

A RANDOMIZED CONTROL STUDY COMPARING EMERGENCE CHARACTERS OF DESFLURANE WITH HALOTHANE IN PAEDIATRIC PATIENTS UNDERGOING GENERAL ANAESTHESIA.

Anaesthesiology

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ABSTRACT

Background: Emergence agitation (EA) was described at first by Eckenhoff et al in the early 1960s. EA has been described as a dissociated state of consciousness in which the child is inconsolable, irritable, uncooperative, typically thrashing, crying, moaning or incoherent. Although EA is usually self-limited and occurs within the first 30-minutes of recovery in PACU, but it can last up to 2 days and lead to physical damage, disconnection of intravenous catheters, removing of dressing or drainage tube and monitoring devices. Although, numerous medications have been studied to prevent or reduce EA in children, no special preventive method has been shown to be highly superior. **Aims and objectives:** The aim of this study is to compare the emergence characters of Desflurane with Halothane. The primary objective is to compare the Emergence characters using PAED (Pediatric Anaesthesia Emergence Delirium) score. The secondary objective is : 1) To compare the recovery characters (Time to recover) using Steward Recovery Scores. 2) To compare the PACU discharge criteria meeting time with Modified Aldrete Score. 3) To assess post operative Pain, nausea, vomiting, shivering. **Materials and Methods:** This Randomized interventional study (single blinded) was conducted in Institute of child health and hospital for children, egmore from October 2019 to December 2019. 70 Pediatric patients based on the parent article, Comparison of Emergence and Recovery characteristics of Sevoflurane, Desflurane, and Halothane in Pediatric Patients undergoing General Anaesthesia, authored by Welborn, Hannallah Published AnesthAnal. 1996 Nov;83(5):917-20. **Result:** Recovery time, Emergence Agitation, Time to reach discharge criteria and post operative complications were compared. Post anaesthesia Emergence Agitation was higher in Desflurane group compared to Halothane group which was statistically significant. Desflurane resulted in faster recovery, early Emergence than Halothane which was statistically significant. This is due the fact that Desflurane has very low Blood Gas Solubility index which results in rapid emergence and thus Emergence Agitation. Though time to reach discharge criteria was not much prolonged in Halothane group, study showed statistically significant difference between two groups. Post operative complications is not statistically significant between two groups. **Conclusion:** In our study Post anaesthesia Emergence Agitation was significantly higher in Desflurane group compared to Halothane group. Desflurane anaesthesia resulted in rapid Emergence, early recovery compared to Halothane anaesthesia.

KEYWORDS

Desflurane; Emergence and Recovery characters; Halothane; paediatric population.

INTRODUCTION:

Emergence agitation (EA) was described at first by Eckenhoff et al in the early 1960s. EA has been described as a dissociated state of consciousness in which the child is inconsolable, irritable, uncooperative, typically thrashing, crying, moaning or incoherent. Nowadays, about 4 million children undergo general anaesthesia annually and EA has been identified as a significant problem in children at Post Anaesthetic Care Unit (PACU) with an incidence ranging from 10 to 80%. EA as a Post Anaesthetic problem interferes with child's recovery and presents a challenging situation for post-anaesthesia care provider in terms of assessment and management. Although, several factors have been identified as etiologies of EA, there is no entire description for emergence agitation. Many different causes have been suggested, such as rapid awakening in an unfamiliar environment, painful events like surgical wounds, agitation on induction, airway obstructions, environmental disturbances, the duration of anaesthesia, hyperthermia, hypothermia, type and site of operation, premedication, inhaled and intravenous anaesthetics and the anaesthetic technique.

Although EA is usually self-limited and occurs within the first 30-minutes of recovery in PACU, but it can last up to 2 days and lead to physical damage, disconnection of intravenous catheters, removing of dressing or drainage tube and monitoring devices. On the other hand, controlling the agitated child needs more nursing care and more post-anaesthesia care providers.

In addition, administration of sedative and analgesics is associated with increased recovery time and delayed PACU discharge. Generally, treatment in all cases mentioned above is directed to the correction of causative agents. Although, numerous medications have been studied to prevent or reduce EA in children, no special preventive method has been shown to be highly superior. So, this study, A Randomised interventional single blinded study has been undertaken to determine the role of Inhalational Anaesthetic agent in Emergence Agitation in Post Anaesthetic period in Paediatric patients undergoing General Anaesthesia.

Aims and objectives:

The aim of this study is to compare the emergence characters of Desflurane with Halothane. The primary objective is to compare the

Emergence characters using PAED (Paediatric Anaesthesia Emergence Delirium) score. The secondary objective is : 1) To compare the recovery characters (Time to recover) using Steward Recovery Scores. 2) To compare the PACU discharge criteria meeting time with Modified Aldrete Score. 3) To assess post operative Pain, nausea, vomiting, shivering.

MATERIAL AND METHOD:

This Randomized interventional study (single blinded) was conducted in Institute of child health and hospital for children, egmore from October 2019 to December 2019. 70 Pediatric patients based on the parent article, Comparison of Emergence and Recovery characteristics of Sevoflurane, Desflurane, and Halothane in Pediatric Patients undergoing General Anaesthesia, authored by Welborn, Hannallah Published AnesthAnal. 1996 Nov;83(5):917-20. (1-7 yrs of age, ASA PS 1, elective surgery) undergoing General Anaesthesia were randomly assigned into 2 groups after getting approval from institutional Ethical committee. Group H- Propofol induction and Halothane maintenance Group D- Propofol induction and Desflurane maintenance. Inclusion criteria: Age: 1 – 7 Years, ASA PS :I, Elective surgery, Who have given valid Informed Consent. Exclusion criteria: Patient/Parent Refusal, Patients posted for emergency surgery Bleeding & coagulation disorder, Altered mental status, History of seizures and any neurological deficit, Allergy to any of the study drugs, Patients with severe Cardiovascular, Respiratory, Renal, Hepatic diseases.

All patients were premedicated with oral Midazolam 0.5mg/kg and oral Atropine 30 mics/kg 30 minutes before procedure. Intra venous cannula inserted and patients shifted to operation theatre after 30mins of premedication. Standard monitors- Pulse oximetry for saturation (SpO₂), Non-invasive blood pressure monitoring (NIBP), Electrocardiogram (ECG), End Tidal Carbon dioxide (EtCO₂) Anaesthesia agent gas monitor were attached and baseline pulse rate, blood pressure, oxygen saturation were recorded. Patients were divided into 2 groups by computer generated random numbers handed over by sealed envelop. Anaesthesia induced by Propofol 2mg/kg i.v and Fentanyl 2 mics/kg i.v, Atacurium 0.5mg/kg i.v and intubated with appropriate sized cuffed endotracheal tube. Group D were maintained with Desflurane adjusted to MAC 1.3. Group H were maintained with Halothane adjusted to MAC 1.3 using appropriate

circuit. Regional analgesia was given as per the need of the surgery. All inhalational agents were cut at the start of the closure of skin incision. Patient were extubated when they are fully awake and met the extubation criteria. Emergence characters using PAED score was noted. Recovery characters noted using Steward score, PACU discharge time noted using modified Aldrete score. Data collected and analysed using statistical package.

RESULTS:

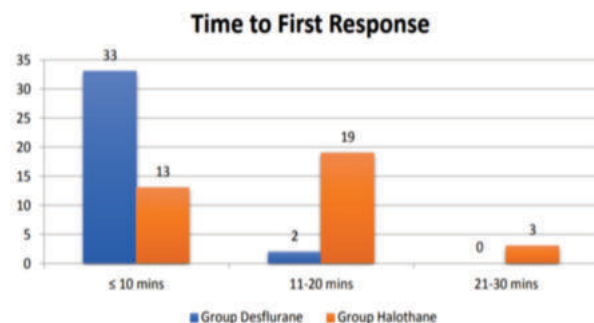


Chart – 1: Time to First Response

While analysing time to first response distribution among paediatric patients undergoing general anaesthesia, it was observed that majority of the study subjects in Desflurane group were distributed in ≤ 10 minutes time to first response class interval (n=33, 94.29%) and 11-20 minutes time to first response class interval in halothane group (n=13, 37.14%) ($p < 0.001$, unpaired t test). overall difference in the time to first response among patients in Desflurane group compared to Halothane group was 6.49 mins lower. This trend of significantly lower time to first response in Desflurane group compared to Halothane group was found to be in the range of 52% decrease.

PAED Score

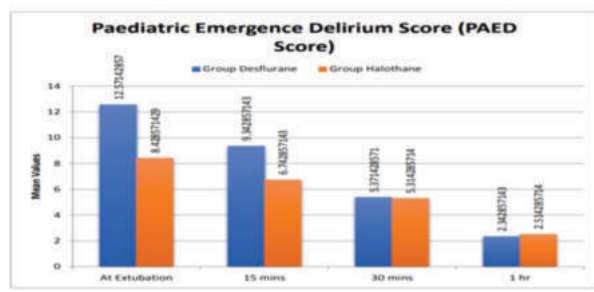


Chart-2 : PAED Score

Study subjects in desflurane group had mean paediatric emergence delirium score recordings of 12.57 (at extubation), 9.34 (15 mins), 5.37 (30 mins) and 2.34 (1 hr). similarly study subjects in desflurane group had mean paediatric emergence delirium score recordings of 8.43 (at extubation), 6.74 (15 mins), 5.31 (30 mins) and 2.51 (1 hr).

Difference in the mean paediatric emergence delirium score of patients at extubation and 15 minutes was found to be statistically significant ($p < 0.001$, unpaired t test) and the difference in the mean paediatric emergence delirium score of patients at 30 minutes and 1 hour was found to be statistically non-significant ($p < 0.05$)

Modified Aldrete Score

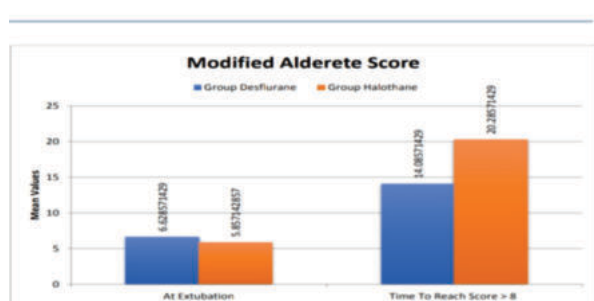


Chart – 3: Modified Aldrete Score

Subjects in desflurane group had mean modified aldrete score recordings of 6.63 points (at extubation) and mean time to reach modified Aldrete score >8 recordings of 14.09 minutes. Similarly study subjects in halothane group had mean modified Aldrete score recordings of 5.86 points (at extubation) and mean time to reach modified aldrete score >8 recordings of 20.29 minutes.

Difference in the mean modified aldrete score of patients at extubation was found to be statistically significant ($p < 0.001$, unpaired t test) and the difference in the mean time to reach modified aldrete score >8 of patients was found to be statistically significant too ($p = 0.026$, unpaired t test)

Steward Recovery Score

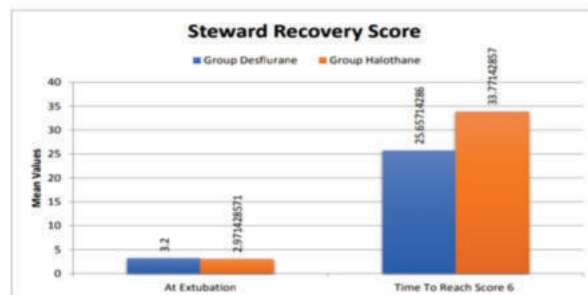


Chart – 4: Steward Recovery Score

Study subjects in desflurane group had mean steward recovery score recordings of 3.20 (at extubation) and mean time to reach score 6 of 25.66 minutes. study subjects in halothane group had mean steward recovery score recordings of 2.97 points (at extubation) and mean time to reach steward recovery score 6 of 33.77 minutes.

Difference in the mean steward recovery score of patients at extubation was found to be statistically non-significant ($p > 0.05$, unpaired t test) and the difference in the mean time to reach steward recovery score 6 of patients was found to be statistically significant too ($p = 0.021$, unpaired t test)

Table – 1: Post-operative Incidence of Nausea, Vomiting and Shivering Status

Post-operative Incidence of Nausea, Vomiting and Shivering Status	Group Desflurane	%	Group Halothane	%
Nil	27	77.14	28	80.00
Nausea	2	5.71	2	5.71
Vomiting	4	11.43	2	5.71
Shivering	2	5.71	3	8.57
Total	35	100.00	35	100.00
P value Fishers Exact Test	0.898			

It was observed that majority of the study subjects in desflurane group had vomiting and majority of the study subjects in Halothane group had shivering .

While comparing post-operative incidence of nausea, vomiting and shivering status between the intervention groups, the difference in the incidence in complications in desflurane group and halothane group was found to be statistically non-significant ($p > 0.05$).

DISCUSSION

Maintenance of General Anaesthesia in Paediatrics is usually managed with a volatile anaesthetic agent. Thus it should provide rapid smooth recovery and Hemodynamic stability. Post operative complications such as Emergence Delirium (ED) Nausea, Vomiting and shivering should also be minimal.

In our study we compared Emergence characters of Desflurane with Halothane in Pediatric patients after maintaining anaesthesia with equal MAC values.

The groups did not differ much with respect to age, gender distribution, weight, ASA- PS status and Duration of Procedure There was a trend for patient emergence from Desflurane anaesthesia to be associated

with a higher incidence of Emergence Delirium (Group Desflurane mean PAED Score at extubation 12.57 versus Group Halothane mean PAED Score at extubation 8.43) Which is statistically significant—p value<0.001.

This is in concordance with previous study by Davis Pj et al(2) and also with the article by Welborn et al (14)

This effect is supported by the fact that Desflurane has rapid emergence from anaesthesia as it has a very low Blood Gas Solubility index (0.4) compared to Halothane (2.25). Rapid emergence in an unfamiliar environment is one of the etiological factors contributing to Emergence Agitation in children.

This significant difference in PAED Score was up to only 15 minutes. At 30th minute mean score was 3.31 in Desflurane group and 2.71 in Halothane group which is not statistically significant, P value — 0.937. This is in concordance with findings by K.P.Mason(6) and B Craig Weldon (1).

This may be supported by the fact that most of the Emergence Agitation is self limiting lasting only for 10 to 15 mins. Another reason for this might be Tender care and Parental presence (one of the proven treatment modalities for EA as discussed previously in introduction) which pacifies the child's anxiety obviating the need for pharmacological interventions in most cases.

Mean time to reach Steward recovery Score Of 6 in group Desflurane was 25.66 minutes and Group Halothane was 33.77 minutes and is statistically significant (p value— 0.021) also-in symphony with study by Welborn et al (17).

The mean time to first response after discontinuing anaesthesia in Desflurane Group was 5.97 mins and in Halothane group it was 12.46, which is statistically significant. This is in concordance with studies by Davis PJ et al(3) and Welborn et al.(17)

Patients under Desflurane Anaesthesia met discharge criteria (Defined as time to reach a modified Aldrete score of 8) much faster compared with patients under Halothane anaesthesia. This is in symphony with previous studies

The significant difference between these two groups in view of early emergence and recovery is proven by the fact that Desflurane has very low blood Gas Solubility index (0.42) compared to Halothane (2.3).

The lower blood:gas solubility allows anesthetic alveolar concentration to remain near inspired concentration, once anaesthetic agent is discontinued, alveolar partial pressures of Desflurane fall much faster than Halothane leading to rapid elimination also Desflurane undergoes much lesser metabolism(0.2%) in body compared to Halothane(20%) which adds on to foreseen results of early emergence and recovery of Desflurane compared to Halothane.

The two groups did not differ much in view of post operative complications (no statistical significance). This is in similarity with previous studies by Wallenberg et al (13) and Welborn et al. (17)

CONCLUSION

In our study Post anaesthesia Emergence Agitation was significantly higher in Desflurane group compared to Halothane group. Desflurane anaesthesia resulted in rapid Emergence, early recovery compared to Halothane anaesthesia.

Abbreviation

MAC - Minimum Alveolar Concentration, PACU- Post Anaesthetic Care Unit,
EA- Emergence Agitation, PAED -Paediatric Anaesthesia Emergence Delirium
PONV - Post operative Nausea and Vomiting.

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Conflict of Interest The authors declare no conflicts of interest.

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