


Lung Ultrasound for Initial Diagnosis and Subsequent Monitoring of Aspiration Pneumonia in Elderly in Home Medical Care Setting

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Abstract

The number of aspiration pneumonia cases has increased in recent times. A definitive diagnosis of aspiration pneumonia is difficult in resource-limited settings where radiological equipment is unavailable. We report the initial diagnosis and subsequent monitoring of aspiration pneumonia in a home medical care setting. An 88-year-old Japanese male presented an acute onset of dyspnea, fever, and productive cough. At home, lung ultrasound displayed pleural effusion along with B-lines and subpleural consolidations. Upon admission, tests revealed increased total leucocyte counts with left-shifted neutrophils, elevated C-reactive protein levels, and positive sputum Gram stain. Chest X-ray imaging and computed tomography (CT) showed bibasilar infiltrates and wall thickening in the left S10 bronchi. The patient was diagnosed with aspiration pneumonia and treated with an antibiotic. After a 10-day hospitalization, lung ultrasound showed some remaining B-lines and disappearance of pleural effusion and subpleural consolidation. Chest X-ray image was normal, and CT revealed pleural abnormality and disappearance of bibasilar infiltrates, consistent with the ultrasound findings. Aspiration pneumonia develops with various clinical signs. However, diagnosis using chest X-ray imaging or CT in resource-limited settings is difficult. Ultrasound might allow physicians to make more accurate judgments, particularly while monitoring aspiration pneumonia following initial diagnosis in resource-limited settings.

Keywords

aspiration pneumonia, diagnostic lung imaging, elderly, home medical care, ultrasound

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Introduction

Aspiration pneumonia is a major cause of morbidity and mortality in the elderly across the world. Particularly, the number of aspiration pneumonia cases has been increasing in Japan (Japanese Respiratory Society, 2009; World Health Organization, 2017). Aspiration pneumonia is associated with various clinical signs and symptoms, often presenting a diagnostic dilemma for clinicians; therefore, chest X-ray or computed tomography (CT) scans are the golden standards for the diagnosis of aspiration pneumonia (Japanese Respiratory Society, 2009; Mandell & Niederman, 2019). Therefore, establishing a definitive diagnosis of aspiration pneumonia for patients who are bedridden in a resource-limited setting (e.g., home medical care setting) that is not equipped with any radiological equipment is difficult. In recent years, ultrasound has been widely used for the diagnosis of respiratory diseases (Reissig et al., 2012; Volpicelli, 2013). Portable ultrasound devices have been

shown to be effective in aiding physicians in the evaluation of pulmonary conditions in resource-limited settings (Amatya et al., 2018). However, there has not yet been any clinical research study focused on evaluating the effectiveness of portable ultrasound as an initial diagnosis and subsequent monitoring tool for aspiration pneumonia in a home medical care setting. Herein, we report the case of a patient with aspiration pneumonia, whose condition was initially diagnosed using ultrasound in a home medical care setting and later monitored in a hospital.

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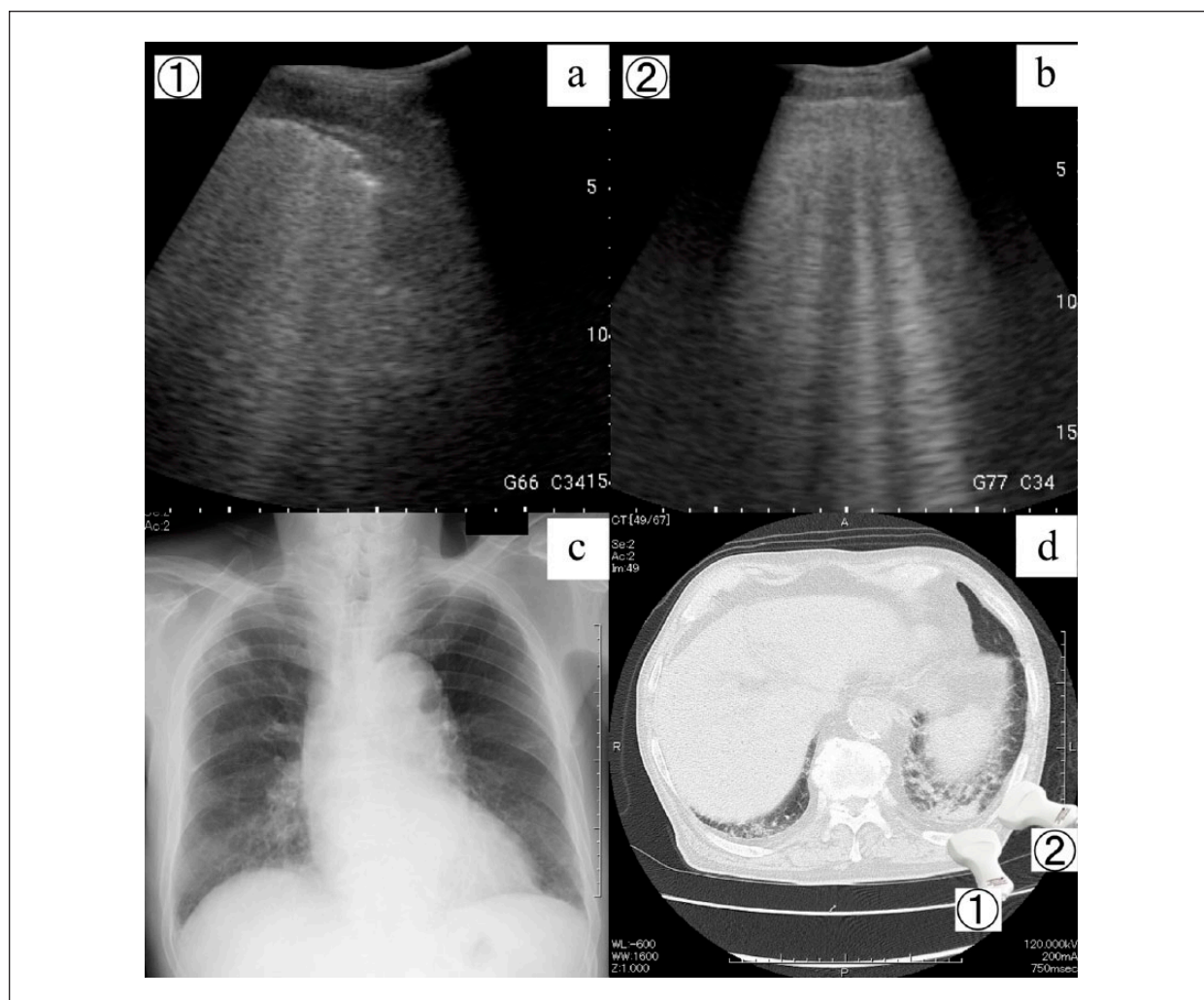


Figure 1. Images obtained at the patient's home and in an emergency department: (a) ultrasound image, obtained at the patient's home, showing lung consolidation with pleural effusion and B-lines (position indicated using ①); (b) ultrasound image, obtained at the patient's home, revealing multiple B-lines (position indicated using ②); (c) chest X-ray, obtained in an emergency department, showing opacity in bibasilar lung infiltrates; and (d) chest CT scan, obtained in an emergency department, showing bibasilar consolidation in the lung base; the left lung shows consolidation along the posterior basal (S10) bronchioles.

Case Report

An 88-year-old man in a wheelchair (Clinical Frailty Scale 7) developed an acute onset of dyspnea, fever, and productive cough after dinner at home. His medical history included Alzheimer's disease, cerebral infarction, hypertension, dyslipidemia, benign prostatic hyperplasia, and insomnia. His regular medication included angiotensin-converting enzyme inhibitors, cilostazol, atorvastatin calcium hydrate, tamsulosin hydrochloride, and zolpidem tartrate. He has been suffering from symptoms of dysphagia and repeated mis-swallowing for 2 years after cerebral infarction.

A general physician visited him at home 5 hr after the onset of the symptoms. Upon examination, the patient was found to be febrile with a temperature of 37.9°C, blood pressure of 118/58 mmHg, pulse of 82 bpm, and respiratory rate of 28/min with an O₂ saturation of 90% in room air. Chest auscultation revealed inspiratory

coarse crackles at the bilateral posterior lower lobe. His cardiovascular examination result was normal. Lung ultrasound (Convex Array probe, 3.5 MHz; body, MIRUCO®, NIPPON SIGMAX Co., Ltd, Tokyo, Japan) examination revealed abnormal findings such as pleural effusion and multiple B-lines (Figure 1a and 1b), which strongly indicated pneumonia. After endotracheal aspiration, some sputum with food residue was aspirated from the respiratory tract. Antibiotics infusion was started (ampicillin-sulbactam [1.5 g IV]) and a blood sample was collected. He was then immediately taken to our emergency department in an ambulance with the physician.

In the emergency department, a blood examination revealed an increased total leucocyte count ($12 \times 10^9/L$) with left-shifted neutrophils ($9.4 \times 10^9/L$) and elevated inflammatory marker levels (C-reactive protein: 11.8 mg/dL). Gram staining of his aspirated sputum with food residue was found to be positive and showed the

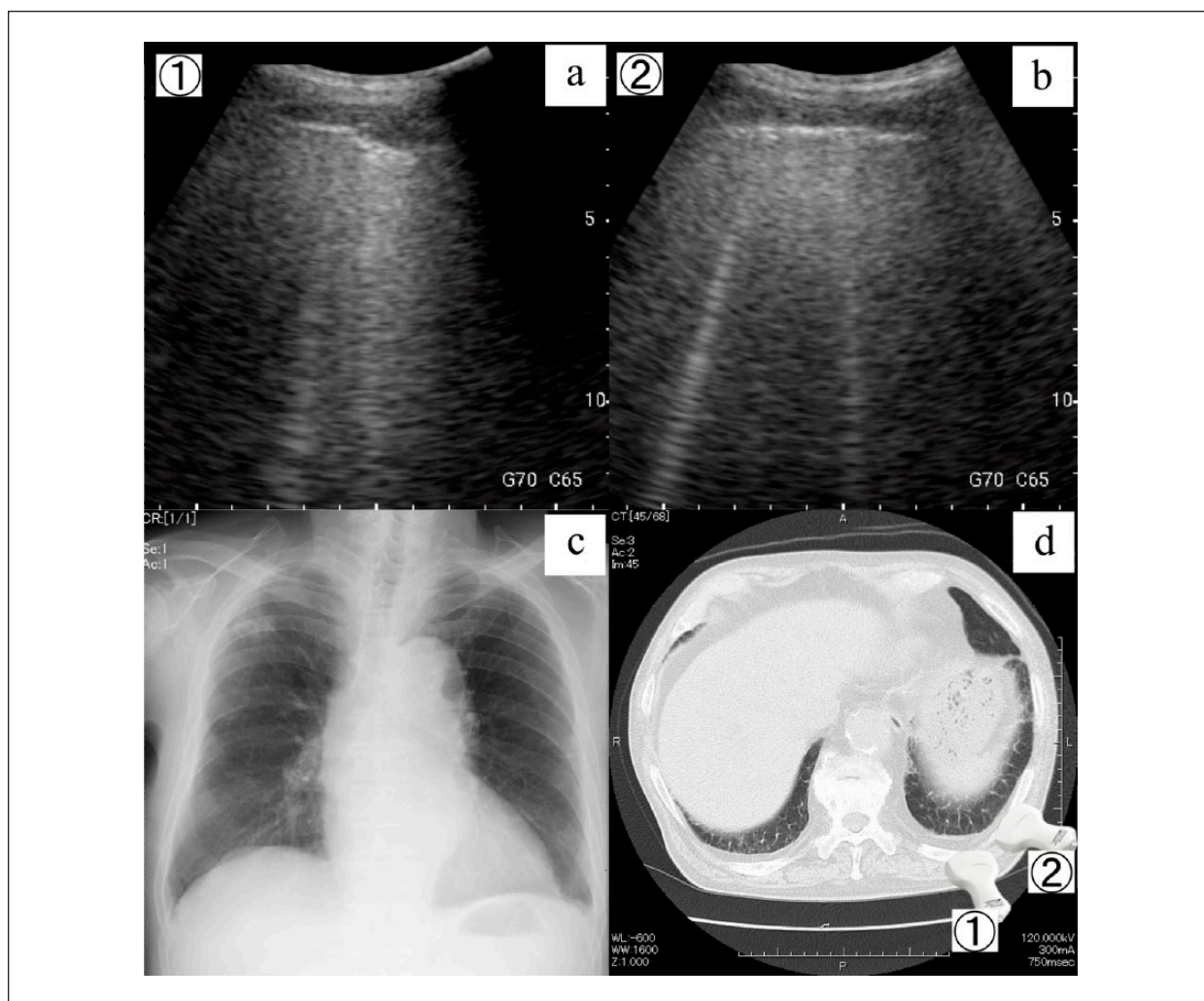


Figure 2. Images obtained in hospital after a 10-day admission: (a) ultrasound image of position ①, showing decreased pleural effusion and lower number of B-lines compared with initial images in Figure 1a; (b) ultrasound image of position ②, showing an almost normal lung with few compact B-lines; (c) chest X-ray, showing disappearance of opacity in bibasilar lung infiltrates; and (d) chest CT scan, showing improvement in bibasilar consolidation in the lung base with decreased pleural effusion in the left lung.

morphological features of anaerobes in large numbers. A chest X-ray (Figure 1c) and a CT scan of the patient’s thorax (Figure 1d) revealed bibasilar infiltrates and wall thickening in the left S10 bronchi. These radiological findings were consistent with the ultrasound results obtained at the patient’s home. The patient was finally diagnosed with aspiration pneumonia.

Upon admission, he was subsequently treated with ampicillin-sulbactam (1.5 g IV) every 6 hr with a normal renal function for 3 days and amoxicillin-clavulanate (375 mg) along with amoxicillin (750 mg) every 8 hr for 4 days. His symptoms gradually disappeared. After 10-day admission, a follow-up examination was conducted by chest auscultation that showed fine inspiratory crackles. Although the lung ultrasound showed the disappearance of pleural effusion and subpleural consolidation, some B-lines still remained (Figure 2a and 2b). His chest X-ray was found to be normal. The CT

scan of the thorax showed disappearance of bibasilar infiltrates, but pleural abnormality was still present, which was consistent with the ultrasound findings (Figure 2c and 2d). After a 14-day admission, he was discharged. There was no subsequent recurrence for 2 months following discharge and with proper oral care and dietary and pharmacologic interventions.

Discussion

First, ultrasound can be an effective tool for initial diagnosis of aspiration pneumonia in situations where a chest X-ray or CT scan cannot be performed. Aspiration pneumonia is a critical health issue in patients receiving long-term care (Cortellaro, Colombo, Coen, & Duca, 2012). Thus, physicians often encounter patients suspected of aspiration pneumonia in resource-limited settings, particularly in a home medical care setting. In

such a scenario, a physician may often have to determine whether the clinical symptoms indicate aspiration pneumonia, based solely on physical examination and without any radiological evaluation (Gruneir et al., 2010). Ultrasound might be a suitable modality to enhance the diagnostic performance of physicians where a chest X-ray or CT scan cannot be performed.

Second, ultrasound might be a useful medical tool for physicians to monitor and manage aspiration pneumonia. Although chest X-ray is a routine tool to diagnose and monitor aspiration pneumonia, it lacks sensitivity and has relatively low accuracy (Ticinesi et al., 2016). The CT scan of the thorax is considered as the golden standard for detecting aspiration pneumonia. Nevertheless, it should not be used as a first-line tool to monitor and manage aspiration pneumonia because of its cost, poor portability, and high radiation dose (Miyashita et al., 2015). Ultrasound could detect most cases of aspiration pneumonia, particularly in elderly patients who are bedridden with frailty, through consolidation found in the middle or lower lobes along with pleural lesions (Reissig et al., 2012). Thus, ultrasound is useful in monitoring and management of aspiration pneumonia.

Third, clinical physicians should use ultrasound to diagnose, monitor, and manage aspiration pneumonia in resource-limited settings. Ultrasound is now considered as the next stethoscope and is being widely implemented by clinicians in different medical settings (Moore & Copel, 2011). Existing evidence supports the effectiveness of ultrasound in providing improved and early diagnoses in a clinical setting (Rooney, 2019). Ultrasound is a highly effective useful tool that allows physicians to evaluate and correlate different findings in case of pulmonary conditions such as aspiration pneumonia and pneumothorax (Amatya et al., 2018). However, aspiration pneumonia shows various image patterns (Ding, Shen, Yang, He, & Zhang, 2011). Although physicians cannot depend solely on ultrasound for diagnosing aspiration pneumonia, ultrasound can be useful for establishing correlations among different findings and health conditions when the physician is aware of the patient's clinical history (DiBardino & Wunderink, 2015).

Finally, we expect ultrasound to reduce the management costs of aspiration pneumonia. Given the increasing economic burden of aspiration pneumonia worldwide, it is essential to reduce the cost of managing this health condition (Hayden & Wrenn, 2009; Wu, Chen, Wang, & Pinelis, 2017). Although some studies have already been conducted to evaluate the economic benefits of ultrasound use in clinical practice, there is no obvious evidence supporting any associated cost reduction (Andersen, Holden, Vela, Rathleff, & Jensen, 2019). Further studies are needed on this aspect.

In conclusion, ultrasound could provide better clinical support for physicians in evaluating aspiration

pneumonia and facilitating more accurate judgment while monitoring in a resource-limited setting, particularly in a home medical care setting.

Informed Consent

Written informed consent was obtained from the patients for their anonymized information to be published in this article.

Declaration of Conflicting Interests

The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: T.K. has a patent for Miruco, which is licensed to trademark in Japan.

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