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Research Article

Comparison of Intraoperative Hemodynamic Stability, Recovery Profile Desflurane vs Sevoflurane during Anesthesia for Cranioplasty: A Randomized Trial

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Abstract

Cranioplasty is a procedure in which the bone flap is replaced after decompressive craniotomy, once the patient's condition stabilizes. Rapid recovery is important in this surgery for recognizing early complications and for immediate intervention. Newer inhalation agents such as desflurane and sevoflurane are widely used in neurosurgery. But not much research has been done for anesthetic management in elective cranioplasty patients. In our study, we compared desflurane and sevoflurane for the maintenance of anesthesia during cranioplasty.

Emergence time, extubation time, GCS and Richmond Agitation Sedation Scale (RASS) were noted. The emergence time and extubation was significantly lower in the desflurane group. RASS score at extubation, on arrival to the PACU and at 30 minutes were also lower in the desflurane group than in the sevoflurane group.

In conclusion, maintenance of anesthesia with desflurane is safe and beneficial in cranioplasty patients due to its rapid recovery, thus offering specific advantage in recognizing early complications.

Keywords: Cranioplasty; Inhalation anaesthesia; Desflurane; Sevoflurane; Recovery profile

Introduction

Decompressive craniotomy is done in patients with intracranial hypertension which involves removing a portion of the skull. Once the patient's condition stabilizes, cranioplasty (replacement of the bone flap) is performed as an elective procedure. Rapid recovery is important in cranioplasty, as it enables early post-operative neurological evaluation and prompt treatment of immediate surgical complications related to intracranial hypertension [1].

In neurosurgery, both Total Intravenous Anesthesia (TIVA) and inhalation anesthesia are used with no superiority of one technique over the other [2,3]. Newer inhalation agents with a shorter duration of action like desflurane and sevoflurane are being increasingly used by anesthesiologists in neurosurgery. The recovery profile and hemodynamic stability of desflurane is proven to be good in general [4], elderly and bariatric [5] populations.

When it comes to elective cranioplasty patients, there is insufficient evidence to show the choice of inhalation agents, and no study has been conducted in this particular group of patients. Hence, this study was carried out to compare the intraoperative hemodynamic stability, recovery profile, and readiness to discharge of patients undergoing cranioplasty from the PACU, in desflurane and sevoflurane.

Methods

Ethical approval for this study was provided by the Dubai Scientific Research Ethics Committee (DSREC) of Dubai Health Authority, Dubai, United Arab Emirates. This study was done in Rashid Hospital and Trauma Center, Dubai, United Arab Emirates.

A total of 56 consecutive patients over 18 years scheduled for cranioplasty were assessed for eligibility for the study. Patients with GCS < 15 and tracheostomized were excluded. After obtaining written informed consent, 24 patients were enrolled in this investigator-initiated prospective randomized controlled study. This sample size was determined using Yamane's formula. A simple randomization method was used by putting 24 chits in a box and picking one chit at a time when a patient meeting the inclusion criteria scheduled for surgery. They were randomly allocated to Group D (desflurane) and Group S (sevoflurane).

No sedative premedications were administered and patients were monitored according to international monitoring standards. The same anesthesia induction sequence with fentanyl (2 micrograms/kg) and propofol (2 milligrams/kg) was followed in both groups. Anesthesia was maintained with 50% air in 50% oxygen, and sevoflurane or desflurane to achieve a MAC of 1.

Fentanyl was supplemented hourly for intraoperative analgesia. Injection Paracetamol and Parecoxib were intravenously administered for analgesia one hour prior to skin closure. Intraoperative hypotension, hypertension, and bradycardia were managed according to a standardized protocol. Upon completion of the surgical wound dressing, the inhalational agents were turned off and the time was noted. The trachea was extubated when the patients met the appropriate extubation criteria. In the PACU vitals and GCS were recorded once every 5 min for the first 15 min, then every 15 min until discharge readiness was achieved using the modified Aldrete score [6]. Residual sedation was assessed using the Richmond Agitation Sedation Scale (RASS) at the time of extubation, on arrival, and 30 min in the PACU [7,8].

The emergence time is measured as the time interval between the discontinuation of the anesthetic agent and the opening of eyes spontaneously or on verbal commands. Extubation time is the interval between anesthetic agent discontinuation and tracheal extubation. After the procedure, the following factors were documented: Duration of anesthesia (time of induction to time to discontinuation of anesthetic agent), total intraoperative blood loss, total fentanyl consumption, and medications used to treat hypotension or hypertension. Statistical analyses were performed using unpaired t-test.

Patients who developed complications like major bleeding, epilepsy and those with failed extubation, were excluded from the study and the data were not considered for further evaluation.

Data is analyzed using SPSS Version 20.0 for Windows (IBM Corporation ARMONK, NY, USA). Categorical variables were presented as numbers and percentages. Normally distributed continuous variables were presented as mean with SD. When the continuous variables were skewed, we presented the median and IQR. Fisher's exact test was used to compare the categorical variables by group. Independent sample t-test or Mann-Whitney test was used to compare the continuous variables by group.

Results

A total of 24 patients were selected for this study and divided into two equal groups. Demographic data including - sex, ASA status, weight, and BMI (Table 1) showed no significant differences between the groups. The duration of anesthesia, surgery and the total amount of intraoperative fentanyl consumption was comparable between the two groups (Table 2). Hemodynamic parameters were comparable at all stages of surgery in both groups.

	Desflurane		Sevoflurane	
	Mean	SD	Mean	SD
Weight (kg)	62.1	11.2	68.8	9.6
BMI	23.5	4.1	23.3	3.6

Table 1: Anthropometric data.

	Desflurane			Sevoflurane			P value
	Median	IQR		Median	IQR		
Total Fentanyl (mcg)	425.0	325.0	500.0	500.0	325.0	500.0	0.509
Duration of Anesthesia (min)	180.0	150.0	205.0	199.0	172.5	210.0	0.172
Duration of surgery (min)	133.5	116.3	170.5	160.0	148.3	165.3	0.092

Table 2: Intra operative details.

The emergence time was significantly lower in the desflurane group mean of 5.9 ± 1.9, compared to the sevoflurane group at 15.2 ± 3.8 with P <0.001 (Table 3). The desflurane's group extubation time was significantly lower (P <0.001). GCS before shifting to the PACU, discharge readiness (min), and time to achieve preoperative GCS (min) were also lower in the desflurane group (Table 4). The emergence agitation score (RASS) at extubation was significantly lower in the desflurane group (P <0.001), while on arrival to the PACU and at 30 min were also lower in the desflurane group than in the sevoflurane group however, it was not statistically significant (Table 5).

There was no significant difference in the requirement for analgesics and the incidence of PONV in either group.

	Desflurane		Sevoflurane		P value
	Mean	SD	Mean	SD	
Emergence Time (min)	5.9	1.9	15.2	3.8	< 0.001

Table 3: Emergence time.

	Desflurane			Sevoflurane			P value
	Median	IQR		Median	IQR		
Extubation Time (min)	8.5	5.5	10.0	16.0	15.0	20.8	< 0.001
GCS before shifting to PACU	15.0	15.0	15.0	14.0	14.0	15.0	0.004
Discharge Readiness (min)	42.5	35.0	66.0	82.5	55.5	127.3	0.005
Time to achieve preop GCS (min)	0.0	0.0	0.0	12.5	0.0	30.0	0.003

Table 4: Extubation and post extubation parameters.

Emergence agitation scale (RASS)	Desflurane		Sevoflurane		P value
	-1 or -2 n (%)	0 n (%)	-1 or -2 n (%)	0 n (%)	
Extubation	2 (16.7)	10 (83.3)	12 (100.0)	-	< 0.001
PACU	2 (16.7)	10 (83.3)	8 (66.7)	4 (33.3)	0.036
30 Min	-	12 (100.0)	2 (16.7)	10 (83.3)	0.478

Table 5: RASS score.

Discussion

Despite being considered as a simple neurosurgical procedure, it can result in serious complications if not recognized early. Studies assessing the above are limited. Hence, we compared the recovery characteristics of sevoflurane and desflurane which are two short-acting inhalational agents. Our study showed that maintenance of anesthesia with desflurane when compared to sevoflurane, resulted in faster emergence, and early extubation with GCS 15 before reaching the post-anesthesia care unit (PACU). However, no statistical difference was seen in total intraoperative fentanyl consumption, duration of anesthesia, duration of surgery, incidence of hypotension and use of vasopressors.

Maintenance of anesthesia for cranioplasty involves various methods including TIVA or inhalation agents. Rapid recovery is important for immediate postoperative evaluation of neurological status. Desflurane, with its pharmacological properties of rapid recovery, is an ideal maintenance anesthetic agent in cranioplasty; therefore we decided to compare desflurane and sevoflurane as maintenance agents for cranioplasty.

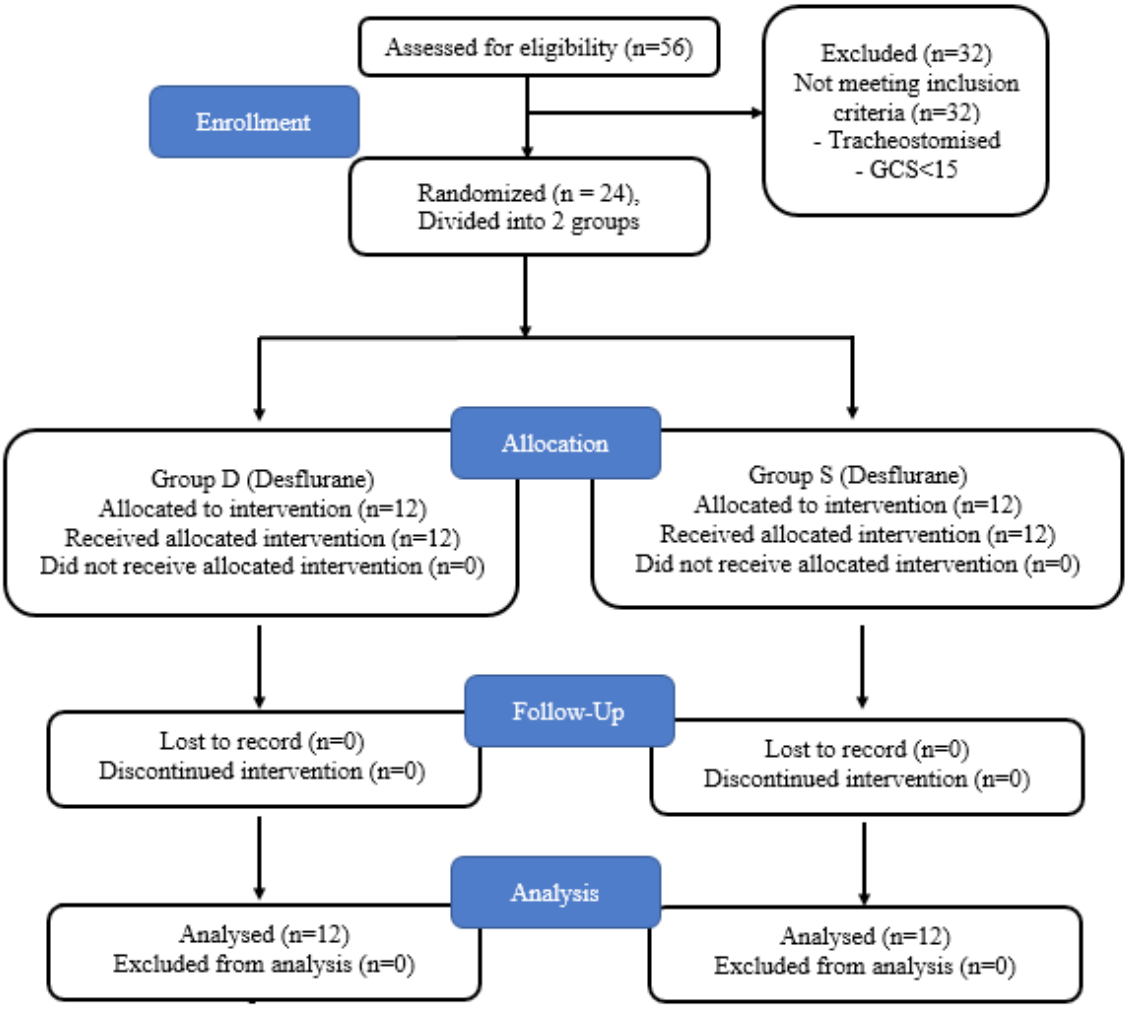
When compared to sevoflurane, our study demonstrated that anesthesia with desflurane resulted in faster and clearer recovery, resulting in early extubation of 7.5 min, emergency time was significantly lower in the desflurane group (5.9 +_ 1.9 min) than in the sevoflurane (15.2 +_ 3.8 min). Faster recovery with desflurane is due to its low blood gas solubility. These results were comparable to those of a study by Magni et al. [9], where they compared sevoflurane and desflurane were compared for anesthesia in patients undergoing craniotomy for supratentorial intracranial surgery and found that patients in the desflurane group achieved GCS score of 15 at recovery. Emergence from anesthesia (RASS) was found to be significantly better on extubation and on arrival in PACU in the desflurane group. After 30mins there was no difference in both groups. Similar findings were obtained by Magni et al while using Short Orientation Memory Concentration Test (SOMCT) scores [10]. This difference may not be significant in the general population of surgical patients; however, in patients undergoing cranioplasty, it might be helpful to detect signs of intracranial hypertension or other neurosurgical complications early, which might require immediate surgical intervention or further evaluation. However, the study done by Surya K et al. had conflicting results [11]. They found no difference between desflurane and sevoflurane with regard to postoperative recovery and hemodynamics in patients undergoing supratentorial craniotomy. This may be due to variable MAC of 0.8 and 1.2 used in their study.

Regarding intraoperative complications such as hypotension, hypertension, bradycardia, and tachycardia, there was no difference between desflurane and sevoflurane. These findings are similar to those reported by Magni et al. and Surya et al. We did not measure factors such as raised Intracranial pressure, such as swelling during the intraoperative period.

Conclusion

Our study demonstrates that maintenance of anesthesia with desflurane is safer than that with sevoflurane in patients undergoing cranioplasty. Many previous studies have compared desflurane and sevoflurane in neurosurgical patients [12-14]. Our study confirms faster recovery with desflurane compared with sevoflurane in patients undergoing cranioplasty. Immediate recovery until 30 minutes was better with desflurane, and later recovery was comparable to those of sevoflurane. This recovery profile of desflurane offers specific advantages for cranioplasty patients in recognizing early complications at the conclusion of surgery. There were no differences in complications between the groups. Even though our study was small due to the selection of the patients with a GCS score of 15 for comparison, the difference in the recovery profile was significant.

Flow Chart



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