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Foreign body aspiration in children: Focus on the impact of delayed treatment

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ABSTRACT

Objective: This study aims to analyze the impact of delayed treatment of foreign body aspiration (FBA) in children.

Materials and methods: In this study, we retrospectively reviewed 220 children who were diagnosed with FBA through rigid bronchoscopy from January 2010 to May 2016 in our hospital. The time elapsed between aspiration event and arrival at our hospital exceeded 24 h was considered to have a delayed treatment. The occurrence rate of complications at admission, operation time and hospitalization time were compared between the delayed treatment group and non-delayed treatment group.

Results: A total of 220 children diagnosed with FBA by rigid bronchoscopy were enrolled in this study, including 138(62.7%) boys and 82(37.3%) girls. The median age was 20 months. Only 102 (46.4%) cases came to our hospital within 24 h. The remaining 118 (53.6%) cases had a delayed treatment. The occurrence rate of complication at admission was significantly higher in the delayed treatment group than in the non-delayed treatment group (80.5% vs. 52.9%, $P < 0.01$). Delayed treatment group also had significantly longer operation time and hospitalization time than non-delayed treatment group (median operation time: 18min vs. 10min; median hospitalization time: 4d vs. 3d; both $P < 0.01$). In multivariate analysis, delayed treatment remained an independent risk factor for longer operation time (HR 2.47, 95% CI 1.13–5.44, $P = 0.02$) and longer hospitalization time (HR 2.19, 95% CI 1.23–3.88, $P = 0.01$).

Conclusion: Delayed treatment of FBA is not only related to higher occurrence rate of complication but also associated with longer operation and hospitalization time.

1. Introduction

Tracheobronchial foreign body aspiration (FBA) is one of the most common life-threatening emergency in children. It used to be a very lethal disease before the 20th century [1]. With the improvement of diagnostic and treatment techniques, the mortality has decreased remarkably [2]. But FBA still remains the leading cause of accidental infantile death nowadays [3,4]. According to the latest data provided by National Health and Family Planning Commission of the People's Republic of China, suffocation following FBA is the ninth greatest cause of infantile death in China, with a death rate of 13.35/100,000 in 2012 [3].

Delayed diagnosis and treatment of FBA is not a rare phenomenon, especially in less-developed areas because of physicians' inexperience and lack of bronchoscopy techniques [5–9]. The clinical manifestations of FBA are usually acute and nonspecific, including coughing, choking and dyspnea [6,10]. These symptoms are so atypical that the aspiration events are usually ignored by caregivers and physicians. The persistent existence of FB in the airway can lead to recurrent cough or wheezing, fever and even hemolysis, which may be interpreted as pneumonia, bronchiolitis and asthma due to the similar symptoms and delay the diagnosis [8,11–13]. Researches have shown that the occurrence rate of long-term complications, such as atelectasis and bronchiectasis, was significantly higher in patients who had a delayed diagnosis and treatment [14]. Besides, the complications associated with bronchoscopy, such as bronchospasm and subglottic edema, were also more frequently seen in delayed patients [15]. Though a lot of studies have shown the hazard of delayed diagnosis and treatment [5,7,8,13–20], few of them focus on the aspect of clinical treatment. Therefore we retrospectively enrolled 220 children diagnosed with

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FBA to analyze the impact of delayed treatment, especially focusing on the aspect of clinical treatment.

2. Materials and methods

We retrospectively reviewed the medical records of pediatric patients who were diagnosed with FBA by rigid bronchoscopy at Zunyi Medical College Affiliated Hospital (a tertiary level medical college hospital) from January 2010 to May 2016. The inclusion criteria included: 1) age under 18 years old; 2) tracheobronchial FB diagnosed by bronchoscopy. The exclusion criteria included: 1) patients who underwent bronchoscopy but finally turned out it was mucus plug in the airway; 2) patients who coughed out the FB by themselves. Bronchoscopy was performed by experienced otolaryngologist surgeons in operation room under general anesthesia. Patients' demographics (gender, age), clinical history (witnessed or not, symptoms, course of disease, directly treated at our center or referred from local clinics), pre-operative chest imaging findings and treatment details (operation time, hospitalization time) were collected. The complication at admission was diagnosed through chest imaging findings. Parenchymal, mediastinal and soft tissue abnormalities were evaluated, including air-trapping, atelectasis, pneumonia, pneumomediastinum, subcutaneous emphysema and so on. The time elapsed between aspiration event and arrival at hospital exceeded 24 h was considered to have a delayed treatment. The study was approved by institutional ethics review board.

Quantitative data was analyzed by the Mann-Whitney *U* test. Pearson's chi-squared or Fisher's exact test was used to compare proportions. Multiple logistic regression analysis was performed to determine the independent risk factor for longer operation time and hospitalization time. Statistical analysis was performed by SPSS software (version 22.0, IBM, Chicago, USA). Two tailed $P < 0.05$ was considered as statistically significant.

3. Results

3.1. Patient demographics

From January 2010 to May 2016, a total of 220 children diagnosed with tracheobronchial FBA by rigid bronchoscopy at Zunyi Medical College Affiliated Hospital were enrolled in this study. Of the 220 patients, 138(62.7%) were boys and 82(37.3%) were girls. The occurrence ratio of boys to girls was 1.7:1. The median age of this cohort was 20 months (range: 4 months to 14 years old). Toddler period (1–3 years old) was the most common age group, accounting for 73.2% (161/220) of all the cases (Table 1).

A variety of FBs were detected by bronchoscopy. The top 10 most common types of FBs were sunflower seeds (80/220, 36.4%), peanuts (67/220, 30.5%), beans (10/220, 4.5%), whistle (7/220, 3.2%), bone (6/220, 2.7%), pumpkin seed (4/220, 1.8%), pen (3/220, 1.4%), metal (3/220, 1.4%), walnut (3/220, 1.4%) and plastic objects(3/220, 1.4%). There were 189(85.9%) organic FBs and 16(7.3%) inorganic FBs (Table 1). 15 cases' FBs couldn't be identified.

The most common location of FBs was right bronchial tree (91/220, 41.4%), followed by trachea (74/220, 33.6%) and left bronchial tree (55/220, 25.0%) (Table 1). The frequency of FBs located in trachea was significantly lower in delayed treatment group than in non-delayed treatment group (16.1% vs. 53.9%, $P < 0.01$).

3.2. Time elapsed between aspiration event and arrival at our hospital

Patients of this study came from 18 counties, 9 cities and 7 provinces in China. Nearly two thirds (148/220, 67.3%) of them did not live in the city where the hospital was. The median time elapsed between FBA event and arrival at our hospital was 48 h (range: 1 h to 1 year). Only 102 (46.4%) cases came to our hospital within 24 h. The remaining 118 (53.6%) cases had a delayed treatment (>24 h). The frequency of misdiagnosis was significantly higher in delayed treatment group compared to non-delayed group (78.8% vs. 9.8%, $P < 0.01$). Pneumonia, bronchitis and upper respiratory tract infection were the most common primary diagnosis among the misdiagnosed cases. One patient was even misdiagnosed with tuberculosis (Fig. 1-A).

As lots of distant health centers lacked bronchoscopy equipment, nearly three-fifth (142/220, 64.5%) of these patients were referred from their local facilities. Only 35.5% (78/220) of them sought treatment directly in our hospital. The median time elapsed between aspiration event and arrival at our hospital was significantly longer in referral group than in direct group (108 h vs 12 h, $P < 0.01$). The occurrence rate of delayed treatment in referral group was significantly higher than that in direct group (71.8% vs. 20.5%, $P < 0.01$).

Table 1
Patient demographics and clinical characteristics at admission.

	n	%
Gender		
male	138	62.7
female	82	37.3
Age(year)		
<1	14	6.4
1–3	161	73.2
4–6	26	11.8
>6	19	8.6
Type of foreign body		
organic	189	85.9
inorganic	16	7.3
Location of foreign body		
trachea	74	33.6
right bronchial tree	91	41.4
left bronchial tree	55	25.0
Clinical characteristics at admission		
cough	207	94.1
choking	156	70.9
dyspnea	97	44.1
wheezing	29	13.2
fever	22	10.0

3.3. Medical history

Of the 220 patients, 90.9% (200/220) of them had a definite history of aspiration witnessed by a caregiver. The witness rate was significantly lower in the delayed treatment group than in the non-delayed treatment group (91.8% vs. 98.0%, $P = 0.04$). Coughing (207/220, 94.1%), choking (156/220, 70.9%), dyspnea (97/220, 44.1%), wheezing (29/220, 13.2%) and fever (22/220, 10.0%) were the most common symptoms (Table 1).

3.4. Complication at admission

Among the 220 patients, 71 patients (32.3%) had no complication at admission, while 89 patients (40.5%) had one complication, 33 patients (15.0%) had two complications, 16 patients (7.3%) had three complications, 9 patients (4.1%) had four complications and 2 patients (0.9%) had five complications. The occurrence rate of complication was significantly higher in the delayed treatment group than in the non-delayed treatment group (80.5% vs. 52.9%, $P < 0.01$). Air-trapping (117 cases) was the most common complication, followed by pneumonia (75 cases), atelectasis (24 cases), pneumomediastinum (12 cases), subcutaneous emphysema (9