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# Foreign Body Inhalation in Adult Population/ Thoracic Department /Baghdad / Iraq

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## Abstract

**Background:** Foreign body aspiration occurs when a foreign body enters the airway which can cause dyspnea or choking. Whatever the type of the object, any aspiration can be a life-threatening situation and demands timely recognition and action to minimize risk of complications.

**Aim of Study:** To evaluate demographic information and bronchoscopic findings in adult patients with airway foreign body aspiration and its removal and to compare it with regional, national and international studies.

**Patients and Methods:** This is a randomized retrospective study for bronchoscopically managed thirty adult patients with foreign body inhalation in single center study, done in the thoracic and vascular department, Medical City complex /Baghdad/Iraq during the period from 1st January 2017 till 31 December 2020. History taking, physical examination and laboratory findings were recorded for all the patients with radiological assessment by CXR and CT-scan. After confirmation of diagnosis, patients were scheduled for bronchoscopic intervention.

**Results:** In this study 28 patients were females and 2 patients were males. The female to male ratio was 14:1. The commonest age group affected was those in their 3rd decade followed by those in their second and forth decade. Metallic pin was the most common foreign body and was seen in 93% of patients. Rigid bronchoscopy was successful in extracting the foreign body in 93% of the patients and thoracotomy was needed in the remaining.

## 1: Introduction

**1:1 History** :Gustav Killian is regarded as the father of modern- day bronchoscopy (Fig. 39.1). He was born in Freiberg, Germany, and was an otolaryngologist. He examined the trachea and the main bronchi of a volunteer, using a laryngoscope, and was later able to remove a pork bone and three other foreign bodies from the main bronchi (Fig. 39.2). This incident was described later by his assistant Kollofrath as follows: On March 30th of this year, I had the honor to assist my admired principal, Prof. Killian, in extraction of a piece of bone from the right bronchus. This case is of such peculiarity with respect to its diagnostic and therapeutic importance that a more extensive description seems justified‖ [5, 6]. This memorable experience led Killian to coin the term ―directe bronkoscopie.‖ A direct ocular mechanism consisting of an illumination and suction

tubing attached to a rigid bronchoscope was developed by a Philadelphia-based otolaryngologist, Chevalier Jackson (1904) (Figs. 39.3, 39.4 and 39.5). This is considered to be the precursor of the modern-day rigid bronchoscopes. Dr. Jackson became renowned in his time for extracting aspirated or swallowed foreign bodies from children and adults. He kept meticulous records of every object he removed to help other doctors learn his techniques. The Mütter Museum in Philadelphia displays 2374 objects recovered by Dr. Jackson during his 75-year-long career. He conducted numerous hands-on training courses which were instrumental in increasing the acceptance of

bronchoscopy. The Pan-American Association of Otolaryngology and the International Bronchoesophagology Society were founded by Dr. Jackson. In 1907, he pub-lished the first systematic textbook on broncho-esophagology and dedicated it to Killian, the ―father of bronchoscopy‖ [7]. Notable mention for other contributors who provided their valu-able service in developing the field of bronchos-copy is as follows: Edwin Broyles who developed an optical telescope with forward viewing, Paul H. Holinger for bronchoscopic photography,

Until the late 1800s, airway foreign body removal was performed by bronchotomy. The first endoscopic removal of foreign body occurred in 1897. **Gustav Killian** is regarded as the father of modern-day bronchoscopy. He was born in Freiberg, Germany, and was an otolaryngologist. He examined the trachea and the main bronchi of a volunteer, using a laryngoscope, and was later able to remove a pork bone and three other foreign bodies from the main bronchi. This memorable experience led Killian to coin the term ―directe bronkoscopie.‖ [1, 2]

A direct ocular mechanism consisting of an illumination and suction tubing attached to a rigid bronchoscope was developed by a Philadelphia-based otolaryngologist, **Chevalier Jackson** (1904). This is considered to be the precursor of the modern- day rigid bronchoscopes. Dr. Jackson became renowned in his time for extracting aspirated or swallowed foreign bodies from children and adults. In 1907, he published the first systematic textbook on bronchoesophagology and dedicated it to Killian, the ―father of bronchoscopy‖ [3]

**Storz** and **Wolf** became the two pivotal companies that introduced newer technologies and newer versions of the rigid bronchoscope. On the other hand, in the United States the next task at hand was the development of telescopic optics for bronchoscopy. This was accomplished by **E. Broyles**, who went on to introduce the optical forceps in 1948 followed by fiber illumination techniques in 1962. [4]

The potential of fiber-optic imaging in bronchoscopy was first recognized by **Shigeto Ikeda** (1962), a thoracic surgeon at the National Cancer Center in Japan. He approached the Machida Corporation to develop a flexible bronchoscope with a diameter of less than 6 mm. [5]

## 1:2 Anatomy

The trachea, also known as the windpipe, is a cartilaginous tube that connects the larynx to the bronchi of the lungs, allowing the passage of air, and so is present in almost all air-breathing animals with lungs. The trachea extends from the larynx and branches into the two primary bronchi. At the top of the trachea the cricoid cartilage attaches it to the larynx. The trachea is formed by a number of horseshoe-shaped rings, joined together vertically by overlying ligaments, and by the trachealis muscle at their ends. The epiglottis closes the opening to the larynx during

swallowing. It is epithelium lined with column-shaped cells that have hair-like extensions called cilia, with scattered goblet cells that produce protective mucins. [6]An adult's trachea has an inner diameter of about 1.5 to 2 centimeters and a length of about 10 to 11 centimeters ; wider in males than females.[7] It begins at the bottom of the larynx and ends at the carina, the point where the trachea branches into the left and right main bronchi.[7]

The upper part of trachea receives and drains blood through the inferior thyroid arteries and veins; the lower trachea receives blood from bronchial arteries.[8] The lymphatic vessels of the trachea drain into the peritracheal nodes that lie in front of the trachea, and paratracheal lymph nodes that lie beside it.[7]

The trachea (windpipe) divides at the carina into two main or primary bronchi. The right main bronchus is wider, shorter, and more vertical than the left main bronchus,[9] its mean length is 1.09 cm. It subdivides into three secondary bronchi (also known as lobar bronchi), which deliver oxygen to the three lobes of the right lung—the superior, middle and inferior lobe [10] The left main bronchus is smaller in caliber but longer than the right, being 5 cm long. It The left main bronchus divides into two secondary bronchi or lobar bronchi, to deliver air to the two lobes of the left lung—the superior and the inferior lobe. [9]

The secondary bronchi divide further into tertiary bronchi, (also known as segmental bronchi), each of which supplies a bronchopulmonary segment. The tertiary bronchi divide further in another three branchings known as 4th order, 5th order and 6th order segmental bronchi which are also referred to as subsegmental bronchi. [9]

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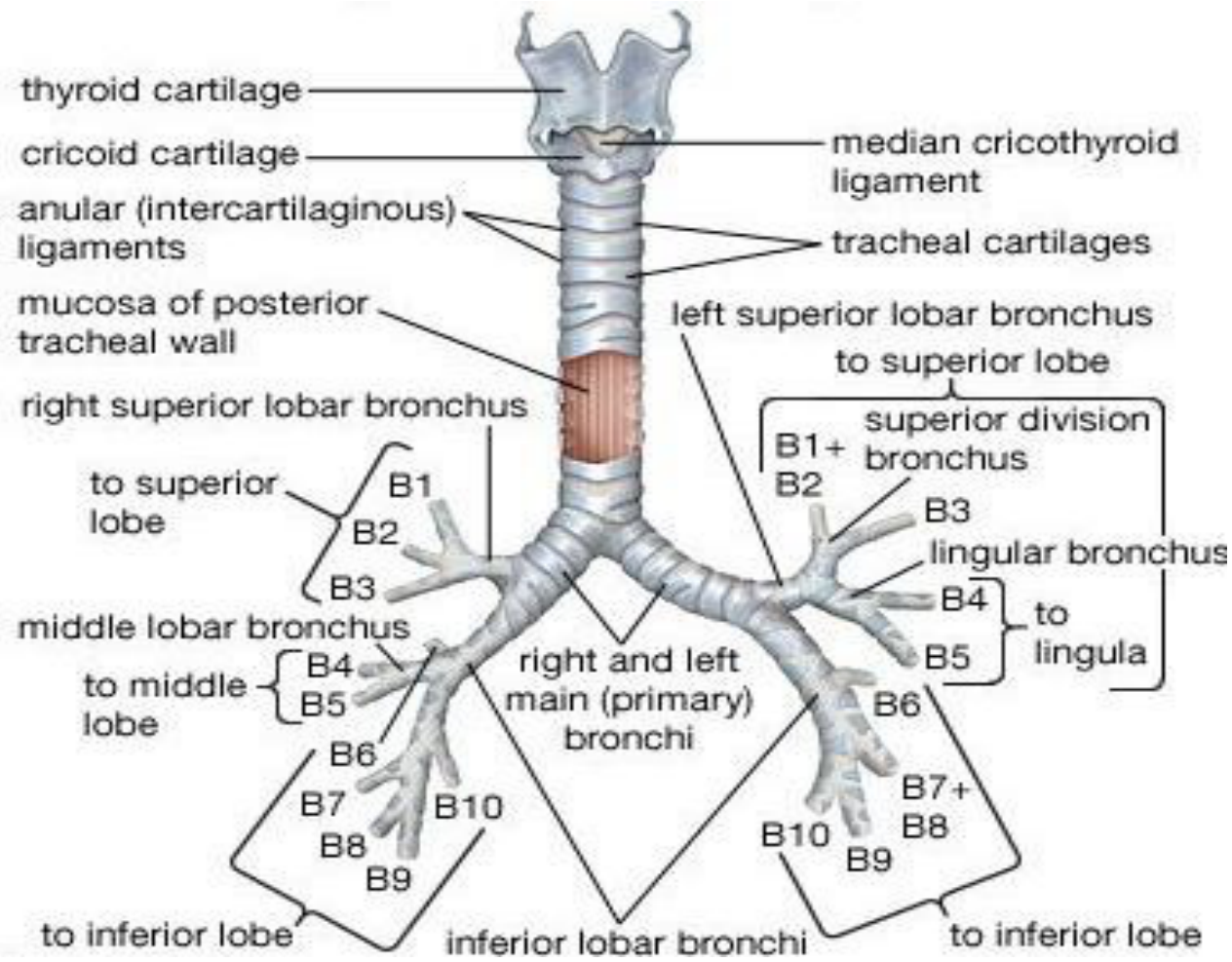


**Figure. (1)** trachea and major bronchi of the lungs 2008 encyclopedia Britannica,inc

Foreign body aspiration occurs when a foreign body enters the airway which can cause difficulty breathing or choking. Objects may reach the respiratory tract and the digestive tract from the mouth and nose, but when an object enters the respiratory tract, it is termed aspiration. The foreign body can then become lodged in the trachea or further down the respiratory tract such as in a bronchus.[11] Regardless of the type of object, any aspiration can be a life-threatening situation and requires timely recognition and action to minimize risk of complications.[12]

### 1:3 Clinical Presentation

Signs and symptoms of foreign body aspiration vary based on the site of obstruction, the size of the foreign body, and the severity of obstruction.[11] 20% of foreign bodies become lodged in the upper airway, while 80% become lodged in a bronchus.[13] Signs of foreign body aspiration are usually abrupt in onset and can involve coughing, choking, and/or wheezing; however, symptoms can be slower in onset if the foreign body does not cause a large degree of obstruction of the airway. With this said, aspiration can also be asymptomatic on rare occasions.[11]

Classically, patients present with acute onset of choking. In these cases, the obstruction is classified as a partial or complete obstruction. Signs of partial obstruction include choking with drooling, stridor, and the patient maintains the ability to speak. Signs of complete obstruction include choking with inability to speak or absence of bilateral breath sounds among other signs of respiratory distress such as cyanosis.[11] A fever may be present. When this is the case, it is possible the object may be chemically irritating or contaminated.[14]

Foreign bodies above the larynx often present with stridor, while objects below the larynx present with wheezing. Increased respiratory rate may be the only sign of foreign body aspiration in a child who cannot verbalize or report if they have swallowed a foreign body.[13]

If the foreign body does not cause a large degree of obstruction, patients may present with chronic cough, asymmetrical breath sounds on exam, or recurrent pneumonia of a specific lung lobe.[11] If the aspiration occurred weeks or even months ago, the object may lead to an obstructive pneumonia or even a lung abscess. Therefore, it is important to consider chronic foreign body aspiration in patients whose histories include recurrent pneumonia or lung abscess with or without fever.[14]

In adults, the right lower lobe of the lung is the most common site of recurrent pneumonia in foreign body aspiration. This is due to the fact that the anatomy of the right main bronchus is wider and steeper than that of the left main bronchus, allowing objects to enter more easily than the left side.[11]

### 1:4 Etiology

Most cases of foreign body aspiration are in children ages 6 months to 3 years due to the tendency for children to place small objects in the mouth and nose. Small, round objects including nuts, hard candy, popcorn kernels, beans, and berries are common causes of foreign body aspiration.[15] Latex balloons are also a serious choking hazard in children that can result in death. A latex balloon will conform to the shape of the trachea, blocking the airway and making it difficult to expel with the Heimlich maneuver.[16] In addition, if the foreign body is able to absorb water, such as a bean, seed, or corn, among other things, it may swell over time leading to a more severe obstruction.[17]

In adults, foreign body aspiration is most prevalent in populations with impaired swallowing mechanisms such as the following: neurological disorders, alcohol use, advanced age leading to senility (most common in the 6th decade of life), and loss of consciousness.[15]

**1:5 Diagnosis History**

The most important aspect of the assessment for a clinician is an accurate history provided by an event witness. Unfortunately, this is not always available.[14]

**Physical examination**

A physical examination by a clinician should include, at a minimum, a general assessment in addition to cardiac and pulmonary exams. Auscultation of breath sounds may give additional information regarding object location and the degree of airway obstruction.[14] The presence of drooling and dysphagia (drooling) should always be noted alongside the classic signs of airway obstruction as these can indicate involvement of the esophagus and impact management.[18]

**Diagnostic Imaging Chest x-ray**

Most patients receive a chest x-ray to determine the location of the foreign body. Lateral neck, chest, and bilateral decubitus end-expiratory chest x-rays should be obtained in patients suspected of having aspirated a foreign body.[13] However, the presence of normal findings on chest radiography should not rule out foreign body aspiration as not all objects can be visualized.[11] Objects that are radiopaque include items made of most metals except aluminum, bones except most fish bones, and glass. If the material does not block the x-ray beams it is considered radiolucent and will appear dark which prevents visualization. This includes material such as most plastics, most fish bones, wood, and most aluminum objects.[19]

Signs on x-ray that are more commonly seen than the object itself and can be indicative of foreign body aspiration include visualization of the foreign body or hyperinflation of the affected lung.[19] Other x-ray findings that can be seen with foreign body aspiration include obstructive emphysema, atelectasis, and consolidation.[20]

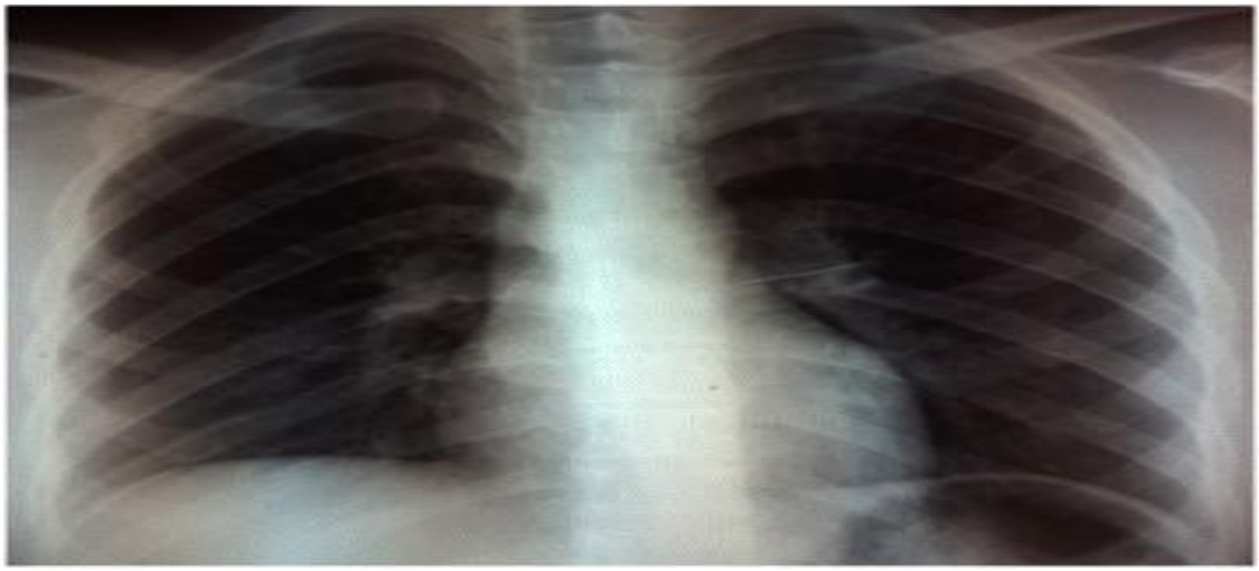

**Figure. (2)** Chest radiograph showing a pin located in left superior lobar bronchus. J Cardiothorac Surg. 2015; 10: 61.

**Ultrasonography**

Intra-operative ultrasonography is occasionally employed to identify sub-pleural radiolucent foreign bodies. [21]

**Computed Tomography**

Computed tomography (CT) of chest helps in localizing and evaluating the nature of the FB and provides better information compared to a plain chest radiograph. The FB is visible on CT in 62% cases and helps in identifying concomitant or indicative consolidation, atelectasis, pleural effusion and bronchial wall abnormalities. [21]

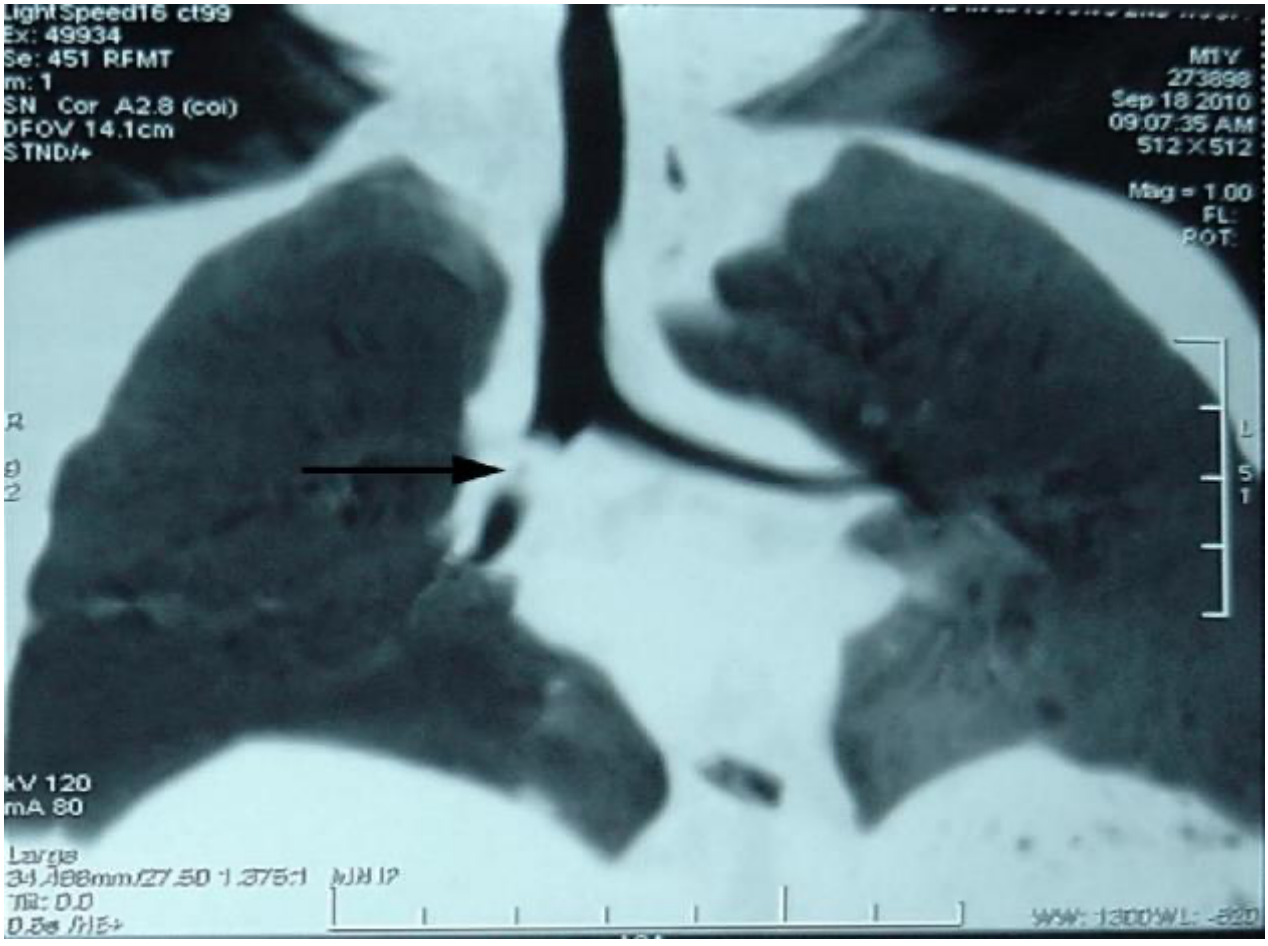


**Figure. (3)** a representative case of tracheobronchial foreign body (arrow) detected by chest CT scan. A retrospective study of 2,000 cases in Northwestern China September 2015 Therapeutics and Clinical Risk Management 11(default):1291-5

**Fluoroscopy**

Fluoroscopy provides real time images and is rarely used for FB evaluation. [19]. It has been used intraprocedurally to guide forceps especially, when the FB gets lodged distally. [22,23]

**Rigid bronchoscopy**

Rigid bronchoscopy under general anesthesia is the gold-standard for diagnosis since the foreign body can be visualized and removed with this intervention. Rigid bronchoscopy is indicated when two of the three following criteria are met: report of foreign body aspiration by the patient or a witness, abnormal lung exam findings, or abnormal chest x-ray findings.[11]

**1:6 Bronchoscopy in Evaluation and Management of FB Aspiration**

**Flexible Bronchoscopy**

Rigid bronchoscopy was widely used until the advent of flexible bronchoscopy by Shigeto Ikeda in 1968. This has transformed the field of bronchoscopy including the management of FB removal. [24] Flexible bronchoscopy allows better visualization of distal airways and can be performed under local anesthesia or moderate sedation though general anesthesia may be more conducive for removal of impacted FB. Overtime, with advancement in bronchoscopy tools and experience with flexible bronchoscopy, it has become the standard technique for initial evaluation and management of FB aspiration among adults. [25] While flexible bronchoscopy is the most common modality for FB removal among today adult, rigid bronchoscopy retains its utility. It is the mainstay for FB removal in children and adolescents.[26]

**Rigid Bronchoscopy**

Rigid bronchoscopy was preferred in patients with no comorbidities, previous failed attempt to remove FB, a longer duration of aspiration and FB of hard consistency. In the latter situation, rigid bronchoscopy is particularly preferred as rigid instruments allow better transfer and control of force in extracting hard and impacted foreign bodies. Also, it allows access to larger suction as significant bleeding may occur with manipulation during extraction of impacted FB, particularly the ones lodged in airway for longer duration.[21]

**Preprocedural planning**

FB removal can be challenging and requires proper planning and organization. Careful history taking and imaging review helps with understanding the nature of FB and thus the tool selection. It is essential for the bronchoscopist to study the size, shape and the position of the FB before any intervention. Organizing the required bronchoscopy instruments and review of procedure plan with the staff is extremely helpful at the time of the procedure. Appropriate patient positioning, such as Trendelenburg position, is helpful in preventing the distal movement of the FB and making it easy for retrieval. Authors prefer to have a rigid bronchoscope available, even when flexible bronchoscopy is chosen as the primary modality.[27]

**Aim of The Study**

To evaluate demographic information and bronchoscopy findings in adult patients with airway foreign body aspiration and its removal.

## 2: Patients and Methods

This is a randomized retrospective study for bronchoscopically managed adult patients with foreign body inhalation in the thoracic and vascular department, surgical sub specialties hospital of the Medical City Teaching Hospital/Baghdad/Iraq during the period from 1st January 2017 till 31 December 2020.
The main determinant of sampling and inclusion in our study was the bronchoscopically treated patients with foreign body inhalation in patients above 14 years of age for both genders.
The documents of 30 patients were studied in our center during 4 years, only patients whom met criteria of the study were included. The other patients were excluded from the study mainly pediatric patients or adult patients who refused bronchoscopy.

History taking, physical examination and laboratory findings were recorded for all the patients with radiological assessment by CXR and CT-scan in some of them. After confirmation of diagnosis, patients were scheduled for intervention.
The information collected from records from patients' medical files and surgeon notes.

Patients were scheduled for bronchoscopy under general anesthesia after fasting for 4-6 hours, taken to the bronchoscopy unit, at which the proper size rigid bronchoscope was selected. Adequate grasping forceps and sucker all to be checked prior to induction of anesthesia. A venous access line inserted. Monitor for $SpO_2$ and pulse rate established by pulse oximetry. Adequate pre oxygenation and short acting muscle relaxant given. The rigid bronchoscopy passed down the trachea and suction of any collected secretion done. The foreign body localized first and by the suitable forceps to be grasped and at that moment the anesthetist to be informed that the foreign body is ready for retrieval, so that the anesthetist will be ready for any unwanted event. The patients were monitored till full recovery. Patients back to the ward and continued to be monitored and after few hours to resume oral fluid intake. Rigid bronchoscopy was successful in retrieving the foreign body in almost all of the cases and surgery represented by thoracotomy was needed only when bronchoscopy attempts failed. A data form used to collect and organize the data of patients which include introductory information about the patient (age, gender), presenting symptoms, pre bronchoscopy investigations, imaging findings, bronchoscopy finding, and post-bronchoscopy possible complications, any morbidity or mortality.

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## 3: Results

Twenty-eight patients were females and two patients were males in our study. The female to male ratio was 14:1. As shown in the fig. (4)

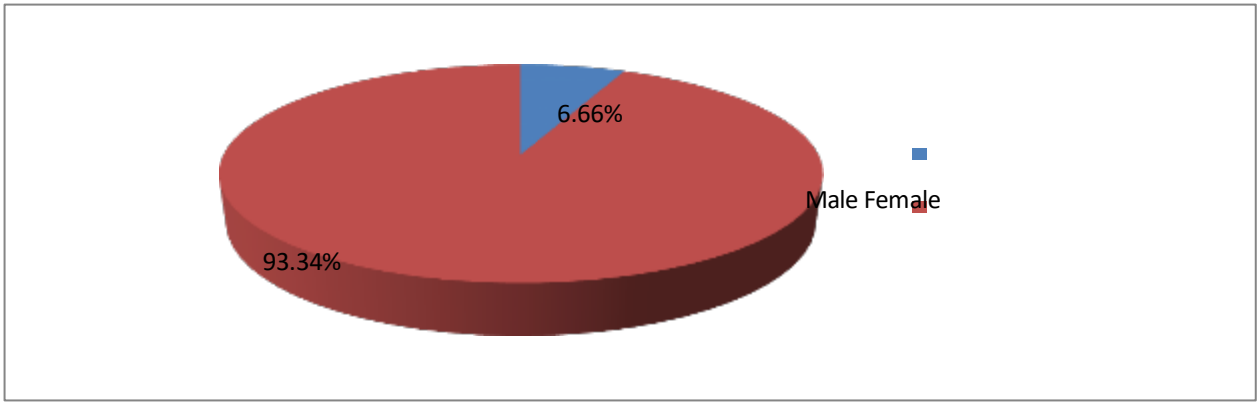


**Figure. (4)** Gender Distribution

The commonest age group affected was those in their 3rd decade followed by those in their second and forth decade whereas the lowest in extreme age groups. As shown in fig. (5)

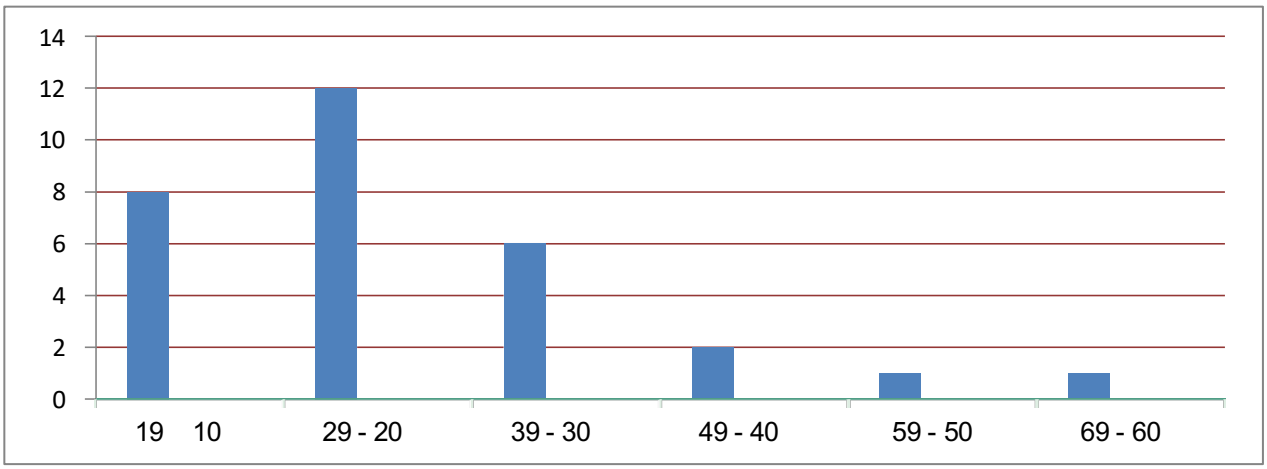


**Figure. (5)** Age Distribution

The most common symptoms were cough (50%) followed by dyspnea (26%),whereas the least symptom was hemoptysis(6.6%). As in the table (1)

**Table (1) signs and symptoms of foreign body inhalation**

| Signs And Symptoms | Frequency | Percentage |
|---|---|---|
| Cough | 15 | 50% |
| Wheezing | 8 | 26.6% |
| Dyspnea | 8 | 26.6% |
| Reduced Air Entry | 5 | 16.6% |
| Chest Pain | 4 | 13.3% |
| Fever | 4 | 13.3% |
| Hemoptysis | 2 | 6.6% |

The commonest site for foreign body inhalation was the left main bronchus (70%) followed by the right main bronchus (10%). As shown in table (2)

**Table (2)**. Site of foreign body dislodgement in the tracheobronchial tree

| Site Of Foreign Body | Number Of Patients |
|---|---|
| Trachea And Carina | 2 |
| Right Main Bronchus | 3 |
| Left Main Bronchus | 21 |
| Right Lower Lobar Bronchus | 2 |
| Left Lower Lobar Bronchus | 2 |

Metallic pin was the commonest foreign body and seen in 93% of the patients. As shown in table (3)

**Table (3)**. Type of foreign body

| Type of foreign body | Number of patients |
|---|---|
| **Metallic pin** | **28** |
| **Whistle** | **1** |
| **Screw** | **1** |

Rigid bronchoscopy was successful in extracting the foreign body in 93% of the patients and thoracotomy was needed in only the remaining two patients. As shown in table (4)

**Table 4**. Operation performed to extract the inhaled foreign body

| Procedure | Number Of Patients |
|---|---|
| **Rigid Bronchoscopy** | **28** |
| **Thoracotomy** | **2** |

The most common complication was atelectasis seen in 13% of patients followed by hemoptysis and bronchiectasis 3.3%. while no mortality seen in our research. as shown in table (5)

**Table (5).** Postoperative complications

| Complication | Frequency | Percentage |
|---|---|---|
| **Atelectasis** | **4** | **13%** |
| **Hemoptysis** | **1** | **3.3%** |
| **Bronchiectasis** | **1** | **3.3%** |

## 4-Discussion

Foreign body inhalation is an uncommon entity in adults. Here we describe our experience with rigid bronchoscopy in the removal of tracheobronchial foreign bodies in adults.

In our study the female patients were twenty eight, while the male patients were only two for which the female to male ratio was 14:1, this was comparable to (MD et al.) who demonstrated the female to male ratio of 1.3:1 There were 151 (42.3%) male and 206 (57.7%) female [28], while not comparable to ( Abdulameer et al. nor with DÖNER et al. ) who demonstrated the female to male ratio as 1:1.8 and 1:1.5 respectively. [29,30] . neither with the study done in China where the female to male ratio was 1:3 [33].

the commonest inhaled foreign body was metallic pin. This is comparable to (MD et al. and DÖNER) who demonstrated their results as metallic pin to be the most common foreign body inhaled at a percentage 35% and 40% respectively, while not comparable to (Elhassani et al., Hussen et al. nor with abdulameer et al.) as they demonstrated their results as watermelon seed to be the most common foreign body inhaled but their study involved pediatric age groups for which most of the foreign bodies noted. [31,32] nor comparable to the study done in China where the commonest inhaled foreign body was bone. **[33]**

In our study females were more commonly affected than males which explained because of most of the girls and women accustomed to wear scarfs fixed by pins which could be accidentally inhaled and impacted in the main bronchi. [32]

In our study the commonest age group affected by foreign body inhalation was those in their 3rd decade (40%) followed by those in their second (26.6%) and forth decade (20%), this was comparable to (MD et al.) who had the 3rd decade as the commonest age group at a percentage of 43.2%. while not comparable to (Abdulameer et al.) who demonstrated the 1st decade as the most common age group, this could be explained by that they take all age groups in their study for which the majority of the cases were pediatrics. [28,29]

The main risk factor for foreign body inhalation was pin holding by lips during veil wearing while in study done in Chine foreign body inhalation occurred in older patients and the main risk factor was drug addiction followed by neurovascular diseases. [82]

The most common symptoms were cough (50%) followed by dyspnea (26%), reduced air entry (16%), etc. This is comparable to (Abdulameer et al, MD et al., DÖNER et al.) and the study done in Chine where cough was the commonest symptom. **[28-30,33]**

In our study the left main bronchus was the commonest site for the lodgment of foreign bodies (70%). This is not comparable to none of the Abdulameer , w. m. Hussen et al., Elhassani et al. , MD et al., DÖNER et al. nor to the study done in Chine where the right main bronchus was the commonest site. Although the right main bronchus is the preferred site of lodgment of foreign body, the metallic pin was more frequently removed from the left main bronchus. [28-31,34]

An X-Ray of the chest should be obtained before bronchoscopy. No matter how many X-ray films have been performed, the final one must be performed to check the presence and position of the

foreign body immediately before bronchoscopy.

In our study all the foreign bodies were radiopaque therefore they were detected by X-ray film. Although only chest radiography was used for diagnosis in majority of the cases in present study, a computed tomography scan was needed in two patients out of thirty (which accounts for 6.6%) where the rigid bronchoscope failed to retrieve the foreign body, and thoracotomy was needed in order to localize the segmental and subsegmental location of the inhaled pin and whether it is impacted or implanted in the lung parenchyma or not. This is incomparable to (DÖNER et al.) where they needed computed tomography in 80% of their patients. [30] and this could be partly due to difficulties in reaching the computed tomography unit, and the excellent experience of the surgeons in our study.

Bronchoscopy is the treatment of choice for the removal of all tracheobronchial foreign bodies. The rigid optic bronchoscope allows excellent visualization of the tracheobronchial lumen, and facilities the use of biopsy forceps to remove the foreign body.

The procedure was carried out under general anesthesia using rigid bronchoscope with calibers chosen according to the size and age of the patient. Out of 30 patients in our study by rigid bronchoscope foreign body was extracted in 28 patients (93.3%). Thoracotomy was needed in the remaining 2 patients. In these two patients, the foreign body was so distal that it was out of reach of the rigid bronchoscope and it was embedded within the bronchial wall by granulation tissue due to the long duration between the time of inhalation and the time of bronchoscopy. And Fiberoptic flexible bronchoscope with or without a rigid bronchoscope was not done for the same reason above. This mean that only 6.6% needed open surgical intervention in our study and this is comparable to (DÖNER et al.) who demonstrated the result as only 5%.

(30)

The most common complication was atelectasis seen in 13% of patients, in whom history revealed long standing missed foreign body which was treated as repeated chest infection, this was comparable by a case report by (W. M. Hussen et al.). followed by hemoptysis and bronchiectasis 3.3%. [34]

There was no mortality reported in our study, this was comparable to (Abdulameer et al.) who had no mortality in their study. but not comparable to (Elhassani et al.) who had 0.09% death rate nor comparable to (MD et al.) who demonstrated the results as 0.56%. this can be explained by the good experience and intervention by the surgeons and that almost all of our patients have no morbidity, as well as small sample size. [28,29,32]

## 5-Conclusions

1. The female to male ratio was 14:1 due to increased incidence of pin inhalation among females due to wearing a veil with pin.
2. The most frequent affected age group by foreign body inhalation are those in their 3rd decade followed by those in their fourth decade.
3. Metallic pin was the commonest inhaled foreign body and contributed to 93% of all cases.
4. Inhaled metallic pin lodge more frequently in the left main bronchus as compared with the right.
5. Bronchoscopy is a safe and effective procedure for the removal of adult airway foreign bodies in the almost all of cases.
6. Surgery was considered when bronchoscopy attempts failed to retrieve the foreign body.

## 6-Recommendations

1- Prevention is better than treatment so all the cases should be considered preventable and every effort should be made to prevent foreign body inhalation.
2- Programs by television, radio etc. should be held to educate people about the risk of foreign body inhalation and the way of prevention.

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