Endovascular Treatment for an Infectious Aneurysm Prior to Cardiac Surgery: A Case Report

Masaki Sunaga, Takao Hashimoto, Daichi Kato, Hiroyumi Okada, Yujiro Tanaka, Hiroaki Namatame, Nobuyuki Nakajima, and Michihiro Kohno

Objective: In patients with infectious endocarditis requiring cardiac surgery, the presence of unruptured infectious intracranial aneurysms is an important issue. We report a patient in whom endovascular treatment for an unruptured infectious intracranial aneurysm was performed prior to cardiac surgery.

Case Presentation: A 20-year-old woman was admitted with infectious endocarditis. During the assessment, a cerebellar abscess was noted and drainage was conducted. An infectious intracranial aneurysm was observed in the posterior cerebral artery and treatment with an antimicrobial drug was continued. Due to severe heart failure, cardiac surgery was required, but there was a slight increase in the aneurysmal size. Intra-aneurysmal embolization was performed while preserving the parent artery. Subsequently, valve plasty was conducted. The patient was discharged.

Conclusion: If cardiac surgery is necessary, the treatment of infectious intracranial aneurysms should be performed in advance. If the heart failure is severe, endovascular treatment, which does not influence hemodynamics, may be useful.

Keywords: infectious intracranial aneurysm, endovascular treatment, cardiac surgery, infectious endocarditis, intra-aneurysmal embolization

Introduction

Many ruptured infectious intracranial aneurysms lead to a serious condition. It is important to determine which treatment option is selected. Continuous therapy with adequate antimicrobial drugs results in the disappearance of infectious aneurysms. However, rupture may occur even during antimicrobial therapy, and therefore the timing of surgery has been discussed. Furthermore, infectious intracranial aneurysms frequently develop in patients with infectious endocarditis who require cardiac surgery in many cases. A consensus regarding therapeutic strategies, such as the treatment of unruptured infectious intracranial aneurysms and the timing of cardiac surgery, in the presence of unruptured infectious intracranial aneurysms in patients with infectious endocarditis requiring cardiac surgery has not been reached. In this study, we report a patient in whom endovascular treatment for an unruptured infectious intracranial aneurysm was performed prior to cardiac surgery for heart failure related to infectious endocarditis, leading to a favorable outcome, and review the literature.

Case Presentation

Patient: A 20-year-old woman.
Complaints: Fever and cerebellar ataxia.
Medical/Family history: Not contributory.
Present illness: Sepsis related to central venous catheter-mediated infection occurred during the treatment of fever and liver dysfunction at a previous hospital. Echocardiography showed vegetation in the mitral valve. The patient was referred to the intensive care unit of our hospital due to heart failure related to infectious endocarditis and mitral insufficiency. On admission, the body temperature was 38.0°C and the Japan Coma Scale (JCS) score was I-1.
Cerebellar ataxia of the left upper/lower limbs, dysarthria, and right gaze nystagmus were noted. Cephalic MRI-diffusion-weighted imaging (DWI) revealed a high signal intensity involving an extensive area of the left cerebellar hemisphere and diffuse high signal intensity involving the cerebral cortex and the right thalamus (Fig. 1). A blood culture test detected methicillin-sensitive Staphylococcus aureus and an antimicrobial drug (meropenem at 2.0 g, three times a day) was administered. Heart failure treatment was started. 3D-CTA on the day of admission did not show any abnormalities, but cerebral angiography for investigating an infectious intracranial aneurysm revealed an aneurysm measuring 2.5 mm at the periphery of the left posterior cerebral artery 4 days after admission (Fig. 2). At this point, the antimicrobial drug administration was continued. Subsequently, consciousness disorder deteriorated (JCS: II-20, Glasgow Coma Scale [GCS]: E3VtM6). Cephalic CT showed a low-attenuation area in the left cerebellar hemisphere and occlusive hydrocephalus (Fig. 3A and 3B). Cephalic MRI-DWI revealed a high signal intensity in the left cerebellar hemisphere and contrast-enhanced T1-weighted imaging showed a ring-like lesion in the left cerebellar hemisphere (Fig. 3C and 3D). Following a diagnosis of a cerebellar abscess, right ventricular drainage, ventriculostomy of the third ventricle, and brain abscess drainage were performed using a neuroendoscope. After surgery, consciousness disorder improved and cephalic MRI confirmed improvements in the cerebellar abscess and the occlusive hydrocephalus (Fig. 3E and 3F). When activity increased during rehabilitation, the heart condition deteriorated. Cardiac surgery for mitral insufficiency was required. We considered cardiac surgery involving systemic heparinization in the presence of an unruptured infectious intracranial aneurysm extremely dangerous if it ruptures. When re-evaluating cerebral angiography findings, the infectious intracranial aneurysm measured 3 mm, showing a slight increase. Therefore, we chose a strategy to conduct endovascular treatment for the infectious intracranial aneurysm prior to cardiac surgery.

Neuroendovascular treatment

Under local anesthesia, a guiding catheter (ENVOY 6 Fr MPD 90 cm; Codman, Johnson & Johnson, Raynham, MA, USA) was inserted into the left vertebral artery through the right femoral artery. A Marathon microcatheter (Covidien, Medtronic, Irvine, CA, USA) was guided to the aneurysmal neck using a TENROU 200 cm microguidewire (Kaneka Medix, Osaka, Japan) (Fig. 4A). After inserting two coils (ED coil Extrasoft, 2.5 × 30 mm, 1.5 × 10 mm, Kaneka Medix) into the aneurysm (Fig. 4B), embolization with 33% n-butyl-2-cyanoacrylate (NBCA) was conducted. NBCA became entangled with the coils, facilitating intra-aneurysmal embolization with the preservation of the parent artery. On vertebral arteriography, the aneurysm was not visualized, and the parent artery, the left posterior cerebral artery, involving its periphery was visualized (Fig. 4C and 4D). After endovascular treatment, mitral valve plasty was performed, with a cardiopulmonary bypass time of 5 hours and 20 minutes. There was no cerebral aneurysmal rupture and surgery was completed. After rehabilitation, the patient was discharged. Cerebral angiography was performed 6 months after discharge. Left vertebral arteriography did not show any additional enlargement of the aneurysm or contrast enhancement. There was no new lesion or vascular occlusion (Fig. 5). Rehabilitation was achieved, with a modified Rankin Scale score of 0.

Discussion

Infectious intracranial aneurysms develop in 4%–15% of patients with infectious endocarditis. According to a previous study, the rupture-related mortality rate is 80%. Even a recent study reported a mortality rate of 37%. Early diagnosis and appropriate antimicrobial drug therapy...
are necessary. However, a consensus regarding the timing of surgery for unruptured infectious intracranial aneurysms has not been reached. Such aneurysms may disappear after the continuous administration of an antimicrobial drug. Many studies recommended that an antimicrobial drug should be initially administered for 4–6 weeks. During antimicrobial drug administration, follow-up should be strictly conducted through image assessment. If there is an increase in the aneurysmal size, rupture may occur, and surgery must be considered. In the present case, an unruptured infectious intracranial aneurysm was present, and after initial continuous administration of an antimicrobial drug, a follow-up CTA was frequently performed.

For the treatment of infectious intracranial aneurysms, no guideline has been established in which order the two procedures, open heart surgery and infectious aneurysm treatment, should be conducted in patients with infectious endocarditis requiring cardiac surgery. The merit of prevailing infectious intracranial aneurysm treatment is to eliminate the risk of aneurysmal rupture. Infectious intracranial aneurysms are false aneurysms, and the risk of rupture is higher than that of saccular aneurysms. As a cardiopulmonary bypass is used during cardiac surgery, systemic heparinization and blood pressure changes are present; ruptured infectious intracranial aneurysms may lead to a fatal outcome. In Japan, several studies have indicated that the treatment of infectious intracranial aneurysms before valve replacement contributed to a better outcome. However, there are some limitations: Surgery for the heart, as the source of embolism/infection, is performed after aneurysm treatment and treatment under general anesthesia may worsen heart failure symptoms. In the present case, the inflammatory response was reduced and there was no active embolic symptom, making elective cardiac surgery feasible. Considering the risk of aneurysmal rupture, cardiac surgery following infectious intracranial aneurysm treatment may be a better option. In addition, follow-up cerebral angiography showed a slight increase in the aneurysmal size, so aneurysm treatment was performed prior to cardiac surgery.

To treat infectious intracranial aneurysms, surgical treatment and endovascular treatment are possible approaches. The merits of surgical treatment include hematoma removal/decompression and revascularization. However, there are some limitations: 1) Surgical treatment is performed under general anesthesia, and deterioration may occur in patients with unstable hemodynamics; 2) it is difficult to start anticoagulant therapy promptly; and 3) surgical procedures are difficult due to the fragile blood vessel and aneurysmal site. On the other hand, the merits of endovascular treatment are as follows: 1) It can be performed under local anesthesia in patients with unstable hemodynamics; 2) anticoagulant therapy can be promptly started; and 3) the aneurysm treatment-related delay in cardiac surgery can be minimized. The limitations of endovascular treatment include the following: 1) Giant hematoma removal/decompression is impossible and 2) parent artery occlusion for eloquent-area aneurysms may induce

Fig. 2 Left vertebral arteriography (A) anterior-posterior view, (B) lateral view. An aneurysm measuring 2.5 mm was observed at the periphery of the left posterior cerebral artery. Circle: aneurysm
Fig. 3  (A) Cephalic CT (axial imaging). In the left cerebellar hemisphere, a low-attenuation area was noted. Occlusion of the cerebral aqueduct and enlargement of the inferior horn of the lateral ventricle were observed. (B) Cephalic CT (axial imaging). Enlargement of the lateral and the third ventricles was noted. (C) Cephalic MRI-DWI (axial imaging). In the left cerebellar hemisphere, a high signal intensity was detected. Narrowing of the fourth ventricle was observed. (D) Cephalic MRI (contrast-enhanced T1-weighted axial imaging). In the left cerebellar hemisphere, a ring-like contrast was noted. (E) Cephalic MRI-DWI. An improvement in cerebellar abscess was noted. (F) Cephalic MRI (FLAIR axial imaging). An improvement in ventricular enlargement was noted. DWI: diffusion-weighted imaging; FLAIR: fluid-attenuated inversion recovery
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The non-eloquent area of the peripheral posterior cerebral artery. As an endovascular treatment procedure, intra-aneurysmal embolization was performed. Considering cardiac surgery, coil embolization with NBCA was conducted to reduce the likelihood of neurological deficits or cerebral infarction. A follow-up after 6 months did not show any additional increase in the aneurysm. In the present case, intra-aneurysmal embolization was adopted, but parent artery occlusion may also be effective for infectious intracranial aneurysms.

In the literature, many strategies to treat infectious intracranial aneurysms have been presented. For endovascular treatment, parent artery occlusion is frequently performed when treating peripheral cerebral aneurysms. It is chosen for non-eloquent-area aneurysms. However, a peripheral blood vessel with an infectious intracranial aneurysm has a history of embolism and it is symptomatic. Alternatively, if it is asymptomatic, it is localized in a non-eloquent area. The embolization of the blood vessel alone, as a parent artery, may not induce any new symptom. Endovascular surgery for infectious intracranial aneurysms may cause infection, but no study has reported the deterioration of infection related to endovascular treatment after potent antimicrobial drug therapy. In the present case, endovascular treatment was chosen for the following reasons: 1) hemodynamics were unstable and local anesthesia was more appropriate and 2) the aneurysm was present in the non-eloquent area of the peripheral posterior cerebral artery. As an endovascular treatment procedure, intra-aneurysmal embolization was performed. Considering cardiac surgery, coil embolization with NBCA was conducted to reduce the likelihood of neurological deficits or cerebral infarction. A follow-up after 6 months did not show any additional increase in the aneurysm. In the present case, intra-aneurysmal embolization was adopted, but parent artery occlusion may also be effective for infectious intracranial aneurysms.

In the literature, many strategies to treat infectious intracranial aneurysms have been presented. The present case suggests that follow-up imaging should be frequently performed while continuing antimicrobial drug therapy for unruptured infectious intracranial aneurysms and that endovascular treatment for infectious intracranial
Fig. 5  Left vertebral arteriography 6 months after treatment (A and C) anterior-posterior view and (B and D) lateral view. No aneurysm was detected and there was no new lesion. Peripheral blood flow was maintained. arrow: coil

Fig. 6  Treatment algorithm for infectious intracranial aneurysms.
aneurysms should be conducted prior to cardiac surgery when necessary. For the treatment of infectious intracranial aneurysms, an appropriate antimicrobial drug should be administered in the early stage. If a giant hematoma related to a rupture is present, surgical treatment should be considered. If it is absent or the risk of aneurysmal rupture is high (large, symptomatic, irregular, or enlarging aneurysms), endovascular treatment or surgical treatment should be considered. If hemodynamics are unstable, endovascular treatment should be considered. If an aneurysm is present in a non-eloquent area under stable hemodynamics, endovascular treatment should be considered. If an aneurysm is present in an eloquent area under stable hemodynamics, surgical treatment should be considered. If the risk of rupture is low, follow-up imaging should be frequently performed while continuing antimicrobial drug therapy. If enlargement or rupture is observed, endovascular treatment or surgical treatment should be considered. Even in patients with unruptured infectious intracranial aneurysms, endovascular treatment should be initially considered when cardiac surgery is required (Fig. 6).

### Conclusion

In infectious endocarditis patients with unruptured infectious intracranial aneurysms requiring cardiac surgery, aneurysm treatment is an issue. Our results suggest that endovascular treatment for infectious intracranial aneurysms prior to cardiac surgery leads to a favorable outcome.

### Disclosure Statement

There is no conflict of interest for the corresponding author and coauthors.

### References


