Original Research Article

# To Study and Compare the Hemodynamic Effects of Intravenous Magnesium Sulpfate and Fentanyl Citrate in Surgical Procedures under General Anaesthesia

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**Received: 09-08-2020 / Revised: 22-09-2020 / Accepted: 26-10-2020**

**Abstract**

**Objective**: To study and compare the hemodynamic effects of intravenous Magnesium sulfate v/s Fentanyl citrate in surgical procedures, under general anaesthesia.Material and methods: This was a prospective randomized study conducted in our hospital on 60 ASA (American Society of Anaesthesiologists) grade I or II patients, of either sex, aged 18-45 years, scheduled for elective surgeries, fulfilling inclusion and exclusion criteria, requiring general anaesthesia with endotracheal intubation. The patients were randomized in two groups of 30 each- F Group patients were given Fentanyl citrate as the study drug while M Group patients were given Magnesium sulfate as the study drug. Randomization was done as per week days like those posted for surgery on Monday were included in group M; and those on Tuesday were included in group F and so on. **Results**: It was observed that-Pulse rate reached near baseline value at 5 minutes after intubation in F group, while in 10 min. after intubation in M group.1) 5 min. after study drug, the fall in SBP was significant in M group (1.29%) but insignificant in F group (0.03%).2) After 5 min. of giving study drug, DBP decreased in F group (insignificantly) but decreased significantly in M group (9.99%). 3) 5 min. after study drug, the fall in MAP was more in M group (1.96%) than in F group (0.61%).**Conclusion:** Magnesium sulfate provides intraoperative hemodynamic stability like Fentanyl citrate; although the hemodynamic stability provided by Magnesium sulfate is not superior to that provided by Fentanyl citrate.

**Keywords:** Anaesthesia, Analgesia, Hemodynamic, Opioid, Fentanyl.



## Introduction

Endotracheal intubation is an important weapon in anaesthetist armour, which requires use of anaesthetic agents. Balanced anaesthetic techniques make optimum use of induction agents, muscle relaxants during endotracheal intubation with minimal haemodynamic disturbances.Laryngoscopy & Endotracheal intubation are noxious stimuli that evoke a transient but marked sympathetic response which can be well tolerated by healthy individuals. However may have detrimental effects like acute left ventricular failure, ruptured cerebral aneurysm[1], and ischemic ECG (electrocardiography) changes [2] or even prove fatal in patients with underlying pre-existing comorbidities. So attempt must be made to prevent the pressor response to laryngoscopy and intubation. A number of drugs & techniques have been used in past to attenuate these undesirable hemodynamic responses however only few were found useful[3]. During surgical procedures, severe pain arises from deep or visceral structures, which requires the use of opioids. Commonly used opioids are Morphine, Fentanyl, Pethidine, etc. But side effects of opioids include sedation, nausea, vomiting, vasodilatation & myocardial depression, pruritus, delayed gastric emptying, constipation, urinary retention & prolonged respiratory depression [4]. Fentanyl is a potent narcotic analgesic [5] and also attenuates cardiovascular, hormonal & metabolic responses after laryngoscopy & endotracheal intubation. Others include Magnesium sulfate which is also used as perioperative analgesic

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due to its antagonistic effect on NMDA (N- Methyl, D-Aspartate) receptors[6] & Calcium ion channels [7]. In this study we ought to study, compare the hemodynamic effects of intravenous Magnesium sulfate and Fentanyl citrate in surgical procedures, under general anaesthesia.

**Materials and method**

This was a prospective randomized study conducted in our hospital on 60 ASA (American Society of Anaesthesiologists) grade I or II patients, of either sex, aged 18-45 years, scheduled for elective surgeries, fulfilling inclusion and exclusion criteria, requiring general anaesthesia with endotracheal intubation. Study was approved by institute ethics committee. Informed consent was obtained from patient and family members and patient were randomized in two groups of 30 each according to week days like those posted for surgery on Monday were included in group M; while those on Tuesday were included in group F and so on. The two groups were:

a} F Group- Patients were given Fentanyl citrate as the study drug.

b} M Group- Patients were given Magnesium sulfate as the study drug.

Inclusion criteria included patients of either sex, age group 18-45 years, planned for elective surgery under general anesthesia lasting <90 minutes and ASA grade I and II. While those patients with blood coagulation disorders, preexisting comorbidities, psychiatric illness, preexisting allergies, patients on calcium channel blockers, hypnotics or narcotic analgesics, deaf and dumb were excluded.

Method: PAC (Pre-anaesthetic check up) was done before surgery. On OT arrival, ringer lactate infusion was started through i.v line. Baseline Pulse rate, BP (systolic and diastolic) were measured; MAP and ECG were recorded and emergency rescue drugs were kept on standby. Patients were premedicated with Inj. Glycopyrolate 0.2 mg i.v. and calculated volume of the study drug was first diluted in a 10 ml syringe and then was injected slowly over a period of 2 min.The patient was preoxygenated with 100% O2, during five minutes after the initial dose of study drug (Group F Fentanyl citrate 1.25mcg/kg; Group M Magnesium citrate 20 mg/kg), followed by induction using Inj. Thiopentone sodium (2.5% solution) 5mg/kg i.v. slow. Intubation was facilitated with Inj. Succinylcholine 2mg/kg. One minute after injecting Succinylcholine, laryngoscopy and endotracheal intubation was performed. Anaesthesia was maintained by ventilating with O2:N2O (33%:66%) and 0.2% Halothane, using Bain's circuit. Muscle relaxation was provided with nondepolarizing muscle relaxant [Atracurium 0.3 mg/kg (loading dose) and 0.1 mg/kg (maintenance dose)].Study drug (Group F Fentanyl citrate 0.5mcg/kg; Group M Magnesium citrate 10 mg/kg) was diluted and repeated slowly, after intubation, that is five minutes before skin incision and at every 30 minutes interval thereafter, till the completion of surgery. So, in 90 minutes' surgery, study drug was given 4 times- first after premedication; second-immediately after intubation; third and fourth- at 30 and 60 minutes after intubation.Intra-operative monitoring was done of PR (pulse rate), SBP (systolic blood pressure), DBP (diastolic blood pressure) 5 minutes after study drug (initial dose), immediately after intubation, at 5, 10, 20, 30, 45, 60, 75 and 90 minutes after intubation. Sympathosomatic responses, like presence of lacrimation, sweating, eye movements, somatic responses like swallowing, grimacing, coughing and eye opening (throughout study period) were noted following surgery; reversal was done with Inj. Glycopyrrolate 0.5 mg and Inj. Neostigmine 2.5 mg i.v.

Statistical analysis:All the quantitative data were summarized in the form of Mean ± SD. The difference between mean value of both groups were analyzed using Student 't' test. All the qualitative data were summarized in form of proportions. The differences between proportions were analyzed using Chi square test. The levels of significance and α - error were kept 95% and 5% respectively, for all statistical analyses.P values <0.05 were considered as Significant (S) and P value > 0.05 as statistically Non Significant (NS).

**Results**

The mean age of patients was 25.53 ± 7.30 years in Fentanyl (F) group and was 25.50 ± 6.75 years in Magnesium sulfate (M) group. Mean weight of the patients was 54.07 ± 9.21 kg in F group and was 54.53 ± 9.12 kg in M group. Numbers of male and female patients were comparable in both the groups.

**Table 1: Comparison of Mean change ± S.D. in Pulse Rate (from the pre-op. value) in both the groups**

| Observation Time | F Group | | | | M Group | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean±SD | Mean change ± S.D. | % Change | P Value | Mean±SD | Mean change ± S.D. | % Change | P Value |
| Pre op (Base line ) | 89.37 ± 9.55 | | | | 97.10 ± 11.81 | | | |
| 5 minutes After Study Drug | 88.53 ± 8.68 | -0.83 ± 3.07 | -0.93 % | 0.1485 | 106.80 ± 12.42 | 9.70 ± 1.24 | 9.99 % | 0.0000 |
| Immediately After Intubation | 95.53 ± 8.22 | 6.17 ± 3.79 | 6.90 % | 0.0000 | 111.67 ± 11.52 | 14.57 ± 2.10 | 15.00 % | 0.0000 |
| 5 minutes after intubation | 88.40 ± 7.43 | -0.97 ± 4.74 | -1.08 % | 0.2729 | 94.57 ± 10.07 | -2.53 ± 3.52 | -2.61 % | 0.0005 |
| 10 minutes after intubation | 88.13 ± 8.10 | -1.23 ± 5.37 | -1.38 % | 0.2187 | 97.07 ± 9.91 | -0.03 ± 4.46 | -0.03 % | 0.9676 |
| 20 minutes after intubation | 90.57 ± 9.50 | 1.20 ± 6.51 | 1.34 % | 0.3214 | 96.03 ± 11.65 | -1.07 ± 0.69 | -1.10 % | 0.0525 |
| 30 minutes after intubation | 91.13± 8.53 | 1.77 ± 7.99 | 1.98 % | 0.2359 | 97.63 ± 8.60 | 0.53 ± 4.35 | 0.55 % | 0.5075 |
| 45 minutes after intubation | 87.57 ± 8.32 | -1.80 ± 8.56 | -2.01 % | 0.2586 | 97.80 ± 8.98 | 0.70 ± 4.76 | 0.72 % | 0.4268 |
| 60 minutes after intubation | 87.67 ± 9.06 | -1.70 ± 9.11 | -1.90 % | 0.3149 | 96.30 ± 8.85 | -0.80 ± 5.55 | -0.82 % | 0.4366 |
| 75 minutes after intubation | 87.17 ± 9.59 | -2.20 ± 9.64 | -2.46 % | 0.2211 | 96.80 ± 10.94 | -0.30 ± 5.57 | -0.31 % | 0.7702 |
| 90 minutes after intubation | 90.77 ± 10.30 | 1.40 ± 9.00 | 1.57 % | 0.4014 | 98.10 ± 10.93 | 1.00 ± 6.01 | 1.03 % | 0.3693 |

**Pulse rate**

In F Group, there was statistically insignificant fall (0.93%) in pulse rate 5 minutes after study drug; and statistically significant rise (6.90%) immediately after intubation. The value of pulse rate reached near baseline value at 5 minutes after intubation and then remained near baseline value throughout the surgery. In M Group, there was statistically significant (9.99%) rise in pulse rate 5 minutes after study drug; and also statistically significant (15.00%) rise after intubation; which reached near baseline values at 10 minutes after intubation and then remained near baseline value throughout the surgery.It was observed that (a) 5 min. after study drug, pulse rate decreased in F group (insignificantly) but increased significantly in M group (9.99%) (b) Mean change in pulse rate after intubation was more for M Group (c) Pulse rate reached near baseline value at 5 minutes after intubation in F group, while in 10 min. after intubation in M group. NS= Non Significant (P value> 0.05); S= Significant (P value< 0.05); (-) = Decrease; (+) = Increase. (Table 1)

**Table 2:Comparison of Mean change ± S.D. in SBP (from the pre-op. value) in both the group**

| Observation Time | F Group | | | | M Group | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean±SD | Mean change ± S.D. | % Change | P Value | Mean±SD | Mean change ± S.D. | % Change | P Value |
| Pre op (Base line ) | 122.30 ± 7.93 | | | | 123.87 ± 7.61 | | | |
| 5 minutes After Study Drug | 122.33 ± 7.46 | 0.03 ± 1.75 | 0.03 % | 0.9177 | 122.27 ± 7.32 | -1.60 ± 2.44 | -1.29 | 0.0012 |
| Immediately After Intubation | 127.07 ± 7.49 | 4.77 ± 1.99 | 3.90 % | 0.0000 | 130.67 ± 7.48 | 6.80 ± 0.92 | 5.49 | 0.0000 |
| 5 minutes after intubation | 120.90 ± 6.49 | -1.40 ± 2.72 | -1.14 % | 0.0087 | 125.80 ± 7.65 | 1.93 ± 0.25 | 1.56 | 0.0000 |
| 10 minutes after intubation | 122.00 ± 6.61 | -0.30 ± 3.49 | -0.25 % | 0.6409 | 124.94 ± 8.11 | 1.10 ± 3.02 | 0.89 | 0.0556 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20 minutes after intubation | 120.90 ± 5.61 | -1.40 ± 4.20 | -1.14 % | 0.0781 | 124.83 ± 7.83 | 0.97 ± 4.25 | 0.78 | 0.2224 |
| 30 minutes after intubation | 120.57 ± 4.94 | -1.73 ± 4.95 | -1.42 % | 0.0652 | 124.23 ± 6.67 | 0.37 ± 4.82 | 0.30 | 0.6803 |
| 45 minutes after intubation | 121.27 ± 4.93 | -1.03 ± 4.93 | -0.84 % | 0.2604 | 123.80 ± 7.58 | -0.07 ± 3.42 | -0.05 | 0.9158 |
| 60 minutes after intubation | 120.63 ± 4.97 | -1.67 ± 5.86 | -1.36 % | 0.1303 | 125.10 ± 7.22 | 1.23 ± 5.67 | 1.00 | 0.2434 |
| 75 minutes after intubation | 120.90 ± 4.84 | -1.40 ± 6.62 | -1.14 % | 0.2559 | 122.43 ± 5.64 | -1.43 ± 4.96 | -1.16 | 0.1243 |
| 90 minutes after intubation | 123.53 ± 4.59 | 1.23 ± 5.92 | 1.01 % | 0.2629 | 124.77 ± 5.39 | 0.90 ± 5.14 | 0.73 | 0.3456 |

**SBP (Systolic BP)**

In F Group, 5 minutes after study drug, there was clinically slight change in SBP; but immediately after intubation, there was statistically significant (3.90%) rise in SBP (Systolic Blood Pressure); which reached near baseline value in 5 minutes after intubation and then remained near baseline value throughout the surgery. In M Group, 5 minutes after study drug, there was statistically significant (1.29%) fall in SBP; but statistically significant (5.49%) rise in SBP immediately after intubation; which reached near baseline value at 10 minutes after intubation, and then SBP remained near baseline value throughout surgery.It was observed that (a) 5 min. after study drug, there was significant fall in SBP in M group (1.29%) but there was insignificant change in F group (0.03%) (b) Mean change in SBP after intubation was more for M Group (c) SBP reached near baseline value at 10 minutes after intubation in both the groups. NS= Non Significant (P value> 0.05); S= Significant (P value< 0.05); (-) = Decrease; (+) = Increase. (Table 2)

**Table 3:Comparison of Mean change ± S.D. in DBP (from the pre-op. value) in both the groups**

| Observation Time | F Group | | | | M Group | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean±SD | Mean change ± S.D. | % Change | P Value | Mean±SD | Mean change ± S.D. | % Change | P Value |
| Pre op (Base line ) | 77.97 ± 7.05 | | | | 79.47 ± 5.56 | | | |
| 5 minutes After Study Drug | 77.10 ± 6.01 | -0.87 ± 1.76 | -1.11 | 0.0114 | 77.67 ± 5.36 | -1.80 ± 1.83 | -2.27 | 0.0000 |
| Immediately After Intubation | 81.57 ± 6.00 | 3.60 ± 2.33 | 4.62 | 0.0000 | 84.70 ± 5.90 | 5.23 ± 1.38 | 6.59 | 0.0000 |
| 5 minutes after intubation | 77.27 ± 5.60 | -0.70 ± 3.17 | -0.90 | 0.2369 | 79.73 ± 4.85 | 0.27 ± 2.05 | 0.34 | 0.4818 |
| 10 minutes after intubation | 78.37 ± 5.67 | 0.40 ± 3.57 | 0.51 | 0.5440 | 79.93 ± 5.27 | 0.43 ± 3.89 | 0.59 | 0.5166 |
| 20 minutes after intubation | 76.37 ± 4.61 | -1.60 ± 4.38 | -2.05 | 0.0550 | 79.23 ± 6.52 | -0.23 ± 5.20 | -0.29 | 0.8077 |
| 30 minutes after intubation | 76.07 ± 4.98 | -1.90 ± 5.14 | -2.44 | 0.0523 | 78.80 ± 6.10 | -0.67 ± 5.67 | -0.84 | 0.5247 |
| 45 minutes after intubation | 75.83 ± 4.83 | -2.13 ± 5.53 | -2.74 | 0.0434 | 78.33 ± 5.29 | -1.13 ± 2.30 | -1.43 | 0.0115 |
| 60 minutes after intubation | 75.47 ± 4.55 | -2.50 ± 5.75 | -3.21 | 0.0239 | 79.90 ± 6.74 | 0.43 ± 6.26 | 0.55 | 0.7072 |
| 75 minutes after intubation | 75.90 ± 4.11 | -2.07 ± 5.85 | -2.65 | 0.0627 | 76.97 ± 3.48 | -2.50 ± 4.33 | -3.15 | 0.0036 |
| 90 minutes after intubation | 78.00 ± 3.51 | 0.03 ± 5.95 | 0.04 | 0.9757 | 79.90 ± 3.32 | 0.23 ± 4.30 | 0.29 | 0.7687 |

**DBP (Diastolic BP)**

In F Group, 5 minutes after study drug, there was statistically insignificant (1.11%) fall in DBP; but immediately after intubation, there was statistically significant (4.62%) rise in DBP (Diastolic Blood Pressure); which reached near baseline value in 5 minutes after intubation and then remained near baseline value most of the times during surgery. In M Group, 5 minutes after study drug, there was statistically significant (2.27%) fall in DBP; but statistically significant (6.59%) rise in DBP immediately after intubation; which reached near baseline value at 5 minutes after intubation, and then DBP remained near baseline value most of the times during surgery.It was observed that (a) 5 min. after study drug, DBP decreased in F group (insignificantly) but decreased significantly in M group (9.99%) (b) Mean change in DBP after intubation was more for M Group (c) DBP reached near baseline value at 5 minutes after intubation in both the groups. NS= Non Significant (P value> 0.05); S= Significant (P value< 0.05); (-) = Decrease; (+) = Increase. (Table 3)

**Table 4:Comparison of Mean change ± S.D. in MAP (from the pre-op. value) in both the groups**

| Observation Time | F Group | | | | M Group | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean±SD | Mean change ± S.D. | % Change | P Value | Mean±SD | Mean change ± S.D. | % Change | P Value |
| Pre op (Base line ) | 92.74 ± 6.82 | | | | 94.27 ± 5.52 | | | |
| 5 minutes After Study Drug | 92.18 ± 6.03 | -0.56 ± 1.49 | -0.61 % | 0.0473 | 92.42 ± 5.12 | -1.85 ± 1.24 | -1.96 % | 0.0000 |
| Immediately After Intubation | 96.71 ± 6.00 | 3.97 ± 1.98 | 4.28 % | 0.0000 | 100.02 ± 5.76 | 5.76 ± 0.95 | 6.11 % | 0.0000 |
| 5 minutes after intubation | 91.81 ± 5.32 | -0.93 ± 2.69 | -1.00 % | 0.0679 | 95.11 ± 5.15 | 0.85 ± 1.37 | 0.90 % | 0.0020 |
| 10 minutes after intubation | 92.91 ± 5.41 | 0.17 ± 3.25 | 0.18 % | 0.7784 | 94.95 ± 5.12 | 0.68 ± 2.68 | 0.72 % | 0.1758 |
| 20 minutes after intubation | 91.19 ± 4.14 | -1.55 ± 4.30 | -1.67 % | 0.0573 | 94.43 ± 6.01 | 0.17 ± 4.22 | 0.18 % | 0.8289 |
| 30 minutes after intubation | 90.90 ± 4.13 | -1.84 ± 5.06 | -1.99 % | 0.0556 | 93.94 ± 5.27 | -0.32 ± 4.76 | -0.34 % | 0.7144 |
| 45 minutes after intubation | 90.98 ± 4.11 | -1.76 ± 5.25 | -1.90 % | 0.0761 | 93.50 ± 5.12 | -0.77 ± 0.93 | -0.81 % | 0.0515 |
| 60 minutes after intubation | 90.52 ± 3.56 | -2.22 ± 5.57 | -2.39 % | 0.0571 | 94.91 ± 6.07 | 0.65 ± 5.34 | 0.68 % | 0.5132 |
| 75 minutes after intubation | 91.24 ± 2.92 | -1.51 ± 5.92 | -1.63 % | 0.1733 | 92.29 ± 3.52 | -1.98 ± 4.14 | -2.10 % | 0.0542 |
| 90 minutes after intubation | 93.18 ± 2.94 | 0.44 ± 5.80 | 0.47 % | 0.6840 | 94.72 ± 2.96 | 0.46 ± 4.28 | 0.49 % | 0.5621 |

Thus, Magnesium sulfate provides intraoperative hemodynamic stability like Fentanyl citrate; although the hemodynamic stability provided by Magnesium sulfate is not superior to that provided by the potent short acting opiate- Fentanyl citrate.However, considering relatively less incidence of side effects, being cheaper and easy availability, Magnesium sulfate can be considered as a useful and good alternative to Fentanyl citrate, especially in circumstances, where the complications associated with opioids are undesirable.

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**Source of Support:Nil**
**Conflict of Interest: Nil**