

PEDIATRICS

Foreign body inhalation in children: an update

Inalazione di corpi estranei nei bambini: meta-analisi della letteratura

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SUMMARY

Accidental inhalation of both organic and non-organic foreign bodies continues to be a cause of childhood morbidity and mortality, requiring prompt recognition and early treatment to minimize the potentially serious and sometimes fatal consequences. In the past, the majority of data on foreign body injuries in children came from single-centre retrospective studies, covering a range of about 3-10 years. Recently, several review papers have discussed the main clinical aspects, Country-specific experiences have been presented, and systematic collections of foreign bodies have been started. Fully aware of the difficulty in meta-analysing data, in an observational context, the aim of the present report is: an attempt to synthesize the epidemiological data published in the literature presenting the evidence on foreign body distribution in a review of the meta-analyses of papers focusing on European and North-American data; improve our ability to prevent and to treat these complex and high risk situations.

KEY WORDS: Foreign body • Inhalation • Children • Bronchoscopy

RIASSUNTO

L'inalazione di corpi estranei di diversa natura costituisce ancor oggi una situazione d'emergenza e talora causa di morte in giovane età. Per questo motivo tale evento richiede una pronta diagnosi e tempestivi provvedimenti ad evitare problematiche irreversibili. Negli anni passati le segnalazioni di questi eventi si limitavano ad esperienze di singoli centri basate su studi retrospettivi di durata variabile dai 3 ai 10 anni. Recentemente diversi lavori hanno discusso aspetti clinici e presentato l'esperienza di interi Paesi sull'argomento in modo da poter iniziare una raccolta sistematica delle diverse casistiche. Consapevoli della difficoltà che comporta una precisa meta-analisi di tutti i dati disponibili, abbiamo eseguito il presente lavoro con i seguenti obiettivi: sintetizzare i dati epidemiologici presenti nelle riviste più accreditate e discutere le evidenze e la distribuzione di tale evento focalizzando la nostra attenzione sui dati relativi a Europa e America del Nord e migliorare le nostre capacità di prevenzione e gestione di tali eventi talora ad alto rischio.

PAROLE CHIAVE: Corpi estranei • Inalazione • Età pediatrica • Broncoscopia

Acta Otorhinolaryngol Ital 2010;30:27-32

Introduction

Foreign body (FB) aspiration is a common problem in children, requiring prompt recognition and early treatment to minimize the potentially serious and sometimes fatal consequences. FB aspiration/inhalation is still a cause of death in childhood, usually in pre-school children.

Epidemiological data

In the past, the majority of data on FB injuries in children came from single-centre retrospective studies, covering a range of about 3-10 years. Recently, several review papers have discussed the main clinical aspects, Country-specific experiences have been presented, and systematic collections of FBs have been started.

Sehgal et al. ¹ analysed the case records of 75 patients sus-

pected of FB aspiration over a 4-year period. Berkowitz & Lim ² summarised their experiences with inhaled laryngeal foreign bodies in 9 children (5 male, 4 female) treated between March 1989 and March 2002, at the Department of Otolaryngology, University of Melbourne, Australia. The FB was removed within 24 hours of a witnessed choking episode in 4 children, and the diagnosis was delayed in 5 children for a period ranging from 4 days to 2 months.

A review of 165 paediatric cases of documented FB inhalation, treated in the Department of Paediatrics, Bapuji Hospital, India, during 1997-2000, was carried out by Shivakumar et al. ³ The University of North Carolina, Department of Otolaryngology has collected foreign bodies acquired from the airways of young children since its inception in 1954 ⁴. Overall 53 paediatric patients (27 boys, 26 girls), who had aspirated from July 1998 to July 2003, were retrospec-

tively studied in a tertiary children's hospital in northern Taiwan⁵. Witnessing choking episodes was the most important historical event to pinpoint an early diagnosis of FB aspiration in children.

Bloom et al.⁶ reviewed all cases of children (1874 patients) undergoing direct laryngoscopy and/or bronchoscopy from January 1, 1997 to September 9, 2003, at the Children's Hospital and Regional Medical Center in Seattle (USA). A total of 105 aspirated foreign bodies were identified. The 9 laryngeal foreign bodies included: 5 clear plastic radiolucent items, 2 radiolucent food items, and 2 sharp radio-opaque pins. Time to diagnosis and treatment was on average 11.6 days; 17.6 days for thin/plastic foreign bodies and 1.6 days for metal/food foreign bodies.

Overall 3300 patients underwent rigid bronchoscopy for suspected FB inhalation, between 1995 and 2005, in Mansoura, Egypt. The data were analysed in 3 groups: negative bronchoscopy for FB (Group 1), and early (Group 2) and delayed diagnosis (Group 3)⁷.

Pinto et al.⁸ reported 31 patients (18 male, 13 female; ages ranging from 6 months to 85 years) referred for clinical suspicion of FB aspiration over a 5-year period.

Rouillon et al.⁹ described 28 paediatric cases of FB inhalation requiring treatment in their Intensive Care Units between 1987 and 1999. In 13 cases, the penetration syndrome was responsible for asphyxia with cardio-respiratory arrest. All these children died, regardless of the initial treatment. Seven children were hospitalized for apparent asthmatic symptoms that did not respond to traditional treatment. The Authors proposed a new strategy for the emergency treatment of FBs based on the use of a laryngoscope and Magill forceps. Flexible endoscopy was still recommended as the appropriate diagnostic tool to eliminate doubt in the case of a first severe asthma attack.

Shlizerman et al.¹⁰ prepared a retrospective review of all the charts of children under 16 years of age, who underwent bronchoscopy for suspected FB aspiration in Ha'Emek Medical Center, from 1994 to 2004. The review presented cases concerning 136 children who had undergone bronchoscopy. Foreign bodies were found in 73% of the cases. A retrospective analysis of airway FBs in 132 children (80 male, 52 female) over a period of 20 years was conducted by Yadav et al.¹¹. The Authors suggested that FBs may escape both the parent's and the physician's notice, because of the lack of knowledge of the exact history and inconclusive radiographic findings. Rigid bronchoscopy under general anaesthesia was performed in 129 cases. A definitive history of FB inhalation or sudden choking episodes was present in 71 children. The FB was successfully removed in 93.2% of the cases. The Authors concluded that rigid bronchoscopy usually provides good results in detecting airway FBs. It should be performed at the earliest opportunity, even when the definitive history is not forthcoming and the chest X-ray is inconclusive.

According to Asif et al.¹², FB inhalation may occur at any

age; however, most of these accidents occur in children, especially those ≤ 5 years of age. A prospective study was performed by the Authors at the Department of Otolaryngology, Head and Neck Surgery, Ayub Teaching Hospital, Abbottabad, from January 2003 to June 2005. A total of 81 patients, suspected of tracheobronchial FB, were included in the study. FB inhalation was more common in male patients, mostly those below the age of 5 years. Choking was the most common symptom and decreased air entry, on auscultation, was the typical examination finding. A peanut was the most common type of FB.

A total of 662 children, who underwent bronchoscopy to remove FBs in the airways, were evaluated at the University Clinical Center Tuzla (Bosnia and Hercegovina) during the period January 1954–December 2004. The analysis included children up to 14 years of age¹³.

Overall, 46 children undergoing rigid bronchoscopy, for suspected FB aspiration, were retrospectively assessed by Pinzoni et al.¹⁴. Rigid bronchoscopy was the procedure of choice for the diagnosis and management of FB inhalation in paediatric patients. Spontaneous ventilation could be considered safe, using either volatile or intravenous agents. Peri-operative complications were not correlated with either the choice of agent (volatile or intravenous) or the duration of surgery. A close collaboration between anaesthesiologists and otorhinolaryngologists and a long-standing experience in paediatric airway emergencies were the key factors for obtaining good results.

Clinical and radiological presentations of inhaled sharp FBs were studied prospectively in 20 young females by Ragab et al.¹⁵. All the sharp pins were extracted using rigid bronchoscopy with grasping forceps in 11, and a magnetic extractor in 9, allowing easy and safe removal. The most common presentation after inhalation was the penetration syndrome (70%) (sudden onset of choking and intractable cough).

A retrospective study was carried out on injuries that occurred in the years 2000–2002 (772 children, aged 0–14 years) in the main hospitals of 19 European Countries, identified by means of the International Classification of Diseases, Ninth Revision (ICD-9) codes listed on hospital discharge records¹⁶. A higher incidence in males (63%) was observed.

In 170 cases, an injury due to the presence of a FB in the pharynx and larynx (ICD933) was reported, and in 552 records a FB located in the trachea, bronchi, and lungs (ICD934) was reported. The FBs were removed by laryngoscopy and bronchoscopy in the majority of cases.

Unlike the complications that occurred in 70 (12.7%) cases, 433 (77.6%) of the total injuries resulted in hospitalisations. The complications were pneumonia and/or atelectasis (20%), bronchitis (12%), bronchospasm (10%), dyspnoea (9%), pneumo-thorax (6%), and odynophagia (3%).

One patient died. Asphyxia was the most dramatic complication, which was commonly associated with globular

shaped FBs (i.e., nuts, grapes, candy). The median age of children who experienced complications was 2 years. Eating was the most common circumstance, with small food items the most common FBs aspirated. The objects which caused complications were nuts, seeds, berries, peas, corn, beans (64%), fish, and bones (12%). Dried vegetables stimulated an inflammatory reaction within a few hours, making the extraction extremely difficult.

Characteristics of injured patients (age, sex)

According to Reilly et al.¹⁷, children ≤ 4 years are more susceptible to FB injuries due to their lack of molar teeth, oral exploration, and poor swallowing coordination. In India, children between the ages of 1 and 3 years were found to be very vulnerable for aspiration and the majority of the children were boys³. In the review by Shlizerman et al.¹⁰, two thirds of the 136 FB patients were male and two thirds were younger than 2 years of age. Children under the age of 2 years, males, and those of Arab descent were at the highest risk of FB aspiration. In the analysis of Yadav et al.¹¹, the majority of patients (46%) were ≤ 3 years of age.

According to Asif et al., 50 children (61.7%) with FB were male and 31 (38.3%) were female. Of these, 63 (77.8%) were ≤ 5 years of age, 13 (16%) were between 5 and 15 years, and 5 (6.2%) were ≥ 15 years¹². In an analysis of Brkić & Umihanić¹³, 66.8% were boys, ranging in age from 9 months to 14 years. Foreign bodies were more frequent in children ≤ 3 years (65.2%).

Typology and features of the FBs

The analysis made by Shivakumar et al.³ in India revealed that the majority of FBs (91.43%) were organic in nature. White et al.⁴, from the University of North Carolina Department of Otolaryngology, reviewed 26 FB cases that were removed bronchoscopically from the airways of children between the years 1955 to 1960, and compared these with 27 FBs collected from 1999 to 2003. The findings showed remarkable similarities in the types of FBs aspirated. Organic FBs were the most common.

Ulkü et al.¹⁸ reported that spherical FBs, such as pen caps and some teeth, proved very difficult to manage. Nuts and peanuts (59%) were the most common FBs aspirated in the report by Chiu et al.⁵. Nuts and seeds are particularly dangerous, and Shlizerman et al.¹⁰ recommended not to allow young children to eat them.

The FBs were mostly of vegetable origin, such as seeds and peanuts, in the report by Sersar et al.⁷. Foreign bodies included tooth fragments (3 cases), nails (2 cases), the metallic spiral of a ball-point pen (1 case), and an earring (1 case) in a report by Pinto et al.⁸. Peanuts were the most common FB in the report by Yadav et al.¹¹.

According to Asif et al.¹², a peanut was the most common FB, retrieved in 45 patients (55.6%). Other FBs included whistles (18.5%), maize seeds (13.6%), bean seeds

(6.2%), nuts (2.5%), a sewing needle with thread, dice, and dentures (1.2% each). In Brkić and Umihanić¹³, most FBs removed were organic (87.1%) and were more frequently found in the right bronchial tree (53%).

In recent years, children have been increasingly exposed to electronic technology containing button batteries. These may be potentially inhaled or ingested. If a child is suspected of ingesting or inhaling a button battery, the key stages of assessment are an accurate history and radiological investigation. Scarf pin inhalation is a cultural hazard in young Middle Eastern girls¹⁵.

Aiming to highlight industrial problems, the European Survey on Foreign Bodies Injuries (ESFBI) study considered 5 kinds of objects:

- I) a non-industrial component;
- II) a piece of an object;
- III) co-presenting with another object (i.e., the cap of a pen);
- IV) a package from a product;
- V) the part of a food product containing inedible (FPCI) materials;

Toys, pieces of toys, and FPCI are rare in cases of FB inhalation.

Diagnostic method

Clinical signs of FB inhalation have low positive predictive values. Since delaying diagnosis and extraction results in potentially severe complications, every attempt to confirm or exclude the diagnosis should be made. Diagnosis and treatment rely on invasive bronchoscopic procedures³; therefore, a carefully designed standardized evaluation should be employed to decrease unnecessary bronchoscopies¹⁹.

In India, rigid bronchoscopy under general anaesthesia was the method preferred for removal of aspirated FB, as in 30% of cases chest X-ray were not useful, while the most common finding (63%) was distal emphysema¹⁻³. Conventional and dual-energy chest radiographic techniques did not reliably exclude the presence of aspirated metallic foil wrappers²⁰.

The plain chest X-ray revealed radio-opaque FBs in 23.56% of all patients with FB inhalation. Bronchoscopy is indicated with an appropriate history and when a FB is suspected. To prevent delayed diagnosis, characteristic symptoms, and clinical and radiological signs of FB inhalation should be checked in all suspected cases. Since clinical and radiological findings of FB inhalation, in delayed cases, may mimic other disorders, the clinician must be aware of the likelihood of FB.

In the study of Pinto et al.⁸, all patients had undergone plain chest X-ray, which was subsequently integrated with multi-slice computed tomography (MSCT) of the chest in 3/31 (9.7%) patients, and bronchoscopy in 27/31 (87.1%) patients. According to the Authors, plain chest X-ray should remain the initial imaging modality for patients

with clinically suspected tracheo-bronchial aspiration of a FB. Nevertheless, in cases with a negative chest X-ray and clinical suspicion of FB aspiration, MSCT – possibly integrated with virtual bronchoscopy – should be considered to avoid unnecessary bronchoscopy.

According to Shlizerman et al.¹⁰, an emergency bronchoscopy must be performed in suspicious cases. The incidence of bronchoscopies positive for FBs was higher in children ≤ 2 years old (82.6%) compared with older children (57.1%) ($p = 0.001$). The incidence of Arab children was higher when compared with Jewish children and significantly higher than the percentage in the general population of children ($p = 0.001$).

In the study of Pinzoni et al.¹⁴, the radiological examination was beneficial in 34 patients.

Chest X-rays were normal in 46/132 cases in the analysis made by Yadav et al.¹¹.

According to Adaletli et al.²¹, low-dose multidetector CT (MDCT) and virtual bronchoscopy (VB) were non-invasive radiological modalities that could be used to investigate FB aspiration in children. MDCT and VB provided the exact location of the obstructive pathology prior to bronchoscopy. If obstructive pathology is depicted with MDCT and VB, a bronchoscopy should be performed, either to confirm the diagnosis or to diagnose an alternative cause for the obstruction. In cases where no obstructive pathology was detected by MDCT and VB, bronchoscopy might not be clinically useful.

Prediction

In an Indian review, over 70% of patients had a positive history of inhalation. Only 60% of the patients presented immediately; that is, within 24 hours after aspiration. Common symptoms were cough and respiratory distress. Obstructive emphysema was found in the majority of cases (49.5%)³.

According to Chiu et al.⁵, sudden onset of cough (72%), dyspnoea (64%), and wheezing (60%) were the predominant symptoms and signs. Obstructive emphysema (53%) and normal chest X-ray (34%) were the most frequent radiological findings.

The penetration syndrome and decreased breath sounds were detected in a significantly high number of the patients with FB inhalation. The patients presented with cough in 27/31 (87.1%) cases, decreased breath sounds in 22/31 (71%), choking in 18/31 (58.1%), fever in 7/31 (22.6%) and cyanosis in 5/31 (16.1%)⁸. In Soysal et al.²², the most common symptoms and findings were cough, dyspnoea-stridor, decreased breath sounds, radio-opaque FB, air trapping, and atelectasis. A total of 67 patients (82.7%) presented mainly with choking, while 59 patients (72.8%) had stridor and 45 patients (55.6%) had cough at the initial presentation.

Asif et al.¹² reported 72 (88.9%) patients with decreased air entry and 42 (51.9%) with wheezing on auscultation,

whereas cyanosis was detected in 5 (6.2%) patients. The most common symptoms were cough and dyspnoea in the analysis made by Pinzoni et al.¹⁴. The duration of symptoms ranged from ≤ 6 hours to 3 months according to Yadav et al.¹¹.

In the study by Bloom et al.⁶, a history of choking and vocal changes was associated with laryngeal FBs. Laryngeal FBs should be included in the differential diagnosis of all children presenting with atypical upper respiratory complaints, especially if a history suggestive of a witnessed aspiration and dysphonia are present

Hospitalization details

The mortality rate from FB inhalation ranges from 0-1.8% according to Shivakumar et al.³. Soysal et al.²² reported that 55.7% of 140 patients presented within 24 hours of aspiration. All 140 patients underwent rigid bronchoscopy, and 110 had the FB extracted via the scope. No FB was detected, at bronchoscopy in 25 cases. In the other 5 cases, the material was visualized, but could not be removed via the scope, and 3 of these patients required thoracotomy for removal.

According to Pinzoni et al.¹⁴, the ideal means of FB removal is rigid bronchoscopy under general anaesthesia, although the choice between spontaneous or controlled breathing and the type of drug used are still subjects of discussion. The mean surgical time was 79 min. Peri-operative complications, such as bronchospasm, bleeding, and desaturation were observed in 5 patients.

In 128 young patients, fibre-optic bronchoscopy showed a diagnostic accuracy rate of 100%, but played a poor therapeutic role, with a case resolution of 10.7%. Rigid bronchoscopy was the main technique, permitting the removal of the tracheobronchial FB in 97.2% of patients²³. During endoscopic procedures, induction and maintenance of anaesthesia were performed by intra-venous or volatile drugs associated with topical airway lidocaine under spontaneous breathing.

In Yadav et al.¹¹, FBs were found in the right main bronchus in 62 cases, in the left main bronchus in 46 cases, and at vocal cord level in 7 cases.

Prevention

FBs are a life-threatening event in children that require early diagnosis and prompt successful management. Prevention is the most critical element in reducing morbidity. Since prevention is the key for dealing with these types of injuries¹⁰, more effort in the caregivers' education is warranted. Prevention of aspiration of FBs is better than the cure. Public awareness through the mass media should draw attention and help prevent FB inhalation¹³. Shlizerman et al.¹⁰ found that well-defined public education programmes could achieve prevention.

Various strategies have been used to decrease choking risks and prevent adverse outcomes, such as changes in

product design and public education campaigns. Primary care physicians play a critical role in increasing education efforts during each child's office visit by helping parents through anticipatory guidance of choking risks²⁴. Small spherically shaped food items, such as nuts and seeds, are those most likely to cause tracheal obstruction and asphyxia. All these foods should be avoided until the child is able to chew them adequately while sitting. Generally, chewing and swallowing become more co-ordinated around the age of 5 years. Therefore, caregivers should be informed that children under the age of 4 should never eat nuts or other round, crunchy foods, making prevention the most effective treatment of FB injuries¹⁶.

Conclusions

Accidental inhalation of both organic and non-organic FBs continue to be a cause of childhood morbidity and mortality. Prevention is best, but early recognition remains a critical factor in the treatment of FB inhalation in children. Patients should be sent to experienced centres for evaluation and treatment. Coughing, choking, acute dyspnoea, and sudden onset of wheezing are the most common symptoms.

Confirmation of the diagnosis should be made with flexible bronchoscopy. Extraction is generally performed by rigid bronchoscopy, which seems to be more reliable. Extraction failure and complications are rare.

Laryngeal FBs represent a small portion of all paediatric airway-FBs. Partial laryngeal obstruction causes hoarseness, aphonia, wheezing, and dyspnoea. Difficulty in identifying laryngeal FBs, especially thin, plastic, radiolucent FBs, can delay treatment. Thin plastic FBs can present without X-ray findings, may be difficult to be seen during endoscopy, and be particularly difficult to diagnose^{6,25}.

A witnessed choking event is the most important historical information in making an early diagnosis of FB aspiration. In children with an unequivocal choking event, even with normal physical and radiographic findings, FB aspiration must be excluded as the cause. Likewise, in toddlers with unexplained persistent cough with refrac-

tory parenchymal infiltrates, unrecognized FB aspiration should also be considered⁵. Undiagnosed and retained FBs may result in asphyxia, pneumonia, atelectasis, and bronchiectasis.

With the aim of starting a systematic analysis of FB injuries in children living in European Countries, the ES-FBJ has studied the phenomenon from a common point of view, focusing on the following points:

- FB characteristics;
- family and social background at the moment of the inhalation;
- hospitalisation details;
- complications.

The ESFBJ Study conclusions were:

- 73.3% of inhaled FBs were organic (nuts, peanuts, seeds, berries, corn, and beans);
- FBs were located in the lower airways (26.3%), in the nose (32.8%), in the pharynx/larynx (8.1%), in the upper-digestive tract (8.9%), and in the ears (23.7%);
- the most common FBs were spherical (46.1%) or tri-dimensional (28%);
- small, round, crunchy foods represented a risk of choking;
- plan batteries could be very dangerous for the digestive mucosa;
- FPCIs were an extremely rare cause of FB inhalation, possibly because parents are more careful with these objects;
- 56.8% of the children involved were male;
- in cases of organic FB, 67.9% of children were eating at the time;
- in the cases of injury while eating, 72.9% of the children were ≤ 3 years;
- a caregiver was present at the time of injury in 48.9% of cases (82.3% while the children were eating, and 33.8% while playing);
- 71.7% of cases underwent endoscopic removal; 8.8% required surgery, and 19.6% were treated as out-patient;
- 12% of children had complications;
- of 2000 cases, one fatal exitus was recorded.

References

- 1 Sehgal A, Singh V, Chandra J, et al. *Foreign body aspiration*. Indian Pediatr 2002;39:1006-10.
- 2 Berkowitz RG, Lim WK. *Laryngeal foreign bodies in children revisited*. Ann Otol Rhinol Laryngol 2003;112:866-8.
- 3 Shivakumar AM, Naik AS, Prashanth KB, et al. *Tracheobronchial foreign bodies*. Indian J Pediatr 2003;70:793-7.
- 4 White DR, Zdanski CJ, Drake AF. *Comparison of pediatric airway foreign bodies over fifty years*. South Med J 2004;97:434-6.
- 5 Chiu CY, Wong KS, Lai SH, et al. *Factors predicting early diagnosis of foreign body aspiration in children*. Pediatr Emerg Care 2005;21:161-4.
- 6 Bloom DC, Christenson TE, Manning SC, et al. *Plastic laryngeal foreign bodies in children: a diagnostic challenge*. Int J Pediatr Otorhinolaryngol 2005;69:657-62.
- 7 Sersar SI, Rizk WH, Bilal M, et al. *Inhaled foreign bodies: presentation, management and value of history and plain chest radiography in delayed presentation*. Otolaryngol Head Neck Surg 2006;134:92-9.
- 8 Pinto A, Scaglione M, Pinto F, et al. *Tracheobronchial*

- aspiration of foreign bodies: current indications for emergency plain chest radiography.* Radiol Med (Torino) 2006;111:497-506.
- ⁹ Rouillon I, Charrier JB, Devictor D, et al. *Lower respiratory tract foreign bodies: a retrospective review of morbidity, mortality and first aid management.* Int J Pediatr Otorhinolaryngol 2006;70:1949-55.
- ¹⁰ Shlizerman L, Ashkenazi D, Mazzawi S, et al. *Foreign body aspiration in children: ten-years experience at the Ha'Emek Medical Center.* Harefuah 2006;145:569-71.
- ¹¹ Yadav SP, Singh J, Aggarwal N, et al. *Airway foreign bodies in children: experience of 132 cases.* Singapore Med J 2007;48:850-3.
- ¹² Asif M, Shah SA, Khan F, et al. *Analysis of tracheobronchial foreign bodies with respect to sex, age, type and presentation.* J Ayub Med Coll Abbottabad 2007;19:13-5.
- ¹³ Brkić F, Umihanić S. *Tracheobronchial foreign bodies in children. Experience at ORL clinic Tuzla, 1954-2004.* Int J Pediatr Otorhinolaryngol 2007;71:909-15.
- ¹⁴ Pinzoni F, Boniotti C, Molinaro SM, et al. *Inhaled foreign bodies in pediatric patients: review of personal experience.* Int J Pediatr Otorhinolaryngol 2007;71:1897-903.
- ¹⁵ Ragab A, Ebied OM, Zalat S. *Scarf pins sharp metallic tracheobronchial foreign bodies: presentation and management.* Int J Pediatr Otorhinolaryngol 2007;71:769-73.
- ¹⁶ Gregori D, Salerni L, Morra B, et al. *The ESFBI Study Group. 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.
- ¹⁷ Reilly JS, Cook SP, Stool D, et al. *Prevention and management of aerodigestive foreign body injuries in childhood.* Pediatr Clin North Am 1996;43:1403-11.
- ¹⁸ Ulkü R, Başkan Z, Yavuz I. *Open surgical approach for a tooth aspirated during dental extraction: a case report.* Aust Dent J 2005;50:49-50.
- ¹⁹ Grigoriu BD, Leroy S, Marquette ChH. *Tracheo-bronchial foreign bodies.* Rev Med Chir Soc Med Nat Iasi 2004;108:747-52.
- ²⁰ Orgill RD, Pasic TR, Peppler WW, et al. *Radiographic evaluation of aspirated metallic foil foreign bodies.* Ann Otol Rhinol Laryngol 2005;114:419-24.
- ²¹ Adaletli I, Kurugoglu S, Ulus S, et al. *Utilization of low-dose multidetector CT and virtual bronchoscopy in children with suspected foreign body aspiration.* Pediatr Radiol 2007;37:33-40.
- ²² Soysal O, Kuzucu A, Ulutas H. *Tracheobronchial foreign body aspiration: a continuing challenge.* Otolaryngol Head Neck Surg 2006;135:223-6.
- ²³ Divisi D, Di Tommaso S, Garramone M, et al. *Foreign bodies aspirated in children: role of bronchoscopy.* Thorac Cardiovasc Surg 2007;55:249-52.
- ²⁴ Hayes NM, Chidekel A. *Pediatric choking.* Del Med J 2004;76:335-40.
- ²⁵ Jesudason WV, Luff DA, Rothera MP. *Delayed diagnosis of laryngeal foreign body.* J Laryngol Otol 2003;117:143-4.

Received: October 20, 2009 - Accepted: November 30, 2009