A Case of Bilateral Tension Pneumothorax after the Successful CO₂ Laser-assisted Removal of a Bronchial Foreign Body in a Child

In Kwon Mun
Yeo Rim Ju
Sang Joon Lee
Seung Hoon Woo

Department of Otolaryngology-Head and Neck surgery, Dankook University College of Medicine, Cheonan, Korea

Bronchial foreign body aspiration (BFA) is a common but emergent condition in infants and children. Furthermore, it can result in various complications such as atelectasis, pneumonia, bronchiectasis, and pneumothorax. Among these, pneumothorax is a very rare complication. However, it can be fatal without the swift implementation of appropriate treatment. We experienced a case of 16-month-old girl with an aspirated peanut. The foreign body was fixed in her left main bronchus. A CO₂ laser was used to safely cut and break the foreign body. Removal was successful after breaking it. But after the process, inflammatory tissue of the tracheal mucosa was ruptured. Bilateral tension pneumothorax followed after the rupture. The patient was treated with bilateral chest tube insertion. Here we present this BFA case with a rare and unexpected complication. We also review the appropriate literature.

Key words

Foreign body; Tension pneumothorax; Chest tubes; CO₂ laser

Received April 26, 2020

Accepted May 7, 2020

Correspondence

Seung Hoon Woo
Department of Otolaryngology-Head and Neck surgery, Dankook University College of Medicine, 201 Manghyang-ro, Dongnam-gu, Cheonan 31116, Korea
Tel.: +82-41-550-1781
Fax: +82-41-550-7837
E-mail: lesaby@hanmail.net

© Korean Society for Laser Medicine and Surgery

© This is an open access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Bronchial foreign body aspiration (BFA) is a common condition between the ages of 0 to 3 years old. Also, it is an emergent condition with up to 7% mortality rate.^{1,2} Nuts and food material are common causes of BFA, and these organic materials may cause localized inflammation and edema, resulting in partial or complete closure of the bronchus.³ In adults, BFA usually occurs in the right main bronchus, whereas in children, the incidence rate of the BFA is not different according to the side.⁴

Although persistent choking cough is the most common symptom of BFA, this diagnosis should also be considered in the presence of dyspnea, chronic cough, or recurring pulmonary infection.² Diagnosis should be made promptly, because BFA can result in various complications, such as atelectasis, pneumonia, and pneumothorax. However, pneumothorax is very rare in this setting as it occurs in only 1.5% cases of BFA.⁵ We experienced a case of bilateral tension pneumothorax after foreign body removal from the left main bronchus of a 16-month-old girl. Tension pneumothorax is one of the most fatal conditions. Therefore, even though its incidence rate is very low, a better understanding of this condition is needed. Accordingly, we present this case with a review of the literature.

CASE

A 16-month-old girl was admitted to our emergency room with fever that had occurred the same day. Physical examination, history taking, and simple chest X-ray were performed at a different hospital. After evaluation, the patient was transferred to our emergency room under the impression of a left bronchial foreign body.

She had an episode of choking on peanuts 4 days prior to the admission, and her parents stated that wheezing breath sounds had been heard since that event. Physical examination showed decreased lung sound on the left side. A simple chest X-ray revealed a right-side deviation of the mediastinum and hyperinflation of the left thorax (Fig. 1). Although a foreign body could not be identified on the simple X-ray, a computed tomography (CT) scan showed a foreign body located in the left main bronchus, 2-3 cm below the carina, with accompanying atelectasis of the left lower lobe (Fig. 2A, 2B).

We planned surgical removal of the foreign body using a flexible bronchoscope and bronchoscopic forceps. We used flexible bronchoscope because the patient was too young to find compatible size of available rigid broncho-

Fig. 1. Simple chest X-ray, AP, left hyperinflated thorax, and mediastinum deviated to the right side.

Fig. 2. Enhanced chest CT. (A) Coronal view and (B) axial view of the foreign body in the left main bronchus 2-3 cm below the carina (white arrow).

scope. The bronchoscope (external diameter, 3.5 mm; diameter of the working channel, 1.2 mm) could not be inserted through the pediatric endotracheal tube (inner diameter, 3.5 mm, uncuffed). Therefore, the apnea technique was used.⁶ A white foreign body, which is fixed in the left main bronchus, was identified. We tried to remove it with grasping forceps, but it was completely stuck with surrounding swollen mucosa. To remove it, we decided to cut it in half with CO₂ laser (FiberLase; Lumenis Ltd., Santa Clara, CA, USA). To avoid heating injury, surrounding mucosa was covered with saline soaked cotton. Ventilation was stopped temporarily, the foreign body was cut in half by CO₂ laser and both fragments were successfully removed with grasping forceps.

An inflammatory mucosal swelling in the bronchus wall (Fig. 3A, 3B) ruptured after the removal with a small amount of bleeding, followed by bronchial wall collapse. The patient's heart rate dropped to 38 beats/min, and her oxygen saturation decreased. She was re-intubated and oxygen was administered; however, her oxygen saturation did not recover. The patient was then switched to manual ventilation using an AMBU bag, and atropine and epinephrine were administered. Immediately obtained chest X-ray showed the presence of bilateral tension pneumothorax. Therefore, chest tubes were inserted bilaterally

(Fig. 4). Her oxygen saturation then recovered and heart rate returned to normal. The patient was moved to intensive care unit. Three days postoperatively, the patient's vital signs had stabilized, and the chest tubes were removed. Chest X-ray showed no specific findings, and she was discharged on the seventh postoperative day. One month after discharge, the patient's follow-up examination showed no other complications.

DISCUSSION

BFA is common in children due to three main reasons: (1) insufficient chewing due to lack of complete tooth development; (2) laughing and running around during eating, with insufficient swallowing mechanism; and (3) curiosity and carelessness.⁷

The first symptoms of BFA include coughing, retching, wheezing, difficulty breathing, cyanosis, hoarse voice, and salivating. In cases of partial obstruction, inspiratory stridor, salivation, and voice changes may be apparent.

Chest X-ray should be performed in all suspected cases of bronchial foreign body, even if the patient shows no specific symptoms. The foreign body itself can be identified in only 8%-10% cases on simple chest X-ray. However, if signs such as hyperinflated thorax, decreased lung

Fig. 3. The foreign body was a whitish food material that partially obstructed the left main bronchus (A), Inflammatory mucosal swelling of the bronchus wall, which was caused by the foreign body (black arrow in A, B) ruptured after its removal (C, D). Bleeding occurred and the lung collapsed shortly after the removal of the foreign body.

Fig. 4. Chest tube insertion. (A) Simple chest X-ray, chest AP, both chest tubes are inserted (black arrow) (B) Patient with both chest tubes inserted.

volume, obstructive emphysema, atelectasis, infiltration, or pneumothorax are observed on simple chest X-ray, bronchial foreign body can be suspected. However, chest X-ray may seem normal in up to 30% cases of BFA.⁸ Also it has a limited sensitivity of 68% and a specificity of 67% for diagnosing BFA.

Therefore, chest CT might be needed for a more accurate diagnosis, not only in BFA cases but also in esophageal foreign body cases.⁹ This imaging modality has a sensitivity of 99.83% and a specificity of 99.89% for diagnosing BFA. Moreover, chest CT can provide additional information such as shape, site and complications of the foreign body.¹⁰ If the presence of BFA remains uncertain even after CT and chest X-ray, the diagnosis can be established using a flexible bronchoscope before performing explorative surgery using a rigid bronchoscope.¹¹

The standard technique for bronchial foreign body removal in children is using a rigid bronchoscope.¹² However, in the absence of a compatible rigid bronchoscope or if the foreign body is located in the peripheral bronchus, a flexible bronchoscope can be used.¹³ In rare cases (0.3%-0.4%), foreign body removal via tracheotomy might be necessary.^{14,15} In case of esophageal foreign body, transnasal flexible esophagoscope has become more popular. Like this, the use of a flexible bronchoscope might become more popular.^{16,17} If the foreign body is an organic material, there is a possibility that it might break during removal. Thus, if there is any suspicion that a fragment of the foreign body left after the removal procedure, postoperative CT is strongly recommended.¹⁸

Atelectasis, pneumonia, bronchiectasis, cardiopulmonary arrest, vocal cord paralysis, and bronchial granuloma are complications that can be caused by the foreign

body itself. Among these, pneumonia and granuloma are the two leading complications.^{19,20} The potential complications of endoscopic manipulation include hemorrhage, pneumomediastinum (which is self-limited in most cases),²¹ subcutaneous emphysema, and bronchial perforation. Furthermore, there may be laryngospasm and bronchospasm caused by the stimulation of the bronchial or laryngeal walls, although these are not common in procedures performed under general anesthesia. About half of patients with BFA visit a hospital over 72 hours after the aspiration episode.^{10,22} In such cases, inflammatory changes may already present at the time of arrival, as in the case reported here. If an inflammatory lesion is observed around the foreign body, tracheal cartilage may be weakened. Thus, the removal procedure should be performed with utmost care to prevent tracheal wall damage.

The complexity of BFA can easily be underestimated, and the treating physician might not be prepared for the rare complications associated with it. However, BFA can result in unexpected and fatal complications. Therefore, the attending physicians should understand the condition and be prepared for the possible complications in order to provide a prompt response.

We believe that multiple factors led to bilateral pneumothorax in the present case. First, regarding the left side, we think that this condition might have been caused by the rupture of a mucosal swelling. The cartilage wall under the mucosa might have weakened, with progression of inflammation, leading to perforation after the rupture. Regarding the right side, manual ventilation, which was performed to relieve the desaturation caused by the left pneumothorax, may have caused barotrauma and led

to pneumothorax.

CO₂ laser is widely used in the field of otorhinolaryngology.²³⁻²⁸ However, there are not many reported cases of CO₂ laser-assisted foreign body removal. In this present case, we achieved successful removal of foreign body. There is some possibility that CO₂ laser might aggravate the mucosal injury. However, the ruptured mucosal swelling was identified even before the use of CO₂ laser, and did not show any deterioration after use. Also, heating injury of CO₂ laser was minimized with covered saline soaked gauze and stopping ventilation. In addition, rupture did not occur until the foreign body was completely removed. Thus, we believe the possibility of CO₂ laser induced mucosal injury would be low, and if there were some, it might not be a direct cause of the rupture.

In case of intractable bronchial foreign body, more invasive procedure can be avoided by using CO₂ laser. Therefore, CO₂ laser can be a useful tool in case of intractable bronchial foreign body.

REFERENCES

- Mantor PC, Tuggle DW, Tunell WP. An appropriate negative bronchoscopy rate in suspected foreign body aspiration. *Am J Surg* 1989;158:622-4.
- Steen KH, Zimmermann T. Tracheobronchial aspiration of foreign bodies in children: a study of 94 cases. *Laryngoscope* 1990;100:525-30.
- Zhijun C, Fugao Z, Niankai Z, Jingjing C. Therapeutic experience from 1428 patients with pediatric tracheobronchial foreign body. *J Pediatr Surg* 2008;43:718-21.
- Van Looij MA, Rood PP, Hoeve LJ, Borgstein JA. Aspirated foreign bodies in children: why are they more commonly found on the left? *Clin Otolaryngol Allied Sci* 2003;28:364-7.
- Altuntaş B, Aydin Y, Eroğlu A. Complications of tracheobronchial foreign bodies. *Turk J Med Sci* 2016;46:795-800.
- Woo SH, Park JJ, Kwon M, Ryu JS, Kim JP. Tracheobronchial foreign body removal in infants who had very small airways: a prospective clinical trial. *Clin Respir J* 2018;12:738-45.
- Altkorn R, Chen X, Milkovich S, Stool D, Rider G, Bailey CM, et al. Fatal and non-fatal food injuries among children (aged 0-14 years). *Int J Pediatr Otorhinolaryngol* 2008;72:1041-6.
- Grover S, Bansal A, Singhi SC. Airway foreign body aspiration. *Indian J Pediatr* 2011;78:1401-3.
- Woo SH, Kim KH. Proposal for methods of diagnosis of fish bone foreign body in the esophagus. *Laryngoscope* 2015;125:2472-5.
- Yang C, Hua R, Xu K, Hua X, Ma P, Zheng JN, et al. The role of 3D computed tomography (CT) imaging in the diagnosis of foreign body aspiration in children. *Eur Rev Med Pharmacol Sci* 2015;19:265-73.
- Na AS, Lim SC, Cho JS, Kim JH, Shin MS. Usefulness of flexible bronchoscopy in the diagnosis of tracheobronchial foreign bodies in children. *Korean J Otorhinolaryngol-Head Neck Surg* 2001;44:1103-6.
- Jang JY, Park JO, Ryu J, Jeong HS. Real-time video-assisted retrieval of airway foreign body in very young pediatric patients. *Clin Exp Otorhinolaryngol* 2014;7:329-33.
- Wood RE, Gauderer MW. Flexible fiberoptic bronchoscopy in the management of tracheobronchial foreign bodies in children: the value of a combined approach with open tube bronchoscopy. *J Pediatr Surg* 1984;19:693-8.
- Kim YD, Min MK, Chun JY, Song KW. A case of tracheal foreign body: removed by partial resection of trachea & permanent tracheostomy. *Korean J Otorhinolaryngol-Head Neck Surg* 1995;38:1481-4.
- Lim JH, Lee SY, Ryu YJ, Hah JH. A case of tracheal foreign body removed by endoscopic approach with tracheotomy. *Korean J Otorhinolaryngol-Head Neck Surg* 2014;57:723-6.
- Chung EJ, Rho YS, Jung KY, Kim JW, Lee SW. The role of transnasal esophagoscopy in ENT office: a prospective, multicenter study in Korea. *Clin Exp Otorhinolaryngol* 2014;7:123-5.
- Kim JP, Kwon OJ, Shim HS, Kim RB, Kim JH, Woo SH. Analysis of clinical feature and management of fish bone ingestion of upper gastrointestinal tract. *Clin Exp Otorhinolaryngol* 2015;8:261-7.
- Lee YW, Cho JH, Koo MB, Yeo CK. Accurate diagnosis with chest CT for bronchial foreign body removal in young patient: report of three cases and review of the literature. *Korean J Otorhinolaryngol-Head Neck Surg* 2014;57:850-3.
- Seo JW, Lee DK, Hong JC, Park HS. Two cases of pneumothorax and subcutaneous emphysema associated with removal of neglected tracheal foreign body. *Korean J Otorhinolaryngol-Head Neck Surg* 2015;58:44-7.
- Kwon OJ, Park JJ, Kim JP, Woo SH. Vocal cord paralysis caused by stingray. *Eur Arch Otorhinolaryngol* 2013;270:3191-4.
- Cho DY, Aaron GP, Shepard KG. Spontaneous retropharyngeal and mediastinal emphysema. *Clin Exp Otorhinolaryngol* 2016;9:178-81.
- Sehgal A, Singh V, Chandra J, Mathur NN. Foreign body aspiration. *Indian Pediatr* 2002;39:1006-10.
- Chu H, Kim DY. Use of lasers in the treatment of alopecia areata. *Med Lasers* 2016;5:71-6.
- Kim S, Park E, Nam S. Synergy effect of combination of fractional CO₂ and fractional Q-switched ruby laser treatment for skin rejuvenation. *Med Lasers* 2015;4:25-8.
- Cho SE, Kim JY, Nam SM, Park ES. Spot CO₂ laser revision of facial atrophic linear scars in Korea. *Med Lasers* 2014;3:22-6.
- Kim YK, Park ES, Cho SB. Double-eyelid blepharoplasty-induced scar treated with a 10,600-nm carbon dioxide fractional

laser. Med Lasers 2013;2:82-4.

27. Ahn KJ, Kang JS, Cho SB. Treatment of xanthelasma palpebrarum by the pinhole method using a 10,600-nm carbon dioxide laser. Med Lasers 2013;2:70-2.
28. Park S, Jung KY, Park MW, Hwang J, Lee SY, Baek SK. A single-arm, prospective study of laser-assisted marsupialization for epiglottic cysts in adults. Med Lasers 2013;2:64-6.

How to cite this article: Mun IK, Ju YR, Lee SJ, Woo SH. A case of bilateral tension pneumothorax after the successful co₂ laser-assisted removal of a bronchial foreign body in a child. Med Lasers 2020;9:65-70. <https://doi.org/10.25289/ML.2020.9.1.65>