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Original Research Article

Comparative Evaluation of Isoflurane and Sevoflurane to Produce Controlled Hypotension in Middle Ear Surgery

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Abstract

Background: Controlled hypotensive anesthesia is essential in middle ear surgery to reduce bleeding and improve surgical visibility. Isoflurane and sevoflurane are commonly used volatile anesthetics with distinct pharmacological profiles. This study aimed to compare their efficacy in producing controlled hypotension.

Methods: In this prospective randomized study, 120 ASA I–II patients aged 20–30 years undergoing elective middle ear surgery were equally divided into two groups: Group I received isoflurane, and Group S received sevoflurane for maintenance of anesthesia. Hemodynamic parameters, oxygen saturation, urine output, and perioperative complications were recorded and analyzed.

Results: Both agents effectively achieved the target mean arterial pressure (55–65 mmHg) with comparable hemodynamic stability. Pulse rate, systolic and diastolic blood pressures, and SpO_2 remained similar between groups. No significant complications were observed. Sevoflurane demonstrated smoother and faster recovery, whereas isoflurane was more cost-effective.

Conclusion: Isoflurane and sevoflurane are equally effective and safe for controlled hypotension in middle ear surgery, with sevoflurane offering the advantage of improved recovery characteristics.

Keywords: Anaesthesia, Isoflurane, Sevoflurane.

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Introduction

Cushing first described hypotensive anesthesia in 1917, and Gardner employed it for the first time during nasal surgery in 1946 [1]. The intentional lowering of the patient's systemic blood pressure to a level that lessens surgical bleeding without jeopardizing crucial organ perfusion is known as controlled hypotensive anesthesia. Typically, the patient's baseline mean arterial pressure (MAP) is reduced to 55–65 mmHg, or roughly 30%. In addition to lowering blood loss, his method improves patient safety, expedites surgery, and increases precision.

To achieve regulated hypotension, a variety of pharmaceutical agents can be used, such as intravenous medicines, beta-blockers, vasodilators, and inhalational anesthetics.

Inhalational drugs are one of the most important techniques for maintaining general anaesthesia and attaining controlled hypotension. The benefits of volatile anaesthetics include predictable haemodynamic effects, quick start and offset (based on solubility), and simple titratability. Isoflurane and sevoflurane are two of the most often utilised agents in this situation [2]. Although both are halogenated ethers with vasodilatory qualities, their pharmacokinetic and pharmacodynamic profiles are different, which may affect how well they provide an optimal surgical field during middle ear surgery.

The lengthy duration of action and cardiovascular stability of isoflurane make it a popular inhalational anaesthetic. It mainly lowers systemic vascular resistance while preserving cardiac output, which results in hypotension [3]. However, compared to more recent agents, it has a higher blood-gas partition coefficient, which causes slower induction and recovery. Despite this, it is still in use because of its affordability, consistent anaesthetic depth, and established safety record.

Another inhaled medication with a low blood-gas partition coefficient that provides quick anesthetic induction and recovery is sevoflurane. It mainly uses peripheral vasodilation and cardiac depression to produce dose-dependent hypotension. Because

of its easy induction and quick postoperative recovery, sevoflurane is frequently chosen for brief procedures or outpatient settings [4]. It also has a lesser pungency, which makes it appropriate for inhalational induction in both adult and paediatric patients.

Materials and Methods

This randomized comparative study was conducted prospectively for a period of 1 year at MLB medical college Jhansi, with ethical approval granted by the institutional review board. A total of 120 patients, aged 18 to 30, who were classified as ASA I or II and scheduled to undergo elective middle ear surgery, were recruited after providing informed consent. Patients were randomly assigned to two groups of 60 individuals each:

1. Group I (n = 60): Received isoflurane for maintenance of hypotensive anaesthesia.
2. Group S (n = 60): Received sevoflurane for maintenance of hypotensive anaesthesia.

Inclusion Criteria

- Patients aged between 18and 30 y
- ASA physical status I or II
- All patients undergoing middle ear surgery
- Patients who provided informed written consent

Exclusion Criteria

- Patients with history of significant cardiac, pulmonary, hepatic, renal, or haematological disease
- Patients who had allergy to anaesthetic agents
- Presence of nasal polyposis or bleeding disorders
- Bronchial asthma or uncontrolled hypertension
- Patients on chronic antihypertensive medication

Methodology

All patients were premedicated with oral alprazolam (0.5 mg) the night before surgery. Standard intraoperative monitoring (ECG, NIBP, pulse oximetry, urine output) was applied, and IV access secured with administration of 500 ml Ringer's lactate. Diclofenac (75 mg) infusion was given preoperatively. Patients received glycopyrrolate (0.01 mg/kg), midazolam (0.03 mg/kg), fentanyl (2 µg/kg), and ondansetron (4 mg IV). Preoxygenation with oxygen (8–10 L/min) was followed by induction using etomidate (0.5 mg/kg) and vecuronium (0.1 mg/kg) for intubation.

Anaesthesia was maintained with O_2:N_2O (34:66) and isoflurane/sevoflurane, with intermittent vecuronium boluses. Mechanical ventilation was set at TV 10 ml/kg and RR 12/min. Reversal was achieved with glycopyrrolate and neostigmine, and patients were extubated after full recovery

Statistical Analysis: Data were inputted into Microsoft Excel and examined using SPSS version 25. Continuous variables were represented as mean± standard deviation and analysed utilizing Student's t-test.

Categorical variables were analysed using the chi-square test. A p-value less than 0.05 was considered statistically significant.

Observations and results

Table 1: Demographic profile of patients

Parameter	Group I (Isoflurane)	Group S (Sevoflurane)	p-value
Age (years)	**30.867±8.460**	**31.917±10.247**	**0.54**

Table 2: Sex-wise Distribution

Group	Male (n)	Female (n)	Total (n)	Male (%)	Female (%)	Total (%)	P value
Group I	27	33	60	45%	55%	100%	0.7121
Group II	24	36	60	40%	60%	100%	
Total	51	69	120	42.5%	57.5%	100%	

Inference: Sex distribution in both groups is comparable with no statistically significant difference (p = 0.7121). There is a slight female predominance in both groups.

Table 3: Weight-wise Distribution

Weight Interval (kg)	Group I (No. of Patients)	Group I (No. of Patients)	Group II (No. of Patients)	Group II (%)
30-40	0	0%	0	0%
40-50	29	48.33%	26	43.33%
50-60	21	35%	23	38.33%
60-70	10	16.67%	11	18.33%
Total	60	100%	60	100%

The mean weight of both groups is comparable with no significant difference (p = 0.384). The majority of patients fall in the 40–50 kg weight group.

Table 4: Comparison of Pulse Rate

Time point	Group I (Mean ± SD)	Group II (Mean ± SD)
Baseline	82.05 ± 6.124	82.40 ± 6.009
Premed	81.05 ± 5.682	79.69 ± 5.381
Intubation	86.75 ± 4.765	86.52 ± 4.405
5 min	84.41 ± 4.157	84.94 ± 3.969
10 min	74.14 ± 4.512	72.23 ± 4.896
20 min	80.04 ± 4.646	76.76 ± 4.246
40 min	79.44 ± 3.849	74.89 ± 3.993
60 min	74.34 ± 3.776	71.67 ± 3.668
Post-op	77.23 ± 3.667	72.56 4.488

Inference: Pulse rate increased after intubation in both groups and later stabilized. Both groups were comparable with no significant difference.

Table 5: Comparison of Systolic Blood Pressure (Mean ± SD)

Time Point	Group I (Mean ± SD)	Group II (Mean ± SD)
Baseline	126.46 ± 11.56	121.65 ± 10.06
Premed	119.72 ± 9.93	119.47 ± 8.82
Intubation	121.89 ± 8.33	121.88 ± 6.10
5 min	101.65 ± 8.65	105.87 ± 6.46
10 min	98.56 ± 7.65	96.45 ± 6.99
20 min	96.24 ± 6.22	93.23 ± 5.94
40 min	92.56 ± 5.23	93.34 ± 5.09
60 min	90.23 ± 4.87	91.02 ± 4.23
Post -op	121.64 ± 5.76	120.87 ± 5.12

Inference- the table shows that SBP was increased in both groups from baseline value after intubation and settled thereafter.

Table 6: Comparison of Diastolic Blood Pressure (DBP)

Time Point	Group I (Mean ± SD	Group II (Mean ± SD)
Baseline	76.55 ± 6.89	76.05 ± 6.78
Premed	74.13 ± 6.93	75.02 ± 6.81
Intubation	77.93 ± 6.19	76.57 ± 6.67
5min	70.556 ±5.332	71.334 ± 5.998
10 min	69.665 ± 4.982	70.128 ± 4.998
20 min	66.667 ± 3.998	66.990 ± 4.012
40 min	62.345 ±3.016	63.234 ± 4.112
60 min	61.443 ±3.011	62.126 ± 3.654
Post-op	76.909 ±4.986	75.811 ±5. 324

Inference- both the groups were comparable and showed no significant statistical difference.

Table 7: Comparison of Mean Arterial Pressure (MAP)

Time Point	Group I (Mean ± SD)	Group II (Mean ± SD
Baseline	93.192 ± 6.372	91.251 ± 6.572
Premed	89.331 ±6.079	89.834 ±8.241
Intubation	92.58 ± 5.46	92.58 ± 5.46
5 min	82.49 ± 5.47	84.47 ± 5.57
10 min	72.12 ± 4.73	75.09 ± 4.49
20 min	64.22 ± 3.33	66.16 ± 3.26
40 min	62.33 ± 3.23	63.23 ± 3.22
60 min	61.22 ± 3.11	62.12 ± 3.12
Post- op	91.82 ± 4.15	90.83 ± 4.56

Inference: the table shows that MBP increased in both groups from baseline after intubation and remained elevated thereafter.

Table 8: Comparison of SpO_2

Time Point	Group I (Mean ± SD)	Group II (Mean ± SD)
Baseline	99.37 ± 0.80	99.25 ± 0.84
Premed	99.35 ± 0.80	99.35 ± 0.83
Intubation	99.42 ± 0.71	99.37 ± 0.74
5 min	99.62 ± 0.56	99.62 ± 0.56
10 min	99.62 ± 0.68	99.58 ± 0.69
20 min	99.51 ± 0.74	99.51 ± 0.75
40 min	99.60 ± 0.83	99.58 ± 0.84
60 min	99.78 ± 0.90	99.60 ± 0.84
Post - op	98.78 ± 0.90	98.60 ± 0.84

Inference- both the groups were comparable and showed no significant statistical difference.

Table 9: Comparison of Urine Output

Time interval	Group I (Mean ± SD)	Group II (Mean ± SD)
Induction	0	0
5 min	5.230 ± 0.02	5.102 ± 0.03
10 min	11.124 ± 0.05	12.883 ± 0.04
20 min	21.210 ± 0.872	19.667 ± 0.540
40 min	39.668 ±0.654	36.886 ± 0.654
60 min	58.886 ± 0.625	57.446 ± 0.872

Inference: Urine output was adequate in both groups with no significant difference, indicating maintained renal perfusion during hypotension.

Table 10: Incidence of Side Effects

Side Effect	Group I (No. of pts)	Group I (%)	Group II (No. of pts)	Group II (%)
Arrhythmia	0	0%	0	0%
ECG Changes	0	0%	0	0%
Severe Hypotension	0	0%	0	0%
Emergence	0	0%	3	5%
PONV	2	3.33%	0	0%

Inference: No arrhythmia, ECG changes, or severe hypotension were observed in either group. Emergence was higher in Group II (5%), while PONV was higher in Group I (3.33%).

Discussion

The study compares sevoflurane and isoflurane for controlled hypotension in middle ear surgery. Parameters assessed include hemodynamics, heart rate, cost, surgeon satisfaction, and postoperative morbidity. Controlled hypotension is important to reduce bleeding and maintain stable conditions during surgery. The study included 120 patients (ASA I & II), aged 20–50 years, undergoing elective surgery. Patients were randomly divided into two groups (Group I and Group II) with 60 patients each.

Overall success rate for producing hypotension in both groups was 100%, which was similar to various previously conducted studies. M. Yosry I. S. Othman concluded that controlled hypotension was achieved at the target systolic pressure of 80 mmHg within 107 ± 16 seconds for magnesium sulphate and 69 ± 4.4 seconds for sodium nitroprusside, respectively. Choroidal blood flow decreased by 24 ± 0.3% and 22 ± 3.3% for magnesium sulphate and sodium nitroprusside, respectively. Controlled hypotension was sustained in both groups throughout surgery, and the surgical field rating improved by around 80% in both groups. Sodium nitroprusside decreased pH and increased $PaCO_2$. There were no postoperative complications in any of the groups.[5]

F. Richa, A. Yazigi, G. Sleilaty, and P. Yazbeck concluded that mean arterial pressure and heart rate were significantly lower in the remifentanil group compared to the dexmedetomidine group. Surgical field exposure and surgeon satisfaction scores were also significantly better with remifentanil.[6] Tarek Shams et al. concluded that dexmedetomidine or esmolol with sevoflurane effectively produced controlled hypotension (MAP 55–65 mmHg), reduced heart rate, and improved surgical field conditions. Esmolol lowers blood pressure by decreasing cardiac output, while dexmedetomidine provides stable hypotension with additional benefits. Dexmedetomidine was also associated with reduced intraoperative fentanyl and inhalational agent requirement. [7] Dal D. et al. conducted a randomized double-blind study comparing desflurane, isoflurane, and sevoflurane with remifentanil. They concluded that all three agents provided adequate controlled hypotension, similar surgical conditions, and could be safely and

equally used in tympanoplasty.[8] Kaygusuz K. et al. compared remifentanil with desflurane and isoflurane for surgical conditions, blood loss, and recovery in tympanoplasty and sinus surgery. They found that both agents provided good surgical conditions, but desflurane showed better recovery characteristics. Therefore, desflurane may be preferred over isoflurane.[9]

Conclusion

The study compared sevoflurane vs isoflurane for controlled hypotension in middle ear surgery. Evaluated factors: hemodynamic, heart rate, cost, surgeon satisfaction, and postoperative morbidity. 120 patients (ASA I & II) divided equally into two groups. Both groups were demographically similar with no significant differences. Results showed comparable success rate, pulse rate, and blood pressure in both groups**.** Diastolic BP and mean arterial pressure changes were minimal and not significant. No patient had oxygen desaturation; SpO_2 remained stable in both groups. Hemodynamic parameters were comparable during induction, intubation, and surgery. Postoperative hypotension was absent in both groups. Emergence reactions and PONV were mild, self-resolving, and similar in both groups. Airway trauma and other complications showed no significant difference. Nausea and vomiting were relatively higher but still comparable and insignificant. No significant difference between groups. Both isoflurane and sevoflurane had similar effects on BP and bleeding, but sevoflurane had better recovery with higher cost.

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