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Case report

A case of pulmonary *Mycobacterium avium* infection in an immunocompetent patient who showed a huge consolidation with a high FDG uptake on PET/CT

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ABSTRACT

We encountered a middle-aged afebrile immunocompetent woman with a slight cough. Positron emission tomography (PET)/computed tomography (CT) revealed a broad left upper-lobe consolidation without cavity lesions, small nodules, or bronchiectasis showing a positive fluorodeoxyglucose (FDG) uptake with a maximum standardized uptake value (SUVmax) of 26.9. Percutaneous needle lung biopsy specimens showed caseous granulomas without atypical cells and *Mycobacterium avium* was cultured from left pleural effusion, which developed after the biopsy. The consolidation significantly decreased following combination chemotherapy for approximately 2 years. Clinicians should remember that pulmonary *M. avium* infection could result in a large consolidation without other typical radiological findings.

1. Introduction

Nontuberculous mycobacteria (NTM), especially *Mycobacterium (M.) avium* complex (MAC), are being recognized with increasing frequency as clinical pathogens of chronic lung disease in immunocompetent patients [1,2]. The common findings of immunocompetent patients with NTM infection in chest computed tomography (CT) are cavity lesions, endobronchial spread or randomly distributed small nodules with bronchiectasis, and consolidation [1–4]. The maximum standardized uptake values (SUVmax) of fluorodeoxyglucose (FDG) in positron emission tomography (PET) were approximately 5–10 in the lesions of NTM infection [5,6].

We herein report a case of pulmonary *M. avium* infection in an immunocompetent woman with a non-disseminated broad consolidation on chest CT and a high FDG uptake (SUVmax: 26.9) in this consolidation on PET/CT.

2. Case presentation

A 41-year-old Korean woman complained of a slight cough without dyspnea or a fever. She was referred to our department by her primary care physician. She was affected by tuberculosis when she was 34 years of age in Korea and treated with unspecified chemotherapy; no signs of relapses occurred until 41 years of age. The precise data regarding her past clinical history in Korea were unavailable. Her hearing ability was lost completely due to unknown reasons. She had no history of diabetes mellitus or other immunosuppressive diseases. Physical examinations at the initial visit showed a height of 162.0 cm, body weight of 58.0 kg, arterial blood pressure of 102/58 mmHg, pulse rate of 74/min, and body temperature of 36.5 °C. The breath sounds were decreased in the left lung. No lymphadenopathy was found. Her laboratory

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examinations are shown in Table 1. The white blood cell count was within the normal range and C-reactive protein (CRP) level was increased to 2.91 mg/dL. The carcinoembryonic antigen (CEA) value was normal, however, the soluble interleukin-2 receptor (sIL-2R) value was increased to 1094 U/mL. The blood glucose level was normal and HIV antibody was negative. The serum immunoglobulin levels were normal. Both $CD4^+$ and $CD8^+$ lymphocyte counts were in the normal ranges. An interferon-gamma release assay (Cellestis Company, QuantiFERON® TB Gold) was negative. The antigens for urine *Streptococcus pneumoniae* and *Legionella pneumophila* were negative. The bacterial culture, acid-fast bacilli smear and culture, and polymerase chain reaction (PCR) tests for *Mycobacterium tuberculosis*, *M. avium*, and *Mycobacterium intracellulare* of the sputum were all negative. A chest X-ray and CT scan showed a broad consolidation with an angiogram sign throughout the upper-lobe of left lung, however, other imaging findings such as cavity lesions, small nodules, and bronchiectasis were not observed (Fig. 1A–C). Lymph nodes around the arch of the aorta and under the carina of the trachea were slightly enlarged. PET/CT showed a high SUVmax of 26.9 on the consolidation shadow (Fig. 1D). Transbronchial aspiration cytology (TBAC) could not obtain adequate specimens from the consolidation due to stenosis of the left upper lobe bronchus. The cytodiagnosis, common bacterium culture, acid-fast bacilli smear and the PCR tests for *M. tuberculosis*, *M. avium*, and *M. intracellulare* of the lavage fluid were all negative. Furthermore, the acid-fast bacilli culture of the lavage fluid was negative. Thus, a CT-guided percutaneous needle lung biopsy was performed and the biopsy specimens showed caseous granulomas without atypical cells by hematoxylin and eosin (H&E) staining (Fig. 2), but no bacteria by Kinyoun staining. The bacterial culture, acid-fast bacilli smear, acid-fast bacilli culture and PCR tests for *M. tuberculosis*, *M. avium*, and *M. intracellulare* of the biopsy specimens were negative. The consolidation of the left lung enlarged and left pleural effusion developed one week following the lung biopsy (Fig. 1E). Thus, we performed a diagnostic puncture in the left thorax. The pleural effusion was lymphocyte predominant and serological tests showed a total protein (TP) concentration of 5.0 g/dL, albumin of 2.5 g/dL, lactate dehydrogenase (LD) of 223 IU/L, glucose of 95 mg/dL, immunoglobulin G (IgG) of 1216 mg/dL, and adenosine deaminase (ADA) of 84.3 U/L. Effusion specimens were negative for antinuclear antibody (ANA) and rheumatoid factor (RF). The acid-fast bacilli smear and PCR tests for *M. tuberculosis*, *M. avium*, and *M. intracellulare* of the effusion were all negative Finally, *M. avium* was cultured from the left pleural effusion and we diagnosed the patient with *M. avium* infection.

Because ethambutol (EB) was thought to be unsuitable due to her complete hearing loss, combination chemotherapy with rifampicin (RFP) 450 mg, clarithromycin (CAM) 800 mg, and levofloxacin (LVFX) 500 mg were administered. The chest image significantly improved after two years of this chemotherapy (Fig. 1F).

3. Discussion

NTM may cause both asymptomatic infection and symptomatic disease in humans [2]. It has been reported that the incidence of a fever was approximately 10–20% in NTM patients without HIV infection [7–9] and 74% in NTM patients with HIV infection [9]. Thus, there is a danger of unintentionally overlooking this infectious disease, especially in afebrile immunocompetent patients with mild symptoms like our case.

Several investigators have reported the CT findings of NTM patients without underlying lung disease and micronodules (95–100%), bronchiectasis (65–94%), cavity formation (13–43%), air space consolidation (22–62%), and pleural thickening (17–52%) were frequently observed in these communications [8]. A study of 59 Japanese patients with *M. avium* complex infection reported that the rates of small nodules, nodules, bronchiectasis, atelectasis, cavity formation, consolidation, and pleural effusion were 100%, 81.3%, 76.2%, 59.3%, 37.3%, 22.0%, and 8.5%, respectively, on chest CT [8]. Interestingly, all of the patients with consolidation showed other common CT findings of NTM infection in this study [8]. Although consolidation is one of the common CT findings in NTM infection, we believe that it is rare for patients with *M. avium* infection to present with common CT findings of NTM infection other than the consolidation of the left lung.

The broad consolidation with a positive angiogram sign on chest CT suggested that the pulmonary structures of the bronchus and blood vessels might not be destroyed, which might be observed in pneumonia and malignant neoplasms such as malignant lymphoma and invasive mucinous adenocarcinoma [10]. Because the present case clinically showed fewer respiratory symptoms without a fever, her large consolidation on chest CT was suspected to be malignant neoplasms, such as malignant lymphoma, at the beginning visit. We speculated that acid-fast bacillus infections could show a FDG accumulation on PET/CT, however, we had not previously experienced such a high SUVmax in a

Table 1
The patient's laboratory data at the initial visit.

Hematology			**Blood Chemistry**			**Serological tests**		
WBC	5660	/μL	TP	6.8	g/dL	CRP	2.91	mg/dL
Neutrophil	63.7	%	ALB	3.2	g/dL	IgA	207	mg/dl
Monocyte	7.6	%	UN	10	mg/dL	IgM	136	mg/dl
Eosinophil	4.4	%	Cre	0.57	mg/dL	IgG	1422	mg/dl
Basophil	0.4	%	AST	13	IU/L	IgD	0.8	mg/dl
Lymphocyte	23.9	%	ALT	9	IU/L	IgE	35	IU/ml
CD4	29	%	γ-GTP	15	IU/L			
CD8	44	%	T-bil	0.47	mg/dL	HIV antibody	–	
RBC	479×10^4	/μL	ALP	19	IU/L			
Hb	12.3		LDH	160	IU/L	**Urinalysis**		
Plt	38.7	/μL	Na	136	mEq/L	PH	7.0	
			K	4.3	mEq/L	SG	1.010	
Tumor marker			Cl	98	mEq/L	Protein	–	
CEA (<3.4)	1.6	ng/mL		88		Glucose	–	
CA19-9 (<37.0)	153.3	U/mL				Occult blood	–	
sIL-2R (<421)	1094	U/mL	Glu	88	mg/dL	Bacteria	–	
ESR						**Urine testing for bacterial antigens**		
1h	40	mm				*S. pneumoniae*	–	
2h	76	mm				*L. pneumophila*	–	

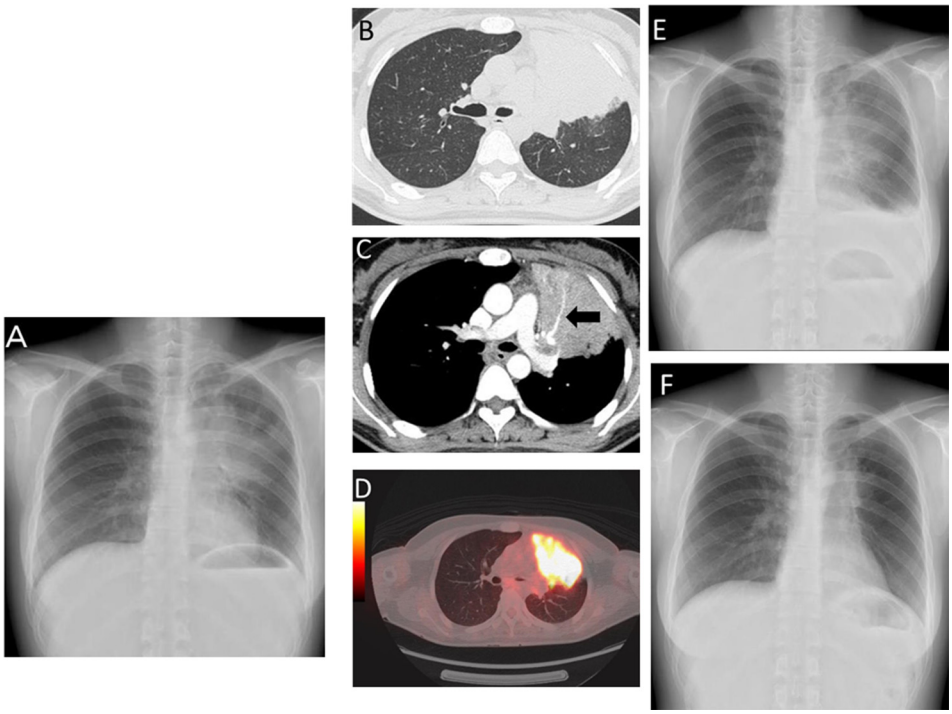

Fig. 1. A chest X-ray (A) and CT (B, C) scan at the initial visit revealed broad consolidation with a positive angiogram sign (arrow) throughout the upper-lobe of the left lung. PET/CT showed a high SUVmax of 26.9 on the consolidation of the left lung (D). A subsequent chest X-ray one week after the percutaneous lung biopsy showed the consolidation getting broader and the development of left pleural effusion (E). A chest X-ray taken two years after chemotherapy revealed a significant improvement in the consolidation and pleural effusion (F).

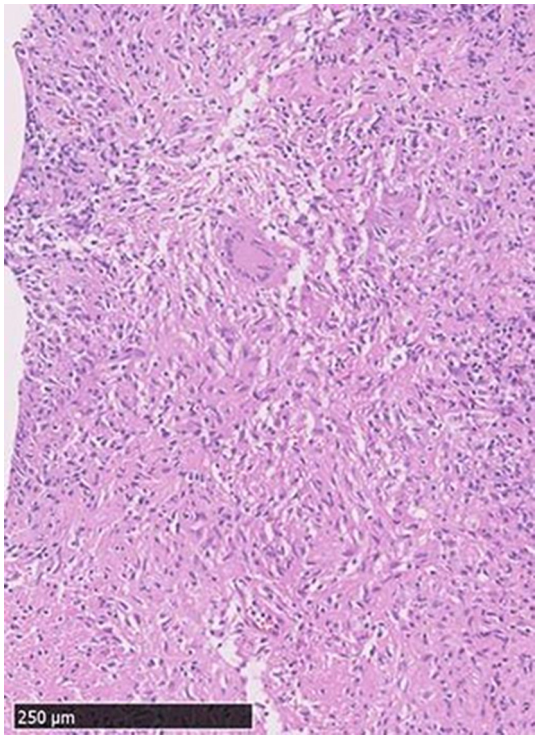

Fig. 2. Percutaneous lung biopsy specimens showed caseous granulomas without atypical cells on hematoxylin and eosin (H&E) staining. Scale bar = 250 μm.

consolidation. To the best of our knowledge, this SUVmax value is the highest value observed on chest CT of the lesions in NTM infection.

Although acid-fast bacillus infections could be suspected according to the evidence of caseous granulomas from percutaneous biopsies specimens, acid-fast bacilli were not detected in the smear of the biopsy specimen or PCR tests. Although tuberculous pleural effusion may occur in up to 30% of patients with tuberculosis [11], the incidence of pleural effusion in NTM infection is relatively low [8]. Combination chemotherapy for tuberculosis in this patient was administered primarily regarding her history of tuberculosis and high levels of ADA in the pleural effusion, which were suitable markers in the diagnosis of tuberculous pleuritis [11–14]. *M. avium* was cultured from the gastric fluid, which is not listed in the diagnostic criteria of NTM infection approved by the American Thoracic Society (ATS)/Infectious Diseases Society of America (IDSA) [1], and we eventually observed *M. avium* in the pleural effusion culture as well. The present case was diagnosed with pulmonary infection and pleurisy due to *M. avium* infection according to the strong laboratory evidence of *M. avium* culture. A previous report showed that a patient with *M. avium* pleuritis had a normal level of ADA in the pleural effusion [15]. Conversely, several cases with NTM infections revealed high ADA concentrations in the pleural effusion [16], such as in our case. Thus, our case reaffirms that ADA concentrations in the pleural effusion of patients with NTM infections could be high.

4. Conclusion

We presented an immunocompetent afebrile patient with *M. avium* infection showing a non-disseminated broad consolidation without other typical sings of NTM infection in chest CT images. Furthermore, *M. avium* infection may reveal a large consolidation with high FDG uptake in chest PET/CT images.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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References

[1] D.E. Griffith, T. Aksamit, B.A. Brown-Elliott, A. Catanzaro, C. Daley, F. Gordin, S.M. Holland, R. Horsburgh, G. Huitt, M.F. Iademarco, M. Iseman, K. Olivier, S. Ruoss, C.F. von Reyn, R.J. Wallace Jr., K. Winthrop, ATS Mycobacterial Diseases Subcommittee, American Thoracic Society, Infectious Disease Society of America, An official ATS/IDSA statement: diagnosis, treatment, and prevention of nontuberculous mycobacterial diseases, Am. J. Respir. Crit. Care Med. 175 (4) (2007) 367–416.

[2] M.T. Henry, L. Inamdar, D. O'Riordain, M. Schweiger, J.P. Watson, Non-tuberculous mycobacteria in non-HIV patients: epidemiology, treatment and response, Eur. Respir. J. 23 (5) (2004) 741–746.

[3] S. Martinez, H.P. McAdams, C.S. Batchu, The many faces of pulmonary non-tuberculous mycobacterial infection, AJR Am. J. Roentgenol. 189 (1) (2007) 177–186.

[4] Y.J. Jeong, K.S. Lee, W.J. Koh, J. Han, T.S. Kim, O.J. Kwon, Nontuberculous mycobacterial pulmonary infection in immunocompetent patients: comparison of thin-section CT and histopathologic findings, Radiology 231 (3) (2004) 880–886.

[5] Y. Demura, T. Tsuchida, D. Uesaka, Y. Umeda, M. Morikawa, S. Ameshima, T. Ishizaki, Y. Fujibayashi, H. Okazawa, Usefulness of 18F-fluorodeoxyglucose positron emission tomography for diagnosing disease activity and monitoring therapeutic response in patients with pulmonary mycobacteriosis, Eur. J. Nucl. Med. Mol. Imaging 36 (4) (2009) 632–639.

[6] K. Kaneko, E. Sadashima, K. Irie, A. Hayashi, S. Masunari, T. Yoshida, J. Omagari, Assessment of FDG retention differences between the FDG-avid benign pulmonary lesion and primary lung cancer using dual-time-point FDG-PET imaging, Ann. Nucl. Med. 27 (4) (2013) 392–399.

[7] Y. Lee, J.W. Song, E.J. Chae, H.J. Lee, C.W. Lee, K.H. Do, J.B. Seo, M.Y. Kim, J.S. Lee, K.S. Song, T.S. Shim, CT findings of pulmonary non-tuberculous mycobacterial infection in non-AIDS immunocompromised patients: a case-controlled comparison with immunocompetent patients, Br. J. Radiol. 86 (1024) (2013) 20120209.

[8] S. Kuroishi, Y. Nakamura, H. Hayakawa, M. Shirai, Y. Nakano, K. Yasuda, T. Suda, H. Nakamura, K. Chida, Mycobacterium avium complex disease: prognostic implication of high-resolution computed tomography findings, Eur. Respir. J. 32 (1) (2008) 147–152.

[9] A.A. El-Solh, J. Nopper, M.R. Abdul-Khoudoud, S.M. Sherif, A.T. Aquilina, B.J. Grant, Clinical and radiographic manifestations of uncommon pulmonary nontuberculous mycobacterial disease in AIDS patients, Chest 114 (1) (1998) 138–145.

[10] R.M. Shah, A.C. Friedman, CT angiogram sign: incidence and significance in lobar consolidations evaluated by contrast-enhanced CT, AJR Am. J. Roentgenol. 170 (3) (1998) 719–721.

[11] J. Ferrer, Pleural tuberculosis, Eur. Respir. J. 10 (4) (1997) 942–947.

[12] J.M. Porcel, Tuberculous pleural effusion, Lung 187 (5) (2009) 263–270.

[13] Q.L. Liang, H.Z. Shi, K. Wang, S.M. Qin, X.J. Qin, Diagnostic accuracy of adenosine deaminase in tuberculous pleurisy: a meta-analysis, Respir. Med. 102 (5) (2008) 744–754.

[14] A. Trajman, M. Pai, K. Dheda, et al., Novel tests for diagnosing tuberculous pleural effusion: what works and what does not? Eur. Respir. J. 31 (2008) 1098–1106.

[15] T. Kakugawa, H. Mukae, S. Kajiki, A. Tanaka, T. Yamayoshi, M. Inoue, H. Ohtani, N. Sakamoto, K. Izumikawa, H. Tasaki, N. Ooe, S. Kohno, Mycobacterium avium pleuritis in a non-immunocompromised patient, Intern Med. 47 (19) (2008) 1727–1731.

[16] T. Sado, Y. Nakamura, H. Kita, Clinical analysis of nontuberculous mycobacterial infection complicated by pleurisy, Kekkaku 89 (12) (2014) 821–824. Japanese.