



“COMPARISON OF EFFICACY OF DEXMEDETOMIDINE WITH MAGNESIUM SULPHATE IN FUNCTIONAL ENDOSCOPIC SINUS SURGERY (FESS) UNDER GA”

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ABSTRACT

Introduction: Surgical treatment for chronic infection of nasal and para nasal sinuses is Functional endoscopic sinus surgery (FESS). Now a days, this is a popular technique accepted all over the world due to its minimally invasive nature and there is preservation of mucosa in this technique. Induced hypotension is advised in FESS to improve visibility of surgical site, decrease blood loss and need for blood transfusion. Pharmacological drugs are the one of the various techniques adopted to achieve controlled hypotension. Our goal of this study is to compare efficacy of Dexmedetomidine and Magnesium sulphate in maintaining intraoperative haemodynamic parameters (MAP and HR) in FESS under GA. **Materials And Methodology:** Prospective double blinded randomized controlled trial in 60 patients undergoing elective FESS. They were randomly divided in two groups using chit and box method with 30 patients in each group. Haemodynamics were monitored throughout the procedure. **Group D:** Dexmedetomidine IV bolus 1 mcg/kg before induction followed by IV infusion 0.5 mcg/kg/hr during surgery **Group M:** Magnesium sulphate IV bolus 40 mg/kg before induction followed IV infusion 15 mg/kg/hr during surgery. **Results:** The heart rate was lower in the group D at all times as compared to group M & they were statistically significant from 10 min after start of IV bolus onwards till after 60 min extubation. Mean arterial pressure was lower in the group D at all times as compared to group M & they were statistically significant from 5 min after start of IV bolus onwards till 60 min after extubation. Surgeon satisfaction score was better in group D as compared to group M. **Conclusion:** Dexmedetomidine is comparatively better than Magnesium sulphate in controlling heart rate and mean arterial pressure, reducing the blood loss and Isoflurane requirement, thus providing a better quality of surgical field throughout the procedure.

KEYWORDS : FESS, Controlled hypotension, Dexmedetomidine and Magnesium sulphate.

INTRODUCTION

Surgical treatment for chronic infection of nasal and para nasal sinuses is Functional endoscopic sinus surgery (FESS). Now a days, this is a popular technique accepted all over the world due to its minimally invasive nature and there is preservation of mucosa in this technique. It is done using an endoscope in a small restricted area making bleeding a major impediment to the procedure. Increased bleeding leads to frequent suctioning by surgeon in the operative field, so as to optimize the field at the cost of prolonging the duration of surgery.

FESS in the early period was done under local anaesthesia, as the patient can alert the surgeon which can minimize trauma and complications. In current times, evolution of technique has allowed the surgeon to be more aggressive in extent of resection. Advantages of general anaesthesia include - Immobile surgical field, Effective airway protection, Adequate analgesia, Patient comfort. Major complications like optic nerve damage, damage to the dura and even meningitis have been reported for FESS under general as well as local anaesthesia.^[1,2]

Induced hypotension is advised in FESS to improve visibility of surgical site, decrease blood loss and need for blood transfusion. Therefore, improving the visibility of the surgical site by reducing bleeding during FESS is an important issue for anaesthesiologists.^[2]

Pharmacological drugs are the one of the various techniques adopted to achieve controlled hypotension. In controlled hypotension several agents have been used. Alpha adrenergic receptor agonists Clonidine, Dexmedetomidine, Beta Blockers like Esmolol, Propofol, Nitroglycerine, Magnesium sulphate are the different agents used to achieve induced hypotension either alone or in combination with each other. However, an ideal agent for inducing controlled hypotension cannot be asserted. The ideal agent used for 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.^[1,3,4,5]

Dexmedetomidine is a highly selective α_2 -adrenoceptor agonist with sedative, anxiolytic, and analgesic characteristics. Dexmedetomidine mediates central α_2 and imidazoline type 1 receptors. The activation of these central receptors results in a decrease in norepinephrine release and leads to decrease in blood pressure and heart rate.^[6]

Magnesium sulphate is also a good agent for induced hypotension. 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.^[5,7,8] In addition Mg^{++} inhibits the release of norepinephrine by blocking the N-type Ca^{++} channels at nerve endings and thus decrease the blood pressure.^[9]

There are several studies which have assessed the effectiveness of Dexmedetomidine and Magnesium sulphate in controlled hypotension. These two agents have been compared with other hypotensive agents in terms of their role in hypotensive anaesthesia but to the best of our knowledge no study comparing these two agents with each other has been cited in the scientific literature.^[2,5,7,10]

Our primary goal in this study is to compare efficacy of Dexmedetomidine and Magnesium sulphate in maintaining intraoperative haemodynamic parameters (MAP and HR) in FESS under GA.

MATERIALS AND METHODOLOGY

This is the Prospective double blinded randomized controlled trial conducted in department of Anaesthesia of GMC Aurangabad after getting the approval from Institutional Ethics Committee.

We included 60 patients belonging to ASA Grade I and II, between age 18 to 55 years, BMI < 25 kg/m² of both sex undergoing elective FESS under general anaesthesia who had given written, valid informed consent. Patients with ASA Grade III and IV, BMI > 25 kg/m², Hepatic, renal or cardiovascular dysfunction, respiratory insufficiency, uncontrolled diabetes mellitus and hypertension, coagulation defects, COPD etc., pregnant and breastfeeding women, history of drug allergies and who refused to participate were excluded. They were randomly divided in two groups using chit and box method with 30 patients in each group.

Group D:

Dexmedetomidine IV bolus 1 mcg/kg before induction followed by IV infusion 0.5 mcg/kg/hr during surgery

Group M:

Magnesium sulphate IV bolus 40 mg/kg before induction followed IV

infusion 15 mg/kg/hr during surgery.

In the operating room baseline pre-operative HR, MAP, RR, ECG, SPO2 was recorded. The patients were supplemented with an additional dose of fentanyl 2 mcg/kg when the HR increases by more than 20%. Anaesthesia was maintained with N2O+O2 and Isoflurane. Throughout the procedure HR & MAP was monitored, baseline / at start of iv infusion / after 5 min / after 10 min / after iv bolus / at induction / at intubation then every 10 min interval. At the end of surgery patient reversed with Neostigmine 50 mcg/kg and Glycopyrrolate 8 mcg/kg, throat pack removed and patient extubated uneventfully. Postoperative monitoring was done at every 10 min interval for 1 hour. Intraoperative blood loss was measured by using intra-operative surgical field evaluation (IOSFE).^[11] Post-operative nausea, vomiting, headache, dryness of mouth, respiratory depression was noted.

In addition, the operative field visibility was rated according to a 5-point scale by Fromme et al^[11] and Boezaart et al^[12] depending on the bleeding occurring at the operative site.

After completion of surgery, post extubation at 0 min & at 60 min Ramsay sedation score and visual analogue score (VAS) was noted.

Data was collected and entered in the Microsoft XL Sheet. Data analysis was done by using one-tailed Students unpaired T-test for continuous variable & Chi Square test for categorical data. Descriptive variables expressed as mean± SD. Data analysis was done by appropriate statistical method with statistical software SPSS Ver. 20.

RESULTS

Table no.1: Demographic profile

variable	Group M	Group D	P Value
Age (mean±SD)	33.88 ± 20.59	32.95 ± 21.58	0.86
Gender(n%)			
Male	53.33	66.67	
Female	46.67	33.33	
ASA SCORE (n%)			=0.107
1	13.33	26.66	
2	86.67	73.33	
DIAGNOSIS OF PATIENTS(n%)			0.07
MUCORMYOSIS	53.33	36.66	
CHRONIC SINUSITIS	20	43.33	
FUNGAL SINUSITIS	13.33	0	
ANTRACHONAL POLYP, DACRO CYSTITIS, ETHAMOIDAL POLYP, DEVIRAED NASAL SEPTUM	3.33 each	0	
INTRA OPERATIVE BLOOD LOSS (mean±SD)	132.1±5.68	126.33±5.08	<0.001
SURGEON SATISFACTION SCORE (mean±SD)	6.40± 0.66	6.98± 0.56	0.022
INTRA OPERATIVE VISIBILTY SCORE (n)			<0.001
1	0	18	
2	13	12	
3	17	0	

Table no 2: Comparison of mean Heart Rate of patients in group M And D

	GROUP	MEAN	STD. DEVIATION	P VALUE
BASELINE HR	M	87.13	5.296	0.62
	D	86.37	9.618	
START IV BOLUS HR	M	81.53	4.805	0.34
	D	79.33	11.792	
5 MIN HR	M	77.90	5.162	0.27
	D	75.30	11.951	
10 MIN HR	M	73.93	4.346	0.02

		D	70.12	8.916	
AT IV INFUSION START HR	M	75.33	3.536	0.01	
	D	70.47	10.136		
AT INDUCTION HR	M	74.80	3.044	0.00	
	D	69.23	9.776		
AT INTUBATION HR	M	72.30	3.282	0.05	
	D	68.23	9.6		
AFTER 10 MIN HR	M	71.70	3.098	0.04	
	D	67.43	9.020		
AFTER 20 MIN HR	M	68.73	12.605	0.04	
	D	65.27	8.2		
AFTER 30 MIN HR	M	71.03	3.429	0.02	
	D	67.50	7.934		
AFTER 40 MIN HR	M	72.77	3.298	0.00	
	D	67.90	8.327		
AFTER 50 MIN HR	M	75.13	2.909	<0.0	
	D	68.13	9.923		
AFTER 60 MIN HR	M	75.87	3.665	<0.0	
	D	68.03	9.114		
AFTER 70 MIN HR	M	68.77	6.826	0.03	
	D	65.56	4.25		
AFTER 80 MIN HR	M	78.88	2.88	<0.0	
	D	69.96	7.1		
AFTER 90 MIN HR	M	67.69	6.77	0.03	
	D	65.57	4.34		
AFTER 100 MIN HR	M	77.54	3.68	<0.0	
	D	68.14	6.65		
AFTER 110 MIN HR	M	76.23	3.16	0.00	
	D	69.86	5.86		
AFTER 120 MIN HR	M	83.23	3.39	0.00	
	D	68.93	6.15		
AFTER REVERSAL HR	M	82.67	3.078	<0.0	
	D	69.60	5.418		
AFTER EXTUBATION HR	M	83.27	4.556	<0.0	
	D	67.67	13.371		
AFTER 10 MIN HR	M	83.17	5.908	<0.0	
	D	71.63	7.453		
AFTER 20 MIN HR	M	84.53	3.256	<0.0	
	D	71.73	6.987		
AFTER 30 MIN HR	M	72.77	3.298	0.04	
	D	71.17	5.347		
AFTER 40 MIN HR	M	75.13	2.909	0.02	
	D	72.80	7.006		
AFTER 50 MIN HR	M	75.87	3.665	0.03	
	D	73.21	6.24		
AFTER 60 MIN HR	M	78.67	3.772	0.00	
	D	74.63	6.980		

The baseline mean heart rate in Group M was 87.13 ± 5.296 and in Group D was 86.37±9.618 with a p value of 0.62. Intraoperatively, heart rate was lower in both the groups as compared to baseline. However, the heart rate was lower in the group D at all times as compared to group M & they were statistically significant from 10 min after start of IV bolus onwards till after 60 min extubation.

Table no 3: Comparison of mean Arterial pressure of patients in group M And D

	GROUP	MEAN	STD. DEVIATION	P VALUE
BASELINE MAP	M	80.53	2.726	0.78
	D	79.23	5.638	
START IV BOLUS MAP	M	71.70	2.395	0.05
	D	67.50	4.61	
5 MIN MAP	M	68.80	1.789	<0.0
	D	64.07	4.487	
10 MIN MAP	M	67.50	2.488	<0.0
	D	63.70	4.714	
AT IV INFUSION START MAP	M	69.17	2.198	<0.0
	D	64.77	4.023	
AT INDUCTION MAP	M	70.30	1.950	<0.0
	D	63.67	4.381	
AT INTUBATION MAP	M	67.63	2.205	0.00
	D	64.50	4.960	

AFTER 10 MIN MAP	M	66.47	2.145	0.03
	D	64.87	3.550	
AFTER 20 MIN MAP	M	67.53	2.474	<0.0
	D	64.20	3.890	01
AFTER 30 MIN MAP	M	67.10	2.295	0.03
	D	64.87	3.12	
AFTER 40 MIN MAP	M	67.23	2.029	0.00
	D	65.13	2.968	2
AFTER 50 MIN MAP	M	67.80	2.219	0.00
	D	72.60	7.842	3
AFTER 60 MIN MAP	M	67.77	2.609	<0.0
	D	64.10	3.294	01
AFTER 70 MIN MAP	M	66.13	2.662	0.03
	D	64.51	3.56	
AFTER 80 MIN MAP	M	68	1.78	0.00
	D	65.73	3.54	5
AFTER 90 MIN MAP	M	67.75	3.3	0.03
	D	63.14	3.36	
AFTER 100 MIN MAP	M	68.45	1.76	0.00
	D	64.71	4.21	1
AFTER 110 MIN MAP	M	67.85	2.45	0.00
	D	63.93	4.89	6
AFTER 120 MIN MAP	M	67.95	2.08	0.01
	D	63.64	4.37	
AFTER REVERSAL MAP	M	68.57	2.029	<0.0
	D	64.37	3.439	01
AFTER EXTUBATION MAP	M	70.93	2.449	<0.0
	D	64.10	4.788	01
AFTER 10 MIN MAP	M	70.77	2.063	<0.0
	D	65.43	3.812	01
AFTER 20 MIN MAP	M	70.17	1.783	<0.0
	D	64.30	4.411	01
AFTER 30 MIN MAP	M	67.97	2.125	0.01
	D	65.93	3.704	
AFTER 40 MIN MAP	M	67.23	2.029	0.00
	D	65.53	2.776	9
AFTER 50 MIN MAP	M	67.80	2.219	<0.0
	D	73.77	7.637	01
AFTER 60 MIN MAP	M	67.77	2.609	0.02
	D	65.10	3.726	

The mean arterial blood pressure baseline was in group M 80.53 ± 2.726 and D group 79.23 ± 5.638 with p value 0.78 which is not statistically significant. Intraoperatively, mean arterial pressure was lower in both the groups as compared to baseline. However, mean arterial pressure was lower in the group D at all times as compared to group M & they were statistically significant from 5 min after start of IV bolus onwards till 60 min after extubation.

DISCUSSION

In our study Age, Gender, Diagnosis and ASA score of patients in group M and group D were not found to be statistically significant (p value >0.05). In our study mean baseline heart rate for group M and group D was not found to be significant (P value=0.62). Distribution of mean heart rate at start of IV bolus and after 5-min was not found to be significant in group D. Distribution of mean heart rate 10 min after start of iv bolus, at start of iv infusion, at induction, at intubation, after 10 min to after 120 min, after reversal, after extubation and after 10 min to 60 min post extubation is significantly lower in Group D compared to Group M (P-value <0.05 in all).

In our study we found that after IV administration of both Magnesium sulphate and Dexmedetomidine, heart rate was decreased than baseline heart rate but significant decrease in heart rate was found in Dexmedetomidine group after 10 min iv bolus. Dexmedetomidine control heart rate by its highly selective and potent central α_2 -receptor agonist action. It has a central and peripheral sympatholytic property manifested by reduced arterial blood pressure, heart rate, cardiac output, and release of norepinephrine.

Magnesium sulphate control heart rate by a decrease catecholamines release and suppressing the pressor response and by acting on NMDA receptor which causes sedation. Magnesium sulphate does not cause reflex tachycardia when used as an intra operative hypotensive agent,

does not produce reflex hypertension, and does not lower cardiac output.^[13]

Dexmedetomidine group found better controlled heart rate during induction, intubation, through intra operative, at reversal, at extubation and in post operative period. It indicates that Dexmedetomidine was better to maintain heart rate than Magnesium Sulphate.

Similar observation noted by Karthik Kamal et al^[14] heart rate remained comparable between two groups during pre induction, post induction, 5 min and 10 min post induction. Significant difference in pulse rate at 15 min, 30 min, at stoppage of drugs and 5 min after stoppage of drugs, which shows pulse rate significantly lower in Dexmedetomidine group than Magnesium sulphate group.

Mean arterial pressure

The mean baseline arterial pressure of group M and group D were not found to be significant (p value- 0.78). Distribution of mean arterial pressure at start of IV bolus was not found to be significant. Distribution of mean arterial pressure 5 min and 10 min after start of iv bolus, at start of iv infusion, at induction, at intubation, after 10 to after 120 min, after reversal, after extubation and after 10 min to 60 min post extubation is significantly lower in Group D compared to Group M (P value < 0.05 in all).

In our study we choose a target MAP of 60–70 mmHg to provide the best quality of surgical field without any adverse effects. In group D we were able to achieve target MAP earlier than group M and maintained it throughout the surgery by titrating Isoflurane concentration. It was found that MAP was lower in Dexmedetomidine group than Magnesium sulphate group. This could be due to combined effect of the decreased central sympathetic outflow and also decrease in the plasma norepinephrine levels after Dexmedetomidine infusion. Induced Hypotension observed better in Dexmedetomidine group than Magnesium sulphate.

In our study we have not found biphasic response in Dexmedetomidine group. Dexmedetomidine like other α_2 agonist, exerts sympatholytic effects by activating inhibitory α_2 receptors both in the central nervous system and on peripheral sympathetic nerve endings, resulting in inhibition of noradrenaline release. The inhibition of sympathetic transmitter release can be measured in humans as a decline in the concentration of noradrenaline in plasma. Similar findings were found in study conducted by Usha Bafana et al^[15]The mean arterial pressure was found to be significant lower from after induction till 70 min after induction. Dexmedetomidine and Magnesium sulphate both achieved controlled hypotension and provided a good comparable surgical field during FESS.

Dexmedetomidine was superior compared to Magnesium sulphate in terms of haemodynamic stability, longer duration postoperative analgesia, and good postoperative sedation level.

Surgeon satisfaction score

Surgeon satisfaction score was better in group D as compared to group M. As regarding intra-operative bleeding score, it was lower among the D group when compared with the M 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. The present study concluded that intraoperative visibility score was better in group D when compared with Group M and the p value was found to be significant. This is due to the decreased blood pressure leads to decreased blood loss and good exposure of the surgical field in patients who received Dexmedetomidine than Magnesium sulphate. These findings were similar to study done by Usha Bafana et al.^[15] the study concluded that Dexmedetomidine and Magnesium sulphate both provided a good and comparable surgical field visibility, with an average category score of 1–3 and 2–3 respectively but concluded that there was no significant difference of mean intraoperative blood loss between the 2 groups.

CONCLUSION

We concluded that hypotensive anaesthesia is an important tool during FESS to improve surgical field. Both Dexmedetomidine and Magnesium sulphate are safe and efficacious to provide oligaemic surgical field with better visualization in FESS surgeries keeping the haemodynamic variation within physiological range. However, Dexmedetomidine is comparatively better than Magnesium sulphate

in controlling heart rate and mean arterial pressure, reducing the blood loss and Isoflurane requirement, thus providing a better quality of surgical field throughout the procedure.

REFERENCES

1. Degoute CS. Controlled hypotension. *Drugs*. 2007 May;67(7):1053-76.
2. Guven DG, Demiraran Y, Sezen G, Kepek O, Iskender A. Evaluation of outcomes in patients given dexmedetomidine in functional endoscopic sinus surgery. *Annals of Otolaryngology, Rhinology & Laryngology*. 2011 Sep;120(9):586-92.
3. Marchal JM, Gomez.Luque A, Martos.Crespo F, Sanchez De La Cuesta F, Martinez.Lopez MC, Delgado.Martinez AD. Clonidine decreases intraoperative bleeding in middle ear microsurgery. *Acta anaesthesiologica scandinavica*. 2001 May;45(5):627-33.
4. Piper SN, Suttner SW, Maleck WH, Kumle B, Haisch G, Boldt J. Effects of sodium nitroprusside-induced controlled hypotension on pancreatic function assessed by pancreatitis-associated protein in patients undergoing radical prostatectomy. *European journal of anaesthesiology*. 2002 Aug;19(8):609
5. Elsharnouby NM, Elsharnouby MM. Magnesium sulphate as a technique of hypotensive anaesthesia. *BJA: British Journal of Anaesthesia*. 2006 Jun 1;96(6):727-31.
6. Jooste EH, Muhly WT, Ibinson JW, Suresh T, Damian D, Phadke A, Callahan P, Miller S, Feingold B, Lichtenstein SE, Cain JG. Acute hemodynamic changes after rapid intravenous bolus dosing of dexmedetomidine in pediatric heart transplant patients undergoing routine cardiac catheterization. *Anesthesia and analgesia*. 2010 Dec;111(6):1490.
7. Ryu JH, Sohn IS, Do SH. Controlled hypotension for middle ear surgery: a comparison between remifentanyl and magnesium sulphate. *British journal of anaesthesia*. 2009 Oct 1;103(4):490-5.
8. Koinig H, Wallner T, Marhofer P, Andel H, Horauf K, Mayer N. Magnesium sulfate reduces intra- and postoperative analgesic requirements. *Anesthesia & Analgesia*. 1998 Jul 1;87(1):206-10.
9. Shimosawa T, Takano K, Ando K, Fujita T. Magnesium inhibits norepinephrine release by blocking N-type calcium channels at peripheral sympathetic nerve endings. *Hypertension*. 2004 Dec 1;44(6):897-902.
10. Ayoglu H, Yapakci O, Ugur MB, Uzun L, Altunkaya H, Ozer Y, Uyanik R, Cinar F, Ozkocak I. Effectiveness of dexmedetomidine in reducing bleeding during septoplasty and tympanoplasty operations. *Journal of clinical anesthesia*. 2008 Sep 1;20(6):437-41.
11. Ghali A, Mahfouz AK, Ihanamäki T, El Btarny AM. Dexmedetomidine versus propofol for sedation in patients undergoing vitreoretinal surgery under sub-Tenon's anesthesia. *Saudi journal of anaesthesia*. 2011 Jan;5(1):36.
12. Coté CJ, Grabowski EF, Stowell CP. Strategies for blood product management, reducing transfusions, and massive blood transfusion. In *A Practice of Anesthesia for Infants and Children 2019* Jan 1 (pp. 257-280). Elsevier.
13. Akkaya A, Tekelioglu UY, Demirhan A, Bilgi M, Yildiz I, Apuhan T, Kocoglu H. Comparison of the effects of magnesium sulphate and dexmedetomidine on surgical vision quality in endoscopic sinus surgery: randomized clinical study. *Revista brasileira de anestesiologia*. 2014 Nov;64:406-12.
14. Karthik Kamal J.S, Kundhavi Devi R, Pradeep Sellappan. A study on comparison between dexmedetomidine and magnesium sulphate in controlled hypotension during functional endoscopic sinus surgery under general anaesthesia. *International Journal of Contemporary Medical Research* 2018;5(11):K7-K11
15. Bafna U, Gurjar SS, Nagal JB. Dexmedetomidine versus magnesium sulfate for induced hypotension during functional endoscopic sinus surgery: A randomized, double-blind study. *Bali Journal of Anesthesiology*. 2020 Oct 1;4(6):39.