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Original Research Article

Comparative Evaluation of Post-Operative Cognitive Function in Patients Undergoing Septoplasty Using Controlled Hypotensive and Normotensive Anaesthesia

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Conflict of interest: Nil

Abstract:

Background: The phenomenon of postoperative cognitive dysfunction (POCD) after anesthesia and surgery is a recognized clinical concern that is characterized by a decline in cognitive performance. Controlled hypotension during anesthesia is a technique used to reduce blood loss in certain surgeries, such as septoplasty, and has been found to be effective in drying the surgical field, shortening the duration of surgery, and improving surgical access. However, the effect of controlled hypotension on postoperative cognitive function remains unknown. This prospective randomized study aims to compare the postoperative cognitive function of patients undergoing septoplasty using controlled hypotensive and normotensive anesthesiausing the Mini-Mental State Examination (MMSE) score.

Methods: The present prospective, randomised, comparative study was conducted among 60 patients undergoing elective septoplasty under Department of Anaesthesiology and Critical Care. The study was approved by Institution Ethics Committee. All patients underwent prea anesthetic evaluation on the day prior to surgery. A total of 60 patients scheduled for septoplasty under general anaesthesia at SMIH, Patel Nagar, Dehradun, over a period of 18 months were recruited for the study. They were divided into two groups by using computer generated randomization code. Group A : (n =30) - Controlled hypotensive anesthesia using isoflurane, Group B : (n =30) - Normotensive anaesthesia using local anaesthetic agent and vasoconstrictor. Data were coded and recorded in MS Excel spreadsheet program. All statistical calculations were done using (Statistical Package for the Social Science)SPSS 21version (SPSS Inc., Chicago, IL, USA)statistical program for Microsoft Windows.

Results: In our study, MMSE score at 30 minutes post-operative period, was lower in Group A [24.6 ± 0.6] than Group B [27.7 ± 0.7] and it was statistically significant [$p < 0.05$].

Conclusion: Our results showed that patients in the controlled hypotension group experienced a statistically significant drop in MMSE score at 30 minutes postoperatively, while patients in the normotensive group did not experience a significant decline in cognitive

function. These findings are consistent with previous studies that have reported a higher incidence of POCD in patients undergoing controlled hypotension.

Keywords: Hypotensive Anaesthesia, Septoplasty, Mini Mental State, Cognitive Function

Introduction

The phenomenon of postoperative cognitive dysfunction (POCD) after anesthesia and surgery is a recognized clinical concern that is characterized by a decline in cognitive performance, including attention, memory, and psychomotor speed. [1,2] While POCD can affect patients of any age, it is more common in elderly patients. [3] One of the possible mechanisms for POCD is a reduction in cerebral blood flow and oxygenation during surgery, which can lead to intraoperative cerebral ischemia and cerebral oxygen desaturation. [4] Controlled hypotension during anesthesia is a technique used to reduce blood loss in certain surgeries, such as septoplasty, and has been found to be effective in drying the surgical field, shortening the duration of surgery, and improving surgical access. [5] However, the effect of controlled hypotension on postoperative cognitive function remains unknown. [6] This prospective randomized study aims to compare the postoperative cognitive function of patients undergoing septoplasty using controlled hypotensive and normotensive anesthesiausing the Mini-Mental State Examination (MMSE) score. The secondary objectives are to compare the hemodynamic parameters between the two groups and assess any complications associated with the anesthesia technique.

The findings of this study may have important implications for the use of controlled hypotensive anesthesia in septoplasty and other surgical procedures. If the study finds that controlled hypotensive anesthesia is associated with a greater decline in cognitive function compared to normotensive anesthesia, alternative anesthesia techniques may need to be considered to improve patient outcomes.

Material and Methods

Study setting & participants-

A total of 60 patients scheduled for septoplasty under general anaesthesia at SMIH, Patel Nagar, Dehradun, over a period of 18 months were recruited for the study. They were divided into two groups by using computer generated randomization code.

Group A: (n =30) - Controlled hypotensive anesthesia using isoflurane,

Group B: (n =30) - Normotensive anaesthesia using local anaesthetic agent and vasoconstrictor.

After obtaining approval from the Ethical committee and written informed consent, 60 patients belonging to ASA I or II, aged 16 - 60 years undergoing septoplasty operation were included.

Inclusion Criteria

1. ASA grade I and II,
2. Age group: 16 to 60 years,
3. Both Sexes.

Exclusion Criteria

1. Hypertensive patients,
2. History of CVA, TIA , IHD,
3. Poor respiratory reserve,
4. Significant hepatic/renal disease,
5. Hypersensitivity to study drug,
6. Allergy to LA.

In Group A: Controlled Hypotensive anesthesia

Anesthesia was introduced using Fentanyl 2 ug/kg IV, Propofol 2 mg/kg IV, and

Vecuronium 0.1 mg/kg IV to facilitate orotracheal intubation.

Anesthesia was maintained by starting minimum alveolar of concentration (MAC) of isoflurane 2% in 50% oxygen and 50% air. The MAC was increased to maintain mean blood pressure between 50 and 60 mmHg or reducing mean blood pressure by 30% of baseline. The patients were mechanically ventilated, and ventilation was adjusted to maintain end tidal CO2 pressure between 30 and 35 mmHg. At recovery, muscle relaxant was antagonized with neostigmine and glycopyrrolate. The patients were transferred to the recovery room on eye opening and responding to verbal command.

In group B: Normotensive anesthesia

The anesthetic management was same as group A except that the isoflurane concentration was adjusted to maintain normotensive blood pressure throughout the operation and general anesthesia was supplemented with local anesthesia as follows: Prior to induction a topical nasal decongestant (xylometazoline hydrochloride 0.1%) was applied and once anaesthesia was induced, the nose was supplemented with submucosal injection of local anesthetic with epinephrine (1% lidocaine with 1:200,000 epinephrine).

Mini Mental State Examination (MMSE) questionnaire was used for evaluation of cognitive function. It consists of questions, evaluating orientation to time and place, registration, attention, calculation, short-term recall, language ability and constructional ability. The MMSE was recorded 30 mins before entry of the patient to the operating room (MMSE0) and then 30 mins (MMSE30) and 60 mins (MMSE60) after extubation of trachea in recovery room and finally 24 hours (MMSE24) after surgery in the ward, by the same anesthesiologist, trained in the use of the test. The maximum score being 30 points, a decrease of 2 or more was recorded as cognitive function decline and a score lower than 24 was recorded as cognitive impairment. Aldrete post-anesthesia recovery score was obtained for each patient 30 and 60 minutes postoperatively, so that cognitive function testing was applied only to patients with the similar post-anesthesia recovery state.

MMSE questionnaire was applied only when the patient was considered awake and having achieved Aldrete Score of 7. The patients were transferred to the ward following the completion of MMSE60 and upon meeting our discharge criteria (i.e the patient being alert, oriented, responding verbally, cooperative with adequate pain control, minimal nausea and vomiting).

Statistical Analysis –

Data was described in terms of range; mean ± standard deviation (± SD), frequencies (number of cases) and relative frequencies (percentages) as appropriate. To determine whether the data was normally distributed, a Kolmogorov-Smirnov test was used. Comparison of quantitative variables between the study groups was done using student t-test and MannWhitney test for parametric and non-parametric data respectively. For comparing categorical data, Chi square ($\chi 2$) test was performed and fisher exact test was used when the expected frequency was less than 5. A probability value (p value) less than 0.05 was considered statistically significant.

All statistical calculations were done using (Statistical Package for the Social Science)SPSS 21version (SPSS Inc., Chicago, IL, USA)statistical program for Microsoft Windows.

Calculation Of Sample Size

By using previous study by Niazi et al [48], the cognitive dysfunction is 23.3% in group A and 0% in Group B

Based on this assumption

The formula used in the situation is as under:

$$n = \frac{[Z_{1-\alpha/2}\sqrt{2\,P\,(1-P)} + Z_{1-\beta}.\sqrt{\{P1(1-P1) + P2\,(1-P2)\}}]^2}{(P1-P2)^2}$$

Where P=(P1+P2)/2

• Approximate value of efficacy/cure rate for standard treatment =P1

• Approximate value of efficacy/cure rate for other treatment = P2

• Effect size = (P2-P1)

• Level of significance (usually 5%)

• Zα = Value of standard normal variate corresponding to α level of significance (1.96)

 Zβ = The standard normal deviate for desired power(0.842)

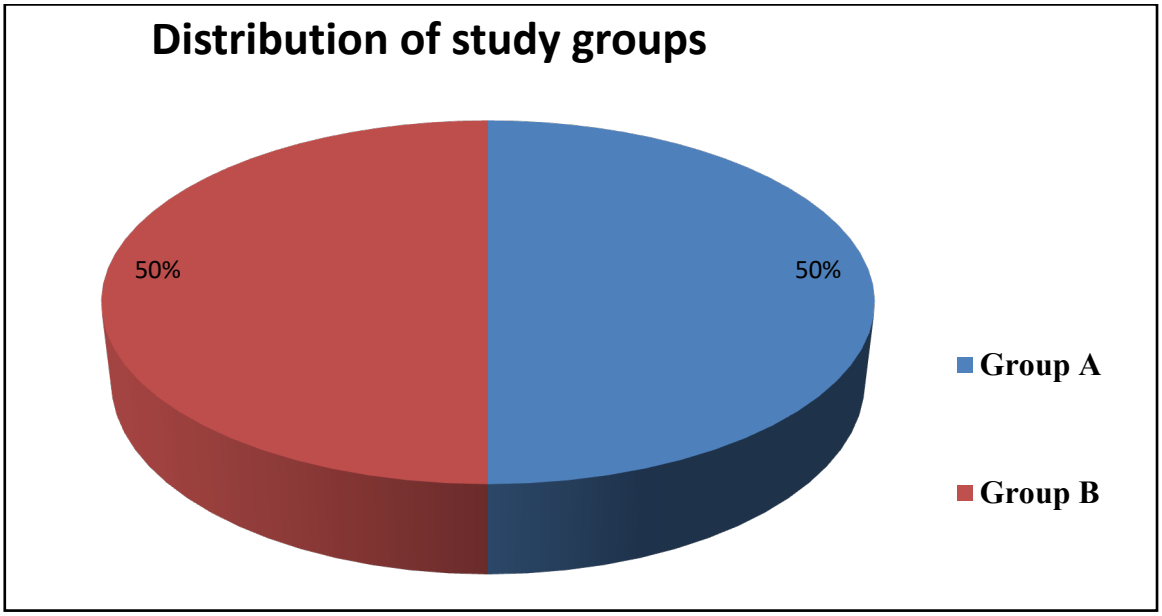
With the above assumptions the sample size for 95% confidence level & 80% power works out 27 in each group.

This number has been increased to 30 per group (a total of 60) to allow for a predicted dropout from treatment

Observation and Results

Table 1: Distribution of study groups

Study Group	N [frequency]	Percentage
Group A [Controlled hypotension]	30	50%
Group B [Normotensive anaesthesia with LA]	30	50%



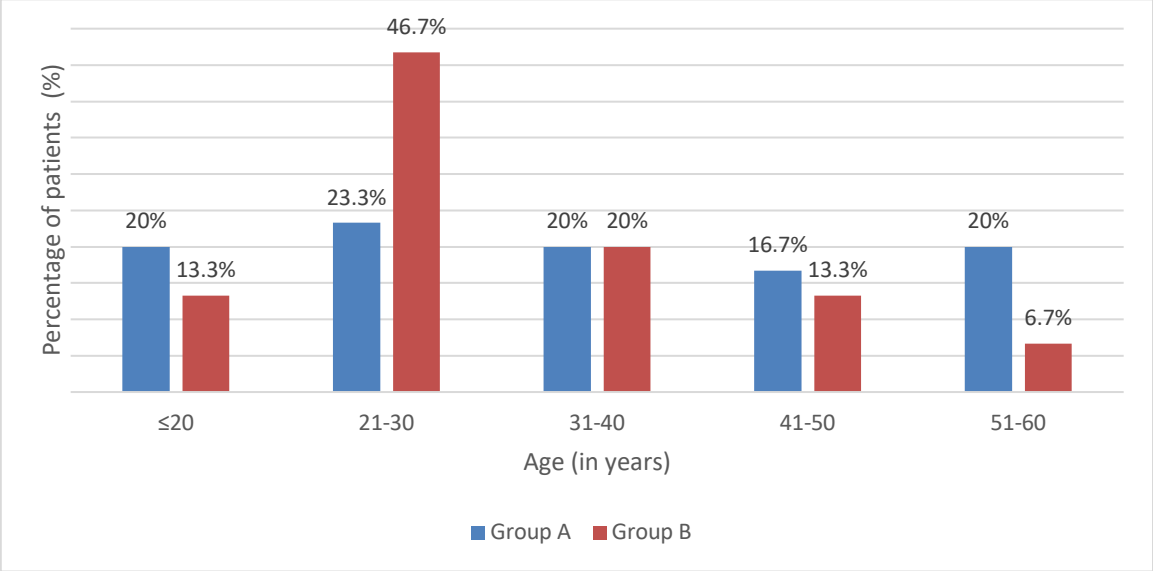
Graph 1: Distribution of study groups

A total of 60 patients were divided into 2 groups of 30 each i.e. Group [A] - Controlled hypotension and Group [B] - Normotensive Group.

Table 2: Distribution based on age

Age group (years)	Group		Total (n=60)	p- value
	Group A (n=30)	Group B (n=30)		
≤ 20	6 (20%)	4 (13.3%)	10 (16.7%)	0.303
21 - 30	7 (23.3%)	14 (46.7%)	21 (35%)	
31 - 40	6 (20%)	6 (20%)	12 (20 %)	
41 - 50	5 (16.7%)	4 (13.3%)	9 (15%)	
51 - 60	6 (20%)	2 (6.7%)	8 (13.3%)	

Mean ± SD	35.2 ± 13.88	30.26 ± 10.31	32.73 ± 12.37	0.123

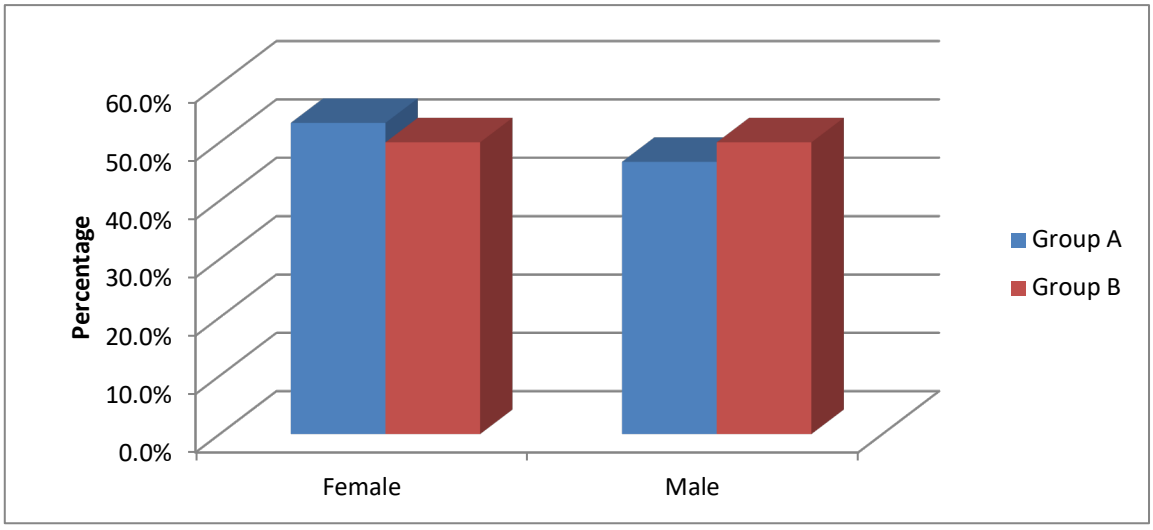


Graph 2: Distribution based on age

Out of 60 patients, majority patients belonged to age group of 21 – 30 years [35%] and least number of patients belonged to age group of 51 – 60 years [13.3%] . In group A, out of 30 patients, majority [23.3%] were from age group of 21-30years and least number of patients [5%] were from age group of 41-50 years. In group B, , out of 30 patients, majority [46.7%] were from age group of 21-30years and least number of patients [6.7%] were from age group of 51-60 years. Mean age of group A was 35.2± 13.88 and mean age of group B was 30.26 ± 10.31 years.

Table 3: Distribution based on sex

Sex	Group		Total (n=60)	p- value
	Group A (n=30)	Group B (n=30)		
Male	15 (50%)	21 (70%)	36 (60%)	0.094
Female	15 (50%)	9 (30%)	24 (40%)	



Graph 3: Distribution based on sex

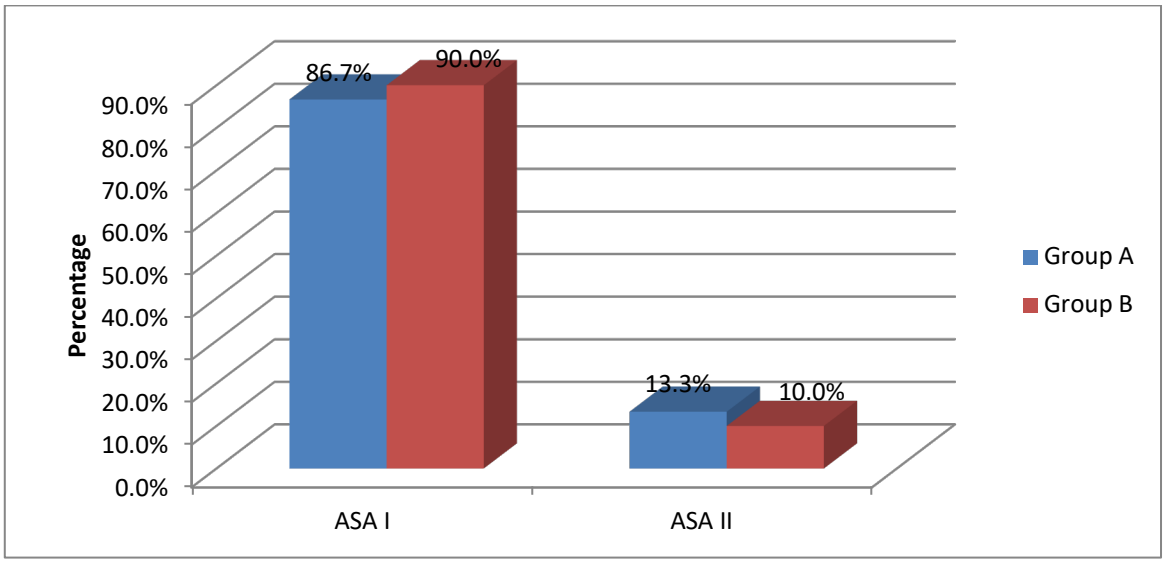
Out of total 60 patients, majority 36 (60%) patients were male and 24 (40%) patients were female. In Group A, out of 30 patients, 15 (50%) patients were male and 15 (50%) patients were female.

In Group B,out of 30 patients, majority 21 (70%) patients were male and 9 (30%) patients were female.

Sex distribution between the groups is statistically non-significant (p>0.05).

Table 4 : Distribution based on ASA grade

ASA Grade	Group		Total (n=60)	p value
	Group A (n=30)	Group B (n=30)		
I	23 (76.7%)	23 (76.7%)	46 (76.7%)	0.619
II	7 (23.3%)	7 (23.3%)	14 (23.3%)	



Graph 4: Distribution based on ASA grade

Out of 60 patients, 46 (76.7%) patients belonged to ASA Grade I and 14 (23.3%) patients belonged to ASA Grade II. In Group A, out of 30 patients, majority i.e 23 patients (76.7%) belonged to ASA Grade I and 7 patients (23.3%) belonged to ASA Grade II. In Group B, out of 30 patients, majority 23 patients (76.7%) belonged to ASA Grade I and 7 patients (23.3%) belonged to ASA Grade II.

ASA Grade was statistically non-significant in both groups (p>0.05).

Table 5 : Distribution of preoperative hemodynamic parameters

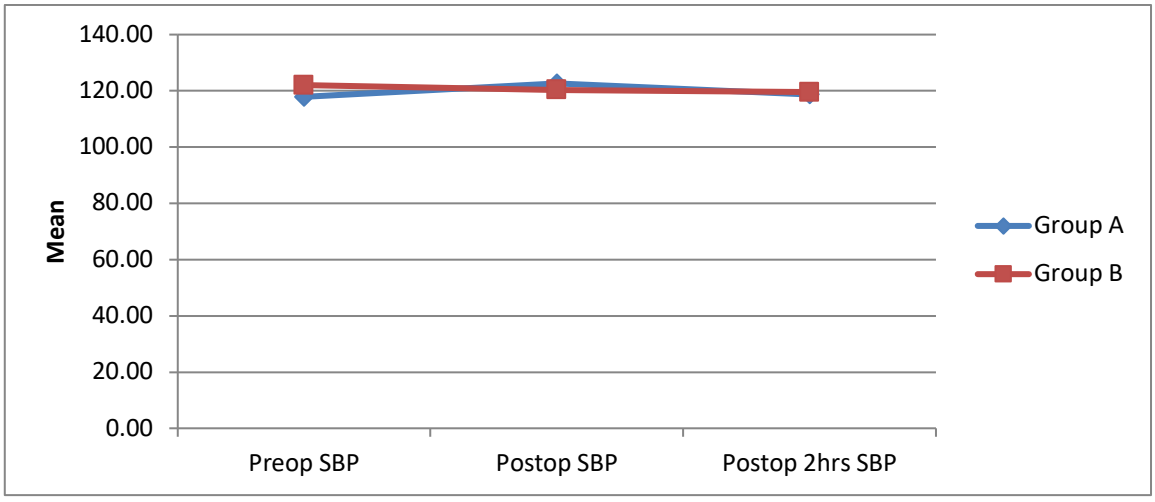
Pre-operative	Mean ± SD		Total (n=30)	p value
	Group A (n=30)	Group B (n=30)		
HR [bpm]	78.90±9.32	82.20±6.10	80.20±7.98	0.110
SBP [mmHg]	117.87±9.58	122.03±7.66	119.95±8.85	0.068
DBP [mmHg]	74.77±9.52	74.97±10.17	74.86±9.76	0.938
SpO2 [%]	98.23±1.01	98.20±1.57	98.23±1.07	0.906

Table 8: Comparison of haemodynamic parameters at various time intervals

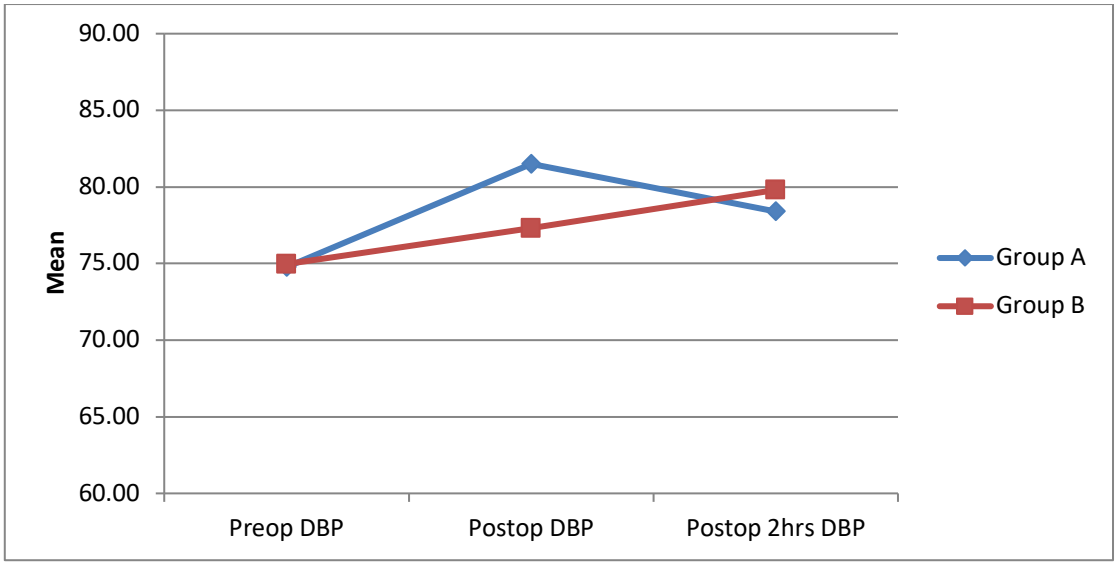
		Mean ± SD		Total (n=60)	p value
		Group A (n=30)	Group B (n=30)		
HR	Preoperative	78.90±9.32	82.20±6.10	80.55±7.98	0.110

[bpm]	**Immediate Postoperative**	85.00±4.58	83.07±5.75	84.03±5.24	0.155
	2 hours post-operative	78.87±5.27	81.60±5.96	80.23±5.75	0.065
SBP [mmHg]	**Preoperative**	117.87±9.58	122.03±7.66	119.95±8.85	0.068
	Immediate Postoperative	122.63±12.34	120.33±9.87	121.48±11.13	0.428
	2 hours post-operative	118.73±7.65	119.57±6.64	119.15±7.11	0.654
DBP [mmHg]	**Preoperative**	74.77±9.52	74.97±10.17	74.86±9.76	0.938
	Immediate Postoperative	81.50±10.89	77.30±10.54	79.40±10.83	0.134
	2 hours post-operative	78.40±9.34	79.80±8.01	79.10±8.65	0.536
SpO2 [%]	**Preoperative**	98.23±1.01	98.20±1.57	98.21±1.07	0.906
	Immediate Postoperative	98.13±0.82	98.00±0.91	98.06±0.86	0.553
	2 hours pot-operative	98.70±0.75	98.60±0.67	98.65±0.71	0.589

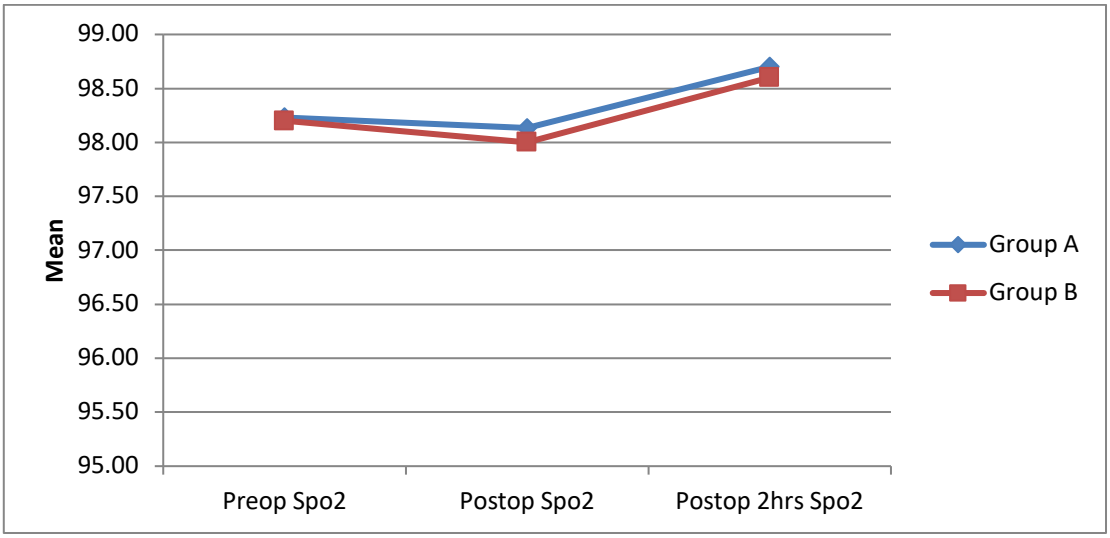
Graph 5: Distribution of hemodynamic parameters- Heart Rate



Graph 6: Distribution of hemodynamic variables- Systolic Blood Pressure



Graph 7: Distribution of hemodynamic parameters- Diastolic Blood Pressure



Graph 8: Distribution of hemodynamic parameters - Oxygen saturation

Out of 60 patients, most of the patients had preoperative HR of 80.20 ± 7.98 beats per minute, SBP of 119.95 ± 8.85 mmHg, DBP of 74.86 ± 9.76 mmHg, Spo2 98.23 ± 1.07% .

In immediate postoperative period, most of the patients had HR of 84.03 ± 5.24 beats per minute, SBP of 121.48 ± 11.13 mmHg, DBP of 79.4 ± 10.83 mmHg, Spo2 98.06 ± 0.86 % . 24 hours postoperatively , most of the patients had HR of 80.23 ± 5.75 beats per minute, SBP of 119.15 ± 7.11 mmHg, DBP of 79.10 ± 8.65 mmHg, Spo2 98.65 ± 0.71 % .

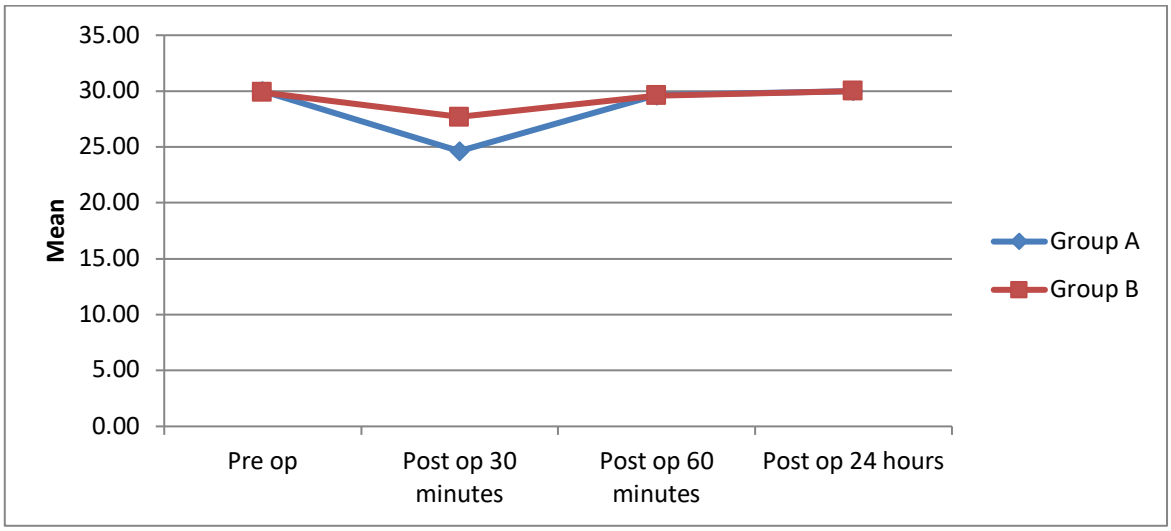
Mean HR, SBP, DBP and SpO2 values were similar in baseline , immediate postop period and 24 hours post operatively.

Hemodynamic parameters of the studied patients showed statistically non-significant association in both groups (p>0.05)

Table 10: MMSE score distribution in both groups

MMSE score	Mean ± SD		Total (n=60)	p value
	Group A	Group B		
Preoperative	30.00 ± 0.0	29.90 ± 0.31	29.95 ± 0.21	0.078

After 30 mins	24.63 ± 0.66	27.70 ± 0.79	26.17 ± 1.71	**< 0.001**
After 60 mins	29.16 ± 1.71	29.60 ± 0.50	29.61 ± 0.49	0.795
After 24 Hours	30.00 ± 0.0	30.00 ± 0.0	30.00 ± 0.0	----



Graph 10: MMSE score distribution in both groups

MMSE score preoperatively was 29.9 ± 0.2 , after 30 min was 26.1 ± 1.7 , after 60 min was 29.6 ± 0.4 and after 24 hours was 30 ± 0

In group A, mean MMSE score preoperatively was 30 ± 0 , 30 minutes post-operatively was 24.6 ± 0.6 , 60 minutes postoperatively was 29.1 ± 1.7 and 24 hours post operatively was 30.0 ± 0.In Group B, mean MMSE score preoperatively was 29.9 ± 0.3 , 30 minutes post-operatively was 27.7 ± 0.7, 60 minutes postoperatively was 29.6 ± 0.5 and 24 hours postoperatively was 30.0 ± 0.

Mean MMSE score was lower in group A at 30 minutes postoperative period as compared to group B in a statistically significant manner.

Discussion

Postoperative cognitive dysfunction (POCD) is a significant concern in the field of anesthesia, as it can result in delayed recovery, extended hospital stay, and decreased quality of life for patients. [7] In recent years, there has been increased interest in the use of controlled hypotension as a technique to reduce intraoperative bleeding and improve surgical conditions. However, there is growing evidence that controlled hypotension may be associated with a higher risk of POCD. [8]Our study aimed to evaluate the impact of controlled hypotension on postoperative cognitive function in patients undergoing septoplasty. Our results showed that patients in the controlled hypotension group experienced a statistically significant drop in MMSE score at 30 minutes postoperatively, while patients in the normotensive group did not experience a significant decline in cognitive function. These findings are consistent with previous studies that have reported a higher incidence of POCD in patients undergoing controlled hypotension.

Although most patients in our study returned to their baseline cognitive function within 24 hours postoperatively, the temporary decline in cognitive function is still a cause for concern, particularly in patients who may already have pre-existing cognitive impairment or who are at a higher risk of developing cognitive dysfunction. It is important for anesthesiologists to carefully weigh the potential benefits of controlled

hypotension against the risk of POCD in individual patients.

There are several possible mechanisms by which controlled hypotension may lead to POCD. One hypothesis is that reduced cerebral perfusion due to hypotension may lead to ischemic injury and neuronal damage in vulnerable brain regions. Another hypothesis is that the stress response to hypotension may activate inflammatory pathways that contribute to cognitive dysfunction. Further research is needed to better understand the underlying mechanisms of POCD in the context of controlled hypotension.

In conclusion, our study highlights the potential risks of controlled hypotension for postoperative cognitive function in patients undergoing septoplasty. While controlled hypotension may offer benefits in terms of improved surgical conditions and reduced bleeding, anesthesiologists should carefully consider the potential risks of POCD when deciding whether to use this technique in individual patients. Further research is needed to identify strategies for minimizing the risk of POCD in patients undergoing controlled hypotension.

Conclusion

This study evaluated the comparative postoperative cognitive function in patients undergoing septoplasty using controlled hypotensive and normotensive anesthesia. Cognitive dysfunction, which can impair perception, memory, and information processing, is common after surgery and can delay recovery. Hypotensive anesthesia has been in practice for decades to reduce bleeding in the surgical field and improve operating conditions. However, hypotension has been implicated as a major factor contributing to postoperative cognitive dysfunction, which presents a challenge for the anesthetist. The study enrolled thirty cases each for Group A (controlled hypotension) and Group B (normotensive group), and the hemodynamic variables such as heart rate, arterial blood pressure, and pulse oxygen saturation were recorded and studied. The study analyzed cognitive function based on MMSE score in both groups. The findings revealed that the degree of postoperative cognitive decline differed in the two groups, with a statistically significant drop in MMSE scores observed in Group A at 30 minutes postoperatively. However, all patients in Group A returned to their basal cognitive function 60 minutes postoperatively, and all but one returned to their basal cognitive function 24 hours postoperatively. The results of this study are in line with previous studies and suggest that controlled hypotensive anesthesia can lead to postoperative cognitive dysfunction, which is transient and resolves within 24 hours. The study provides valuable information for anesthetists who are faced with the challenge of balancing the need for hypotensive anesthesia and the prevention of postoperative cognitive dysfunction.

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