Ruptured Intracranial Mycotic Aneurysm in Infective Endocarditis: Radiological and Clinical Findings

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The management of patients with infective endocarditis complicated by intracranial mycotic aneurysm can be medical or surgical. However, it is unclear which modality is the most effective for these aneurysms. Endovascular treatment for intracranial mycotic aneurysms was recently developed, improving treatment outcome. We report a case of successful intracranial endovascular embolization in a patient with infective endocarditis who presented with acute stroke and subarachnoid hemorrhage secondary to intracranial mycotic aneurysm.

PATIENT DESCRIPTION

A 23 year old woman was admitted to our institution with a 1 month history of progressive behavioral changes, apathy, low grade fever, headache and fatigue. Physical examination revealed mild left facial paralysis, mild left hemiparesis, left upper quadranopsia and fever of 39ºC. Computed tomography and subsequent magnetic resonance imaging of the head showed subacute stroke in the right temporo-parieto-occipital lobe. A focus of subarachnoid hemorrhage in the right Sylvian fissure was noted. CT angiography showed a branch occlusion of the right middle cerebral artery at the site of the hemorrhage, but no evidence of mycotic aneurysms [Figures A-C].

The working diagnosis of cerebral infarct with unknown etiology led to subsequent investigations, which did not reveal any associated coagulopathies and the panel of autoimmune markers was within normal limits. Lumbar puncture showed pleocytosis with 330 polymorphonuclear cells, normal lactate and protein, and 37 mg/dl glucose (92 mg/dl blood glucose). Empiric intravenous ampicillin, ceftriaxone and acyclovir were started. After negative polymerase chain reaction for herpes simplex virus in a sample of spinal fluid, acyclovir was stopped and gentamicin was added. Transesophageal echocardiogram revealed moderate regurgitation associated with large mobile vegetations on the aortic and mitral valves [Figures D and E]. Blood cultures were positive for *Enterococcus faecalis* and a diagnosis of infective endocarditis was thus established.

On day 6 of admission, the patient developed signs of pulmonary hypertension and right congestive heart failure. Urgent cardiac operation disclosed perforation of the leaflets of the bicuspid aortic valve and of the anterior leaflets of the mitral valve, with multiple vegetations on the valve leaflets. The vegetations on all leaflets of both valves were shaved off. A biological prosthesis for the aortic valve was implanted, while for the mitral valve the rim of perforation was excised and commissuroplasty was performed obviating the need for prosthesis. Cultures of the vegetations yielded *Enterococcus faecalis*. Postoperative echocardiography revealed a functional mitral valve without evidence of recurrent endocarditis.

Due to the subarachnoid hemorrhage in the temporal lobe, follow-up CT angiography was performed; the angiogram raised suspicion of intracranial mycotic aneurysm in the MCA branch occlusion. Cerebral digital subtraction angiograph was performed 11 days postoperatively. It showed the established occlusion in the right MCA but also revealed a 3 mm aneurysm of the right MCA (M2 Sylvian segment) suspected to be the hemorrhagic source [Figure F]. Multiple small aneurysms of the distal MCA were also found bilaterally. Endovascular embolization was considered appropriate mainly because of the narrow neck of the aneurysm. The catheter was advanced super-selectively to the right MCA and placed inside the aneurysm. Embolization was performed using platinum coils, and the aneurysm was completely obliterated as demonstrated in Figure G. It was decided to continue with a 6 week antibiotic regimen while monitoring the size of the aneurysms. Over the course of a year, no further cerebral complications arose and the neurological symptoms resolved.

COMMENT

Intracranial mycotic aneurysms develop in infective endocarditis when friable cardiac vegetations give rise to septic emboli that lodge in intracranial vessels at branching points and distal branches. These emboli may occlude vessels, cause cerebral infarction, or promote infection. Intracranial

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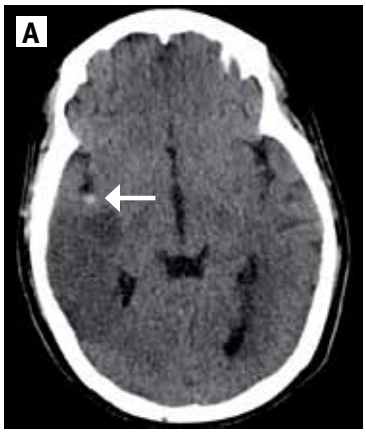
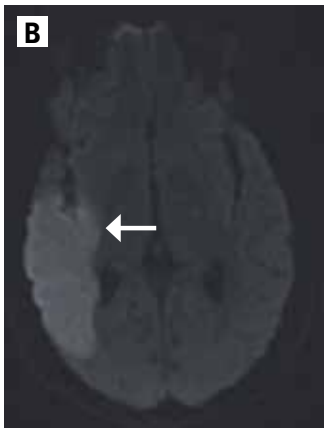
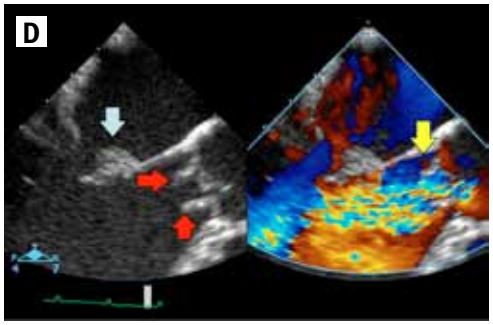
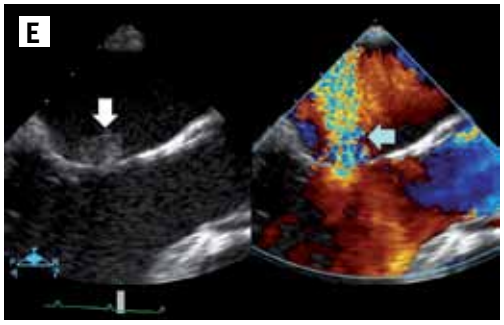
MCA = middle cerebral artery



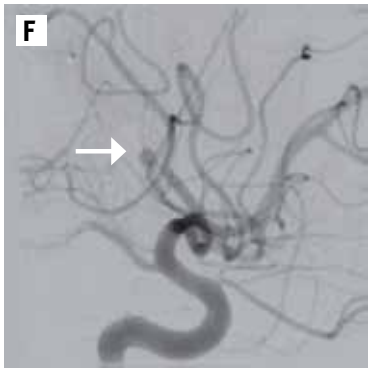


[A] Axial unenhanced head CT image showing right parieto-temporal infarct and a hyperdense focus (arrow) within the right Sylvian fissure, suspicious for acute subarachnoid hemorrhage **[B]** Diffusion-weighted MRI of brain on admission (axial view) showing an acute ischemic stroke with diffusion restriction in right parieto-temporal territory marked by arrow **[C]** T2* weighted gradient echo image showing an area of low intensity within the right Sylvian fissure consistent with hemosiderosis due to acute subarachnoid hemorrhage





[D] Transesophageal echocardiogram during diastole showing large vegetations on anterior mitral valve leaflet (white arrow) and on ventricular aspect of the aortic valve (red arrow) with associated severe aortic regurgitation (yellow arrow) **[E]** Transesophageal echocardiogram during systole showing large vegetation on anterior mitral valve leaflet (white arrow) with perforation and severe mitral regurgitation Selected DSA images reveal:



[F] Occlusion of a major Sylvian segment of the right middle cerebral artery (M2 segment) with an associated 3 mm mycotic aneurysm with narrow neck, and **[G]** following endoluminal coiling

mycotic aneurysms account for an estimated 0.7–5.4% of all intracranial aneurysms. Infective endocarditis is the most frequently encountered cause. However, many cases are clinically silent and are recognized in only 2–10% of patients with infective endocarditis. Intracranial mycotic aneurysms can manifest initially as headache and low/high grade fever; at a later stage in the course, focal deficit or subarachnoid hemorrhage may develop [1].

Digital subtraction angiography is considered the gold standard tool for the diagnosis of intracranial aneurysm. Nevertheless, the advent of multidetector CT imaging has increased the resolution of CT angiograms, allowing complete visualization of the intracranial vascular tree. A recent study demonstrated that in comparison to DSA, CTA had a sensitivity of 83% and specificity of 93% [2]. However, for aneurysms < 3 mm the sensitivity was estimated to be 45%, as compared to 95.3% for aneurysms > 3 mm. Fortunately, in our case the diagnosis of acute stroke was established early in the hospital setting, but the mycotic aneurysm (< 3 mm) was suspected only after a subsequent follow-up CTA, and was proven by DSA. Generally, in the presence of mycotic aneurysms with cerebral infarction, the risk of rupture or hemorrhagic transformation warrants a 2–3 week postponement of cardiac surgery. Heparinization and hypotension during cardiopulmonary bypass or postoperative

CTA = computed tomography angiography

DSA = digital subtraction angiography

anticoagulant therapy are liable to amplify the cerebral damage. Exception to the rule would be, as in our case, development of heart failure as a consequence of infective endocarditis. The presence of heart failure would compromise cerebral perfusion, thus negating the benefits of any prior interventions performed on an intracranial mycotic aneurysm. Hashimoto et al. [3] reported the case of a 24 year old female with mitral valve infective endocarditis and ruptured intracranial mycotic aneurysm who safely underwent urgent mechanical mitral valve replacement for worsening congestive heart failure 10 days after suffering an intracerebral hemorrhage. Neither the infective endocarditis nor the aneurysm recurred in the postoperative 4 year follow-up.

There have been no randomized controlled trials or prospective cohort studies evaluating the various treatment approaches to intracranial mycotic aneurysms in infective endocarditis. Hence, the treatment approach is highly individualized and varied among clinicians and is dependent on the patient's hemodynamic and rupture status. Usually a combination of antimicrobial, surgical and/or endovascular approaches is practiced [1,4].

When a diagnosis of mycotic aneurysm is established, a 6 week therapeutic regimen of intravenous antibiotic therapy tailored to culture results, when available, should be followed. While ruptured mycotic aneurysms should be immediately secured via surgical or endovascular means, unruptured aneurysms may be managed empirically with antibiotics. To determine the effectiveness of medical therapy, serial follow-up angiographic studies are essential. The evolution of mycotic aneurysms with antibiotic therapy can be unpredictable: they may regress, disappear, persist, enlarge, or rupture. If the aneurysm is decreased in size or completely resolved, surgical or endovascular intervention is usually unnecessary and antimicrobial therapy should be continued. However, if the aneurysm increases in size or remains unchanged, it is most likely that the patient will require intervention. Although the risk of rupture is < 2%, it should be borne in mind that it is associated with high rates of morbidity and mortality reaching 80%, hence it is prudent that an aggressive therapeutic approach be followed [5].

Whether surgical or endovascular treatment is most appropriate depends on various factors [4]. Endovascular therapy has improved its efficacy and ability to access more distal aneurysms. It is potentially safer and more effective than open craniotomy if performed at a high volume tertiary center and in the absence of increased intracranial pressure, mass effect, hypotension, hematoma, or involvement of eloquent territory, in which cases surgical therapy with open craniotomy is preferred [5]. Endovascular treatment for intracranial mycotic aneurysms, which differs from treatment for berry aneurysms, warrants occlusion of the parent arteries since these aneurysms rarely have a neck. If sacrifice of the proximal parent arteries is liable to cause infarction of their distal territories, a bypass operation should be considered.

To conclude, the case presented here emphasizes the importance of considering infective endocarditis with the presence of mycotic aneurysms in the differential diagnosis of young patients presenting with fever and focal neurological deficits. Interventional radiology, together with cardiac and neurosurgical consult is necessary to determine appropriate therapeutic intervention once the diagnosis has been established. A high level of suspicion, early diagnosis and meticulous individualized treatment is critical for successful treatment of such aneurysms. The investigation should start with a CT angiography and, if suspicion persists, DSA should be the next step.

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"It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change"

Charles Darwin (1809-1882), English naturalist who established the theories of evolution and natural selection

"Words are loaded pistols"

Jean-Paul Sartre, writer and philosopher (1905-1980), French philosopher, playwright, novelist, political activist and literary critic. He was one of the key figures in the philosophy of existentialism and phenomenology, and one of the leading figures in 20th century French philosophy and Marxism. His work has also influenced sociology, critical theory, post-colonial theory and literary studies, and continues to influence these disciplines. Sartre has also been noted for his open relationship with the prominent feminist theorist Simone de Beauvoir. He was awarded the 1964 Nobel Prize in Literature but refused it