

RESPIRATION AND THE AIRWAY

The effects of thermal softening of double-lumen endobronchial tubes on postoperative sore throat, hoarseness and vocal cord injuries: a prospective double-blind randomized trial

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Abstract

Background: It is well known that thermal softening of polyvinyl chloride tracheal tubes reduces nasal damage during nasotracheal intubation. We hypothesized that thermal softening of double-lumen endobronchial tubes (DLTs) may be effective for reducing airway injury. This randomized double-blind study was performed to investigate whether thermal softening of DLTs decreased postoperative sore throat, hoarseness or vocal cord injuries.

Methods: Patients ($n=140$) undergoing one lung anaesthesia were randomized into two groups ($n=70$ each) depending on whether the DLT was softened by warming or not before tracheal intubation. The DLTs were placed in warm saline [$40(1)^{\circ}\text{C}$] in the thermal softening group or in room temperature saline in the control group for 10 min. The vocal cords were examined by using flexible laryngoscopy immediately after extubation. Sore throat and hoarseness were evaluated for three postoperative days. The primary outcomes were the incidence of sore throat, hoarseness, and vocal cord injuries.

Results: Sore throat and vocal cord injuries occurred less frequently in the thermal softening group than in the control group [14/70 vs 27/70, risk ratio (95% CI): 0.52 (0.30–0.90), $P=0.025$ for sore throat; 15/70 vs 27/70, risk ratio (95% CI): 0.56 (0.32–0.95), $P=0.042$ for vocal cord injuries]. However, the incidence of hoarseness was comparable between the two groups.

Conclusions: Tracheal intubation with DLTs softened by warming decreased the postoperative incidence of sore throat and vocal cord injuries. Therefore, thermal softening of DLTs before intubation seems to be helpful in reducing airway injuries associated with DLT intubation.

Clinical trial registration.: NCT 01626365.

Key words: airway management; anesthesia, general; bronchi; intubation, intratracheal; one-lung ventilation

Accepted: October 28, 2015

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Editor's key points

- Warming the tracheal tube reduces nasal injuries during nasotracheal intubation.
- This simple study compared the effect of warming the distal part of a double lumen endobronchial tube (DLT) on airway complications.
- Sore throat and vocal cord injuries were reduced but post-operative hoarseness was unaffected.
- Warming the distal part of a DLT seems to be an easy and effective way of reducing some airway complications.

For lung isolation, double-lumen endobronchial tubes (DLTs) are more commonly used than single-lumen tracheal tubes with bronchial blockers because the DLT facilitates faster positioning and lung deflation and enables separate ventilation of each lung.^{1,2} However, tracheal intubation using DLTs is more likely to result in airway injuries or postoperative discomfort, such as sore throat and hoarseness as compared with single-lumen tracheal tubes¹⁻³ probably because DLTs are stiffer, have a larger external diameter, and are inserted deeply into the mainstem bronchus. Therefore, every care should be taken to minimize the potential airway injuries associated with intubation of DLTs.

Nasotracheal intubation is more traumatic than orotracheal intubation. For nasotracheal intubation, thermal softening of tracheal tubes made of polyvinyl chloride has been known to be effective to reduce nasal damage and epistaxis, because it makes the tube less stiff and increases flexibility of the tube during nasal passage.⁴⁻⁶ Likewise, the thermal softening pretreatment of DLTs may be useful for preventing the airway injuries that are associated with the use of DLTs.

Therefore, we hypothesized that thermal softening of DLTs may reduce the airway injuries associated with DLT intubation. This study was performed to investigate whether the use of DLTs softened by warming decreased postoperative sore throat, hoarseness, and vocal cord injuries in patients undergoing one lung anaesthesia.

Methods**Study design**

This prospective, double-blind, single-center, parallel-arm, randomized controlled trial was approved by the Institutional Review Board of Seoul National University Hospital (Seoul, Korea) and registered at ClinicalTrials.gov (NCT01626365). After obtaining written informed consents, we enrolled patients with ASA physical status I-III, aged 20-75 yr, and undergoing elective thoracic surgery under one-lung anaesthesia, using left-sided DLTs from May 2012 and April 2013. We excluded patients with pre-existing sore throat, hoarseness, upper respiratory tract infection, cervical spine diseases, presence of tracheostomy, and Mallampati score ≥ 3 . Patients were randomly assigned to one of the two groups in a 1:1 ratio depending on whether the DLT was softened by warming or not before tracheal intubation. All patients were unaware of their group assignment. Group allocation was randomized using a computer-generated randomization code and the sealed envelope method by a clinician not involved in the study.

Thermal softening of double-lumen endobronchial tubes

According to random allocation, all DLTs were pretreated by an assistant who was unaware of the study protocol. After deflating

the tracheal and bronchial cuffs, the distal portion of the DLT, from the bronchial tip to the proximal margin of the tracheal cuff, was immersed in sterile normal saline in a bottle for 10 min before tracheal intubation (Fig. 1). The temperature of the saline was manually maintained at 40 (1)°C for the softened group and at operating room temperature for the control group, which were measured via using an aseptic thermometer (Ewha Biomedics, Seoul, Korea). The saline bottle was covered with an opaque insulation blanket made of styrofoam and foil so as to minimize heat loss and to blind the pretreatment of the DLT (Fig. 1). The DLTs were withdrawn from the bottle immediately before tracheal intubation, and, without any lubrication to the cuffs, handed over to one of the two investigators (JHS and JHB) who were blinded to the group assignment.

Anaesthetic management

The DLT size was chosen depending on the sex and height of the patients as follows: 39-Fr for men >178 cm; 37-Fr for men 160-178 cm and women >165 cm; 35-Fr for men ≤ 160 cm and women 153-165 cm; and 32-Fr for women ≤ 153 cm.^{7,8}

The patients were monitored with electrocardiography, non-invasive bp, pulse oximetry, acceleromyography (TOF-watch SX; MSD BV, Oss, the Netherlands), and a bispectral index monitor (A-2000 XP; Aspect Medical Systems, Newton, MA, USA). In the patients undergoing thoracotomy, epidural catheterization was performed at the level of T4-5 or T5-6 for postoperative pain management.



Fig 1 Treatment of a double-lumen tube before intubation. Only the distal part of the tube was immersed in sterile normal saline (left) and the bottle was covered with an opaque insulation blanket made of styrofoam and foil to minimize heat loss and to blind the pretreatment of the tube (right).

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