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Original Research Article

A Comparative Study of Infusion Dexmedetomidine and Infusion Magnesium Sulphate on Attenuation of Hemodynamic Changes in Laparoscopic Surgery Under General Anaesthesia

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Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to evaluate which premedication drugs dexmedetomidine or magnesium sulphate causes minimum haemodynamic instability in laparoscopic surgery.

Methods: The present study was double blinded randomized, controlled study done in IGIMS, Patna between April 2019 to September 2020.Total 150 patients included in study and divided into three groups.

Results: Age wise distribution of the Dexmedetomidine, Magnesium Sulphate & Normal saline showed that maximum patients of 50-60 years in Dexmedetomidine, maximum patients of 40-49 years in Magnesium sulphate and Normal Saline. The mean ± SD in Dexmedetomidine group was 40.50±12.50, Magnesium sulphate group is 40.96±11.58 and Normal Saline group was 40.30±10.87. Sex wise distribution of the Dexmedetomidine, Magnesium Sulphate & Normal saline shows that in dexmedetomidine Male 17(34%), and Female 33(66%), in magnesium sulphate, Male 23(46%) and Female 27 (54%), in normal saline Male 14(28%) and Female 36 (72%) respectively. On comparing the height and weight, no significant difference was found (P. value = 0.259) among the groups. The mean heart rate from basal to HR (T8) minute recording was statistically not significant between the groups. The mean SBP, DBP and MAP from basal to T8 minute recording was statistically not significant between group D and group M.

Conclusion: In our study we found dexmedetomidine is highly selective and specific alfa-2 agonist and is superior to magnesium sulphate in attenuating the cardiovascular effects of pneumoperitoneum. Further research is required to reveal the usefulness of Dexmedetomidine as premedication in Laproscopic surgery.

Keywords: Laproscopic surgery, Haemodynamic instability, dexmedetomidine, magnesium sulphate.

Introduction

Laparoscopic surgery is associated with increase in serum catecholamine and vasopressine levels during pneumoperitoneum and carbon dioxide insufflation. All leads to significant alterations in hemodynamics which is harmful to the patients with compromised cardiac function in whom this may predispose the myocardium to ischemia. The two main factors responsible for the hemodynamic variations are raised PaCO2 and intra-abdominal pressure. Both mechanical and neuroendocrine factors contribute to the hemodynamic changes induced by CO2 pneumoperitoneum. An increase in intra-abdominal pressure more than 10 mmHg and patient positioning inflicts significant changes including decreased thoraco pulmonary compliance (30% to 50%), increased systemic and pulmonary vascular resistance (SVR), severely increased arterial pressure and IVC compression leading to decreased venous return, consequently, decreased cardiac output. (10% to 30%). These factors can precipitate an adverse cardiac event in patients with pre-existing cardiovascular diseases.[1-3]

Laryngoscopy and intubation produce a reflex sympathetic discharge which causes adverse hemodynamic changes such rise in the arterial blood pressure, heart rate, pulmonary arterial pressure and wedge capillary pressure and can even cause cardiac arrhythmias additionally these laparoscopic surgeries also incur an overall stress because of the pneumoperitoneum caused by carbon dioxide insufflation.4 Nowadays there is a vogue of opioid free anaesthesia where multiple drugs like dexamethasone, lignocaine, magnesium sulphate, paracetamol, dexmedetomidine are being used intraoperatively. Anesthesiologists are in constant search of a multimodal approach to blunt these unwanted responses. Magnesium being the fourth most common salt in the body which inhibits release of catecholamines from adrenergic nerve endings and adrenal medulla causing vasodilation and drop in BP and it serves as a good adjuvant.[5] Dexmedetomidine is a selective alpha 2 agonist that stimulates the alpha-2 receptors in the lateral reticular nucleus resulting in reduced sympathetic outflow and blunting of unpleasant stimuli and hence preventing the overall hemodynamic variability.[6]

The hemodynamic response to endotracheal intubation, pneumoperitoneum and extubation can increase perioperative morbidity and mortality. Maintaining the hemodynamic parameters during laparoscopic procedures is of paramount importance because of the significant hemodynamic variations observed, even in healthy individuals. Several studies like Karla et al. and Shruthi et al. used intravenous Magnesium sulphate to suppress pressure responses to anesthetic and surgical manipulation during laparoscopic cholecystectomy.[7,8]

The aim of the present study was to evaluate which premedication drugs dexmedetomidine or magnesium sulphate causes minimum haemodynamic instability in laparoscopic surgery.

Materials And Methods

The present study had been undertaken at IGIMS Patna, India. The study period is from April 2019 to September 2020. The study was done on 150 patients. The subjects were divided into three groups with 50 in each group. The topic “A comparative study of infusion Dexmedetomidine and infusion Magnesium sulphate on Attenuation of Hemodynamic changes in laproscopic surgery under general anaesthesia” was duly submitted before the ethical committee of our institution and the ethical committee approval was obtained.

CTRI Registration Number : CTRI / 2019/04/018356

Inclusion Criteria:

- Patients of ASA physical status 1 and 2
- Patients between 18 – 60 years of age of either sex
- Patient undergoing laparoscopic surgery.
- Patient willing to participate.

Exclusion Criteria:

- Patient's refusal to participate, ASA III above
- Patients with pregnancy, morbid obesity, full stomach and emergency surgery.
- Patient with suspected difficult laparoscopic surgery, patient sensitive to the drugs

Outcome parameters: Comparison of infusion Dexmedetomidine and infusion Magnesium sulphate on attenuation of blood pressure surge in laparoscopic surgery.

Sample size: Total 150 subjects were enrolled and divided into three group.

50 in group C,

50 in group D,

50 in group M

Sampling type: Double blinded sampling

Details of materials: Patients admitted for laparoscopic surgical procedures under general anaesthesia, who were willing to participate and fulfill the inclusion criteria was enrolled in the study.

Intervention & data collection methods:

After enrolment in the study the patients were assessed preoperatively and premedicated with Alprazolam 0.5mg and Ranitidine 150 mg orally on the night before surgery. In preoperative area baseline parameters were took then intravenous loading dose of study drugs were given and then infusion started follow.

Group C: Saline infusion 20 ml over15 min

Group D: received infusion dexmedetomidine loading 1mcg/kg in 20 ml normal saline over 15 min, dexmedetomidine infusion at rate of 0.4mcg/kg/hr.

Group M: received infusion Magnesium sulphate loading 2g in 20ml Normal saline over 15 min, Magnesium sulphate infusion at rate of 15 mcg/kg/min. Routine monitoring in the form of ECG,SPO2,NIBP,EtCO2 was attached.GA was induced with inj fentanyl 2 mcg/kg,inj propofol 2mg/kg and vecuronium 1mg/kg. GA was maintained O2, N2O, isoflurane intermittent top up dose of vecuronium. All data collected at Baseline(T0) including systolic blood pressure(SBP) ,diastolic blood pressure(DBP) ,mean arterial blood pressure(MAP), and heart rate(HR), Intraoperative hemodynamic measures were determined before intubation (T1), 1 min after intubation (T2),before and 5 min after peritoneal insufflation (T3 and T4),5min after peritoneal deflation (T5),after extubation (T6), at time of admission to PACU(T7) and upto 6 hours in PACU(T8). Mean of collective intraoperative changes of HR SBP, DBP and MA.

Statistical Analysis

All the data were analyzed using SPSS package (Stata, version 26.0 SPSS INC, Chicago, IL, USA) for windows. The data were presented as descriptive statistics for continuous variables and percentage for categorical variables and was subjected Chi-square test, t test & Fisher Exact test. Other values were represented in number, proportions (%) and mean ± SD.

Results

Table 1: Age and sex distribution in Group Dexmeditomidine, Magnesium Sulphate & Normal Saline

Age in years	Dexmedetomidine (N=50)		Magnesium sulphate (N=50)		Normal Saline (N=50)		P. Value
	Number	Percentage	Number	Percentage	Number	Percentage	
18-28	10	20%	8	16%	11	22%	0.849
29-39	14	28%	12	24%	9	18%	
40-49	10	20%	14	28%	18	36%	
50-60	16	32%	16	32%	12	24%	
Mean ±SD	40.50±12.50		40.96±11.58		40.30±10.87		

Sex	Dexmedetomidine (N=50)		Magnesium sulphate (N=50)		Normal Saline (N=50)	
	Number	Percentage	Number	Percentage	Number	Percentage
Male	17	34%	23	46%	14	28%
Female	33	66%	27	54%	36	72%

Age wise distribution of the Dexmedetomidine, Magnesium Sulphate & Normal saline showed that maximum patients of 50-60 years in Dexmedetomidine, maximum patients of 40-49 years in Magnesium sulphate and Normal Saline. The mean ± SD in Dexmedetomidine group was 40.50±12.50, Magnesium sulphate group was 40.96±11.58 and Normal Saline group was 40.30±10.87. By conventional criteria, this difference was considered to be not statistically significant as the p value is 0.849. Sex wise distribution of the Dexmedetomidine, Magnesium Sulphate & Normal saline shows that in dexmedetomidine Male 17(34%), and Female 33(66%), in magnesium sulphate, Male 23(46%) and Female 27 (54%), in normal saline Male 14(28%) and Female 36 (72%) respectively.

Table 2: Height distribution in Group Dexmeditomidine, Magnesium Sulphate & Normal Saline

Height	Dexmedetomidine (N=50)		Magnesium sulphate (N=50)		Normal Saline(N=50)		P. Value
	Number	Percentage	Number	Percentage	Number	Percentage	
140-150	3	6%	1	2%	0	0%	0.259
151-160	15	30%	13	26%	10	20%	
161-170	32	64%	36	72%	40	80	
Mean ±SD	161.98±6.22		163.12±4.18		164.20±3.79		

Mean height of patients in group D was 161.98±6.22, Group M was 163.12±4.18 and Group N was 164.20±3.79 cm. On comparing the data statistically no significant difference was found (P. value = 0.259) among the groups.

Table 3: Weight distribution in Group Dexmeditomidine, Magnesium Sulphate & Normal Saline

Weight	Dexmedetomidine (N=50)		Magnesium sulphate (N=50)		Normal Saline (N=50)		P. Value
	Number	Percentage	Number	Percentage	Number	Percentage	

38-48	8	16%	3	6%	1	2%	0.759
49-59	26	52%	22	44%	19	38%	
60-69	14	28%	23	46%	29	58%	
>69	2	4%	2	4%	1	2%	
Mean ±SD	55.66±8.05		58.12±6.85		60.46±5.01		

Mean weight of patients in group D was 55.66±8.05, Group M was 58.12±6.85 and Group N was 60.46±5.01cm. On comparing the data statistically no significant difference was found (P. value = 0.759) among the groups.

Table 4: Mean heart rate in bpm at various intervals

HR in min	Dexmedetomidine (N=50) Mean±SD Group D	Magnesium Sulphate (N=50) Mean±SD Group M	Normal Saline (N=50) Mean±SD Group N	P value D vs M	P value D vs N	P value M vs N
HR (T0)	85.53±6.42	86.00±12.3	89.73±17.27	0.563	0.126	0.337
HR(T1)	89.53±6.31	89.03±11.82	94.83±16.65	0.839	0.109	0.125
HR(T2)	83.06±5.35	89.66±14.74	88.90±18.48	0.286	0.100	0.860
HR(T3)	81.53±6.61	86.50±18.19	78.96±17.39	0.164	0.44	0.107
HR(T4)	78.06±5.59	81.66±19.47	74.40±13.88	0.330	0.184	0.101
HR(T5)	78.53±4.75	76.80±14.65	75.40±11.47	0.270	0.550	0.192
HR (T6)	77.46±4.57	79.76±14.01	75.23±9.24	0.814	0.240	0.622
HR(T7)	76.73±4.50	76.93±12.68	76.56±9.48	0.520	0.313	0.900
HR(T8)	78.46±3.18	78.76±9.35	78.33±11.52	0.860	0.950	0.874

In the group D (Dexmedetomidine), the basal value of mean heart rate is 85.53± 6.42 bpm and we observed a decrease in mean heart rate which is maximum of 8.80 bpm from basal value at HR(T7) (10.2% decrease from basal value). In the group M (Magnesium sulphate), the basal value of mean heart rate is 86.00 ± 12.34 bpm and we observed a decrease in mean heart rate which is maximum of 9.26 bpm from basal value at HR(T5) minute(10.68% decrease from basal value). In the group N (Normal Saline), the basal value of mean heart rate is 89.73± 17.27 bpm and we observed a decrease in mean heart rate which is maximum of 15.33 bpm from basal value at HR (T4) minute (17.08% decrease from basal value). The mean heart rate from basal to HR (T8) minute recording was statistically not significant between the groups.

Table 5: Mean SBP at various time intervals in mm Hg

SBP in min	Dexmedetomidine (N=50) Mean±SD Group D	Magnesium Sulphate (N=50) Mean±SD Group M	Normal Saline (N=50) Mean±SD Group N	P value D vs M	P value D vs N	P value M vs N
SBP(T0)	127.40±5.308	128.13±7.82	126.00±8.48	0.673	0.447	0.316
SBP(T1)	122.80±5.18	125.60±9.83	124.86±10.30	0.173	0.330	0.779
SBP(T2)	118.20±5.88	120.73±9.05	114.30±17.84	0.204	0.485	0.748
SBP(T3)	115.46±6.078	116.53±8.64	112.33±11.46	0.025	0.977	0.114
SBP(T4)	112.70±5.22	113.46±8.05	107.33±11.09	0.120	0.676	0.133
SBP(T5)	110.73±5.023	110.66±12.63	109.86±10.64	0.809	0.020	0.107

SBP(T6)	112.40±4.76	111.20±12.60	108.00±10.66	0.100	0.002	0.293
SBP(T7)	117.20±6.35	112.13±11.63	109.96±9.286	0.014	0.001	0.808
SBP(T8)	117.33±6.48	116.400±10.6	110.26±9.780	0.683	0.002	0.024

In the group D (Dexmedetomidine), the basal value of mean SBP is 127.40±5.308 mm Hg and we observe a fall in mean SBP which is maximum of 15 mm Hg from the mean basal SBP at SBP (T6) minute (11.77% fall from basal SBP). In the group M (Magnesium sulphate), the basal value of mean SBP is 128.13±7.82 mm Hg and we observe a fall in mean SBP which was maximum of 17.46 mm Hg from basal SBP (T5) (13.63% fall from basal SBP). In the group N (Normal saline), the basal value of mean SBP is 126.00±8.48 mm Hg and we observe a fall in mean SBP which is maximum of 18.66 mm Hg from mean basal SBP (T3) (14.81% fall from basal SBP). We observed a maximum fall in mean SBP (T5) which is 17.47% from base value in group M. In group M, the mean SBP (T5) is 110.6±12.62 mm Hg and remained more after that. We observed a maximum fall in mean SBP (T3) which is 14.81% from basal value in group N. The mean SBP in group N at T3 minute is 107.3±11 mmHg and remained more after that.

Table 6: Mean DBP at various time intervals in mm Hg

DBP (min)	**Dexmedetomidine (N=50) Mean±SD Group D**	**Magnesium Sulphate (N=50) Mean±SD Group M**	**Normal Saline (N=50) Mean±SD Group N**	**P value D vs M**	**P value D vs N**	**P value M vs N**
DBP(T0)	81.80±3.12	81.46±6.51	81.67±9.72	0.048	0.943	0.195
DBP(T1)	81.80±3.12	78.53±7.314	78.80±8.19	0.028	0.066	0.895
DBP(T2)	80.33±3.11	76.26±8.415	76.00±5.87	0.001	0.016	0.887
DBP(T3)	76.80±3.34	72.53±8.06	70.73±10.58	0.010	0.004	0.462
DBP(T4)	72.66±2.98	72.00±8.18	67.86±0.576	0.677	0.040	0.181
DBP(T5)	71.60±5.10	68.33±12.36	71.66±10.25	10.00	0.553	0.587
DBP(T6)	70.46±3.98	70.13± 7.62	70.53±9.15	0.385	0.579	0.855
DBP(T7)	73.00±6.09	70.46±6.31	71.33±8.273	0.016	0.378	0.138
DBP(T8)	73.20±5.39	72.33±12.09	71.53±7.13	0.721	0.312	0.756

In the group D (Dexmedetomidine), the basal value of mean DBP is 81.8±3.12 mmHg and we observed a fall in mean DBP which is maximum of 11.34 mmHg from mean basal DBP (T7) (13.84% fall from basal DBP). In group M (Magnesium sulphate), the basal value of mean DBP is 81.46±6.51 mmHg and we observed a fall in mean DBP which is maximum of 13.13 mmHg from mean basal DBP (T6) (16.11% fall from basal DBP). In group N (Normal saline), the basal value of mean DBP is 81.6±9.76 mmHg and we observed a fall in mean DBP which was maximum of 13.81 mmHg from mean basal DBP (T4) (16.90% fall from basal DBP).

Table 7: Mean MAP at various time intervals in mm Hg

MAP (min)	Dexmedetomidine (N=50) Mean±SD Group D	Magnesium Sulphate (N=50) Mean±SD Group M	Normal Saline (N=50) Mean±SD Group N	P value D vs M	P value D vs N	P value M vs N

MAP(T0)	96.96±4.97	96.53±8.43	96.83±9.06	0.838	0.961	0.826
MAP(T1)	94.96±4.95	94.89±6.37	95.26±8.32	0.946	0.866	0.917
MAP(T2)	90.06±6.38	89.93±4.96	89.50±8.49	0.928	0.810	0.771
MAP(T3)	85.46±4.52	87.36±7.76	84.23±10.50	0.251	0.559	0.196
MAP(T4)	84.42±3.86	85.10±7.70	81.06±12.40	0.479	0.240	0.136
MAP(T5)	84.40±4.87	82.96±6.93	82.53±10.45	0.908	0.379	0.362
MAP(T6)	83.93±4.60	84.56±6.11	82.80±8.762	0.083	0.038	0.570
MAP(T7)	85.42±3.86	84.93±11.0	84.50±8.02	0.274	0.101	0.863
MAP(T8)	86.53±3.94	85.80±9.46	85.26±7.36	0.180	0.044	0.808

In group D (Dexmedetomidine), the basal value of mean MAP is 96.13±6.47 mmHg and we observed a fall in mean MAP which is maximum of 12.2 mmHg from mean basal MAP (T6) (12.69% fall from basal MAP). In the group M (Magnesium sulphate), the basal value of mean MAP is 96.53±8.43 mmHg and we observed a fall in mean MAP which is maximum of 13.56 mmHg from mean basal MAP (T5) (14.04% fall from basal MAP). In group N (Normal saline), the basal value of mean MAP is 96.83±9.05 mmHg and we observed fall in mean MAP which is maximum of 14.20 mmHg from mean basal MAP (T3) (14.66% fall from basal MAP). The mean MAP from basal to T8 minute recording was statistically not significant between group D and group M.

Discussion

Appropriate multimodal analgesia is now becoming an integral part of general anaesthesia for providing a safe balanced and opioid free anaesthesia. Giving up the old opioid-centric model, anaesthesiologists are now focusing more on nonsteroidal anti-inflammatory drugs like acetaminophen, gabapentinoids, NMDA antagonists, alpha-2-agonists, and sodium and calcium channel blocking agents.[9] Our study correlates with the study done by Nand kishore Kalra et al[10] study in which administration of magnesium sulphate and Dexmedetomidine was done for attenuation of hemodynamic responses to pneumoperitoneum. The authors conducted that Dexmedetomidine blunts hemodynamic responses to pneumoperitoneum more effectively than magnesium sulphate (50mg/Kg). In this study dexmeditomidine of 1mcg/kg body weight over 10 minutes, was given 15 min before induction of pneumoperitoneum, followed by 0.5mcg/kg/hour. And infusion of magnesium sulphate 30mg/kg over 10 minutes, 15 mins before induction of pneumoperitoneum, followed by10mg/kg/hour and it was observed that dexmeditomidine group was more effective in the attenuation of haemodynamic surge than magnesium sulphate group. Magnesium sulphate group was observed to have marginally lower clinical values of SBP, MAP but it was statistically insignificant.

Another study correlated with us, Godhki et all, Dexmedetomidine (1 mcg\kg) in laparoscopic surgery. They found that Dexmedetomidine can be safely used in laparoscopic surgery without fear of awareness.[11] Concerning laparoscopic surgery, the obtained results supported what was previously reported by Smania et al. who found that dexmedetomidine efficiently blocks the hemodynamic responses to nociceptive stimuli when combined with inhaled for anesthesia of children submitted to laparoscopic video appendectomy.[12] The effect of dexmedetomidine on hemodynamics is due to decrease of sympathetic outflow from the locus ceruleus. Its sympatholytic effect leads to decrease of mean arterial blood pressure (MAP) and heart rate (HR) by reducing norepinephrine release. Its analgesic actions are mediated by releasing

of substance P from the dorsal horn of the spinal cord.

Gourishankar Reddy Manne et al[13], in 2014 compared the effects of low dose dexmedetomidine infusion (0.2 mcg/Kg/h and 0.4mcg/Kg/h)with normal saline on hemodynamic stress response, sedation and post-operative analgesia requirement in patients. They reported that low dose dexmedetomidine infusion in the dose of 0.4 mcg/kg/h showed lower values of heart rate and mean arterial pressure than other groups, and also it effectively attenuates hemodynamic stress response during laparoscopic surgery with reduction in post-operative analgesic requirements. We use dexmedetomidine of 1mcg/kg body weight followed by 0.5mcg/kg/hour. In our study also, similar effects with dexmedetomidine were observed. No cases of delayed arousal in group-D were noted. Vaishali Waindeskar et al[14], in 2015 assessed the role of dexmedetomidine as anesthetic adjuvant in laparoscopic surgeries. 150 patients were divided into three groups. Dose of dexmedetomidine used was 1mcg/Kg as loading dose and maintained with 0.2 mcg/Kg/h infusion. They reported that the fall in mean heart rate and mean systolic blood pressure with respect to dexmedetomidine was significant compared to the Group M. Bidyut Borah et al[15] 2017, A comparative study between Dexmedetomidine, clonidine and magnesium sulfate in attenuating hemodynamic response to laryngoscopy and intubation –a randomized study concluded that Dexmedetomidine (1mcg/kg) in comparison to clonidine(1mcg/kg) and magnesium sulfate (30mg/kg) was former effective in blunting the hemodynamic response to laryngoscopy in patients undergoing surgical procedures under general anesthesia. Md Shahbaz Alam et al[16] concluded that Out of the three haemodynamic parameters (Heart rate, SBP and DBP) dexmedetomidine and magnesium sulphate are equally effective in diminishing the BP in response to intubation and laryngoscopy but, dexmedetomidine is better in controlling the heart rate. Krishna Chaitanya et al[17], concluded that in addition to attenuate the pressor response magnesium sulphate also reduces the requirement of anaesthetic agents in the intraoperative period.

Conclusion

From this study, we concluded that intravenous premedication with Dexmedetomidine infusion for laparoscopic surgery under general anaesthesia is more beneficial than Magnesium sulphate and Normal saline in attenuating the blood pressure surge due to pneumoperitoneum.

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