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Transbronchial Needle Aspiration in Bronchogenic Carcinoma With Visible Lesions: Diagnostic Yield and Cost

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BACKGROUND: Transbronchial needle aspiration (TBNA) is a bronchoscopic technique whose usefulness in diagnosing endobronchial lesions has not yet been clearly established.

OBJECTIVE: We aimed to determine whether the diagnostic yield of fiberoptic bronchoscopy could be increased, without a negative impact on diagnostic costs, if TBNA were used in combination with conventional diagnostic techniques (bronchial washings and bronchial brushings and forceps biopsy).

PATIENTS AND METHODS: The cases of 130 patients diagnosed with bronchogenic carcinoma with endoscopically visible lesions were analyzed retrospectively. All had undergone conventional diagnostic procedures; TBNA was also performed if the bronchoscopist considered it was indicated. The final cost was calculated in euros for each diagnosis as the sum of the cost of the procedures needed to reach the diagnosis, including both endoscopic procedures and others (transthoracic needle aspiration, lymph node biopsy). Diagnostic yield and costs in cases diagnosed using only conventional techniques were compared to the yield and costs in cases in which both conventional techniques and TBNA were used.

RESULTS: TBNA was performed in 49 patients and provided the diagnosis in 85.7%. Conventional techniques led to cytological and histological diagnosis in 80.2% of the cases, and the combination of conventional techniques and TBNA gave a diagnosis in 89.7% (*P*=.01). Significant differences were observed in extrinsic compression (conventional 37.5%; conventional+TBNA 100%; *P*=.01), submucosal infiltration (conventional 54.6%; conventional+TBNA 85%; *P*=.03), and exophytic mass with necrosis (conventional 80%; conventional+TBNA 100%; *P*=.01). The mean (SD) cost of diagnosis was €381.60 (€156.53) using conventional techniques and €413.25 (€112.91) for conventional techniques in combination with TBNA. By adding TBNA, costs decreased for diagnoses of submucosal infiltration, exophytic mass with necrosis and extrinsic compression, although the saving was significant only for extrinsic compression.

CONCLUSION: The diagnostic yield of TBNA is high for endoscopically visible bronchial anomalies suggesting neoplasm, particularly when the lesion is due to extrinsic compression, submucosal infiltration, or exophytic mass with necrosis.

Key words: *Transbronchial needle aspiration. Bronchogenic carcinoma. Endobronchial lesion. Diagnostic cost.*

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Punción transbronquial en el carcinoma broncogénico con lesión visible: rendimiento y coste económico

FUNDAMENTO: La punción transbronquial (PTB) es una técnica broncoscópica cuya utilidad en tumores con lesión endobronquial no está claramente establecida.

OBJETIVO: Con nuestro trabajo pretendemos estudiar si la combinación de la PTB con las técnicas diagnósticas convencionales (aspirado, cepillado y biopsia bronquiales) incrementa el rendimiento de la fibrobroncoscopia, sin repercutir negativamente en el coste económico (CE) del proceso diagnóstico.

PACIENTES Y MÉTODOS: Se analizó de forma retrospectiva a 130 pacientes diagnosticados de carcinoma broncogénico con lesión endoscópica visible, a quienes se les practicaron las técnicas convencionales, quedando a criterio del broncoscopista responsable la realización de PTB. Se calculó el coste final por proceso, en euros, constituido por la suma del coste de los procedimientos necesarios para lograr el diagnóstico, en los que se incluían los endoscópicos y otros (punción transtorácica, punción-biopsia ganglionar). Se compararon el rendimiento y el CE entre el grupo de pacientes a los que se practicaron las técnicas convencionales (ACB) y aquellos a los que se añadió PTB (ACB + PTB).

RESULTADOS: La PTB se realizó en 49 pacientes y proporcionó el diagnóstico de naturaleza en el 85,7% de los casos. Con ACB se logró la filiación citohistológica en el 80,2% de los casos, y en el 89,7% con ACB + PTB (p = 0,01); se apreciaron diferencias significativas en: compresión extrínseca (ACB: 37,5%; ACB + PTB: 100%; p = 0,01), infiltración submucosa (ACB: 54,6%; ACB + PTB: 85%; p = 0,03) y masa exofítica con necrosis (ACB: 80%; ACB + PTB: 100%; p = 0,01). El CE medio fue de 381,60 ± 156,53 euros en ACB y 413,25 ± 112,91 en ACB + PTB; al añadir la PTB se redujo el CE en infiltración submucosa, masa exofítica con necrosis y compresión extrínseca, aunque este ahorro sólo resultó significativo en compresión extrínseca.

CONCLUSIÓN: La punción transbronquial es una técnica de elevada rentabilidad en presencia de anomalías endobronquiales indicativas de neoformación, particularmente cuando la lesión visualizada corresponde a compresión extrínseca, infiltración submucosa o masa exofítica con superficie necrótica.

Palabras clave: *Punción transbronquial. Carcinoma broncogénico. Lesión endobronquial. Coste.*

Introduction

Fiberoptic bronchoscopy is the method of choice in the diagnosis of endobronchial carcinoma. A combination of techniques such as forceps biopsy, bronchial brushings, and bronchial washings have traditionally been used for their high yield—over 80%—in the classification of tumors.

Transbronchial needle aspiration (TBNA) is a relatively recent bronchoscopic technique mainly used for lymph node staging.[1] It is also of great utility in cases of endobronchial mass with necrosis, severe bleeding,[2] submucosal lesions and peribronchial tumors causing extrinsic compression.[3] However, due to the high cost of disposable needles, TBNA is not recommended when endobronchial anomalies are present.[4] Moreover, the combination of conventional diagnostic techniques such as bronchial brushings and forceps biopsy have demonstrated satisfactory cost-effectiveness.[5]

We aimed to determine whether the diagnostic yield of fiberoptic bronchoscopy could be increased without adverse impact on diagnostic costs if TBNA were used in combination with conventional diagnostic techniques (CDT) such as bronchial washings, bronchial brushings, and forceps biopsy.

Patients and Methods

Patients

The cases of 140 patients diagnosed with bronchogenic carcinoma from January 1999 through December 2001 were analyzed retrospectively. Fiberoptic bronchoscopy was performed on all patients, with visible endobronchial lesion defined as exophytic mass, mucosal infiltration (consisting of abnormalities or granuloma in the bronchial wall with friable mucosa), submucosal infiltration (with thickening or loss of longitudinal mucosal folds) and extrinsic compression (swelling of lung walls or carinal widening).

Procedure

The examinations were carried out by three different specialists and bronchial washings, bronchial brushings, and forceps biopsy samples were essential requisites. When the bronchoscopist considered TBNA was indicated, it was carried out prior to other techniques. For the patient to be included in our study at least 2 bronchial brushings, 3 forceps biopsies, and 2 TBNAs were required.

Cytological analysis was considered positive only when a sufficient number of definitely malignant cells was observed. Cellular atypia and abnormal cells highly suggestive of malignancy were considered negative. Samples were immediately fixed in 95% proof alcohol; all samples were assessed by the same cytologist, who was blinded to the histological techniques used. In all TBNA cases, 22-gauge needles (MW-222; Mill-Rose Lab, Mentor, OH, USA) were used; disposable catheters 1.7 mm in diameter (1601 Boston Scientific, Watertown, MA, USA) were used for bronchial brushings. The choice of forceps for biopsy was left to the bronchoscopist in charge.

Exclusion Criteria

Patients were withdrawn when thoracotomy was required to classify the neoplasm, or when the cytology samples were considered inadequate.

Variables

First, the diagnostic yield for CDT was compared to the yield for CDT+TBNA. The diagnostic positivity by bronchoscopy was determined in both groups as a function of the visualized lesion.

Second, the cost of diagnosis was calculated in euros using the figures provided by the billing department at our hospital. The cost per diagnosis was the sum of costs needed to reach a diagnosis including endoscopic and other procedures such as transthoracic needle aspiration, and lymph node biopsy. The charges for diagnostic procedures used are listed in Table 1. The costs of analyzing samples after the various endoscopic diagnostic procedures were included for both CDT and CDT+TBNA cases.

Statistical Analysis

The results of data analysis of quantitative variables are expressed as means (SD). Percentages were used for the qualitative variables. Percentages were compared using χ^2 tests. Independent sample means were compared with Student *t* tests.

Results

Of the 140 patients enrolled in the study, 10 were excluded on the following grounds: 2 because they had undergone thoracotomy and 8 because their samples were considered inadequate. Therefore, the study population was made up of 130 patients: 120 men (91.5%), with a mean age of 62.02 (9.90) years. During the examination, the following lesions were observed: exophytic mass in 55 patients, mucosal infiltration in 31, extrinsic compression in 13, and submucosal infiltration in 31. The histological classification was

TABLE 1
Hospital Charges for the Diagnostic Procedures Used (in Euros)*

Procedure	Cost
Diagnostic technique	
Fiberoptic bronchoscopy	77.42
Fiberoptic bronchoscopy with forceps biopsy	93.07
Bronchial brushings	77.42
Transbronchial needle aspiration	77.07
CT transthoracic needle aspiration	311.32
Lymph node biopsy	64.66
Cytology and histology sample	
Bronchial brushing and washing cytology and transbronchial needle aspiration	35.76
Forceps and lymph node biopsy	100.37
Cytology, transthoracic needle aspiration, lymph node aspiration	45.68

*CT indicates computed tomography.

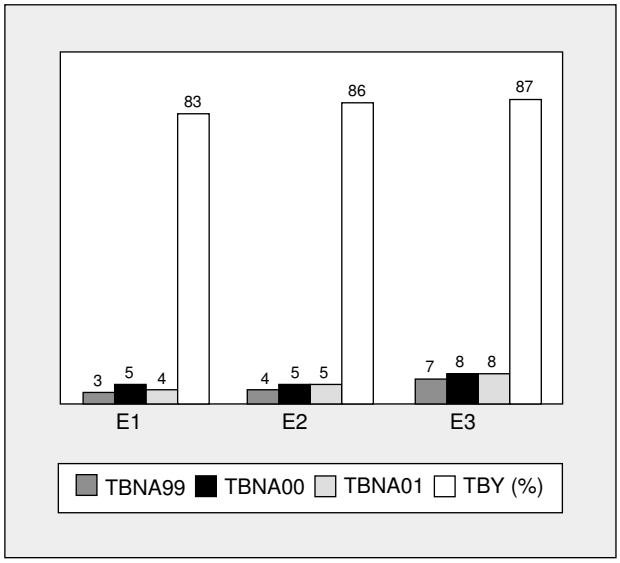

Figure 1. Transbronchial needle aspirations and yields by endoscopist. E1 indicates endoscopist 1; E2, endoscopist 2; E3, endoscopist 3; TBNA99, transbronchial needle aspirations in 1999; TBNA00, transbronchial needle aspirations in 2000; TBNA01, transbronchial needle aspirations in 2001; TBY, transbronchial needle aspiration yield.

epidermoid carcinoma for 71 patients (54.6%), adenocarcinoma for 28 (21.5%), microcytic carcinoma in 17 (13.1%) and undifferentiated large cell carcinoma in 14 (10.8%). TNBA was performed on 49 patients and its diagnostic yield of 85.7% was higher than that of any other technique (Table 2). No serious complications related to the procedure were observed except on 2 occasions in which moderate bleeding occurred. Bleeding was controlled by conventional endoscopic means. Figure 1 shows the number of TBNAs performed by each practitioner as well as the diagnostic yield obtained.

Diagnostic Yield for Fiberoptic Bronchoscopy

CDT led to cytohistological diagnosis in 80.2% of cases and CDT+TBNA gave positive results in 89.7% (*P*=.01). The gain in diagnostic yield continued to be significant for the following lesions: extrinsic compression (CDT: 37.5%; CDT+TBNA: 100%; *P*=.01), submucosal infiltration (CDT: 54.5%; CDT+TBNA: 85%; *P*=.03), and exophytic mass with surface necrosis (CDT: 80%: CDT+TBNB:100%; *P*=.01). Table 4 shows the diagnostic yield by the type of endobronchial lesion and presence of necrosis.

Study of Costs

The mean (SD) cost per disease diagnosed was €393.53 (€142.04): €381.60 (€156.53) with CDT and €431.25 (€112.91) in CDT+TBNA.

Table 4 shows that the addition of TBNA lowered costs when submucosal disease (CDT: €488.68 [€209.44]; CDT+TBNB: €419.70 [€125.95]), exophytic mass with necrosis (CDT: €386.59 [€169.10]; CDT+TBNB: €376.74 [€24.92]), and extrinsic compression (CDT: €557.04 [207.56]; CDT+TBNB: €383 [€0]; *P*=.02) were present.

Discussion

For the staging of lung carcinoma TBNA has been widely studied and is recommended as part of standard medical practice in various scientific associations' guidelines, the same cannot be said of its use in the diagnosis of an endoscopically visible lesion. Few authors have evaluated its utility in this respect.

TBNA diagnosed malignancy in 85.7% of the patients analyzed retrospectively in the present study and obtained the highest yield of all techniques, proving better than forceps biopsy for all endobronchial anomalies. It was also the only procedure able to establish the diagnosis in 17% of cases. The addition of TBNA to conventional cytology and histology techniques significantly increased the diagnostic yield of the endoscopic exploration by 9.5%, to reach a yield of 89.7%. Increased yield was observed for exophytic mass lesions with surface necrosis, submucosal disease, and extrinsic compression.

Other authors have reported similar results. For example, in a prospective analysis by Govert et al,[6] TBNA showed a sensitivity of 79% for classifying malignancy; TBNA plus forceps biopsy and bronchial brushings positivity increased positivity to 95%, although greatest usefulness of TBNA was observed in extrinsic compression and submucosal infiltration. In a similar study by Dasgupta et al[7] TBNA obtained an overall yield

TABLE 2
Positivity by Endobronchial Lesion and Endoscopic Technique*

	BW	BB	FB	TBNA
Type of lesion				
Exophytic mass	56.3% (31/55)	63.6% (35/55)	83.6% (46/55)	90.9% (10/11)
Mucosal infiltration	64.5% (20/31)	67.7% (21/31)	83.8% (26/31)	84.6% (11/13)
Extrinsic compression	23.1% (3/13)	30.8% (4/13)	0% (0/13)	100% (5/5)
Submucosal infiltration	38.7% (12/31)	54.8% (17/ 31)	67.7% (21/31)	80% (16/20)
Total	50.4%	59.2%	71.5%	85.7%
Dx, sole technique	1.5%	1.5%	13.8%	17%

*BW indicates bronchial washings; BB, bronchial brushings; FB, forceps biopsy; TBNA, transbronchial needle aspiration; Dx, diagnostic.

TABLE 3
General Characteristics*

	CDT	CDT+TBNA
Age, SD	61.69 (9.51)	62.49 (10.8%)
Sex		
Male	75 (92.6%)	44 (89.8%)
Female	6 (7.4%)	5 (10.2%)
Histological type		
Adenocarcinoma	21 (25.9%)	7 (14.3%)
Epidermoid carcinoma	47 (58%)	24 (49%)
Small cell carcinoma	9 (11.1%)	8 (16.3%)
Undifferentiated large cell carcinoma	4 (4.9%)	10 (20.4%)
Endoscopic visualization		
Upper lobe and segment 6	33 (40.7%)	29 (59.1%)
Other	48 (59.3)	20 (40.9%)
Endobronchial lesion		
Exophytic mass	44	11
Necrotic	10	10
Nonnecrotic	34	1
Mucosal infiltration	18	13
Submucosal infiltration	11	20
Extrinsic compression	8	5
Nonendoscopic techniques		
Transthoracic needle aspiration	14 (17.3%)	4 (8.2%)
Lymph node needle aspiration	1 (1.2%)	
Lymph node forceps biopsy	1 (1.2%)	1 (2%)

*CDT indicates conventional diagnostic techniques; TBNA, transbronchial needle aspiration.

of 85%; TBNA plus forceps biopsy and brushing increased the yield to 96% in cases of exophytic mass lesion, submucosal disease, and extrinsic compression. Similarly, diagnostic yields ranging from 82% to 97% have been reported for submucosal infiltration.[8,9]

In short, the usefulness of TBNA seems beyond question. Nonetheless, it is important to remember that the aim of a new technique is to increase diagnostic yield and reduce the cost[10] of diagnosing patients with lung carcinoma. According to Govert el al,[5] a cytology diagnosis that increases the yield of endoscopy by 6% is cost effective, and so the regular use of endoscopy seems advisable based on our results and the literature cited. We should also remember that the endoscopist´s aim is to reduce the number of explorations that fail to provide a diagnosis and to avoid the use of additional techniques.[11] Taking all these points into consideration, we analyzed the cost of both endoscopic and nonendoscopic techniques needed for cytohistological typing. Table 4 shows that TBNA combined with other techniques reduces the number of endoscopies failing to provide diagnoses, mainly when the lesion visualized is submucosal infiltration, exophytic mass with necrosis, or extrinsic compression. This is reflected in lower costs, although only in the case of extrinsic compression is the saving significant.

Our deduction is based on the assumptions outlined, TBNA meets the necessary requirements for regular use in the diagnosis of bronchogenic carcinoma with visible endoscopic lesions.

Our study may suffer from a certain sampling bias given the possibility inherent to its retrospective design that there was a certain degree of variability in the criteria the 3 endoscopists used when describing and interpreting the lesions visualized. Variation in the yield of bronchoscopy might also have been present. Similarly, although the cytology samples were always analyzed by the same pathologist, 2 different groups handled the histology specimens. Nevertheless, in our judgment, the impact on the study results of having different groups was minor, since our endoscopists and pathologists have had solid experience that allowed them to define the anomaly observed in similar ways, with no significant differences among them in diagnostic yield. Furthermore, all the data were collected by the same person using a standard protocol and for the inclusion of a case in the study we required a minimum number of samples to have been taken, following previously established guidelines.

In spite of these limitations, we believe that our results are valid and they acquire particular importance for 2 reasons: *a*) given the importance of factors that have nothing to do with endoscopic exploration, such as an effect of the observer[12] or pathologist in charge, any procedure which helps to optimize the yield of fiberoptic bronchoscopy would be of great assistance, and *b*) even though the role of TBNA is acknowledged by several expert committees[13] to be quite important, it remains an underutilized technique probably due to a lack of awareness of its advantages, as shown by surveys.[14,15] Further studies that demonstrate the safety and cost effectiveness of the technique will undoubtedly be of great assistance in overcoming this obstacle.

TABLE 4
Diagnostic Yield and Cost of Fiberoptic Bronchoscopy, by Observed Lesion*

Lesion	CDT	CDT+TBNA
Exophytic mass	90.9% (40/44)/344.59 (116.64)	90.9% (10/11)/413.81(125.21)
Mucosal infiltration	88.9% (16/18)/328.66 (94.53)	92.3%(12/13)/414.30(111.24)*
Extrinsic compression	37.5% (3/8)/557.04 (207.56)	100% (5/5)*/383.45 (0)*
Submucosal infiltration	54.5% (6/11)/488.68 (209.44)	85% (17/20)*/419.70 (125.95)
Exophytic necrotic mass	80% (8/10)/386.59 (169.10)	100% (10/10)*/376.74 (24.92)
Total	80.2% (65/81)/381.60 (156.53)	89.7% (44/49)*/413.25 (112.25)

*CDT indicates conventional diagnostic techniques (washings, brushings and forceps biopsy); TBNA, transbronchial needle aspiration. $P<.05$.

We conclude that TBNA is a technique that substantially increases the yield of endoscopic exploration for cases of endobronchial lesions suggestive of neoplasia, with no negative impact on the cost of the diagnostic process, when the lesion corresponds to submucosal disease, exophytic mass with necrosis, or extrinsic compression.

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