Intravascular gas in multiple organs detected by postmortem computed tomography: effect of prolonged cardiopulmonary resuscitation on organ damage in patients with cardiopulmonary arrest

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Abstract A 76-year-old woman was found in cardiopulmonary arrest with her head submerged in water in a bathtub. Despite cardiopulmonary resuscitation (CPR) for over 1 h by professional emergency technicians and medical doctors, the patient died. Postmortem computed tomography revealed not only pulmonary edema associated with drowning but also the presence of intravascular gas in the pulmonary artery, liver, kidneys, heart (right ventricle), and brain. It was speculated that intravascular gas was generated and spread to multiple organs during CPR procedures via the alimentary tract and lungs, which had been damaged by ischemia after cardiopulmonary arrest. Prolonged CPR procedures may involve the risk of additional organ damage and systemic air emboli.

Key words Prolonged cardiopulmonary resuscitation · Autopsy imaging · Postmortem computed tomography · Hepatic portal venous gas · Gas in cadaver

Introduction The new techniques of autopsy imaging (Ai; in Japan)1–3 and virtual autopsy (Virtopsy; in Europe and the United States)4,5 integrate autopsy with diagnostic imaging methods such as computed tomography (CT)2–8 or magnetic resonance imaging (MRI)1,4,6,9 and have recently gained widespread acceptance worldwide. In the face of increasing needs to clarify the cause of death and a worldwide decline in the number of autopsies owing to refusal of consent for surgical autopsy by families, autopsy imaging has gained popularity because of its advanced diagnostic capabilities, easy handling, and cost-effectiveness.1,6,7,9 Because postmortem imaging reveals the cause of death to a certain degree, it has been proposed as an alternative to autopsy or as a procedure that can be performed in combination with autopsy.1,4,6,7,9 Characteristic findings from postmortem images have been documented, such as hypostasis, the existence of intravascular gas in the liver, air bubbles underneath the right ventricular wall, and dilatation of the alimentary tract by air retention.2,3,8 Herein, we present a case of drowning in which postmortem CT after prolonged cardiopulmonary resuscitation (CPR) revealed intravascular gas in multiple organs. We discuss the possible mechanism of such systemic gas generation and its association with CPR.

Case report A 76-year-old Japanese woman was found with her head submerged in water in a bathtub. Approximately 4 h before the incident, she was reported to be normal, with
no medical complaints. When emergency technicians reached the patient, she was in cardiopulmonary arrest. They immediately started performing CPR in accordance with a regional protocol based on the 2005 American Heart Association Guidelines for CPR and emergency cardiovascular care; that is, they performed chest compression, artificial respiration with bag-mask ventilation following endotracheal intubation, and peripheral intravenous catheterization following which 1 mg of epinephrine was administered. While continuously performing CPR, the patient was transported to our hospital in an ambulance, which took approximately 39 min. Although CPR was performed for an additional 20 min after arrival at the hospital, the patient did not respond and was declared dead. After a careful investigation of the site where she was found lying and subsequent cadaveric examination, the police ruled out death due to accident or criminal cause. The corpse exhibited livor mortis and rigor mortis, but any other early signs of putrefaction such as dark green discoloration in the lower abdomen were not detected. Because the cause of death remained unclear and the family did not consent to autopsy, CT was performed within 5.5 h of death.

Examination of the thorax revealed diffuse ground-glass opacity and interlobular septal thickening in the lungs, as is observed with pulmonary edema or acute respiratory distress syndrome (Fig. 1). In addition, intravascular gas was detected in the pulmonary artery (Fig. 2) and underneath the right ventricular anterior wall (Fig. 3). Marked calcification along the aortic wall and coronary arteries (Fig. 4) was noted. In the abdominal cavity, intravascular gas was widespread in the liver (Fig. 5) and kidneys (Fig. 6), and the gastrointestinal tract was markedly dilated (Figs. 5, 6). CT of the head also revealed multiple intravascular gas shadows in the brain (Fig. 7).