ENDOTRACHEAL TUBE CUFF USING AIR OR SALINE TO PREVENT POSTOPERATIVE HOARSENESS AND SORE THROAT: A RANDOMIZED CONTROLLED TRIAL

Ibrahim A. Zahran, MD, Mohamed AL-Sukkar, MD**

ABSTRACT

Objective: To compare the frequency and severity of sore throat and hoarseness following inflation of the endotracheal cuff using air or saline.

Methods: A double-blind, randomized controlled trial in 63 intubated patients was conducted at Queen Alia Military Hospital in 1999. Patients were included if they were ASA 1-3, aged 18 years or older, scheduled for operation below the neck which were expected to last longer than one hour. Following placement of the tracheal tube, the cuff was inflated slowly (using air or saline), until no leak was felt and was connected to a three-way stopcock, extension tubing and connection to a pressure transducer. Intra-cuff pressures were compared to assess any change due to inward diffusion of nitrous oxide.

Results: The frequency of significant sore throat and/or hoarseness overall was 15%. There were no statistically significant difference between the groups (air 15%, saline 14.5%). In the air group mean, intra-cuff pressure increased significantly (start 14 mmHg, end 40 mmHg), while in the saline group there was no significant increase (start 12.7 mmHg, end 14.6 mmHg).

Conclusion: The substitution of saline reliably results in sustained low intra-cuff pressure but high tracheal pressure, but is not an important factor in the development of sore throat or hoarseness postoperatively within the pressure range and duration of the operations.

Key words: Endotracheal intubation, Air inflation, Saline inflation.

JRMS Dec 2003; 10(2): 38-40

Introduction

The use of the cuffed tracheal tube (TT) is a standard practice where facilitation of positive pressure ventilation and protection of the airway from aspiration of stomach contents are required. The pressure exerted by the inflated cuff on the tracheal mucosa, (cuff-tracheal pressure (CTP) [1,2], may be responsible for a range of adverse consequences including sore throat and hoarseness [3]. High CTP may arise during anesthesia with nitrous oxide because the intra-cuff pressure will increase due to net influx of nitrous oxide into an air-filled cuff. The volume and pressure of a tracheal tube cuff inflated with air increase during nitrous oxide anesthesia [4]. The tracheal tube diameter and cuff lubrication at intubation are important etiological factors, but others, including CTP, have been suggested. CTP is of primary importance in the prevention of tracheal damage during long-term intubation and many techniques have been developed to limit the CTP in the clinical setting [5].

The aim of this randomized, controlled study was to compare the incidence of postoperative sore throat and hoarseness when saline or air were used to inflate the cuff.

Methods

Sixty-three patients were chosen randomly from different surgical lists in the hospital. Patients were included if they were American Society of Anesthesiology 1-3, aged 18 years or older and

*From the Department of Anesthesia and Intensive Care, Queen Alia Military Hospital, (QAMH), Amman-Jordan
Correspondence should be addressed to Dr. I. Zahran, P. O. Box 1884 Amman 11941 Jordan
Manuscript received December 11, 2000. Accepted March 6, 2003

scheduled for operations below the neck which were expected to last longer than one hour and the anesthetist's usual technique involved general anesthesia and single-lumen tracheal intubation. Patients were not eligible for inclusion if there was an indication for prolonged intubation postoperatively.

Anesthetic Technique

Laryngoscopy was performed by the specialist anesthetist with a standard size 3 or 4 Macintosh metal blade and oral intubation achieved with an unlubricated plastic TT, 8.0 mm internal diameter in males and 7.5 mm internal diameter in females.

Following placement of the TT, the cuff was inflated slowly using either air or saline by the assistant until no leak was heard by the anesthetist on inflation of the lungs. The cuff was inflated using a three-way stopcock, extension tubing and connection to a pressure transducer applying the method of Cox and Schatz (Fig. 1). The pressure transducer was connected, calibrated to zero and the mean pressure during the expiratory pause recorded. This method eliminates false low reading due to compression of the dead space air in the manometer and tube system by the simple maneuver of inflating the cuff [(4)]. No further observation of cuff pressure was made until just prior to administration of atropine and neostigmine to reverse residual neuromuscular blockade at the end of the procedure. Anesthesia was maintained with a volatile agent and nitrous oxide at a concentration of 60%.

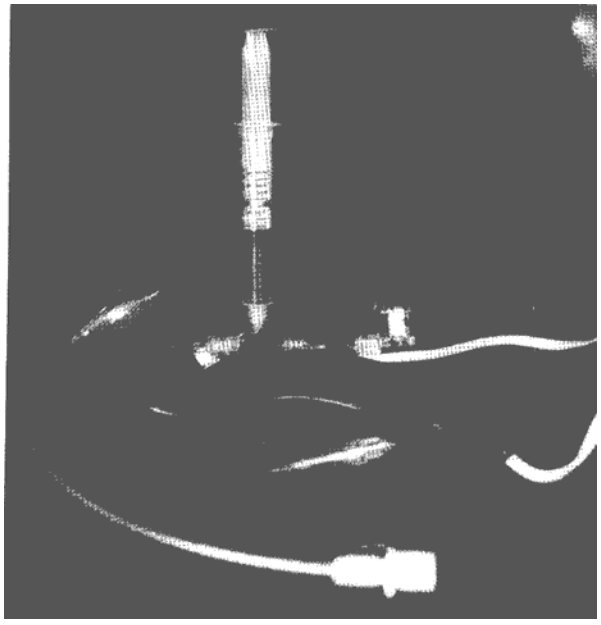

Fig. 1. Tracheal cuff pressure-monitoring set-up. Note position of the stopcock allowing simultaneous cuff inflation and pressure transduction.

The following data were recorded during the surgical procedure: Time of intubation and extubation, nature of the procedure, administration of antisialogogue premedication, number of times the laryngoscope was inserted during intubation, presence or absence of a gastric tube, administration of intraoperative opioids.

Outcome Assessment

At a single interview between 14 and 30 hours postoperatively, sore throat and hoarseness were estimated using continuous visual analogue scales positioned by the subject. This involved the patient locating a pointer on a concealed scale from 0 (no problem) to 100 (most severe problem). In addition, each subject was asked by direct questioning if their combined degree of sore throat and hoarseness was a significant part of their postoperative discomfort (yes or no). The dose of opioids given in the first 24 hours from the induction was recorded as a morphine equivalent dose.

The difference between two means was tested using the t-test at a 0.05 level of significance.

Results

Of the 63 patients in the trial, one was not available for statistical analysis due to failure to interview within 30 hours postoperatively. The distribution of demographic data is listed in Table I.

Table I. Characteristics of study subjects according to study group.

	Air group	**Saline group**
Mean age in years (±SD*)	52.6 ± 17.6	58 ± 16.3
Sex (**M/F**)	15/17	13/18
Passage of gastric tube Yes/No	21/10	27/5
Intubation time in minutes (±SD*)	154 ± 76.9)	137 ± 56.7
Percentage of hoarseness and sore throat	15.9	14.5

* SD: Standard Deviation

The distribution of sore throat and hoarseness scores was analyzed. Many patients in both treatment groups reported scores of zero. The median sore throat in the air group was 4 while in the saline group it was 7. The difference (3 points) was not statistically significant. The median hoarseness score in the air group was 26 and in the saline group 23.5. This difference (2.5 points) was not statistically significant.

The overall proportion of patients who reported sore throat and/or hoarseness as a significant part of their postoperative discomfort was 15%; 15.9% patients in the air group and 14.5% in the saline group.

The mean cuff pressures in both groups at the start and end of the procedure are summarized in Table II. The cuff pressure in the air group increased significantly during the period of intubation and at the end of the procedure. However, there was no statistically

significant difference in the saline group at the start and end of the procedure.

Those who complained of a significant sore throat or hoarseness did not have significantly longer intubation times (Standard deviation duration of intubation in minutes 154 versus 137, difference was 17).

Table II. Comparison of cuff pressures at the start and end of procedure (mmHg)

	Start	**End**	**P value**
Air Group	14.0	40.9	0.0001
Saline Group	12.7	14.6	0.12

Discussion

Many studies about the incidence of postoperative hoarseness and sore throat following anesthesia with tracheal intubation reported that it was due to low volume high pressure cuffs [(6)]. The recommended cuff pressure is less than 25 mmHg, as excessive pressure produces ischemia of the tracheal mucosa and many results suggest that keeping the cuff pressure under 15 mmHg can prevent postoperative hoarseness and sore throat at 24 hours after intubation [(7)]. The incidence of significant hoarseness following tracheal intubation for surgical procedures up to six hours in duration was 15.9% in this study. This is lower than previous estimates [(3-4)], but is very comparable to the 14.4% reported by Christensen *et al* in a recent prospective review of 1325 patients [(9)]. This study failed to demonstrate any significant clinical benefit from the use of saline in the TT cuff compared with the usual practice of inflating the cuff with air. While there was some indication of a slight benefit with regard to sore throat scores, it is unlikely to be clinically important. Careful insertion techniques of the tracheal tube are very important in the prevention of airway trauma and postoperative sore throat [(8)]. Our study included individuals who were difficult to intubate or had a gastric tube inserted. Although numbers are small, this study found no evidence for increased postoperative sore throat or hoarseness in those who required more than one pass of the laryngoscope in order to be successfully intubated, supporting the finding of the prospective review by Christensen *et al* [(9)]. The interesting recent Japanese study conducted by Karasawa indicate that inflation of the cuff with 40% N_2O was recommended to prevent both excessive endotracheal cuff pressure and air leaks during anesthesia with 67% N_2O, reducing postoperative sore throat and hoarseness [(10)].

Conclusion

This study has determined the incidence of postoperative sore throat and hoarseness following intubation using either air or saline to inflate the TT cuff. While using saline successfully avoids the increase in cuff tracheal pressure observed when air is used, there is no evidence of either sore throat or hoarseness during procedures from one to three hours duration. This study failed to demonstrate any significant clinical benefit from the use of saline in the TT cuff compared with the usual practice of the inflating the cuff with air. While there was some indication of a slight benefit with regards to sore throat scores, this study suggests that any such benefit is unlikely to be of clinical importance. The principal effect of the use of saline is to keep endotracheal cuff pressure low during the course of an operative procedure by the prevention of inward diffusion of nitrous oxide.

References

1. **Knowlson GTG, Bassett HFM.** The pressure exerted on the trachea by endotracheal inflatable cuffs. *Br J Anesth* 1970; 42:834-437.
2. **Loeser EA, Orr DL.** Endotracheal tube cuff design and postoperative sore throat. *Anesthesiology* 1976; 45: 684-687.
3. **Raeder JC, Borochgrevink PC, Sellevold OM.** Tracheal tube cuff pressure. *Anesthesia* 1985; 40: 444-447.
4. **Patel RI, Oh TH, Chandra R, Epstein BS.** Tracheal tube cuff pressure. Changes during nitrous oxide anesthesia following inflation of cuffs with air and saline. 1984; 39: 862-864.
5. **Kay J, Fisher JA.** Control of endotracheal tube cuff pressure using a simple device. *Anesthesiology* 1987; 66:523.
6. **Stenqvist O, Nilsson K.** Postoperative sore throat related to tracheal tube cuff design. *Can Aneth Soc J* 1982; 29: 384-386.
7. **Suzuki N, Kooguchi K, Mizobe T, *et al*.** Postoperative hoarseness and sore throat after tracheal intubation: effect of a low intracuff pressure of endotracheal tube and the usefulness of cuff pressure indicator. *Masui* 1999; 48: 1091-1095.
8. **McHardy FE, Chung F.** Postoperative sore throat: Cause, prevention and treatment. *Anesthesia* 1999; 54: 444-453.
9. **Christensen AM, Willememoes-Larsen H.** Postoperative throat complaints after tracheal intubation. *Br J Anesth* 1994; 73: 786-787.
10. **Karasawa F, Ohshima T, Takamatsu I, *et al*.** The effect on intracuff pressure of varios nitrous oxide consentrations used for inflating an endotracheal tube cuff. *Anesth Analg* 2000; 91: 708-713.