

Clinical Reports

RONALD D. MILLER, M.D., *Editor*

Anesthesiology
52:257-259, 1980

Reduction of Postoperative Sore Throat with New Endotracheal Tube Cuffs

EDWARD A. LOESER, M.D.,* GEORGE M. BENNETT, M.D.,† DANIEL L. ORR, D.D.S.,‡ THEODORE H. STANLEY, M.D.§

Two recent reports from this laboratory demonstrated that use of high-residual-volume, low-pressure endotracheal tube cuffs results in a significantly higher incidence of postoperative sore throat than use of low-residual-volume, higher-pressure cuffs.^{1,2} Those studies suggested that a major cause of postoperative sore throat was tracheal mucosal damage secondary to cuff-trachea contact. To further evaluate cuff-trachea contact as a cause of postoperative sore throat, we compared four cuffs of various lengths and thus, various cuff-tracheal contact areas, on an identical tube from one manufacturer, plus two additional cuffs of another manufacturer in 280 patients undergoing similar orthopedic, gynecologic, or general surgical operations.

METHODS

Similar National Catheter Corporation endotracheal tubes were supplied with four types of cuffs: the standard low-volume-high-pressure-low-tracheal-cuff-contact-area cuff, the large-volume-low-pressure-high-contact-area "Hilo" cuff, a cuff intermediate between those in cuff volume and tracheal contact area (medium cuff), and a new (narrow) low-volume-low-pressure-low-tracheal-contact-area cuff. Portex Corporation supplied endotracheal tubes with two types of cuffs: the original large-volume-low-pressure-low-tracheal-contact-area cuff and a new, lower-volume-low-pressure-lower-tracheal-contact-area "taper" cuff. Forty patients were randomly chosen to have their tracheas intubated with one of the six types of endotracheal tubes, and an additional 40 patients

undergoing similar operations without endotracheal tubes were also evaluated. Informed written consent was obtained at the preoperative visit from the patients being endotracheally intubated with the National Catheter experimental tubes but the human experimental committee judged this unnecessary for the other patients. Tubes studied were either 7.5, 8.0, or 8.5 mm ID; three examples of each of the cuffs studied were measured for cuff length as previously described.¹ Patients who needed a nasogastric tube, sustained a difficult endotracheal intubation, *i.e.*, more than one attempt at passage of the tube, or coughed after intubation or before extubation were excluded from the study.

All patients were similarly premedicated, and anesthesia was induced with thiopental, 3-4 mg, iv. Patients were paralyzed with succinylcholine, 1.5 mg, iv, and the tracheas intubated in the usual fashion. The endotracheal tubes were lubricated with 5 per cent lidocaine ointment.¶ Cuffs were filled with a sample of the inspired mixture of gases until the trachea was just sealed. Cuff volumes and pressures were measured immediately after endotracheal intubation and just prior to extubation as previously described.³ Anesthesia was maintained with halothane (1-2 per cent) or enflurane (1-3 per cent) plus 60 per cent nitrous oxide in oxygen and intermittent doses of pancuronium. All patients had sterile, disposable, Ohio® plastic oral airways (size 3 or 4) in place throughout the operation; some had them in place during the early postoperative period. Extubation of the trachea was accomplished in the operating room before anesthesia was terminated.

All patients were interviewed 20-30 hours postoperatively by an anesthesiologist who used a set protocol but did not know which endotracheal tube had been used or whether the trachea had been intubated.

* Clinical Instructor of Anesthesiology.

† Assistant Professor of Anesthesiology.

‡ Resident in Anesthesiology.

§ Professor of Anesthesiology/Surgery.

Received from the Department of Anesthesiology, University of Utah College of Medicine, Salt Lake City, Utah 84132. Accepted for publication September 10, 1979.

Address reprint requests to Dr. Stanley.

¶ Astra, Inc., Worcester, Mass. (5 per cent lidocaine [Xylocaine] in polyethylene glycols and propylene glycol).

TABLE 1. Mean Cuff Length, Intracuff Seal Pressure, and Incidence and Severity of Postoperative Sore Throat with National Catheter and Portex Endotracheal Tubes (Mean \pm SD)

Cuff	Cuff Length (mm)	Intracuff Seal Pressure (torr)	Sore Throat (Per Cent)	Sore Throat Severity (0-3)
National Catheter Cuffs				
Standard	25	133 \pm 21.4	24	0.26
Hilo	37*	18* \pm 9.8	58*	0.74*
Medium	30+	17* \pm 7.6	47†	0.60*
Narrow	22+	17* \pm 12.1	10†	0.10†
Portex Cuffs				
Taper	29	15 \pm 5.5	38	0.50
Large volume	39	17 \pm 11.9	54‡	0.68‡
Mask	—	—	22	0.26

* $P < 0.01$, † $P < 0.05$, compared with standard cuff by chi-square test.

‡ $P < 0.05$ compared with taper cuff by the chi-square test.

Patients were asked whether they had experienced a sore or scratchy throat between the time of their operation and the interview. Any positive response was recorded as a sore throat. For evaluation of severity, patient responses were evaluated and graded on a 0-3 scale as has been previously reported^{1,2}: 0 = no sore or scratchy throat at any time since operation and no evidence of hoarseness at the time of interview; 1 = minimal sore or scratchy throat for the same period and no hoarseness at the time of interview; 2 = moderate sore throat and/or some hoarseness; 3 = severe sore throat for the same period and/or obvious hoarseness at the time of interview.

Data were examined for statistical significance utilizing the chi-square test and standard parametric correlation coefficients.

RESULTS

Durations of operations (average 123 ± 18 min), durations of endotracheal intubations (average 137 ± 21 min), types of operative procedures, and sex distributions were similar in all groups of patients studied. There were 40 patients in each of the National Catheter groups except the Hilo cuff group, which had 41, and 40 patients in the mask and Portex large-volume cuff groups. The Portex taper-cuff group had 39 patients. None of the endotracheal tube cuffs significantly increased in cuff volume or pressure at the end of operation. Cuff lengths of all cuffs studied, as well as mean intra-cuff seal pressures just after intubation, are given in table 1.

The incidence and severity of postoperative sore throat with the National Catheter standard cuff was ($P < .05$) less than that with the "Hilo" or medium-

sized cuffs (table 1). Patients intubated endotracheally with the new narrow National Catheter cuff had a remarkably low (10 per cent) incidence and severity (.10) of postoperative sore throat. Indeed, the incidence of sore throat after endotracheal intubation with the narrow cuff was even lower than in those patients receiving anesthesia via a face mask. Similarly, the new taper cuff of Portex produced lower incidence and less severity of postoperative sore throat than the Portex large-volume cuff (table 1). However, the taper cuff still resulted in an incidence and severity of postoperative sore throat greater than those produced by mask anesthesia. There was no statistically significant difference in the incidences or severities of postoperative sore throat between the National Catheter Hilo cuff and the Portex large-volume cuff or between the National Catheter medium cuff and the Portex taper cuff. However, the incidence and severity of postoperative sore throat were significantly less in patients whose tracheas were intubated with the medium or taper cuffs than in those intubated with either Hilo or large-volume cuffs.

Correlation of the mean incidence and severity of sore throat versus cuff length was high, $r = .95$ and $r = .92$, respectively. There was poor correlation, $r < .4$, of endotracheal intubation time, age, type of operation, cuff pressure, or endotracheal tube size with the incidence or severity of sore throat.

DISCUSSION

This study demonstrates that the incidence and severity of "postoperative sore throat" after endotracheal intubation is highly correlated with the length of the cuff used on the endotracheal tube but not with intubation time, age of the patient, type of operation, or intracuff pressure. Our findings indicate that endotracheal tubes with narrow cuffs can significantly reduce postoperative sore throat, and this can be achieved, through proper cuff design, without increasing cuff pressures necessary for tracheal seal.

A recent report from this laboratory showed that while large-volume-low-pressure endotracheal tube cuffs produce less average depth of tracheal mucosa erosion after approximately six hours of endotracheal intubation than do low-volume-high-pressure cuffs, the tracheal erosion produced by the former is evidenced over a much larger area of tracheal mucosa than that of the latter.⁴ Additionally, that study found that many large-volume-low-pressure endotracheal tube cuffs currently manufactured wrinkle in spite of proper inflation, and the wrinkles result in deep mucosal grooves. Our laboratory work indicates that neither the new taper cuff of Portex nor the experi-

mental narrow cuff of National Catheter wrinkles when inflated in dogs' tracheas (Loeser EA, unpublished data). Both cuffs decrease the length of tracheal mucosa erosion resulting from six hours of endotracheal intubation in dogs when compared with other (large-volume) cuffs manufactured by National Catheter and Portex. These findings, when combined with those of this study, suggest that superficial tracheal mucosal erosions produced by endotracheal tube cuffs may play a part in the present-day "post-operative sore throat syndrome" that follows endotracheal intubation.

National Catheter's narrow cuff resulted in the lowest incidence and severity of postoperative sore throat in this study. Because the "narrow" cuff was the narrowest of those investigated, *i.e.*, had the shortest length, this was not unexpected. However, we did not expect the National Catheter narrow cuff to reduce both the incidence and severity of postoperative sore throat to less than half that found following face-mask anesthesia. A ready explanation of this finding is not apparent. However, we used dry (unhumidified) gases, and it is possible that in patients ventilated with

face masks significant dehydration of the upper airway mucosa occurs and also causes sore throat in the post-operative period.

In conclusion, this study demonstrates that post-operative sore throat after endotracheal intubation is highly correlated with cuff length and can be significantly decreased by using endotracheal tubes with narrow cuffs and thus, by reducing areas of cuff-trachea contact.

REFERENCES

1. Loeser EA, Orr DL, Bennett GM, et al: Endotracheal tube cuff design and postoperative sore throat. *ANESTHESIOLOGY* 45:684-687, 1976
2. Loeser EA, Machin R, Colley J, et al: Postoperative sore throat: Importance of endotracheal tube conformity versus cuff design. *ANESTHESIOLOGY* 49:430-432, 1978
3. Stanley TH: Nitrous oxide and pressures and volumes of high- and low-pressure endotracheal cuffs in intubated patients. *ANESTHESIOLOGY* 42:637-640, 1975
4. Loeser EA, Hodges M, Gliedman J, et al: Tracheal pathology following short term intubation with low and high pressure endotracheal tube cuffs. *Anesth Analg (Cleve)* 57:578-579, 1978

Anesthesiology
52:259-261, 1980

Epidural Anesthesia for Labor and Delivery of Twins of a Paraplegic Mother

DAVID W. WATSON, M.D., MAJ, M.C.,* AND GORDON O. DOWNEY, M.D., CPT, M.C.†

Although pregnancy in the paraplegic above the T6 level is rare, it necessitates special considerations for the possibility of autonomic dysreflexia during labor and delivery. The syndrome is manifest by profuse sweating, piloerection and flushing above the level of the lesion, bradycardia, hypertension, and cephalgia.¹⁻⁵ This is a report of the use of epidural anesthesia to control autonomic dysreflexia during labor and delivery.

REPORT OF A CASE

A 29-year-old white woman, paraplegic at the T4 level from a traumatic injury five years earlier, was hospitalized in the thirtieth

week of a twin gestational pregnancy because of premature cervical dilation. During the thirty-eighth week, spontaneous rupture of membranes occurred, and two hours later a good labor pattern was established. At this time, 9:30 PM, the patient was comfortable. Vital signs were blood pressure 130/80 torr, pulse 80/min, and respiratory rate 16/min. However, 30 min later the patient complained of a headache and was sweating. Vital signs were blood pressure 176/94 torr, pulse 60/min, and respiratory rate 16/min (see fig. 1).

The patient was turned into the right lateral decubitus position, and, using loss-of-resistance technique, the epidural space was identified at the L3-4 level. An epidural catheter was passed 3 cm into the epidural space and secured. A test dose of 3 ml 0.25 per cent bupivacaine was injected through the catheter, and no clinical change was evident in 5 min. Then 8 ml of 0.25 per cent bupivacaine were injected into the epidural space and 7 min later the patient said her headache was subsiding. She was no longer sweating, and blood pressure was 130/80 torr, pulse 80/min, and respiratory rate 16/min.

One hour and 45 min later, she complained that her headache was returning. Blood pressure was 150/100 torr, pulse 60/min. Eight additional ml 0.25 per cent bupivacaine were injected into the epidural space, and within 10 min she was asymptomatic. At 1:30 AM she again complained of headache and was sweating. Blood pressure was 156/92 torr and pulse 60/min. A third injection of 8 ml 0.25 per cent bupivacaine was made into the epidural space. Ten minutes later she was asymptomatic, and pelvic examination

* Staff Anesthesiologist.

† Senior Resident, Obstetrics and Gynecology.

Received from the Departments of Surgery and Obstetrics and Gynecology, Tripler Army Medical Center, Hawaii 96859. Accepted for publication September 10, 1979.

Address reprint requests to Major Watson: Box 76, Tripler Army Medical Center, Hawaii 96859.

The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of Army or the Department of Defense.