

N. Saki MD¹
S. Nikakhlagh MD²
M. Tahmasebi MD³

Diagnostic Accuracy of Conventional Radiography for Esophageal Foreign Bodies in Adults

Background/Objective: Foreign body in the esophagus is a common emergency presentation. Conventional x-ray imaging is usually obtained to aid the diagnosis during the initial evaluation. The decision for surgical intervention is usually based on a suspicious history, physical examination and radiologic findings. Our hypothesis is that radiographic imaging should not alter the decision for surgical intervention in patients with a suspicious history and appropriate findings on physical examination.

Patients and Methods: Seven hundred and five adult patients with suspected impaction of an esophageal foreign body were reviewed from 1994 to 2006 at Imam Khomeini Hospital, Ahwaz. Plain films were performed in every patient with suspected esophageal foreign body (EFB). Patients were included in this review if they were older than 15 years of age, initially presented for ingested foreign body evaluation, and underwent radiographic imaging prior to surgical intervention. Only adults satisfying all 3 criteria were included.

Results: The study group contained 705 patients (528 male and 177 female) with the male-female ratio of 3:1. Of the total 705 cases, 636 patients had a radiologic study suggestive of FB and 623 cases (98%) had an FB at the time of esophagoscopy. The remaining 69 patients did not have an FB at the time of esophagoscopy. The sensitivity and specificity of conventional radiographs in the diagnosis of an ingested FB were 100% and 84.2%, respectively. Chicken bones were the most frequently responsible foreign body and the area just below the cricopharyngeus muscle was the most frequent level of impaction. Rigid esophagoscopy was used successfully for foreign body removal in 97.6%.

Conclusion: The approach towards a patient with a foreign body in the esophagus comprises a thorough history and systematic examination followed by relevant investigations. Ingested FBs are commonly investigated with cervical x-ray studies.

Keywords: Esophageal, Foreign Body, Conventional Radiography, Esophagoscope, Adult

Introduction

Foreign body (FB) ingestion is an everyday occurrence and a common emergency presentation.¹ Many ingested FBs become impacted, often in the esophagus, and have the potential to cause serious complications, apart from significant distress to the patient and family. The otolaryngologist is often called upon to aid in the diagnosis and management of these difficult cases. The decision for operative intervention is based on a complete history and physical examination.²⁻⁴ Conventional x-ray imaging is usually obtained to aid the diagnosis during the initial evaluation.^{3,5} The basic principles of endoscopic removal of FB management have not changed since the days of Chevalier Jackson. The first esophagoscope used in 1890 by Mackenzie was later improved by Jackson, Ingals, and Mosher.^{5,6} We performed this study to identify the role of radiology in the diagnosis, treatment, and complications of esophageal foreign bodies.

In this study, we retrospectively reviewed the cases of ingested FB at Imam Khomeini Hospital that had both radiologic imaging and surgical intervention between 1994 and 2006.

1. Associate Professor, Department of Otolaryngology, Head and Neck Surgery, Ahwaz Jondishapour University of Medical Sciences, Ahwaz, Iran.

2. Assistant Professor, Department of Otolaryngology, Head and Neck Surgery, Ahwaz Jondishapour University of Medical Sciences, Ahwaz, Iran.

3. Assistant Professor, Department of Radiology, Ahwaz Jondishapour University of Medical Sciences, Ahwaz, Iran.

Corresponding Author
Nader Saki

Address: Department of Otolaryngology, Head and Neck Surgery, Imam Khomeini Hospital, Ahwaz, Iran.

Telefax: +98-611-377-2027
E-mail: nsaki_lr@yahoo.com

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Patients and Methods

In a cross-sectional study, 705 adult patients who required esophagoscopy for suspected impaction of an esophageal foreign body were admitted and treated at Imam Khomeini hospital of Ahwaz Jondishapour University of Medical Sciences from March 1994 to June 2006. The following findings were reviewed: sex, age, diagnosis on admission, history of preexisting disease, clinical symptoms on admission, type of radiographic investigation, estimated duration and site of impaction, type and number of foreign body(ies) removed, complication and duration of hospital stay.

Patients were included in this review if they were older than 15 years of age, initially presented for ingested foreign body evaluation, and underwent radiographic imaging prior to operative intervention. Only adults satisfying all 3 criteria were included. Ingested FB was defined as an ingestion of foreign substance lodging between the hypopharynx and the distal esophagus.

The number and type of different x-ray studies were recorded for each patient. The charts and official reports of each x-ray study were reviewed to determine the type of radiographic abnormality, its location within the esophagus, and if it was suggestive of an esophageal FB. These factors were compared to the intra-operative findings at the time of surgical intervention (direct laryngoscopy and esophagoscopy). The time interval between the ingestion and x-ray study was determined in each case. The study population was grouped by different time intervals depending on the elapsed time from ingestion to endoscopy. The clinical diagnostic value (sensitivity, specificity, accuracy, negative predictive value and positive predictive value) of the x-ray studies in identifying the presence of FB were determined for the entire study group.

Results

The study group contained 528 male patients and 177 female patients with the male-female ratio of 3:1. The age of the patients ranged from 15 years to 78 years, with the median age of 47.5 years.

Odynophagia was the commonest symptom, followed by dysphagia. Impactions were most common in the cervical esophagus just below the cricopharyngeus muscle—522 cases (84.1%)— followed by the piriform sinus—62 cases (9.9%)—the middle third—24 cases (3.9%)—and the distal third of the esophagus—13 cases (2.1%). Bones from chicken or meat were usually surrounded by soft tissue and had sharp edges; their average length was 4 cm, meat without bones was also found as a bolus with an average size of 2 cm × 4 cm. All foreign bodies were removed by rigid esophagoscopy, except for 5 cases that required left lateral cervicotomy. These cases included 4 dentures and one big beef bone lodged in the cervical esophagus.

A total of 1394 radiologic studies were used to evaluate these patients: 1310 AP & lateral cervical x-rays, 72 PA & lateral chest x-rays, 6 abdominal x-rays and 6 fluoroscopic studies of the chest. These studies were suggestive of an ingested FB in 636 patients. Of these 636 patients, 623 (98%) cases had an FB at the time of esophagoscopy.

Of the 705 patients who had esophagoscopy, 623 (88.4%) had a foreign body. The type of the FBs in our investigation are listed in Figure 1.

The time intervals between the ingestion and the surgical intervention are shown in Figure 2.

The sensitivity and specificity of conventional radiographs in the diagnosis of an ingested FB were 100% and 84.2%, respectively. The positive predictive value (PPV) and negative predictive value (NPV) in our study were 98% and 100%, respectively. The accuracy was 98.2% (Table 1).

Chicken bone (Fig. 3) was the most frequently encountered foreign body, followed by beef bone (Fig.

Table 1. Diagnostic Indices of Radiography for Esophageal Foreign Body

True Positive	False Negative	True Negative	False Positive	Sensitivity (CI 95%)	Specificity (CI 95%)	PPV (CI 95%)	NPV (CI 95%)	PLR (CI 95%)	NLR
623	0	69	13	100% (99.4-100)	84.2% (74.4-91.3)	98% (96.5-98.9)	100% (94.8-100)	6.3 (3.8-10.4)	-

PPV: Positive Predictive Value, NPV: Negative Predictive Value, PLR: Positive Likelihood Ratio, NLR: Negative Likelihood Ratio

4), meat, fish bone, metallic objects (Fig. 5), dentures, coins and glass. Two patients had received radiation for an esophageal carcinoma. Nine patients had a history of esophageal foreign body impaction, four of them had a history of caustic ingestion and one was a laryngectomized patient.

Most patients, even those in whom no foreign body was found, reported relief of symptoms after esophagoscopy, 85.1% of the patients initiated oral intake in the first 24 hours after foreign body removal and 78% were discharged by the third day.

The average hospital stay was 2.5 days. In 11 patients (1.56%) complications were found, but no deaths occurred. Complications such as deep neck infection, esophageal perforation, ulcerative esophagitis and stricture of the esophagus were detected.

Discussion

Cricopharyngeal and esophageal foreign bodies are potentially hazardous and may pose problems regarding their diagnosis and management. They may sometimes produce fatal complications or may be indicative of an underlying disease. When an esophageal foreign body is suspected by history and physical examination, a radiologic evaluation is performed to assess its location and size and to anticipate the possibility of multiple foreign bodies.^{3,4,6,7}

Patient presentations vary, although dysphagia and odynophagia are the most frequently reported symptoms.^{5,8} Other features that may be present include history of an FB ingestion,⁸ presence of persistent FB sensation,^{7,8-10} chest pain,¹¹ pooling of saliva,^{6,12} vomit-

ing^{1,13} and regurgitation.^{1,5} The patient could either be asked to point towards the area of maximum discomfort (or FB sensation) or could be asked to swallow to determine the possible site of FB lodgment.^{10,14} The water-drinking test and positive laryngeal rub both have high sensitivity and specificity for esophageal FBs.¹⁵ In our study, odynophagia was the commonest symptom, followed by dysphagia. Impactions were most common in the cervical esophagus just below the cricopharyngeus muscle—522 cases (84.1%)—followed by piriform sinus—62 cases (9.9%)—the middle third—24 cases (3.9%)—and the distal third of the esophagus—13 cases (2.1%). This concurs with the findings of Halvorson.⁶

X-ray evaluation is indicated for all patients in whom an esophageal FB is suspected.^{5,16} Lateral and anteroposterior roentgenograms of the neck, along with chest and abdomen x-rays, can be conducted to elicit a radio-opaque FB. Esclamado and Richardson reported that AP and lateral soft tissue cervical x-rays are superior to chest x-ray studies in the diagnosis of FB.¹⁷ Svedstrom et al. reported the sensitivity and specificity of 68% and 67%, respectively, in their series of 83 patients.⁹ Halvorson et al. reported that 5 out of 7 patients with an FB in their series had diagnostic cervical films.⁶ In our study, a total of 1394 radiologic studies were used to evaluate the patients; 1310 AP and lateral cervical x-rays, 72 PA and lateral chest x-rays, 6 abdomen x-rays and 6 fluoroscopic studies of the chest. These studies were suggestive of an ingested FB in 636 patients. Of these 636 cases, patients with a radiologic study suggestive of an FB—621 (97.6%)—had an FB at the time of esophagoscopy

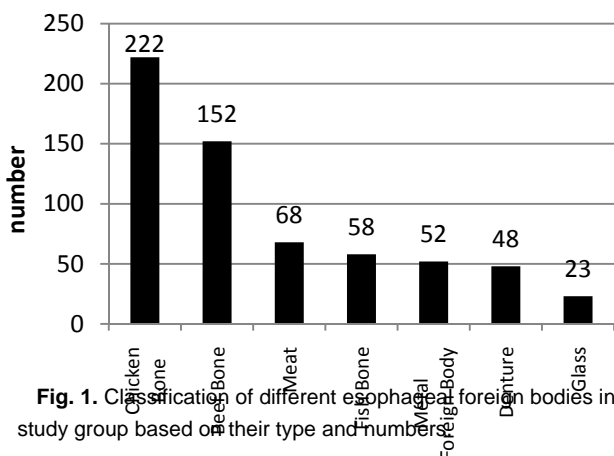


Fig. 1. Classification of different esophageal foreign bodies in study group based on their type and number.

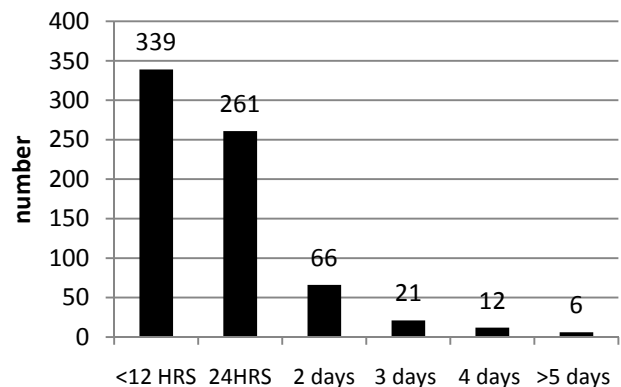


Fig. 2. Elapsed time from ingestion to endoscopy in patients with and without foreign body (n=705)



Fig. 3. Chicken bone in the upper esophageal lumen in a 62-year-old female patient.



Fig. 4. Beef bone lodged in the cricopharynx of a 48-year-old male patient.



Fig. 5. Metal foreign body lodged in the upper esophagus of a 60-year-old female patient.

A. AP view.

B. Lateral view.



and 2.4% did not.

In undetected cases and cases of suspected perforation, CT scanning should be performed.¹³ The pres-

ence of even radiolucent objects could be hinted at by air entrapment in the preceding portion of the esophagus,⁶ although radiological findings are not consi-

dered helpful for identification purposes in cases of radiolucent FBs.^{11,15}

Ingested FBs are commonly imaged with cervical x-ray studies. The sensitivity and specificity of conventional x-ray studies in the diagnosis of an ingested FB were 93.8% and 65%, respectively, in our study. Svedstrom et al. reported sensitivity and specificity of 68% and 67%, respectively, in their series. They concluded that chest x-ray studies are neither sensitive nor specific enough to diagnose FB. Our data support this statement.

A high index of suspicion for an ingested FB must be maintained during the evaluation of a patient with a history of an ingested event or suspicious GI symptoms.

If a high index of suspicion is not maintained, then a delay in diagnosis can occur. A delay of less than 24 hours in diagnosis has been noted in 40% to 72% of cases in several studies.^{4,6,8}

PPV refers to the chance that positive test results will be correct. The PPV in our study was 98%. On the other hand, NPV is concerned only with negative test results. In our study, all of 69 negative test results were correct, giving an NPV of 100%.

The decision for surgical intervention is based on a suspicious history and physical examination. The history is of paramount importance. The patient who presents with a history of ingestion of an inedible substance places the physician in a position of having to prove whether or not a foreign body is retained. Radiopaque foreign bodies can be identified in many instances with a lateral neck X-ray. Evidence of non-opaque foreign bodies of the esophagus may also be found, such as an increase in the distance between the cervical vertebrae and the larynx and trachea or air in the cervical esophagus. If the foreign body cannot be located on the lateral neck X-ray, posterior-anterior and lateral chest X-rays may demonstrate a radiopaque foreign body. If the foreign body cannot be located in this manner, a contrast study of the esophagus is necessary.^{5,7,9,13}

There is no rule of thumb to determine whether a foreign body is present or even more difficult to rule out its presence, but in our experience, presenting symptoms have been the most accurate indicators of foreign body impaction. As in other series, odynophagia and dysphagia have been associated with a

higher incidence of foreign body impaction. In addition pharyngeal discomfort has been associated with a higher incidence of negative esophagoscopy. It may be difficult to differentiate the foreign body from ossification in the laryngeal cartilages. Air in the soft tissues or in the esophagus, held open by a non-opaque foreign body, is an important sign.^{14,15} Most of our patients initially try to dislodge their impaction by drinking water or eating a small bolus of bread.

Most esophageal foreign bodies in adults are of considerable size, with cutting borders and sharp points. We found rigid esophagoscopy a safe, reliable technique for removing foreign bodies. This technique has great advantages over blind methods. The method allows direct visualization of the foreign body and its possible damage to the esophageal mucosa and also allows esophagus re-exploration to confirm that no foreign bodies remain. Perforation risks are about 0.6%, which are low.

Age and sex, as well as the nature of the foreign bodies, have changed in the different series. Coins, fish bones and safety pins are no longer the most frequently found foreign bodies, but in our study, chicken bones were the most frequent. We agree with Phillips and Patel that the main reasons for people ingesting a foreign body are either sheer misfortune or sheer carelessness by people bolting food.¹⁶

Early recognition and treatment of esophageal foreign bodies is imperative because the complications are serious and can be life-threatening. Radiology plays an important role in the initial diagnosis, in recognition of complications, and in treatment. Esophagoscopy is the safest method for esophageal foreign body extraction.

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