Morbidity and mortality in children undergoing bronchoscopy for foreign body removal

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Introduction

Airway foreign bodies (AFB) can be difficult to diagnose and can be associated with catastrophic outcomes. Presentation can be delayed, particularly if aspiration is not witnessed by a caregiver. Symptoms can be absent or nonspecific. Almost 2,000 children are admitted yearly to U.S. hospitals for this diagnosis,[1] and the mortality rate has been reported to be up to 2.5%.[2] Bronchoscopy is the only way to rule out an AFB as chest radiographs can be normal.[3]

The purpose of this study was to assess significant complications following bronchoscopy for AFB in children.

Methods

This multicenter retrospective review utilized the American College of Surgeons Pediatric National Surgical Quality Improvement Program from 2014 and 2015. Eighty sites were included in 2015 and 50 sites were included in 2014. Patients were identified using CPT code 31635, "BRONCHOSCOPY, RIGID OR FLEXIBLE, WITH REMOVAL OF FOREIGN BODY." Age, gender, race, preoperative comorbidities, ASA class, specialty of the surgeon performing the procedure, operative times, anesthesia times, length of hospitalization, reoperations and readmissions, and postoperative complications were included in this study. Multivariate logistic regression was used to identify predictive factors for major adverse events.

Table 1: Comorbidities in children undergoing bronchoscopy for airway foreign bodies.

Comorbidity	Number of Patients (%)
Asthma	27 (8.1)
Chronic lung disease	16 (4.8)
Structural pulmonary or airway disorder	36 (10.8)
Tracheostomy	18 (5.4)
Oxygen supplementation requirement preoperatively	22 (6.6)
Ventilation requirement within 48 hours of procedure	17 (5.1)
Recent pneumonia for which patient was on antibiotics at time of surgery	4 (1.2)
Congenital malformation including prematurity	16 (4.8)
No cardiac risk factors	317 (94.9)
Previous cardiac surgery	8 (2.4)
Seizure disorder	9 (2.7)
Gastroenterological disorder	23 (6.9)
Neuromuscular disease	3 (0.9)
Sepsis or SIRS	19 (5.7)

Table 2: ASA classification of children undergoing bronchoscopy for airway foreign bodies.

ASA Classification	Number of Patients (%)
1	141 (42.1)
2	114 (34.0)
3	67 (20.0)
4	11 (3.3)
5	1 (0.3)

Table 3: Location of airway foreign body identified by bronchoscopy. *Percent of those with airway foreign body as a post-operative diagnosis.

Location	Number of Patients (%*)	Mean Age (yrs)	Mean Operative Time (mins)
Larynx	20 (7.43)	3.39	18.25
Trachea	16 (5.95)	4.61	18.25
Mainstem Bronchus	168 (62.83)	3.62	25.29
Other specified parts bronchus or lung	19 (7.06)	3.55	31.45
Unspecified airway	42 (15.61)	1.79	30.37
Pharynx	4 (1.49)	2.70	11.33

Results

334 patients were identified with mean age of 3.7 years. 5.7% of patients had a preoperative sepsis syndrome, and 8.1% of patients had asthma. 5.4% of patients had a tracheostomy. Comorbidities are displayed in Table 1, and ASA classification at time of surgery is shown in Table 2. Bronchoscopy was performed by an otolaryngologist (65.4%) or a pediatric surgeon (33.1%). Mean operative time was 27.4 minutes, while mean total operating room time was 54.6 minutes. Airway foreign bodies were located in 279 patients (83.5%) with 62.8% being located in the mainstem bronchus (Table 3). Operative time was longer when foreign bodies were in the mainstem bronchus or distal to it. One patient (0.3%) required reoperation for respiratory reasons, and three patients (0.9%) required readmission for related reasons. Mean total length of stay was 1.28 days. No patients remained hospitalized at 30 days. Two patients (0.6%) had a post-operative pneumonia and two patients (0.6%) required reintubation. One patient death (0.3%) occurred within two weeks of bronchoscopy. No significant differences were identified in operative time, time to surgery, or length of hospitalization based on age, gender, presence of tracheostomy, or surgical specialty.

Discussion

While there are currently no procedure-specific complications included in the NSQIP database, the main complications of potential interest for the present study are included – pneumonia, return to the operating room, subsequent procedures, readmissions for related reasons, intubations, and prolonged hospitalizations. We found very few complications: 0.6% for pneumonia or reintubation (all of whom had AFB), 0.9% for readmission (2 of whom had AFB), and 0.3% for reoperation for a respiratory complaint (which was not related to an AFB in this specific case).

Patients had a mean total length of hospitalization of 1.28 days, much shorter than the mean length of stay of 6.4 days described using the KID Inpatient database in 2003 that also included esophageal foreign bodies.[4] Patients in the latter study also had an average of 2.4 procedures completed.[4] The NSQIP group had far fewer procedures, suggesting the management of AFB has changed over the last 10 years. Similarly, the mortality rate of 0.3% is much lower than the previously reported 2.5% using the KID database for 2003-2012,[2] though this was reviewed for a diagnosis of AFB using ICD9 codes that would include patients who had not undergone bronchoscopy. Other studies reviewing patients who had undergone bronchoscopy for AFB have found mortality rates of 0.3%[5] and 0.26%.[6] These results suggest that bronchoscopy is associated with a decreased mortality rate in AFBs when compared to all children with this diagnosis.

We found that about 2/3 of AFB were treated operatively by otolaryngologists. There were no significant differences in outcomes based on specialty. There were shorter anesthesia times, both induction and emergence, for cases performed by otolaryngologists. Otolaryngologists and anesthesiologists share the airway on a daily basis and likely have developed efficient routines to do so.

Conclusions

Although airway foreign bodies may have a high mortality rate overall, bronchoscopy as part of their management appears to have low morbidity and mortality.

This study reflects many surgeons at multiple centers and a recent patient cohort, so the results are directly applicable to today's patient population.

Bronchoscopy plays a crucial role in the diagnosis of AFB in these patients as well as in the treatment of AFB and reduction of associated morbidity and mortality.

References

1. Kim IA, Shapiro N, Bhattacharyya N. The national cost burden of bronchial foreign body aspiration in children. *Laryngoscope*, 2015:125;1221-4.
2. Johnson K, Linnaus M, Notrica D. Airway foreign bodies in pediatric patients: anatomic location of foreign body affects complications and outcomes. *Pediatr Surg Int*, 2016. doi 10.1007/s00383-016-3988-9.
3. Sink JR, Kitsko DJ, Georg MW, Winger DG, Simons JP. Predictors of foreign body aspiration in children. Oto-HNS, 2016:155(3);501-7.
4. Shah RK, Patel A, Lander L, Choi SS. Management of foreign bodies obstructing the airway in children. *Arch Otol Head Neck Surg*, 2010:136(4);373-9.
5. Zhang X, Li W-X, Cai Y-R. A time series observation of Chinese children undergoing rigid bronchoscopy for an inhaled foreign body: 3149 cases in 1991-2010. *Chinese Medical Journal*, 2015:128(4);504-9.
6. Boufersaoui A, et al. Foreign body aspiration in children: experience from 2624 patients. *Int J Ped Otorhinolaryngol*, 2013:77;1683-8.