

## Foreign bodies in children's airways: a challenge to clinicians and regulators

The celebrated American playwright Tennessee Williams was discovered dead in a New York hotel room on 24 February 1983. The coroner found that the cause of death was asphyxia "due to obstruction of the glottis...by a plastic over-cap (of the type used to cover the opening of nasal spray or ophthalmic solution dispenser)". It was never determined however, whether such a dispenser was actually involved, what if any medication Williams might have taken, or indeed how this apparent accident may have happened.<sup>1</sup> Did Williams perhaps place the cap in his mouth while dispensing the contents, as some have surmised? Whatever the facts in this instance, sudden death due to inhalation of a foreign body is by no means uncommon in persons of all ages.

In the case of children, more than 600 sudden deaths caused by foreign body inhalation are reported each year in the United States alone<sup>2</sup>; and there must also be an untold number of traumas and near fatalities. These unfortunate occurrences can stem from a long list of causes, including: inadequate supervision, poor judgement, unsafe product design, unwise personal habits, and cultural practices. According to a recent study of 2103 such children consecutively admitted to hospitals in 16 European countries, this phenomenon is not just a challenge to clinicians, but constitutes a major global public health problem.<sup>3</sup> In this study, the mean cost of treatment for foreign body inhalation was estimated to be as high as €1017 per case (95% confidence interval, 963-1074). To date, there is an abundance of studies of the epidemiology, management, and financial impact of this problem in western populations. Although cases of foreign body inhalation in the Hong Kong population have been reported sporadically, a systematic local study of paediatric foreign body inhalation was lacking.<sup>4</sup> The article by Chik et al in this issue of the *Hong Kong Medical Journal* bridges this knowledge gap.<sup>5</sup>

In children under 3 years old, underdeveloped swallowing mechanisms and second molars with poor grinding ability render them more susceptible to this hazard. It is not surprising to note therefore that children between the ages of 1 and 3 years are the most commonly affected, and the median age for those who suffer complications is 2 years.<sup>3,6,7</sup> Boys outnumber girls by 3:2,<sup>6,8</sup> and Chik et al<sup>5</sup> demonstrated a similar epidemiological trend in our population.

The majority of inhaled foreign bodies in children are generally organic in nature,<sup>9</sup> though they vary widely according to geographical location. In Turkey, watermelon seeds are the most common, dried pumpkin seeds are regularly encountered in Greece and fish bones are frequently the cause in Asia, including China.<sup>8,10,11</sup> In the rest of the world, by contrast, peanuts, coins, and small toys constitute the

most common foreign bodies.

Thin, long, or penetrating objects are reported to be more prone to lodge in the larynx.<sup>12</sup> Acute impaction in the glottic airway may lead to laryngospasm and complete airway obstruction. Stridor and cyanosis are clear indicators of this condition, which demands urgent intervention. In this situation, an immediate 'Heimlich manoeuvre' (involving upper abdominal compression of the standing child) must be performed without delay in an attempt to expel the foreign body. Other emergency manoeuvres in infants or small children include abdominal thrusts or blows to the back. In a hospital setting, while emergency preparations for surgical removal are under way, recourse to high-flow oxygen or a helium-oxygen mixture may help reduce the work of breathing.<sup>13</sup>

In contrast, inhalation and impaction of small, round, and non-penetrating foreign bodies that lodge more distally in a child's tracheobronchial tree can pose a diagnostic challenge. Although initial choking, coughing and even protracted wheezing are cardinal symptoms of foreign body inhalation, in some cases they may be absent.<sup>14-16</sup> On rare occasions, a foreign body may remain asymptomatic for up to 25 years or be revealed eventually at autopsy.<sup>17,18</sup> As parents and clinicians often miss the initial event, delays in arriving at and confirming the diagnosis, and instituting management are quite common. To establish the diagnosis promptly, a high index of suspicion and timely chest X-ray are necessary in symptomatic (or asymptomatic) children. If a child is well and co-operative, a plain chest X-ray may show the characteristic changes of obstructive emphysema (air trapping beyond a partially obstructed bronchus). If the foreign body is left untreated, mediastinal shift, pneumothorax, pneumonia, or bronchiectasis may ensue. In one series however, the sensitivity and specificity of chest X-ray was as low as 66% and 51%, respectively.<sup>19</sup> The value of computed tomography in the diagnosis of tracheobronchial foreign bodies is limited, since vegetable objects such as peanuts do not show up well. In children with a suggestive history but negative radiological findings, it is therefore necessary to consider diagnostic bronchoscopy to either confirm or confidently exclude a foreign body in the airway.

Whether a flexible or rigid bronchoscope should be used remains controversial. Otorhinolaryngologists recommend the use of the rigid bronchoscope to examine the airway and remove the foreign body. The rigid optic bronchoscope allows excellent visualisation of the tracheobronchial lumen, and facilitates use of biopsy forceps to remove the foreign body. Nevertheless, recent studies have also documented the utility of flexible bronchoscopy to confirm the diagnosis, which is then followed by successful

removal of the offending object using ureteral stone baskets and forceps.<sup>20</sup> The choice between these instruments often depends on their availability, as well as the experience and expertise of the clinician, the probable nature of the foreign body, the medical condition of the child, and the duration of impaction. Once the diagnosis is suspected, timely examination is necessary, and if needed bronchoscopic retrieval instituted. During the procedure, an aggressive search for the foreign body must be performed to avoid missing small objects hidden in granulation tissue. Furthermore, simultaneous inhalation of multiple foreign bodies occurs in about 13% of instances. Thus, after the index foreign body is removed, a meticulous re-examination of the tracheobronchial tree is needed to identify any possible secondary objects or other abnormality.<sup>8</sup> In general, rigid bronchoscopy is highly effective and safe.<sup>10</sup> In one large series, open thoracotomy was required in 1.8% of cases, as the foreign bodies had been lodged for protracted periods.<sup>10</sup> On rare occasions, lobectomy or pneumonectomy are necessary as a last resort.

Prevention is always better than cure. Greatly heightened public awareness of the symptoms and hazards of foreign body inhalation is essential for the

safety of children, which should include education directed at parents and carers. Preventing children from accessing products that pose an asphyxiation hazard is equally important. The size and shape of 7000 inhaled foreign bodies encountered in 51 children's hospitals in 15 countries on five continents were the subject of one report.<sup>21</sup> Non-spherical objects with a dimension equal to or less than 1.5 inches (38 mm), or spherical objects with diameters of 1.75 inches (45 mm) appeared to pose the greatest risk of airway obstruction.<sup>21</sup> Legislation forbidding the production or sale of such small components in toys is imperative to reduce both morbidity and mortality in susceptible children as well as to minimise the need for medical interventions.

**Martin W Pak**, FRCS(Ed)(ORL), FHKAM (Otorhinolaryngology)

E-mail: martinpak@hotmail.com

**Charles A van Hasselt**, MMed (Otol)

Department of Otorhinolaryngology, Head and Neck Surgery

Prince of Wales Hospital

The Chinese University of Hong Kong  
Shatin, Hong Kong

## References

1. Daley S. Williams choked on a bottle cap. *The New York Times* 1983 Feb 27.
2. Accident Facts. US: National Safety Council; 1980:7.
3. Gregori D, Salerni L, Scarinzi C, et al. Foreign bodies in the upper airways causing complications and requiring hospitalization in children aged 0-14 years: results from the ESFBI study. *Eur Arch Otorhinolaryngol* 2008;265:971-8.
4. Pak WM, Lee WC, van Hasselt CA. Fish bone inhalation in infancy. *Eur Arch Otorhinolaryngol* 2000;257:393-5.
5. Chik KK, Miu TY, Chan CW. Foreign body aspiration in Hong Kong Chinese children. *Hong Kong Med J* 2009;15:6-11.
6. Brown TC, Clark CM. Inhaled foreign bodies in children. *Med J Aust* 1983;2:322-6.
7. Yeh LC, Li HY, Huang TS. Foreign bodies in tracheobronchial tree in children: a review of cases over a twenty-year period. *Changeng Yi Xue Za Zhi* 1998;21:44-9.
8. Mu L, He P, Sun D. Inhalation of foreign bodies in Chinese children: a review of 400 cases. *Laryngoscope* 1991;101:657-60.
9. Mantel K, Butenandt I. Tracheobronchial foreign body aspiration in childhood. A report on 224 cases. *Eur J Pediatr* 1986;145:211-6.
10. Eren S, Balci AE, Dikici B, Doblan M, Eren MN. Foreign body aspiration in children: experience of 1160 cases. *Ann Trop Paediatr* 2003;23:31-7.
11. Daniilidis J, Symeonidis B, Triaridis K, Kouloulas A. Foreign body in the airways: a review of 90 cases. *Arch Otolaryngol* 1977;103:570-3.
12. Brama I, Fearon B. Laryngeal foreign bodies in children. *Int J Pediatr Otorhinolaryngol* 1982;4:259-65.
13. Brown L, Sherwin T, Perez JE, Perez DU. Heliox as a temporizing measure for pediatric foreign body aspiration. *Acad Emerg Med* 2002;9:346-7.
14. Blazer S, Naveh Y, Friedman A. Foreign body in the airway. A review of 200 cases. *Am J Dis Child* 1980;134:68-71.
15. Rothmann BF, Boeckman CR. Foreign bodies in the larynx and tracheobronchial tree in children. A review of 225 cases. *Ann Otol Rhinol Laryngol* 1980;89:434-6.
16. Tseng R, Stewart I, van Hasselt A. Lego asthma [letter]. *N Engl J Med* 1996;334:406-7.
17. al-Majed SA, Ashour M, al-Mobeireek AF, al-Hajjaj MS, Alzeer AH, al-Kattan K. Overlooked inhaled foreign bodies: late sequelae and the likelihood of recovery. *Respir Med* 1997;91:293-6.
18. Pritt B, Harmon M, Schwartz M, Cooper K. A tale of three aspirations: foreign bodies in the airway. *J Clin Pathol* 2003;56:791-4.
19. Ayed AK, Jafar AM, Owayed A. Foreign body aspiration in children: diagnosis and treatment. *Pediatr Surg Int* 2003;19:485-8.
20. Swanson KL, Prakash UB, Midthun DE, et al. Flexible bronchoscopic management of airway foreign bodies in children. *Chest* 2002;121:1695-700.
21. Milkovich SM, Rider G, Greaves D, Stool D, Chen X. Application of data for prevention of foreign body injury in children. *Int J Pediatr Otorhinolaryngol* 2003;67(Suppl 1):179S-182S.