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COMPARATIVE EVALUATION OF PROPOFOL AND DEXMEDETOMIDINE INFUSION FOR HYPOTENSIVE ANESTHESIA DURING FUNCTIONAL ENDOSCOPIC SINUS SURGERY: A PROSPECTIVE RANDOMIZED TRIAL

Anaesthesiology

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ABSTRACT

Background: Intense bleeding during general anesthesia is the major limitation during functional endoscopic sinus surgery. It affects operative field visibility and increases complications. Hypotensive anesthesia is preffered to improve surgical outcomes. This study aimed to compare the efficacy of propofol and dexmedetomidine infusion for hypotensive anesthesia in patients undergoing FESS. **Objective:** To compare the efficacy and safety of dexmedetomidine and propofol for hypotensive anesthesia in functional endoscopic sinus surgeries. **Materials and methods:** This prospective randomized trial was conducted in 60 adult patients who were scheduled for FESS under general anesthesia. Patients were randomly divided into two groups: group P (n = 30) received propofol infusion of 50–150mcg/kg/min and group D (n = 30) received dexmedetomidine with a loading dose of 1 mcg/kg diluted in 10 mL 0.9% saline to be infused over 10 min after induction, followed by maintenance infusion of 0.4–0.8 mcg/kg/h. The infusions were titrated to maintain mean arterial pressure (MAP) between 60 and 70 mm Hg and hemodynamic stability. Intraoperative blood loss, quality of the surgical field (Fromme- Boezaart scale), hemodynamic control, and patient recovery were recorded. **Results:** In our study, the mean arterial pressure and heart rate were significantly lower in group D throughout the surgery than in group P. Blood loss was significantly higher in group P (105.82 ± 15.16 ml) than in group D (90.50 ± 16.78 ml). The Fromme's score (Surgical field visibility) 1/2/3 was comparable between the groups. The awakening time was significantly short in group D than group P. Intraoperatively, only one incidence of bradycardia and hypotension was observed in group D (2.5%) compared to that in group P, which was managed successfully. **Conclusion:** In our study, we observed that both dexmedetomidine and propofol are efficacious and safe drugs for achieving controlled hypotension during FESS; however, dexmedetomidine provides better hemodynamic control and is associated with lesser degree of sedation without any significant adverse effects.

KEYWORDS

Dexmedetomidine, Functional endoscopic sinus surgery, Hypotensive anesthesia, Propofol, Controlled hypotension, Surgical field

INTRODUCTION

The introduction of Functional endoscopic sinus surgery (FESS) associated with enhanced illumination and visualization has dramatically improved surgical dissection. It is a highly sophisticated surgery that has reformed the surgical management of chronic sinusitis in the modern era. The term FESS was first coined by Kennedy [4] and introduced in the mid-1980s.Due to the nature of location where endoscopic sinus surgery is done, even a small amount of bleeding can leave a negative effect on vision of surgeon. The main hindrance to clear endoscopic visibility is excessive bleeding during surgery[2]. Hence, it is essential to keep the surgical field as free of blood as possible, which can be achieved through the reverse Trendelenburg position, preoperative steroid administration, topical local anesthetics and vasoconstrictors such as phenylephrine, and controlled hypotension through various anesthetic techniques [3].

Controlled hypotension or hypotensive anesthesia is an anesthetic technique in which there is deliberate reduction in systemic blood pressure during anesthesia, which should be in accordance with the patient's baseline blood pressure rather than a specific target pressure. Achieving optimum hypotension is a skill, as excess lowering of BP may be hazardous due to the reduced perfusion to essential organs such as brain, heart, and kidneys. The mean arterial blood pressure (MAP) can be reduced by 30% below the patient's baseline MAP, with a minimum MAP of 60–70 mmHg in American Society of Anesthesiologists class 1 patients being clinically acceptable [1].For achieving controlled hypotension, certain characteristicsare desired in the agent used for the purpose. The ideal agentshould have ease of administration, short onset time, an effect that disappears quickly on discontinuation, rapid elimination withouttoxic metabolites, negligible or no effects on vital organs, andpredictable and dose-dependent effects. [5]

Various agents such as vasodilators (sodium nitroprusside, nicardipine, and nitroglycerin), adrenergic beta blockers (propranolol, esmolol, labetalol and metoprolol), magnesium sulphate, inhalational agents (isoflurane, sevoflurane and desflurane), intravenous α-2 agonists like dexmedetomidine, clonidine, and short-acting opioids like fentanyl or remifentanil areroutinely used.

Dexmedetomidine is a highly selective α2 agonist.It acts on α2A and imidazoline type I receptors. Alpha-2 receptorsregulate the autonomic nervous and cardiovascular systems. Theyare located in the blood vessels, where they cause vasoconstrictionand in the sympathetic terminal where they inhibit norepinephrine release. This ultimately leads to fall in BP and heart rate (HR). It has got inherent analgesic, sedative, andanesthetic-sparing properties that avoid use of multiple drugs[7,8]. It exerts sedative and analgesic-sparing effectthrough central locus ceruleus and in the dorsal horn of the spinalcord [6].

Propofol is an intravenous anesthetic agent useful for controlled hypotension. It is associated with positive influence on the inhibitory function of the neurotransmitter γ-aminobutyric acid (GABA) through GABA-A receptors. [9, 10] Propofol has negative inotropic effect throughinhibition of sympathetic vasoconstrictor nerve activity. It has gotanti-emetic, antipruritic, and anticonvulsant activity. Complete awakening without residual central nervous system effects hasmade it popular for day care surgery. The use of propofol infusionfor controlled hypotension is associated with improved quality ofsurgical field in functional endoscopic sinus surgery (FESS). [11]

Our study compared the efficacy of dexmedetomidine and propofol infusion when used for controlled hypotension during FESS.

MATERIALAND METHODS

This study has been conducted in the Department of Anesthesia, ENT operation theater, Govt. Medical College Jammu and associated hospitals through the period of May'21 to May'22 after being approved by the institutional ethical committee and after obtaining informed written consents from all the patients. 60 patients with American Society of Anesthesiologists grade I or II of either sex aged between 18 and 50 years, scheduled for elective FESS were enrolled in the study. Patients with history of uncontrolled hypertension autonomic neuropathy, ASA physical status III or IV, hepatorenal dysfunction, coagulation disorders, recurrent sinus surgery, hypersensitivity to study drugs and pregnant females were excluded from the study.

A routine preanaesthetic checkup was performed a day before surgery which included a detailed history, general physical and systemic examination. Basic investigations (complete blood count, fasting blood sugar, urea, creatinine, serum electrolytes, chest x-ray and 12 lead electrocardiogram) were done. All eligible patients were advised preoperative fasting for a period of 8 hours and premedication with 0.25mg Alprazolam tablet and 150mg ranitidine tablet was given at

night and in the morning (2 hours before) on the day of surgery. A total of 60 patients were randomly divided into two groups (30 patients each); Group D (dexmedetomidine) and Group P (propofol).

After transporting to the patient to the operating room, multi parameter monitor with five lead echocardiogram, pulse oximetry, noninvasive blood pressure and temperature tracker was attached and base line parameters were recorded.

Two intravenous lines with 20 gauze intravenous canula were secured, one for infusion of study drug and other for the infusion of intravenous fluids and other anaesthetic drugs. All patients in both groups were started with Ringer's lactate in one intravenous line @ 4 – 6 ml/kg/hr and received injection Ondansetron 0.10 – 0.15 mg/kg, injection glycopyrolate 0.004 mg/kg (anti secretory) agent and injection tramadol 1 – 2 mg/kg intravenously as pre medication.

After preoxygenation, induction was performed with intravenous propofol 1.5-2.5 mg/kg until loss of verbal contact followed by injection atracurium 0.5 mg/kg intravenously to facilitate endotracheal intubation. The oropharynx was packed with a saline soaked throat pack. Anesthesia was maintained with O2:N2O (40:60), one minimum alveolar concentration of isoflurane and the top up doses of atracurium 0.1 mg/kg were given as and when required to maintain muscle relaxation.

Group D (dexmedetomidine): All patients received dexmedetomidine with a loading dose of 1mcg/kg diluted in 10 mL 0.9% saline to be infused over 10 min after induction, followed by maintenance infusion of 0.4–0.8mcg/kg/h.

Group P (propofol): All patients received propofol infusion of 50–150mcg/kg/min after induction of anesthesia.

The infusion rate of the study drugs was regulated in both groups to maintain a mean arterial blood pressure between 60 and 70 mmHg. To further reduce the amount of surgical bleeding, lignocaine (1%) with 1:100,000 adrenaline was infiltrated at the surgical site by the surgeon in all patients.

The surgeon was allowed to start surgery only after 10 min of starting the infusion in both groups. Intraoperative hemodynamic parameters such as heart rate (HR), systolic blood pressure, diastolic blood pressure, MAP, and oxygen saturation (SpO2) were recorded at baseline, during induction, 5 min after induction, and every 5 min thereafter until the end of surgery. HR < 50 beats/min was considered bradycardia and managed with 0.5 mg atropine intravenously.

MAP <60 mmHg (significant hypotension) was initially managed by titrating the dosage of infusion and further stoppage of infusion if no response was obtained, and then mephentermine 6 mg intravenously was administered to treat hypotension.

The study drug was discontinued 5 min before the end of surgery. The residual neuromuscular blockade was reversed with intravenous neostigmine 0.05 mg/kg and glycopyrrolate 0.008 mg/kg, and extubation was performed when the patient was fully awake and breathing regularly with adequate tidal volume. Recovery time, that is, time taken from cessation of anesthesia until the patient obeyed verbal commands, was noted at every 2-min interval. The duration of surgery was also recorded.

The surgeon estimated the quality of the surgical field using apredefined category adopted from that of the Fromme–Boezzart scale. An average category scale for assessment of the intra operative surgical field was used:

0. No bleeding;
1. Slight bleeding—no suctioning of blood required;
2. Slight bleeding—occasional suctioning required. Surgical field not threatened;
3. Slight bleeding—frequent suctioning required. Bleeding threatens surgical field a few seconds after suction is removed;
4. Moderate bleeding—frequent suctioning required. Bleeding threatens surgical field directly after suction is removed;
5. Severe bleeding—constant suctioning required. Bleeding appears faster than can be removed by suction. Surgical field severely threatened and surgery not possible.

The ideal category scale values for surgical conditions were determined to be two and three. The total blood loss was measured on the basis of the volume of blood in the suction bottle minus the irrigation fluid and the volume of the total blood-soaked patties (5 ml for each soaked patty).

Perioperative complications such as hypotension (MAP<60), hypertension (MAP>90), tachycardia (HR>100), bradycardia (HR<50), hypoxemia (Spo2<94%) and sedation were also noted.

Statistical analysis

The entire statistical analysis was performed using Statistical Package for Social Sciences (SPSS version 11.5, Chicago, IL) for MS Windows.Independent t- test was used for quantitative data.Chi-square test was used for qualitative data.Mann–Whitney *U* test was used to compare the Surgical Site Visibility Scoring Using the Fromme–Boezaart Scale.The result was considered statistically significant if the p-value was < 0.05.

RESULTS

The demographic parameters including age, sex, weight, American Society of Anesthesiologists I/II status and duration of surgery were comparable without any statistically significant difference in both the groups (Table 1). Intraoperatively, the estimated mean blood loss during FESS was 90.50 ± 16.78 ml in group D as compared to 105.82 ± 15.16 ml in group P, and this difference was highly significant (P = 0.001) (Fig. 1). The mean HR and MAP in group D were lower than those in group P at almost all-time intervals intraoperatively, and these differences were statistically significant except preoperatively and during induction (Figs. 2, 3).

Moreover, both HR and MAP were significantly decreased (P < 0.05) in both groups after administering a loading dose of the study drugs as compared to baseline. Both groups were comparable in visibility of the surgical field with Fromme's score of 1 in 10% of patients, 2 in 70% of patients, and 3 in 20% of patients in group D and a score of 1 in 3.3% of patients, 2 in 76.7% of patients, and 3 in 20% of patients in group P with a mean Fromme–Boezaart score of 2.22 ± 0.46 and 2.32 ± 0.54 in groups D and P, respectively, and this difference was statistically insignificant (P > 0.05) (Table 2).

The recovery time was comparable in both groups with duration of recovery of 32.90 ± 1.82 min in group D and 33.12 ± 1.92 min in group P (P > 0.05).

Intraoperatively, only one incidence of bradycardia and hypotension was observed in group D (2.5%) compared to that in group P, which was managed successfully. Postoperatively, no significant adverse effects were observed in either group, except sedation in group D (2.5%), which was statistically and clinically insignificant.

Table 1. Demographic Data and Duration of Surgery.

Variable	Group D (n =30)	Group P (n =30)	P value
Age (years)	37.24 ± 3.62	39.36 ± 6.34	0.06
Weight (kg)	64.95 ± 8.26	68.07 ± 8.58	0.167
Duration of surgery	111.60 ± 10.21	112.55 ± 11.12	0.179
Sex (M/F)	14/16	15/15	0.689
ASA physical status (I/II)	27/3	25/5	0.732

Values are presented as mean ± SD or number only. ASA, American Society of Anesthesiologists physical status. P > 0.05, not significant.

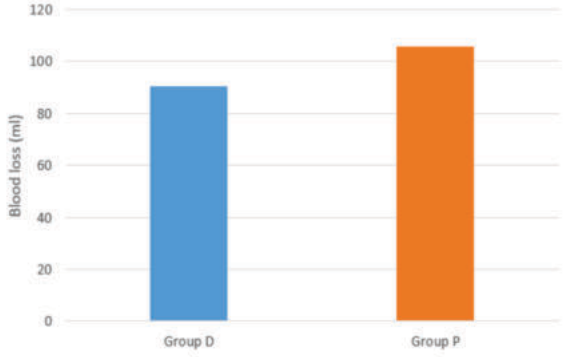

Fig.1. Intraoperative mean blood loss (ml).

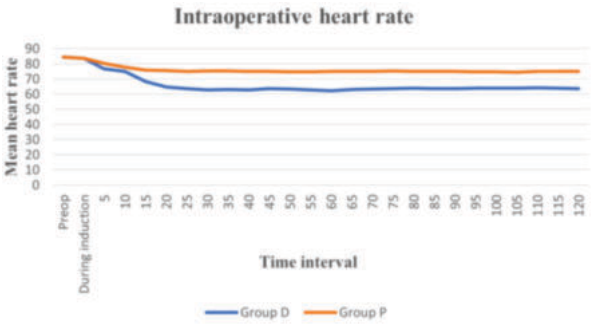

Fig 2. Intraoperative heart rate HR (beats per min).

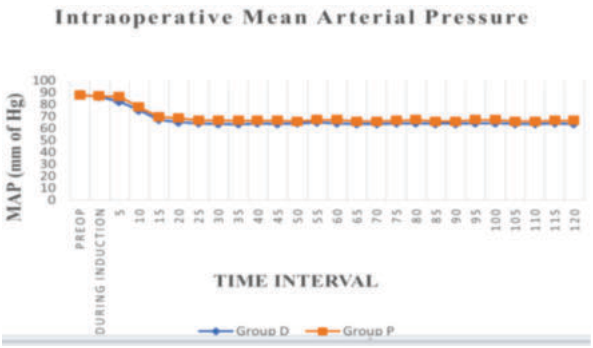

Fig 3. Intraoperative Mean arterial pressure MAP (mmHg).

Table 2. Surgical Site Visibility Scoring Using the Fromme–Boezaart Scale

Score	Group D (number of patients)	Group P (number of patients)	P value (Mann–Whitney U test)
0	0	0	0.103
1	3	1	
2	21	23	
3	6	6	
4	0	0	
5	0	0	

P > 0.05, not significant.

DISCUSSION

A lot of efforts have been done to optimize the surgical conditions for FESS. Induced hypotension has been widely advocated to control bleeding during FESS to improve the quality of surgical field. [12,13] In our study, we chose a target MAP of 60–70 mmHg to provide the best quality of surgical field without any adverse effects as performed by Aujla et al.[14] and Bajwa et al. [15]. Both drugs were effective in achieving MAP of 60 to 70 mmHg and lowering the heart rate ensured good surgical condition and providing dry surgical field during FESS.

Mathur *et al*. [16] also undertook a similar study comparing dexmedetomidine–isoflurane and propofol–fentanyl basedanesthesia. They used dexmedetomidine at a loading doseof 1mcg/kg over 10 minutes and continuous infusion of a 0.5mcg/kg/hour dose. The propofol infusion dose was also similar to our study butthey started fentanyl infusion in a separate infusion pump at0.5mcg/kg/hour. Both groups were able to achieve the target MAPwithin 5 minutes and were able to maintain this intraoperatively.However, they chose a target MAP of 60 to 75 mmHg, which is inthe higher range when compared with our study.

In our study, we have used a loading dose of dexmedetomidine of 1 mcg/kg over 10 min, followed by a maintenance dose of 0.4–0.8 mcg/kg/h, as similar doses were used by Shams et al. [17] for controlled hypotension in the FESS. Propofol infusion 50–150mcg/kg/min dosewas used in our study, as Ankichetty et al. [18] also used propofol 200 mg as loading dose and 133 mcg/kg/min as maintenance dose in FESS patients to achieve controlled hypotension.

In our study, both drugs for hypotensive anesthesia were compared with respect to blood loss during surgery, quality of the surgical field (Fromme's score), hemodynamic control, recovery time, and any other significant adverse effects. We found that although controlled hypotension was achieved with both drugs, dexmedetomidine produced a more stable hemodynamic with lower readings of MAP and HR as compared to that of propofol. Moreover, the target MAP range, i.e., 66.85 ± 1.63 mmHg in group D and 69.38 ± 1.69 mmHg in group P, was achieved after 15 min of infusion onwards. Similarly, a study conducted by Shah and Kulkarni [19] observing hemodynamic stability and operative field visibility in 60 patients undergoing FESS using dexmedetomidine and propofol infusion identified that the dexmedetomidine group showed better hemodynamic control with a lower HR and MAP compared to that in the propofol group.

Our study also found that intraoperative blood loss was significantly lower in the dexmedetomidine group than that in the propofol group. Similarly, Vineela et al. [20] and Somayaji and Raveendra [21] also found lesser blood loss with the use of dexmedetomidine during FESS. Consequently, we observed that blood loss was decreased in both groups (dexmedetomidine and propofol) individually as well as in combination; therefore, we compared both drugs for their usefulness in reducing blood loss during FESS. A recent study by Bharathwaj and Kamath [22] also compared dexmedetomidine and propofol infusion for controlled hypotensive anesthesia in 80 patients undergoing FESS and found that blood loss was 83.75 ± 14.80 ml in the dexmedetomidine group compared to that in the propofol group where it was 96.25 ± 16.12 ml. These results are in concordance with the present study but differ in that they used fixed dosages for infusions (dexmedetomidine, loading dose 0.5 mcg/kg for 20 min, maintenance dose 0.3 mcg/kg/h, and propofol, started at 12 mg/kg/h for 10 min, then at 10 mg/kg/h for the next 10 min, and a maintenance dose of 8 mg/kg/h).

Bajwa et al. [15] also compared the efficacy of infusion of three different drugs (nitroglycerine, esmolol, and dexmedetomidine) and found that the mean HR was significantly lower ($P < 0.05$) in the dexmedetomidine group than that in the other two groups.

The recovery time in our study was comparable in both groups, similar to the study by Moshiri et al. [23]. Regarding adverse effects, a single episode of intraoperative bradycardia and hypotension was noted in the dexmedetomidine group (2.5%) than that in the propofol group, which was statistically insignificant. This was similarly observed in a study by Shah and Kulkarni [19], in which 2 of 60 patients developed bradycardia in the dexmedetomidine group and managed successfully. No other incidences of hypotension, hypertension, or hypoxemia occurred in the present study.

Our study has a few limitations. First, invasive monitoring for the MAP, which was not done in the present study, can be used as a sensitive marker for monitoring hypotensive anesthesia; however, a recent study concluded that it does not aid in achieving lower target blood pressures [24]. Second, the method of blood loss measurement could be improved in the present study by performing calculations based on hemoglobin values and total volume in the suction canister, as done by Ahn et al. [25]. Third, the present study used a target range of MAP (60–70 mmHg) to achieve controlled hypotension. However, it is sometimes recommended that hypotensive anesthesia needs to be adjusted in relation to the patient's preoperative blood pressure and be limited to the level necessary to reduce bleeding in the surgical field; however, how best to characterize controlled hypotension still remains unclear.

CONCLUSION

From the observations in our clinical study, we conclude that both dexmedetomidine and propofol infusion are efficacious and safe drugs for facilitating controlled hypotension. Both drugs can provide haemodynamic stability, an ideal surgical field and reduce blood loss throughout the FESS procedure. However, dexmedetomidine is comparatively better than propofol in controlling heart rate and mean arterial pressure and in reducing blood loss.

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