

Bronchoscopy for Removal of Aspirated Tracheobronchial Foreign Bodies at Kenyatta National Hospital, in Kenya.

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Background: *This study was aimed at defining the presentation, morbidity and mortality following inhalation and subsequent removal of tracheobronchial foreign body using a rigid bronchoscope.*

Methods: *This was a retrospective, cross-sectional study undertaken in the Ear Nose and Throat-Head and Neck Surgery Unit of Kenyatta National Hospital. The study population consisted of patients with bronchoscopically proven tracheobronchial foreign body. Case notes of 107 consecutive admissions with bronchoscopically verified tracheobronchial foreign bodies were analyzed for age, sex, time interval between inhalation and removal, duration of stay in hospital, complications and mortality.*

Results: *The vast majority of patients were below 3 years of age and 63% of them presented within 3 days after onset of symptoms. The right bronchus was the most frequent destination of inhaled foreign bodies (50.5%) followed by the left bronchus (17.8%) and carina (14.2%) in that order. The turnover of patients with inhaled foreign bodies was high with 86.9% being discharged within 6 days after surgery. The bronchoscopic procedure was uneventful in 76.6% of patients. Repeat bronchoscopy was performed in three patients with one undergoing eventual thoracotomy.*

Intraoperative cardiac arrest occurred in 5 cases (4.6%) with successful resuscitation in 2 and mortality in three (2.7%) % cases.

Conclusion: *Bronchoscopic removal of inhaled foreign bodies remains one of the riskiest otolaryngologic emergencies in Kenyatta National Hospital partly because of involvement of the life sustaining airway and partly because of lack of ideal equipment and adequate expertise. The need for hands on experience and close cooperation and familiarity between the anaesthesiologist and the bronchoscopist is emphasized.*

Introduction

Bronchoscopic removal of tracheobronchial foreign bodies is one of the most common emergency surgical operations done at the Ear, Nose and Throat-Head and Neck (ENT-HN) Surgical Unit of the Kenyatta National Hospital (KNH). It is also reckoned to be one of the most risky emergency surgical operations more so with the use of rigid rather than flexible bronchoscope. Moreover, the patient who is frequently below 3 years of age has a narrow airway which is easily occluded by the foreign body and the bronchoscopic maneuvers occur in the same avenue where anaesthetic agents and life sustaining oxygen are delivered. In this country, the expertise and equipment for tracheobronchial foreign body removal is lacking in most level four and five hospitals and delay in prompt management is a factor. The morbidity and mortality associated with removal of inhaled tracheobronchial foreign bodies using rigid bronchoscopes has continued to be high especially in developing countries despite recent advances in endoscopic surgery¹.

This study assesses the demographic features, sites of impaction of foreign body along the tracheobronchial tree, the nature of foreign body, duration of hospital stay, morbidity and mortality

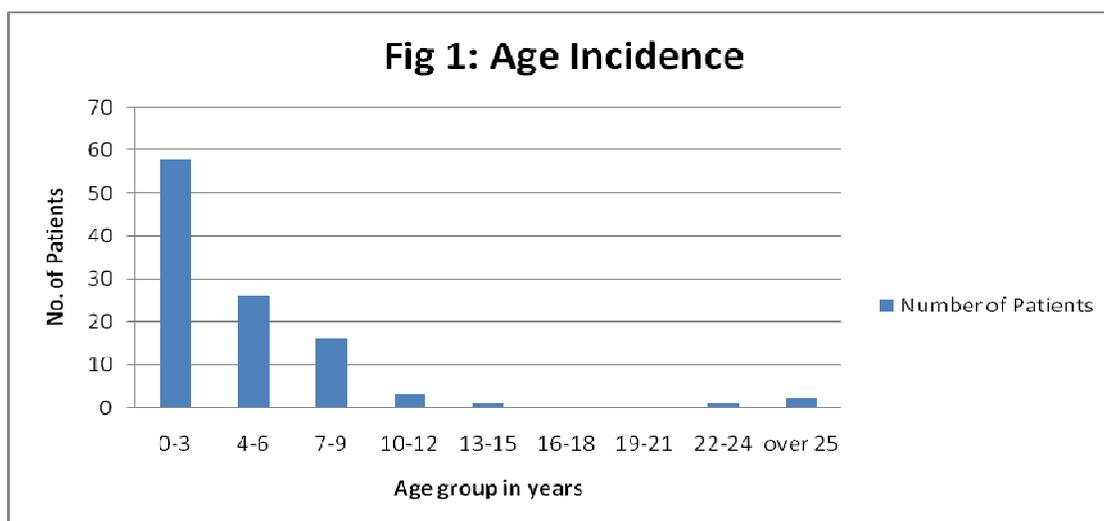
Patients and Methods

This was a cross sectional retrospective study. Case notes, theatre and in-patients registers and radiographs of 107 consecutive patients presenting at the Kenyatta National Hospital Department of ENT-HN Surgery with bronchoscopically proven inhaled foreign bodies at the ENT-HN surgery unit of KNH between January 2003 and December 2009 were analyzed for evidence of inhaled tracheobronchial foreign body.

The patients' documents were analyzed for demographic features, positive history of foreign body inhalation, geographical location of the patient at the time of inhalation, radiological evidence, anatomical position of lodgment, the nature of the foreign body, the ensuing complications and length of hospital stay before the discharge order. These were retrieved, recorded in a custom made questionnaire and illustrated in the form of tables and histograms.

Results

A total of 107 patients were studied. The Male to female sex ratio was 1.8:1. The age distribution of the patients is as shown in Figure 1. A total of 54.2% of the patients were aged 3 years and under; 93.5% of the patients were aged being below 10 years.



Time Lapse before Presentation

Time lapse between onset of symptoms to presentation of the patient to the hospital is as shown in Figure 2. About 63.3% of the patients presented to KNH within three days of the onset of symptoms. Because of the disparity of the infrastructure in the country, the effect of the distance of geographical site of inhalation from the hospital on the delay in presentation was not determined. Positive history of inhalation of foreign body was obtained in 93.4% patients

Radiological Features

Plain chest X-rays examination was done in 65 out of 107 patients. This omission was partly due to the adverse clinical condition of the patient and logistics involved in obtaining an X-ray without delay. There were negative findings in 22 patients. Positive findings including opaque foreign bodies, pneumonitis, lung collapse, atelectases, pulmonary hyperinflation were found in 43 patients suggesting that 66% of patients having tracheobronchial foreign bodies would have some radiological findings (Figures 3, 4 and 5 for sample X-rays).

Type of Surgical Armamentarium Used

The preferred method of induction of anaesthesia was halothane, nitrous oxide and oxygen by mask, or propofol and oxygen in adults. The anaesthesiologist would also use succinyl choline or an intermediate acting muscle relaxant depending on the physical condition of the patient and the perceived length of the procedure. The armamentarium used for removal of foreign bodies was appropriately sized Karl Storz rigid bronchoscopic set and relevant microforceps suitable for the nature of the foreign body involved (Figure 6). Oxygenation continued through the anaesthetic portal located at the proximal part of the bronchoscope

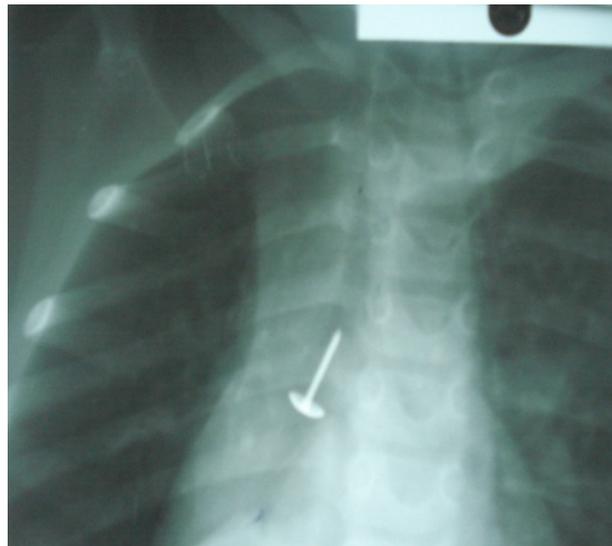
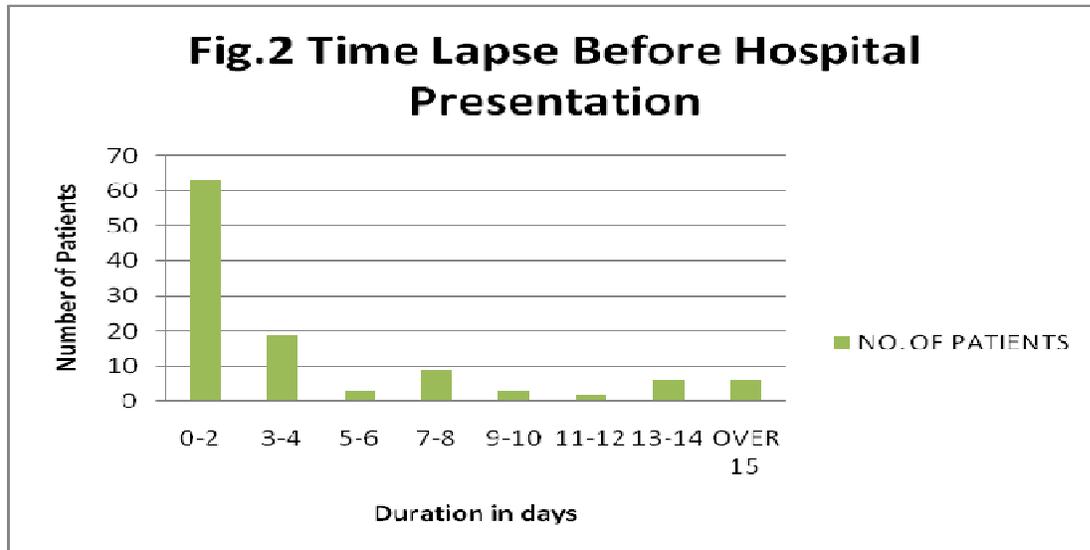


Figure 3. Drawing pin right bronchus

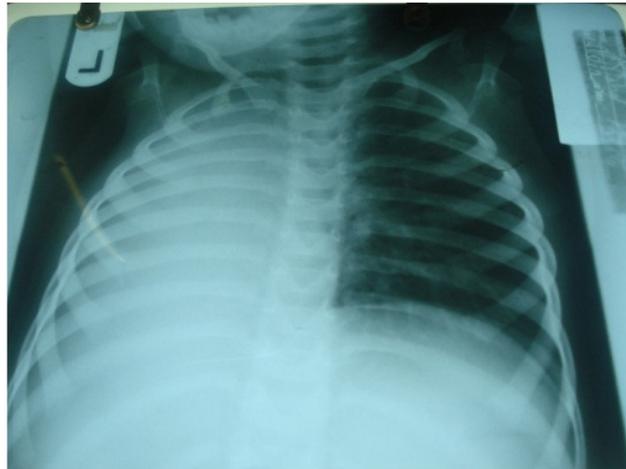


Figure 4. Diffuse consolidation right lung

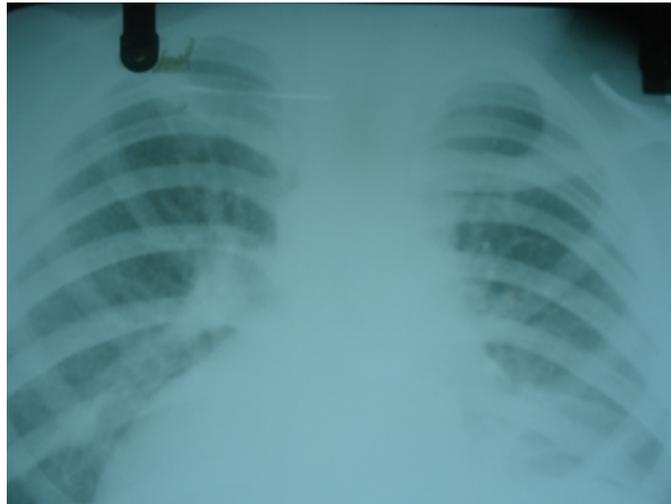


Figure 5. Bilateral bronchopneumonic changes



Figure 6. Rigid Bronchoscopic Set

Nature of Foreign Bodies

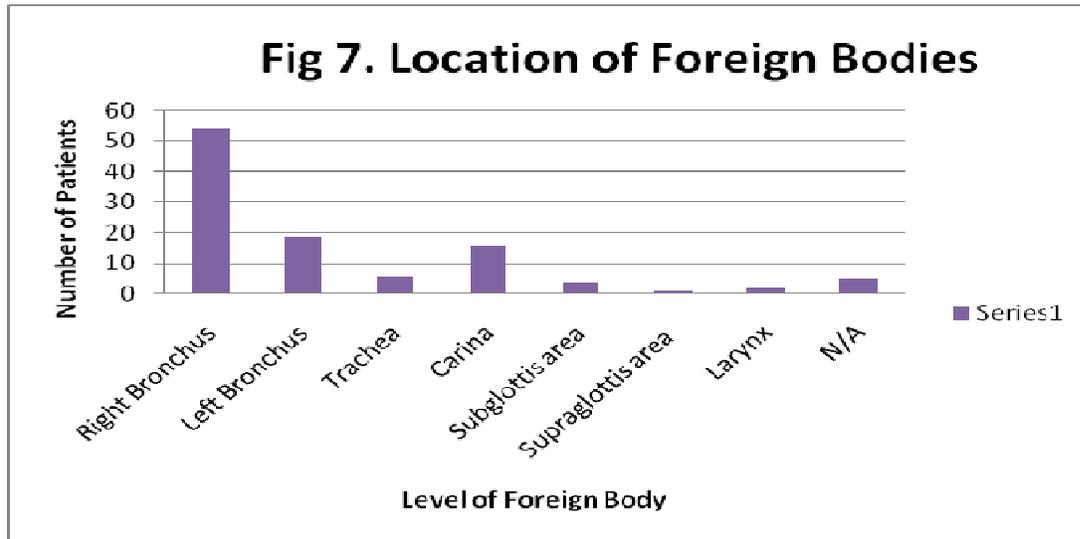
The most common variant of foreign body were the vegetable type, especially the seeds. In this regard, food particles were the most likely foreign body to be encountered. Table 1 shows the different types of inhaled foreign bodies found in this series

Table 1. Nature of foreign bodies

Subgroup	Type	Category	Number	
Vegetable	Seeds	Beans	21	
		Maize	10	
		Cowpeas	2	
		Peanuts/groundnuts	10	
		Coffee	2	
		Orange	1	
		Pumpkin	3	
		Unidentified fruits/seeds	3	
		Bean/cotyledon	1	
		Food Pieces	Mango	2
			Sugar cane	1
			Carrot	1
			Mashed potatoes	1
			Fish bone	1
Bone from meat chop	1			
Non Vegetable	Plastics	Plastic Beads	6	
		Doll's eye	2	
		Indeterminate plastics	3	
		Button	1	
		Biro Bottom	1	
		Metallic	Biro spring	3
	Nail		1	
	Drawing pin (thumb tuck)		1	
	Zipper Head		2	
	Calculator battery		1	
	Torch bulb		1	
	Fountain pen handle		1	
	Bottle top		1	
	Metallic bead		1	
	Ear ring stud		1	
	Unidentified metal pieces		8	
	Miscellaneous		Rubber	2
			Cellotape	1
			Stones	2
			Calabash fragment	1
		Piece of wood	2	
Tooth		1		
Unidentified foreign bodies		4		
Total			107	

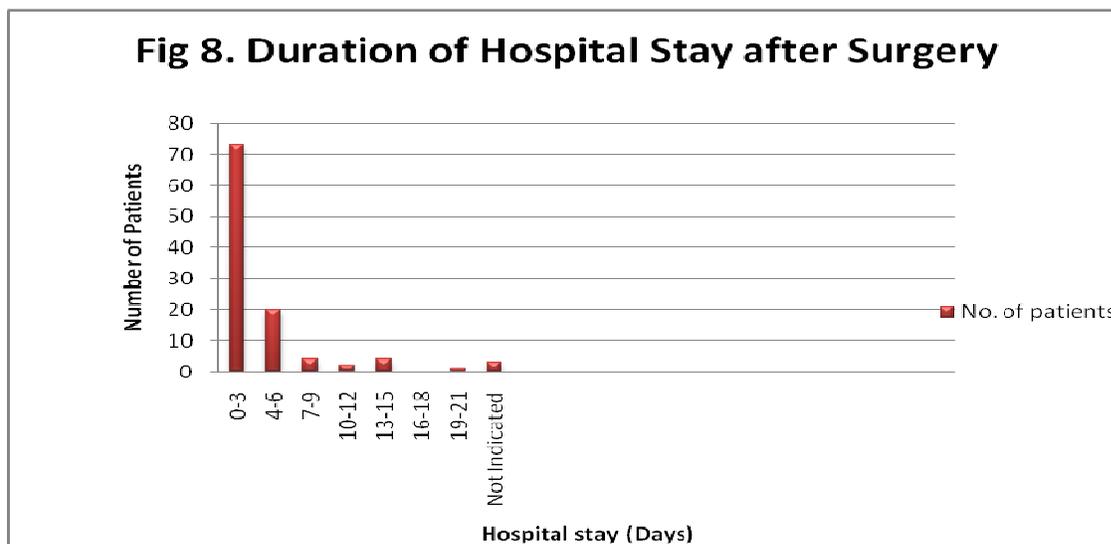
Anatomical location of foreign bodies

The anatomical location was most frequently in the right bronchus (50.5%) followed by left bronchus (17.8%) and carina (14.2%) then trachea and larynx in that order (Figure 7).



Duration of Hospital Stay before Discharge

This was considered from the moment of completion of surgical operation to the day permission was granted for the patient to go home. The exact day of the patient’s departure from the hospital was determined by a variety of social and logistical reasons and was therefore not analyzed. Sixty eight per cent of patients were discharged three days after surgery while 86.9% had been discharged home within six days (Figure 8)



Complications

Morbidity: Eighty two (76.6%) of the patients had uneventful bronchoscopy. Two (1.8%) of the patients needed immediate preoperative ICU admission for cardiopulmonary stabilization before bronchoscopy, one of them ending up as one of mortalities. Although excessive secretions in the respiratory tract necessitating suction and physiotherapy was found in 7 (6.5%) patients it was not considered as a significant morbidity because this procedure is almost routine in all patients

undergoing rigid bronchoscopy for removal of foreign body. Repeat bronchoscopy was performed in three patients, with two undergoing staged thoracotomy procedure to effect successful foreign body removal. These complications necessitated ICU and HDU admission in 12 (11.2%) cases.

Cardiac Arrest and Mortality: Intraoperative cardiac arrest occurred in 5 (4.6%) patients, 2 being successfully resuscitated and 3 (2.7%) ending up in Intraoperative mortality. One of the three mortalities resulted from an induced flooding of the lungs by secondary pulmonary abscess opened up during bronchoscopic manipulations. This patient had not had a preoperative chest X-ray and the operators were oblivious of the presence of the abscess. Readmission with ipsilateral bronchopneumonia occurred one month after discharge in one case of a 2 year old child with an inhaled primary incisor tooth

Discussion

Inhalation of foreign bodies is one of the most common paediatric otolaryngologic emergencies. Most of the affected children are usually below 3 years of age and this is in keeping in studies done elsewhere^{1,2,3}. Hollinger and Hollinger⁴ reviewed 2000 patients only 6% of cases were over 14 years old. Over 70% of patients are likely to be between 1 and 6 years old, a figure not far from what was found in this study. This high prevalence in childhood is partly explained by development and maturation of the mental age of the child and the progressive maturation of the physiology of deglutition.

During normal deglutition, the soft palate closes the nasal cavity, the whole tracheolaryngeal column is elevated, the vocal cords close the airway and the intra-tracheal pressures are also raised. This way, the ingested material is excluded from the nasal and laryngeal airway, but is channeled into the hypopharynx and oesophagus. This is a well coordinated and complicated process that needs fully developed and mature neuronal and skeletal components of the airway to function competently. However, the foregoing conditions notwithstanding, some physiological processes like laughing, talking, coughing or crying while eating may precipitate inhalation. Likewise, inspiration in situations like drowning or excessive sedation following intake of a sedative agents are also more likely to cause inhalation of any object in the mouth.

Inhaled foreign bodies characteristically cause some degree of respiratory difficulties ranging from mild irritation, sudden choking, respiratory arrest and death⁵. More frequently, however, a vigorous attempt to expel the offending foreign body by coughing occurs although the rate of successful expulsion is suspected to be very low. The cough subsides over a period of time and would be replaced by various degrees of wheezing and stridor. Rhonchi and later crepitations and even reduced breath sounds can be heard over the affected lung fields in an otherwise healthy child. A positive history of aspiration of a foreign body is not always available, less likely so in children. In one study involving such patients, a positive history of such an occurrence was available in only 47.9% of cases⁶ as opposed to this study which had a 95% corresponding figure. The accurate figure for the availability of a positive history can only be ascertained in a well designed prospective study and accurate documentation. Prompt arrival by most patients to seek medical redress at the KNH despite the inadequate national infrastructure including roads and means of transport underscores the sudden onset and dramatic nature of symptoms.

Preoperative assessment of the patient is vital but should not consume valuable time. Asymmetrical chest movements and air entry, wheezing and rhonchi and radiological features of foreign body and its effects which may be present in 97 % of cases⁷, are all important indicators of the presence of and location of tracheobronchial foreign body. Their absence does not rule out the presence of tracheobronchial foreign body. Radiological features associated with inhaled LTFBs are usually radiologically evident and was found to be evident in about 70% of the patients^{8,9,10} as in this study. It is this scenario that necessitates prompt and competent action to remove the

foreign body. The universal male predominance in cases of inhaled foreign bodies is probably based on behavioural differences between the male and female child.

Anaesthetic management is of paramount importance because airway foreign body impaction is as much an endoscopic problem as it is an anaesthetic problem, the anaesthesiologist sharing the main life sustenance avenue where the bronchoscopic manipulations occur. The anaesthesiologist in this set up would induce the patient with halothane, nitrous oxide, and oxygen mixture in a child and may or may not use succinyl choline or intermediate acting muscle relaxant depending on the physical condition of the child and the perceived duration of the procedure. The anaesthesiologist then makes way for the surgeon to introduce the bronchoscope and remove the foreign body. Oxygenation continues through the side airway portal on the bronchoscope. Alternatively propofol may be used in adults but its respiratory suppressive effects must be monitored. In difficult bronchoscopies, this process may be repeated severally although such repeated insertions of bronchoscopes increase chances of morbidity and mortality. It is of paramount importance that the surgeon and the anaesthesiologist recognize the overall importance of the airway and that the anaesthesiologist should have unimpeded access of the airway on demand. Moreover postoperatively, a significant fraction of patients end up under the care of anaesthesiologist and critical care specialist during recovery and rehabilitation. It should be appreciated that bronchoscopic removal of foreign bodies under general anaesthesia provides a more formidable challenge to the anaesthesiologist than to the bronchoscopist.

Only rigid bronchoscopes are currently used in this set up. It is important to choose the right size of the bronchoscope and the next smaller one on the line. The operator must also be familiar with the all foreign body removal forceps so as to select the most appropriate one for the nature of the foreign body. Rigid bronchoscopes have a wider lumen and inbuilt lighting system and ventilation portal. It should however be noted that during the last four decades, flexible bronchoscopes have come into vogue with the advantages of less trauma to the respiratory tract and ability to be connected to a video monitoring system for documentation¹¹. Ventilation can be done through a parallel inserted endotracheal tube. Alternatively, the flexible bronchoscope can be inserted via the endotracheal ventilation tube due to its slim nature¹². Conversely, spontaneous ventilation and sedation can be used in older patients. In all bronchoscopic instances cardiopulmonary monitoring system and emergency respiratory ventilation facility must be readily available. In trained hands and in a relevantly equipped facility, flexible bronchoscopy should be the method of choice of removal of tracheobronchial foreign bodies. The set up at KNH is more comfortable with the rigid bronchoscope in view of the current prevailing circumstances.

Inhaled articles can lodge in the larynx, trachea, carina or bronchi. A foreign body lodged at or above the carina is more likely to cause complete airway obstruction than the one lodged in one of the bronchi. As is shown in this study, the most of inhaled foreign bodies however find their way into the right main bronchus². This is because the right bronchus is more vertical and wider than the oblique left counterpart. However, some studies show that bronchial foreign bodies are more likely to be lodged in the left bronchus especially in children¹. Vegetable variety of foreign bodies and especially seeds and food particles are the most frequent foreign bodies in the airway and this is in concordance with a recent study done in Tanzania³ and elsewhere. This is a statistical expectation because food is the most frequent traverser of the upper aerodigestive tract. In this study, the vegetable variety of foreign bodies, head the list of tracheobronchial foreign bodies especially in childhood. Other frequent foreign bodies are plastic and metal implements depending on the socioeconomic and geographical environment of the subject at the time of the event. Other studies^{1,13} found stones to be the most frequent variety.

This study underscores the high morbidity and mortality usually associated with rigid bronchoscopic removal of LTFBs especially in children. This may be due to delay in presentation due to the basic infrastructure in the country. There was considerable post operative need for

chest physiotherapy to cater for increased thoracic secretions caused by the foreign body and trauma secondary to bronchoscopic procedure. Cardiac arrest occurred in 4.6% of cases and an overall mortality of 2.7%. Mortality is usually associated with the type of foreign body, skill of the operator, and anaesthesiologist, prolonged period of bronchoscopy and length of time before attempts at surgical removal. A similar retrospective study in South Africa on 62 patients posted 28 out of 62 patients presenting with mortality and morbidity¹². Another similar study involving a larger sample in China posted a negligible mortality rate of only 3 out of 1428 patients (0.002%)¹³ and a more recent one registered negligible mortality and a zero mortality rate using flexible bronchoscope in 1027 cases¹¹.

Conclusions

Inhaled tracheobronchial foreign bodies continue to be a formidable problem at Kenyatta National Hospital with significant mortality and morbidity. At the time of this study, Kenyatta National Hospital was the only public medical facility offering bronchoscopic services in this country. It is hoped that with the upgrading of infrastructure, health facilities, purchase and installation of ideal equipment and relevant training of bronchoscopists from different medical disciplines, this morbidity and mortality in bronchoscopic removal of aspirated tracheobronchial foreign bodies will be reduced to acceptable levels seen in developed countries.

Acknowledgement

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