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Original Research Article

Comparative Study of Effect of Dexmedetomidine vs Magnesium Sulphate for Controlled Hypotension in Functional Endoscopic Sinus Surgery

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Abstract:

Introduction: Functional Endoscopic Sinus Surgery (FESS) is a minimally invasive surgical technique for the treatment of chronic rhinosinusitis and other sinus pathologies. FESS presents certain intraoperative challenges, including intraoperative bleeding, which can obscure the surgical field, reduce the precision of the surgery, prolong operative time, and increase the risk of complications. To address these challenges, various anaesthetic techniques have been developed to improve the surgical field, among which controlled hypotension. The present study was conducted to compare efficacy of Dexmedetomidine Vs Magnesium Sulphate during FESS to enhance operative conditions, reduce complications, and provide a higher standard of care for patients undergoing FESS.

Methods: The present quasi-experimental research model with non-randomized design was conducted to evaluate the efficacy dexmedetomidine (DEX) and magnesium sulphate ($MgSO_4$) in achieving controlled hypotension during functional endoscopic sinus surgery (FESS) amongst 60 patients in a tertiary care hospital during Feb. 2023 to Sept. 2024. Participants were allocated into two groups: i) Group D (Dexmedetomidine): Received a loading dose of 1 µg/kg diluted in 100 mL normal saline (NS) over 10 minutes pre-induction, followed by a maintenance infusion of 0.5–1 µg/kg/hr. and ii) Group M (Magnesium Sulphate): Received a loading dose of 40 mg/kg in 100 mL NS over 10 minutes pre-induction, followed by a maintenance infusion of 10–15 mg/kg/hr. Both groups received standardized premedication and Anaesthesia protocols.

Results: In our study, there was no significant difference between both groups with respect to age, gender, ASA class, weight. The mean HR was significantly lower in group D compared to group M, after post intubation, intraoperatively till 45 min and after 5 min of stopping infusions and at extubation. The mean, SBP, DBP and MAP were significantly lower in group D compared to group M after post intubation, intraoperatively till 45 min and after 5 min of stopping infusions and at extubation. The average intraoperative bleeding was less in Group D as compared to Group M. Profoundly deeper sedation with dexmedetomidine (Group D) was recorded using modified Ramsay sedation score. Thus, Dexmedetomidine (Group D) provided better operating conditions due to less intraoperative bleeding as compared to magnesium sulphate (Group M).

Conclusion: In this study, we conclude that Dexmedetomidine was found to be more effective than magnesium sulphate in achieving controlled hypotension in patients undergoing functional endoscopic sinus surgery (FESS).

Keywords: Dexmedetomidine, Magnesium Sulphate, FESS, Sinus Surgery, Ramsay Sedation Score.

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Introduction

Functional Endoscopic Sinus Surgery (FESS) is a minimally invasive surgical technique that has revolutionized the treatment of chronic rhinosinusitis and other sinus pathologies. The technique involves the use of a nasal endoscope to access and treat the paranasal sinuses, allowing for improved drainage and ventilation while preserving mucosal integrity. [1]

Despite its advantages, FESS presents certain intraoperative challenges, including intraoperative bleeding, which can obscure the surgical field, reduce the precision of the surgery, prolong operative time, and increase the risk of complications such as tissue trauma or incomplete resection. [2] The sinonasal region exists anatomically close to important structures including the orbit and anterior skull base which requires minimal surgical errors because clear operative fields reduce possible complications with orbital injuries and cerebrospinal fluid leaks.

To address these challenges, various anaesthetic techniques have been developed to improve the surgical field, among which controlled hypotension remains one of the most effective. Controlled hypotension is defined as a deliberate reduction in the patient's mean arterial pressure (MAP) to a target level—typically 50–65 mmHg or a 30% reduction from baseline—during surgery to reduce capillary bleeding and improve operative conditions. [3]

Several pharmacological agents have been used to achieve controlled hypotension, including volatile anaesthetics, beta-blockers, calcium channel blockers, vasodilators, and α2-adrenergic agonists. Among the newer and more effective agents being explored are Dexmedetomidine and Magnesium Sulphate. Both have distinct mechanisms of action and pharmacological profiles that make them suitable candidates for hypotensive anaesthesia.

Dexmedetomidine is a highly selective α2-adrenergic receptor agonist with sedative, anxiolytic, analgesic, and sympatholytic properties. Its ability to provide stable haemodynamics, reduce intraoperative anaesthetic and analgesic requirements and promote postoperative sedation and analgesia makes it an attractive agent for controlled hypotension in surgeries such as FESS.

On the other hand, Magnesium Sulphate exerts its hypotensive effect by acting as a calcium antagonist. It causes smooth muscle relaxation, leading to vasodilation and a subsequent decrease in blood pressure. It also has antiarrhythmic, analgesic, and NMDA receptor antagonist properties, which may contribute to intraoperative haemodynamic stability and improved surgical conditions. Moreover, it is known to potentiate the effects of anaesthetic agents, allowing for dose reduction and minimizing potential side effects. Given their unique advantages and differing mechanisms of action, a comparative evaluation of Dexmedetomidine and Magnesium Sulphate in achieving controlled hypotension during FESS is both timely and clinically relevant. [4]

The present study was conducted to compare efficacy of Dexmedetomidine or Magnesium Sulphate with other drugs during FESS to enhance operative conditions, reduce complications, and provide a higher standard of care for patients undergoing FESS.

Methods

The present quasi-experimental research model with non-randomized design was selected to evaluate the efficacy of two pharmacological agents—dexmedetomidine (DEX) and magnesium sulphate ($MgSO_4$)—in achieving controlled hypotension during functional endoscopic sinus surgery (FESS). The study involved two parallel groups, each receiving one of the interventions, and outcomes were measured prospectively. The design allowed for direct comparison of hemodynamic stability, surgical field visibility, blood loss, recovery time, and adverse effects between the groups. Purposive sampling was employed to ensure homogeneity in participant selection, aligning with the inclusion and exclusion criteria.

The research was conducted in a tertiary care hospital equipped with advanced surgical and anesthetic facilities during Feb. 2023 to Sept. 2024. The institution's ENT department regularly performed FESS procedures, ensuring a consistent case load for participant recruitment.

Inclusion Criteria: ASA grade I or II, Age between 18–60 years, Willingness to provide written informed consent, Scheduled for elective FESS under general Anaesthesia and Body mass index (BMI) <35 kg/m².

Exclusion Criteria: ASA grade III or IV, Age <18 or >60 years, Refusal to participate in the study, History of allergic reactions to DEX, $MgSO_4$, or other protocol medications, Pregnancy or lactation, Coagulation disorders or chronic anticoagulant use and Severe cardiovascular, renal, or hepatic dysfunction. Participants who developed intraoperative complications (e.g., allergic reactions) or voluntarily withdrew were excluded post-enrolment.

A purposive sampling technique was utilized to select participants meeting predefined eligibility criteria. This non-probability method ensured homogeneity in the study population, minimizing confounding variables such as comorbidities or surgical complexity. The ENT department's surgical roster was screened daily to identify eligible candidates, and informed consent was obtained preoperatively. Sampling aimed to achieve equal distribution between the two intervention groups while maintaining demographic and clinical comparability.

The sample size was calculated using the scientific formula and after the initial calculation yielded 26 participants per group. Accounting for a 10% attrition rate, the final sample size was 30 participants per group, totalling 60 participants (Group D: 30, Group M: 30).

Participants were allocated into two groups:

i) Group D (Dexmedetomidine): Received a loading dose of 1 μg/kg diluted in 100 mL normal saline (NS) over 10 minutes pre-induction, followed by a maintenance infusion of 0.5–1 μg/kg/hr. ii) Group M (Magnesium Sulphate): Received a loading dose of 40 mg/kg in 100 mL NS over 10 minutes pre-induction, followed by a maintenance infusion of 10–15 mg/kg/hr.

Both groups received standardized premedication (glycopyrrolate, ondansetron, midazolam) and Anaesthesia protocols (propofol induction, vecuronium bromide, isoflurane maintenance).

Study Parameters: Hemodynamics: Systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR) recorded at baseline, post-induction, post-intubation, and every 10 minutes intraoperatively. Blood Loss: Quantified using the Boezaart scale (6-point scoring system: 0 = no bleeding; 5 = severe bleeding). Surgical Field Visibility: Rated by surgeons using a 4-point Likert scale (1 = poor; 4 = excellent). Recovery Time: Duration from Anaesthesia discontinuation to extubation and postoperative discharge readiness. Adverse Events: Hypotension (MAP <60 mmHg), bradycardia (HR <50 bpm), nausea/vomiting, or allergic reactions. Additional Interventions: Requirement for rescue hypotensive agents (e.g., nitroglycerin). If decrease in MAP was more than 30% despite minimum limit of maintenance dose, Inj. Mephentermine 6 mg was given. Bradycardia was defined as fall in heart rate less than heart rate 50 beats/minute, atropine 0.6 mg administered in patients who developed bradycardia.

Study Procedure:

Preoperative Phase: Pre-anesthetic evaluation (medical history, physical examination, laboratory tests) was conducted 24 hours before surgery. Participants were kept NBM for 6 hours and premedicated with intravenous glycopyrrolate (0.004 mg/kg) and ondansetron (0.1 mg/kg). (Midazolam 0.03 mg/kg)

Intraoperative Phase: Standard monitors (ECG, SpO_2, NIBP, $EtCO_2$) were applied.

Group-specific loading doses were administered 10 minutes before induction. Anaesthesia was induced with propofol 1-2 mg/kg Fentanyl (2mg/ kg) and vecuronium bromide (0.1–0.2 mg/kg), followed by endotracheal intubation. Maintenance included isoflurane (1–1.5%) and vecuronium. Ventilation targeted $EtCO_2$ of 35–45 mmHg. Hemodynamic parameters and bleeding scores were recorded at predefined intervals.

Postoperative Phase: Neuromuscular blockade was reversed with neostigmine (0.08 mg/kg) and glycopyrrolate (0.05 mg/kg). Sedation score was recorded using modified Ramsay sedation score Participants were monitored in the recovery room for adverse events and recovery time. Aldrete Score ≥ 9 was recorded to discharge patient from recovery room to ward.

Aldrete Score:

Respiration	**2**	**1**	**0**
	Able to keep deep breath and cough	Dyspnea / shallow breathing	Apnea
O2 Saturation	2	1	0
	Maintains > 92% on room air	Needs oxygen inhalation to maintain o2 saturation	Saturation < 90% even with supplemental o2
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

The Aldrete Score, also known as the Post Anaesthesia Recovery Score (PARS), is a standardized scoring system used to assess a patient's readiness for discharge from the post-Anaesthesia care unit (PACU). It evaluates the recovery of vital physiological functions following general, regional, or sedation Anaesthesia.[44]

Components of the Aldrete Score: The score is based on five clinical criteria, each scored from 0 to 2, with a maximum possible score of 10:

Results

Table 1: Bleeding Score (Boezzart Scale)

		Groups		Total	P value
		Dexmedetomidine	Magnesium Sulphate		
Bleeding Score	1	5	0	5	< 0.001
	2	14	4	18	
	3	11	11	22	
	4	0	12	12	
	5	0	3	3	
Total		30	30	60	

Table no.1 shows Boezzart bleeding scores differed significantly between groups ($p < 0.001$), favouring dexmedetomidine. The best score (1) was seen only in the dexmedetomidine group (5 patients), and score grades 4 and 5—indicative of worse bleeding—occurred exclusively in the magnesium sulphate group (12 with grade 4, 3 with grade 5). Intermediate scores (2 and 3) were more evenly distributed, but overall, dexmedetomidine produced a clearer surgical field with less bleeding, while magnesium sulphate had more cases with substantial intraoperative bleeding.

Table no.2) Surgeon Satisfaction Score

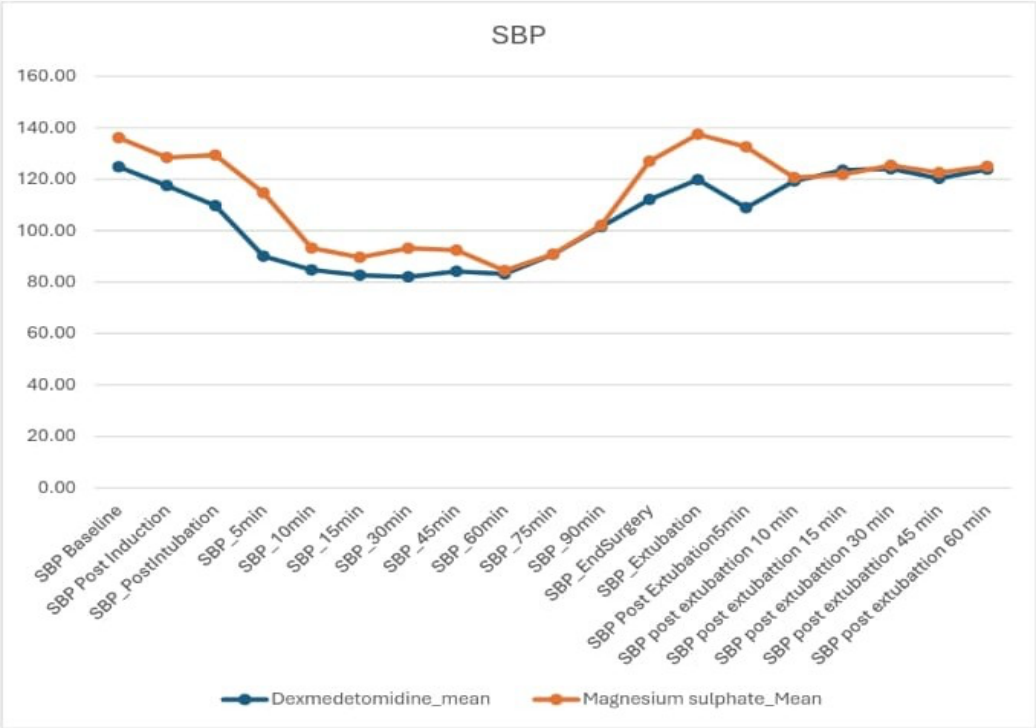
		Groups		Total	P value
		Dexmedetomidine	Magnesium Sulphate		
Surgeon Satisfaction Score	1	0	10	10	< 0.001
	2	4	6	10	
	3	7	10	17	
	4	19	4	23	
Total		30	30	60	

Table no.2 shows that Surgeon satisfaction differed significantly between groups ($p < 0.001$), with the dexmedetomidine group showing superior operative conditions. The highest satisfaction score (4) was reported in 19 of 30 dexmedetomidine cases compared to only 4 in the magnesium group. Conversely, the lowest scores (1 and 2) were more frequent with magnesium sulphate (10 with score 1, and 6 with score 2) versus virtually none in dexmedetomidine. This aligns with better bleeding control and suggests dexmedetomidine provided a clearer surgical field and improved surgeon-perceived quality.

Table 3: Modified Ramsay Sedation Score

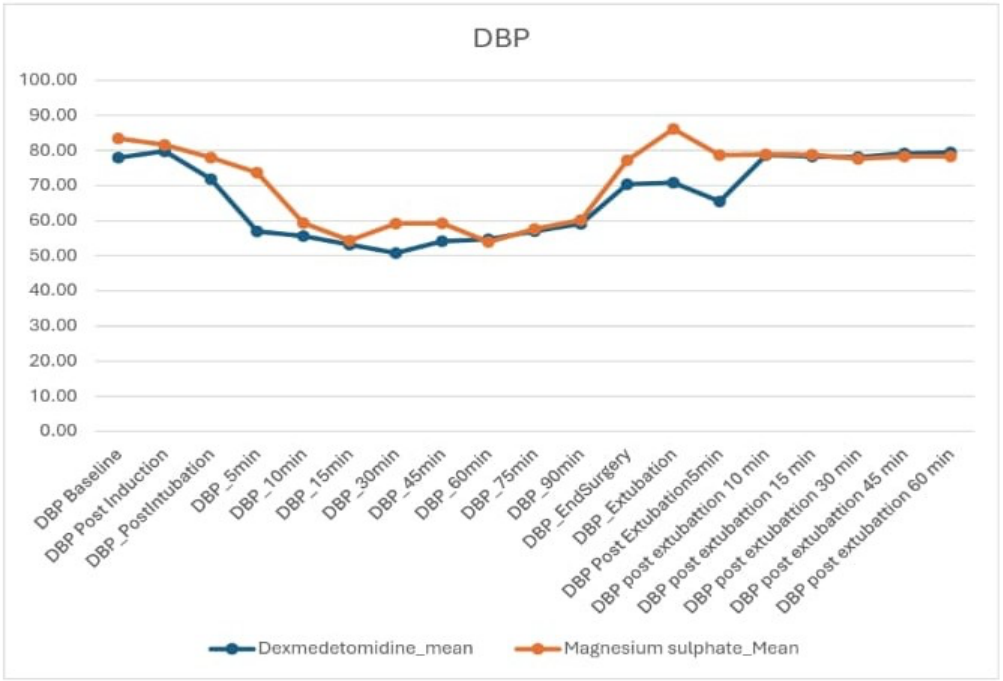
		Groups		Total	P value
		Dexmedetomidine	Magnesium Sulphate		
Modified Ramsay Sedation Score	1	0	7	7	< 0.001
	2	0	23	23	
	3	28	0	28	
	4	2	0	2	
Total		30	30	60	

Table no.3 shows that sedation differed profoundly between groups ($p < 0.001$). The dexmedetomidine group achieved deep sedation: 28 patients had score 3 and 2 had score 4, while none had scores 1 or 2. In contrast, the magnesium sulphate group had only light sedation—7 patients scored 1 and 23 scored 2, with no higher scores. This clear dichotomy demonstrates that dexmedetomidine provides significantly deeper sedative effect compared to magnesium sulphate in the perioperative period for FESS.



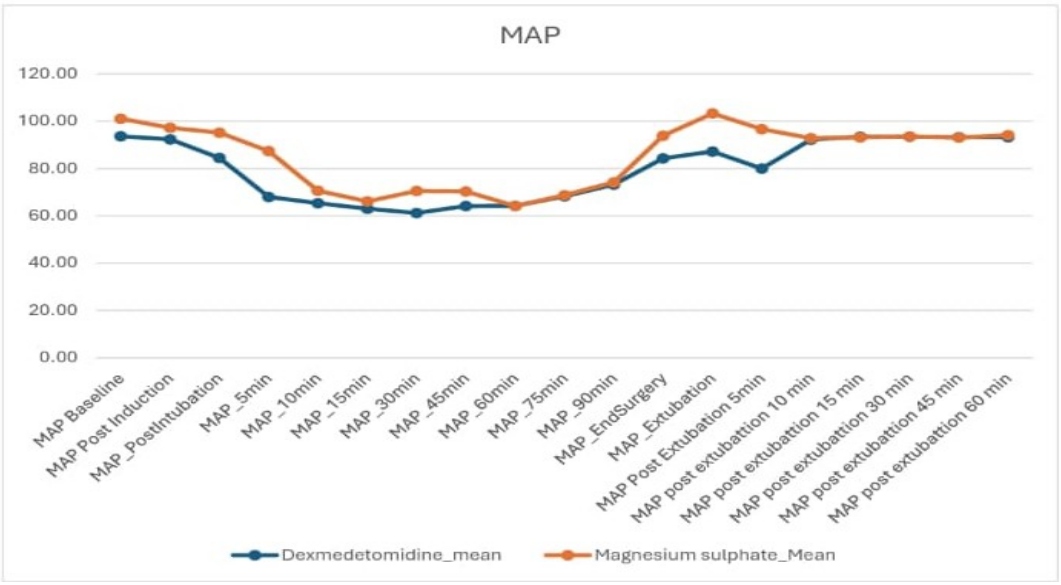
Graph 1: Mean Systolic Blood Pressure Over Time

Graph no. 1 shows that the mean SBP trajectory shows dexmedetomidine produced a pronounced and sustained reduction during early surgery compared to magnesium sulphate. At baseline SBP was 124.80 vs. 136.13 mmHg; post-intubation, 109.73 vs. 129.40 mmHg. At 5, 10, and 15 minutes, SBP was markedly lower with dexmedetomidine (90.07 vs. 114.73; 84.73 vs. 93.27; 82.73 vs. 89.60 mmHg). The gap narrowed by 60 minutes (83.13 vs. 84.47). By 90 minutes values converged (101.53 vs. 102.07). End-surgery and extubation readings remained lower under dexmedetomidine (112.07 vs. 126.93; 119.87 vs. 137.47), with gradual normalization thereafter.



Graph 2: Mean diastolic Blood Pressure Over Time

Graph no. 2 shows that early DBP was comparable at baseline (78.00 vs. 83.47 mmHg; p=0.175) and post-induction (79.80 vs. 81.60; p=0.295). After intubation, dexmedetomidine produced a significantly lower DBP (71.87 vs. 78.00; p=0.003), and this divergence widened at 5 minutes (56.93 vs. 73.67; p<0.001). The trend of lower DBP with dexmedetomidine persisted at 10 and 15 minutes (55.60 vs. 59.33, p=0.031; 53.20 vs. 54.40, p=0.041), reflecting its stronger early hypotensive effect compared to magnesium sulphate.



Graph 3: Mean Arterial Pressure Trajectory

Graph no. 3 shows that the MAP trajectory shows that dexmedetomidine induced a more pronounced early intraoperative reduction compared to magnesium sulphate. At baseline and post-induction, values were relatively close (93.6 vs. 101.0 and 92.36 vs. 97.22). After intubation and during the first 45 minutes, dexmedetomidine maintained substantially lower MAP (e.g., 5 min: 67.98 vs. 87.36; 30 min: 61.20 vs. 70.53), consistent with controlled hypotension. By the end of surgery and at extubation, magnesium sulphate groups had higher MAP (93.78 vs. 84.29 and 103.24 vs. 87.16), indicating earlier reversal. Recovery values converged thereafter, with minimal differences by 10–45 minutes post-extubation.

Discussion

The aim of this study was to directly compare the effects of dexmedetomidine versus magnesium sulphate for achieving controlled hypotension in patients undergoing functional endoscopic sinus surgery (FESS), with a focus on intraoperative hemodynamic stability (heart rate, systolic/diastolic blood pressure, and mean arterial pressure), depth of sedation, quality of the surgical field (bleeding score), surgeon satisfaction, need for adjunct hypotensive agents, and safety endpoints including bradycardia and hypotension.

Age Distribution: The age distribution between the dexmedetomidine and magnesium sulphate groups was comparable (p = 0.613), with most participants falling within the 20–40-year range and few at the extremes (<20 or >50). This mirrors methodological rigor in prior studies: Aboushanab et al. ensured similarly matched age distributions when comparing these two agents for deliberate hypotension in middle ear surgery, enhancing internal validity of hemodynamic and recovery comparisons [5]. Bayram et al.'s FESS-focused randomized trial also reported equivalent age distributions while demonstrating dexmedetomidine's superiority in surgical field quality and hemodynamic stability, reinforcing that differential outcomes were likely pharmacologic rather than demographic [6]. In our study, the uniformity of age supports that any observed superiority in bleeding control, deeper sedation, or more stable hemodynamics under dexmedetomidine is not attributable to underlying age-related physiological differences.

Gender Distribution: Gender distribution was statistically similar between groups (p = 0.602), with a slight male predominance overall but balanced representation in both arms. This parity limits sex-related confounding, as hormonal and physiological differences can subtly affect vascular tone, bleeding tendency, and responses to sedative and vasodilatory agents. Ensuring comparable sex ratios aligns with design strengths of earlier trials; for instance, Guven et al. and Akkaya et al. both maintained balanced demographic profiles, including sex, when assessing dexmedetomidine's efficacy for intraoperative bleeding control and hemodynamic stability in sinonasal surgeries [7],[8].

ASA Grade: The distribution of ASA physical status showed no significant difference between dexmedetomidine and magnesium sulphate groups ($p = 0.405$), with most patients classified as ASA I and the remainder ASA II, indicating comparable baseline systemic health and operative fitness. This equivalence is crucial because variations in preoperative comorbidity burden could affect vascular reactivity, tolerance of induced hypotension, and recovery, potentially obscuring true differences attributable to the study drugs. Prior comparative work, such as Aboushanab et al., also ensured similar ASA grading to meaningfully evaluate recovery and surgical field quality under each agent, thereby reducing bias from differing physiological reserves [5]. Bayram et al.'s FESS study similarly reported balanced ASA distribution while highlighting dexmedetomidine's superior control of the surgical field and hypotension, reinforcing that baseline health status did not account for its observed benefits [6].

Baseline Continuous Characteristics: Baseline continuous variables including weight (66.29 ± 10.60 vs. 64.93 ± 12.70 kg; $p = 0.653$), patient age (36.37 ± 11.60 vs. 38.93 ± 12.62 years; $p = 0.416$), and surgical duration (127.83 ± 17.07 vs. 126.20 ± 20.46 minutes; $p = 0.738$) were statistically comparable between groups. Uniformity in weight and age mitigates variability in drug distribution and metabolism, while similar surgery length ensures that exposure time to hypotensive conditions does not differ as an independent variable—factors that could otherwise skew bleeding, hemodynamic recovery, or sedation comparisons. These controlled baseline characteristics are in line with the study designs of Akkaya et al. and Bayram et al., who also matched these parameters to isolate the specific effects of dexmedetomidine versus magnesium sulphate on operative field visibility and intraoperative hemodynamics in sinonasal surgeries [8],[6]. Aboushanab et al. applied similar matching to compare recovery profiles and found that recovery speed differences were more attributable to drug properties than baseline disparities [5].

Time to Achieve Target MAP: Time to achieve the target mean arterial pressure did not differ significantly between groups ($p = 0.626$), with 25 of 30 patients in each arm reaching the desired hypotensive level within 5–15 minutes. A marginal, non-significant advantage was seen with dexmedetomidine in the earliest bracket (0–5 minutes: 4 vs. 2), suggesting a slightly more rapid onset in some individuals, likely attributable to its central sympatholytic mechanism. The comparable achievement time highlights that both agents are effective for initiating controlled hypotension in FESS within clinically acceptable windows. This resembles findings in Aboushanab et al., where both magnesium sulphate and dexmedetomidine were capable of deliberate hypotension, though their depth and recovery characteristics diverged subsequently [5]. Elsharnouby and Elsharnouby's work on magnesium sulphate demonstrated its effectiveness in lowering arterial pressure and heart rate for hypotensive Anaesthesia, supporting the utility of magnesium in achieving target pressures, albeit with potential trade-offs in recovery due to CNS depression [9]. Conversely, the predictability of dexmedetomidine's onset has been corroborated in FESS and related surgeries (e.g., by Bayram et al. and Akkaya et al.), where it provided smooth induction of hypotension with minimal fluctuation, lending itself to surgical timing precision [8],[6].

Heart Rate: Dexmedetomidine produced a significantly greater reduction in heart rate during the intraoperative period and immediate recovery than magnesium sulphate, with notable differences post-intubation and at 5, 10, and 15 minutes (e.g., 5 min 69.03 vs. 88.83; all $p < 0.001$). This reflects the agent's central $\alpha 2$-adrenergic agonism leading to sympatholysis and vagal predominance, contributing to lower myocardial oxygen consumption and potentially improved surgical field through reduced bleeding from lower perfusion pressures. The sustained early suppression also persisted into early post-extubation intervals (both $p < 0.001$), with convergence later, suggesting a predictable but resolvable pharmacodynamic tail. These findings align with Modir et al., who observed that dexmedetomidine yielded lower intraoperative heart rates compared to magnesium and remifentanil, providing better conditions for blood loss control at the expense of longer recovery [10]. Similarly, Soliman and Fouad documented significant heart rate lowering but increased bradycardia incidence with dexmedetomidine, underscoring the need for vigilant monitoring despite its benefits in surgical exposure [11]. Magnesium sulphate's more modest impact on heart rate is consistent with its peripheral vasodilatory profile and the literature (e.g., Elsharnouby et al.), which report effective blood pressure reduction with less central autonomic alteration [9]. The combined effect of lower heart rate with dexmedetomidine likely synergizes with blood pressure control to enhance surgical visibility but must be balanced against the risk of excessive bradycardia, particularly in susceptible individuals.

Systolic Blood Pressure (SBP): Dexmedetomidine led to a pronounced and sustained reduction in systolic blood pressure during the initial intraoperative window. Post-intubation SBP dropped to 109.73 ± 10.00 mmHg compared to 129.40 ± 14.66 mmHg in the magnesium group ($p < 0.001$), with significantly lower values maintained at 5, 10, 15, 30, and 45 minutes (all $p < 0.001$). These results corroborate those of Bayram et al., who found that dexmedetomidine provided more stable

and deeper hypotension than magnesium sulphate, translating into improved surgical visibility in FESS without delaying recovery [6]. Akkaya et al. also reported lower SBP and reduced intraoperative bleeding with dexmedetomidine, enhancing operative conditions in endoscopic sinus procedures [8]. Magnesium sulphate's reduced and more variable SBP control, while still effective, mirrors prior observations where it occasionally required additional adjustments or adjuncts to meet target pressure criteria [5]. The attenuation of SBP difference by 60 minutes ($p = 0.069$) and subsequent normalization post-extubation demonstrate that dexmedetomidine's effect is both strong and temporally appropriate—providing early field optimization with diminishing influence as the procedure concludes, which may favour a balance between operative efficacy and postoperative safety.

Diastolic Blood Pressure (DBP): The diastolic blood pressure trajectory further highlights dexmedetomidine's stronger early hypotensive effect. Significant reductions versus magnesium were evident from post-intubation onward—post-intubation DBP 71.87 ± 7.65 vs. 78.00 ± 7.41 mmHg ($p = 0.003$), and notably at 5 minutes (56.93 ± 3.14 vs. 73.67 ± 7.90; $p < 0.001$), continuing with statistical differences at 10 and 15 minutes ($p = 0.031$ and 0.041, respectively). Similar findings were reported by Soliman and Fouad and Bayram et al., where dexmedetomidine demonstrated superior and sustained reductions in both systolic and diastolic components, albeit with heightened need for monitoring due to cardiovascular intensity [6],[11]. Magnesium sulphate's less profound early impact on DBP is consistent with its mechanism and prior literature showing it can induce hypotension but with more modest depth and variability, sometimes requiring adjunct support [9],[5]. Importantly, the convergence of DBP values later in the operative and recovery periods indicates a controlled tapering of dexmedetomidine's effect, offering the benefit of early field optimization without prolonged hemodynamic suppression. Taken together, these results affirm dexmedetomidine's efficacy in reducing diastolic pressures part of a comprehensive controlled hypotension strategy while balancing reversibility.

Mean Arterial Pressure (MAP): Dexmedetomidine produced a significantly greater early reduction in mean arterial pressure, with differences from magnesium sulphate evident post-intubation through 45 minutes (post-intubation 84.49 ± 8.05 vs. 95.13 ± 9.15 mmHg; $p < 0.001$), reflecting a potent combined effect on SBP and DBP. This enabled a stable hypotensive milieu during the essential operative window for FESS. Prior studies such as Bayram et al. observed similar controlled MAP depression with dexmedetomidine that translated into clearer surgical fields without compromising recovery [6], while Soliman and Fouad highlighted the necessity of careful cardiovascular monitoring given the depth of hypotension and associated bradycardia risk [11]. Magnesium sulphate, while capable of MAP reduction, showed less consistency and depth in the early period, occasionally necessitating supplementary interventions, as noted in Aboushanab et al. [5]. Overall, dexmedetomidine achieves a more reliable and robust MAP trajectory conducive to superior operative conditions in FESS.

Modified Ramsay Sedation Score: Sedation depth differed markedly between groups ($p < 0.001$), with dexmedetomidine achieving deep sedation (score 3 in 28 and score 4 in 2) versus only light sedation in the magnesium sulphate group (scores 1 and 2). Guler et al. demonstrated dexmedetomidine's ability to attenuate airway and circulatory reflexes during extubation, producing smoother emergence and underlining its central modulatory role on autonomic tone [12]. Although magnesium sulphate can aid controlled hypotension, its lack of substantial sedative effect—documented in prior studies like Elsharnouby and Elsharnouby and Aboushanab et al.—means it may not afford the same synergistic reduction in surgical field disruption from sympathetic spikes or inadvertent movement [9],[5]. However, deeper sedation with dexmedetomidine comes with trade-offs; studies such as Khalifa and Awad noted longer recovery and discharge times with dexmedetomidine due to residual sedative effects, warranting attention in postoperative planning [13]. In FESS, where patient immobility and blunted stress responses contribute materially to operative quality, dexmedetomidine's sedation profile offers substantial advantages despite necessitating slightly prolonged monitoring for awakening and early recovery.

Bleeding Score: Bleeding control—a pivotal determinant of visualization during FESS—was significantly better with dexmedetomidine ($p < 0.001$). The most favourable bleeding grade (1) appeared only in the dexmedetomidine group, while more severe bleeding (grades 4 and 5) was confined to magnesium sulphate patients. This improved field likely arises from the combination of lower heart rate, reduced SBP/DBP, and deeper sedation. Akkaya et al. reported similar superiority with dexmedetomidine over magnesium sulphate, linking reduced bleeding and heart rate to improved surgical visibility and higher surgeon satisfaction in endoscopic sinus surgery [8]. Bayram et al. also found dexmedetomidine provided clearer operative fields and greater surgeon confidence compared to magnesium while maintaining stable hypotension [6]. Magnesium sulphate, although capable of inducing hypotension, produced less consistent bleeding control and often required adjunctive optimization to approach similar results [5]. Given

the constrained working space in FESS, this superior bleeding score under dexmedetomidine likely translates to more efficient dissection, fewer interruptions, and potentially reduced operative time, underscoring its clinical utility when optimal visualization is a priority.

Need for Nitroglycerin: The requirement for adjunct nitroglycerin appeared only in the magnesium sulphate group (3/30) versus none in the dexmedetomidine arm (trend, $p = 0.076$), suggesting occasional insufficiency of magnesium to maintain target MAP without supplementation. This is consistent with Aboushanab et al., who observed that while both agents could produce deliberate hypotension, magnesium sometimes needed additional vasodilatory support to sustain optimal pressure, whereas dexmedetomidine provided steadier maintenance [5]. Clinically, minimizing the need for supplemental medications reduces cumulative side effects and streamlines anaesthetic delivery—advantages that favour dexmedetomidine in settings demanding tight and uninterrupted hypotensive control.

Bradycardia: Bradycardia occurred exclusively in the dexmedetomidine group (3/30; $p = 0.076$), reflecting its known central sympatholytic and vagomimetic properties. While this represents an expected adverse effect, the relatively low incidence indicates it is manageable with standard intraoperative monitoring and predefined intervention thresholds (e.g., anticholinergic administration). Soliman and Fouad documented a similar trade-off: dexmedetomidine provided superior operating conditions but had a higher frequency of bradycardia and hypotension, emphasizing the importance of vigilant hemodynamic supervision [11].

Hypotension and Post-Extubation Hemodynamics: Clinically significant hypotension was rare (1 in dexmedetomidine vs. 0 in magnesium; $p = 0.313$), indicating both drugs achieved deliberate hypotension without excessive compromise. Most post-extubation parameters—including SBP, DBP, and MAP at 10–45 minutes—converged, suggesting safe recovery trajectories. Subtle residual effects were noted: MAP at 60 minutes post-extubation remained slightly lower in the dexmedetomidine group (mean difference −0.867; $p = 0.023$), and heart rate at 30 minutes post-extubation was modestly lower ($p \approx 0.023$), indicative of a mild lingering sympatholytic tail. These patterns align with prior reports of dexmedetomidine's extended hemodynamic influence, as seen in Khalifa and Awad and Modir et al., where superior intraoperative control was coupled with somewhat prolonged recovery or discharge times [13],[10]. Salmasi et al.'s work underscores that controlled hypotension, when maintained within safe absolute MAP thresholds, does not inherently increase end-organ risk, supporting the safety of the profiles observed here [14]. Magnesium sulphate's quicker normalization reflects its less potent and more transient systemic effects, consistent with earlier findings of faster recovery albeit with slightly less robust early intraoperative control [5].

Conclusion

In this study, we conclude that Dexmedetomidine was found to be more effective than magnesium sulphate in achieving controlled hypotension in patients undergoing functional endoscopic sinus surgery (FESS). Its use resulted in improved surgical field visibility due to less bleeding and higher surgeon satisfaction. Additionally, Dexmedetomidine provided superior attenuation of the hemodynamic stress response to tracheal intubation and extubation. These advantages were achieved without prolonging recovery time or increasing the incidence of adverse effects. Therefore, Dexmedetomidine can be considered a safe and reliable agent for controlled hypotension, with the potential to enhance surgical conditions and reduce intraoperative bleeding in FESS.

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