

PATTERNS, MANAGEMENT AND OUTCOMES OF PATIENTS WITH AERO-DIGESTIVE TRACT FOREIGN BODIES AT KENYATTA NATIONAL HOSPITAL

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DEBRA MUTILE ELIJAH

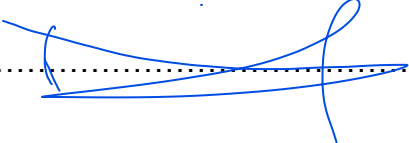
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STUDENT DECLARATION

I declare that this study is my original work and has not been presented for an award of any degree at any other institution or university.

Dr. Debra Mutile Elijah

Signature:.......... Date: 25th May 2023.....

Department of Surgery
University of Nairobi
Principal Investigator


SUPERVISORS APPROVAL

This research dissertation has been submitted with our approval as the University of Nairobi supervisors.

Dr. Mark Nelson Awori

MBChB, MMed(Surg.), FCS CTS (ECSA).

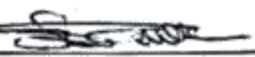
Senior Lecturer and Consultant Congenital Cardiac Surgeon.
Department of Surgery- University of Nairobi.

Signature:  Date: 29th May 2023

Dr. Daniel Kinyuru Ojuka

MBChB, MMed (Surgery)

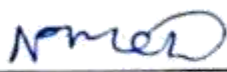
Senior Lecturer and Consultant General Surgeon
Department of Surgery-University of Nairobi.

Signature:  Date: 26.5.2023

Dr. Nikita Mehta

MBChB, MMed (TCVS)

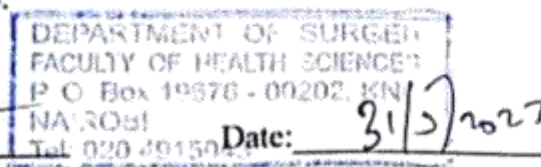
Lecturer and Consultant Cardiothoracic Surgeon
Department of Surgery-University Of Nairobi

Signature:  Date: 29/5/2023

DEPARTMENTAL APPROVAL

This is to certify that this dissertation is the original work of Dr Debra Mutile which was presented at a departmental meeting held on September 29th 2022 and thereafter approved by the Kenyatta National Hospital – University of Nairobi Ethics and Research Committee (KNH-UoN ERC).

Signature: _____



Dr Kiboi Julius Githinji, MBChB, MMed (UON)

Senior Lecturer and Consultant Neurosurgeon

Department of Surgery

University of Nairobi

ACRONYMS AND ABBREVIATIONS

ENT – Ear Nose and Throat

F.B. – Foreign Body

FBA – Foreign Body Aspiration

FBI –Foreign Body Ingestion

FDA – Food and Drug Administration

CPSC – Consumer Product Safety Commission

KNH – Kenyatta National Hospital

LOHS – Length of Hospital Stay

SD – Standard Deviation

CI – Confidence Interval

DEFINITION OF TERMS

- Foreign body - is an endogenous or exogenous substance inconsistent with the anatomy of the site where it is found.
- Aero-digestive Foreign Body – refers to a Foreign Body in the airway or digestive tract; for purposes of this study this refers specifically to esophageal, tracheal, and bronchial F.B.s.
- Pattern: Patient characteristics consist of age and sex. Clinical characteristics include symptoms such as dysphagia, odynophagia, drooling, cough, choking, dyspnea, and clinical findings of dehydration, wasting, lethargy, respiratory distress, wheezing, rhonchi, and reduced breath sounds.
- Outcome – determined using the length of hospital stay, morbidity, and mortality.
- Morbidity – determined by perforation, fistula formation, need for lung resection, and need for esophageal replacement

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ABSTRACT

Study background: Aero-digestive foreign bodies (F.B.s) are increasingly being encountered in the surgical units in many hospitals. F.B. lodgement in the aero-digestive tract constitutes an important cause of significant morbidity and mortality in patients. Whereas it is notably common, a dearth of information exists on its patterns, treatment, and associated outcomes.

Broad objective: The broad objective was to establish the pattern, management, and outcomes of foreign body aspiration and ingestion at Kenyatta National Hospital.

Study design: Retrospective cohort study.

Study site: Kenyatta National Hospital, records department.

Participants and methods: All patients who were admitted and treated for foreign body aspiration and ingestion at the KNH from January 2017 to December 2021 were recruited through consecutive sampling. Data was collected on demographic and clinical characteristics, treatment methods, and outcomes (determined by length of hospital stay, mortality, and morbidity) of F.B. aspiration and ingestion.

Data analysis: The collected data was entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics such as means and medians were used in the description of the characteristics of the study participants. Chi-square tests were used in comparing categorical variables and proportions across groups. Continuous variables were compared using a student t-test.

A p-value of less than 0.05 was considered statistically significant. Data was presented in written reports, frequency tables, bars, and pie charts.

Results: A total of 196 participants were recruited, aero-digestive F.Bs occurred more commonly in the paediatric population with a mode of 2-3 years, and a female preponderance at 53.06%. Symptoms lasted an average of 32.6 days, with an SD of 136. Endoscopy (83.67%) was the most commonly utilized method of extraction. Foreign bodies commonly lodged in the esophagus (73.47%), then bronchi (18.37%), and trachea (1.53%). Hospital stay averaged at 4.5 days with an SD of 8.1, and no mortalities were reported. Morbidity was observed in 9.18% of the patients.

Conclusion: The study revealed aero-digestive foreign bodies were encountered more commonly in the pediatric population, with coins being the most frequently ingested and button batteries causing the most morbidity.

A high index of suspicion for foreign body ingestion and aspiration should be maintained for children with a history of treatment for respiratory tract infection and those with overt symptoms such as drooling, dysphagia, odynophagia, and weight loss.

Surgery was performed in patients who the foreign body could not be extracted via endoscopy and for longstanding foreign bodies, while watchful waiting was an option for ingestions that showed distal migration on imaging. Early diagnosis, referral, and intervention are crucial to alleviate associated morbidity.

CHAPTER ONE

1.0 INTRODUCTION

Aero-digestive tract foreign bodies are defined as inhalation and ingestion of an F.B. into the airway and digestive tract, respectively. Specifically, Foreign Body Aspiration refers to the occurrence of a foreign object inferior to the vocal cords, which can potentially be life-threatening since it can obstruct the respiratory tract, thus impairing oxygen flow and breathing. In contrast, foreign body ingestion is the presence of foreign objects in the esophagus.

Food is usually the most prevalent foreign body in adults in the aero-digestive tract. Small inedible objects such as toys are more prevalent for infants and toddlers as they tend to explore the environment with their oral cavity (1,2).

The common symptoms of foreign bodies in the esophagus include pain or difficulty swallowing. However, they can lead to complete digestive tract obstruction with an overflow of discharges and aspiration. Big objects in the esophagus can compress the trachea leading to respiratory difficulty or stridor (3,4). Patients may sometimes present subtle symptoms, especially if the FBA was unwitnessed. Thus, to establish a diagnosis, the physicians require thorough history taking, examination, and use of imaging and bronchoscopy as adjuncts to investigating the problem (1). While FBA is rare in adults, it is not unheard of and is potentially life-threatening. Symptoms include a choking episode and subsequent occurrence of cough and dyspnea, which may mimic a chronic lung disease like asthma.

The ideal investigation for F.B. aspiration is bronchoscopy. However, chest radiographs and Computer Tomography may be adjuncts to assessing the problem (3).

An aero-digestive foreign body is a prevalent condition more commonly affecting the pediatric population. About four-fifths of occurrences happen in patients aged 15 years and below, with one-fifth occurring over 15 years, as indicated by data from the National Security Council (1).

Mortality from FBA is largely known to occur in children under 1 year and older people over 75 years. Among the causes of accidental deaths in children, FBA ranks fourth, with literature indicating a peak incidence between one to two years. Tracheobronchial FBA is uncommon among older children and young adults, with the incidence rising in older people over 75 years and mortality peaking at 85 years. The rate of FBA in adults has been reported as 0.66 per 100,000. One institution documented the extraction of 89 F.B.s in adults over 20 years. In contrast, a study at the Mayo Clinic reported 60 adults treated for FBA over 33 years, and research from an institution in Taiwan documented 43 cases over 15 years (4).

According to some studies, bronchi form the common site for aspirated F.B.s, with the right bronchus being more commonly affected than the left. However, no clear data exist on the laterality of the F.B. in the airway (5,6). The occurrence of complications is largely influenced by the object's size, location, and duration after aspiration (7).

If the correct diagnosis is made after three days after the aspiration of onset of symptoms, it is referred to as a late diagnosis. Such can occur in children due to parental negligence, professional misdiagnosis, normal imaging findings, atypical symptoms and signs, poor patient management, and negative findings after bronchoscopy.

The esophagus presents the most prevalent site of impaction in the ingested foreign body (2,8). The foreign objects often lodge in physiologic or pathological luminal narrowing areas, such as the upper and lower esophageal strictures.

While obstruction may be partial or complete, a partial obstruction may be emergent in cases where the object is embedded in the wall and causes perforations. The most common symptom post ingestion is acute dysphagia (9), which may be accompanied by an inability to swallow oral secretions (hypersalivation), gagging and choking, retrosternal fullness, odynophagia and in some cases, blood-stained saliva. A tightly impacted object can cause pressure necrosis and increase perforation likelihood when the F.B. is left in situ for more than 24 hours (10). Impacted discs and button batteries are of greater concern due to their causative nature of liquefactive necrosis and ease of perforation.

Information on the patterns and outcomes of foreign bodies in this environment is inadequate. Further studies are required to promote parental prevention and clinical management efforts in this condition. This study investigated foreign bodies' pattern, management, and outcomes at Kenyatta National Hospital.

CHAPTER TWO LITERATURE REVIEW

2.1 Epidemiology

2.1.1 Aspiration

The incidence of mortality from choking in children under five years in the United States is reported as 0.43/100,000, as indicated by a 2016 report from the National Safety Council. Non-fatal choking occurred with an incidence of 20.4 per 100,000 among children under 14. In 55.2% of the non-fatal choking in children under four, the most common objects were candy, hotdogs, and nuts. Regarding sex distribution, 55.4% were males; however, the sex differences were not statistically significant. Further analysis indicates that jewelry is increasingly more common, with coins becoming less common in the United States. The incidence of FBA has remained relatively similar according to data from 2001 to 2014 (2).

International data indicates that Ethiopia recorded high mortality of eleven percent, India six percent, Puerto Rico seven-point five percent, and Nigeria eight point three percent. Other studies from India have indicated a very low mortality rate of 1.58%, while China has recorded a mortality rate of below 0.25% from foreign body aspiration (2).

A two-year study in Ethiopia of children with foreign bodies presenting to Tikur Annbesa Hospital, including 81 children who had undergone rigid bronchoscopy evaluation, indicated that in 93% of the cases, the foreign objects were identified and removed. Patients' characteristics included a mean age of 4.6 years ranging from 5 months to 11 years; males were 71.1%, and females 28.9%. Objects retrieved included plastic tips 22.4%, seeds 19.7%, balloon inflator tips (9.2%), metallic tips (6.6%), and hijab pin (2.6%). Mortality was reported in 1 case (1.3%) (11).

Another research at the Tamale Teaching Hospital (TTH), Ghana, included 33 pediatric patients managed over a 5-year duration. Males were 48.5%, with females being 51.5%. Groundnuts represented 13 (39.4%), with metallic objects 7 (21.1%). The median age of occurrence was ≤ 3 years. The site of the foreign bodies (F.B.s) was the right bronchi in (75.8%) and the left main bronchi in 24.2%. Emergency tracheostomy for failed bronchoscopy was performed in 1 patient (5).

Serious complications have been noted in high-income countries at a frequency of 10% compared with low-middle-income countries at 20% (8). There is minimal data on the pattern, morbidity, and mortality of Foreign Body Aspiration in Kenya.

2.1.1 Ingestion

The United States reports more than 100,000 cases of foreign body ingestion annually. Of these, seventy-five percent occur in pediatric cases, with the most affected being children aged 6 months to 3 years. Rare cases of multiple object ingestion and recurrent instances have been reported, and if they occur, they are more notable in children with developmental and behavioral challenges or psychiatric illnesses. Mortality from foreign body ingestion is rare, probably due to prompt management; however, deaths have been reported.

Causes of foreign body impaction include underlying digestive tract abnormalities, such as those arising from surgeries, or pre-existing medical illnesses such as esophageal cancer (10,11).

2.2 Types of Foreign Bodies

2.2.1 Aspiration

Research by Saki et al. has indicated that organic objects such as food form the bulk of the most aspirated objects. Peanuts, melon, and sunflower seeds are widely reported. The differences in the types of organic objects implicated are explained by variations in culture and regional and dietary habits among different communities (12).

In Ghana, studies have indicated that fishbone, groundnuts, seeds, plastic materials, and metallic materials were the most implicated types of F.B.s. Mayo Clinic, Rochester, reported dental pieces in 14 (22%) cases, nuts in 12 (18%), corn kernels in 7 (11%), vegetable matter in 7 (11%), bones in 6 (9%), plastic pieces 4 (6%), pills 2 (3%), and one each of the following: nail, laryngeal polyp, broken piece of an endotracheal tube, broken piece of a voice prosthesis, meat, tracheostomy cleaning brush, folded drinking straw, foil, surgical staple, surgical pledget, balloon fragment, sunflower seed, and a sewing needle (4).

Ground nuts were the most reported aspirated F.B.s in India, where patients largely presented with cough, wheezing, and diminished breath sounds. The right main bronchus formed the site where most F.Bs were impacted.

However, other authors still report the left main bronchus as the most common site of F.B. lodgment. Arguments for the variations include that both bronchi are less pronounced in children than in adults (6).

2.2.2 Ingestion

With sharp objects, including pins, screws, and dental prostheses, there could be serious complications, including esophageal ulceration. In communities with high fish intakes, such as in Korea and China, fishbone ingestion is commonly implicated, especially in children. Large objects (> 6 cm in length) routinely require intervention within 24 hours since they have a lower likelihood of passing through the duodenum and ileocecal valve (9).

More than 250,000 coin ingestions in children are documented in the United States. The location of a coin in the esophagus, the age of the child, and coin size are the key determinants of whether it undergoes spontaneous passage.

Button battery ingestion is increasingly seen due to its increased use in electronic devices. These devices resemble coins in shape and size and often require a careful X-ray radiographic assessment to avoid diagnostic delays (9).

Other increasingly noted ingested objects in children are the magnets. A single one can be spontaneously excreted if not too large. If multiple or a single one with metallic objects, their contact with mucosal surfaces can result in severe effects (9).

2.3 Risk factors

2.3.1 Aspiration

Children tend to place objects in their oral cavity, thus a higher likelihood of F.B. aspiration. Other contributing factors to aspiration include a lack of molars to chew solid food types, crying or running with objects in their oral cavity, and underdeveloped mechanisms which coordinate swallowing (2).

Before 2 years, molars are usually absent, which contributes to the likelihood of FBA since children in this age group cannot grind food effectively into smaller pieces. Furthermore, children use oral cavities to explore things and objects, thus increasing the risk of ingestion/aspiration. Similarly, they have high activity levels and are easily distracted while feeding, thus compounding the risk (13).

A smaller diameter of the airway in children increases the risk of obstruction. For older children and adults, the risk factors for FBA include reduced consciousness, neurologic abnormalities, and alcohol or sedative abuse.

Males are more affected than females at a ratio of 1.5 – 2.4: 1 – 1.1. Adults represent approximately a quarter of the cases. Older people aged 65 years and above tend to fail to recall the aspiration episode, with studies showing as many as 30% being affected.

Affected adults sometimes show neurological abnormalities affecting swallowing or have altered mental status, neuromuscular disorders, intoxication with alcohol, or iatrogenic causes (2,9). In most studies, the mean age in adults is between 50 to 60 years old, and FBA risk increases with age.

Dental procedures requiring local anesthesia or prone positioning are the main causes of iatrogenic F.B. aspiration in adults. Some are linked to tracheostomy care including during cleaning, for instance, with a curette. Aspiration of teeth can occur during airway management (2).

2.3.1 Ingestion

In pediatric groups, most ingestion cases are accidental with no underlying illness. Most affected are aged between 0 and 3 years, with the incidence peaking between one and two years (12). Death from FBA peaks in children < 1 year old and adults >75 years (14). Children are at more risk due to uncoordinated and immature oropharyngeal mechanisms that help prevent choking. Sometimes, foreign bodies are ingested intentionally by drug smugglers to evade detection. People with mental health disorders are also at risk, especially those that do it purposely and repeatedly, like patients with trichophagia.

The other populations at risk of unintentional foreign body ingestion include people with dentures, the elderly, and intoxicated adults due to their inability to chew food, causing esophageal impaction adequately. (2,8). Foreign bodies in the rectum have been seen to be inserted intentionally during sexual play but get lodged unintentionally.

2.4 Clinical Presentation

2.4.1 Aspiration

Asymptomatic presentation occurs, with history taking being the only source of information on aspiration. However, the more common symptoms are sudden onset of cough, choking, and dyspnea.

Choking and acute cough showed a sensitivity and specificity of 91.1% and 45.2%, respectively, according to the findings of a prospective study. Wheezing on chest examination has been documented in three-fifths of the patients, with approximately thirty-two percent having asymmetric breath sounds.

Recurrence of symptoms occurred in 50% of the F.B.s located in the esophagus and in 92 (32%) patients with symptoms, the most prevalent was vomiting (7%). An abnormal clinical examination has a sensitivity of 80.4% and a specificity of 59.5% for FBA (14,15). Suppose an F.B. is impacted in the upper respiratory system, the major bronchi, or the trachea.

Patients may present with stridor, persistent cough, dyspnea, and audible wheeze, which can point to the site of F.B. impaction. Similarly, lack of breath sounds should hint towards the affected sides.

Wheezing may occur on the dependent side when the chest is auscultated in the lateral decubitus. The ball-valve phenomenon may occur, leading to hyperinflation of the affected side with the simultaneous appearance of a larger chest cage (10). Atelectasis or lung collapse can occur due to complete airway obstruction by the F.B. with an absence of breath sounds.

2.4.2 Ingestion

Most patients presenting with foreign body ingestion present with acute dysphagia, accompanied by hypersalivation, gagging, and choking. The patient may present with hyperventilation due to anxiety and discomfort, which may mimic respiratory distress and acute dyspnea, but with normal chest auscultatory findings. Abnormal chest findings are more likely to suggest a foreign airway body rather than the esophagus (12). Other symptoms include retrosternal fullness, odynophagia, and blood-stained saliva. In some cases, the foreign body may scratch the esophageal wall but does not lodge, causing a foreign body sensation but none present.

2.5 Sites of Impaction

2.5.1 Aspiration

The right bronchial tree forms the site of most F.B.s' impaction because of an increased vertical orientation of the right main stem bronchus (9). However, the variation is not statistically notable in children. In adults, an estimated forty percent of F.B.s occur at the left bronchial tree, with only 5–11% lodging in the trachea (2,8,9).

In children, the upper airway is relatively narrowed compared to other parts of the tracheobronchial tree, thus forming the most likely site of impaction of F.B. Moreover, most children have a symmetric tracheal angle between the two bronchi. Thus F.B. tended to impact on either side at a similar frequency (9). Whenever there is a seeable aortic indentation on the trachea on X-ray images, notwithstanding the age, the right bronchial angle tends to be less discerning than the left one; thus, aspiration tends to happen more on the right lung.

According to a study conducted in Ahwaz, Iran, by the University of Medical Sciences, the distribution of foreign bodies was as follows, right main bronchus 560 (55.1%) cases, left main bronchus 191 (18.8%) cases, trachea 173 (17.1%), vocal cords 75(7.4%) and both bronchus 16 (1.6%). Forty-eight cases (8.7%) had no foreign body located during bronchoscopy (12).

2.5.2 Ingestion

The gastrointestinal tract, i.e., esophagus, gastric, and small intestines, can impact F.B.s. The esophagus is the most common site of impaction in the gastrointestinal tract (4). The esophagus has physiologic constrictions located at the upper esophageal sphincter (cricopharyngeus muscle), the level of the aortic arch, the level of the left bronchus, and the lower esophageal sphincter. Esophageal F.Bs are more prone to lodge in the areas of constrictions. Some foreign bodies can cause mechanical obstruction, while others can cause perforation, depending on the nature of the object ingested.

Esophageal constrictions are illustrated in the diagram below,

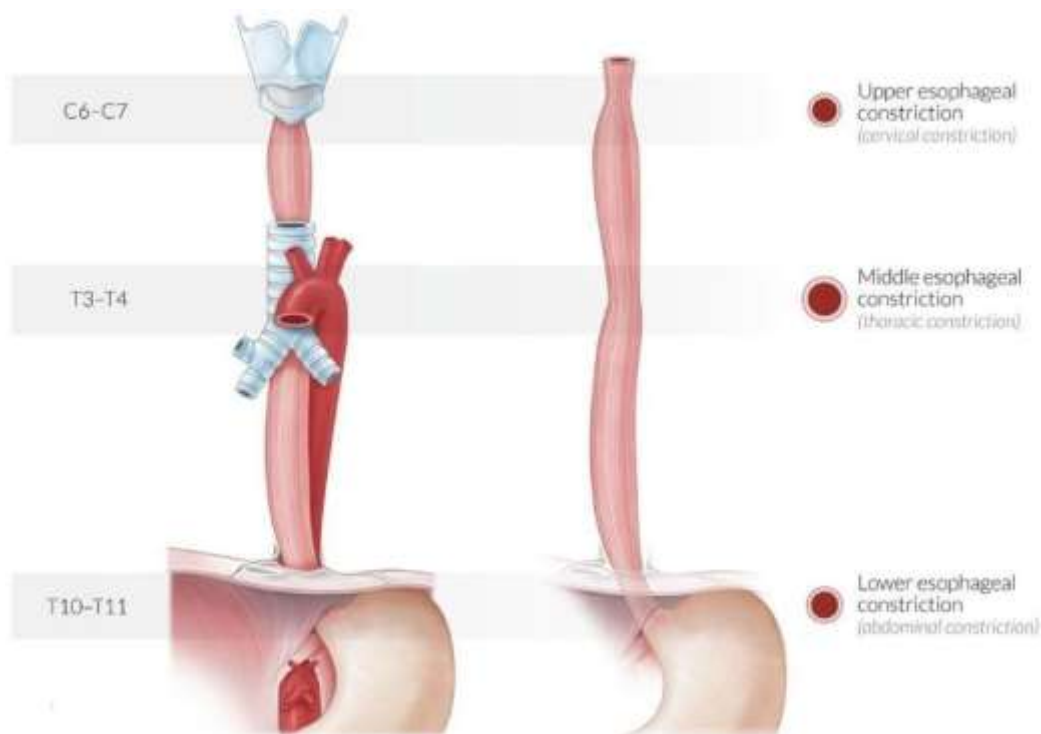


Figure 1: Anatomy of the esophagus, with an illustration of esophageal constrictions *Cervical constriction at the level of the upper esophageal sphincter; thoracic constrictions at the level of the aorta and the left main bronchus, and an abdominal constriction at the level of the lower esophageal constriction (Adapted from Amboss Esophagus) (16).*

2.6 Treatment Methods

2.6.1 Aspiration

FBA definitive diagnosis and management involves bronchoscopy or open surgical techniques to remove the offending object. Bronchoscopy is key to confirming the diagnosis of F.B. and aiding in the treatment efforts (10). However, the diagnostic equipment requires correct use to effectively identify and treat F.B. The method of treatment is largely determined by the type of F.B. (12).

Rigid bronchoscopy is the most recommended technique for F.B. extraction in the pediatric group. However, recent data indicates that flexible bronchoscopy is gaining much acceptance among practitioners (17) since it allows the assessment of subsegmental bronchi and can be performed with local anesthesia combined with deep sedation. Flexible bronchoscopy is also less invasive compared to rigid bronchoscopy (17,18). New pediatric flexible scopes are increasingly becoming available, as well as the expertise for the procedure.

Still, some studies have shown rigid bronchoscopy to be superior since it allows ventilation using the rigid bronchoscope, enhanced visualization with a rigid telescope, and greater potential to allow different sizes of suctioning and optical forceps. Using a rigid scope has a wider space for manipulation of the F.B., thus making extraction easier while avoiding blockade at the glottis level (19).

Open surgical techniques can be applied in cases of failed endoscopy. They include cervicotomy and or thoracotomy with tracheotomy for tracheal F.B.s and thoracotomy with bronchotomy for bronchial F.B.s.

As outlined by Mark et al., the physician, no matter how experienced they are, must be ready to abandon the endoscopic F.B. extraction technique and result in to open method if the following circumstances occur;

- 1) Encounter of a large object in the subglottis or trachea that can be more easily extracted via tracheostomy,
- 2) grass heads that can lead to irreversible pulmonary injury and require lung resection,
- 3) F.B.s impacted in the lung periphery,
- 4) double-pointed devices that are stuck within the respiratory tract of small children, and
- 5) any F.B. for which the likelihood of complications following the endoscopic extraction may surpass that of an open surgical approach (20).

2.6.2 Ingestion

There are guidelines for F.B. removal in the upper GIT in the adult population as defined by the European Society of Gastrointestinal Endoscopy (ESGE). Such includes the diagnostic evaluation from a history of presentation and patient symptoms followed by a meticulous clinical examination targeting the patient's general status and assessment of any emerging complications. Patients without complications with nonbony food bolus impaction are not recommended for radiographic examination.

When the F.B. is suspected to be radio-opaque, a plain X-ray is recommended to evaluate the presence, location, size, configuration, and several ingested F.B.s. Suspicion of perforation or other complications needing surgery warrants a computed tomography scan (C.T. scan). A barium swallow is discouraged since it carries an aspiration risk, worsening endoscopic vision. Clinical monitoring can be performed for patients without symptoms due to ingestion of small and blunt devices, excluding batteries and magnets while avoiding endoscopic removal. The role of medical treatment of the impaction of food in the esophagus is not clear, and it should never delay endoscopy (21).

Open surgical exploration is employed following endoscopic methods' failure to retrieve impacted F.B.s. In addition, it is performed in patients with F.B.s protruding into the neck or mediastinal space.

In a study conducted by Orji et al., in Nigeria, 13 (11%) patients underwent open surgical procedures, including cervical esophagostomy (3 cases), objects retrieved included a stuck metal beer bottle cap, a large denture, and a fish hook; thoracotomy (6 cases), objects removed included impacted dentures with 4 patients having impacted fish bones (22). Determinants for surgical approach include the location of stuck F.B. or the presence of a perforation.

Options include left lateral cervicotomy performed along the sternocleidomastoid muscle, right thoracotomy in space IV, V, and VI left distal thoracotomy, or laparotomy for impaction in the distal esophagus. The nature of the F.B. is another determining factor.

Surgery is an important adjunct to treatment, especially when other methods have failed or patients have developed complications. Perforations indicate surgery, though there are reports of successful conservative treatment. Moreover, if detected early, perforations should be repaired or diversion performed in serious cases (23).

2.7 Outcomes of Foreign Body

2.7.1 Aspiration

Several factors including the shape, size, type, position of the F.B., and the duration of aspiration before the presentation of symptoms determine the clinical status and the outcome of the FBA.

A retrospective study at the University of Medical Sciences, Ahmaz, Iran, reported that among all patients with foreign body aspiration, hospital discharges 253 patients (88.8%), hospitalizations 21 (7%), and 4 (1.4%) were referred to an outpatient facility. Besides, patients were transferred to the Observation Unit were 17 (5.9%). Among the hospitalized 21 (7.3%) cases, clinical monitoring was performed in 57%, and endoscopic procedure in 45% (2). Asphyxia at initial emergency bronchoscopy may result in some mortalities.

However, most in-hospital mortalities occur due to hypoxic cardiac arrest when the object is being extracted, rupture of the bronchus, and intraoperative complications of unspecified nature in previously stable patients (12). The cardiovascular arrest resulted in the mortality of three children during bronchoscopy (0.5%). One death during bronchoscopy (0.5%) has been reported in the literature (7). Some authors firmly state that the death of children occurs after bronchoscopy.

2.7.2 Ingestion

Some foreign bodies, especially those impacted in the esophagus, stomach, or small bowel, pass spontaneously and are released through feces within 24 hours without complications. Large foreign bodies in the GIT necessitate urgent removal due to the risk of obstruction.

Button batteries contain hydroxide, which, when it undergoes hydrolysis, can result in severe damage to the mucosa and caustic damage secondary to high pH and minimal electrical burns due to the lithium. Burns can occur as early as 4 hours of impaction (2).

Ingestion of numerous magnets or a magnet combined with a metallic foreign body can result in pressure necrosis of the mucosa, obstruction of the intestines, fistulation, and perforation. These effects occur in ingesting sharp and pointed foreign bodies leading to high morbidity and mortality. Fish bones impacted in the esophagus can cause mucosa ulceration or an inflammatory reaction leading to esophageal narrowing, perforation, an abscess in the deep neck, mediastinum inflammation, an abscess of the lung, and a fistula with the aorta

Table 1: Summary of studies detailing characteristics of aero-digestive F.B.s

Reference	Sample size	Study type	Demographic pattern	Type, Location	Outcome
Gupta et al (2013)	108	Retrospective	Ingestion – 85.2% Male – 65.22% Female – 34.78% Age - <10yrs (70.65) Aspiration – 14.8% Male – 68.75% Female- 31.25% Age - < 10yrs (50%)	Ingestion. Type- Coin (81%) Cricopharynx Aspiration. Type – Vegetative FB Location-Right Bronchus	-
Sahni et al (2021)	100	Prospective	67% - Male 33% - Female	Coin -42% Peanuts - 33% Others- 25% Esophageal -31%	-

Bronchus -6%

Others-63%

Morbidities

					3.3%
Adeoye et al (2022)	66	Retrospective	M: F ratio =1.6:1. Ingested 57.6% Aspiration 42.4%	Denture -30.3% Plastic whistle -6.1 Cervical 44.7%, Upper thoracic 26.3%, Middle thoracic 5.3% esophagus. Right bronchus -35.7% Left bronchus-25.0%	Mortality 1.5%

Lermberg et al (1996)	367	Retrospective	Esophageal: Airway FBs 2.5:1 Male: Female1.7:1.	64% FBA - nuts and seeds 50%. Ingestion Coins - 76% Rt bronchus-44% oeft bronchus-38%.	-
Ding G et al (2020)	200	Retrospective	Male: Female2.6:1 < 3yrs – 69%	FBA<2 years left bronchus >2right bronchus. Majority FBAs-	-

Food

items.

Pietraz et al
(2021)

66	Retrospective	3 years - 74.24%	Right bronchus M: F 63.64%: 36.36%	main - 57.14% left bronchus- 42.86%. Organic - 80.95%	-

Nuts - 57.14%
Inorganic-19.05%

2.8 Statement of the problem

Minimal published reports on aero-digestive foreign bodies in children exist in our local setup. Thus, this retrospective study aimed to review the pattern, clinical presentation, and type of the F.B. and the outcome of all cases managed for aero-digestive foreign bodies at the Kenyatta National Hospital, Kenya.

American Academy of Pediatrics in 2010, in a drive, to minimize the occurrence of aero-digestive F.B., proposed measures in collaboration with the U.S. Food and Drug Administration (FDA) along with the Consumer Product Safety Commission (CPSC) to monitor and regulate food items. Although this significantly helps control the situation, parental negligence has not been adequately addressed.

This study helps to identify the effect of parental/guardian sensitization on the aero-digestive foreign body and the need for emergent hospital intervention, and the complications due to ingestion and aspiration of foreign bodies. Most literature has focused on treatment strategies while ignoring the role of misdiagnosis by healthcare practitioners.

It also aimed to bridge the gap by focusing on the role of early diagnosis, identification of the need for referral, and early intervention through the sensitization of caregivers and healthcare workers to reduce morbidity and mortality caused by aero-digestive foreign bodies.

2.9 Study Justification

The findings of this study provided information on the pattern, management, and outcomes of aero-digestive foreign bodies in our local setup, as there is a shortage of information on this subject. It formed a basis for formulating local practice guidelines on managing this condition.

This study will form a basis for formulating education plans for parental/caregiver education and emphasizes to the clinician the importance of early diagnosis, identification of the need for referral, and timely intervention of patients with aero-digestive foreign bodies.

2.10 Research question

What are the pattern, management, and outcomes of aero-digestive F.B.s amongst patients seen at KNH?

2.11 Objectives of the Study

2.11.1 Broad objective

- i. To establish an aero-digestive foreign body's pattern, management, and outcomes at the Kenyatta National Hospital

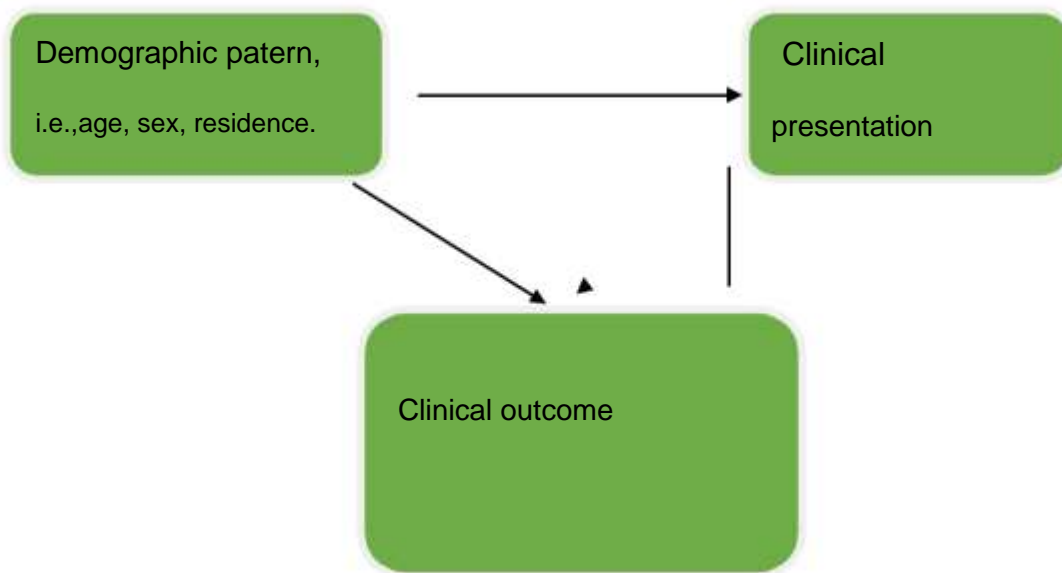
2.11.2 Specific Objectives

- i. To describe the pattern of aero-digestive foreign bodies in patients presenting at KNH
- ii. To describe the management of aero-digestive F.B.s at the KNH
- iii. To determine the clinical outcomes of patients with aero-digestive F.B.s at KNH

2.12 Conceptual framework

The conceptual framework outlines the relationship between the exposure and outcome variables. In this study, clinical outcome, including mortality or complications, is determined by the demographics, such as the patient's age, sex, and clinical presentation, such as dyspnoea or choking, among other characteristics.

Figure 2. Conceptual Framework



CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Design

This study was a retrospective cohort study of patients who presented with aerodigestive F.B.s from January 2017 – December 2021.

3.2 Study site

The study was conducted in KNH, Kenya's level 6 national referral hospital. It has a bed capacity of 1800 and receives patients from all over the country. The study was conducted at the KNH records department, Clinic 19.

3.3 Study Population

The study population was all patients who presented with aerodigestive foreign bodies and were managed at the KNH.

3.3.1 Inclusion Criteria

All patients who presented with aerodigestive F.B.s at the KNH

3.3.2 Exclusion Criteria

Patients who had incomplete records

3.4 Sample Size determination

Sample size estimation was calculated using the statistical Cochran formula,

Where;

$$N = \frac{Z^2 [P(P-I)]}{D^2}$$

Z^2 = Standard error associated with a chosen significance level (1.96)

D^2 = Sampling error margin (0.05)

P = Expected proportion of patients; the expected P is 15% for F.B. ingestion (15% is used as the expected P value) - Gupta et al. (24).

N= Sample size

$$N = \frac{1.96 \times 1.96 [0.15 (1 - 0.15)]}{(0.05)^2}$$
$$= 196$$

As preliminary data from the health records department indicated, an estimated 50 patients were seen with the condition every year in the hospital. Thus, in 5 years, approximately 250 patients were seen with foreign body ingestion or aspiration.

3.5 Sampling technique

A consecutive sampling technique was used. In this technique, all file records of patients who presented with F.B. and met the inclusion criteria were retrieved, and data was collected from them until the desired sample size was achieved. There was no specific sequencing of the files for data collection. The sequencing was based on the availability of files as they were retrieved. This method was appropriate for this study since a significant number of patients presented with this condition; hence, recruitment effectively achieved the study objectives as the files were retrieved.

3.6 Data collection

Records of patients who were managed for aero-digestive F.B.s were retrieved from Clinic 19, the records department of KNH. A research assistant (medical students above level 5) underwent a one-day training on the study topic and how to extract data from the files.

3.6.1 Quality assurance

The filled data collection tools were counterchecked for accuracy and completion by the principal investigator routinely before uploading them to the Excel sheet. Further cleaning and coding were performed after that. Passwords were used for data protection, with only the principal investigator and data manager allowed access to information to maintain the confidentiality of information.

3.6.2 Validity of the study tool

A pilot study was conducted using 10% of the study sample to confirm the applicability and validity of the study tool.

3.7 Variables

Table 2: Table of Variables

Type of variable	Variables
Independent	Age, sex, type of foreign body, location of foreign body
Dependent	Mortality, morbidity, length of hospital stay

3.8 Data Management and Statistical Analysis

The collected data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics such as means, medians, and mode were used in the description of the characteristics of the study participants. Chi-square tests were used in comparing categorical variables and proportions across groups. Continuous variables were compared using a student t-test. A p-value of less than 0.05 was considered statistically significant. Data were presented in written reports, frequency tables, bars, and pie charts.

3.9 Bias/Limitations

Missing information, i.e., unrecorded data could have impacted the study's findings. However, multiple sources and accurate retrieval of information were carried out to minimize the impact of missing information.

3.10 Ethical considerations

The research was undertaken following written approval by the University of Nairobi and Kenyatta National Hospital Scientific and Ethical Review Committee. Approval was also obtained from the KNH administration. No consent was required from patients as this was a retrospective study from file records of patients managed in the hospital.

De-identification of the participants' details was performed, where each participant was assigned a unique identifier only applicable to the study. This coded information was uploaded to excel sheet that was password protected. Data was backed up and placed in a password-encrypted hard drive only known to the principal investigator.

CHAPTER FOUR

RESULTS

4.1 Patient characteristics

4.1.1 Age

There were 196 patients presenting with a foreign body; their mean age was 5 years, median age was 3 years, with of SD=7.1 and a range of 0.08 up to 52 years.

4.1.2 Age groups

The mode of the age group affected was between 2 to 3 years (41.3%).

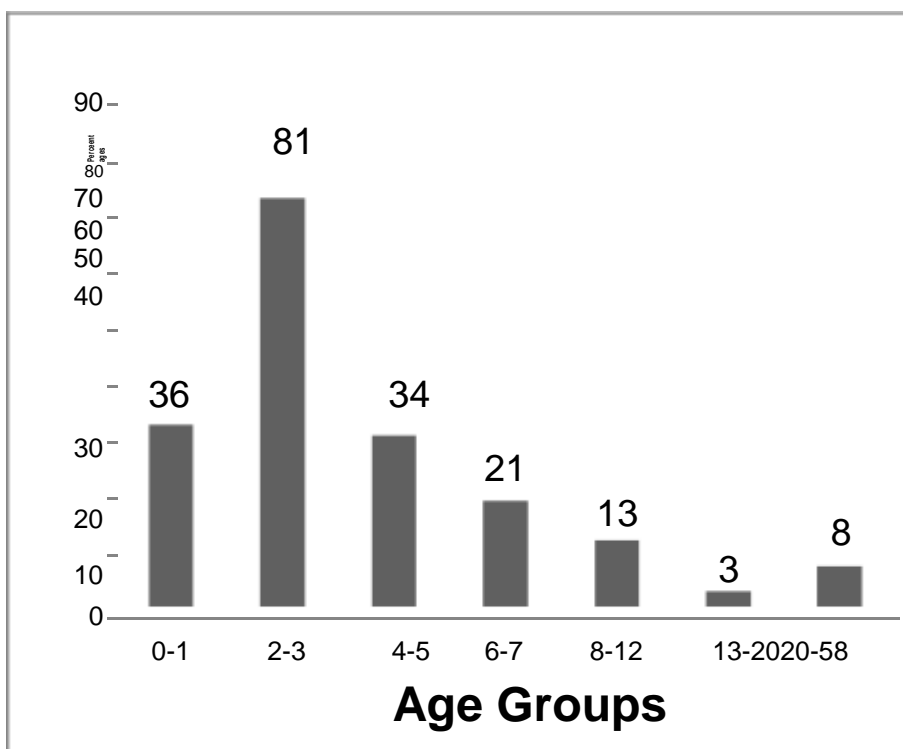


Figure 3: Bar graph of age groups

4.1.3 Sex

This illustration represents the proportion of patients by sex; and a female preponderance at 53.06%.

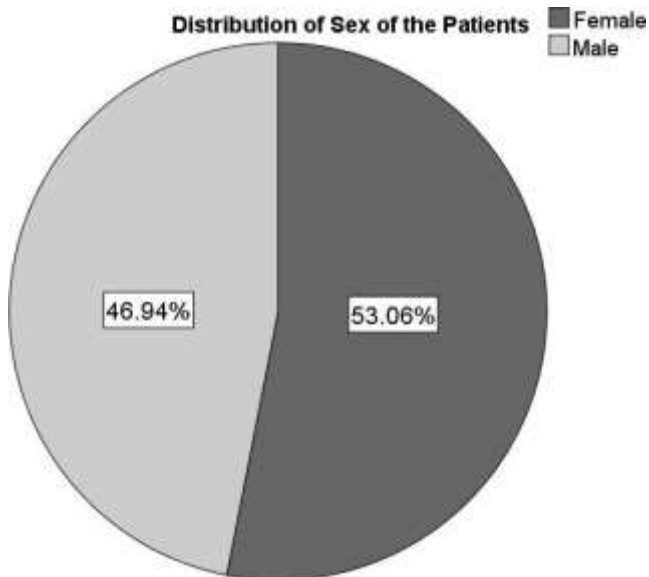


Figure 4: Sex distribution

4.2 Clinical characteristics

4.2.1 Duration of symptoms

The range of duration of symptoms was 3 hours to 1 year, with a mean of 32.6 days and an SD of 136.

4.2.2 Method of extraction used

The most common method of extraction used was endoscopy 164(83.7%), followed by open surgical 19(9.7%), and then spontaneous expulsion of F.B. 13(6.6%).

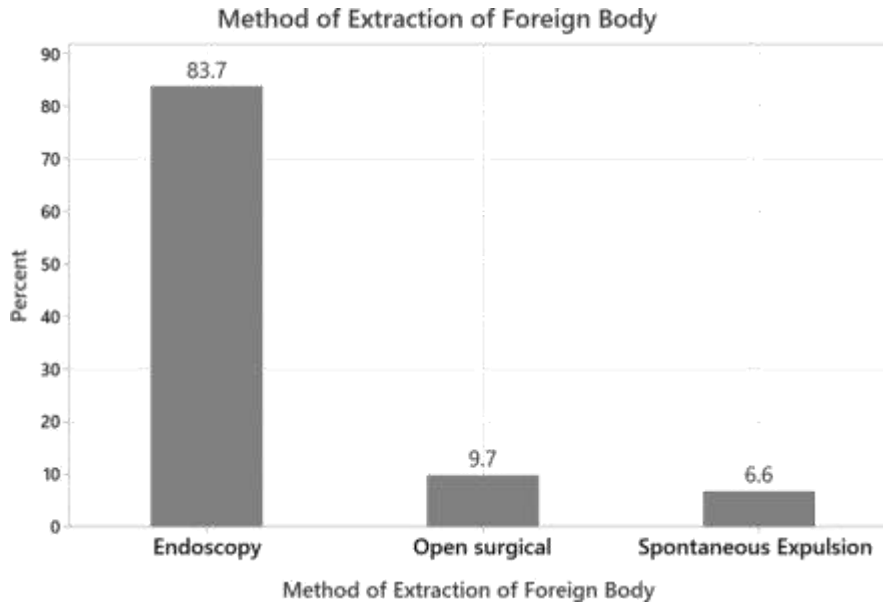
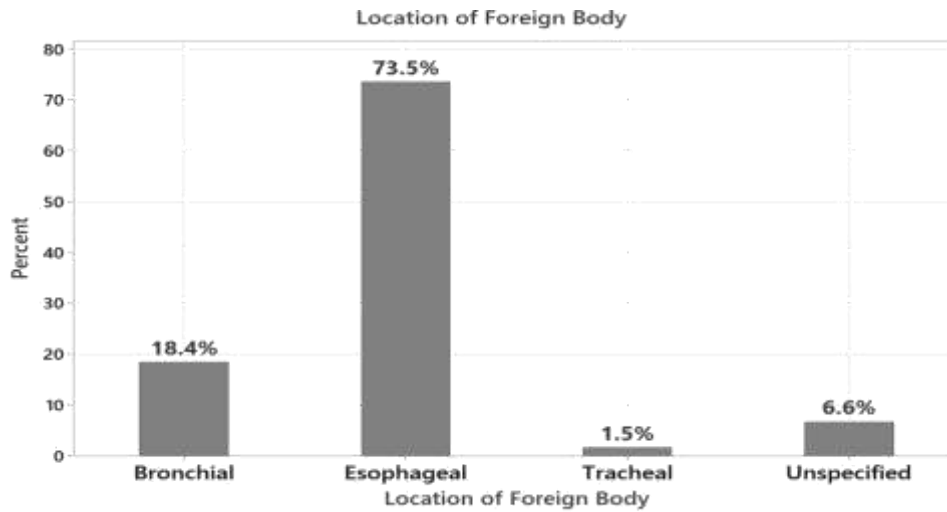


Figure 5: Method of extraction

4.3.1 Location of the foreign body

Out of the total of 196 patients, 144(73.5%) had their foreign bodies located in the esophagus, followed by the bronchus at 36(18.4%), and lastly, trachea at 3(1.5%). Thirteen patients had spontaneous expulsion of F.B hence location could not be accounted for. The ratio of ingested F.Bs versus aspirated F.Bs was 3.7:1.



Percent is calculated within all data.

Figure 6: Location of foreign body

4.3.1.1 Esophageal

Amongst patients with esophageal foreign bodies, those located in the upper esophagus were 141(97.9%) while lower were 3(2.1%).

4.3.1.2 Bronchus

Among the 36 patients with foreign body in the bronchus, 22(61.1%) were located in the right bronchus and 14 (38.9%) in the left bronchus.

4.4 Outcomes

4.4.1 Length of Hospital Stay

The mean length of stay in the hospital is 4.5 days with an SD of 8.1 and a range of 1 day to 43 days.

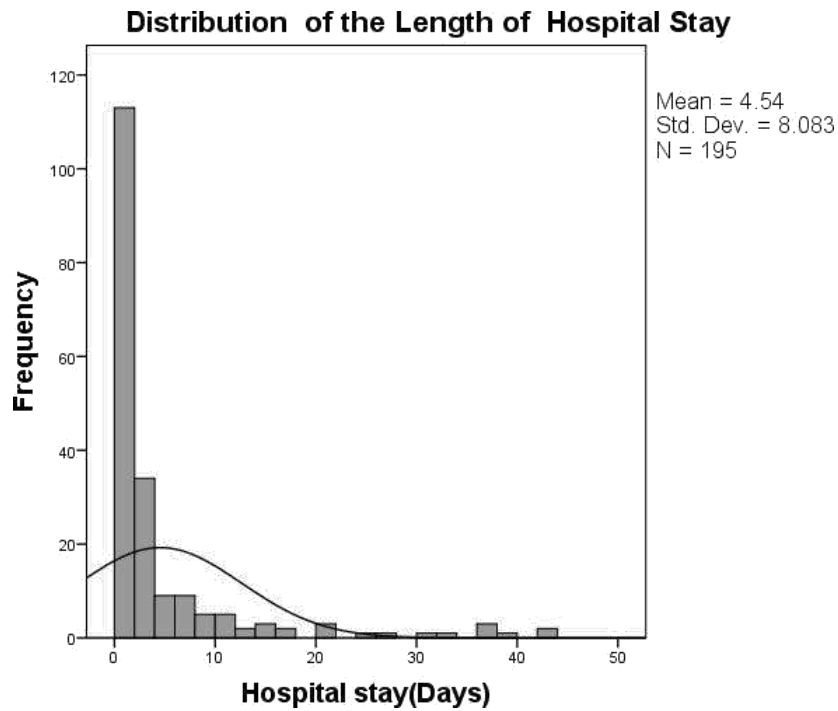


Figure 7: Length of hospital stay

4.4.2 Mortality

Mortality was recorded at 0(0%), all the patients with aero-digestive foreign bodies that were studied survived, 196(100%).

4.4.3 Morbidity

Majority of the patients, 178 (90.8%) did not suffer any morbidity. Perforation was the most common morbidity at 11 cases (5.6%), followed by fistula formation with 3 cases (1.5%). Need for lung resection and esophageal replacement had 2 cases each (1%).

Table 3: Counts for morbidity

Morbidity	Count	Percentage
Fistula Formation	3	1.5
Need for esophageal replacement	2	1.0
Need for lung resection	2	1.0
Perforation	11	5.6
None	178	90.8

4.5 Type of item extracted

Table 4: Type of FB extracted

Type Extracted	Count	Percentage	Type Extracted	Count	Percentage
Coin	120	59.41	Bolt	1	0.5
button battery	19	9.41	Carrot	1	0.5
Seed	10	4.95	earphone piece	1	0.5
Pin	9	4.46	Earring	1	0.5
Bone	6	2.97	fungal esophagitis	1	0.5
Bead	4	1.98	Glass	1	0.5
Key	3	1.49	Leaf	1	0.5
None	3	1.49	Marble	1	0.5
pen cap	3	1.49	Meatball	1	0.5
Spring	3	1.49	Metal	1	0.5
cloth button	2	0.99	Metallic screw	1	0.5
plastic piece	2	0.99	metallic spring	1	0.5
milk market piece	1	0.5	Ring	1	0.5
Nail	1	0.5	Tooth	1	0.5
pen piece	1	0.5	Zipper	1	0.5

Table 5: Summary of treatment methods, and location of FB

Variable	Counts	Percentage
Method of Extraction Used Successfully		
Endoscopy	164	83.7
Open surgical	19	9.7
Spontaneous expulsion of FB	13	6.6
Successful Endoscopy (n=164)		
Flexible	2	1.3
Rigid	162	98.7
Location of the foreign body		
Tracheal	3	18.4
Bronchial	36	73.5
Esophageal	144	1.5
Esophageal (n=144)		
Lower	3	2.1
Upper	141	97.9

4.6 Associations with outcomes

Table 6: Summary of associations with morbidity

	Morbidity	P-value
Sex		
Female	13/104 (12.5%)	0.087
Male	5/92 (5.2%)	
Type of foreign body		
Button battery	14/18 (77.8%)	0.0001
Cloth cotton	1/2 (50%)	
Coin	1/116 (0.9%)	
Pen cap	1/3 (33.3%)	
Pen piece	1/1 (100%)	
Button battery		
Yes	14/18 (9.2%)	P<0.001
No	4/178 (2.3%)	
Location of the foreign Body		
Bronchial	2/36 (5.6%)	0.419
Esophageal	16/144 (11.1%)	
Tracheal	0/3 (0%)	

4.7 Associations for Length of Hospital Stay

There were 103 female patients with a mean LOHS at 4.5 days, and a SD of 7.9), and the 95% CI was (2.9-6.0 days). For the 92 male patients, there was (mean LOHS at 4.6 days, and a SD of 8.2), and the 95% CI was (2.9-6.3 days). The P-value=0.5422 shows it is insignificant since $p > 0.05$; therefore, the sex of the patient had no effect on the length of hospital stay.

Table 10 shows the results from a univariate model, and there is a statistical significance between the length of hospital stay and the duration of symptoms P-Value=0.005.

Table 7: Summary of associations for length of stay

Length of hospital stay	P-Value
Age	0.322
Duration of symptoms	0.004
Sex	
Female	0.9157
Male	
Type of foreign body	
Button battery	0.001

CHAPTER FIVE

DISCUSSION

5.1 The Pattern of Aero-digestive Foreign Bodies

5.1.1 Demographic features

From the 196 patients studied, the mean age was 5 years, and the median age was 3 years, with an SD=7.1 with a range of 0.08 for up to 52 years. These findings were consistent with previous studies that also showed most cases occurring in the pediatric population (2,6,15,24). The age group that was consistently affected was children between 2-3 years. More so, it was noticed that as the age of the patients increased, the number of patients decreased. Several factors could account for this observation; these include an increased tendency to place objects in the oral cavity among children, lack of molars to chew some food, crying with objects in their oral cavity, and undeveloped mechanisms to coordinate swallowing (2). Parents' negligence, accidents, and smaller airway diameter in children increase the obstruction risk.

More female patients (53.06%) than male patients (46.94%) presented with aero-digestive foreign body obstructions (11). This finding conflicted with most other studies that observed a greater frequency of occurrence of foreign bodies among male patients. (1,6,15,24) The sex of the patient did not affect the length of the hospital stay or the associated morbidity of aero-digestive foreign body obstructions (5)

5.1.2 Location of foreign bodies

Most foreign bodies were located in the esophagus. In the esophagus, the upper esophageal sphincter, formed by the cricopharyngeus muscle, was the commonest place of lodgement of F.B., followed by the lower esophageal sphincter. This was in tandem with findings by Gupta et al. (24). This anatomy of the esophagus with its physiologic constrictions makes it common to find the F.B. in the previously stated locations.

The right bronchus showed a higher frequency of lodgement than the left bronchi (9), this is in agreement with majority of the studies (1,2,4, 6,9,11), however a study by Rizk Neg et al disputed this by showing a higher frequency on the left bronchus. (5) The lodging of the F.Bs in the airway is supported by the size and the fact that the respiratory tree is relatively underdeveloped in the pediatric group (6). All tracheal F.B.s in this study were found in children, this can be explained by the relatively smaller upper airway compared to adults, thus forming a likely site of impaction of foreign bodies; this accounts for the foreign bodies located in the trachea (9). The number of patients who presented with F.B. aspiration was 39(19.9%) and 144 had F.B(73.46%). ingestion. F.B. ingestion is more common than F.B. aspiration in keeping with findings by Gupta et al. (24)

5.1.3 Types of foreign bodies

Coins were the most common objects entrapped in the digestive tract which was consistent with the majority of the studies. The location of a coin in the esophagus, the age of the child, and coin size are the key determinants of whether it undergoes spontaneous passage.

Button batteries had the highest morbidity, this was in line with other studies (9,15,21). They have a higher risk of perforations as they contain basic hydroxide and can cause caustic injury. The frequency of button battery ingestion is increasing as it is fueled by technology and its increased use in electronic devices. Fish bones increase the risk of esophageal perforation and inflammation of esophageal mucosa. Therefore, the type of foreign body ingested can affect morbidity and influence the duration of hospital stay (2,9).

Various factors have been shown to influence the type of object ingested or aspirated, including culture, type of food, and parental negligence, among others. In comparison, other studies found a higher frequency of organic objects, such as food, forming the bulk of most aspirated objects, this study shows similar findings. In western communities, iatrogenic causes of foreign body aspiration were common, especially from dental procedures or vocal cord prostheses (4).

5.2 Management of aero-digestive foreign bodies

Good history taking, thorough examinations, and imaging are still a cornerstone in diagnosing aero-digestive foreign body obstruction. History taking is important, especially when the patient is asymptomatic. The most prevalent symptoms were dysphagia, odynophagia, drooling, cough, choking, and dyspnea. Furthermore, dehydration, wasting, lethargy, respiratory distress, wheezing, rhonchi, and reduced breath sounds were the most common signs. The mean duration of the symptoms in days was 32.6 days with an SD = 136.

Endoscopy is key to confirming the diagnosis of F.B. and aiding in the treatment efforts (12). From the study conducted, 83.7% of the cases underwent an endoscopy. Rigid endoscopy was widely utilized (89.29%), while flexible endoscopes were utilized less commonly (1.53%). Rigid endoscopes are superior to flexible endoscopes since they allow ventilation and better visualization and use different sizes of suctioning and optical forceps (17). Using a rigid scope also has a wider space for manipulation of the foreign body, making extraction of the foreign body easier.

In recent days, however, a flexible endoscope has been gaining traction since it allows the assessment of subsegmental bronchi and can be performed with local anesthesia combined with deep sedation, and it is less invasive (17,18).

Watchful waiting is commonly practiced for foreign bodies that have been ingested. Spontaneous expulsion of foreign bodies was successful for 6.6% of the cases. Surgeries are recommended for removal of complicated large objects, grass heads that can lead to pulmonary injury, sharp or double-pointed objects, and cases with complications.

These complications include the need for esophageal replacement, need for lung resection, fistula formation, and perforation (19). Failure of retrieval of the foreign body via endoscopy is an indication of open surgery. In this study, 90.82% of the cases did not have any complications. Open surgeries were performed for 9.7% of the cases that were studied.

5.3 Clinical outcomes

The mean length of stay in the hospital was 4.5 days with an SD=8.1 and a range of 1 day to 43 days. 90.82% of the cases did not develop any complications. For the remainder, perforations were the most common complication. Other complications included the need for esophageal replacement, the need for lung resection, and fistula formation.

Females were more prone to develop complications, but this finding was not clinically significant. Button batteries were the most common objects that led to further complications. Objects lodged in the esophagus were prone to cause perforation compared to the bronchi and trachea, which had minimal risk altogether, this can be attributed to the esophagus having thinner walls hence making it more susceptible to damage from sharp or pointed F.B.s, however the risk ultimately depends on size and composition of F.B. Button batteries were associated with an increased duration of the hospital stay, this has not been demonstrated by previous studies.

This study showed no recorded deaths from aero-digestive tract foreign bodies at KNH. Other countries in the region have recorded significant mortality. Ethiopia and Nigeria reported high mortality of 11% and 8%, respectively, from foreign body aspirations.

India and Puerto Rico also had relatively high mortality rates from foreign body aspirations. Most in-hospital mortalities occurred due to hypoxic cardiac arrest when the object was being extracted, rupture of the bronchus, and intraoperative complications. Asphyxia at initial emergency bronchoscopy was also the culprit for the deaths in these countries. However, mortality from foreign body ingestion was rare (7).

5.4 CONCLUSION

Aero-digestive foreign bodies remain a commonly encountered condition in the pediatric population, with coins being the most frequently ingested and button batteries causing the most morbidity.

A high index of suspicion for F.B. ingestion aspiration should be maintained for children with a history of treatment for recurrent respiratory tract infections. Open surgery should be performed in patients with failed endoscopic extraction and in management of complications such as fistula formation and lung destruction, while surveillance should be done in ingested F.B.s that show distal migration on imaging.

This study's findings emphasize the importance of early diagnosis, and timely intervention which are crucial in alleviating associated morbidity.

5.5 STUDY LIMITATIONS AND DELIMITATIONS

5.5.1 Limitations

Relying on existing medical records, which can be incomplete, inaccurate, or inconsistent, can affect the study's objectivity. Some records/data relating to patients who could have died may not have been available leading to zero mortality. Secondly, confounding variables may influence the outcomes in the study, such as patient comorbidities or the experience of the treating physician. The study might have selection bias as the researchers' selected subjects from only one facility, the Kenyatta National Hospital.

Finally, the study's retrospective nature limits the ability to establish causality between management strategies and outcomes, as other unmeasured factors may influence the results.

5.5.2 Delimitations

Only complete medical records were included in the study. Additionally, multiple sources were used to retrieve accurate information. Selection bias was minimal as Kenyatta National Hospital served the entire population of Kenya during the study period.

5.5.3 Recommendations

1. A high index of suspicion for aspirated foreign bodies should be considered in patients who have been managed for recurrent respiratory tract infections, especially in the pediatric population.
2. Button batteries should be extracted immediately as an emergency, while longstanding F.B.s need to be managed in centers with equipment and specialized personnel who can manage complications that are present or could occur after extraction.
3. Education of parents and caregivers on importance of disposal and safe keeping of items such as button batteries, identification of signs and symptoms of aerodigestive F.B.s and emphasize on importance of basic life support skills for management in the acute setting.

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APPENDICES

APPENDIX 1: DATA COLLECTION TOOL.

Form number. _____

PATIENT BIODATA.

1. Age (in years) _____

2. Sex Male _____ Female _____

3. Residence _____

HISTORY.

4. What is the duration of the symptoms?

5. What symptoms did the patient present with:

- Ingestion.

Dysphagia: Yes / No

Odynophagia: Yes / No

Vomiting: Yes / No

Choking: Yes / No

Drooling: Yes / No

Others: Specify _____

Choking: Yes / No

Cough: Yes / No

Difficulty in breath: Yes / No

Others: Specify _____

6. What was the examination findings ingestion?

Dehydration: Yes / No

Wasting: Yes / No

oethargy: Yes / No

Respiratory distress: Yes / No

Others: Specify _____

Respiratory distress: Yes / No

Wheezing: Yes / No

Rhonchi: Yes / No

Reduced breath sound: Yes / No

Others; Specify: Yes /

7. What method of extraction was utilized for the removal of the foreign body

8. Endoscopy: Rigid

Flexible

Open surgical (If yes, specify):

Spontaneous expulsion of F.B.:

9. Was the foreign body extraction converted from endoscopy to open surgical techniques: Yes No

10. What type of foreign body was extracted

11. What was the location of the foreign body:-
Esophageal: _____ Upper / oower

Tracheal: _____

Bronchus: _____ Right /
oeft

POSTOPERATIVE.

11. Did the patient sufer the following Complications;

Perforation Yes _____ No _____

Fistula formation Yes _____ No _____

Need for lung resection Yes _____ No _____

Need for esophageal replacement Yes No

Others: If yes, specify _____

12. For how many days was the patient admited to the ward postoperatively

13. In-hospital mortality: Yes _____ No _____

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