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Evaluation of the Use of Fiberoptic Bronchoscopy Following Rigid Bronchoscopy in Foreign Body Aspiration

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Abstract

Background: Foreign body aspiration (FBA) is a life-threatening problem that can be lethal in some cases. It usually occurs in children between 1–3 years old. Bronchoscopy is the best way for recognition, treatment and management of this problem. We aimed to evaluate the use of fiberoptic bronchoscopy after rigid bronchoscopy in foreign body aspiration in pediatric population.

Materials and Methods: 275 pediatric patients with a history of choking were entered to this cross-sectional study, from August 2015 to September 2018. The study was done in a Dr. Sheikh hospital, Mashhad, Iran. The age and gender of the patients were recorded individually. Rigid bronchoscopy was done for all patients. After that, fiberoptic bronchoscopy was performed immediately or 72 hours after the first procedure based on the patients' symptoms, time and personnel conditions. Data were analyzed by the SPSS software version 16.0.

Results: Among 275 patients, 175 cases (63.6%) were male. The patients' age was 3 months to 15 years old. In rigid bronchoscopy, 85 cases had no foreign body and in 190 cases, foreign body was found. In 43 cases fiberoptic bronchoscopy found a residual organic material in spite of negative rigid bronchoscopy. The most residual organic material pertained to 0-3 year age group and the cases with residue in males were more than females. There was a significant difference between FBA and age and gender ($p < 0.001$).

Conclusion: FBA in airway branches may not be seen by rigid bronchoscope due to the limited access to the distal branches. We suggest fiberoptic bronchoscopy as a complementary management along with rigid bronchoscopy to investigate distal branches, especially if the foreign body is soft in material.

Key Words: Bronchoscopy, Foreign body, Pediatric.

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1- INTRODUCTION

Foreign body aspiration (FBA) is a life-threatening problem that can be lethal in some cases because of airway obstruction. It also can have serious and dangerous consequences such as lung infections, atelectasis, recurrent hemoptysis and bronchiectasis. The cases of FBA are usually younger than 15 years old; however, it usually occurs in children between 1–3 years old (1). There are two types of foreign body ingested, organic and inorganic materials. The most common organic materials reported are nuts, seeds, foods and bones. Inorganic materials, which are more prevalent in children, are coins, pins, jewels, batteries and toy parts. The type and the position of the foreign body determine the severity of the complication. Accurate and immediate diagnosis is essential to prevent complications (2).

One of the diagnostic tools is chest x-ray which is not specific for FBA and it may not be able to show the FBA in some cases (3). The process of diagnosis and treatment is very complicated, and requires close cooperation of pediatrics, pulmonologists and surgeons (4). Bronchoscopy is the best way for recognition, treatment and management of this problem (5). There are two common methods of bronchoscopy. Rigid bronchoscopy is commonly used for extraction of aspirated foreign body in pediatric centers. It is performed under general anesthesia (6). Fiberoptic bronchoscopy is usually preferred for the early diagnosis of aspirated foreign body in adult patients (7). However, it can be used for diagnostic and therapeutic treatment in children. The use of fiberoptic bronchoscopy has increased in pediatric population with the advent of the smaller-sized bronchoscopes (8). Its use under anesthesia prevents the extra expenses, risk, and complications (9). However, fiberoptic bronchoscopy has not been able to replace rigid bronchoscopy, mainly because of the wide working channel of rigid bronchoscope which provides good ventilation, visualization, and instrumentation (10). Few complications were reported after bronchoscopy such as Laryngeal edema, surgical emphysema pneumothorax, mucosal inflammation and granulation tissue (11). On the other hand, when airway FB cannot be taken out by bronchoscopy, surgical intervention is needed which could have more severe complications (2). The aim of this study is to evaluate the use of fiberoptic bronchoscopy after rigid bronchoscopy in foreign body aspiration in pediatric population.

2- MATERIALS AND METHODS

This is a cross-sectional study. From August 2015 to September 2018, 275 pediatric patients with a history of choking were entered to our study. Children whose parents did not consent to re-performing fibrotic bronchoscopy were excluded from the study. The study was done in a referral pediatric hospital (Dr. Sheikh hospital, Mashhad, Iran). The age and sex of the patients were recorded individually. Chest X-ray was done for all patients after admission and children who were candidate for rigid bronchoscopy were prepared in the earliest activation time of the operating room (24 hours after admission). Clinical conditions were explained for the parents and primary sedation was performed at the entrance of the operating room while the child was in the arms of the parents. The surgical and anesthetic staff was present from the beginning at the patient's bedside. The controlled breathing technique with hypnotic and narcotic drugs and relaxant was used for rigid bronchoscopy anesthesia. The size of the rigid bronchoscope was appropriately selected according to the age and the body of the patient and rigid bronchoscopy was done. Then, fiberoptic bronchoscopy was performed by a pediatric pulmonologist

Immediately or after 72 hours. Approximately 30% of flexible bronchoscopy was done after 72 h and it was based on the patients' symptoms, time and personnel conditions and it was not a planned procedure. If the fiberoptic needed to be done immediately, the patient would be intubated. For the cases that were done after 72 hours, the patient would be incubated. Bronchoscopy results and foreign body type were also recorded. The results were analyzed by the SPSS software version 16.0 and Chi-square test. Ethics committee of Mashhad University of Medical Sciences approved the study. Written informed consent for participation in the study was obtained where participants are children (under 16 years old) from their parent or guardian. The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

3- RESULTS

3-1. Age and sex distribution

Among 275 patients, 175 cases (63.6%) were male and 100 cases (36.4%) were female. They were between 3 months and 15 years old. Most of them (138 cases or 50.2%) were under three years old (**Table-1**).

Table1: Age and sex distribution of participants, n= 275.

Age group, year	Frequency	Gender	Frequency
0-3 year	138 (50.2%)	Male	89 (64.5%)
		Female	49 (35.5%)
3-6	84 (30.5%)	Male	57 (67.9%)
		Female	27(32.1%)
6-9	43 (15.6%)	Male	24 (55.8%)
		Female	19 (44.2%)
9-12	6 (2.2%)	Male	2 (33.3%)
		Female	4(66.7%)
12-15	4 (1.5%)	Male	3 (75%)
	0	Female	0

3-2. Rigid bronchoscopy

All patients underwent rigid bronchoscopy, 85 cases (31%) had no foreign body and in 190 cases (69%) foreign body was evident. 85 of 190 cases (44.7%) had hard foreign body (non-food objects) like toy, needle, coil, etc. 105 cases of them (55.3%) had soft foreign body (food objects) such as nuts and vegetables). Chi-square test showed that recognition and treatment of FBA by rigid bronchoscopy had significant difference in various age groups, and in groups older than 6 years old recognition of FBA was more accurate so that the percentage of cases without FBA was very low at these ages (**Table-2**).). Chi-square test showed that there was a significant difference between FBA and gender group ($p<0.001$). Also, significant difference was observed between different types of FBA and different age groups so that, in the age groups older than 6 years, soft FBs and in the age group of 3-6 years hard FBs were found more (**Table.3)**.

Table-2: FBA Rigid bronchoscopy in various age groups of participants.

Variables	Sub-group	Age, year					P-value
		0-3	3-6	6-9	9-12	12-15	
FBA Rigid bronchoscopy	With FBA	79	62	40	5	4	<0.001
	Without FBA	59	22	3	1	0	
Total	138	84	43	6	6	4	

FBA: Foreign body aspiration.

Table-3: FBA type in male and female groups of participants.

Variable	Sub-group	Gender		P-value
		Male	Female	
FBA Type	Hard	69	16	<0.001
	Soft	63	42	
	None	43	42	
Total		175	100	

FBA: Foreign body aspiration.

3-3. Fiberoptic bronchoscopy

Fiberoptic bronchoscopy showed that, in 85 cases without foreign body in rigid bronchoscopy, 8 cases (9.4%) had fine material in distal branches and in 105 cases with soft foreign body, 35 cases (33.3%) had residual organic material in distal branches. Overall, fiberoptic bronchoscopy found 43 cases with residual organic material that rigid bronchoscopy could not show it. Cases with hard FBs did not have any residue. The most residual organic material pertained to 0-3 year age group (26 cases), and the cases with residue in males were more than females (28 cases against 15 cases). Chi-square test showed that there was not any significant difference in recognition residue by fiberoptic bronchoscopy and age groups. Also, there was not any significant difference in recognition of residual organic material by fiberoptic bronchoscopy and sex groups.

4- DISCUSSION

In this study, the use of fiberoptic bronchoscopy after rigid bronchoscopy in foreign body aspiration in pediatric population was evaluated. Foreign body aspiration (FBA) is a life-threatening problem that may cause morbidity and mortality in children. It occurs more frequently in children less than 3 years old (12). So we chose a pediatric hospital to investigate and 50.2% of the patients were under 3 years old. This can be related to the physiological characteristics of children at this age such as inadequate coordination at some stages of swallowing and lack of teeth for chewing harsh food (10). Our hospital is a training center and this was one of the reasons for the large number of negative results. Most of the negative results were related to the children under the age of three, because the information was based on the parents' description and the child could not explain the history and symptoms. FBA is more prevalent in males than females (7, 12, 13), as we showed in our study, it was two times more prevalent in males in comparison to females. Tang et al. also gained this ratio in their study and stated that this may be related to the more activity of boys (14). Our results indicated

that organic materials had a greater percentage in FBA (55.3%), that confirmed the results of similar studies (15, 16). Fiberoptic bronchoscopy found 43 cases with residual organic material in spite of negative rigid bronchoscopy. Cases with inorganic FBs did not have any residue. Inorganic foreign bodies rarely have distal fragments associated with them. We also showed that in groups older than 6 years old recognition of FBA was more accurate so that the percentage of cases without FBA was very low at these ages. In fact, they are easier to diagnose clinically in children >6 years. The reason of this can be associated with the ability of explaining the history and symptoms by the patient at these ages. Accurate history is essential to prevent delayed diagnosis (17). Accurate and immediate diagnosis of FBA is necessary to prevent severe complications and death (18).

Rigid bronchoscopy is used to diagnose and treat the FBA in pediatrics as an old method. Flexible bronchoscopy was considered for adults previously, but nowadays recent studies have shown that flexible bronchoscopy is a helpful procedure for removal of FBs in children population (19). The use of flexible bronchoscope is increasing in pediatric intensive care units for assessment of the lower airways. The small size of the fiberoptic bronchoscope allows them to be used even in neonates (20). Both procedures have advantages and disadvantages. The considerable advantage of rigid bronchoscopy for children is more access to the airways and ensuring control of the airway (6). In addition, a rigid bronchoscope provides a very efficient airway to suction out blood in case of enormous bleeding (2). But one of the disadvantages of this method is its limitation in surveying distal branches. This problem is solved in fiberoptic bronchoscopy that is a facile, safe and successful method for investigating FBA in distal branches (7). In our study, fiberoptic bronchoscopy indicated 43 cases with organic material residue that rigid bronchoscopy could not show. In this study we used both the rigid and then fiberoptic bronchoscopy to extract the FBs for the first time in our country. Many foreign bodies, especially if placed on the trachea, require a lot of power for FBs handling that is not possible with delicate fiberoptic bronchoscope. The first and safest procedure for extraction of FBs is rigid bronchoscopy, and then if there is an organic FB it is recommended to use fiberoptic bronchoscope to observe distal branches and extract any organic residues. In a study in which second bronchoscopy was performed after some days of first bronchoscopy, 26% residue of FBs was found. They concluded that investigation of bronchial tree is essential after FBs removal (14).

A meta-analysis of published papers of foreign bodies revealed that a small percentage of papers reported details about clinical presentation, diagnostic procedures and complications which show attention deficit to the follow-up of patients after FB extraction and its long-term consequences (21). Finally, we did not have a control group. Flexible bronchoscopy has recently been used in our department and we decided to use it following rigid bronchoscopy. In fact, we suggest these techniques following each other based on our experiences but it needs more investigation. However, we have past patients data in our hospital information system and it could be used as a control group in our prospective research.

5- CONCLUSION

In conclusion, foreign bodies are most common in children <3 years and in boys. Hard foreign bodies rarely have distal fragments associated with them. They are easier to diagnose clinically in children >6 years. FBA in airway branches may not be

seen by rigid bronchoscope due to the limited access to the distal branches. We would suggest the use of flexible bronchoscopy directly following on from rigid bronchoscopy, especially if the foreign body is soft in material.

6- AUTHORS' CONTRIBUTIONS

MJ conceived and designed the study. MJ, SJS and MF were the doctors of the patients. AA, GS and SG participated in data collection. SG drafted the current manuscript, with critical review by MJ and MF. AA and SJS edited the manuscript. All authors contributed, read and approved the final manuscript.

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8- CONFLICT OF INTEREST: None.

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