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# The Effect of i.v.Lidocaine on Postoperative Respiratory Comlications of Isoflurane Anaesthesia in Paediatrics

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## ABSTRACT

**Background:** *Inhalation anesthesia using Isoflurane in pediatrics is related to airway irritability, coughing, breath holding, and laryngeal spasm. This study aims to determine the effect of* i.v. *Lidocaine 5 minutes before emergence on the incidence and severity of postoperative respiratory complications of Isoflurane in a pediatric population.* **Method:** *A randomized clinical trial study conducted in Children Welfare Hospital included 118 unpremeditated children, aged 6 months to 10 years who were enrolled in the study and randomized to receive iv. Lidocaine (n=54, Group A) and Not receiving Lidocaine (n=64, Group B). Were 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 a scale of 0-3.* **Results:** *The incidence of coughing (31% vs 56%) and laryngospasm (22% vs 59%), coughing severity score (26 vs 72), breath-holding severity score (16 vs 38), and the need to change to a higher $FiO_2$ (4% vs 11%) were more frequent in Group A than in Group B ($p<0.05$). There was no difference regarding the incidence of breath-holding (26% vs 31%) and secretion (30% vs 31%).* **Conclusions:** i.v. *Lidocaine 5 minutes before emergence from anesthesia reduces the frequency and severity of coughing, the frequency of laryngospasm, the severity of breath-holding, and the need to change to higher $FiO_2$ in pediatrics.*

**Keywords:** Isoflurane, Paediatric anesthesia, Respiratory complications, i.v.Lidocaine

## INTRODUCTION

Isoflurane is used for the 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 to being 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 because of its pungency that leads to irritation of the airway [1].

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

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

The use of I i.v. lidocaine is another prophylactic measure that is commonly used by anesthetists. The mechanism by which it acts is not well understood. There are many propositions like the suppression of airway sensory C fibres, the reduction of neural discharge of peripheral nerve fibres, 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.* indicates 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 shown to be an effective antitussive agent that 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 stimuli in several airway afferent nerve subtypes [11].

So, the objective of this study is to determine the effect of i.v. Lidocaine 5 minutes before emergence on the incidence and severity of postoperative respiratory complications of Isoflurane in the 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 the 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, oesophageal 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 unpremeditated, 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 minutes 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, and arterial oxygen saturation ($SaO_2$).

The incidence of breath-holding, coughing, laryngospasm, bronchospasm, and secretions, were recorded. The severity of each complication was graded on a scale of 0-3 (Table 1). The total severity score for a particular complication in each group was calculated and compared between groups. Mild ($SaO_2$<96%) and severe ($SaO_2$<90%) episodes of arterial oxygen desaturation and the need to change to 100% $FiO_2$ were recorded. ($SaO_2$=arterial oxygen saturation).

**Table 1 Respiratory Complications (Grading Scale)**

| Grade | | |
|---|---|---|
| **Coughing** | | |
| **None** | | 0 |
| **Mild** | l-2 Coughs | 1 |
| **Moderate** | >2 coughs (no laryngospasm) | 2 |
| **Severe** | >2 coughs (laryngospasm) | 3 |
| **Breath-holding None** | | |
| **Mild** | | 0 |
| **Moderate** | <15 sec | 1 |
| **Severe** | 15-60 sec | 2 |
| | >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 | At present, no suction is required | 1 |
| **Moderate** | Suction 1-2 | 2 |
| **severe** | Suctioning >2 | 3 |

**Statistical Analysis**

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

Demographic data were compared using a Statistical t-test. Data is presented by frequency and percentage. The incidence, severity of respiratory complications, and episodes of arterial oxygen desaturation were analyzed using the Mann-Whitney U test and Chi-squared analysis. Statistical significance was 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)**

| Characteristics | 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 |

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% of children (Group A), and 33% of children (Group B). A coughing severity score of 3 occurred in 7% of children (Group A), and 26% of children (Group B).

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

There was a high incidence of laryngospasm in Group A (Lidocaine), ie. 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 a change to 100% oxygen occurred in Group B (no-Lidocaine) compared to 4% of children in Group A (Lidocaine).

**Table 3 Incidence and severity of respiratory complications occurring**

| Complications | 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** | | |
| **$SaO_2$<96%** | 15 (27.78%) | 19 (29.69%) |
| **$SaO_2$<90%** | 7 (12.96%) | 10 (15.63%) |
| **Change $FIO_2$** | 2 (3.70%) | 11 (17.19%)* |
| Statistical significance *p<0.05 | | |

There were no differences between groups (Group A vs Group B) regarding 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($SaO_2$) <96% occurred in 28% of children (15/54) (Group A), and 30% of children (19/64) (Group B). Oxygen saturation ($SaO_2$) <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, are substantially more expensive than isoflurane [12]. However, Isoflurane is also used for the 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 the pediatric population, especially in unpremeditated patients [15-17].

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

the use of i.v. 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 longer in 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 IV lidocaine suppresses the airway's excitatory sensory C-fibres and the release of sensory neuropeptides, which decrease irritation and inflammation. i.v. lidocaine appeared to be safe and did not result in any difference in adverse events [21].

There are insufficient data to determine a conclusion on the ideal dose of i.v. lidocaine for the prevention of cough. Both low dose(<1.5 mg/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 use of i.v. lidocaine to prevent intubation, extubation, and opioid-induced cough [22]. They reported a large reduction in cough with the use of i.v. lidocaine at 1.5 mg/kg, as we concluded.

## CONCLUSION

In conclusion, the use of i.v. 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 effects of i.v. Lidocaine in pediatrics.

## DECLARATIONS

**Conflict of Interest**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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