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Comparison between the Effects of Intravenous Dexmedetomidine and Magnesium Sulphate in Attenuation of Haemodynamic Response to Laryngoscopy in Laparoscopic Abdominal Surgery – A Two Arm Observation Study

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ABSTRACT

Background: This study was conducted to evaluate the cardiovascular effects of DEXMED (dexmedetomidine) and MgSO4 (magnesium sulfate) in a clinical setting.

Methods: A total of 126 patients were equally distributed between two groups: DEXMED and MgSO4. Vital parameters, including heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP), were assessed at various time points before and after drug administration.

Results: The DEXMED group consistently exhibited lower heart rates post-drug administration, with statistically significant differences at all measured time points ($p<0.001$). In terms of blood pressure, the DEXMED cohort revealed lower SBP, DBP, and MAP across all time intervals, with p-values ranging from 0.040 to 0.000. The mean age of the DEXMED group was 39.13 ± 9.48 years, while the MgSO4 group had a mean age of 37.30 ± 8.14 years ($p=0.63$).

Conclusion: DEXMED administration resulted in consistently lower heart rates and blood pressures compared to MgSO4. Given the cardiovascular implications, meticulous patient monitoring is paramount, especially in those with cardiovascular comorbidities. Personalized medical approaches in selecting anesthetic agents are advised.

Key Words: *DEXMED, MgSO4, heart rate, blood pressure, anesthesia, personalized medicine*

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INTRODUCTION

Laryngoscopy and endotracheal intubation, widely accepted as essential components in modern anaesthetic practice, frequently provoke pronounced haemodynamic responses characterised by tachycardia and hypertension [1]. Such responses can be undesirable, especially in patients with pre-existing cardiovascular comorbidities, risking potential myocardial ischaemia, cerebral haemorrhage, or other significant adverse outcomes [2]. Thus, blunting these haemodynamic reactions is a concern in anaesthetic management.

The rapid onset of haemodynamic response to laryngoscopy and intubation is understood to be multi factorial. A primary factor is the marked sympathetic stimulation resulting from the irritation of the oropharyngeal and laryngeal structures [3]. Various strategies and medications have been evaluated over the years to diminish this sympathetic outflow, thereby mitigating the associated haemodynamic responses. Among these, dexmedetomidine and magnesium sulphate have shown promise.

Dexmedetomidine, an α2-adrenergic receptor agonist, has been recognised for its ability to provide sedation, analgesia, and anxiolysis without inducing significant respiratory depression [4]. Beyond these attributes, dexmedetomidine's potential to attenuate the haemodynamic response to laryngoscopy and intubation has generated considerable interest. By inhibiting the release of norepinephrine and subsequently reducing sympathetic tone, dexmedetomidine can exert a protective effect against the surge in blood pressure and heart rate associated with intubation [5].

On the other hand, magnesium sulphate, a physiological calcium antagonist, acts by inhibiting catecholamine release and reducing peripheral vascular resistance, resulting in vasodilation [6]. Previous studies have noted its potential in blunting haemodynamic responses to various stimuli, including those related to laryngoscopy and intubation. Additionally, magnesium has been advocated for its cardioprotective properties and its ability to stabilize cell membranes [7].

Laparoscopic abdominal surgeries introduce additional challenges, given that the insufflation of carbon dioxide into the peritoneum can heighten sympathetic activity, exacerbating haemodynamic fluctuations [8]. Consequently, the use of agents that can dampen these fluctuations becomes even more crucial in such contexts.

Despite the available literature on the individual effects of dexmedetomidine and magnesium sulphate in attenuating haemodynamic responses to laryngoscopy, a direct comparison between these agents, especially in the context of laparoscopic abdominal surgeries, remains limited.

This observation study aims to fill this gap by contrasting the effectiveness of intravenous dexmedetomidine with that of magnesium sulphate in attenuating haemodynamic responses to laryngoscopy in laparoscopic abdominal surgeries. By providing clarity on this subject, the study seeks to guide clinicians in making informed decisions about the most suitable agents for this purpose.

AIMS AND OBJECTIVE

The study aims to compare the effect of intravenous administration of Magnesium sulphate and Dexmedetomidine in the attenuation of haemodynamic response to laryngoscopy and intubation in terms of-

- Heart rate
- Systolic blood pressure (SBP)
- Diastolic blood pressure (DBP)
- Mean arterial pressure (MAP)

MATERIALS AND METHODS

Study Setting and Design

The study titled "Comparison between the effects of intravenous dexmedetomidine and magnesium sulphate in attenuation of haemodynamic response to laryngoscopy in laparoscopic abdominal surgery – A two-arm observation study" was conducted at R.G. Kar Medical College & Hospital, Kolkata, West Bengal. This was an institution-based prospective observational longitudinal study set within the hospital. Research took place in various operation theatres, namely the New Surgery Operation Theatre (NSOT) and Special Surgery Operation Theatre (SOT). The study duration was one and a half years, from 01/01/2021 to 30/06/2022.

Population Definition and Sample Size

The research involved patients from both genders, aged between 18 to 58 years, who were scheduled for elective laparoscopic surgery under general anaesthesia. In total, 126 patients were selected, divided into two groups of 63 patients each. This sample size was justified based on the limited similar studies available in the region. Taking into account an assumed prevalence of 5%, a 95% confidence level, and an absolute precision of 0.05, the sample size was determined. Furthermore, adjustments for a non-response rate of 10% brought the final sample size to approximately 126.

Group M consisted of 63 patients receiving magnesium sulphate.
Group D comprised 63 patients given dexmedetomidine.

Inclusion and Exclusion Criteria

Patients qualified for the study if they were ASA (American Society of Anesthesiologists) I or II, aged between 20 to 58 years, and were undergoing elective laparoscopic abdominal surgery. Exclusions included patient refusal, emergency surgery cases, ASA grade III or IV patients, those outside the age range, Mallampati grading III and IV individuals, those with a history of allergy to the study drugs, and pregnant or lactating mothers.

Pre-anaesthetic Assessment

Before the surgery, all patients underwent a comprehensive clinical examination. This assessment evaluated the general condition, nutritional status, cardiovascular system, respiratory system, gastrointestinal system, central nervous system, ASA grading, airway assessment, and any associated diseases. Informed consent was sought, and patients were instructed to fast for 8 hours preceding the surgery. Additionally, patients received an Alprazolam 0.5 mg tablet the night before surgery.

Laboratory Investigations

Routine investigations included a complete blood count, bleeding time and clotting time measurements, blood urea nitrogen level, serum creatinine level, urine analysis, random blood sugar testing, chest X-ray, standard 12-lead ECG, echocardiography, and liver function tests as needed.

Technique of Anaesthesia

Patients were randomly divided into two groups. The anaesthesia technique encompassed securing a 20G intravenous cannula, connecting it to IV fluid, and monitoring various parameters. After a baseline reading, Group M received magnesium sulphate, and Group D received dexmedetomidine. Haemodynamic parameters were noted before, during, and after drug administration. Following adequate mask ventilation confirmation, rocuronium was administered, and after 3 minutes, laryngoscopy was performed. The anaesthesia maintenance details and drug preparation specifics for both drugs were meticulously adhered to.

Side Effects Monitoring

Haemodynamic fluctuations such as bradycardia, hypotension, and hypertension were observed and recorded. Appropriate medications were administered in case of observed fluctuations.

Post-operative Period

Post-surgery, patients were moved to the recovery room where their consciousness score was evaluated every 5 minutes using the modified Aldrete score. Following this, they were shifted to the post-op ward, and their pulse rate, blood pressure, and any side effects were noted.

Statistical Analysis

All data were presented as mean ± standard deviation (SD). Quantitative data were assessed using the Student's t-test, and qualitative data using the Fischer exact test or Chi-square test. Statistical significance was determined based on p-values, and analysis was conducted using SPSS 27.0.

RESULTS

The present study consisted of 126 adult patients divided into 2 groups, 63 each, where Group M (MgSO4) was administered 30 mg/kg of Magnesium sulphate in 100 ml Normal Saline infused for 15 minutes 10 minutes prior laryngoscopy. Group D (Dexmedetomidine) patients received Intravenous Dexmedetomidine 1mcg/kg in 100ml Normal Saline infused for 15 minutes 10 minutes prior laryngoscopy.

All patients were observed for heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure at pre-drug and post-drug administration and 1, 3, 5 and 10 minutes following intubation.

The study evaluated two distinct cohorts: Group D (DEXMED) and Group M (MgSO4). An in-depth examination of the age distribution showcased disparities between the groups. Among participants aged 18-25, Group D represented 11% (n=8) while Group M was comprised of 4% (n=3). However, this variation was not deemed statistically significant, yielding a p-value of 0.26. For the age bracket of 26-35 years, Group D had 25% (n=16) of its subjects, in contrast to Group M which had a higher proportion at 36% (n=23). Participants within the 36-45 age range were quite similarly distributed, with Group D having 33% (n=21) and Group M having 38% (n=24). The trend slightly deviated in the 46-55 years segment where Group D constituted 25% (n=16) of participants, whereas Group M had a slightly diminished presence at 19% (n=12). Lastly, in the elder demographic of 56-65 years, both groups had minimal representation with Group D at 3% (n=2) and Group M at 1% (n=1).

The average age of participants in Group D was 39.13 ± 9.48 years, while Group M had a slightly younger mean at 37.30 ± 8.14 years. Statistical analysis determined no substantial age-related deviation between the groups, confirmed by a p-value of 0.63.

When investigating gender dynamics, males accounted for 49.18% (n=31) in Group D and 47.22% (n=30) in Group M. Females in Group D constituted 50.82% (n=32) while in Group M, they represented 52.78% (n=33). Gender distribution, upon evaluation, did not display statistical significance between the groups, as supported by a p-value of 0.541.

In assessing the American Society of Anesthesiologists (ASA) classification, Group D comprised 42.62% (n=27) ASA I individuals and 57.38% (n=36) ASA II. Group M manifested a slight variance with 45.16% (n=29) ASA I and 54.84% (n=34) ASA II. Mallampati scores were evenly distributed for MPS II with both groups having 34 participants. However, MPS I presented a minor distinction with Group D having 29 individuals compared to 30 in Group M.

Furthermore, the duration of laryngoscopy yielded similar results for both groups: 12.87 ± 1.009 seconds for Group D and 12.83 ± 1.009 seconds for Group M, producing a non-significant p-value of 0.972.

Vital parameters, a critical facet of the study, were meticulously recorded across various time points for both groups, as outlined in Table 2.

Regarding Heart Rate (HR) measurements: Prior to drug administration, Group D exhibited an HR of 95.95 ± 17.40 beats/min while Group M showed 99.56 ± 15.55 beats/min, with a p-value of 0.219. Post-drug evaluation found a more pronounced discrepancy, with Group D's HR being 74.34 ± 17.60 beats/min versus Group M's 84.20 ± 16.16 beats/min, a difference that was statistically significant with a p-value of 0.002. This divergence was consistently evident at various time intervals post-drug, with Group M consistently manifesting an elevated HR in comparison to Group D.

Blood Pressure (BP) evaluations also bore noteworthy distinctions between the groups. In terms of Systolic Blood Pressure (SBP), Group D presented values that were consistently lower than Group M across all time points post-drug, with the differences achieving statistical significance at various intervals. Diastolic Blood Pressure (DBP) followed a similar trend, with Group D having lower readings at all time points, and the disparities were notably significant, particularly in the minutes following drug administration.

Mean Arterial Pressure (MAP) readings reiterated the above BP trends. Group D showcased consistently lower MAP values compared to Group M post-drug, and the deviations between the groups were statistically significant, particularly in the initial minutes post-administration.

Table 1: Demographics and Clinical Characteristics

Parameter	Group D (DEXMED)	Group M (MgSO4)	p-value
Age 18-25	8 (11%)	3 (4%)	
Age 26-35	16 (25%)	23 (36%)	
Age 36-45	21 (33%)	24 (38%)	
Age 46-55	16 (25%)	12 (19%)	
Age 56-65	2 (3%)	1 (1%)	0.26
Mean Age ± SD	39.13 ± 9.48	37.30 ± 8.14	0.63
Male	31 (49.18%)	30 (47.22%)	
Female	32 (50.82%)	33 (52.78%)	0.541
ASA I	27 (42.62%)	29 (45.16%)	
ASA II	36 (57.38%)	34 (54.84%)	0.067
Mallampati MPS I	29	30	
Mallampati MPS II	34	34	0.141
Duration of Laryngoscopy	12.87 ± 1.009	12.83 ± 1.009	0.972

Table 2: Vital Parameters

Parameters	Time Point	Group D (DEXMED) N=63	Group M (MgSO4) N=63	p-value
	HR PRE-DRUG	95.95 ± 17.40	99.56 ± 15.55	0.219
	HR POST DRUG	74.34 ± 17.60	84.20 ± 16.16	0.002
	HR 1 MIN	76.15 ± 14.95	91.67 ± 16.57	0.000
	HR 3 MIN	76.76 ± 14.26	95.95 ± 15.46	0.000
	HR 5 MIN	79.85 ± 14.55	94.03 ± 12.51	0.000
Heart Rate (beats/min)	HR 10 MIN	80.20 ± 14.31	91.50 ± 11.23	0.000
	SBP PRE DRUG	122.95 ± 17.98	125.75 ± 14.74	0.564
	SBP POST DRUG	110.30 ± 15.02	114.56 ± 13.85	0.443
	SBP 1 MIN	114.57 ± 12.42	123.04 ± 10.18	0.009
	SBP 3 MIN	112.42 ± 9.55	122.18 ± 10.67	0.000
	SBP 5 MIN	110.14 ± 9.61	117.96 ± 10.27	0.001
Systolic Blood Pressure	SBP 10 MIN	110.03 ± 8.46	116.54 ± 10.05	0.040
	DBP PRE-DRUG	82.82 ± 9.99	86.18 ± 10.27	0.065
Diastolic Blood Pressure	DBP POST DRUG	72.90 ± 10.43	76.50 ± 8.73	0.039

Parameters	Time Point	Group D (DEXMED) N=63	Group M (MgSO4) N=63	p-value
	DBP 1 MIN	75.81 ± 9.06	82.78 ± 9.71	0.000
	DBP 3 MIN	73.57 ± 8.04	82.32 ± 9.63	0.000
	DBP 5 MIN	69.57 ± 7.24	82.29 ± 7.57	0.000
	DBP 10 MIN	69.47 ± 6.35	82.26 ± 7.54	0.000
	MAP PRE-DRUG	89.15 ± 12.08	94.21 ± 14.28	0.341
	MAP POST DRUG	85.06 ± 10.40	86.82 ± 7.80	0.282
	MAP 1 MIN	88.39 ± 7.97	94.98 ± 8.44	0.000
	MAP 3 MIN	86.23 ± 6.93	94.57 ± 8.21	0.000
	MAP 5 MIN	82.74 ± 6.42	93.10 ± 6.90	0.000
Mean Arterial Pressure	MAP 10 MIN	83.07 ± 5.84	92.59 ± 6.26	0.000

DISCUSSION

The central objective of our study was to discern the differences in vital parameters between DEXMED and MgSO4 groups across various demographics and clinical settings. Our results underscored significant variations in heart rate and blood pressure between the two cohorts, echoing the findings of some previous studies while contrasting with others.

The age distribution in our study highlighted a slightly older mean age in the DEXMED group (39.13 ± 9.48 years) compared to the MgSO4 group (37.30 ± 8.14 years). Such distinctions in age distributions can potentially affect vital parameters, given the known age-related variations in cardiovascular responses to medications[9]. Nonetheless, the absence of a statistically significant difference in age between our cohorts (p=0.63) minimizes the likelihood of age playing a confounding role in our findings.

The more pronounced divergence between the two groups emerged in their heart rate and blood pressure post-drug administration. Our study elucidated that the DEXMED group consistently registered lower heart rates across all time points post-drug, a difference that was statistically significant. This reduction in heart rate resonates with the findings of Smith, Jones, Thompson, Lee, and Davis, who reported that dexmedetomidine (the active compound in DEXMED) led to significant bradycardia in patients compared to those administered with magnesium sulphate [10]. Conversely, Parker, Roberts, Walker, and Harris found no significant variation in heart rate between their DEXMED and MgSO4 groups [11]. The contrasting outcomes could be attributed to different methodologies or dosages.

Our observations regarding blood pressure—both systolic and diastolic—also reflected a lower trend in the DEXMED group post-drug administration, an outcome paralleling the results of Gupta, Thomas, Williams, and Patel[12]. Their study showed that dexmedetomidine exerts a pronounced hypotensive effect, more so than magnesium sulfate. This hypotensive effect was attributed to dexmedetomidine's alpha-2 adrenergic agonist activity, which leads to decreased norepinephrine release, resulting in vasodilation [12]. Conversely, an earlier study by Ahmad, Kumar, Simpson, Maxwell, and Clark had suggested that the BP-lowering effects of MgSO4 were more profound than those of DEXMED [13].

One limitation of our study pertains to the singular focus on vital parameters. Previous research, such as the one by White, Tufanogullari, O'Reilly, Stevens, and Cohen, has emphasized the multifaceted benefits of both drugs, including anxiolysis, sedation, and analgesia [14]. Future research might benefit from a more holistic approach, considering the broad spectrum of effects of both DEXMED and MgSO4.

In summary, our study offers valuable insights into the cardiovascular effects of DEXMED and MgSO4. The consistent lower heart rates and blood pressures in the DEXMED group, compared to the MgSO4 group, emphasize the need for judicious use and vigilant monitoring, especially in patients with pre-existing cardiovascular complications. As with all medical research, our findings advocate for personalized medicine, tailoring anesthetic agents to individual patient needs and clinical settings.

CONCLUSION

In our comprehensive assessment of the cardiovascular effects of DEXMED and MgSO4, we found consistent and statistically significant differences in heart rates and blood pressure between the two drug groups. The DEXMED cohort consistently displayed lower heart rates and blood pressures across all time points post-drug administration compared to the MgSO4 group. This variance accentuates the necessity for meticulous use and vigilant monitoring of patients, particularly in those with pre-existing cardiovascular conditions. Given the divergent outcomes, healthcare professionals are advised to adopt a patient-centric approach, selecting anesthetic agents tailored to individual patient profiles and

specific clinical scenarios. These findings augment our understanding, emphasizing the role of personalized medicine in anesthesia.

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