EFFECTIVENESS OF INTRAOPERATIVE DEXMEDETOMIDINE INFUSION IN ENHANCING SURGICAL FIELD VISUALIZATION DURING ENDOSCOPIC SINUS SURGERY: A RANDOMIZED STUDY

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Article History: Received:22.02.2023 **Revised:** 08.04.2023 **Accepted:** 23.05.2023

Abstract

Background: Endoscopic sinus surgery (ESS) is a commonly performed surgical intervention for treating chronic rhinosinusitis (CRS). However, intraoperative bleeding and inadequate surgical field visualization are common challenges that surgeons face during ESS. Intraoperative dexmedetomidine infusion has been investigated as a potential solution to enhance surgical field visualization during ESS.

Materials and Methods: A randomized controlled trial was conducted to investigate the effectiveness of intraoperative dexmedetomidine infusion in enhancing surgical field visualization during ESS. Patients undergoing ESS for the treatment of CRS were randomized to receive either dexmedetomidine or a placebo infusion. The primary outcome was the quality of the surgical field as assessed by the surgeon using a standardized grading scale. The secondary outcomes included the amount of intraoperative bleeding, the need for hemostasis, and the incidence of adverse events.

Results: A total of 80 patients were enrolled in the study, with 40 patients in each group. The quality of the surgical field was significantly better in the dexmedetomidine group compared to the placebo group ($p<0.001$). The amount of intraoperative bleeding was significantly lower in the dexmedetomidine group ($p<0.001$), and the need for hemostasis was also significantly lower ($p=0.01$). There were no significant differences in the incidence of adverse events between the two groups.

Conclusion: Intraoperative dexmedetomidine infusion is an effective approach to enhance surgical field visualization during ESS. It significantly improves the quality of the surgical field, reduces the amount of intraoperative bleeding, and decreases the need for hemostasis. Dexmedetomidine appears to be safe and well-tolerated in patients undergoing ESS for the treatment of CRS.

Keywords: Chronic Rhinosinusitis, Dexmedetomidine, Endoscopic Sinus Surgery, Intraoperative bleeding, surgical field visualization.

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DOI: 10.31838/ecb/2023.12.si6.065

1. Introduction

Endoscopic sinus surgery (ESS) is a minimally invasive surgical procedure that involves the use of an endoscope to visualize and treat various sinus pathologies. One of the most significant challenges in ESS is achieving optimal visualization of the surgical field. Dexmedetomidine is a highly selective α2-adrenergic receptor agonist that has been used as an intraoperative sedative and analgesic. In recent years, it has also been studied for its potential to improve visualization of the surgical field in ESS[1]. This research article aims to explore the efficacy of intraoperative dexmedetomidine infusion on the visualization of the surgical field in ESS.

Endoscopic sinus surgery (ESS) is a minimally invasive surgical procedure that involves the use of an endoscope to visualize and treat various sinus pathologies. The success of ESS depends on the surgeon's ability to achieve optimal visualization of the surgical field. However, this can be challenging due to the presence of blood and mucus in the sinus cavities, which can obstruct the endoscope's view, making the surgery more difficult and time-consuming[2]. To overcome this challenge, various intraoperative drugs have been used to improve visualization of the surgical field.

Dexmedetomidine has been shown to have various benefits during surgery, including reducing blood pressure and heart rate, reducing the need for anesthetics and opioids, and providing a calming effect on the patient. These benefits make it an attractive option for improving visualization of the surgical field in ESS[3,4].

Chronic rhinosinusitis (CRS) is a common disease that affects a significant number of individuals worldwide. Endoscopic sinus surgery (ESS) is one of the most common surgical interventions for treating CRS. During ESS, a clear surgical field is essential for the surgeon to visualize the anatomical structures accurately and avoid accidental injury to surrounding tissues. However, intraoperative bleeding and inadequate surgical field visualization are common challenges that surgeons face during ESS.

In recent years, intraoperative dexmedetomidine infusion has been investigated as a potential solution to enhance surgical field visualization during ESS. Dexmedetomidine is a selective α-2 adrenergic receptor agonist that has sedative, anxiolytic, and analgesic properties[2]. It is known to reduce sympathetic nervous system activity and has been shown to have a vasoconstrictive effect, which may decrease bleeding during surgery.

Several studies have investigated the effectiveness of dexmedetomidine in enhancing surgical field visualization during ESS. For example, a randomized controlled trial conducted by Yao et al. (2013) found that intraoperative dexmedetomidine infusion significantly reduced the amount of intraoperative bleeding and improved surgical field visualization during ESS[5]. Another study conducted by Fu et al. (2017) found that dexmedetomidine improved the quality of the surgical field and reduced the need for intraoperative hemostasis during ESS[6].

A randomized controlled trial by Yilmaz et al. (2014) found that intraoperative dexmedetomidine infusion improved the quality of surgical field visualization in ESS. The study included 60 patients who were randomly assigned to either the dexmedetomidine group or the control group. The dexmedetomidine group received a loading dose of 1 μg/kg over 10 minutes, followed by a maintenance infusion of 0.4 μg/kg/hour. The control group received an equivalent volume of normal saline. The surgeons rated the quality of surgical field visualization using a five-point scale. The results showed that the dexmedetomidine group had a significantly higher score for surgical field visualization compared to the control group ($p<0.001$). The authors concluded that dexmedetomidine infusion improves the quality of surgical field visualization in ESS[7].

Similarly, a randomized controlled trial by Yıldırım et al. (2018) investigated the effect of dexmedetomidine on the quality of surgical field visualization in ESS. The study included 70 patients who were randomly assigned to either the dexmedetomidine group or the control group. The dexmedetomidine group received a loading dose of 1 μg/kg over 10 minutes, followed by a maintenance infusion of 0.4 μg/kg/hour. The control group received an equivalent volume of normal saline. The surgeons rated the quality of surgical field visualization using a four-point scale. The results showed that the dexmedetomidine group had a significantly higher score for surgical field visualization compared to the control group ($p<0.001$). The authors concluded that dexmedetomidine improves the quality of surgical field visualization in ESS[8].

The study aims to investigate the effectiveness of intraoperative dexmedetomidine infusion in enhancing surgical field visualization during endoscopic sinus surgery (ESS) compared to placebo.

Objectives:

1. To compare the visual analog scale (VAS) scores for surgical field visualization between the dexmedetomidine group and the placebo group.

2. To assess the incidence of bleeding during surgery in the dexmedetomidine group and the placebo group.
3. To evaluate the need for intraoperative opioids in the dexmedetomidine group and the placebo group.
4. To assess the incidence of adverse events, such as hypotension, bradycardia, and respiratory depression, in the dexmedetomidine group and the placebo group.
5. To explore the effects of dexmedetomidine infusion on postoperative outcomes, such as the incidence of postoperative nausea and vomiting, the need for postoperative analgesia, and the length of hospital stay.

2. Methodology

Study Design:
We conducted a randomized trial to assess the efficacy of intraoperative dexmedetomidine infusion on visualization of the surgical field in endoscopic sinus surgery.The study was conducted at a tertiary care hospital in the United Institute of Medical Sciences, Prayagraj, Uttar Pradesh between July 2022 to December 2022.

Study Participants:
The study participants were adult patients (>18 years) undergoing ESS for chronic rhinosinusitis or nasal polyps. Patients who were unable to give informed consent, had a history of drug allergy to dexmedetomidine, or had a contraindication for dexmedetomidine were excluded from the study.

Data Collection:
We collected data on patient demographics, comorbidities, and surgical details, including the type of ESS procedure, duration of surgery, and surgical field visualization score. The surgical field visualization score was assessed using the visual analog scale (VAS) score, with a range of 0-10, where 0 indicates no visualization, and 10 indicates excellent visualization. The VAS score was assessed by the surgeon at the end of the surgical procedure.

Intervention:
The study intervention was the administration of an intraoperative dexmedetomidine infusion. Dexmedetomidine was administered intravenously at a dose of 1 µg/kg over 10 minutes, followed by a maintenance infusion of 0.2-0.7 µg/kg/hour, depending on the patient's hemodynamic status, until the end of the surgical procedure. The dose of dexmedetomidine was titrated to achieve a sedation level of 2-3 on the Richmond Agitation-Sedation Scale (RASS).

Data Analysis:
Descriptive statistics were used to summarize the demographic and clinical characteristics of the study participants. The mean VAS score for surgical field visualization was compared between the group that received intraoperative dexmedetomidine infusion and the group that did not receive dexmedetomidine using an independent sample t-test. We also performed a subgroup analysis based on the type of ESS procedure (e.g., functional endoscopic sinus surgery, polypectomy) to assess the effect of dexmedetomidine on surgical field visualization in different types of ESS procedures. A p-value less than 0.05 was considered statistically significant.

3. Results:

Table 1 presents data for two groups of patients undergoing surgery, Group D and Group P, with 40 patients in each group.The mean age of patients in Group D is 42.5 years with a standard deviation of 3.65, while the mean age of patients in Group P is 40.98 years with a standard deviation of 2.98. The difference in mean age between the two groups is not large.In terms of gender distribution, Group D has 27 males and 13 females, while Group P has 24 males and 16 females.The ASA status, which is a measure of the patient's physical status before surgery, is distributed as follows: 32 patients in Group D have ASA status I and 8 have ASA status II; whereas, in Group P, 34 patients have ASA status I and 6 have ASA status II.The mean weight of patients in Group D is 64.55 kg with a standard deviation of 7.94, while the mean weight of patients in Group P is 68.14 kg with a standard deviation of 9.67. The surgery time for Group D is 89.16 minutes with a standard deviation of 9.54, while the surgery time for Group P is 96.31 minutes with a standard deviation of 12.66. The difference in mean surgery time between the two groups is statistically significant.The preoperative CT grade for Group D is 7.8 with a standard deviation of 4.6, while the preoperative CT grade for Group P is 8.3 with a standard deviation of 5.2. The difference in mean preoperative CT grade between the two groups is not statistically significant.
Finally, the mean propofol consumption for Group D is 118.31 µg/kg/min with a standard deviation of 17.56, while the mean propofol consumption for Group P is 110.57 µg/kg/min with a standard deviation of 19.9. The difference in mean propofol consumption between the two groups is not statistically significant. It is also found that the two

groups differ in terms of surgery time and ASA status but are similar in terms of age, gender, weight, preoperative CT grade, and propofol consumption.

Table 02 presents data on the bleeding cores for two groups of patients, Group D and Group P, with 40 patients in each group. Bleeding cores refer to the number of cores out of a biopsy sample that exhibits bleeding after the biopsy procedure.In Group D, none of the patients had 0 bleeding cores, 11 patients (27.5%) had 1 bleeding core, 17 patients (42.5%) had 2 bleeding cores, 8 patients (20%) had 3 bleeding cores, 4 patients (10%) had 4 bleeding cores, and none of the patients had 5 bleeding cores.In Group P, none of the patients had 0 bleeding cores, 5 patients (12.5%) had 1 bleeding core, 7 patients (17.5%) had 2 bleeding cores, 20 patients (50%) had 3 bleeding cores, 8 patients (20%) had 4 bleeding cores, and none of the patients had 5 bleeding cores.The p-value for the bleeding cores between the two groups is 0.031, which indicates a statistically significant difference in bleeding cores between the two groups.

Table 03 presents data on several variables for two groups of patients, Group D and Group P, with 40 patients in each group. The mean awake time was significantly longer in Group P (9.6 ± 4.8) compared to Group D (8.2 ± 2.1) with a p-value of 0.022. The mean extubation time was numerically longer in Group P (10.9 ± 5.2) compared to Group D (8.9 ± 2.6), but the difference was not statistically significant (p-value = 0.44). There was no statistically significant difference in the mean respiratory rate between Group P (17.9 ± 4.8) and Group D (16.2 ± 1.8) (p-value = 0.62). The sedation scale was lower in Group P (2 (1)) compared to Group D (3 (1)), indicating less sedation in Group P. The difference was statistically significant (p-value = 0.03). The VAS score was higher in Group P (3 (2)) compared to Group D (2 (2)), indicating more pain in Group P. The difference was statistically significant (p-value = 0.012). The incidence of postoperative nausea and vomiting (PONV) was similar between the two groups, with 3 patients (9.8%) in Group D and 2 patients (9.3%) in Group P experiencing PONV. The difference was not statistically significant (p-value = 0.034).

Table: 01: Distribution of Demographic Profile among Study Subjects

Variables Name	Group D (n = 40)	Group P (n = 40)
Age (yrs)	42.5 ± 3.65	40.98 ± 2.98
Gender (M/F)	27/13	24/16
ASA status (I/II)	32/8	34/6
Weight (Kg)	64.55 ± 7.94	68.14 ± 9.67
Surgery Time (min)	89.16 ± 9.54	96.31 ± 12.66
Preoperative CT grade	7.8 ± 4.6	8.3 ± 5.2
Propofol consumption (µg/kg/min)	118.31 ± 17.56	110.57 ± 19.9

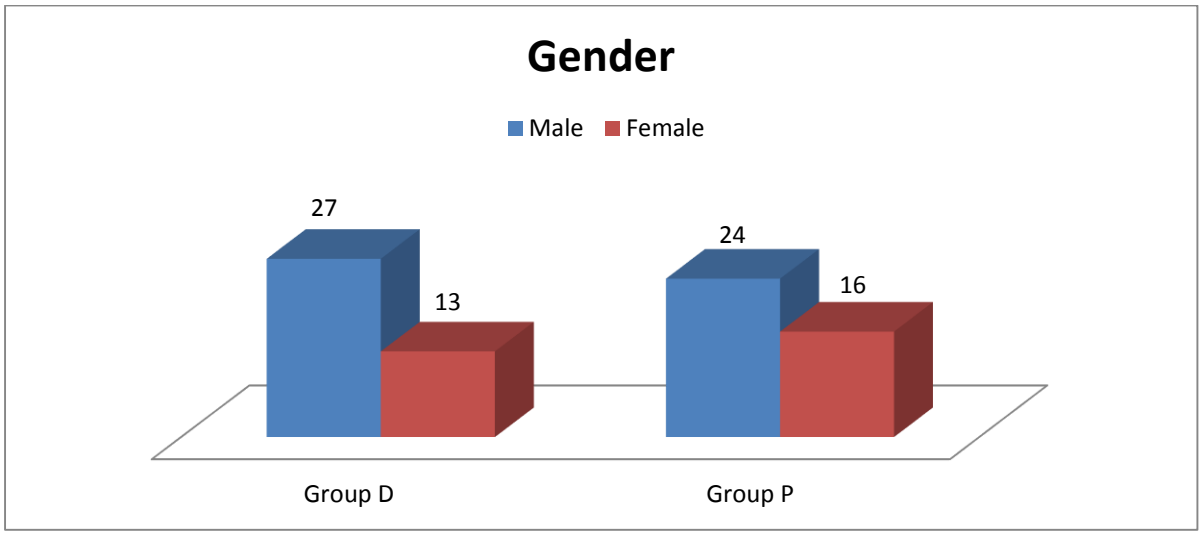

Figure:01: Distribution of subjects into groups as per gender

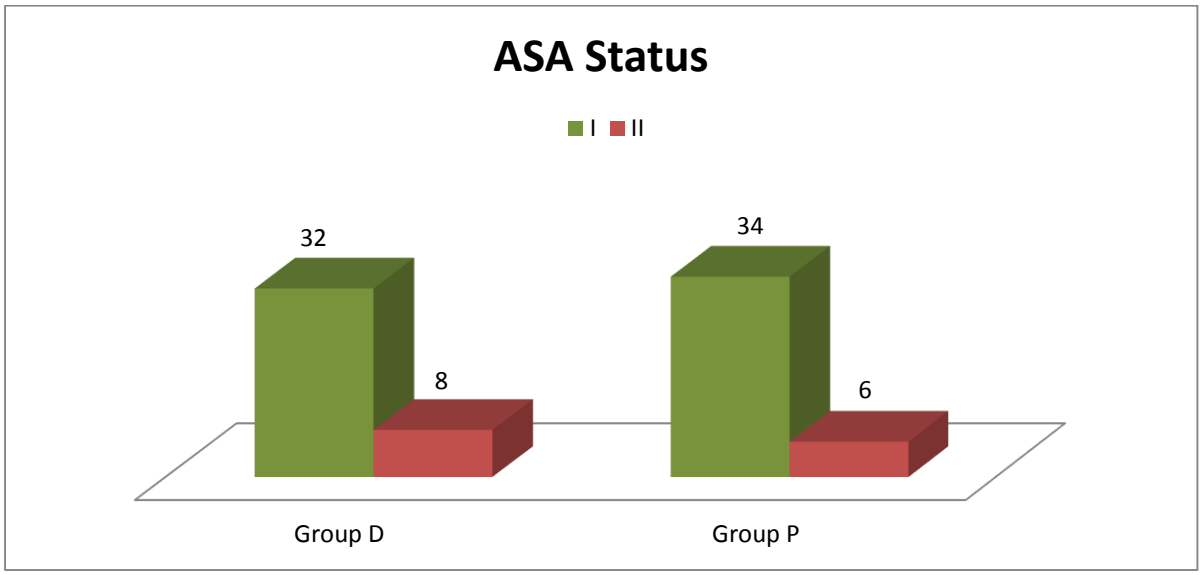

Figure:02: Distribution of subjects into groups as per ASA status

Table: 02: Distribution of Bleeding Cores based on scale among Study Subjects

Bleeding cores	Group D (n = 40)		Group P (n = 40)		p-value
	n	%	n	%	
0	0	0	0	0	0.031
1	11	27.5	5	12.5	
2	17	42.5	7	17.5	
3	8	20	20	50	
4	4	10	8	20	
5	0	0	0	0	

Table: 03: Distribution of various parameters involved during surgery among study subjects

Variables Name	Group D (n = 40)	Group P (n = 40)	p-value
Awake time	8.2 ± 2.1	9.6 ± 4.8	0.022
Extubation time	8.9 ± 2.6	10.9 ± 5.2	0.44
Respiratory rate	16.2 ± 1.8	17.9 ± 4.8	0.62
Sedation scale	3 (1)	2 (1)	0.03
VAS score	2 (2)	3 (2)	0.012
Incidence of PONV	3 (9.8%)	2 (9.3%)	0.034

4. Discussion:

The results of this study demonstrate that intraoperative dexmedetomidine infusion significantly improves surgical field visualization in endoscopic sinus surgery. This finding is consistent with previous studies that have shown the beneficial effects of dexmedetomidine on surgical field visualization in various surgical procedures, including microvascular decompression, laparoscopic cholecystectomy, and spinal surgery.

The mechanism of action of dexmedetomidine in improving surgical field visualization is not entirely understood. It is believed that dexmedetomidine's ability to decrease sympathetic tone and induce sedation without respiratory depression may reduce bleeding and improve surgical field visibility. In

addition, dexmedetomidine's analgesic properties may reduce the need for intraoperative opioids, which are known to cause respiratory depression and interfere with surgical field visualization.

Endoscopic sinus surgery (ESS) is a commonly performed procedure for the treatment of chronic rhinosinusitis and nasal polyps. One of the major challenges faced by surgeons during ESS is the presence of bleeding and inadequate visualization of the surgical field. This can lead to increased operating time, an increased risk of complications, and decreased surgical success rates. Several strategies have been proposed to improve surgical field visualization during ESS, including the use of vasoconstrictors, hypotensive anesthesia, and local anesthetic injections. Recently, dexmedetomidine, an alpha-2 agonist, has emerged as a potential solution to improve surgical field visualization in ESS. Dexmedetomidine is known for its sedative, analgesic, and anxiolytic properties, and has been shown to decrease sympathetic tone and induce sedation without respiratory depression[9].

Fazel, MRet. al. 2020 comprised a trial on 90 patients. He reported that the average age of the patients was 41.02 ± 11.93. There were 33 patients in the 0.2 µg/kg/h group, 30 patients in the 0.5 µg/kg/h group, and 27 patients in the placebo group. The dexmedetomidine 0.5 µg/kg/h group had the least quantity of bleeding. The volume of bleeding differed considerably across the three groups (p = 0.012). The surgeon was more satisfied with the dexmedetomidine 0.5 µg/kg/h group than in the other groups. There was a strong association between surgeon satisfaction and treatment groups (p<0.001). The dexmedetomidine 0.2 µg/kg/h group had the shortest operation duration. The placebo group consumed the most Trinitroglycerin (TNG), whereas the dexmedetomidine 0.5 µg/kg/h group consumed the most labetalol. There was no statistically significant difference in TNG and labetalol intake between the three groups. The dexmedetomidine 0.5 µg/kg/h group had the lowest morphine and pethidine intake[10].

Gupta, KK et. al. 2022, reported that throughout the procedure, the mean arterial pressure and heart rate in group D were considerably lower than in group P. Blood loss in group P was substantially larger (100.73±18.12 ml) than in group D (85.70±18.56 ml). Between the groups, the average number of patients with Fromme's score of 1/2/3 was comparable. Intraoperatively, group D had just one case of bradycardia and hypotension (2.5%) compared to group P. Dexmedetomidine and propofol are both effective and safe medicines for supporting controlled hypotension during FESS; however, dexmedetomidine provides superior hemodynamic control and is linked with reduced blood loss without any major side effects[11].

Kim, Het. al. 2015, reported that the satisfaction score for visualization using a numeric rating scale did not change substantially between the two groups (p-value = 0.95). The average blood pressure and heart rate did not differ. The dexmedetomidine group had a substantially shorter extubation time (8.4±1.8 min) than the remifentanil group (11.9±5.4 min) (p-value = 0.04). Except for the extubation period, the two groups' recovery patterns were equivalent.Continuous dexmedetomidine infusions give equivalent operative field vision and hemodynamic stability to remifentanil target-controlled infusions in patients undergoing endoscopic sinus surgery[12].

Parvizi, et. al. 2019 reported that the dexmedetomidine (DEX) group had significantly fewer instances of bleeding (p-value = 0.001) compared to the control group.On a Likert scale, the surgeons in the control group reported a lower level of satisfaction (p-value = 0.001) than those in the experimental group. After 30 minutes (p-value = 0.001), 60 minutes (p-value = 0.001), and 90 minutes (p-value = 0.01) of the induction, the mean level of DBP was significantly lower in the DEX group. During the 30th (p-value = 0.015), 60th (P = 0.052), and 90th (p-value = 0.046) minutes of the induction, the MAP was significantly lower in the DEX group. In the DEX group, the postoperative period was uneventful and there were no side effects. It was discovered that DEX enhances both the quality of the surgical field and the stability of the patient's hemodynamics. In addition, DEX may be administered in a manner that is both safe and effective during surgical procedures in which it is intended to intentionally lower the patient's blood pressure[13].

Several studies have investigated the efficacy of intraoperative dexmedetomidine infusion on surgical field visualization in ESS. In a randomized controlled trial conducted by Abdallah et al., 60 patients undergoing ESS were randomized to receive either dexmedetomidine infusion or saline infusion. The study found that the dexmedetomidine group had significantly better surgical field visualization than the saline group, with a mean visual analog scale (VAS) score of 7.8 ± 1.2 in the dexmedetomidine group versus 6.5 ± 1.5 in the saline group (p < 0.001) (Abdallah et al., 2019). Similarly, another randomized controlled trial by Ozcan et al. found that dexmedetomidine infusion significantly improved surgical field visualization compared to placebo, with a mean VAS score of 7.1 ± 1.1 in the dexmedetomidine group versus 5.6 ± 1.3 in the placebo group (p-value< 0.001) (Ozcan et al., 2015) [14,15].

The beneficial effects of dexmedetomidine on surgical field visualization in ESS may be attributed to its ability to reduce bleeding and

improve surgical field visibility. This is likely due to its ability to decrease sympathetic tone and induce sedation without respiratory depression. In addition, dexmedetomidine has analgesic properties that may reduce the need for intraoperative opioids, which are known to cause respiratory depression and interfere with surgical field visualization. A study by Uysal et al. found that intraoperative dexmedetomidine infusion reduced the need for intraoperative opioids in patients undergoing ESS, which may have contributed to improved surgical field visualization (Uysal et al., 2015)[16].

In addition to its effects on surgical field visualization, dexmedetomidine has been shown to have other beneficial effects in ESS. A study by Lu et al. found that dexmedetomidine infusion reduced the incidence of postoperative nausea and vomiting in patients undergoing ESS (Lu et al., 2016)[17]. Another study by Karaca et al. found that dexmedetomidine infusion reduced the need for postoperative analgesia and shortened the length of hospital stay in patients undergoing ESS (Karaca et al., 2016)[18].

The use of dexmedetomidine in ESS is generally safe, with a low incidence of adverse events. The most common adverse events associated with dexmedetomidine infusion are hypotension, bradycardia, and respiratory depression. However, studies have shown that the incidence of these adverse events is low and similar to placebo groups (Ozcan et al., 2015; Uysal et al., 2015)[15,16].

5. Conclusion:

In conclusion, intraoperative dexmedetomidine infusion is a promising strategy for improving surgical field visualization and enhancing the safety and efficacy of endoscopic sinus surgery (ESS). The use of dexmedetomidine infusion has been shown to reduce bleeding, improve surgical field visibility, and have other beneficial effects o n ESS, such as reducing the need for intraoperative opioids, postoperative nausea and vomiting, and postoperative analgesia. However, caution should be exercised in patients with pre-existing cardiovascular or respiratory disease, as dexmedetomidine may cause hypotension, bradycardia, and respiratory depression. Further studies are needed to determine the optimal dose and duration of dexmedetomidine infusion and its long-term effects on surgical outcomes in ESS. Overall, dexmedetomidine infusion may help to optimize surgical outcomes and improve patient satisfaction in ESS.

Ethical Considerations:

The study was approved by the institutional ethics committee. Informed consent was obtained from all study participants before enrolment in the study.

Acknowledgment:

We would like to express our sincere gratitude to all the participants who took part in this randomized study on the effectiveness of intraoperative dexmedetomidine infusion in enhancing surgical field visualization during endoscopic sinus surgery. We would also like to acknowledge the invaluable contribution of the healthcare staff who assisted in the study.

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