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Research Article

Nebulized lidocaine and fentanyl before sevoflurane induction of anesthesia in congenital diaphragmatic hernia repair: Prospective double blind randomized study

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KEYWORDS

Fentanyl;
Lidocaine;
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Abstract *Introduction:* Gastric overdistension by mask ventilation during induction of anesthesia in congenital diaphragmatic hernia (CDH) repair may worsen hypoxemia. Topical airway anesthesia may improve the intubating conditions during sevoflurane induction without muscle relaxation. The present study was designed to evaluate the effect of nebulized lidocaine and fentanyl on the intubating conditions without muscle relaxation during sevoflurane induction of anesthesia in infants undergoing CDH repair. The secondary aim was studying hemodynamic changes during induction.
Patients and methods: Forty patients scheduled for (CDH) repair were randomly selected and blindly categorized to the following: Nebulizer group: Nebulized solution of 4 mg kg^{-1} lidocaine 1% plus 2 μg kg^{-1} fentanyl, Control group: Nebulized solution of comparable volume/weight normal saline 0.9%. Nebulizer of either solution was applied 15 min before sevoflurane induction.
Results: Heart rate (HR) and mean arterial blood pressure (mABP) statistically significantly increased in the control group following intubation and for 2 min regarding HR and for 5 min regarding mABP in comparison with the base line and relative to the nebulizer group. There was a statistical significant improvement regarding the intubation conditions in the nebulizer group relative to the control group ($p \leqslant 0.001$). The same was noticed regarding the intubation time and the number of intubation attempts ($p \leqslant 0.001$).
Conclusions: Premedication of infants undergoing CDH repair with nebulized solution containing 4 mg kg^{-1} lidocaine 1% plus 2 μg kg^{-1} fentanyl improves the intubating conditions under inhalational sevoflurane induction without muscle relaxation. The studied combination can suppress patients' hemodynamic changes to intubation.

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1. Introduction

Congenital diaphragmatic hernia (CDH) occurs in approximately 1 of 2500 newborn infants [1]. Outcome in CDH is variable between different centers in the world regarding prognosis with reported mortality rates between 20% and 60%. The morbidity and mortality of CDH is traditionally related to the mechanical compression of the herniated viscera on the developing lung leading to pulmonary hypoplasia and pulmonary hypertension [2]. After birth, gut distension at any time due to face mask ventilation exacerbates the ventilatory compromise by further compression of the lungs. Positive pressure ventilation by mask at induction of anesthesia should be avoided as the passage of gas into the esophagus may increase the stomach volume and further compromise the pulmonary function [3]. Sevoflurane is frequently used for inhalational induction in pediatrics because of its relatively pleasant smell, low airway irritability, rapid onset of action and cardiovascular stability [4]. Several methods have been described to improve intubating conditions with sevoflurane. These include the use of $\alpha 2$ agonists for premedication [5], extended exposure to sevoflurane [6], high inspired fraction of sevoflurane [7], addition of nitrous oxide [8], opioids [9], or propofol [10]. Local anesthesia to the airway may be an important adjunct of this technique [11]. Lidocaine is a cheap, widely available drug with a good safety profile when nebulized [12]. Several authors documented the presence of peripheral opioid receptors and explored the action of opioids peripherally [12,13].

2. Aim of the study

The primary aim was to evaluate the effect of premedication by a combination of nebulized lidocaine and fentanyl on the intubating conditions without muscle relaxation during high inspired concentration of sevoflurane induction of anesthesia in infants undergoing CDH repair. The secondary aim was to study the effect of the same nebulized solution on the hemodynamic response to endotracheal intubation.

3. Patients selection

This prospective, double-blind, randomized, and placebo-controlled study was performed at Alshatby university hospital from March 2014 to October 2014. Forty patients of any gestational age ASA physical status II–III scheduled for congenital diaphragmatic hernia (CDH) repair were selected from those admitted to Alshatby pediatric intensive care unit. Patients were calculated according to the following formula:

$$n = \frac{t^2 \times p(1-p)}{m^2}$$

where n = required sample size, t = confidence level at 95% (standard value of 1.96), p = estimated measurements, m = margin of error at 5% (standard value of 0.05)

The power of the study was 80%

Patients were excluded if they were already intubated, with suspected neuromuscular disorders, having history of opioid intake or infusion during the past three hours and finally those with anticipated difficult intubation in the form of known congenital airway anomalies.

4. Study design

The study protocol was reviewed and approved by the Ethics Committee of the Alexandria Main University Hospitals. The study was registered in the PACTR database under a number of PACTR201410000871409. A written consent was obtained from the parents for participation of their kid in the study. Complete history was taken from the parents and from the intensive care staff members and all patients were subjected to thorough examination and routine laboratory investigations. Patients were randomly categorized using a computer-generated program to one of two groups undergoing induction of anesthesia with sevoflurane. An independent participant prepared the nebulized solution which was given to patients in the intensive care 15 min preoperatively at a flow of $3\,l\,min^{-1}$ and patients were blindly categorized into the two following groups according to the components of the nebulized solution:

- *Nebulizer group:* The nebulized solution contained $4\,mg\,kg^{-1}$ lidocaine 1% plus $2\,\mu g\,kg^{-1}$ fentanyl.
- *Control group:* The nebulized solution contained a comparable volume according to weight of normal saline 0.9%.

After admission to the operative theater, all patients were monitored by continuous electrocardiography, heart rate, pulse oximetry, non-invasive arterial blood pressure, endtidal capnography and transrectal temperature probe. An intravenous line was already existing. Anesthesia was induced with 8% sevoflurane in 100% oxygen for 90 s using an appropriate sized face mask via a primed pediatric circle system. The proper sized endotracheal tube was inserted by Macintosh blade size 0 or 1. Failed trial of intubation was defined as failure to insert the endotracheal tube between the vocal cords before the arterial oxygen saturation reaches 80%. In case of failure of intubation, a second attempt was tried after intravenous injection of $1\,mg\,kg^{-1}$ propofol and application of 8% sevoflurane in 100% oxygen via a face mask for 30 s. After insertion of the endotracheal tube, anesthesia was maintained with fentanyl $1\,\mu g\,kg^{-1}$, rocuronium $0.6\,mg\,kg^{-1}$ and sevoflurane 2–3%.

5. Measurements

5.1. Hemodynamic parameters

- *Heart rate (HR)*
- *Mean arterial blood pressure (mABP)*
- *Arterial oxygen saturation (SpO_2)*

The previous parameters were recorded at the following times:

- Before nebulizer setting.
- Before induction of anesthesia.
- After induction of anesthesia.