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# Prevalence of flexible bronchoscopic removal of foreign bodies in the advanced elderly

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## Abstract

**Objectives:** to define the likelihood and establish the overall safety and effectiveness of flexible bronchoscopy in the removal of foreign bodies in the advanced elderly compared to those younger.

**Design:** a retrospective case–control analysis.

**Setting:** tertiary care academic hospital.

**Population:** 7,089 adults (age >18 years), including 949 (15%) advanced elderly (age >75 years), who underwent flexible bronchoscopy between January 1995 and June 2007.

**Measurements:** in those patients with foreign body aspiration (FBA) ( $n = 20$ ), a comparison of multiple clinical characteristics based on defined age groups (group 1, age <75 years and group 2, age >75 years) was performed.

**Results:** FBA requiring bronchoscopic removal was greater than three and a half times more likely in patients aged >75 years compared to those younger (OR 3.78, CI 1.4–10;  $P < 0.05$ ). Flexible bronchoscopy was 87.5% effective in the removal of foreign bodies in the advanced elderly and associated with no increase in adverse events.

**Conclusion:** bronchoscopic removal of foreign bodies is more likely in the advanced elderly when compared to those younger. This implies that this population may be most at risk. Flexible bronchoscopy is a safe and effective initial diagnostic and therapeutic approach in this age group.

**Keywords:** *foreign body aspiration, elderly, advanced elderly, flexible bronchoscopy*

## Introduction

Foreign body aspiration (FBA), defined as the introduction of a large particulate material into the tracheobronchial tree,

is a rare event that increases with age [1–4]. Despite this age association, the risk of FBA in older adults remains poorly defined. The presence of cerebrovascular disease, heart

failure and lung disease as well as other factors such as dysphagia, dementia or sedating medication that affect the level of consciousness all have been suggested to predispose older adults to aspiration [5–9]. Whether these conditions affect the likelihood of FBA remains unknown. Without prompt recognition and removal, FBA can result in severe and potentially life-threatening problems [1, 2, 10, 11]. Flexible bronchoscopy (FB) is regularly performed to confirm and identify foreign bodies and is effective in FBA removal [12–14]. Although large case studies on FBA in adults have been published [1–4], there is no specific literature addressing bronchoscopic removal of foreign bodies in older adults despite previous reports that bronchoscopy in this age group is generally safe and well tolerated [15–21]. The most common indications reported for FB in older adults are pneumonia, pulmonary infiltrates and possible neoplasm [15]. Institutional experience at Wake Forest University Baptist Medical Center (WFUBMC) suggested that both diagnostic and therapeutic bronchoscopic removal of foreign bodies occurred more frequently in very old adults, defined as age  $\geq 75$  years. A study was designed to determine whether the very old were more likely to undergo bronchoscopic removal of foreign bodies and whether FB provides a safe and effective method of foreign body removal in this age group. We reviewed the last 12.5 years of experience at WFUBMC with therapeutic bronchoscopy for the removal of foreign bodies (January 1995–June 2007).

## Methods

### Study design

A retrospective case–control study examining bronchoscopies related to FBA in very old adults was performed at WFUBMC, a tertiary care academic medical centre. Procedural logbooks from the bronchoscopy laboratory were reviewed, documenting all adult bronchoscopies, defined as age 18 years or older, from January 1995 to June 2007. All procedures with the indication of FBA, both suspected and known, were identified. A review of the paper chart or electronic medical record was then performed to verify whether suspected cases were true FBA events. Only clearly documented or proven FBA events were included in the final analysis. After all cases were identified, the medical record was reviewed, and the following clinical characteristic data were collected: age, gender, nature of material aspirated, the presence or absence of radiological changes, presenting symptoms, the presence of possible contributing risk factors (underlying neurological disease, congestive heart failure or pulmonary disease), the mechanism of foreign body removal (flexible vs. rigid bronchoscopy), device (s) utilised for removal, dosage and type of sedation utilised, complications of bronchoscopy and outcome of the FBA event (survival). Lastly, age and gender for all adult bronchoscopies performed at WFUBMC during this same time period were documented for comparison. Bronchoscopic procedures were excluded from analysis when age or gender could not be

identified due to recording errors or when the information was protected. Safety of bronchoscopy was assessed by reviewing procedural documentation (beginning from start of bronchoscopic procedure to patient discharge from a post-procedure recovery area) and then identifying any major complications (defined as cardiovascular collapse, respiratory failure requiring intubation, or death) or minor complications [defined as cardiovascular changes (i.e. alterations in heart rate, heart rhythm or blood pressure) or reductions in pulse oximetry that required additional treatment to complete the procedure or that occurred in the recovery area after procedure]. Effectiveness of bronchoscopic removal was defined as identification and removal of the foreign body.

### Analysis

Case–control comparison was limited to age only. Two hundred control subjects were selected randomly using Microsoft Excel<sup>®</sup> (Redmond, WA, USA). This was accomplished by randomly selecting 10 patients (controls) that had undergone a bronchoscopic procedure in the same year as each FBA event (cases). Statistical significance for case–control analysis was calculated using chi-square (Pearson uncorrected). Comparison of the clinical characteristics for FBA was performed by placing patients into two age groups, group 1 (age  $< 75$  years) and group 2 (age  $\geq 75$  years) (Table 1). Comparison of the clinical characteristics between group 1 and group 2 was performed using Fisher's exact test. The percentage of FBA per total bronchoscopies per decade of age beginning at age 18 years (ages 18–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75–84, 85+) was calculated. Lastly, the percentage of FBA per bronchoscopies was analysed based on two age groups (group 1, age  $< 75$  years and group 2, age  $\geq 75$  years). All analyses were performed using Microsoft Excel<sup>®</sup> with a  $P$ -value  $< 0.05$  considered statistically significant.

## Results

During the study period of 12.5 years, 7,089 adult bronchoscopies [4,082 (58%) males and 3,007 (42%) females] were performed at WFUBMC. Fifteen per cent (949) of these bronchoscopies were performed in persons  $> 75$  years of age. Twenty cases of true FBA requiring bronchoscopic removal were identified (Table 1). This represents 0.28% of the total bronchoscopies performed. The overall prevalence of FBA in adults requiring FB was 1.67 cases per year. FBA occurred in 11 male patients (55%) and 9 female patients (45%). Ages ranged from 21 to 93 years with a median age of 72 years. The peak prevalence of FBA, by the age distribution, occurred in the age group of 75–84 years (30%). Forty per cent (8/20) of all FBA events occurred in patients aged  $\geq 75$  years.

### FBA and bronchoscopy based on age

FBA requiring bronchoscopic removal was greater than three and a half times more likely in patients aged  $\geq 75$  years compared to those aged  $< 75$  years (OR 3.78, CI 1.4–10.0:

Table 1. FBA cases ( $n = 20$ )

Case	Age	Gender	Aspirated material	Radiological changes	Presenting symptoms	Risk factors	Removal	Outcome
Group 1								
1	21	F	Pin	Metallic object LLL	None	None	Flexible, FB not identified	Survived
2	25	F	Pushpin	Metallic object RML	Cough, wheeze	None	Flexible	Survived
3	26	F	Sand	Bibasilar airspace opacities	Intubated	Neurological	Flexible	Survived
4	39	M	Tooth	None	Intubated	Neurological	Flexible	Survived
5	39	M	Wood fragment	None	Intubated	Neurological	Flexible	Died
6	45	M	Pill fragment	RLL Atelectasis	Cough, dyspnoea	None	Flexible	Survived
7	58	M	Pill fragment	Diffuse airspace opacities	Dyspnoea, respiratory failure	None	Flexible	Died
8	61	M	Tooth	Opacity Right mid-lung	Intubated	Neurological	Flexible	Survived
9	66	M	Organic material <sup>a</sup>	Atelectasis RUL	Cough	COPD	Flexible	Survived
10	72	M	Apples	Bilateral Atelectasis	Dyspnoea, respiratory failure	CHF	Flexible	Died
11	74	F	Chicken bone	Atelectasis RML	Dyspnoea	COPD	Flexible	Survived
12	74	M	Almond	Speculated nodular density	Fever, cough, haemoptysis	CHF, neurological	Flexible	Survived
Group 2								
13	76	M	Pill	No CXR	Choking, cough, dyspnoea, chest pain	COPD	Flexible	Survived
14	77	F	Pill	Atelectasis RLL	Choking, cough, dyspnoea, wheeze, chest pain	None	Flexible	Survived
15	80	F	Organic material <sup>a</sup>	RLL opacity	Dyspnoea, respiratory failure	None	Flexible	Died
16	81	M	Button Battery	Metallic object RLL	Choking, Cough	CHF, COPD	Flexible	Survived
17	82	F	Fishbone	Soft tissue density trachea	Choking, cough, wheeze	Neurological	Flexible	Survived
18	83	F	Chocolate covered cherry	None	Cough	CHF	Flexible	Survived
19	87	M	Tooth	Soft tissue density RML	Cough, dyspnoea	Neurological, COPD	Flexible, then rigid	Survived
20	93	F	Dental appliance	Metallic object RLL	None	None	Flexible	Survived

Group 1 (age <75 years), group 2 (age ≥75 years), foreign body aspiration (FBA), foreign body (FB), left lower lobe (LLL), right upper lobe (RUL), right middle lobe, (RML), right lower lobe (RLL), chest X-ray (CXR).

<sup>a</sup>Likely foodstuff.

$P < 0.05$ ). Further analysis comparing bronchoscopic removal of aspirated foreign bodies in patients ≥65 years to <65 years of age was not statistically significant (OR 2.4, CI 0.96–6.0;  $P = 0.053$ ). The percentage of FBA per bronchoscopy per cohort (based on age) is shown in Table 2. Age >85 years represented the highest cohort with 2/90 FBA events per bronchoscopies (2.2%). The next highest 6/859 (0.7%) was for age 75–84 years. The fewest FBA per 1/1,246 (0.08%) occurred in the age cohort of 45–54 years. The per cent of FBA events per bronchoscopies was more than four times greater for group 2 (age ≥75 years) compared to group 1 (age <75 years) (0.2% vs. 0.84%).

### Safety and effectiveness of FB

FB for removal of foreign bodies in patients aged ≥75 years was not associated with an increase in adverse events when compared to those younger and was equally effective in both groups. Minor complications associated with FB were identified in both groups, but not statistically different [decrease in oxygen saturation: 1/12 (group 1) vs. 2/8 (group 2) and transient hypotension: 1/12 (group 1) vs. 0/8 (group 2),  $P = 1.0$ ]. All minor complications were recognised and treated effectively. There were no major complications. Although there were four deaths, none of these were associated with FB [3/12 (group 1) vs. 1/8 (group 2),  $P = 0.62$ ]. The overall

**Table 2.** Bronchoscopies and FBA by age cohorts

Age	Bronchoscopies	FBA	FBA/bronchoscopy (%)
18–24	225	1	0.444%
25–34	502	2	0.398%
35–44	864	2	0.231%
45–54	1,246	1	0.080%
55–64	1,603	2	0.124%
65–74	1,700	4	0.235%
75–84	859	6	0.698%
85+	90	2	2.22%

Foreign body aspiration (FBA).

effectiveness of FB was 90% [group 1, 92% (11/12) vs. group 2, 87.5% (7/8),  $P = 1.0$ ].

### Clinical characteristics

The clinical characteristics of patients are summarised in Table 1. Between the two groups, choking was the only statistically significant presenting symptom, occurring in 50% (4/8) of group 2 patients (age  $\geq 75$  years) compared to none of the patients in group 1 (age  $< 75$  years) ( $P = 0.029$ ). No other clinical characteristic was found to be significant between the two groups.

### Discussion

Fatal and non-fatal FBA occur rarely but are more often present in the extremes of life (i.e. the very young and very old) [1–4, 22]. The exact incidence of FBA in older adults is not known. It is presumed that many cases go unrecognised or resolve (expectorated) without medical attention. Thus, defining the true incidence of FBA is not practical. This study is the first to attempt to define the likelihood of bronchoscopic removal of foreign bodies as it relates to older age. Bronchoscopy performed to remove foreign bodies was more than three and a half times as likely to occur in those  $\geq 75$  years of age compared to those  $< 75$  years. This implies that the likelihood of FBA may also be higher in this age group compared to younger patients. Other studies have suggested this as well. In a large 33-year retrospective analysis of 60 adult patients, Limper *et al.* found that 42% of FBA events requiring bronchoscopic removal occurred in the seventh decade of life with a median age of 60 years [1]. Chen *et al.* reported a 15-year experience of 43 Chinese adults with FBA and found that 19/43 events (40%) occurred in the sixth decade [2]. Baharloo and colleagues described their 20-year experience with FBA in Belgium, including 28 adults, and found a peak incidence occurring in the sixth decade of life (28% of all adult cases) [3].

The 40% prevalence of FBA identified in the very old adults in this study is in agreement with Limper, but does differ by suggesting a higher median age than previously reported (72 years compared to 60 years) [1]. The increase of an ageing population since Limper's study may explain this

difference. The overall prevalence of FBA events (1.67/year) identified in this study is similar to previous studies (1.4–2.86 FBA events/year) [1–4]. The peak prevalence of FBA events occurred in the age group of 75–84 years and is also comparable to Limper's findings [1].

FB as an initial approach to foreign body removal was safe and efficacious in both groups. The success of FB in the removal of foreign bodies achieved in this study is similar to previous reports [12–14]. More importantly, no differences were found in procedure-associated complications when comparing very old adults with younger patients. These findings suggest that FB should be considered as the initial diagnostic procedure as well as the therapeutic modality of choice in the removal foreign bodies in very old adults. To our knowledge, this is the first study to address the safety of FB in FBA in older adults.

In reviewing clinical characteristics, choking was found to occur only in group 2 patients and achieved a statistical significance when compared to group 1. Choking combined with intractable cough is commonly referred to as 'penetration syndrome'. Limper's study suggested an occurrence of penetration syndrome in both children and adults which was reported in 49% of cases at initial presentation [1]. It is unclear in this study why penetration syndrome was found only in the very old adults. It is possibly related to the fact that four patients in group 1 were intubated serving to mask these patients' symptoms. Although choking, cough and dyspnoea do occur frequently, no symptom is reliably sensitive or specific for FBA. A presumptive diagnosis of FBA was based upon a witnessed event or the patient history in the majority of the cases presented in this study. Without a supportive history, the diagnosis of FBA was often delayed by days to month. An eventual diagnosis of FBA was obtained only after persistence of respiratory symptoms, suggestive radiological changes or an increased clinical suspicion. Therefore, practitioners who care for very old adults should maintain a high clinical suspicion for FBA in the absence of a supportive history.

Several limitations to this study must be recognised. The experience is limited to FB performed at a single institution, and the analysis utilises a retrospective approach. Although all indications for bronchoscopy were available for review, the data for analysis are dependent on the accuracy of documentation. Despite the reported safety of FB in older patients, there may be 'age' discrimination in performing FB in these patients, decreasing the overall number of FB done in this population. Other limitations of this study would include its observational nature with a possible inability to distinguish residual confounders. When considering the low incidence of FBA, a prospective, multi-institutional case-control design is likely needed to determine what prognostic factors may contribute to FBA in very old adults. This study shows that although the prevalence of FB for FBA is low in all age groups, there is significant clustering in older adults. Because symptoms and signs may not clearly suggest FBA, a high clinical suspicion for FBA should be maintained in these patients. Foreign bodies can be removed safely with FB and should be

consider the primary modality of removal in stable conscious patients.

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### Key points

- Very old adults are at a higher risk for bronchoscopic removal of foreign bodies.
- With this in mind, older adults may be more likely to experience FBA and thus a heightened clinical suspicion should be maintained.
- FB is both safe and effective in the removal of foreign bodies in very old adults.
- Choking is a common clinical characteristic in FBA, but should be considered in context with patient history, associated symptoms and radiological findings, as well as clinical suspicion.

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### Conflicts of interest

None.

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