J Infect Chemother (2011) 17:493–498
DOI 10.1007/s10156-010-0205-y

ORIGINAL ARTICLE

Organizing pneumonia pattern in the follow-up CT of *Legionella*-infected patients

Attiya Haroon · Futoshi Higa · Kenji Hibiya · Shusaku Haranaga · Satomi Yara · Masao Tateyama · Jiro Fujita

Received: 13 September 2010 / Accepted: 15 December 2010 / Published online: 18 January 2011

Abstract The main aim of this study was to describe the appearance of the CT pattern of organizing pneumonia in *Legionella*-infected patients. Serial CT scans obtained from five sporadic cases of *Legionella pneumophila* pneumonia were retrospectively reviewed. The mean time of follow-up was 14 days. Chest CT was analyzed with regard to frequency and appearance of CT patterns of pulmonary abnormalities. Consolidation and ground-glass opacities, with or without an air bronchogram, were the most common abnormalities detected in CT scans during follow-up patients with *L. pneumophila* pneumonia. Two patterns were observed: subpleural and peribronchovascular. The subpleural pattern was seen in four patients and the peribronchovascular pattern in one. Interlobular septal thickening was seen in one patient. Pleural effusion was seen in one patient. The CT pattern of organizing pneumonia, a subpleural pattern, was frequently observed after treatment of *L. pneumophila* pneumonia.

Keywords *Legionella pneumophila* pneumonia · CT · Organizing pneumonia pattern · Subpleural pattern

Introduction

Legionella pneumophila and other species of *Legionella* have been increasingly recognized as causes of both community-acquired and nosocomial pneumonia [1]. Although the prognosis has improved greatly with the appropriate antibiotics, some patients who survive from acute pneumonia develop different pulmonary sequelae, which include pulmonary fibrosis and organizing pneumonia, with or without bronchiolitis obliterans [2–7]. Organizing pneumonia is defined as an inflammatory lung disease that corresponds to the presence of buds of granulation tissue in the lumen of distal airspaces. It has distinctive clinical, radiological and pathological features with many causes and associations [8–10]. *Legionella* infection is a common cause of organizing pneumonia, so proper diagnosis and relevant treatment of the organizing pneumonia requires radiological findings [8].

CT findings of organizing pneumonia, according to previously reported data, are unilateral or bilateral, patchy ground-glass opacities or consolidation, nodules, fibrosis, interlobular septal thickening, and band-like opacities [5, 6, 10–15]. Previously reported CT patterns of organizing pneumonia include subpleural [16, 17], peribronchovascular [18] or perilobular [19] patterns. However, to the best of our knowledge, the CT pattern of *L. pneumophila*-induced organizing pneumonia has not been reported. The main aim of this study was to describe the frequency and appearance of the CT pattern of organizing pneumonia in *L. pneumophila*-infected patients.

Materials and methods

Patient characteristics

This retrospective study was performed at the Hospital, University of the Ryukyus, Okinawa, Japan. Between October 2001 and September 2008, 23 patients were

A. Haroon · F. Higa · K. Hibiya · S. Haranaga · S. Yara · M. Tateyama · J. Fujita (✉)
Department of Infectious, Respiratory, and Digestive Medicine, Control and Prevention of Infectious Diseases (First Department of Internal Medicine), Faculty of Medicine, University of the Ryukyus, 207 Uehara, Nishihara-cho, Okinawa 903-0125, Japan
e-mail: fujita@med.u-ryukyu.ac.jp

Table 1 Characteristics of the patients

Patient no.	Age/sex	Predisposing factors	Temperature (°C)	WBC (1 μl)	Prognosis
1	69/M	Diabetes mellitus	40.0	13,200	Alive
2	51/M	None	39.2	19,800	Alive
3	64/F	Diabetes mellitus	39.4	15,700	Alive
4	52/M	None	39.0	12,000	Alive
5	56/M	None	40.0	10,700	Alive

diagnosed with *L. pneumophila* pneumonia. Serial CT sections were obtained in five patients, and their main clinical characteristics are shown in Table 1. There were four men and one woman aged 50–70 years. Two patients had diabetes mellitus and three did not have any underlying disease or predisposing factor. No patients had previous lung diseases. All five patients presented with complaints of cough, shortness of breath, malaise and aches. A fever of more than 38°C was recorded in all cases. Laboratory data showed leukocytosis (>10,000/μl) and elevated C-reactive protein levels in all five patients. Chest X-ray and CT were performed in all cases.

The diagnosis of *L. pneumophila* pneumonia was based on clinical symptoms, laboratory results, radiological findings and CT imaging results. These findings were consistent with acute pneumonia. The etiological diagnosis of *L. pneumophila* infection was made on the basis of one of the following findings: positive urinary antigens for *L. pneumophila*; isolation of *L. pneumophila*; PCR positive for *L. pneumophila*; a fourfold increase in *L. pneumophila* antibody titers to 128 or more in paired acute and convalescent phase sera. After the administration of appropriate antibiotics and supportive therapy, chest CT was repeated in all patients. The average time of follow-up was 14 days. CT scans were analyzed for the pattern of organizing pneumonia.

Chest CT analysis

The CT scans were viewed at window settings optimized for the lung parenchyma. The CT scans were observed and assessed by two physicians specialized in pulmonary disease (JF, FH). The CT scans were assessed for the presence and distribution of the following features: (1) consolidation and ground-glass opacities; (2) pattern of opacities; (3) distribution of opacities; (4) other findings such as fibrosis, interlobular septal thickening, band-like thickening, air bronchogram and nodules; and (5) involvement of pleura and pleural effusion. These features were observed in CT scans performed in series before and after specific treatment.

On CT scans, airspace consolidation was considered to be present when the vascular margins were obscured. Ground-glass opacity was defined as a hazy increase in attenuation without obscuring the vascular markings. A subpleural pattern was defined if the abnormality was adjacent to the visceral pleura or lay within 1 cm of the pleural surface. A peribronchial pattern was defined if the

Table 2 CT findings and patterns of parenchymal lesions in *L. pneumophila*-infected patients before and after the specific treatment

Case no.	CT findings	Before treatment	After treatment
1	Consolidation	+ (diffuse)	+ (subpleural)
	GGO[a]	+ (diffuse)	+ (subpleural)
	Pleural effusion	+	–
2	Consolidation	+ (diffuse)	+ (subpleural)
	GGO	+ (diffuse)	+ (subpleural)
	Pleural effusion	+	–
3	Consolidation	+ (peribronchovascular)	+ (peribronchovascular)
4	Consolidation	+ (diffuse)	+ (subpleural)
	GGO	+ (diffuse)	+ (subpleural)
	Interlobular septal thickening	+	+
	Pleural effusion	+	+
5	Consolidation	+ (diffuse)	+ (subpleural, peribrochovasucular)
	GGO	+ (diffuse)	+ (subpleural)
	Air bronchogram	+	–
	Pleural effusion	+	–

[a] Ground-glass opacities