Case Report

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A Case Report of Endotracheal Tube Cuff Herniation During Lumbar Discectomy

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ABSTRACT

BACKGROUND AND OBJECTIVE: Damage to the endotracheal tube cuff during general anesthesia can cause ventilatory failure for the patient. The aim of this study is to report structural defect and herniation of the endotracheal tube cuff in a patient undergoing lumbar discectomy in the prone position.

CASE REPORT: The patient was a 77-year-old woman who was a candidate for Lumbar discectomy who referred to Kowsar Hospital in Sanandaj for surgery. The patient underwent general anesthesia with a spiral endotracheal tube in the prone position. After 30 minutes of surgery, there were symptoms of increased airway pressure, decreased saturation, and increased carbon dioxide. Postoperative examinations revealed that the patient's endotracheal tube cuff had a hernia which blocked the airway; the problem was resolved and surgery continued. Diagnosis and treatment of this case have important and significant points that are mentioned below.

CONCLUSION: Structural defects in the endotracheal tube and its cuff may cause insufficient ventilation of the patient and reduce the delivery of anesthetic gases to the patient. The definitive solution to endotracheal tube cuff defect is replacement, but conservative measures may be used as a temporary solution in some clinical situations. The anesthesia team should be prepared with adequate equipment, programs, and personnel to follow "Guidelines for Management of the Difficult Airway" developed by the American Society of Anesthesiologists (ASA) in the case of loss of air exchange in the patient.

KEY WORDS: *Endotracheal Intubation, Endotracheal Tube Cuff, Airway, Complications*.

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Introduction

Spinal stenosis surgery is one of the most common surgeries in the world and patients selected for this surgery are operated in different treatment centers under different methods under general anesthesia or intrathecal anesthesia (1). Intratracheal intubation is a common and important procedure in patients under general anesthesia in the operating room to ventilate and prevent air leakage and aspiration of stomach and throat contents into the trachea (2, 3). Endotracheal tube cuffs are designed to seal the lower airways for precise ventilation and protection against pathogens entering the throat. Therefore, the cuff must have a sufficient continuous pressure (4).

Maintaining a cuff pressure between 20 and 30 cm of water is essential to minimize air leakage, maintain current volume, and prevent tracheal mucosal damage (5). The endotracheal tube cuff is designed to provide sufficient pressure to seal the inferior airway without causing perfusion problems in the tracheal mucosa (6). Therefore, damage to the endotracheal tube cuff during general anesthesia can cause ventilation failure for the patient (7). Structural defects in the endotracheal tube are a serious and dangerous problem for the patient, especially if the patient is under surgery (8).

The most common structural cause of air leakage from endotracheal tube is a defect in its cuff (9). Rho et al. suggested that cuff defects may be due to manufacturing defects (10). Excessive air leakage has been reported to have led to abnormal cuff inflation due to manufacturing defects. Most of the time, however, cuff defects are caused by unwanted damage to the thin wall of the cuff. Friction with sharp teeth during multiple insertions and removal of the endotracheal tube to intubate patients is a major cause of cuff damage (8). Spraying topical anesthetics on the cuff is another cause of damage to the cuff (11).

Endotracheal tube replacement is necessary when a major structural defect occurs in the endotracheal tube and conservative measures fail (9, 10, 12). However, in some cases, depending on the patient's condition and the type of surgery, endotracheal tube replacement is not possible. Therefore, in this situation, conservative measures should be taken for the patient (11-14). The purpose of reporting this case is to increase the awareness of our colleagues to consider such rare cases in patients and despite confirmation of proper intubation and ventilation of both lungs of the patient, take the necessary measures according to the specific conditions of the patient and the type of surgery after noticing the alarm of increased airway resistance.

Case Report

After obtaining informed consent regarding the presentation of results while observing the maintenance of patient information confidentiality, the results of this study is reported with the ethics code IR.MUK.REC.1399.112 from Kurdistan University of Medical Sciences.

The patient was a 77-year-old female candidate for lumbar discectomy who referred to Kosar Hospital in Sanandaj for lumbar discectomy. The patient had a history of tubal ligation surgery under general anesthesia 10 years ago and had a history of high blood pressure and had not taken any medication to lower blood pressure. The patient was monitored after entering the operating room, and the symptoms were as follows: RR= 14, HR= 75, $ETCO_2$= 25, SPO_2= 100, BP= 150.85.

The patient underwent general anesthesia with spiral endotracheal tube for surgery. The endotracheal tube cuff was examined before anesthesia and no defects were observed in the cuff. Then, based on the order of the surgeon and with the permission and coordination of the anesthesia team, the patient underwent a prone position to start the surgery. The patient's endotracheal tube was checked again by hearing and symmetry of both lungs, capnograph was checked and surgery was started. The patient was monitored for 3 minutes for proper monitoring and control of blood pressure. Thirty minutes after the start of surgery, the anesthesiologist began to sound the alarm, announcing increase in airway resistance and decrease in arterial blood oxygen saturation (SPO_2= 94%).

The patient was separated from the anesthesia ventilator by the anesthesiologist and ventilation was done manually. Requirement was performed for 30 seconds with 60 cm of water pressure, then changes were made in the device settings and the alarm was resolved and the percentage of oxygen was restored to 100%. One hour after surgery, the anesthesia machine began to sound the alarm again, showing $ETCO_2$= 45 mmHg and SPO_2= 93%. The patient underwent endotracheal suction with lavage without any discharge. Examination of the endotracheal tube was performed to remove the obstruction or displacement of the tube, but no case was observed. The patient was also checked for depth of anesthesia and recurrence of spontaneous

respiration, which was in the normal range and without spontaneous respiration, but there was still an increase in airway resistance in the patient. During the entire period of the surgery, which was about 4 hours, all necessary measures were taken to reduce airway resistance, such as changing the anesthesia settings, airway suction, use of salbutamol spray, replacement of anesthesia machine and replacement of soda-lime glass, administration of drugs such as hydrocortisone and dexamethasone and examining the position of the endotracheal tube, but there was still an increase in airway pressure in the patient. Due to the patient's prone position and approaching the end of surgery and having no doubt about the endotracheal tube cuff herniation due to pre-intubation check and also difficult intubation in this position, given that both lungs of the patient were ventilated and since the location of the endotracheal tube was appropriate, replacement of the tube was avoided.

The operation was completed successfully without causing any complications for the patient. After the operation and changing the patient's position to supine, the spiral endotracheal tube was removed and replaced with normal endotracheal tube No. 7. Immediately after the operation: $ETCO_2$= 26 mmHg and SPO_2= 100%. After endotracheal extubation, herniation was observed in endotracheal tube cuff (Figure 1), which occurred over time in the tube and caused an obstruction at the air inlet to the patient's lungs, causing obstruction and increased airway resistance. After suction and return of the swallowing reflex and the appropriate respiratory volume and awakening, the endotracheal tube was removed and the patient was transitioned to the recovery in a normal and awake state and was sent to the ward after one hour of recovery. The patient started drinking fluids after 6 hours. The day after surgery, the patient was discharged without any problems and was sent home.

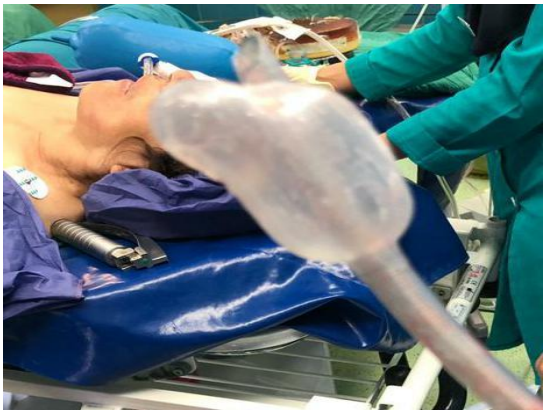

Figure 1. Endotracheal tube cuff herniation

Discussion

In our patient, the endotracheal tube was filled and emptied with air before intubation and no defect was observed in the cuff. One of the most important and necessary things for the anesthesia team is to test the swelling and safety of the cuff before endotracheal intubation to ensure the proper functioning of the endotracheal tube during anesthesia (9, 12). Clinical signs of endotracheal tube cuff damage depend on the loss of volume, patient characteristics, type of intubation, and type of surgery. These symptoms include hearing abnormal sounds from the patient's respiratory system and loss of current volume, in which case it is necessary to change the patient's endotracheal tube (8).

In our patient, there was an increase in airway pressure, a decrease in arterial blood oxygen saturation, and an increase in end-tidal carbon dioxide ($ETCO_2$). Secretions from the contents of the stomach or throat may also enter the lungs because there is no suitable isolation to protect the lungs (9, 13, 14). Moreover, in case of damage to the cuff, the patient may receive an insufficient concentration of anesthetic gases, so that the patient may not have the proper depth of anesthesia (9, 12). In our patient, after the onset of symptoms of increased airway resistance, throat secretions were suctioned and changes were made in the anesthesia device settings, and arterial oxygen saturation reached 100% again, but after one hour, the symptoms of airway resistance increased again.

When there is a defect in the cuff of the endotracheal tube, the definitive solution is to replace it, but this solution can be technically difficult in patients with difficult airway and patients with increased intracranial pressure, as well as patients with coronary artery disease. They may not tolerate another laryngoscopy and re-intubation may be life-threatening. In many cases, such as head and neck surgery and patients with airway edema, the endotracheal tube cannot be replaced. A conservative and innovative solution to the cuff leak problem is to replace the endotracheal tube with a soft gas pack to limit leakage (9). In our patient, due to the prone position and lumbar disc surgery, it was not possible to change the patient's position and replace the endotracheal tube, so conservative measures were taken for the patient.

When symptoms such as decrease in current volume and abnormal breathing sound occur, oxygen delivery to the patient is urgent. Rapid examination of the anesthesia machine is then necessary to eliminate equipment leaks. Then the depth of the endotracheal

tube is examined through dental and lip marks and then direct laryngoscopy in performed. The definitive solution to the endotracheal tube cuff damage is to replace it, but a hasty and unplanned decision may endanger the patient's life (9, 13). In our patient, after observing the respiratory symptoms, more oxygen was given to the patient and the settings of the anesthesia device were checked and then the depth of the endotracheal tube was checked and suction of secretions was performed. The patient was supported by conservative measures, and finally, after the operation and change of the patient's position from prone to supine, re-intubation was performed for the patient.

Based on the above report, it can be concluded that a structural defect in the endotracheal tube and its cuff may occur even when we have previously tested the cuff and made sure that it is fine. Defects in the endotracheal tube cuff cause insufficient ventilation of the patient and reduce the delivery of anesthetic gases to the patient. Management of endotracheal tube cuff defect should be based on a thorough risk-benefit analysis based on certain clinical scenarios. New clinical methods with different approaches as well as international guidelines on patient treatment and survival can play an important role. However, conducting clinical studies and case reports in this area and integrating and combining clinical knowledge and experience to generalize the results of evidence-based clinical studies will be very helpful (14, 15).

The definitive solution to endotracheal tube cuff defect is replacement, but conservative measures may be used as a temporary solution in some clinical situations. In the event of a major defect in the endotracheal tube cuff or if conservative measures have failed, anesthesiologists should be prepared with adequate equipment, programs, and personnel to follow the “Guidelines for Management of the Difficult Airway” developed by the American Society of Anesthesiologists in cases where the airway is obstructed.

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References

1.Sane S, Mahdkhah A, Golabi P, Hesami SA, Kazemi Haki B. Comparison the effect of bupivacaine plus magnesium sulfate with ropivacaine plus magnesium sulfate infiltration on postoperative pain in patients undergoing lumbar laminectomy with general anesthesia. Br J Neurosurg. 2020:1-4.

2.Sane S, Aghdashi MM, Kazemi Haki B, Gholamveisi B, Rajabzadeh M, Golabi P. The Effect of Pregabalin on the Prevention of Succinylcholine-Induced Fasciculation and Myalgia. J Perianesth Nurs. 2020;35(3):255-9.

3.Mendelsohn AH, Mukdad L, Dhillon A. High intraoperative endotracheal tube cuff pressure incidence and clinical impact. Can J Anaesth. 2018;65(3):331-2.

4.Aeppli N, Lindauer B, Steurer MP, Weiss M, Dullenkopf A. Endotracheal tube cuff pressure changes during manual cuff pressure control manoeuvres: An in-vitro assessment. Acta Anaesthesiol Scand. 2019;63(1):55-60.

5.Letvin A, Kremer P, Silver PC, Samih N, Reed-Watts P, Kollef MH. Frequent Versus Infrequent Monitoring of Endotracheal Tube Cuff Pressures. Respir Care. 2018;63(5):495-501.

6.Hamilton VA, Grap MJ. The role of the endotracheal tube cuff in microaspiration. Heart Lung. 2012;41(2):167-72.

7.Nishikawa K, Fujita Y. Cuff Failure of Spiral-Filled Polyvinyl Chloride Endotracheal Tube Immediately after Tracheal Intubation Using a Channeled Videolaryngoscope (Pentax Airway Scope). Case Rep Anesthesiol. 2020;2020.

8.Krishnakumar M, Goyal A, Sudhir V, Reddy KM. Intraoperative endotracheal tube cuff leak during cerebral aneurysm surgery-A hard row to hoe. Indian J Anaesth. 2019;63(7):590-2.

9.El-Orbany M, Salem MR. Endotracheal Tube Cuff Leaks: Causes, Consequences, and Management. Anesth Analg. 2013;117(2):428-34.

10.Rho EH, Long TR, Wass CT. Inadequate tidal volume: asymmetric endotracheal tube cuff inflation resulting in a massive persistent airway leak. Anesth Analg. 2003;97(6):1853.

11.Walmsley AJ, Burville LM, Davis TP. Cuff failure in polyvinyl chloride tracheal tubes sprayed with lignocaine. Anaesthesia. 1988;43(5):399-401.

12.Eftekhari J, Kazemi Haki B, Tizro P, Alizadeh V. A Comparison to Facilitate Insertion of the Laryngeal Mask: Term of Recovery and Postoperative Nausea and Vomiting after Anesthesia with Propofol-Atracurium and Thiopental-Atracurium. Acta Med Iran. 2015;53(2):117-21.

13.Kazemi Haki B, Golabi P, Lebadi S, Kalashipor F, Hamze S, Goljabini S, et al. Characterization and Identification of Mistakes and Errors Made by Clinic Staffs During Cardio Pulmonary Resuscitation. Jentashapir J Health Res. 2018;9(4): e67162.

14.Kazemi Haki B, Moaddab SR, Rafii MR, Eftekhari M, Lebadi S, Ghorbaniyan N, et al. The Effect of Sodium Selenite on the Acute Phase Protein Response and Plasma Variables in Patients Admitted in ICU. Jentashapir J Health Res. 2017;9(2):e65647.

15.Kazemi Haki B, Eftekhari J, Alizadeh V, Tizro P. Comparison of hemodynamic stability, bleeding, and vomiting in propofol-remifentanil and isoflurane-remifentanil techniques in septorhinoplasty surgery. Jentashapir J Health Res. 2014;5(3):e94125.