Case Report

Unusual Airway Obstruction during General Anesthesia following Endotracheal Tube Cuff Herniation; A Case Report

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Abstract

Background: Airway management is always of great concern for anesthesiologists especially in the prone position. Utilizing an Armored endotracheal tube is considered to be safe in such patients.

Cases Report: In this current case, we introduce a patient undergoing a wake-up test during spinal surgery who suffered from hypoventilation at the end of surgery. His condition improved only after extubation. After extubation, we confronted a herniated cuff that was not deflated, although we tried twice. We concluded that the patient's respiratory effort against obstructed airway produced a negative pressure, which made the cuff herniated, resulting in airway obstruction. Moreover, the patient biting the tube during the wake-up test damaged the tube and cuff deflation pathway.

Conclusion: It is important to consider cuff herniation as a cause of obstruction when other possible etiologies are ruled out.

Keywords: Endotracheal tube, Airway obstruction, Wake up test, Cuff herniation

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Introduction

Hypoxia and decreased O2 saturation during general anesthesia usually result from impaired alveolar ventilation, gas diffusion disturbances, pulmonary edema, pulmonary emboli, pneumothorax, bronchospasm, one-lung ventilation, and airway obstruction[1,2,3].

Complete airway obstruction under general anesthesia often results from the accumulation of mucous plugs[2]. However, it may happen secondary to endobronchial tumor, malposition of endotracheal tube (ETT), biting or kinking of ETT, foreign body entrapment in ETT, and cuff herniation[1,2]. ETT cuff herniation is usually reported when a large-volume, low-pressure cuff is overinflated, and the subsequent obstruction reveals after deflating the cuff[4,5]. Nitrous oxide can predispose cuff herniation by diffusing to the cuff and increasing its pressure[4,6].

On the other hand, the wake-up test, a kind of intraoperative neurophysiologic monitoring introduced by Stagnara and colleagues, remains a useful test despite many disadvantages. The disadvantages include unexpected movement intravenous line dislodgement,

unexpected endotracheal tube extubation, pneumothorax, and soft tissue emphysema[7,8].

Case Report

An 18-year-old man, known case of congenital Scheuermann's disease, was admitted for elective kyphosis correction following an initial preoperative visit by an anesthesiologist. The patient did not have any past medical history except being overweight (weight= 103kg, height= 187 cm, and BMI=29.45). Neurosurgeon planned to insert Rad in T2 to L2 level of vertebral bodies via a posterior approach while the patient in the prone position. They also asked the anesthesiologist to perform wake-up test, when needed during surgery. The surgery was planned and patient entered operating room after 8 hours of fasting. He was fully conscious with stable hemodynamic status, and auscultation of heart and lungs also showed no abnormality. Induction of anesthesia was done after 3 minutes of preoxygenation with 100% oxygen via facemask. After administration of premedication (3.5 mg Midazolam,100 micg Fentanyl, 80 mg Lidocaine), induction occurred with 500 mg Thiopental sodium and 50mg of Atracurium. Afterward, a number 8 armoured endotracheal tube was inserted under direct visualization of laryngoscopy. The patient was connected to the anesthesia machine after confirming symmetric ventilation of both lungs. The anesthesia machine was set on volume assisted mode with a tidal volume of 600^{cc}, frequency of 12, and positive end-expiratory pressure of 3mmHg with 50% oxygen and 50% nitrous oxide. 0.5mac of Isoflurane along with propofol with infusion rate of 30 mg per hour was instituted for maintenance of anesthesia along with N2O. The patient was positioned after insertion of three large bore intravenous catheters (18G), arterial line and fixing Foley catheter. All extremities, both eyes, face, nipples, abdomen and genitalia were checked and all other pressure points were padded appropriately. Tranexamic acid infusion at the rate of 5ml (500 mg) per hour was initiated to minimize intraoperative blood loss. In addition to hemodynamic and urine output monitoring, we also utilized train of four (TOF) neuromuscular monitoring for qualitative assessment of neuromuscular drug effect during surgery. The surgeons asked for wake-up test 8 hours after initiation of anesthesia. After cessation of Propofol infusion, nitrous oxide and Isoflurane and a bolus of 1mg neostigmine and 0.5 mg atropine, patient was awakened and successfully obeyed the commands. Maintenance of anesthesia following bolus administration of

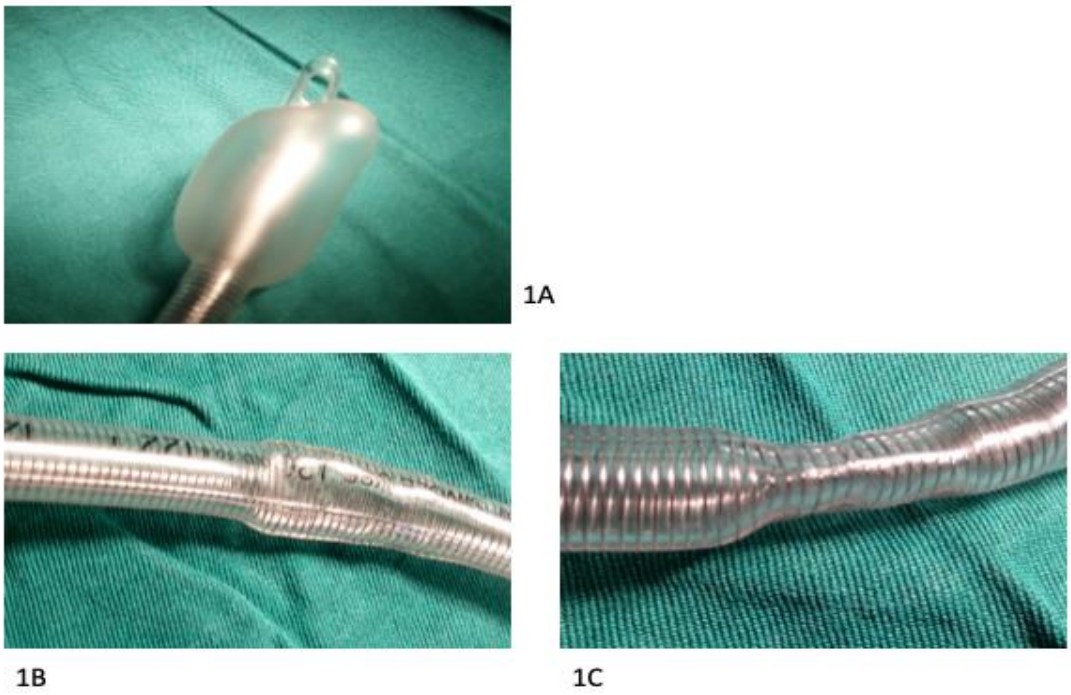

Figure 1. A. Endotracheal cuff herniation, B & C. Impact of patients biting force on ETT.

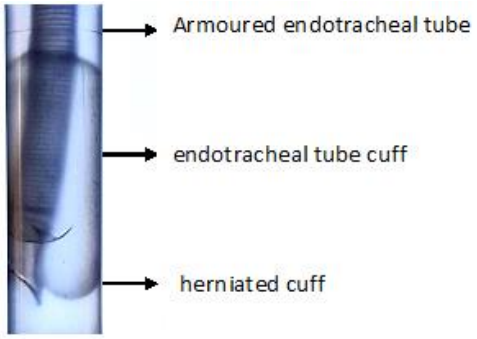

Figure 2. This figure shows how the ETT is probably placed in trachea. It acts as a check valve, during inspiratory phase with positive pressure airway is just partially closed and allows the flow into the lungs, however, during passive expiration it closes the airway, disturbing normal gas flow.

Atracurium and Propofol was continued again with combination of Isoflurane and Propofol; simultaneously infusion of second packed red blood cells started according to ongoing blood loss of 1600^{cc}. Five hours later following a bucking effort due to light anesthesia state patients heart rate increased from 65-75 to 88-90 beats per minute and the blood pressure rise to 145/100 mmHg. Capnogram also manifested a rise from 32 to 38. Nitrous oxide was initiated again but SpO2 and EtCO2 continued to worsen, 93-94% and 45-46 respectively. Half an hour later patient suddenly experienced a significant decrease in blood pressure to 90/40 and Spo2 continued to drop to 77% and EtCO2 rose to about 60, meanwhile soda limes canister was a little warm, and a rise in airway pressure was also detected. At this point we separated the patient from anesthesia machine and ventilated patient with bag valve mask and oxygen. Anesthesia machine and all connections were rechecked. Since the bag was stiff, we deflated the tracheal tubes cuff, but patient's condition did not change (airway resistance was still high). Meanwhile, packed red blood cells transfusion was abruptly stopped and an ABG was sent. Auscultation of thorax revealed decreased breath sounds in right lung, subsequently Endotracheal tube was taken out about 1.5 cm and some alterations in position was done in order to reduce chest wall pressure and the surgeons were asked to finish suturing as soon as possible. All of the aforementioned measures resulted in Spo2=85%, EtCO2=47 and BP=95/58mmHg, ABG was sent and patient repositioned to supine position after 30 minutes and another ABG was sent, all of which are showed in

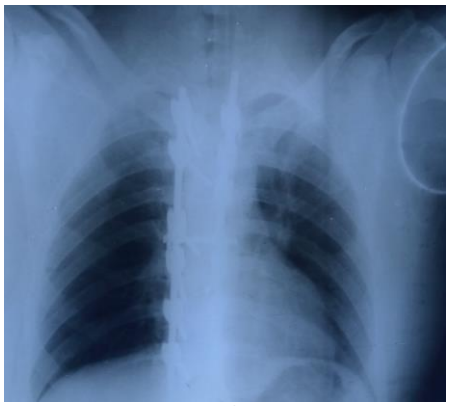

Figure 3. Patient's Chest X-Ray after surgery.

Table 1. The ETT lumen obstruction was ruled out after suctioning and direct visualization with fiberoptic stylet. Fiber optic revealed no pathology in the airway and the airway path was not obstructed. Cuff was deflated twice, however, the patient's condition did not change. Despite the discontinuation of all anesthetics and aforementioned measures hypercapnia, tachycardia and sweating worsened. At this moment abnormal ETT (signs of biting) got our attention and we decided on changing the ETT. After changing ETT, we confronted an inflated herniated cuff that was not deflated despite our prior attempt to emptying it and the sign of biting on ETT (Figure 1 and 2). The patient was extubated after partial cessation of anesthetic drugs and return of patients spontaneous breathing and reversal of residual effects of neuromuscular blocker agents with the administration of 5 mg neostigmine and 2mg atropine, however, the patient was not still completely awake. The oral cavity was then suctioned and supportive oxygen via facemask was carried out, and all the previous problems started to resolve gradually. Immediate Chest X-Ray was normal after all (Figure 3). Later, patient was admitted to the intensive care unit for postoperative care. The day after, the patient was discharged from the ICU and transferred to the regular care ward for further care.

Discussion

We hypothesized that the endotracheal tube was kinked during surgery, most likely during the wake-up test or at the time of bucking near the end of the surgery, which might best justify the sign of biting after extubation. Since it might happen when patient was in supine position, we would have notified it. Then the negative

pressure produced by patient's respiratory effort against an obstructed endotracheal tube resulted in internal cuff herniation. However, the positive pressure provided artificially by the anesthesia machine was able to inflate the lungs during inspiration; subsequently, the tip of the ETT was pushed along the tracheal wall causing partial obstruction, especially during expiration. Meanwhile, the herniated cuff obscured the murphy eye and makes airway obstruction partial during inspiration with positive pressure ventilation but more noticeable during exhalation, which resulted in air trapping and accumulation of carbon dioxide. In addition, the patient's effort to bite the ETT damaged the connection between the pilot balloon and cuff, so our effort for deflating the cuff was unsuccessful.

Cuff herniation should always be considered as a possible cause of complete airway obstruction. This is usually confirmed by cuff deflation; however, it is not reliable as it happened in our case. Utilization of fiberoptic to identify obstruction is also an alternative that was of no help for us.

Conclusion

Special considerations should be made to perform wake-up tests, especially in obese patients, while kinking of the tracheal tube during patient's arousal may occur without the anesthesiologist even notifying it because of the limited visualization of patients face during prone position. In addition, although newer generations of endotracheal tubes such as armored are believed to be safer, it is judicious to check it frequently during the procedure. Nitrous oxide should also administer with caution as it can predispose cuff herniation.

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