Role of CT-guided transthoracic core needle biopsy in the diagnosis of pulmonary tuberculosis

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Abstract

Purpose: To evaluate the value of CT-guided core-needle biopsy in the diagnosis of pulmonary tuberculosis.

Materials and methods: 67 patients suspected with pulmonary tuberculosis underwent CT-guided core-needle biopsy in our hospital between March 2009 and January 2014. The biopsy procedures, pathologic findings, and microbiologic results were recorded.

Results: 67 patients were enrolled including 40 men and 27 women, with a mean age of 45.4 years (range, from 17 to 75 years). Histological diagnosis were made by CT-guided core-needle biopsy as follows: The organism were detected in 20 patients; for organism negative patients, tumor tissue were found in 5 patients, epithelioid granulomatous reaction with caseation were found in 18 patients; epithelioid granulomatous reaction without caseation were found in 15 patients; nonspecific results were found in 9 patients. Smears and cultures were performed on 42 patients with TB positive in 15 patients. Finally, 51(76.12%) patients were diagnosed with TB; the specific diagnosis made by CT guided biopsy was 74.63%(50/67).

Conclusion: CT-guided transthoracic core needle biopsy had high performance on the diagnosis of pulmonary tuberculosis and facilitated the diagnosis of malignancy, lymphoma and other infectious disease.

Keywords: Pulmonary tuberculosis; CT-guided; Core needle biopsy; Infectious disease

1. Introduction

Tuberculosis (TB) is a worldwide public health crisis of immense proportions and the majority of the world's TB burden is carried by developing countries with limited resources [1]. The diagnosis of pulmonary TB can be obtained from sputum. However, clinicians often face a dilemma when a suspected patient with active pulmonary TB has negative sputum result. The culture of clinical specimens for TB requires several weeks and radiographic diagnosis is not very accurate [2,3].

As widely reported, computed tomography (CT)-guided percutaneous core needle biopsy is a safe and high-yield technique to determine the nature of a pulmonary lesion [4–7]. However, few studies on CT-guided core-needle biopsy for pulmonary TB have been done [4]. The aim of the study is to verify the clinical value of histopathological and microbiologic diagnosis of pulmonary tuberculosis obtained by CT-guided transthoracic biopsies.

2. Materials and methods

Institutional review board approval was obtained for this retrospective study. All patients whose clinical features and CT findings indicated suspected pulmonary TB in our hospital between March 2009 and January 2014 were reviewed.
We routinely conduct sputum smear for these patients. We excluded patients whose sputum smears were positive for TB, and patients for whom the final diagnosis was not established. The patients referred to the radiology department for the CT-guided core-needle biopsy were included in this study.

3. Biopsies

Before biopsies, informed consent was obtained from all patients. Prothrombin time (PT), partial thromboplastin time (PTT) and platelet count (PLT) were measured. Patients with prolonged PT and PTT values and/or PLT <50,000/μL received appropriate corrective treatment. Severe respiratory insufficiency was considered the contraindication. All biopsies were performed under CT guidance. Patients underwent 5-mm slices through the area of interest at suspended inspiration using a spiral CT (Sensation 16, Siemens Healthcare, Forchheim, Germany) (Fig. 1a). The entry site was prepared and draped in sterile fashion. All biopsies were performed under local anesthesia along with 10 mL of 1% lidocaine hydrochloride. All biopsies were performed by 18 G biopsy-cut (Angiotech, SuperCore™ Biopsy Instrument, USA) needle. The length of the biopsy groove was measured with 20 mm. The biopsy needle was injected into the lesion with breath-holding. Five millimeter sections were obtained to verify the location of the needle tip (Fig. 1b). The numbers of samples were obtained depend on their size. After biopsy procedures, CT was immediately conducted at the level of biopsy sites to investigate the presence of complications such as pneumothorax or parenchymal hemorrhage. The asymptomatic pneumothoraces were managed conservatively. The immediate placement of a chest tube was reserved for patients with signs of shortness of breath, respiratory distress, or rapidly enlarging pneumothorax. A chest radiograph was not required after the biopsy procedure if patients had no symptoms. In case of pneumothorax, patients were monitored conservatively or drained by a chest tube if they had shortness of breath, respiratory distress, or rapidly enlarging pneumothorax. Patients with slight respiratory symptoms or slight pneumothorax which had not been enlarged on sequential chest radiography were treated conservatively.

3.1. Histologic and microbiologic analysis

Biopsy specimens were fixed routinely in 10% buffered formalin, embedded in paraffin, and routinely stained with hematoxylin and eosin (HE) for histopathological examinations. The Ziehl–Neelson stain for acidfast bacillias well as PAS and Gomori methenamine silver stains for fungi were also performed.

Pathologic findings were classified into two groups: Group 1, specific pathogenic organism could be found, such as TB, fungi; Group 2, no specific pathogenic organism, 2A with specific pathologic findings, such as tumor tissue or epithelioid granulomatous reaction with caseation — specific finding for TB; 2B with epithelioid granulomatous reaction without caseation — TB diagnosis was considered; 2C: no specific pathologic findings.

Microbiologic examination was performed if there were enough samples. Microbiologic investigations were considered as positive if a smear or culture was positive for AFB or fungi.

The CT-guided core needle biopsy diagnosis was eventually confirmed by either pathologic or microbiologic examinations involving bronchoscopy examination, thoracotomy, or by clinical follow-up. Subsequent therapy management was based on the final diagnosis.

4. Results

The group of 67 patients included 40 men and 27 women, with a mean age of 45.4 years (range, 17–75 years). Test for human immunodeficiency virus yielded negative results in all patients. The diseases were within the lungs at the initial diagnosis. The clinical features as well as high-resolution computed tomography (HRCT) features on the enrolled 67 patients were listed in Tables 1 and 2.
Nodules and consolidations were the lesions we chose for biopsies. During CT-guided core-needle biopsies, one to four specimens (mean 2.4) was obtained for a satisfactory sampling (the total length of samples obtained were 20–30 mm). There were 8 minor complications including 5 (7.46%) small stable pneumothoraces and 3 cases (4.48%) of minor hemoptysis. No serious complications were noted in all patients who underwent CT-guided core-needle biopsy.

Histological diagnosis was made by CT-guided core-needle biopsy as follows: An organism was detected in 20 patients. For organism negative patients, tumor tissue was found in 5 patients; epithelioid granulomatous reaction with caseation was found in 18 patients; epithelioid granulomatous reaction without caseation was found in 15 patients and nonspecific results were found in 9 patients. Smears and cultures were performed in 42 patients, 15 patients was proved of positive results for TB, and 2 for fungi (Table 3).

Sixteen patients (23.89%) with non-diagnostic core-needle biopsies were finally diagnosed by bronchoscopic examination (n = 4), surgical interventions including open surgical biopsy and video-assisted thoracoscopic biopsy (n = 8) and sputum culture (n = 5) during clinical follow-up.

Finally, 51(76.12%) patients were diagnosed as TB in this study. The specific diagnosis made by CT guided core needle biopsy was 74.63% (50/67), and 12 cases (80%) with epithelioid granulomatous reaction without caseation was TB.

### 5. Discussion

TB was hard to diagnose sometimes because of the difficulties in the culture on the slow-growing organism in laboratories [8,9]. An integrated evaluation for TB must include medical histories, chest radiographs, physical examinations as well as microbiologic smears and cultures [10]. All sputum smears from patients in this study were negative for TB. The difference of the clinical and laboratory findings could not distinguish PTB from other diseases and made PTB hard to differentiate from other diseases.

The efficacy of CT-guided transthoracic core needle biopsy in the diagnosis of pulmonary disease had already been established and applied to both malignant as well as benign lesions [4–7]. Cutting needles were mainly for the biopsies since the tissue specimens were better to be obtained with acore biopsy in comparison with an aspiration method [11]. In this study, specific pathogenic organisms were found in 20 patients from

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**Table 1**

| Features                  | N  |
|---------------------------|----|
| Asymptomatic              | 5(7) |
| Constitutional symptoms   |    |
| Fever                     | 49(73) |
| Weight loss               | 23(34) |
| Night sweats              | 39(58) |
| Respiratory symptoms      |    |
| Cough                     | 51(76) |
| Expectoration             | 42(63) |
| Exertional dyspnea        | 22(33) |
| Hemoptysis                | 13(19) |

**Table 2**

High-resolution computed tomography features of patients with primary pulmonary lymphoma.

| Features                                | N   |
|-----------------------------------------|-----|
| Tree in bud appearance                  | 21(31) |
| Nodule or mass                          | 29(43) |
| Ground glass opacity                    | 38(57) |
| Consolidation                           | 39(58) |
| Cavity                                  | 18(27) |
| Calcification                           | 13(19) |
| Pleural effusion                        | 24(36) |
| Hilar or mediastinal lymphadenopathy    | 18(27) |
| Main lesion in S1, S2, and S6           | 33(49) |

**Table 3**

Flowchart of patients undergoing CT-guided core needle biopsy.

| Specific pathogenic organism (+) n = 20 | Specific pathogenic organism (−) n = 47 |
|----------------------------------------|----------------------------------------|
| TB (n = 16)                            | TB (n = 3)                              |
| Fungi (n = 3)                           | Fungi (n = 1)                           |
| Cryptococcus (n = 1)                    |                                      |
| Microbiologic examination for 12 patients (TB, n = 5; Fungi, n = 1) | Microbiologic examination for 3 patients |
| Tumor (n = 5)                           | Epithelioid granulomatous reaction with caseation (n = 18) |
| Adenocarcinoma (n = 3)                  | Microbiologic examination for 11 patients (TB, n = 4) |
| Lymphoma (n = 2)                        | Epithelioid granulomatous reaction without caseation (n = 15) |
|                                        | Microbiologic examination for 10 patients (TB, n = 4; Fungi, n = 1) | Final diagnosis with other methods |
|                                        | TB (n = 8)                              |
|                                        | Fungi (n = 1)                           |
|                                        | Sarcoïdosis (n = 1)                     |
|                                        | Nonspecific pathologic findings (n = 9) |
|                                        | Microbiologic examination for 6 patients (TB, n = 2) | Final diagnosis with other methods |
|                                        | TB (n = 3)                              |
|                                        | Fungi (n = 1)                           |
|                                        | Organizing pneumonia (n = 3)             |

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histopathological examinations. Although acid-fast bacilli must be identified directly from the sample in order to establish a definitive diagnosis of tuberculosis, positive findings of acid-fast bacilli appeared to be infrequent in core tissue specimens with mycobacterial pulmonary diseases [4,7]. Specific histopathological findings such as epithelioid granulomatous reaction with caseation found in specimen could help to establish the diagnosis of tuberculosis without acid-fast bacilli detection [12]. Fukuda et al. [4] evaluated the value of CT-guided transthoracic core biopsy for the diagnosis of mycobacterial pulmonary nodules and found that 30 subjects with pulmonary nodules had been histopathologically either diagnosed as tuberculosis or suspected as tuberculosis based on the specimen obtained by CT-guided transthoracic core biopsies.

In clinical practice, TB was considered even if only epithelioid cell granulomas were found [4,13]. The epithelioid cell granulomas response was a nonspecific manifestation for lung diseases [14]. In tuberculosis, the active tissue was histologically marked by a characteristic granulomatous with inflammatory reaction that forms both caseating and non-caseating tubercles. The specificity of epithelioid cell granuloma without necrosis in the diagnosis of TB with bronchoscopic biopsies was around 60% [14]. If granuloma was noncaseating, the interpretation should be cautious. Even in our study, in a country of high prevalence of TB, only 80%(12/15) of cases was TB for epithelioid granulomatous reaction without caseation. Therefore, the epithelioid cell granulomas without caseating might indicate TB diagnosis, but not a definite diagnosis for TB.

The collection of smear and culture samples in addition to tissue specimen was ideal in aiding the diagnosis of pulmonary tuberculosis, whereas the microbiologic examination needed more samples. In this study, not every patient had enough samples for microbiologic examinations.

The therapeutic trial with antitubercular therapy was advocated, however, it might delay the diagnosis of malignancy, lymphoma and other infectious disease [4,15]. In our study, only 76.12% patients were finally diagnosed with TB.

5.1. Limitations of the study

One of the limitations in this study is the retrospective nature of the data whereas it doesn't hamper the objective of the study. Secondly, the smear and culture samples has not been performed for every patient.

6. Conclusion

In conclusion, CT-guided transthoracic core needle biopsy had high diagnostic performance on the diagnosis of pulmonary TB and facilitated the diagnosis of malignancy, lymphoma and other infectious disease.

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