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Comparative study between magnesium sulphate and dexmedetomidine in controlled hypotension during functional endoscopic sinus surgery: a prospective randomized study

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Abstract

Background: Functional endoscopic sinus surgery (FESS) has been proposed as a selected treatment used in patients with chronic sinusitis that have not responded to medical therapy. Due to the nature of the location of endoscopic sinus surgery, even a small amount of bleeding can reduce the operative visibility. The aim of the work was to compare between dexmedetomidine and magnesium sulphate regarding their efficacy as a hypotensive agent in FESS in adult patients to obtain a bloodless surgical field.

Patients and methods: Sixty patients were randomly assigned into two groups, (D group) for dexmedetomidine (n = 30) and (M group) for magnesium sulphate (n = 30). In (D group), patients received 1 μg/kg dexmedetomidine in 100 ml saline solution as the loading dose 10 min before induction and 0.5–1 μg/kg/h infusion via syringe pump during surgery. In (M group), patients received 40 mg/kg magnesium sulphate in 100 ml saline solution over 10 min as the intravenous loading dose 10 min before induction, with a subsequent 10–15 mg/kg/h infusion. If there is an increase in the arterial blood pressure greater than the targeted MAP (55–65 mmHg), nitroglycerine infusion was started by 0.5 μg/kg/min. The surgeon estimated the quality of the surgical field and recorded it. The total blood loss was measured. In recovery, time to reach Aldrete score ≥ 9 was recorded to fulfill the discharge criteria. Pain score was assessed by the NRS numerical rating score. The time needed to first analgesia requirement was recorded. Sedation score was recorded using Ramsay sedation score.

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Results: There was no statistically significant difference between both groups regarding MAP except at 30 min postoperatively as there was a statistically significant decrease in the MAP among the dexmedetomidine (D group) ($p = 0.039$). Nitroglycerine was required in eight cases in the magnesium sulphate (M group) to reach the targeted MAP which was statistically significant compared to the (D group). Patients in the (D group) had a statistically significant decrease in heart rate than in the (M group) during and after the operation ($p = 0.35$). The quality of the surgical field was significantly better among the (D group) ($p < 0.05$), and accordingly, the surgeon satisfaction was significantly higher in the (D group) ($p = 0.001$). Time to reach Aldrete score ≥ 9 and time for first analgesic requirement postoperatively were significantly longer in the (D group) ($p = 0.023$, $p = 0.001$ respectively). Regarding the Ramsay sedation score (RSS), it was higher in the (D group) which was statistically significant ($p \leq 0.001$).

Conclusion: Dexmedetomidine was more effective than magnesium sulphate to achieve controlled hypotension in patients undergoing FESS. Compared with magnesium, dexmedetomidine offers the advantage of better clarity of the field, surgical satisfaction, less bleeding, and prolonged postoperative analgesia.

Keywords: Magnesium sulphate, Dexmedetomidine, Controlled hypotension, Sinusitis

Background

Rhinosinusitis is a well-recognized clinical syndrome affecting patients of all ages and gender (Khalil and Nunez 2006). Endoscopic sinus surgery has been proposed as a selected treatment method, and it is widely used in patients with chronic sinusitis that have not responded to medical therapy. Due to the nature of the location of endoscopic sinus surgery, even a small amount of bleeding can leave a negative effect on the vision of the surgeon leading to many problems in establishing a proper surgical field; thus, surgery becomes harder and longer (Cho et al. 2012).

This may lead to many complications like cerebrospinal fluid (CSF) leak, intracranial infection, orbital complications, hemorrhage requiring blood transfusion, or surgical control. Controlled hypotension is a technique in which the arterial blood pressure is lowered in a deliberate but controllable manner to minimize surgical blood loss and complications and enhance the operative field visibility (Guven et al. 2011).

The ideal agent used in controlled hypotension must have certain characteristics, such as ease of administration, a short onset time, an effect that disappears quickly when administration is discontinued, rapid elimination without toxic metabolites, negligible effects on vital organs, and predictable and dose-dependent effects (Degoute 2007).

Dexmedetomidine is a highly selective and potent central α_2-receptor agonist which binds to transmembrane G protein-binding adrenoreceptors; it has a unique property among sedatives used because it produces sedation without causing respiratory depression, analgesic effects known as opioid-sparing, anxiolytic, and sympatholytic property in anesthesia (Mantz et al. 2011). Central and peripheral sympatholytic performance of dexmedetomidine is manifested by reduced arterial blood pressure, heart rate, cardiac output, and reduced release of norepinephrine (Lee et al. 2013).

Magnesium sulphate is a good agent for controlled hypotension and that it stabilizes the cell membrane and intracytoplasmic organelles by mediating the activation of Na^+-K^+ ATPase and Ca^{++}ATPase enzymes, which play a role in transmembrane ion exchange during the depolarization and repolarization phases. In addition, Mg^{2+} inhibits the release of norepinephrine by blocking the N-type Ca^{++} channels at nerve endings and thus decreases the blood pressure (Ryu et al. 2009).

The aim of this work was to compare the efficacy of magnesium sulphate and dexmedetomidine in inducing controlled hypotension to obtain a bloodless surgical field for better exposure and surgeon satisfaction during functional endoscopic sinus surgery (FESS) and their effects on postoperative recovery, discharge, and analgesic requirement.

Methods

This randomized prospective comparative study was conducted at the Ain Shams University Hospitals at the Otorhinolaryngology Department from March 2017 to March 2019. After approval of the Ethical Committee (code number: FMASU M D 42/ 2018), written informed consent was obtained from all participants.

Sixty patients were enrolled in the study after fulfilling the inclusion criteria and were randomly assigned into two equal groups, (D group) for dexmedetomidine ($n = 30$) and (M group) for magnesium sulphate ($n = 30$). Randomization was done using sequentially numbered, opaque, sealed envelopes containing computer-generated random allocations in a ratio of 1:1.

The study included patients with grades I and II according to the American Society of Anesthesiology physical status (ASA-PS) of either sex from 18 to 60

years of age, who were scheduled for FESS under general anesthesia, while patients who refused, age < 18 or > 60, pregnant women, and patients with hypertension, ischemic heart diseases, cerebrovascular insufficiency, neuromuscular diseases, diabetic neuropathy, peripheral vascular diseases, renal impairment, hepatic impairment were excluded from the study. In addition, patients with coagulopathies or receiving drugs influencing blood coagulation were also excluded.

Routine preoperative assessment was done for each patient including routine history taking, clinical examination, and laboratory investigations (complete blood picture, kidney function tests, liver function tests, prothrombin time, and partial thromboplastin time).

Patients were informed for verbal numerical rating scale (NRS) (0: no pain, 10: severe pain). All patients' body weights were recorded in their files. All patients fasted according to standard rules and premedicated with midazolam 0.07 mg/kg I.M., ranitidine 50 mg I.V., and granisetron 1 mg I.V., 30 min before the scheduled time of surgery.

In the operating room, patient's hemodynamic data were monitored after attachment of monitors, five lead electrocardiography (ECG), non-invasive blood pressure, and pulse oximetry (DatexOhmeda S/5).

In (D group), patients received 1 μg/kg dexmedetomidine in 100 ml saline solution as the loading dose 10 min before induction and 0.5–1 μg/kg/h infusion via syringe pump during surgery. In (M group), patients received 40 mg/kg magnesium sulphate in 100 ml saline solution over 10 min as the intravenous loading dose 10 min before induction, with a subsequent 10–15 mg/kg/h infusion via syringe pump during surgery (according to the patient's body weight, the range of maintenance rate was attached on the syringe before handling it to attending anesthesiologist).

All patients received standard anesthetic technique with propofol 1–2 mg/kg and fentanyl 2 μg/kg; endotracheal intubation was facilitated with atracurium 0.5 mg/kg with suitable size cuffed tube. Anesthesia was maintained with 1–2% isoflurane. All patients were mechanically ventilated by volume-controlled mode with O_2/air mixture FiO_2 0.6. Capnography for end tidal CO_2 measurement was established to maintain normocapnia.

After induction of anesthesia, an arterial catheter was inserted into the radial artery for continuous monitoring of mean arterial blood pressure and also capnography for end-tidal CO_2. Heart rate (HR) and mean arterial blood pressure (MAP) were recorded at baseline before loading dose; after anesthetic induction then at 15, 30, 60, 90, 120 min; and postoperatively at end of surgery, post-extubation, and 30 min after extubation.

If there is an increase in the arterial blood pressure above the targeted MAP (55–65 mmHg), nitroglycerine infusion was started by 0.5 μg/kg/min. The drug infusion rate decreased when the targeted MAP was achieved, and this was recorded as the total amount of nitroglycerin used for each patient.

When MAP reached the desired range (55–65 mmHg) and maintained for at least 10 min, the surgeon satisfaction was estimated for quality of the surgical field and was rated using a 4-point Likert scale at the end of surgery: 1 = bad, 2 = moderate, 3 = good, and 4 = excellent (Bayram et al. 2015). The total blood loss was measured, and bleeding score assessment used 0 = no bleeding; 1 = slight bleeding, no aspiration required; 2 = minor bleeding, aspiration required; 3 = minor bleeding, frequent aspiration required; 4 = moderate bleeding, visible only with aspiration; and 5 = severe bleeding, continuous aspiration required (Boezaart and van der Merwe 1995).

The studied drug infusions and isofluorane stopped by the end of the endoscopic sinus surgery, and the residual neuromuscular blockade was reversed with neostigmine 0.04 mg/kg and atropine 0.02 mg/kg. Patients were extubated when they open their eyes in response to verbal commands.

In recovery, time to reach Aldrete score ≥ 9 was recorded to discharge the patient from the post-anesthetic care unit (PACU) to ward (Table 1) (Aldrete 1995). Pain score was assessed by the NRS numerical rating score (Childs et al. 2005). Sedation score was recorded using the Ramsay sedation score (Table 2) (Ramsay et al. 1974) at 15, 30, and 60 min after tracheal extubation. The time needed to first analgesia requirement (100 mg ketoprofen I.M.) was recorded.

All intraoperative and postoperative complications were recorded. Hypotension was defined as MAP < 50 mmHg and was treated by increment doses of ephedrine 10 mg I.V., bradycardia was defined as HR < 50 beats/min and was treated by atropine 0.01 mg/kg, patients who have nausea and vomiting were given additional 1 mg granisetron I.V., and shivering patients who displayed shivering was warmed with heated blankets.

The primary outcome was to measure bleeding score, and secondary outcomes were mean arterial blood pressure and heart rate to reach bloodless surgical field by controlled hypotension, measure surgeon satisfaction, duration of operation, recovery from anesthesia using, Aldrete score, sedation using Ramsay sedation score, and first analgesia requirement postoperative using numerical rate score.

Sample size calculation

Data collected were analyzed using the PASS program setting alpha error 5% and power 80%. Results from a previous study (Bayram et al. 2015) showed that bleeding score > 2 was 23% in the dexmedetomidine group

Table 1 Aldrete score

Respiration	**2**	**1**	**0**
	Able to keep deep breath and cough	Dyspnea/shallow breathing	Apnea
O_2 saturation	**2**	**1**	**0**
	Maintains > 92% on room air	Needs oxygen inhalation to maintain O_2 saturation > 90%	Saturation < 90% even with supplemental O_2
Consciousness	**2**	**1**	**0**
	Fully awake	Arousable on calling	Not responding
Circulation	**2**	**1**	**0**
	BP ± 20 mmHg preoperative	BP ± (20–50) mmHg preoperative	BP ± 50 mmHg preoperative
Activity	**2**	**1**	**0**
	Able to move 4 extremities voluntary or on command	Able to move 2 extremities voluntary or on command	Able to move 0 extremities voluntary or on command

compared to 65% among the magnesium group. Based on this, the needed sample was 30 cases per each group (total 60). Effect size equals 0.79

Statistical analysis

Recorded data were analyzed using the Statistical Package for Social Sciences, version 20.0 (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage. The following tests were done: independent sample t test of significance was used when comparing between two means. Chi-square (χ^2) test of significance was used in order to compare proportions between qualitative parameters. The confidence interval was set to 95%, and the margin of error accepted was set to 5%. So, the p value was considered significant as the following: probability (p value); p value < 0.05 was considered significant.

Results

In this study, there were no statistically significant differences among the two groups regarding gender, age, weight, ASA-PS, and duration of operation (Table 3). There was no statistically significant difference between the two groups regarding MAP at baseline before loading dose; at induction then at 15, 30, 60, 90, 120 min; or post-extubation, but there was a statistically significant decrease in the MAP among (D group) 66.5 ± 4.56 mmHg compared to (M group) 73.11 ± 4.74 mmHg at 30 min postoperatively (p = 0.039) (Table 4). There was a statistically significant difference between the two groups regarding nitroglycerin requirements which was only used in the (M group) (8 cases) (p = 0.008). The total dose of nitroglycerine used in the (M group) was 145.48 ± 160.1 μg.

There were no statistically significant differences between the two groups regarding HR at baseline, but there was a statically significant decrease in the HR after anesthetic induction and at 15, 30, 60, 90, and 120 min intraoperatively and postoperatively; at the end of surgery; post-extubation; and 30 min later among the (D group) compared to the (M group) (Table 5).

Regarding bleeding score, there were significantly higher scores among the (M group) than the (D group) (Table 6). There was a statistically significant decrease in the amount of blood loss among (D group) compared to (M group) (p = 0.019). The surgeon satisfaction was significantly higher in (D group) than in (M group) (Table 7).

Time to reach Aldrete score ≥ 9 was significantly higher in the (D group), compared to the (M group) (p = 0.023). There was a statistically significant difference in the Ramsay sedation score (RSS) between the two groups at 15, 30, and 60 min post-extubation (p < 0.001) as it was significantly higher in the (D group) compared to the (M group) (Table 8). The time for first analgesic

Table 2 Ramsay sedation score

1	Anxious or agitated or restless
2	Cooperative, oriented, and tranquil
3	Drowsy but responds to commands
4	Asleep, brisk response to light glabellar tap or loud auditory stimulus
5	Asleep, sluggish response to light glabellar tap or loud auditory stimulus
6	Asleep and unarousable

A sedation score of 1 and 2 correspond to minimal sedation
A sedation score of 3 and 4 correspond to moderate sedation
A sedation score 5 and 6 corresponds to deep sedation

Table 3 Comparison between both groups according to demographic data

Demographic data	(D group) (***n*** = 30)	(M group) (***n*** = 30)	t/x^2	***p*** value
Gender				
Male	11 (36.7%)	13 (43.3%)	1.821#	0.259
Female	19 (63.3%)	17 (56.7%)		
Age (years)				
Range	18–60	18–60	0.450	0.674
Mean ± SD	40.17 ± 9.64	39.66 ± 9.52		
Weight (kg)				
Range	60–87	60–87	1.844	0.123
Mean ± SD	75.71 ± 18.17	74.68 ± 17.92		
ASA				
I	24 (80.0%)	22 (73.3%)	1.827#	0.236
II	6 (20.0%)	8 (26.7%)		
Duration of operation (min)				
Range	126.18 ± 17.66	132.75 ± 18.03	0.679	0.446
Mean ± SD				

Using: Independent Sample t-test; #x2: Chi-square test
p-value >0.05 NS; **p*-value <0.05 S

requirement postoperatively was significantly longer in the (D group) compared to the (M group) (45.68 ± 3.20 min versus 20.30 ± 1.42 min) ($p \leq 0.001$).

Two cases of hypotension (MAP ˂ 50 mmHg) were recorded among the dexmedetomidine group and treated by ephedrine increments 12.5 mg, but this was statistically insignificant. Five cases of bradycardia (HR ˂ 50 b/m) occurred in the dexmedetomidine group and one case in the magnesium group and were treated with atropine 0.5 mg with no statistically significant difference. Two cases of nausea and vomiting were recorded among the magnesium group which were insignificant. They were treated with 1 mg granisetron I.V. Two cases showed shivering with magnesium and were warmed with a heated blanket.

Discussion

Functional endoscopic sinus surgery (FESS) is a surgical procedure, which is performed using a fiberoptic endoscope with magnificent powerful camera. Bleeding should be minimal as a drop of blood may obscure the surgical field completely. Various approaches have been used to secure a dry operating field; among them are topical vasoconstrictors, Fowler's position, alpha- and beta-adrenergic blockade, and preoperative steroids. All these methods are associated with significant side effects. Other approved approach to this problem is to combine total intravenous anesthesia using propofol and remifentanil, together with esmolol (Drozdowski et al. 2011). Other studies used oral nifedipine as a premedication for induced hypotension in FESS (Hassanien and Talaat 2015).

Table 4 Comparison between both groups regarding the mean arterial blood pressure (MAP) (mmHg)

MAP (mmHg)	(D group) (***n*** = 30)	(M group) (***n*** = 30)	***t*** test	***p*** value
Baseline	85.79 ± 5.77	84.85 ± 5.7	0.149	0.724
After induction	74.41 ± 5.11	77.33 ± 5.31	0.680	0.445
After 15 min	65.96 ± 4.52	68.6 ± 4.7	0.569	0.492
After 30 min	58.37 ± 3.99	60.74 ± 4.15	0.071	0.777
After 60 min	54.95 ± 3.75	57.2 ± 3.9	0.851	0.450
After 90 min	58.2 ± 3.97	60.56 ± 4.14	1.741	0.173
After 120 min	60.93 ± 4.16	63.38 ± 4.34	1.167	0.287
End of surgery	66.6 ± 4.56	69.25 ± 4.75	1.476	0.218
Post-extubation	71.22 ± 4.89	75.15 ± 5.16	2.712	0.075
Post-operative 30 min	66.5 ± 4.56	73.11 ± 4.74	3.702	0.039*

Using: Independent Sample t-test
p-value >0.05 NS; **p*-value <0.05

Table 5 Comparison between both groups regarding the heart rate (beat/min)

Heart rate (beat/min)	(D group) (***n*** = 30)	(M group) (***n*** = 30)	***t*** test	***p*** value
Baseline	82.54 ± 5.78	81.72 ± 5.72	0.941	0.342
After induction	73.27 ± 5.13	79.90 ± 5.59	4.343	0.029*
After 15 min	66.86 ± 4.68	72.71 ± 5.09	3.104	0.037*
After 30 min	60.17 ± 4.21	65.44 ± 4.58	4.823	0.029*
After 60 min	57.16 ± 4.00	62.17 ± 4.35	6.803	0.012*
After 90 min	60.02 ± 4.20	65.27 ± 4.57	9.004	0.008*
After 120 min	62.42 ± 4.37	67.88 ± 4.75	6.070	0.017*
End of surgery	67.42 ± 4.72	72.98 ± 5.11	6.031	0.011*
Post-extubation	74.16 ± 5.19	82.47 ± 5.77	4.525	0.017*
Post-operative 30 min	68.23 ± 4.78	75.87 ± 5.31	3.607	0.035*

Using independent sample *t* test; *p* value > 0.05 non-significant, **p* value < 0.05 significant

In the current study, dexmedetomidine and magnesium sulphate were used. Dexmedetomidine is a highly selective and potent central α_2-receptor agonist; it has a central and peripheral sympatholytic property manifested by reduced arterial blood pressure, heart rate, cardiac output, and release of norepinephrine. In addition, it has a unique sedative property among other sedatives as it causes sedation without respiratory depression. Also, it has good analgesic (known as opioid-sparing) and anxiolytic effects. Regarding magnesium sulphate, it induces deliberate hypotension by intervention of the activation of membrane Ca^{2+} ATPase and Na–K ATPase involved in the transmembrane ion exchanges during depolarization and repolarization phases. Also, Mg^{++} inhibits the release of norepinephrine. In addition, it acts as a vasodilator by increasing the synthesis of prostacyclin, as well as inhibiting angiotensin-converting enzyme activity.

In the current study, we found that dexmedetomidine was more effective than magnesium sulphate to achieve controlled hypotension in patients undergoing FESS. Dexmedetomidine controlled blood pressure better than magnesium sulphate as nitroglycerin was added to achieve the targeted MAP in the (M group) providing a favorable quality of the surgical field, higher surgeon satisfaction, and less bleeding and has a potent analgesic effect with overall fewer side effects.

Table 6 Comparison between both groups regarding the bleeding score

Bleeding score	(D group) (***n*** = 30)	(M group) (***n*** = 30)	χ^2	***p*** value
0	1 (3.3%)	0 (0.0%)	1.889	0.212
1	3 (10.0%)	0 (0.0%)	1.280	0.217
2	15 (50.0%)	6 (20.0%)	3.798	0.039*
3	8 (26.7%)	4 (13.3%)	4.002	0.017*
4	2 (6.7%)	12 (40.0%)	2.681	0.028*
5	1 (3.3%)	8 (26.7%)	4.199	0.031*

Using χ^2 chi-square test; *p* value > 0.05 non-significant, **p* value < 0.05 significant

Dexmedetomidine and magnesium have been used in several other studies for controlled hypotension. In Patel et al. study, dexmedetomidine was compared with nitroglycerin to produce controlled hypotension; dexmedetomidine had the advantage of maintaining better cardiovascular stability as compared to nitroglycerine (Patel et al. 2018). In Bajwa et al. study, dexmedetomidine was compared with esmolol as a hypotensive drug; dexmedetomidine produced lower HRs and BP as well as better surgical field condition, compared with esmolol (Bajwa et al. 2016). In Ghodraty et al. study, magnesium was compared with remifentanil. Both drugs were similar in terms of providing controlled hypotension; also, similar hemodynamic properties were reported (Ghodraty et al. 2014). In the current study, controlled hypotension was achieved in both dexmedetomidine and the magnesium and the hypotensive effect was suitable for FESS.

Many investigators studied the hormonal and metabolic responses among patients subjected to controlled hypotension with MAP range between 55 and 65 mmHg; there was no risk of tissue ischemia (Newton et al. 1996). We decided to maintain the MAP within 55–65 mmHg to prevent cerebral hypoxia among patients. In the current study, patients in the (D group) had lower HRs than in the (M group) during the operation, which may explain the better surgical field condition in the (D group) bradycardia occurred in 5 patients in the (D group) that needed atropine administration, while bradycardia occurred just in one patient among the (M group). In a study by Byram and his colleagues, the incidence of bradycardia occurred in 4 patients in the dexmedetomidine group versus one patient in the magnesium group (Bayram et al. 2015),

Table 7 Comparison between both groups regarding surgeon satisfaction

Surgeon satisfaction	(D group) (***n*** = 30)	(M group) (***n*** = 30)	χ^2	***p*** value
Bad	1 (3.3%)	6 (20.0%)	5.249	0.022*
Moderate	5 (16.7%)	14 (46.7%)	9.053	0.003*
Good	9 (30.0%)	7 (23.3%)	3.481	0.049*
Excellent	15 (50.0%)	3 (10.0%)	17.190	< 0.001**

Using χ^2 chi-square test; *p* value > 0.05 non-significant, **p* value < 0.05 significant, ** *p* value < 0.001 highly significant

while in a study by Sie´skiewicz and his colleagues, the assessment of correlation between mean arterial pressure and intraoperative bleeding during endoscopic sinus surgery in patients with low heart rate, they reported that by decreasing the HR, better operative field condition could be achieved with no need to decrease MAP to the risky low levels (if HR was maintained as low as 60 beats/min) (Sieśkiewicz et al. 2010).

Regarding bleeding score, it was lower among the (D group) when compared with the (M group). Surgeon's satisfaction score for operative field visibility was higher among patients in the (D group). Peripheral vasoconstriction might be another reason for less bleeding and better surgical field among patients in the (D group) besides the decrease in BP and HR effects.

These results were similar to the Faranak et al. study, in which bleeding score was lower and the surgeon's satisfaction score was higher in the dexmedetomidine group than those of the magnesium group (Faranak et al. 2017). In Bayram et al. study, which compared the efficacy of $MgSO_4$ and dexmedetomidine in producing hypotension in FESS surgeries, it showed that dexmedetomidine provided a higher surgeon satisfaction than the magnesium group (Bayram et al. 2015). However, in another study done by Eghbal and his colleagues, comparing dexmedetomidine and labetalol in controlling bleeding during FESS, it showed that a better visibility of the surgical field and a higher surgeon satisfaction were experienced in the labetalol group than the dexmedetomidine group (Eghbal et al. 2018).

In the current study, patients in the dexmedetomidine group were more sedated while they were in the PACU, and the time to reach Aldrete score ≥ 9 was much longer when compared with the magnesium group. These results are consistent with Faranak et al. study, in which patients in the dexmedetomidine group were more sedated at the PACU and the time to reach modified Aldrete score ≥ 9 was longer compared with those of the magnesium group (Faranak et al. 2017). In Erdem et al. study, the sedation score was also higher when dexmedetomidine was administered to induce hypotension during FESS when compared with esmolol (Erdem et al. 2016). In Lee et al. study which compared dexmedetomidine and remifentanil administration as a hypotensive agent during operation, they observed that patients receiving dexmedetomidine were more sedated and the time needed to reach modified Aldrete score ≥ 9 was longer than those of the patients that received remifentanil (Lee et al. 2013). In Özcan et al. study, the same result was found for comparing dexmedetomidine versus remifentanil during FESS; they concluded that recovery time of patients in the dexmedetomidine group was longer than the remifentanil group (Özcan et al. 2012).

In the current study, the time to first analgesic requirement in the (D group) was less than the (M group) after the operation. It seems that dexmedetomidine has a stronger analgesic effect than magnesium. The analgesic effect of dexmedetomidine is due to the high selectivity of α_2 adrenergic receptor agonist in the locus coeruleus and spinal cord that has sedative, analgesic, and anti-anxiety actions, but does not cause respiratory depression (Chomey et al. 2013), while that of magnesium sulphate is due to NMDA receptor antagonist (Srebro et al. 2017). Faranak et al. study showed the same result as in the current study as less analgesic was required in the dexmedetomidine group than the magnesium group (Faranak et al. 2017). Dong et al. studied dexmedetomidine added to a sufentanil-based analgesic regimen for postoperative pain control in spine surgery, and it was found that dexmedetomidine reduced opioid requirement and satisfactory pain control during postoperative period (Dong et al. 2016). Yu and his colleagues studied the use of intravenous magnesium sulphate on postoperative analgesia in orthopedic surgery and

Table 8 Comparison between both groups regarding the Ramsay sedation score

Ramsay sedation score	(D group) (***n*** = 30)	(M group) (***n*** = 30)	***t*** test	***p*** value
RSS at 15 min postoperatively	4.75 ± 0.33	2.42 ± 0.17	15.651	< 0.001**
RSS at 30 min postoperatively	3.82 ± 0.30	2.26 ± 0.16	14.040	< 0.001**
RSS at 60 min postoperatively	3.20 ± 0.29	2.12 ± 0.15	12.572	< 0.001**

Using independent sample *t* test; ***p* value < 0.001 highly significant

concluded that perioperative intravenous administration of magnesium sulphate could reduce postoperative analgesic consumption and reduce postoperative pain (Yu et al. 2018).

A major strength of the study was its design. It was a randomized controlled trial with adequate computerized concealment of allocation. In the current study, the time needed for the first analgesic requirement was also recorded in both groups which were absent in previous similar studies.

One important limitation of this study is there was no controlled group. Another possible area of weakness is that this study was undertaken with subjects classified as ASA I or II and between the age of 18 and 60, so we cannot generalize the conclusions to other sub-groups. The small sample size may not have allowed for the detection of other adverse events that could occur with a low frequency. Furthermore, postoperative magnesium sulfate level was not measured, but no patients showed any signs of excessive neuromuscular blocks or toxicity. Finally, we did not report intraoperative inhalational consumption or muscle relaxant amount requirements.

Conclusion

The main conclusion is that dexmedetomidine is more effective than magnesium sulphate to achieve controlled hypotension in patients undergoing FESS. Dexmedetomidine controlled blood pressure better than magnesium sulphate which needed additional nitroglycerin providing a favorable quality of the surgical field, higher surgeon satisfaction, and less bleeding. Also, dexmedetomidine has a potent analgesic effect than magnesium with decreased duration of analgesic requirement postoperatively.

Abbreviations

ASA-PS: American Society of Anesthesiologists physical status; ATP: Adenosine triphosphate; b/m: Beat per minute; Ca^{++}: Calcium; CSF: Cerebrospinal fluid; ECG: Electrocardiogram; FESS: Functional endoscope sinus surgery; FiO2: Fraction of inspired oxygen; HR: Heart rate; I.M: Intramuscular; I.V: Intravenous; K^{+}: Potassium; MAP: Mean arterial pressure; Mg^{2+}: Magnesium sulphate; *N*: Number; Na^{+}: Sodium; NMDA: *N*-Methyl-D-aspartate; NRS: Numerical rating scale; O_2: Oxygen; PACU: Post-anesthesia care unit; RSS: Ramsay sedation score

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Authors' contributions

AA designed the study, revised the literature, followed up the patients, and critically reviewed the manuscript. GS designed the study, analyze the data, wrote and critically revised the manuscript. ME and AE revised literature, followed up the patients, collected the data, performed the analysis, and wrote the manuscript. All authors approved the final version of the manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Approval of the research ethical committee of the Faculty of Medicine, Ain-Shams University, was obtained (code number: FMASU M D 42/ 2018) and informed consent was obtained from all patients.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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