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Lubrication of Tracheal Tubes to Prevent Sore Throat from Intubation

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Sore throat and hoarseness in the first 24 h after operation are common side effects of tracheal intubation. The incidence of patients complaining of sore throat after intubation for general anesthesia has been reported to be as high as 90%,[1] and as low as 5.7%.[2] There is little published information to indicate the best lubricant (if any) to use on cuffed, disposable, polyvinyl chloride tracheal tubes. This study was designed to determine if any of four commonly used tracheal tube lubricants would decrease the incidence or severity of subjective complaints of sore throat and hoarseness within the first 24 h after orotracheal intubation during general anesthesia.

MATERIALS AND METHODS

The complaint of a sore throat was evaluated postoperatively in 160 adults requiring general anesthesia for elective operative procedures. All patients for whom orotracheal intubation was planned as a standard part of their anesthetic management were assigned from a table of random numbers into one of five groups. Patients who received general anesthesia delivered by a face mask served as a control group. Orotracheal tubes were prepared with one of the following: (1) no lubricant; (2) water-soluble jelly; (3) normal saline solution; (4) lidocaine 2% jelly; and (5) lidocaine 2½% ointment. Approximately 2 ml of lubricant were applied to the outside of the orotracheal tube cuff for tubes prepared with water-soluble jelly, lidocaine jelly, and lidocaine ointment. Tubes lubricated with normal saline were dipped to the 16-cm mark into sterile 0.9% sodium chloride irrigation solution. The following patients were excluded: those who had nasogastric tubes passed before, during, or within the first 24 h of operation; those who required nasotracheal intubation; those who required more than one attempt for orotracheal intubation; those having oropharyngeal procedures or bronchoscopy; and those who remained intubated after discharge from the recovery room.

After preoxygenation for 2 to 5 min, anesthesia was induced with intravenous administration of 3 mg curare, 2.5 μg/kg fentanyl, and 0.10 mg/kg diazepam, or 3–4 mg/kg sodium pentothal, and 1.5 mg/kg succinylcholine. Orotracheal intubation immediately followed induction. All orotracheal tubes were lubricated within 15 min of their use. All intubations were performed deftly and with ease by experienced personnel. All patients inhaled nonhumidified gases through a disposable, Mapleson-D, piggyback breathing circuit (Vital Signs, Inc., East Rutherford, New Jersey). Anesthesia was maintained with nitrous oxide, oxygen, and intravenous fentanyl. Muscle relaxation was maintained with pancuronium bromide. Fresh gas flow into the anesthesia circuit was delivered at 70 $ml \cdot min^{-1} \cdot kg^{-1}$. Use of an oropharyngeal airway and size of the orotracheal tube were at the discretion of the anesthetist. Tracheal tube cuffs were filled with the minimal volume of room air that would prevent an audible leak immediately after intubation. No change in cuff inflation and no manipulation of the tube occurred until extubation at the end of the procedure. Only sterile, disposable tracheal tubes (Ohio Medical Products, Madison, Wisconsin) with an inside diameter of 7.0 to 9.0 mm and a high residual-volume, low-pressure cuff were used.

Twenty to thirty hours after extubation, one of the authors (MCS), without knowledge of the groups to which patients had been assigned, interviewed all patients. She first asked generally about postoperative complaints or problems. Then the patient was questioned directly about whether sore throat or hoarseness had occurred since the operation. The patient's smoking history also was elicited, as well as whether the patient had smoked the day of or the day before the operation. Patients' responses were graded on a scale of 0–3 described by Loeser *et al.*[3] as follows: 0 = no sore or scratchy throat and no hoarseness; 1 = minimal sore or scratchy throat and no hoarseness; 2 = moderate sore throat and/or some hoarseness; and 3 = severe sore throat and/or obvious hoarseness at the time of interview. After the interview, the anesthetic record of

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TABLE 1. The Incidence and Severity of Sore Throat as a Function of the Placement and the Lubrication of the Tracheal Tube

Group	N	Rating*				Sore Throat (%)	Severe Sore Throat (%)	Score	P†
		0	1	2	3				
No tube	38	30	5	3	0	21	8	0.3	0.0001
Dry tube	22	12	2	1	7	45	36	1.1	0.91
Normal saline	19	11	4	1	3	42	21	0.8	0.91
Water-soluble jelly	20	11	4	4	1	45	25	0.8	0.91
Lidocaine jelly	27	16	3	4	4	41	30	0.9	0.91
Lidocaine ointment	34	17	9	4	4	50	24	0.9	0.91

* Severe sore throat occurred when the severity rating was 2 or 3.

† Compared with all other groups.

each patient was reviewed and tracheal tube preparation was recorded.

For each group considered, a mean score was derived by adding the values of all the individual ratings in that group and dividing the sum by the total number of patients in the group. The mean score for each group was handled as noncontinuous data and was analyzed by using a weighted least-squares analysis of functions of categorical data (FUNCAT).[4,5]

RESULTS

Only the presence or absence of an orotracheal tube significantly influenced the occurrence of sore throat and hoarseness (table 1). When patients were intubated (mean score 0.9), they complained of sore throat and hoarseness much more than did those patients who had anesthesia administered with a mask (mean score 0.3) ($P < 0.0001$). Those who received lubricated tubes (mean score 0.8) complained of sore throat and hoarseness to the same extent as those who received non-lubricated tubes (mean score 1.1) (NS). In addition, the presence of lidocaine in the endotracheal tube lubricant (mean score 0.9) did not alter the incidence or severity of sore throat or hoarseness when compared with those who received tubes prepared with lubricants which did not contain lidocaine (mean score 0.8) (NS).

DISCUSSION

Investigations examining factors that influence the incidence of sore throat generally have been conducted with endotracheal tubes that are reusable. Even so, these reports give insight into the factors that must be considered when studying the incidence of sore throat after intubation with polyvinyl chloride tracheal tubes that are disposable.

Information relating different types of tracheal tube lubricants is not clear. Lund and Daos[6] found the incidence of sore throat significantly decreased with a viscous lidocaine ointment compared with less viscous lubricants, with or without local anesthetic agents added. In contrast, Conway and co-workers[7] reported a significant increase in the incidence of sore throat when endotracheal tubes were lubricated with an ointment containing cinchocaine compared with other lubricants, some containing other anesthetic agents. Winkel and Knudsen[8] found no alteration in the incidence of sore throat by using a jelly that contained cinchocaine. Therefore, investigators who used reusable rubber, latex, or plastic tracheal tubes did not agree in their quest for a lubricant that would consistently decrease the occurrence of sore throat.

Our results provide further evidence that intubation of the trachea for general anesthesia increases the incidence of sore throat and hoarseness in the first 24 h postoperatively, compared with the incidence observed in patients receiving general anesthesia with a mask. This has been found previously to be true for both reusable plastic orotracheal tubes[2] and disposable polyvinyl chloride tubes.[1] Loeser and co-workers[1] reported that, compared with nonlubricated cuffed endotracheal tubes, uncuffed lubricated endotracheal tubes provide no advantage in decreasing the incidence of sore throat. However, these investigators did not examine the incidence of sore throat complaints when cuffed endotracheal tubes were lubricated.

We found no significant difference in the incidence or severity of sore throats based on the type of lubricant used on the tracheal tube or based on the presence or absence of lidocaine in the lubricant. In fact, there was no difference in the incidence or severity of sore throat in patients who were intubated with dry tubes compared with those intubated with lubricated tubes. Experienced anesthetists performed all intubations and reported that intubation was mechanically easier when some form of lubrication was applied to the tube.

In conclusion, tracheal intubation during general anesthesia increases the incidence and severity of sore throat complaints postoperatively. However, lubricating the tube does not influence the incidence or severity of these complaints. Therefore, if prevention of sore throat and hoarseness postoperatively is the sole con-

sideration for tracheal tube lubrication, the addition of a lubricant seems unnecessary. However, lubrication of the tracheal tube may be used as a vehicle for drug administration, *e.g.*, lidocaine. Or, it may be used to facilitate passage of the tube through the oropharynx, in which case, the least expensive lubricant may be chosen.

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Air Embolism during Radical Hysterectomy

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Air embolism has been reported during surgery involving the head and neck[1] in intracranial procedures in the sitting position,[2] during laparoscopy and hysteroscopy,[3] and as a hazard of intravenous therapy.[4] Its pathophysiologic factors and treatment have been discussed extensively, and precordial doppler monitoring, right atrial or pulmonary artery catheterization, and end-tidal carbon dioxide measurement have become accepted procedures when air embolism is anticipated.[5] Although several reviews[1,6] mention the possibility of air embolism during pelvic procedures, no case reports of such an occurrence have been reported since Larson's[11] postmortem description of intracardiac air following a cardiac arrest in 1951. The following report describes a case of massive air embolism during hysterectomy in a situation in which air embolism was *not* anticipated, and in which no monitoring devices were in place to allow rapid diagnosis and treatment.

Report of a Case

A 26-year-old, 60-kg woman underwent abdominal hysterectomy with bilateral pelvic node dissection for invasive cervical carcinoma. Her past medical history was unremarkable and preoperative laboratory studies, physical examination, chest roentgenogram, and electrocardiogram were normal. The patient was classified as ASA physical status I.

The patient received 6 mg morphine sulfate and 0.4 mg atropine, im. Ninety minutes later, anesthesia was induced with 300 mg thiopental, iv. The trachea was intubated after neuromuscular blockade was induced by 100 mg succinylcholine, iv. Anesthesia was maintained with 70% nitrous oxide and 1–2% enflurane. Tubocurarine was administered intravenously to provide muscle relaxation, but the patient was not paralyzed completely. Ventilation at a minute volume of 5.4 l was controlled with a volume-limited ventilator. An ECG recorded cardiac rate and rhythm, and temperature was monitored via an esophageal thermistor probe. A Foley catheter was inserted in the bladder from which urinary output was monitored. The patient was positioned in Trendelenburg's position (approximately 10° head-down tilt) and surgery was started.

The operation proceeded uneventfully until approximately three hours after induction of anesthesia. The vaginal cuff was being closed after the uterus and adnexa had been removed, when it was noticed that the patient had suddenly become deeply cyanotic, and was making gasping respirations. Frequent premature ventricular contractions were present on ECG, and the external jugular veins had become distended. Arterial blood pressure at this time was 90/60 mmHg, a slight decrease from previous values. Mechanical ventilation and administration of all anesthetic drugs were discontinued, and the correct placement of the endotracheal tube confirmed. Severe bradycardia then ensued, and heart sounds became absent from the esophageal stethoscope. No peripheral pulses were palpable and no blood pressure was obtainable via the sphygmomanometer. Atropine, 0.6 mg, and 20 mg ephedrine iv were administered. An aortic pulse was then palpable in the abdomen. Upon removal of the abdominal packs, the iliac veins were noticed to look "funny." Upon inspection, they were found to contain large air bubbles. Simultaneously, heart sounds were noticed and a mill wheel murmur was found to be present. The inferior vena cava was occluded and the patient was placed in the steep Trendelenburg position. A mixture of air and foam, 60 ml, was aspirated from

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