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EFFECT OF MAGNESIUM SULPHATE ON INTUBATION AND INTRAOPERATIVE HEMODYNAMIC RESPONSE IN LAPROSCOPIC CHOLECYSTECTOMY

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ABSTRACT
Background: Endotracheal intubation and carbon dioxide pneumoperitoneum in patients undergoing laparoscopic cholecystectomy changes hemodynamic parameters**.** The impact of magnesium sulfate on hemodynamic responses during laparoscopic cholecystectomy remains controversial
Objectives: To evaluate the efficacy of administration of magnesium sulphate to attenuate hemodynamic responses during laparoscopic cholecystectomy
Methods: This was a randomized control study conducted in the department of Anaesthesia. Forty patients undergoing laparoscopic cholecystectomy were assigned into two groups. One group received magnesium sulfate (50mg/kg) and second group received normal saline (0.9%). Systolic and diastolic blood pressures, heart rate and mean arterial pressure were measured before the induction, at the end of infusion and after the induction in both the groups.
Results: There is no statistically significant differences between magnesium sulphate and normal saline groups in terms of age, gender, weight, ASA grade and duration of surgery ($p>0.05$). Common adverse effects like bradycardia, and hypotension were observed. The mean values of systolic blood pressure, diastolic blood pressure, heart rate and mean arterial pressure were significantly less ($P< 0.05$) in magnesium sulphate group as compared to normal saline group.
Conclusion: Magnesium sulphate effectively attenuates hemodynamic responses during intubation and pneumoperitoneum during laparoscopic cholecystectomy.

Keywords: Laparoscopy Cholecystectomy, Magnesium Sulphate, hemodynamic responses

INTRODUCTION
Laparoscopic cholecystectomy is known as one of the most common laparoscopic surgeries worldwide [1, 2]. Pneumoperitoneum with carbon dioxide (CO_2) insufflations for laparoscopic surgery induces abrupt elevations of arterial pressure and systemic vascular resistance, possibly due to an increase in intra peritoneal pressure and stimulation of the peritoneum by CO_2.and due to humeral mediators like catecholamines, prostaglandins, the renin-angiotensin system, and vasopressin which cause an increase in systemic vascular resistance [3]. Magnesium sulphate also produces the vasodilator effect, and high dose Magnesium diminishes vasopressin-stimulated vasoconstriction [4]. Magnesium sulphate blocks the release of catecholamines from the adrenergic nerve terminals and adrenal glands in vitro. It also produces vasodilation by acting directly on blood vessels and also on coronaries [5]. High dose magnesium attenuates vasopressin stimulated vasoconstriction and normalizes sensitivity to vasopressin.8 Magnesium sulphate also blocks the NMDA receptors in CNS thus producing pain relief [6-7]. Magnesium sulfate is a well-known safe antihypertensive drug, which can be used during the perioperative period [8]. It can effectively attenuate the adverse hemodynamic fluctuations during laparoscopy, prevent the adverse cardiovascular events during laryngoscopy and tracheal intubation [9], reduce the stress response, and strengthen the postoperative analgesia [10]. Furthermore, it was reported that high doses of intravenous magnesium sulfate could attenuate increased blood pressure and systemic vascular resistance [11].

Aim of this study: To study the effect of magnesium sulphate on intubation response and intraoperative hemodynamic response in laparoscopic cholecystectomy.

PRIMARY OUTCOME MEASURES:

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- Systolic blood pressure, diastolic blood pressure, mean arterial pressure, heart rate to be measured after intubation and after pneumoperitoneum .

1. Baseline
2. After intubation
3. After pneumoperitoneum- PP0, PP5, PP10, PP20, PP30, PP40, PP50

SECONDARY OUTCOMES:

- To assess for any intraoperative and post operative complications
- To assess delay in extubation time
- To assess the sedation by scoring system at the time of extubation

MATERIALS AND METHODS

This prospective randomized control study was conducted in the department of Anaesthesia in Rajiv Gandhi government general hospital, Madras Medical College, Chennai from September 2019 to September 2020 (one year duration).

A total of 40 patients who underwent elective laparoscopic cholecystectomy under general anesthesia were enrolled.

Inclusion criteria:

- Patients 18-50 years of age with both gender
- Patients having BMI <25 Kg/m2
- Patients underwent elective cholecystectomy with ASA grade I & II
- Patients who provided written informed consent for the study

Exclusion criteria:

- Patients who refused to give consent
- ASA PS II/greater
- H/O consumption of antihypertensive drugs, sedatives, hypnotics and anti depressants pre-operatively
- Pre-existing CVS disease, significant respiratory, renal, hepatic diseases, diabetes mellitus, hypertension
- History of alcohol abuse
- Pregnant women
- Hypermagnesemia
- Drugs, beta blockers, MAO inhibitors, TCA antidepressants
- Conversion to open procedure
- History of seizures or any neurological deficit
- Emergency procedures
- History of allergy
- Psychiatric diseases

The patients who satisfied the inclusion criteria were explained about nature of procedure, tests, advantages and side effects in an elaborate manner. Written consent was obtained and procedure was explained to patient in his or her own language. Age, height, weight, BMI were noted down. Vital parameters recorded. Basic investigation Complete blood count, renal function test, electrolytes, blood grouping and typing, bleeding time and clotting time, liver function test, ecg, chest x ray taken. Systemic and airway examination was done.

Preoperative magnesium levels were taken on the day before surgery.

MATERIALS:

Boyles machine, Laryngoscope with different blades, Endotracheal tubes, Airway gadgets, 18 G venflon

DRUGS:

INJ. Glycopyrrolate, Inj. Fentanyl, Inj. Thiopentone sodium, Inj. Atracurium. Inj. Neostigmine, Inj. Magnesium sulphate, Inj. Nitroglycerine, Inj. Atropine. Inj. Dopamine & inj. Adrenaline, Inj. Calcium gluconate. All emergency drugs kept ready.

INTRAVENOUS FLUID:

Normal saline, Ringer lactate.

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MONITORS:

- NIBP
- ECG
- 55
- SPO2
- EtCO2
- IAP monitoring

All patients were kept on 6 hours starvation. Patients were pre medicated with T. alprazolam 0.25mg, T.ranitidine 150mg given day before surgery.
Pre-operative serum magnesium was taken on the day before surgery.
Two groups of patient monitors were attached to patients and all baseline parameters like HR, NIBP, oxygen saturation and ECG were recorded.

Group I: Magnesium sulphate 50mg/kg in 250ml of 0.9%NS IV 15-20 minutes before induction
Group II: Same volume of 0.9%NS IV 15-20 minutes before induction → Inj. Glycopyrrolate 0.2mg IV given. Inj. Fentanyl 2 microgram/kg i.v given 5 minutes before induction → Pre oxygenation for 3 minutes

Induction using Inj.Thiopentone 3 to 5mg/kg, Inj.Succinylcholine 1.5mg/kg i.v following
Intubation with appropriate size endotracheal tube and ETCO2 were connected → All patients maintained with 33% oxygen 67% nitrous oxide, 2% Sevoflurane and intermittent positive pressure ventilation.

Non depolarizing muscle relaxants like atracurium 0.5 mg/kg i.v as loading dose, 0.1 mg/kg as maintenance dose given as intermittent boluses every 40 minutes. The tidal volume and respiratory rate adjusted to maintain end tidal carbon dioxide between 35 and 40 mm Hg. During surgery, Ringer‟s lactate was infused in accordance with maintenance volume requirements and blood loss. CO2 pneumoperitoneum was created and intra abdominal pressure maintained at 12 mm Hg. 20% increase from the baseline blood pressure is considered hypertension treated with nitroglycerine infusion. 20% decrease from baseline blood pressure was considered as hypotension which was treated with crystalloid bolus and titrated vasopressor support. 20% decrease in baseline heart rate was considered as bradycardia which was treated with atropine injection.

Assessment of parameters
The parameters like Systolic blood pressure, Diastolic blood pressure, mean arterial Blood pressure, heart rate were recorded at the following point of time.
1. Prior to induction (baseline value)
2. At the end of infusion (PP0)
3. 5 min after pneumoperitoneum (PP5)
4. 10 min after pneumoperitoneum (PP10)
5. 20 min after pneumoperitoneum (PP20)
6. 30 min after pneumoperitoneum (PP30)
7. 40 min after pneumoperitoneum (PP40)

Patients were monitored for any adverse effects like bradycardia, and hypotension during intraoperative period. Neuromuscular block was reversed with intravenous neostigmine 0.05 mg/kg and glycopyrrolate 0.02 mg/ kg and after adequate recovery, patient extubated.

SECONDARY OUTCOMES:
Adverse effects immediately after the extubation the patients were monitored for nausea, vomiting, and level of sedation assessed by Modified Ramsay sedation score.
Post operative side effects like bradycardia, hypotension monitored for one day in Post anesthetic care unit. Post operative magnesium levels were taken for all patients

Ethical consideration: Written inform consent was obtained from all the patients and the study were approved from the institutional ethics committee.

Statistical analysis: Data were analysed by using SSPS version 20.0. Descriptive data were calculated in form of

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frequency, mean standard deviation. Student t test was used to compare continuous variables. Chi-square test used to compare the various continuous variables. Significance level: $p < 0.05$ is considered significant

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RESULTS

A total of forty patients undergoing laparoscopic cholecystectomy under general anesthesia randomly divided into two groups. One group received magnesium sulphate and another group received normal saline. Both groups are compared in terms of demographics and vital parameters.

Majority of the patients 31-45 years age group (45% in group I & 55% in group II). Female was predominant (65%) in group I whereas male was common group II (65%). Majority of the cases were ranging between 41 kgs to 50 kgs in both groups. Most of the cases belonged to ASA grade I (95% in group I & 85% in group II). No significant differences between both the groups in terms of age, gender, weight, ASA grade and duration of surgery (p>0.05).

Table 1: Baseline characteristics of cases and controls

Baseline characteristics		Group 1 (n=20)	Group 2 (n=20)
Age group (In years)	<30	2 (10%)	1 (5%)
	31–45	9 (45%)	11 (55%)
	46-60	9 (45%)	8 (40%)
(Mean ± SD) Age in years		36.9± 5.46	37.6± 5.03
Gender	Male	7 (35%)	13 (65%)
	Female	13 (65%)	7 (35%)
Weight (in kg)	<30	0 (00%)	1 (5%)
	31–40	7 (35%)	7 (35%)
	41-50	11 (55%)	10 (50%)
	51-60	2 (10%)	2 (10%)
ASA	I	19 (95%)	17 (85%)
	II	1 (5%)	3 (15%)
Duration of Surgery (Mean±SD)		59.85± 2.26	61.20 ± 2.86
Adverse Effects	Hypotension	2 (10%)	-
	Bradycardia	1 (5%)	-
	No adverse effects	17 (85%)	20 (100%)

The mean values of heart rate were significantly less (P< 0.05) at PP 10 minutes, 40 minutes and 50 minutes in magnesium sulphate group.

Table 2: Comparison of Heart Rate among both the groups

Heart Rate	Group 1	Group 2	P Value
	Mean ± SD	Mean ± SD	
Baseline	79.90 ± 7.59	78.10 ± 8.30	0.416
Pre Intubation	88.65 ± 8.65	88.65 ± 9.03	1.000
After Intubation	94.30 ± 10.29	97.55 ± 10.10	0.344
PP 0 Minutes	91.00 ± 9.44	93.50 ± 9.79	0.329
PP 5 Minutes	88.25 ± 8.65	91.40 ± 8.91	0.135
PP 10 Minutes	85.95 ± 9.71	92.65 ± 7.58	0.007
PP 20 Minutes	85.40 ± 11.22	90.45 ± 7.80	0.127
PP 30 Minutes	84.30 ± 9.43	89.00 ± 7.18	0.147
PP 40 Minutes	81.85 ± 9.91	88.75 ± 8.63	0.049
PP 50 Minutes	82.30 ± 9.71	89.50 ± 8.50	0.048

The mean arterial pressure was statistical significance (P < 0.05) at after intubation PP 0 minutes, 5 minutes, 10 minutes & 20 minutes.

Table 3: Comparison of Mean arterial pressure among both the groups

Mean arterial pressure	Group 1	Group 2	P Value
	Mean ± SD	Mean ± SD	
Baseline	94.10 ± 5.67	96.40 ± 6.83	0.287
Pre Intubation	86.30 ± 5.46	88.15 ± 8.27	0.380
After Intubation	97.85 ± 6.27	101.25 ± 10.48	0.007
PP 0 Minutes	95.15 ± 7.52	102.40 ± 7.34	0.006
PP 5 Minutes	100.25 ± 7.98	109.95 ± 7.98	0.007

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PP 10 Minutes	102.15 ± 8.92	102.80± 8.30	0.005
PP 20 Minutes	102.80± 8.30	110.70 ± 4.64	0.002
PP 30 Minutes	102.35± 8.34	109.55± 4.87	0.007
PP 40 Minutes	103.55± 8.72	110.90± 6.70	0.101
PP 50 Minutes	105.40± 5.56	110.85± 5.81	0.115

The mean systolic blood pressure were statistical significance (P < 0.05) after Intubation, at PP 0 minutes, 5 minutes, 10 minutes, 20 minutes & 30 minutes between the groups.

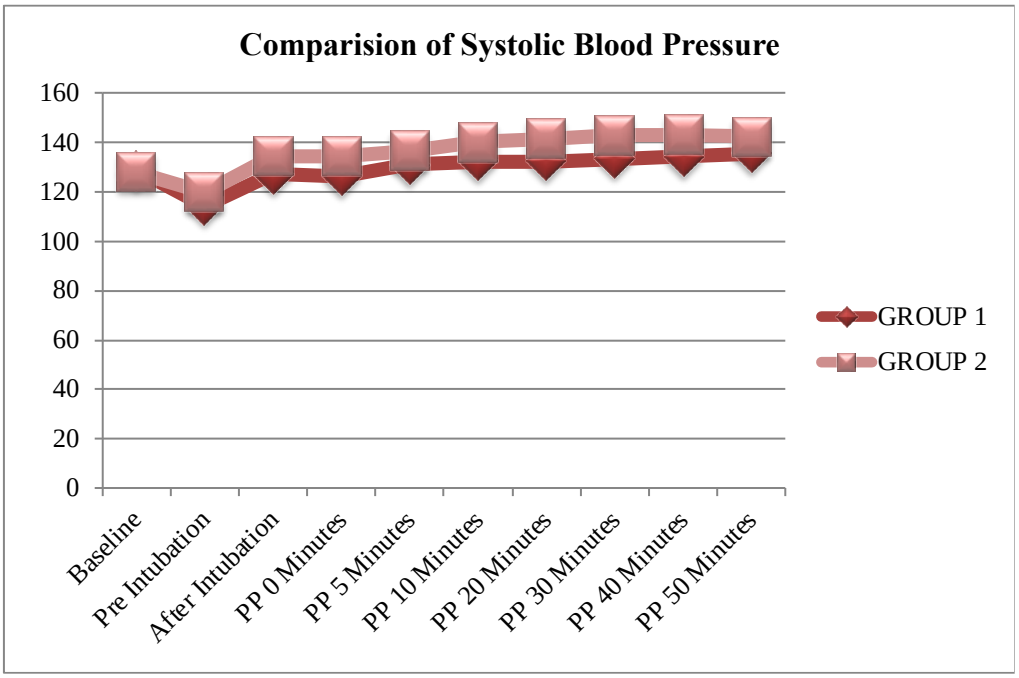

Figure 1: Comparison of Systolic Blood Pressure in both the groups

The mean values of diastolic blood pressure when compared between two groups proved a statistical significance (P < 0.05) at after intubation, PP 0 minutes, 5 minutes, 10 minutes & 20 minutes

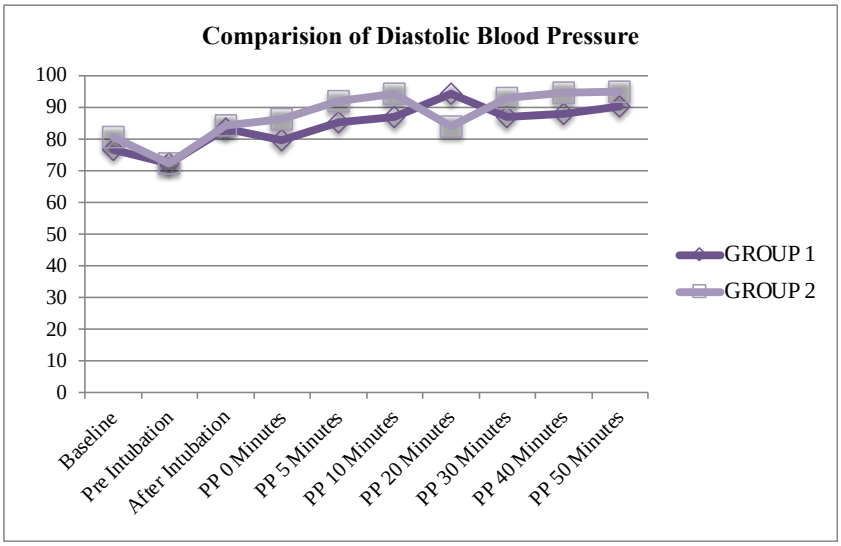

Figure 2: Comparison of Diastolic Blood Pressure in both the group

DISCUSSION

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Elevated intra-abdominal pressure induced by pneumoperitoneum and CO2 in laparoscopic laparotomy can produce some adverse effects on the cardiovascular and hemodynamic system. Magnesium has a vasodilator action, thus contributing to the reduction of blood pressure. Magnesium sulfate has been reported to attenuate the adverse hemodynamic response of endotracheal intubation.

In our study there was no significant difference between the groups regarding
Mean age, gender, weight and ASA grade (P>0.05), consistent finding reported by R. Uma, et al [12] and Mohan A, et al [13].

Magnesium sulfate has been reported to attenuate the some adverse hemodynamic response (hypotension and bradycardia) in the current research, concordance with the Zhang et al [14].

The mean systolic blood pressure was significantly less in magnesium sulphate group (P < 0.05) after Intubation, at PP 0 minutes, 5 minutes, 10 minutes, 20 minutes & 30 minutes, similar results observed in other studies: Akhondi M, et al [15] and Tan et al [16].

Present study reported that magnesium sulphate doses were statistically significantly differ in Pre and post operatively (p<0.**0**5), in agreement with the Anjum S, et al [17] and Das S, et al [18].

We have seen that Mean arterial pressure was significantly low in magnesium sulfate group than control group after intubation PP 0 minutes, 5 minutes, 10 minutes and 20 minutes, findings correlate with the Paul et.al [19] and Masood, et al [20].

Mean heart rate was significantly fall after magnesium sulphate infusion at PP 10 minutes, 40 minutes and 50 minutes, accordance with the Desai DJ, et al [21] and Jaisawal S, et al [22].

The mean values of the HR and MAP were highly significantly less than the baseline value with MgSO4 compared to NS.

In this study the mean diastolic blood pressure was significantly differ between the magnesium sulphate and NS group (P < 0.05) at after intubation, PP 0 minutes, 5 minutes, 10 minutes & 20 minutes, our results comparable to Patil VPB, et al [23] and Kamble SP, et al [24].

Overall effect of magnesium sulphate on attenuation of hemodynamic responses during laparoscopic surgeries that heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure were significantly less in magnesium sulphate group as compared to normal saline group (p<0.05).

CONCLUSION

We have concluded that the Intravenous administration of magnesium 50 mg/kg before induction is effective in blunting the hemodynamic stress responses during intubation and laparoscopic surgeries and has incidence of hypotension, bradycardia without delay in extubation time.

Conflicts of interest: None

REFERENCES

1. Kao LS, Ball CG, Chaudhury PK. for Members of the Evidence Based Reviews in Surgery, Evidence-based reviews in surgery: early cholecystectomy for cholecystitis. Ann Surg 2018; [Epub ahead of print].
2. Ozkardes AB, Tokac M, Dumlu EG, et al. Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a prospective, randomized study. Int Surg 2014; 99:56–61.
3. Chandrasekaran V, Jayaraj P. Comparison of Dexmedetomidine and Magnesium Sulphate to assess neuroendocrine response using blood glucose as a marker in laparoscopic Cholecystectomy. IOSR-JDMS. 2017; 16(10):77-80.
4. Forkin KT, Nemergut EC. Miller's Anesthesia, 8th Edition. Anesthesiology. 2016; 124(4):977–8. https://doi.org/10.1097/aln. 0000000000001020.

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5. Larsen JF, Svendsen FM, Pedersen V. Randomized clinical trial of the effect of pneumoperitoneum on cardiac function and haemodynamics during laparoscopic cholecystectomy. Br.J.Surg. 2004; 91(7):848–854.
6. Mentes O, Harlak A, Yigit T, Balkan A, Balkan M, Cosar A, et al. Effect of intraoperative magnesium sulphate infusion on pain relief after laparoscopic cholecystectomy. Acta Anaesthesiologica Scandinavica. 2008;52(10):1353-9
7. Hazra R, Manjunatha S, Manuar M, et al. Comparison of the effects of intravenously administered dexmedetomidine with clonidineon hemodynamic responses during laparoscopic cholecystectomy. Anaesth Pain Intensive Care. 2014; 18:25–30.
8. De Baaij JH, Hoenderop JG. Magnesium in man: implications for health and disease. Physiol Rev. 2015; 95:1–46.
9. Panda NB, Bharti N. Minimal effective dose of magnesium sulfate for attenuation of intubation response in hypertensive patients. J Clin Anesth. 2013; 25:92–7.
10. Albrecht E, Kirkham KR, Liu SS. Peri-operative intravenous administration of magnesium sulphate and postoperative pain: a meta-analysis. Anaesthesia. 2013; 68:79–90.
11. Jee D, Lee D, Yun S. Magnesium sulphate attenuates arterial pressure increase during laparoscopic cholecystectomy. Br J Anaesth. 2009; 103:484–9.
12. R. Uma, Meera Rani Nayak & Hansa Jayakumar. Journal of Pharm Biomed Science 2013, Februalry; 27(27): 451-455
13. Mohan A, Saha G. A comparative study of the efficacy of intravenous magnesium sulphate and intravenous dexmedetomidine in attenuating haemodynamic response to laryngoscopy and endotracheal intubation. *Indian J Clin Anaesth* 2023; 10(4):351-357.
14. Juyi Zhang, Yubin Wang, Hao Xu, Juan Yang, Influence of magnesium sulfate on hemodynamic responses during laparoscopic cholecystectomy, Medicine (2018) 97:45(e12747.
15. Mahboobeh Akhondi and Ali Sarkoohi, Effect of Intravenous Injection of Magnesium Sulphate on Intraoperative End-Tidal CO2 Level and Postoperative Pain in Laparoscopic Cholecystectomy, Anesth Pain Med. 2023 December; 13(6):e135189.
16. Wei Tan, Dong-chen Qian, Meng-meng Zheng, Xuan Lu, Yuan Han and Dun-yi Qi, Effects of different doses of magnesium sulfate on pneumoperitoneum-related hemodynamic changes in patients undergoing gastrointestinal laparoscopy: a randomized, double-blind, controlled trial, BMC Anesthesiology (2019) 19:237 https://doi.org/10.1186/s12871-019-0886-4
17. Anjum Shamim, Raja Suhail Shounthoo, Sabeeha Gul, Effect of Magnesium Sulphate on intraoperative hemodynamic responses in laparoscopic cholecystectomy, *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 14, Issue 10 Ver. VI (Oct. 2015), PP 73-82.*
18. Das S, Basu S, Sasidharan S, Dhillon HS. The effects of magnesium sulphate on haemodynamic stress response to pneumoperitonium in laparoscopic cholecystectomy: a double blinded randomised controlled study. Int J Adv Med 2021;8:872-80.
19. Paul S, Biswas P, Bhattacharjee DH, Sengupta J. Effects of magnesium sulfate on hemodynamic response to carbon dioxide pneumoperitoneum in patients undergoing laparoscopic cholecystectomy. Anesthesia: Essays and researches. 2013 May-Aug; 7:228-231.
20. Masood Entezariasl Khatereh Isazadehfar, Zeinab Hasani. Effect of magnesium sulfate on hemodynamic response to endotracheal intubation and carbon dioxide pneumoperitoneum in laparoscopic cholecystectomy. *Biomedicine and Nursing* 2018; 4(1): 27-31]. ISSN 2379-8211 (print); ISSN 2379-8203(online).http://www.nbmedicine.org.
21. Desai DJ, Shah S and Upadhyay MR (2019) A Prospective Randomized Comparative Study of Intravenous Dexmedetomidine versus Magnesium Sulphate as an Adjunct during Anesthesia for Laparoscopic Cholecystectomy. J Anesth Clin Res 10: 930
22. Shivam Jaisawal, Vijay Kumar Nagpal, Amlendu Yadav, Sandeep Kumar*, Rupesh Yadav, Comparison of Magnesium Sulphate and Dexmedetomidine for Attenuation of Stress Response in Patients Undergoing Laparoscopic Cholecystectomy under General Anaesthesia by Measuring Biochemical Markers of Stress Response: A Prospective Randomized Study, Archives of Anesthesiology and Critical Care (Spring 2024); 10(2): 154-159.
23. Patil VPB, Tambakhe MG, Lawhale SS, Upadhye JJ. Hemodynamic response in laparoscopic cholecystectomy after magnesium sulphate versus clonidine administration. Int J Res Med Sci 2018; 6:3239-45.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE8, 2024

24. 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. Ane Essays Res. 2017; 11(1):67-71.