Tracheobronchial foreign body aspiration in children in Soweto, South Africa: A retrospective descriptive study

A Moola,[1,2] MB BCh, DA (SA); **C Verwey,**[1,3] MB ChB, FC Paed (SA), MMed (Paed), Cert Pulmonology (SA) Paed, PhD; **T Mabaso,**[1] BSc, MB ChB, MMed (Paed); **K Mopeli,**[1] MB BCh; **A Withers,**[4] MB BCh; **J Loveland,**[4] MB BCh, FCS (SA), Cert Paed Surg; **N Patel,**[4] BA Hons, MA, MB BCh, MMed (Paed Surg), FC Paed Surg (SA); **Z Dangor,**[1,3] MB BCh, FC Paed (SA), MMed (Paed), Cert Pulmonology (SA) Paed, PhD

[1] *Department of Paediatrics and Child Health, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa*

[2] *Department of Anaesthesia, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa*

[3] *South African Medical Research Council Vaccines and Infectious Diseases Analytics Research Unit, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa*

[4] *Department of Paediatric Surgery, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa*

Corresponding author: *A Moola (ayeshamoola0@gmail.com).*

Background. Airway foreign bodies are a common cause of accidental death in children. Tracheobronchial foreign body aspiration (FBA) can result in severe immediate and long-term complications if the foreign body is not identified and removed. Little is known about the burden of tracheobronchial FBA in the Soweto area, south of Johannesburg, South Africa.

Objectives. To describe the burden and clinical characteristics of tracheobronchial FBA in hospitalised children in a tertiary-level hospital in Johannesburg.

Methods. This was a retrospective, single-centre, descriptive study of children aged <10 years who presented to Chris Hani Baragwanath Academic Hospital from 1 January 2011 to 31 December 2020. Children with FBA were identified from the paediatric pulmonology and paediatric surgery databases using the relevant International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10), codes (T17.4 and T17.5). Clinical and radiological data were extracted from medical records and the databases.

Results. Forty-seven children with FBA were identified during the study period. Overall, the incidence of FBA among children aged <10 years of age was 1.42 per 100 000 person-years (95.0% confidence interval 1.04 - 1.88). FBA occurred more commonly in males (66.0%; *n*=31), and the mean (standard deviation) age at presentation was 68 (28.2) months. Most of the children (42.6%) were in the 7 - <10-year age group, followed by the 5 - <7-year age group (27.7%). Chronic respiratory symptoms were reported in one-third of the children, and a history of witnessed FBA was reported in only 59.6% of cases. Inorganic foreign bodies (*n*=29; 61.7%) were aspirated more commonly than organic foreign bodies; these included metal objects such as pins or springs (21.3%), toy parts (17.0%), pen or pencil lids/stoppers (12.8%) and plastic objects (6.4%).

Conclusion. Our study highlights the fact that tracheobronchial FBA is prevalent in school-aged children, and public safety campaigns targeted at this age group are warranted. Furthermore, to prevent sequelae, a high index of suspicion in required in children with respiratory symptoms that fail to respond to appropriate therapy.

Keywords. Aspiration, foreign body, tracheobronchial.

Afr J Thoracic Crit Care Med 2024;30(2):e1145. https://doi.org/10.7196/AJTCCM.2024.v30i2.1145

Study synopsis

What the study adds. Our study demonstrated that tracheobronchial foreign body aspiration (FBA) was most prevalent in school-aged children (7 - <10 years of age), which is in contrast to studies that have reported a high prevalence in children aged <3 years. Chronic respiratory symptoms were reported in only a third of the children, and a history of witnessed FBA was reported in only 59.6%. Chest radiographs were normal in a high proportion of cases in which a chest radiograph was done (56.3%). Inorganic foreign bodies were aspirated more commonly than organic foreign bodies.

Implications of the findings. Public safety campaigns should be targeted at school-aged children in Soweto, South Africa. Clinicians should investigate children with respiratory symptoms suggestive of FBA, even if a history is not forthcoming. Furthermore, to prevent long-term respiratory sequelae, a high index of suspicion in required in children with respiratory symptoms that fail to respond to appropriate therapy.

Airway foreign bodies are the third most common cause of death due to unintentional injury in children aged <1 year in the USA, where they have been reported to occur in 0.43 per 100 000 children aged <5 years.[1,2] Survivors of tracheobronchial foreign body aspiration (FBA) who are not timeously managed may suffer severe immediate and long-term complications. There are no local data on the scale and scope of FBA.

The most common presenting symptoms of tracheobronchial FBA are cough, wheezing, and choking followed by cough, with a history of witnessed FBA.[2-4] The most common clinical signs of FBA are decreased air entry and wheezing in the affected hemithorax.[5] Radiologically, air trapping or hyperinflation (35%) and/or atelectasis (16%) on a plain radiograph of the chest may be observed.[6] Common complications of tracheobronchial FBA are recurrent pneumonia, pneumothorax, lung abscess, bronchiectasis, pneumomediastinum and granuloma formation.[7] Furthermore, in-hospital complications may arise from instrumentation of the airway during foreign body retrieval, as well as from the need for mechanical ventilation, and prolonged admission in the intensive care unit (ICU).[8]

Studies from low- and middle-income countries (LMICs) report a relatively high prevalence of organic nut tracheobronchial FBA (40%), whereas studies from high-income countries report a relatively high prevalence of inorganic magnet foreign body aspiration (34%).[2] Types of material aspirated also differ by age; children aged <5 years aspirate food particles more commonly than older children.[9] In South Africa (SA), foreign body aspiration and ingestion of coins (30%), followed by beads (8%) and pellets (7%), were described in a Cape Town study in 2016, with the majority of aspirated/ingested foreign bodies being of a metallic nature (44%).[9]

Little is known about the burden of tracheobronchial FBA in Johannesburg, SA. Identifying demographic and clinical characteristics of children with FBA is essential to make public health recommendations and develop local management guidelines. We describe the burden and clinical characteristics of tracheobronchial FBA in hospitalised children in a tertiary-level hospital in Johannesburg.

Methods

This was a retrospective, single-centre, descriptive study of children aged <10 years who presented to Chris Hani Baragwanath Academic Hospital (CHBAH) from 1 January 2011 to 31 December 2020. CHBAH is the third largest hospital in the world, situated in the periurban township of Soweto, south of Johannesburg. There are ~400 medical and surgical paediatric beds, 9 paediatric ICU beds, and 10 000 medical and 2 300 surgical admissions annually.[10]

We searched the paediatric pulmonology and paediatric surgery databases to identify children with tracheobronchial FBA according to the relevant *International Statistical Classification of Diseases and Related Health Problems*, 10th revision (ICD-10), codes (T17.4 and T17.5). Clinical and radiological data for children who presented with confirmed tracheobronchial FBA were extracted from medical records and the databases (Fig. 1).

Data were analysed using Jamovi statistical software (version 2.3.21, developed by Jonathon Love, Damian Dropmann and Ravi Selker in Sydney, Australia). Categorical variables were reported as proportions, and the mean or median was reported for continuous variables. Incidence was calculated as the number of cases divided by the estimated mid-year population estimates for regions D and G in the Johannesburg metropolitan area as per Statistics South Africa. The study was approved by the University of Witwatersrand Human Research Ethics Committee (ref. no. M211195).

Results

Forty-seven children were identified with FBA during the 10-year study period. Overall, the incidence of FBA among children aged <10 years was 1.42 per 100 000 person-years (95.0% confidence interval 1.04 - 1.88). There were 31 males (66.0%), and the mean (standard deviation) age at presentation was 68 (28.2) months (Fig. 2). Most children (42.6%) were in the 7 - <10-year age group, followed by the 5 - <7-year age group (27.7%).

A history of witnessed FBA was reported in 28 children (59.6%). Sixteen children (34.0%) presented with cough, 6 (12.8%) with wheezing, 6 (12.8%) with dyspnoea and 4 (8.5%) with recurrent pneumonia (Table 1). Thirteen children (27.7%) presented with more than one symptom. Seven children (14.9%) required admission to the ICU and 5 (10.6%) required ventilatory support. No child was recorded as having died. A foreign body was visible on 6 chest radiographs (37.5%). One child (6.3%) had air trapping on the radiograph and 2 children (12.5%) had atelectasis (Table 1).

Inorganic foreign bodies (*n*=29; 61.7%) were aspirated more commonly than organic foreign bodies (*n*=4; 8.5%) (Fig. 1). The type of aspirated object was unspecified/not recorded in 14 cases (29.8%). Of the inorganic foreign bodies aspirated, 10 (21.3%) were metal objects. These metal objects were pins (*n*=6; 12.8%), springs (*n*=2; 4.3%), or unspecified (*n*=2; 4.3%). The next most common were toy parts, which were aspirated in 8 cases (17.0%). Pen and pencil parts, lids and stoppers were aspirated in 6 cases (12.8%). Aspirated organic foreign bodies were nuts (*n*=1; 2.1%), fruit and vegetables (*n*=1; 2.1%) and other organic or unspecified objects (*n*=2; 4.3%).

Table 1. Presenting clinical signs and symptoms and radiological signs in children with tracheobronchial foreign body aspiration (*N*=47)

	n (%)
Clinical signs/symptoms*	
Known history of aspiration	28 (59.6)
Cough	16 (34.0)
Wheezing	6 (12.8)
Dyspnoea	6 (12.8)
Recurrent pneumonia	4 (8.5)
Other†	4 (8.5)
Radiological signs*	
Radiographic findings documented	16 (34.0)
Normal radiograph	9/16 (56.3)
Foreign body visible	6/16 (37.5)
Atelectasis	2/16 (12.5)
Air trapping/hyperinflation	1/16 (6.3)
No radiograph	7 (14.9)
Unknown‡	24 (51.1)

*Some patients had more than one clinical sign/symptom or radiological sign.
†Other clinical signs included 1 child with drooling, 1 with sweating, and 2 with audible whistling while breathing.
‡No data available on whether a radiograph was done or the radiological findings.

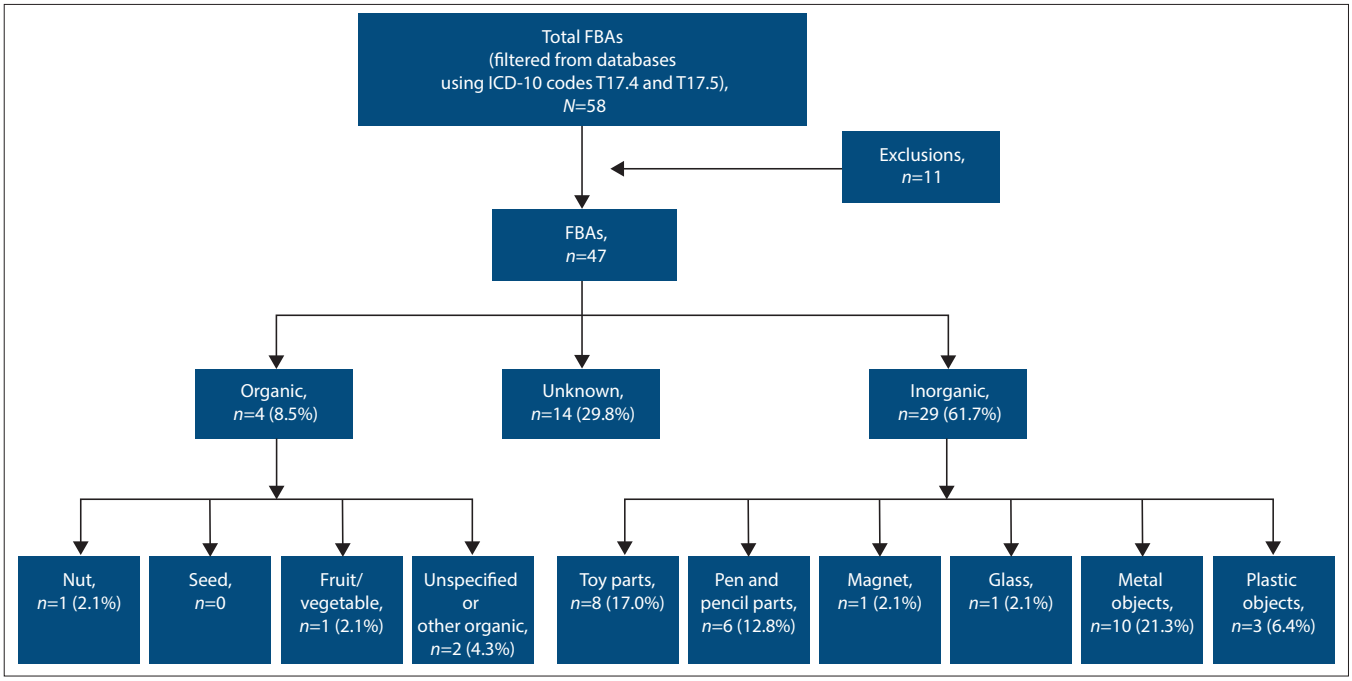

*Fig. 1. Flow chart depicting the study population of patients with FBA. (FBA = foreign body aspiration; ICD-10 = International Statistical Classification of Diseases and Related Health Problems, 10th revision; *Children aged ≥10 years and those hospitalised outside the study period were excluded.)*

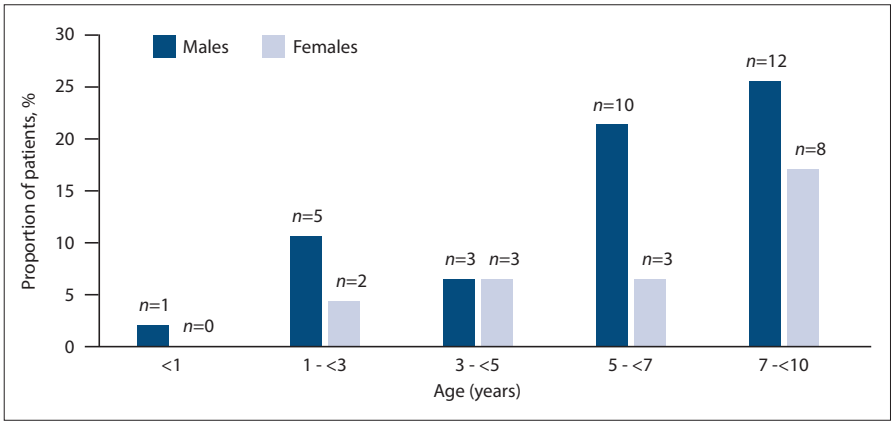

*Fig. 2. Bar graph showing age and gender distribution of children with tracheobronchial foreign body aspiration (*N=*47).*

None of the children in the 7 - <10-year age group aspirated organic material, and most organic aspirations (*n*=35; 75.0%) occurred in children <3 years of age.

Discussion

The incidence of tracheobronchial FBA in hospitalised children at CHBAH is higher than reported in high-income settings, and more than double the incidence reported in the late 1990s in the USA (0.66 per 100 000 person-years).[11,12] Children from LMICs may be at increased risk of tracheobronchial FBA and its complications because of lower socioeconomic status, limited access to healthcare, and less awareness of the risks of aspiration.[13] A field study in this setting noted that children are often left to play unsupervised.[14] A postulated reason for this lack of supervision is that both parents in the household work, with escalated risk during school holidays when children are at home unsupervised for longer periods of time.

The present study also demonstrated a high proportion of tracheobronchial FBA in older children, particularly aspiration of inorganic foreign bodies. Aspirated items vary across the world, and their nature is largely socioeconomically or culturally related.[6] Our findings raise concerns that local schoolchildren may tend to keep foreign objects in their mouths, and that these could be aspirated during activities such as laughing, coughing or talking.[15] This risky behaviour provides an opportunity for education around injury prevention in schools, and prevention strategies targeted to this age group and their teachers and guardians.

Previous studies have reported a high prevalence (72 - 92%) of tracheobronchial FBA in children aged <3 years, because toddlers explore the environment through their mouths.[5,6,16,17] In addition to anatomical factors such as absent molars, immature chewing mechanisms and a floppy tongue and epiglottis, children of this age may be unable to distinguish between edible and inedible items.[6] In contrast, the prevalence of tracheobronchial FBA in the present study was 29.8% in children aged <5 years.

A male predominance of FBA has been described in previous literature. The reason for this has been postulated as male children having a more adventurous and impulsive nature than females.[11]

Radiolucent foreign bodies are difficult to detect, so other radiological signs such as air trapping/hyperinflation or atelectasis should alert the clinician to the need for bronchoscopy, particularly if symptoms are chronic.[6] Reported sensitivities and

specificities of plain radiography in the detection of FBA range from 66% to 88% and 30% to 71.4%, respectively.[6] The presence of a normal chest radiograph does not exclude the diagnosis of FBA, as was highlighted in our study, in which 9/16 children (56.3%) had a reportedly normal chest radiograph.

A proposed new scoring system for predictors of FBA has been described.[3] Features include new-onset, recurrent or persistent wheeze (93.3% specificity), noisy breathing/stridor/dysphonia (89% specificity), unilateral reduced air entry (81.5% specificity), abnormal findings on the chest radiograph (47.6% specificity), and a witnessed episode of choking (36% specificity).[3] Despite the availability of scoring systems, clinicians should nevertheless have a high index of suspicion for FBA in children with chronic respiratory symptoms.[18,19]

Study limitations

A limitation of this study was that it was retrospective and there were missing data. Furthermore, the study findings cannot be generalisable to primary- and secondary-level hospitals. Children may have presented to primary healthcare clinics and other hospitals without being referred to CHBAH, and would therefore not be included in the study sample. In addition, we could not ascertain whether some children had neurological, cognitive or psychiatric disorders that may have placed them at increased risk for aspiration and its complications.[20]

Conclusion

The risk of serious respiratory sequelae following tracheobronchial FBA is largely avoidable through prevention and prompt intervention. Tracheobronchial FBA, particularly of metallic and plastic objects, is prevalent in school-aged children. Public safety anti-choking campaigns should not only be directed at parents of toddlers but at teachers and at schoolchildren themselves, encouraging children to keep items such as pins, pens and pencils out of their mouths. Children with acute and chronic respiratory symptoms that fail to respond to appropriate therapy require referral for investigations such as computed tomography or bronchoscopy, even if a history is not forthcoming.

Declaration. None.

Acknowledgements. None.

Author contributions. All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by AM, ZD and NP. The first draft of the manuscript was written by AM, ZD and NP. All authors commented on all versions of the manuscript, and all authors read and approved the final manuscript.

Funding. None.

Conflicts of interest. None.

1. Concepcion E. Pediatric airway foreign body. Medscape, 27 April 2021. https://emedicine.medscape.com/article/1001253-overview#a6 (accessed 16 February 2023).
2. Cramer N, Jabbour N, Tavarez M, Roger S. Foreign body aspiration. Last updated 31 July 2023. In: StatPearls. Treaure Island, Fla: StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK531480/ (accessed 5 October 2023).
3. Janahi IA, Khan S, Chandra P, et al. A new clinical algorithm scoring for management of suspected foreign body aspiration in children. BMC Pulm Med 2017;17(1):61. https://doi.org/10.1186/s12890-017-0406-6
4. Lea E, Nawaf H, Yoav T, Elvin S, Ze'ev Z, Amir K. Diagnostic evaluation of foreign body aspiration in children: A prospective study. J Pediatric Surg 2005;40(7):1122-1127. https://doi.org/10.1016/j.jpedsurg.2005.03.049
5. Ding G, Wu B, Vinturache A, Cai C, Lu M, Gu H. Tracheobronchial foreign body aspiration in children: A retrospective single-center cross-sectional study. Medicine (Baltimore) 2020;99(22):e20480. https://doi.org/10.1097/MD.0000000000020480
6. Mathew RP, Liang TIH, Kabeer A, Patel V, Low G. Clinical presentation, diagnosis and management of aerodigestive tract foreign bodies in the paediatric population: Part 2. SA J Radiol 2021;25(1):2027. https://doi.org/10.4102/sajr.v25i1.2027
7. Rodríguez H, Passali GC, Gregori D, et al. Management of foreign bodies in the airway and oesophagus. Int J Pediatr Otorhinolaryngol 2012;76(Suppl 1):S84-S91. https://doi.org/10.1016/j.ijporl.2012.02.010
8. Karaaslan E, Yildiz T. Management of anesthesia and complications in children with tracheobronchial foreign body aspiration. Pak J Med Sci 2019;35(6):1592-1597. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6861508/ (accessed 12 February 2023).
9. Sultan TA, van As AB. Review of tracheobronchial foreign body aspiration in the South African paediatric age group. J Thorac Dis 2016;8(12):3787-3796. https://doi.org/10.21037/jtd.2016.12.90
10. Zanini A, Maistry N, Brisighelli G, et al. The burden of disease and pathology at a rapidly expanding tertiary paediatric surgical unit in South Africa. World J Surg 2021;45(8):2378-2385. https://doi.org/10.1007/s00268-021-06144-x
11. Salih AM, Alfaki M, Alam-Elhuda DM. Airway foreign bodies: A critical review for a common pediatric emergency. World J Emerg Med 2016;7(1):5-12. https://doi.org/10.5847/wjem.j.1920-8642.2016.01.001
12. Hughes CA, Baroody FM, Marsh BR. Pediatric tracheobronchial foreign bodies: Historical review from the Johns Hopkins Hospital. Ann Otol Rhinol Laryngol 1996;105(7):555-561. https://doi.org/10.1177/000348949610500712
13. Hochdorn A, Oliveira A, Lorenzoni G, et al. Monitoring public perception of health risks in Brazil and Italy: Cross-cultural research on the risk perception of choking in children. Children (Basel) 2021;8(7):541. https://doi.org/10.3390/children8070541
14. Klingberg S, van Sluijs EM, Draper CE. Parent perspectives on preschoolers' movement and dietary behaviours: A qualitative study in Soweto, South Africa. Public Health Nutr 2021;24(12):3637-3647. https://doi.org/10.1017/S1368980020003730
15. Mahajan JK, Rao SG. Pen cap aspirations: Maneuvering for successful extraction. J Pediatr Intensive Care 2018;7(3):126-128. https://doi.org/10.1055/s-0037-1613672
16. Oğuz F, Citak A, Unüvar E, Sidal M. Airway foreign bodies in childhood. Int J Pediatr Otorhinolaryngol 2000;52(1):11-16. https://doi.org/10.1016/s0165-5876(99)00283-9
17. Haddadi S, Marzban S, Nemati S, Ranjbar Kiakelayeh S, Parvizi A, Heidarzadeh A. Tracheobronchial foreign-bodies in children: A 7 year retrospective study. Iran J Otorhinolaryngol 2015;27(82):377-385. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4639691/ (accessed 16 April 2023).
18. Ding L, Su S, Chen C, Yao H, Xiao L. Tracheobronchial foreign bodies in children: Experience from 1,328 patients in China. Front Pediatr 2022;10:873182. https://doi.org/10.3389/fped.2022.873182
19. Antón-Pacheco JL, Martín-Alelú R, López M, et al. Foreign body aspiration in children: Treatment timing and related complications. Int J Pediatr Otorhinolaryngol 2021;144:110690. https://doi.org/10.1016/j.ijporl.2021.110690
20. Ruiz F. Airway foreign bodies in children. Airway foreign bodies in children. UpToDate, 2022. https://www.uptodate.com/contents/airway-foreign-bodies-in-children/print (accessed 7 January 2023).

Received 6 January 2024. Accepted 25 March 2024. Published 4 July 2024.