Integration of TBNA and TCNA in the Diagnosis of Peripheral Lung Nodules. Influence on Staging

Ann. Ital. Chir., LXX, 6, 1999

S. GASPARINI, L. ZUCCATOSTA, P. ZITTI, E. BICHI SECCHI*, M. FERRETTI**, P. GUSELLA**

Pulmonary Department, Azienda Ospedaliera "Umberto 1°", Ancona (Italy)
*Radiology Institut, University of Ancona
**Citopathology Service, Azienda Ospedaliera "Umberto 1°", Ancona (Italy)

Abstract

Although transbronchial and percutaneous approaches to peripheral pulmonary lesions (PPL) are widely diffused, effective and safe diagnostic techniques, no standardised strategy yet exists that defines the specific role of each in this clinical setting. With the aim of defining the role of each approach and of verifying if the two techniques are alternative or may be integrated in a logical diagnostic sequence based on the advantages and the limits of each biopsy method, the authors analysed their experience with the integrated use of transbronchial and percutaneous approach to PPL performed on 1,680 consecutive patients affected by PPL. The procedure used was as follows: 1) bronchoscopy with exploration of the bronchial tree and transbronchial needle aspiration (TBNA) of hilar/mediastinal lymphonodes for staging N factor followed by TBNA and transbronchial pulmonary biopsy (TBPB) of the PPL under fluoroscopic guidance and immediate cytological assessment (ICA); 2) if TBNA was diagnostic, the procedure was stopped; if not, a second pass with the needle was performed and then the bronchoscope removed; 3) if the second TBNA was not diagnostic, percutaneous approach (PCNA) with ICA was performed up to a maximum of three needle passes. Diagnostic sensitivity for malignant lesions was: 50.0% for TBPB, 70.1% for TBNA, 76.0% for TBPB and TBNA together, 92.8% for PCNA, and 95.0% overall. The percentage of benign nodules correctly defined was 43.0% for TBPB, 16.7% for TBNA, 47.8% for PCNA. Examination of the upper airways and bronchial tree was positive for lesions endoscopically visible in 11.4% of cases. TBNA of hilar/mediastinal lymponodes was positive for metastatic involvement in 43.9%.

The authors' experience demonstrates that transbronchial and percutaneous approaches must be considered complementary and that their integrated use not only increases diagnostic yield but also permits important information to be obtained for the Staging of Lung Cancer. The creation of teams able to utilise both approaches with the cytopathologist present for ICA should be encouraged in order to optimise the diagnostic management of PPL.

Key words: Transbronchial pulmonary biopsy, transbronchial needle aspiration, percutaneous fine needle aspiration, pulmonary nodules.

Riassunto

Benché l'approccio transbronchiale e percutaneo alle lesioni periferiche polmonari (PPL) siano metodiche diffuse, efficaci e sicure non esiste ancora una loro precisa standardizzazione

Introduction

Peripheral pulmonary lesions (PPL) can be approached, for diagnostic purposes, either with a transbronchial or a percutaneous approach[1, 2]. Since these lesions are located beyond the visible range of the fiberoptic bronchoscope, the help of imaging techniques for guiding the biopsy instruments is required. For the transbronchial approach, different sampling instruments, such as biopsy forceps, brushing, curette, transbronchial needles or needle brush can be pushed under fluoroscopic guidance through the working channel of the bronchoscope up to the lesion[3]. The percutaneous approach may be performed under fluoroscopic or CT scan guidance[4, 5]; also ultrasonography can be used, when the lesion is closely adjacent to the thoracic wall[6].

Although both the techniques are largely employed and have demonstrated their effectiveness and safety, there is not yet a standardised strategy that defines the specific role of each methods in this diagnostic field and the choice of which approach to use is generally determined by different factors such as the operating physician's experience or speciality (radiologist, pulmonologist, surgeon) and the local availability of diagnostic facilities (fluoroscopy, CT scan)[7].

With the aim of defining the role of each approach and of verifying if the two techniques are alternative or may be integrated in a logical diagnostic sequence based on the advantages and the limits of each biopsy method, we analysed our experience with the integrated use of transbronchial and percutaneous approach to PPL performed by the same diagnostic team.

di utilizzo. Allo scopo di definire il ruolo delle due tecniche e di verificarne la complementarietà, gli Aa hanno analizzato la loro esperienza in 1680 pazienti consecutivi con PPL. La procedura è consistita: 1) broncoscopia con agoaspirato transbronchiale (TBNA) dei linfonodi ilari/mediastinici allo scopo di stadiare il fattore N, seguita da TBNA e biopsia transbronchiale (TBPB) della lesione sotto flouroscopia ed esame citologico immediato (ICA); 2) in caso di positività l'esame viene interrotto; in caso contrario viene eseguito un secondo passaggio dell'ago; 3) nel caso che anche la seconda TBNA risulti non diagnostica, si passa all'agoaspirato percutaneo (PCNA) con ICA eseguito su un numero massimo di 3 passaggi. La sensibilità per le lesioni maligne è risultata del 50% per TBPB, 70.1% per TBNA, 76% per TBPB e TBNA associati, 92.8% per PCNA e del 95% complessivamente. La percentuale di lesioni benigne correttamente riconosciute è stata del 43% per TBPB, 16.7% per TBNA, 47.8% per PCNA. L'esame endoscopico ha consentito di individuare lesioni nell'11.4% dei casi. Il TBNA dei linfonodi ilari/mediastinici è risultato positivo per coinvolgimento metastatico nel 43.9% dei pazienti. Tale esperienza dimostra che le metodiche devono essere considerate complementari ed in grado di fornire importanti informazioni non solo diagnostiche ma anche ai fini della stadiazione del carcinoma del polmone.

Parole chiave: Biopsia polmonare transbronchiale, agoaspirato tronsbronchiale, agoaspirato percutaneo, linfonodi.

Material and methods

From January 1985 to December 1998, 1,680 consecutive patients (1310 M, 370 F, mean age 63 yrs, range 14-85) affected by PPL were referred at the Regional Hospital of Ancona (Italy) for a diagnostic bioptic approach. The mean diameter of the lesions was 3.5 cm (range 0.8-9 cm). The patients were examined in a radiologic suite equipped with a rotating C-arm fluoroscope by a diagnostic team composed by a pulmonologist, a radiologist and a cytopathologist, all simultaneously present in the diagnostic room during the procedure. The transbronchial approach with the use of the transbronchial needle aspiration (TBNA) and of the biopsy forceps (TBPB) was performed as the first step, if the patient had not previously received a bronchoscopic examination. If the patient had undergone bronchoscopy prior to coming under our observation, PCNA was the first step of the procedure. The following diagnostic steps, already described in detail[7], were performed (Fig. 1): 1) bronchoscopy with exploration of the bronchial tree and TBNA of the hilar/mediastinal lymphonodes, if requested

Tab. I – SENSITIVITY FOR MALIGNANCY OF THE DIFFERENT SAMPLING TECHNIQUES IN THE WHOLE SAMPLE AND WITH REGARD TO THE SIZE OF THE LESION

	TBPB	TBNA	TBPB + TBNA	PCNA
Whole sample	50.0%	70.1%	76.0%	92.8%
PPL ≤ 2 cmm.	42.0%	64.2%	65.9%	86.7%
PPL > 2 cm.	56.3%	77.6%	80.7%	94.6%

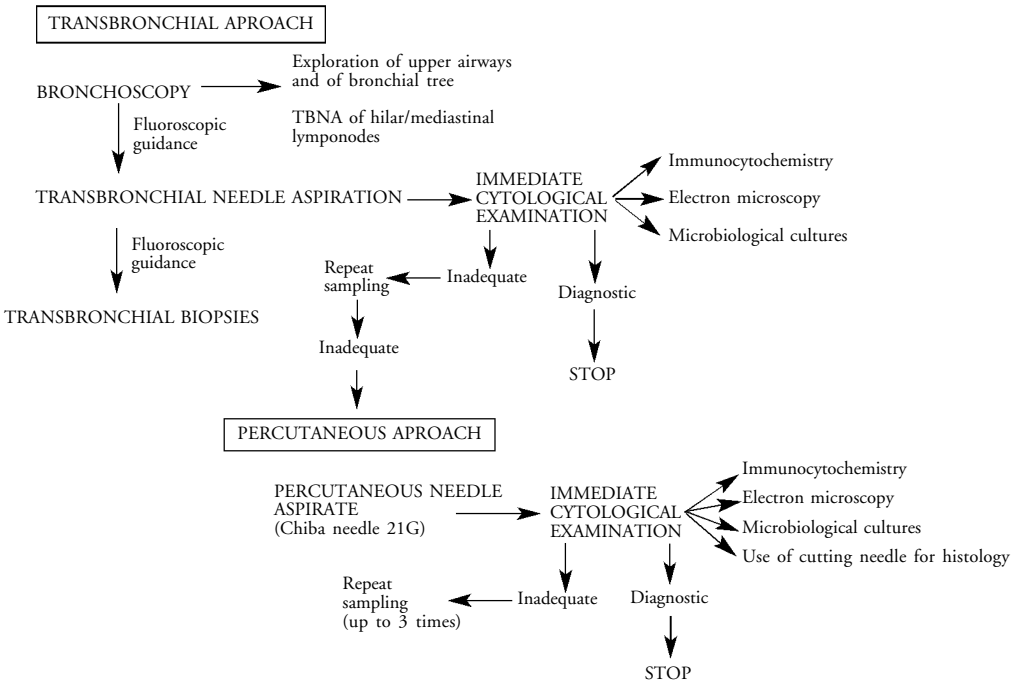

Fig. 1: Algorithm of the procedure used in the transbronchial and percutaneous integrated approach to PPL.

Tab. II – DIAGNOSIS OF BENIGN PPL OBTAINED WITH THE DIFFERENT TECHNIQUES

Technique	*Diagnosis*	*Number of patients*
TBPB	Tuberculosis	20
	Fibrosis	15
	Hamartoma	9
	Silicosis	7
	Typical carcinoid	5
	Aspecific pneumonia	5
	Abscess	3
	Sarcoidosis	3
TBNA	Hamartoma	6
	Abscess	6
	Aspecific pneumonia	5
	Tuberculosis	5
	Typical carcinoid	2
	Sarcoidosis	1
	Mycetoma	1
PCNA	Abscess	25
	Hamartoma	17
	Tuberculosis	12
	Pneumonia	12
	Typical carcinoid	4
	Echinococcal cyst	3
	Mycetoma	2
	Inflammatory pseudotumor	2
	Others	8

by CT evidence of lymphonodes enlargement and if useful for staging purposes (according to the method proposed by Wang)[8]; 2) TBNA of the PPL under fluoroscopic guidance with immediate cytologic assessment; 3) at least three TBPB always under fluoroscopic control, while the cytopathologist observes the material obtained by TBNA;4) if TBNA is diagnostic the procedure is stopped; if not a second pass with the transbronchial needle is performed and the bronchoscope is then removed, 5) if the second TBNA is not diagnostic, a PCNA is immediately performed without moving the patients from the table, always under fluoroscopic control and with immediate cytologic examination; 6) if PCNA is not diagnostic, up to three needle passes are repeated.

Results

Of the 1680 patients studied, 1,008 underwent transbronchial approach and 1,020 PCNA. 348 patients underwent both the procedures. Of the patients who underwent the transbronchial approach, 243 (24.8%) received also TBNA of the hilar/mediastinal lymponodes for staging purposes. The final outcome, obtained with surgical procedures or clinical-roentgenologic follow-up or necroscopy, was established in 1,529 patients, while 151 were lost to the follow-up. Of the 1,529 patients with a final diagnosis, 1,238 were affected by a malignant lesion (bronchogenic carcinoma in 1,089, metastatic carcinoma in 115, atypical carcinoid in 8 and nonepithelial tumors in 26) and 291 by a benign lesion.

The sensitivity of the procedure for malignant PPL was: 50.0% for TBPB, 70.1% for TBNA ($p < 0.01$:TBPB vs TBNA; chi-square test), 76.0% for TBPB and TBNA together, 92.8% for PCNA and 95.0% for both approaches considered together.

We also evaluated the sensitivity of the different techniques according to the size of the lesions.

For malignant PPL smaller or equal to 2 cm the sensitivity was: 42% for TBPB, 64.2% for TBNA, 65.9% for TBPB and TBNA together, 86.7% for PCNA. For the lesions greater than 2 cm., TBPB provided diagnostic results in 56.3% of cases, TBNA in 77.6%, TBPB and TBNA in 80.7%, PCNA in 94.6% (PPL less or equal 2 cm. vs. PPL greater than 2 cm. for both approaches: $p < 0.01$, chi-square test). Table I shows the sensitivity of the different sampling technique in the whole sample and with regard to the size of the lesion.

There was only one false-positive result obtained with PCNA (cytologic diagnosis: adenocarcinoma; definitive diagnosis after surgery: tubercoloma).

With regard to the 291 patients with a benign PPL, the specific diagnosis of the disease (the results showing non-malignant cells without any other information were not considered) was obtained in 43.0% with TBPB, in 47.8% with PCNA and in 16.7% with TBNA. Tab. II shows the diagnosis of benign PPL obtained with the different techniques.

In the 1,008 patients who underwent the bronchoscopic approach, the examination of the upper airways and of the bronchial tree was positive for lesions endoscopically visible (not suspected with the imaging techniques) in 115 patients (11.4%); Particularly, we found neoplastic lesions of the trachea or of the main bronchi in 16 patients, of the lobar or segmental bronchi in 73, laryngeal carcinoma in 4, laryngoparalysis in 5, neoplastic bronchial lesion controlateral to PPL in 5 and widening of bronchial spurs due to lymphonode involvement in 12.

Concerning the TBNA to study hilar/mediastinal lymphnodes, we introduced this technique in our Institution only in the last months of 1993. Since this date, TBNA for mediastinal staging has been performed in 223 patients who underwent a bronchoscopic approach for a PPL. TBNA was positive for metastatic lymponodes involvement in 98 patients (43.9%).

With regard to the complications encountered, no death occurred with either approach. PCNA determined complications in 127 patients (12.4%) (moderate pneumothorax in 75, severe pneumothorax with need for drainage in 32, hemoptysis in 15, air embolism with transient left hemiparesis in 1, syncope in 1, pneumonia in 1, bilateral pulmonary interstitial edema in 1 and

myocardial necrosis arousing immediately after the procedure in 1). With the transbronchial approach complications occurred in 46 patients (4.5%) (hemoptysis in 37, pneumothorax moderate in 2, pneumothorax severe with need for drainage in 2, perilesional pulmonary haemorrhage in 4, severe bronchospasm in 1).

Discussion and Conclusions

Transbronchial and percutaneous approach to PPL are safe and effective techniques widely used for the diagnosis of PPL. Although the difference in sensitivity, the rate of complications and the information that each single approach can provide have been demonstrated in numerous studies, there are only a few works that compare the results obtained by the two techniques[9-12]. Furthermore, these studies are generally performed by separate teams who carried out the diagnostic procedures at different times and in different contexts.

The analysis of the literature shows that the transbronchial approach to PPL has a lower diagnostic yield than PCNA, providing a wide variability of results and values of sensitivity generally under 70%[3]. In effect, the effectiveness of the transbronchial approach is linked to several factors, particularly to the size of the lesion[13], to the relationship between the lesion and the airways[14], to the sampling instruments used[3] and to the operator experience. With regard to the relationship of the airways with the PPL, some authors[14, 15] suggest that a criterion to foresee the success of the transbronchial approach could be a positive bronchus sign (i.e. an evidence on thin-section CT of a bronchus leading to the lesion). However these studies were performed using biopsy forceps and not TBNA, which could pass through the bronchial wall and penetrate into the lesion even if the bronchus is not directly contained within it. We have not evaluate the presence of the bronchus sign in our patients, but we can speculate that the better sensitivity of TBNA in comparison with TBPB that we obtained, can be related to the ability of the needle to penetrate into the PPL even if it does not infiltrate the bronchial wall. In effect, in all the studies where TBNA was used[7, 16, 17], this instrument demonstrated a better diagnostic yield than other transbronchial sampling means. Our results show that the use of TBNA and TBPB together further increases the sensitivity of the transbronchial approach, since there are some patients where TBNA is negative while TBPB can be diagnostic. Furthermore, the association of the two sampling instruments is justified by the better capability of TBPB in define the nature of benign PPL, where TBNA provides unsatisfactory results. It should be emphasised that, for benign lesions, the accuracy of TBPB (43.0%) is very near that of PCNA (47.8%).

Another point that is generally considered a factor against the use of the transbronchial approach is the size of the lesion[3]. In effect, the sensitivity of TBPB and TBNA is lower for PPL less or equal 2 cm but this is true for the percutaneous approach too, and we were able to diagnose with the transbronchial approach also a good percentage of small size lesions (65.8%).

The transbronchial approach to PPL led us to obtain useful information for staging in 115 patients with regard to the extension of the disease to the tracheobronchial tree (T parameter) and in 98 patients with regard to the lymphonode involvement (N parameter). These information is essential for prognostic and terapeutical purposes, especially in patients candidate to surgery.

With regard to the incidence of complications, our results confirm the safety of both approaches, with a lower complication rate for the transbronchial approach. Pneumothorax is the most frequent complication observed with PCNA (10.5%). Although generally pueumothorax does not determine serious clinical consequences, it can cause delay in the further diagnostical procedures and in the treatment of the patients, can increase the hospitalisation cost and may determine a risk for patients with impaired lung function.

On the basis of our experience we can conclude that:

1) transbronchial and percutaneous approach are both safe and effective techniques for the diagnosis of PPL;

2) in case of PPL, bronchoscopy must be done with the help of fluoroscopy to make the best diagnostic possibilities by this technique. There is enough evidence that TBNA is the sampling instrument that provide the better results with the transbronchial approach to PPL, therefore it should be always used to maximise the diagnostic yield of this method;

3) although transbronchial approach provides a lower sensitivity than PCNA, it permits to obtain important information regarding the stage of peripheral neoplastic lesions, both with regard to T and N parameters. Furthermore, the transbronchial approach has a lower incidence of complications in comparison to PCNA. These observations lead us to suggest that, since a bronchoscopy is generally necessary in these patients, the transbronchial approach should be performed before PCNA. Using this sequence, about 75% of our patients had their condition diagnosed avoiding the percutaneous procedure, with consequent reduction in cost and risks. This assertion should be particularly observed for patients candidate to surgery (for which a careful stage of the disease is necessary) and for patients with severe respiratory impairment (for which a risk of pneumothorax could be excessive);

4) transbronchial and percutaneous approach must be considered complementary. Their integrated use determines an increase of diagnostic possibilities, as well as permitting to obtain important information for staging the disease. In this context, the creation of teams able to utilise both approaches at the same time should be encouraged, in order to optimise the diagnostic management of PPL.

References

1) Tsubi E., Ikeda S., Rajima M.: *Transbronchial biopsy smear for diagnosis of peripheral pulmonary carcinoma.* Cancer, 1967, 20:687-698.

2) Nordenstrom B.: *A new technique for transthoracic biopsy cancer.* Br J Radiol, 1965, 38:550-553.

3) Mehta A.C., Kathawalla S.A., Chan C.C., Arrikuga A.: *Role of bronchoscopy in the evaluation of solitary pulmonary nodule.* J Bronchol, 1995, 2:315-322.

4) Zelch J.V., Lalli A.F., McCormack L.J.: *Aspiration biopsy in diagnosis of pulmonary nodule.* Chest, 1973, 63:149-152.

5) Gobien R.P., Stanley J.H., Vujic I.: *Thoracic biopsy: CT guidance of thin-needle aspiration.* AJR, 1984, 142:827-830.

6) Chandrasekhar A.L., Reynes C.J., Churchill R.J.: *Ultrasonically guided percutaneous biopsy of peripheral pulmonary messes.* Chest, 1976, 70:627-630.

7) Gasparini S., Ferretti M., Bichi Secchi E., Baldelli S., Zuccatosta L., Gusella P.: *Integration of transbronchial and percutaneous approach in the diagnosis of peripheral pulmonary nodules or masses. Experience with 1,027 consecutive cases.* Chest, 1995, 108:131-137.

8) Wang K.P.: *Staging of bronchogenic carcinoma by bronchoscopy.* Chest, 1995, 106:588-593.

9) Borgeskov S., Francis D.: *A comparison between fine-needle biopsy and fiberoptic bronchoscopy in patients with lung lesions.* Thorax, 1974, 29:352-354.

10) Wallace J.M., Deustsch A.L.: *Flexible fiberoptic bronchoscopy and percutaneous needle lung aspiration for evaluation the solitary pulmonary nodule.* Chest, 1982, 81:665-671.

11) Levine M.S., Weiss J.M., Harrel J.H.: *Transthoracic needle aspiration biopsy following negative fiberoptic bronchoscopy in solitary pulmonary nodules.* Chest, 1988, 93:1152-1155.

12) Wang K.P., Gonullu U., Baker R.: *Transbronchial needle aspiration versus transthoracic needle aspiration in the diagnosis of pulmonary lesions.* J Bronchol, 1994, 1:199-204.

13) Radke J.R., Conway W.A., Eyler W.R., Kvale P.A.: *Diagnostic in peripheral lung lesions. Factors predicting success with flexible fiberoptic bronchoscopy.* Chest, 1979, 76:176-179.

14) Naidich D.P., Sussman R., Kutcher W.L., Aranda C.P., Garay S.M., Ettenger N.A.: *Solitary pulmonary nodules. CT-Bronchoscopic correlation.* Chest, 1988, 93:595-598.

15) Gaeta M., Russi E.G., La Spada F., Barone M., Casablanca G., Pandolfo I.: *Small bronchogenic carcinomas presenting as solitary pulmonary nodules. Bioptic approach guided by CT-positive bronchus sign.* Chest, 1992, 102.1167-1170.

16) Shure D., Fedullo P.F.: *Transbronchial needle aspiration of peripheral masses.* Am Rev Respir Dis, 1983, 128:1090-1092.

17) Wang K.P., Haponik E.F., Britt E.J., Khouri N., Erozan Y.: *Transbronchial needle aspiration of peripheral pulmonary nodules.* Chest, 1984, 86:819-823.

Postal address:

Dott. Stefano GASPARINI
Divisione di Pneumologia
Ospedale Torrette
Via Conca
60020 ANCONA (Italy)
e-mail: s.gasparini@fastnet.it