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The Ultrasound Findings in a Lethal Case of Pulmonary Embolism

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Abstract: A 49-year-old woman presented with palpitations. She had a uterine myoma but she had not received any treatment for it. One day before she arrived at our hospital, she visited a local clinic. The physician there could not detect any significant abnormalities. The next day, she experienced palpitations and shortness of breath on standing after lunch and called an ambulance. When the emergency medical technician checked her, she complained of dyspnea with shocked vital signs. After accommodation in the ambulance, she entered cardiac arrest with pulseless electrical activity. Upon arrival, she remained in a state of cardiopulmonary arrest. During cardiopulmonary resuscitation, she underwent a Rapid Ultrasound in a SHock (RUSH) examination, and a D-shaped LV with a snowstorm pattern with a dilated inferior vena cava and massive uterine myoma were observed. Postmortem plain CT revealed no other remarkable findings related to her death. Her D-dimer level was 16.7 μg/ml. She was diagnosed with a pulmonary embolism.The inferior vena cava and/or the iliac vein by the massive uterine myoma was suspected to have been the cause of the embolism. Our findings in the present case suggest that using ultrasonography during cardiopulmonary arrest is indeed useful for detecting the cause of cardiac arrest.
Keywords: ultrasound; pulmonary embolism; snow storm pattern.

INTRODUCTION

The gold standard for the diagnosis of a pulmonary embolism (PE) is the presence of an intraluminal filling defect due to the embolism on enhanced computed tomography (CT) [1]. However, transferring patients with severe unstable circulation induced by a PE to the CT room can be difficult. Conducting ultrasonography at the patient's bedside may therefore allow for the safe, quick, real-time diagnosis of a PE. The timely diagnosis of a PE is crucial, as prompt, appropriate management can decrease the risk of mortality [2, 3]. The major representative findings for a PE on an ultrasound are a right ventricular dilatation/dysfunction, marked tricuspid regurgitation, and small left ventricle (LV) cavity size, called a "D-shaped LV" [4]. We herein report a case of a PE diagnosed via an ultrasound study with elevated D-dimer levels.

CASE PRESENTATION

A 49-year-old woman presented with palpitations. She had a uterine myoma but she had not received any treatment for it. One day before she arrived at our hospital, she visited a local clinic. The physician there could not detect any significant abnormalities through the standard medical examinations, so she underwent Holter electrocardiography to detect arrhythmia. The next day, she experienced palpitations and shortness of breath on standing after lunch and called an ambulance. When the emergency medical technician checked her, she complained of dyspnea with shocked vital signs (blood pressure 70/50 mmHg, pulse rate 120 beats per minute, SPO_2 89% under room air), and she was administered high-flow oxygen. After accommodation in the ambulance, her heart rate became bradycardiac, and she entered cardiac arrest with pulseless electrical activity.

Upon arrival, she remained in a state of cardiopulmonary arrest with nonreactive dilated pupils, and her initial rhythm was asystole. She underwent immediate tracheal intubation and mechanical ventilation, and a venous route was secured and adrenaline administered. The results of a venous gas analysis were pH 6.884, PCO_2 62.2 mmHg, PO_2 25.9 mmHg, HCO_3^- 11.1 mmol/l, and base excess -20.6 mmol/l. During cardiopulmonary resuscitation, she underwent a Rapid Ultrasound in a SHock (RUSH) examination [5], and a D-shaped LV with a snowstorm pattern with a dilated inferior vena cava and massive uterine myoma were observed (Figure 1, 2). The femoral veins were negative for thrombus.

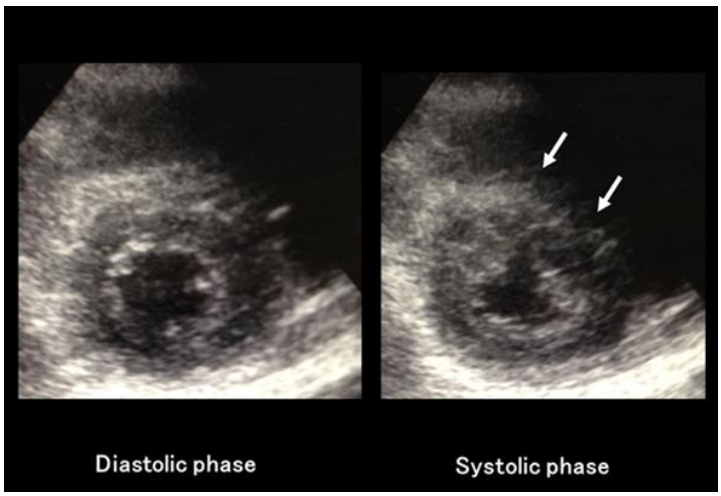

Fig-1: The ventricle findings on a Rapid Ultrasound in SHock (RUSH) examination, The RUSH findings showed a D-shaped left ventricle (arrow)

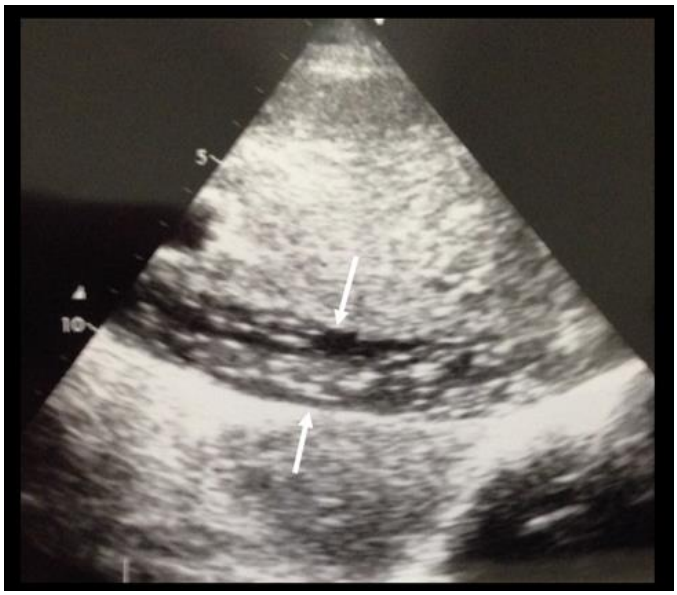

Fig-2: The vena cava findings on a Rapid Ultrasound in a SHock (RUSH) examination, The RUSH findings showed snowstorm pattern (see the arrows) in the dilated inferior vena cava

After the administration of 4 mg of adrenaline in total, she regained spontaneous circulation. Her electrocardiogram revealed a right bundle branch block. She entered cardiac arrest again, though, and died 30 minutes after arrival. Postmortem plain CT revealed a dilated right atrium and ventricle with massive uterine myoma (Figure 3). There were no other remarkable findings related to her death. Her D-dimer level was 16.7 μg/ml. She was diagnosed with a PE based on the complaint of palpitations and dyspnea, the D-shaped LV with a snowstorm pattern on ultrasonography, the elevated D-dimer level, and the lack of any other cause of death on CT. We did not obtain permission from her family to perform an autopsy, but the compression of the inferior vena cava and/or the iliac vein by the massive uterine myoma was suspected to have been the cause of the embolism.

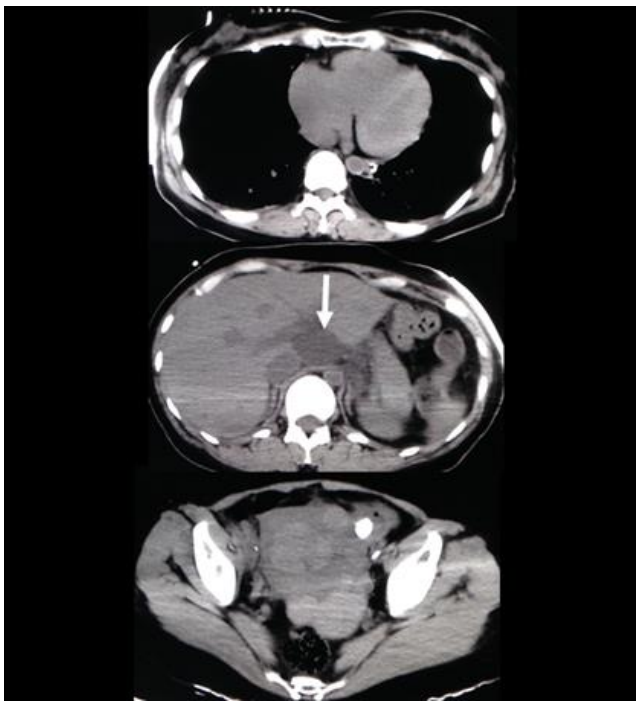

Fig-3: Postmortem computed tomography (CT) images, Postmortem plain CT revealed a dilated right atrium, ventricle, and inferior vena cava (arrow) with massive uterine myoma

DISCUSSION

Previous studies have reported conducting an ultrasound during cardiopulmonary resuscitation via the chest wall or esophagus [6, 7]. Ultrasound studies have proven useful for detecting the cause of cardiac arrest, such as cardiac tamponade, flap or thickness of the aortic wall due to dissection, a D-shaped LV with loss of respiratory movement on dilated vena cava and/or thrombus in the right cardiac system due to a PE, the loss of sliding signs of the pleura and/or a bar code sign due to tension pneumothorax, and the flattening of the inferior vena cave due to hypovolemia, including massive hemorrhaging, massive fluid in thorax and/or abdomen due to hemorrhaging, infection, or a malignant tumor. An ultrasound study can also suggest acute cardiac infarction based on the findings of asymmetrical motion of the cardiac wall, if the motion is observed. The findings of bilateral atrophic kidney suggest chronic renal failure, and an irregular liver surface with multiple nodules and enlarged spleen also suggest liver cirrhosis.

The guidelines for cardiopulmonary arrest do not address the use of ultrasound during resuscitation [8]; however, our findings in the present case suggest that using ultrasonography during cardiopulmonary arrest is indeed useful for detecting the cause of cardiac arrest. While this patient unfortunately died without any specific treatment, thrombolysis during cardio-pulmonary resuscitation may result in favorable outcomes after obtaining a diagnosis of PE during cardiopulmonary arrest [9].

Ultrasonography in the present patient revealed a snowstorm pattern in the inferior vena cava, a finding which is characteristic of gas embolisms, such as with barotrauma, iatrogenisis, or decompression sickness [10,11]. Snowstorm patterns have also been reported during orthopedic operations, where they typically indicate a fat embolism [12]. However, the present patient had not been diving, received any orthopedic operation, or shown pneumothorax on CT or the ultrasound study. As such, the likelihood of a gas or fat embolism was low. We believe that the minute high echoic points may have been indicative of minute thrombi. However, it is interesting to note that we detected this finding in a patient in a state of cardiac failure and shock. Accordingly, further microscopic hematological studies and/or biochemical studies of the blood will be required to clarify the cause of the snowstorm pattern.

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