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Original Research Article

A Comparative Study of Dexmedetomidine and Nitroglycerine for Induced Hypotension in Functional Endoscopic Sinus Surgery

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Abstract

Background: During functional endoscopic sinus surgery, induced hypotension reduces intra-operative blood loss, allowing for greater sight of the surgical field and reducing the risk of significant complications (FESS). The aim of the study was to compare Dexmedetomidine with Nitroglycerine for hypotensive anesthesia for Functional Endoscopic Sinus Surgeries (FESS) with respect to quality of the surgical field, hemodynamics, amount of blood loss, intraoperative opioid requirement, time to first analgesic request and recovery profile.

Methods: A total of n=100 patients of physical status American Society of Anesthesiologists (ASA) I and II between elective Functional Endoscopic Sinus have been randomly selected for the present study. The patients were randomly allocated into two groups comprising n=50 patients in each group. Group D (n=50) received Dexmedetomidine, 0.4-0.8 µg/kg/hr and Group N (n=50) received Nitroglycerine infusion at 0.5-1.0 µg/kg/hr. The infusion rates were then titrated to keep the MAP between 50-60 mm Hg or a 30% drop from baseline, whichever was higher. Heart rate, mean arterial pressure, blood loss (Average Category Scale), emergence time, time to first rescue analgesia, and post-operative recovery are among the parameters measured.

Results: The volume of blood loss in cases in both groups was measured. It was found that the mean volume of blood loss in the dexmedetomidine group was 91.0 ml and, in the nitroglycerine, group the mean blood loss was 107.0 ml the p-values were found to be significant. Similarly, the surgeon's satisfaction with anesthesia and blood loss was assessed and in group D all the cases have satisfactory results and in group N n=4 cases the results were not satisfactory.

Conclusion: Both Nitroglycerine and Dexmedetomidine can be used for hypotensive anesthesia in Functional Endoscopic Sinus Surgeries alone or combined with other drugs. The Mean Heart Rate was more in the Nitroglycerine Group compared with the dexmedetomidine group. Lower changes in HR and Less Blood loss were observed in the Dexmedetomidine group. Slower reversibility to normal limits was seen in the dexmedetomidine group.

Keywords: Dexmedetomidine, Hypotensive Anesthesia, Functional Endoscopic Sinus Surgery (FESS), Nitroglycerine

Introduction

Functional Endoscopic Sinus Surgery (FESS) is the most commonly employed surgery for Sinusitis and polypousrhinosinusitis and can result in significant improvements in the clinical symptoms of patients with rhinosinusitis[1, 2], but intraoperative bleeding is the major problem in these techniques. In the case of FESS, classic local anesthesia is gradually being replaced by general anesthesia and local bleeding is difficult to control due to anatomical and pathological characteristics. [1] Anesthesia influences intraoperative bleeding in several ways and the absence of regional blocks for the above surgeries, the role of an anesthesiologist becomes very important.As such the option for the procedure to be done in general anesthesia offers numerous benefits and the role of the anesthetist in FESS is undoubtedly significant. General anesthesia will allow immobile surgical field, effective airway protection, adequate analgesia, and patient comfort is good. Bleeding may be difficult to control surgically due to extensive vascular supply in the sinus region and pathophysiological changes in the patient. capillary bleeding is the most serious problem barring any inadvertent trauma to feeding arteries. Bleeding from capillary circulation may be greatly reduced by decreasing the patients' MAP. Controlled hypotension is a method by which the arterial blood pressure is decreased in a deliberate but predictable manner to limit intraoperative blood loss and to provide the best possible surgical field for operating[3].Methods to achieve controlled hypotension can broadly be classified as pharmacological and nonpharmacological. The latter include tourniquets, patient positioning, positive airway pressure, etc. while the former includes local infiltrations, non-depolarizing muscle relaxants, inhalational agents, alpha/beta-blockers, and direct vasodilators. Nitroglycerin chiefly used to treat angina has also been used for controlled hypotension. It is a directly acting vasodilator that primarily dilates capacitance vessels reducing venous return with concomitant reductions in stroke volume and cardiac output thereby causing hypotension. used to achieve induced hypotension because it could be titrated with rapid onset and rapid offset[4]. However, it causes reflex tachycardia and venous congestion in and around the surgical site and thus may increase blood loss. Dexmedetomidine is an α_2-adrenoceptor agonist with sedative, anxiolytic, sympatholytic, analgesic-sparing effects, and minimal depression of respiratory function. It is potent and highly selective for α_2-receptors[5].Dexmedetomidine exerts its hypnotic action through activation of central pre-and postsynaptic α_2- receptors in the locus coeruleus. Dexmedetomidine is rapidly distributed and is mainly hepatically metabolized into inactive metabolites by glucuronidation and hydroxylation[6].The α_2-receptors are involved in regulating the autonomic and cardiovascular systems. In blood vessels, these receptors cause vasoconstriction, and in the sympathetic terminals, they inhibit the release of norepinephrine[7]. There exist studies that compare the efficacy of Nitroglycerine either singly or with a calcium channel blocker, esmolol in controlled hypotension. 13,14 Few studies are available on nitroglycerine and dexmedetomidine so far. In our study, an attempt will be made to compare the efficacies of Nitroglycerin and dexmedetomidine with reference to intraoperative bleeding and the quality of surgical field during controlled hypotensive anesthesia induced by either intravenous Nitroglycerin or intravenous dexmedetomidine when performing elective ENT surgeries (particularly FESS) under general anesthesia.

Material and Methods

This cross-sectional study was conducted in the Department of Anesthesiology, Osmania Medical College, Hyderabad. Institutional Ethical approval was obtained for the study.

Written consent was obtained from all the participants of the study.

Inclusion Criteria

- ASA Physical Status I and II
- Age 20 – 40 years
- Posted for elective Functional endoscopic Sinus Surgeries

Exclusion Criteria

- ASA Physical Status III and IV
- Age <20, > 40 years
- Emergency surgeries
- Known Hypersensitivity to Dexmedetomidine or Nitroglycerine
- Patients not willing to participation

A total of n=100 patients of physical status American Society of Anaesthesiologists (ASA) I and II between elective Functional Endoscopic Sinus have been randomly selected for the present study. The patients were randomly allocated into two groups comprising n=50 patients in each group. Group D (n=50) received Dexmedetomidine, and Group N (n=50) received Nitroglycerine. Preoperative Investigations: Complete Blood Picture, Random Blood Sugar, Blood Grouping and Typing, Electrocardiogram, Prothrombin time, International Normalized Ratio, chest X-ray, Liver, and Kidney Function Tests were done.

A preoperative visit was conducted one day before surgery. All patients were confirmed to be physically fit and belong to ASA Physical status I and II. The minimal fasting period is 8 hrs. Once patients entered the operation room, monitoring with ECG, noninvasive arterial blood pressure, $ETCO_2$, and oxygen saturation measurement was carried out. Preoperative vitals are recorded. 18-G intravenous catheters were inserted. All patients were premedicated with intravenous midazolam at 0.05 mg/kg. Anesthesia was induced by propofol 2 mg/kg and fentanyl 2μg/kg. Vecuronium 0.08 mg/kg was given to facilitate endotracheal intubation and end-tidal carbon dioxide was applied. Patients were ventilated with 3:2 nitrous and oxygen and sevoflurane 1 MAC was used for maintaining anesthesia. Top-up doses ofvecuronium 0.15 mg/kg were given. Every effort was made to standardize the anesthetic technique. Patients in group D received Dexmedetomidine 0.4-0.8 μg/kg/hr in 500 ml 0.9% normal saline started after the induction. Patients in group N received Nitroglycerine 0.5 – 1.0 μg/kg/hr in 500 ml 0.9% normal saline. The nasal mucosae of all the patientswere infiltrated using 4 ml of 2% xylocaine with adrenaline (1: 200000). Target MAP of 60–70 mmHg was maintained in all patients. Vitals like MAP, HR, Saturation, and $ETCO_2$ every 3 min after starting the infusion, quality of the surgical field is assessed by an average category scale. 0=Absence of bleeding, 1=slight bleeding, suctioning of blood not necessary, 2=slight bleeding, sometimes blood has to be suctioned out, 3=slight bleeding, sometimes blood has to be evacuated, the visible operative field for some seconds after evacuation, 4=average bleeding, blood has to be often evacuated, the operative field is visible only right after evacuation and 5=high bleeding, constant blood evacuation is needed, sometimes bleeding exceeds evacuation. Dexmedetomidine/Nitroglycerine infusion was stopped approximately 20 min before the expected end of surgery. After the stoppage of infusion, Patients were monitored at 3 min time intervals for vital parameters especially mean arterial pressure & heart rate till the time of extubation. Upon completion of the surgery, residual paralysis was reversed with neostigmine 0.05 mg/kg and glycopyrrolate 0.08 mg/kg iv, and after complete recovery patients were extubated. The highest infusion dose for each patient was recorded. Reflex tachycardia was defined as a persistent rise in heart rate >20% from baseline or absolute value of heart rate >120/min for a period of 10 min or more. It was treated with Inj. esmolol 0.5 mg/kg IV. Patients with reflexes were excluded and managed by other medications (anesthetic drugs or other antihypertensive

drugs). If severe hypotension below the targeted level occurred, hypotensive drugs were discontinued as a first step, and if there was no response within 1 min, mephenteramine 6 mg was given, which could be repeated to achieve desirable blood pressure, and the patient was excluded from the study. Bradycardia was defined as a decrease in heart rate<20% from baseline or<50/min and that was treated with Inj. atropine 0.01 mg/kg or 0.6 mg IV and the patient was excluded from the study. They were also monitored for postoperative complications in the form of nausea/vomiting, bradycardia, hypotension, and shivering for a period of up to two hours. All operations were done by the same surgeon and the duration of surgical intervention (from beginning to end of surgical procedure) and surgeon satisfaction were recorded. Blood loss volume, measured in a suction bottle and by the visual estimation of the soaked swabs if present (depending on the swab size and soaking percentage), was recorded. Infusion of the hypotensive agent was stopped 5 min before the anticipated end of surgery. We also observed the time to the reversibility of the hypotensive state at the end of operation as our secondary outcome parameters.

Results

The mean age of both groups did not differ significantly, and it was comparable. Similarly, the number of males in group D was 68% and females were 32% and in group N number of males was 82% and females were 18% the p values were not significant. The ASA categories and duration of surgical intervention were also found to be comparable in both the groups' details depicted in table 1.

Table 1: Demographic profile of cases included in the study

Parameters	Group D (n=50)	Group N (n=50)	p- value
Age (years)	25.25 ± 8.42	24.45 ± 8.96	0.746
Sex (male/female)	34/16	41/9	0.507
ASA I/II	39/11	40/10	0.732
Duration of surgical intervention (min)	86.16 ± 3.76	85.84 ± 4.72	0.792

Figure 1 Data is presented as mean ± SD of mean arterial pressure at various time intervals including from basal levels followed by immediately after infusion of nitroglycerin and dexmedetomidine and after that in each group at the end of 3 min, 6 min, 9 min, 15 min, 30 min, 33 min, and Te at the endpoint of administration of hypotensive agents. The p values were <0.05 hence considered significant.

Figure 2 Data are presented as mean ± SD of mean heart rate recorded at various time intervals including from basal levels followed by immediately after infusion of nitroglycerin and dexmedetomidine and after that in each group at the end of 3 min, 6 min, 9 min, 15 min, 30 min, 33 min, and Te at the endpoint of administration of hypotensive agents. The p values were <0.05 hence considered significant.

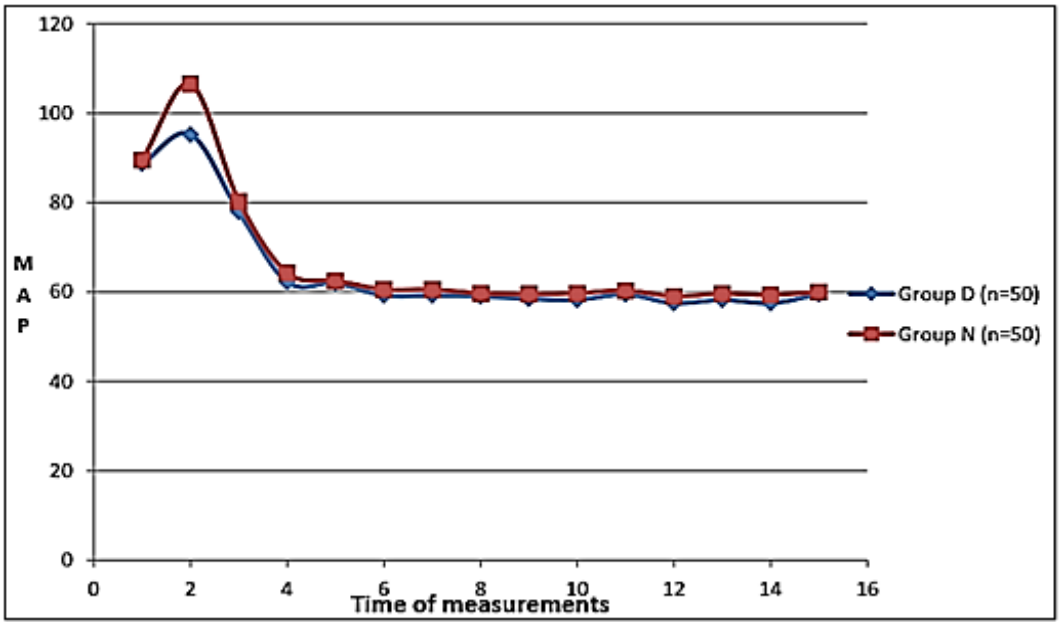

Figure 1: Comparison of Mean arterial pressure recorded at various intervals in the cases of study

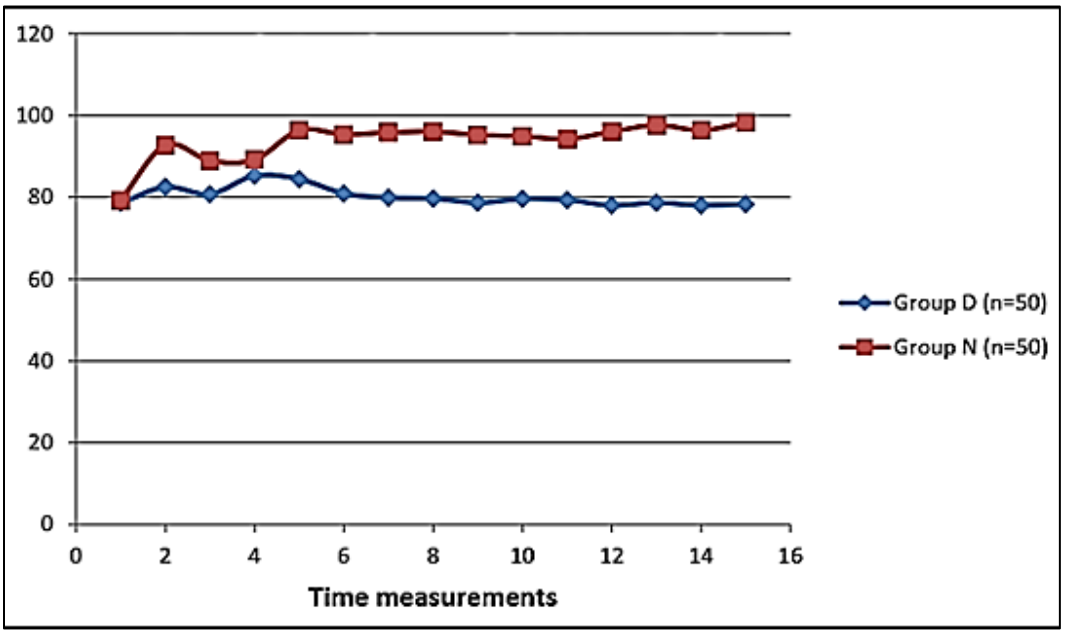

Figure 2: Comparison of Mean heart rate recorded at various intervals in the cases of study

The volume of blood loss in cases in both groups was measured. It was found that the mean volume of blood loss in the dexmedetomidine group was 91.0 ml and, in the nitroglycerine, group the mean blood loss was 107.0 ml the p-values were found to be significant. Similarly, the surgeon's satisfaction with anesthesia and blood loss was assessed and in group D all the cases have satisfactory results and in group N n=4 cases the results were not satisfactory given in table 2.

Table 2: Blood loss volume and surgeon satisfaction

Parameters	Group D (n=50)	Group N (n=50)	P-value
Blood loss volume (ml)	91.0 ± 4.47	107.0 ± 9.51	0.0001*
Surgeon satisfaction (yes/no)	50/0	46/4	0.148

* Satisfactory

As shown in Figure 3, the time taken for MAP to return to normal was significantly lesser in Group N when compared to Group D. MAP reverted to normal within 7.80 ± 5.10 minutes in Group D and within 2.60 ± 1.14 minutes in Group N.

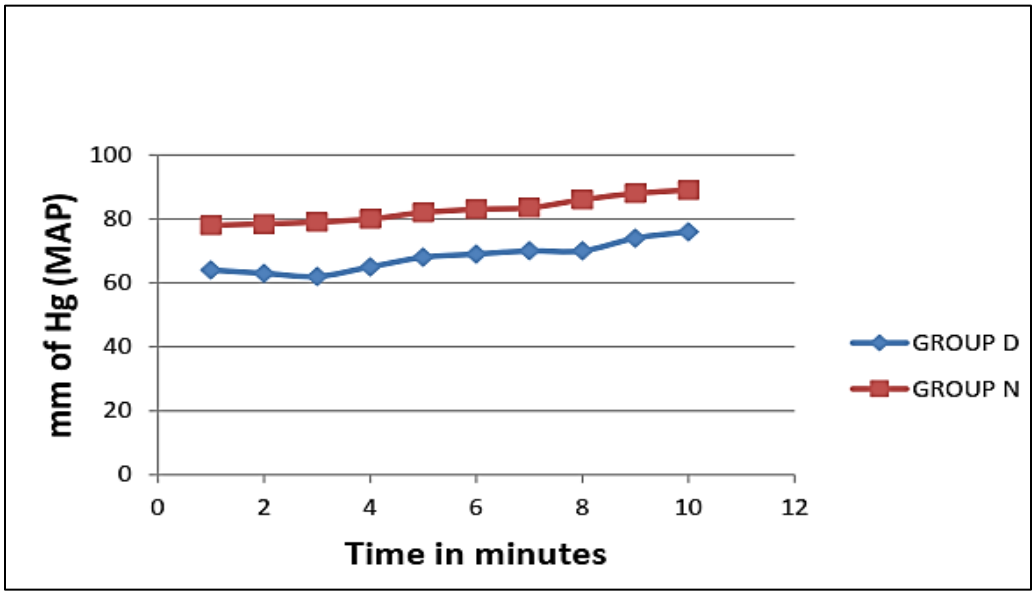

Figure 3: Reversibility of hypotensive state in the cases of study

Discussion

Functional Endoscopic Sinus Surgery is a surgical method that involves employing an endoscope with a fiber-optic camera to do all essential maneuvers. Bleeding must be kept to a minimum during surgery, as even a tiny quantity of blood can impede visibility via the endoscope. During FESS, many measures have been employed to ensure a dry working field. Capillary bleeding has the greatest impact on operational field vision, and it can be decreased by utilizing local vasoconstrictors and maintaining controlled hypotension. A controlled hypotensive approach, which includes decreasing the patient's mean arterial blood pressure to below normal, is a frequently used method for minimizing bleeding under general anesthetic. In the current study, we found the visual field clarity was better in the dexmedetomidine group as compared to the nitroglycerine group. The overall blood loss was less in the dexmedetomidine group. Nasreen F*et al*.[8], and Drumus M *et al*.[9], in their studies found dexmedetomidine infusion started before induction provided a better visual field and less blood loss and decreased requirements of induction agent dosage fentanyl and isoflurane requirements in patients compared with placebo. Several studies have found that dexmedetomidine comparison with normal saline causes decreased blood loss and reduces the requirement of inhalation anesthetic in the dexmedetomidine group[10-12]. Studies have found a significant reduction in the percentage of halothane requirement in the dexmedetomidine group [13] Similarly, a decrease in isoflurane requirements in the dexmedetomidine group[8]. The comparison

of dexmedetomidine with other drugs for hypotensive anesthesia during different ENT surgical procedures has effectively decreased the blood and provided clear visuality of the surgical site. On the contrary G Turan*et al*. [14], comparing dexmedetomidine, Remifentanil, and Esmolol in controlled hypotensive anesthesia in patients undergoing tympanoplasty found no significant difference between these drugs. In another interesting study by Richa F *et al*.[15], using dexmedetomidine and Remifentanil found that infusion of dexmedetomidine, at the doses (0.4-0.8 µg/kg/hr) used in this study, was less effective than remifentanil in achieving controlled hypotension, good surgical field exposure condition, and surgeon's satisfaction during tympanoplasty. S Bajwa*et al*.[16], in their study found dexmedetomidine and esmolol provided better hemodynamic stability and operative field visibility compared to nitroglycerin during FESS. In our study**,** we observed lower heart rate change and low heart rate and amount of blood loss thereby better surgical field in the Dexmedetomidine group and early reversibility of hypotension in the Nitroglycerin group. In this also no significant difference between MAP of the two groups, but Mean HR was significantly higher in the nitroglycerine group but the time of reversibility of hypotension was less in the nitroglycerin group.

Conclusion

Both Nitroglycerine and Dexmedetomidine can be used for hypotensive anesthesia in Functional Endoscopic Sinus Surgeries alone or combined with other drugs. The Mean Heart Rate was more in the Nitroglycerine Group compared with the dexmedetomidine group. Lower changes in HR and Less Blood loss were observed in the Dexmedetomidine group. Slower reversibility to normal limits was seen in the dexmedetomidine group. We concluded that Dexmedetomidine may be a better alternative for Nitroglycerine in Functional Endoscopic Sinus Surgeries.

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