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Research Article

The effect of nebulized lidocaine hydrochloride on emergence from sevoflurane anesthesia in children undergoing Tonsillectomy

Riham Hasanein *, **Wael El-Sayed**

Faculty of Medicine, Cairo University, Egypt

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KEYWORDS

Lidocaine;
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Abstract *Background:* Sevoflurane-related emergence agitation (EA) is considered a significant problem that interferes with children's recovery; our aim was to evaluate the efficacy of nebulized lidocaine hydrochloride when given before sevoflurane anesthesia in attenuating EA in children undergoing tonsillectomy.

Materials and methods: A randomized clinical study was conducted on eighty children ASA I and II who underwent tonsillectomy. The children were randomized to one of two groups according to the nebulizer contents. Lidocaine group (group L) received nebulized solution of 4 mg/kg lidocaine hydrochloride and placebo group (group P) received nebulized solution contains 0.9% normal saline.

Results: The number of agitated patients were significantly lowered in the lidocaine group compared to the placebo group; *p* value (0.012).

Conclusion: The use of nebulized lidocaine before sevoflurane anesthesia for pediatric patients undergoing tonsillectomy attenuated the sevoflurane-related EA with no side effects.

1. Introduction

Sevoflurane is the most commonly used inhaled anesthetic in children, due to its pleasant smell and low blood gas solubility coefficient that lead to rapid induction and recovery [1]. However, emergence agitation (EA) occurs in up to 80% of pediatric patients receiving sevoflurane [2]. In addition to the stress imposed on both caregivers and the family, it is considered as a potentially serious complication due to the possibility of self-injury.

Otolaryngeal procedures are considered as one of the independent risk factors for EA [3]. Although the exact etiology of sevoflurane EA is still unclear, rapid emergence, variable neurological recovery, and increased sensation of pain are the proposed causes of EA related to sevoflurane (4). Different techniques have been used to attenuate the EA including propofol, narcotics, ketamine, and alpha 2-agonists [1,2,5–7]. However, these techniques may interfere

* Corresponding author. Address: King Faisal Street, PO Box 30353, Alkhobar 31952, Saudi Arabia. Tel.: +20 966532912388.
E-mail address: rihamhasaneen@yahoo.com (R. Hasanein).
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with the goal of having a conscious child without excessive sedation on arrival to the recovery room.

Lidocaine hydrochloride is a widely available local anesthetic with a good safety profile when given by nebulization [8]. It is frequently nebulized before bronchoscopy procedures, allowing the bronchoscope to reach greater depths in the airway. Lidocaine levels in the blood after nebulization for adults at normal doses were found to be safe [9]. Also, lidocaine was given by nebulization for flexible bronchoscopy in children in doses 4 and 8 mg/kg of 2% lidocaine and was well tolerated with no side effects, or symptoms of toxicity [10].

We hypothesized that achieving preemptive analgesia using preoperative lidocaine nebulization for pediatric patients undergoing tonsillectomies with sevoflurane anesthesia can result in less EA without excessive sedation in recovery room.

We conducted this double-blind, placebo-controlled, randomized study to evaluate the efficacy of nebulized lidocaine when given before sevoflurane anesthesia for children undergoing tonsillectomy in attenuating EA.

1.1. Material and methods

After approval of the ethical committee at Saad Specialist Hospital, Saudi Arabia, written informed consents were obtained from the parents of 80 children ASA physical status I and II aged 4–6 years old, undergoing tonsillectomy under general anesthesia during the period from April to October 2012. Children with history of cardiovascular, neurologic and liver diseases, bronchial asthma, obstructive sleep apnea, recent upper respiratory tract infection within the previous 2 weeks, and patients in whom surgery had taken more than 1 h were excluded from this study.

The children were randomly divided using closed envelope technique for randomization to one of two groups according to the nebulizer contents:

Group L ($n = 40$): Lidocaine group received nebulized solution of 4 mg/kg lidocaine.
Group P ($n = 40$): Placebo group received nebulized solution contains 0.9% normal saline.

The study drug consisted of identically labeled 5 ML vials; the contents of the vials were only known to the pharmacy department, of either:

- Lidocaine hydrochloride (Astra Zeneca, New South Wales, Australia.) calculated to be equal to 4 mg/kg of lidocaine 2% and then normal saline is added to make the study solution up to 5 ml; hence, the lidocaine concentration was variable and dependent on the child's weight.
- Or 0.9% normal saline (placebo) 5 ml.

The solution was applied to the patient by face mask and a compressed gas-powered jet nebulizer with 6 L/min oxygen. The child was asked to inhale deeply.

The nebulizers were given by the nurses in the holding area according to the instruction written in the sealed envelope; the anesthesiologists in charge of the case were unaware of the component of the nebulizer except in emergency conditions in order to ensure the double-blind nature of the study.

All children were fasting 6 h before surgery and an intravenous cannula (24 or 22 gauge) was inserted to all of them on admission to the hospital. Lactated Ringer's solution started at the standard maintenance fluid therapy according to the patient's weight.

All patients received atropine 0.01 mg/kg followed by ketamine 1 mg/kg intravenously as a premedication and to facilitate separation from the parents just before shifting to the operating room. In the operating room, the ECG, pulse oximeter, and noninvasive arterial blood pressure monitor were attached and the anesthesia was induced to all patients with fentanyl 2 μg/kg, sevoflurane 2–8%, and atracurium 0.5 mg/kg. Orotracheal intubation was done using a suitable size, lubricated tube. Anesthesia was maintained with sevoflurane 2% in 50:50% O_2/N_2O with pressure controlled mode of ventilation aiming to maintain $etco_2$ between 30 and 35 mmHg. Spo_2, $etco_2$, heart rate, and noninvasive arterial blood pressure were monitored. Immediately after intubation, a suppository of paracetamol (Adol, Julphar Pharmaceutical Industries, UAE) 20 mg/kg was given.

The same surgeon performed all the operations; at the end of surgery, sevoflurane and N_2O were discontinued, muscle relaxant was reversed using neostigmine and atropine after return of at least two of the train-of-four by peripheral nerve stimulator and proper suction of the throat under vision, and the patients were put in the recovery position and extubated after displaying a regular respiratory pattern, purposeful movement, and return of the swallow reflex. After extubation, 100% O_2 were applied by face mask till the patient open his eyes in response to verbal commands and then shifted to the recovery room for observation and monitoring until they reach a score 9 or more on Modified Aldrete score [11] before discharging to the ward.

The following variables were recorded during the study.

- Demographic data.
- The duration of operation: (the time between application and removal of the mouth gag).
- The duration of anesthesia: (the time from induction of anesthesia till extubation).
- The duration of extubation: (the time from discontinuation of the anesthetic till extubation).
- The duration of emergence: (the time from the discontinuation of anesthesia to the time of eye opening on verbal command).
- State of emergence at the time of admission to recovery room using emergence agitation scale [12], Table 1; for our study, the score of 4 or more was considered agitation and needs treatment with increments of fentanyl 1 μg/kg slowly intravenously with close monitoring for any signs of respiratory depression and can be repeated if needed at 10 min intervals.

Table 1 Five-point emergence agitation scale [12].

Score	
1	Obtunded with no response to stimuli
2	Asleep, but responsive to movement and stimuli
3	Awake and appropriately responsive
4	Crying and difficult to console
5	Wild thrashing behavior that requires restraint