

# OBSTRUCTION OF ENDOTRACHEAL TUBE; A MANUFACTURING ERROR

## - Case Report -

FATEMEH HAJIMOHAMMADI\*, ARMAN TAHERI\*\*  
AND PAYAM EGHTESEADI-ARAGHI\*\*\*

Manufacturing defects in endotracheal tubes (ETT) are known to occur, and may cause ETT obstruction in various ways<sup>1</sup>. We report an ETT manufacturing error resulting in partial airway obstruction with a 7.0 mm cuffed tube due to partial perforation of the distal orifice of the ET tube.

### Case Report

A fourteen-year-old girl 49 kg, ASA I with chronic sinusitis was scheduled for an elective functional endoscopic sinus surgery. Monitoring equipment including pulse oxymeter, sphygmomanometer, and ECG were applied and her basic vital signs were within normal range.

Patient was premedicated with midazolam 2 mg and fentanyl 100 µg, via an IV route. Anesthesia was induced with thiopentone 250 mg and muscle relaxation was achieved using 25 mg atracurium. The trachea was intubated with a cuffed oral PVC ETT (Supa high volume-low pressure cuff, single use, ID = 7.0 mm) without any complication. ETCO<sub>2</sub> monitoring was established and bilateral lung expansion confirmed by auscultation although bag ventilation was difficult because of high inspiratory pressure. Then the lungs were artificially ventilated at tidal volume of 500 ml (end-tidal CO<sub>2</sub> of 40 mmHg) and rate of 10 breaths per minute with a mixture of oxygen, nitrous oxide (50%) and halothane (1%) for anesthesia maintenance.

Before preparation and draping, a pharyngeal pack was inserted. After several minutes, the peak airway pressure increased from 30 to 65 cmH<sub>2</sub>O gradually. This was accompanied by heart rate increase (120 beat/min) and end-tidal CO<sub>2</sub> rise to 60 mmHg. SaO<sub>2</sub> remained unchanged at 100% with FiO<sub>2</sub> of 50%.

Upon noting the rise in ETCO<sub>2</sub> and drop in expired tidal volume, the patient was immediately disconnected from the ventilator and the lungs ventilated manually, nitrous oxide was discontinued and pharyngeal pack was removed. The circuit was checked systematically for kinks, obstructions or leaks, but none was found. ETT marking at the incisor was checked and remained the same at 18 cm. Lung auscultation revealed expiratory wheezing. Visual inspection of the ETT did not reveal any cause of airway obstruction. A 10F suction catheter was then passed down the lumen of the ETT for suctioning of secretion but the suction catheter could not be passed fully down the tube and resistance was encountered. After that, the surgery was delayed and patient's ETT was substituted

---

From Department of Anesthesiology and Critical Care, Amiralam Hospital, Tehran University of Medical Sciences, Tehran, Iran.

\* MD, Assistant Professor of Anesthesiology.

\*\* MD, Assistant Professor of Anesthesiology.

\*\*\* MD, Anesthesiologist, President of Parsteb Pajouheshyar Medical Sciences Research Institute, Tehran, Iran.

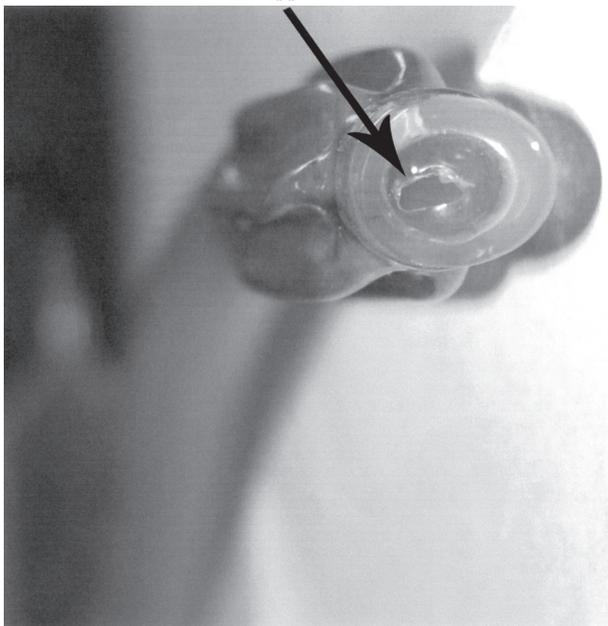
Corresponding author: Payam Eghtesadi-Araghi, MD, Anesthesiologist, President of Parsteb Pajouheshyar Medical Sciences Research Institute, Department No. 5, 37<sup>th</sup> (Eastern), First Golzar St., Ashrafi Esfahani Bulv., Ponak Sq., Tehran 1476783476, Iran. Tel & Fax: (+98) 21-44454814, E-mail: payam\_eghtesadi@yahoo.com

with another same size new cuffed ETT under direct laryngoscopy which resulted in marked improvement in ventilation.

Examination of the former tube revealed that there was as a manufacturing error (Fig. 1) consisting of a plastic film covering the distal opening of the tube with a small perforation (approximately 2.5 mm in diameter) at its mid-upper point. The subsequent anesthetic course was uneventful.

*Fig. 1*

*Plastic film at the distal end of the ETT that was removed from the patient. Arrow shows the orifice in the plastic film with diameter of approximate 2.5 mm*



## Discussion

Difficulty in ventilating an intubated patient during anesthesia may be ascribed to a variety of causes, basically including anesthesia gas delivery malfunction, obstruction of the breathing circuit (somewhere between the common gas outlet and the end of the ETT), poor pulmonary compliance (extrinsic or intrinsic), esophageal intubation or acute bronchospasm, tension pneumothorax, and endobronchial mass lesion<sup>4</sup>.

Several manufacturing defects in ETT have been described. These include cuff defects leading to herniation of the ETT cuff and intraluminal tracheal obstruction<sup>5,7</sup>, elliptical defects in the tube wall at the

level of the notch cut for insertion of the pilot tube causing air leak<sup>8,9</sup> kinking of the ETT<sup>3,4</sup> and intraluminal plastic films and meniscus<sup>4,10</sup> causing near complete airway obstruction.

The checking of ETT for defects before tracheal insertion is an integral part of routine checking of anesthetic equipment. This usually includes examining the tube to ensure patency and inflating the cuff to detect air leakage<sup>3</sup>. In our case, routine check of the ETT failed to find the structural problem at the tube end hole. Only after intubation and ventilation for a period of time did the structural defect become obvious.

Barst et al<sup>4</sup> and Kee<sup>10</sup> have described similar cases. Barst et al<sup>4</sup> described a 6-months-old girl that was intubated with an uncuffed 3.5 mm-internal-diameter Sheridan ETT and following no air entry confirmation she was reintubated with new tube. On inspection, the tube's lumen was entirely occluded by a plastic meniscus that must have been introduced during the tube's manufacturing process.

As this case demonstrates, the intrinsic occlusion of the ETT itself should be considered. Increasing airway peak pressure on a volume control mode of ventilation and persistently high ET $\text{CO}_2$  due to hypoventilation were the only early warning signs. The suction catheter was unable to pass through the tube due to the distal end block as the tube was occluded with a plastic film.

This incident was reported to the Supa Corporation together with the tube's Lot number.

Although this occurrence is rare, we feel that it is timely to highlight this case to relay that any structural defects in the tube may result in significant airway incidents.

In conclusion, inspection of ETT prior to use is still the most crucial factor in confirming tube function. Vigilant monitoring of ventilator pressure and end tidal  $\text{CO}_2$  is the key to the early detection of airway obstruction. When airway obstruction is encountered in an intubated patient, it is important to consider both mechanical and pathologic factors. In cases where no other cause for inadequate ventilation is found, it is imperative to replace the ETT.

## References

1. LEE YW, LEE TS, CHAN KC, SUN WZ, LU CW: Intratracheal kinking of endotracheal tube. *Can J Anaesth*; 2003, 50:311-2.
2. SZEKELY SM, WEBB RK, WILLIAMSON JA, RUSSELL WJ: The Australian Incident Monitoring Study. Problems related to the endotracheal tube: an analysis of 2000 incident reports. *Anaest Intensive Care*; 1993, 21:611-6.
3. CHUA WL, NG AS: A defective endotracheal tube. *Singapore Med J*; 2002, 43:476-8.
4. BARST S, YOSSEFY Y, LEBOWITZ P: An unusual cause of airway obstruction. *Anesth Analg*; 1994, 78:195.
5. HENDERSON MA: Airway obstruction with a cuffed single-use plastic endotracheal tube. *Anaesth Intensive Care*; 1993, 21:370-2.
6. DUNN HC: A defective endotracheal tube. *NZ Med J*; 1988, 13:101-460.
7. FAMEWO CE: A not so apparent cause of intraluminal tracheal tube obstruction. *Anesthesiology*; 1983, 58:593.
8. LEWER BM, KARIM Z, HENDERSON RS: Large air leak from an endotracheal tube due to a manufacturing defect. *Anesth Analg*; 1997, 85:944-5.
9. GETTELMAN TA, MORRIS GN: Endotracheal tube failure: undetected by routine testing. *Anesth Analg*; 1995, 81:1313.
10. KEE WD: An unusual problem with an endotracheal tube. *Anaesth Intensive Care*; 1993, 21:247-8.

