Medicine®

CLINICAL CASE REPORT

OPEN

Identifying and Managing a Malpositioned Endotracheal Tube Bite Block in an Orotracheally Intubated Patient

A Case Report

Hui-Ling Chou, RRT, Sheng-Yuan Ruan, MD, and Huey-Dong Wu, MD

Abstract: The universal bite block is increasingly used in orotracheally intubated patients. Here, we report a case of pilot tube dysfunction caused by a malpositioned universal bite block in an orotracheally intubated patient. We summarize the key points on identifying and managing a malpositioned universal bite block from this case and literature review.

A 74-year-old woman was emergently intubated during an episode of hyperkalemia-related cardiac arrest. A universal bite block was used for fixing the endotracheal tube. After her condition stabilized, ventilator weaning was attempted; however, a positive cuff-leak test result was observed.

The cuff-leak test revealed a lack of elasticity of the pilot balloon, which was completely deflated after 2 mL of air was removed. Pilot tube dysfunction was highly suspected. The bite block was slightly pulled out, and 8 mL of air was aspirated from the pilot tube. The patient was successfully extubated without stridor and respiratory distress.

Our case highlighted that a malpositioned bite block may obstruct the pilot tube, causing unfavorable consequences. While fixing the bite block on an endotracheal tube, it is crucial to ensure that the takeoff point of the pilot tube is located within the C-notch of the bite block.

(*Medicine* 95(12):e3161)

Abbreviations: ICU = intensive care unit.

INTRODUCTION

Cuffed endotracheal tubes prevent hazardous aspiration from the oropharynx and gas leak from positive pressure ventilation in mechanically ventilated patients. Regularly monitoring the cuff pressure to maintain a pressure of 20 to 30 cm H_2O is crucial for patient care.[1] However, the pressure measured from the pilot balloon may not be equivalent to the actual cuff pressure.[2] In orotracheally intubated patients, a bite block is generally required for avoiding tube biting and for more effectively fixing the endotracheal tube.[3] Three types of bite blocks, namely the oral bite block, universal bite block, and endotracheal tube holder with an integrated bite block, are commonly used in clinical practice. The universal bite block has an advantage over the oral bite block because it exerts less pressure on the tongue, palate, and lip.[4] However, the space relationship between the universal bite block and pilot tube causes universal bite block malpositioning, resulting in pilot tube dysfunction. Here, we report a case of acute respiratory failure in which the cuff-leak test yielded a positive result during ventilator weaning. The test subsequently yielded a false-positive result because of bite block-related pilot tube obstruction. Although the universal bite block is increasingly used in clinical practice, the method for detecting and preventing its malpositioning has not been well addressed. This report summarizes the key points on the development of bite block-related pilot tube obstruction and discusses the prevention and early detection of this complication. Ethical approval and patient consent were not necessary for this report because this is a retrospective case report and no information or image might identify the patient.

CASE REPORT

A 74-year-old woman with a history of breast cancer surgery and valvular heart disease presented to the hospital because of poor appetite, oliguria, and generalized edema. She was intubated with a 7.0-mm, cuffed endotracheal tube (Mallinckrodt/Covidien, Nakompathom, Thailand) in the emergency department because of hyperkalemia-related cardiac arrest. Spontaneous circulation returned after 6 minutes of cardiopulmonary resuscitation. A universal bite block (Pacific Hospital Supply Co., Ltd, Taiwan) was used for fixing the endotracheal tube (Figure 1). The patient was then admitted to the intensive care unit (ICU) for further treatment.

After the medical condition of the patient stabilized in the ICU, ventilator weaning was initiated. On the third ventilator day, the patient passed a spontaneous breathing trial with a T-piece. A cuff-leak test was conducted on volume control ventilation before the extubation attempt. The settings of the test were as follows: tidal volume set 600 mL; post-deflation tidal volume 600 mL; air leakage 0 mL (0%); predeflation airway pressure 30 cm H_2O; and postdeflation airway pressure, 30 cm H_2O. The patient had no cough after cuff deflation, suggesting a positive cuff-leak test result. In our hospital, a positive cuff-leak test is defined as a leak <110 mL or $<15\%$ of tidal volume or absence of cough.[5] However, although the endotracheal tube cuff was deflated, the pilot balloon was completely deflated after 2 mL of air was removed. Although the cuff was reinflated, only 2 mL of air could be added. The pilot balloon exhibited a lack of elasticity. A detailed patient examination revealed that the endotracheal tube cuff pressure was 25 cm H_2O, and the pilot tube was not twisted. However, the takeoff point of the pilot tube was not visible (Figure 1). To ensure that the bite block did not compress the pilot tube or takeoff point, it was

Editor: Bernhard Schaller.
Received: December 15, 2015; revised: February 21, 2016; accepted: February 22, 2016.
From the Department of Integrated Diagnostic and Therapeutics (HLC and HDW); and Department of Internal Medicine, National Taiwan University Hospital, Taipei, Taiwan (SYR and HDW).
Correspondence: Huey-Dong Wu, Department of Internal Medicine, National Taiwan University Hospital, No. 7, Chung-Shan South Rd, Taipei 10002, Taiwan (e-mail: hdwu@ntuh.gov.tw).
The authors have no funding and conflicts of interest to disclose.

ISSN: 0025-7974
DOI: 10.1097/MD.0000000000003161

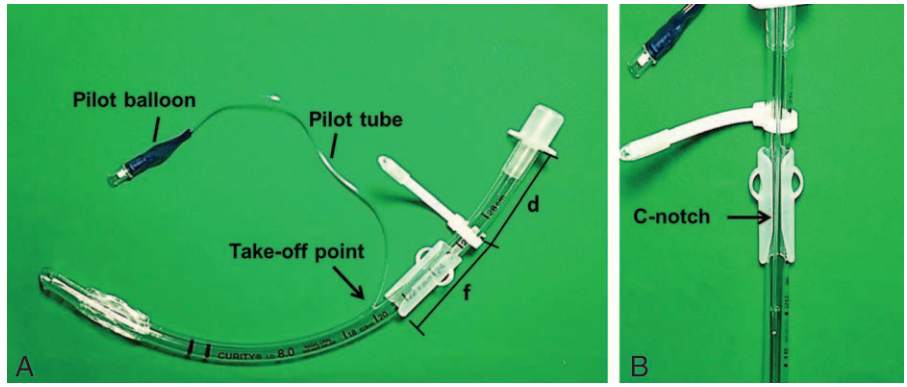

FIGURE 1. (A) Design of the endotracheal tube and universal bite block. (B) The takeoff point of the pilot tube should be kept within the C-notch of the universal bite block.

slightly pulled out. Furthermore, 8 mL of air was aspirated from the pilot tube after adjustment of the bite block position, and the patient was successfully extubated without stridor and respiratory distress. The cuff and pilot tube were re-examined after the endotracheal tube was removed from the patient, and they showed normal functioning. Pilot tube kinking because of the compression by the endotracheal tube bite block was considered to cause the pilot tube dysfunction in this case (Figure 2).

DISCUSSION

This case report addressed a crucial but possibly underreported complication associated with the use of the endotracheal tube universal bite block. The universal bite block compressed the takeoff point of the pilot tube on an endotracheal tube and obstructed the tube (Figure 2); this obstruction subsequently complicated deflating the cuff of the endotracheal tube and resulted in a false-positive cuff-leak test result. If pilot tube dysfunction is not detected, endotracheal tube removal might be difficult and may injure the airway during extubation. This report highlighted the importance of evaluating the position of the universal bite block, of which malpositioning is possibly a differential diagnosis for a false-positive cuff-leak test result.

An appropriately positioned universal bite block on an endotracheal tube ensures that the takeoff point of the pilot tube is within the C-notch of the bite block (Figure 1B). However, it is not easy to identify the relative position between the bite block and takeoff point of the pilot tube when an endotracheal tube is placed in the airway because the takeoff point of the pilot tube may be located in the dark oropharyngeal cavity. During emergent intubation, the position of the bite block is more likely to be overlooked than it is during elective intubation because of multiple tasks required in limited time. Therefore, it is likely that a universal bite block is not appropriately fixed by health care professionals unfamiliar with its use. Another approach for preventing the complications of a malpositioned bite block is the early identification of pilot tube dysfunction and assessment of the accuracy of bite block positioning during postintubation care.

A small amount of air (<2 mL) being required for deflating the pilot balloon is a crucial indicator of pilot tube obstruction.[2] The lack of elasticity of the pilot balloon can be observed simultaneously after cuff inflation. When pilot tube obstruction

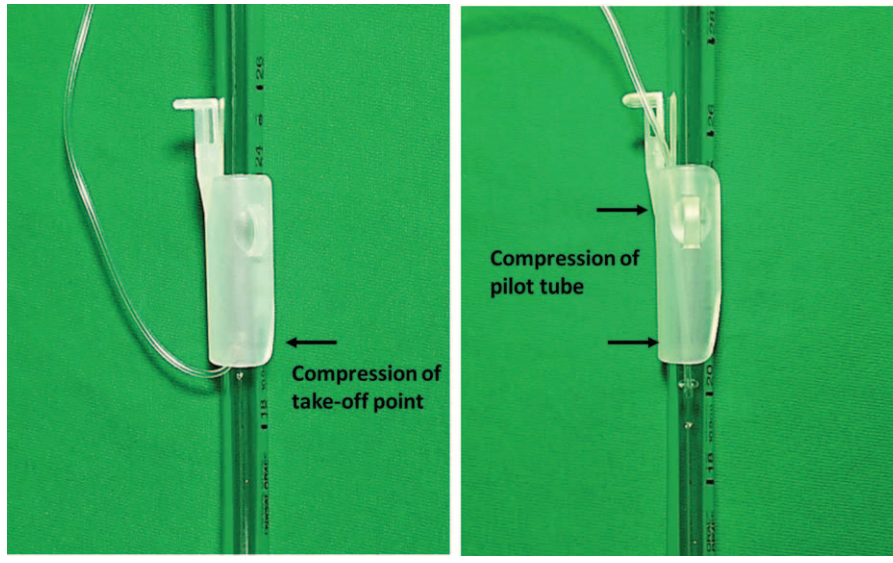

FIGURE 2. Simulated conditions of a malpositioned bite block causing pilot tube kinking.

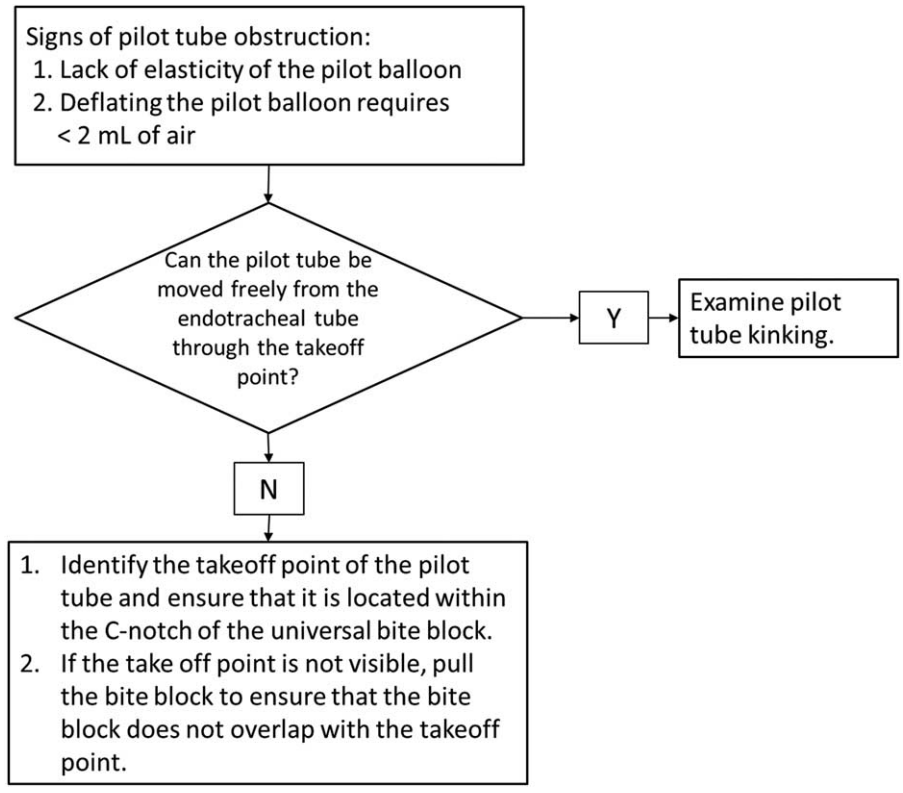

FIGURE 3. Algorithm proposed for evaluating and managing pilot tube obstruction in case of an appropriately placed universal bite block.

is suspected, the pilot tube should be inspected to ensure that it freely moves from the endotracheal tube without obstruction through the takeoff point level because the pilot tube and its wall should be smooth without kinking. Moreover, the takeoff point of the tube should be examined to ensure that it is located within the C-notch of the universal bite block. If the takeoff point is not visible, its relative position to the bite block should be further assessed. Because the takeoff point of a pilot tube on an endotracheal tube varies with the size and brand of the tube,[2] a same-sized endotracheal tube can be used for simulating the relative position between the bite block and takeoff point of the pilot tube. The range covered by a universal bite block can be estimated by summing its fixation depth (Figure 1A, labeled d) and length (Figure 1A, labeled f). Furthermore, the location of the takeoff point of the pilot tube and the range covered by the bite block should be compared. If the bite block overlaps with the takeoff point of the pilot tube, the takeoff point must be visibly located within the C-notch of the bite block or the bite block should be pulled out to prevent compression of the takeoff point. Figure 3 presents an algorithm proposed for evaluating and managing pilot tube obstruction based on the present case and review of relevant literature.[2,6–9]

A cuff-leak test is a common procedure used to screen the occurrence of airway obstruction before extubation. However, the specificity and sensitivity of a cuff-leak test varied largely in previous studies.[10,11] In the case with absence of cough during a cuff-leak test, the sensitivity and specificity for postextubation stridor was 0.75 and 0.79 respectively.[12] It is worth noting that there are many confounding factors, which may influence the performance of a cuff-leak test.[10,11] Previous data suggested that the quantitative cuff leak test was an indicator of risk for postextubation stridor, rather than an instrument to preclude the extubation attempt.[10]

CONCLUSION

The present case reveals that a malpositioned universal bite block may obstruct the pilot tube, causing unfavorable consequences. The reasons for the development of such a complication and a procedure for evaluating pilot tube obstruction are described according to the experience in this case and relevant literature review. It is crucial to ensure that the takeoff point of the pilot tube is located within the C-notch of the bite block when fixing a universal bite block on an endotracheal tube.

REFERENCES

1. Sole ML, Su X, Talbert S, et al. Evaluation of an intervention to maintain endotracheal tube cuff pressure within therapeutic range. *Am J Crit Care.* 2011;20:109–118.
2. Adams JR, Hoffman J, Lavelle J, et al. Pilot balloon malfunction caused by endotracheal tube bite blockers. *Respir Care.* 2014;59:e22–e24.
3. Deutsch JM. Endotracheal tube care. In: Karen K, ed. *AACN procedure manual for critical care.* Fourth Edition Elsevier Health Sciences; 2001:17–19.
4. Zaratkiewicz S, Teegardin C, Whitney JD, et al. Retrospective review of the reduction of oral pressure ulcers in mechanically ventilated patients: a change in practice. *Crit Care Nurs Q.* 2012;35:247–254.
5. Wittekamp BH, van Mook WN, Tjan DH, et al. Clinical review: post-extubation laryngeal edema and extubation failure in critically ill adult patients. *Crit Care.* 2009;13:233.

6. Alkire MT. Ventilatory compromise secondary to occlusion of anendotracheal tube's balloon air channel by a malpositioned bite block. *Anesthesiology.* 1998;88:1419.
7. Brock-Utne AJ. The universal bite-block: A word of caution. *Anesth Analg*. 2006;103:495–496.
8. Gleich SJ, Mauermann WJ, Torres NE. Torres. An unusual cause of a difficult extubation. *Respir Care.* 2008;53:376.
9. Singh M, Rautela RS, Kumar S. Laryngeal Tube® pilot balloon kinking in the presence of a bite block. *Can J Anaesth.* 2009;56:880–881.
10. De Bast Y, De Backer D, Moraine JJ, et al. The cuff leak test to predict failure of tracheal extubation for laryngeal edema. *Intensive Care Med.* 2002;28:1267–1272.
11. Jaber S, Chanques G, Matecki S, et al. Postextubation stridor in intensive care unit patients. Risk factors evaluation and importance of the cuff-leak test. *Intensive Care Med.* 2003;29:69–74.
12. Maury E, Guglielminotti J, Alzieu M, et al. How to identify patients with no risk for postextubation stridor. *J Crit Care.* 2004;19:23–28.