

Foreign body aspiration in Hong Kong Chinese children

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Objectives To describe and compare the demographic, clinical, radiological, and bronchoscopy features and outcomes of children with foreign body aspiration in early- and late-diagnosis groups, to report the reasons for delay in diagnoses, and to determine what objects are commonly aspirated.

Design Retrospective study.

Setting Department of Paediatrics, Queen Elizabeth Hospital, Hong Kong.

Patients All children younger than the age of 18 years with foreign body aspiration admitted to the study hospital from 1 January 1993 to 31 May 2006.

Results Sixteen (59%) of the patients were categorised into the early-diagnosis group (correctly diagnosed foreign body aspiration <7 days of symptom onset) and 11 (41%) into the late-diagnosis group (correctly diagnosed ≥ 7 days after symptom onset). The common clinical manifestations of foreign body aspiration were persistent cough (100%) and history of choking (74%). Most children (82%) in the late-diagnosis group and 25% in early-diagnosis group ($P=0.004$) were misdiagnosed as respiratory infections and asthma. Intra-bronchial granulation was more common in the late-diagnosis group (13% vs 55%, $P=0.033$). Peanuts and watermelon seeds accounted for 85% of the aspirations; 63% of the foreign body aspirations occurred around the Chinese New Year festival.

Conclusion Foreign body aspiration is difficult to diagnose in children. Misdiagnosis as asthma and respiratory infection can delay treatment and result in intra-bronchial granuloma. We therefore suggest early bronchoscopy in suspicious cases. Parents should be cautious when giving peanuts and watermelon seeds to their children.

Introduction

Foreign body aspiration (FBA) is one of the major causes of persistent respiratory symptoms in children, yet is commonly missed by physicians. According to a retrospective study of 53 children with FBA admitted to a children's hospital in Taiwan between 1998 and 2003, the mean time elapsing from symptom onset before reaching the correct diagnosis was 11 days.¹ Notably, 43% of these children were initially diagnosed as having asthma, pneumonia, or common colds; and 26% of the cases were correctly diagnosed 7 days or more after symptom onset. Delay in diagnosis of FBA can cause significant morbidity (airway granulations/granuloma, bronchoesophageal fistula, and bronchiectasis),^{1,2} as well as death. According to statistics for the United States in 2000, there were 160 deaths attributed to FBA among children 14 years or under,³ for this reason early diagnosis and appropriate management are important. Despite the clinical significance of this problem, recent local data were lacking. Hence, the objectives of this study were to: (1) describe and compare the demographic factors, clinical manifestations, radiological features, bronchoscopy findings, and outcomes of children with FBA in early- and late-diagnosis groups, (2) report on the reasons for delayed diagnoses, and (3) determine what objects such children aspirated.

Methods

This was a retrospective study performed in Queen Elizabeth Hospital, which is a tertiary

Key words

Child; Early diagnosis; Foreign bodies; Hong Kong

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facility in Hong Kong. Clinical data were obtained through the Clinical Data Analysis and Reporting System of the Hospital Authority. We identified children under 18 years of age admitted through the emergency department or referred from other hospitals, who were discharged with a principal diagnosis of FBA for the period 1 January 1993 to 31 May 2006. Patients were categorised into two groups according to the elapsed time between the onset of symptoms and diagnosis; those diagnosed within 7 days of symptom onset were termed 'early', and those diagnosed after 7 days or more were termed 'late'.

The diagnosis was confirmed by bronchoscopy (Karl Storz ventilating rigid bronchoscope; size, 3.5 mm, 4 mm or 4.5 mm). Just before the procedure, the vocal cords and trachea of all the children were sprayed with lignocaine as local anaesthesia. Some were also given atropine as premedication. In addition, some had inhalational anaesthesia (halothane or sevoflurane), and others received intravenous anaesthesia (propofol). The children were allowed spontaneous respiration during the procedure.

Data collection

Medical records were retrieved and reviewed. Demographic data, clinical manifestations, radiological features, bronchoscopic findings, aspirated objects, and the outcomes were recorded and analysed. Two children with negative bronchoscopic findings were excluded. They were 12 and 14 months old when they presented with cough, irritability, and history of eating peanuts a day before symptom onset, but choking was not noticed. Physical examination and chest X-rays of these two children were normal, but their symptoms had not improved even 3 days after admission. Therefore rigid bronchoscopy was performed but no foreign body was seen. They were followed up in the out-patient clinic and remained symptom-free. According to the case notes, their bronchoscopies were performed for a suspicious history and persistent symptoms after admission.

Statistical analysis

Data analysis was performed with the Statistical Package for the Social Sciences (Windows version 15.0; SPSS Inc, Chicago [IL], US) to determine any significant difference between the groups with respect to demographic factors, clinical features, investigation results, bronchoscopic findings and outcomes. For continuous variables, the unpaired Student's *t* test or the Mann-Whitney test were used, and for categorical variables Chi squared or Fisher's exact tests were applied. A *P* value of less than 0.05 was considered statistically significant.

香港華人兒童的呼吸道異物阻塞

目的 在分別為早診斷及遲診斷有呼吸道異物阻塞的兩組兒童中，描述及比較他們的人口學、臨床、放射學和支氣管鏡檢查的特徵及結果，並報告遲診斷的原因，及阻塞呼吸道的異物種類。

設計 回顧研究。

安排 香港伊利莎伯醫院小兒科。

患者 1993年1月1日至2006年5月31日期間，因呼吸道異物阻塞而入院的18歲以下兒童。

結果 16名兒童（59%）為早診斷組（即由出現症狀至正確診斷的時間為7日內），另11名兒童（41%）為遲診斷組（即由出現症狀至正確診斷的時間超過7日）。普遍的臨床特點為持續咳嗽（100%）和哽塞（74%）。遲診斷組中大部份兒童（82%）被誤診為呼吸道發炎及哮喘，早診斷組中則有25%類似的誤診（ $P=0.004$ ）。內支氣管肉芽在遲診斷組中較為普遍（13%比55%， $P=0.033$ ）。有85%的呼吸道阻塞都是由花生及瓜子引起；而63%的呼吸道阻塞個案均於農曆新年期間發生。

結論 兒童的呼吸道異物阻塞很難診斷。誤診為哮喘及呼吸道發炎會延誤治療，繼而導致內支氣管肉芽的出現。所以我們建議對疑似病例及早進行支氣管鏡檢查。兒童進食花生及瓜子時，尤其是在農曆新年期間，父母應多加留意。

Results

Demographic factors

During the study period, 27 patients under the age of 18 years were hospitalised with FBA. Their mean age was 25 months (range, 8 months-9 years), and 85% were 3 years old or younger. The male-to-female ratio was 1.7:1. All patients were healthy except one who had a quadriplegic cerebral palsy. Sixteen (59%) patients were categorised into the early-diagnosis group and 11 (41%) into the late-diagnosis group. There was no statistical difference between the groups with respect to their demographic data.

Clinical manifestations

Thirteen children (13/16; 81%) were witnessed to have had choking in the early-diagnosis group and seven (7/11; 64%) in the late-diagnosis group. The elapsed time from aspiration of the foreign body to symptom onset was variable. Five children in the early-diagnosis group had immediate choking followed by persistent symptoms (cough), whereas one in the late-diagnosis group had choking but remained asymptomatic for 6 days thereafter. The mean and standard deviation (\pm SD) for the time from choking to symptom onset was significantly longer among children with a delayed diagnosis (45 ± 45

TABLE 1. Presenting clinical features, physical findings, and corresponding patient numbers with foreign body aspiration

	Early-diagnosis group (<7 days; n=16)	Late-diagnosis group (≥7 days; n=11)	P value
Presenting clinical features			
Cough	16 (100%)	11 (100%)	-
Choking witnessed	13 (81%)	7 (64%)	0.391
Mean (±SD)* elapsed time from choking to symptom onset (hours)	17±15	45±45	0.042
Dyspnoea	11 (69%)	7 (64%)	1
Irritable	8 (50%)	6 (55%)	0.69
Noisy breathing	7 (44%)	2 (18%)	0.231
Transient cyanosis	5 (31%)	0 (0%)	0.06
Vomiting	4 (25%)	3 (27%)	1
Mean (±SD) elapsed time from symptom onset to first medical consultation (days)	1±1	4±4	0.001
Misdiagnosis	4 (25%)	9 (82%)	0.004
Asthma	3 (19%)	3 (27%)	0.662
Respiratory tract infection	1 (6%)	6 (55%)	0.009
Mean (±SD) delay time to diagnosis (days)	1.5±0.6	14.3±11.8	<0.001
Physical findings			
Fever (rectal temperature >38°C)	2 (13%)	7 (64%)	0.011
Mean (±SD) admission rectal temperature (°C)	37±1	38±1	0.015
Mean (±SD) duration of fever (days)	2.0±1.0	2.6±3.3	0.032
Tachypnoea	4 (25%)	7 (64%)	0.061
Decreased breath sounds	9 (56%)	9 (82%)	0.231
Wheeze	7 (44%)	6 (55%)	0.581
Stridor	6 (38%)	0 (0%)	0.054
Crepitation	3 (19%)	1 (9%)	0.624

* SD denotes standard deviation

TABLE 2. Radiological findings of patients with foreign body aspiration

Radiological findings	No. of patients		P value
	Early-diagnosis group (<7 days; n=16)	Late-diagnosis group (≥7 days; n=11)	
Unilateral obstructive emphysema	8 (50%)	6 (55%)	0.69
Consolidative changes	2 (13%)	3 (27%)	0.37
Normal findings	6 (38%)	0	0.055
Lung collapse	3 (19%)	1 (9%)	0.62
Radio-opaque object	1 (6%)	0	1.00
Pleural effusion	0	1 (9%)	0.41

hours vs 17±15 hours; P=0.042). More children in the late-diagnosis group had fever (rectal temperature >38°C) on admission (64% vs 13%; P=0.011). The mean (±SD) temperature on admission in the late-diagnosis group was significantly higher than that in the early-diagnosis group (38±1°C vs 37±1°C; P=0.015), and the mean duration of their fever also longer (2.6 vs 2.0 days; P=0.032). Caregivers in the early-diagnosis group tended on average to seek a medical consultation earlier after their child had symptoms (1±1 vs 4±4 days; P=0.001). There was no statistically significant difference with respect to other symptoms and signs

between the two groups. Persistent cough was the commonest symptom after aspiration in both groups; dyspnoea (18/27, 67%), noisy breathing (9/27, 33%), stridor (6/27, 22%), and transient cyanosis (5/27, 19%) were more common in children with early diagnosis; whereas tachypnoea (11/27, 41%), decreased breath sounds (18/27, 67%), and wheeze (13/27, 48%) were more common in those diagnosed late. Misdiagnosis was more common among children with a delayed diagnosis. Thirteen children in total (13/27, 48%) were misdiagnosed (early 25% vs late 82%, P=0.004). The mean delay in making correct diagnosis after symptom onset due to misdiagnosis in these 13 children was 10 (SD, 12) days. In all, 54% (7/13) and 46% (6/13) were misdiagnosed as respiratory tract infection and asthma, respectively (Table 1).

Chest X-ray findings

There was no significant difference in the chest X-ray findings between the two groups (Table 2); 22% (6/27) of the children had no abnormality. Other common radiological abnormalities were: unilateral obstructive emphysema (14/27, 52%), consolidative changes (5/27, 19%), lung collapse (4/27, 15%), radio-opaque object in the lung field (1/27, 4%), and pleural effusion (1/27, 4%).

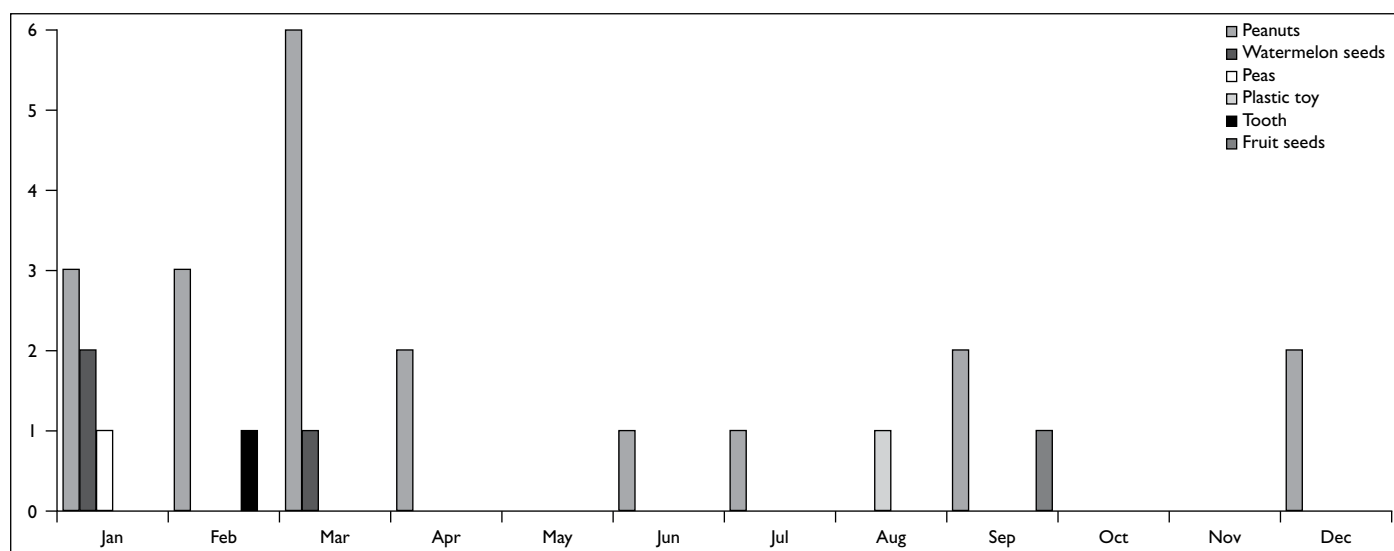


FIG. Number of admissions for foreign body aspiration in each month (over 13 years)

Bronchoscopic findings

Rigid bronchoscopy was performed in 26 (96%) of the patients. One child coughed out the foreign body in the operating theatre just before bronchoscopy. The mean (\pm SD) time to bronchoscopy after admission was 6 ± 5 hours in the early-diagnosis group and 12 ± 14 hours in the late-diagnosis group. The localisation and nature of the aspirated foreign bodies did not show any statistically significant difference between the groups. However, those who had foreign bodies in the trachea or on both sides tended to present earlier. Two (2/26; 8%) children had their foreign body in the trachea; 12 (46%) in the right main bronchus and 11 (42%) in the left main bronchus. Two of the latter 11 children had proximal and distal bronchial involvement; one of whom received immediate mechanical ventilation on admission. Another child who had foreign bodies in the bronchi on both sides also received immediate assisted ventilation after admission (Table 3). Peanuts were the commonest aspirated objects (20/27, 74%), followed by watermelon seeds (3/27, 11%), toy pieces (1/27, 4%), fruit seeds (1/27, 4%), a tooth (1/27, 4%), and peas (1/27, 4%). During the study period, 63% (17/27) of the admissions for FBA occurred around the Chinese New Year festival (January to March; Fig). All instances of watermelon seed aspirations and 60% of peanut aspirations occurred during this period.

Outcomes and complications

Complications related to these foreign bodies and the related bronchoscopy examinations were also studied in the two groups. Intra-bronchial granuloma were more common in the late-diagnosis group

TABLE 3. Locations of foreign bodies and bronchoscopic findings in patients with foreign body aspiration

	No. of patients		P value
	Early-diagnosis group (<7 days; n=16)	Late-diagnosis group (≥ 7 days; n=11)	
Location of foreign bodies*			
Left bronchus	6 (40%)	5 (45%)	0.55
Right bronchus	6 (40%)	6 (55%)	0.868
Trachea	2 (13%)	0	0.238
Both sides of bronchi	1 (7%)	0	1.00
Bronchoscopic findings*			
Granulation	2 (13%)	6 (55%)	0.033
Mucosal oedema	3 (20%)	5 (45%)	0.218
Contact bleeding	0	1 (9%)	0.423

* Only 15 children in early-diagnosis group had bronchoscopy investigation; one child had coughed out the aspirated object in the operating theatre

(13% vs 55%, $P=0.033$). Other foreign body-related complications included: mucosal oedema (8/26, 31%) and contact bleeding (1/26, 4%), which were both more common in children with a delayed diagnosis. Two children in the early-diagnosis group suffered respiratory failure and received immediate assisted ventilation after admission. One child in the late-diagnosis group had a parapneumonic effusion. Bronchoscopy-related complications did not show any statistically significant difference between the groups; 36% of the children in the late-diagnosis group required assisted ventilation due to laryngeal oedema after the procedure, compared with 7% in the early-diagnosis group. These patients were intubated for 12 to 24 hours and received intravenous dexamethasone for their laryngeal oedema before

TABLE 4. Outcomes and complications related to foreign body aspiration (FBA) and/or bronchoscopy

Outcome and complications*	No. of patients		P value
	Early-diagnosis group (<7 days; n=16)	Late-diagnosis group (≥7 days; n=11)	
Outcomes			
Mean (±SD) duration of hospital stay (days)	3±2	6±4	0.054
Complications related to FBA			
Intrabronchial granuloma/granulation†	2 (13%)	6 (55%)	0.033
Mucosal oedema†	3 (20%)	5 (45%)	0.218
Contact bleeding†	0 (0%)	1 (9%)	0.423
Pneumonia/parapneumonic pleural effusion	2 (13%)	4 (36%)	0.39
Respiratory failure	2 (13%)	0	0.499
Complications related to bronchoscopy†			
Repeated bronchoscopy	2 (13%)	2 (18%)	1.00
Laryngeal oedema (received assisted ventilation)	1 (7%)	4 (36%)	0.142
Post-bronchoscopy PICU care	6 (40%)	7 (64%)	0.234
Mean (±SD) duration of PICU care (days)	1±2	2±2	0.083

* SD denotes standard deviation, and PICU Paediatric Intensive Care Unit

† Only 15 children in the early-diagnosis group had bronchoscopy investigation; one child coughed out the aspirated object in the operating theatre

extubation. In all, 13% and 18% respectively of the children in early- and late-diagnosis groups underwent repeated bronchoscopy due to residual fragments. Seven (64%) children with a delayed diagnosis received intensive care after bronchoscopy, whereas six (40%) did so in the early-diagnosis group. The mean (±SD) periods of hospital stay of the early- and late-diagnosis groups were 3±2 days and 6±4 days, respectively. There was no mortality in our series (Table 4).

Discussion

Almost 50% of our patients were diagnosed as having FBA 7 days after onset of symptoms. The delayed diagnosis rate in our locality was high compared to rates of 17% and 23% reported in other Asian studies.^{1,4} One possible reason for a delayed diagnosis was that parents were not aware of the significance of choking; choking was actually witnessed in two thirds of our children. Because the children usually do not have severe symptoms immediately after the choking, parents may not seek medical help until there is a persistent cough and fever (as occurred in our study). Such behaviour was also described in other studies showing that almost 20% of parents had ignored or forgotten the choking episodes until

questioned further or after the foreign bodies were removed at bronchoscopy.^{1,5} A second reason was that many of the clinical and radiological features of FBA are non-specific (as in our study) and therefore mimic common paediatric respiratory illnesses such as infections or asthma. Other studies also reported that 16 to 56% of FBA patients were diagnosed as respiratory tract infections, and 40 to 50% were initially diagnosed as asthma.^{1,4} Moreover, almost one fourth of our children with FBA had normal chest X-rays, similar to the normal chest X-ray rates of 20 to 47% reported by others.^{6,7} Thus, normal chest X-ray appearances may falsely reinforce the belief that FBA was unlikely. To avoid the misdiagnoses in the future, physicians should be aware that FBA is one of the differential diagnoses in toddlers with symptoms of respiratory tract infections or asthma.

In our study, intrabronchial granuloma were common among children in the late-diagnosis group, which was similar to observations described by Chiu et al.¹ Although there was no statistically significant difference in outcomes between the early- and late-diagnosis groups in our study, the morbidities and complications related to foreign bodies and/or bronchoscopy examination were more common in the late-diagnosis group. They endured longer hospitalisation and intensive care support, as well as bronchoscopy-related laryngeal oedema. Some studies have also suggested that delayed diagnosis increases the risk of pneumonia,^{1,5} bronchoesophageal fistula, and bronchiectasis.² In our study, persistent coughing and choking were the most common symptoms after FBA. We therefore suggest early bronchoscopy be considered in children with a history of choking and persistent cough, even if the chest X-rays are normal. This strategy might reduce some of the complications, such as intrabronchial granuloma.

Food is the commonest aspirated object.^{1,4,8} In Turkey and other Middle East countries, sunflower seeds were the most commonly aspirated objects^{5,9}; in our locality they were peanuts and watermelon seeds. The latter are common festive food items during the Chinese New Year period and easily accessed by children. This possibility is supported by the increase in the numbers of admissions for FBA during Chinese New Year periods (January to March). Toddlers and young children below the age of 3 years are particularly at risk of aspiration, as demonstrated in our study as well as others.^{1,10,11} Caregivers should therefore avoid giving peanuts and watermelon seeds to such children, and become especially vigilant during the Chinese New Year festival.

Rigid bronchoscopy was used in our centre as the definitive diagnostic and therapeutic strategy. It provides a better view of the upper airway, including the trachea and larynx. It also facilitates better ventilation during the procedure than flexible

instrumentation. Compared to rigid bronchoscopes, flexible ones offer more versatility, and can enable inspection of the peripheral airways.¹² Nevertheless, when there is a high suspicion of FBA in children, the rigid bronchoscope should be used as the first instrumentation. It can serve both diagnostic and therapeutic purposes, though it is more invasive and requires general anaesthesia. For less clear cut cases, flexible bronchoscopy is recommended to establish the diagnosis, and then if needed proceed to rigid bronchoscopy for foreign body retrieval.

This study had two important limitations. First, our sample size was small. Second, our clinical information was obtained only from children admitted to a single tertiary hospital in Kowloon, and thus may not be applicable to the entire population in Hong Kong.

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Conclusion

Diagnosis of FBA in children is difficult, because its presentation can be mistaken as asthma or respiratory tract infection, which leads to delayed diagnosis and treatment, and can result in intrabronchial granuloma formation. Therefore, early bronchoscopy is helpful. Parents should be cautious when offering peanuts and watermelon seeds to toddlers, and need to inform physicians of any such food intake and/or choking if their children develop respiratory symptoms.

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