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Case report

Possibilities of using ultrasound for diagnosis of invasive pulmonary mucormycosis – A case study

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ARTICLE INFO

Article history:

Received 23 May 2016

Received in revised form

6 July 2016

Accepted 10 November 2016

Available online xxx

Keywords:

Invasive pulmonary mucormycosis

Transthoracic ultrasonography

Halo sign

Reversed halo sign

Invasive fungal lung infection

ABSTRACT

Introduction: Mucormycosis is a rare but highly lethal fungal infection, usually affecting immunocompromised patients.

Aim: To present and analyze the diagnostic capabilities of transthoracic ultrasonography in invasive pulmonary mucormycosis.

Case study: We present a case involving a 41-year-old female patient with pneumonia complicated by multisystem organ failure, who was diagnosed with invasive pulmonary mucormycosis.

Results and discussion: Transthoracic ultrasonography (TUS) revealed a consolidation area of heterogeneous echostructure with an abnormal air bronchogram, possibly suggestive of an invasive pulmonary fungal disorder. The presence of lesions observed with TUS was confirmed by computed tomography (CT). The final diagnosis of mucormycosis was possible after *Mucor* species fungi were detected in bronchoalveolar lavage culture.

Conclusions: (1) TUS is a widely available and inexpensive diagnostic method that is characterized by the absence of adverse effects, and its applicability in the diagnosis of pulmonary disorders other than invasive fungal infections is well documented. (2) Ultrasonographic analysis of lesions facilitates differentiation between bacterial and fungal pneumonia, and the high sensitivity and specificity of the procedure compared to CT scans as a reference method supports the reliability of ultrasound scans in the diagnosis of invasive pulmonary aspergillosis (IPA). (3) The use of TUS in the diagnosis of invasive pulmonary mucormycosis appears warranted, particularly in cases when it is impossible to obtain a proven diagnosis. (4) Ultrasonographic diagnosis of invasive lung disorders, including mucormycosis, requires further studies.

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<http://dx.doi.org/10.1016/j.poamed.2016.11.004>

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1. Introduction

Mucormycosis is a rare but highly lethal fungal infection, usually affecting immunocompromised patients. Early diagnosis of the disease, combined with aggressive treatment, is crucial for patient survival.

2. Aim

We present a case of invasive pulmonary mucormycosis complicated by multisystem organ failure, and analyze the capabilities of transthoracic ultrasonography in the diagnosis of mucormycosis.

3. Case study

A 41-year-old female patient with pneumonia complicated by multisystem organ failure was admitted to our Intensive Care Unit (ICU) for further diagnosis and treatment. Her history included approximately a month of a persistent cough with hemoptysis. The patient was previously hospitalized at the Department of Tuberculosis and Lung Diseases. Due to dyspnea, she was transferred first to the Internal Medicine Department, and later to one of the municipal ICUs, where she was intubated and provided assisted respiration due to exacerbating respiratory failure. Diagnostic examinations revealed features of multiorgan failure, and bleeding into the retroperitoneal space with perforation into the peritoneal cavity. Two approaches to laparotomic surgery failed to identify the cause of the bleed. Corticosteroids were introduced into the treatment plan.

Upon admission to our ICU, the patient was in a severe condition; she was under the influence of analgesics and sedatives, yet responsive to voice and capable of performing simple orders. The patient was respiratorily unstable and required ventilatory assistance via a tracheostomy tube. Chest mobility was normal and symmetrical, and respiratory sounds revealed isolated rhonchi. The patient presented with sinus cardiac rhythm with her heart rate maintained within peripheral arteries. Capillary refill time was within normal limits. Arterial pressure (invasive method) was 130/80 mmHg. The abdomen was raised beyond the level of the chest and was swollen, with audible peristalsis. Abdominal integuments featured a post-laparotomy wound fitted with a dressing. In addition, physical examination revealed massive generalized edema, numerous ecchymoses on the skin of the extremities and the trunk, as well as increased muscle tone and increased lower limb tendon reflexes. The urinary bladder was catheterized, revealing clear urine. The patient's own diuresis was preserved. Her body temperature was 35.5°C. The patient interview revealed that she was a bakery worker and had no other known disorders to date.

Upon admission to the ICU, the patient was connected to a respiratory device, and samples were collected for a panel of laboratory and microbiological analyses. Anticoagulation prophylaxis and hemodynamic monitoring of gastrointestinal bleeding were initiated. In addition, due to the massive edema

and features of water intoxication, hemodialytic treatment was initiated under hemodynamic monitoring. Empirical antibiotic treatment was enhanced by the addition of colistin, ampicillin/sulbactam, linezolid, levofloxacin, and caspofungin. During her hospitalization, the patient had consultations with a nephrologist, a neurologist, and a pneumologist. Microbial and laboratory diagnostic tests were extended to include screening for hepatitis B and C virus, toxoplasmosis, borreliosis, tick-borne meningoencephalitis, and Epstein-Barr virus. A nasopharyngeal smear was collected for genomic screening for viruses, including type A and B influenza, type A and B respiratory syncytial viruses (RSVs), coronaviruses, adenoviruses, metapneumoviruses, rhinoviruses, parainfluenza viruses (type 1, 2, and 3). The smear was also used for genomic screening for bacteria, including *Chlamydia pneumoniae*, *Bordetella pertussis*, *Legionella pneumophila*, *Mycoplasma pneumoniae*, *Haemophilus influenzae*, and *Streptococcus pneumoniae*. Enzyme immunoassay was performed to determine the levels of cANCA, pANCA, anti-GBM, and anti-Le antibodies, as well as complement components C3 and C4. All results were negative. Bronchoscopy was performed, including collection of a bronchial biopsate. A specimen of nasal septum was collected for histopathological examination, and bronchoalveolar lavage samples were collected for tuberculosis screening. The results ruled out suspected systemic diseases and tuberculosis. Specimens for microbial analysis of fluids and secretions were collected several times, yet all results were negative.

4. Results

On the 3rd day of hospitalization, transthoracic ultrasonography (TUS) of the lungs revealed a subpleural consolidation area approximately 10 × 30 mm. The area was characterized by a heterogeneous echostructure and echogenicity similar to that of the liver, with an irregular outline and a fragmentarily visible dynamic air bronchogram. The pleural line above the consolidation area was invisible. In the rest of the lung, the pleural line was visible and the pleural sliding sign was preserved. Color-coded Doppler scan revealed no flow within the vessels of the aforementioned consolidation area. Interstitial-alveolar opacities were also revealed bilaterally in the vicinity of the consolidation area. Invasive fungal lung infection was concluded from the ultrasonographic presentation (Fig. 1). On the 5th day of hospitalization, a CT scan of the chest, abdomen, and pelvis was performed with and without contrast administration. Lesions visualized in TUS were confirmed in a thoracic CT scan (Fig. 2). CT of the abdomen and pelvis minor revealed a hematoma within the right pararenal and retroperitoneal spaces, running along the right iliolumbar muscle down into the pelvis minor. Due to the poor overall condition of the patient and the high risk of bleeding, biopsy of the lesion was abandoned. Broad-spectrum antibiotic therapy was continued, including administration of antifungal medications (caspofungin). Despite treatment, no improvement was observed in the patient's condition. The final diagnosis of mucormycosis was possible only after *Mucor* species fungi were detected in bronchoalveolar lavage culture. Amphotericin B was added to the therapy. The treatment led to gradual improvement of the overall condition of the patient,

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