

Efficacy of Intravenous Lidocaine in Preventing Laryngospasm in Children Undergoing Tonsillectomy

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ABSTRACT

Background: Laryngospasm is a well-known problem typically occurring immediately following tracheal extubation. Lidocaine is known to inhibit airway reflexes. Pediatric laryngospasm is an anesthetic emergency. It is a relatively common phenomenon that occurs with varying frequency dependent on multiple factors. Treating laryngospasm by using lidocaine is controversial.

Aim: To compare the efficacy of intravenous lidocaine with placebo for prevention of laryngospasm in children undergoing tonsillectomy.

Methods: This was a randomized controlled trial conducted in the department of Anesthesia, Mayo Hospital Lahore. Total 150 patients were included in the study and randomly divided into 2 groups. Each group contained 75 patients each. In Group-P patients were given placebo and in Group-L patients were given IV Lidocaine. Informed consent was taken from parents of each patient in both treatment groups. Relevant information was recorded on a well-defined Performa. Data entry and analysis was done by using SPSS 11.5.

Results: Average age of all 150 patients was 8.33 ± 2.33 years. Average age of patients in Group-P and in Group-L was 8.09 ± 2.37 and 8.56 ± 2.32 years respectively. In placebo group laryngospasm was present in 20% and in Lidocaine group 8% of the patients had laryngospasm. Efficacy of Lidocaine in controlling laryngospasm was 92% where as efficacy of placebo group was 80%. Lidocaine shows greater efficacy for controlling laryngospasm.

Conclusion: On the basis of obtained results it is concluded that Lidocaine effectively controls laryngospasm in children undergoing Tonsillectomy.

Keywords: Laryngospasm, Lidocaine, Tonsillectomy, Placebo, Efficacy

INTRODUCTION

Laryngospasm after extubation is a complication which anesthetists frequently come across in daily practice¹. Laryngospasm may resolve itself with routine measures like giving 100% oxygen with face mask, jaw thrust, positive pressure ventilation etc, but at times, if not treated properly, it may result in complications such as hypoxia, hypercarbia, bradycardia, arrhythmias^{2,3,4}, negative pressure pulmonary edema and even cardiac arrest. In these situations it may become a life threatening situation^{5,6,7}.

Laryngospasm is a matter of concern in both adults and pediatric population with an incidence of 8.7/1000 and 17.4/1000 respectively. High incidence of laryngospasm in pediatric population is attributed to their anatomical tracheal narrowing which results in early respiratory obstruction from laryngeal edema due to secretions, blood, foreign bodies, surgical operations, instrumentation, physical and chemical stimuli as smoke etc^{8,9,10,11,12}.

Studies have concluded that lower the age of the child the greater the probability of laryngospasm, being highest in the first year of life and maximum in the first 3 months^{2,3,4}.

A large number of studies have been conducted to investigate causes of laryngospasm after extubation and certain factors like age, upper respiratory tract infection in the past 6 weeks, operations on oropharynx especially adenotonsillectomy and cleft palate have been found to contribute.^[2-4] The experience of the anesthetist in handling pediatric patients, technique of anesthesia and the anesthetic drugs used, all affect the post extubation condition of the patient. Volatile anesthetic agents like isoflurane are said to cause respiratory passage irritation and hence laryngospasm. Halothane and sevoflurane do not cause laryngospasm, as they depress the laryngeal reflexes. Propofol, an intravenous induction agent, is also said to protect against laryngospasm by depressing the laryngeal reflexes^{3,8,13-19}.

There is a high incidence of laryngospasm (20%-26.5%) in children undergoing oropharyngeal surgery and adenotonsillectomy under general anaesthesia. The anesthetists have been using different techniques, strategies and drugs in an effort

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to minimize the incidence of this complication which can be responsible for morbidity and mortality in children^{5,9,10,11,12,20-24}.

Lidocaine is one drug which has been extensively studied. It is well known to suppress hemodynamic stress response at intubation and extubation when given intravenously, topically or instilled through endotracheal tube during anesthesia²⁵⁻³¹.

Although available data accepts the role of intravenous lidocaine in prevention of laryngospasm its timing of injection is still controversial. Few studies have been done to see the effect of lidocaine at different time intervals which needs to be confirmed locally on patients. Thus, the purpose of this study is to find the time of optimal effect of lidocaine in prevention of laryngospasm in children when given 2 minutes before extubation^{17,32}.

MATERIAL & METHODS

This randomized controlled trial was conducted in the Department of Anesthesia Mayo Hospital Lahore. 150 patients of both sexes between 5 to 12 years of age were divided into two equal groups of 75 patients each. Placebo group (Group P) and lidocaine group (Group L). (n=75) was selected with 80% power of test, 1% level of significance. Taking expected percentage of efficacy in both groups i.e., 94.29% in Group L versus 76.68% in Group P in patients undergoing tonsillectomy. Sampling technique was non probability purposive sampling Patients scheduled for elective tonsillectomy ASA I and II (American Society of Anesthesiologists) of either gender were included in this study. Patients with history of upper respiratory tract infection in the previous four weeks, difficult airway, history of chronic cough, bronchial asthma and mental retardation states like Down syndrome, cerebral palsy or any other conditions requiring postoperative ventilation were excluded^{19,32}.

Data collection procedure: 150 patients planned for elective tonsillectomy fulfilling the inclusion criteria were included. The study was done in ENT operation theater King Edward Medical University/Mayo Hospital Lahore after approval of the hospital ethical committee. Informed consent was obtained from all parents. Demographic data like name, age, sex were noted. Children were randomly allocated to Group L (Lidocaine Group) and Group P (Placebo Group) using lottery method. On arriving in the theatre ECG, heart rate, $SPAO_2$ (on room air) and non invasive blood pressure monitoring was started and baseline readings were noted. After securing intravenous access, induction was done with injection propofol 2mg/kg followed by suxamethonium 2mg/kg intravenously. Endotracheal tube of appropriate size

was passed. Maintenance was carried out with 50% nitrous in oxygen and halothane 0.6 MAC with injection atracurium 0.5 mg/kg with controlled ventilation. At the completion of surgery when spontaneous ventilation resumed neuromuscular blockade was antagonized with neostigmine 0.05 mg/kg and glycopyrolate 0.01 mg/kg. Three minutes after reversal Group P received 3 ml normal saline and Group L received lidocaine 1.5 mg/kg intravenously. Patients were extubated two minutes after giving the study drugs (lidocaine or saline) and oxygenated via face mask for three minutes. After extubation patients were observed for laryngospasm for 10 minutes using 4 point modified scale. Efficacy was measured in terms of no laryngospasm (absence of laryngospasm).

Four point modified scale⁵

1. No laryngospasm = 0
2. Stridor during inspiration = 1
3. Total occlusion of vocal cords = 2
4. Cyanosis = 3

Patients who developed laryngospasm were treated according to severity of symptoms using maneuvers such as jaw thrust, clearing of secretions and positive pressure ventilation. Injection suxamethonium 1mg/kg with atropine was administered if laryngospasm persisted.

Statistical Analysis: All data collected on Performa's was entered in SPSS version 1.5 and analyzed. Qualitative variables like gender were presented as frequencies and percentages. For the quantitative variables like age, the simple descriptive statistics like mean, standard deviation were used. Chi square test was applied to find out the significance of difference between efficacies of two groups. P value of less than or equal to 0.05 was taken as significant.

RESULTS

One hundred and fifty patients of ages between 5 to 12 years, with an average age of 8.33 ± 2.33 years were planned for tonsillectomy. In Group P average age was 8.09 ± 2.37 years whereas in Group L it was 8.56 ± 2.32 years (Table 1).

Table 1: Comparison of average age of patients between two groups

| Group-P | Group-L | P Value |
|-----------------------|-----------------------|---------|
| 8.09 ± 2.37 years | 8.56 ± 2.32 years | 0.42748 |

There was no significant age difference between the two patient groups (P value=0.42748). Gender distribution pattern showed 28 males (37.3%) and 47 females (62.7%) in Group P whereas in Group L it

was 41 males (54.7%) and 34 females (45.3%) (Table 2).

Table 2: Gender distribution

| Gender | Group-P | Group-L |
|--------|-----------|-----------|
| Male | 28(37.3%) | 41(54.7%) |
| Female | 47(62.7%) | 34(45.3%) |

Laryngospasm was observed in 15 patients in Group P and 6 patients in Group L. In Group L number of patients having laryngospasm was less (8% of the total group population) as compared to the number of patients having laryngospasm in Group P (20% of the total group population) (Table 3). (P Value = 0.034). Of the 15 patients of group P (20%) who had laryngospasm, eleven patients had Grade I laryngospasm, four patients had Grade II laryngospasm and one patient had Grade III laryngospasm. The patient who had Grade III laryngospasm was 10 years of age with a history of frequent attacks of tonsillitis but at the time of operation had no signs of infection and had not had tonsillitis in the preceding four weeks. All patients in Group P with Grade I, II and III laryngospasm responded to oxygenation, jaw thrust and positive pressure ventilation, propofol and none of them had to be re intubated. In contrast, 6 patients in Group L (8%) had laryngospasm and all of them had Grade I laryngospasm and responded to oxygenation and jaw thrust, showing that lidocaine not only decreased the incidence of laryngospasm but also its severity when given 2 minutes before extubation.

The criterion for efficacy was taken as absence of laryngospasm. Efficacy in Group P was observed in 80% of the total group population, which means that in Group P laryngospasm was absent in 60 patients and present in 15 patients. Efficacy in Group L was observed in 92% of the total group population, which means that in Group L laryngospasm was absent in 69 patients and present in 6 patients.

Table 3: Comparison of laryngospasm in patients between the groups

| Group | Laryngospasm | | Efficacy of lidocaine | |
|-------|--------------|---------|-----------------------|---------|
| | Yes | No | Yes | No |
| P | 15(20%) | 60(80%) | 60(80%) | 15(20%) |
| L | 6(8%) | 69(92%) | 69(92%) | 6(8%) |

*Criteria for efficacy has been considered as absence of laryngospasm.

P-Value = 0.034

DISCUSSION

Laryngospasm is a condition which can be trivial or self-limiting but it may progress to life threatening situations. Anesthetists have always been concerned about this complication and tried different strategies

and drugs which include administering lidocaine by different routes during pre or post-extubation period at varying time intervals^{1,5,25,32}. Certain drugs like propofol, suxamethonium, benzodiazepines, nitroglycerines, doxapram etc. have been used to treat laryngospasm but all with inconclusive results^{1,2,3,4,7,10,19,22,25,32}.

Some factors are said to increase the incidence of laryngospasm in patients. These include age, technique of anesthesia, anesthetic agent, experience of anesthetist, type of operation, upper airway sensitivity, upper respiratory tract infection, timing of lidocaine injection and its serum level^{3,8,13-15}.

Post extubation laryngospasm and effects of lidocaine on it have been studied extensively yet its mechanism of action is not clear.^[12] It is postulated that lidocaine may suppress the respiratory and laryngeal reflex response by a direct effect or depressing the motor function³².

Children have a narrow respiratory passage and also consume more oxygen because of high metabolic rate so they are more susceptible to hypoxemia during and after operation. After extensively studying effects of various drugs on laryngospasm the only drug persistently found to have some effect on laryngospasm was lidocaine^{12,14,33,35}. Many research studies have been conducted on the efficacy of Lidocaine in suppressing respiratory and laryngeal reflexes but with conflicting results^{2,5,10,19,22}.

In our study, we had incidence of laryngospasm in 20% of the total patients in Group P which is in agreement with the studies conducted for ENT surgical procedures under general anesthesia by Baraka, Ko C, Webster A. C, Gulhas^{34,21,33,22}. Our results are also consistent with Tam S, et al^[15] who studied the optimal time of lidocaine injection before tracheal intubation.

One of the earliest studies to find the effect of lidocaine on laryngospasm was conducted by Baraka³⁴. His control group had 20% incidence of laryngospasm and his study group had 0% incidence of laryngospasm in comparison our control group (Group P) which had the same incidence i.e., 20% but our study group (Group L) had 8% incidence. This difference might have resulted from meperidine and phenobarbital given as premedication and concentration of halothane 2-4% used to maintain anesthesia. Both these factors increased the depth of anesthesia and potentiated the effect of lidocaine depressing the respiratory and laryngeal reflexes. This effect has also been explained by Kim et al in their study³⁶.

The results of Leicht P, et al¹² are also in disagreement with our study; who studied 100 patients schedule for elective tonsillectomy under

general anesthesia between 3 to 7 years of age. He found the same incidence of 22% laryngospasm in both his control and study groups in contrast to 20% and 8% in our control group (Group P) and our study group (Group L) respectively.

His patients although heavily pre medicated with Mepridine, chlorpromazine and promethazine and maintained on halothane throughout the operation, were extubated during the lighter plain of anesthesia when their swallowing activity had returned. The lighter plain of anesthesia, N₂O washout, the timing of injecting lidocaine and extubation criteria all resulted in increased incidence of laryngospasm in his both groups as compared to ours^{37,38}.

Sanikop C et al studied a total number of 74 patients to determine efficacy of lidocaine in preventing extubation laryngospasm undergoing cleft palate surgery⁹. The incidence of laryngospasm in his control group was high at 24.32% as compared to 20% in our control group (Group P). His study group had a lower incidence of laryngospasm of 5.7% as compared to 8% in our study group (Group L). The lesser incidence of laryngospasm in his study can be attributed to depression of respiratory and laryngeal reflexes resulting from analgesia and depth of anesthesia due to ketamine given as premedication and inducing agent.

In Sanikop C study the control group showed greater incidence of laryngospasm because they received saline and not lidocaine. In addition, the age of his patients (3 months to 6 years), cleft palate surgery and ketamine all resulted in excessive secretions, swelling and edema of the airway which resulted in respiratory obstruction and laryngospasm^{3,4,8,11}.

Results of study conducted by T. O. Erb et al in 2013 are also not similar to ours³². Their control group (base line) had incidence of 38% as compared to 20% of our control group. The study group of T. O. Erb, comparable to ours, also had increased incidence of laryngospasm i.e., 15% compared to 8% in our study group (Group L). This can be assumed to have resulted from their experimental study design, selection of patients regarding age and upper respiratory tract infection, anesthesia technique, use of LMA and timing of giving lidocaine. As a study design all their patients had stimulation of vocal cords, patients age was lower than ours (2 to 7 years compared to 5 to 12 years in our study)⁴², exclusion criteria included upper respiratory tract infection in preceding two weeks compared to our exclusion criteria of preceding four weeks¹³ using only sevoflurane and emitting N₂O throughout the study period compared to the use of propofol and halothane by us. This resulted in lighter plain of anesthesia and exaggerated respiratory and

laryngeal reflexes in their patients^{3,8,17,19,40,41}. In addition, timing of injection lidocaine can influence its mean serum level. T. O. Erb after intravenous injection found mean serum level of lidocaine 3.2 (0.8ug/ml) at 2 minutes and it dropped to 2 (0.4ug/ml) at 10 minutes explaining why different studies had conflicting results.

To conclude the discussion it is clear from our study that lidocaine efficiently prevents laryngospasm in children undergoing tonsillectomy provided extubation is done after 2 minutes of giving lidocaine. Other factors required to prevent laryngospasm may include proper history taking of the patient to rule out any precipitating cause like bronchial asthma, upper respiratory tract infection in preceding four week, anesthetist experienced in pediatric anesthesia, selection of suitable anesthetic technique and agent.

REFERENCES

1. Al-Metwalli RR, Mowafi HA, Ismail SA. Gentle chest compression relieves extubation laryngospasm in children. *Journal of anesthesia* 2010;24(6):854-7.
2. ALALAMI AA, AYOUB CM, BARAKA AS. Laryngospasm: review of different prevention and treatment modalities. *Pediatric Anesthesia* 2008;18(4):281-8.
3. Mamie C, Habre W, Delhumeau C, Argiroffo CB, Morabia A: Incidence and risk factors of perioperative respiratory adverse events in children undergoing elective surgery. *Paediatr Anesth* 2004; 14:218 –24
4. Olsson G, Hallen B. Laryngospasm During Anesthesia. A Computer-Aided Incidence Study in 136 929 Patients. *Acta anesthesiologica scandinavica* 1984;28(5):567-75.
5. Sheta SA, Abdelhalim AA, Nada E. Evaluation of "no touch" extubation technique on airway-related complications during emergence from general anesthesia. *Saudi Journal of Anesthesia* 2011;5(2):125.
6. Bolaji B, Oyedepo O, Dunmade A, Afolabi O. Negative Pressure Pulmonary Oedema Following Adenoidectomy Under General Anesthesia: A Case Series. *West African journal of medicine* 2011;30(2):121-4.
7. Waheed Z, Khan JA. Negative pressure pulmonary oedema: A rare complication following general anesthesia. *Journal of the Pakistan Medical Association* 2011;61(3):290.
8. von Ungern-Sternberg BS, Boda K, Chambers NA, Rebmann C, Johnson C, Sly PD, Habre W: Risk assessment for respiratory complications in paediatric anesthesia: A prospective cohort study. *Lancet* 2010; 376:773– 83
9. Sanikop C, Bhat S. Efficacy of intravenous lidocaine in prevention of post extubation laryngospasm in children undergoing cleft palate surgeries. *Indian journal of anesthesia* 2010;54(2):132.
10. BURGOYNE LL, ANGHELESCU DL. Intervention steps for treating laryngospasm in pediatric patients. *Pediatric Anesthesia* 2008;18(4):297-302.
11. Orliaguet GA, Gall O, Savoldelli GL, Couloigner V. Case scenario: perianesthetic management of laryngospasm in children. *Anesthesiology* 2012;116(2):458-71.
12. Leicht P, Wisborg T, Jørgensen BC. Does intravenous lidocaine prevent laryngospasm after extubation in children? *Anesthesia & Analgesia* 1985;64(12):1193-6.
13. Tait AR, Malviya S, Voepel-Lewis T, Munro HM, Seiwert M, Pandit UA: Risk factors for perioperative adverse respiratory events in children with upper respiratory tract infections. *ANESTHESIOLOGY* 2001; 95:299 –306

14. Minogue SC, Ralph J, Lampa MJ. Laryngotracheal topicalization with lidocaine before intubation decreases the incidence of coughing on emergence from general anesthesia. *Anesthesia & Analgesia* 2004;99(4):1253-7.
15. Tam S, Chung F, Campbell M. Intravenous Lidocaine: Optimal time of injection before tracheal intubation. *Anesth Analg* 1987;66:1036-8.
16. Schreiner MS, O'Hara I, Markakis DA, Politis GD. Do children who experience laryngospasm have an increased risk of upper respiratory tract infection? *Anesthesiology* 1996;85(3):475.
17. Oberer C, von Ungern-Sternberg BS, Frei FJ, Erb TO: Respiratory reflex responses of the larynx differ between sevoflurane and propofol in pediatric patients. *ANESTHESIOLOGY* 2005;103:1142–8
18. Schroeck H, Fecho K, Abode K, Bailey A: Vocal cord function and bispectral index in pediatric bronchoscopy patients emerging from propofol anesthesia. *Pediatr Pulmonol* 2010;45:494 –9
19. Afshan G, Chohan U, Qamar-UI-Hoda M, Kamal RS. Is there a role of a small dose of propofol in the treatment of laryngeal spasm? *Pediatric Anesthesia* 2002;12(7):625-8.
20. Lee CK, Chien TJ, Hsu JC, Yang CY, Hsiao JM, Huang YR, Chang CL: The effect of acupuncture on the incidence of postextubation laryngospasm in children. *Anesthesia* 1998;53:917–20
21. Ko C, Kocaman F, Aygen E, Ozdem C, Ceki A: The use of preoperative lidocaine to prevent stridor and laryngospasm after tonsillectomy and adenoidectomy. *Otolaryngol Head Neck Surg* 1998; 118:880 –2
22. Gulhas N, Durmus M, Demirbilek S, Tugal T, Ozturk E, Ersoy MO. The use of magnesium to prevent laryngospasm after tonsillectomy and adenoidectomy: a preliminary study. *Pediatric Anesthesia* 2003;13(1):43-7.
23. Murat I, Constant I, Maud'huy H: Perioperative anesthetic morbidity in children: A database of 24,165 anesthetics over a 30-month period. *Paediatr Anesth* 2004; 14:158 – 66
24. Cohen MM, Cameron CB: Should you cancel the operation when a child has an upper respiratory tract infection? *Anesth Analg* 1991; 72:282– 8
25. Bidwai AV, Bidwai VA, Rogers CR, Stanley TH. Blood-pressure and pulse-rate responses to endotracheal extubation with and without prior injection of lidocaine. *Anesthesiology* 1979;51(2):171-2.
26. Bidwai AV, Stanley TH, Bidwai VA. Blood pressure and pulse rate responses to extubation with and without prior topical tracheal anesthesia. *Canadian Anesthetists' Society Journal* 1978;25(5):416-8.
27. Jee D, Park SY. Lidocaine sprayed down the endotracheal tube attenuates the airway-circulatory reflexes by local anesthesia during emergence and extubation. *Anesthesia & Analgesia* 2003;96(1):293-7.
28. Gonzalez R, Bjerke R, Drobycki T, Stapelfeldt W, Green J, Janowitz M, et al. Prevention of Endotracheal Tube-Induced Coughing During Emergence from General Anesthesia. *Survey of Anesthesiology* 1995;39(3):183
29. Diachun CAB, Tunink BP, Brock-Utne JG. Suppression of cough during emergence from general anesthesia: laryngotracheal lidocaine through a modified endotracheal tube. *Journal of clinical anesthesia* 2001;13(6):447-51.
30. Fagan C, Frizelle HP, Laffey J, Hannon V, Carey M. The effects of intracuff lidocaine on endotracheal-tube-induced emergence phenomena after general anesthesia. *Anesthesia & Analgesia* 2000;91(1):201-5.
31. Estebe J-P, Gentili M, Le Corre P, Dollo G, Chevanne F, Ecoffey C. Alkalinization of intracuff lidocaine: efficacy and safety. *Anesthesia & Analgesia* 2005;101(5):1536-41.
32. The effect of intravenous lidocaine on laryngeal and respiratory reflex responses in anesthetised children* T. O. Erb,1 B. S. von Ungern-Sternberg,2 K. Keller3 and F. J. Frei1 *Anesthesia* 2013, 68, 13–20
33. Webster A, Morley-Forster P, Dain S, Ganapathy S, Ruby R, Au A, et al. Anesthesia for adenotonsillectomy: a comparison between tracheal intubation and the armoured laryngeal mask airway. *Canadian journal of anesthesia* 1993;40(12):1171-7.
34. Baraka A. Intravenous lidocaine controls extubation laryngospasm in children. *Anesthesia & Analgesia* 1978;57(4):506-7.
35. Colman MF, Reynolds R. The use of topical cocaine to prevent laryngospasm after general anesthesia on endoscopy procedures. *The Laryngoscope* 1985;95(4):474-.
36. Kim WY, Lee YS, Ok SJ, et al. Lidocaine does not prevent bispectral index increases in response to endotracheal intubation. *Anesthesia and Analgesia* 2006; 102: 156–9.
37. Phillips OC, Lyons WB, Harris LC, Nelson AT, Graff TD, Frazier TM. Intravenous lidocaine as an adjunct to general anesthesia: a clinical evaluation. *Anesth Analg* 1960;39:317.
38. Himes RS, DiFazio CA, Burney RG. Effects of lidocaine on the anesthetic requirements for nitrous oxide and halothane. *Anesthesiology* 1977;47:437-40.
39. Mevorach DL. The management and treatment of recurrent postoperative laryngospasm. *Anesth Analg* 1996; 83: 1110.
40. von Ungern-Sternberg BS, Boda K, Schwab C, Sims C, Johnson C, Habre W: Laryngeal mask airway is associated with an increased incidence of adverse respiratory events in children with recent upper respiratory tract infections. *Anesthesiology* 2007; 107:714–9
41. Flick RP, Wilder RT, Pieper SF, van Koeverden K, Ellison KM, Marienau ME, Hanson AC, Schroeder DR, Sprung J: Risk factors for laryngospasm in children during general anesthesia. *Paediatr Anesth* 2008; 18:289 –96
42. Roy WL, Lerman J. Laryngospasm in paediatric anesthesia. *Can J Anesth* 1988;35:93-8.