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Research Article

Comparison of Clonidine versus Esmolol in Controlled Hypotension in Patients Undergoing FESS Surgery

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ABSTRACT

Background: FESS has its share of complications which can be a challenge for both the surgeon as well the anesthetist and achieving a bloodless surgical field is essential So the principle of controlled hypotension can be used to combat this issue.
Methods: A hospital-based randomized comparative interventional study was conducted on 60 patients to compare Clonidine (2mcg/kg in 10 ml of saline over 10 minutes before induction followed by an infusion of 1mcg/kg/hr during maintenance) and Esmolol (1mg/kg in 10 ml of saline over 10 minutes before induction followed by an infusion of 1mg/kg/hr during maintenance) to assess and compare the hypotensive properties of both the drugs.
Results: After the induction of anesthesia, there was a significant difference in the mean heart rate, and mean arterial pressure between the two groups throughout the intraoperative period (p-value < 0.05). Both groups achieved a target mean arterial pressure (MAP) of 65-70 mmHg and improved surgical field quality.
Conclusion: This study concluded that clonidine and esmolol both provide hemodynamic stability and a better surgical field in functional endoscopic sinus surgery (FESS). Clonidine also helps in achieving postoperative sedation and analgesia.

Introduction

Functional Endoscopic Sinus Surgery (FESS) has become a popular treatment modality nowadays that has revolutionized the management of various head and neck pathologies, but it has its share of complications. One such challenge for the anesthetist is to minimize blood loss so that a clear operating field is provided for the surgeon. [1]

Controlled hypotension is characterized by a lowering of systolic blood pressure to a range of 80 to 90 mm Hg, a reduction in mean arterial pressure (MAP) to the range of 50 to 65 mm Hg, or a decrease of 30% from the baseline MAP. [2]. Hypotensive agents like nitrates, beta-antagonists, calcium channel blockers, alpha-2-agonists, etc. can be used [3-4]. In this study, we will compare the effectiveness and safety of clonidine versus that of esmolol as a hypotensive agent in functional endoscopic sinus surgery. Clonidine is an alpha-2-agonist that has analgesic, sedative, and hypotensive properties due to its central sympatholytic effects. Esmolol is a cardio-selective -1 receptor blocker that has a fast onset, a brief duration of action, and no detectable intrinsic sympathomimetic or membrane-stabilizing effect at therapeutic dosages. We aim to assess and compare the hemodynamic parameters in both groups such as heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial blood pressure.

Methods

After receiving approval from the Institutional Ethics Committee and registering with the Clinical Trials

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Registry-India (CTRI/2022/03/041451), this hospital-based prospective randomised interventional study was carried out from April 2022 to August 2022 in the ENT theatre at a tertiary care hospital. The entire study was carried out following the Declaration of Helsinki, [5] which ensured the patients' safety and well-being. In this study, Sixty-eight patients who were scheduled to undergo FESS under GA for a duration of 60-70min belonging to the American Society of Anesthesiologists (ASA) Physical Status grades I and II of either sex, weighing 45-65kg, and age group between 20–60 years, were included. The study excluded patients with any history of hypertension, coronary artery disease, bleeding, coagulation abnormality, recurrent sinus surgery, orbital abscess, and allergy to the drugs. In this study, 60 patients were randomized into 2 groups by using the opaque sealed envelope method. One of my colleagues picked up an envelope. Patients were allocated to 2 groups mentioned on the envelope. The study drug was prepared by one researcher and was administered by another researcher. Observations were noted by another researcher not involved in the preparation and administration of the study drugs so that observation bias could be eliminated.

After a thorough pre-anesthetic checkup, consent, and counseling, patients were posted for surgeries. All routine monitors were attached and baseline heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure, and blood oxygen saturation were obtained. After transferring the patient to OT, an 18-G intravenous catheter was placed and injection ringer lactate infusion was started @10ml/kg. All patients received intravenous premedication with ondansetron 0.15mg/kg, midazolam 0.02 mg/kg, glycopyrrolate 4 g/kg, and fentanyl 2 g/kg. Pre-oxygenation with 100% oxygen and induced using Inj Thiopentone sodium 5 mg/kg and succinylcholine 1.5 mg/kg and then tracheal intubation was performed. Anaesthesia was maintained using 40% O2+60% N2O and atracurium 0.1 mg/kg and Isoflurane 0.4 MAC. The study drug's loading dose was given 10 minutes before induction of general anaesthesia (GA), and its maintenance dose infusion was started shortly after. It was continued intraoperatively until 5 minutes before the surgery was finished or stopped on the occurrence of hypotension below our target, whichever came first. Vital signs (HR, SBP, DBP, MAP, SPO2), the need for suctioning, and checking the surgical site for bleeding were monitored at baseline, after the loading dose, after induction, 1 min after intubation, 5 min after intubation and thereafter every 10 min until shifting of the patient to the recovery area. The quality of surgical site bleeding was assessed using an average categorical scale proposed by Fromme and Boezaart [6].

Score 0-no bleeding

Score 1- Slight bleeding, no suctioning of blood required

Score 2- Slight bleeding, occasional suctioning required, surgical field not threatened

Score 3- Slight bleeding, frequent suctioning required, bleeding threatens the surgical field a few seconds after suction is removed

Score 4- Moderate bleeding, frequent suctioning required, bleeding threatens the surgical field directly after suction is removed

Score 5- Severe bleeding, constant suctioning required, bleeding appears faster than can be removed by suction, surgical field severely threatened, and surgery suspended.

The study was conducted in the following two groups of patients.

Group A (Clonidine) received Inj. clonidine bolus 2mcg/kg in 10 ml of 0.9% normal saline, over 10 minutes before induction followed by an infusion of 1mcg/kg/hr through an infusion pump.

Group B (Esmolol) received Inj Esmolol bolus 1mg/kg, over 1 minute before induction followed by an infusion of 1mg/kg/hr through an infusion pump.

Hypotension was corrected by using fluids initially, if no improvement was seen, then the rate of infusion of study drug was decreased or even stopped, followed by inj mephentramine 6 mg slow iv bolus if needed. Bradycardia was defined as a heart rate below 60 beats per minute, which was seen in 3 patients and was resolved by stopping the infusion. If not resolved, Inj. Atropine 0.6 mg IV every 3-5 minutes to a maximum of 3 mg for bradycardia [7].

Inj. Neostigmine 0.05 mg/kg i.v. and Inj. Glycopyrrolate 0.01 mg/kg was used to reverse the patient followed by extubation when the patient was fully awake. Emergence Time was defined as the interval between the cessation of anesthetics to the gradual return of consciousness. The post-operative Ramsay Sedation Score, emergence time, and VAS score after surgery were assessed every 30 min. On achieving a VAS score of 3 rescue analgesia was given and time of administration was noted. This was the end point of our study. Intravenous diclofenac 75 mg was given as a rescue analgesic. Incidence of adverse effects like nausea, vomiting, hypotension, bradycardia, headache, and redness of face and neck were recorded.

The sample size was calculated at 95% confidence and 80% power expecting a minimum detectable difference of 8.0+10 mmHg in mean blood pressure in both the groups from baseline, 1 minute after intubation. Statistical analysis was performed with the SPSS, version 22 for Windows statistical software package (SPSS Inc., Chicago, IL, USA). The Categorical data was presented as numbers (percent) and were compared among groups using the Chi-square test. The quantitative data was shown as mean and standard deviation and were compared by students t-test. Probability was considered to be significant if less than 0.05.

Results

All the demographics were comparable in both groups as seen in (Table 1). Baseline HR and MAP were comparable in both groups. After giving a loading dose

of the drugs, both HR and MAP significantly decreased at all observation times and were statistically lower in group A (p-value <0.05) as seen in (Tables 2-3). The scores of the average category scale (ACS) for quality of the surgical field bleeding varied between 2-3 at most times during the intraoperative period in both groups (Figure 1). There was no significant difference between both group scores. Mean emergence time was significantly higher in Group A as compared to Group B (p<0.001) as seen in (Figure 2). The time to first analgesic request was significantly longer in group A (Figure 3). In our study, the postoperative sedation score (Figure 4) was assessed using the Ramsay sedation score and was significantly higher in group A. The mean VAS score in group A was statistically lower at different time intervals in comparison to group B. However, the difference in VAS scores showed a statistically significant difference between the two groups (p<0.05) after 90 minutes postoperatively (Figure 5). There was no statistically significant difference in the occurrence of postoperative nausea, vomiting, shivering, dryness of mouth, hypotension, and bradycardia between the groups (Figure 6). The most frequently reported side effect of clonidine was hypotension (3/30). The occurrence of bradycardia, although statistically insignificant, was more in the clonidine group (3/30) as compared to the esmolol group (1/30).

Table 1- Demographic variables

Demographic	Group A	Group B	P value
	Mean ± SD	Mean ± SD	
Age	37.93±12.32	35.76±9.95	0.456**
Weight	55.37±6.32	55.57±6.71	0.905**
Duration of surgery	67.07±2.56	67.90±1.86	0.154**
ASA (I:II)	18:12	21:9	
Gender (M:F)	18:12	22:8	

ASA (American society of anaesthesiologist), M-male, F- female, **- non significant, * significant

Table 2- Mean Heart Rate (MHR)

	Group A (Mean ± SD)	Group B (Mean ±SD)	Result (P value)
Baseline	85.4± 12.98	89.00± 11.87	0.266**
After loading of study drug	77.57± 8.11	82.70± 8.61	0.020*
After induction	75.03± 6.84	80.93± 8.41	0.004*
1 min after intubation	76.70± 6.69	81.80± 8.45	0.012*
5 min after intubation	73.72± 5.80	79.70± 7.71	0.001*
10 min	71.63± 5.19	77.33± 7.81	0.001*
20 min	71.17± 4.90	75.40± 7.92	0.015*
30 min	69.20± 3.49	74.23± 7.44	0.001*
40 min	68.93± 3.18	73.23± 7.61	0.005*
50 min	68.50± 2.83	72.27± 7.16	0.009*
60 min	69.17± 3.62	72.60± 7.38	0.025*
70 min	70.93± 2.88	75.18± 6.62	0.003*

*Significant; ** Non-Significant

Table 3- Mean arterial pressure (MAP)

	Group A (Mean±SD)	Group B (Mean±SD)	Result (P value)
Baseline	121.50± 11.68	126.97± 8.24	0.040**
After loading of study drug	110.43± 10.02	117.27± 7.21	0.003*
After induction	106.00± 7.25	111.40± 7.84	0.007*
1 min after intubation	103.67± 6.18	110.53± 7.52	0.0002*
5 min after intubation	100.47± 5.18	107.33± 7.98	0.0002*
10 min	97.90± 3.93	104.63± 6.95	p<0.001*
20 min	95.73± 5.18	103.27± 6.46	p<0.001*
30 min	93.80± 4.80	101.07± 6.53	p<0.001*
40 min	92.07± 4.68	98.83± 6.75	p<0.001*
50 min	90.80± 4.75	97.10± 5.75	p<0.001*
60 min	91.37± 4.43	95.03± 5.23	0.004*
70 min	92.89± 3.29	97.75± 4.90	p<0.001*

*Significant; **Non Significant

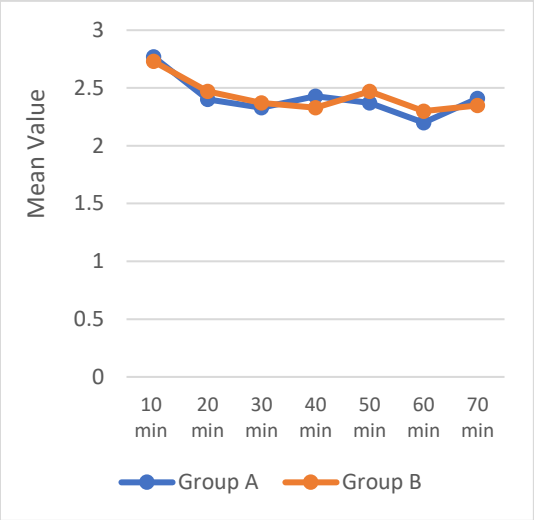

Figure 1- Average category scale (ACS)

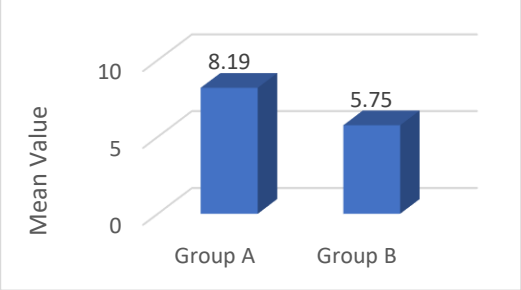

Figure 2- Emergence time

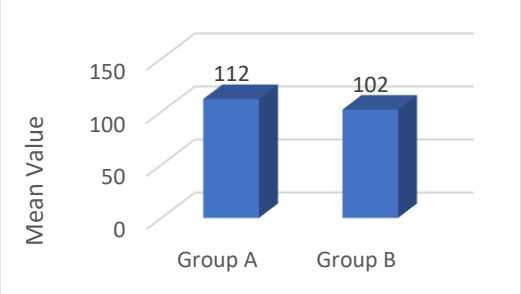

Figure 3- Time to demand for first rescue analgesic

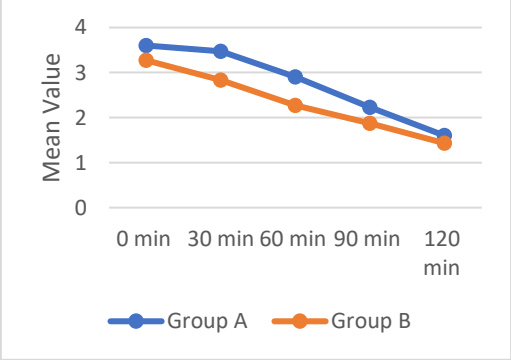

Figure 4- Mean sedation score

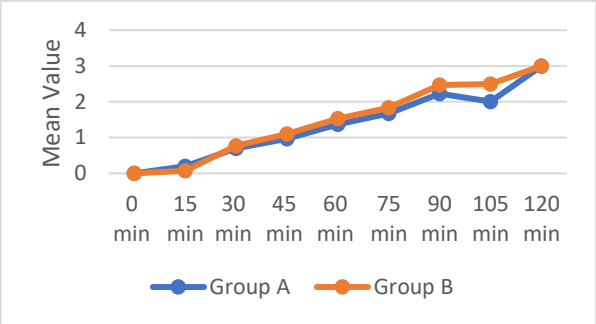

Figure 5- Postoperative VAS score

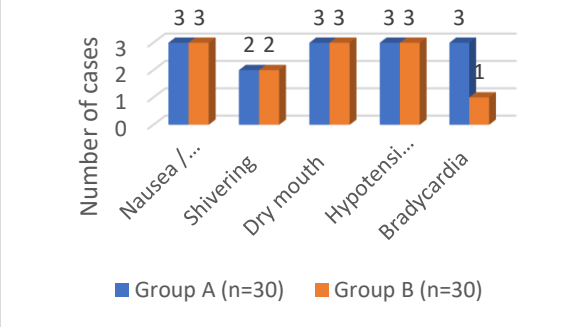

Figure 6- Prevalence of post operative complications

Discussion

Controlled hypotension has improved surgical dissection during functional endoscopic sinus surgery (FESS) and has drastically reduced intraoperative blood loss. Because more tissue damage is likely to happen in restricted view due to bleeding, which might lead to the formation of post-operative adhesions and the outcome of surgery [8]. There have been numerous studies done in the past comparing the effects of different hypotensive drugs on the operative field during endoscopic sinus surgery. However, there hasn't been a direct comparison made between the effects of clonidine and esmolol as hypotensive agents in FESS. The hemodynamic parameters, mean average category scale, mean emergence time, mean sedation score, time to first rescue analgesic, and post-operative complications were compared between these two medications in our study.

Demographics were comparable between the two groups. We observed that while both drugs were effective for achieving hypotension, compared to Esmolol, clonidine produced more stable hemodynamics with lower MAP and HR values, longer post-operative analgesia, and emergence times. The fall in blood pressure in the Clonidine group was due to its central sympatholytic effect and Esmolol, have negative chronotropic and inotropic effect leading to decreased cardiac output and lower arterial blood pressure. Our results are similar to Ibrahim et al [9] who studied the effect of clonidine and esmolol in 60 patients undergoing for laparoscopic cholecystectomy and concluded that

clonidine control hemodynamic changes more effectively than esmolol. They also concluded that clonidine provides more postoperative sedation than esmolol as seen in our study. Clonidine's act on presynaptic α-2 adrenoreceptor on the locus coeruleus (LC) is responsible for its sedative effect.

Similarly, Bafna et al [4] studied the effect of dexmedetomidine and clonidine on controlled hypotension in FESS. They also found out both the drugs help in achieving stable hemodynamics, post operative analgesia and also the role of clonidine in conscious sedation. α-2 receptors present in the LC, plays a large role in autonomic function and states of arousal. Pathak et al [10] studied the effect of pre operative infusion of clonidine in laparoscopic cholecystectomy and they found out that patient who received clonidine were more sedated as per Ramsay sedation score at the end of surgery and rescue analgesic dose requirement was also delayed owing to the same reason. This effect of clonidine is seen due to its effect on dorsal horn of spinal cord and ventrolateral preoptic nucleus.

Blood loss and bleeding score using Fromme–Boezaart scale was 2 or 3 in both groups. Similarly, Kumar et al [11] did a comparison of Dexmedetomidine with Clonidine based anaesthesia for controlled hypotension in functional endoscopic sinus surgery. In their study, surgical site scoring was found to be 1 or 2 in both groups.

This is in contrast to the findings of Hamed et al [12] in 2019 compared the effect of esmolol on intraoperative bleeding on patients undergoing open myomectomy. They found out that esmolol does not significantly decrease mean HR, MAP but the mean blood loss was non significantly lower in their esmolol group which doesn't coincide with our findings possibly because they have used lesser dose of esmolol (0.5mg/kg) as compared to ours (1mg/kg).

The most frequent reported side-effect was hypotension and bradycardia, although statistically insignificant, was more in clonidine group (3/30) as compared to esmolol group (1/30) and was resolved by stopping the infusion. None of the patients needed Inj. mephentramine and Inj. atropine respectively. Patil et al [13] also observed similar side effects in their study which were statistically insignificant.

There were some inevitable limitations in our study. We included participants of both genders in an equal quantity, and male participants predominated. It appears that the results cannot be applied to both genders as a whole. We did not use invasive BP monitoring in our study to measure the hemodynamic as it is not routinely used in FESS and it would be unethical to use that just for the study purpose. Also blinding was not achieved in our study but as most of the parameters were objective and observation was made by person not directly involved in the study so it does not affect the result.

Conclusion

As compared to esmolol, clonidine offers better hemodynamic stability, operational field visibility, and the added benefits of lowering bleeding and the need for analgesics during the postoperative period. With clonidine, postoperative sedation was also observed. Use of clonidine is simple, safe and cheap which is more economically better in developing and developed countries. Further research is always needed to determine the effects of clonidine and esmolol on postoperative sedation and controlled hypotension in patients receiving general anaesthesia.

References

[1] Chhabra A, Saini P, Sharma K, Chaudhary N, Singh A, Gupta S. Controlled hypotension for FESS: A randomised double-blinded comparison of magnesium sulphate and dexmedetomidine. Indian J Anaesth. 2020; 64(1):24–30.

[2] Degoute CS. Controlled hypotension: a guide to drug choice. Drugs. 2007; 67(7):1053–76.

[3] Barak M, Yoav L, Abu el-Naaj I. Hypotensive Anesthesia versus Normotensive Anesthesia during Major Maxillofacial Surgery: A Review of the Literature. Sci World J. 2015; 2015:e480728.

[4] Bafna U, Sharma P, Singhal RK, Gurjar SS, Bhargava SK. Comparison of hypotensive properties of dexmedetomidine versus clonidine for induced hypotension during functional endoscopic sinus surgery: A randomised, double-blind interventional study. Indian J Anaesth. 2021; 65(8):579–85.

[5] WMA - The World Medical Association-WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects [Internet]. [cited 2022 Jun 1]. Available from: https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/

[6] Boezaart AP, van der Merwe J, Coetzee A. Comparison of sodium nitroprusside- and esmolol-induced controlled hypotension for functional endoscopic sinus surgery. Can J Anaesth J Can Anesth. 1995;42(5 Pt 1):373–6.

[7] Part 7.3: Management of Symptomatic Bradycardia and Tachycardia. Circulation. 2005; 112(24_supplement):IV–67.

[8] Puthenveettil N, Rajan S, Kumar L, Nair SG. 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(3):371–5.

[9] Ibrahim AN, Kamal MM, Lotfy A. Comparative study of clonidine versus esmolol on hemodynamic responses during laparoscopic cholecystectomy.

Egypt J Anaesth. 2016; 32(1):37–44.
[10] Pathak AS, Somalaraju J, Sanyal R. The effect of pre-operative intravenous clonidine infusion on patient hemodynamics in those undergoing laparoscopic cholecystectomy. Med J Dr Patil Univ. 2015; 8(1):31.
[11] Suggala KK, B. KR, M. H. N. Comparison of Dexmedetomidine, with Clonidine Based Anaesthesia for Controlled Hypotension in Functional Endoscopic Sinus Surgery. J Evid Based Med Healthc. 2020; 7(15):782–6.
[12] Hamed JME, Ataalla WM. Esmolol Infusion Reduces Blood Loss and Opiate Consumption during Fertility Preserving Myomectomy. Anesth Essays Res. 2019; 13(3):423–9.
[13] Patil V, Kulakarni V. Comparative Evaluation of Oral Clonidine and Oral Atenolol as Premedication in Functional Endoscopic Sinus Surgery (FESS) Under General Anaesthesia. J Med Sci Clin Res [Internet]. 2017 Nov 15 [cited 2022 Dec 10];5(11). Available from:http://jmscr.igmpublication.org/v5-i11/183%20jmscr.pdf