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Case Report

Fatal *Clostridium perfringens* septicemia suggested by postmortem computed tomography: A medico-legal autopsy case report

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ABSTRACT

We report a fatal case of suspected *Clostridium (Cl.) perfringens* septicemia in a previously healthy woman in her eighties. At first, she presented at the hospital complaining of upper abdominal discomfort and vomiting, and was discharged the next day after ruling out any fatal conditions. However, her condition deteriorated approximately 10 h after discharge and she died shortly after.

The postmortem computed tomography (PMCT) performed 29 h postmortem revealed an excessive systemic gas accumulation compared with the postmortem external appearance and time elapsed since her death, which suggested the presence of a gas-forming infection. Histopathological examination showed diffuse proliferation of Gram-positive bacilli in almost all the organ tissues, especially in blood vessels. Along with these findings, hyperthermia 3 h postmortem, and severe anemia and thrombocytopenia without an obvious site of hemorrhage suggested hemolysis due to *Cl. perfringens* septicemia. These findings suggested the diagnosis before performing the conventional autopsy. To the best of our knowledge, this is the first case report to describe PMCT findings of gas-forming infection and septicemia in contrast with the external appearance and histopathological findings in a medico-legal autopsy setting.

1. Introduction

Cl. perfringens is an anaerobic Gram-positive rod, commonly found in soil as well as in the human gastrointestinal, biliary, and female genital tracts. Clinical presentations of its infection exhibit various forms as food poisoning, necrotizing fasciitis, gas gangrene, and septicemia with massive hemolysis. Gas gangrene and septicemia are the most fulminant and lethal presentations of clostridial infections. *Clostridium (Cl.) perfringens* is the most commonly isolated organism from patients with gas gangrene and septicemia [1–6], and other *Clostridium* species reported as causative organisms were *Cl. septicum* [1,4–6], *Cl. sordelli* [3,4], and *Cl. novyi* [1,4]. The effects of exotoxin (alpha-toxin) such as shock and acute massive hemolysis accelerate the course of the infection, thereby worsening patient prognosis. The clinical course of clostridial gas gangrene and septicemia is fulminant. Moreover, patients do not usually show specific or severe symptoms at onset. They usually die shortly after the admission or discharge from the hospital, often before a definitive diagnosis can be established [7–11]. A considerable number of patients might not even seek medical attention. In Forensic Pathology practice, these cases of sudden or unexpected death are sometimes managed as medical malpractice cases. In those situations, it is possible that the massive and accelerated putrefaction might lead to incorrect labeling of the changes as simple postmortem changes or cause error of the estimation of the time elapsed after death.

Postmortem CT (PMCT) is widely practiced today, and one of its advantages compared with conventional autopsy is the detection of unusual gas collections inside the body (e.g., pneumothorax, pneumoperitoneum, and intravascular gas) [12–15], and the state of cadaveric alteration can be estimated by quantification of the PMCT gas presentation in the body [16]. Thus, it is expected that

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PMCT has diagnostic value for the identification of gas gangrene as well. However, clear differentiation between gangrene-produced gas and postmortem putrefaction gas is difficult because, in both instances, gases are produced endogenously and have almost the same distribution patterns. Analysis of cadaveric gases sampled using PMCT guidance might provide additional information [17]; however, it is also difficult to discriminate these two because *Clostridia* sp. is one of the causative agents of usual gaseous alterations postmortem. There are few autopsy-based postmortem studies of fatal clostridial gas gangrene and septicemia, particularly in medico-legal autopsy cases [7,18], and the PMCT features of gas gangrene that may be useful to guide the diagnosis have not been thoroughly described in the medical literature so far.

We report a medico-legal autopsy case of suspected *Cl. perfringens* septicemia, in which the PMCT finding of massive gas formation was useful to establish the diagnosis. To the best of our knowledge, this is the first case report describing the PMCT findings of typical septicemia with systemic gas formation in contrast with the external appearance and histopathological findings.

2. Case history

2.1. Clinical course

A previously healthy woman in her eighties visited a hospital at 2:30 p.m., complaining of chest and upper abdominal discomfort associated with vomiting. Based on the physical examination and electrocardiography findings, myocardial infarction (MI) was suspected initially. She was transferred and admitted to a tertiary care hospital, and coronary angiography performed at 5:30 p.m. ruled out the diagnosis of MI. Laboratory tests on admission showed no special abnormalities, except for a mild elevation of the leukocyte count (11,420/μL). She was hospitalized and underwent fluid therapy that day. On the following day, she underwent upper gastrointestinal endoscopy and chest CT, without any remarkable abnormalities. Since the patient's symptoms had improved, she was discharged at 1:00 p.m. that day. The only abnormal laboratory result just prior to her discharge was a slight elevation of the C-reactive protein (CRP) level (0.23 mg/mL), whereas the leukocyte count had normalized (7200/μL). At 10:45 p.m., she complained of back pain and physical weariness to her family at home, and her condition deteriorated rapidly within the next several hours. Her family called for an ambulance because her breathing was abnormal. When she arrived at the emergency department at approximately 3:00 a.m. the next day, she presented cardiopulmonary arrest. Despite standard resuscitation attempt, including cardiac massage, fluid resuscitation, epinephrine administration, and mechanical ventilation, the patient died shortly after (4:11 a.m.). Laboratory tests at that time showed severe anemia (hemoglobin 5.8 mg/mL), thrombocytopenia, coagulation disorder, elevated liver enzymes, indirect-dominant bilirubin (Bil) elevation (total Bil 2.3 mg/dL, direct Bil 0.3 mg/dL), hyperkalemia, and a mildly elevated CRP level (2.3 mg/L). At the time of death, the definitive diagnosis had not been established clinically. During the postmortem examination by police officials, the rectal body temperature at 7:40 a.m. (about 3 h after death) was 38.8 °C, whereas the environmental temperature was 18.8 °C, which suggested an extremely elevated body temperature when she died.

2.2. Radiological examination

After postmortem examination by police officials, the cadaver was preserved cryogenically in a coffin cooled with dry ice at the hospital morgue for approximately 14 h. Then, it was refrigerated at 3 °C for 12 h. Thus, the whole-body PMCT was performed 29 h after the death certification. A 16 multidetector-row CT (ECLOS, Hitachi Medical Corporation, Tokyo, Japan) scan was performed at the following protocol and parameters: collimation 1.25 mm, tube voltage 120 kV, tube current 200 mA, and rotation time 1 r/s. The patient was scanned from the head to the lower extremities in the supine position. Contrast medium was not administered.

One board-certified radiologist with experience in forensic imaging and one board-certified emergency physician with 3 years of experience in forensic medicine and forensic imaging interpreted and analyzed the acquired CT data on a workstation (Synapse Vincent, Fujifilm Medical, Tokyo, Japan). The images were processed on the workstation to obtain two-dimensional transverse, coronal, and sagittal data sets. The reconstructed images were generated using a window width of 1500 Hounsfield Units (HU) and a window level of −600 HU. The PMCT images showed remarkable systemic gas densities (Fig. 1a). Gases were distributed extensively in the subcutaneous pectoral tissues and thoracic cavity (Fig. 1b), and blood vessels and solid organ parenchyma in the abdominal cavity. The small granular parenchymal gas collections presented as diffuse alveolar- and sponge-like gas patterns in the internal hepatic structure (Fig. 1c, d).

2.3. External examination and conventional autopsy

The autopsy was performed by a forensic pathologist with 20 years of experience, immediately following the PMCT. The cadaver had systemic cutaneous emphysema and red-to-purplish marbling on the torso and upper extremities, which is usually observed after a longer postmortem period. However, other advanced putrefactive changes of the external surface, such as greenish discoloring of abdominal wall caused by hydrogen sulfate produced postmortem or skin blisters, were not yet observed (Fig. 2). Intra-abdominal examination revealed more marked necrotic changes in the upper abdominal organs (Fig. 3a) than in the lower abdominal organs, including the bowel. A cross-section of the liver presented a spongy appearance (Fig. 3b), and there were several gallstones in the distended gallbladder and common bile duct (Fig. 3c). No hemorrhage or hematoma was observed.

2.4. Histology and microbial cultivation

Tissues were sampled according to our routine procedure during the autopsy from the heart, lungs, liver, spleen, gallbladder, bile duct, kidney, adrenal glands, pancreas, thyroid gland, and femoral artery. The histologic examination of all tissues was performed by the same forensic pathologist who performed the autopsy and one forensic pathologist with 3 years of experience. Additionally, both were advised by a clinical pathologist with 20 years of experience. All sampled tissues were stained with hematoxylin and eosin. Additionally, Gram stain was performed on myocardial and liver tissue. The microscopic examination revealed proliferation of Gram-positive bacilli in almost all tissue samples. In tissue form the liver (Fig. 4a) and adrenal gland (Fig. 4b), there was a mild neutrophil infiltration along with the bacilli. Diffuse accumulation of the same bacilli was observed in tissue of various organs, such as the myocardium, connective tissue around the bile duct, and solid organs including the pancreas, kidneys, and spleen. Intravascular bacterial proliferation was observed in some organs (Fig. 4c). Although there was no inflammatory cell infiltration in the myocardium (Fig. 4d), proliferation of similar bacilli were observed at the site of focal necrosis. Lungs were edematous; however, there was no pathological finding suggesting pneumonia, such as massive bacterial proliferation or inflammatory reaction in the alveoli. The microbial cultivation test was outsourced to the company