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A survey of flexible bronchoscopy practice at Kenyatta National Hospital, Kenya

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ABSTRACT

Objectives: Flexible bronchoscopy (FB) is an essential diagnostic and therapeutic tool for managing respiratory diseases, and an audit of its practice is important; it enhances standardization of practice and improves outcomes and patient safety. This study aimed to describe the FB practice at Kenyatta National Hospital (KNH) regarding indications, peri-procedure practice, gross and histologic findings, and safety.

Materials and Methods: This study was a quantitative and retrospective chart review of files of 282 patients who underwent flexible bronchoscopies over 5 years in KNH.

Results: We reviewed 282 flexible bronchoscopies done between January 2016 and December 2020. There was a significant documentation gap (22%); 54 out of the 282 cases audited had incomplete documentation. The male-to-female ratio was 1:1, with a median age of 51 years. Most (58.2%) of the patients were residents of counties outside Nairobi. Despite a lack of evidence for routine evaluation, we noted significant rates (75.9%) of routine laboratory evaluations (International normalized ratio (INR), platelet count). The most common indication of bronchoscopy was the evaluation of a lung mass (100) 35.7%, pulmonary infiltrate 53 (18.9%), and assessment for interstitial lung disease 39 (13.9%). The most common gross bronchoscopic findings were visible tumors at 38.5% (107) and normal endoscopic findings at 29.5% (82). The practice was safe, with a complication rate of 3.2%. The most common diagnostic outcome was lung cancer (40.1%), with adenocarcinoma being the most common (45.1%) histologic subtype. The diagnostic yield for malignancy where there was a visible tumor was 87.2%.

Conclusion: Our study showed that FB practice at KNH is safe and provides a good diagnostic yield, but a significant documentation gap and record keeping exist. Adenocarcinoma was the most predominant lung cancer histologic subtype among the mostly non-smoker population.

Keywords: Flexible bronchoscopy, Practice, Indications, Outcomes

INTRODUCTION

Since the discovery of flexible bronchoscopy (FB) by Ikeda in 1964, it has become an important diagnostic and therapeutic tool for the management of respiratory diseases. FB is an easy-to-perform and safer procedure compared to rigid bronchoscopy. The FB has replaced rigid bronchoscopy because it can be performed as an outpatient procedure and is safer. It can also be performed under conscious sedation and local anesthesia, thereby avoiding the attendant complications of general anesthesia and allowing it to be conducted as an outpatient procedure.

The practice of FB is not standardized even in the developed world despite the availability of guidelines concerned primarily with the safety of the procedure.[1] It is for this reason that the

British Thoracic Society in its 2013 guideline on the practice of diagnostic FB recommends periodic clinical audits of the practice for conformity with the standards.[2]

Clinical audits and surveys on the practice of FB have shown considerable variation in physicians' routines in patient preparation, drug therapy, sampling method, and occurrence of complications. This variability was thought to result from a combination of individual bronchoscopist experience and a lack of accepted standard practice guidelines. British Thoracic Society (BTS) 2001 guideline recommends several pre-procedure patient evaluations and preparation to enhance patient safety.

The Kenyatta National Hospital (KNH) Respiratory and Infectious Disease Unit has been performing bronchoscopy for over 20 years now, yet there is no published local data on the practice, indications, pattern of bronchoscopic findings, and safety. The goal of this study was to document bronchoscopy practice in KNH in terms of indications, patient evaluation, patient preparation, anesthetic technique, patient monitoring, sampling procedures, gross and histologic findings, and complications related to bronchoscopy.

MATERIALS AND METHODS

Study site

This study was conducted at the KNH, the largest referral hospital in Kenya, with a 2000-bed capacity in Nairobi County, Kenya. The catchment area is mainly from the Nairobi metropolis, with referrals from all over Kenya and East Africa. It has an established weekly out-patient specialized chest clinic, daily asthma clinic, tuberculosis (TB) clinic multidrug-resistant TB ward, and a respiratory disease ward with a bronchoscopy suite. The bronchoscopy suite has been operational since 1995, with about 786 bronchoscopies done between 1995 and 2020, with more than 50% in the past 10 years. The bronchoscopy unit has a team of five pulmonologists and three trained bronchoscopy nurses. The unit has no dedicated anesthetist, in-house pathologist, and fluoroscopy services, but these expertise/services are available in the hospital and are thus accessible to the unit whenever needed. The unit predominantly does diagnostic bronchoscopies with minimal therapeutic services (except for a few cases of foreign body removal).

Study design

This study was a retrospective chart review.

Study population

The study population was files of patients aged 18 years and above who underwent FB between January 2016 and December 2020.

Exclusion criteria

The file of patients younger than 18 years was excluded from the study.

Sample size/sampling method

All 282 files of patients who underwent flexible bronchoscopies over the 5-year study period were purposively included in the study.

Data collection

The data were collected using a structured study pro forma with a unique study serial number to avoid duplication. The files of the patients and the bronchoscopy register were used as primary sources.

Files with incomplete documentation were supplemented by other secondary data sources such as the bronchoscopy register, duplicate bronchoscopy report, and histology and microbiology department register.

Data analysis

All data from the study proforma were coded, entered, and managed in a Microsoft Excel 2016 data entry sheet. Data were exported into the Statistical Package for the Social Sciences version 23.0 for analysis. The study population was described by summarizing sociodemographic characteristics into percentages and means or medians for categorical and continuous data, respectively.

Indications for the bronchoscopy, the peri-procedural practices such as pre-procedure laboratory evaluations done, intraprocedure patient monitoring practice (Blood pressure [BP], pulse rate, and oxygen saturation [SPO_2] monitoring), anesthetic technique and choice of anesthetic agents used, and sampling procedures employed during the procedure were analyzed and expressed as proportions.

The gross bronchoscopic findings were also analyzed from the bronchoscopy report and expressed as proportions. The immediate (intraprocedure) complications such as hypoxemia (SPO_2 <90% or drop >4% from baseline), tachycardia (heart rate [HR]>100 bpm), bradycardia (HR <60 bpm), bronchospasm, bleeding, and intraprocedure death as documented on the bronchoscopy report were analyzed and expressed as percentages.

The overall histocytologic yield of the bronchial specimens was expressed as frequencies and percentages. It was calculated by the number of cases with a diagnosis (histologic/microbiologic results) divided by the total number of cases sampled for histologic and/or microbiologic evaluation * 100.

The diagnostic yield for malignancy was also expressed as a percentage. It was calculated as the number of malignancy

diagnoses made divided by the total number of visible tumors reported on bronchoscopy * 100.

Ethical considerations

Data collection was done after ethical approval was obtained from the Ethics Committee at the KNH (P181/03/2021). We requested a waiver of consent from the Ethics Committee because the study involved a review of the medical records. Absolute confidentiality was maintained.

RESULTS

A total of 290 bronchoscopies were conducted between January 2016 and December 2020. Eight cases were under 18 years. Two hundred and eight-two cases were eligible for inclusion in our study. Of the 282 cases, 228 had complete documentation while 54 cases had incomplete documentation.

We analyzed the entire cohort of the 282 cases including patients with incomplete documentation; hence, the numerator was different for the different variables.

Trends of bronchoscopy

The 5-year retrospective audit demonstrated a gradually increasing trend of FB practice at KNH with only 24 cases done in 2016, 104 in 2019, and 74 cases in 2020.

Sociodemographic characteristics

The mean age of the participants was 52.3 years (standard deviation 16.3). The male-to-female ratio was 1:1. The majority (58.2%) of the patients were residents of counties outside of Nairobi. Most of the cases (72.3%) were done as outpatients while 24.8% were in-patient as shown in Table 1.

Table 1: Patients' sociodemographic characteristics.

Variable	Frequency (%)
Mean age (SD) (*n*=282)	51.3 (SD 16.3)
Gender (*n*=282)	
Male	145 (51.4)
Female	137 (48.6)
Smoking history (*n*=226)	
Non-smoker	154 (68.1)
Current smoker	26 (11.4)
Ex-smoker	46 (20.4)
Not documented	56
Employment status (*n*=224)	
Unemployed	124 (55.4)
Employed	41 (18.3)
Self-employed	59 (26.3)
Not documented	58
Residence (*n*=249)	
Nairobi	104 (41.8)
Outside Nairobi	145 (58.2)
Not documented	33

SD: Standard deviation, *n*: Number of patients

Indications of bronchoscopy

The most common indication of bronchoscopy was the evaluation of a lung mass 100 (35.7%), pulmonary infiltrate on radiograph 53 (18.9%), assessment for interstitial lung disease 39 (13.9%), evaluation of atelectasis 18 (6.4%), and pleural effusion 14 (5).

Periprocedure practices

Laboratory evaluation

The majority of the patients had routine pre-procedure complete blood count done including a platelet count (75.9%) and INR (88.3%).

Patient monitoring practices

More than 91% of the patients had their BP, HR, respiratory rate (RR), and SPO_2 monitored during the procedure and recorded on the bronchoscopy form. Monitoring of SPO_2 was most common at 96.5%.

Anesthetic practices

The most commonly used anesthetic technique was local anesthesia (2% lidocaine) with sedation (98.2%), while 5 cases (1.8%) had local anesthesia without sedation.

Diagnostic sampling technique

About 177 cases (66.5%) had more than one sampling technique employed while 89 cases (33.5%) underwent a single sampling technique. The most commonly used combination was a biopsy (both endobronchial and transbronchial biopsies) and bronchial wash in 97 cases (36.5%). The most common single sampling technique used was biopsy (26.3%). In seven cases, there was no diagnostic sampling done because the procedures were either therapeutic (foreign body removal) or exploratory (evaluation for post-pneumonectomy stump dehiscence).

Gross bronchoscopic pattern of findings

The most common macroscopic findings were visible tumors, normal bronchoscopic findings, and non-specific inflammatory changes as shown in Table 2.

Complications

The vast majority (96.7%) of the patients had no intraprocedure complications and 3.2% had minor complications. There was no procedure-related mortality.

Table 2: Gross bronchoscopic findings.

Variable	Frequency (%)
Tumor	107 (38.5)
Normal	82 (29.5)
Inflammatory changes	32 (11.5)
Secretions/mucus plug	23 (8.3)
Narrowed segment/extrinsic compression	18 (6.5)
Others	16 (5.7)
Not documented	4

Final diagnosis (histological/cytological/microbiological diagnosis)

The most common diagnostic outcome of bronchoscopic specimens collected was lung cancer 91 cases (40.1%), 37 cases (15.9%) showed interstitial pneumonia, and 14 cases (6.2%) were diagnosed with tuberculosis (TB). These results are summarized in Table 3.

Table 3: Final patient diagnosis post-bronchoscopy.

Variable *n*=227	Frequency (%)
Lung cancer	91 (40.1)
Normal	39 (17.2)
Interstitial pneumonia	36 (15.9)
TB	14 (6.2)
Chronic non-specific inflammation	12 (5.3)
Non-MTB infections	10 (4.4)
Others	10 (4.4)
Aspergillosis	9 (3.0)
Sarcoidosis	4 (1.8)
Chronic bronchitis	2 (0.9)
Not documented	1

TB: Tuberculosis, MTB: Multidrug-resistant tuberculosis, *n*: Number of patients

The most common histologic subtype of lung cancer was adenocarcinoma 41 cases (45.1%) of all lung cancer cases, followed by squamous cell carcinoma with 23 cases (25.3%) and small cell lung cancer with 7 cases (7.7%).

Diagnostic yield

There were 181 positive diagnoses out of 221 cases where bronchoscopic specimens were collected for diagnosis giving an overall diagnostic yield of 81.9%.

There were 86 cases of macroscopically visible tumors on bronchoscopy, all were biopsied and 75 cases were diagnosed with malignancy, this gives a diagnostic yield for malignancy of 87.2%.

DISCUSSION

The 5-year retrospective audit demonstrated a gradually increasing trend of FB practice at KNH. The number of patients undergoing FB increased from 24 cases in 2016 to 104 and 74 cases in 2019 and 2020. The drop in cases in 2020 was attributed to the coronavirus disease outbreak and national movement restrictions. The increase in trends can be attributed to a better staffing of the unit with a dedicated bronchoscopy nurse and additional chest physicians. Similar trends in the uptake of FB services were observed in studies in Nigeria[3] and Tanzania.[4] We found that 51.4% of patients undergoing FB were male while 48.6% were female with an overall mean age of 51.3 years. Ndilanha *et al.* in Tanzania, Adewole *et al.* in Nigeria, Kontakiotis *et al.* in Greece, and Bennett *et al.* in the UK found a similar pattern. The mean age of patients in the above studies ranged between 54 years and 65 years.[3-6] The finding that the majority of our patients (58.2%) were residents of counties outside Nairobi including as far as Meru county which is over 200km away from Nairobi could indicate the unavailability of bronchoscopy services in those counties and/or the concentration of expertise within Nairobi.

The most common indications for bronchoscopy were found to be the evaluation of lung mass (35.7%), pulmonary infiltrates (18.9%), suspected interstitial lung disease (13.9%), atelectasis (6.4%), and hemoptysis (3.9%). This is similar to findings of retrospective studies in Tanzania, Egypt, Nigeria, and Greece with the evaluation of lung mass being the most common indication.[3-5,7]

Over 91% of the patients who underwent FB in the 5 years under study had their pre- and post-procedure BP, HR, respiratory rate (RR), and SPO_2 monitored and documented. The regular patient monitoring in our study was also attributable to the availability of a dedicated nurse for the bronchoscopy unit who ensures patient monitoring and documentation. This practice is in line with most guideline recommendations. Both BTS and the Joint Indian Chest Society (JICS) recommend that all patients should have their BP, HR, RR, and SPO_2 monitored, and recorded repeatedly before, during, and after the procedure. Furthermore, the JICS endorses that the RR and the depth of sedation should be documented during FB. Insufficient monitoring combined with too deep sedation and undetected respiratory depression can lead to substantial complications in bronchoscopic procedures.[8]

The majority of the patients (98.2%), in our study, underwent FB under sedation with only 1.8% being done under local anesthesia without sedation. This was similar to findings in surveys among pulmonologists in the UK (96%) and Pakistan (98%).[2,9] This sedation rate was however much higher when compared to 44% found by Kontakios *et al.* in an audit of private hospitals in Greece.[5] The lower sedation rate in the Greece study was attributed to the concept of "Vocal Anesthesia" employed in that study. This concept involved pre-procedure patient preparation and education, and simple explanations of the maneuvers during the procedure. Smyth and Stead also note that extent of explanation and reassurance

given to the patient is likely to affect the need for anesthesia.[1] We found the technique of sedation to be variable, with the majority of the patients getting a combination of Ketamine and benzodiazepine (often midazolam) (74.3%), a combination of opioids and benzodiazepine (15.4%), while about 10% got local anesthesia with either monotherapy of ketamine only (0.7%), benzodiazepine only (8.9%), and opioid only (0.7%), this variability could be due to preference of an individual bronchoscopist, system factors as well as some patient factors. According to Credle *et al*., there is no consensus on whether to sedate or not and the choice of sedatives.[10]

About 94.3% of the patients, in our study, underwent one or more bronchoscopic diagnostic procedures for microbiologic, cytological, and/or histologic diagnosis. Over 60% of these underwent combination diagnostic procedures. The most common combination is bronchial wash and bronchial biopsy. This is similar to the findings of studies done in Egypt and Saudi Arabia.[11,12] The use of a combination of bronchoscopic sampling procedures is a BTS guideline recommendation. It recommends that biopsy (at least 5 biopsies), brushing, and washing be combined to increase the diagnostic yield of endobronchial tumors. In the evaluation of infectious etiologies, the guidelines recommend a combination bronchial wash and Broch alveolar lavage.[2]

The most common macroscopic finding in our setting was visible tumors (38.5%), closely followed by normal bronchoscopic findings (29.5%), inflammatory changes (11.5%), and secretions (8.3%). This was similar to findings in Egypt and Nigeria[3,13] but different from a study in Saudi Arabia by Alamoudi *et al*. that found 64% had inflammatory changes, 31% had narrowed segments, and 19% had visible tumors.[12] The study in Saudi Arabia had an evaluation of pulmonary infiltrates (suspected infection) as the most common indication for flexible bronchoscopy, unlike our study where a third of the patient was due to suspected lung cancer.[12]

Immediate procedure-related complications were rare and minor. We reported a complication rate of 3.2%. The global prevalence rate ranges between 0.5% and 5%. Pue and Pacht, in a 5-year retrospective review of bronchoscopy, found a complication rate of 0.5%, this low rate was attributed to the fact that most cases, in his study, did not undergo a biopsy.[20] Dreisin *et al*., in a prospective study of 205 bronchoscopies, found a complication rate of 5%.[14] The variability in the reported complications is influenced by the nature of the sampling procedures done, patient selection, and whether or not late complications were included in the study. Complication rates, in our study, may be an underestimation as it only focuses on reported immediate intraprocedure complications.

The most common bronchoscopic diagnosis was lung cancer (40.1%), interstitial lung disease (15.9%), and TB (6.2%). This is similar to the findings of studies done in Tanzania, Nigeria, Egypt, Saudi Arabia, Greece, and the UK which all found lung cancer to be the most common bronchoscopic diagnosis.[3-6,11] The most common histologic subtype of lung cancer in our study was adenocarcinoma (45%), followed by squamous cell carcinoma (25.3%) and small cell lung cancer (7.7%). This was similar to a study in Tanzania that found adenocarcinoma as the most common histologic subtype.[4] Our findings are in keeping with recent studies in the USA, Norway, and Japan that showed a trend toward a greater predominance of adenocarcinoma.[15-17] However, studies in Egypt and Saudi Arabia found squamous cell carcinoma as a more common histologic subtype.[7,12] These findings could be explained by the fact that the proportion of smokers, both current and ex-smokers is much higher in Saudi Arabia (>50%) and Egypt (61.5%)[7,12] compared to our setting (31.8%).

The proportion of smokers (current and ex-smokers) among patients with malignancy was also lower at 36.3%, compared to 84% found by Alamoudi *et al*., who found squamous cell carcinoma as the most common histologic subtype.[12] These findings suggest that a large proportion of patients with lung cancer in our setting were non-smokers. Multiple factors contribute to the development of lung cancer, including environmental toxin exposure, genetic predisposition, infectious comorbidities, and individual lifestyle.[18] Long-term air pollution exposure increases the risk of lung cancer,[19] in addition, increasing exposure to particulate matter (PM2.5) increases the risk of non-smoking individuals with pre-existing mutations.[18] This could be a plausible explanation for our findings but this needs further work.

The overall diagnostic yield of bronchoscopy was 81.9%. This was similar to what was reported in studies in Egypt that found overall yields of 78.6%.[7] The diagnostic yield for malignancy where there was a visible endobronchial tumor was 87.2%. This was similar to rates found in studies by Halima *et al*.[7] and Mohamed *et al*.[11] who reported diagnostic yield of 95% and 94.7%, respectively, for malignancy where there was an endobronchial tumor. Our study disagrees with a study by Adewole *et al*. in Nigeria that reported much lower rates of 55%.[3] This variability in diagnostic yield can be explained by the possible difference in bronchoscopist experience, diagnostic sampling methods used, and the number of biopsies taken. The rate of 87.2%, in our study, meets the recommendation of the British thoracic guideline that recommends a diagnostic yield of more than 85% where there is a visible tumor.[2] This is to minimize the need for repeat bronchoscopy for biopsy and ensure timely diagnosis of lung tumors.

The study was the first to review the practice in Kenya; however, it was a retrospective chart review and there were significant documentation gaps.

CONCLUSION

Our study showed that FB practice at KNH is safe and provides a good diagnostic yield; however, significant documentation gaps exist. There is a need to individualize the pre-procedure laboratory evaluation rather than as a routine workup.

The most common lung cancer histologic subtype was adenocarcinoma among mostly a non-smoker population.

Our practice is comparable to other countries in Africa and the rest of the world in terms of patient preparation, procedural practices, complication rates, and diagnostic yield.

Recommendation

Current practice in Kenya is good and in keeping with international practice; however, there is a need to improve documentation and record keeping, improve access to bronchoscopy in public hospitals in other counties and further studies on lung cancer risk factors and the need for screening strategy.

Declaration of patient consent

Institutional Review Board (IRB) permission obtained for the study.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The author(s) confirms that there was no use of Artificial Intelligence (AI)-Assisted Technology for assisting in the writing or editing of the manuscript and no images were manipulated using the AI.

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