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Research Communication

COMPARISON OF EMERGENCE AND RECOVERY CHARACTERISTICS OF SEVOFLURANE AND DESFLURANE IN PEDIATRIC PATIENTS UNDERGOING AMBULATORY SURGERY

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Abstract
Introduction: *Emergence and recovery is a common problem after general anesthesia especially in the pediatric age group. Sevoflurane and desflurane both provide smooth and rapid recovery with minimal side effects. So we decided to compare both agents in terms of emergence and recovery characteristics to find out the better agent.*
Materials and methods: *This prospective, randomized, double blind study involved 80 children divided into two groups (n=40 each). Patients were induced with IV propofol 2mg/kg, fentanyl 2 µg/kg and inj atracurium 0.5mg/kg. Group I was maintained with oxygen: air: sevoflurane and group II on oxygen: air: desflurane. Emergence time defined as the time from discontinuation of anesthetics to extubation. Recovery time was measured from the time of discontinuation of anesthetic until the achievement of Steward Recovery Score of 6.*
Results: *Desflurane exhibited shorter emergence (5.85 ± 1.21 vs 11.75 ± 1.84 min) and recovery time (11.7 ± 2.08 vs 20 ± 3.06 min) as compared to sevoflurane. PAED scale score for desflurane was significantly higher (3.35 ± 0.92) compared to that of sevoflurane (1.75 ±0.71) implying higher incidence of agitation and excitement than sevoflurane.*
Conclusion: *We recommend use of sevoflurane in pediatric patients for ambulatory surgery in view of less incidence of emergence delirium than desflurane.*

Introduction

An ideal general anesthetic for day care surgeries should provide smooth and rapid induction, optimal operating conditions, and rapid recovery with minimal side effects like nausea, vomiting, bleeding and postoperative pain.[1] Given the low blood: gas partition coefficient of sevoflurane and desflurane, faster emergence from anesthesia is expected compared to traditional inhalation anesthetic.[2-4] Emergence and recovery is a common problem after general anesthesia especially in the pediatric age group. Sevoflurane and desflurane both provide smooth and rapid recovery with minimal side effects. So we decided to compare both agents in terms of emergence and recovery characteristics to find out the better agent. Ambulatory surgery fulfils the need of a current medical era where time is money. Ambulatory day care surgery offers numerous advantages like shorter hospital stay, fixed scheduling which reduces cancellations by patients and thus more efficient operation theatre use, reduced disruption of patients daily routine, decrease in both the time taken to perform surgical procedures and their costs. These are particularly important in developing countries like India where huge number of patients outnumbers health care facilities. The advances in surgery, anesthesia and pain management have allowed huge expansion of this modality of care with a consequent reduction in the need for hospitalization. [5-7] Outpatient surgery has many advantages in pediatric settings also. It decreases separation anxiety, promotes parental involvement in the child's postoperative care and decreases the risk of nosocomial infections.[8]

Aims and Objectives

The purpose of this prospective randomized study was to evaluate and compare emergence and recovery characteristics of Sevoflurane and Desflurane for outpatient pediatric surgical procedures.

Materials and Methods

After institutional ethics committee approval and informed written consent of parents/guardian, 80 children undergoing ambulatory surgery were randomly divided by sealed envelope technique into two groups (n=40 each) viz. group I (receiving sevoflurane) and group II (desflurane). All ASA III/IV patients, ex preterm infants, child having Obstructive Sleep Apnea, Asthma, Congenital heart disease, Obesity, Mental retardation, Recent history of Respiratory tract infection and less than 1 year were excluded from the study. Ambulatory surgeries like Circumcision, Anal dilatation, Urethral dilatation, Laparoscopic appendicectomy, Laparoscopic hernia repair, Diagnostic laparoscopy were considered. Laparoscopic surgery converting into open laparotomy and/or excessive blood loss during surgery were also excluded.

After confirming adequate starvation, patients were monitored with Pulse oximeter, Cardioscope, End tidal CO2, Non-invasive blood pressure and Respiratory gas monitor. All patients were Premedicated with intravenous Inj midazolam 0.03mg/kg, Inj ketamine 0.5mg/kg and Inj glycopyrrolate 4µg/kg.

Induction was done with IV propofol 2mg/kg, fentanyl 2 µg/kg IV and inj atracurium 0.5mg/kg. Airway was secured with proseal laryngeal mask airway or adequate sized endotracheal tube. Patients <20kg were ventilated with Jackson Rees circuit and others with closed circuit. Patients were maintained on either oxygen: air (50:50) and sevoflurane (1-3%) [Group I] or oxygen: air (50:50) and desflurane (3-8%) [Group II]. End-tidal concentration of volatile inhalational agent was maintained at approximately 1.3 MAC (minimum alveolar concentration) throughout the surgery. Depending on the nature of surgery; analgesia was maintained with caudal clonidine+ bupivacaine or Inj Paracetamol 10-15 mg/kg IV. All anesthetic agents were discontinued when spontaneous recovery of neuromuscular function was confirmed at the end of surgery and reversed with Inj Glycopyrrolate 8 mcg/kg and Inj Neostigmine 0.05 mg/kg. Ventilation was continued at the same fresh gas flow until the return of cough reflex. Each patient's trachea was extubated or LMA was removed after ensuring cough and gag reflex, grimace and purposeful movements.

We defined emergence time as "the time from discontinuation of anesthetics to extubation". Recovery time was measured from the time of discontinuation of anesthetic until the achievement of Steward Recovery Score [9] of 6. Recovery time was recorded in PACU by the nursing staff blinded to the study group. Emergence and recovery times in the two groups were recorded. Incidence of postoperative nausea and vomiting was also recorded.

The child's emergence response was noted on the pediatric anesthesia emergence delirium scale (PAED scale) [10] as follows.

PAED scale:

1 - The child makes eye contact with the care giver.
2 - The child's actions are purposeful.
3 - The child is aware of his/her surroundings.
4 - The child is restless.
5 - The child is inconsolable.

Children who were inconsolable were given Injection fentanly 1-2 micrograms i.v.
The primary end point of the study was achievement of steward score of 6.

Steward recovery score:

Score	Consciousness	Airway	Movement
0	Not responding	Airway requires maintenance	Moving limbs purposefully
1	Responding to stimuli	Maintaining good airway	Non purposeful movements
2	Awake	Coughing on command or crying	Not moving

All data are presented as mean ± SD and analyzed using SPSS 16 software. The mean values of the two groups of data were analyzed using unpaired Student t test and Mann Whitney Test. P value <0.05 was considered significant.

Observation and Results

Table 1:
Demographic characteristics

Parameters	Sevoflurane		Desflurane		P value	Test
	Mean	SD	Mean	SD		
Age (yrs)	4.8	0.76	5.0	0.96	0.456	Mann Whitney Test
Sex(Male/Female)	28/12		30/10		0.723	Chi square test
Weight (kg)	13.75	1.56	13.40	2.01	0.689	Mann Whitney Test
Duration of surgery (min)	39	2.83	40	3.44	0.322	Mann Whitney Test

Patients in both groups were comparable with regard to demographic data, i.e., age, sex and weight. They were also comparable with regard to duration of surgery. [Table 1]

Table 2:
Recovery Characteristics and Complications between Two Groups

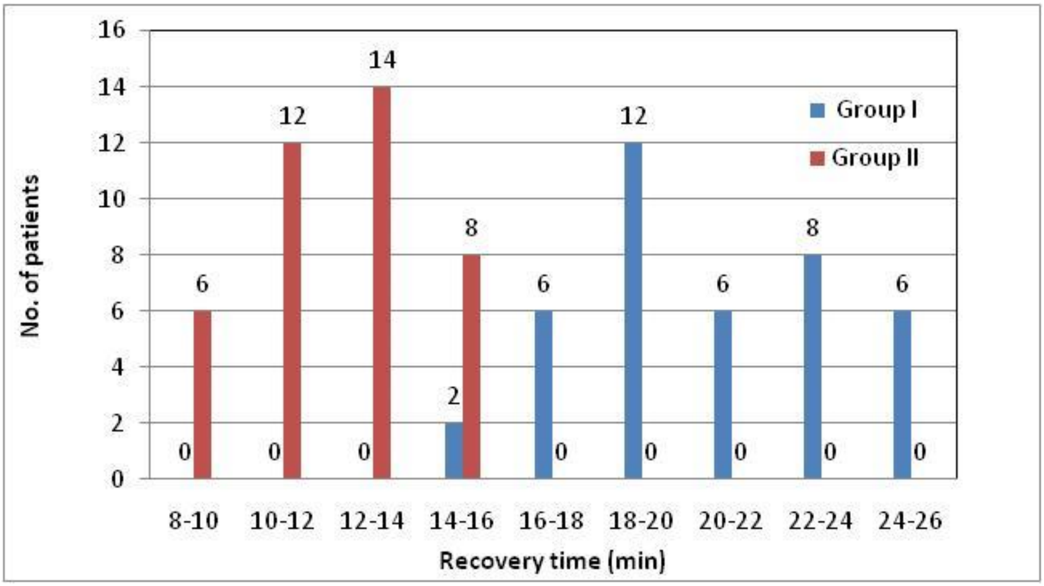
Parameters	Group I (Sevoflurane)		Group II (Desflurane)		P value	Test
	Mean	SD	Mean	SD		
Emergence Time (minutes)	11.75	1.84	5.85	1.21	0.000	Unpaired t- test
Recovery Time (minutes)	20	3.06	11.7	2.08	0.000	
PAED Scale score	1.75	0.71	3.35	0.92	0.000	Mann Whitney test
Nausea/ Vomitting	18/40		20/40		0.752	Chi square test

In this study, we found an earliest emergence time of 3 to 5 minutes in desflurane group as compared to sevoflurane (9-11 min). Minimum recovery time was 8-10 minutes in desflurane group. There was significantly shorter emergence and recovery time (5.85 ± 1.21 vs 11.75 ± 1.84 min and 11.7 ± 2.08 vs 20 ± 3.06 min respectively) with desflurane anaesthesia as compared to sevoflurane.

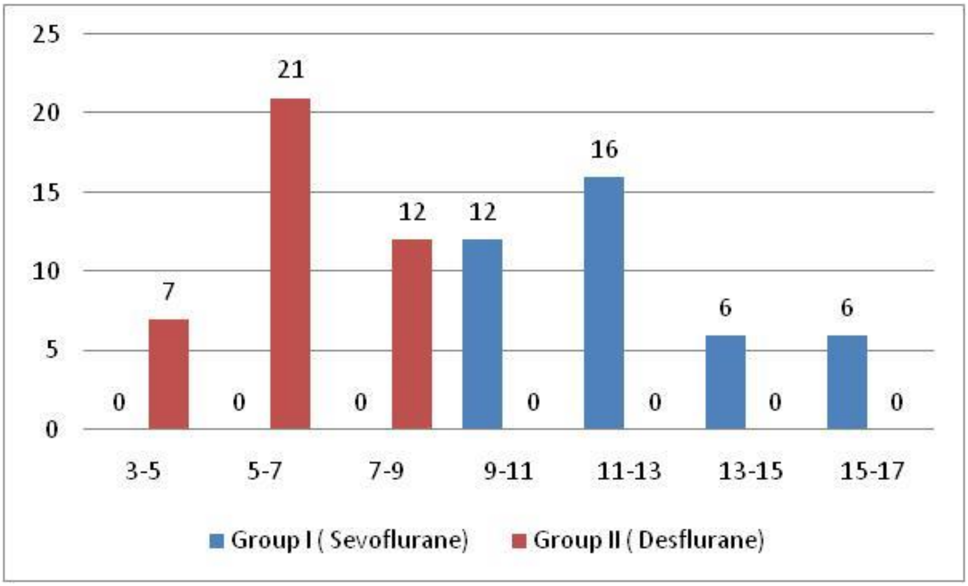
PAED scale score for desflurane was significantly higher (3.35 ± 0.92) compared to that of sevoflurane (1.75 ±0.71). Patients with desflurane anesthesia showed agitation and excitement more frequently than sevoflurane anesthesia.

The differences in the incidence of post-operative nausea and vomiting among the study groups were not clinically significant.

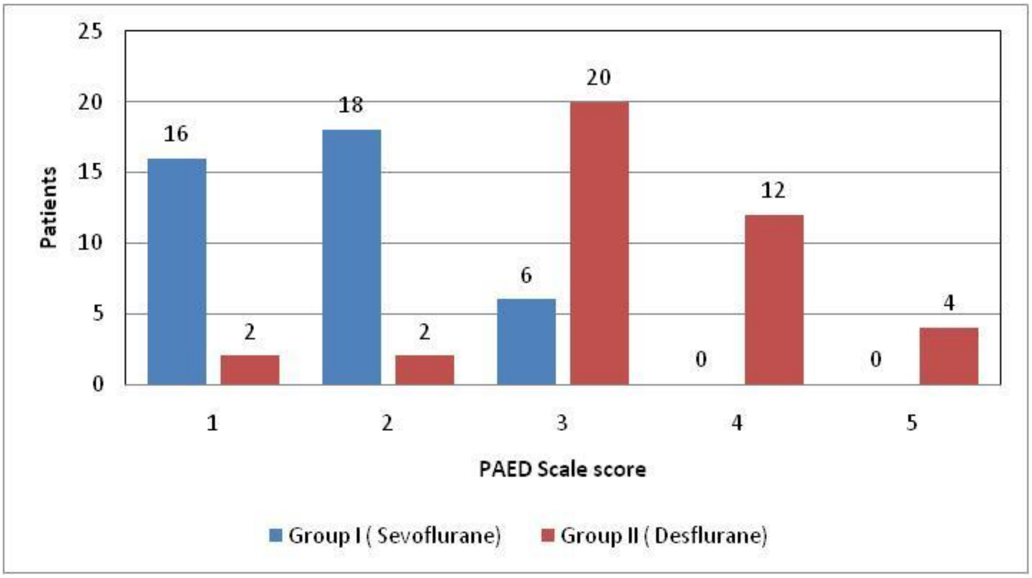
Graph 1: Comparison of Recovery time



Graph 2: Comparison of Emergence time



Graph 3: Comparison of PAED scale



Discussion

The choice of anaesthesia determines speed of recovery after surgery. Volatile anesthetics are convenient to use in ambulatory surgery because changes in the depth of anesthesia can be made readily due to rapid uptake and elimination of these anesthetics potentially resulting into early discharge. Thus ideal anesthetic for ambulatory surgery should provide rapid and smooth induction and emergence as well as hemodynamic stability.

We observed that maintenance of anesthesia with desflurane resulted in early emergence. Desflurane group demonstrated almost 6 minutes earlier extubation than sevoflurane (5.85 $\pm$ 1.21 vs 11.75 $\pm$ 1.84 minutes). This was not a surprising finding considering very low blood gas partition coefficient (0.42) of desflurane.[11] In adult patients undergoing outpatient surgery, White et al [12] reported that recovery end points, such as time to eye opening on verbal command and regaining orientation, were significantly faster with desflurane compared to sevoflurane. In pediatric patients undergoing ambulatory surgery, the emergence (extubation) and recovery from anesthesia (Steward score= 6) were significantly faster in the desflurane group compared to sevoflurane.[13] These results are concordant with our study. The differences between the two anesthetics might not be as important in the general population of surgical patients; however, a faster recovery of protective airway reflexes in patients undergoing oropharyngeal surgery, who are at risk of pulmonary aspiration caused by postoperative bleeding, may be helpful. In this regard, Mckay et al [14] tested whether delayed awakening was associated with a delayed restoration of protective airway reflexes. As expected, they showed that desflurane, a less soluble anesthetic, allowed for an earlier return of protective airway reflexes. Also, airway reflex recovery was shown to be significantly less predictable after sevoflurane anaesthesia compared to desflurane.[15] Nevertheless, previous reports demonstrated that desflurane had deleterious effects on markedly exaggerated airway narrowing in children with susceptible airways.[16] As respiratory adverse events are major causes of morbidity and mortality during pediatric anesthesia, some clinicians are reluctant to use desflurane in children with susceptible airways. However no such respiratory adverse event occurred in our study group.

Desflurane was previously shown to be associated with a higher incidence of emergence agitation in a prior study of pediatric adenoidectomy, although desflurane enabled more rapid wake-up than sevoflurane or halothane. Welborn, et al [13] reported that desflurane involves a significantly greater incidence (55%) of postoperative agitation and excitement in pediatric patients, compared with sevoflurane (10%), both of which are known to prolong PACU stay. In our prospective study, we assessed the incidence of postoperative emergence delirium according to PAED scale. Our study showed that PAED scale score was significantly higher in patients receiving Desflurane as compared to Sevoflurane (3.35 $\pm$ 0.92 vs 1.75 $\pm$ 0.71).

Previous study explained that a rapid transition from anesthesia to consciousness in a strange area with unfamiliar environment and postoperative pain results in fear and apprehension in children.[17] The combination of propofol [18,19] and opioid [20], slow transition to consciousness and developing close relationships between children and caregivers, could reduce the incidence of emergence agitation.[21] In addition, the potential decrease in OR(Operating Room) and PACU(Post-Anesthesia Care Unit) stay has economic implications. The reduction of emergence time reduces direct labour costs of OR time, especially with over-utilized OR.[22,23] Dexter, et al[24] insisted that reductions in the average of and variance in time to extubation can be interpreted and monitored in terms of corresponding expected 75% reductions in the incidences of prolonged extubation time using desflurane relative to sevoflurane.

We did not find any statistically significant difference in the incidence of post-operative nausea and vomiting between the two groups which is comparable to other study.[13]

Limitations

The use of clonidine in caudal epidural block in certain surgical cases might have affected emergence and recovery time in our study due to its sedative properties and it might be a confounding factor in our study.

Conclusion

Desflurane has faster emergence and recovery but higher incidence of emergence delirium compared to sevoflurane. So we recommend use of sevoflurane in pediatric patients for ambulatory surgery in view of less incidence of emergence delirium.

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