Implementation of bronchoscopic conventional transbronchial needle aspiration service in a tertiary care chest hospital

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Background Conventional transbronchial needle aspiration (C-TBNA) is a unique technique that allows the sampling tissue from beyond the endobronchial tree, such as enlarged lymph nodes, peribronchial, or submucosal lesions. However, it remains underutilized and even unavailable in many countries and centers around the world including Egypt.

Objective This study aimed to implement bronchoscopic C-TBNA service in a tertiary care chest hospital with special emphasis on the diagnostic yield, complications encountered, and learning experience.

Patients and methods This cohort study was conducted on 60 patients with bronchoscopic nonvisible extraluminal lesions who have sought bronchoscopic C-TBNA service at the Bronchoscopy Unit of both Ain Shams University Hospital and Giza Chest Hospital during the period from June 2016 to February 2018.

Results The overall C-TBNA had a diagnostic yield of 88.3% in which 68.3% were malignant and 20% had sarcoidosis without serious complications recorded except for minor non-life-threatening bleeding in 21.7% of cases. After 6 months of C-TBNA learning experience, the diagnostic yield showed improvement in physicians without previous C-TBNA experience, but without reaching a statistical significance. Also, there were significant reduction in both duration and complications of C-TBNA.

Conclusion Implementing C-TBNA service in a tertiary care chest hospital in bronchoscopically nonvisible extraluminal lesions seems to be a safe, easy technique with high diagnostic yield and its learning performance was able to be improved over time.

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Introduction

Conventional transbronchial needle aspiration (C-TBNA) was developed in the 1980s by Wang and Terry. It is a method of sampling performed via a flexible bronchoscope (FB) under conscious sedation with low consequent risk of complications. Major complications represent 0.3% in a meta-analysis and were hemorrhage, pneumothorax requiring chest drainage, and pneumomediastinum [1].

Chest physicians usually need to determine the significance of lymph node enlargement and submucosal or peribronchial diseases to distinguish benign and malignant processes and add essential staging information to select the best treatment strategy for patients who have non-small-cell lung cancer [2].

Despite C-TBNA has been an available procedure for almost three decades with a sensitivity ranging from 39 to 78%, it remained underutilized [3–6]. This may be related to the widely recognized TBNA utilization problems (e.g. fear of complication, and damage to the bronchoscope, cost of disposable needles, 'blind' bronchoscopic technique, and lack of cytopathologist's experience) [7]. In Egypt, as in many countries and centers around the world C-TBNA is underutilized [6,7]. A survey of adult FB practice in Cairo showed that only 28% of bronchoscopists were experienced in C-TBNA, with a total of 295 procedures performed in the year before the survey [7]. Thus, it seems crucial to implement bronchoscopic C-TBNA service in a tertiary care chest hospital with special emphasis on diagnostic yield, complications encountered, and learning experience.

Patients and methods

This cohort study was conducted in the Bronchoscopy Unit of Ain Shams University Hospital and Giza Chest Hospital from June 2016 to February 2018. A written consent was obtained from all patients before the procedure. Giza Chest Hospital is a tertiary care governmental hospital in Egypt having 125 beds and performing around 107 basic bronchoscopy practice in the previous year with no previous experience in C-TBNA of its bronchoscopy team.

Patients with bronchoscopic nonvisible extraluminal lesions (extrinsic compression of airway, submucosal lesions, and hilar and mediastinal lymph nodes) were included. Exclusion criteria were any patient with contraindication(s) for FB as stated by the British Thoracic Society guidelines on diagnostic FB [8]. All patients underwent full history taking, clinical examination, routine laboratory investigations (complete blood count, liver and kidney functions, bleeding profile), chest radiography, computed tomographic chest scan, and then FB was performed either under topical lidocaine anesthesia, supplemental oxygen and pulse oximetry monitoring or under general anesthesia according to the national and international standards of practice [9], patient preference, and bronchoscopist's opinion.

FB used was either: FB18V (Pentax LH 150 PC; Pentax; Asia Optical, Tokyo, Japan-(Business Wire) – Hoya Group) with a 5.9 mm insertion tube, 2.8 mm working channel, and 60 cm working length or HD Pentax 3.2 Medical 70 K series (EB-1970 K) video bronchoscope and I-Scan Video Processor EPK-i (Japan), with an insertion tube of 6.3 mm, 2.3 mm instrument channel, and 600 mm working length.

C-TBNA was performed using two needles NA-2C (21 G; 13-mm long cytology needle; Olympus, Tokyo, Japan) and EndoFlex (1.8 mm; 0.9 mm; 12 mm length; Germany) using jabbing and hub against wall techniques either single or in combination as previously described in detail by Minai *et.al.* [10]. At least three passes were obtained per target site from the center of the most abnormal area in all types of lesions like exophytic, submucosal, and peribronchial [10]. The specimens were collected and stored at the lumen of the needle and then blown into the slide by air in the syringe, but before smearing, another glass slide was used to press and smear the specimen, then immediately fixed in 95% alcohol and send to the cytologist [11].

Cytological preparation, staining, and examination of samples were done and cytological criteria for adequate TBNA samples were assessed according to usual standards [10,12] and TBNA was considered nondiagnostic in cases of obtaining adequate representative negative samples and inadequate nonrepresentative samples [10]. Other bronchoscopic diagnostic procedures, for example, bronchial washing or forceps biopsy were done whenever indicated.

Assessment of the learning curve was achieved based on: reading literature on C-TBNA, observation of 10 cases of C-TBNA, performing C-TBNA single handed, evaluation of diagnostic yield, and recording complications.

Approval was obtained from the local institutional board (Research Ethics Committee at the Faculty of Medicine, Ain Shams University (FMASU MD 174/ 2016).

Statistical methods

The collected data were coded, tabulated, and statistically analyzed using IBM SPSS statistics software, version 18.0, 2009 (IBM Corp., Chicago, Illinois, USA). Inferential analyses were done for quantitative variables using the Shapiro–Wilk test for normality testing and independent *t*-test in cases of two independent groups with normally distributed data. In qualitative data, inferential analyses for independent variables were done using Fisher's exact test for variables with small expected numbers. The level of significance was taken at a *P* value of less than 0.050 which is significant, otherwise is considered nonsignificant.

Results

Sixty patients undergoing diagnostic bronchoscopy met the inclusion criteria for TBNA, and the detailed baseline patients' characteristics are shown in Tables 1 and 2. TBNA samples were adequately representative in 96.6% of the studied cases. The diagnostic yield of TBNA was 88.3% among the studied cases (75.0% in Giza Chest Hospital) (Table 2). Definite diagnosis was reached in 53 cases, the detailed diagnosis is shown in Table 3 and TBNA was the only diagnostic procedure in 55% of cases and was combined by other biopsies in 33.3% (Table 4).

There were no serious complication related to C-TBNA, just minor non-life-threatening bleeding in 21.7% (18.3% in Giza Chest Hospital) that was controlled with saline and adrenaline. Desaturation occurred only in one case due to the effect of general anesthesia which was resolved with induction of oxygen and observation only.

TBNA learning experience after 6 months of study for physicians without previous TBNA experience showed significantly shorter (bronchoscopy time, TBNA durations) and less frequent complications and improvement of diagnostic yield, but without reaching a statistical significance (Tables 5 and 6).

Discussion

This study emphasis the importance of implementing C-TBNA service in a tertiary care chest hospital reaching a diagnostic yield of 88.3% among the studied cases with minor non-life-threatening

Table 1 Detailed baseline patient characteristics

Characteristics	Mean±SD	Range
Age (years)	51.1±15.9	13.0–83.0
Sex [*n* (%)]		
Male	37 (61.7)	
Female	23 (38.3)	
Smoking [*n* (%)]		
Never	26 (43.3)	
Ex	15 (25.0)	
Current	19 (31.7)	
CT findings of studied cases [*n* (%)]		
Mass	48 (80.0)	
Peribronchial	44 (73.3)	
Paratracheal	4 (6.7)	
LN location in the mediastinum [*n* (%)]		
Subcarinal	6 (10.0)	
Right hilar	2 (3.3)	
Left hilar	4 (6.7)	
Mass location [*n* (%)]		
Bronchus intermedius	4 (6.7)	
Right hilar	8 (13.3)	
Left hilar	4 (6.7)	
RUL	5 (8.3)	
ML	2 (3.3)	
RLL	3 (5.0)	
Right paratracheal	4 (6.7)	
LUL	10 (16.7)	
LLL	4 (6.7)	

CT, computed tomography; LLL, left lower lobe; LN, lymph node; LUL, left upper lobe; ML, middle lobe; RLL, right lower lobe; RUL, right upper lobe.

Table 2 Transbronchial needle aspiration indications among the studied cases

Findings	*n* (%)
Extraluminal compression	42 (70.0)
Mediastinal LNs	8 (13.3)
Extraluminal compression and submucosal lesions	8 (13.3)
Mediastinal mass	1 (1.7)
Submucosal lesion	1 (1.7)

LN, lymph node; TBNA, transbronchial needle aspiration. Sites of needle insertion in case of extraluminal compression was inserted directly into the site of bulge (*n*=50) and the site of submucosal lesion (*n*=1), into station 3 in case of mediastinal mass (*n*=1) and in case of mediastinal LN (*n*=8) site were station 11 in five cases and station 9 in one, station 2 in two cases.

complications encountered and its learning performance was able to be improved over time.

The results showed that the C-TBNA samples were adequately representative in 96.6% of the studied cases. The diagnostic yield of TBNA was 88.3% among the studied cases. There were wide variations in the rates of adequacy ranging from 71 to 98% in some literatures [13,14]. In contrast, the diagnostic yield ranged from 46 to 87.2% in other literatures [13–19]. The differences between the literatures may be attributed to the different number of cases in each study, C-TBNA indication, site and the size of lesion sampled, and the experience of the bronchoscopist.

Table 3 Cytological criteria of transbronchial needle aspiration samples

Cytological criteria	*n* (%)
Adequacy of samples	
Inadequate nonrepresentative samples	2 (3.4)
Adequate representative samples	58 (96.6)
Diagnostic yield	
Diagnostic	53 (88.3)
Nondiagnostic	7 (11.6)
Inadequate nonrepresentative samples	2 (28.6)
Adequate representative samples	5 (71.4)

TBNA, transbronchial needle aspiration. Criteria for TBNA samples adequacy are rare bronchial epithelial cells, dominant lymphocytes, strict criteria for cytological diagnosis of malignancy should be established and all samples are classified as negative, suspicious, or definitely malignant, samples with no evidence of lymphocyte is considered true negative) [10,12].

Table 4 Cytopathological findings of transbronchial needle aspiration in the studied cases

TBNA histopathological findings	*n* (%)
Inflammatory	7 (11.7)
Sarcoidosis	12 (20.0)
Malignancy	41 (68.3)
NSCLC	25 (41.7)
Adenocarcinoma	6 (10.0)
Squamous cell carcinoma	1 (1.7)
Poorly differentiated	18 (30.0)
SCLC	4 (6.6)
Round cell tumors	3 (5.0)
Lymphoma	1 (1.7)
Unknown malignancy	8 (13.3)

NSCLC, non-small-cell lung cancer; SCLC, small-cell lung cancer; TBNA, transbronchial needle aspiration.

Definite diagnosis in this study was reached in 53 cases, the most common diagnosis was malignancy in 68.3%. The most common histopathological diagnosis was non-small-cell lung cancer in 41.7% of cases, while small-cell lung cancer comprised 8.3% of cases. Definite diagnosis of sarcoidosis was reached in 20% of the studied cases.

Also, Szlubowski *et al.* [20] reported that C-TBNA provides diagnosis of malignancy in 67.1%. In contrast, Tutar *et al.* [21] reported that TBNA provides diagnosis of malignancy in 40% of studied cases (22.6% of them were non-small-cell lung cancer and 4.8% were small cell lung cancer). A higher result was noticed by SharafKhaneh *et al.* [22] who reported that C-TBNA revealed diagnosis of malignancy in 85 cases (69.0%), 64.0% of them were non-small-cell lung cancer and 260 (87.0%) of them were small cell lung cancer. The low range of results about the diagnostic percentage of sarcoidosis (12.9 and 37%) was observed

Table 5 Analysis of diagnostic transbronchial needle aspiration yield

Number of diagnostic TBNA	*N*=60 [*n* (%)]
Total number of cases that TBNA was diagnostic	53 (88.3)
Number of cases TBNA was the only diagnostic procedure	33 (55.0)
Number of cases that TBNA diagnosis was not the only diagnostic procedure	20 (33.3)

TBNA, transbronchial needle aspiration. Nondiagnostic TBNA (*n*=7).

Table 6 Transbronchial needle aspiration learning experience: evaluation of progression of transbronchial needle aspiration skills in first and second 6 months of study in physicians without previous transbronchial needle aspiration experience

	First 6 months (*n*=22) [*n* (%)]	Second 6 months (*N*=28) [*n* (%)]	*P* value
Bronchoscopy duration (mean±SD)	15.9±2.0	13.8±2.1	<**0.001**a*
TBNA duration (mean±SD)	10.8±1.9	8.9±1.4	<**0.001**[a,*]
Side effects	8 (36.4)	3 (10.7)	**0.042**[b,*]
Fault technique			
Inadequate sample	1 (4.5)	1 (3.6)	1.000[b]
Outcome			
Diagnostic	18 (85.7)	27 (96.4)	0.301[b]
Nondiagnostic	3 (14.3)	1 (0.0)	

TBNA, transbronchial needle aspiration. [a]Independent *t*-test. [b]Fisher's exact test. *Significant. *P* value <0.05 is significance.

in the study by Tutar *et al*. [21] and the study by SharafKhaneh *et al*. [22], respectively. In contrast, there were higher range of results about the diagnostic percentage of sarcoidosis (59%) as observed in the study by Szlubowski *et al*. [20].

This study revealed that C-TBNA was the only diagnostic procedure in 55% of cases and was combined by other biopsies in 33.3%. Previous experience was stated by SharafKhaneh *et al*. [22], Cetinkaya *et al*. [13], Hsu *et al*. [11], and Walia *et al*. [23] in which C-TBNA was the sole diagnostic procedure in 33.4% (*n*=56), 50% (*n*=30), 30% (*n*=27), and 54.5% (*n*=6), respectively.

There were no serious complications related to C-TBNA just minor nonlife-threating bleeding in 21.7% of cases that was controlled with saline and adrenaline. Desaturation occurred only in one case and was due to the effect of general anesthesia which was resolved with induction of oxygen and observation only.

A low consequent risk of complications ranging from 0 to 8% was seen in different studies in the form of either minor bleeding, hemorrhage, pneumothorax, or pneumomediastinum [11,15,18,19,21,24].

Evaluation of C-TBNA learning experience after 6 months of this study in physicians without previous C-TBNA experience showed significantly shorter bronchoscopy, TBNA durations, and less frequent complications and improvement of diagnostic yield, from 85.7 to 96.4% but without reaching a statistical significance.

De Castro *et al*. [25] reported that after a training period of 24 months, TBNA diagnostic yield improved from 32 to 78%; also they estimated that a training period of 50 procedures was required for good technique to be attained. Haponik *et al*. [26] revealed that following a 3-year period of training, TBNA diagnostic yield increased from 21.4 to 47.6% and that inadequate samples decreased from 10.5 to 2% over this period. Hsu *et al*. [11] showed a borderline of significance over the study period (4 years) of decreased frequency of inadequate samples and explained the observation that TBNA diagnostic yield tended to vary in different studies due to different thresholds specified as being necessary to perform the technique as determined by different physicians at different institutions. Tutar *et al*. [21] found that the diagnostic yield was statistically significant after 30 procedures compared with the first 30 procedures.

The limitation of this study was the small study sample size. TBNA procedures were not fully supervised, and a short period of experience and absence of an estimated period was required for good technique to be reached.

Conclusion

From this study, we concluded that C-TBNA is safe and easy to implement with minimal complications. The diagnostic yield of TBNA is very high in lung cancer diagnoses. An observational educational program is helpful for learning TBNA and its performance was able to be improved over time.

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Conflicts of interest

There are no conflicts of interest.

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