Complete Transection of a Silicon Double Lumen Tube during the Process of Extubation - A Case Report-

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INTRODUCTION

A 30-year-old male without any significant past medical history was admitted for lung wedge resection due to spontaneous pneumothorax. Induction of anesthesia and video-assisted thoracoscopic surgery (VATS) were performed without any adverse events, but during emergence from anesthesia, the patient bit the distal portion of Humanbroncho® tube and it was transected completely. Although in this case, the transected fragment of DLT (Humanbroncho®, Insung Medical, Seoul, Korea) was removed in the oral cavity without any serious complications, we should remember the possibility of reoccurrence when the same type of tube is used in another thoracic surgery and which could potentially result in disastrous consequences such as airway obstruction, airway spasm and injury caused by aspiration.(1,2)

CASE REPORT

A 30-year-old male patient, 178 cm in height and 65 kg in weight was scheduled for blebectomy via VATS for left sided spontaneous pneumothorax. Until the occurrence of this illness, the patient was healthy with no other medical issues and was classified as American Society of Anesthesiologists classification 1 preoperatively. After 5 min of denitrogenation with 100% oxygen, general anesthesia was induced with intravenous propofol 2 mg/kg and rocuronium 0.6 mg/kg while 0.2 μg/kg/min of remifentanil was infused. Once the proper depth of anesthesia and muscle relaxation were achieved in the patient, Left 37 French Humanbroncho® was inserted via the conventional technique without any complications and appropriate positioning of the tube was confirmed by auscultation. Anesthesia was maintained with desflurane 6 vol%-oxygen 2 L/min-air 2 L/min along with continuous infusion of remifentanil 0.05-0.20 μg/kg/min. One of the lower front teeth of the patient had grade 2 mobility; hence, we did not insert an oropharyngeal airway to avoid worsening the mobility of the tooth. The operation was
completed at 75 minutes after induction of anesthesia without any adverse events. Pyridostigmine 10 mg with glycopyrrolate 0.4 mg was given to reverse muscle relaxation. Soon afterwards, we attempted extubation of the tube although complete recovery of consciousness was not achieved and the patient did not respond to the verbal command of ‘open your eyes’, because sufficient reversal of muscle relaxation was observed by recovered self-respiration up to tidal volume greater than 5 ml/kg and full strength fist clenching lasted longer than 5 minutes. Both bronchial and tracheal cuffs were deflated first and extubation of the DLT was initiated. While withdrawing the DLT for extubation, the patient started biting the tube while the distal 7-8 cm of the tube was still within the oral cavity. The anesthesiologist tried to open the patient’s mouth forcibly to continue withdrawing the tube for extubation, but he failed to open the patient’s mouth and the patient kept biting the tube forcefully and there was no recovery of mental status of the patient without eye opening. Due to failure to open the patient’s mouth, the anesthesiologist tried to continue withdrawing the tube but the tube could not be removed and then it was transected completely at the point of distal 7-8 cm of the tube. At that time, patient’s SpO₂ was maintained at 100% with spontaneous respiration without any signs of respiratory distress, but the patient’s mouth still could not be opened due to increased stiffness of jaw muscles and thus the remnant portion of the tube within the oral cavity could not be removed. Immediately, propofol 150 mg and succinylcholine 100 mg were injected intravenously and with the disappearance of spontaneous respiration in about one and a half minute, the patient’s mouth could be opened. The anesthesiologist checked the oral cavity with a laryngoscope and found the transected remnant portion of the tube in the oral cavity without aspiration or swallowing. The transected fragment (Fig. 1) was immediately removed with the Magill forceps and after 5-minute-mask bagging of 100% oxygen, patient recovered spontaneous respiration. All vital parameters including SpO₂ were maintained within normal range. In one minute, the patient completely recovered his consciousness with proper response to verbal command and appropriate communication. After confirming sufficient recovery of spontaneous respiration and normal range of all vital parameters, the patient was transferred to the recovery room. The patient awakened fully in the recovery room and all vital signs were maintained within normal range for 30 minutes. The patient did not complain of any discomfort except for pain at the surgical wound site. Chest simple radiograph was performed and it showed no pathologic
The patient was transferred to the general ward and discharged on the 7th postoperative day without complications.

**DISCUSSION**

Silicon DLT has several advantages over PVC DLT (Bronchocath®, Mallinckrodt, USA). First, a softer material, silicon, is used; hence the risk of airway mucosal injury is reduced. (3) Actually, it has been reported that the incidence of postoperative sore throat and hoarseness was significantly lower in patients in whom silicon DLT was used rather than PVC DLT. (4) Moreover, structurally, the angle to the left of the bronchial portion of the silicon DLT is 30° which is more angulated than that of the PVC DLT which is 15°, and the bronchial cuff is narrower and more distally located in silicon DLT than in PVC DLT; hence, it has been reported that the incidence of malposition such that the bronchial segment is wrongly inserted into the right bronchus instead of the left bronchus during intubation and the incidence of displacement such that the bronchial segment of the tube is moved out from the left bronchus into the right side after position change are lower with silicon DLT than with PVC DLT. (3) To maintain these structural features of silicon DLT, the bronchial segment is reinforced by a wire so that angulation of the bronchial segment is maintained and folding or collapse of the bronchial segment is prevented. However, due to this wire reinforcement, the distal portion is manufactured separately and grafted onto the proximal portion afterwards. We regard that this characteristic method of manufacturing silicon DLT was associated with tube transection in this case. The transected cross-section of the tube in this case was clearly demarcated without any teeth marks even if it was cut due to biting of the tube by the patient (Fig. 2). We confirmed that the transection point accurately matched the point of grafting of the wire-reinforced bronchial segment of the tube onto the proximal tracheal portion from the person-in-charge at the manufacturing company. This implies that the transection of the tube was triggered by the external force due to biting, but it was also associated with the vulnerability at the tube connecting point.

It is not rare that the patient bites the endotracheal tube during the process of emergence at the end of anesthesia. This biting of the tube may result in some adverse consequences such as negative pressure pulmonary edema due to the obstruction of the tube (5) or respiratory collapse caused by circuit leakage through the site of damage to the tube. (6,7) In this case, although, the biting of the tube occurred on the graft site of the tube during extubation, it resulted in an unusual and unexpected consequence of complete transection of the tube. Fortunately in this case, the transected remnant portion of the tube was removed safely by the anesthesiologist without any other adverse consequences. However, the transected tube remnant has a risk of aspiration especially when the patient’s consciousness has not fully recovered and the aspirated tube remnant may result in some disastrous consequences like airway obstruction, airway injury, airway spasm, and fatal hypoxia. (1,2) Therefore, anesthesiologists need to pay special attention when they use DLT made up of the same material.

In most cases, biting of the tube by the patient during emergence from anesthesia is associated with turbulent emergence. (8) Therefore, to avoid biting of the tube by the patient, a smooth emergence technique such as low dose opioid infusion during emergence may play an important role. (8,9) In addition, in this case, we attribute turbulent emergence and forceful biting of the tube by the patient to almost complete muscle relaxation during a state of incomplete recovery.
of consciousness.(10) Hence, complete reversal of consciousness together with reversal of muscle relaxation would be important to avoid agitation and biting of the tube by the patient. Also, we suggest that when turbulent emergence is expected, insertion of oropharyngeal airway or other forms of bite blocks should be considered during induction of anesthesia or before the initiation of reversal of neuromuscular block.(5,11)

At our center, oropharyngeal airway is not routinely inserted during anesthesia because of the risk of dental injury, stimulation of gag reflex and upper airway spasm.(10,12) Particularly in this case, there was grade II mobility in the lower front tooth of the patient; hence, we did not consider insertion of oropharyngeal airway or other type of bite block. Instead, we chose to induce smooth emergence by continuing low dose infusion of remifentanil.(9) However, we experienced that this method of inducing smooth emergence does not guarantee the same response in all patients. Thinking retrospectively, the situation in which avoiding biting of the tube is mandatory such as with the use of silicon DLT, it is necessary to consider insertion of a bite block prior to emergence from anesthesia in spite of the risk of tooth injury in conjunction with confirming complete recovery of consciousness along with recovery of muscle relaxation to avoid potential respiratory hazard due to tube transection.(1,2,13)

In conclusion, in spite of the several advantages of silicon DLT such as its soft and flexible texture, modified distal curve structure, and wire-reinforced bronchial tip,(3,4) its unique method of manufacturing - fixation of the distal wire reinforcement segment on the proximal body - may cause vulnerability at the point of connection and this vulnerability may even result in complete transection of the tube by external forceful injury like biting of the tube by the patient, and this may potentially lead to disastrous airway accidents. When turbulent emergence is expected with the use of silicon DLT, anesthesiologists should be cautious and they should avoid turbulent emergence and consider bite block insertion. In addition, if we can suggest, with respect to manufacturing, after recognizing the possibility of transection of the tube at the graft site by an external force, we need to focus on developing a method for manufacturing a single-piece tube without a connecting process or improving the durability of the graft site of the tube.

**ABSTRACT**

The frequency of use of silicon material double lumen tube (DLT) in one-lung ventilation anesthesia is increasing because of its several advantages over the existing usual polyvinyl chloride (PVC) DLT such as softer material and less frequency of malposition or displacement due to its structural characteristics. However, we recently experienced an unexpected and potentially disastrous event of complete transection of the distal bronchial portion of this tube during the process of emergence from anesthesia. Here, we report a case to contemplate the association of this event with the structural vulnerability of this tube which may be related to the characteristic process of manufacturing of the tube and describe some methods to prevent reoccurrence of the same event.

**Key Words:** Biting, Double Lumen Tube, Silicon, Transection

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