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**Research Article**

# The effect of different drugs on sevoflurane emergence agitation in pediatric patients undergoing hypospadias repair surgery

**Manal M. Rashad** *, **Dalal E.M. Soud**

*Department of Anaesthesia and Intensive Care, Faculty of Medicine, Zagazig University, Egypt*

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**KEYWORDS**

Sevoflurane;
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Propofol;
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Ketamine

**Abstract** *Background:* Various methods are used to decrease the incidence of emergence agitation (EA) in children following general anaesthesia with sevoflurane.
*Objective:* The present study aims to compare the effect of intravenous injection of small dose of propofol, fentanyl or ketamine at the end of surgery, just before the discontinuation of sevoflurane on the incidence and severity of sevoflurane emergence agitation in children undergoing hypospadias repair operations.
*Patients and methods:* Eighty patients undergoing elective hypospadias repair under sevoflurane general anaesthesia with caudal block were randomly divided into four groups (20 patients each); group P received intravenous 1 mg/kg propofol, group K received intravenous 0.25 mg/kg ketamine, group F received intravenous 1 μg/kg fentanyl, and group S received intravenous saline as control group. All those injections were given just before the discontinuation of sevoflurane. The emergence agitation was evaluated by emergence agitation scale from awakening every 5 min for 30 min. Complications like laryngospasm, desaturation, cough, and vomiting were recorded. Awakening time and PACU duration were also recorded.
*Results:* The incidence of emergence agitation was significantly lower in groups P and F ($p < 0.05$). The time for awakening was significantly prolonged in groups P, K and F ($p < 0.05$), while PACU duration was significantly prolonged in group F ($p < 0.05$). No significant complications occurred except a significantly higher incidence of vomiting in group F.
*Conclusion:* The use of propofol or fentanyl just before the discontinuation of sevoflurane reduces the incidence of emergence agitation in children, on the other hand fentanyl was accompanied with a significantly longer PACU duration and higher incidence of vomiting.


* Corresponding author. Tel.: +20 1005671564.
E-mail addresses: mannola1972@gmail.com, mervatassy@yahoo.com (M.M. Rashad).
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## 1. Introduction

Emergence agitation (EA) or delirium is a frequent problem among pediatrics during recovery from general anaesthesia specially with sevoflurane. It is a mental disturbance in the form of excitation, hallucination, involuntary physical activity with crying or even thrashing about in bed which can lead to self injury and cause stress to both caregivers and parents although it does not increase morbidity [1].

The incidence of EA is up to 80% and more frequently observed in the preschool age [2].

Sevoflurane now is the inhalational anaesthetic agent of choice for pediatrics, as it is nonpungent, with minimal airway irritation characters, and its cardiac adverse effects are minimal like cardiac depression and dysrhythmias [3].

On the other hand, sevoflurane has low blood/gas solubility, and causes rapid induction and recovery which were documented in several studies to increase the incidence of EA when used for anaesthesia in children [4].

The pathogenesis of postoperative EA is still undefined [5], but sevoflurane has intrinsic effects that may share in emergence agitation like its different electroencephalogram pattern from halothane [6,7], and its degradation to inorganic fluoride ions and compound A which may have a role in the occurrence of EA [8].

Even if propofol-based anaesthesia is used from the start to achieve smoother recovery, maintenance with sevoflurane is still preferred by many anaesthetists [9]. So many strategies have been used to decrease the severity and incidence of EA of sevoflurane like premedication with sedative agents, changing the technique of maintenance, or administration of certain agents at the end of anaesthesia which were thought to be the most effective and applicable strategies in clinical practice [10].

Several studies were done before on our studied drugs regarding their effect on emergence agitation, and they found that administration of small dose of ketamine or propofol just before the end of sevoflurane anaesthesia would decrease emergence agitation incidence without delaying patient awakening or discharge from post anaesthesia care unit (PACU) [11,12]. Also other studies were done on fentanyl found that involving fentanyl in the anaesthetic technique would decrease agitation of sevoflurane independent of any effect of pain [13].

This study was performed to compare the administration of small dose of either propofol, ketamine, or fentanyl before discontinuation of sevoflurane anaesthesia in decreasing the incidence of EA without serious side effects.

## 2. Patients and methods

After approval of the local medical ethics committee and obtaining written informed consent from parents, this comparative prospective study was conducted in Zagazig University hospital on 80 healthy male children aged from 1 to 3 years, ASA I-II physical status scheduled for ambulatory hypospadias repair under general sevoflurane anaesthesia. Children with psychological/emotional disorder, cognitive problem, developmental delay, parents refusal, or children under certain medications like sedatives, anticonvulsants were excluded.

Children were randomly assigned by means of random numbers generated by computer to one of the four groups (twenty patients each), referred to as the propofol (P) group, the ketamine (K) group the fentanyl (F) group, and the saline (S) group. These medications were administered by the resident according to the group to which the patient was randomized.

All patients were requested during the preanaesthetic visit to be fasting for 6–8 h with permission of clear fluids up to 4 h before operation.

No premedication was used. After application of pulse oximetry, anaesthesia was induced inhalationaly by mask with 8% sevoflurane in 100% O2 and then sevoflurane concentration was decreased to 2–2.5% after child loss of consciousness and all thorough the operation for maintenance of anaesthesia. Then peripheral intravenous cannula was inserted and 0.01 mg/kg atropine injected intravenously. Monitors were applied like electrocardiography, noninvasive blood pressure monitor then capnography connected to laryngeal mask (LMA) which was inserted after adequate jaw relaxation and oral airway tolerance, its size was chosen according to the body weight of the child as written by the manufacturer. All monitors' data were recorded every 5 min, then caudal block was performed with 1 ml/kg Bupivacaine 0.25% (20 ml max). If LMA insertion failed for three trials the child was intubated and excluded from the study to avoid effects of muscle relaxants on some parameters measured in the study like awakening time and postanaesthesia care unit (PACU) duration.

Spontaneous ventilation was maintained but was assisted to achieve end tidal CO2 (PETCO2) levels between 35 and 40 mmHg.

10 ml/kg of Lactated Ringer's solution was infused over 20 min after intravenous line insertion followed by standard fluid maintenance therapy according to the child's weight.

Adequate caudal block was assessed by skin incision, if heart rate did not increase by more than 20% of the basal heart rate within 60 s, it was considered adequate, if not the child was excluded from the study.

Just before the end of the surgery and the discontinuation of sevoflurane, patients of the fentanyl (F) group were given 1 μg/kg fentanyl IV, patients of ketamine (K) group were given 0.25 mg/kg ketamine IV, patients of propofol (P) group were given 1 mg/kg propofol IV all medications completed to 10 ml by saline, and those of saline (S) group were given equal volume of saline IV. All solutions were given over 1 min.

At the end of surgery, LMA was removed semi inflated to sweep secretions with it under anaesthesia and then sevoflurane was discontinued immediately. Face mask with jaw thrust and 100% oxygen was used with careful suction while the patient was still deeply anaesthetized and carefully observed for any upper airway obstruction, laryngospasm or breathholding. Oral airway was used in some patients but removed once reflexes started to be regained. Then when patent airway and spontaneous respiration without assistance were confirmed patients were transferred to the PACU where their parents or one of them were present. Moreover there was one resident anaesthesiologist who was blinded about the study observed the patients for 30 min for any complications like laryngospasm, desaturation, cough, vomiting which was treated by i.v. 150 μg/kg dexamethasone if occurred, and agitation which was assessed using the 5-step Emergence Agitation Scale (EAS) to be recorded every 5 min from awakening and for 30 min.

Emergence Agitation Scale (EAS)

1 = obtruded with no response to stimulation.