# Controlled Hypotension in Functional Endoscopic Sinus Surgery: A Comparison between Esmolol and Dexmedetomidine - A Randomized Prospective Study

**Kakati R[1], Borah P[2], Bhattacharyya RK[3], Deori AK[4]**

**ABSTRACT**

**Introduction:** Controlled hypotension is a tried and tested tool in minimizing blood loss, thus aiding haemodynamic stability intra-operatively. This study aims at comparing the efficacy of esmolol versus dexmedetomidine in achieving and maintaining controlled hypotension in Functional Endoscopic Sinus Surgery under General Anaesthesia.

**Material and Methods:** All American Society of Anaesthesiologists Grade-I patients 20-45 years of age, admitted for Functional Endoscopic Sinus Surgery between January to September 2017, were enrolled in this prospective randomized study. The first patient was randomly allocated one of the drugs, and the subsequent patient was allocated the other drug alternately and so on. Dexmedetomidine was administered as a loading dose of 1 mcg/kg over 15 minutes intravenously, followed by 0.5 mcg/kg/min intravenously during maintenance. Esmolol was administered as a loading dose of 1 mg/kg intravenously over 1 minute followed by 0.5 mg/kg/min intravenously during maintenance. Extent and duration of controlled hypotension, visibility of operative field, and presence of any adverse effects were observed.

**Results:** Out of the two drugs, esmolol was able to achieve satisfactory levels of controlled hypotension. It was associated with more haemodynamic stability, less required dosage and less incidence of adverse effects. However, it was seen that dexmedetomidine was able to cause profound sedation, analgesia and decreased dose requirements of other anaesthetic agents.

**Conclusion:** Esmolol was found to be better suited for controlled hypotension in Functional Endoscopic Sinus Surgery than dexmedetomidine owing to better onset, maintenance and offset of hypotension; better quality of surgical field, and less incidence of adverse effects.

**Keywords:** Hypotensive Anaesthesia, Mean Arterial Pressure, Heart Rate

## INTRODUCTION

Intra-operative bleeding is a complication which is faced commonly by anaesthesia providers, irrespective of the type of surgery. It often results in haemodynamic instability and increased requirements of blood transfusion. Therefore, one of the most important goals for an anaesthesiologist is to reduce bleeding to a minimum so as to ensure optimal safety of the patient as well as satisfaction of the surgeon.

Functional Endoscopic Sinus Surgery (FESS) is a popular and highly sophisticated type of surgery which has revolutionized the management of numerous acute and chronic sinus pathologies where conservative management has failed. During FESS, the surgeon operates in a confined space with a severely limited field of view on delicate and highly vascular structures. As such, control of intra-operative bleeding assumes a lot more importance during the anaesthetic management of FESS, where general anaesthesia is the technique of choice. Bleeding impairs the visibility of the surgical field and increases operation risk and time.[1]

Intentional induced systemic hypotension is one of the most effective methods of reducing intra-operative bleeding and there are several advantages of this technique during anaesthetic management of FESS. These include reduction of blood loss, as well as improvement in the visual quality of surgical field. This leads to decreased blood transfusion requirements as well as less time required to operate.

In controlled hypotension during anaesthesia, the blood pressure of the patient is reduced such that the mean arterial pressure (MAP) is lowered by 30% from baseline or at 60-70 mm Hg, whichever is greater.[2,3] For this purpose, several drugs have been used by various research workers over the years. These include vasodilators such as sodium nitroprusside and nitroglycerine[4], beta blockers[5] such as esmolol, and higher dose of inhaled anaesthetic agents[6], used either alone or in combination. However, an ideal agent for this purpose is yet to be discovered. Such an agent should have a short onset and offset time without toxic metabolites; besides having dose dependent predictable hypotensive effects and which is easy to administer.[7]

Esmolol is a cardioselective beta-1 adrenoceptor antagonist. It has a rapid onset and a very short duration of action. It is found to have little or no significant intrinsic sympathomimetic or membrane stabilising activity at therapeutic dosages. The perioperative use of this drug as an anaesthetic adjunct has been only recently explored by various studies, although its use for hemodynamic stability and cardiac protection is well accepted.[8,9,10]

Dexmedetomidine is a highly selective alpha-2 adrenergic

[1]Postgraduate Trainee (2nd year MD), [2]Assistant Professor, [3]Professor and Head, [4]Professor, Department of Anaesthesiology, Assam Medical College and Hospital, Dibrugarh, India

**Corresponding author:** Dr. Rishav Kakati, Room no. 26, PG Hostel No. 8, Assam Medical College Hospital, Dibrugarh- 786002, Assam, India.

**How to cite this article:** Kakati R, Borah P, Bhattacharyya RK, Deori AK. Controlled hypotension in functional endoscopic sinus surgery: a comparison between esmolol and dexmedetomidine - a randomized prospective study. International Journal of Contemporary Medical Research 2018;5(2):B30-B33.

agonist. It is an anxiety reducing sedative medication which is notable for its ability to provide sedation without risk of respiratory depression and can provide cooperative or semi-arousable sedation. It causes hypotension and bradycardia on infusion due to its sympatholytic and vagomimetic properties.[11]

The objective of this study was to compare the efficacy (onset and duration) of producing controlled hypotension using esmolol versus dexmedetomidine during FESS in adults. Besides, the two agents were compared with respect to visibility of surgical field and presence of any adverse effects.

## MATERIAL AND METHODS

With due permission from the Institutional Ethics Committee, it was decided to include all ASA Grade 1 patients of age group 20-45 years, who were admitted to the hospital and planned for Functional Endoscopic Sinus Surgery between January and September, 2017. Written and informed consent was taken from every case.

**Exclusion criteria** for the study included patient refusal, any hypersensitivity or contraindication to Esmolol or Dexmedetomidine, pregnant or lactating mothers, paediatric patients, any hepatic, renal or cardiopulmonary abnormality, alcoholism, diabetes mellitus, bleeding diatheses, patients on calcium channel blockers, patients with history of significant neurological, psychiatric or neuromuscular disorders, and patients with bilateral ethmoidal polyp, bilateral extensive sinusitis, orbital abscess, CSF leak with or without CSF rhinorrhea, orbital decompression surgery.

**Case selection:** A total of 40 patients were divided into two equal groups: Group E for esmolol and Group D for dexmedetomidine. The first randomly selected case under this study was given esmolol and the next case was given dexmedetomidine. This sequence was repeated for all the remaining cases by allotting the same drug to every alternate case and thus randomization was maintained. Group E cases received esmolol with loading dose of 1 mg/kg IV infused over 1 minute followed by 0.5 mg/kg/h IV infusion during maintenance. Group D cases received dexmedetomidine with loading dose of 1 mcg/kg IV over 15 minutes followed by 0.5 mcg/kg/h infusion during maintenance. Both the study drugs were diluted to 50 mL using normal saline and administered using infusion pumps. The ENT surgeon and study participants were blinded regarding the study drug used.

Each case underwent a thorough pre-operative assessment. This included history taking with special focus on past surgical history, presence of any co-morbidities, drug, and allergy history. Then, general and systemic examination was done with emphasis on the airway. After checking the necessary routine investigations, the cases were given clearance for surgery. Pre-operatively, the patients were kept nil per orally from 10PM on the night before the procedure. All the cases received oral alprazolam 0.5 mg and oral ranitidine 150 mg on the night before the procedure.

Half an hour prior to shifting the patient to OT, cotton swabs soaked with 1/1000 adrenaline, 0.01% xylometazoline and 2% lignocaine were placed in every patient's nasal cavity This was done by the ENT surgeon for topical vasoconstriction and local anaesthesia. They were removed just prior to starting the surgery.

Upon shifting to OT, patients were connected to monitoring equipment for ECG, $SpO_2$, NIBP and $etCO_2$. IV access was secured and infusion of Ringer's lactate started. Thereafter, each case received esmolol or dexmedetomidine as per allocation.

Following administration of study drug, pre-oxygenation was done for 3 minutes during which pre-medications were given in the form of IV palonosetron 75 mcg, tramadol 1.5 mg/kg, pantoprazole 40 mg and glycopyrrolate 0.01 mg/kg. Patients were then induced with IV propofol 2.5 mg/kg. Atracurium 0.5 mg/kg was then given to facilitate laryngoscopy and intubation. After successful intubation, the patient was maintained using 33% oxygen in 66% nitrous oxide with isoflurane and intermittent boluses of IV atracurium 5 mg as and when needed.

When intra-operative MAP increased more than 80 mm Hg, 50 mcg nitroglycerine IV was given; when MAP got decreased below 55 mm Hg, 6 mg mephentermine IV was given. When HR became less than 50, 0.3 mg atropine IV was given.

At the completion of surgery, infusion pump was turned off and residual neuromuscular blockade was antagonized using IV neostigmine 0.05 mg/kg and IV glycopyrrolate 0.01 mg/kg. Patient was then extubated after confirmation of emergence, and then transferred to the post-operative ward.

For comparison of controlled hypotension, mean arterial pressures measured non-invasively were taken before the start of drug administration, and then at 5, 10, 20, 40, 80 minutes during controlled hypotension and finally 15 minutes after the end of drug administration. The HR, $SpO_2$, $etCO_2$ and any side effects were also noted at the same intervals during the surgery. The quality of surgical field for bleeding and dryness was evaluated every 15 minutes by the ENT surgeon using a qualitative scale as per following criteria (table-1)[13]:

## STATISTICAL ANALYSIS

The raw data was entered into a Microsoft Excel spreadsheet and analyzed using standard statistical tests. Age, weight, haemoglobin %, duration of controlled hypotension, mean arterial pressure and heart rate readings were compared between groups D and E using regression analysis (ANOVA test) and a P value of $<0.05$ was considered statistically significant. Other findings such as incidence rate of nitroglycerine, mephentermine, atropine administration and poor quality surgical field (ENT surgeon's score 3 or 4) between the two groups were also compared.

## RESULTS

The two groups, D and E were comparable with respect to age, sex, weight, haemoglobin estimation and duration of controlled hypotension as shown in the table-2.

| Nasal surgical field quality | Surgeon's score |
|---|---|
| Minor bleeding, no aspiration required | 1 |
| Minor bleeding, aspiration required | 2 |
| Moderate bleeding, needs frequent aspiration | 3 |
| Major bleeding, visible only with very frequent aspiration | 4 |

**Table-1:** Nasal bleeding score

| Parameter (mean) | Group D | Group E | P value |
|---|---|---|---|
| Age (years) | 31.6 | 30.15 | 0.68 |
| Sex ratio (M:F) | 1:1 | 1:1 | - |
| Weight (kg) | 55.7 | 54.6 | 0.89 |
| HB% (g/dl) | 11.6 | 11.32 | 0.86 |
| Controlled hypotension duration (hh:mm) | 1:52 | 1:43 | 0.74 |

**Table-2:** Subject characteristics and controlled hypotension

| Adverse events | Group D (n=20) | Group E (n=20) |
|---|---|---|
| Hypotension | 0 | 02 (10%) |
| Hypertension | 12 (60%) | 02 (10%) |
| Bradycardia | 09 (45%) | 03 (15%) |
| Poor surgical field | 08 (40%) | 01(5%) |

**Table-3:** Adverse events during the intraoperative period

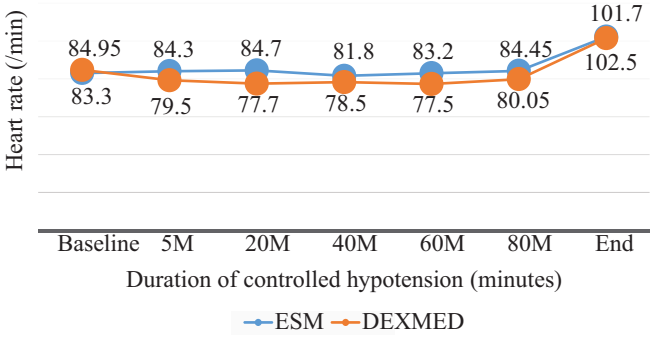


**Figure-1:** Comparison of heart rate intra-operatively

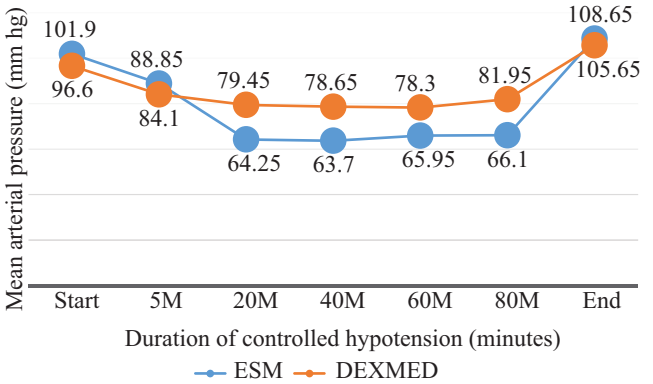


**Figure-2:** Controlled hypotension: Mean arterial pressure versus time

It was seen that the esmolol group was associated with a more rapid onset as well as a greater extent of controlled hypotension as well as a more rapid offset on stopping the drug at the end of surgery. Regression analysis of mean arterial BP between the two groups yielded a P value of 0.002, which was statistically significant.

Heart rate, however, was comparable between the two groups. Major fluctuations in heart rate were not seen in the majority of the cases in both groups and the P value comparing heart rates was not statistically significant.

Further, it was seen that the incidences of adverse events (hypertension requiring nitroglycerine, hypotension requiring mephentermine, bradycardia requiring atropine) were more in the dexmedetomidine group as compared to the esmolol group.

It was also noteworthy that there were significantly lesser incidences of poor surgical field (Surgeon's score 3 or 4) in the esmolol group (5%) as opposed to the dexmedetomidine group (40%). These findings are summarized in the table-3.

Graphical representations of the trends seen on plotting average MAP and HR against time between the two groups is shown in figure 1,2.

However, it was seen that dexmedetomidine was able to cause profound sedation and analgesia on administration. The patient, despite being sedated, was capable of spontaneous respiration and followed commands. Also, dexmedetomidine infusion resulted in reduced requirements of isoflurane and atracurium in maintaining the state of anaesthesia. These were however not evaluated quantitatively as they were outside the scope of this study.

## DISCUSSION

Controlled hypotension is regarded as an effective technique for reducing blood loss and optimizing the surgical field during FESS. Many studies have been conducted by various research workers over the years using different agents in the quest for an ideal agent for controlled hypotension.

In this study, the target MAP was chosen based upon a review of the literature conducted by Barak et al with a MAP of 50-65 mm Hg during major maxillofacial surgeries.[12] Boezaart et al showed that mandibular osteotomy done using controlled hypotension upto MAP 60-70 mm Hg with sodium nitroprusside or nitroglycerine was safe and not associated with significant increases in pyruvate, lactate or glucose levels.[13] Shen et al in a placebo controlled trial found that esmolol not only produces relative hypotension and bradycardia but also improves the surgical field and reduces the average blood loss.[14] Celebi et al showed that intraoperative infusion of esmolol reduced the intra and post op analgesic consumption and reduced the visual analog pain scores.[15] Dexmedetomidine was given in FESS as a preoperative medication by Guven et al where they found lower HR and MAP, lower bleeding scores, visual analog pain scores and shorter operative time when compared to a placebo group.[16] Ibraheim et al conducted a similar study using the same two drugs and a control group, where it was found that dexmedetomidine group produced more profound and sustained hypotension than esmolol.[17] Kol et al, however, found that in esmolol group, recovery from anaesthesia was significantly shorter than those of the dexmedetomidine group.[18] Bayram et al conducted a similar study comparing controlled hypotension in FESS using dexmedetomidine versus magnesium sulphate and found dexmedetomidine

to be superior.[19] Srivastava et al found that esmolol reduced the bleeding in FESS significantly when compared to nitroglycerine.[20]

In the present study, comparison of esmolol and dexmedetomidine showed esmolol to be the better drug. Esmolol produced a better quality of controlled hypotension. It also resulted in a better operative field for the surgeon as well as better patient safety because of lesser adverse effects. There were some limitations in this study that need mention. No placebo controlled group was enrolled as it was not allowed by the ethical committee. Further, esmolol and dexmedetomidine doses were established based on their known safe optimal doses in the perioperative context without knowledge of their equipotent doses.

## CONCLUSION

The study concludes that esmolol is a better drug than dexmedetomidine as regards controlled hypotension in FESS because it causes a more rapid onset, greater extent as well as a more rapid offset of hypotension and is associated with a better quality of surgical field as well as less side effects and decreased requirements of rescue medications to maintain controlled hypotension.

## REFERENCES


1. Atighechi S, Azimi MR et al. Evaluation of intraoperative bleeding during an endoscopic surgery of nasal polyposis after a pre-operative single dose versus a 5-day course of corticosteroid. Eur Arch otorhinolaryngol 2013;270:2451-4.
2. Guney A, Kaya FN et al. Comparison of esmolol to nitroglycerine in controlling hypotension during nasal surgery. Eurasian J Med 2012; 44:99-105.
3. Rodrigo C. Induced hypotension during Anaesthesia with special reference to orthognathic surgery. Anesth Prog 1995;42:41-58.
4. Mishra A, Singh RB et al. A comparison between nitroprusside and nitroglycerine for hypotensive Anaesthesia in ear, nose and throat surgeries: A double blinded randomized study. Med J DY Patil Univ 2015;8:182-8.
5. Puthanveettil N, Rajan S et al. A comparison of effects of oral premedication with clonidine and metoprolol on intraoperative hemodynamics and surgical conditions during functional endoscopic sinus surgery. Anesth Essays Res 2013;7:371-5.
6. Dal D, Celikar V et al. Induced hypotension for tympanoplasty: A comparison of desflurane, isoflurane and sevoflurane. Eur J Anesthesiol 2004;21:902-6.
7. Degoute CS. Controlled hypotension: A guide to drug choice. Drugs 2007;67:1053-76.
8. POISE Study Group, Devereaux PJ, Yang H et al. Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial): A randomized controlled trial. Lancet 2008;371:1839-47.
9. Chia YY, Chan MH et al. Role of beta-blockade in Anaesthesia and postoperative pain management after hysterectomy. Br J Anesth 2004;93:799-805.
10. Lee SJ, Lee JN. The effect of perioperative esmolol infusion on the postoperative nausea, vomiting and pain after laparoscopic appendectomy. Korean J Anesthesiol 2010;59:179-84.
11. Huang R, Hertz L. Receptor subtype and dose dependence of dexmedetomidine-induced accumulation of [14C] glutamate in astrocytes suggests glial involvement in its hypnotic-sedative and anesthetic-sparing effects. Brain Res 2000;873:297-301.
12. Barak M, Yoav L et al. Hypotensive Anaesthesia versus normotensive Anaesthesia during major maxillofacial surgery: A review of the literature. Scientific World Journal 2015;2015:480728.
13. Boezaart AP, van der Merwe J et al. Comparison of sodium nitroprusside and esmolol induced controlled hypotension for functional endoscopic sinus surgery. Can J Anesth 1995;42(5 Pt 1):373-6.
14. Shen PH, Weitzel EK et al. Intravenous esmolol infusion improves surgical fields during sevoflurane-anesthetized endoscopic sinus surgery: A double blind, randomized, placebo-controlled trial. Am J Rhinol Allergy 2011;25:e208-11.
15. Celebi N, Cizmeci EA et al. Intraoperative esmolol infusion reduces postoperative analgesic consumption and anesthetic use during septorhinoplasty: A randomized trial. Rev Bras Anestesiol 2014;64:343-9.
16. Guven DG, Demiraran Y et al. Evaluation of outcomes in patients given dexmedetomidine in functional endoscopic sinus surgery. Ann Otol Rhinol Laryngol 2011;120:586-92.
17. Ibraheim OA, Abdulmonem A, et al. Esmolol versus dexmedetomidine in scoliosis surgery: Study on intraoperative blood loss and hemodynamic changes. Middle East J Anesthesiol 2013;22:27-33.
18. Kol IO, Kaygusuz K et al. Controlled hypotension with desflurane combined with esmolol or dexmedetomidine during tympanoplasty in adults: A double-blinded, randomized, controlled trial. Curr Ther Res Clin Exp 2009;70:197-208.
19. Bayram A, Ulgey A et al. Comparison between magnesium sulphate and dexmedetomidine in controlled hypotension during functional endoscopic sinus surgery. Rev Bras Anestesiol 2015;65:61-7.
20. Srivastava U, Dupargude AB et al. Controlled hypotension for functional endoscopic sinus surgery: Comparison of esmolol and nitroglycerine. Indian J Otolaryngol Head Neck Surg 2016;65:440-4.


**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 28-01-2018; **Accepted:** 1-03-2018; **Published:** 09-03-2018