RESEARCH ARTICLE
Dexmedetomidine and esmolol for induced hypotension for functional endoscopic sinus surgery-a comparative study

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ABSTRACT

Background: Functional endoscopic sinus surgery is a minimally invasive surgical procedure performed under controlled hypotensive anesthesia. This technique has the advantage of minimal blood loss and visualizes surgical field distinctly. 

Aim and Objectives: To compare the efficacy of Dexmedetomidine and Esmolol for the induction of controlled hypotension in functional endoscopic sinus surgeries. 

Materials and Methods: A total of 80 cases with paranasal sinus pathologies posted for functional endoscopic sinus surgeries between 21 and 60 years were recruited. Study participants were randomly divided into two study groups, i.e. Group 1 administered with dexmedetomidine and Group 2 administered with Esmolol. Parameters such as hemodynamics, total intraoperative fentanyl consumption, duration of surgery, and total blood loss were noted.

Results: The mean difference of systolic blood pressure, diastolic blood pressure and mean arterial pressure was not statistically significant (P > 0.05). The mean difference of heart rate between two study groups was statistically significant (P < 0.05). The mean duration surgery in Group 1 was 87.9 min and in Group 2 was 89.5 min. The estimated blood loss was 132.2 ml in Group 1 and 134.2 ml in Group 2. No desaturation was observed in the study participants during recovery and the postoperative period. 

Conclusion: Both dexmedetomidine and esmolol infusion are efficacious and are safe drugs for maintaining controlled hypotension and improve the quality of surgical field. Dexmedetomidine was associated with good postoperative sedation while esmolol associated with early recovery time. Surgeon satisfaction score was similar was similar in both groups.

KEY WORDS: Functional Endoscopic Sinus Surgery; Dexmedetomidine; Esmolol; Controlled Hypotension

INTRODUCTION

Functional endoscopic sinus surgery (FESS) is a minimally invasive approach to the sinus cavities. There are major complications reported for FESS under general anesthesia resulting from impaired visibility due to excessive intraoperative blood loss. Controlled hypotension is a novel method used to minimize the intraoperative blood loss to visualize surgical field distinctly and improves surgical success rate. 

To achieve controlled hypotension, some anesthetic drugs such as inhalational anesthetics, calcium channel blockers, α-adrenergic agonists, β-blockers, and vasodilators are used in the surgery. 

Dexmedetomidine, a highly selective alpha 2 adrenoceptor agonist is used as an adjuvant to general anesthesia during surgery. It has sedative, analgesic, and anesthetic sparing effect and sympatholytic properties. Central sympatholytic action of dexmedetomidine mediated by alpha 2 adrenergic receptors manifest as dose-dependent decrease in arterial...
blood pressure, HR, cardiac output, and norepinephrine release.\textsuperscript{[5-7]} Esmolol, an ultrashort acting, cardioselective beta 1 receptor antagonist reduces HR and blood pressure hence it is effectively used in blunting adrenergic responses to perioperative stimuli such as laryngoscopy, tracheal intubation, and extubation. It has rapid onset of action when given as a bolus and as an infusion.\textsuperscript{[4,8]} Hence, the present study was designed to compare the efficacy of Dexmedetomidine and Esmolol for the induction of controlled hypotension in functional endoscopic sinus surgeries.

**MATERIALS AND METHODS**

The present prospective randomized study was carried out in the Department of Anaesthesiology, Dr. Patnam Mahender Reddy Institute of Medical Sciences, Rangareddy and SVS Medical College, Mahaboobnagar from April 2019 to March 2021. A total of 80 cases with paranasal sinus pathologies posted for functional endoscopic sinus surgeries were recruited. The cases of ASA grade I and ASA grade II, cases age group between 21 and 60 years and willing to participate in the study were included. Cases with diabetes mellitus, uncontrolled hypertension, cardiovascular complications, COPD, cerebrovascular diseases and renal complications were excluded. Informed consent was obtained from all the study cases and study protocol was approved by institutional ethics committee.

The study participants were randomly divided into two study groups based on the drug administered i.e. Group 1 administered with dexmedetomidine and Group 2 administered with Esmolol. Prior to the surgery, complete clinical history, physical examination, vital signs and airway assessments was done for all the participants. All the participants were premedicated with Inj. glycopyrrolate 0.2 mg intramuscularly and Inj. ondansetron 4mg iv, 30 min prior to induction. Before induction of anaesthesia, baseline measurements of heart rate, mean arterial pressure (MAP) and oxygen saturation levels were noted. Patients were then preoxygenated for 3 min, and anaesthesia was induced with thiopentone 5 mg/kg and fentanyl 1 μg/kg intravenously. Succinyl choline 1–1.5 mg/kg iv was given to facilitate endotracheal intubation with appropriate size cuffed oral endotracheal tube and lidocaine iv 1–1.5 mg/kg was given to suppress hemodynamic response to laryngoscopy and tracheal intubation. Anesthesia was maintained with oxygen (40%), nitrous oxide (60%), sevoflurane (1.5–2%), vecuronium on controlled ventilation with closed circuit. Group 1 participants were administered with dexmedetomidine loading dose of 1 μg/kg within 10 min followed by 0.4–0.8 μg/kg/h infusion during maintenance. Group 2 participants were administered with Esmolol with loading dose 1 mg/kg being infused over one min followed by 0.5 mg/kg/h infusion during maintenance. All infusions were titrated to maintain a MAP between 70 and 75 mm Hg. Parameters like heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), MAP, oxygen saturation levels were measured and noted every 2 min up to first 10 min, thereafter every 5 min up to 30 min and later for every 15 min up to 60 min. The total intraoperative fentanyl consumption, duration of surgery and total anesthesia time and time for first analgesic request after surgery was noted. The post-operative sedation score was assessed with Ramsay sedation score (at 15 min, 30 min, and 60 min) after tracheal extubation and post-operative side effects were recorded.

The SPSS version 23 was used to carry out statistical analysis relevant to the study. The frequency and percentages (%) were calculated. The chi-square test was used to test the significance of qualitative data. \( P < 0.05 \) was considered as statistically significant.

**RESULTS**

Findings of the present study are depicted in Tables 1-4 and Figures 1-3.

| Table 1: Demographic data of two study groups |
|-----------------------------------------------|
| Demographic parameters | Group 1 Mean±SD | Group 2 Mean±SD | \( P \)-value |
|-------------------------|-----------------|-----------------|---------------|
| Age (In years)          | 29.24±1.38      | 29.45±2.51      | 0.286         |
| BMI                     | 23.04±1.13      | 22.89±1.88      | 0.674         |
| Height                  | 168.2±3.37      | 167.5±3.56      | 0.662         |
| Weight                  | 64.04±8.78      | 63.98±6.53      | 0.264         |
| ASA grade               |                 |                 |               |
| I                       | 24              | 22              |               |
| II                      | 16              | 18              |               |
| Duration of surgery     | 87.9±10.36      | 89.5±12.43      | 0.561         |
| Blood loss              | 132.2±6.27      | 134.2±5.96      | 0.274         |

**Figure 1:** Comparison of \( \text{SpO}_2 \) levels between two study groups after induction.
DISCUSSION

The mean age in Group 1 cases was 29.24 and in Group 2 were 29.45. The mean difference of age between the groups was statistically not significant \((P = 0.286)\). The mean BMI in Group 1 was 23.04 and in Group 2 was 22.89. The mean difference of BMI \((P = 0.674)\), height \((P = 0.662)\), and weight \((P = 0.264)\) between the two study groups was not statistically significant. In this study, the mean duration surgery in group 1 was 87.9 min and in group 2 was 89.5 min. The estimated blood loss was 132.2 ml in Group 1 and 134.2 ml in Group 2 \[Table 1\]. In a study by Bajwa et al. noticed that there was no statistically significant difference between the study groups with regards to demographic variables.\[9\] A study by Shams et al. found mean age in group DEX was 34.8 years and in group Esmolol was 36.1 years. The mean duration of surgery was 88.1 min in group DEX, 90 min in group Esmolol. The estimated blood loss was 130.6 ml in group 1 and 131.4ml in group 2.\[4\] A study by Liu et al. found no significant difference between age, weight, and surgery duration.\[10\] The mean difference of SBP, DBP, and MAP was not statistically significant \((P > 0.05)\). There was

| Duration | SBP Mean±SD | P-value | DBP Mean±SD | P-value |
|----------|-------------|---------|-------------|---------|
| At beginning | 114.2±2.82 | 0.541 | 68.66±1.18 | 0.568 |
| 2 min | 112.7±3.20 | 0.238 | 67.45±1.59 | 0.451 |
| 4 min | 108.5±2.27 | 0.141 | 65.63±1.66 | 0.237 |
| 8 min | 104.5±4.23 | 0.530 | 64.89±1.98 | 0.366 |
| 10 min | 101.2±2.98 | 0.872 | 61.33±1.68 | 0.891 |
| 15 min | 98.56±5.45 | 0.212 | 60.84±1.45 | 0.567 |
| 20 min | 98.20±5.06 | 0.386 | 59.79±2.01 | 0.436 |
| 25 min | 98.01±4.12 | 0.158 | 59.62±1.28 | 0.279 |
| 30 min | 97.69±3.65 | 0.275 | 59.56±1.89 | 0.057 |
| 45 min | 97.48±2.68 | 0.247 | 59.34±1.75 | 0.489 |
| 60 min | 97.37±2.08 | 0.359 | 59.45±1.44 | 0.065 |

SBP: Systolic blood pressure, DBP: Diastolic blood pressure

| Duration | MAP Mean±SD | P-value | Mean heart rate Mean±SD | P-value |
|----------|-------------|---------|-------------------------|---------|
| At beginning | 81.23±2.45 | 0.278 | 80.23±4.63 | 0.002 |
| 2 min | 80.98±2.20 | 0.182 | 79.60±5.63 | 0.048 |
| 4 min | 77.65±2.58 | 0.537 | 78.29±4.87 | 0.162 |
| 8 min | 75.47±1.56 | 0.246 | 76.58±5.66 | 0.024 |
| 10 min | 73.11±2.85 | 0.380 | 75.29±5.81 | 0.031 |
| 15 min | 72.45±2.30 | 0.458 | 73.26±4.28 | 0.044 |
| 20 min | 72.57±1.53 | 0.621 | 69.56±3.39 | 0.024 |
| 25 min | 72.89±1.86 | 0.936 | 66.23±3.40 | 0.022 |
| 30 min | 72.28±2.13 | 0.412 | 64.82±3.92 | 0.018 |
| 45 min | 72.43±1.68 | 0.687 | 62.58±4.81 | 0.031 |
| 60 min | 72.31±1.56 | 0.258 | 62.34±5.40 | 0.024 |

MAP: Mean arterial pressure

| Duration | Sedation score | Group 1 \((n=40)\) | Group 2 \((n=40)\) | P-value |
|----------|----------------|---------------------|---------------------|---------|
| 15 min | 1 | 2 | 3 | 0.981 |
| | 2 | 38 | 37 | |
| 30 min | 1 | 06 | 02 | 0.552 |
| | 2 | 34 | 38 | |
| 60 min | 1 | 07 | 01 | 0.145 |
| | 2 | 33 | 39 | |
no requirement of antihypertensive drugs and there was no incidence of hypotension [Tables 2 and 3]. The mean heart rate was comparable in both the study groups. The mean difference between two study groups was statistically significant ($P < 0.05$) [Table 3]. In the present study, the mean oxygen saturation levels were constant between two study groups. No desaturation was observed in the study participants during recovery time and post-operative period. The mean difference of end-tidal CO$_2$ levels in study subjects between the two study groups was statistically not significant. The surgeon satisfaction score among the subjects of two study groups had high satisfaction scores. The sedation scores were assessed at 15, 30, 60 min of post-operative period by RSS score. At 15 min, more Group 2 subjects had higher sedation rates; whereas at 30min and 60min group I cases had higher rates of sedation scores [Table 4 and Figure 3].

The MAP was significantly lower in the dexmedetomidine group than the Esmolol group after infusion of study drugs. None of the cases experienced bradycardia, resistant hypotension, or hypertension during the study period.$^9$ A study by Shams et al. noticed baseline values of MAP were comparable between both study groups. In both the study group, there was a significant reduction in MAP compared to baseline value intraoperatively.$^4$ A study by Bajwa et al. noticed that the mean heart rate was significantly lower in the dexmedetomidine group than the Esmolol group.$^9$ A study by Bajwa et al. observed that 72% of patients given dexmedetomidine had sedation scores 3 and above while only 20% of patients given esmolol had such higher sedation score.$^9$ The sedation scores were significantly lower in the E group compared with the DEX group at 15 min and 30 min postoperatively. Time to first analgesic request was significantly longer in the DEX group.$^9$ No side effects were observed to the study drugs during the entire study period. A study by Bajwa et al., noted minimal side effects related to the study drugs.$^9$

A study by Valecha et al. concluded that dexmedetomidine has better analgesic property, better sedative and reduced dose of inducing agent than esmolol.$^{11}$ A study by Bajwa et al. concluded that Dexmedetomidine and Esmolol provided better hemodynamic stability while performing FESS. Dexmedetomidine provides an additional benefit of reducing the analgesic requirements and providing postoperative sedation.$^9$ A study by Shams et al. concluded that both dexmedetomidine and Esmolol are effective drugs for controlled hypotension and effective in providing ideal surgical field during FESS. Dexmedetomidine has more sedative and analgesic effect than Esmolol.$^9$ A study by Bajwa et al. concluded that Esmolol was effective for controlled hypotension in FESS than DEX. Esmolol is effective in providing quality of surgical field and minimal adverse postoperative complications.$^{10}$ A study by Kakati et al. concluded that Esmolol was effective in providing surgical field along with low blood loss and better hemodynamics than metoprolol.$^{12}$ A study by Ajay et al. concluded that Dexmedetomidine is effective in providing intraoperative hypotension with minimal postoperative adverse effects than Esmolol.$^{14}$ The study was limited with a limited dosage of drugs, further studies are required to assess the drug efficacy with different drug dosage.

**CONCLUSION**

The results of this study concluded that both dexmedetomidine and esmolol infusion are efficacious and safe drugs for maintaining controlled hypotension and improve the quality of surgical field. Both the study drugs can provide hemodynamic stability and minimal blood loss during the FESS. However, dexmedetomidine was associated with good postoperative sedation while esmolol was associated with
early recovery time. Surgeon satisfaction score was similar in both drug groups.

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