed by fluid boluses followed by i.v. phenylephrine bolus dose of 50 mcg (titrated to patient response), and hypertension (MAP >20% of the baseline despite adequate analgesia and depth of anaesthesia) was managed with i.v. Glyceryl Trinitrate (GTN) at titrated doses. Data regarding HR, MAP, and SpO_2 were recorded at baseline, after the test drug administration, after induction, five minutes after intubation, and throughout the pneumoperitoneum (i.e., starting from the creation of pneumoperitoneum, 15 minutes after, 30 minutes after, 45 minutes after, 60 minutes after, and 75 minutes after). The total dose of rescue analgesic administered in the postoperative 24 hours (mg) and VAS scores (at 30 minutes, 4 hours, 12 hours, 24 hours after the surgery) were also noted. The anaesthesiologist who recorded the data was unaware of the composition of the study drug administered.

STATISTICAL ANALYSIS

The data were entered into a Microsoft Excel Spreadsheet and then analysed using Statistical Package for Social Sciences (SPSS) version 24. The data were summarised as mean and SD for numerical variables and count and percentages for categorical variables. Comparisons among the three groups were conducted using the ANOVA test and Tukey's HSD test, and the Chi-square test was applied where applicable. A p-value of <0.05 was considered statistically significant.

RESULTS

The study groups were comparable in terms of age, sex, BMI, and ASA status. A male preponderance was observed in the present study subjects. Although ASA statuses were comparable within the three groups, the majority of the study population belonged to ASA class-1 [Table/Fig-2]. The study groups were also comparable in terms of baseline SpO_2 [Table/Fig-2], and no abnormalities were detected in the baseline ECG of the study subjects. There were no incidences of any adverse events in the study groups.

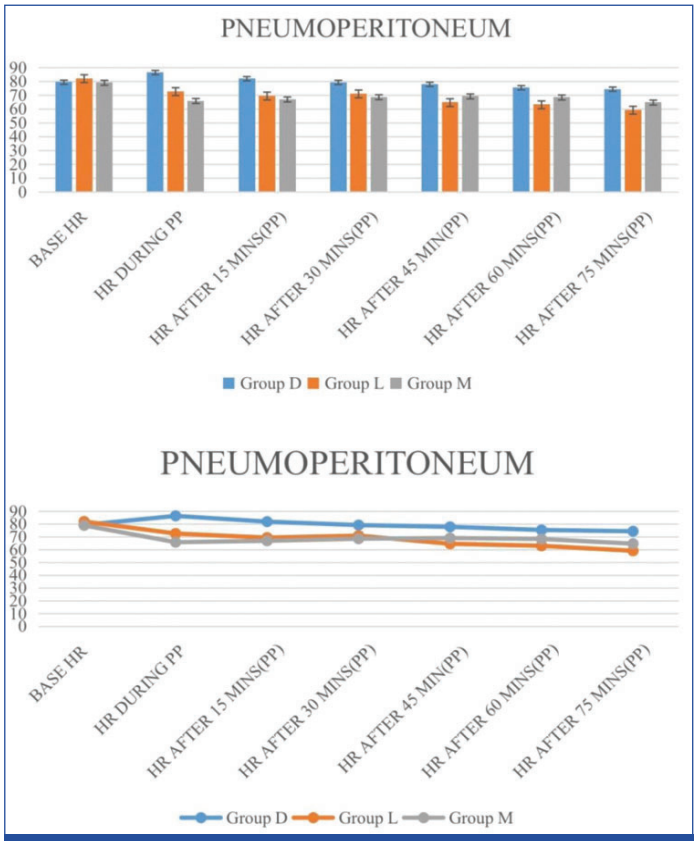
Characteristics		Group-D	Group-M	Group-L	p-value
Age (years) Mean±SD		**39.13±9.48**	**37.30±8.14**	**36.5±7.2**	**0.26**
Sex n (%)	Female	14 (40)	15 (42.8)	14 (40)	0.94
	Male	21 (60)	20 (57.2)	21 (60)	
BMI (kg/m^2) Mean (SD)		25.9 (2.03)	24.7 (2.7)	23.8 (3.2)	0.94
ASA Grade	ASA 1	21	20	22	0.97
	ASA 2	14	15	13	
SpO_2 (%)		98.37 (1.19)	99.51 (1.03)	99.45 (1.01)	0.86

[Table/Fig-2]: Patients' baseline characteristics.
*One-way ANOVA for Age; Chi-square test for Sex; Independent t-test for BMI, and Chi-square test for ASA Grade

A picture of the trend of HR for the three groups of drugs throughout the pneumoperitoneum, starting from the creation of pneumoperitoneum, 15 minutes after, 30 minutes after, 45 minutes after, 60 minutes after, and 75 minutes after is presented in [Table/Fig-3,4]. [Table/Fig-3,4] show that HR decreased from the baseline after administering a bolus dose of the test drug in all three groups. This change was statistically significant in the Dexmedetomidine and Lignocaine groups, and not statistically significant in the Magnesium group. Postinduction, a decrease in HR was statistically

Time interval	Group-D	Group-M	Group-L	p-value (Preop vs different time interval)		
Baseline	79.43	82.09	79.06	Group-D	Group-M	Group-L
After bolus dose	75.65	81.06	67.23	<0.001**	0.48	<0.001**
After induction	69.85	74.8	63.11	<0.001**	<0.001**	<0.001**
After intubation	94.31	75.11	60.6	<0.001**	<0.001**	<0.001**
During pneum-operitoneum	86.49	72.69	65.91	<0.001**	<0.001**	<0.001**
P15	82	69.49	67	<0.001**	0.19	<0.001**
P30	79.31	71.03	68.63	<0.001**	0.30	<0.001**
P45	77.91	64.71	69.2	<0.001**	0.01*	<0.001**
P60	75.49	63.11	68.63	<0.001**	0.003*	<0.001**
P75	74.46	59.23	64.77	<0.001**	<0.001**	<0.001**

[Table/Fig-3]: Changes in HR (bpm) at various time intervals in three groups.
*ANOVA, post-hoc Tukey HSD; P15,30,45: 15 min, 30 min, 45 min after pneumoperitoneum; p-value <0.05: statistically significant. p<0.001** statistically highly significant



[Table/Fig-4]: Variation of HR from baseline up to 75 minutes after pneumoperitoneum.

significant in all three groups. Postintubation, HR significantly decreased in the Magnesium and Lignocaine groups, but there was a significant increase in HR in the Dexmedetomidine group. During pneumoperitoneum, HR significantly decreased in Group-L and Group-M, whereas in Group-D, HR significantly increased, and then there was a stable trend of HR throughout the surgery.

The variation of MAP among the three groups (D, L, and M) starting from baseline and throughout pneumoperitoneum at intervals of 15 minutes up to 75 minutes after pneumoperitoneum is depicted in [Table/Fig-5]. Post-test drug bolus and postintubation MAP were lower than baseline in all three groups, but in Group-L, the difference was not statistically significant. During pneumoperitoneum, there was a significant decrease in MAP in Group-D and Group-L, but no change was seen in Group-M. Dexmedetomidine had the most stable MAP near the baseline during pneumoperitoneum followed by Lignocaine and then Magnesium Sulphate.

Time interval	Group-D (n=35)	Group-L (n=35)	Group-M (n=35)	p-value		
				D vs L	L vs M	M vs D
Preoperative	91.11±10.69	89.03±7.46	90.52±9.64	0.398	0.827	0.515
After study drug administration	89.21±8.92	80.97±6.17	85.28±7.94	<0.001**	0.083	0.024*
After induction	84.14±7.89	75.41±6.94	81.24±8.53	<0.001**	0.188	<0.05*
After intubation	109.07±9.31	91.24±9.52	101.55±10.02	<0.001**	<0.05	<0.001**
During Pneumoperitoneum	110.9±7.09	97.26±8.92	117.78±8.63	<0.001**	<0.04	<0.01*
P 15	104.04±8.61	85.21±7.95	98.07±7.61	<0.001**	<0.05*	<0.001**
P 30	102.11±7.84	86.10±8.12	96.14±7.91	<0.001**	<0.05*	<0.001**
P 45	100.96±8.4	84.07±8.5	97.10±6.60	<0.001**	0.059	<0.001**
P 60	91.23±6.85	102.94±4.43	102.8±5.84	<0.001**	0.994	<0.001**
P 75	90.33±2.27	100.46±3.23	104±2.58	<0.001**	0.007*	<0.001**

[Table/Fig-5]: Changes in MAP at various time intervals in three groups.
*ANOVA, post-hoc Tukey HSD; P15,30,45: 15 min, 30 min, 45 min after pneumoperitoneum; p-value <0.05: statistically significant. p<0.001** statistically highly significant

There was no statistically significant difference in SpO_2 in the perioperative period among the study groups as shown in [Table/Fig-6].

The information about the number of patients receiving rescue analgesia among the three groups at four intervals of time: 30 minutes, 4 hours, 12 hours, and 24 hours postoperatively is provided in [Table/Fig-7]. Here, the authors observed that the number of patients requiring rescue analgesia was highest in the Magnesium Group followed by the Lignocaine Group. The minimum number of patients requiring rescue analgesia was seen in the Dexmedetomidine Group. The differences were statistically significant (p-value <0.05 in all three groups).

Time interval	Group-D	Group-M	Group-L	p-value
Baseline	98.37 (1.19)	99.51 (1.03)	99.45 (1.01)	0.86
After study drug administration	99.94 (0.06)	99.91 (0.08)	99.94 (0.06)	0.86
After induction	99.94 (0.06)	99.91 (0.08)	99.94 (0.06)	0.86
After intubation	99.94 (0.06)	99.94 (0.06)	99.94 (0.06)	1
Start of Pneumoperitoneum	99.89 (0.10)	99.94 (0.06)	99.91 (0.14)	0.75
P 15	99.91 (0.08)	99.94 (0.06)	99.91 (0.14)	0.9
P 30	99.91 (0.08)	99.91 (0.08)	99.94 (0.06)	0.88
P 45	99.89 (0.10)	99.86 (0.12)	99.89 (0.16)	0.93
P 60	99.86 (0.18)	99.94 (0.06)	99.94 (0.11)	0.49
P 75	99.86 (0.18)	99.89 (0.10)	99.89 (0.16)	0.94

[Table/Fig-6]: Changes in SpO_2 at various time intervals in three groups.
*One-way ANOVA; p-value <0.05: statistically significant; p<0.001** statistically highly significant

The VAS scores estimated in each group at 30 minutes, 4 hours, 12 hours, and 24 hours in the postoperative period is depicted in [Table/Fig-8]. It was observed that the lowest VAS Score was seen in the Dexmedetomidine group. Lignocaine gave an intermediate picture, and the Magnesium Sulphate group had the highest VAS Score, with the result being statistically significant.

The total analgesic used in the postoperative period among the three groups is compared in [Table/Fig-9]. It shows that the least amount of rescue analgesic was used in the Dexmedetomidine group followed by the Lignocaine group. Patients in the Magnesium group required the maximum amount of rescue analgesic. The differences between the groups in terms of postoperative analgesic usage were statistically significant.

The modified Aldrete score in the three study groups at five minutes and 10 minutes in the postoperative period is depicted in [Table/Fig-10]. Although there were some statistically significant differences between the study groups in terms of postoperative modified Aldrete score at five minutes and 10 minutes, the differences were not clinically significant.

DISCUSSION

Laparoscopic surgeries are currently the mainstay of surgical modality in certain types of surgeries. The pneumoperitoneum imposes greater physiological challenges such as intraoperative haemodynamic alterations, which are more pronounced in elderly patients and patients with co-morbid conditions [18-20]. Postoperative pain is an important factor in postoperative recovery.

Time interval	Group-D	Group-L	Group-M	p-value (Total no. of patients)		
				D vs L	L vs M	M vs D
30 minutes	6	10	13	<0.001**	0.062	<0.001**
4 hours	10	22	27			
12 hours	8	20	23			
24 hours	2	27	10			
Total (Mean±SD)	6.5±3.14	14.75±7.36	18.25±8.06			
p-value	<0.001	<0.001	<0.001			

[Table/Fig-7]: Number of patients requiring rescue analgesia over 24 hours.
*One-way ANOVA, post-hoc Tukey HSD; p-value <0.05: statistically significant; p<0.001** statistically highly significant

Time interval	Group-D (Mean±SD)	Group-L (Mean±SD)	Group-M (Mean±SD)	p-value			
					D vs L	L vs M	M vs D
VAS at 30 min	2.83±0.71	3.31±0.58	2.66±0.59	<0.001**	0.003*	<0.001**	0.003*
VAS at 4 hours	3.2±0.58	3.89±0.58	3.89±0.58	<0.001**	<0.0001	1.00	<0.001**
VAS at 12 hours	3.14±0.55	3.57±0.61	3.51±0.61	0.006*	0.003*	0.68	0.01*
VAS at 24 hours	2.54±0.61	3.2±0.58	3.2±0.58	<0.001**	<0.001**	<0.001**	<0.001**

[Table/Fig-8]: Comparison between VAS scores at different time intervals.
*One-way ANOVA, post-hoc Tukey HSD; p-value <0.05: statistically significant; p<0.001** statistically highly significant

Group	Dose of analgesic required (mg) Mean(SD)	p-value		
		D vs L	D vs M	L vs M
Group-D	55.86 (5.05)	<0.001**	<0.001**	<0.001**
Group-L	126.43 (17.69)			
Group-M	156.43 (7.91)			

[Table/Fig-9]: Comparison of total analgesics used in the postoperative period. *One-way ANOVA, post-hoc Tukey HSD; p-value <0.05: statistically significant; p<0.001** statistically highly significant

	Group-D	Group-M	Group-L	D vs M	D vs L	M vs L
Postop 5 min	8.97 (0.38)	8.8 (0.41)	9.51 (0.5)	0.23	<0.001**	<0.001**
Postop 10 min	9.82 (.38)	9.31 (0.47)	9.85 (0.35)	<0.001**	0.845	<0.001**

[Table/Fig-10]: Comparison of modified Aldrete score among the study groups. *One-way ANOVA, post-hoc Tukey HSD, Independent t-test, p-value <0.05: statistically significant; p<0.001** statistically highly significant

Inadequate pain relief in the perioperative period can lead to various physiological and psychological traumas, resulting in an increased duration of hospital stay and should therefore be effectively managed [21]. Therefore, considering the perioperative haemodynamic effects and analgesic properties of the test drugs dexmedetomidine, magnesium sulphate, and lidocaine as researched in previous studies [3,5,15], we compared the effectiveness of these drugs on the haemodynamic profile and postoperative analgesia in patients undergoing laparoscopic abdominal surgeries under general anaesthesia.

In the present study, during pneumoperitoneum, the surge in MAP was most effectively prevented by Dexmedetomidine, followed by Lidocaine and Magnesium Sulphate. Throughout the surgery, Dexmedetomidine was found to be the superior drug compared to Magnesium Sulphate and Lidocaine in maintaining a stable MAP near the baseline. There was a significant decrease in HR after the administration of the bolus dose of the test drug. There was a significant decrease in HR post-test drug bolus dose, with the most pronounced effect seen in the Magnesium Sulphate and Dexmedetomidine groups, while no change was observed in the Lidocaine group. Postinduction, there was a significant decrease in HR across the groups, with Magnesium Sulphate showing the most significant decline. After intubation, Lidocaine and Magnesium Sulphate were shown to be superior in maintaining HR stability. During pneumoperitoneum, initially, Dexmedetomidine was unable to prevent surges, but throughout the surgery, it was able to maintain a stable HR, whereas Lidocaine and Magnesium Sulphate showed a rising trend in HR during the entire period of pneumoperitoneum.

In the studies of Ismail MA and Hesham SA, the effects of magnesium sulphate, dexmedetomidine, and lidocaine on haemodynamic responses were studied in patients undergoing laparoscopic cholecystectomy. The changes in HR and MAP were found to be greater in both the lidocaine and control groups than in the dexmedetomidine and magnesium sulphate groups [3]. These findings were consistent with the present study. This is important because it has been reported that persistent intraoperative hypertension of 20 mmHg or more is associated with a higher incidence of cardiac ischaemia, myocardial infarction, and death [14,15]. Zhang J et al., investigated the effect of magnesium sulphate (50 mg/kg) on haemodynamic stress responses induced by pneumoperitoneum and found that HR increased, and systolic and diastolic arterial pressures were lower in the magnesium group after pneumoperitoneum. They explained their findings by suggesting that the attenuation of hypertension was linked to inhibiting the release of catecholamines and/or vasopressin, as magnesium sulphate is known to have a relaxing effect on vascular smooth muscles [13]. These findings were similar to the findings of the present study. Similarly, Kalra NK et al., reported that the administration of magnesium sulphate or clonidine maintained stable haemodynamics in response to pneumoperitoneum [11]. Here the effects of Magnesium Sulphate were comparable with the present study trends. In the current study, the beneficial effect of administered dexmedetomidine aligns with the findings of Tripathi A et al., who stated that the α_2 agonist group showed promising results in attenuating haemodynamic responses associated with laparoscopic surgery during intubation, pneumoperitoneum, and extubation [22]. Consistent with the present study results, Srivastava VK et al., found that dexmedetomidine was more effective than esmolol in maintaining haemodynamic stability during pneumoperitoneum [23]. In another study by Srivastava VK et al., they reported that dexmedetomidine was more effective than magnesium sulphate for maintaining haemodynamic stability in spine surgeries [7]. In the current study, the VAS score was consistently lower in the Dexmedetomidine group compared to the other two groups. The lowest VAS score was observed in the Dexmedetomidine group. In terms of analgesic efficacy, Lidocaine showed an intermediate effect, while the Magnesium Sulphate group had the highest VAS score. Consequently, rescue analgesic usage was minimal in the Dexmedetomidine group and highest in the Magnesium group. The number of patients requiring rescue analgesia was significantly higher in the Lidocaine and Magnesium Sulphate groups compared to the Dexmedetomidine group.

In the present study, rescue analgesic usage was minimal in the Dexmedetomidine group, highest in the Magnesium group, and Lidocaine showed an intermediate effect. The number of patients receiving rescue analgesia was significantly higher in the Lidocaine and Magnesium Sulphate groups compared to the Dexmedetomidine group. This is consistent with the study conducted by Weinberg L et al., who reported similar findings [6]. Dexmedetomidine also exhibited similar characteristics in studies conducted by Srivastava VK et al., and Menshawi MA and Fahim HM [7,8].

Koppert W et al., studied the effect of perioperative local anaesthetic lidocaine infusion in patients undergoing major abdominal surgeries and found that systemic small-dose lidocaine administration during the perioperative period reduces pain. This aligns with the present study results [24]. Menshawi MA and Fahim HM demonstrated that dexmedetomidine has a better sparing effect on intraoperative anaesthetic consumption and a longer time to the first postoperative analgesic demand compared to lidocaine, with no significant difference between the agents in terms of intraoperative analgesic demand [8]. These findings support the results of the present study.

Limitation(s)

The present study did not evaluate the impact of co-morbid conditions on intraoperative and postoperative management.

CONCLUSION(S)

Dexmedetomidine is more efficacious than magnesium sulphate and lidocaine in maintaining haemodynamic stability throughout the perioperative period in patients undergoing laparoscopic abdominal surgeries under general anaesthesia. During pneumoperitoneum, the surge of MAP was maximally prevented by Dexmedetomidine, followed by Lidocaine and Magnesium Sulphate. Dexmedetomidine has superior analgesic properties compared to lidocaine and magnesium sulphate. Magnesium Sulphate and Lidocaine have been shown to be superior in preventing postintubation haemodynamic surges compared to dexmedetomidine. After the post-test drug bolus dose, a significant decrease in HR occurred, which was most pronounced in the Magnesium Sulphate and Dexmedetomidine groups, while no change was observed in the Lidocaine group.

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