

Received: 2026.02.19

Accepted: 2026.09.09

Available online: 2026.10.18

Published: 2026.XX.XX

Isolated Disturbance of Consciousness as Initial Presentation of *Staphylococcus aureus* Endocarditis: A Case Report With Brief Literature Review

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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Financial support: This work was supported by the Sanming Project of Medicine in Shenzhen (No. SZZYSM202401018)
Conflict of interest: None declared

Patient: Male, 50-year-old
Final Diagnosis: Acute cerebral infarction (right temporal-parietal lobe) with secondary right frontal lobe hemorrhage • infective endocarditis • sepsis with MODS
Symptoms: Disturbance of consciousness • fever
Clinical Procedure: —
Specialty: Cardiology • Infectious Diseases • Neurology

Objective: Challenging differential diagnosis
Background: Infective endocarditis (IE) typically presents with fever, a heart murmur, or constitutional symptoms, making diagnosis challenging when neurological manifestations predominate. We report an atypical case of IE in which disturbance of consciousness was the initial manifestation.

Case Report: A man in his 50s was admitted to our hospital with isolated disturbance of consciousness and no history of fever; a temperature of 38 °C was recorded on admission. Investigations confirmed an extensive acute right hemispheric watershed (border-zone) infarction involving the right temporoparietal lobe, without evidence of hemorrhagic transformation or intracranial hemorrhage. Subsequent workup identified *Staphylococcus aureus* bacteremia, mitral valve vegetation, and multiple organ dysfunction syndrome. The absence of classic IE risk factors contributed to a delayed diagnosis. Guideline-concordant clinical management was implemented. Long-term outcome data were unavailable because of patient transfer; only in-hospital mortality (after transfer) was confirmed. We discuss the application of the 2023 Duke criteria to this case and examine factors contributing to the delayed diagnosis of IE. Disturbance of consciousness as the predominant initial manifestation of *S. aureus* IE is rare and frequently results in diagnostic delay. This case underscores the importance of maintaining a high index of suspicion for IE in patients with sepsis complicated by acute cerebral infarction, particularly among critical care and neurology clinicians.

Conclusions: This case highlights isolated disturbance of consciousness as an atypical initial presentation of IE. Although IE is frequently complicated by acute cerebral infarction, clinicians may not routinely consider IE in the differential diagnosis of patients presenting with disturbed consciousness.

Keywords: Cardiology • Case Reports • Consciousness Disorders • Diagnosis • Endocarditis • Literature Review
Full-text PDF: <https://www.amjcaserep.com/abstract/index/idArt/953169>

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Introduction

Infective endocarditis (IE) is a rare and severe disease associated with high in-hospital mortality [1]. A Norwegian prospective study showed that the annual incidence increased from 10.4 (in 2016) to 14.1 (in 2022) per 100 000 residents [2]. Risk factors for IE include native or prosthetic valve disease, intra-cardiac devices, hospital-acquired infection, intravenous drug use, and advanced age [3]. Clinically, IE manifests with highly variable and nonspecific symptoms, posing considerable diagnostic challenges. Typical clinical presentations are characterized by persistent fever and a cardiac murmur; isolated disturbance of consciousness as the predominant initial manifestation is extremely atypical and rarely reported [4]. In the absence of classic febrile and cardiac manifestations, this unusual presentation carries a high risk of missed diagnosis and delayed intervention. Here, we report a case of IE caused by *Staphylococcus aureus*, in which isolated disturbance of consciousness was the initial manifestation.

Case Report

A man in his 50s was admitted to the intensive care unit with fatigue of 2 days' duration and altered consciousness for 1 day. He had a history of gouty arthritis and denied any other medical conditions. The patient reported no fever before admission. On admission, his temperature was 38 °C, heart rate

was 110 beats/min, blood pressure was 110/61 mm Hg, and peripheral oxygen saturation was 98% with high-flow nasal oxygen (AIRVO 2). His Glasgow Coma Scale score was 7 (E1, V1, M5). The pupils were equal and round (approximately 3 mm), with sluggish light reactivity. The neck was supple. A grade 3/6 blowing systolic murmur was audible over the mitral valve area. Limb strength could not be assessed because of poor cooperation, whereas muscle tone was mildly increased. Movement of the left limbs was reduced compared with movement of the right limbs. Physiological reflexes were preserved, and pathological reflexes were not elicited.

Emergency noncontrast cranial computed tomography excluded intracranial hemorrhage. Subsequent noncontrast cranial magnetic resonance imaging (**Figure 1**) demonstrated an extensive acute right hemispheric watershed-pattern (border-zone) infarction involving the right temporoparietal lobe. Poor visualization of the M2 segment of the right middle cerebral artery raised suspicion of right middle cerebral artery M2 occlusion. There was no evidence of hemorrhagic transformation or intracranial hemorrhage.

Laboratory findings were as follows (**Table 1**): white blood cell count, $19.93 \times 10^9/L$; high-sensitivity C-reactive protein, 134.31 mg/L; procalcitonin, 9.63 ng/mL; blood urea nitrogen, 28.0 mmol/L; serum creatinine, 358.7 $\mu\text{mol/L}$; glomerular filtration rate, 15.8 mL/min; alanine aminotransferase, 165 U/L; N-terminal pro-B-type natriuretic peptide, 4316 pg/mL; and

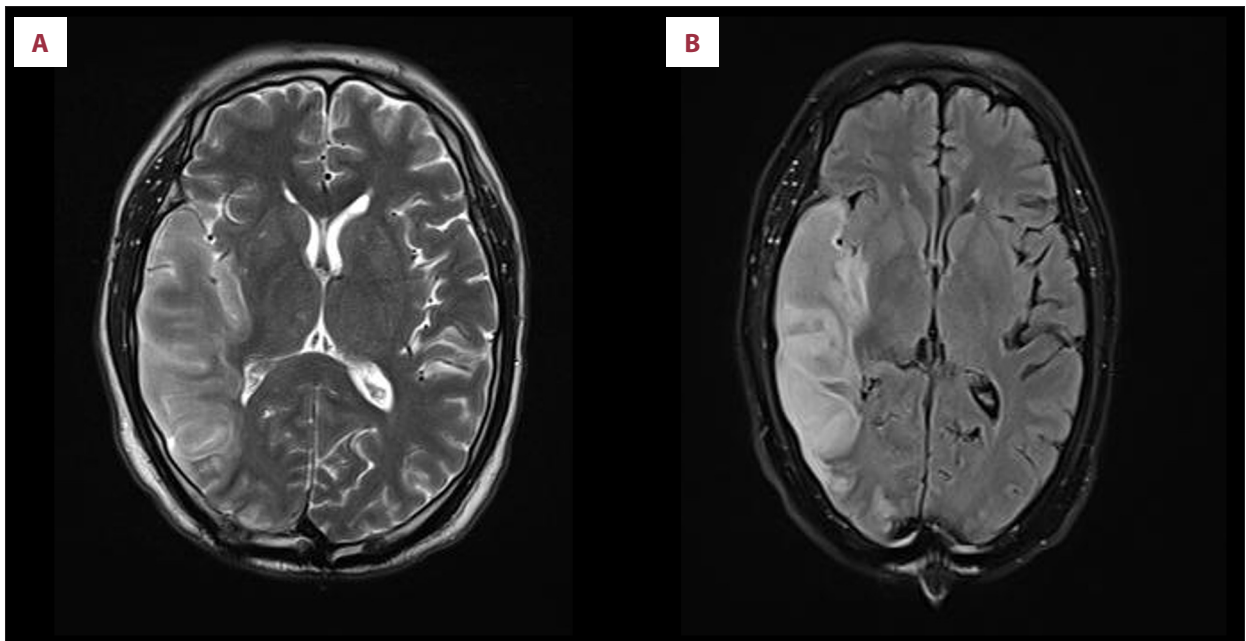


Figure 1. Brain magnetic resonance imaging findings. (A) Axial T2-weighted image. **(B)** Axial fluid-attenuated inversion recovery image demonstrating an extensive acute right hemispheric watershed-pattern (border-zone) infarction involving the right temporoparietal lobe. Imaging findings were suggestive of right middle cerebral artery M2 occlusion, without evidence of hemorrhagic transformation or intracranial hemorrhage.

Table 1. Blood test results on admission and before transfer.

Marker	Admission	Day 4	Reference range
WBC	19.93	13.84	$3.5-9.5 \times 10^9/L$
NEUT	18.4	12.6	$1.8-6.3 \times 10^9/L$
LY	0.7	0.5	$1.1-3.2 \times 10^9/L$
HGB	134	111	115-150 g/L
PLT	260	252	$125-350 \times 10^9/L$
Cr	358.7	294.2	46-92 $\mu\text{mol/L}$
BUN	28.0	27.3	2.5-6.1 mmol/L
TB	27.8	15.1	3.0-22 $\mu\text{mol/L}$
ALT	165	131	< 35 U/L
ALB	36.7	32.3	35-50 g/L
APTT	28.6	21.6	24-35 s
NT-proBNP	4316	6677	< 450 pg/mL
K	4.82	4.76	3.5-5.1 mmol/L
Na	128	141	135-145 mmol/L
hsCRP	134.31	111.03	0-5 mg/L
PCT	9.63	5.84	< 0.05 ng/mL
Lactate	1.0	1.0	0.7-2.5 mmol/L

ALB, albumin; ALT, alanine aminotransferase; APTT, activated partial thromboplastin time; BUN, blood urea nitrogen; Cr, creatinine; HGB, hemoglobin; hsCRP, high-sensitivity C-reactive protein; K, serum potassium; LY, lymphocyte count; Na, serum sodium; NEUT, neutrophil count; NT-proBNP, N-terminal pro-B-type natriuretic peptide; PCT, procalcitonin; PLT, platelet count; TB, total bilirubin; WBC, white blood cell count.

serum sodium, 128 mmol/L. Cardiac troponin I was 3.240 ng/mL, and creatine kinase isoenzyme was 9.31 ng/mL. Hepatitis B surface antigen test results were negative, as were test results for human immunodeficiency virus antigen and antibody.

The preliminary diagnoses were as follows: (1) extensive acute right hemispheric watershed-pattern (border-zone) infarction involving the right temporoparietal lobe, without hemorrhagic transformation or intracranial hemorrhage; and (2) sepsis complicated by multiple organ dysfunction syndrome (MODS) involving the liver, kidneys, and heart.

The patient's APACHE II score on admission was 25, with a concurrent Glasgow Coma Scale score of 7, as noted above. Limb strength, muscle tone, and limb movement findings supported a diagnosis of acute cerebral infarction and corresponding treatment. Given the unknown time of infarction onset, thrombolysis and thrombectomy were not performed. The patient had presented with fever and MODS, supporting a diagnosis of sepsis. In accordance with the 2018 Chinese Guidelines for Emergency Treatment of Sepsis/Septic Shock [5], blood, urine, and sputum cultures were collected following domestic

microbiological sampling standards. Two sets of peripheral blood cultures (each comprising aerobic and anaerobic bottles) were obtained from separate venipuncture sites before antimicrobial therapy; clean-catch midstream urine and adequate sputum specimens were also obtained. Fluid resuscitation was initiated, and targeted investigations were performed to identify the primary source of infection.

Given the patient's coma, fever, and greatly elevated leukocyte count, high-sensitivity C-reactive protein, and procalcitonin levels, occult aspiration pneumonia and gram-negative bacterial infection were strongly suspected. No risk factors for gram-positive infection, including skin breakdown, were identified. Accordingly, broad-spectrum ceftriaxone 2 g intravenously every 12 hours was initiated as first-line antimicrobial therapy. Gram-positive organisms were detected by blood culture smear microscopy 8 hours after specimen submission (both aerobic and anaerobic bottles). The antibiotic regimen was switched to vancomycin 1 g intravenously every 12 hours, with planned therapeutic drug monitoring. The isolate was identified as *S. aureus* at 14 hours, and antimicrobial susceptibility testing was subsequently performed. The

Table 2. Antibiotic susceptibility of *Staphylococcus aureus* isolated from blood culture.

Antibiotics	MIC (µg/mL)	Susceptibility
Levofloxacin	0.5	S
Penicillin G	≥ 0.5	R
Teicoplanin	≤ 0.5	S
Vancomycin	1	S
Clindamycin	0.25	S
Daptomycin	0.25	S
Erythromycin	≤ 0.25	S
Gentamicin	≤ 0.5	S
Linezolid	2	S
Moxifloxacin	≤ 0.25	S
Oxacillin	0.5	S
Rifampicin	≤ 0.5	S
Trimethoprim-sulfamethoxazole	≤ 10	S
Tigecycline	≤ 0.12	S
Ceftobiprole	0.25	S

MIC, minimum inhibitory concentration; R, resistant; S, susceptible.

isolate was susceptible to levofloxacin, teicoplanin, vancomycin, clindamycin, daptomycin, erythromycin, gentamicin, linezolid, moxifloxacin, oxacillin, rifampicin, trimethoprim-sulfamethoxazole, tigecycline, and ceftobiprole; it was resistant to penicillin G (Table 2).

On hospital days 2 and 3, transthoracic echocardiography demonstrated vegetation on the posterior leaflet of the mitral valve, accompanied by mild-to-moderate mitral regurgitation (Figure 2). The vegetation measured 1.14 cm along its long axis and 0.81 cm along its short axis. Considering the patient's body weight of 60 kg and serum creatinine level of 358.7 µmol/L, enoxaparin sodium 4000 IU was administered subcutaneously every 12 hours for anticoagulation.

Positive blood cultures yielding *S. aureus* and mitral valve vegetation visualized on echocardiography satisfied 2 major Duke criteria [6], confirming the diagnosis of IE (Table 3). The final diagnoses were as follows: (1) IE with *S. aureus* bacteremia; (2) acute cerebral infarction involving the right temporoparietal lobe; and (3) sepsis complicated by MODS involving the liver, kidneys, and heart.

Given that the patient presented with predominantly infectious and neurological manifestations, the time of acute stroke onset remained unknown, and emergent thrombectomy was not indicated. Additionally, there were no signs of uncontrolled infection or refractory heart failure warranting urgent surgical intervention; thus, conservative management centered on antimicrobial therapy was adopted. The vancomycin trough

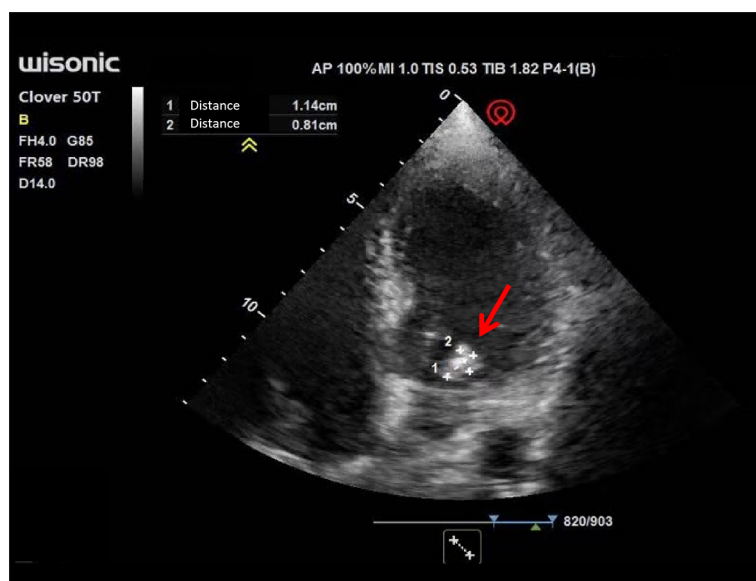


Figure 2. Transthoracic echocardiography.

A mobile, oscillating vegetation measuring 1.14 × 0.81 cm is visible on the posterior leaflet of the mitral valve (red arrow), accompanied by mild-to-moderate mitral regurgitation.

Table 3. Modified Duke criteria for the diagnosis of infective endocarditis.

Classification	Diagnostic criterion	Present
Major criteria	1. Two separate positive blood cultures for typical IE-related pathogens	Y
	2. Echocardiographic findings: vegetation, cardiac abscess, or new valvular regurgitation	Y
Minor criteria	1. Predisposing heart disease or intravenous drug use	N
	2. Fever ($\geq 38.0^{\circ}\text{C}$)	Y
	3. Vascular embolic events or peripheral vascular lesions	Y
	4. Immune-mediated lesions	N
	5. Positive blood culture not meeting a major criterion or serological evidence of infection	N
Definite IE	2 major criteria	Y
	1 major + 3 minor criteria	N
	5 minor criteria	N
Possible IE	1 major + 1 minor criterion	N
	3 minor criteria	N

IE, infective endocarditis; N, no; Y, yes.

concentration obtained before the fourth dose was 12.1 $\mu\text{g/mL}$, consistent with the therapeutic target. The patient received vancomycin for a total of 3 days (5 doses) prior to transfer. Repeat laboratory testing on hospital day 4 showed that the patient became afebrile after treatment. Inflammatory markers declined, and renal function improved, as reflected by increased urine output and decreased serum creatinine (Table 1).

For family reasons, the patient was transferred to Xiangya Hospital (Changsha, China) for further treatment on hospital day 4, precluding completion of the planned antimicrobial course at our institution. Therefore, repeat blood cultures were not obtained, and bacterial clearance could not be confirmed. Long-term outcome data were unavailable after transfer; only in-hospital mortality (after transfer) was confirmed.

Laboratory Methods

Blood cultures were collected aseptically using BACTEC aerobic and anaerobic bottles (BD Biosciences, Franklin Lakes, NJ, USA) and incubated in the BACTEC FX automated blood culture system (BD Biosciences). Culture-positive bottles were subjected to Gram staining followed by subculture on appropriate media. Species identification was performed using the Bruker matrix-assisted laser desorption/ionization-time of flight mass spectrometry rapid microbial identification system. Antimicrobial susceptibility testing was performed using the E-test and interpreted according to the clinical breakpoints specified in the 2024 Clinical and Laboratory Standards Institute guidelines [7].

Discussion

Case Summary

The patient in this case presented with isolated disturbance of consciousness and no established risk factors for IE, such as intravenous drug use or prior valve replacement [3]. Fever and MODS at initial presentation led to early suspicion of sepsis; therefore, a comprehensive diagnostic workup and standard antimicrobial therapy were promptly initiated. Transthoracic echocardiography demonstrated mitral valve vegetation, and *S. aureus* was isolated from blood cultures, confirming IE with cerebral infarction. The absence of classic risk factors and the isolated neurological presentation created a diagnostic pitfall that resulted in delayed recognition.

Unique Features

IE presents with diverse, nonspecific clinical manifestations [8]. Persistent fever ($> 38^{\circ}\text{C}$) and cardiac murmur are observed in 77.7% and 64.5% of patients, respectively [8], and imaging facilitates definitive diagnosis [9]. Disturbance of consciousness was the predominant presenting feature in our patient, accompanied only by low-grade fever (peak, 38°C) and a cardiac murmur; there were no established risk factors for IE. Intracranial pathology was initially suspected, and cranial imaging subsequently confirmed an extensive acute right hemispheric watershed-pattern (border-zone) infarction involving the right temporoparietal lobe, without evidence of hemorrhagic transformation

or intracranial hemorrhage. Cerebral infarction is a common septic embolic complication of IE [10-13], and mitral valve vegetation, as identified in the present case, is a well-recognized embolic source. However, the predominance of embolic neurological symptoms, consistent with findings in our patient, is uncommon in IE and frequently leads to diagnostic delay [14]. Similarly, a Brazilian research group described a patient with IE who exhibited atypical visual impairment and recovered after antimicrobial treatment [15]. Taken together, these findings suggest that IE should be included in the differential diagnosis of patients who present with unexplained disturbance of consciousness and embolic stroke, even in the absence of classic features of IE.

IE is frequently complicated by sepsis [16]. Typical manifestations of sepsis, including fever and organ dysfunction, can hinder early recognition of IE. However, standard sepsis management in the intensive care unit—despite initially diverting the diagnostic focus—enabled comprehensive microbiological evaluation, thereby facilitating pathogen identification and guiding targeted antimicrobial therapy. *S. aureus* was isolated in the present case, consistent with previous studies in which it was identified as the predominant pathogen in IE, followed by viridans group streptococci [10,16,17]. *S. aureus* bacteremia is a well-established risk factor for IE and associated embolic complications [18,19]. However, the considerable false-negative rate of blood cultures can lead to underdiagnosis when conventional microbiological methods alone are used. Diagnostic or therapeutic delay is among the strongest predictors of mortality in patients with IE [20]. In this context, next-generation sequencing has emerged as a valuable adjunct to conventional culture, with substantial potential to improve diagnostic accuracy and guide treatment optimization in culture-negative or complicated cases of IE [21,22].

Although the mitral valve vegetation measured 1.14×0.81 cm (exceeding the 10-mm threshold cited in the 2023 European Society of Cardiology guidelines, which supports Class IIb consideration of surgical intervention), a multidisciplinary team comprising specialists in cardiology, cardiac surgery, neurology, and infectious diseases chose conservative management after a comprehensive risk-benefit assessment [3]. The patient sustained an acute cerebral infarction secondary to septic embolization. Early cardiac surgery under such circumstances carries a risk of hemorrhagic transformation of the ischemic lesion associated with cardiopulmonary bypass and systemic anticoagulation (reportedly < 10% in contemporary cohorts and as low as 2% in recent studies) [23]. Concomitant sepsis substantially increases perioperative mortality and the risk of complications related to extracorporeal circulation. Our patient had no heart failure (left ventricular ejection fraction, 72%), perivalvular abscess, uncontrolled infection, or recurrent embolism despite appropriate antibiotic therapy—all of which represent strong Class I indications for surgery. Accordingly, consistent with the 2023 European Society of Cardiology guidelines that advocate

individualized decision-making and multidisciplinary evaluation, conservative antibiotic therapy with close clinical and echocardiographic monitoring was considered the safer initial strategy.

Clinical Implications

According to the 2023 Duke-International Society for Cardiovascular Infectious Diseases criteria, positive blood cultures and endocardial imaging findings constitute major diagnostic criteria for IE [6]. Epidemiological studies have demonstrated that *S. aureus* and viridans group streptococci are the predominant pathogens; cerebral infarction occurs in 4.3% to 16.1% of cases and is frequently associated with mitral valve vegetations [10,11]. *S. aureus* bacteremia is associated with substantial mortality, and vancomycin remains a preferred empiric first-line antimicrobial agent for such infections [19,24]. The present case emphasizes that unexplained neurological dysfunction accompanied by *S. aureus* bacteremia warrants urgent echocardiographic evaluation for IE, even when fever is low-grade and the clinical presentation is otherwise atypical.

Limitations

This study is a single-case report, which limits its generalizability. Next-generation sequencing was not performed, precluding assessment of its potential diagnostic value [21,22]. Long-term neurological and cardiac follow-up data were not obtained. Additionally, transesophageal echocardiography could not be performed because of the patient's high procedural risk.

Conclusions

This case highlights isolated disturbance of consciousness as the initial presentation of IE. Due to its heterogeneous clinical spectrum, IE poses a diagnostic challenge. Acute cerebral infarction resulting from septic embolization of valvular vegetations is a frequent complication of IE; nevertheless, clinicians may not routinely consider IE in patients who present with stroke. IE should be considered in patients with unexplained disturbance of consciousness or acute ischemic stroke, even in the absence of typical risk factors. Early blood cultures and echocardiography are essential for prompt diagnosis.

Department and Institution Where Work Was Done

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Patient Consent

Written informed consent for publication was provided by the patient's family.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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