ORIGINAL ARTICLE

The contribution of CT-guided transthoracic lung biopsy to the diagnosis of organising pneumonia

F. Metzger\textsuperscript{a}, D. Pernet\textsuperscript{a}, P. Manzoni\textsuperscript{b}, E. Ranfaing\textsuperscript{c}, J.-C. Dalphin\textsuperscript{a,*}

\textsuperscript{a} Chest Clinic, Jean Minjoz University Hospital, 25000 Besançon, France
\textsuperscript{b} Radiology Department C, Saint Jacques University Hospital, 25000 Besançon, France
\textsuperscript{c} Pathology Lab, Jean Minjoz University Hospital, 25000 Besançon, France

Available online 18 May 2010

Summary

\textit{Background.} — Organising pneumonia is a pulmonary disease with variable clinical and radiological features and with many differential diagnoses. Diagnosis is based on histology obtained by either transbronchial or surgical lung biopsy but these techniques have several disadvantages. The aim of this study was to evaluate the diagnostic yield of CT-guided transthoracic lung biopsy in organising pneumonia and to compare it to the usual diagnostic tools.

\textit{Methods.} — Six cases of organising pneumonia diagnosed with CT-guided lung biopsy are reported and discussed. The role of CT-guided lung biopsy in the diagnosis of organising pneumonia was also reviewed in the literature.

\textit{Results.} — CT-guided transthoracic lung biopsies provided a higher rate of adequate samples than transbronchial biopsies (92—100% versus 77—86%). The samples were larger, which reduced the risks of misdiagnosis and increased the diagnostic yield (88—97% versus 26—55% in pulmonary nodules and 42—100% versus 66—75% in diffuse pulmonary disease). Complications were rare and generally not serious.

\textit{Conclusion.} — CT-guided transthoracic lung biopsy may be considered in place of transbronchial biopsy in the diagnosis of organising pneumonia. Surgical lung biopsy remains the gold standard method for diagnosis.

© 2010 SPLF. Published by Elsevier Masson SAS. All rights reserved.
Introduction

Organising pneumonia (OP), formerly known as bronchiolitis obliterans with OP, or BOOP, is an inflammatory, proliferative fibrotic lung disorder that remains difficult to diagnose. The presumed diagnosis is based on the clinical and radiological findings. However, neither the non-specific clinical picture (cough, dyspnoea, low-grade pyrexia mimicking an infectious process) nor the various radiological presentations (bilateral migrating alveolar opacities, forms with diffuse alveolar consolidation mimicking an interstitial lung disorder or isolated nodules suggesting cancer) permit a certain diagnosis. A formal diagnosis requires a tissue biopsy to visualise the buds of granulation tissue that develop inside the alveoli and are the hallmark of OP [1—3]. Biopsies entail an invasive procedure to harvest a fragment of lung tissue that is usually obtained either by transbronchial lung biopsy (TBB) or by surgical lung biopsy (SB). However TBB yields samples of unequal quality and SB requires a general anaesthetic, which is not always possible. In many cases, especially when the patient is frail, OP is diagnosed without any histological confirmation and the patient is test-treated on steroids on the basis of the radiological and clinical data, backed up by the bronchoalveolar lavage findings (BALF). This strategy should be avoided whenever possible since there is a non-negligible likelihood of misdiagnosis because of the broad range of differential diagnoses for OP. A misdiagnosis can sometimes have serious repercussions, either by masking a malignancy or through the adverse effects of steroid treatment on a disorder that has been missed such as mycobacteriosis, or simply because long courses of steroid treatment are risky in elderly patients. To limit these “presumed diagnoses” we felt that it would be interesting to discuss the value of CT-guided transthoracic lung biopsy (TTB) in the histological diagnosis of OP. For this purpose, we have collated six personal case reports that we report and discuss in the light of the data in the literature on this subject, comparing the advantages and drawbacks of each diagnostic procedure.

Methods

We report on six cases of patients, treated in two university hospital chest clinics in the Franche-Comté area of France between September 2005 and April 2007, who all presented with a radiological and clinical picture compatible with OP and were given CT-guided TTB to confirm the diagnosis.

Results

Case report No.1

A male patient was admitted to hospital with resting dyspnoea, pyrexia 38.5 °C and haemoptysis. His PaO₂ was 65 mmHg under oxygen at 4 L/min (1 mmHg = 7.5 kappa) and his CRP level was 273 mg/L. A CT scan of the chest revealed a bilateral interstitial syndrome, forming patches of reticular lesions affecting mainly the interstitial tissue of the right lung in the lower part of the lobes, and consolidation of the alveoli in the mid zone. He was treated by a combination of antibiotics associating amoxycillin, clavulanic acid and ofloxacin. The patient did not respond to this treatment, his hypoxaemia worsened and the radiograph showed that the lesions had spread. The general anaesthetic required for an SB was contraindicated because of the patient’s vulnerable respiratory status so he was given CT-guided TTB and a specimen was harvested from the consolidated area in the mid portion of the pulmonary parenchyma. (Fig. 1A). No procedure-related complications occurred. The histological examination confirmed OP (Fig. 1B). He was then put on a course of steroid treatment at 0.75 mg/kg per day, which was gradually tapered off over a total period of 6 months. The atorvastatine and amiodarone treatment was withdrawn in case the OP was drug-related. The patient was clinically free of symptoms with normal radiological findings after 2 months of steroid treatment. (Fig. 2). A year after he had stopped taking the steroids he had not relapsed.
Case report No.2

A male patient was admitted for resting dyspnoea despite an antibiotic treatment associating ceftriaxone and ofloxacin that he had been taking for 5 days. He had no pyrexia but presented with crepitation in the right lung area when his chest was examined. His PaO$_2$ was 45 mmHg on air and his CRP was 43 mg/L. His thoracic CT scan is shown in Fig. 3A. He was given another 12-day course of antibiotic treatment associating ceftriaxone and spiramycin but showed no improvement. The bronchial fiberoptic exploration findings were unremarkable. He was then given CT-guided TTB and a specimen was harvested from the mid zone lung parenchyma. The procedure was completed with no complications. The histological examination confirmed OP (Fig. 3B). After consulting the literature, we felt that the patient's condition was probably caused by a drug reaction and the simvastatin treatment was therefore withdrawn. He was put on a course of steroids at 0.75 mg/kg per day, which was gradually tapered off over a period of 6 months. The patient has now recovered his normal respiratory status and his chest x-ray findings are normal; he has not relapsed 9 months after the end of his steroid treatment.

Case report No.3

A carpenter came to consult for a cough and pyrexia with a weight loss of 8 kg in 1 month. His PaO$_2$ was 63 mmHg on air and his CRP was at 275 mg/L. The chest CT scan showed bilateral patches of consolidation in the pulmonary parenchyma. The symptoms and the signs on the x-ray were still present after a 10-day course of antibiotics associating ceftriaxone and ciprofloxacin. The patient had a bronchial fiberoptic examination; the biopsies taken from the bronchial spurs were normal, the BALF findings showed neutrophilic alveolitis. The fine needle aspiration findings (FNAF) showed a strain of Haemophilus influenzae that was sensitive to the antibiotic treatment the patient had started. A CT-guided TTB was performed in a consolidated area of the lower left lobe parenchyma. The procedure was complicated by a minor, immediate left lung pneumothorax that was no worse when checked 5 minutes later and subsequently resolved spontaneously. The histology of the biopsy specimens confirmed the diagnosis of OP. The sildenafil treatment was withdrawn because it may have been the causal agent. Steroid treatment was administered at 0.75 mg/kg per day then gradually tapered off and the pulmonary lesions disappeared. After 6 months' follow-up the patient had no further relapse.

Case report No.4

A female patient treated with amiodarone for atrial fibrillation was admitted for acute bronchitis that rapidly developed into respiratory distress with fever. Her chest CT scan is shown in Fig. 4A. Her condition did not improve after 10 days of antibiotic treatment, so she was given a CT-guided TTB in the left upper lobe; no complications occurred during the procedure. The histological diagnosis was extensive OP (Fig. 4B). Steroid treatment was administered at a dose of 1 mg/kg per day and gradually tapered off over a period of 4 months when her clinical examination became normal once again. Fig. 5 shows the patient's CT scan at the end of the treatment. She has not relapsed 5 months after stopping the steroid treatment.
Case report No.5

A female patient treated with simvastatin for hypercholesterolaemia came to consult for a non-productive cough and exertion dyspnoea; she had been experiencing these symptoms for 3 months and several courses of antibiotics had not improved her condition. Her oxygen saturation on air was 94%, she had no pyrexia but rales and crepitation were heard in the area of her right lung when her chest was examined. Her CRP level was 118 mg/L. Her CT scan showed consolidated areas in the alveoli of the lower lobe of her right lung with an extensive air bronchogram despite the antibiotic treatment. She had a bronchial fiberoptic examination and a bronchoalveolar lavage, but the findings did not suggest an infectious cause or neoplasm. She was given a CT-guided TTB in a consolidated area of her right lung (Fig. 6); no complications occurred during the procedure. The histology findings confirmed the diagnosis of OP. Simvastatin was felt to be the cause and the treatment was therefore withdrawn. She was then put on a course of steroids at 0.3 mg/kg per day; this was gradually tapered off over a period of 3 months by when her cough had disappeared and her x-ray findings were once again normal. Three weeks after the steroid treatment was withdrawn the patient presented again with dyspnoea, pyrexia at 38 °C and a CRP level at 188 mg/L. These signs showed the onset of the syndrome in her right upper lobe. A 10-day course of antibiotics did not improve her condition and the diagnosis was a relapse of OP. The steroid treatment was resumed at 0.5 mg/kg per day and the lesions had disappeared from the x-ray 1 month later. Her steroid treatment has been decreased to 0.3 mg/kg per day for the last month and she has had no further clinical or radiological signs of relapse.

Case report No.6

A male patient presented with a productive cough, yielding purulent expectorate, that had started during a trip to Asia; he had lost 3 kg in 10 days. His CT scan showed bilateral patches of consolidation in the parenchyma and ground glass type lesions. After several courses of antibiotic treatment the patient’s clinical symptoms had improved but...
the lesions on the chest x-ray persisted. The bronchoscopy and bronchoalveolar lavage with FNA in the bronchial spurs was histologically normal and showed no signs of infection. He was then given a CT-guided TTB in the consolidated area of the left lower lobe (Fig. 7). He had some minor complications during the procedure including bleeding at the puncture site and partial collapse of the left lung, which was asymptomatic and resolved spontaneously. The histology results confirmed OP. With a further antibiotic treatment associating imipenem and ciprofloxacin but no corticosteroids the patient’s clinical and radiological signs and symptoms improved and 3 months later the alveolar lesions had completely disappeared from his CT scan on which only a few residual patches of ground glass lesions persisted. The final diagnosis was OP connected to a lung infection and no further treatment was prescribed. The patient has not relapsed after 11 months of surveillance.

It is important to note that for all six of these case reports the TTBs were performed by the same radiologist or under his control, using a 20 G coaxial core biopsy needle, harvesting four samples and a needle aspiration. All the histology samples were analysed by the same pathologist who is specialised in lung diseases. Table 1 sums up the main features of these case reports.

Discussion

On the basis of these personal case reports TTB seems to be a possible alternative to TBB for the histological diagnosis of OP. To support this hypothesis, we have described both of the current diagnostic methods for OP and listed their advantages and drawbacks. We have also discussed the value of TTB in the diagnosis of OP in comparison to the data in the literature.

Current methods used for the diagnosis of OP

A firm diagnosis for OP has always been based on TBB or SB because these are the only methods that prove the presence of buds of granulation tissue in the alveoli that are the hallmark of OP. TBB is often used as a first-line diagnostic method; the subsequent choice of SB, either immediately after or in a secondary stage depends on how strongly the radiological and clinical signs suggest OP and whether there is a risk of misdiagnosis. There are many clinical and radiological differential diagnoses for OP and some of the disorders involve lesions with identical histology [1–4]. One of these is Wegener’s granulomatosis in which buds of granulation tissue are found in the alveoli around the granulomatous lesions and can sometimes be the main histological anomaly. Budding granulation tissue can also be found in the form of peripheral lesions around bronchial carcinoma, in pneumonia, hypersensitive lung disorders, non-specific interstitial lung disease and even in chronic eosinophilic lung disorders. SB and TBB each have their advantages and drawbacks in eliminating these numerous differential diagnoses (Table 2).

The advantage of SB is that it is more focused (the diseased areas of the lung are visible to the surgeon’s naked eye) and the diagnostic yield is therefore excellent; 98 to 100% of the biopsy samples are adequate in the literature [5–7]. It also yields larger samples (several cubic centimetres), containing intra-alveolar bronchovascular structures that are more suitable for assessing the topography of the lesion and discriminating endoalveolar buds from other histological lesions. SB is the gold standard method for diagnosing OP and is essential when the clinical and radiological picture is atypical or the TBB is not helpful [2,8,9]. However, SB is an invasive procedure entailing the aftermath of chest surgery, although the development of mini-invasive video-assisted surgery by thoracoscopy has improved the outcome [6,7,10,11]. It means that a team of medical and nursing staff and an operating theatre must be available and of course requires a general anaesthetic, which may well be contraindicated in some particularly frail patients, or those with seriously impaired respiratory function.

TB (12) is performed by positioning the end of the bronchoscope as far as possible down into a sub-segmental bronchus to harvest a tissue specimen for histology from an appropriate area of the lung. A biopsy punch is placed inside the bronchoscope then pushed downwards until it can go no further and is no longer seen by the surgeon; it is then drawn back a centimetre or two, opened, then pushed back until it meets with resistance and then withdrawn from the bronchoscope. The fragment that is harvested is, in theory, a sample of the pulmonary parenchyma. The advantage of TBB is that it can be performed during a “standard” bronchoscopic examination under local anaesthesia and does not require a large amount of technical equipment or medical staff. This is why it is usually used as a first-line examination for suspected OP. However, the samples are not always adequate. Because they are harvested “blind” using only the fact that the forceps has been pushed home as a judgement criterion, only 77 to 86% of TBB contain pulmonary parenchyma [13,14] and even when they do, there is no guarantee that the biopsy was taken from a diseased portion of the affected lung. The diagnostic value of TTB (the number of diagnoses made by TBB and finally confirmed) varies according to the type of lesion: from 26 to 55% for a circumscribed lesion [13,15] and from 66 to 75% for diffuse lesions [15,16]. The percentage is lower for peripheral...
<table>
<thead>
<tr>
<th>Patient</th>
<th>Gender</th>
<th>Age</th>
<th>Clinical presentation</th>
<th>Radiological findings</th>
<th>Aetiology</th>
<th>Treatment</th>
<th>Evolution</th>
<th>Complications of TTB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>57</td>
<td>Dyspnoea</td>
<td>Bilateral interstitial syndrome Right alveolar consolidation</td>
<td>Drug-related OP</td>
<td>Causal drug withdrawn Steroids</td>
<td>Clinical and radiological cure</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fever</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Haemoptysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Crepitation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hypoxia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>77</td>
<td>Dyspnoea</td>
<td>Bilateral alveolar consolidation Ground glass Pleurisy</td>
<td>Drug-related OP</td>
<td>Causal drug withdrawn Steroids</td>
<td>Clinical and radiological cure</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Crepitation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hypoxia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>61</td>
<td>Dyspnoea</td>
<td>Bilateral alveolar consolidation Disrupted architecture</td>
<td>Drug-related or cryptogenic OP</td>
<td>Causal drug withdrawn Steroids</td>
<td>Clinical and radiological cure</td>
<td>Non-drained minor haemothorax</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fever</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8 kg weight loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hypoxia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>82</td>
<td>Respiratory distress</td>
<td>Bilateral alveolar consolidation Ground glass Micromeshing</td>
<td>Drug-related or cryptogenic OP</td>
<td>Causal drug withdrawn Steroids</td>
<td>Clinical and radiological cure</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pyrexia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Female</td>
<td>73</td>
<td>Cough</td>
<td>Consolidation of the right lower lobe</td>
<td>Drug-related or cryptogenic OP</td>
<td>Causal drug withdrawn Steroids</td>
<td>Relapse when steroid treatment was withdrawn</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dyspnoea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Crepitation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>49</td>
<td>Cough, pyrexia</td>
<td>Bilateral alveolar consolidation Ground glass</td>
<td>OP-related to a lung infection</td>
<td>Broad spectrum antibiotics</td>
<td>Clinical and radiological cure</td>
<td>Minor pneumothorax</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Weight loss 3 kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not requiring drainage</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Some alveolar bleeding</td>
</tr>
</tbody>
</table>

TTB: transthoracic lung biopsy; OP: organising pneumonia.
<table>
<thead>
<tr>
<th>Type of anaesthetic</th>
<th>Volume of biopsy</th>
<th>Visual control of the biopsy site</th>
<th>Adequate biopsy fragments</th>
<th>Diagnostic value</th>
<th>Main complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBB LA Around 6 mm³</td>
<td>No</td>
<td>77—86% [19,20]</td>
<td>Circumscribed lesions: 26—55% [12,14]</td>
<td>1—6% [12,20,21]</td>
<td>Pyrexia mortality 0.2—2% [12,20]</td>
</tr>
<tr>
<td>TTB LA Around 20 mm³</td>
<td>Yes</td>
<td>92—100% [27,29,30]</td>
<td>Nodular lesions: 88—97% [32,34—36]</td>
<td>20—30% [41—43]</td>
<td>Gas embolism &lt;0,1% Propagation of tumour along the puncture trajectory &lt;0.1% Haemothorax &lt;0.5% Cardiac arrest &lt;0.5% [41—43]</td>
</tr>
<tr>
<td>SB GA A few cm³</td>
<td>Yes</td>
<td>~100% [14—16]</td>
<td>Diffuse lesions: 98—100% [5—7]:</td>
<td>—</td>
<td>Risks of GA Morbidity: 6—12% Postoperative surgical mortality: 2—6,5% [6,7,10,11]</td>
</tr>
</tbody>
</table>

LA: local anaesthetic; GA: general anaesthesia; TBB: transbronchial biopsy; PNO: pneumothorax; TTB: transthoracic biopsy; HEMO: haemothorax; SB: surgical biopsy; AH: serious alveolar haemorrhage (causing haemoptysis over 50 mL).
lesions [15], and increases with the number of biopsies and their size, which means that the percentage can be significantly higher if the procedure is performed under general anaesthetic using a rigid bronchoscope [17]. Poletti et al. assessed the sensitivity of TTB in the diagnosis of OP at 64% [18]. The size of the samples harvested with TTB is smaller than those obtained by SB, around a few cubic millimetres, at the best containing between 50 and 100 alveolar walls and often less [19,20]. The main complications of TBB [14,21,22] are severe pulmonary haemorrhage and pneumothorax.

Bibliography

We carried out a search in the literature with the PubMed search engine using as keywords "BOOP, COP and OP" subsequently combined with "CT-guided biopsy", "percutaneous biopsy", "needle biopsy", "transthoracic biopsy" and "Tru-cut lung biopsy" to study the existing data on the value of CT-guided TTB in the diagnosis of OP. Six articles have been published and are summed up in Table 3. There is also another article on the clinical and radiological features of OP [29], in which the authors claim that they obtained a histological diagnosis of OP by TTB and/or TBB in 18 out of their series of 26 patients. However, it should be noted that for references [26—29], the authors do not say whether TTB was performed under CT guidance; other methods of guidance such as ultrasound are also described.

The clinical findings that warranted TTB in our case reports are the same as those in the literature, that is to say a clinical picture of dyspnoea, pyrexia and coughing that did not respond to antibiotic treatment, which is the most frequent clinical presentation of OP [29,30]. The radiological findings are also the same: bilateral alveolar consolidation in two out of six cases in the literature and four out of six of our personal cases, unilateral alveolar thickening in two out of six of the cases in the literature and two out of six of our personal cases, an associated interstitial syndrome was found in two out of six cases in the literature and one of our cases. These findings are part of the clinical picture in the most frequent presentations of OP [29,30]. The only case in the literature in which the initial diagnosis of OP made by TTB was finally not confirmed was an unusual radiological presentation with cavity lesions. A SB was performed because the patient did not respond well to steroid treatment and in this case the diagnosis was corrected. In the cases in the literature a TTB was performed as a first-line investigation but did not contribute to the diagnosis in one case. In our case reports, TTB was the only procedure the patients had for histology and the diagnosis was retrospectively confirmed when they responded well to steroid treatment and/or the incriminated drug was withdrawn, which justified the fact that they were given no further invasive examination. In our case reports, the majority of the cases of OP were probably due to a drug reaction (83%), whereas the cases in the literature are all presented as cryptogenic except for one, in which bicalimine is the causal agent. With respect to the treatment, there are no precise details of the steroid treatment in the cases reported in the literature. In our case reports, the steroid treatment was implemented according to the Groupe d’études et de recherche sur les maladies "orphelines" pulmonaires (GERM"O"P) recommendations, which are based on several studies [31,32] for cases No.1, 2 and 3. In case No.4, the duration of the course of steroids was decreased to 4 months, but the initial dose was increased. In case No.5, the patient relapsed, probably due to the fact that the initial dose of steroid treatment was insufficient and the treatment was shorter than recommended.

Procedure, advantages and drawbacks of CT-guided transthoracic lung biopsy (TTB)

CT-guided TTB consists of taking a pulmonary biopsy with a coaxial cutting needle through the chest wall under local anaesthetic and CT-guidance. The CT scan is performed in thin slices (2 to 5 mm) to locate the lesion to biopsy and optimise the patient’s position [33,34]. The most common procedure is to use coaxial core biopsy needles: the outer part of the biopsy needle is inserted percutaneously, pushed through the chest wall and left in position close to the perimeter of the lesion throughout the procedure, its position is regularly checked on the CT scan. A semi-automatic "Tru-cut" type biopsy cutting needle is then inserted several times and the samples are harvested within an area of 2 cm immediately downstream. Thus, several histological samples and a needle aspiration can be taken from the lesion through a single breach in the pleura, harvesting sufficient material for the histology and cytology tests [33]. The percentage of samples judged to be adequate by the pathologists in the literature is around 92 to 100%, even for nodules of a diameter less than 20 mm and for needle calibres between 18 and 25 G [33,35,36]. Laurent et al. report adequate samples in 98.9% of the cases in a study of 202 biopsies of pulmonary nodules performed with a 20 G coaxial needle identical to the one we used [33]. The diagnostic value of TTB is between 88 and 97%, and is better in malignancies than in benign lesions [33,35—37]. These data are for pulmonary nodule biopsies, not very many studies having been carried out on the use of TTB in interstitial pneumonia. In an article that dates back to 1981 [38], the authors found a diagnostic value of only 42% for TTB, but the biopsy techniques have changed since. Many more recent articles report an aetiological diagnosis of interstitial pneumonia obtained by TTB in 79 to 100% of the cases [39—41]. In one of the studies [40] on 23 patients in which the diagnosis was made by TTB in all cases, the authors state that 20 of these patients had previously had TBB but it had not contributed to the diagnosis (Table 2).

The main complications are pneumothorax (8 to 61% according to the study but in most cases around 20 to 30%, requiring chest drainage in 3 to 15% of the cases). The risk largely depends on the type of needle used, on the number of breaches made in the pleura and on the distance between the pleura and the lesion. Pneumothorax is in most cases detected almost immediately on the end-of procedure CT slices [42—46]. Minor alveolar bleeding frequently occurs in the biopsy area and can cause some blood to be coughed up, although it is never usually serious. The other complications are rare: haemothorax, severe alveolar bleeding, gas embolism, tumour propagation along the tract of the puncture site if the lesion is malignant and cardiorespiratory arrest.
Table 3  Summary of the cases in the literature in which a diagnosis of organising pneumonia was obtained by trans-thoracic lung biopsy.

<table>
<thead>
<tr>
<th>Case</th>
<th>Clinical presentation</th>
<th>Radiological presentation</th>
<th>First line examination result</th>
<th>Second line examination result</th>
<th>Aetiology confirmed</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1</td>
<td>Dyspnoea Pyrexia</td>
<td>ND</td>
<td>TTB OP</td>
<td>TBB OP</td>
<td>Cryptogenic OP</td>
<td>NC</td>
</tr>
<tr>
<td>No.2</td>
<td>Cough resistant to antibiotic treatment</td>
<td>Bilateral alveolar syndrome</td>
<td>None</td>
<td>OP caused by a drug reaction to bucillamine</td>
<td>Non-Hodgkin’s lymphoma with satellite OP lesions</td>
<td>Cure after withdrawal of bucillamine and steroid treatment</td>
</tr>
<tr>
<td>No.3</td>
<td>Dyspnoea Pyrexia</td>
<td>Bilateral cavitary lesions</td>
<td>TTB OP</td>
<td>SB Non-Hodgkin’s lymphoma</td>
<td>Non-Hodgkin’s lymphoma with satellite OP lesions</td>
<td>NC</td>
</tr>
<tr>
<td>No.4</td>
<td>Cough resisting antibiotic treatment</td>
<td>Right pulmonary alveolar consolidation</td>
<td>SB OP</td>
<td>TTB OP</td>
<td>Cryptogenic OP</td>
<td>Cure after steroid treatment</td>
</tr>
<tr>
<td>No.5</td>
<td>Cough, pyrexia resisting antibiotic treatment</td>
<td>Migrating right alveolar consolidation</td>
<td>TBB Non conclusive</td>
<td>TTB OP</td>
<td>Cryptogenic OP</td>
<td>Cure after steroid treatment</td>
</tr>
<tr>
<td>No.6</td>
<td>Respiratory distress, pyrexia</td>
<td>Bilateral alveolar consolidation</td>
<td>TTB OP</td>
<td>None</td>
<td>Cryptogenic OP</td>
<td>Cure after steroid treatment</td>
</tr>
</tbody>
</table>

NC: information not communicated when the article or abstract was accessible; TTB: transthoracic lung biopsy; TBB: transbronchial lung biopsy; SB: surgical biopsy; OP: organising pneumonia.

The value of CT-guided TTB in the diagnosis of OP

In the light of the above data we felt that it might be interesting to consider the value of CT-guided TTB in the diagnosis of OP. The advantage of the procedure is that it can be performed under local anaesthesia and can thus be envisaged for patients whose respiratory status is relatively frail. The accuracy of CT-guidance gives it a better diagnostic yield than TBB, providing lung tissue samples for the histology and cytology tests that are larger than those obtained by TBB and decreasing the risk of misdiagnosis by harvesting samples of a satellite disease associated with a focus of OP. TTB has a higher diagnostic value than TBB, whatever the presentation of the lesions (alveolar, foci of nodular or diffuse lesions), which we know can vary in OP. The complications are rare and in most cases benign. Pneumothorax occurs more frequently with TTB than with TBB, but in most cases it is not serious, does not need draining and is detected at an early stage on the CT scan at the end of the procedure. If it does develop, it can be drained immediately under CT guidance.

Safadi’s et al. article [25] illustrates the fact that a misdiagnosis with TTB is always possible because the samples are smaller than those obtained by SB, which remains the gold standard for the diagnosis of OP. Of course, the results of TTB must always be interpreted in the light of the clinical findings, as demonstrated by our sixth case in which the
diagnosis was debatable. If the diagnosis had been made on the basis of TTB alone OP would have been confirmed and a course of steroid treatment would have been appropriate. However, it is possible to find OP lesions around a focus of lung infection and the fact that this patient responded well to antibiotic treatment suggests that this latter hypothesis was correct, thereby justifying antibiotic treatment alone in this particular case because steroids can have a deleterious effect in cases of infection. CT-guided TTB must be assessed as a replacement for TBB in the diagnostic approach to OP in hospitals that have a radiologist who is experienced in the procedure and in lung pathology. It is important to be aware of the limitations that must be applied when performing and interpreting the procedure. If there is any immediate doubt concerning the diagnosis on the basis of the initial radiological and clinical findings or, above all, if the patient does not respond positively to steroid treatment and his/her condition permits, a surgical biopsy should be performed. The SB will either confirm any hesitation concerning OP or, conversely, correct the diagnosis made by TTB.

Conclusion

We feel that CT-guided TTB has a justified role to play in the diagnostic approach to OP. SB remains the gold standard diagnostic method for suspected OP and rather than usurping its rightful position and undoubted value TTB should be assessed as an alternative to TBB in this indication because its yield is better.; It also provides larger samples of pulmonary tissue than TBB, thereby mitigating the risk of misdiagnosis in a disorder that has many differential diagnoses.

Conflict of interest

No author has any conflict of interest to declare.

References


