



“Comparative Evaluation of Effects of Single Dose Dexmedetomidine and Magnesium Sulphate On Hemodynamic Parameters during Laparoscopic Cholecystectomy under General Anesthesia”- A Randomized, Double blinded, Controlled Study

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Background: Carbon dioxide pneumoperitoneum during laparoscopic surgery produces significant elevation of arterial pressure and systemic and pulmonary vascular resistance. Dexmedetomidine (DX) and magnesium sulfate (MG) both depress the sympathetic activity and control the hemodynamic responses to pneumoperitoneum. Bolus followed by continuous infusion of DX has been used during laparoscopic surgeries as per literature. In the present study, a single dose of DX was used in view of its elimination half-life (2.1–3.1 h) (duration of action up to 2 h), sufficient to cover the average period of pneumoperitoneum created for laparoscopic cholecystectomy (LC). **Aim:** The aim of this study was to compare the effects of a single dose of DX, MG, and normal saline (NS) on hemodynamic responses to pneumoperitoneum during LC and postoperative hemodynamic stability. **Methods:** Forty-five patients (the American Society of Anesthesiologists Class I, 18–60 years, male and female) undergoing elective LC were selected and randomly divided by computer-generated randomization table into three equal groups. Patients were given either 100 ml NS 0.9% intravenous (group NS, $n = 15$) or DX 1 $\mu\text{g}/\text{kg}$ in 100 ml NS (group DX, $n = 15$) or MG 50 mg/kg in 100 ml NS (group MG, $n = 15$) over 10 min in double-blinded manner after induction of anesthesia but before the creation of pneumoperitoneum. All patients were monitored for their heart rate (HR), noninvasive blood pressure, oxygen saturation, end-tidal carbon dioxide (CO_2), intra-abdominal pressure, and isoflurane concentration and recorded at various intervals. **Results:** HR in groups DX and MG remained below the baseline value (before induction) of respective group throughout the procedure following the infusion of drug with a significant difference. There was also significant difference in HR among the groups at various time intervals ($P < 0.05$). Systolic blood pressure was significantly different between groups NS and DX and groups DX and MG during the period of pneumoperitoneum at 10, 20, 30, and 40 min. A significant reduction in systolic blood pressure (SBP) of group DX as compared to its baseline value was observed throughout the period of pneumoperitoneum ($P < 0.05$). **Conclusion:** DX 1 $\mu\text{g}/\text{kg}$ and MG 50 mg/kg both were effective in their respective groups to control hemodynamic responses during CO_2 pneumoperitoneum created for LC. MG provided more stability in hemodynamic parameters, whereas DX was associated with more than desired reduction in HR and SBP, hence further evaluation with a lower dose of DX is suggested.

Key words: Dexmedetomidine, magnesium sulfate, laparoscopic cholecystectomy, hemodynamic

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INTRODUCTION

Laparoscopic cholecystectomy (LC) has become a gold standard for the treatment of gallstone diseases due to many advantages over the open technique such as smaller incision size, lesser pain, shorter hospital stay, faster recovery, and overall lesser morbidity.¹ During carbon dioxide (CO₂) pneumoperitoneum, increased levels of norepinephrine, epinephrine, and vasopressin cause rise in arterial pressure and systemic and pulmonary vascular resistance along with reduction in cardiac output.² Reverse Trendelenburg position during surgery further decreases venous return and hence cardiac output. Pneumoperitoneum also decreases thoracopulmonary compliance and functional residual capacity results in atelectasis and increased PaCO₂ level. These changes are well tolerated by the American Society of Anesthesiologists (ASA)-I patients but may be detrimental in patients with poor cardiovascular reserve, pre-existing hypertension, ischemic cardiac disease, or those with increased intracranial and intraocular pressure.³ Many agents have been used to control these hemodynamic responses such as clonidine, beta-blockers, calcium channel blockers, opioids, and inhalational anesthetic agents.

Dexmedetomidine (DX) is a novel α_2 agonist that has been used to control these hemodynamic changes but with some side effects such as hypotension, bradycardia, and sedation.⁴ It inhibits sympathetic outflow, hence, it creates a more stable hemodynamic profile during stressful events such as pneumoperitoneum, intubation, and extubation. It has been successfully used in anesthesia and critical care in view of its several actions which include sedation, analgesia, anxiolysis, perioperative sympatholysis, cardiovascular stabilizing effects, reduced anesthetic requirements, and preservation of respiratory function.⁵

Magnesium sulfate (MG) is known to block the release of catecholamines from both adrenergic nerve terminals and adrenal gland in response to stress like pneumoperitoneum.⁶ Moreover, it directly acts on blood vessels to reduce vascular resistance, produces vasodilatation, and hence reduces blood pressure and improves tissue perfusion without producing side effects in contrast to DX.⁷

Both DX and MG have analgesic properties. DX causes, dose dependent inhibition of C fibers and A-delta fibers involved in pain, also its alpha-2 agonist action on locus coeruleus area inhibits nociceptive neurotransmission and hence provide analgesic property.⁸ Magnesium exhibits antinociceptive effects due to inhibition of calcium influx, antagonism of NMDA receptors, attenuation or prevention of central sensitization after peripheral tissue injury or inflammation.⁹

In the present randomized double-blind controlled study, a single dose of intravenous DX and MG were used to compare their effects on hemodynamic parameters during LC.

MATERIALS AND METHODS

Sample size

Taking 13.38 and 13.36, as the standard deviation in control and MG groups, respectively, to study a difference of 14 mmHg in systolic blood pressure (SBP) between these two groups at $\alpha = 5\%$ and power = 80%, a sample of 15 cases was required in each group. We have considered the data on MAP for calculating sample size for comparison between the control and DX groups. Taking 12.3 and 18, as the standard deviation in the DX and control group to study a difference of 20 mmHg in MAP in these two groups at $\alpha = 5\%$ and power = 80%, a sample of 10 cases in each group is required.¹⁰ The final sample size considered was 15 in each group. The whole analysis was performed by the SPSS version 17.0 (IBM USA) program for Windows, version 17.0.

After getting approval from the Institutional Ethical Committee-Human Research (approval date: 27 November 2013) and informed consent from each patient to participate in the study, 45 patients of ASA physical status-I, aged between 18 and 60 years of either sex undergoing elective LC, were included in the study [Figure 1]. The study was carried out in accordance with the principles of the Declaration of Helsinki, 2013. The clinical trial is registered in the UMIN Clinical Trials Registry (UMIN-CTR) under the registration number UMIN000054257.

Patients with a history of cardiovascular disease, endocrine disease such as uncontrolled diabetes mellitus, thyroid disorder, compromised renal, hepatic, neuronal functions, pregnant or lactating females, or any patient taking drugs affecting cardiovascular parameters were excluded from the study. Criteria for withdrawal from the study included conversion of laparoscopic to open cholecystectomy, excessive internal bleeding leading to hypotension or requiring blood transfusion, or duration of pneumoperitoneum more than 2 h. Patients were allocated into one of the three groups by computer-generated randomization table. Patients were given either 100 ml 0.9% NS (Group NS: $n = 15$), DX 1 $\mu\text{g/kg}$ body weight diluted in NS to make a total volume of 100 ml (Group DX: $n = 15$) or MG 50 mg/kg body weight diluted in NS to make a total volume of 100 ml (Group MG: $n = 15$) as an infusion over 10 min after induction of anesthesia but before creation of pneumoperitoneum. The drug was prepared by an anesthesiologist who was not participating in study. Patient and observer both were not aware of the nature of drug or group allocated to maintain double blinding.

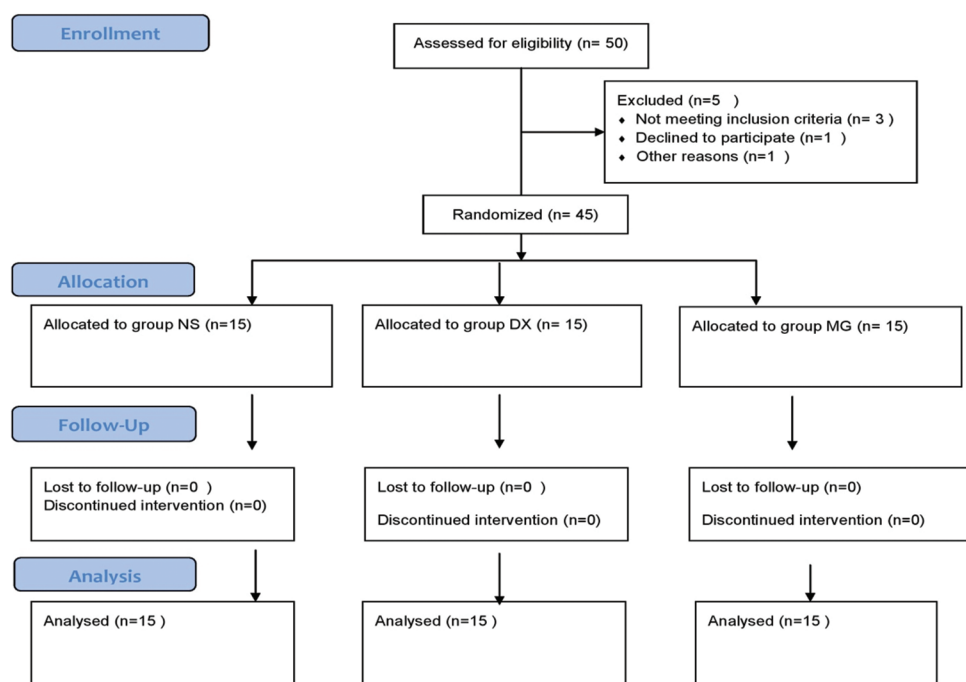


Figure 1: Consolidated standards of reporting trials flow of participants. *n* = Number of patients; NS = Normal saline; DX = Dexmedetomidine; MG = Magnesium sulphate

Anesthesia was induced by injection of morphine 0.1 mg/kg body weight, injection of thiopentone sodium (2.5%) 4–6 mg/kg body weight, and injection of vecuronium bromide 0.1 mg/kg. The trachea was intubated with appropriate-sized oral cuffed endotracheal tube. Anesthesia was maintained by mixture of O₂ + N₂O (1:2) and isoflurane (0.5%–2%). Ventilatory parameters were adjusted to maintain EtCO₂ between 35 and 40 mmHg. After induction of anesthesia but before the creation of CO₂ pneumoperitoneum, the study drug/NS was infused intravenously over 10 min according to the group allocated. CO₂ pneumoperitoneum was created by the surgeon and intra-abdominal pressure was maintained around 12 mm Hg. At the end of surgery, CO₂ was released from the peritoneal cavity and neuromuscular blockade was reversed by injection of neostigmine 0.05 mg/kg and injection of glycopyrrolate 0.006 mg/kg. The trachea was then extubated after adequate recovery.

During the surgery, it was tried to keep the SBP within the range of $\pm 20\%$ of the preoperative baseline value, by titrating the concentration of isoflurane by dial setting. In the event of bradycardia (HR <60/min), an injection of atropine 0.3 mg intravenous was given. All these events were recorded.

Intraoperatively, values of HR, non-invasive blood pressure (NIBP) (SBP, diastolic blood pressure [DBP], and mean arterial pressure [MAP]), and oxygen saturation (SpO₂) were recorded preoperatively, after medication, prepneumoperitoneum, during pneumoperitoneum at the interval of 10 min. EtCO₂ and concentration of isoflurane were also recorded after

tracheal intubation every 10 min till the end of surgery. Intrabdominal pressure was also recorded every 10 min during pneumoperitoneum.

Postoperatively, HR, NIBP (SBP, DBP, and MAP), and SpO₂ were monitored and the pain was assessed by Visual Analogue Scale score (VAS 0–10 points) and sedation score by Ramsay sedation score¹¹ and were recorded at 0, 30, 60 and 120 min.

Statistical analysis

Statistical analysis was performed by the SPSS program for Windows, version 17.0. Continuous variables are presented as mean $\pm$ standard deviation (SD), and categorical variables are presented as absolute numbers and percentages. Data were checked for normality before statistical analysis using Shapiro–Wilk test. Normally distributed continuous variables were compared using analysis of variance. If the *F* value was significant and the variance was homogeneous, the Tukey multiple comparison test was used to assess the differences between the individual groups; otherwise, Tamhane's T2 test was used. Categorical variables were analyzed using the Chi-square test. For all statistical tests, *P* < 0.05 was taken to indicate a significant difference.

RESULTS

The demographic parameters of all patients of the three

Table 1: Demographic parameters

Parameters	Group NS (n=15)	Group DX (n=15)	Group MG (n=15)	P
Age (years)	32.93±6.65	30.73±8.80	30.87±9.20	0.719
Body weight (kg)	56.47±8.59	55.33±11.10	56.40±10.60	0.943
Female:male ratio	12:03	12:03	14:01	
Total duration of pneumoperitoneum (min) (range)	68.00±70.67 (40–100)	70.67±13.35 (40–90)	66.67±14.48 (50–100)	0.769
Total IV fluids (mL) Infused	1486.67±279.97	1586.67±255.98	1513.33±292.45	0.595

$P < 0.05$ significant difference. Data are expressed as mean±SD. n=Number of patients; NS group=Normal saline; DX group=Dexmedetomidine; MG group=Magnesium sulphate; SD=Standard deviation; IV=Intravenous

Table 2: Depicting mean±standard deviation with P values of heart rate (bpm) and systolic blood pressure (mmHg) of three groups at different points of time

Time interval	HR				SBP			
	Group NS (n=15)	Group DX (n=15)	Group MG (n=15)	P	Group NS (n=15)	Group DX (n=15)	Group MG (n=15)	P
Before induction	87.87±9.33	87.60±8.46	93.40±15.51	0.30	126.47±10.08	125.53±8.94	123.93±9.11	0.75
Postinfusion under GA	82.60±11.56*	72.27±11.04* [‡]	82.93±11.39* [‡]	0.02	106.53±11.92*	103.27±9.51*	104.07±12.33*	0.71
Before pneumo	82.80±11.45	73.80±12.45*	79.60±11.20*	0.11	109.07±12.68*	100.27±7.04*	103.40±11.56	0.09
During pneumo at 0 min	84.93±13.63	74.00±13.37*	80.60±15.82*	0.12	119.33±21.21	107.40±11.65*	115.27±18.53	0.18
10 min	85.07±17.64	71.33±13.14*	82.20±17.35*	0.06	127.00±19.51	110.13±14.74* [‡]	122.20±18.57 [§]	0.04
20 min	86.93±16.40	74.80±12.64*	83.87±17.27*	0.09	130.47±14.46	110.40±8.81* [‡]	124.67±16.28 [§]	0.00
30 min	85.47±17.06	76.73±13.10*	82.73±16.78*	0.30	130.27±14.63	110.13±7.67* [‡]	122.20±14.24 [§]	<0.001
40 min	85.00±16.08	75.53±12.35*	82.87±17.05*	0.21	127.00±15.33	111.40±9.34* [‡]	122.20±15.69 [§]	0.01
Postoperative at 0 min	90.33±18.35	74.53±13.97* [‡]	88.53±18.41	0.02	131.87±17.24	120.73±12.44	125.13±17.02	0.16
30 min	83.13±14.92	76.47±14.46*	83.87±18.64*	0.39	125.40±16.94	118.93±12.34*	121.40±18.04	0.54
60 min	78.53±7.63*	75.73±7.53*	77.67±11.76*	0.41	124.60±16.34	113.47±13.45*	116.87±15.98	0.14
120 min	78.13±9.79*	73.87±9.18*	77.80±10.33*	0.42	120.87±15.96	107.80±9.31 [‡] *	115.20±10.65*	0.02

* $P < 0.05$ significantly different from preinduction base line value of corresponding group; [‡] $P < 0.05$ significant difference between NS and DX group at corresponding time; [§] $P < 0.05$ significant difference between NS and MG group at corresponding time; [§] $P < 0.05$ significant difference between DX and MG group at corresponding time. $P < 0.05$ significant difference; Data are expressed as mean±SD. n: Number of patients; NS group=Normal saline; DX group=Dexmedetomidine; MG group=Magnesium sulphate; SD=Standard deviation; SBP=Systolic blood pressure; HR=Heart rate; GA=General anesthesia

groups were comparable with no statistically significant difference ($P > 0.05$). The total duration of pneumoperitoneum and intravenous fluids infused was similar in all three groups with no statistically significant difference [Table 1]. Since the duration of pneumoperitoneum was variable in all subjects of the three groups, the minimum duration of pneumoperitoneum, common to all patients of the three groups, was 40 min. Hence, 40 min duration was used for the purpose of statistical analysis.

Mean ± SD of heart rate (HR) and systolic blood pressure before induction were comparable in all three groups [Table 2 and Figures 2, 3]. Postinfusion of the drug at 15 min there was a significant reduction in HR and SBP in all three groups as compared to preinduction baseline value of respective groups ($P < 0.001$), but among the groups, there was no significant difference ($P = 0.71$).

During pneumoperitoneum, there was a significant reduction in HR of DX and MG groups at all point of time till desufflation as compared to preinduction values of the respective group. However, the reduction was more in group

DX (from 87.60 ± 8.46 to 71.33 ± 13.14 bpm) as compared to group MG (from 93.40 ± 15.51 to 82.20 ± 17.35 bpm). In the NS group, there was no significant difference in HR during pneumoperitoneum at any point of time as compared to its preinduction value.

During pneumoperitoneum in DX group, SBP was lower as compared to its preinduction (baseline) value at all points of time ($P < 0.001$) and none of the patient developed hypotension. Statistical analysis also revealed that it was significantly lower as compared to the NS and MG groups at all corresponding time intervals. In the MG group, there was no rise in SBP throughout the period of pneumoperitoneum as compared to the preinduction (baseline) value ($P > 0.05$).

A significant reduction in HR was persisted throughout the postoperative period in the DX and MG group as compared to their respective preinduction value.

In the postoperative period, a significant reduction in SBP of group DX was observed as compared to its baseline value till 2 h ($P < 0.001$) but it remained above 100 mmHg in all

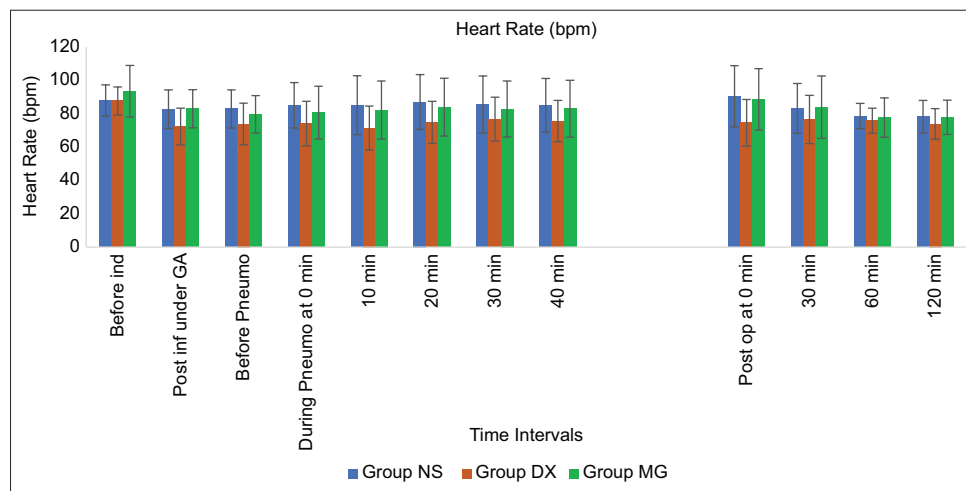


Figure 2: Showing mean $\pm$ standard deviation of heart rate (beats per min) of three groups at various time intervals intra and postoperatively ($P > 0.05$ no significant difference among the groups except at post infusion of drug and postoperative at “0” min). NS = Normal saline; DX = Dexmedetomidine; MG = Magnesium sulphate; GA = General anesthesia

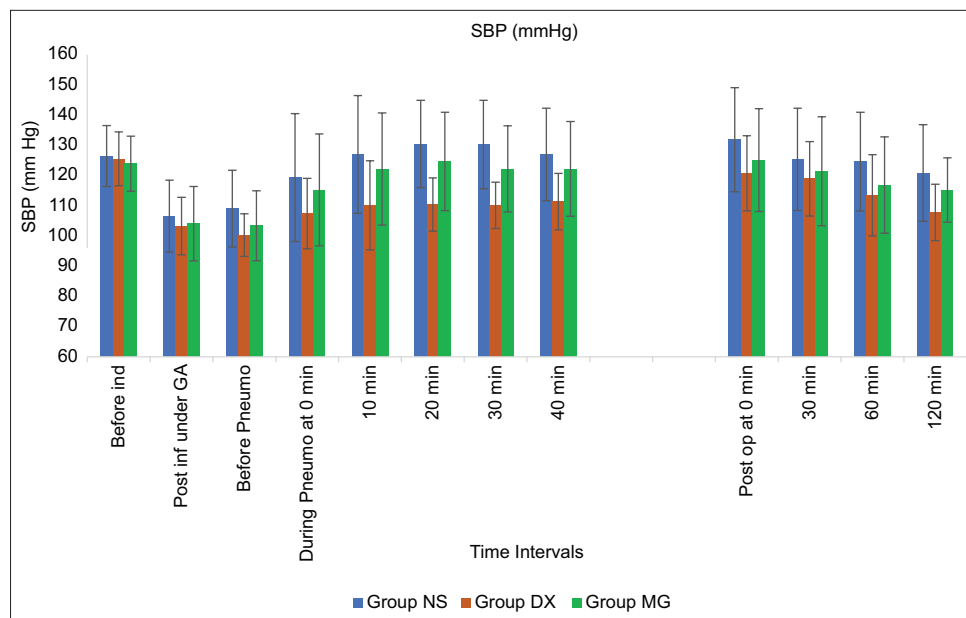


Figure 3: Showing mean $\pm$ standard deviation of systolic blood pressure (mmHg) of three groups at various time intervals intra and postoperatively. NS = Normal saline; DX = Dexmedetomidine; MG = Magnesium sulphate; GA = General anesthesia, Pneumo = pneumoperitoneum, Ind = induction, Inf = Infusion, Post op = Postoperative

patients at all time points, whereas group MG and NS did not show a significant reduction [Table 2 and Figures 2, 3].

The concentration of isoflurane was titrated by dial setting to maintain SBP $\pm$ 20% of preinduction (baseline) value. Statistical analysis revealed that the requirement of isoflurane was significantly less in the DX group as compared to the NS and MG group at corresponding time intervals during pneumoperitoneum. On comparing groups, NS and MG requirement of isoflurane was significantly higher in the NS group than MG group during pneumoperitoneum [Table 3 and Figure 4].

The pain was assessed by VAS score and it was observed comparable in all three groups at any point of time in the postoperative period [Figure 5].

Sedation score was recorded for all patients of three groups using the Ramsay Sedation Scale at postoperative period 0, 30, 60, and 120 min. At postoperative 0 min, 7 patients of the MG group, 4 patients of the DX group, and 5 patients of the NS group had a sedation score of 5 (a sluggish response to light glabellar tap or loud auditory stimulus). Even at 30 min, 6 patients of group MG and 2 patients of group DX had a score 5. After 90 min, all patients in the three groups were awake,

Table 3: Mean±standard deviation and *P* values of isoflurane concentration in percentage of three groups at different points of time

Time interval	Group NS (<i>n</i> =15)	Group DX (<i>n</i> =15)	Group MG (<i>n</i> =15)	<i>P</i>
Before pneumoperitoneum	0.98±0.19	0.91±0.15*	0.96±0.11	0.40
10 min	1.23±0.42	0.84±0.17* [‡]	1.00±0.32 [#]	0.008
20 min	1.29±0.42	0.83±0.17* [‡]	1.15±0.47	0.015
30 min	1.37±0.47*	0.83±0.17* [‡]	1.18±0.48 [§]	0.005
40 min	1.37±0.47*	0.83±0.17* [‡]	1.18±0.48	0.002

**P*<0.05 significantly different from preinduction base line value of corresponding group, [‡]*P*<0.05 significant difference between NS and DX group at corresponding time, [#]*P*<0.05 significant difference between NS and MG group at corresponding time, [§]*P*<0.05 significant difference between DX and MG group at corresponding time. NS group=Normal saline; DX group=Dexmedetomidine; MG group=Magnesium sulphate

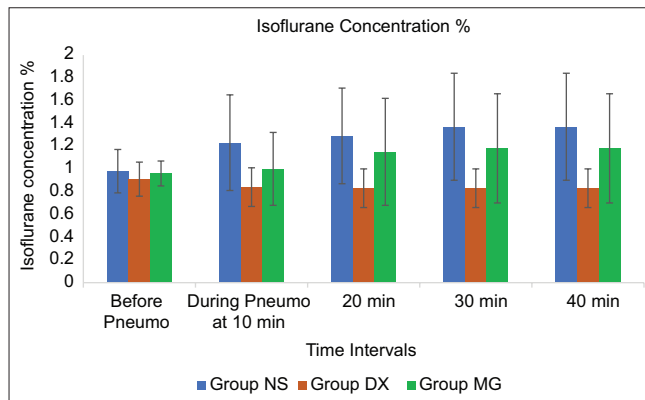


Figure 4: Showing mean ± standard deviation of isoflurane concentration required by three groups to maintain systolic blood pressure within 20% of baseline value (*P* < 0.05 significant difference among the groups). NS = Normal saline; DX = Dexmedetomidine; MG = Magnesium sulphate

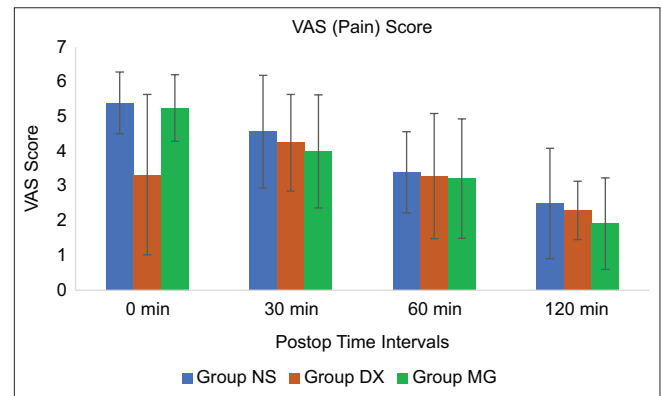


Figure 5: Showing mean ± standard deviation of postoperative pain (visual analogue scale) score of three groups (*P* > 0.05 no significant difference among the groups). NS = Normal saline; DX = Dexmedetomidine; MG = Magnesium sulphate; VAS = Visual analogue scale

cooperative, and oriented and were shifted to the ward without any delay due to sedation or any other side effect.

DISCUSSION

The present study revealed that DX 1 µg/kg and MG 50 mg/kg both were effective as compared to the saline group to control hemodynamic changes during CO₂ pneumoperitoneum created for LC. DX was more effective than MG in attenuating these hemodynamic changes but caused mild hemodynamic depression as compared to MG.

During laparoscopic surgery, carbon dioxide insufflation produces significant hemodynamic, respiratory, and endocrine changes.² Hemodynamic changes include elevation of arterial pressure and systemic and pulmonary vascular resistance, decreased cardiac output without any alteration in HR due to increased release of catecholamines and vasopressin.³ It is important to control this sympathetic response to decrease the morbidity of the patient during the perioperative period. Various drugs have been used for the attenuation of these hemodynamic changes. These include DX, clonidine, MG, beta-blockers, opioids, and calcium channel blockers.

Recently magnesium and DX have been used by various authors in different doses by different techniques, like continuous infusion throughout the pneumoperitoneum to attenuate hemodynamic changes during CO₂ pneumoperitoneum created for LC.

DX and magnesium have been used in various doses either as bolus or infusion or both during laparoscopic surgeries to control hemodynamic changes due to pneumoperitoneum.¹²⁻¹⁵

Sharma *et al.* used DX 0.5 µg/kg over 10 min before induction followed by 0.5 µg/kg/h infusion in patients undergoing LC. They observed that 5 out of 50 patients who received DX developed bradycardia intraoperatively.¹⁶ Similarly, Ahmed and Abdelraouf also observed bradycardia (24%) and hypotension (20%) in patients when DX was used in a loading dose of 1 µg/kg followed by a maintenance dose of 0.5 µg/kg/h (infusion) during LC.¹⁷

However, the present study revealed that there was no need for continuous infusion of DX throughout the period of pneumoperitoneum to control hemodynamic changes as done by various authors. In the present study, a low single dose of DX with its elimination half-life (2.1–3.1 h) (duration of

action up to 2 h) was sufficient to cover the average period of pneumoperitoneum created for LC.⁴

Both DX and magnesium cause decrease in HR and blood pressure as observed in the present study. Postinfusion of the drug at 15 min there was a significant reduction in HR and SBP in all three groups as compared to preinduction value of respective groups. Similar to the present study Panchgar *et al.* also observed that DX effectively controlled hemodynamics during LC without any major side effects.¹⁸ DX was also used by Khare *et al.* to control hemodynamic changes during LC in the dose of 1 µg/kg bolus followed by an infusion of 0.6 µg/kg/h. They observed that intraoperative HR and mean blood pressure were lower in patients who received DX.¹⁹

MG was used by Paul *et al.* in the dosage of 30 mg/kg as bolus before pneumoperitoneum and observed that mean arterial pressure and HR were significantly low throughout the period of pneumoperitoneum as compared to the control group.²⁰ In the year 2019, Tan *et al.* used different doses of magnesium in patients undergoing laparoscopic gastrectomy immediately before the creation of pneumoperitoneum. The mean arterial pressure, systemic vascular resistance, and central venous pressure were significantly lower in the magnesium group.²¹

Similar to other studies, in the present study also during pneumoperitoneum, there was a significant reduction in HR in the DX group as compared to group MG and NS. In group MG, there was a mild reduction in HR, whereas in the NS group, there was no significant change. Systolic blood pressure in the NS group was increased during pneumoperitoneum. While in group DX, it was significantly reduced from its preinduction value and also as compared to group MG and group NS ($P < 0.05$). In group MG, there was no rise in SBP throughout the period of pneumoperitoneum as compared to the preinduction value. Hence, blood pressure was better controlled in the DX group.

DX and MG also decreases the requirement of inhalational anesthetic agent. DX acts as sedative and analgesic by inhibiting the release of norepinephrine by activating alpha-2 adrenoceptor, and by inhibition of C fibers and A-delta fibers in central nervous system thus produces sedation and analgesia.²² Hence it may reduce the requirement of inhalational anesthetic agent. There was 30% decrease in the requirement of isoflurane with loading dose (1 µg/kg) followed by infusion (0.2 µg/kg) during LC as observed by Ghodki *et al.*²³

Volatile anesthetics, such as isoflurane, act by inhibiting hippocampal presynaptic calcium channels in the brain. These channels are also inhibited by magnesium, probably this leads to decreased inhalation anesthetic requirement during magnesium infusion.²⁴ Norawat *et al.* also observed isoflurane concentration ($1.24\% \pm 0.14\%$) was recorded as significantly higher (at all-time points) during pneumoperitoneum in

patients who received saline compared to patients who received magnesium during LC.²⁵

As corresponding with the above results in the present study also requirement of isoflurane was significantly less in the DX group as compared to the NS and MG groups at corresponding time intervals during pneumoperitoneum. On comparing, the NS and MG groups requirement of isoflurane was significantly higher in the NS group than MG group during pneumoperitoneum.

In the present study, in postoperative period, the VAS score for pain in the patients of the three groups was comparable. In this regard, the results of the present study did not support the results of other studies.^{13,18} The different results might be because of the single bolus dose of drugs used in the present study without continuous infusion of the drugs as used in other studies.

Bradycardia (HR <60) was observed in 1 patient of group NS and group MG each and 6 patients in group DX. But none of the patients had HR <50 bpm. Hypotension (by definition, reduction by 20% of the baseline value of SBP of the individual patient) was observed in 4 patients of group NS, 3 patients of group MG, and 9 patients of group DX intraoperatively but none of the patients had SBP < 100 mmHg at every point of time.

CONCLUSION

Hence, on the basis of the results and observations of the present study, it was concluded and recommended that a single dose of either DX 1 µg/kg or MG 50 mg/kg intravenously may be used before the creation of pneumoperitoneum to control the changes in hemodynamic parameters during LC. However, the use of DX was associated with more than desired reduction in HR and SBP, hence further evaluation with lower doses of DX is suggested.

Data availability statement

The data that support the findings of this study are available from the corresponding author, Dr. Mahendra Kumar, upon reasonable request.

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Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Coccolini F, Catena F, Pisano M, Gheza F, Fagioli S,

- Di Saverio S, *et al.* Open versus laparoscopic cholecystectomy in acute cholecystitis. Systematic review and meta-analysis. *Int J Surg* 2015;18:196-204.
2. Thangavelu R. Laparoscopy and anesthesia: A clinical review. *Saudi J Laparosc* 2018;3:6-15.
3. Atkinson TM, Giraud GD, Togioka BM, Jones DB, Cigarroa JE. Cardiovascular and ventilatory consequences of laparoscopic surgery. *Circulation* 2017;135:700-10.
4. Weerink MA, Struys MM, Hannivoort LN, Barends CR, Absalom AR, Colin P. Clinical pharmacokinetics and pharmacodynamics of dexmedetomidine. *Clin Pharmacokinet* 2017;56:893-913.
5. Lee S. Dexmedetomidine: Present and future directions. *Korean J Anesthesiol* 2019;72:323-30.
6. Ghodraty MR, Zamani MM, Jamili S, Pournajafian A, Salemi P, Ghadrdoost B, *et al.* The effects of magnesium sulfate loading on hemodynamic parameters during laparoscopic cholecystectomy: Randomized controlled trial. *Arch Anesthesiol Crit Care* 2017;3:313-8.
7. Do SH. Magnesium: A versatile drug for anesthesiologists. *Korean J Anesthesiol* 2013;65:4-8.
8. Tang C, Xia Z. Dexmedetomidine in perioperative acute pain management: A non-opioid adjuvant analgesic. *J Pain Res* 2017;10:1899-904.
9. De Oliveira GS Jr., Castro-Alves LJ, Khan JH, McCarthy RJ. Perioperative systemic magnesium to minimize postoperative pain: A meta-analysis of randomized controlled trials. *Anesthesiology* 2013;119:178-90.
10. Bhattacharjee DP, Nayek SK, Dawn S, Bandopadhyay G, Gupta K. Effects of dexmedetomidine on haemodynamics in patients undergoing laparoscopic cholecystectomy- a comparative study. *J Anaesth Clin Pharmacol* 2010;26:45-8.
11. Ramsay MA, Savege TM, Simpson BR, Goodwin R. Controlled sedation with alphaxalone-alphadolone. *Br Med J* 1974;2:656-9.
12. Kataria AP, Attri JP, Kashyap R, Mahajan L. Efficacy of dexmedetomidine and fentanyl on pressor response and pneumoperitoneum in laparoscopic cholecystectomy. *Anesth Essays Res* 2016;10:446-50.
13. Chilkoti GT, Karthik G, Rautela R. Evaluation of postoperative analgesic efficacy and perioperative hemodynamic changes with low dose intravenous dexmedetomidine infusion in patients undergoing laparoscopic cholecystectomy – A randomised, double-blinded, placebo-controlled trial. *J Anaesthesiol Clin Pharmacol* 2020;36:72-7.
14. Kamble SP, Bevinaguddaiah Y, Nagaraja DC, Pujar VS, Anandaswamy TC. Effect of magnesium sulfate and clonidine in attenuating hemodynamic response to pneumoperitoneum in laparoscopic cholecystectomy. *Anesth Essays Res* 2017;11:67-71.
15. Zhang J, Wang Y, Xu H, Yang J. Influence of magnesium sulfate on hemodynamic responses during laparoscopic cholecystectomy: A meta-analysis of randomized controlled studies. *Medicine (Baltimore)* 2018;97:e12747.
16. Sharma P, Gombar S, Ahuja V, Jain A, Dalal U. Sevoflurane sparing effect of dexmedetomidine in patients undergoing laparoscopic cholecystectomy: A randomized controlled trial. *J Anaesthesiol Clin Pharmacol* 2017;33:496-502.
17. Ahmed IM, Abdelraouf HS. Magnesium sulfate, dexmedetomidine, and lignocaine in attenuating hypertension during laparoscopic cholecystectomy: A comparative study. *Al Azhar Assiut Med J* 2018;16:327-32.
18. Panchgar V, Shetti AN, Sunitha HB, Dhulkhed VK, Nadkarni AV. The effectiveness of intravenous dexmedetomidine on perioperative hemodynamics, analgesic requirement, and side effects profile in patients undergoing laparoscopic surgery under general anesthesia. *Anesth Essays Res* 2017;11:72-7.
19. Khare A, Sharma SP, Deganwa ML, Sharma M, Gill N. Effects of dexmedetomidine on intraoperative hemodynamics and propofol requirement in patients undergoing laparoscopic cholecystectomy. *Anesth Essays Res* 2017;11:1040-5.
20. Paul S, Biswas P, Bhattacharjee DP, Sengupta J. Effects of magnesium sulfate on hemodynamic response to carbon dioxide pneumoperitoneum in patients undergoing laparoscopic cholecystectomy. *Anesth Essays Res* 2013;7:228-31.
21. Tan W, Qian DC, Zheng MM, Lu X, Han Y, Qi DY. Effects of different doses of magnesium sulfate on pneumoperitoneum-related hemodynamic changes in patients undergoing gastrointestinal laparoscopy: A randomized, double-blind, controlled trial. *BMC Anesthesiol* 2019;19:237.
22. Li A, Yuen VM, Goulay-Dufay S, Kwok PC. Pharmacokinetics and pharmacodynamics of dexmedetomidine. *Drug Dev Ind Pharm* 2016;42:1917-27.
23. Ghodki PS, Thombre SK, Sardesai SP, Harnagle KD. Dexmedetomidine as an anesthetic adjuvant in laparoscopic surgery: An observational study using entropy monitoring. *J Anaesthesiol Clin Pharmacol* 2012;28:334-8.
24. Herroeder S, Schoenherr ME, DeHert SG, Hollmann MW, Warner DS. Magnesium-essentials for anesthesiologists. *J Am Soc Anesthesiol* 2011;114:971-93.
25. Norawat R, Kumar M, Maybauer M. Magnesium sulphate significantly reduces isoflurane and vecuronium bromide requirements in laparoscopic cholecystectomies. *Br J Anaesth* 2018;120:e17-8.