

Is Early Diagnosis of Foreign Body Aspiration Effective in Reducing Re-bronchoscopy in Children?

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Abstract

Background:

Flexible Fiber-optic Bronchoscopy (FFB) is a diagnostic and therapeutic tool for respiratory diseases and evaluation. One of its major advantages is in the diagnosis and treatment of foreign body aspiration.

Objectives:

This study reports the indications, outcomes, and possible complications of FFB in patients suspected of foreign body aspiration diagnosis in the Iranian population.

Methods:

The data for this study was gathered from medical records of the patients in Children's Medical Centre, which is a tertiary pediatric hospital affiliated with Tehran University of Medical Sciences (TUMS), from August 2015 to February 2021.

Results:

Of the 358 FFBs that were performed for patients suspected of foreign body aspiration diagnosis, major indications included choking (158, 44.13%), coughing (157, 43.58%), wheezing (34, 9.49%), and stridor (6, 1.67%). Nuts were the most common foreign body that was removed among airways in these patients (116, 65.16%). In 15 (4.18%) cases the foreign object was extracted via re-bronchoscopy. The location of 130 foreign objects was identified which right bronchus (52, 40%), left bronchus (38, 29.23%), trachea (8, 6.15%), and carina (6, 4.61%). In 358 procedures that were performed, a total of 27 cases (7.54%) developed complications include hypoxia and laryngospasm. The mean interval from the first sign of choking and the admission of the child into the hospital was 44.43 days \pm 10.88 (range: 1 to 1095 days, 95% CI: 22.87-65.99). There was a significant association between later days of admission and the necessity for re-bronchoscopy according to the logistic regression test (p-value=0.012).

Conclusion:

Our results show that by early diagnosis and hospitalization and so performing flexible fiber-optic bronchoscopy in an earlier time than foreign body aspiration can increase the number of successful procedures.

1. Background

Flexible Fiber-optic Bronchoscopy (FFB) has been broadly used for diagnostic and therapeutic purposes (1). Continuously, FFB has been undergoing different modifications to improve its aptness for obtaining adequate and well-preserved respiratory specimens (2). FFB is generally used as a diagnostic tool in patients with hemoptysis, chest infection, parenchymal lung disease, lung nodules or masses, and

persistent lung infiltrates (3). Furthermore, it is therapeutically used in patients with foreign body aspiration, ablation, or debulking of endobronchial masses, and airway stenosis (4, 5). Multiple complications and adverse effects can occur either due to medication or the procedure itself. Neuropathy, seizures are caused by local anesthetics overdose. prolonged neuromuscular paralysis, hyperthermia, and hemodynamic instability are also among other medication-related complications (6). Pneumothorax, pulmonary hemorrhage, and respiratory failure are also among its procedural complication (7, 8). Although FFB is substantially used in clinical settings, available reports regarding its complications and indications in developing countries are scarce (9, 11). Therefore, the objectives of this study were to evaluate the indications of FFB in patients suspected of foreign body aspiration, characteristics of its patients, and its complications.

2. Objectives

This study was designed to report and highlight the risk of complications, indications, result, and therapeutic applicability of FFB in patients suspected of foreign body aspiration diagnosis in the Iranian Population.

3. Methods

This study is a retrospective cross-sectional analysis of 366 children Flexible Fiber-optic Bronchoscopy (FFB) was performed in patients suspected of foreign body aspiration diagnosis to remove a foreign body from the airways. This study took place in Children's Medical Centre, which is a tertiary pediatric hospital affiliated with Tehran University of Medical Sciences (TUMS), from August 2015 to February 2021. The data regarding patients' characteristics (gender and age), the primary indication for bronchoscopy, final diagnosis, and related complications were gathered and extracted from bronchoscopy reports and patients' charts review. The history of choking before the admission, Persistent wheezing, stridor preceding the acute presentation, and upper and lower airway disease and pulmonary disease were our inclusion criteria for patients who had undergone FFB to remove a possible foreign object. The Research Ethics Committee at TUMS (Tehran University of Medical Sciences) granted its ethics approval to this study. This study is by the Declaration of Helsinki by the World Medical Association.

Regarding the method and description of the FFB procedure, concise information and knowledge can be obtained elsewhere (12, 14). In this study foreign bodies in the airways were extracted by FFB (EVIS EXERA III CLV-190) with a diameter of 2.8 and 3.5 mm and "Zero Tip" Nitinol Stone retrieval 4-wire basket with 1.9F (0.63mm) diameter that maintains its shape in the most challenging anatomy (figure-1). However, rigid bronchoscopy was used for extraction cases of large foreign bodies or position of the object or granulation tissue in the airways. patients underwent general anesthesia that sevoflurane was used as an anesthetic drug. No muscle relaxants were used. All patients were under cardiorespiratory monitoring along with intravenous lines. To detect the potential complications, all patients were under close observation after the procedure. An experienced pediatric anesthetist was responsible for the

provision of anesthesia. Before the procedure, fasting was necessary for at least 6 hours before the anesthesia. Before the procedure intravenous (IV) atropine was given to all the patients (0.1 mg/kg). Vocal cords and trachea were anesthetized with topical 1% lidocaine. Following the procedure, the patients were maintained NPO for at least 6 hours with the administration of IV fluids and vital sign monitoring every fifteen minutes after regaining consciousness.

The data were analyzed using STATA V.14.0. To find any relation between days of admission after choking and different variables in our study, the Wilcoxon Rank-Sum test and ordered logistic regression was performed. P values less than 0.05 were considered statically significant. Other variables were demonstrated in the number of occurrence and percentage

4. Results

A total number of 366 patients underwent FFB to remove possible foreign objects over 5 years. Among the 366 medical records, 8 records were incomplete, hence 358 records were gathered and evaluated. 130 (36.72%) of the patients were female and 224 (63.28%) were male and The mean age was 28.54 months \pm 1.45 (range: 1 to 168 months, 95% CI: 25.63–31.36). The age distribution is also demonstrated in Figure-2.

Major indications included choking (158, 44.13%), coughing (157, 43.58%), wheezing (34, 9.49%), and stridor (6, 1.67%). Indications are summarized in Table 1.

For 165 (46.08%) cases, no foreign bodies were found and the outcome of FFB was normal. In 178 (49.72%) cases the foreign body was found and removed, in 15(4.18%) cases, re-bronchoscopy was needed.

For those patients with foreign bodies found in their airways and removed in the first procedure among 178 cases, the 150 cases (84.26%) foreign bodies were identified. In 28(15.73%) cases, the foreign objects were unknown.

The most common result of foreign body aspiration among these patients was nuts (116, 65.16%), Un-identified 28 (15.73%). bone (14, 7.86%), fruits (6, 3.37%). Interestingly, a tooth was found in one patient

In 15(4.18%) cases the foreign object was extracted via re- bronchoscopy because of granulation formation, that 12 cases underwent re-bronchoscopy after 3 to5 days receiving corticosteroids and in 3 cases, the foreign body was extracted with rigid bronchoscopy.

In 178 cases that foreign objects were removed, 147 cases (82.58%) were extracted by using a retrieval basket and in 22 cases (12.45%) rigid bronchoscopy was used for extraction because of large foreign bodies or position of objects or granulation tissue in the airways, finally in 9 cases (12.5%) foreign body removed with some appropriate pence.

Totally among 193 cases that foreign body has been removed from airways, 168 cases (87.04%) extracted with FFB.(Success rate: 87.04%)

43 (12.01%) cases had a history of previous rigid bronchoscopy, from which 27 (62.79%) cases had undergone rigid bronchoscopy once and 16 (37.21%) twice. Among those 27 patients, 7 cases had the normal outcome from FFB, 16 cases underwent rigid bronchoscopy again and in the remaining 4 cases, the foreign bodies were extracted via FFB. Also, among those 16 patients, 6 cases had normal outcomes for FFB, one case underwent rigid bronchoscopy again and in the remaining 9 cases, the foreign bodies were extracted via FFB.

The Location of foreign body objects is demonstrated in Table 2.

The location of 130 of these foreign objects was reported which right bronchus (52, 40%), left bronchus (38, 29.2%), trachea (8, 6.1%) were the most common locations of the foreign body aspiration. Detailed demonstration of further locations can be found in Table 3.

In 117 cases the interval between first choking and admission of the child into the hospital was recorded, which is 75.81% of the cases the child was admitted to the hospital within 30 days of choking. The mean interval was 44.43 days \pm 10.88 (range: 1 to 1095 days, 95% CI: 22.87–65.99). There was a significant association between later days of admission and the necessity for rigid bronchoscopy according to the ordered logistic regression test (p-value = 0.012).

In terms of complications, from 358 procedures that were performed, a total of 27 cases (7.54%) developed complications, including 24 cases (88.88%) with transient hypoxia and 2 cases (11.11%) with laryngospasm that all of them were cured by receiving oxygen.no mortality were reported in our study.

5. Discussion

This study was designed to investigate and report common indications, outcomes, complications, and diagnostic yield of the FFB procedures that were performed in a tertiary pediatric hospital in Tehran, Iran, over 5 years.

FFB can be readily performed in hospital settings and has successfully supplanted rigid open tube bronchoscopy. However, in some cases performing rigid instead of flexible bronchoscopy is inevitable. To our knowledge, this is the third report from Iran that describes the outcomes and indications of FFB in the pediatric population, the two last articles can be found elsewhere (9, 10). Reports come from different countries and diverse populations with variable numbers of procedures per annum. This diversity between different populations and local practice as well as the difference in the age distribution of the patents makes the comparison between the results of different centers problematic (15, 16).

Foreign body aspiration is one of the frequent causes of pediatric emergency. A detailed history and thorough physical examination are necessary for the diagnosis of the foreign body aspiration because patients may be fairly asymptomatic and the only clue for foreign body aspirations may be found during

the process of taking history and by asking from the caregiver of these children which are mostly their mothers in the country. Similar to China's study in 2006 on 304 children who have had a foreign body removed (17), however, the sudden onset of cough, wheezing, or choking can be the most common symptoms (18). The most common aspirated foreign object was nuts in our study. The same result has been obtained from another study that investigated foreign body aspiration in 235 children (19). Also, Sink et al examined the predictors of foreign body aspiration in 102 patients, in which the same result has been obtained, with nuts and fragments of seeds being the most common aspirated object (20). The majority of the procedures were performed on male patients (224 in comparison with 130 females) which could suggest a sex discrepancy in foreign object choking. This finding is similar to other studies, in which the number of male patients was higher than female patients (21, 22) that the reason may be more activity of boys. Choking, Coughing, and wheezing were the most common indications for performing FFB in this study. These findings are similar to those of Aslan et al and Sink et al (20, 23). The most common location of extracted foreign bodies was right and left bronchus, respectively, which are similar to Aslan et al and the study was performed in Children's Medical Centre from 2007 to 2011 (10, 21). Other studies also indicated right bronchus as the common location of the aspirated foreign objects (17, 22). It has been suggested that the anatomic characteristics of the right bronchus predispose a higher rate of foreign body aspiration in the right bronchus in comparison with the left bronchus. The angle between the left bronchus and trachea is sharper than the right bronchus, suggesting this higher rate of foreign body aspiration according to the current literature review (25).

In terms of comparing complications, Contrary to study in China with three deaths, 21.4% with severe pulmonary complication and five cases of respiratory failure were reported (17), we have 7.54% transient complication with no mortality

The mean interval between the first sign of choking and the admission of the child into the hospital was approximately 44 days. In most of the cases, the children were admitted to the hospital within the first 30 days. In another study the interval between the choking event and the admission ranged from one hour to 60 days, however, one-third of the study population were admitted to the hospital within the first 24 hours (24). also in the study was performed in our center ten years ago, patients were diagnosed ≤ 24 hours from the time of choking were 21.5 %. (early diagnosis) (10), that is similar to Study was performed in China in 20003 (21.1%).(17)

The mean interval can indicate the parents' alertness and their awareness of the life-threatening consequences of foreign body aspiration. According to our statistical analysis, there was a significant association between later days of admission and the necessity for re-bronchoscopy. Granulated tissue can be formed around the aspirated object, hence the longer the parents delay in admitting their child after choking, the higher is the chance of granulation tissue formation (26).

Our study's most prominent limitation was the incomplete records for patient information. We believe that longer intervals are associated with granulation tissue formation, however, our study didn't have an adequate sample size to investigate this association, due to the lack of interval data. Also, larger sample-

sized and complete records may be useful in finding associations between different variables. For instance, sex discrepancies have not had any significant association with other variables, although the number of boys was two-fold higher than girls. Also, there may be a possible association between the location of the aspirated object and the interval of the emergence of the first symptom, which can be analyzed by a larger size sample and complete data.

6. Conclusion

Our results show that by early diagnosis and hospitalization and so performing flexible fiber-optic bronchoscopy in an earlier time than foreign body aspiration can increase the number of successful procedures.

Declarations

Ethical Approval: The study was approved by the Ethics Committee of Tehran University of Medical Sciences. The process of this study was performed in accordance with the Declaration of Helsinki and other applicable guidelines, laws, and regulations

Consent for publication: All parents were asked to fill an informed consent before the procedures were performed.

Availability of data and materials:

The analyzed data set is available during the current study in the Children's medical center hospital archives.

Competing interests: The authors have no conflict of interest to declare.

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Authors' Contribution:

Critical revision of the manuscript, Study concept and design: Mohammad Reza Modaresi;

acquisition, analysis and interpretation of data, drafting of the manuscript: Mahya Sadat Mohammadi

participation in the data acquisition: Rohola Shirzadi, Seyed Hossein Mirlohi, and Sedigheh Yousefzadegan

analysis, interpretation of data, statistical analysis: Nikan Zargarzadeh

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Tables

Major indications included choking (158, 44.13%), coughing (157, 43.58%), wheezing (34, 9.49%), and stridor (6, 1.67%). Indications are summarized in Table 1.

Indication	No. (%)
chocking	158 (44.13%)
Coughing	157 (43.58%)
Wheezing	34 (9.49%)
Stridor	6 (1.67%)
Pneumonia	1 (0.27%)
Dyspnea	1 (0.27%)
Seen in intubation	1 (0.27%)
Total	358 (100%)

The Location of foreign body objects is demonstrated in Table 2.

Objects	No. (%)
Right bronchos	52(40%)
Left bronchos	38 (29.23%)
Trachea	8(6.15%)
Epiglottis	6 (4.61%)
Left lower lobe of lung	6 (4.61%)
Carina	6 (4.61%)
Left lung	5 (3.84%)
Right upper lobe of lung	3 (2.3%)
Subglote	2(1.5%)
Vocal cord	1 (0.7%)
Esophagial entrance	1 (0.7%)
Left upper lobe of lung	1 (0.7%)
Right lower lobe of lung	1 (0.7%)
Total	130 (100%)

Detailed demonstration of further locations can be found in Table 3.

Objects	No. (%)
Nuts	116 (65.16%)
Unidentified	28 (15.73%)
Bone	14 (7.86%)
Fruits	6 (3.37%)
Pop corn	4 (2.24%)
Plastic material	2 (1.12%)
Bean	2 (1.12%)
Food	2(1.12%)
Pills	1 (0.05%)
Cotton	1 (0.05%)
Tooth	1 (0.05%)
Metal pin	1 (0.05%)
Total	178 (100%)

Figures

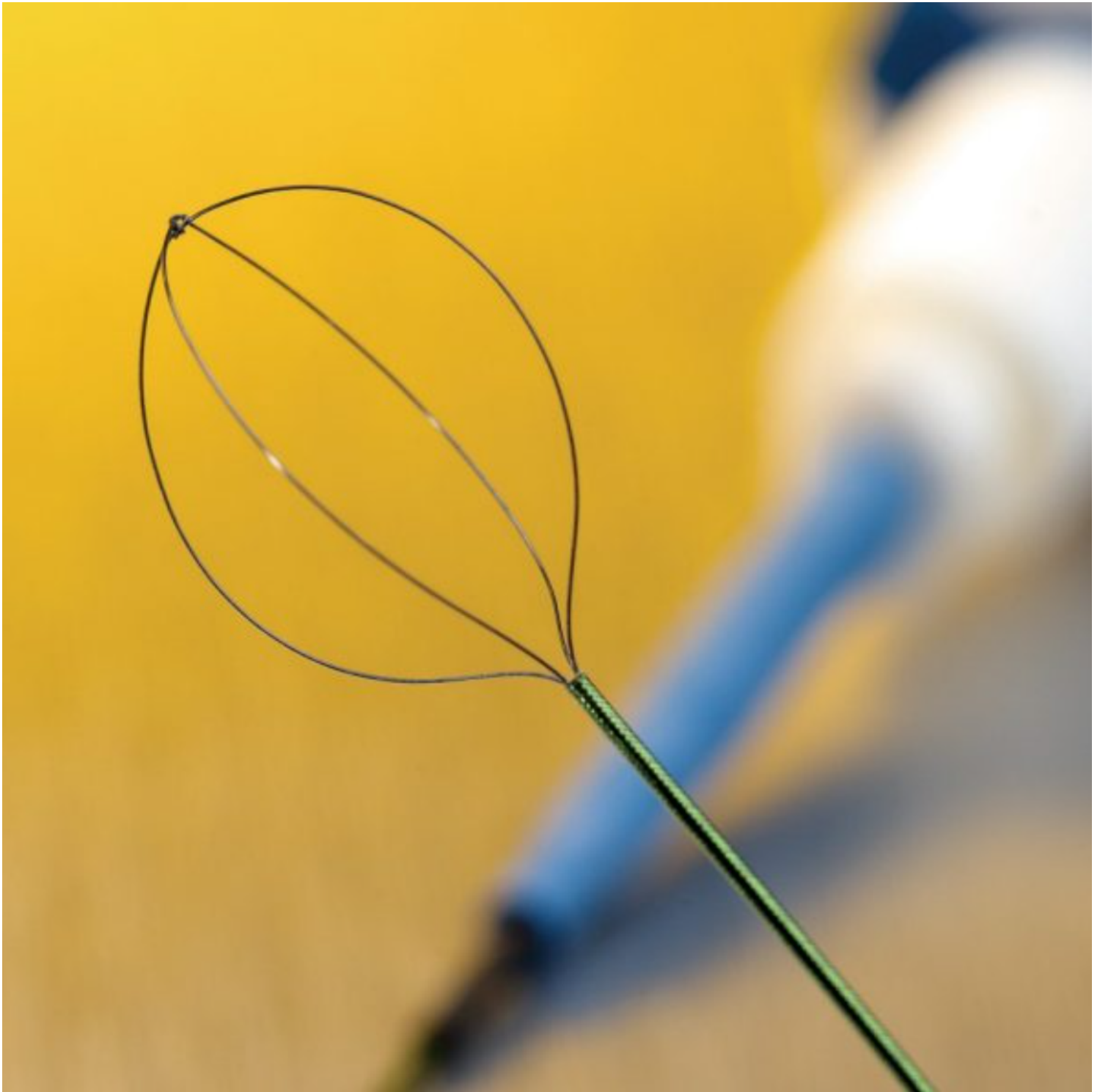


Figure 1

Regarding the method and description of the FFB procedure, concise information and knowledge can be obtained elsewhere (12,14). In this study foreign bodies in the airways were extracted by FFB (EVIS EXERA III CLV-190) with a diameter of 2.8 and 3.5 mm and “Zero Tip” Nitinol Stone retrieval 4-wire basket with 1.9F (0.63mm) diameter that maintains its shape in the most challenging anatomy (figure-1).

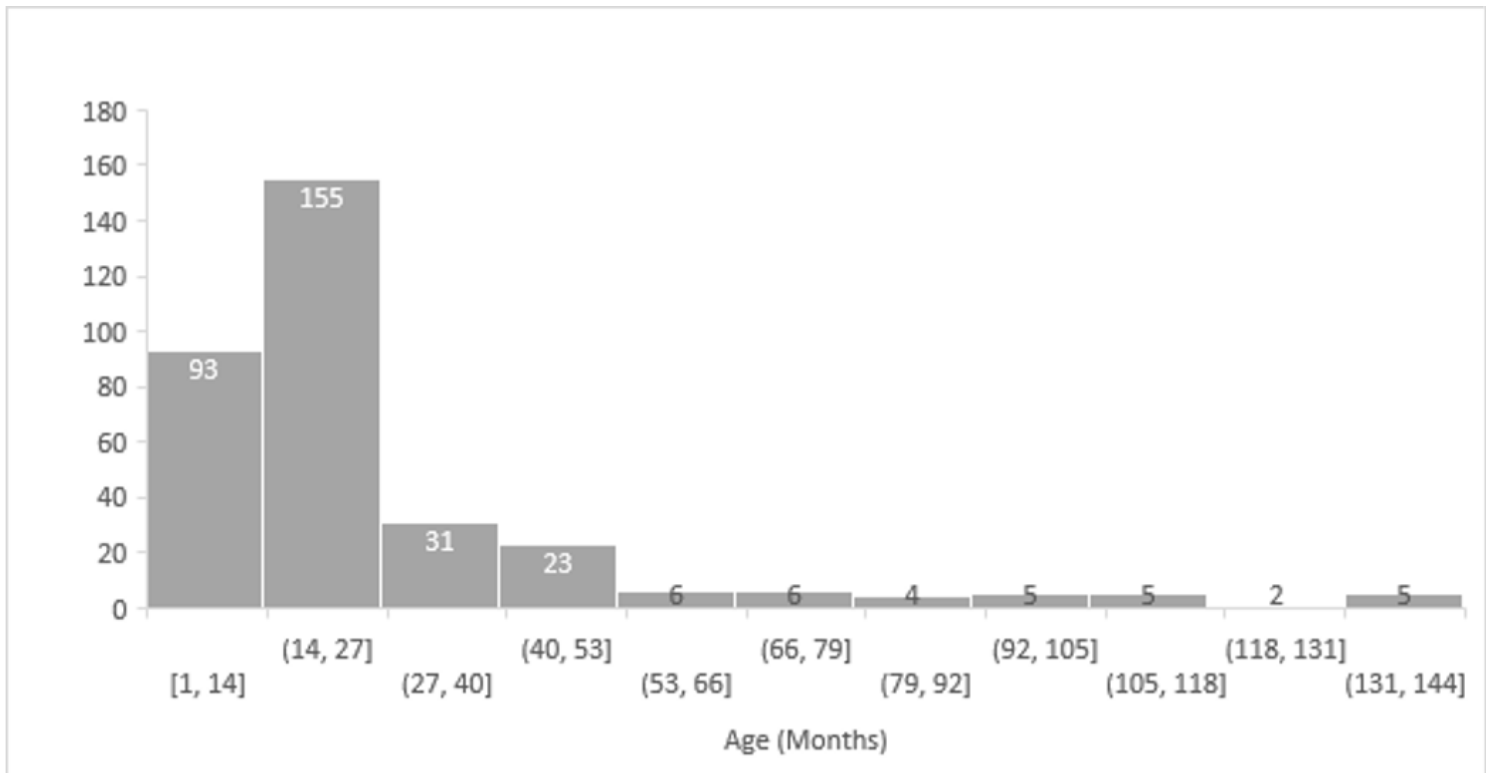


Figure 2

A total number of 366 patients underwent FFB to remove possible foreign objects over 5 years. Among the 366 medical records, 8 records were incomplete, hence 358 records were gathered and evaluated. 130 (36.72%) of the patients were female and 224 (63.28%) were male and The mean age was 28.54 months \pm 1.45 (range: 1 to 168 months, 95% CI: 25.63-31.36). The age distribution is also demonstrated in Figure-2.