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Case Report

Fulminant infectious endocarditis caused by *Staphylococcus aureus* with pseudoaneurysms in the superior mesenteric, hepatic, and popliteal arteries: a case report ☆

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ABSTRACT

Staphylococcus aureus infectious endocarditis has a high mortality, major causes of death being cardiac failure, systemic embolism, and sepsis. Pseudoaneurysms, a rare complication of this infection, are not invariably fatal with appropriate treatment. A previously healthy 32-year-old man was found to have multiple cerebral infarctions, and infectious endocarditis with mitral valve vegetation was diagnosed by echocardiography. Because methicillin-resistant *Staphylococcus aureus* (MRSA) was identified from blood cultures, vancomycin was administered. Massive intracerebral hemorrhage in the left temporo-occipital lobe occurred in the patient on the 3rd day after admission, and the hematoma was completely removed surgically. Another hemorrhage was identified in the right occipital region on the 7th hospital day, which led the patient deep coma. Blood cultures on the 10th day were negative for MRSA; however, imaging studies revealed pseudoaneurysms in the superior mesenteric, hepatic, and left popliteal arteries 3 weeks after admission. No surgical indication was applied to these pseudoaneurysms because the patient remained comatose. On the 78th

Abbreviations: MRSA, Methicillin-resistant Staphylococcus aureus; MRA, Magnetic resonance image; DWI, Diffusion-weighted image; FLAIR, Fluid attenuated inversion recovery; CT, computed tomography; 3D-CTA, 3 dimentional-CT angiography; HE, Hematoxilin-Eosin; GCS, Glasgow coma scale.

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day after admission, the patient's blood pressure suddenly dropped and he died. Autopsy demonstrated massive bleeding in the abdominal cavity caused by rupture of the superior mesenteric artery pseudoaneurysm. Our patient's clinical course was fulminant, his endocarditis being complicated by cerebral infarctions, intracranial hemorrhages, and multiple pseudoaneurysms within 3 weeks of admission. In retrospect, he may have survived if emergency resection of the mitral valve vegetation had been performed on the first or second day of admission; however, the in-hospital mortality rate after such surgery is high.

Introduction

Infectious endocarditis has a high mortality rate, the in-hospital mortality rate reportedly being 1-5%22% [1–3]. *Staphylococcus aureus* is the commonest causative bacterial pathogen and has the highest mortality rate [4]. The major causes of death include heart failure, embolic events, and septic complications. However, *S. aureus* rarely causes pseudoaneurysms that contribute to sudden death by rupturing.

Case presentation

A previously healthy 32-year-old man was admitted to our hospital because of sudden onset of mild motor weakness in the right limbs, dysarthria, and left hemianopia. He had been experiencing general fatigue and high fever (>38.0°C) for 3 days, for which he had been taking non-steroidal anti-inflammatory drugs. On admission, blood tests showed a white blood cell count of 7400/μL (normal range: 3300-8600), hemoglobin 13.8 g/dL (13.7-16.8), platelets 11.7 $\times$ 10^4/μL (15.8-34.8), C-reactive protein 7.93 mg/dL (≤0.14), fibrinogen degradation products 7.2 μg/mL (≤5.0), D-dimer 3.1 μg/mL (≤1.0), prothrombin time 73.5% (80-100), prothrombin time-international normalized ratio 1.19, activated partial thromboplastin time 31.6 seconds (24.0-39.0), fibrinogen 616 mg/dL (170-410), and COVID-19 negative. Diffusion-weighted and fluid attenuated inversion recovery magnetic resonance imaging showed multiple acute cerebral infarctions in the left pons, right thalamus, internal capsule, right occipital lobe, and occipitoparietal subcortex bilaterally (Fig. 1A). T2* images demonstrated many microbleeds in the infarcted areas (Fig. 1A; white arrows). Infectious endocarditis was diagnosed by echocardiography, which showed fluttering 0.83-cm vegetation in the left ventricle (Fig. 1B). Methicillin-resistant *S. aureus* (MRSA) was identified in blood cultures taken on admission, prompting commencement of vancomycin. On the 3rd day of admission, the patient's level of consciousness deteriorated suddenly (Glasgow Coma Score [GCS] 5: E1V1M3), and computed tomography (CT) scanning showed a massive intracranial hemorrhage in the left occipitoparietal lobe with a midline shift (Fig. 2A-a). Emergency removal of the hematoma and external decompression were performed (Fig. 2A-b) and the patient's level of consciousness improved slightly (GCS 9: E3V1M5). Unfortunately, an-

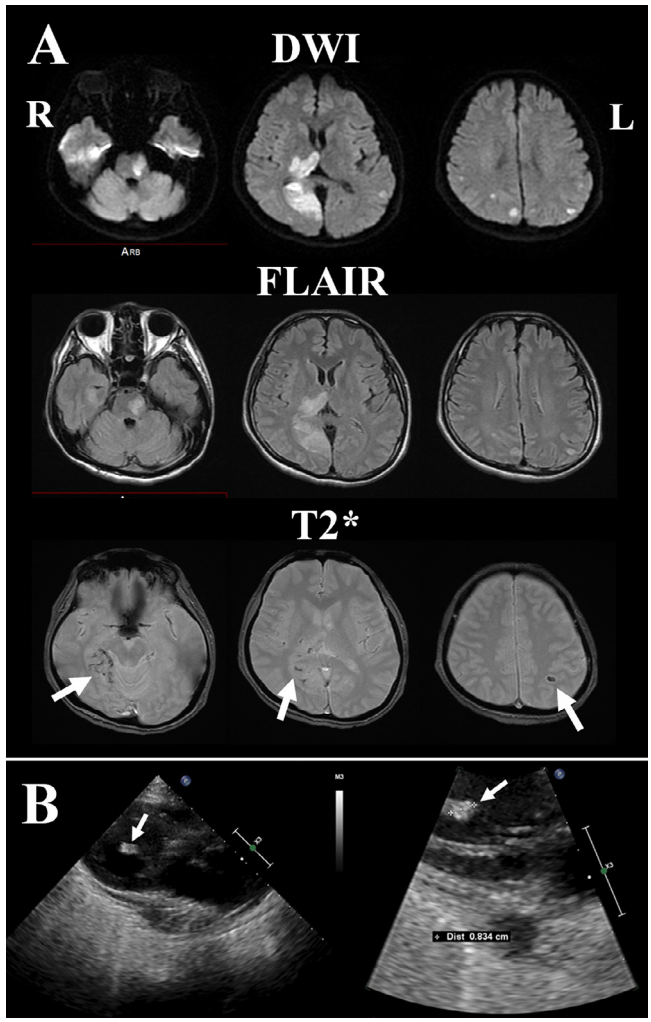

Fig. 1 – (A) Magnetic resonance imaging on admission. Diffusion-weighted images demonstrating several lesions in both hemispheres, denoting multiple areas of acute ischemia. The main lesions are in the left pons, right occipital lobe, thalamus, and posterior limb of the internal capsule. These lesions are shown as high signals on FLAIR, suggesting cerebral infarctions. Microbleeds in the fresh infarctions are identifiable on T2* images as spotty low signal lesions (white arrows). (B) Echo cardiography on admission. Echocardiography showing a 0.83-cm mass in the left ventricle that is fluttering synchronously with the heartbeat.

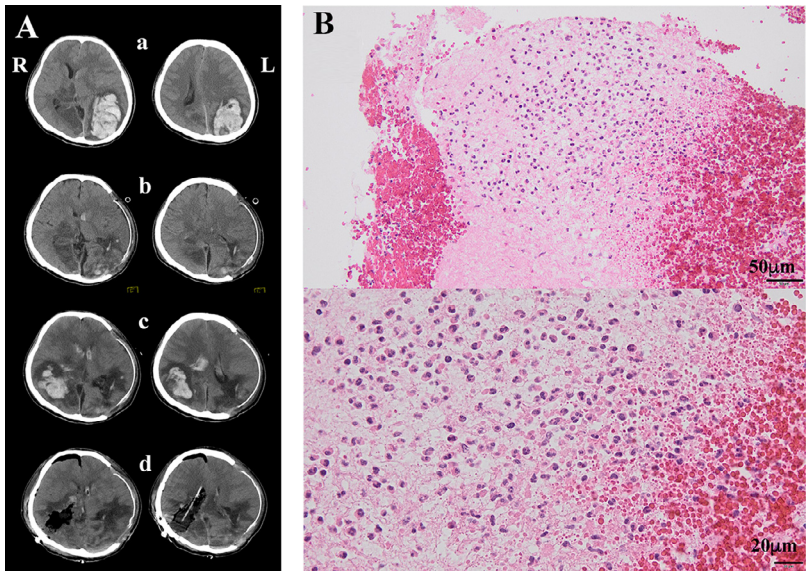

Fig. 2 – (A) Cranial CT images. a. On the 3rd day after admission, a massive hemorrhage causing a marked midline shift is visible in the left occipitoparietal lobe. b. The hematoma has been completely removed and the midline shift is less marked. c. On the 7th day after admission, another bleed is identifiable in the right temporo-occipital lobe and penetrating into the right lateral ventricle. d. The hematoma has been removed and ventricular drainage performed. (B) Histology around the hematoma. Microabscesses with clusters of neutrophils in the excised brain tissue adjacent to the hematoma are identified by Hematoxylin-Eosin staining.

other intracranial hemorrhage with intraventricular hemorrhage occurred in the right temporo-occipital lobe on the 7th day after admission (Fig. 2A-c). Emergency removal of the hematoma with ventricular drainage was achieved (Fig. 2A-d); however, the patient remained in a deep coma after the second surgery (GCS 4: E1V1M2). Pathological examination (Hematoxylin-Eosin stain) of the operative specimen revealed several microabscesses (Fig. 2B). Antibiotic treatment was continued. Blood cultures for MRSA were negative on the 10th day after admission. The patient's spontaneous breathing was confirmed and he was able to be extubated, but there was little improvement in his consciousness level (GCS 5: E1V1M3). His left leg swelled 3 weeks after admission. Three-dimensional CT angiography (3D-CTA) demonstrated a 6-cm-diameter pseudoaneurysm in the left popliteal artery and other pseudoaneurysms in the hepatic (Fig. 3A; dotted arrows) and superior mesenteric (Fig. 3A; arrows) arteries. One month later, the pseudoaneurysm in the hepatic artery had resolved with ongoing antibiotic therapy, whereas those in the superior mesenteric and popliteal arteries did not respond to this treatment (Fig. 3B). No intracranial pseudoaneurysms were identified on 3D-CTA (Fig. 3C). Because the patient was in a coma, the vascular surgeons considered that surgical treatment for both the mitral valve vegetation and pseudoaneurysms was contraindicated. On the 78th day after admission, the patient's blood pressure suddenly decreased and he died despite cardiopulmonary resuscitation. An autopsy was performed.

Autopsy

Autopsy revealed that the cause of death was massive bleeding into the peritoneal cavity from rupture of the pseudoaneurysm in the superior mesenteric artery (Fig. 4A; white arrow), which was adherent to the pancreas (Fig. 4A; black arrow). The rupture point was clearly identifiable (Fig. 4A; red arrow). There was also a hemorrhage in the left calf caused by rupture of the popliteal artery pseudoaneurysm (Fig. 4B; white arrowhead). There was still vegetation on the mitral valve (Fig. 4C; white square). No MRSA was detected in blood collected at autopsy.

Discussion

Both the cause of our patient's infectious endocarditis, even at autopsy, and the duration of his MRSA infection were unclear. Only palliative treatments were achieved to the patient because of its fulminant clinical course. Cerebrovascular complications of infectious endocarditis occur relatively frequently, reportedly in 25%-70% of patients [3]. Multiple episodes of cerebral embolization had occurred before the patient presented to our clinic and further huge intracerebral hemorrhages occurred on the 3rd and 7th day after admission. We considered that our patient's severe neuro-

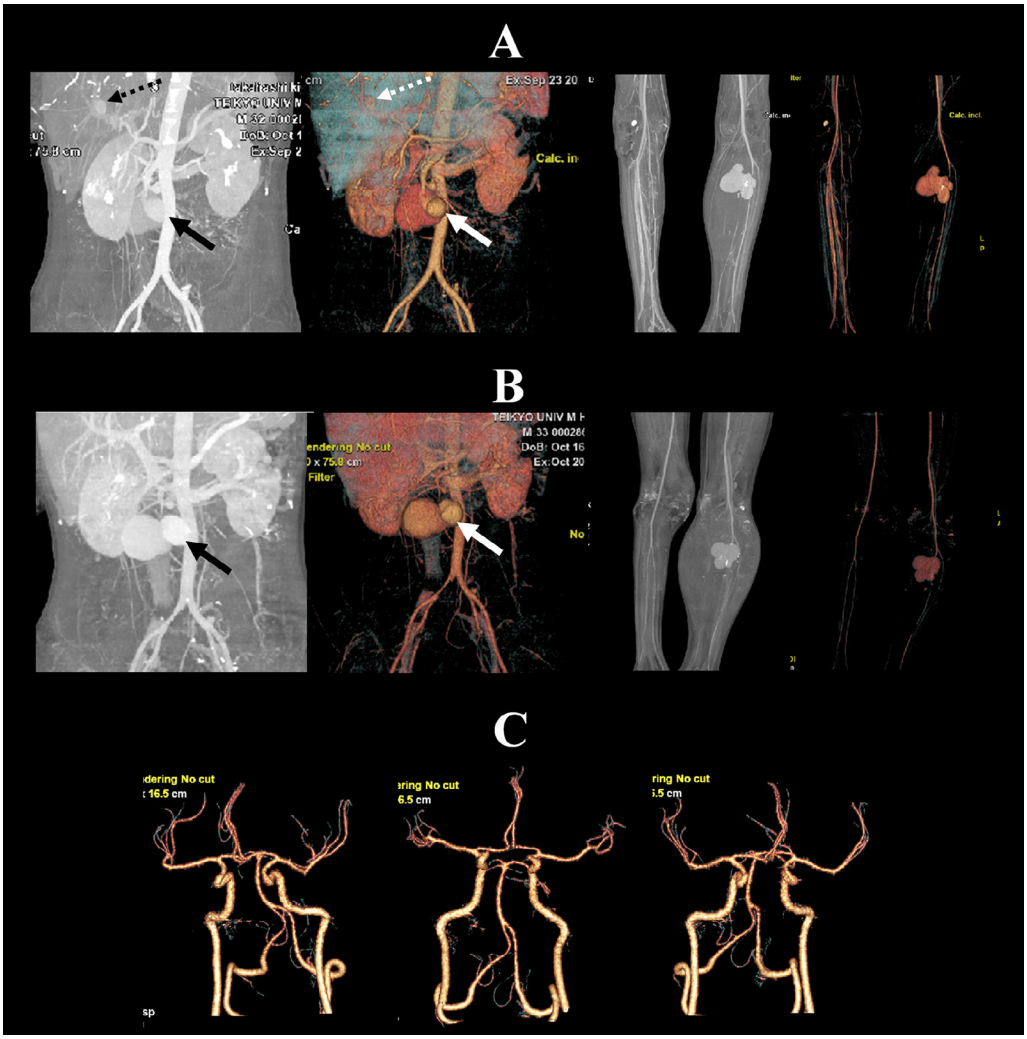

Fig. 3 – 3D-CT angiography. (A) Three weeks after admission: 3D-CT angiography image showing pseudoaneurysms in the hepatic (dotted arrows), superior mesenteric (arrows), and left popliteal arteries. The pseudoaneurysm in the left popliteal artery is extremely large, being 6 cm in diameter. (B) Seven weeks after admission. The pseudoaneurysm in the hepatic artery is no longer apparent, whereas those in the superior mesenteric and popliteal arteries are still present. The diameter of the popliteal pseudoaneurysm has decreased; however, the left lower leg is enlarged, suggesting bleeding into the left calf. (C) Intracranial 3D-CT angiography. No intracranial pseudoaneurysms are identifiable on 3D-CT angiography.

logical sequelae contraindicated aggressive treatment. *S. aureus* endocarditis rarely causes pseudoaneurysms in the superior mesenteric, hepatic, or popliteal arteries; however, a few cases of successful treatment of such pseudoaneurysms by surgery or endovascular therapy have been reported [5, 6]. In contrast to our patient, all the reported cases had a single pseudoaneurysm and no neurological deficits. To the best of our knowledge, this is the first reported case of MRSA endocarditis with 3 pseudoaneurysms in 3 weeks, despite blood cultures having been negative for MRSA after the 10th day of admission. Ongoing antibiotic treatment was effective only against the hepatic artery pseudoaneurysm, probably because it was relatively small. The other 2 pseudoaneurysms were too large to resolve. If our patient had not remained comatose, an interventional approach or surgical resection of the pseudoaneurysms may have been successful.

Retrospectively, the only treatment that may have saved this patient would have been emergency resection of the mitral valve vegetation within the first 2 days of admission. However, operative intervention would have been challenging, the reported in-hospital mortality being 10%-30% [7]. Administration of heparin, which is indispensable for cardiac surgery, may have resulted in further intracranial hemorrhage [8]. However, successful resection of the bacterial vegetation could have prevented the multiple pseudoaneurysms that were caused by subsequent emboli.

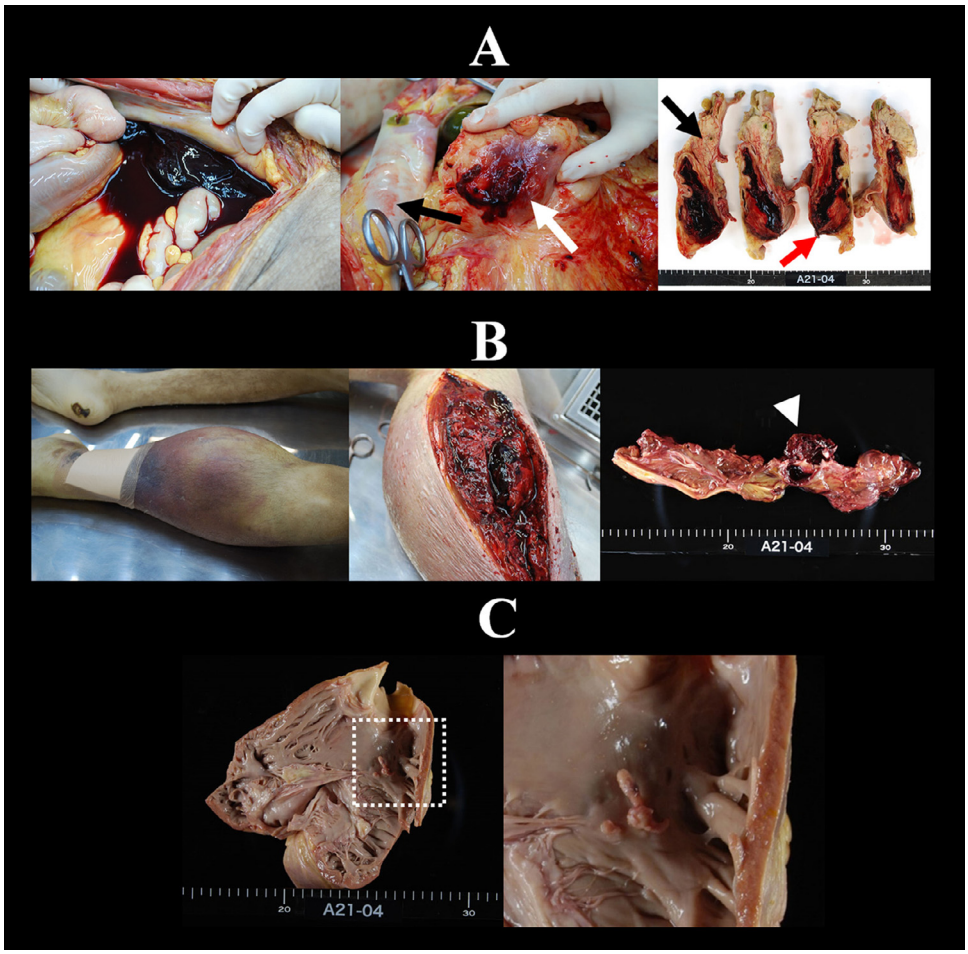

Fig. 4 – Autopsy findings. (A) Massive bleeding into the peritoneal cavity from rupture of the pseudoaneurysm in the superior mesenteric artery (white arrow), which is adherent to the pancreas (black arrows). The rupture point is clearly identifiable at the dome of the aneurysm (red arrow). (B) The left leg is swollen as a result of subcutaneous and intramuscular hemorrhage and a ruptured pseudoaneurysm is visible on the left popliteal artery (white arrowhead). (C) A vegetation is attached to the mitral valve (white square) in the left ventricle.

Patient consent

Written consent to publishing details of this patient's case was obtained from his family.

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