



Flexible bronchoscopy: the first-choice method of removing foreign bodies from the airways of children

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DEAR EDITOR:

Foreign body aspiration into the airway is an important cause of death in children worldwide.^(1,2) Before the advent of bronchoscopy, the only treatment for that was palliative tracheostomy and the death rate was as high as 50%. The first bronchoscopy was performed by Gustav Killian in 1897 to extract an airway foreign body (AFB) from the trachea of a child (a pig bone). Since then, bronchoscopy has been extensively used for the evaluation and treatment of AFBs, reducing the mortality rate to less than 1%.⁽³⁾

The incidence of AFBs is higher in children aged 1-2 years, because of inherent developmental characteristics: immature coordination of swallowing, easiness of distraction, oral exploration, and incomplete dentition.⁽⁴⁾ The presentation and severity depend on the degree of airway obstruction—total or subtotal obstruction of the proximal airway may lead to life-threatening asphyxia. Prompt recognition is essential, because delayed diagnosis can lead to a chronic condition (e.g., recurrent pneumonias, lung abscess, bronchiectasis, pneumothorax, or asthma-like symptoms—cough, wheezing).⁽⁴⁾ The radiological findings are usually nonspecific or even absent, so, if there is a consistent clinical history, a bronchoscopic evaluation is needed.⁽⁵⁾

Bronchoscopic removal of AFBs in children is a complex and demanding procedure with a high potential for complications (e.g., hemoptysis, laryngeal/pulmonary edema, pneumonia, atelectasis, fever, respiratory failure, tracheoesophageal fistula, pneumothorax).⁽³⁾ Historically, rigid bronchoscopy has been the gold standard for the treatment of foreign body inhalation in children; however, flexible bronchoscopy (FB) has been increasingly used, and several authors have described FB as a diagnostic and therapeutic method for AFBs.⁽⁶⁻¹⁰⁾

Rigid bronchoscopy has some advantages—rigid bronchoscopes are larger in diameter, ensuring safe ventilation, and provide a better operative view, being useful in cases of massive bleeding or central airway obstruction by large or sharp foreign bodies—but it requires general anesthesia and is more invasive.^(5,8)

FB is more accessible, with greater availability of trained professionals, and relatively easier and safer to perform, requiring mostly only sedation and local anesthesia in older children and adolescents. When general anesthesia is opted for, FB allows ventilation in a closed system and the safe use of inhaled anesthetics. Another advantage is that FB is less traumatic to the airways, can reach

bronchi that are more distal, and can be used in patients with cervical, jaw, or skull fractures.⁽⁸⁾

We present our experience using therapeutic FB as the first-choice method of removing AFBs in children.

We performed a retrospective study of pediatric patients (under 18 years of age) who underwent bronchoscopy for AFB removal at the Respiratory Endoscopy Department of the University of São Paulo School of Medicine *Hospital das Clínicas* Heart Institute, located in the city of São Paulo, Brazil, between January of 2014 and June of 2020. We reviewed medical and bronchoscopy records and collected information about the equipment used, foreign body location/nature, age, sex, success rate, and complications.

All patients underwent FB to locate the AFB in the tracheobronchial tree, evaluate the degree of inflammation or supuration of the tracheobronchial mucosa, and choose the equipment that was necessary for therapeutic measures. Rigid bronchoscopy was available for immediate use in case of FB failure.

The procedures were performed in the operating room under sedation or general anesthesia. One percent lidocaine without a vasoconstrictor was used as a topical anesthetic on the airways, with the maximum dose being 4 mg/kg. All patients were monitored with oximetry, cardiac monitoring, and noninvasive arterial pressure measurement.

The following equipment was used: a flexible bronchoscope (Pentax FB-10X, Asahi Optical Co., Tokyo, Japan) with an external diameter of 3.2 mm and a working channel of 1.2 mm in children younger than 10 years of age; and a flexible bronchoscope (P30; Olympus BF, New Hyde Park, NY, USA) with an external diameter of 4.9 mm and a working channel of 2.0 mm in children 10 years of age or older. A rigid bronchoscope (Karl Storz GMBH, Tuttlingen, Germany) with an external diameter of 3.5 or 5.5 mm, a telescopic optical system, a suspension laryngoscope, or a combination of methods was used in specific cases when FB failed.

After the procedure, a complete reexamination of the tracheobronchial tree was carried out to exclude the presence of other AFBs, fragments of the removed AFB, or structural alterations. The patients were sent to the recovery room, being monitored and allowed to recover from anesthesia/sedation.

The project was approved by the institutional review board via the Brazilian Research Database, *Certificado*

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Table 1. Demographic data of the patients, location/nature of the airway foreign body, and procedure used.

Variable	Patient, n (%)
Male gender	22 (55)
Age, years	
< 1	1 (2.5)
1 to < 2	15 (37.5)
2 to < 3	5 (12.5)
3 to < 4	2 (5.0)
4 to < 5	2 (5.0)
5 to < 6	3 (7.5)
6 to < 7	2 (5.0)
7 to < 8	2 (5.0)
8 to < 9	1 (2.5)
9 to < 15	4 (10.0)
15 to < 18	3 (7.5)
Location of the airway foreign body	
Larynx	3 (7.5)
Trachea	7 (17.5)
Right main bronchus	14 (35.0)
Left main bronchus	12 (30.0)
Bronchus intermedius	3 (7.5)
Left lower lobe	1 (2.5)
Nature of the airway foreign body	
Organic	16 (40)
Inorganic	22 (55)
Unknown	2 (5)
Anesthesia	
General	36 (90)
Sedation	4 (10)
Procedure	
Flexible bronchoscopy	35 (87.5)
Rigid bronchoscopy	3 (7.5)
Flexible + rigid bronchoscopy	1 (2.5)
Laryngoscopy	1 (2.5)
Ancillary material	
Basket	19 (47.5)
Rat tooth forceps	14 (35.0)
Forceps	1 (2.5)
Rigid forceps	4 (10.0)
Unknown	2 (5.0)

de Apresentação para Apreciação Ética (CAAE, Presentation Certificate for Ethical Appreciation; no. 17877919.0.0000.006).

A total of 40 pediatric patients were treated, 22 (55%) of whom were boys. Children under 3 years of age accounted for 52.5% of cases, with a peak incidence occurring among those aged 1 year to less than 2 years (37.5% of cases; Table 1).

Thirty-five percent of the AFBs were lodged in the right main bronchus, 30% were lodged in the left main bronchus, and 17.5% were lodged in the trachea. The majority was inorganic (55%) and was removed by FB (87.5%) under general anesthesia (90%), using either a basket (47.5%) or rat tooth forceps (35%; Table 1).

The overall success rate of AFB removal was 100%. In 35 cases (87.5%), the AFB was removed using FB. In 3 cases (7.5%), there was a need for rigid bronchoscopy—in one of those cases, rigid bronchoscopy was the attending physician's first choice; in another, an unsuccessful attempt at removal by FB had been made at another institution; and, in the third case, there was a subglottic stenosis impeding the passage of the flexible bronchoscope. In 1 case (2.5%), both methods were used (Table 1).

Complications occurred in 3 cases (7.5%). One of them was a minor complication—right main bronchus laceration during removal. There were 2 cases of major complications: 1 of respiratory failure and 1 of cardiac arrest (both cases required orotracheal intubation). No deaths were reported.

Our study has some limitations: it is single center, retrospective, and small sample sized. We also did not have access to the clinical data collected on admission to the emergency room.

In conclusion, based on our series and on results from previous reports, we believe that rigid bronchoscopy is not mandatory in all cases of AFB and that FB can be the first therapeutic option. Some factors contribute to the success rate of FB with minimal complications: an experienced team and ready availability of equipment. Knowledge of the different bronchoscopic techniques minimizes therapeutic failures by facilitating the removal of unexpected objects, especially in infants.

CONFLICT OF INTEREST

None declared.

REFERENCES

1. França EB, Lansky S, Rego MAS, Malta DC, França JS, Teixeira R, et al. Leading causes of child mortality in Brazil, in 1990 and 2015: estimates from the Global Burden of Disease study. *Rev Bras Epidemiol.* 2017;20(Suppl 01(Suppl 01):46-60. <https://doi.org/10.1590/1980-5497201700050005>
2. Cheng J, Liu B, Farjat AE, Routh J. National estimations of airway foreign bodies in children in the United States, 2000 to 2009. *Clin Otolaryngol.* 2019;44(3):235-239. <https://doi.org/10.1111/coa.13261>
3. Rodrigues AJ, Oliveira EQ, Scordamaglio PR, Gregório MG, Jacomelli M, Figueiredo VR. Flexible bronchoscopy as the first-choice method of removing foreign bodies from the airways of adults. *J Bras Pneumol.* 2012;38(3):315-320. <https://doi.org/10.1590/S1806-37132012000300006>
4. Lowe DA, Vasquez R, Maniaci V. Foreign Body Aspiration in Children. *Clin Pediatric Emerg Med.* 2015;16(3):140-148. <https://doi.org/10.1016/j.cpem.2015.07.002>
5. Paşaoğlu I, Doğan R, Demircin M, Hatipoğlu A, Bozer AY. Bronchoscopic removal of foreign bodies in children: retrospective analysis of 822 cases. *Thorac Cardiovasc Surg.* 1991;39(2):95-98. <https://doi.org/10.1055/s-2007-1013940>
6. Cutrone C, Pedruzzi B, Tava G, Emanuelli E, Barion U, Fischetto D, et al. The complimentary role of diagnostic and therapeutic endoscopy

- in foreign body aspiration in children. *Int J Pediatr Otorhinolaryngol*. 2011;75(12):1481-1485. <https://doi.org/10.1016/j.ijporl.2011.08.014>
7. Swanson KL, Prakash UB, Midthun DE, Edell ES, Utz JP, McDougall JC, et al. Flexible bronchoscopic management of airway foreign bodies in children. *Chest*. 2002;121(5):1695-1700. <https://doi.org/10.1378/chest.121.5.1695>
 8. De Palma A, Brascia D, Fiorella A, Quercia R, Garofalo G, Genuardo M, et al. Endoscopic removal of tracheobronchial foreign bodies: results on a series of 51 pediatric patients. *Pediatr Surg Int*. 2020;36(8):941-951. <https://doi.org/10.1007/s00383-020-04685-1>
 9. Kim K, Lee HJ, Yang EA, Kim HS, Chun YH, Yoon JS, et al. Foreign body removal by flexible bronchoscopy using retrieval basket in children. *Ann Thorac Med*. 2018;13(2):82-85. https://doi.org/10.4103/atm.ATM_337_17
 10. Tang LF, Xu YC, Wang YS, Wang CF, Zhu GH, Bao XE, et al. Airway foreign body removal by flexible bronchoscopy: experience with 1027 children during 2000-2008. *World J Pediatr*. 2009;5(3):191-195. <https://doi.org/10.1007/s12519-009-0036-z>