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Case report

Severe meningitis and infectious aneurysm rupture of the middle cerebral artery following mechanical thrombectomy in infective endocarditis: A case report

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ABSTRACT

Introduction: Infective endocarditis (IE) is known to precipitate several severe complications, often culminating in dire outcomes. In this report, we present the case of a 33-year-old female with IE, which was further complicated by the occurrence of brain infarction, meningitis, and infectious aneurysm.

Case report: A 33-year-old female patient, presenting with left limb weakness persisting for a duration of 15 h, was admitted to our medical facility. A head MRI scan disclosed the presence of an acute cerebral infarction located in the left hemisphere, and subsequent CT angiography confirmed an occlusion of the M1 segment of the left middle cerebral artery. Consequently, the patient underwent mechanical thrombectomy as an intervention. Several days later, echocardiography revealed the presence of a 6.5 × 3.2 mm vegetation on the anterior mitral valve cusp, while blood cultures returned positive for Streptococcus mitis. A diagnosis of IE was established, and antibiotic therapy tailored to the microbiological sensitivities was promptly initiated. However, on the ninth day of her hospitalization, the patient's clinical condition deteriorated significantly due to the emergence of critical complications, including meningitis and a infectious aneurysm. Despite the implementation of aggressive antibiotic therapy, her condition continued to worsen, ultimately resulting in her demise on the sixteenth day of hospitalization, precipitated by the rupture of the infectious aneurysm.

Conclusions: The occurrence of infective endocarditis alongside brain infarction, meningitis, and infectious aneurysm in a single patient represents a rare, intricate, and gravely serious clinical scenario. In such instances, the responsibility for management should be vested in a multidisciplinary team of healthcare professionals.

Introduction

Streptococcus mitis represents a remarkable microorganism within the realm of microbiology. Traditionally, it has been regarded as a relatively innocuous member of the oral streptococcus group, inhabiting the oral commensal microbiota. Nonetheless, Streptococcus mitis has exhibited the capacity to break free from its usual niche, triggering an array of infectious complications, including infective endocarditis, bacteremia, and septicemia. Notably, it stands as the most prevalent causative agent of infective endocarditis, an ailment associated with a spectrum of central nervous system sequelae such as strokes, intracerebral hemorrhages, infectious aneurysms, meningitis, and cerebral abscesses [1]. The presence of neurologic complications significantly hampers treatment modalities and is correlated with an unfavorable prognosis, evident by a mortality rate of 45 % among affected individuals, compared to 24 % in those devoid of such complications [2,3]. Consequently, the importance of early diagnosis and the implementation of effective treatment strategies can not be overstated in the clinical management of this condition.

Case report

A 33-year-old female patient was admitted to the hospital following a sudden onset of left-sided hemiparesis, which had persisted for a duration of 15 h. She had a medical history characterized by unexplained low-grade fever, anemia, and headaches over the preceding six months. Upon admission, her clinical presentation included a heart rate of 106 beats per minute, a body temperature of 37.5 °C, a regular heart rhythm accompanied by a middle and late apical systolic murmur, a blood pressure reading of 108/70 mmHg, and normal breath sounds.

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Neurological assessment revealed somnolence, mixed transcortical aphasia, right central facial paralysis, right limb hemiplegia, and a positive right Babinski sign.

Laboratory investigations disclosed elevated C-reactive protein (CRP) levels at 25.0 mg/L, a hemoglobin concentration of 9.0 g/dL, and a serum albumin level of 32.9 g/L. A head MRI scan revealed recent infarction in the left frontal, parietal, temporal, and insular lobes. Subsequent CTA and CTP scan confirmed the occlusion of the M1 segment of the left middle cerebral artery, along with diminished perfusion and reduced blood flow velocity within the corresponding region.(Figs. 1–3).

In response to the diagnosis, an emergent mechanical thrombectomy using a stent retriever was performed to address the occlusion of the middle cerebral artery. Cerebral angiography demonstrated complete occlusion of the left middle cerebral artery with no abnormalities detected in the left internal carotid artery. The arterial thrombus was meticulously removed, and the occluded vessel was successfully reopened (Fig. 4).

On the second day of her hospitalization, the patient's body temperature spiked to 39.5 °C, and a 6.5 × 3.2 mm vegetation on the anterior mitral valve cusp was confirmed through echocardiography (Fig. 5). Hematoxylin and Eosin (H&E) staining of the thrombus specimen extracted from the left middle cerebral artery revealed substantial neutrophilic infiltration, while Gram staining indicated the presence of Gram-positive cocci (Fig. 6). Notably, a characteristic Janeway lesion was identified on her palms. Subsequent blood culture results were positive for Streptococcus mitis, prompting a modification of the antibiotic regimen to vancomycin based on susceptibility testing. The patient now met the modified Duke diagnostic criteria for infective endocarditis, which encompassed two primary criteria: positive blood culture results and evidence of endocardial involvement.

Seven days after the onset of symptoms, the patient experienced neurological deterioration, characterized by a decreased level of consciousness and tetraparesis. Cranial magnetic resonance imaging (MRI) revealed extensive areas of acute cerebral infarction with mild hemorrhagic transformation in the right frontal, bilateral cingulate gyrus, left basal ganglia, left frontal, left parietal, left temporal, and left insular lobes. Additionally, findings included an 6.0 × 3.5 mm aneurysm in the left internal carotid artery C7 segment, occlusion of the left middle cerebral artery M1 segment, stenosis of bilateral anterior cerebral artery A1 segments, and localized stenosis in the left internal carotid artery C5-C7 segments (Fig. 7). The likely cause for this is that the arterial injury associated with mechanical thrombectomy, in combination with bacterial seeding, collectively results in intimal infection, and the latter subsequently gives rise to stenosis of cerebral arteries and aneurysm. Consultations with a neurosurgeon and a cardiac surgeon were sought for potential surgical interventions, but given the patient's grave infection, they recommended postponing surgery to a later date.

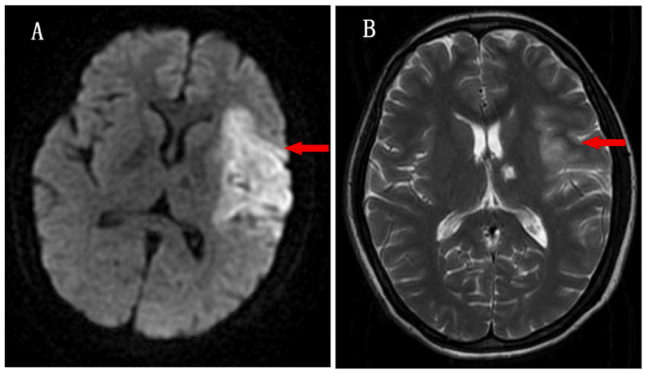

Fig. 1. Head MRI of the patient. (A) Recent infarction is indicated by the red arrow in the left frontal, and temporal lobes. (B) An old infarct in the left basal ganglia is marked by the red arrow.

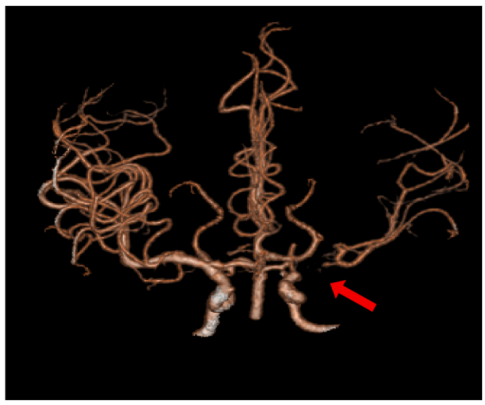

Fig. 2. Head CT angiography of the patient. The red arrow points to occlusion of the left middle cerebral artery M1 segment.

Two days later, on the ninth day of her hospital stay, the patient's neurological examination revealed signs of meningeal irritation, including cervical rigidity. A subsequent lumbar puncture yielded cloudy cerebrospinal fluid (CSF) with an initial pressure exceeding 400 mmH2O. Routine CSF analysis indicated elevated protein levels (0.99 g/L), decreased glucose levels (2.00 mmol/L), a high leukocyte count (641 × 10^6/L), a procalcitonin level of 1.01 ng/mL, and interleukin-6 levels exceeding 1000 pg/mL. Treatment strategies involved the administration of mannitol to reduce intracranial pressure, thereby mitigating the effects of cerebral edema. Additionally, linezolid was substituted for vancomycin to enhance the permeability coefficient of the blood-brain barrier.

Following a four-day course of linezolid, the patient exhibited signs of improved consciousness and demonstrated visual responsiveness by tracking movements on the thirteenth day of her hospitalization. Concurrently, a repeat CSF examination (initial pressure 120 mmH_2O, protein 0.79 g/L, glucose 1.4 mmol/L, leukocytes 120 × 10^6/L) on the same day indicated amelioration of the meningitis.

However, on the sixteenth day, the patient's condition abruptly deteriorated. Within 2–3 min, her heart rate plummeted to 25 beats per minute, pupils bilaterally dilated to 5 mm with the loss of light reflex, oxygen saturation dropped to 66 %, she ceased breathing, systolic blood pressure declined to 60 mmHg, and she succumbed shortly thereafter. A post-mortem lumbar puncture was performed, and CSF analysis suggested a ruptured infectious cerebral aneurysm as the cause of death.

Discussion

Infective endocarditis is characterized by an infection of the endocardial surfaces of the heart, primarily affecting valve leaflets, the mural endocardium, chordae tendinae, prosthetic valves, and implanted devices. Epidemiological studies indicate an estimated annual incidence of approximately 30 cases per million inhabitants [4], with a 1-year mortality rate of roughly 30 % [5]. The pathophysiology of infective endocarditis involves intricate interactions between circulating microorganisms, damaged valvular endothelium, and the host's immune defenses [6]. This condition is associated with high mortality and severe complications, including embolic events, valvular destruction, arrhythmias, and a range of central nervous system complications [1,7]. Symptomatic neurological complications occur in 15–30 % of patients with infective endocarditis [1,3,8], with cerebrovascular events and infectious cerebral aneurysms representing particularly serious occurrences [9]. Among them, infectious aneurysms are more likely to occur in the middle cerebral artery, particularly in the distal part of the artery, and the unruptured ones frequently exhibit intrasulcal T2 * and FLAIR signal abnormalities on MR imaging [10].

Brain infarction is the most frequent neurological complication,

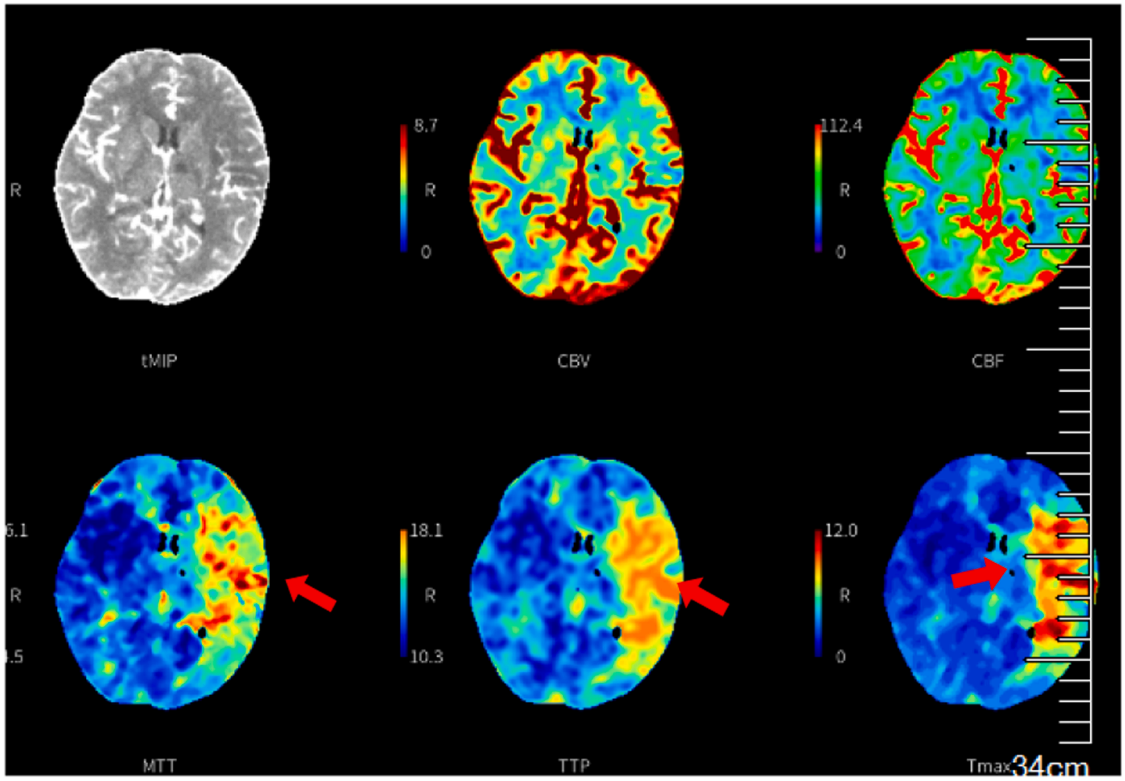

Fig. 3. Head CT perfusion of the patient. The red arrow highlights focal areas with decreased perfusion and reduced blood flow velocity in the territory supplied by the left middle cerebral artery.

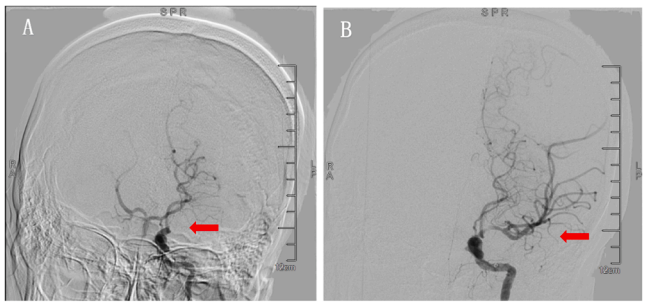

Fig. 4. Cerebral angiography of the patient. (A) Complete occlusion of the left middle cerebral artery is indicated by the red arrow. (B) The red arrow shows the successful reopening of the left middle cerebral artery.

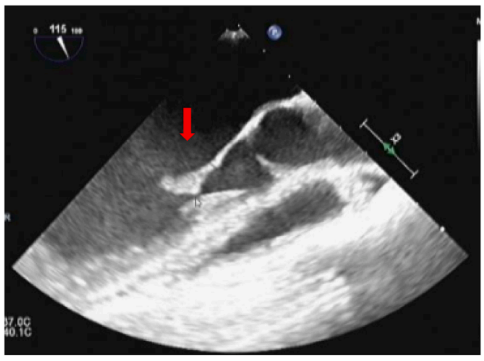

Fig. 5. Transthoracic echocardiography showing a 6.5 × 3.2 mm vegetation on the anterior mitral valve cusp (red arrow).

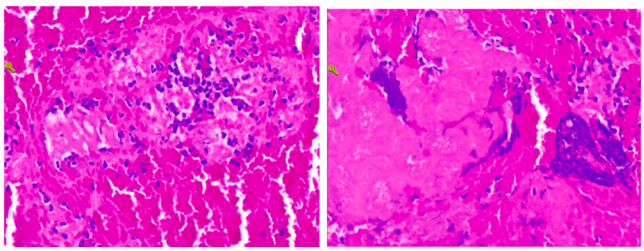

Fig. 6. The pathological specimen of the patient's cerebral thrombosis was stained with hematoxylin & eosin (H&E) reveals marked neutrophilic infiltration, with Gram-positive cocci detected by Gram staining.

often attributed to emboli from vegetations [11]. It is reported in 10–40 % of infective endocarditis cases [12,13] and is more prevalent in individuals with left-sided endocarditis [14]. Remarkably, neurological complications can manifest as the initial signs of infective endocarditis in up to 47 % of patients [15], making it a condition with a diverse array of clinical presentations [16].

While thrombolysis with intravenous alteplase remains the primary therapy for acute ischemic stroke, its use in cases of infective endocarditis-related cerebral embolism is contentious. Histopathological studies suggest that cerebral infarcts resulting from septic emboli are particularly prone to hemorrhagic transformation due to septic arteritis, which erodes the arterial wall in the recipient vessel, with or without the formation of infectious aneurysms [17]. Consequently, the American Heart Association/American Stroke Association guidelines do not recommend thrombolysis in such cases (Class III; harm) [18]. Therefore, the safety and effectiveness of mechanical thrombectomy in patients with infective endocarditis-related cerebral embolism remain a subject of debate.

In our specific case, the patient underwent a timely intra-arterial mechanical thrombectomy with a stent retriever, leading to the

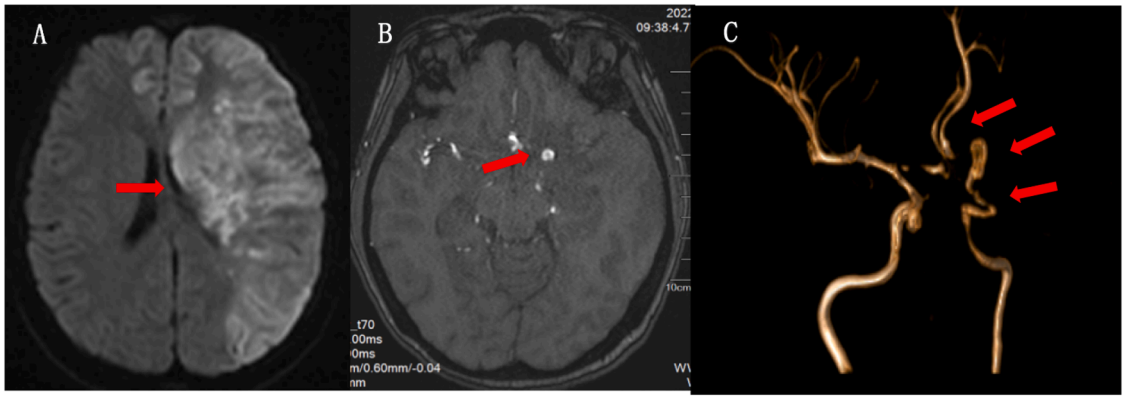

Fig. 7. Head MRI of the patient. **(A)** Large areas of acute cerebral infarction with mild hemorrhagic transformation are marked by the red arrow. **(B)** An 6.0 × 3.5 mm aneurysm in the left internal carotid artery C7 segment is indicated by the red arrow. **(C)** The red arrows point to left middle cerebral artery M1 segment occlusion, bilateral anterior cerebral artery A1 segment stenosis, and localized stenosis in the left internal carotid artery C5-C7 segments.

recanalization of blocked blood vessels. Following the procedure, her symptoms, including somnolence and limb weakness, demonstrated improvement. Although the expansion of the area of ischemic lesions and the exacerbation of clinical symptoms occurred in the subsequent few days, we should not overlook the possibility that the mechanical thrombectomy has damaged the arterial intima, resulting in the intimal infection of the left middle cerebral artery and adjacent arteries (including bilateral anterior cerebral artery and left internal carotid artery) and causing arterial stenosis. The patient's initially favorable outcome is in line with a study conducted by Katharina and colleagues, who analyzed data from the German Stroke Registry - endovascular treatment during the period from 2015 to 2019. Their findings indicated a favorable recanalization rate (74.5 %) for patients with ischemic stroke due to infective endocarditis, albeit lower than that observed in patients with atrial fibrillation (87.5 %) [19]. It is essential to note, however, that the benefits of mechanical thrombectomy were transient, and its clinical efficacy lacks strong support from the available data [20,21].

Several studies have even reported that mechanical thrombectomy may increase the incidence of postoperative cerebral hemorrhage in patients with infective endocarditis-related cerebral embolism [22]. Furthermore, it has been associated with the development of catastrophic infectious aneurysms. Mechanical thrombectomy can potentially induce endothelial dysfunction or damage [23], which may facilitate local bacterial seeding and infectious aneurysm formation at the site of the procedure. This connection between thrombectomy and infectious aneurysm is also supported by relevant case reports, including our own patient [24].

Studies exploring the impacts of different thrombectomy modalities on the vessel wall and the severity of endothelial injury suggest that thrombectomy with a stent retriever may be more harmful to all layers of the arterial wall, particularly the endothelium [25]. Conversely, cyclical aspiration appears to have a better safety profile at the end of the procedure [26]. While the safety and efficacy of cyclical aspiration in infective endocarditis-related cerebral embolism require further investigation, it is crucial to consider the specific risks, such as further septic embolization, intraprocedural arterial rupture, and infectious aneurysm formation, when offering endovascular stroke treatment to this patient population [24].

It is known that 1–20 % of patients with infective endocarditis present with meningitis [27], a rare but serious complication with reported mortality rates ranging from 2 % to 29 % [28,29]. Meningitis arises from the entry of microbes into the cerebrospinal fluid, often occurring through the rupture of blood vessels due to necrotizing arteritis or the rupture of an aneurysm or microabscess [11]. Timely identification, diagnosis, and effective antibiotic therapy are critical for improving prognosis [30]. Although early and effective antibiotic treatment in our case prevented the development of cerebral infection, it unfortunately did not alter the fatal outcome of the patient, who experienced a rupture of the infectious aneurysm with typical clinical manifestations of subarachnoid hemorrhage.

Conclusion

The co-occurrence of infective endocarditis, brain infarction, meningitis, and infectious aneurysm in a single patient presents a rare and intricate clinical scenario. Given the imperative need for urgent and condition-specific therapeutic interventions, it is essential to approach each aspect of this complex medical situation with precision. In cases where cerebral infarction manifests in individuals at a heightened risk, it is crucial to consider the possibility of underlying infective endocarditis. Risk factors contributing to this association include a history of prior infective endocarditis, the presence of prosthetic heart valves or cardiac devices, structural or congenital heart disease, intravenous drug use, and recent invasive medical procedures [31]. These factors underscore the importance of vigilant consideration of infective endocarditis in such cases. For patients with a high degree of suspicion of infective endocarditis complicated by cerebral embolism, when thrombectomy is necessary, cyclical aspiration might be more appropriate than mechanical thrombectomy. Throughout the course of treatment for this multifaceted condition, the responsibility for management falls upon a multidisciplinary team comprising cardiologists, neurologists, intensive care specialists, and cardiac surgeons. This collaborative approach ensures comprehensive and well-coordinated care, optimizing the patient's prospects for a successful outcome.

Ethical approval

Not applicable.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

Yeting Luo contributed to patient management, data collection and wrote the manuscript. Zhijuan Lu contributed to data collection. Yunhui Zhu contributed to review and editing. Zhaohui Lai contributed to supervision.

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CRediT authorship contribution statement

Yeting Luo: Writing – original draft, Project administration, Conceptualization. **Zhaohui Lai:** Writing – review & editing. **Zhijuan Lu:** Formal analysis, Data curation. **Yunhui Zhu:** Resources, Data curation.

Declaration of Competing Interest

The authors declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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