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ORIGINAL RESEARCH ARTICLE

Hemodynamic effects of different anaesthetic agents for induced hypotension in functional endoscopic sinus surgery: an observational study

Dr. Chandrani Dutta Biswas[1], Dr Soumen Mandal[2], Dr Imran Ahmed[3], Dr Kajal Kumar Patra[4]*

1. Senior Resident, Dept of Anaesthesiolgy, Burdwan Medical College & Hospital, Burdwan, West Bengal, India
2. Associate Professor, Dept of Anaesthesiolgy, Burdwan Medical College & Hospital, Burdwan, West Bengal, India
3. Assistant professor, Dept of anesthesiology, Gouri Devi Institute of Medical Science, Durgapur, West Bengal, India
4. Professor and Head, Dept of Gynae and Obstetrics, Gouri Devi Institute of Medical Science, Durgapur, West Bengal, India

Corresponding author:
Dr Kajal Kumar Patra
Professor and Head, Dept of Gynae and Obstetrics
Gouri Devi Institute of Medical Science
GT Road, National Highway 2, Rajbandh,
Durgapur, West Bengal 713212
Mobile : +91 9830212433
Email: drmch2000@gmail.com

ABSTRACT

Background: Functional endoscopic sinus surgery (FESS) is one of the common surgical procedures requiring hypotensive anesthesia; many agents have been tried to reduce the amount of blood loss. Its introduction associated with enhanced illumination and visualization has dramatically improved surgical dissection. This study aims to compare the hemodynamic effects of intraoperative propofol infusion or sevoflurane inhalation along with dexmedetomidine. **Methods:** This study was a prospective comparative observational study conducted in the Department of anaesthesiology, Burdwan Medical College & Hospital, Burdwan, West Bengal, India from May 2020 to July 2021. 26 patients each in two groups i.e. observational group and another group received propofol infusion were included in the study. A suitable predesigned pretested Proforma for data collection was prepared. Routine Obstetric, menstrual, relevant past, personal and family history were also elicited. Template was generated in MS excel sheet and

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analysis was done on SPSS software. **Results:** In the present study in P Group, 8(30.8%) patients were ≤30 years old, 6(23.1%), In S Group, 6(23.1%) patients were ≤30 years old. In P Group, 12(46.2%) patients were Female and 14(53.8%) patients were male. In S Group, 12(46.2%) patients were Female and 14(53.8%) patients were male. The data collected from both the observational group shows, "Gr.S" has better (statistically significant) control of SBP, DBP, and MAP in some selective point of time than "Gr. P". However, the quality of surgical field (assessed by SFR scale) is equally favourable in both Gr. S and Gr. P. There were no statistically significant variations between the groups in case of other perioperative data such as HR, BIS etc. **Conclusions:** hemodynamic effects are better in sevoflurane Group compared to propofol Group for induced hypotension in a background of loading dose of dexmedetomidine (as premedication) in FESS.

Keywords: Anaesthetic agents, endoscopic, hypotension, hypotensive anesthesia

INTRODUCTION

Functional endoscopic sinus surgery (FESS) is an advanced surgical procedure performed in otorhinolaryngological diseases with an aim to restore the drainage and aeration of Paranasal sinuses while maintaining the natural mucocilliary clearance mechanism and seeking topreserve the normal anatomical structure.[1,2] Having a clear visual field is critical part of this surgery, while increased bleeding causes surgical difficulties. Proper anaesthetic management helps to ensure a good outcome. Considerations in such cases include local versus general anaesthesia, SGA device versus ETT, and they take into account patient's comorbidities, as well as preferences of the surgeon and anaesthesiologist. The most important goals are a blood free surgical field, patient's immobility, stable cardiorespiratory conditions and gentle emergence from anaesthesia.[3]

General anaesthesia is often preferred over topical anaesthesia to avoid the discomfort and moreover topical anaesthesia is also associated with incomplete block.[4] Controlledhypotension is required in FESS procedures for better visualisation and to minimise the operative time and blood loss.

General anaesthesia allows achieving hypotensive anaesthesia. Various agents like beta blockers, alpha agonists, vasodilators, and magnesium sulphate have been used to achieve controlled hypotension along with general anaesthesia.[5,6]

The volatile anaesthetic agents, such as isoflurane, sevoflurane, desflurane have a potent vasodilator action, and this property can be exploited to reduce blood pressure by increasing the agent's concentration when needed.[7,8] However recent studies show that sevoflurane is a modern better alternative to isoflurane for inducing hypotensive anaesthesia in these surgeries.

Dexmedetomidine is a highly selective alpha2 adrenoreceptor agonist that exhibits a unique sedative effect with minimum respiratory depression.[9] Dexmedetomidine also has many other advantages, for example, recent studies reported that a loading dose of dexmedetomidine during

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anaesthesia maintenance promotes the effect of analgesic drugs, reduces postoperative restlessness and vomiting, and improves patient's satisfaction with anaesthesia.[10-15]

Dexmedetomidine exhibits a high ratio of specificity for alpha 2 receptor [alpha 2/alpha1 - 1600/1] and is a complete alpha 2 agonist. However it may activate alpha 1 adrenergic receptors on peripheral blood vessels and produces hemodynamic fluctuation.[16] studies show that the use of dexmedetomidine prior to induction is associated with controllable hypotension.[17,18]

Propofol (2,6-diisopropylphenol) is an intravenous induction agent as well as a maintenance agent used in anaesthesia. The major cardiovascular effect of propofol is a decrease in arterialBP owning to a drop in systemic vascular resistance, cardiac contractility, and preload.[19]It causes direct myocardial depression and peripheral vasodilation. It blunts the sympathetic response to endotracheal tube insertion and surgical stimulation. Infusion rate based onpatient's body weight and hemodynamic response provide adequate BP control. It alsodecreases cerebral metabolism, and cerebral blood flow is reduced by auto regulation. This reduces flow through the ethmoidal, sphenoidal, and frontal sinuses improving surgical visibility.[20]

In this institution (Burdwan Medical College and Hospital) FESS is a common surgery and a loading dose of dexmedetomidine [1mcg/kg] 10min prior to operationhas regularly been used as a premedication. Induced hypotension in FESS in our institution is being achieved by administering either sevoflurane inhalation or intravenous propofol infusion. Dexmedetomidine; as premedication, augments the effect of hypotension exerted by propofol or sevoflurane. Dexmedetomidine also maintains better outcome in postoperative period and increases patient's satisfaction.

Therefore, an observational study has been planned to evaluate the effect of propofol infusion versus sevoflurane inhalation (in the background of loading dose of dexmedetomidine as a premedication) on hemodynamic changes as well as quality of surgical fields during FESS.

Method and Materials:

Study design : Observational, Cross-Sectional Institution Based Study.

Study setting: Patients admitted for FESS in otorhinolaryngological ward in the department of anaesthesiology, Burdwan Medical College & Hospital, Burdwan, West Bengal, India. The study started with the submission of research proposal.

Period of study: May 2020 to July 2021

Study population : Patients admitted for FESS in otorhinolaryngological ward who was scheduled for surgery fulfilling the requisite criteria.

Inclusion Criteria: American Society of Anaesthesiology (ASA) physical status 1,2, mallampati grading (MPG) 1,2, age: 16-60yrs, Male/Female, BMI less than 30 kg/meter^2, FESS up to 3hrs.

Exclusion criteria : Bleeding disorder, major hepatic, renal or cardiovascular dysfunction, pregnancy, patients on anticoagulant therapy, postural hypotension, anticipated hypotension and MI, ASA 3 and 4, MPG 3 and 4

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Sample size : Assuming p value <0.05 to be significant and considering effect to be two sided, they get Zα =1.96; assuming power of study to be 90% they get Z1-β = 1.28; considering an effect size (Difference in MAP after 5 minutes) of 6 to be statistically significant they get n > 2(Zα + Z1- β)2 x SD2/d2 they get n = 26. Hence minimum 26 patients were taken in each group.

Method of data collection: After obtaining approval from the institutional ethics committee and written informed consent from the willing participants who fulfilled the inclusion criteria, an observational study was conducted on these patients undergoing Functional endoscopic sinus surgery under general anaesthesia. As per institutional protocol, preoperative assessment had done on the day prior to surgery and patients were explained about the procedure. Proper informed consent was explained and signed by the patient and his /her close relatives at the time of PAC. All patients were kept nil orally from 12 midnight before the day of surgery. They were received tab. Alprazolam 0.5mg as premedication a night before surgery.

Statistical Analysis:

For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. Paired t-tests were a form of blocking and had greater power than unpaired tests. One-way analysis of variance (one-way ANOVA) was a technique used to compare means of three or more samples for numerical data (using the F distribution). A chi-squared test ($\chi 2$ test) was any statistical hypothesis test wherein the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true..

Ethical clearance: The study was conducted only after obtaining written approval from the Institutional Ethics Committee. Written informed consent was taken from every study patient.

Results

The present observational study was planned to explore the hemodynamic changes and quality of surgical field during FESS in the background of using two sets of hypotensive agents during the procedure (one set being the propofol infusion and another set with sevoflurane inhalation, both being premedicated by the loading dose of Dexmedetomidine). Thus total 52 paients were included in the study. The time period for the study was from May 2020 to July 2021. In all the cases, thorough history taking and clinical examination was done after taking proper consent. Data thus obtained was noted in the Proforma. Results thus obtained were analysed and expressed in tables.

Table 1: Association between Age in group: GROUP.

	Group		
Age in group	**Group-P**	**Group-S**	**Total**
≤30	8	6	14
Row %	57.1	42.9	100.0
Col %	30.8	23.1	26.9

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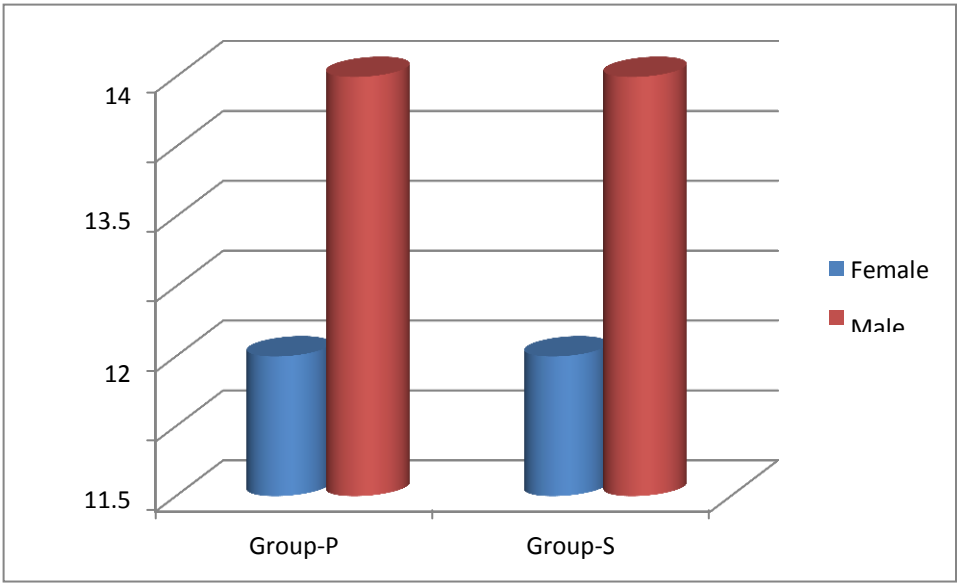
31-40	6	5	11
Row %	54.5	45.5	100.0
Col %	23.1	19.2	21.2
41-50	6	10	16
Row %	37.5	62.5	100.0
Col %	23.1	38.5	30.8
51-60	6	5	11
Row %	54.5	45.5	100.0
Col %	23.1	19.2	21.2
Total	26	26	52
Row %	50.0	50.0	100.0
Col %	100.0	100.0	100.0

Chi-square value: 1.4675; **p-value:** 0.6898;

In the present study in P Group, 8(30.8%) patients were ≤30 years old, 6(23.1%) patients were 31-40 years old, 6(23.1%) patients were 41-50 years old and 6(23.1%) patients were 51-60 years old. In S Group, 6(23.1%) patients were ≤30 years old, 5(19.2%) patients were 31-40 years old, 10(38.5%) patients were 41-50 years old and 5(19.2%) patients were 51-60 years old. Association of Age in group vs group was not statistically significant (p=0.6898). (table 1)



Chi-square value: <0.0001; **p-value:** 1.0000
Odds ratio: 1.0000 (0.3361, 2.9756)

Figure 1 : Association between GENDER: GROUP.

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From the above figure we conclude the conclusion which are being observed for the 120 sample of cases for this study along with the no of cases and their respective percentages. Some of these complications we pain in the abdomen, dribbling p/v, MSL, bleeding p/v etc. (Figure 1)

In P Group, 12(46.2%) patients were Female and 14(53.8%) patients were male. In S Group, 12(46.2%) patients were Female and 14(53.8%) patients were male. Association of gender vs group was not statistically significant (p=1.0000). (Figure 1)

Table 2: Distribution of mean age : group, weight : group, BMI : group.

		Number	Mean	SD	Minimum	Maximum	Median	p-value
Age	Group-P	26	40.3462	12.1653	20.0000	58.0000	40.0000	0.9440
	Group-S	26	40.5769	11.4059	21.0000	57.0000	43.0000	
Weight	Group-P	26	60.9231	8.5833	40.0000	72.0000	64.0000	0.4665
	Group-S	26	62.7308	9.1719	45.0000	81.0000	60.0000	
BMI	Group-P	26	21.9231	1.9985	18.0000	25.0000	22.0000	0.0889
	Group-S	26	22.9615	2.3062	18.0000	28.0000	23.0000	

In P Group, the mean Age (mean± s.d.) of patients was 40.3462± 12.1653. In S Group, the mean Age (mean± s.d.) of patients was 40.5769± 11.4059. In P Group, the mean weight (mean± s.d.) of patients was 60.9231± 8.5833. In S Group, the mean weight (mean± s.d.) of patients was 62.7308± 9.1719. In P Group, the mean BMI (mean± s.d.) of patients was 21.9231± 1.9985. In S Group, the mean BMI (mean± s.d.) of patients was 22.9615± 2.3062. All associations were not statistically significant. (Table 2)

Table 3: Distribution of mean HRb: group, HRd : group, HRi10 : Group, HRe : group.

		Number	Mean	SD	Minimum	Maximum	Median	p-value
HRb	Group-P	26	93.6538	12.2407	70.0000	120.0000	92.5000	0.8770
	Group-S	26	93.0385	16.0287	69.0000	130.0000	91.0000	
HRd	Group-P	26	77.2308	9.5637	60.0000	95.0000	78.0000	0.3909
	Group-S	26	74.3077	14.3214	58.0000	106.0000	69.0000	
HRi10	Group-P	26	75.6538	9.4528	58.0000	92.0000	76.0000	0.2872
	Group-S	26	72.0769	14.0739	55.0000	102.0000	68.0000	
HRe	Group-P	26	97.5769	11.2931	80.0000	122.0000	96.0000	0.9741

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	Group-S	26	97.4615	14.0634	80.0000	135.0000	95.0000	

In P Group, the mean HRb(mean± s.d.) of patients was 3.6538± 12.2407. In S Group, the mean HRb (mean± s.d.) of patients was 93.0385± 16.0287. In P Group, the mean HRd (mean± s.d.) of patients was 77.2308± 9.5637. In S Group, the mean HRd (mean± s.d.) of patients was 74.3077± 14.3214. In P Group, the mean HRi10 (mean± s.d.) of patients was 75.6538± 9.4528. In S Group, the mean HRi10 (mean± s.d.) of patients was 72.0769± 14.0739. All associations were not statistically significant .(Table 3).

Table 4: Distribution of mean SBPb: group, SBPd : group, SBPi10 : group, SBPe : group.

		Number	**Mean**	**SD**	**Minimum**	**Maximum**	**Median**	**p-value**
SBPb	Group-P	26	116.2308	11.7518	98.0000	137.0000	117.5000	0.4308
	Group-S	26	118.7308	10.9309	98.0000	136.0000	122.0000	
SBPd	Group-P	26	116.9231	12.5950	96.0000	138.0000	118.0000	0.6566
	Group-S	26	118.3846	10.9072	90.0000	132.0000	119.5000	
SBPi10	Group-P	26	117.2692	13.3852	95.0000	140.0000	116.5000	0.8849
	Group-S	26	116.7308	13.3013	90.0000	140.0000	118.0000	
SBPe	Group-P	26	121.1538	9.5024	100.0000	140.0000	122.0000	0.8624
	Group-S	26	121.6538	11.1281	100.0000	142.0000	122.0000	

In P Group, the mean SBPb (mean± s.d.) of patients was 116.2308± 11.7518. In S Group, the mean SBPb (mean± s.d.) of patients was 118.7308± 10.9309. In P Group, the mean SBPd (mean± s.d.) of patients was 116.9231± 12.5950. In S Group, the mean SBPd (mean± s.d.) of patients was 118.3846± 10.9072. In P Group, the mean SBPi10 (mean± s.d.) of patients was 117.2692± 13.3852. In S Group, the mean SBPi10 (mean± s.d.) of patients was 116.7308± 13.3013. In P Group, the mean SBPe (mean± s.d.) of patients was 121.1538± 9.5024. In S Group, the mean SBPe (mean± s.d.) of patients was 121.6538± 11.1281. All associations were not statistically significant. (Table 4)

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Table 5: Distribution of mean DBPb: group, DBPd : group, DBPi10 : group, DBPe : group.

		Number	Mean	SD	Minimum	Maximum	Median	p-value
DBPb	Group-P	26	66.8846	9.3523	50.0000	82.0000	67.5000	0.3807
	Group-S	26	69.1154	8.8287	50.0000	86.0000	70.0000	
DBPd	Group-P	26	66.6538	10.1191	45.0000	84.0000	64.0000	0.8463
	Group-S	26	67.1538	8.2979	52.0000	80.0000	69.0000	
DBPi10	Group-P	26	66.4231	9.8597	46.0000	84.0000	64.5000	0.6246
	Group-S	26	67.6923	8.6892	52.0000	82.0000	66.0000	
DBPe	Group-P	26	65.3462	7.4078	50.0000	81.0000	65.0000	0.2113
	Group-S	26	67.8462	6.8158	60.0000	84.0000	68.0000	

In P Group, the mean DBPb (mean± s.d.) of patients was 66.8846± 9.3523. In S Group, the mean DBPb (mean± s.d.) of patients was 69.1154± 8.8287. In P Group, the mean DBPd (mean± s.d.) of patients was 66.6538± 10.1191. In S Group, the mean DBPd (mean± s.d.) of patients was 67.1538± 8.2979. In P Group, the mean DBPi10 (mean± s.d.) of patients was 66.4231± 9.8597. In S Group, the mean DBPi10 (mean± s.d.) of patients was 67.6923± 8.6892. In P Group, the mean DBPe (mean± s.d.) of patients was 65.3462± 7.4078. In S Group, the mean DBPe (mean± s.d.) of patients was 67.8462± 6.8158. All associations were not statistically significant. (Table 5)

Table 6: Distribution of mean MAPb : group, MAPd : group, MAPi10 : group, MAPe : group.

		Number	Mean	SD	Minimum	Maximum	Median	p-value
MAPb	Group-P	26	83.3333	9.3357	66.0000	99.3333	83.6667	0.3375
	Group-S	26	85.6540	7.8829	72.6667	98.6667	85.1667	
MAPd	Group-P	26	83.4103	9.7549	65.0000	101.3333	83.1667	0.7363
	Group-S	26	84.2308	7.5782	68.6667	97.3333	84.3333	
MAPi10	Group-P	26	83.3718	9.8099	66.0000	102.0000	83.3333	0.7950
	Group-S	26	84.0385	8.5481	66.0000	101.3333	84.0000	

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MAPe	Group-P	26	83.9487	6.6838	68.3333	96.6667	83.3333	0.3428
	Group-S	26	85.7821	7.1143	73.3333	100.6667	83.3333	

In P Group, the mean MAPb (mean± s.d.) of patients was 83.3333± 9.3357. In S Group, the mean MAPb (mean± s.d.) of patients was 85.6540± 7.8829. In P Group, the mean MAPd (mean± s.d.) of patients was 83.4103± 9.7549. In S Group, the mean MAPd (mean± s.d.) of patients was 84.2308± 7.5782. In P Group, the mean MAPi10 (mean± s.d.) of patients was 83.3718± 9.8099. In S Group, the mean MAPi10 (mean± s.d.) of patients was 84.0385± 8.5481. In P Group, the mean MAPe (mean± s.d.) of patients was 83.9487± 6.6838. In S Group, the mean MAPe (mean± s.d.) of patients was 85.7821± 7.1143. All associations were not statistically significant. (Table 6)

Table 7: Distribution of mean BISb : group, BISd : group, BISi10 : group, BISe : group.

		Number	**Mean**	**SD**	**Minimum**	**Maximum**	**Median**	**p-value**
BISb	Group-P	26	90.9231	4.1850	83.0000	98.0000	90.5000	0.1610
	Group-S	26	92.5000	3.7974	85.0000	98.0000	92.5000	
BISd	Group-P	26	77.1154	11.6596	58.0000	92.0000	77.5000	0.8735
	Group-S	26	77.5385	6.7601	65.0000	92.0000	78.5000	
BISi10	Group-P	26	56.8077	14.3444	41.0000	80.0000	50.0000	0.9757
	Group-S	26	56.9231	12.7528	35.0000	85.0000	56.0000	
BISe	Group-P	26	88.1154	2.4220	84.0000	92.0000	88.0000	0.0670
	Group-S	26	86.4231	3.9209	75.0000	91.0000	87.0000	

In P Group, the mean BISb (mean± s.d.) of patients was 90.9231± 4.1850. In S Group, the mean BISb (mean± s.d.) of patients was 92.5000± 3.7974. In P Group, the mean BISd (mean± s.d.) of patients was 77.1154± 11.6596. In S Group, the mean BISd (mean± s.d.) of patients was 77.5385± 6.7601. In P Group, the mean BISi10 (mean± s.d.) of patients was 56.8077± 14.3444. In S Group, the mean BISi10 (mean± s.d.) of patients was 56.9231± 12.7528. In P Group, the mean BISe (mean± s.d.) of patients was 88.1154± 2.4220. In S Group, the mean BISe (mean± s.d.) of patients was 86.4231± 3.9209. All associations were not statistically significant. (Table 7)

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Table 8: Distribution of mean Anesthesia (A) time : group, mean Operation (O) Time : group, mean SFR : group

		Number	Mean	SD	Minimum	Maximum	Median	p-value
A TIME	Group-P	26	57.1154	5.6874	45.0000	65.0000	57.5000	0.0998
	Group-S	26	54.4231	5.8868	45.0000	65.0000	55.0000	
O TIME	Group-P	26	42.1154	5.6874	30.0000	50.0000	42.5000	0.0998
	Group-S	26	39.4231	5.8868	30.0000	50.0000	40.0000	
SFR	Group-P	26	2.8077	.6337	2.0000	4.0000	3.0000	0.3237
	Group-S	26	2.6154	.7524	2.0000	4.0000	2.0000	

In P Group, the mean A Time (mean± s.d.) of patients was 57.1154± 5.6874. In S Group, the mean A TIme (mean± s.d.) of patients was 54.4231± 5.8868. in p group, the mean o time (mean± s.d.) of patients was 42.1154± 5.6874. In S Group, the mean O Time (mean± s.d.) of patients was 39.4231± 5.8868. In P Group, the mean SFR (mean± s.d.) of patients was 2.8077± .6337. In S Group, the mean SFR (mean± s.d.) of patients was 2.6154± .7524. All associations were not statistically significant. (Table 8)

DISCUSSION

The present observational study was planned to explore the hemodynamic changes and quality of surgical field during FESS in the background of using two sets of hypotensive agents during the procedure (one set being the propofol infusion and another set with sevoflurane inhalation, both being premedicated by the loading dose of Dexmedetomidine).

The result shows differences among the demographic data within the subjects (age, gender, weight, BMI) are statistically not significant.

Among the hemodynamic parameters SBP, DBP, MAP shows statistically significant differences between propofol group and sevoflurane group.

There are significant differences ($P<0.05$) in mean SBP values at SBP5, SBP10, SBP15, SBP20, SBP35, SBP50 during the study, suggesting more effective reduction in SBP valuesin group S than group P.

There are also significant differences in mean DBP values at DBP35and DBP50 during the study suggesting more effective reduction in DBP values in group S than group P.

The MAP values at MAP5, MAP10, MAP15, MAP20, MAP35, and MAP50 also show more effective reduction for group S than group P.

In sevoflurane group the MAP values were well maintained in the targeted range which was not maintained in case of propofol group.

However other parameters like HR and BIS during operative hours show no statistically significant changes in both the groups.

Also in case of studying the quality of surgical field, it has been found out that in both the groups

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the surgical field was equally bloodless and favourable for the surgery. There may be two explanations to support this finding. Firstly, being a subjective parameter, SFR score is not always adequate to diagnose trivial increase in bleeding around the field. Secondly, the significant increase in SBP, DBP, and MAP are present in some selective timelines during the operation (not throughout the operation). Therefore, very short periodical changes in bleeding around the surgical field may not be noticeable by the surgical team.Various hypotensive agents have been used in last ten years in FESS to produce "controlled hypotension".

Propofol against isoflurane proved equally effective in a study by Saravanan P Ankichetty et al. in 2011.[21]

Sevoflurane against propofol with intravenous opioid has also been studied and it has been found that intravenous medications are better choice than inhalational (here sevoflurane) to produce controlled hypotension when propofol is combined with intravenous opioid infusion (Milonski J et al in 2013).[22]

Dexmedetomidine a selective $\alpha 2$ agonist has also been studied in FESS to produce controlled hypotension against clonidine. It has been shown that dexmedetomidine is also a better alternative for the very purpose of having ideal surgical field in FESS (Das A et al in 2016).[23]

Another study shows sevoflurane as a better agent than propofol infusion in FESS with a background of continuous opioid infusion (remifentanil) along with intraoperative dexmedetomidine infusion. (Yuan Han et al. in 2018).[24]

In the present study, the efficacy of two different sets of hypotensive agents (i.e. sevoflurane inhalation against propofol infusion) have been observed in a background of dexmedetomidine loading dose in both groups.

It has been again found out that sevoflurane inhalation is a better choice over propofol infusion when dexmedetomidine used as a premedication (loading dose).

CONCLUSIONS

Dexmedetomidine has been used as a premedication in loading dose in all cases. One observational group (Gr. S) received sevoflurane inhalation during the operative procedure and other observational group (Gr. P) received propofol infusion to achieve controlled hypotention and hence, bloodless surgical field. It has been concluded that hemodynamic effects are better in sevoflurane Group compared to propofol Group for induced hypotension in a background of loading dose of dexmedetomidine (as premedication) in FESS

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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