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# The Effect of IV Lidocaine on Postoperative Respiratory Complications of Isoflurane Anesthesia in Pediatrics

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## ABSTRACT

**Background:** Inhalation anesthesia using Isoflurane in pediatrics is related with airway irritability, coughing, breath holding, and laryngeal spasm. The aim of this study is to determine the effect of IV Lidocaine 5 min before emergence on the incidence and severity of postoperative respiratory complications of Isoflurane in pediatric population.

**Method:** A randomized clinical trial study conducted in Children Welfare Hospital included 118 unpremeditated children; aged 6 months to 10 years were enrolled in the study and randomized to receive IV. Lidocaine (n=54, Group A) and not receiving Lidocaine (n=64, Group B) all induced with Propofol and maintained with Isoflurane. The occurrence of coughing, breath-holding, laryngospasm, bronchospasm, and secretion was recorded. The severity of each complication was graded on scale of 0-3.

**Results:** the incidence of coughing (31% vs. 56%) and laryngospasm (22% vs. 59%), and coughing severity score (26 vs. 72), breath-holding severity score (16 vs. 38), and the need to change to higher FiO2 (4% vs. 11%) were more frequent in Group A than in Group B ($p< o.05$). There was no difference in regardto the incidence of breath-holding (26% vs. 31%) and secretion (30% vs. 31%).

**Conclusions:** IV Lidocaine 5 min before emergence from anesthesia reduces the frequency and severity coughing, the frequency of laryngospasm, the severity of breath-holding, and the need to change to higher FiO2 in pediatrics.

**Keywords:** Isoflurane, Pediatric anesthesia, Respiratory complications, IV lidocaine

## INTRODUCTION

Isoflurane is used for induction and maintenance of general anesthesia. It has advantages over older inhalants that are: speed of induction and recovery, greater control of depth of anesthesia, less metabolism by the drug in the liver and significantly less sensitization of the heart to catecholamines. In addition tobe less costly than newer more expensive agents. These properties have made it an outstanding choice for all anesthesia procedures; however, it is associated with an increased frequency of coughing, breath-holding and laryngospasm when used for inhalation induction of anesthesia [1] because of its pungency that leads to irritation of airway.

Inhalation induction is commonly used in pediatric anesthesia, so the incidence of these airway complications is more frequents in this age group in addition to the fact that reflex airway responses are more abundant in pediatric population.

Several measures have been proposed to decrease the incidence of airway complications, such as extubation under deep plane of anesthesia IV opioids, and topical or intra-cuff administration of lidocaine [2-5].

The use of IV lidocaine is another prophylactic measure that is commonly used by anesthetists. The mechanism of which it acts is not well understood. There are many propositions like: the suppression of airway sensory C fibers, the

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reduction of neural discharge of peripheral nerve fibers, and the selective depression of pain transmission in the spinal cord [6-8].

The airways are innervated by C-fibers, which express voltage-gated Na+ channels with sensitivity or resistance to tetrodotoxin (TTX). Kamei et al. indicate that sodium channels, mainly TTX-resistant sodium channels, may play an important role in the enhancement of C-fiber-mediated cough pathways [9]. The depression of brain stem functions by lidocaine may be responsible for cough suppression or lidocaine may act by anesthetizing peripheral cough receptors in the trachea and hypopharynx [10].

Lidocaine is showed to be effective antitussive agent who blocks sensory neuron voltage-gated sodium channels and suppresses action potential generation and propagation of neurons, the mechanism of action likely involves a reduction in action potential formation evoked by a variety of stimuliin several airway afferent nerve subtypes [11].

So, the objective of this study is to determine the effect of IV Lidocaine 5 min before emergence on the incidence and severity of postoperative respiratory complications of Isoflurane in pediatric population, the advantage of that, if confirmed, is to open the door to use Isoflurane more widely in pediatrics instead of the more expensive inhalation agents (Sevoflurane or Desflurane) especially in remote or low income areas where these expensive agents are not available.

## METHOD

With Hospital Ethics Committee approval and informed parental consent, 118 children, ASA 1-2, aged 6 months to 10 years, scheduled to undergo minor elective day-case surgical procedures (not involving airway) were enrolled in a randomized double-blind study protocol.

Exclusion criteria included a history of asthma, recent upper respiratory tract infection, cardiac, renal or hepatic disease, esophageal reflux, difficult airway, passive smoker, a history of malignant hyperthermia or any adverse response to previous anesthetics.

A standardized anesthetic technique was used for all patients; all children were unpremedicated, anesthesia induced using IV Propofol 1.5 mg/kg and maintained with isoflurane 1.5 to 2 MAC using an Ayre's T-piece with Jackson- Rees' modification (weight < 25 kg), or a Bain breathing system (Mapleson's Type D) (weight > 25 kg), using a fresh gas flow, 2.5 times the patient's minute ventilation, to prevent rebreathing.

The children randomized to receive IV 1.5 mg/kg 5 min before emergence from anesthesia (Group A), and non-receiving group (Group B).

The following measurements were conducted on all subjects and recorded every 3 minutes: heart rate, respiratory rate, arterial oxygen saturation (SaO2).

The incidence of breath-holding, coughing, laryngospasm, bronchospasm, and secretions, were recorded. The severity of each complication was graded on a scale 0-3 **(Table 1)** and the total severity score for a particular complication in each group was calculated and compared between groups. Mild (SaO2 < 96%) and severe (SaO2 < 90%) episodes of arterial oxygen desaturation and the need to change to 100% FiO2 were recorded (SaO2 = arterial oxygen saturation).

**Table 1.** Respiratory Complication (Grading Scale).

| | | Grade |
|---|---|---|
| **Coughing** | | |
| **None** | | 0 |
| **Mild** | l-2 Coughs | 1 |
| **Moderate** | >2 coughs (no laryngospasm) | 2 |
| **Severe** | >2 coughs (lamygospasm) | 3 |
| **Breath holding** | | |
| **None** | | 0 |
| **Mild** | <15 sec | 1 |
| **Moderate** | 15-60 sec | 2 |
| **Severe** | >60 sec | 3 |
| **Laryngospasm** | | |
| **None** | | 0 |
| **Mild** | >5 sec phonation | 1 |
| **Moderate** | 5-10 sec phonation, transient or complete obstruction | 2 |
| **Severe** | >10 sec complete obstruction | 3 |
| **Bronchospasm** | | |
| **None** | | 0 |
| **Mild** | Wheeze end-expiration | 1 |
| **Moderate** | Wheeze (throughout expiration)-adequate ventilation | 2 |
| **Severe** | Wheeze (throughout expiration)-impaired ventilation | 3 |
| **Secretions** | | |
| **None** | | 0 |
| **Mild** | Present, no suction required | 1 |
| **Moderate** | Suction 1-2 | 2 |
| **Severe** | Suctioning >2 | 3 |

**Statistical analysis**

The data analyzed using Statistical Package for Social Science (SPSS) version 26.

Demographic data were compared using Statistical t-test. Data presented byfrequency and percentage. The incidence, severity of respiratory.

Complications and episodes of arterial oxygen desaturation were analyzed using Mann-Whitney U test and Chi-squared analysis. Statistical significancewas a $P < 0.05$.

RESULTS

There were no demographic differences between groups **(Table 2)**. The incidence and severity of respiratory complications occurring in emergence were recorded in **Table 3**.

**Table 2.** Demographic data and group characteristics. Age and weight expressed as mean (range).

| | **Group A (Lidocaine) n=54** | **Group B (no-Lidocaine) n=64** |
|---|---|---|
| Age (yr) | 3.5(0.6-9.4) | 4.3(0.62-9.7) |
| Weight (kg) | 13(6.5-23) | 15.1(7.1-25) |
| Sex (M/F) | 34/20 | 46/18 |

**Table 3**. Incidence and Severity of Respiratory Complications Occurring.

| | **Group A (Lidocaine) n=54** | **Group B (no-Lidocaine) n=64** |
|---|---|---|
| **Incidence** | | |
| **Coughing** | 17 (31.48%) | 36 (56.25 %)* |
| **Breath-holding** | 14 (25, 92%) | 20 (31.25%) |
| **Laryngospasm** | 12 (22.22%) | 38 (59.38%) |
| **Bronchospasm** | 0 | 0 |
| **Severity score** | | |
| **Coughing** | 26 | 72* |
| **Breath-holding** | 16 | 38* |
| **Laryngospasm** | 40 | 60 |
| **Secretions** | 20 | 26 |
| **Desaturation** | | |
| **SaO2 < 96%** | 15 (27.78%) | 19 (29.69%) |
| **SaO2 < 90%** | 7 (12.96%) | 10 (15.63%) |
| **Change FIO2** | 2 (3.70%) | 11 (17.19%)* |

*Statistical significance *P < 0.05*

The incidence and severity of cough were greater in Group B (no-Lidocaine) ($P < 0.05$). In Group A (Lidocaine) 31% of children (17/54) coughed, compared with 56% of children (36/64) in Group B (no-Lidocaine). Coughing severity score of 2 or 3 was recorded in 6% children (Group A), and 33% children (Group B). Coughing severity score of 3 occurred in 7% children (Group A), and 26% children (Group B).

Episodes of breath-holding were longer in Group B (no-Lidocaine) ($P < 0.05$). Moderate breath-holding (15-60 sec) and severe breath-holding (>60 sec) (severity score of 2 or 3) occurred with two children in Group A, comparedwith 14 children (26%) in Group B.

There was a high incidence of laryngospasm in Group A (Lidocaine), i.e. 52% of children (28/54), compared to Group B (no-Lidocaine) 59% of children (38/64) ($P > 0.05$).

A higher incidence (17%) ($P < 0.05$) of respiratory complications requiring change to 100% oxygen occurred in Group B (no-Lidocaine) compared to 4% of children in Group A (Lidocaine).

There were no differences between groups (Group A vs. Group B) with regard to the incidence of breath holding (26% vs. 31%), and secretions (30% vs. 31%), ($P > 0.05$).

Episodes of oxygen desaturation that occurred in both groups were not different ($P > 0.05$). Oxygen saturation (SaO2) <96% occurred in 28% of children (15/54) (Group A), and 30% of children (19/64) (Group B). Oxygen saturation (SaO2) <90% occurred in 13% of children (7/54) (Group A), and 15.6% of children (10/64) (Group B).

**DISCUSSION**

The most commonly used inhalational anesthetic agents, Desflurane and Sevoflurane, substantially more expensive than isofurane [12]. However, Isolurane is also used for induction and maintenance of anesthesia. But, because of its pungency, it is irritant to the airways, causing cough, breath-holding, laryngospasm and episodes of arterial oxygen desaturation [13,14].

These problems are more prevalent in pediatric population, especially unpremedicated patients [15-17].

Methods of topical lidocaine application included lidocaine spray onto the larynx, lidocaine spray to the supraglottic [18], glottic and subglottic areas, aerosoladministration [19] or lidocaine jelly placed on the dorsal surface of the supraglottic airway device [20].

The use of IV lidocaine, compared with placebo, led to a large reduction in the incidence and severity of postoperative complications after Isoflurane anesthesia, The incidence and severity of coughing, and the incidence of laryngospasm, were greater and the duration of breath-holding was

longerin the control group, Group B (no-Lidocaine) than in Group A (Lidocaine) (P< 0.05). There were no differences between groups regarding the incidence of breath-holding, and secretions (P > 0.05).

The exact mechanism of action of IV Lidocaine appears to be unknown. One postulated mechanism could be because of the fact that IV lidocaine suppresses the airway's excitatory sensory C-fibers and the release of sensory neuropeptides [21], which decrease irritation and inflammation.

IV lidocaine appeared to be safe and did not result in any difference in adverseevents.

There are insufficient data to determine a conclusion on the ideal dose of IV lidocaine for the prevention of cough. Both low dose (<1.5mg/kg) and high dose (1.5 mg/kg) represent effective measures for cough prevention with a non-significant statistical difference. However, in our study, we use a dose of 1.5 mg/kg which was reviewed by Clivio and colleagues, who examined the useof IV lidocaine to prevent intubation, extubation, and opioid-induced cough [22]. They reported a large reduction in cough with the use of IV lidocaine at 1.5mg/kg, as we concluded.

## CONCLUSION

In conclusion, the use of IV lidocaine decreases the incidence and severity of coughing, the incidence of laryngospasm, the duration of breath-holding, and the need to change to 100% oxygen in pediatrics which was related to Isoflurane pungency. There was no effect on the incidence of secretions or breath-holding. Further work is needed to decide the most appropriate dose, time of administration, and any adverse effect of IV. Lidocaine in pediatrics.

## REFERENCES

1. Phillips AJ, Brimacombe JR, Simpson DL (1988) Anesthetic induction with isoflurane or halothane. Anaesthesia 43: 927-929.
2. Neelakanta G, Miller J (1994) Minimum alveolar concentration of isoflurane for tracheal extubation in deeply anesthetized children.Anesthesiology 80: 811e3.
3. Lee B, Lee JR, Na S (2009) Targeting smooth emergence: the effect site concentration of remifentanil for preventing cough during emergence during propofol remifentanil anesthesia for thyroid surgery. Br J Anaesth 102: 775e8.
4. Crerar C, Weldon E, Salazar J, Gann K, Kelly JA, et al. (2008) Comparison of 2 laryngeal tracheal anesthesia techniques inreducing emergence phenomena. AANA J 76: 425e31.
5. Lam F, Lin YC, Tsai HC, Chen TL, Tam KW, et al. (2015) Effect of intracuff lidocaine on postoperative sore throat and the emergence phenomenon: A systematic review and meta-analysis of randomized controlled trials. PLoS One 10: e0136184.
6. Burki NK, Lee LY (2010) Blockade of airway sensory nerves and dyspnea in humans. Pulm Pharmacol Ther 23: 279e82.
7. Tanelian DL, MacIver MB (1991) Analgesic concentrations of lidocaine suppress tonic A-delta and C fiber discharges produced by acute injury. Anesthesiology 74: 934e6.
8. Woolf CJ, Wiesenfeld-Hallin Z (1985) The systemic administration of local anesthetics produces a selective depression of C afferent fiber evoked activity in the spinal cord. Pain 23: 361e74.
9. Kamei J, Nakanishi Y, Ishikawa Y, Hayashi SS, Asato M (2011) Possible involvement of tetrodotoxin-resistant sodium channels in cough reflex. Eur J Pharmacol 652: 117-120.
10. Poulton TJ, James FM III (1979) Cough suppression by lidocaine. Anesthesiology 50: 470-472.
11. Adcock JJ, Douglas GJ, Garabette M, Gascoigne M, Beatch G, et al. (2003) RSD931, a novel antitussive agent acting on airway sensory nerves. Br J Pharmacol 138: 40-416.
12. Golembiewski J (2013) Economic considerations in the use of inhaled anesthetic agents CIR MAY AMB 18 (2): 70.
13. Kingston HGG (1986) Halothane and isoflurane anesthesia in pediatric outpatients. Anesth Analg 65: 181-184.
14. Warde D, Nagi H, Raflery S (1991) Respiratory complications and hypoxic episodes during inhalation induction with isoflurane in children. Br J Anaesth 66: 327-330.
15. Fisher DM, Robinson S, Brett CM, Perin G, Gregory GA (1985) Comparison of enflurane, halothane, and isoflurane for diagnostic and therapeutic procedures in children with malignancies. Anesthesiology 63: 647-650.
16. McAuliffe GL, Sanders D J, Mills PJ (1994) Effect of humidification on inhalation induction with isoflurane in children. Br J Anaesth 73: 587-589.
17. Raftery S, Warde D (1990) Oxygen saturation during inhalation induction with halothane and isoflurane in children: Effect of premedication with rectal thiopentone. Br J Anaesth 64: 167-169.
18. Staffel JG, Weissler MC, Tyler EP, Drake AF (1991) The prevention of postoperative stridor and laryngospasm with topical lidocaine. Arch Otolaryngol Head Neck Surg 117: 1123-1128.
19. Penaloza IV, Diaz MVP, Jimenez TD (1999) Use of

beclametazone dipropionate for prevention of post intubation laryngospasm in pediatrics vs. topical lidocaine. Anestesiaen Mexico 11: 162-166.

20. O'Neill B, Templeton JJ, CaramicoL, Schreiner MS (1994) The laryngeal mask airway in pediatric patients: Factors affecting ease of use during insertion and emergence. Anesth Analg 78: 659-662.

21. Solway J, Leff AR (1991) Sensory neuropeptides and airway function. J Appl Physiol 71: 2077e87.

22. Clivio S, Putzu A, Tramer MR (2019) Intravenous lidocaine for the prevention of cough: systematic review and meta-analysis of randomized controlled trials. Anesth Analg 129: 1249e55.