

Intraoperative Repair of Pilot Balloon Inflation Line Damage: A Practical Solution to Tube Replacement

Hacı Yusuf Güneş¹, Aslan Aydın¹

¹Van Yüzüncü Yıl University, Faculty of Medicine, Department of Anesthesiology and Reanimation, Van, Türkiye

Abstract

Intraoperative damage to the pilot balloon inflation line of an endotracheal tube (ETT) can result in cuff deflation, leading to ineffective ventilation and increased aspiration risk. This case report describes a practical repair technique that allowed continued safe ventilation without tube replacement. A 70-year-old woman underwent elective coronary artery bypass grafting. During central venous catheter placement, the anesthesia machine displayed low etCO₂ and ventilator failure alarms. Diminished bilateral breath sounds were noted, and the pilot balloon was found severed. As the patient's hemodynamics remained stable, a 20G intravenous catheter steel needle tip was inserted directly into the inflation line, carefully positioned to avoid further damage. The cuff was reinflated using a syringe, and appropriate pressure was maintained with a three-way stopcock and cuff manometer. The air leak resolved, and surgery proceeded without requiring tube exchange. Pilot balloon damage can be safely managed intraoperatively using readily available equipment. This practical approach may serve as a valuable alternative to endotracheal tube replacement, especially in cases involving a difficult airway. Familiarity with such repair methods can enhance airway safety during surgery.

Key words: Airway management; cut pilot balloon; cuff inflation line repair; endotracheal tube; intraoperative complication.

Introduction

Endotracheal tubes (ETTs) are transparent, flexible, hollow tubes designed to secure the airway and facilitate mechanical ventilation. Cuffed ETTs include an inflatable cuff, a pilot balloon with a valve, and an inflation line. When the cuff is inflated, it seals the gap between the tube and the tracheal wall, thereby preventing air leakage. The structural integrity of the pilot balloon is critical to maintaining effective and continuous ventilation, preventing aspiration, and ensuring patient safety. Therefore, the ETT system must be thoroughly checked before use¹⁻³. Any damage to the cuff, valve, pilot balloon, or inflation line can result in air leakage. Such damage may occur intraoperatively due to unintentional contact with surgical instruments, excessive traction, thermal injury, or manufacturing defects. Depending on the type of injury, the cuff pressure may drop or the cuff may fully deflate, leading to ineffective ventilation and increased aspiration risk. In such cases, urgent replacement of the endotracheal tube may be required, which could increase morbidity risk, especially in patients with difficult airways⁴⁻⁶. In this case report, we present the intraoperative management of a cut pilot balloon detected

through ventilator alarms such as “Low etCO₂,” “Bellows not moving,” and “Refill the bellows.”

Case Presentation

A 70-year-old woman (165 cm, 70 kg) with known coronary artery disease was scheduled for coronary artery bypass grafting. Her medical history included diabetes mellitus and coronary stenting of the left main coronary artery performed 9 years earlier. Preoperative echocardiography revealed an ejection fraction of 45% with mildly reduced left ventricular systolic function. Laboratory parameters were within normal limits. Standard ASA monitoring was conducted, including invasive arterial blood pressure and central venous catheterization. Vital signs were stable. General anesthesia was induced using midazolam, lidocaine, propofol, fentanyl, and rocuronium. Endotracheal intubation was performed uneventfully with a 7.5-mm transparent, cuffed ETT (Tuoren, China). The cuff was inflated to an appropriate pressure and the tube was secured safely with a neckband. During ultrasound-guided central venous catheterization of the right internal jugular vein, the anesthesia machine issued alarms, including “Low etCO₂,” “Bellows not moving,” and “Refill

*Corresponding Author: Hacı Yusuf Güneş Department of Anesthesiology and Reanimation, Faculty of Medicine, Van Yüzüncü Yıl University, Tuşba, Van, Türkiye email: hyusufgunes@hotmail.com **Orcid:** Hacı Yusuf Güneş [0000-0003-3594-0345](https://orcid.org/0000-0003-3594-0345), Aslan Aydın [0009-0004-8409-7192](https://orcid.org/0009-0004-8409-7192)



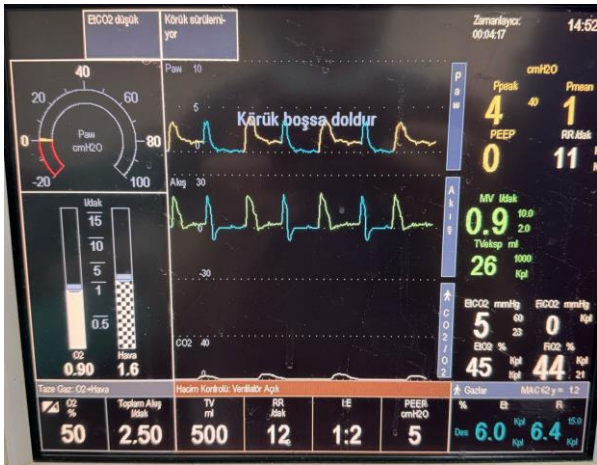


Figure 1: Anesthesia machine screen showing “Low etCO₂,” “Bellows not moving,” and “Refill the bellows” alarms.



Figure 2: Reinflation of the cuff using a 20G IV angiocatheter needle inserted into the severed pilot balloon inflation tube.

the bellows” (Figure 1). The anesthesia system was checked, but no equipment-related malfunction was identified. On auscultation, diminished breath sounds were noted bilaterally. Inspection of the ETT revealed a severed inflation line of the pilot balloon. During the intraoperative period, the patient's vital signs remained stable. Instead of replacing the endotracheal tube (ETT), an alternative approach was adopted to manage the ruptured pilot balloon. A 20G intravenous angiocatheter was inserted into the remaining

inflation line of the balloon. During the first attempt, the plastic cannula over the steel needle became bent during insertion. On the second attempt, the plastic cannula was removed, and the steel needle tip was inserted directly into the inflation line, carefully positioned to avoid further damage. Because the steel needle has a lumen, the pilot balloon was successfully reinflated using a syringe (Figure 2), which resolved the ventilator alarms. A three-way stopcock and a cuff pressure manometer were subsequently connected to the system, allowing for continuous monitoring and adjustment of cuff pressure. The stopcock was closed to prevent air leakage. Central venous catheterization was completed without complication. The surgical procedure lasted approximately three hours. The patient was transferred to the cardiovascular intensive care unit (ICU) while still intubated. The ICU team was informed about the pilot balloon repair and instructed on the management of the modified system. The patient was extubated eight hours postoperatively and transferred to the surgical ward on postoperative day two.

Discussion

Although pilot balloon line damage is rarely encountered intraoperatively, it can result in significant ventilation problems. Deflation of the cuff may lead to air leakage, inadequate ventilation, and increased risk of aspiration. Endotracheal tube replacement in such cases increases patient exposure to risks associated with repeat laryngoscopy and intubation. In patients with a difficult airway, tube exchange can be especially hazardous. Various temporary repair techniques have been described in the literature. Wang et al. (2022) reported a successful repair using a 22G intravenous angiocatheter connected to a Y-extension set, allowing for safe ventilation without the need for ETT replacement.⁷ Similarly, Hao et al. utilized a 22G angiocatheter and a stopcock valve to repair the pilot balloon inflation line and completed the surgery without complications.⁸ In the present case, a 20G angiocatheter needle, syringe, and three-way stopcock were used to repair the severed inflation line of the pilot balloon. This setup enabled reinflation and maintenance of appropriate cuff pressure (25–30 cmH₂O) using a manometer. Air leakage was controlled successfully, and ventilation remained stable. The 20G intravenous angiocatheter needle was found to be easy to insert; however, to our knowledge, this technique has not been previously reported for repairing a ruptured pilot balloon. This technique provided a

practical and effective airway-saving alternative to ETT replacement in a hemodynamically stable patient. Moreover, both the needle and plastic cannula components of 20G and 22G intravenous angi catheters proved effective in the repair of inflation line damage (Figures 3–5).

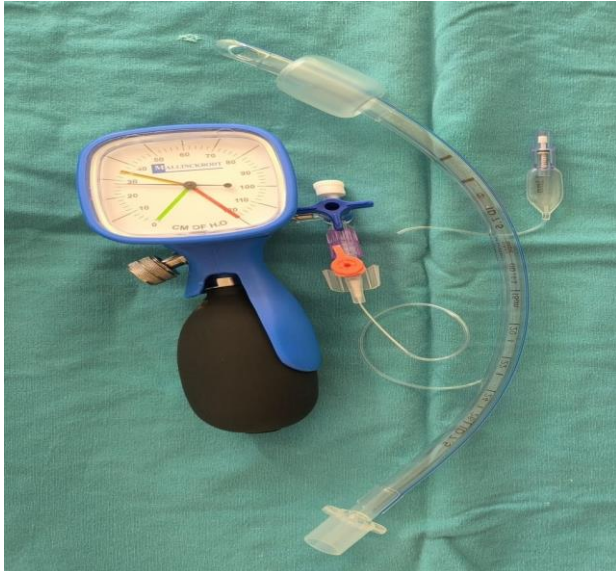


Figure 3: Controlled reinflation of the cuff using a cuff pressure manometer, three-way stopcock, and 20G/22G IV angi catheter (needle or plastic cannula) in various configurations.

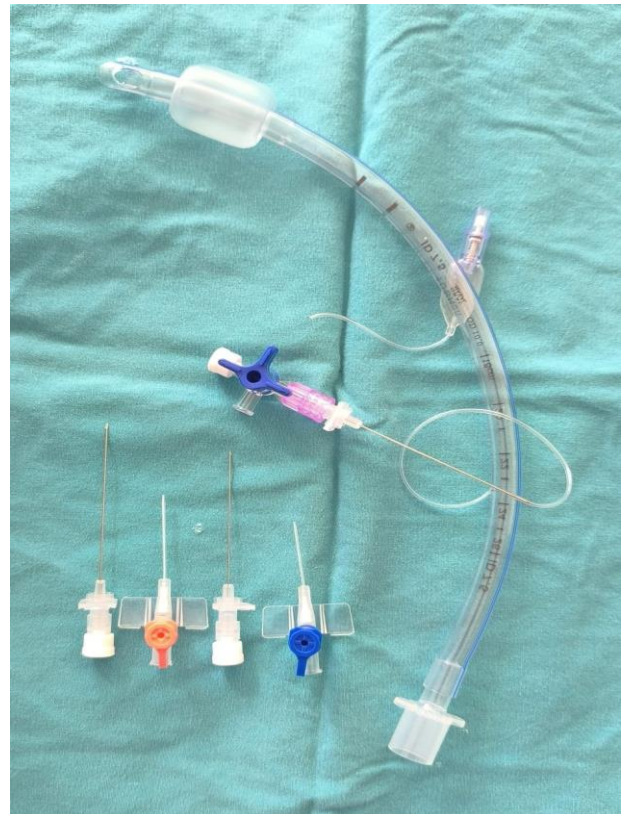


Figure 5: Controlled reinflation of the cuff using a cuff pressure manometer, three-way stopcock, and 20G/22G IV angi catheter (needle or plastic cannula) in various configurations.



Figure 4: Controlled reinflation of the cuff using a cuff pressure manometer, three-way stopcock, and 20G/22G IV angi catheter (needle or plastic cannula) in various configurations.

Conclusion

Pilot balloon damage can be safely managed intraoperatively using readily available equipment. This practical approach may serve as a valuable alternative to endotracheal tube replacement, especially in cases involving a difficult airway. Familiarity with such repair methods can enhance airway safety during surgery.

Authors: H.Y.G, A.A

Ethics approval and consent: Written informed consent was obtained from the patient for publication of this case and related images.

Conflict of interest: The authors declare no conflicts of interest.

Funding: This research received no external funding.

Author contributions: Concept – H.Y.G.; Design – H.Y.G., A.A.; Supervision – A.A.; Data Collection – H.Y.G.; Literature Review – H.Y.G.; Manuscript Writing – H.Y.G.; Critical Review – H.Y.G.; A.A.

References

1. Sharma L, Chauhan RS, Goyal S, Paliwal B, Sharma A. Intra-operative cuff leak-an anaesthetist's dilemma. *Turk J Anaesthesiol Reanim* 2021;49(3):261-262.
2. Balakrishnan M, Kuriakose R. Endotracheal tube damage during head and neck surgeries as a result of harmonic scalpel use. *Anesthesiology* 2005;102(4):870–871.
3. Gupta N. Endotracheal tube leak: What should we do? *J Anaesthesiol Clin Pharmacol* 2015;31(4):459.
4. Epstein RH, Dexter F. Structural integrity of a simple method to repair disrupted tracheal tube pilot balloon assemblies. *Anesth Analg* 2016;123(5):1287–1290.
5. Kaur H, Kumar A. Damaged cuff inflation line: Modified technique of repair. *J Anaesthesiol Clin Pharmacol* 2013;29(2):260–261.
6. Owusu-Bediako K, Turner III H, Syed O, Tobias J. Options for intraoperative repair of a cut pilot balloon on the endotracheal tube. *Med Devices (Auckl)* 2021; 14:265–269.
7. Wang TT, Wang J, Sun TT, Hou YT, Lu Y, Chen SG. Perianesthesia emergency repair of a cut endotracheal tube's inflatable tube: A case report. *World J Clin Cases* 2022;10(14):4594–4600.
8. Hao D, Johnson JJ, Patel SS, Liu CA. Technique to manage intraoperative cuff leak from damaged endotracheal tube pilot balloon. *Int J Oral Maxillofac Surg* 2021;50(12):1588–1590.