Case Report

A novel diagnostic approach for *Pneumocystis jirovecii* pneumonia using fine-needle aspiration, electromagnetic navigational bronchoscopy and rapid on-site evaluation

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Submission: 02-06-2019
Accepted: 01-07-2019

Access this article online

Quick Response Code:

Website: www.thoracicmedicine.org

DOI: 10.4103/atm.ATM_171_19

Abstract:

Cavitary lung lesions are common in patients with human immunodeficiency virus infections. Both atypical infections and thoracic malignancies can manifest as a cavitary pulmonary lesion. Standard bronchoscopy is commonly used to evaluate these abnormalities but is limited in its ability to fully assess for cancer and infection. Bronchoalveolar lavage samples are likely to aid in the diagnosis of infection but are less useful in the evaluation of malignancy. In addition, many of these pulmonary lesions are located in the periphery of the lung and are not accessible for tissue sampling by standard bronchoscopy. We present a unique presentation of *Pneumocystis jirovecii* pneumonia and discuss the utility of electromagnetic navigational bronchoscopy in the evaluation of immunocompromised patients with peripheral cavitary lung lesion.

Keywords:

Bronchoscopy, cavitary lung lesion, fine-needle aspiration, immunocompromised, *Pneumocystis jirovecii*

Cavitary pulmonary lesions can be seen in both infectious and malignant conditions in human immunodeficiency virus (HIV)-infected individuals. Most are the result of fungal infections. *Pneumocystis jirovecii* (PJP) makes up to 2% of these occurrences.[1]

In addition, lung cancer is more prevalent and portends a worse prognosis in this population compared to nonHIV-infected individuals.[2] Approximately 67% of these cancers will be squamous cell carcinoma, of which 80% will present as a cavitating lung lesion.[3]

Standard bronchoscopy is the initial standard approach in the evaluation of these lesions. However, it is limited in its ability to diagnose malignancy with bronchoalveolar lavage (BAL) (diagnostic yield of 33%)[4] but is excellent in the evaluation of infections (diagnostic yield of 98%).[5] Standard bronchoscopy is frequently restricted in accessing these lesions for tissue sampling if they are located in the periphery of lung. These drawbacks often lead to additional invasive procedures and therefore increased risk of a complication. This ultimately may cause a delay in diagnosis and therapy.

Electromagnetic navigational bronchoscopy (ENB) is an image-guided approach that

How to cite this article: Houshmand F, Aly FZ, Bowling MR. A novel diagnostic approach for *Pneumocystis jirovecii* pneumonia using fine-needle aspiration, electromagnetic navigational bronchoscopy and rapid on-site evaluation. Ann Thorac Med 2019;14:285-7.

uses a three-dimensional-reconstructed computed tomography (CT) scan and an electromagnetic sensor locator to access peripheral lung lesions beyond the reach of standard bronchoscopy. Once the lesion is located, tissue can be collected.

We present a unique and unexpected finding in the evaluation of a peripheral cavitary lung lesion in an immunocompromised patient utilizing ENB-guided fine-needle aspiration (FNA).

Case Report

A 40-year-old male with a history of smoking and untreated HIV infection presented to the hospital with concerns for a 10 lb weight loss, night sweats, and a nonproductive cough for 2 months. His initial laboratory studies demonstrated a white blood cell count of 2.6 K/μl, lymphocytes of 0.24 K/μL, and CD4 count of 0. A chest X-ray demonstrated a thick-walled cavitary lesion in the right upper lung, which was confirmed on a CT scan of the chest [Figure 1]. The right upper-lobe cavitary lesion was accessed by ENB, and several (seven FNA and seven forceps biopsy) samples were collected. Rapid on-site evaluation (ROSE) was available for immediate microscopic assessment of the tissue, and a preliminary diagnosis was rendered as concerning for the presence of *P. jirovecii*. This diagnosis was confirmed with the use of Grocott–Gomori's methenamine silver stain [Figure 2]. A bronchoalveolar sample was also collected from the right upper lobe, and *P. jirovecii* organisms were detected on cytologic evaluation of the BAL fluid. There was no malignancy or other infectious organism detected from the tissue of BAL samples.

Discussion

To our knowledge, this is the first reported case of an adult with the use of ENB-guided FNA of a lung lesion and immediate diagnosis of PJP with the use of ROSE. This case is noteworthy for several reasons; first, although cystic lung changes are seen with PJP, cavitary lung lesions are a rare finding in these infections. This adds to the uniqueness of the presented case in that other diagnoses such as malignancy and fungal or mycobacterial infections would have been considered a more likely etiology in immunocompromised patients with a solitary cavitary lung lesion.

Second, the diagnosis of PJP by FNA is rare. There are two previous reports of a diagnostic FNA of thyroid masses, which proved to be an extrapulmonary *P. jirovecii* infection.[6,7] In addition, mediastinal lymph node sampling by the use of endobronchial ultrasound FNA has been reported to find PJP in both a HIV/AIDS patient[8] and a nonAIDS immunocompromised patient with a renal transplant.[9] Interestingly, Moualla and Saeed reported a simultaneous BAL to be nondiagnostic.[9] The choice of FNA with fiber-optic bronchoscopy in an immunocompromised pediatric population with diffuse pulmonary lesions and high clinical suspicion for PJP was reported by Choi *et al*., which showed a high yield and conveyed to be a safe procedure.[10]

Finally, ENB-guided FNA with ROSE is commonly used in the evaluation of thoracic malignancies, but there is no established use for it in the setting of the infectious disease workup. While bronchoscopy with BAL is a reasonable method for evaluating a cavitary lung lesion, a lavage sample would be unlikely to

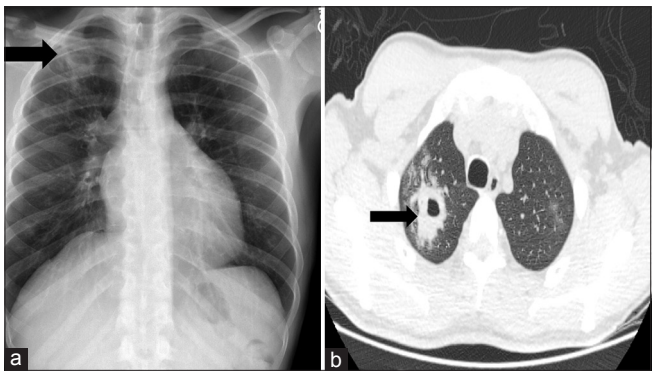

Figure 1: Chest roentgenogram and computed tomography scan of the chest. (a) The posteroanterior image of the chest with a cavitary lesion in the right upper lung (black arrow). (b) The axial image of the chest tomography scan with a thick-walled cavitary lesion in the right upper lung (black arrow)

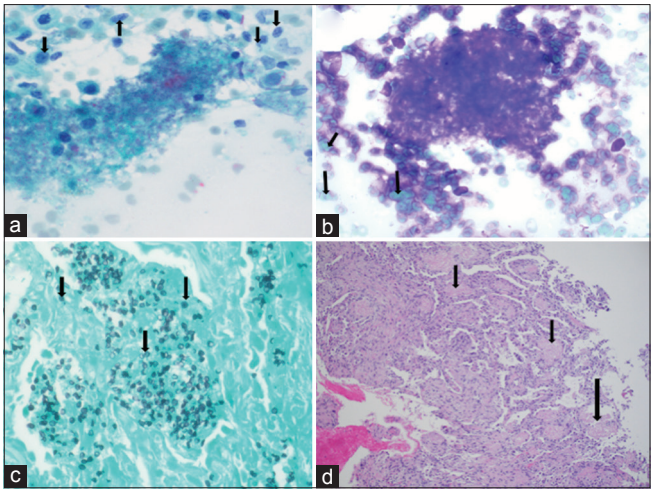

Figure 2: Pictures documenting appearance of pneumocystis in various cytologic preparations. (a) High-power view of dot-like organisms within the foamy cast (black arrows). (Papanicolaou, ×60). (b) High-power view of dot-like organisms within the foamy cast (black arrows) (Diff-Quick, ×60). (c) Fine-needle aspiration specimen showing *Pneumocystis* organisms as alveolar casts. Typical appearance of *Pneumocystis* organism with crescent shape, spheres with a dense dot, and collapsed spheres also known as crushed ping pong balls (Grocott–Gomori's methenamine silver, ×60). (d) Fine-needle aspiration cell block specimen demonstrating foamy cast adherent to the alveolar cell wall (black arrows) (H and E, ×10)

render a diagnosis of malignancy. In addition, many of these cavitary lesions may be located in the periphery of the lung and are difficult to access with conventional bronchoscopy and sampling via a transthoracic needle approach with radiologic guidance can lead to a pneumothorax (complication rates from 17% to 26%).[11-13] These methods may result in delays in treatment, the need for additional invasive procedures, and procedural complications. In our case, due to the presentation of a single cavitary lung lesion, with a history of heavy tobacco abuse, this patient could just as likely have had a malignancy as an infection; therefore, we felt that a simple BAL or sputum sample may not assess the possibility of malignancy as thoroughly as a biopsy and BAL.

The use of ENB-guided biopsies in combination with ROSE may be an efficient approach to the management of these patients because both infectious and malignant etiologies can be evaluated safely. The complication rate of ENB-guided biopsies has been reported to be approximately 4%.[14] ENB both with and without ROSE has a diagnostic yield for malignancy that ranges from 38% to 97%.[14] In this case, we utilized the Super D™ (Medtronic, Minneapolis, MN, USA) ENB system because this is the navigational system we use at our institution. However, other image-guided modalities such as virtual bronchoscopy and radial ultrasound could also be employed.

Conclusion

The use of ENB-guided biopsies with ROSE in the assessment of cavitary lung lesions in immunocompromised patients is efficient and safe. Collaboration between an astute pathology team and chest physician is essential to maximize the utility of this procedural technique. Immediate feedback and direction from the pathologists concerning the need for additional tissue for culture is vital in maintaining the utility of the procedure and potentially avoiding unnecessary additional sampling or repeated invasive diagnostic studies.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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