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Effectiveness of Dexmedetomidine to Reduce Bleeding During Tympanoplasty and Functional Endoscopic Sinus Surgery (FESS): An Interventional Study

Suma KV[1], K Udaya Bhaskar[2], RVR Santosh Naidu[3]

[1]Associate Professor, Department of Anesthesiology, JJM Medical College, Davanagere, Karnataka 577004, India. [2]Associate Professor [3]Post Graduate, Department of Anesthesiology, PES Institute of Medical Sciences and Research, Kuppam, Andhra Pradesh 517425, India.

Abstract

Context: Bleeding during the nasal and middle ear surgeries can impair the visibility of the surgical field. Controlled hypotension is a technique used to bring down the Mean Arterial Pressure (MAP) and reduce the bleeding in the surgical field. *Aims:* To evaluate the effectiveness of dexmedetomidine, a selective α2-adrenoceptor agonist, on reducing the intra-operative bleeding and duration of surgery. *Settings and Designs:* Randomized, double blind, control study. *Materials and Methods:* We included sixty patients who were posted for tympanoplasty and FESS under general anesthesia and divided randomly to Group D where dexmedetomidine 1 µg/kg loading dose plus a maintenance of 0.5 to 0.8 µg/kg/hr and Group P in whom normal saline 1 ml/kg loading dose and 1 ml/kg/hr maintenance was administered. Heart rate and MAP was measured at 15,30,45,60 minutes and at extubation. Bleeding severity score and the duration of surgery were noted. Student t-test and chi-square test were used for data analysis, p - value < 0.05 was considered statistically significant. *Results:* The fall in heart rate, MAP was more in the Group D than in Group P and was significantstatistically ($p < 0.05$). Bleeding severity score was lower in the Group D than in Group P. (none of the patients had a score of 3 in Group D and in Group P 10 patients had a score of 3). The mean duration of surgery was also less in the Group D (55.55 min ± 2.34) when compared to Group P (68.39 min ± 4.38) which was statistically significant ($p < 0.01$). *Conclusion:* Dexmedetomidine infusion started as loading dose along with intra-operative maintenance results in a decrease in the MAP, reduced bleeding and shorter surgical duration.

Keywords: Bleeding severity score; Controlled hypotension; Dexmeditomidine; Placebo.

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Introduction

A blood less field is needed while performing Tympanoplasty and Functional endoscopic sinus surgery [FESS] in order to provide a better vision to the surgeon.[1–3] It is a challenge to the anesthesiologist to provide the same. The method of reducing the blood pressure in order to reduce the bleeding in the intra-opreative period and in turn improve the operative field visibility is called controlled hypotension.[4] Volatile anesthetic agents, sodium nitroprusside, nitroglycerine, beta blockers and calcium channel blockers are some of the drugs used to produce controlled hypotension.[5–7] Problems that can be seen with these drugs can be a delay in recovery when volatile anesthetics are used, drug resistance with vasodilators, cyanide toxicity and tachyphylaxis with nitroprusside.[8–10]

Selective α2 receptor agonist Dexmedetomidine has anti-hypertensive effect. It also has other

Corresponding Author: K. Udaya Bhaskar, Associate Professor, Department of Anesthesiology, PES Institute of Medical Sciences and Research, Kuppam, Andhra Pradesh 517425, India.

E-mail: druday79@gmail.com

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properties like analgesia, sympatholysis and sedation without causing major respiratory depression. It has been used to suppress sympathetic response also. Opioid requirement is also decreased in addition to a reduction in stress responses to surgery and post-operative shivering.[11] Previous studies have concluded dexmeditomidine to be beneficial in tymoanoplasty and FESS. As dexmeditomidine was not used in our institution routinely we decided to conduct this study to know if it can effectively reduce bleeding in tymoanoplasty and FESS surgeries.

Materials and Methods

ASA class I and II patients sixty in number of both sex, in the age group of *18–40 years*, scheduled to undergo elective FESS and tympanoplasty under general anesthesia were selected for the study. Institutional ethical committee approval and written informed consent from the patients were obtained. Two groups, the dexmedetomidine group (D) and the placebo group (P) were done and patients were allotted randomly in to one of them. Patients with comorbid diseases coming under ASA II and ASA III physical status, pregnant females, patients with bleeding disorders, patients having Sinus Bradycardia, Heart Block, Conduction defects, Ischemic Heart Diseases (IHD)/Rheumatic Heart Disease, Chronic Renal Diseases with deranged renal parameters and hypotension pre-operatively were not included in the study. This study was done in the Operation theatre with facilities for Induced Hypotension and Resuscitation. Patients were examined in the pre-operative period and laboratory investigations, Electrocardiogram (ECG) and chest *X*-ray were ordered. Patients were kept nil by mouth for eight hours.

On shifting to Operation theatre, an 18G/20G I.V. canula secured and dextrose normal saline infusion was started. Monitors were connected to record non-invasive blood pressure, Pulse rate, ECG, O_2 saturation and end-tidal carbon dioxide.

Heart rate, Blood Pressure both Systolic and Diastolic and MAP before induction were recorded. Bolus dose of dexmedetomidine *1 µg/kg* over *10 mins* in an infusion of *100 ml* normal saline was started in Group (D), and normal saline *100 ml* infusion in Group (P) at a rate of *1 ml/kg/hr* via an extension of *25 cms* connected to the canula with the maintenance fluid. Injection glycopyrrolate *0.2 mg* was given before induction of anesthesia and injection fentanyl *1.5 µg/kg* given for analgesia. Pre-oxygenation with 100% oxygen was done for *3 minutes*, induction of anesthesia done using injection Propofol *2 mg/kg*, endotracheal intubation facilitated with injection succinylcholine *1.5 mg/kg*, and intubated with a appropriate sized tube. Maintenance of anesthesia was done with nitrous oxide and oxygen 65:35 ratio along with 0.4%–1% isoflurane and vecuronium *0.05 mg/kg* used for intra-operative muscle relaxation. During intra-operative period a maintenance dose of dexmedetomidine at *0.5–0.8 µg/kg/hr* was used in Group D and the infusion rate was reduced if the MAP went below *60 mm* of *Hg* or heart rate below 50 beats per minute and Normal saline infusion *1 ml/kg/hr* was continued in Group (P). The infusions were stopped *20 minutes* before the end of surgery. Heart rate and blood pressure was noted before any intervention, at *15,30,45,60 minutes* after drug administration, and at the time of extubation for statistical analysis but a continuous monitoring of heart rate and blood pressure every five minutes was done during surgery. Atropine *0.6 mg* was given if the heart rate was 50 beats per minute. Ephedrine *5 mg* increments was used to correct MAP if it went below *60 mm Hg*. Opinion of the surgeon regarding the operative field and intra-operative bleeding was assessed using the Bleeding severity score obtained by the following questionnaire and graded accordingly. We modified the score used by Fromme *et al*.[2]

0-virtually blood less field without any bleeding. 1-A mild Bleeding that was not a surgical nuisance. 2-Moderate bleeding causing a surgical nuisance not interfering with accurate dissection. 3-Moderate bleeding that compromised the surgical dissection moderately. 4-A severe bleeding but controllable and interfering significantly with surgical dissection. 5-Massive bleeding which could not be controlled and made dissection impossible.

The anesthesiologist recording the parameters and the surgeon were both unaware of the drug administered. Ondansetron *4 mg* intravenous was administered *30 min* prior to end of surgery for anti-emesis. Duration of surgery in minutes was recorded. Glycopyrrolate *0.02 mg/kg* and Neostigmine *0.05 mg/kg* was used for reversing the residual neuromuscular block after the completion of surgery and patients were shifted to the recovery area and were shifed from the recovery on achieving Aldrette score of 9. Purposive sampling technique was used to calculate sample size with the confidence interval (1-α) at 95% and power of study (1-β) at 80%. Data was entered in Microsoft excel, statistics were calculated using stata 14.1 software. Numerical data was calculated from mean and standard deviation, categorical variables using

percentage. Student *t*-test was used for numerical data and chi-square test for categorical data, *p* – value < 0.05 was considered statistically significant.

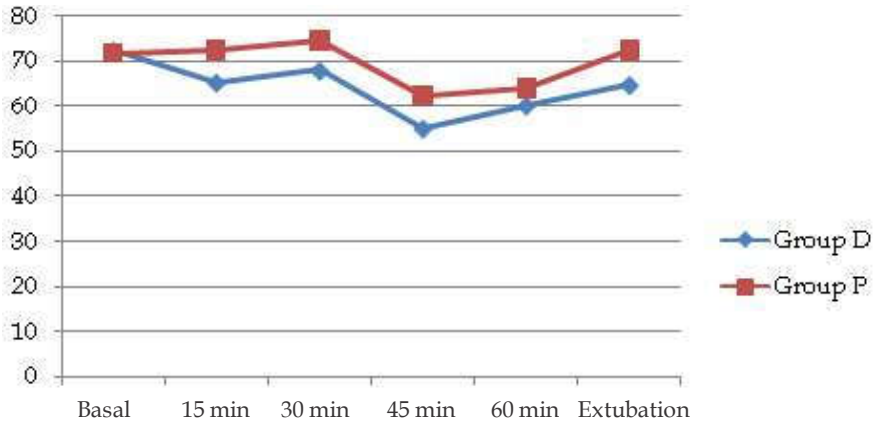
Results

No difference in the age, sex ratio and body weight was present between the groups. Shows (**Table 1**) Mean baseline heart rate was 72.35 ± 1.69 in group D and 71.8 ± 3.25 in group P ($p = 0.414$). Mean arterial pressure [MAP] at baseline was 91.97 ± 4.53 for Group D and 93 ± 2.46 for Group P ($p = 0.28$) both of which were statistically not significant. Heart rate and MAP gradually decreased following loading dose of injection dexmedetomidine I.V. in group D at *15 minutes* and throughout the duration of surgery at all the measured time intervals compared to Group P which was statistically significant ($p < 0.001$) displays (**Graphs 1 & 2**). The maximum fall in mean arterial pressure was seen *45 minutes* after the starting of the drug and was around 30% from baseline in group D (61.29 ± 3.76) compared to a fall of 28% in Group P (65.39 ± 3.18.) the fall being more in group D and significant stastistically. ($p < 0.05$). The lowest mean heart rate recorded in Group D was 55.05 ± 2.74 while in Group P it was 62.34 ± 2.94 the decrease being significant in Group D compared to group P ($p < 0.05$) at *45 minutes* after the start of the loading dose.

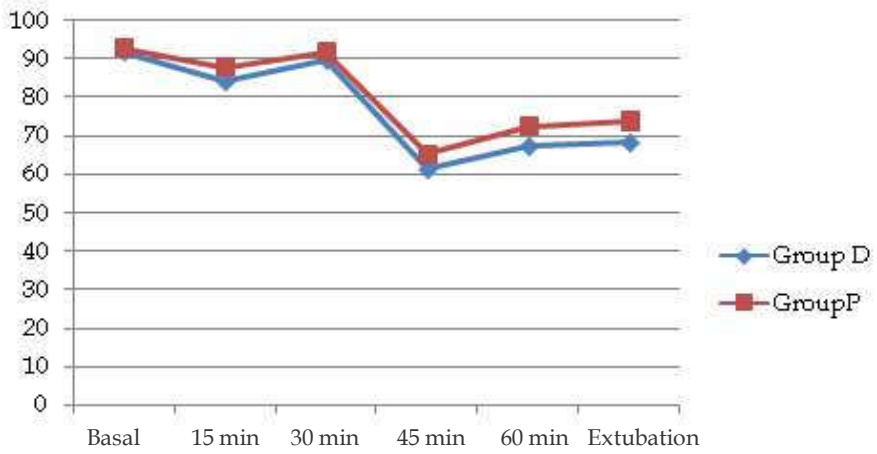
Table 1: Showing Age weight and sex of the patients

Parameter	Group D		Group II		*p* - value
Mean age	32.7		37.43		0.179
Weight in kilograms	Male	Female	Male	Female	0.184
	61.47	52.6	59.2	54.2	
Sex of patients	Male	Female	Male	Female	0.436
	15	15	12	18	

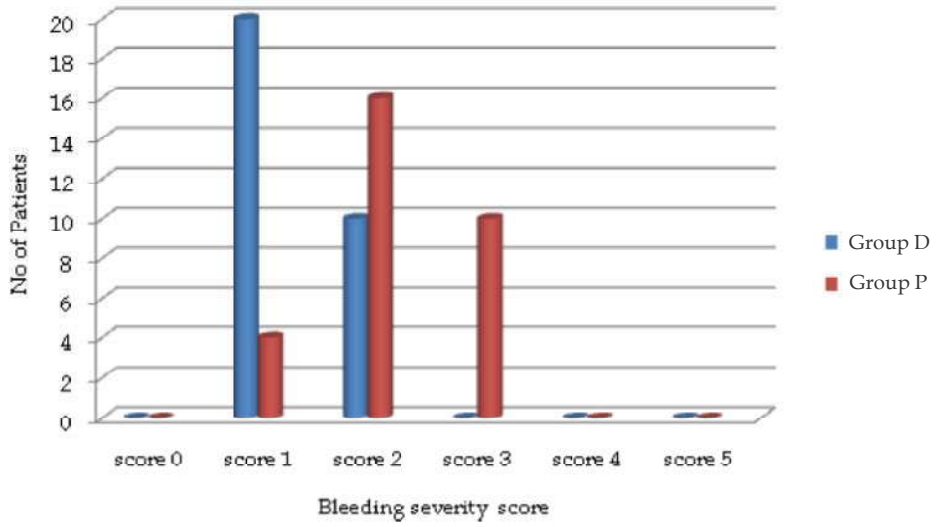
Bleeding severity score was 1 in 66.6% and 2 in 33.3% patients in Group D compared to 2 in 53.33% and 3 in 33.3% patients in Group P, more number of patients with lower scores in Group D, thus resulting in a shorter duration of surgery in Group D (*55.55 min ± 2.34*) when compared to Group P (*68.39 min ± 4.38*) which was statistically significant ($p < 0.01$) (**Graphs 3 & 4**). The volatile anesthetic agent needed in Group D was less Compared to Group P.



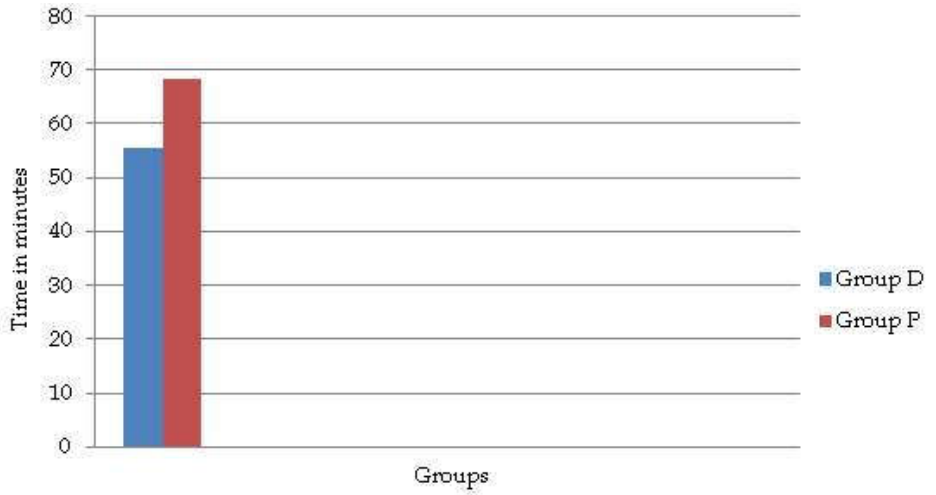
Graph 1: Heart Rate



Graph 2: Mean arterial pressure (MAP)



Graph 3: Bleeding severity score



Graph 4: Mean duration of surgery

Discussion

Bleeding associated with impairment of visibility in the intra-operative period and resultant prolongation of the surgical time is a problem seen in middle ear and nasal surgical procedures.[1,2,3,5] The reduction of MAP in the intra-operative period by around 30% of the basal values is called controlled hypotension.[1] This technique is employed in middle ear and nasal surgeries, operation of spine, head and neck surgical procedures,

In neurosurgery and orthopedic surgeries that are associated with major bleeding. Controlled hypotension in addition to improving the surgical visibility also reduces the need for blood transfusions by reducing the blood loss during surgery.[13,14] The drugs used to reduce the MAP should be specific, easy to titrate, have minimal or no interactions with other drugs with the duration of action being short.[15] The drugs used for producing controlled hypotension act by mainly by reducing the vascular tone.[5] Opioids like remifentanyl, volatile anesthetic agents, vasodilators like sodium nitroprusside and nitroglycerine are used with certain advantages and disadvantages.[8–10] α_2 agonist clonidine was used in many studies to reduce the bleeding during middle ear and nasal surgery.[15] A selective α_2 receptor agonist dexmeditomidine was approved for human use by the FDA in 1999. Clonidine the α_2 adrenergic receptor agonist has α_2:α_1 binding ratio of 220:1 [partial α2] with a elimination half life of eight hours while dexmeditomidine has α_2:α_1 of 1620:1 [full agonist of α_2] with elimination half life being 2–2.5 hours. Hence, dexmedetomidine is a preferred drug over clonidine.[11] Dexmedetomidine reduces the

blood pressure and bleeding by α_2 receptor mediated decrease in the norepinephrine release with resultant symphatholysis.[4] We selected the loading dose of *1 µg/kg* along with a maintenance dose of *0.5–0.8 µg/kg/hour* based on the results of the previous studies.[1,4,5]

The basal MAP was not different significantly amongst the groups. A reduction in the MAP was observed in the Group D, from a mean of 91.97 ± 4.53 to 61.29 ± 3.76 with maximum reduction seen at *45 minutes* after the starting of the dexmeditomidine and in the Group P also a fall of MAP was present from a basal mean of 93 ± 2.46 to 65.39 ± 3.18, with a maximum fall at *45 minutes* after the infusion. However, the fall in the Group D was significantly lower when compared with group P at all the time intervals. Ayoglu *et al.* in their study done to know the effectiveness of dexmedetomidine on blood loss in septoplasty and tympanoplasty found dexmedetomidine to cause a fall in blood pressure from the basal values.[1] In studies done to assess the effects of dexmedetomidine in patients subjected to laparoscopic surgeries Vora KS[16] *et al.* and Panchgar V *et al*.[17] noted a significant fall in the MAP in patients who received dexmedetomidine when compared to placebo. Durmus *et al*.[5] in the study of dexmedetomedine versus placebo in patients undergoing tympanoplasty reported a fall in blood pressure in both the groups without a significant difference which is in contrast to our findings. The higher fall in MAP in Group D can be attributed to dexmedetomidine mediated symphatolysis with a decrease in the vascular tone. Durmus *et al.*[5] used nitroglycerine infusion along with isoflurane to maintain lower levels of MAP in both the groups. Hence, there was a fall in MAP in both the groups. The bleeding severity score obtained by questioning the surgeons was lower in patients in the Group D. 66.6% (20 patients) had a score of 1 and 33.3% (10 patients) had a score of 2. In the placebo group the score was higher 13% (4 patients) had a score of 1, 53% (16 patients) had a score of 2, 33% (10 patients) had a score of 3. Significantly higher number of patients had a score of 1 in the group D. ($p < 0.05$). Ayoglu *et al.*, Durmus *et al*.[5] also reported a lower surgical bleeding scores in dexmedetomidine groups. Shams *et al.* in the study comparing dexmedetomidine and esmolol administration in FESS noticed a lower surgical bleeding scores when dexmedetomidine was used.[4] Lower scores for severity surgical bleeding can be due to a decrease in the MAP and bleeding in the intra-opertive period. We also noted a significant reduction in the surgical time in Group D which could be due to decreased bleeding and better visibility of the operating field. There was also a reduction in the mean heart rate in Group D which reduced to 55.05 ± 2.74 from 72.35 ± 1.69 at *45 minutes* after the start of dexmedetomidine. The mean heart rate in Group P was 71.8 ± 3.25 before the start of the infusion and reached the lowest of 62.34 ± 2.94 at *45 minutes* after the placebo administration. The fall was more in Group D which again is due to symphatholysis caused by dexmeditomidine. Ayoglu *et al.* [1], Durmus *et al*.[5], Vora KS *et al*.[16] and Panchgar V *et al*.[17] also observed a decrease in the heart rate when Dexmedetomidine was administerd. The requirement of isoflurane to decrease the intra-operative MAP and bleeding was higher in the Group P compared to Group D.

Conclusion

Dexmedetomidine used as an intravenous loading dose pre-operatively along with maintenance during tympanoplasty and FESS surgery reduces the MAP, intra-operative bleeding, surgical time, heart rate and requirement of volatile anesthetic.

Source of support: Nil

Conflicts of interest: Nil

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