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Effects of Alkalinized Intra-cuff Lidocaine on Postoperative Airway Complaints Following Cesarean Section

Yong Cheol Lee, M.D., Yong Sup Shin, M.D.[1], Ji Hee Hong, M.D.,
Ae Ra Kim, M.D., Young Ho Jang, M.D.

Department of Anesthesiology and Pain Medicine, Keimyung University School of Medicine, Daegu,
Handong University Sunlin hospital, Pohang, Korea[1]

Abstract : Many reports have described postoperative airway complaints after endotracheal intubation for general anesthesia, however, none have addressed cesarean sections. We investigated the incidence and severity of postoperative airway complaints in pregnant women receiving elective general anesthesia and evaluated the effect of intratracheal cuff lidocaine administration on these complaints. Two hundred and ninety-four pregnant women undergoing elective cesarean sections under general anesthesia, with American Society of Anesthesiologists physical status ratings Ⅰ or Ⅱ, were randomly assigned to the two groups having endotracheal tube cuffs inflated with either air (group A, mean volume = 6.4 ± 1.8 mL) or alkalinized lidocaine (group L, mean volume = 6.2 ± 1.5 mL) (n = 147 in each group). Alkalinization of lidocaine was achieved by the addition of 8.4% $NaHCO_3$ to a 1:10 ratio of lidocaine:$NaHCO_3$. The incidence and severity of postoperative sore throat (POST), hoarseness, and coughing were evaluated during the 24 hours immediately following cesarean sections. The incidence of POST, hoarseness, and coughing were decreased in the group L (67.3%, 53.7%, and 9.5%, respectively) compared to the group A (78.9%, 69.4%, and 19%, respectively) (p=0.025, 0.006, and 0.02, respectively). Intra-cuff lidocaine significantly attenuated the severity of hoarseness. There was no significant difference in Apgar scores in neonates between the two groups. Intra-cuff lidocaine effectively decreased the incidence and severity of postoperative airway complaints in pregnant women undergoing cesarean sections without affecting fetal outcome.

Key Words : cesarean section, hoarseness, lidocaine, postoperative complaints, sore throat

Introduction

Postoperative sore throat (POST) and hoarseness frequently arise after endotracheal intubation (ETI) for general anesthesia, even after a brief period of anesthesia[1-4]. Major proposed etiologies of POST and hoarseness include intubation trauma and mucosal edema or dehydration[5,6]. Multiple factors are associated with the development of POST and hoarseness after ETI, including female gender, young age, use of nitrous oxide, bloodstain on the ET tube (ETT), surgical sites around the neck, a history of smoking or lung disease, duration of anesthesia, and nasogastric tube insertion[7,8]. Although general anesthesia is not the predominant regimen for elective cesarean sections and its incidence has declined, it is still required in various cases. Pregnant women receiving general anesthesia for their cesarean sections have a number of factors for POST and hoarseness, such as female gender, young age, and the use of nitrous oxide. Nitrous oxide is commonly administered to 70% with a volatile anesthetic agent following delivery during general anesthesia for cesarean sections[9]. In addition, increased extracellular fluid, vascular engorgement, and elevated estrogen level typically lead to edema of the airway in pregnant women, which may lead to airway trauma during ETI[10-12]. In an effort to decrease the incidence of postoperative airway complaints after ETI, a variety of methods and adjuvants have been used, including alkalinized intracuff lidocaine (IC-L)[13,14].

The purpose of the present study, therefore, was to investigate the incidence and severity of postoperative airway complaints-including POST, hoarseness, and coughing-in pregnant women after general anesthesia with ETI for cesarean sections. In addition, we investigated whether alkalinized IC-L could reduce the incidence of these airway complaints without affecting fetal outcome after cesarean sections.

Materials & Methods

Two hundred and ninety-four pregnant women receiving general anesthesia with ETI for cesarean section were enrolled after obtaining approval of the hospital ethics committee and written informed consent. Specific exclusion criteria included preeclampsia or other emergent operation, upper respiratory tract infection, obesity, and history of laryngeal or tracheal disease.

Pregnant women were randomly assigned into one of two groups according to ETT cuff inflation; the Group A, received air inflation: and the Group L, received alkalinized lidocaine inflation (n = 147 for each group). At the induction of anesthesia, pregnant women breathed 100% oxygen via a face mask and then were anesthetized according to a standard protocol. They received 4 mg/kg of thiopental sodium and 1.5 mg/kg of succinylcholine to facilitate ETI. Laryngoscopy was performed by same type of blade and the trachea was intubated by one skilled anesthesiologist with a standard high-volume, low-pressure cuff ETT (Tracheal tube, Mallinckrodt medical, Athlone, Ireland) having an 6.5 mm of internal diameter and an 8.7 mm of outer diameter. Sterile water was used as a lubricant for the ETT. The ETT cuffs were

inflated with the minimal volume of either air or 4% alkalinized lidocaine (Litaine Inj®, Daehan Pharmacy, South Korea) without gas leakage at 20 cmH_2O. Alkalinization of lidocaine was achieved by the addition of 8.4% $NaHCO_3$ (Sodium Bicarbonate Inj®, Jaeil Pharmacy, South Korea) to a 1:10 ratio of lidocaine:$NaHCO_3$[15]. The cuff pressure was monitored throughout the operation with manometers (Mallinckrodt medical, Athlone, Ireland) and was kept between 20 and 40 cmH_2O throughout the anesthesia by manual pressure release. Anesthesia was maintained with vecuronium bromide, nitrous oxide/oxygen, and sevoflurane. After delivery, all parturients received 2 μg/kg of fentanyl and end-tidal sevoflurane concentrations of about 1.0 vol% by volume with nitrous oxide/oxygen (FiO_2 = 0.33). The anesthesiologist recorded fetal Apgar scores at one and five minutes after delivery.

Extubation was performed when all of the following criteria were met full reversal of neuromuscular block (ulnar nerve T4/T1 ratio 1:1, with sustained tetanus at 50 Hz for 5s and no fade), spontaneous ventilation, and the ability to follow verbal commands (eye opening or hand grip) or demonstrate purposeful unilateral movement (attempting self-extubation).

Blood or blood stained secretions in the ETT, cuff intactness, bucking, coughing, apnea, airway obstruction, laryngospasm, or bronchospasm following the extubation were all investigated. POST, hoarseness, and coughing were checked at postextubation periods of 1, 6, 12, and 24 h. A blinded interviewer who was not involved in anesthetic practice checked the grade of postoperative airway symptoms using a prepared checklist. POST and coughing were graded as follows: 0 = no symptoms; 1 = mild (less severe than with a cold); 2 = moderate (similar to that noted with a cold); and 3 = severe (more severe than with a cold). Hoarseness was graded as follows; 0 = no symptoms; 1 = mild (no symptom at interview time but mild symptoms prior to interview); 2 = moderate (the patient complained of hoarseness); 3 = severe (interviewer could easily confirm hoarseness).

Prior to initiation of the study, power analysis was performed to determine population size. For previous data using IC-L, POST could be reduced approximately 30%[14]. We calculated that 147 pregnant women were required in each group to detect a difference with a two-tailed analysis with a type Ⅰ error rate of [alpha] = 0.05 and a type Ⅱ error rate of [beta] = 0.20, *i.e.*, power equal 0.80. Analyses were performed using the SPSS statistical package version 12.0 (SPSS for Windows, SPSS Inc., Chicago, IL, USA). Data are expressed as means ±SD. The demographic data and Apgar scores were compared by the unpaired Student's *t*-test and the incidence was compared using the Chi-square test. Differences in severity between groups were compared using the Mann-Whitney U-test. A p-value of less than 0.05 was considered to constitute statistical significance.

Results

There were no significant differences between the two groups with respect to age, body weight both before pregnancy and before cesarean section, height, gestational

age, or duration of anesthesia (Table 1). Surgical indications for cesarean sections were previous cesarean section and fetopelvic disproportion, abnormal fetal presentation, dysfunctional uterine activity, placenta previa, and previous myomectomy. There was no difference in surgical indications for cesarean sections between the two groups (data not shown), and there were no failed intubations on the first attempt. There also was no significant difference in the initial volume injected into the ETT cuff (6.4 ± 1.8 mL for the group A and 6.2 ± 1.5 mL for the group L). Surgical conditions were satisfactory and all Apgar scores were over 7 (mean 1-minute Apgar scores were 8.9 for the group A and 9.0 for the group L; and mean 5-minute Apgar scores were 9.9 for both groups; $p>0.05$). Eight pregnant women in the group A had ETT-related events after ETI - 4 of blood-stained tube, 3 of coughing, and 1 of bucking. Five pregnant women in the group L had ETT-related events after ETI - 3 of blood-stained tube and 2 of coughing. There was no statistically significant difference in the frequency of these events between the two groups ($p>0.05$).

Presence and severity of symptoms of POST, hoarseness and coughing over time are displayed in table 2. Severity of hoarseness was significantly decreased in the group L at postoperative 1 and 24 hours ($p=0.043$ and 0.005) and the incidences of hoarseness significantly decreased at 6 and 12 hours after operation in the group L. However, there were no significant differences in the

Table 1. Demographic data in pregnant women and Apgar scores in newborns following cesarean sections (n = 147 for each)

Variable	Group A	Group L
Age (yr)	29.7 ± 3.8	29.7 ± 3.3
Weight (Kg)		
before pregnancy	55.4 ± 8.6	56.8 ± 8.4
before cesarean section	69.8 ± 8.7	71.8 ± 8.6
Height (cm)	159.4 ± 5.4	159.8 ± 4.9
Gestational age (weeks)	39.3 ± 0.9	39.2 ± 1.1
Duration of anesthesia (min)	58.4 ± 11.2	58.1± 8.6
Apgar score		
at 1 min	8.9 ± 0.5	9.0 ± 0.2
at 5 min	9.9 ± 0.3	9.9 ± 0.1

Data are expressed as mean ± SD. There were no significant differences between the groups. Group A: intra-tracheal cuff inflation with air; Group L: intra-tracheal cuff inflation with alkalinized lidocaine.

Table 2. Presence and severity of symptoms of POST, hoarseness, and coughing over time (n = 147 for each)

	Postoperative time (hrs)			
	1	6	12	24
Sore throat				
Group A	47.0(31.3/14.3/1.4)	57.8(43.5/14.3/0)	50.3(38.1/10.9/1.4)	39.5(32.0/7.5/0)
Group L	38.7(26.5/10.2/2.0)	49.7(42.9/5.4/1.4)	50.4(45.6/4.8/0)	36.0(30.6/5.4/0)
Hoarseness				
Group A	48.2(8.8/15.6/23.8)	57.1(13.6/19.0/24.5)	50.3(16.3/10.9/24.5)	39.5(9.5/13.6/15.0)
Group L	37.4(4.8/22.4/10.2)*	38.0*(5.4/19.7/12.9)	38.1*(8.8/15.0/14.3)	27.9(1.4/20.4/6.1)*
Coughing				
Group A	8.9(6.8/1.4/0.7)	9.6(8.2/1.4/0)	8.9(7.5/0.7/0.7)	6.1(4.1/2.0/0)
Group L	6.8(5.4/1.4/0)	5.5(4.1/1.4/0)	6.8(6.8/0/0)	5.4(5.4/0/0)

Values are percentage of parturients in each group, expressed as total (mild/moderate/severe).
Group A: intra-tracheal cuff inflation with air; Group L: intra-tracheal cuff inflation with alkalinized lidocaine. *; $p < 0.05$ compared to group A. For detailed grade, see the text.

severities of POST and coughing at any time.

The incidences of POST, hoarseness, and coughing in pregnant women during the 24 hours following cesarean sections are shown in figure 1. The incidences of POST during the first day after cesarean sections were 78.9% in the group A and 67.3% in the group L (p=0.025), the incidences of hoarseness were 69.4% in the group A and 53.7% in the group L (p=0.006), and the incidences of coughing were 19.0% in the group A and 9.5% in the group L (p=0.02).

Discussion

POST and hoarseness are frequent after ETI, even with short-duration anesthesia[4]. Female gender, younger age, and the use of nitrous oxide may act as strong predictors of the development of POST and hoarseness after general anesthesia for cesarean sections. To our knowledge, however, there has been no previous study to investigate postoperative airway complications when using alkalinized IC-L after cesarean sections in pregnant women with an altered airway character. In the current study, alkalinized IC-L with general anesthesia for cesarean sections reduced the incidence of POST, hoarseness, and coughing by 14.7%, 22.6%, and 50%, respectively, compared to the air-inflated group (p<0.05). In addition, the severity of hoarseness also significantly decreased at 1 and 24 hrs in our pregnant women after using IC-L.

When alkalinized IC-L instead of air is used to fill the ETT cuff, POST, coughing, and

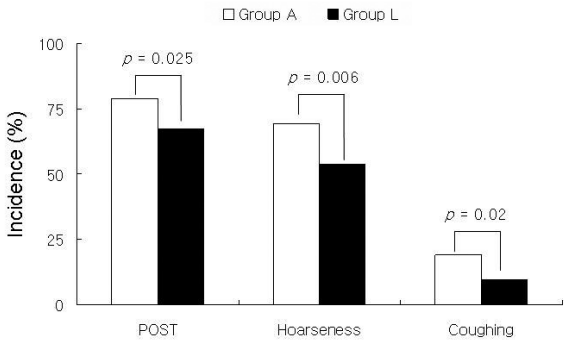

Fig. 1. Incidence of postoperative sore throat (POST), hoarseness, and coughing during postoperative 1 day after cesarean sections. Group A: intra-tracheal cuff inflation with air; Group L: intra-tracheal cuff inflation with alkalinized lidocaine. POST, hoarseness, and coughing were significantly lower in group L than in group A.

bucking are decreased following anesthesia using nitrous oxide[16]. Plasma lidocaine concentrations abruptly increase after addition of $NaHCO_3$ into the ETT cuff and reach the peak level at about 160 min[14]. The C_{max} for lidocaine plasma concentration in patients with an ETT cuff inflated with alkalinized lidocaine was reported to be 52.4 ± 22.4 ng/mL[13]. The actual peak lidocaine concentrations reported by Estebe *et al.*[13] . were in the range of 50 ng/mL after IC-L application. The plasma lidocaine levels are apt to be less than this level in pregnant women because of their increased plasma volumes. However, the plasma binding of local anesthetics also decreases during pregnancy. Therefore, it should be noted that the high proportion of free fraction of the local anesthetic could offset the increase in plasma volume.

The degree of lidocaine transfer across the placenta may depend on the maternal concentration of lidocaine, maternal cardiac output, uterine blood flow, placental surface available for transfer, and maternal and fetal blood pH[17]. Among them, in our two pregnant women groups, the major different factor in lidocaine transfer from mother to the fetus between the two groups was considered to be the maternal lidocaine concentration. However, in our study, we did not directly measure the maternal and neonatal plasma lidocaine concentrations.

We explain no severity differences in POST and coughing between two groups as follows. Firstly, the duration of anesthesia is positively correlated with the risk of POST development[2], but the duration of anesthesia for cesarean sections in the current study was short (58.4 ± 11.2 min for group A and 58.1 ± 8.6 for group L). Secondly, when the ETT cuff is inflated with air during nitrous oxide anesthesia, the cuff pressure normally increases gradually to about 50 cmH_2O at 1 hr[18]. However, we controlled the ETT cuff pressure intermittently by manual pressure release to prevent excessive pressure in air inflated group.

Variables typically associated with POST and hoarseness are ETT cuff design and size, ETI technique, laryngoscopy blade, airway placement, suctioning technique, and anesthetic technique. However, these variables were not considerations in our study because they were controlled in all pregnant women.

There are several limitations in this study. Firstly, we did not compare the effect of intracuff-saline, because intracuff inflation with saline is not commonly used in our

anesthetic practice. The approach with intracuff-saline rather than air would have allowed for true blinding and improved randomization process. In addition, the differences in our results between the two groups inflated with lidocaine or air could be due to cuff compliance differences caused by inflating with liquid versus gas. Secondly, all subjects for our present study were consisted of pregnant women. This may cause difficulty in comparing our findings with those of non-pregnant women. Therefore, to establish a true difference between pregnant and non-pregnant women, comparison with non-pregnant women with same anesthesia period may be recommended. This may define the effect of airway changes on postoperative airway complaints during pregnancy.

In conclusion, even though the duration of ETT placement is short, the incidences of POST and hoarseness after general anesthesia in pregnant women undergoing cesarean sections are over 50%. IC-L effectively decreased the incidence of postoperative airway complaints without affecting Apgar score. IC-L could also decrease the severity of hoarseness following general anesthesia for cesarean sections.

Summary

We investigated the incidence and severity of postoperative airway complaints in pregnant women receiving elective general anesthesia and evaluated the effect of intratracheal cuff lidocaine administration on these complaints.

Two hundred and ninety-four pregnant women undergoing elective cesarean sections, with American Society of Anesthesiologists physical status ratings Ⅰ or Ⅱ, were randomly assigned to the two groups having endotracheal tube cuffs inflated with either air (group A, mean volume = 6.4 ± 1.8 mL) or alkalinized lidocaine (group L, mean volume = 6.2 ± 1.5 mL) (n = 147 in each group). The incidence and severity of postoperative sore throat (POST), hoarseness, and coughing were evaluated during the 24 hours immediately following cesarean sections.

Intra-cuff lidocaine effectively decreased the incidence and severity of postoperative airway complaints in pregnant women undergoing cesarean sections without affecting fetal outcome.

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