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Original Research Paper

A Study to Evaluate the Effects of Isoflurane and Desflurane on Recovery in Patients Undergoing Surgery for Supratentorial Brain Lesions

Medical Science

KEYWORDS : NeuoAnaesthesia, inhalational anaesthetics, isofurane, desflurne

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ABSTRACT

Neuro-anaesthesia emphasizes on the provision of optimal operative conditions, preservation of neurocognitive function, and a rapid, high-quality recovery. Cerebral hyperaemia can lead to intracranial haemorrhage, edema and even confusion. Isoflurane has minimal effects on CBF and ICP while desflurane is beneficial in neurosurgical patients due to its low solubility. We conducted a study to compare 1 MAC of desflurane(group D) with that of 1 MAC of isoflurane (group I) on hemodynamics in patients undergoing excision of supratentorial mass lesion. The brain relaxation was found better with Isoflurane, with scores of 1.95 and 2.50 in group I and D respectively, showing significantly relaxed brain with isoflurane as compared to desflurane. The recovery time was found 6.25 minutes with Desflurane versus 15.50 minutes with Isoflurane.

INTRODUCTION

With the advancing neuro-anaesthesia, there is increased emphasis on the provision of optimal operative conditions, preservation of neurocognitive function, and a rapid, high-quality recovery. The aim should be quicker recovery, minimal perioperative morbidity, and reduced hospital stay. In neurosurgical procedures stressful events increase the CBF and cerebral metabolic oxygen requirement (CMRO2), resulting elevation of intracranial pressure and favouring cerebral insults. Cerebral hyperaemia can lead to intracranial haemorrhage, edema and even confusion. An extubation and recovery from general anaesthesia is even more stressful for a neurosurgical patient.[1]

Besides the aim of quicker recovery, achieving an adequate depth of anaesthesia is also desirable for preventing awareness in neurosurgical patients. Deeper planes of anaesthesia if maintained with higher dose of sedatives and hypnotics can result in delayed awakening and difficult detection of neurological deficits.[2]

The anaesthetic agents used intraoperatively should provide hemodynamic stability and should have no or minimal effect on ICP and brain swelling. “An ideal inhaled anaesthetic agent” would thus provide safe and effective anaesthesia having minimal effects on respiration and circulation. But, all of the halogenated inhalational agents available these days cause cerebral vasodilatation to some extent and thus a variable rise in ICP. Isoflurane has minimal effects on CBF and ICP. It has few advantages of causing greatest reduction in CMRO2 and may offer some protection from brain ischemia. Similarly, desflurane’s lower blood solubility(0.47) result in rapid induction and emergence. This property of desflurane is beneficial in neurosurgical patients especially elderly and obese patients.[3,4]The purpose of this study was to compare 1 MAC of desflurane with that of 1 MAC of isoflurane on hemodynamics in patients undergoing excision of supratentorial mass lesion.

MATERIAL AND METHODS

The study was conducted in department of anaesthesia of a teaching hospital after approval from hospital ethical committee. Informed consent was obtained from all participants. A total of forty patients of either sex in the age group of 16 to 65 years, having physical status class I to III American Society of Anesthetists, scheduled for elective craniotomy for supratentorial brain lesions were enrolled in the study. Patients having obesity, GCS <15, lesions extending to the infratentorial space, midline shift >0.5 cm, any planned postoperative ventilation in the ICU were excluded from the study.

Study design

It was prospective, randomised and double blind study. Randomisation was performed by keeping 40 coded slips in a box.

All the patients were examined preoperatively and details history, and systemic examination were recorded and routine investigations required were carried out. Patient was kept fasting for 6 hours prior to scheduled time of surgery. Random allocation was done into two groups comprising 20 patients each. Group I received 1 MAC of isoflurane in 50% nitrous oxide and groupD received 1 MAC desflurane in 50% nitrous oxide for maintenance of anaesthesia. In operating room monitoring comprising of electrocardiography (ECG), pulse oximeter (spO2) and invasive blood pressure monitoring was established. Anaesthetic induction was done with injection Propofol 2 mgkg-1 and vecuronium 0.1 mgkg-1. Intubation was performed using appropriate size endotracheal tube. Injection fentanyl 2 μkg-1 used for analgesia and inhalational agent started as per group allocation. End tidal carbon dioxide (etCO2), end tidal gas concentration was monitored intraoperatively. Ventilation was controlled to maintain an end tidal CO2 between 30 to 35. Normal saline was used as the maintenance fluid and a fixed dose 1gmkg-1 intravenous mannitol was infused to all patients. Subsequently temperature, urinary output and neuromuscular monitoring continued. Vecuronium infusion was continued to maintain train of four (TOF) 2 twitches. Intravenous fentanyl infusion was continued at rate of 0.5 μ kg-1hr-1 until the muscle suturing. Inhalational agent was continued till the skin suturing. At the end of surgery at TOF 0.4, the residual NM block was reversed using inj. neostigmine 0.05 mg kg-1 with inj. Glycopyrrolate 0.01 mg kg-1. Haemodynamic parameters noted were heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MAP), SpO2. EtCO2, TOF, Bispectral index (BIS), tracheal extubation time, recovery time, any emergence reaction were also recorded in all the patients. Brain relaxation score (a subjective score assessed by operating neurosurgeon after craniotomy, before incision on the dura) was also noted. It assesses the brain relaxation on a scale of 4. (Table 1)

RESULTS:

Both groups were comparable statistically in demographic profile (Table2). Hemodynamic parameters HR, SBP and DBP are shown graphically in fig 1, 2 and 3shows no statistical significant difference in both the groups. The mean brain relaxation score in group I was 1.95 and in groupD was 2.50, showing a statistically significant relaxed brain with isoflurane as compared to desflurane (P< 0.006). From awake BIS of above 90 the levels quickly fell in both groups to attain almost stable values. BIS values were significantly lower (P<0.05) in desflurane group at all the times except first 15 mins remained lower till 225 mins of surgery (Fig 4). The mean extubation time was significantly lower (2.780 minutes) and statistically significant (P< 0.001) in the desflurane group as compared to group I (4.700 minutes). The recovery time when compared in both the groups was found [6].250 minutes in groupD versus 15.500 minutes in group I. The two findings were statistically significant P < 0.001.

DISCUSSION

The preservation of hemodynamic stability in supratentorial craniotomies is crucial for postoperative morbidity and mortality. Any stressful events increase the CBF and CMRO2, potentially producing an elevation of ICP, thus favouring cerebral insults.5 We studied the effects of isoflurane and desflurane on recovery in patients undergoing surgery for supratentorial brain lesions. In our study there was no significant variation in HR and MAP in two groups. The HR were lower in the desflurane group, but difference was not significant (P>0.05). Fraga etal documented the effects of isoflurane and desflurane on intracranial pressure and cerebral arteriovenous oxygen content difference in normocapnic patients with supratentorial brain tumours. They stated that desflurane did not significantly alter CPP or arteriovenous oxygen content.[5] Few authors reported higher cerebrospinal fluid pressure (CSFP) in patients receiving desflurane but neither desflurane nor isoflurane changed ICP from baseline.[4] Study by Yildiz et al proved satisfactory hemodynamic stability using both the agents from induction till recovery, though MAP was slightly higher in desflurane group than in the isoflurane group (P <0.05).6 Zubicki et al compared the hemodynamic effects of desflurane/N_2O and isoflurane/N_2O anaesthesia in vascular surgery patients at different depths of anaesthesia. Analysis of HR and MAP was done and plasma catecholamine concentration was measured and concluded that at anaesthetic depth upto 1.5 MAC, MAP and indices of sympathetic activity decreased with both anaesthetics. The MAP response to each level of anaesthesia was similar with both volatile anaesthetics.[7]

Ornstein et al studied that concentrations 1 MAC, had the same influence on haemodynamic stability and CBF as at concentrations of 1.5 and 1.25 MAC. CBF measurements for both the agents showed that, cerebral vascular reactivity was well maintained. Hyperventilation was preceded by CBF measurement. They demonstrated that with mild to moderate hypocapnia, the effects of desflurane are similar to isoflurane in terms of absolute CBF even in higher concentrations.[8] Comparative effects of desflurane and isoflurane on lumbar cerebrospinal fluid pressure (LCSFP) and their recovery profile was studied by Kaye et al. HR, MAP, LCSFP and mean CPP values in both the groups did not vary significantly in a hypocapnic state. They showed that time of eye opening and following commands were roughly 50% shorter with desflurane, which supports our findings although the concentrations used in the studies were slightly higher.[9] The MAP was consistently lower in the desflurane group after 15 minutes of induction of general anaesthesia in our study. This seems to be more desirable in the neurosurgical patients who require lower values of CSFP. Muzzi et al administered preoperative dexamethasone in their study which may be helpful in reducing ICP but not clearly demonstrated. They suggested that factors like surgical technique may be responsible for the results, which differ from other studies.[4]

Isoflurane and desflurane are more potent intrinsic cerebral vasodilators as compared to halothane. A higher Vmca was observed with isoflurane and desflurane at concentration of 1.5 MAC than halothane, however the effects of all three were similar at 0.5 MAC. Isoflurane may be least potent cerebral vasodilator amongst the inhaled anaesthetics, attributed to its more potent cerebral depressant effect.[10]

Brain relaxation is the most important component of neurosurgery. Nearly all anaesthetic agents seem to have vasodilatory effect on the intracranial vessels. Isoflurane seems to be preferable to halothane, because lesser changes in ICP and CBF, but the effects have been questioned in various human and animal studies like study of Todd et al.11 The desflurane shown to have conflicting effects on the CBF and ICP in study of Turner et al in which desflurane can increase ICP and decrease cerebral perfusion pressure in neurosurgical patients, whereas others like Kaye et al have concluded that it does not affect the CSFP. The ICP changes can be either assessed directly by measuring with a subarachnoid catheter in situ in lumbar space or by subjective assessment of the surgical field intraoperatively by the neurosurgeon through a four point assessment score (Brain relaxation score [BRS]).9,12 Brain relaxation was assessed by an experienced neurosurgeon by subjective assessment method in our study and a better brain relaxation was found in the isoflurane group, which was statistically significant (P<0.05).

Few authors found that desflurane increases ICP and CPP, and while others documented effect only at concentrations more than 1MAC and stated that the brain relaxation becomes poorer at higher agent concentrations.4,12 Yildiz et al used 1 MAC desflurane and isoflurane anaesthesia in their patients and found no significant difference in the brain relaxation. Their assessment was also subjective, using the four point brain relaxation score.6 In our study also, the overall relaxation score was higher in desflurane group (less brain relaxation) which was supported by the previous studies done by Muzzi et al.

BIS monitoring, decrease the drug usage and hasten recovery. Long periods of deep hypnosis (BIS<40) may increase postoperative morbidity and mortality.13 In our study the BIS values were significantly lower (P<0.05) in the desflurane group at all the times except first 15 mins. Lower values of BIS were found by kim et al who studied the relationship of BIS to minimum alveolar concentration during isoflurane, sevoflurane and desflurane anaesthesia in female patients during thyroidectomy surgeries. They gave a 15 minute equilibrium period before recording the BIS values, and found that the time averaged BIS value during the study period was significantly lower with desflurane than sevoflurane (37±4.9 vs 41.5±5.9). However, the difference between desflurane and isoflurane group was not significant.[14]

The extubation time and time to eye opening was found to be quicker in the desflurane group in our study. Few studies reported smaller extubation times with desflurane in neurosurgical patients. 6,15Yildiz et al had found the extubation time of 5.37 ± 3.31 and 1.98 ± 1.11minutes in the isoflurane and desflurane group respectively. The recovery times too were almost 4 minutes shorter in the desflurane group standing at 8.52 versus 4.30 minutes in isoflurane and desflurane group respectively.[6]

Juvin et al compared emergence from prolonged desflurane, isoflurane and propofol anaesthesia. After a prolonged anaesthesia, immediate recovery times were significantly shorter with desflurane than with isoflurane or propofol. Desflurane seemed to provide a transient advantage compared to the other two agents with respect to early recovery from prolonged anaesthesia.[16]

Emergence from anaesthesia is documented to be more rapid with desflurane than with isoflurane in our study. This difference in wake up times may become more significant as duration of anaesthetic exposure increases. Thus, desflurane may be preferred in patients undergoing prolonged neurosurgical procedures. The rationale for a 'rapid awakening strategy' after craniotomy is to perform an early neurologic evaluation to diagnose postoperative neurologic complications which can limit potentially devastating consequences and improve patient outcome and have long term benefits in terms of early discharge and decreased rate of complications.[17]

Table 1
SHOWING BRAIN RELAXATION SCORE

SCORE	BRAIN RELAXATION EVALUATION
1	Excellent, no swelling
2	Minimal but acceptable swelling
3	Serious swelling but no intervention required
4	Severe brain swelling requiring intervention

TABLE 2

DEMOGRAPHIC PROFILE					
group		Age(years)	weight(kg)	Females	Males
I	Mean	45.65±11.146	59.20±7.208	12	8
D	Mean	39.35±12.617	8.629	8	8

FIG 1
SHOWING VARIATION IN PR IN BOTH GROUPS

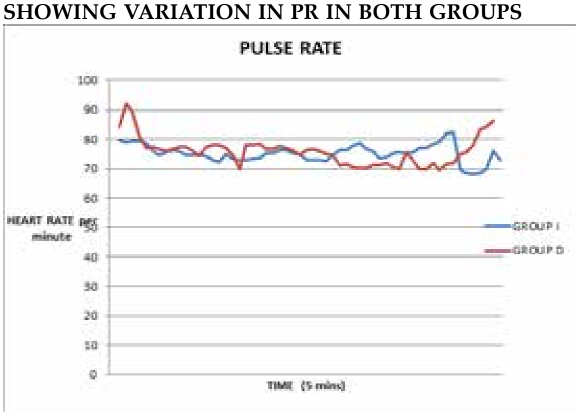


Fig 2
SHOWING VARIATION IN SBP IN BOTH GROUPS

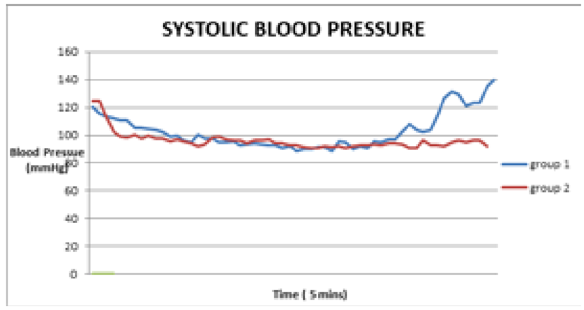


Fig 3
SHOWING VARIATION IN DBP IN BOTH GROUPS

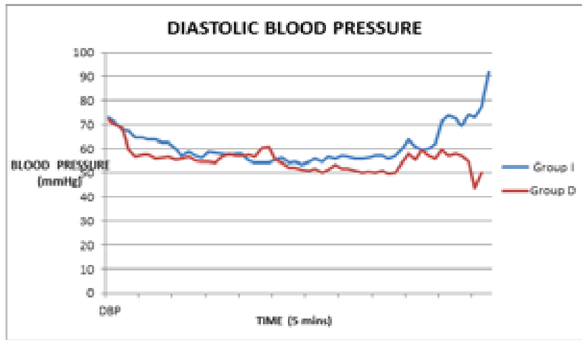
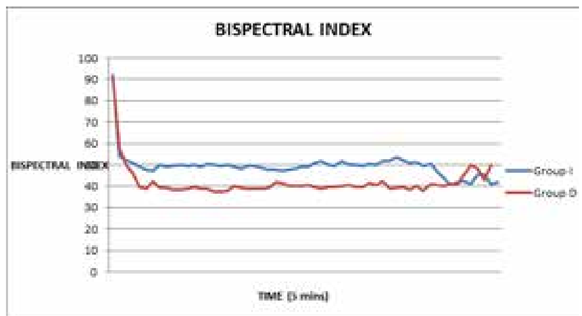


FIG 4
SHOWING VARIATION IN BIS IN BOTH GROUPS



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