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Research Article

Comparative Evaluation of Dexmedetomidine and Magnesium Sulphate in Mitigating Pressor Response While Extubation in Patients Undergoing Mastoidectomies

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ABSTRACT

Background: Ear surgeries performed under general anaesthesia mandate smooth emergence after surgery to facilitate a good surgical outcome. We conducted this study with primary objective of comparing dexmedetomidine and magnesium sulfate ($MgSO_4$) in attenuating extubation response after mastoid surgeries. The secondary outcome was to study the adverse effects if any.

Methods: Sixty patients of ASA grade I and II, aged 18 -50 yrs were randomized into 2 groups of 30 each receiving either dexmedetomidine 0.5µg/kg or MgSO4 30 mg/kg respectively 10 minutes prior to completion of surgery. Efficacy of both drugs in attenuating cough reflex, PONV, shivering and fluctuations in haemodynamic response were recorded. Postoperative sedation was noted. Any laryngospasm, bronchospasm, hypotension, bradycardia, desaturation was also noted.

Statistical analysis: The observations were recorded and analysed using statistics calculator SPSS 19.00 version. Student's t test and $\chi 2$ (chi square) test were used to analyze quantitative and qualitative data respectively. P-value<0.05 was considered statistically significant.

Results: The variations in systolic, diastolic blood pressure and heart rate were significantly less with dexmedetomidine as compared to MgSO4 ($p<0.01$). Incidence of coughing ($p=0.002$), PONV($p=0.002$), was less with dexmedetomidine while shivering control was similar in both groups, the sedation was more with dexmedetomidine ($p=0.004$). Patients with dexmedetomidine infusion were more satisfied in terms of reduced nausea sensation, drowsiness.

Conclusion: Dexmedetomidine provides a smoother recovery profile as compared to MgSO4 when administered prior to extubation improving the surgical outcome and patient satisfaction in patients undergoing mastoidectomies.

Extubation is often associated with detrimental effects like tachycardia ,hypertension, coughing, straining and breath holding. Aggressive or stormy extubation not only causes discomfort to the patient but also the surgical outcome is compromised. Magnesium sulfate (MgSO4) and Dexmedetomidine are two routinely used agents to attenuate extubation response after general anesthesia (G.A) [1-6]. The efficacy of these drugs to attenuate extubation response has not been reported in cases of tympanomastoid surgeries.

Most mastoidectomies are performed under general anesthesia and certain issues need to be addressed with utmost importance during middle ear surgery are: need for smooth emergence, and postoperative nausea and vomiting (PONV) prevention and treatment. The incidence of PONV following otologic surgery is high and it is reasonable to offer prophylaxis to all patients, unless there are any patient-specific contraindication.

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For ear surgeries an anaesthetic technique which provides a stable cardiovascular functioning and smooth emergence while extubation should be selected. This study was conducted to compare the effect of intravenous dexmedetomidine and magnesium sulphate in facilitating smooth endotracheal extubation in terms of haemodynamics, airway reflexes and sedation in patients undergoing mastoidectomies.

Methods

This study was conducted in ENT Operation Theatre at a Tertiary Care Centre. We conducted the study in accordance with guidelines of Helsinki declaration. This prospective, randomized, double blind study included 60 patients of American Society of Anesthesiologists physical status I and II, age 18–50 years, body weight 45–70 kg who were posted for elective tympanomastoid surgeries. Prior ethical permission was taken from our Institutional Ethical Committee and written informed consent was obtained from all patients enrolled for the study.

Patients with comorbidities such as asthma, dysrhythmia, congestive heart failure, and dementia were excluded. Heart rate (HR), peripheral oxygen saturation (SpO2), non-invasive blood pressure (NIBP) and end-tidal carbon dioxide (ETCO2) were monitored. All patients were premedicated with glycopyrrolate 0.2 mg, midazolam 1mg and ondansetron 4mg. Anaesthesia was induced with 1.5 -2 mg/kg propofol and 1.5µg/kg fentanyl. Vecuronium (0.1 mg/kg) was used for neuromuscular relaxation and endotracheal intubation was performed (8 or 8.5 mm for males, 7 or 7.5 mm for female patients, high-volume/low pressure portex endotracheal tubes. Anaesthesia was maintained with sevoflurane (1-2% end-tidal concentration) and 66% nitrous oxide in oxygen using mechanical ventilation. End-tidal carbon dioxide partial pressure was maintained at 4.2-5.5 kPa. No additional opioid was given after induction. Patients were allocated randomly to one of the two groups in a double-blind manner. Anaesthetist blinded to the group prepared the solution. Ten minutes prior to the completion of the surgery, patients in group D (n = 30) received 0.5 mg/kg dexmedetomidine in 10 ml of isotonic solution, and patients in group M (n =30) received 10 ml of isotonic solution both given over 300 s. Sevoflurane and nitrous oxide were discontinued at the end of the operation and 0.05 mg/kg neostigmine and 0.008mg/kg were given for neuromuscular block reversal when train of four (TOF) was 0.5. Oropharyngeal secretions were suctioned out before extubation. After tracheal extubation, 100% oxygen was administered via a facemask for 5 min. The same anaesthetist, blinded to the drug given, was present for assessment during extubation of all the patients. Coughing after extubation was assessed with a 4-point scale:

1- no coughing,
2- minimal coughing (once or twice),
3- moderate coughing (3-4 times)
4- Severe coughing (5-10 times).
5- poor extubation, very uncomfortable and forced breathing (laryngospasm and coughing >10 times).

PONV was graded as:

Grade 1- no nausea, no vomiting
Grade 2-nausea, no vomiting
Grade3- nausea and vomiting

Ramsay sedation score was used to assess the degree of sedation

1- anxious and agitated or restless or both
2- co-operative,oriented and tranquil
3- responding to commands only
4- brisk response to light glabellar tap or loud auditory stimulus
5- sluggish response to light glabellar tap or loud auditory stimulus
6- no response to stimulus

Shivering was graded as: 0-none i.e. no shivering

1- mild i.e. shivering localized to neck and or thorax only
2- moderate i.e. shivering involves gross movement of upper extremities with neck and thorax
3- severe i.e. shivering involves gross movement of trunk and both extremities

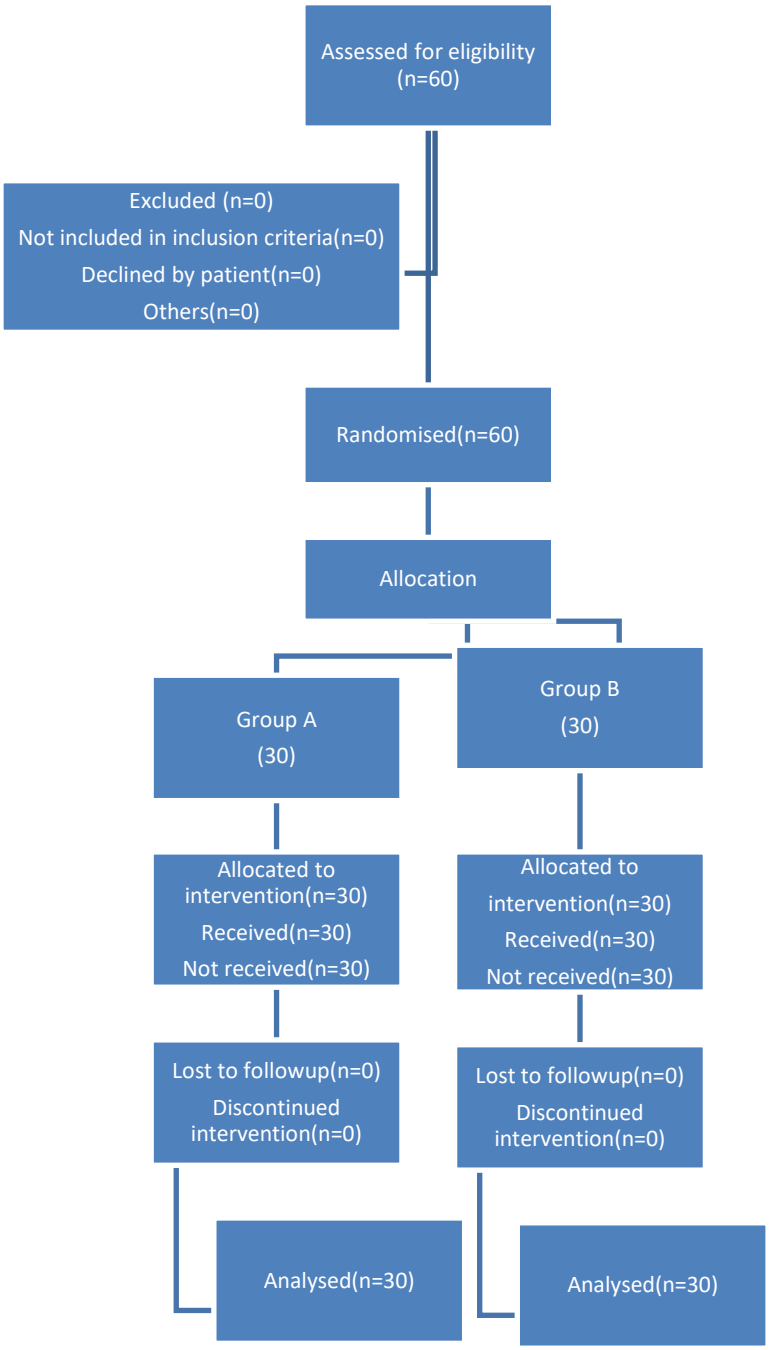
Desaturation was defined as a decrease of peripheral arterial oxygen saturation >5% from baseline, and holding breath for 20 s or more as breath holding. Any laryngospasm, bronchospasm and desaturation were recorded.

Heart rate, systolic blood pressure, and diastolic blood pressure values were recorded before and at 1, 3 and 5 min after drug administration, during extubation, and at 1, 3, 5 and 10 min after extubation. Extubation time (defined as the time between the discontinuation of inhalation agents and extubation), and emergence time (between the discontinuation of inhalation agents and verbal and motor responses to verbal stimuli) were recorded. Blood pressure and heart rate were maintained at between 80% and 120% of the pre-operative values by increasing or decreasing the concentration of sevoflurane until the end of surgery. Intravenous beta blockers were used to control severe hypertension (defined as systolic blood pressure > 180 mmHg) and tachycardia (defined as HR >100/min, lasting longer than 3 min) not controlled by increasing the concentration of inhalation agent. Mephentermine (6-12 mg i.v bolus) was given when hypotension (decrease in systolic blood pressure > 25% from baseline, or an absolute systolic value < 90 mmHg) could not be controlled within 3 min by increasing the fluid infusion and decreasing gas concentrations, and atropine (0.6 mg i.v bolus) was given for bradycardia (HR <45 min). Possible adverse effects during and after the administration of dexmedetomidine and MgSO4 during the postoperative period such as arrhythmia, bradycardia, tachycardia, hypotension, hypertension, vomiting and dry mouth were recorded.

Statistical analysis:

The parameters were noted, and data were tabulated into Microsoft Excel 2016. Sample size was calculated by Primer of Biostatistics software version 6.0 (by Stanton A. Glantz, © 2005 McGraw-Hill) and analysis of the statistical data obtained from study was carried out by Statistical Package for the Social Sciences software version 19 (SPSS Inc., Chicago, Illinois, USA).Power analysis demonstrated a difference of 30% in the incidence of coughing on extubation among dexmedetomidine and MgSO4 group would require 30 patients in each group, and that 24 patients in each group would provide a power of 80% and alpha error of 0.05. To cover the dropouts 30 patients were included in each group. Statistical significance was accepted as significant at P< 0.05. The categorical measurements were noted as the number and percentage, continuous measurements as the arithmetic mean and standard deviation. The numerical data were analyzed using Student's t test. The Chi square test was used to analyze extubation quality, sedation scores, and adverse events.

Figure 1- Consort Diagram

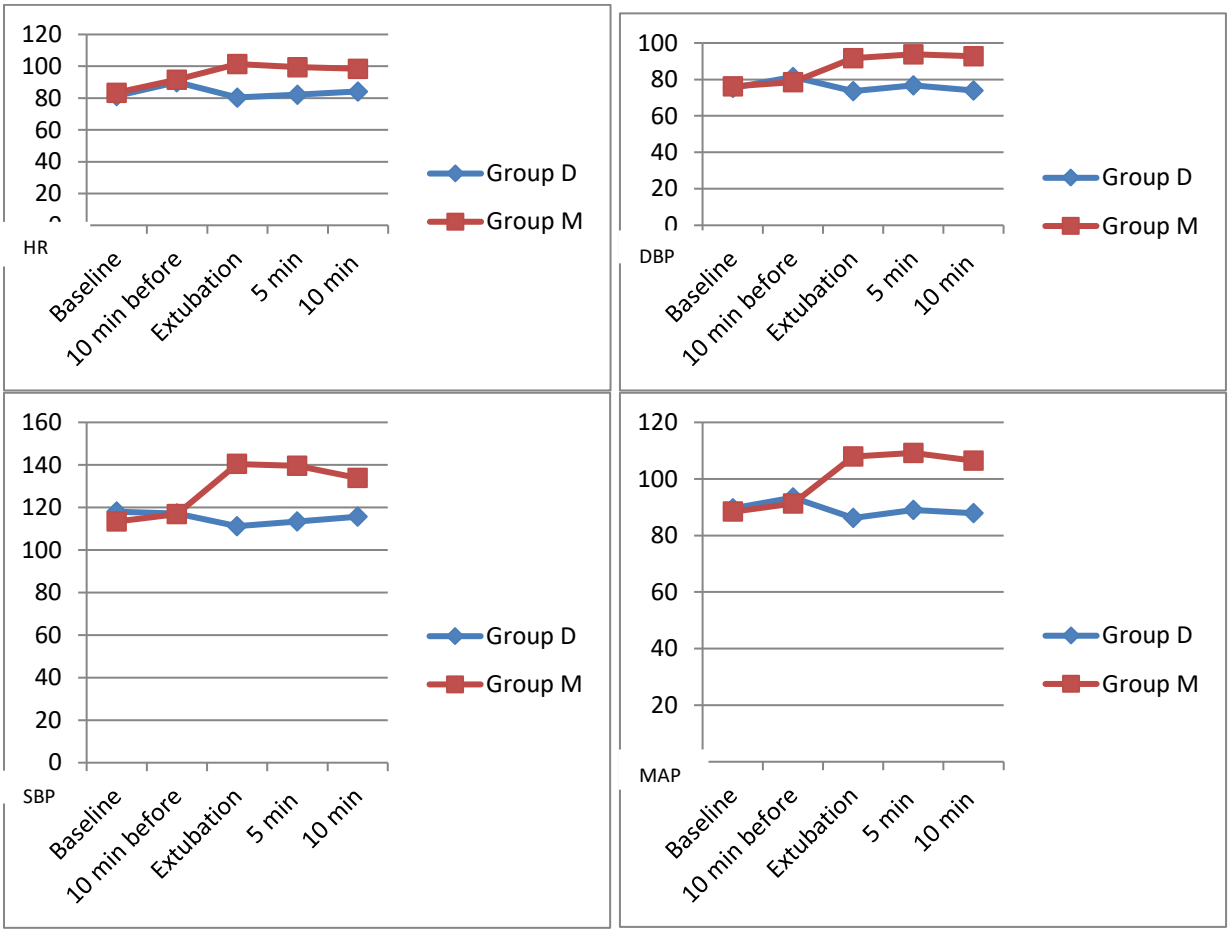


Results

Table 1- Demographic profile of both the groups (mean +/-SD)

Variables	Group D	Group M
Age (in yrs)	31.7±9.80	31±10.47
Sex	14:16	16:14
Weight (in kg)	57.4±6.32	59.5±7.80
Duration of anaesthesia(in min)	176.66±38.10	176.83±35.82

Figure 1- Changes in heart rate (beats per minute), systolic, diastolic and mean arterial pressure (mmHg)



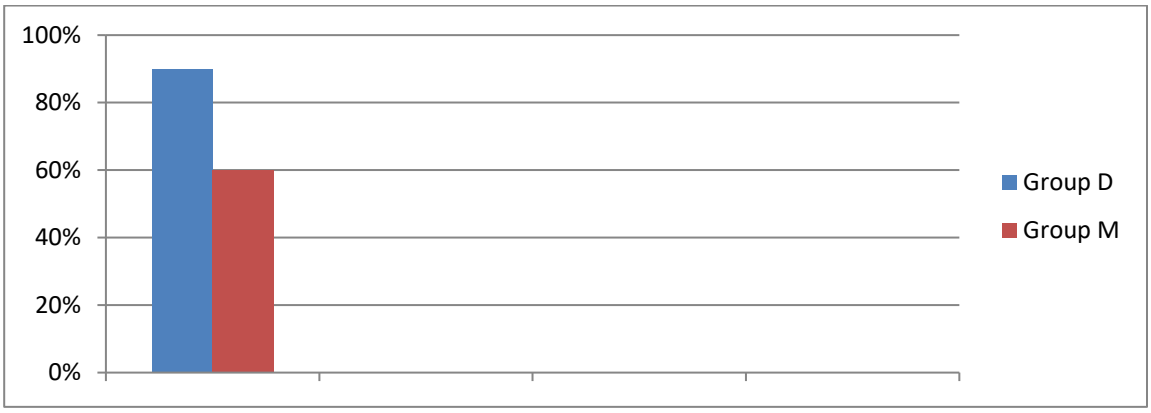
Group D- Dexmedetomidine
Group M- Magnesium sulphate
HR(p<0.01), SBP(p<0.01), DBP(p <0.03), MAP(p<0.03)

Table 2- Side Effects

Variables	Group D	Group M	P value
Coughing	1.1±0.31	1.9±0.56	0.002
PONV	1±0	1.6±0.51	0.002
Shivering	0.1±0.31	0.4±0.51	0.13
Ramsay sedation score	2.2±0.42	1.5±0.52	0.004

Patients from both the groups were asked whether they were satisfied or unsatisfied with recovery from anaesthesia in postoperative period. Patient satisfaction score was found to be 90% in Group D and 60% in group M. p<0.01 which was significant.

Figure 2- Patient satisfaction bar diagram in group D and group M



Group D- Dexmedetomidine

Group M-Magnesium sulphate

Discussion

The process of extubation is often accompanied by tachycardia and hypertension and also associated with coughing, straining along with PONV and are the most common reflex response which occur due to the presence of endotracheal tube.

Straining and PONV produces tachycardia and hypertension, increased pressure in the middle ear which can affect the performed ossiculoplasty or graft placement, strain on suture line and can lead to surgical site bleeding.

Various studies have been conducted in the past using different agents to attenuate extubation response, dexmedetomidine and MgSO4 are among them [1-7]. To the best of our knowledge this is the first study highlighting the importance of smooth recovery in mastoid surgeries and comparing the effect of two drugs investigated in our study in achieving this goal.

In our study we could derive a conclusion that dexmedetomidine is more efficacious in blunting haemodynamics and airway responses in patients following mastoidectomies.

Extubation after mastoid surgeries demands smooth extubation as any aggressive or stormy response can have a negative impact on the surgical outcome. The graft placement or the ossiculoplasty done may get dislodged or may cause discomfort to the patient. Handling of middle and inner ear in itself is a provocating factor for PONV.

We conducted this study to compare the extubation response based on various parameters, the first one being haemodynamics. We could strongly affirm that dexmedetomidine 0.5µgm/kg was more efficacious in controlling the tachycardia and hypertension than MgSO4 30mg/kg during and after extubation [8-9]. Aksu R et al reported in their study that dexmedetomidine was more efficacious than fentanyl for blunting haemodynamic response to tracheal extubation during rhinoplasty [2]. Rani P et al also compared dexmedetomidine and fentanyl in their study and derived a conclusion that Single dose of 0.75 µg/kg dexmedetomidine given 15 min before extubation provides smooth extubation when compared to fentanyl [10]. While Panda et al concluded in their study that Magnesium 30 mg/kg is the most optimum dose to control BP during intubation in hypertensive patients. A further increase in the dose of magnesium causes significant hypotension [8].

Our results were consistent with both the above mentioned studies and also the dose of MgSO4 was used in reference with the above mentioned study. Dexmedetomidine activates receptors in the vasomotor center of medulla, reducing the release of noradrenaline and decreasing central sympathetic outflow resulting in alteration in sympathetic function and reduces heart rate and blood pressure [11-12].

Magnesium sulfate is a physiological calcium channel antagonist and causes vasodilatation directly and indirectly blocks the sympathetic ganglion whilst inhibiting the release of catecholamines leading to decrease in arterial blood pressure [13].

A suppressed cough reflex and response to suctioning during extubation was noted with dexmedetomidine as compared to MgSO4 in our study results which can be attributed to the analgesic, sedative and anxiolytic action of dexmedetomidine. Dexmedetomidine causes alpha 2 receptor stimulation which results in smooth muscle relaxation thereby preventing bronchoconstriction [12]. Our study results are coherent with Rani P et al who compared dexmedetomidine with fentanyl and found that single dose of 0.75 µg/kg dexmedetomidine when given 15 min prior to extubation resulted in smooth extubation as compared to fentanyl [10]. There have been no studies suggesting a suppressed cough response while extubation with magnesium sulphate. The results of our study do not

show any significant effect of MgSO4 in suppressing airway reflexes during and after extubation.

The anti-shivering effect of dexmedetomidine and MgSO4 was also noted in our study and the results clearly suggest that both dexmedetomidine 0.5 µg/kg and MgSO4 30mg/kg possess anti-shivering properties [12,14]. The dexmedetomidine depresses the thermoregulation threshold leading to the antishivering effect. It exerts a dual effect by avoiding vasoconstriction and increasing the level of shivering threshold. Also MgSO4 is likely to induce thermoregulation tolerance [15]. A meta-analysis by Hiromasa Kawakami et al confirmed the availability of sufficient data to support the anti-shivering effect of IV magnesium, and further trials need not be necessary to reach a conclusion [14].

PONV after extubation is a common distressing complaint. Several causative factors are responsible for PONV and treatment includes use of antiemetics and opioid free analgesia. We decided to study the antiemetic action of dexmedetomidine and MgSO4 avoiding the need for antiemetics and assessing their role in aiding opioid free postop-analgesia [16-17]. Arsian et al. reported that the incidence of PONV for patients undergoing ear surgery was as high as 65.7 % and the use of prophylactic antiemetic drugs could reduce it to 22.9 %. Fan et al suggested reduced PONV with dexmedetomidine group than remifentanil [17]. They attributed their finding to the antiemetic and opioid sparing effect of dexmedetomidine. In our study only 1 patient complained of PONV suggesting comparable anti emetic action of both drugs.

Sedation scores compared in the study groups obviate the finding that patients receiving dexmedetomidine were more sedated as reflected by higher sedation scores than patients treated with MgSO4. This is attributed to the central stimulation of parasympathetic outflow and inhibition of sympathetic outflow from the locus ceruleous in the brainstem causing sedation and anxiolysis produced by dexmedetomidine [12].

Limitations of our study were that there was selection bias, ASA 3 and 4 patients were not included. Also different doses of dexmedetomidine and MgSO4 were not considered.

Conclusion

Dexmedetomidine 0.5µg/kg is more effecacious than magnesium sulfate 30 mg/kg in mitigating vasopressor response, maintaining stable haemodynamics and preventing PONV when administered prior to extubation and hence improving the surgical outcome in cases undergone mastoidectomy surgeries.

Abbreviations

ASA(American Society of Anaesthesiologists), DBP(Diastolic blood pressue), ENT(Ear, Nose, and Throat), GA(General Anaesthesia), ETCO2(End-tidal carbon dioxide) HR(Heart Rate), Kg(Kilogram), MAP(Mean arterial pressure), MgSO4(Magnesium sulphate), Min(Minute), NIBP(Non-invasive blood pressure), PONV(Post operative nausea and vomiting), SBP(Systolic blood pressure), SD(Standard deviation), SpO2(Peripheral oxygen saturation), TOF(Train of four), Yrs(years)

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