Original Paper

LIDOCAINE AS ENDOTRACHEAL TUBE CUFF INFLATING AGENT

Ali NP[1], Tauhid-ul-Mulck M[2], Noor MM[3], Mollick MT[4], Ahmed M[5], Chowdhury MRA[6]

Abstract

A prospective study was carried on 120 patients undergoing surgical operations lasting less than 90 minutes. The incidence of postoperative sore throat, dysphasia and hoarseness of voice with 2% lidocaine (Group L) as endotracheal cuff inflating agent was compared with that with distilled water (Group D) and air (Group A). Seventy two percent of lidocaine group in comparison to 60% distilled water group and 37% air group experienced none of the above complications during the entire study period. Only 5% in lidocaine group had sore throat after 22-24 hours compared to 20% in the distilled water group and 45% in the air group. Twenty three percent complained of dysphasia in both lidocaine and distilled water group after 1-3 hours compared to 45% in air group. After 22-24 hours it completely resolved in lidocaine group compared to 20% persisting in the other two groups. Twenty three percent complained of hoarseness in lidocaine group as compared to 35% and 55% in distilled water and air groups respectively after 1-3 hours. This completely resolved in lidocaine group but persisted in 20% and 45% in the distilled water and air group respectively after 22-24 hours. The results showed an advantage in using lidocaine as an endotracheal tube cuff inflating agent in reducing postoperative sore throat, dysphasia and hoarseness in comparison to distilled water and air.

Key Words: Lidocain, Endotracheal tube (ETT) cuff inflating agent.

Introduction

Postoperative sore throat, dysphasia and hoarseness are undesired and neglected occurrences after general anaesthesia with endotracheal intubation. Though a minor complication, any one of these may be troublesome, and can make the patient feeling uncomfortable. Evidence of these complications following general anaesthesia has been found to be 80-90% in most quoted studies. Contributory mechanisms have included: (a) trauma to the tonsillar pillars, pharynx, tongue, larynx and trachea[1], (b) drying out of mucosal membrane in the trachea with endotracheal intubation or the upper airway following anaesthesia by mask, (c) involvement of cuff-tracheal surface contact area that have the largest cuff tracheal surface contact upon inflation[2,3], (d) infection, (e) type of cuff, cuff pressure and inflating agent of the cuff. Drying effects of anaesthetic gases and anti-sialagogue effects of anticholinergic drugs may also play a role[4]. The highest incidence of sore throat and other airway related symptoms tend to occur in patients who have undergone tracheal intubation[5].

There are different methods for prevention of intubation related sore throat, but none have been totally successful. Many pharmacological interventions have been suggested, and one of these is the use of different forms of lidocaine through different routes. A comparison between intubation with dry tubes or a tube lubricated with jelly suggested that the use of lubricants containing local anaesthetics might be beneficial. The tracheal tube material may also be a cause of sore throat. Traditionally endotracheal tubes have been made of red rubber or latex, which can be cleaned and sterilized for reuse. However, these materials are opaque and inadequate cleaning is always apparent from superficial examination. Sterility does not prevent postoperative sore throat by 100%, but severity and incidence may be reduced. Currently plastics [polyvinyl chloride (PVC) and more recently polyurethane] and to a lesser degree, silicone rubber have replaced red rubber and latex as primary materials, because they are non-irritant. They are also cheap to produce to allow single patient use and can be sterilized more reliably during manufacture. The red rubber had a low residual volume, high-pressure cuff and the exertion of this high pressure on the tracheal mucosa was thought to be damaging[6]. Modern disposable tube cuffs may be made from a thin inelastic material (PVC) which when inflated would have a larger than required volume to effect a seal. In situ there is a large area of contact between the cuff and tracheal wall before the material is fully stretched. When a thin walled low pressure, high volume cuff was used, blood flow did not cease until cuff pressures were in the range of 80-120 mm of Hg[7]. From all these information, it is evident that the incidence and severity of postoperative sore throat may be significantly reduced by the use of PVC endotracheal tube with a high volume, low pressure cuff of adequate size. The cuff has to be filled up to a certain pressure, which has to be maintained, to avoid vascular and tracheal mucosal damage. Filling the cuff with saline, distilled water, or lidocaine will prevent N_2O diffusion. Lidocaine, being a

1. Maj Nadeem Parvez Ali, DA, FCPS, Anaesthesiologist, CMH Bogra; 2. Maj Md Tauhid-ul-Mulck,DA, FCPS, Anaesthesiologist, CMH Dhaka; 3. Col Md Mahbub Noor, FCPS, Anaesthesiologist, CMH Bogra; 4. Lt Col Md Torab Mollick, FCPS, Anaesthesiologist, CMH Jessor; 5. Maj Masud Ahmed, FCPS, , Anaesthesiologist, AFMC; 6. Brig Gen Md Rezaul Alam Chowdhury, MD, Adviser Specialist in Anaesthesiology, CMH Dhaka.

local anaesthetic may have an additional advantage. Hence, a prospective comparative study was carried out to reveal incidence of postoperative complications.

Materials and Methods

This prospective study was carried out at the Department of Anaesthesiology and Intensive Care Unit (ICU), Combined Military Hospital, Dhaka Cantonment from August to September 2005. Formal approval was obtained and informed consent was also taken from each of the study subject.

One hundred and twenty patients were included in this study. Patients were randomly divided into three groups (each of 40 patients) by card sampling method. In group A, air was used to fill the endotracheal tube cuff. In group D, distilled water was used to fill the tube cuff and in group L, 2% lidocaine was used to fill the cuff tube. A fresh sterile endotracheal tube (Rusch; 7.5 mm in women, 8.0 mm in men) of high volume and low pressure was used in all the cases. Cases requiring more than one attempt at intubation or those found to be difficult were excluded from the study. Patients having a history of sore throat in the last 6 weeks, smokers and tobacco chewers and patients having nasogastric tubes in-situ were excluded from the study. The participants were all of ASA grade I or II undergoing general endotracheal anaesthesia for abdominal surgery of duration of less than 90 minutes duration of operation.

All patients underwent a prescribed anaesthetic protocol. Induction was accomplished with 3 to 6 mg/kg of thiopental sodium followed by 1.5 mg/kg of succinylcholine for intubation. Prior to intubation, ventilation was controlled with 100% oxygen via facemask. Maintenance anaesthesia included 35% O_2/65% N_2O, halothane, opioid and vecuronium as muscle relaxant. At the conclusion of surgery, muscle relaxation was antagonized with neostigmine and atropine.

Table- I : Patient Characteristics.

Characteristics	Group A n = 40	Group D n = 40	Group L n = 40	Statistical Significance
Age in years (Mean± SD)	45±7.6	43.88 ± 6.5	44 ± 6.6	NS
Sex (Male: Female)	11:29	17:23	19:21	NS
Body weight in kg (Mean± SD)	70±15.9	72 ±16.6	73±18.7	NS
ASA grade (I : II)	32:8	32:8	36:4	NS

NS: Not significant p>0.05 (among three groups) for Age and Body wt; analysis done by ANOVA
NS: Not significant p>0.05 (among three groups) for Sex and ASA; analysis done by chi-squared test

The Endotracheal tube (ETT) cuffs of the lidocaine group were prefilled with 8 ml of 2% lidocaine for 90 minutes prior to intubation to enhance diffusion of lidocaine across the cuff. All cuffs were evacuated to sub-atmospheric pressure prior to intubation. Following intubation, the ETT cuffs were inflated with air or distilled water or lidocaine as appropriate until no leak was heard. The volume of lidocaine used never exceeded 5mg/kg, so as to protect the patient from local anaesthetic toxicity, if the cuff ruptured.

Postoperatively, patients were directly asked about the presence of sore throat, cough, difficulty in deglutition and change of voice (hoarseness of voice). Verbal rating scale was used on the three groups of patients to assess the presence and severity of sore throat at two intervals, 1 to 3 hours postoperatively and 22 to 24 hours postoperatively. Data were collected in a specially designed 'data sheet'. Findings were analyzed using relevant statistical tests. Data of the present study were analyzed in the light of comparison among three groups and within groups as appropriate. All results were expressed as Mean ± SD, values were considered significant if $p<0.05$ and presented in tabular and graphical forms.

Results

Patient characteristics are shown in Table I. Mean ages of group-A were 45±7.6 years, group D was 43.88±6.5 years and group L was 44±6.6 years. Mean body weight of group A was 70±15.9 kg group D was 72±16.6 kg and group L was 73±18.7 kg. Sex ratio (male : female) of group A was 11:29, group D was 17:23 and group L was 19:21. The ASA grade ratio was 32:8 in group A, 32:8 in group D and 36:4 in group L. There were no significant ($p>0.05$) difference observed among the three groups.

Table- II : Comparison of sore throat in different groups.

	Group A (n=40)	Group D (n=40)	Group L (n=40)	p value	Statistical Significance
Sore throat After 1-3 hours	25 (63%)	16 (40%)	11(28%)	0.544	NS
Sore throat After 22-24 hours	18 (45%)	08 (20%)	02 (5%)	0.023	Sig

Sig: Significant p<0.05 (among three groups); analysis done by chi-squared test.
NS: Not Significant p>0.05 (among three groups); analysis done by chi-squared test.

The frequencies of hoarseness of voice, dysphasia and sore throat after 1-3 hours were lowest in the lidocaine group compared to air and distilled water groups.

Table - III : Comparison of dysphasia in different groups.

	Group A (n=40)	Group D (n=40)	Group L (n=40)	p value	Statistical Significance
Dysphasia After 1-3 hours	21 (45%)	9 (23%)	9 (23%)	0.021	Sig
Dysphasia After 22-24 hours	08 (20%)	8 (20%)	0 (0%)	0.016	Sig

Data are in numbers with percentages in parenthesis.
Sig: Significant p<0.05 (among three groups); analysis done by chi-squared test.

Hoarseness of voice and dysphasia were significantly absent after 22-24 hours in the lidocaine group. Seventy two percent of the lidocaine group (29 of 40) in comparison to 60% of the distilled water and 37% of the

Table - IV : Comparison of hoarseness in different groups.

	Group A (n=40)	Group D (n=40)	Group L (n=40)	p value	Statistical Significance
Hoarseness After 1-3 hrs	21 (53%)	14 (35%)	9 (23%)	0.011	Sig
Hoarseness After 2-24 hrs	18 (45%)	08 (20%)	0 (0%)	0.042	Sig

air group experienced no sore throat during the entire study period ($p < 0.05$). Only 5% in the lidocaine group had sore throat after 22-24 hours compared to 20% in the distilled water group and 45% in the air group (Table II).

Dysphasia was observed in 23% of cases of both lidocaine and distilled water group after 1 to 3 hours, whereas that was present in 45% of members of air group. After 22-24 hours, it completely resolved in the lidocaine group in comparison to the 20% persisted in the other two groups (Table III).

Twenty three percent complained of hoarseness in the lidocaine group as compared to 35% and 53% in the distilled water and air groups respectively after 1-3 hours. This completely disappeared in the lidocaine group but persisted in 20% and 45% in the other groups after 22-24 hours (Table IV).

Discussion

Proposed aetiologies of postoperative sore throat include intubation trauma, mucosal dehydration or oedema, pharyngeal airways, and succinylcholine[8]. Excessive pressure exerted by the ETT cuff on the tracheal mucosa has been associated with tracheal ischaemia, sore throat[9, 10] and aggressive oropharyngeal suctioning[8]. ETT cuff design and size are also considered important variables[3].

In order to determine whether using lidocaine instead of air or distilled water to inflate the ETT cuff decreases postoperative sore throat, dysphasia and hoarseness, all of the above factors were kept constant.

A fresh high volume-low pressure ETT, choosing 7.5 mm for women and 8.0 mm for men, thus standardizing the type and size of the tube. Other variables typically associated with postoperative sore throat, including intubation technique, laryngoscope blade, airway placement, suctioning technique, and anaesthetic technique, were controlled. Patients having a history of sore throat in the last 6 months, smokers, tobacco chewers and patients with nasogastric tubes in-situ were excluded from the study.

In this study, it was observed that the incidence and severity of postoperative sore throat, hoarseness and dysphasia were considerably less in the group L compared to both group A and D. The incidence was only 28% in group L compared to 40 % and 63% in group D and A respectively. Dysphasia was present in 23% of group L in comparison to 23% and 45% of group D and A after 1-3 hours. It persisted in 20% cases in group A and D after 22-24 hours and completely resolved in group L. Except for sore throat after 1-3 hours, all others were significant ($p<0.05$). Hoarseness was complained in 23% cases of group L compared to 35% and 21% of group D and A respectively after 1-3 hours. This persisted in 20% and 18% in group D and A respectively and completely resolved in group L after 22-24 hours.

Navarro et al[11] in a study in 1997 used lidocaine as ETT cuff inflating agent and found that there was a significant reduction of incidence and severity of postoperative sore throat but there was no comment on dysphasia or hoarseness of voice. Another study conducted by Husson et al[12] in 1999 compared lidocaine, air and normal saline. This study found no statistical significance between the groups. Bennet et al[13] observed statistical significance between air and saline groups for hoarseness and sore throat. Soltani et al[14] in 1999 studied the effect of different lidocaine application methods on postoperative cough and sore throat. In their study, intracuff lidocaine was found to be more effective in prevention of postoperative sore throat.

Seegobin, VanHasselt[9] and Stanley[15] studied the effect of N_2O on endotracheal air-filled cuff pressure. They found that N_2O diffused through the thin walled cuff causing rise in cuff pressure than initial pressure, which then impaired mucosal blood pressure. This tracheal mucosal blood flow is an important factor in tracheal morbidity associated with intubation. They also found that some damage to tracheal mucosa due to the contact between cuff material and tracheal wall was inevitable. This cuff over expansion during anaesthesia may be significant cause of tracheal or laryngeal trauma and possibly also postoperative sore throat in intubated patients. Patel et al[16] found that the pressure in the cuff inflated with room air increases more rapidly and to a higher level than pressure in the cuffs inflated with saline.

N_2O being insoluble in distilled water and lidocaine, it did not diffuse into the cuff. Perhaps the additional benefit of using lidocaine over distilled water and air are (1) there is no increase in cuff volume as there is no diffusion of N_2O, (2) it has a local anaesthetic effect on the tracheal mucosa.

The results of this study show that using lidocaine as cuff inflating agent reduced the incidence postoperative sore throat, dysphasia and hoarseness in comparison to distilled water and air. It is proposed that the difference was produced by the continual local anaesthetic action of lidocaine on the tracheal mucosa.

Conclusion

Postoperative sore throat, dysphasia and hoarseness may be one the minor complications after general anaesthesia, but it can create an uncomfortable situation for both the patient and the anaesthesiologist. Many methods have been advocated in prevention of these complications, none

that using intra-cuff lidocaine to some extent can be effective in controlling these complications.

References

1. Kambic V, Radsel Z. Intubation lesions of the larynx. British Journal of Anaesthesia 1978; 58: 587.
2. Loeser EA, Orr DL, Bennet GM, Stanely TH. Endotracheal tube cuff design and postoperative sore throat. Anaesthesiology 1976; 45: 684.
3. Loeser EA, Machin R, Colley J, Orr D, Bennet GM, Stanely TH. Post operative sore throat- importance of endotracheal tube conformity versus cuff design. Anaesthesiology 1978; 49: 430.
4. Smith G, Atkinhead AR. Textbook of Anaesthesia, 4th ed. London Churchill Livingstone; 2001. p. 542.
5. McHardy FE, Chung F. Postoperative sore throat: cause, prevention and treatment. Anaesthesia 1999; 54: 444-453.
6. Moyle JTB, Davey A. Ward's anaesthetic equipment; 4th ed:148-9.
7. Nordin U, Lindholm CE, Wolgast M. Blood flow in the rabbit tracheal mucosa under normal conditions and under the influence of tracheal intubation. Acta Anaesthesiologica Scandinavica 1977; 21: 81-94.
8. Monroe MC, Gravenstrin N, Saga-Rumlley S. Postoperative sore throat: effects of oropharyngeal airway in orotracheally intubated patients. Anaesthesia and Analgesia 1990; 70: 512-6.
9. Seegobin RD, Van Hasselt GL. Endotracheal cuff pressure and tracheal mucosal blood flow: endoscopic study of effects of four large volume cuffs. Br Med J 1984; 288: 965-8.
10. Nordin U: The trachea and cuff induced tracheal injury. An experimental study on causative factors and prevention. Acta Otolaryngol 1977: 345(Suppl): 1-71.
11. Navarro RM, Baughman VL. Lidocaine in the endotracheal tube cuff reduces postoperative sore throat. Journal of Clinical Anesthesia 1997;Aug; 9 (5): 394-7.
12. Husson J, Porter NE, Sidou V. Postoperative sore throat: incidence severity after use of lidocaine, saline, or air to inflate the endotracheal tube cuff. AANA Journal 1999; 67: 49.
13. Bennett MH, Isert PR, Cumming RG. Postoperative sore throat and hoarseness following tracheal intubation using air or saline to inflate the cuff- a randomized controlled trial. Anaesth Intensive Care 2000; Aug; 28 (4): 408-13.
14. Soltani HA, Aghadavoudi O. The effect of different lidocaine application methods on postoperative cough and sore throat. Journal of Clinical Anesthesia 2004; 16(1):79-80.
15. Stanley TH, Foote JL, Liu WS. A simple pressure relief valve to prevent increases in endotracheal tube cuff and volume in intubated patient. Anaesthesiology 1975: 42.
16. Patel RI, Ott TH, Epstein BS. Effects of nitrous oxide on pressure changes of tracheal tube cuffs following inflation with air and saline. Anaesthesia 1983; 38: 44-5.