Comparative Study of Recovery after Sevoflurane versus Halothane Anaesthesia in Adult Patients

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Abstract

Background: Induction and maintenance characteristics of sevoflurane and halothane have been studied, but little work has been done to compare the postoperative recovery of these two agents.

Methods: Sixty adult, ASA I and II patients were allocated randomly into Group A and Group B of 30 each. Group A received sevoflurane and Group B received halothane for maintenance. At the end of surgery early recovery, intermediate recovery and discharge criteria were assessed.

Results: Early recovery assessed with the mean time to extubation was 6.7 ± 2.29 min in Group A and 9.07 ± 1.64 min in Group B; eye opening was 7.28 ± 2.3 min in Group A and 10.6 ± 1.77 min in Group B; response to verbal command was 8.52 ± 2.83 min in Group A and 12.33 ± 2.17 min in Group B, while orientation was 10.43 ± 3.15 min in Group A and 14.77 ± 2.66 min in Group B. These differences were statistically significant ($p < 0.001$). The mean time to reach post anaesthesia care unit discharge criteria was shorter for Group A (21.1 ± 4.69 min) as compared to Group B (27.43 ± 6.51 min) and this difference was statistically significant ($p < 0.001$).

Conclusion: Early recovery time and time taken to achieve discharge criteria were faster with sevoflurane.

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Key Words : Sevoflurane; Halothane; Post-operative recovery

Introduction

As the practice of anaesthesia introduces newer drugs which provide rapid and smooth anaesthetic induction, reliable intra-operative analgesia and amnesia, the role of emergence from anaesthesia has become important. This is especially true for pediatric anaesthesia, day care surgery and prolonged surgery in which the quality of the anaesthetic emergence is important for both the patient and the anaesthesia care provider.

Sevoflurane is a desirable anaesthetic for induction and maintenance because of its low blood-gas solubility, rapid-induction and emergence characteristics, nonirritating airway properties and stable patient hemodynamic characteristics. Rapid recovery is desirable, to ensure early efficient coughing and to decrease the rate of postoperative respiratory complications. We conducted this study to compare the characteristics of postoperative recovery of adult patients who had received either sevoflurane or halothane for maintenance of anaesthesia.

Material and Methods

Sixty adult patients were studied after obtaining the requisite Hospital Ethical Committee approval and written

informed consent from all eligible patients. These patients were allocated randomly into Group A and Group B of 30 each. Anaesthesia in Group A was maintained with sevoflurane while in Group B it was maintained with halothane. Inclusion criteria were adult patients aged between 18-55 years, ASA-I and 2 physical status, scheduled for elective surgeries under general anaesthesia (GA) lasting approximately one and half hours or more and those admitted for 24 hours after surgery. Patients with significant coronary artery disease, chronic pulmonary disease, renal failure, hepatic dysfunction, morbid obesity, hematocrit less than 25%, personal or family history of malignant hyperthermia, exposure to GA agents in previous seven days and any contraindication for using nitrous oxide were excluded.

All patients were examined one day prior to surgery and standard institutional preoperative advice was given. The P-deletion test was used to assess the early recovery. In this patient was asked to identify P's in lines of 100 random letters in a duration of three minutes. Digit Symbol Substitution Test (DSST) was used to assess baseline recovery test. In this test, the patient was asked to replace random digits of 0-9 by symbols given in the test paper. The score is calculated as the number of correctly substituted digits in 120s. Patients were asked to take DSST and P-deletion tests before premedication, every 10 minutes (min) in post anaesthesia care unit (PACU) until discharged. On day of surgery, base

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line recording of heart rate, arterial blood pressure, temperature and respiratory rate was done before anaesthesia. Patients were premedicated with injection fentanyl 12 mcg/kg intravenous (IV) and injection glycopyrrolate 0.2 mg IV. Induction was done with injection propofol 2 mg/kg IV. Patients were intubated with injection succinylcholine 2 mg/kg IV. Maintenance of anaesthesia in Group A was done with sevoflurane 0.6-1.75% and in Group B with halothane 0.2-0.8% alongwith nitrous oxide and oxygen in the ratio of 3:2. Brief adjustments were permitted in response to drastic changes in haemodynamic variables (>20% change from baseline). However, the initial response to this degree of hypotension was intravascular volume expansion or a small dose of a vasopressor (5-15 mg ephedrine IV or 30-100 mg phenylephrine IV). Neuromuscular blockade was provided

Table 1
Modified post-anaesthesia discharge scoring system

Vital signs must be stable consistent with age and preoperative base line	
Blood pressure & pulse within 20% of preoperative baseline	2
Blood pressure & pulse within 40% of preoperative baseline	1
Blood pressure & pulse >40% of preoperative baseline	0
The patient must have minimal nausea vomiting prior to discharge	
Minimal	2
Moderate	1
Severe	0
The patient should have no pain or minimal pain prior to discharge	
The level of pain that the patient has should be acceptable to the patient	
The location, type, intensity of pain should be consistent with the anticipated postoperative discomfort.	
Acceptability	
Yes	2
No	1
Postoperative bleeding be consistent with the expected blood loss for the procedure	
Minimal: Does not require dressing change	2
Moderate: Up to two dressing changes required	1
Severe: More than three dressing changes required	0

Table 2
Comparison of mean values of two groups

Variable	Sevoflurane (n=30)		Halothane (n=30)		t value	p value
	Mean	SD	Mean	SD		
Age	37.03	10.2	32.8	9.64	1.65	0.1
Weight	56.13	8.67	59.77	8.68	1.62	0.11
Total anaesthesia time	108.2	18.3	111.07	17.68	0.63	0.54
Total surgical duration	100.6	17.3	104.07	17.77	0.76	0.45
Time to extubation	6.7	2.29	9.07	1.64	4.6	p<0.001
Time to eye opening	7.28	2.3	10.6	1.77	6.26	p<0.001
Time to verbal command	8.52	2.83	12.33	2.17	5.86	p<0.001
Time to orientation	10.43	3.15	14.77	2.66	5.76	p<0.001
P deletion at 10 minutes	91.33	13.1	84.5	19.45	1.6	0.12
DSST at 10 minutes	91.33	11.4	99	134.37	0.31	0.76
MP DSS at 10 minutes	7.27	0.78	6.97	0.67	1.59	0.12
P deletion at 20 minutes*	95	7.07	93.75	4.43	0.32	0.75
DSST at 20 minutes*	90	14.1	81.88	5.3	1.46	0.18
MP DSS at 20 minutes*	7	0	7	0	1.62	0.11
Time taken to post-anaesth discharge criteria	21.1	4.69	27.43	6.51	4.32	p<0.001

* n=2 for sevoflurane group and n= 8 for halothane group

using incremental doses vecuronium, with the dosage guided by neuromuscular monitoring. Depth of anaesthesia was adequately maintained and intraoperative complications, if any were dealt as per institutional protocol. Intraoperatively monitoring aids included non invasive blood pressure (NIBP), pulse oximetry, electrocardiograph (ECG), EtCO₂, nitrous oxide and volatile anaesthetic concentration. A trained, independent observer who was not administering the anaesthesia, recorded data throughout the preoperative, operative, emergence, and recovery periods. The following data was recorded; total anaesthesia time from administration of induction agent to stopping of the volatile agent; total surgical duration from skin incision to the placement of last suture; time to extubation from discontinuation of volatile agent; early recovery; time to awakening (eye opening); time to verbal command (squeeze finger); time to orientation (place, time, date); time taken to discharge the patient from post-operating care room, when DSST and P-deletion scores are more than 75%; time to achieve modified post anaesthesia discharge scores (MPDSS) of more than 6 (Table 1).

The student's t-test and chi square test were done to determine the statistical significance of the difference between the two groups.

Results

Sixty patients in the age group 18-55 years, of either sex participated in the study. Majority were in ASA-I. The details of data collected from the two groups is shown in Table 2. The mean time to extubation was lower in Group A as compared with Group B and this difference was statistically significant (p<0.001). The mean time to eye opening, verbal command, orientation were significantly (statistically) increased in Group B. The average p-deletion scores and DSST at 10 minutes was higher in Group A but was not statistically significant (Table 2). However P-deletion scores and DSSR scores at 20 minutes between the groups were statistically significant (p<0.05). The average (MPDSS)

scores at 10 minutes was higher in Group A, however this difference was not statistically significant ($p=0.12$), and at 20 minutes there was no difference between the two groups. The average time to PACU discharge criteria was lower in Group A and this difference was statistically significant ($p<0.001$).

Discussion

The rapidity of recovery from inhalation anaesthesia depends on the solubility of the volatile anaesthetics. The blood/gas partition coefficient of sevoflurane is 0.69, which is comparable to that of nitrous oxide (0.46) and halothane (2.54) [1]. Our study demonstrated that the time required for emergence and recovery in patients anaesthetized with sevoflurane and nitrous oxide were significantly shorter than those in patients receiving halothane and nitrous oxide. The study was designed only to assess the recovery from anaesthesia and not the side effects of the volatile agents e.g. incidence of vomiting, effect on postoperative pain etc. The results indicate that the use of sevoflurane may reduce hospital stay.

The low incidence of postoperative vomiting in pediatric anaesthesia and day care surgeries with the use of sevoflurane, should encourage its usage [2,3]. Both these study indicate incidence of postoperative vomiting between 15-55%. The reason for this wide margin depends on patient factors, type of surgery, duration of surgery etc. Emergence from anaesthesia was significantly faster in patients receiving sevoflurane (with or without nitrous oxide) than in patients receiving halothane and nitrous oxide. Time to attain discharge criteria from the recovery room with patients receiving sevoflurane occurred significantly earlier than with those receiving halothane. Among the paediatric patients not receiving intraoperative analgesics, those maintained with sevoflurane required postoperative analgesics earlier than those who received halothane. The earlier time for extubation, requirement of analgesics and discharge readiness suggest that sevoflurane provided more rapid emergence and earlier awakening than halothane [4]. In a separate study sevoflurane was compared with propofol for induction and maintenance of anaesthesia [5]. Inhalation induction of anaesthesia with sevoflurane was slower than an intravenous induction with propofol but was equally well tolerated by non premedicated outpatients. Emergence and recovery characteristics were not altered by the induction or maintenance anaesthetic drugs used in this study. Thus, sevoflurane appears to be a useful alternative to propofol for induction and/or maintenance of general anaesthesia during ambulatory surgery.

In our study early recovery in sevoflurane group was

shorter when compared to study done by Heavener et al [6], probably due to the fact that our study did not include elderly patients and the duration of anaesthesia was 108 minutes as compared to 159 minutes in Heavener's study. Moore et al [7], compared recovery characteristics in pediatric day care surgery using sevoflurane and halothane for maintenance and the discharge time was shorter in sevoflurane group [7]. The discharge time in our study is in agreement with the above study, however we did not include paediatric patients. The recovery of cognitive function after general anaesthesia with desflurane and sevoflurane in elderly patients was compared by Xiaoguang et al [8]. Recovery with sevoflurane group was mildly delayed when compared to our study [8]. In the study done by Welborn et al [9], the mean time to reach PACU discharge criteria in halothane group was 29 minutes, which is in agreement with our time of 27.43 minutes.

Sale et al [10], concluded that infants woke up faster from general anaesthesia when maintained with desflurane as compared to sevoflurane, but there was no difference in postoperative respiratory events between the groups. Mayer et al [11], concluded that the use of desflurane for maintenance of anaesthesia after sevoflurane induction in children is associated with less severe emergence agitation and faster emergence. Macario et al [12], concluded that patients receiving desflurane recovered one to two minutes earlier in the operating room than patients receiving sevoflurane. No significant differences were detected in the Phase I or II PACU recovery times or in the rate of PONV. Weldon et al [13], found that emergence agitation appears to be an early and transient phenomenon after sevoflurane anaesthesia in children with effective postoperative analgesia as compared to halothane.

No studies comparing halothane and sevoflurane for their recovery characteristics in adult patients undergoing prolonged surgery could be found in recent literature. Most studies have been done comparing these agents in paediatric and elderly patients undergoing ambulatory surgery. The use of sevoflurane for prolonged surgeries is costly. However, cost analysis mode developed by Duke University, demonstrated that the comparable maintenance drug cost was similar for isoflurane, desflurane and sevoflurane for surgeries lasting up to one hour. Sevoflurane provides a more precise control over the delivery of anaesthesia and a rapid recovery from anaesthesia due to its lower solubilities permit.

In conclusion, clinical efficacy of sevoflurane lies in terms of faster postoperative recovery, reduction in operating room time and post-operative care discharge time, leading to reduced hospital stay of patients.

Conflicts of Interest

None identified

Intellectual Contribution of Authors

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Book Review

SK Adaval, editor. Fatal Aircraft Accidents: A Pathologist's Notebook. KW Publishers Pvt Ltd. 1st edition. Hardbound. Pages 183, Price Rs 620/-, ISBN Number 978-81-87966-77-7.

This book comprehensively addresses various aspects of aviation pathology with emphasis on the investigation of fatal aircraft accidents. The book is divided in two parts, the first on pathology and the second on applied toxicology. The first part is divided into 10 chapters and focuses on concepts of aviation pathology, autopsy techniques including histopathology, injury analysis, collection and storage of specimens and is well illustrated with specific incidents of airline disasters in India and abroad. The second part on applied toxicology is divided into four chapters and highlights the toxic hazards in aircrafts with specific chapters on exposure to carbon monoxide and alcohol and drug detection techniques.

The book is well written and easy to read with a natural flow of prose bringing out the relevant aspects of aviation air accident pathology and designed for practicing pathologists. The content is presented in a methodical fashion with adequate coverage of

procedures and laboratory techniques as well as the method of correlation with accident details and antecedent circumstances. Service pathologists often need to perform autopsies and tackle the intricacies of aviation pathology in unfamiliar settings and this book will serve as a useful reference. This book also adds to the existing literature on the subject and the author has effectively elaborated on the text with his personal experiences. Useful examples of correlation of accident details with autopsy findings have been provided as well as an adequate list of references for those interested in in-depth study

This book will benefit pathology libraries in our hospitals and is worthy of possession by every practicing pathologist of the Armed Forces Medical Services.

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