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A Case of a Home Hemodialysis Patient With Infective Endocarditis Complicated by Cerebral Infarction and Septic Pulmonary Embolism, Most Likely Caused by Frequent Shunt Punctures

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Abstract

We report a case of home hemodialysis with infectious endocarditis complicated by cerebral infarction and septic pulmonary embolism, most likely due to frequent shunt punctures. The patient, a 52-year-old man, was introduced to hemodialysis at our hospital 11 years ago due to reduced renal function caused by polycystic kidney disease and was transferred to home hemodialysis in the same year. Fever and general weakness appeared four days before he was urgently admitted to our department. Two blood culture sets revealed methicillin-susceptible *Staphylococcus aureus* (MSSA), brain MRI revealed multiple cerebral infarctions, and transesophageal echocardiography revealed infective endocarditis. The patient was transferred to the cardiology department of an affiliated hospital, treated with antimicrobials (for a total of 58 days), and discharged home on the 63rd day after admission. Frequent shunt punctures were considered to be the cause of the bloodstream infection leading to multiple complications.

Keywords

Hemodialysis
Infective endocarditis
Pulmonary embolism
Cerebral infarction

1. Introduction

Infective endocarditis (IE) due to a history of prosthesis insertion or hemodialysis is known as healthcare-associated infective endocarditis (HAIE), which its prevention and early detection are essential to prevent serious complications [1]. Previous reports have shown that home hemodialysis (HHD) patients have a higher risk of hospitalization due to vascular access

infections, although the overall complication rate is not significantly different as compared to facility hemodialysis patients [2,3]. In the present study, we report a case of home hemodialysis with infectious endocarditis, cerebral infarction, and septic pulmonary embolism, which are the most likely causes of frequent shunt punctures.

2. Case

A 52-year-old male had a chief complaint of fever and generalized weakness for 4 days before admission. The patient had no family history of note, and a medical history of hypertension treated medically and polycystic kidney disease, hence he was introduced to dialysis 11 years ago, and transferred to HHD in the same year, with 6 sessions/week (2.5 hours per session, hemodialysis product: 90).

Four days before admission, he had a fever of 38.5°C and generalized weakness, and visited his doctor, his severe acute respiratory syndrome coronavirus (SARS-CoV-2) polymerase chain reaction (PCR) result was negative, and he was prescribed antipyretic medication, but there was no improvement, hence he visited our off-hours clinic. He was urgently admitted to our department because of an elevated inflammatory response with a white blood cell count of 15140/μL and C-reactive protein of 29.4 mg/dL, as well as multiple infiltrates with cavitary lesions in both lungs showed on chest X-ray and CT scans.

On admission, the patient was 175.0 cm tall, weighs 61.0 kg (dry weight 58.2 kg), body mass index of 19.9, a Glasgow Coma Scale (GCS) of 14 (E4V4M6), a body temperature of 39.3°C, blood pressure of 177/98 mmHg, pulse 108/min, respiratory rate 24/min, SpO_2 100%. The eyelid conjunctiva was not anemic and there were no hemorrhagic spots. No yellowing of the ocular conjunctiva. No hemorrhagic spots in the oral cavity. Heart sounds were clear and no heart murmur was heard. Respiratory sounds were clear and did not differ between the right and left sides. The abdomen was flat and soft without tenderness, and intestinal peristalsis was audible. There was an internal shunt on the left forearm with erythema and swelling near the puncture site. There were no skin rashes (Osler's node or Janeway lesion) on the extremities. There was mild weakness in the extremities, but no obvious paralysis.

Laboratory findings on admission as shown in **Table 1**: blood tests showed an increase in white blood cell count, predominantly neutrophil, significantly elevated procalcitonin (46 pg/dL), hyponatremia

Table 1: Admission examination findings

Blood count		**Biochemistry**		**Coagulation**	
WBC	15,150/μL	TP	5.9 g/dL	APTT time	39.1 sec
NEUT	94.1%	Alb	2.5 g/dL	PT time	11.2 sec
LYMP	2.0%	AST	149 U/L	PT %	120%
EOSI	0.0%	ALT	94 U/L	PT ratio	0.92
RBC	419×10^4/μL	LDH	739 U/L	PT-INR	0.91
Hb	13.2 g/dL	Cr	11.86 mg/dL	D-Dimer	1.08 μg/mL
HCT	15.8%	eGFR	4.2 mL/min		
MCV	85.4 fL	UA	5.9 mg/dL	**Immunity**	
PLT	13×10^4/μL	BUN	72.8 mg/dL	β-D-Glucan	< 6.0 pg/mL
		Na	119 mEq/L	T-SPOT	Negative
		Cl	80 mEq/L		
Endocrine		K	4.3 mEq/L	**Bacterial culture test**	
Procalcitonin	46.89 pg/mL	Ca	7.4 mg/dL	Vein blood	MSSA detected
		CRP	29.42 mg/dL	Artery blood	MSSA detected

(119 mEq/L), liver dysfunction (aspartate aminotransferase 149 U/L, alanine aminotransferase 94 U/L). Methicillin-susceptible *Staphylococcus aureus* (MSSA) was detected in two sets of blood cultures.

Post-hospitalization course as shown in **Figure 1**: A chest X-ray on admission (**Figure 2** left) showed a cavitary lesion in the right upper lung field. Chest CT scan (**Figure 2** right) also showed multiple cavitary lesions in both lungs, mainly in the right upper lobe, right middle lobe, and left upper lobe. The patient was started on meropenem hydrate 1.0 g/day + vancomycin hydrochloride 0.5 g/day for severe infection. Continuous renal replacement therapy (CRRT) was started. As for the source of infection, there was swelling and redness at the shunt puncture site, and bloodstream infection due to frequent shunt punctures was highly suspected.

The patient was weaned from CRRT within three

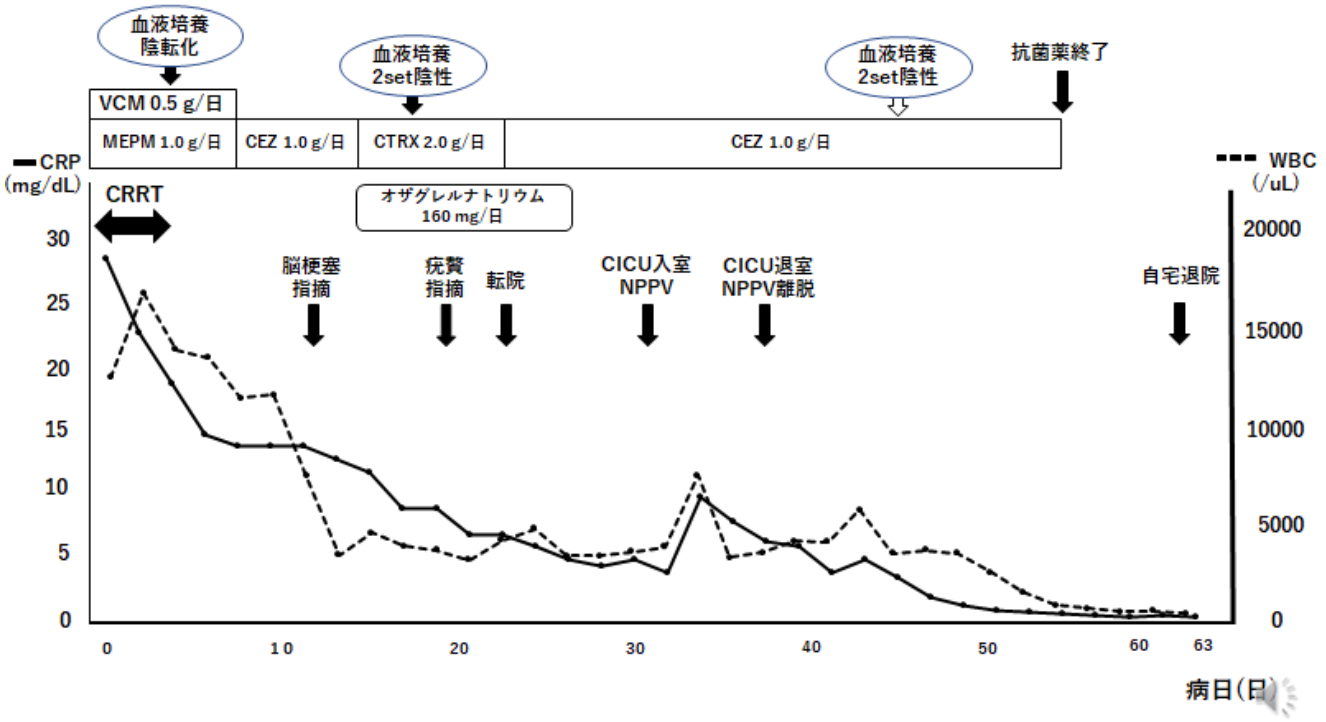

Figure 1. Post-hospitalization progress. VCM: vancomycin; MEPM: meropenem; CEZ: cefazolin; CTRX: ceftriaxone; NPPV: non-invasive positive pressure ventilation; CRP: C-reactive protein; WBC: white blood cell.

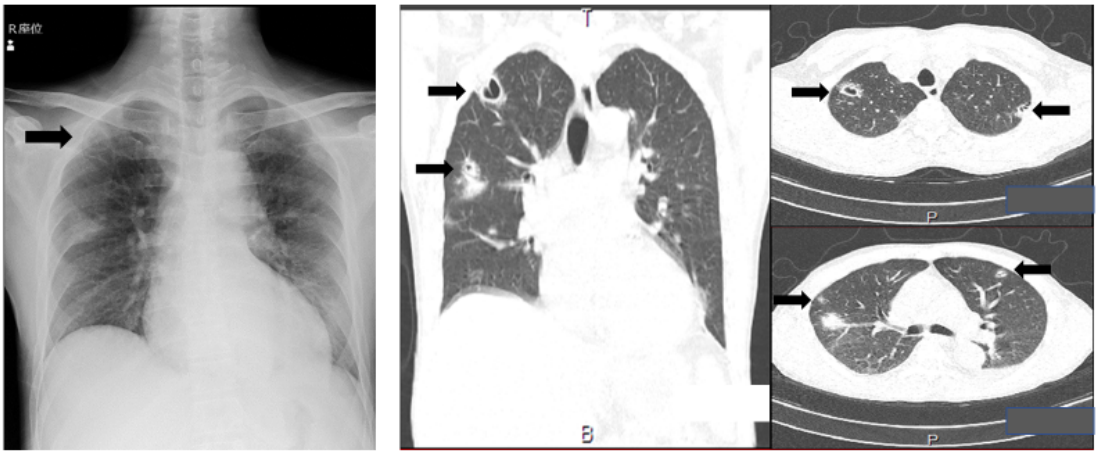

Figure 2. Chest X-ray (left) and CT scan (right) showed cavitary lesions in the right upper lung field. Multiple cavitary lesions were present in both lungs, mainly in the right upper, right middle, and left upper lobes.

days and started regular hemodialysis three times a week from day 3. Transthoracic echocardiography was performed but no obvious verrucae were detected, and the patient was considered to have developed septic pulmonary embolism as a result of MSSA sepsis.

The patient was de-escalated to cephazolin sodium 1.0 g/day on the 7th day, and the inflammation did not flare up. On admission, the patient was aware of generalized weakness, so a brain MRI scan (**Figure 3** left) was performed on the 11th day, and a diffusion-weighted image showed a high-signal area near the left thalamus, leading to a diagnosis of cerebral infarction. After consultation with the neurologist, ozagrel sodium 160 mg/day was started and the antimicrobial agent was changed to ceftriaxone sodium 2.0 g/day, which has good CSF transferability.

The possibility of IE could not be ruled out due to septic pulmonary embolism and cerebral infarction, and transoesophageal echocardiography (**Figure 4**) was performed on the 19th day, which revealed a 20 mm diameter wart on the mitral valve and a diagnosis of IE. On the 22nd day, a follow-up brain MRI scan (**Figure 3** right) revealed a new high-signal area near the right cerebral capsule. The diagnosis of IE, multiple cerebral infarctions, and septic pulmonary embolism due to MSSA infection caused by frequent shunt punctures was made, and the patient was transferred to the cardiovascular surgery department of an associated

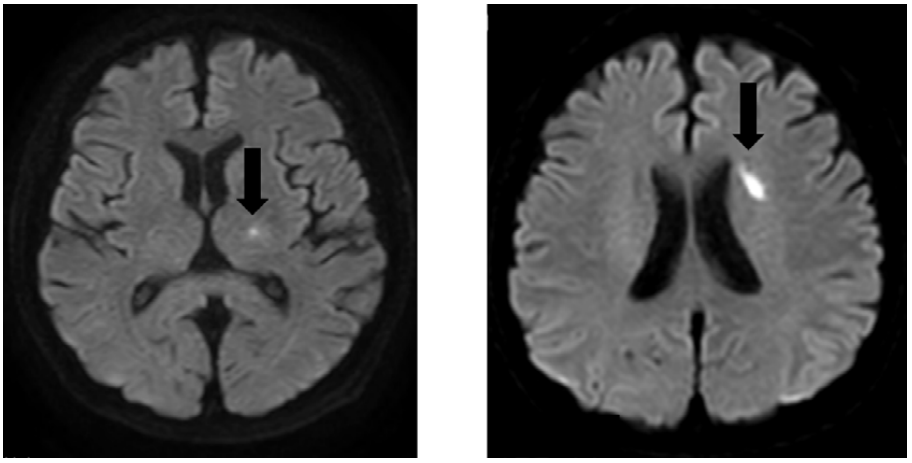

Figure 3. Diffusion-weighted MRI scan of the head (left: day 11, right: day 22) Diffusion-weighted images showed high-signal areas near the left thalamus (day 11) and right cortex (day 22) (arrows), which led to the diagnosis of a new stroke.

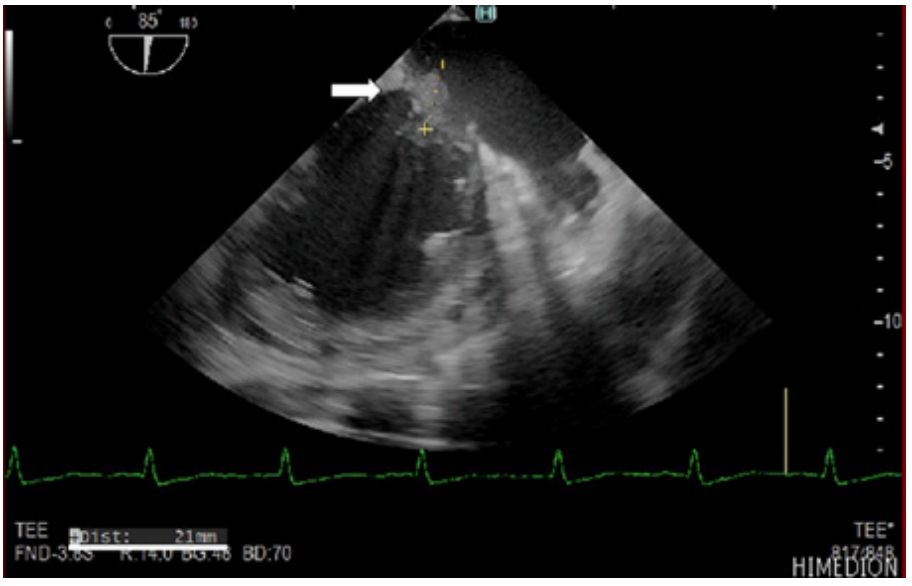

Figure 4. Transoesophageal echocardiography. A 20 mm diameter verruca on the mitral valve was diagnosed as infective endocarditis.

institution on the 23rd day. After transfer, treatment with cefazolin sodium 1.0 g/day was continued. The inflammatory response was improving, but the patient developed heart failure on day 32 and noninvasive positive pressure ventilation (NPPV) was started in the cardiovascular intensive care unit (CICU). The patient was weaned from NPPV on the 38th day and was released from the CICU. After antimicrobials were started, blood cultures were submitted as necessary, but all were negative, and antimicrobials were discontinued on the 54th day. The inflammatory response remained within normal limits after antimicrobials were discontinued, and the patient was discharged home on day 63. Since shunt puncture due to self-puncture was suspected as the most likely cause of sepsis, the patient underwent institutional hemodialysis three times a week at a neighboring dialysis facility after discharge.

Discussion

We have experienced a case of home hemodialysis in which the most suspected cause of infective endocarditis was frequent shunt punctures, which were complicated by cerebral infarction and septic pulmonary embolism. HAIE has been increasing in recent years, and its causes include the aging of patients, the increasing prevalence of underlying diseases, the development of various intracardiac devices, and the increasing number of patients on dialysis, due to the development of healthcare. The number of HAIEs associated with shunt puncture has been elevating over the years, with the frequency of shunt puncture-associated HAIE being 17 times higher than that of IE in non-dialysis patients, and the mortality rate is known to be as high as approximately 65% in those who develop HAIE [2].

HHD patients have a higher number of dialyzes per week than facility dialysis patients (3 dialyzes/week) and therefore have a lower number of deaths related to congestive heart failure and hyperkalemia, and a lower overall risk of death in HHD patients [3]. On the other hand, although there is no significant difference in the overall complication rate, complications related to vascular access problems are more frequent in HHD patients than in facility dialysis patients, with a particularly high risk of hospitalization due to infections [4,5].

Vascular access for maintenance hemodialysis can be either an autologous arteriovenous fistula (AVF), an artificial arteriovenous graft (AVG), a cuffed catheter, or a superficialized artery. Hemodialysis with AVF or AVG is known to be superior to catheter-based hemodialysis in terms of improved survival, fewer mechanical and infectious complications, prolonged patency, and reduced healthcare costs [6,7].

The shunt puncture method includes the rope ladder method, the buttonhole method, and the area method (**Figure 5**). The buttonhole method creates a route through the skin and blood vessels by making the same hole at each puncture site. This method is known to cause less pain due to the use of a puncture needle with a blunt tip, and lessen trypanophobia as compared to other puncture methods [8]. However, it is reported to have an access infection rate approximately three times higher than other puncture methods [8,9]. The rope ladder method was used in this case, and it was the first infection in 11 years since the start of HHD. The patient's repeated shunt punctures due to hand tremors that appeared with diarrhea were considered to be the cause of the infection. Although the patient had the intention to continue HHD, he did not consult the hospital when he had repeated mispunctures and was not compliant, so we requested that the hospital be informed in case of an emergency if he continued HHD. Furthermore, it was explained to the patient that the risk of infection was higher if the cleanliness operation was incomplete, as compared to dialysis in a facility. After consultation with the patient and his family, it was decided to shift the patient to facility dialysis three times a week in order to reduce the risk of infection. Since then, the patient has been doing well.

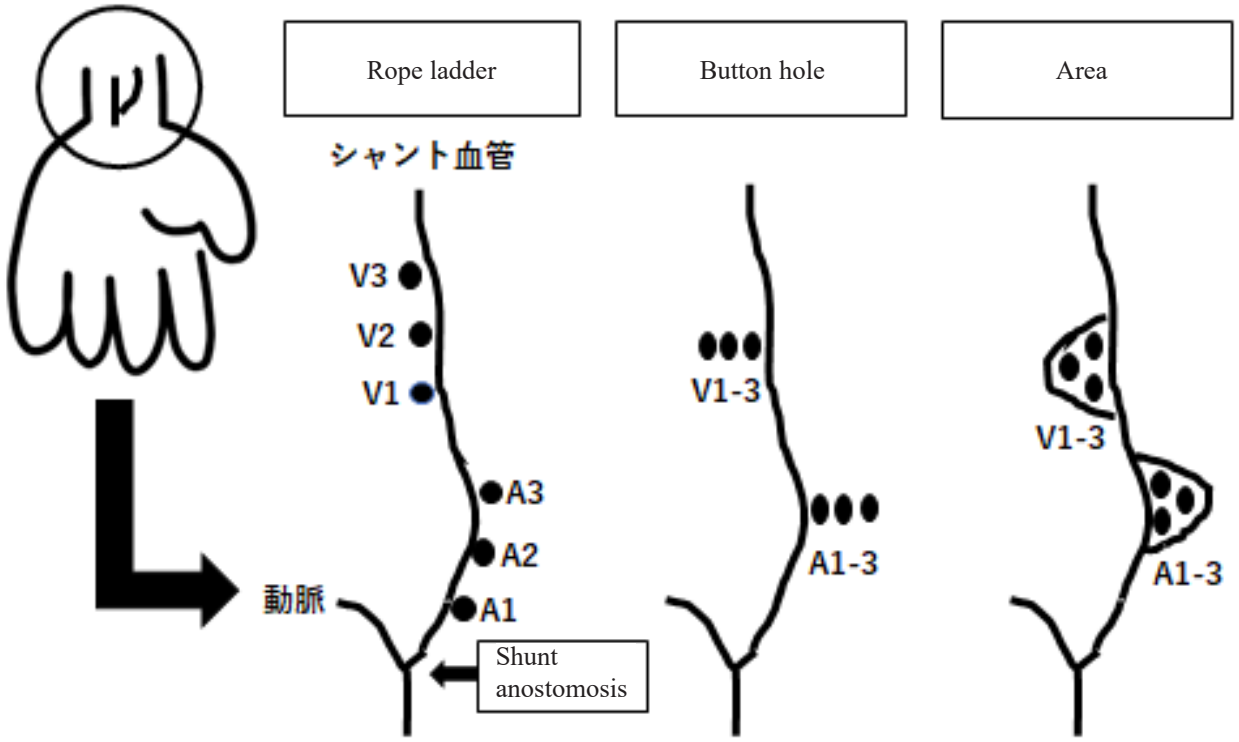

Figure 5. Types of shunt puncture: rope ladder, buttonhole, and area methods

In our hospital, HHD is only eligible for initiation after at least three months of training including disinfection and self-puncture, and after confirming that there are no problems with cleanliness and operation. Thereafter, patients visit the nephrology outpatient clinic once a month, and the dialysis conditions are changed based on the HHD records and blood sampling results brought at that time. In addition, a home visit was made once every six months, but the visit was limited to equipment maintenance and checking on the patient's current status, and the overall procedure, including cleanliness procedures, was checked only once every two to three years. Although the shunt puncture was thought to have been induced by hand tremors associated with diarrhea in this case, it was considered necessary to set new rules for the continuation of long-term HHD, such as using the opportunity of the visit to check the cleanliness operation.

Conclusion

We experienced a case of HHD with infective endocarditis, cerebral infarction and septic pulmonary embolism, most likely related to frequent shunt mispunctures. HAIE may associate with potentially fatal complications, and it is essential for patients to fully understand the benefits as well as risks of HHD.

Disclosure statement

The authors declare no conflict of interest.

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