



Rigid bronchoscopy results in pediatric patients with foreign body aspiration suspicion during the COVID-19 pandemic and before in Mashhad, Iran

Ali Samady Khanghah, MD^a, Atefeh Abbaszadeh, MD^b, Seyed Javad Sayedi, MD^c, Leila Ameri, MD^d, Khashayar Atqiaee, MD^b, Ahmad Mohammadipour, MD^b, Ali Azadmand, MD^b, Mahdi Parvizi Mashhadi, MD^{b,*}

Objective: The changes in the pattern of referrals and manifestations of foreign body aspiration (FBA) during the COVID-19 pandemic in Mashhad City, East of Iran, have yet to be investigated in detail. The present study was conducted to determine the clinical symptoms and results of rigid bronchoscopy in patients referred with suspicion of FBA during the COVID-19 pandemic and before the outbreak.

Materials and methods: This retrospective study was conducted by collecting data about hospitalized patients suspected of FBA between the ages of 6 months and 14 years at the Children's Hospital of Mashhad between 2018 and 2022. The items recorded in this study included age, gender, chief complaint at presentation, accompanying symptoms, duration of hospitalization, bronchoscopy report, and final diagnosis.

Results: A total of 394 children with suspicion of FBA with an average age of 29.89 ± 26.97 months (6–157 months) were included, of which 232 (58.9%) were male, and the rest female. Of these, 213 (54.1%) patients were referred before the start of the pandemic, and 181 (45.9%) were referred during it. There was a meaningful difference between the genders ($P = 0.019$) of the two groups of patients; there were more males during the pandemic. Bronchoscopy results in the two groups had a significant difference ($P = 0.033$); before the pandemic, a foreign body was observed in 56.3% of the bronchoscopies. In contrast, after the pandemic, this value reached 66.9%.

Conclusion: The rate of foreign body observation in bronchoscopy of children suspected of having a foreign body during COVID-19 is higher than in the pre-COVID-19 era.

Keywords: bronchoscopy, children, COVID-19, foreign body aspiration

Introduction

Foreign body aspiration (FBA) is a common problem among children that may have severe consequences and cause acute and chronic health problems. It requires prompt management to reduce

^aDepartment of Surgery, Fatemi Hospital, Ardabil University of Medical Sciences, Ardabil, Iran, ^bDepartment of Pediatric Surgery, Akbar Children's Hospital, Mashhad University of Medical Sciences, Mashhad, Iran, ^cDepartment of Pediatric Pulmonology, Akbar Children's Hospital, Mashhad University of Medical Sciences, Mashhad, Iran and ^dParisian Medical Center, Mashhad, Iran

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The corresponding author ensures that the e-mail address is given and the contact details mentioned above are kept up to date. They also declared that there are no conflicts of interests.

*Corresponding author. Address: Department of Pediatric Surgery, Akbar Children's Hospital, Mashhad University of Medical Sciences, Kaveh 14. Kaveh Blvd., Mashhad, Iran. Tel.: +98 9389810987. E-mail: mpmmmd1983@gmail.com (M. Parvizi Mashhadi).

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HIGHLIGHTS

- Foreign body aspiration (FBA) is a common problem among children, particularly those under 3 years old, that may have severe consequences.
- Most cases (85%) are diagnosed in time; however, 15% of FBAs diagnosed later develop complications, including pneumonia, atelectasis, and abscesses.
- FBA can mimic the symptoms of COVID-19 pneumonia. Thus, it should be included in the differential diagnosis of COVID-19.
- In our study, the foreign body bronchoscopic detection rate increased during COVID-19.
- We concluded that children with stronger clinical suspicion underwent bronchoscopy.

the risk of complications and irreversible lung injury. From 2001 to 2016, FBA was responsible for a total of more than 305,000 cases of nonfatal suffocation injuries in children under 19 years in the United States^[1]. Before the 20th century, FBA had a mortality rate of about 24%. However, the mortality rate has significantly decreased with the development of modern bronchoscopy techniques^[2]. Approximately 80% of pediatric FBA episodes occur in those younger than 3 years of age, with the highest incidence occurring between 1 and 2 years old^[3,4]. At this age range, most children can stand and move independently and

discover their world through the oral route. They also have the fine motor skills to place a small object in their mouth but do not yet have large molars to chew food. They may have uncoordinated or immature swallowing mechanisms, increasing aspiration likelihood^[5]. Foodstuffs are the most common items aspirated by infants and toddlers, while non-food items (e.g., coins, paper clips, pins, and pen caps) are more commonly aspirated by older children^[6]. FBA can mimic the symptoms of COVID-19 pneumonia. Thus, it should be included in the differential diagnosis of COVID-19. On the other hand, the pandemic lead to delay in any diagnosis particularly among pediatric population^[7] besides increasing the homestay duration. There are numerous studies in the literature representing a reduction in the rate of visiting the emergency due to illness during the COVID-19 period, while the rate of accidents at home have been increased^[8-10].

The present study was conducted with the aim of determining the clinical manifestations and results of rigid bronchoscopy in patients referred with suspicion of FBA during the COVID-19 pandemic and before the outbreak.

Materials and methods

This retrospective comparative study was conducted by collecting data related to hospitalized patients suspected of FBA between the ages of 6 months and 14 years in Children's Hospital of Mashhad before and during the Covid-19 pandemic (March 2018–February 2020 in comparison to February 2020–March 2022). Obtaining patients' information and extracting data were done using the health information system and the relevant surgical codes. Finally, the data were entered into SPSS software version 22, and the results before COVID-19 were compared with those after COVID-19. First, descriptive statistics were described, including mean and standard deviation for normal and median quantitative variables, the interquartile range for abnormal quantitative variables, frequency and frequency percentage for qualitative variables, demographic characteristics, and other variables. Finally, the results of analytical statistics (a comparison between before the outbreak of COVID-19 and after the outbreak) were presented. Regarding the sample size, the present study was conducted using total sampling, and all eligible patients were included. All steps of the study followed the ethical principles of Helsinki. This work has been reported in line with the Strengthening The Reporting Of Cohort Studies in Surgery criteria^[11].

Results

A total of 394 children with suspicion of FBA, with an average age of 29.89 ± 26.97 months (minimum age 6 and maximum age 157 months), were included in the study; of these, 232 (58.9%) were male and the rest were female. Table 1 shows the age, the time spent since the onset of symptoms in the patients, and the length of their stay in the hospital. Table 2 represents the clinical characteristics of patients at the time of referral. As can be seen, the most common chief complaint of patients was FBA (168 cases, 42.6%).

All patients with suspicion of FBA underwent rigid bronchoscopy. Table 3 represents the result of rigid bronchoscopy and the diagnosis of patients after the procedure. The final diagnosis was FBA in 249 patients (63.5%). Out of the total number of patients included in the study, 213 people (54.1 percent) were referred before the outbreak of COVID-19, and 181 people

Table 1

Age, the time elapsed from the onset of symptoms to the hospital referral and the length of hospitalization in the patients included in the study

Variable	SD \pm Mean	Minimum	Maximum
Age (month)	29.86 ± 26.97	6	157
The interval between the onset of symptoms and the referral (day)	9 ± 17.42	0	150
Hospitalization period (day)	2.97 ± 3.08	0	29

(45.9 percent) were referred during the pandemic. Table 4 compares the demographic and clinical characteristics of patients referred during the COVID-19 pandemic and before it. There was a meaningful difference between the gender ($P = 0.019$) of the two groups of patients, so before the pandemic, 53.5% of the patients were male, but this value reached 65.2% during the pandemic. Table 5 compares the result of rigid bronchoscopy and the final diagnosis of the two patient groups. The result of rigid bronchoscopy was significantly different in the two groups ($P = 0.033$), so before the COVID-19 pandemic, a foreign body was observed in 56.3% of the bronchoscopies. In contrast, after the pandemic, this value had reached 66.9%.

Discussion

FBA is an urgent, potentially life-threatening state, in addition to one of the leading causes of mortality and morbidity in children younger than 3 years^[12,13]. It is of great importance to make a diagnosis or even to suspect FBA during the first examination based on the patient history, general status, and data obtained from the parents or guardians^[14]. According to the literature data, 85% of cases are diagnosed in time; however, 15% of FBAs diagnosed later develop complications, including pneumonia, atelectasis, and abscesses^[15,16]. By accepting all complications, compared to flexible bronchoscopes, suspension laryngoscopes, rigid endoscopes, and fluoroscopes that have all been used in managing FBA, rigid bronchoscopes are the gold standard procedure for removing foreign bodies^[17]. The present study investigated the clinical symptoms and results of rigid bronchoscopy in children with suspected FBA during the COVID-19 pandemic and before.

Table 2

Clinical characteristics of patients at the time of presentation

	Frequency	Percent
Chief complaint		
Foreign body aspiration	168	42.6
Respiratory signs	123	31.2
Suffocation/Cyanosis	73	18.5
Fever	24	6.1
Vomiting	3	0.8
Miscellaneous ^a	3	0.8
Accompanying signs		
Fever	39	9.9
Loss of consciousness	12	3
Respiratory signs	254	64.5
Drop in oxygen saturation	9	2.3

^aIncluding foreign body ingestion, fatigue, and frequent pneumonia.

Table 3
Bronchoscopy results and diagnosis of patients after the procedure

	Frequency	Percent
The result of rigid bronchoscopy		
Foreign body detection	241	61.2
Lack of foreign body detection	153	38.8
Diagnosis after bronchoscopy		
Foreign body aspiration	249	63.5
Foreign body ingestion	10	2.6
Pneumonia/COVID	21	5.4
Lack of foreign body detection	112	28.6

The pandemic was a disrupting global health, social welfare. In addition to the effects of the disease itself on public health, a collateral effect was found from near-universal disruption, and cancelation of surgical services has emerged particularly by canceling the surgical sessions^[18].

For this, 394 children under 14, mostly male, were included in the study. In general, the most common complaint of the patients was FBA, which was present in 42% of the patients. However, more than half of the patients presented with complaints other than aspiration, including respiratory symptoms, suffocation or cyanosis, fever, and vomiting. Bronchoscopy was performed in all patients, and finally, in 61% of them, a foreign body was found during the procedure. In the following, the findings of the patients referred before the COVID-19 pandemic were compared with those hospitalized during the pandemic.

Table 4
Investigating the relationship between the clinical characteristics of patients and the time of their referral

	Frequency (%) or median (q1-q3) before the covid-19 pandemic	Frequency (%) or median (q1-q3) during the covid-19 pandemic	P value
Gender			
Male	114 (53.5)	118 (65.2)	0.019 ^a
Female	99 (46.5)	63 (34.8)	
Age (month)	19 (13–33)	20 (13–37)	0.522 ^b
The interval between the onset of symptoms and the referral (day)	5 (1–14)	2 (1–4)	0.001 ^b
Hospitalization duration (day)	2 (1–4)	2 (1–4)	0.522 ^b
Chief complaint			
Foreign body aspiration	88 (41.3)	80 (44.2)	0.291 ^a
Respiratory signs	62 (29.1)	61 (33.7)	
Suffocation/Cyanosis	42 (19.7)	31 (17.1)	
Fever	18 (8.5)	6 (3.3)	
Vomiting	1 (0.5)	2 (1.1)	
Miscellaneous	2 (0.9)	1 (0.6)	
Accompanying signs			
Fever	28 (13.1)	11 (6.1)	0.019 ^a
Loss of consciousness	7 (3.3)	5 (2.8)	0.763 ^a
Respiratory signs	126 (59.2)	128 (70.7)	0.017 ^a
Drop in oxygen saturation	4 (1.9)	5 (2.8)	0.738 ^c

^aChi-squared test.

^bMann–Whitney test.

^cFishers exact test.

The results showed that although there were more male than female patients at both times, the frequency of males increased significantly after the pandemic. Before the start of COVID-19, boys made up 53% of all patients, but after the COVID-19 pandemic, this rate increased to 65%. In terms of age, there was no significant difference between the patients of the two groups, and in both groups, the average age of the referring patients was nearly 2.5 years. This is to be expected because, in general, FBA is seen under the age of 3 years. After all, at this age, children are very interested in taking food and small objects to their mouths. Also, the duration of hospitalization was not significantly different between the two groups. However, the interval between the onset of symptoms and the time of referral in patients hospitalized during COVID-19 was significantly lower than in those hospitalized before COVID-19. This issue is probably because, during the COVID-19 pandemic, many families feared respiratory symptoms in their children and were referred to the hospital more quickly. Regarding the main complaint, no significant difference was observed in the patients of the two groups. However, some signs and symptoms found in the history and physical examination of the patients of the two groups were different. There was significantly more fever in patients referred before the pandemic than in patients referred during the pandemic. Also, the rate of respiratory symptoms in the patients referred during the pandemic was significantly higher than in the patients referred before. Regarding the main complaint, no significant difference was observed in the patients of the two groups. However, some signs and symptoms found in the history and physical examination of the patients of the two groups were different. There was significantly more fever in patients referred before the pandemic than in patients referred during the pandemic. Also, the rate of respiratory symptoms in the patients referred during the pandemic was significantly higher than in the patients referred before. The higher frequency of fever among the patients who underwent bronchoscopy before the pandemic period can be explained by the fact that after the outbreak of COVID-19, patients with fever were more likely to be infected with Covid-19, and for this reason, they were less likely to undergo bronchoscopy. Before the COVID-19 era, in some cases, despite the presence of fever in patients, rigid bronchoscopy was performed to rule out the presence of a foreign body in the airways. Finally, the results of rigid bronchoscopy were examined in the two groups, and it was found that the rate of foreign body observation was significantly increased during the COVID-19 pandemic, such that foreign bodies were observed in nearly 67% of bronchoscopies during the COVID-19 pandemic in the pre-pandemic period, 56% of bronchoscopies showed foreign bodies. Regarding the reason for observing these results, it can be stated that during the COVID-19 pandemic, due to many families' fear of going to hospitals for the possibility of contracting this disease, patients who had mild symptoms fewer people went to the hospital and only people who had severe symptoms were hospitalized. On the other hand, due to the risks of performing bronchoscopy for doctors regarding the spread of aerosols containing the virus, doctors have only subjected people who have a high clinical suspicion of the presence of a foreign body to undergo bronchoscopy. The sum of these cases has led to the fact that in patients who underwent bronchoscopy during the COVID-19 period, foreign bodies were found in more than two-thirds of cases. In the study by Ozturk *et al*, the rate of foreign body detection in rigid

Table 5**Investigating the relationship between bronchoscopy results and diagnosis of patients after bronchoscopy with their referral time**

	Frequency before the COVID-19 pandemic (%)	Frequency during the COVID-19 pandemic (%)	P value
Rigid bronchoscopy results			
Foreign body detection	120 (56.3)	121 (66.9)	0.033 ^a
Lack of foreign body detection	93 (43.7)	60 (33.1)	
Diagnosis after bronchoscopy			
Foreign body aspiration	121 (57.3)	128 (70.7)	0.029 ^a
Foreign body ingestion	8 (3.8)	2 (1.1)	
Pneumonia/COVID	14 (6.6)	7 (3.9)	
Lack of foreign body detection	68 (32.2)	44 (24.3)	

^aChi-squared test.

bronchoscopy was significantly higher in patients referred during the COVID-19 pandemic (59% during COVID-19 and 38% before COVID-19). These results are similar to the findings of our study because, in our study, the rate of foreign body observation was higher during the COVID-19 era. As mentioned, it seems that the reason for this issue is that during the COVID-19 era, only patients who had a high clinical suspicion of the presence of a foreign body underwent bronchoscopy. One of the other findings of the study mentioned above was that the length of hospitalization in patients during the COVID-19 era was significantly lower than that of the patients hospitalized before COVID-19, which does not coordinate with our study^[19]. In another study published in 2023 by Golan-Tripto *et al*, the authors assessed 345 children with FBA in Israel, including 276 cases over 4 years before the COVID-19 pandemic and 69 cases referred in 1 year during the outbreak of COVID-19. The results showed no significant difference in the prevalence of FBA in the two groups. Also, there was no significant difference between the number of confirmed and missed foreign bodies between these two times. However, the rate of using flexible bronchoscopy to remove the foreign body was significantly higher during COVID-19^[20]. In our study, the rate of foreign body detection via bronchoscopy during the COVID-19 era showed a significant increase compared to before, which is not consistent with the findings of the study of Golan-Tripto and her colleagues. The reason for this issue cannot be determined precisely. Also, another difference between the results of the two studies was that in our study, only the results of rigid bronchoscopy were examined, and despite the fact that flexible bronchoscopy was performed for some patients, its results were not analyzed and reported. In contrast, the study mentioned earlier performed and reported foreign body removal in some patients using flexible bronchoscopy.

Conclusion

In our study, the foreign body bronchoscopic detection rate increased during COVID-19, possibly because children with stronger clinical suspicion underwent bronchoscopy.

Ethical approval

The Ethics Committee of Mashhad University of Medical Sciences has reviewed and approved all aspects of this research, from proposal to the final form of the manuscript. This work has been approved by the Research Ethics Committee of Mashhad University of Medical Sciences with the unique number of “IR.MUMS.REC.1401.151”.

Consent

Written informed consent was obtained from the patients' guardians for review by the publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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The authors confirm that they did not receive any financial support.

Author contribution

A.S.K. prepared the initial version of the manuscript. S.J.S. was responsible for bronchoscopy and supervised the study. L. A. contributed to the interpretation of results. K.A. was the designer of the plan and edited the manuscript. A.M. and A. A. supervised the project. M.P.M., the corresponding author, was one of the designers of the plan and supervised the study.

Conflicts of interest disclosure

The authors declare that there are no conflicts of interest preparing this manuscript and accept any responsibilities.

Research registration unique identifying number (UIN)

Since this work does not contain any novel surgical intervention, we have not registered it in the Research Registry.

Guarantor

Mahdi Parvizi Mashhadi accepts full responsibility for the work and approves the whole process from designing the study to publish.

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Data availability statement

N/A.

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