A COMPARATIVE EVALUATION OF EFFECTS OF DESFLURANE AND SEVOFLURANE ANAESTHESIA ON EMERGENCE CHARACTERISTICS AND EARLY POSTOPERATIVE COGNITIVE FUNCTION AFTER NEUROSURGICAL PROCEDURES

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Abstract

Background: Timely recovery from anaesthesia is an important goal after any surgery, be it a day-care procedure or a major surgery. It ensures patient safety such that the patient is able to maintain a clear airway, exhibit protective airway reflexes and respiration as well as oxygenation are satisfactory. It decreases the risk of post-operative cognitive dysfunction. It may also facilitate early transfer of the patient from the operating room and the post-anaesthesia care unit and hence reduce costs4. One of the major factors determining the speed of recovery from anaesthesia is the choice of anaesthetic technique. An ideal general anaesthetic should provide smooth and rapid induction, optimal operating conditions and rapid recovery with minimal side effects. Newer less soluble inhalational agents such as desflurane and sevoflurane are now available. They allow rapid recovery from anaesthesia compared to the traditional inhalational agents and intravenous agents.

Aim and Objectives: To comparatively assess recovery characteristics following desflurane and sevoflurane anaesthesia in neurosurgery patients, to comparatively evaluate the early post-operative cognitive function between both the groups and to assess and compare postoperative adverse events.

Materials and Methods: The patients were divided into two groups using Block Randomisation in blocks of four patients each. Group S- received Sevoflurane as maintenance anaesthetic agent and Group D- received Desflurane as maintenance anaesthetic agent. The following parameters for each patient were noted and compared: Haemodynamic variations in the two groups, Emergence characteristics i.e. time from discontinuing nitrous oxide and inhalational agent to Eye Opening, following commands, Hand squeeze, Tracheal extubation, Orientation to place and person. Pre- and Postoperative scores of the cognitive function tests (SOMCT, DSST and TDT) at 30, 60 and 90 minutes and Postoperative adverse events, if any. Statistical analysis was done using paired and unpaired student's t-test, chi square test and Mann-Whitney tests. For all statistical comparisons in this study, $p<0.05$ was taken as significant.

Discussion and Conclusion: It can be concluded that newer inhalational agents, desflurane and sevoflurane, both provide rapid emergence and faster recovery of cognitive functions postoperatively. Desflurane, compared to sevoflurane, is associated with a more rapid awakening, earlier return of orientation and less cognitive function impairment in neurosurgical procedures. The earlier awakening, orientation and more rapid recovery after desflurane might have a significant beneficial effect in neurosurgical patients as postoperative neurological assessment can be performed early and complications can be suspected and diagnosed quicker.

Key-words: desflurane, sevoflurane, neurosurgery, eye opening, hand squeezing, tracheal extubation and cognitive function tests

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INTRODUCTION:

Timely recovery from anaesthesia is an important goal after any surgery, be it a day-care procedure or a major surgery. It ensures patient safety such that the patient is able to maintain a clear airway, exhibit protective airway reflexes and respiration as well as oxygenation are satisfactory [1]. It decreases the risk of post-operative cognitive dysfunction [2,3]. It may also facilitate early transfer of the patient from the operating room and the post-anaesthesia care unit and hence reduce costs [4].

One of the major factors determining the speed of recovery from anaesthesia is the choice of anaesthetic technique. An ideal general anaesthetic should provide smooth and rapid induction, optimal operating conditions and rapid recovery with minimal side effects. Newer less soluble inhalational agents such as desflurane and sevoflurane are now available. They allow rapid recovery from anaesthesia compared to the traditional inhalational agents and intravenous agents [5].

Early postoperative recovery of neurologic and cognitive functions is an important goal after neurosurgical procedures. It expedites diagnosis of life threatening complications such as intracranial haematoma or cerebral oedema [6]. Early neurological evaluation helps distinguishing which patient has a new neurological deficit and would require a specialised diagnostic test or even an emergent intervention [7]. Also, patients with rapid recovery have less cognitive impairment (eg. delirium, confusion) making the assessment findings more reliable. Rapid recovery does not necessarily translate to earlier discharge from the post-anaesthesia care unit (PACU). For neurosurgical patients, prolonged postoperative monitoring is needed for surgical reasons [2].

In this group of patients, it is the ability to perform early neurological assessment, rather than the duration of the PACU stay, which is the major clinical concern [1]. Sevoflurane and desflurane are valuable in neuro anaesthesiology. These highly fluorinated ethers are very insoluble which extends a kinetic advantage. Given their low blood:gas and fat:blood partition coefficients, there is more rapid equilibration between inspired and alveolar concentrations of anaesthetic during wash-in and wash-out period. This results in easy intraoperative titratability and rapid return to awareness and ability to follow commands [8]. Cerebral haemodynamic and metabolic effects of desflurane and sevoflurane are comparable with those of isoflurane [9,10].

Although numerous studies have been conducted on desflurane and sevoflurane, there is still a paucity of studies comparing their use in neurosurgical procedures. Hence the present study was undertaken to comparatively evaluate the effects of either of these agents on the emergence characteristics and early post-operative cognitive functions when used as maintenance agents during various neurosurgical procedures.

OBJECTIVES: The objectives of the study include

1. To comparatively assess recovery characteristics following des flurane and sevoflurane anaesthesia in neurosurgery patients.
2. To comparatively evaluate the early post-operative cognitive function between both the groups.
3. To assess and compare postoperative adverse events.

MATERIALS AND METHODS:

The present prospective, randomised, observer blinded, two-arm comparative study was conducted to evaluate the effects of desflurane and sevoflurane anaesthesia on recovery characteristics and postoperative cognitive functions in neurosurgical patients.

Inclusion criteria: Sixty adult patients undergoing craniotomy under general anaesthesia were studied. The patients who satisfied the following criteria were included in the study: ASA risk status I/II/III, Age 18 to 65 years, Either sex, GCS (Glasgow Coma Scale) 15/15.

Exclusion criteria: The patients satisfying any of the following criteria were excluded from the study: Unwilling to participate in the study, Duration of surgery more than 6 hours, Inability to perform cognitive function tests, Severe coronary, pulmonary, hepatic or renal disease, Pregnant or Lactating females, Morbid Obesity (BMI $\geq$35), Surgeries where use of nitrous oxide is contra-indicated, Known personal or family history of malignant hyperthermia, Surgeries where patients would be electively put on ventilator support post-operatively The patients were divided into two groups using Block Randomisation in blocks of four patients each. Group S- received Sevoflurane as maintenance anaesthetic agent and Group D- received Desflurane as maintenance anaesthetic agent. The following parameters for each patient

were noted and compared: Haemodynamic variations in the two groups, Emergence characteristics i.e. time from discontinuing nitrous oxide and inhalational agent to Eye Opening, following commands, Hand squeeze, Tracheal extubation, Orientation to place and person.

Pre- and Postoperative scores of the cognitive function tests (SOMCT, DSST and TDT) at 30, 60 and 90 minutes and Postoperative adverse events, if any.

Statistical analysis was done using paired and unpaired student's t-test, chi square test and Mann-Whitney tests. For all statistical comparisons in this study, $p<0.05$ was taken as significant.

RESULTS:

Table 1: Shows age wise and gender wise distribution of study population

Parameter		Group S	Group D	p Value
Age(Yrs)	**Mean ± S.D.**	34.27 ± 12.36	36.2 ± 14.28	0.690
Weight(Kg)	**Mean ± S.D.**	57.90 ± 9.66	56.33 ± 10.66	0.399
Sex	**Male**	22	21	0.774
	Female	8	9	

Table 2: Shows duration of anaesthesia in each group

Study Parameter		Group S (n=30)	Group D(n=30)	p Value
Duration of anaes.(min)	**Mean ±S.D.**	190.5 ± 81.84	197.5 ± 75.96	0.636

Table 3: Shows Emergence Characteristics

Time from discontinuing agent to(min)		Group S (n=30)	Group D (n=30)	p Value
Eye opening	**Mean ± S.D.**	13.43 ± 3.02	9.23 ± 2.25	0.000*
Obeying commands	**Mean ± S.D.**	17.03 ± 3.74	11.60 ± 2.86	0.000*
Hand Squeeze	**Mean ± S.D.**	17.53 ± 3.48	12.27 ± 3.13	0.000*
Tracheal extubation	**Mean ± S.D.**	18.67 ± 3.92	13.47 ± 3.63	0.000*
Orientation to place &person	**Mean ± S.D.**	23.3 ± 4.22	16.73 ± 4.06	0.000*

Table 4: Short Orientation Memory Concentration Test (SOMCT)

SOMCT score (out of28)	Group S (n=30)		Group D (n=30)		p Value
	Mean ± S.D.	**Median ± IQR**	**Mean ± S.D.**	**Median ± IQR**	
Baseline	27.73 ± 0.87	28.00 ± 0.00	27.70 ± 0.95	28.00 ± 0.00	0.988
30 min	23.10 ± 4.05	24.00 ± 4.00#	25.47 ± 1.80	26.00 ± 3.00#	0.004*
60 min	24.77 ± 3.53	25.50 ± 3.00#	26.87 ± 1.53	28.00 ± 2.00#	0.003*
90 min	27.23 ± 1.43	28.00 ± 1.00#	27.70 ± .95	28.00 ± 0.00	0.271

Table 5: Digit Symbol Substitution Test (DSST)

DSST score (out of 10)	Group S (n=30)		Group D (n=30)		p Value
	Mean ±S.D.	**Median ±IQR**	**Mean ±S.D.**	**Median ±IQR**	
Baseline	10.00±0.00	10.00±0.00	10.00±0.00	10.00±0.00	1.000
30 min	7.07±1.72	8.00±2.00#	9.00±1.14	10.00±2.00#	0.000*
60 min	8.80±1.45	9.00±2.00#	9.73±0.69	10.00±0.00	0.012*
90 min	9.80±0.61	10.00±0.00	10.00±0.00	10.00±0.00	0.506

Table 6: Trieger Dot Test (TDT) Number of dots missed

TDT (No. ofdots missed)	Group S		Group D (n=30)		p Value
	Mean ±S.D.	**Median ±IQR**	**Mean ±S.D.**	**Median ±IQR**	
Baseline	0.50±1.04 (n=30)	0.00±0.00	0.20±0.55	0.00±0.00	0.460
30 min	4.29±1.48 (n=27)	4.00±1.00#	3.37±1.00	3.00±1.00#	0.007*
60 min	3.30±1.07 (n=27)	3.00±2.00#	2.33±0.99	2.00±1.00#	0.003*
90 min	1.24±1.24 (n=29)	1.00±2.00#	0.77±0.90	0.50±1.00#	0.185

Table 7: Trieger Dot Test (TDT) Line-dot distance

TDT (Line- dot distin mm)	Group S		Group D (n=30)		p Value
	Mean ±S.D.	Median ±IQR	Mean ±S.D.	Median ±IQR	
Baseline	0.69±2.00 (n=30)	0.00±0.00	0.23±0.63	0.00±0.00	0.606
30 min	12.37±5.99 (n=27)	12.00±6.00#	7.40±3.02	7.50±2.00#	0.000*
60 min	8.59±3.69 (n=27)	9.00±4.00#	4.60±2.18	4.00±3.00#	0.000*
90 min	2.21±2.94 (n=29)	2.00±4.00#	0.97±1.38	0.50±2.00#	0.217

Table 6.12: Postoperative adverse events

Adverse event	Group S	Group D
Confusion on emergence	1	1
Delirium	0	0
Nausea, Vomiting	2	0
Dizziness	3	1
Coughing	0	1
Significant hypertension	0	0
Significant hypotension	0	0
Desaturation	0	0
Arrhythmias	0	0
Any other	0	0

DISCUSSION:

Wakening the patient is as important as sending them to sleep especially in neuroanaesthesia. In neurosurgical patients, complete awakening and orientation allows early evaluation for neurological complications. Early awakening can be achieved with use of the newer inhalational agents such as desflurane and sevoflurane as they undergo rapid elimination from the body. This study was conducted to comparativelyevaluate the effects of desflurane and sevoflurane on emergence characteristics and postoperative cognitive functions after neurosurgical procedures. It was a prospective, randomised, observer blinded, two-arm comparative study. Sixty consenting patients, with ASA status I/II/III and GCS 15/15, undergoing craniotomy under general anaesthesia were included in thestudy. They were divided into two groups of 30 patients each, Group S and D received sevoflurane and desflurane respectively as the maintenance anaesthetic agent with nitrous oxide.In the preoperative holding area, patients were explained and asked to perform the three cognitive function tests after obtaining their consent. The baseline scores of the Short Orientation Memory Concentration Test (SOMCT), Digit Symbol Substitution Test (DSST) and Trieger Dot Test (TDT)were noted. After confirming adequate starvation and attaching non-invasive monitors, all patients were pre-medicated with Inj. Glycopyrrolate 0.004mg/kg, Inj. Fentanyl Citrate 1-2 µg/kg and Inj. Midazolam hydrochloride 0.0 mg/kg intravenously. Anaesthesia was induced with Inj. Thiopentone sodium,5 mg/kg. Neuromuscular blockade was achieved with Inj. Vecuronium Bromide 0.1 mg/kg. The patients in Group S were maintained on oxygen + nitrous oxide + sevoflurane 0.6-1.75% and the patients in Group D were maintained on oxygen + nitrous oxide + desflurane 2-6% with vecuronium infusion. Vecuronium infusion was switched off approximately half an hour before the end of the surgery. Sevoflurane or desflurane were discontinued along with N_2O at the end of surgery. Emergence characteristics were assessed at 60 seconds' intervals and noted by an observer blinded to the maintenance agent. Postoperatively SOMCT, DSST and TDT were performed at 30, 60, and 90 minutes after extubation by the same observer. If any such intraoperative event occurred which warranted postoperative ventilatory support, the patient was withdrawn from the study. The following parameters for each patient were noted and compared:

Haemodynamic variations in the two groups, Emergence characteristics i.e. time from discontinuing nitrous oxideand inhalational agent to Eye Opening, following commands, Hand squeeze, Tracheal extubation, Orientation to place and person, Pre- and Postoperative scores of the cognitive function tests (SOMCT, DSST and TDT) at 30, 60 and 90 minutes, Postoperative adverse events, if any. Both the groups were comparable in terms of the demographic data, baseline vital parameters and baseline scores of cognitive function tests. Desflurane group had faster emergence compared to sevoflurane leading to earlier extubation and orientation. Patients receiving desflurane performed the cognitive function tests better than those who received sevoflurane at 30 and 60 minutes post-operatively. The performance was similar at 90 minutes. Thus, they had lesser cognitive

impairment compared to those who received sevoflurane. Intraoperative haemodynamics and postoperative complicationswere similar in both the groups. The desflurane group had significantly faster emergence timings as a result of which they attained orientation earlier. Thus, it was possible to suspect and detect any neurological complications in the early postoperativeperiod. Also, patients from both the groups were able to perform the cognitive function tests as early as 30 minutes. Patients receiving desflurane scored significantly higher in all three cognitive function tests done 30 and 60 minutespostoperatively. The findings of our study are in accordance with the studies conducted in the past [11-17].

CONCLUSION:

Our study concludes that the newer inhalational agents, desflurane and sevoflurane, both provide rapid emergence and faster recovery of cognitive functions postoperatively. Desflurane, compared to sevoflurane, is associated with a more rapid awakening, earlier return of orientation and less cognitive function impairment in neurosurgical procedures. The earlier awakening, orientation and more rapid recovery after desflurane might have a significant beneficial effect in neurosurgical patients as postoperative neurological assessment can be performed early and complications can be suspected and diagnosed quicker.

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