Original Research Article

Indian Journal of Anesthesia and Analgesia
2018; 5 (2): 203-208
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.5218.9

Comparison of Nitroglycerine and Dexmedetomidine for Inducing Controlled Hypotension in Functional Endoscopic Sinus Surgery (FESS)

Mohammed Haji[1], Karunagaran Pradeep[2]

[1]Consultant, Dept. of Anaesthesiology, Erode Medical Centre, Erode, Tamil Nadu 638011, India. [2]Assistant Professor, Dept. of Anaesthesiology, Saveetha Medical College Hospital, Thandalam, Kanchipuram District, Tamil Nadu 602105, India.

Abstract

Background and Aims: Induced hypotension reduces blood loss during functional endoscopic sinus surgery (FESS), provides better surgical field visibility and minimizes the incidence of major complications. We aimed at comparing nitroglycerine (NTG) and dexmedetomidine for inducing controlled hypotension in patients undergoing FESS. *Material and Methods:* Sixty adult patients of ASA physical status I or II, undergoing FESS under general anaesthesia were randomly allocated to two groups of 30 patients each. Group N received NTG infusion at the rate of 0.5-5 mcg/kg/min while Group D patients received a loading dose of Dexmedetomidine 1mcg/kg/min followed by an infusion at the rate of 0.2-0.7 mcg/kg/hr. The infusions were titrated to maintain mean arterial pressure (MAP) in the range of 65-75 mm Hg in both the groups. The visibility of surgical field was assessed by the surgeon using Average Category Scale (ACS) scores. The haemodynamic parameters, rescue fentanyl usage, emergence time and time to first postoperative analgesic request were recorded. *Results:* The desired MAP (65-75mm Hg) could be achieved in both the groups. No significant intergroup differences were observed in ACS scores. The mean heart rate was significantly lower in Group D at various time intervals ($P<0.05$). Rescue fentanyl usage was significantly lower in Group D. Emergence time was significantly lower in Group N. Time to first analgesic request was significantly longer in Group D. *Conclusion:* Dexmedetomidine is comparable to Nitroglycerine for inducing controlled hypotension in FESS and provides good operative field visibility. Dexmedetomidine has the added advantage of reducing perioperative analgesic requirements.

Keywords: FESS; NTG; Dexmedetomidine; Controlled Hypotension; ACS Score.

Introduction

Functional endoscopic sinus surgery (FESS) is a minimally invasive surgical technique utilized to treat medically refractory chronic rhino sinusitis with or without polyps or recurrent acute rhino sinusitis [1]. Good visibility during FESS is necessary because of tiny nasal anatomical structures, which are full of vessels and limit the nasal endoscopic access. Major complications like Cerebrospinal fluid (CSF) leak, injury to orbit and its adnexa, ethmoidal artery transection etc have been reported for FESS under general anaesthesia resulting from impaired visibility due to excessive bleeding [2]. An important technique to reduce bleeding during the surgery is hypotensive anaesthesia which is a state of inducing controlled hypotension to reduce bleeding and improve the surgical site visibility, adjusted to the patient's age, preoperative blood pressure and past medical history [3]. In hypotensive anaesthesia, patient's mean arterial blood pressure (MAP) is reduced by 30% of baseline or kept at 60-70 mm Hg [3,4]. Various agents e.g., ganglion blocking drugs (hexamethonium [5], trimethaphan [6] and pentolinium [7]), vasodilators (sodium nitroprusside [8], nitroglycerine [9] (NTG)), high doses of potent inhaled anaesthetics [10], beta adrenergic antagonist [11], calcium channel blockers [12] and magnesium sulphate [13] have been used

Corresponding Author: Pradeep Karunagaran, Assistant Professor, Anaesthesiology Saveetha Medical College Hospital Thandalam Kanchipuram District, Tamil Nadu 602105, India.
E-mail: drkpradeep@gmail.com

Received on 31.10.2017, **Accepted on** 23.11.2017

to achieve controlled hypotension. Of these agents, inhaled anaesthetics, short acting beta blockers and NTG are in common clinical practice at present. NTG has been used since many years to induce hypotension in developing countries in view of its easy titratability, limited interaction with anaesthesia drugs and low cost [14].

Dexmedetomidine is a potent and highly selective α_2 adrenergic receptor agonist. It has sedative, amnesic, analgesic, anaesthetic sparing effect and sympatholytic properties [15]. The central and peripheral sympatholytic action of dexmedetomidine is mediated by α_2 adrenergic receptors and is manifested by dose-dependent decrease in arterial blood pressure, heart rate (HR), cardiac output and nor epinephrine release [16,17].

We felt that dexmedetomidine would be a good addition to the list of drugs used for hypotensive anaesthesia because of its favourable pharmacological actions (reduction in BP and HR). Hence we conducted a prospective randomized study in which we compared the efficacy of dexmedetomidine to produce induced hypotension in FESS with that of NTG. The secondary goal was to compare the two agents with regard to visibility of surgical field, recovery profile and need for perioperative analgesia.

Materials and Methods

After obtaining Institutional Review Board approval and patients' written informed consent, this prospective, randomized study was conducted in Saveetha Medical College Hospital, on 60 healthy patients who underwent elective FESS under general anaesthesia. Patients of ASA physical status I & II of either sex, aged 18- 60 years were included in this study. Patients with major hepatic, renal or cardiovascular dysfunction, bleeding disorders, pregnancy and patients on anticoagulant medication were excluded from the study. Patients were allocated randomly to one of the two groups (Group N or D, n= 30 in each group) by a computer generated random number. Patients received NTG in Group N for controlled hypotension while in Group D, Dexmedetomidine was used for the same.

All patients were kept nil oral the night before surgery and received oral Diazepam 5 mg at night before surgery and 3 hours before surgery. In the operating room, patient was connected to electrocardiogram (ECG), non-invasive blood pressure (NIBP), end tidal carbondioxide ($ETCO_2$) and pulse oximetry (SpO_2) monitors. An 18G cannula was inserted with 3 way adaptor for infusion of intravenous fluids and dexmedetomidine / NTG. After preoxygenation for 3 minutes, anaesthesia was induced with fentanyl 2mcg/kg, propofol 2mg/kg and vecuronium 0.1mg/kg. Endotracheal (ET) intubation was done with a suitable cuffed ET tube. Oropharyngeal pack was kept. Patient was positioned in 15 degree reverse Trendelenberg position, mechanically ventilated and anaesthesia was maintained with isoflurane 1% along with 66% Nitrous oxide (N_2O) and 33% Oxygen (O_2). Muscle relaxation was maintained with vecuronium top ups.

In group D, all patients received a loading dose of dexmedetomidine 1mcg/kg (over10 minutes) before induction of anaesthesia followed by a maintenance infusion at the rate of 0.2-0.7 mcg/kg/hr which was started after the placement of oropharyngeal pack. In group N, NTG infusion was started after the placement of oropharyngeal pack and maintained at the rate of 0.5-5 mcg/kg/min and continued till the end of the procedure. In both the groups, infusions were titrated between ranges to attain target MAP of 65- 75mm Hg and signs of inadequate anaesthesia like increase in the MAP greater than the target MAP or somatic responses (movement, tearing or sweating) were treated with additional dose of fentanyl.

The systolic blood pressure (SBP), diastolic blood pressure (DBP), MAP, heart rate (HR), SpO_2 and $ETCO_2$ of all patients were recorded at baseline prior to drug infusion and during the hypotensive period every 5 minutes. The operation site was evaluated by the surgeon throughout the procedure. Intraoperative blood loss was estimated by assessment of suction bottle & swab counting. Quality of surgical field was assessed by the surgeon using Average Category Scale (ACS) based on previous studies by Fromme et al [18] and Boezaart et al [19].

Infusions and isoflurane were stopped at the end of surgery (nasal packing). Residual neuromuscular block was antagonized with neostigmine 50µg/kg & glycopyrrolate 10µg/kg. Awakening time following reversal was noted and patient was extubated awake with intact airway reflexes after thorough oropharyngeal suctioning. The time of requirement of first dose of post operative analgesia was also recorded.

Statistical Analysis

Sample size was estimated to be 20 in each group for a power of 80% at 5%significant level based on previous studies. This was increased to 30 in each

group to account for possible dropouts. Statistical analysis was done using SPSS 20 software. The parametric data (age, haemodynamic parameters [HR, SBP, DBP and MAP], duration of surgery, intraoperative blood loss, Average Category Scale for surgical field, first dose of post-operative analgesia requirement and emergence time) were expressed as mean and standard deviation and analysed using Independent unpaired t-test. Sex of the patients and intraoperative rescue fentanyl usage were expressed as percentage and analyzed using Chi-square test. P value of <0.05 was considered statistically significant.

Results

Patients in both the groups were comparable in terms of age, sex, height and weight (Table 1). There were no statistically significant differences between the two groups with regard to systolic, diastolic or mean blood pressures recorded and the duration of surgery. The heart rates recorded at various time intervals (15, 20, 30, 35, 40, 45, 50, 55, 60, 70, 80, 85, 90, 95 and 100 minutes after induction) were significantly lower in Group D compared to Group N. The amount of blood loss intraoperatively in group D was significantly lower compared to group N (31.67±6.47 ml versus 37.83±10.39ml). The Average Category Scale (ACS) for quality of surgical field was comparable in both the groups (2.07±0.25 in Group D versus 2.23±0.51 in Group N). Mean intraoperative rescue fentanyl usage was significantly lower in group D than group N (3.3% versus 20.0%). Time recorded to first analgesic request was significantly longer in group D than group N (62.17±22.46 min versus 32±10.22 min). Emergence time was significantly longer in group D than group N (19.03±6.57 min versus 10.93±4.89 min) (Tables 2 & 3, Figures 1& 2).

Discussion

In our prospective randomized study of comparing dexmedetomidine and NTG, we found that both drugs were effective in achieving a MAP of 65 to 75 mmHg and provided a dry surgical field as suggested by the ACS scores during FESS. In this study, we had chosen a target MAP of 65-75 mmHg to provide the best surgical conditions without the risk of tissue hypoperfusion based on a review of

Table 1: Demographic Data

	Group N (30)	Group D (30)	P value
Age (years) *	33.97±10.19	31.60±10.65	0.383
Sex male/female count	14/16	16/14	0.606
Height (cm) *	163.83±4.17	162.57±5.19	0.302
Weight (Kg) *	67.83±7.7	64.33±9.07	0.113

* Mean ± Standard deviation

Table 2: Intraoperative and Postoperative Parameters

	Group N (30)	Group D (30)	P value
Duration of Surgery (minutes) *	85±16.81	87.5±21.68	0.620
Intraoperative Blood loss (ml) *	37.83±10.39	31.67±6.47	0.008
Average Category Scale *	2.23±0.51	2.07±0.25	0.111
Rescue Fentanyl usage (number of patients & percentage)	6(20%)	1(3.3%)	0.044
Time to first analgesic request (minutes) *	32±10.22	62.17±22.46	0.000
Emergence Time (minutes) *	10.93±4.89	19.03±6.57	0.000

* Mean ± Standard deviation

Table 3: Average Category Scale

Grading	Explanation	Number of patients Group N	Number of patients Group D
0	No bleeding (cadaveric conditions)	0	0
1	Slight bleeding, no suctioning required	1	0
2	Slight bleeding, occasional suctioning required	21	28
3	Slight bleeding, frequent suctioning required; bleeding threatens surgical field a few seconds after suction is removed	8	2
4	Moderate bleeding, frequent suctioning required and bleeding threatens surgical field directly after suction is removed	0	0
5	Severe bleeding, constant suctioning required; bleeding appears faster than can be removed by suction; surgical field severely threatened and surgery usually not possible	0	0

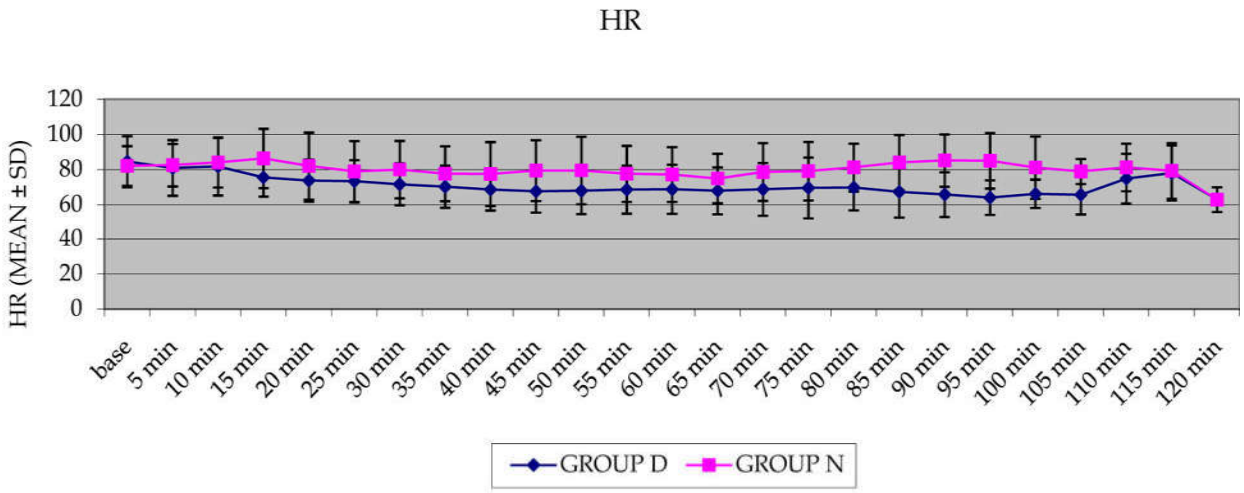

Fig. 1: Heart rate

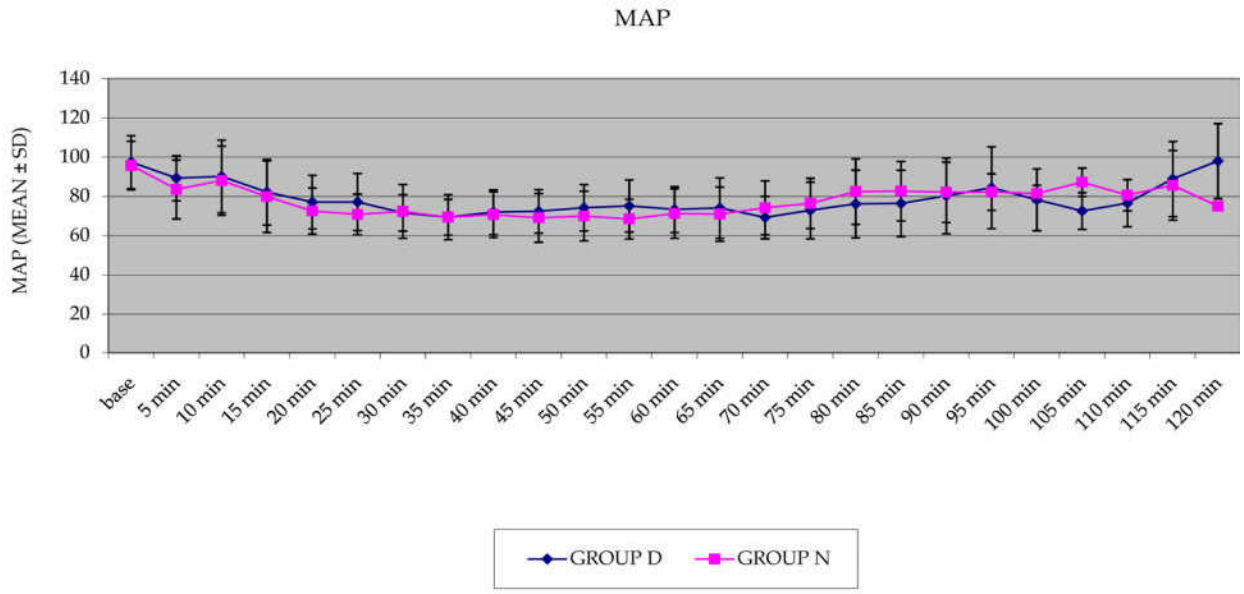

Fig. 2: Mean Arterial Pressure

literature published by Barak et al [20], in which the authors have recommended a MAP of 50 to 65 mmHg during major maxillofacial surgeries. Boezaart et al [19] demonstrated hypotensive anaesthesia induced by sodium nitroprusside or NTG in mandibular osteotomy to achieve MAP of 60-70 mm Hg and found to be absolutely safe and associated with no significant increase in pyruvate, lactate or glucose levels.

In our study, patients who were treated with dexmedetomidine (Group D), had hypotension comparable to Group N. However Group D patients had significant decrease in heart rates at various time intervals compared to Group N. This could be attributed to the known sympatholytic effect of α_2 agonists. Basar et al [21] investigated the effect of single dose of dexmedetomidine 0.5 mcg/kg administration 10 minutes before induction of anaesthesia and reported significant reduction in MAP and HR.

In a study conducted by Durmus et al [22], patients who received dexmedetomidine infusion for controlled hypotension during tympanoplasty and septorhinoplasty, had significant reduction in MAP and HR compared to placebo group.

The amount of blood loss intraoperatively in group D was significantly less compared to group N (31.67 ml versus 37.83 ml) in our study. Though there was a statistcally significant difference, the values clearly show that the difference was not clinically significant.

The ACS score for quality of surgical field was comparable in both the groups (2.07 in Group D versus 2.23 in Group N). The efficacy of dexmedetomidine in providing good surgical conditions and reduced blood loss during controlled hypotension has been previously reported by Durmus et al [22] during tympanoplasty and septorhinoplasty. Guven et al [23] reported better haemodynamic stability, visual analogue scale for pain and clear surgical field with lesser side effects in dexmedetomidine group than placebo group when FESS was done under either conscious sedation or local anaesthesia.

In our study, NTG administration provided a stable course of controlled hypotension and a good surgical field as evidenced by favourable ACS scores. Cincikas and Ivaskevicius [24] used NTG infusion (0.79±0.34 μg/kg/min) to maintain MAP of 50-60 mmHg during endoscopic nasal surgery and observed reduced surgical bleeding and improved surgical view quality.

Intra-operative rescue fentanyl usage was significantly less in dexmedetomidine group compared with N group. It has been previously reported by Scheinin et al [25] that premedication with dexmedetomidine reduces the intraoperative requirement of fentanyl.

Our study also demonstrated prolonged postoperative analgesia in dexmedetomidine group. This is in accordance with a study conducted by Gurbet et al [26] who reported that intraoperative infusion of dexmedetomidine reduces peri-operative analgesic requirements.

Dexmedetomidine has sedative and analgesic sparing effects via central actions in the locus ceruleus and in the dorsal horn of the spinal cord [27]. Dexmedetomidine group in our study was associated with significantly longer emergence time compared to NTG group. Delayed emergence associated with Dexmedetomidine has been previouslyreported by Kol et al [28] in tympanoplasty and by Bajwa et al [29] in FESS.

Conclusion

With the strength of literature evidence available and based on our study, we feel that dexmedetomidine is an effective alternative to NTG for inducing hypotension in FESS and thereby improving surgical visibility and surgeon satisfaction. Dexmedetomidine has the added advantage of reducing perioperative analgesic requirements.

Conflict of Interest: None to declare.

Key Messages

Dexmedetomidine improves surgical field visibility during FESS comparable to NTG and reduces perioperative analgesic requirements.

References

1. Dalziel K, Stein K, Round A, Garside R, Royle P. Endoscopic sinus surgery for the excision of nasal polyps: A systematic review of safety and effectiveness. Am J Rhinol 2006;20(5):506-19.
2. Stankiewicz JA. Blindness and intranasal endoscopic ethmoidectomy: Prevention and management. Otolaryngol Head Neck Surg 1989;101:320-3.
3. Rodrigo C: Induced hypotension during anaesthesia with special reference to orthognathic surgery. Anaesth Prog 1995; 42(2): 41-58.
4. Guney A, Kaya FN, Yavascaoglu B, Gurbet A, Selmi NH, Kaya S, et al. Comparison of esmolol to nitroglycerine in controlling hypotension during nasal surgery. Eurasian J Med 2012;44(2):99-105.
5. Shackleton RPW. The reduction of surgical haemorrhage. Some observations on controlled hypotension with methonium compounds. Br Med J 1951;1:1054-6.
6. Magill IW, Scurr CF, Wyman JB. Controlled hypotension by a thiophanium derivative. Lancet 1953;1:219-20.
7. Enderby GEH. Pentolinium tartrate in controlled hypotension. Lancet 1954;2:1097-8.
8. Moraca P, Bitte EM, Hale DE, Wasmuth CE, Poutasse EF. Clinical evaluation of sodium nitroprusside as a hypotensive agent. Anesthesiology 1962;23:193-9.
9. Fahmy NR. Nitroglycerine as a hypotensive drug during general anaesthesia. Anesthesiology 1978;49: 17-20.
10. Murtagh GP. Controlled hypotension with halothane. Anaesthesia 1960;15:235-44.
11. Blau WS, Kafer ER, Anderson JA. Esmolol is more effective than sodium nitroprusside in reducing blood loss during orthognathic surgery. Anesth Analg 1992; 75:172-8.
12. Reves JG, Kissin I, Lell WA, Tosone S. Calcium entry blockers: Uses and Implications for Anesthesiologists. Anesthesiology 1982;57:504-18.
13. Elsharnouby NM, Elsharnouby MM. Magnesium sulphate as a technique of hypotensive anaesthesia. Br J Anaesth 2006;96(6):727-31.
14. Yaster M, Simmons RS, Tolo VT, Pepple JM, Wetzel RC, Rogers MC. A comparison of nitroglycerine and

nitroprusside for inducing hypotension in children: a double-blinded study. Anesthesiology 1986;65(2): 175-9.

15. Bloor BC, Ward DS, Belleville JP, Maze M. Effect of intravenous dexmedetomidine in humans. II. Hemodynamic changes. Anesthesiology 1992;77: 1134-42.
16. Schmelling WT, Kampine JP, Roerig DL, Warltier DC. The effect of the stereoisomers of the α_2 adrenergic agonist dexmedetomidine on systemic and coronary haemodynamics in conscious dogs. Anesthesiology 1991;75:499-511.
17. Richa F, Yazigi A, Sleilaty G, Yazbeck P. Comparison between dexmedetomidine and remifentanil for controlled hypotension during tympanoplasty. Eur J Anaesthesiol 2008;25:369-74.
18. Fromme GA, MacKenzie RA, Gould AB, Lund BA, Offord KP. Controlled hypotension for orthognatic surgery. Anesth Analg 1986; 65: 683–6.
19. Boezaart AP, Merwe J, Coetzee A. Comparison of sodium nitroprusside and esmolol induced controlled hypotension for functional endoscopic sinus surgery. Can J Anesth 1995;42:373-6.
20. Barak M, Yoav L, el-Naaj AI. Hypotensive anesthesia versus normotensive anesthesia during major maxillofacial surgery: A review of the literature. Scientific World Journal 2015;2015:480728.
21. Basar H, Akpinar S, Doganci N, Buyukkocak U, Kaymak C, Sert O,. The effect of preanaesthetic single dose dexmedetomidine on induction, haemodynamic and cardiovascular parameters. J Clin Anesth 2008; 20:431-6.
22. Durmus M, But AK, Dogan Z Yucel A, Miman MC, Ersoy MO. Effect of dexmedetomidine on bleeding during tympanoplasty or septorhinoplasty. Eur J Anaesthesiol 2007;24:447-53.
23. Guven DG, Demiraran Y, Sezen G, Kepek O, Iskender A. Evaluation of outcomes in patients given dexmedetomidine in functional endoscopic sinus surgery. Ann Otol Rhinol Laryngol 2011;120:586-92.
24. Cincikas D, Ivaskevicius J. Application of controlled arterial hypotension in endoscopic rhino surgery. Medicina (Kaunas) 2003;39:852–9.
25. Scheinin H, Jaakola ML, Sjovall S, Melkkila TA, Kaukinen S, Turunen J et al. Intramuscular dexmedetomidine as premedication for general anesthesia: a comparative multicenter study. Anesthesiology 1993;78:1065–75.
26. Gurbet A, Basagan-Mogol E, Turker G, Ugun F, Kaya FN, Ozcan B. Intraoperative infusion of dexmedetomidine reduces perioperative analgesic requirements. Can J Anaesth 2006;53:646-52.
27. Guo TZ, Jiang JY, Buttermann AE, Maze M. Dexmedetomidine injection into the locus ceruleus produces antinociception. Anaesthesiology 1996;84: 873-81.
28. Kol IO, Kaygusuz K, Yildirim A, Dogan M, Gursoy S, Yucel E, et al. Controlled hypotension with desflurane combined with esmolol or dexmedetomidine during tympanoplasty in adults: A double-blind, randomized, controlled trial. Curr Ther Res Clin Exp 2009;70:197-208.
29. Bajwa SJS, Kaur J, Kulshrestha A, Haldar R, Sethi R, Singh A: Nitroglycerine, Esmolol and Dexmedetomidine for induced hypotension during functional endoscopic sinus surgery: a comparative evaluation ; J Anaesthesiol Clin Pharmacol 2016;32(2):192-7.