INTRODUCTION

Pediatric acute ischemic stroke (AIS) is a relatively rare disease with an estimated incidence of 2.4–13 per 100000 children. However, pediatric AIS can lead to significant morbidity and mortality. Stroke in children differs from that in adults with respect to etiology, clinical presentation, or management. Therapeutic options for adult AIS are intravenous tissue plasminogen activator, intra-arterial pharmacological thrombolysis, and mechanical thrombectomy. However, management strategies for pediatric AIS, extrapolated largely from those of adult AIS, remain controversial. In this article, we present our experience in a boy with AIS, who was successfully treated with mechanical thrombectomy, by utilizing the Solitaire FR revascularization device.

Index terms
Pediatric
Stroke
Thrombectomy

CASE REPORT

A previously healthy 6-year-old boy was brought to the emergency department of another hospital 1 hour after acute onset of headache. There was no history of head injury or fever. Initial assessment revealed no neurologic signs and his first brain computed tomography was unremarkable. He arrived at our hospital 5 hours after the initial symptom. On arrival to our hospital, he developed a generalized seizure and impaired consciousness. His Pediatric NIH Stroke Scale score was 18. In an effort to sta-
Acute Ischemic Stroke in a 6-Year-Old Boy, Treated with Mechanical Thrombectomy

bilize his condition and perform magnetic resonance imaging (MRI) of the brain, he was intubated and sedated. MRI of his brain showed an acute infarction in the left middle cerebral artery (MCA) territory (Fig. 1A, B). Contrast-enhanced MR angiography (MRA) showed an occlusion of the proximal left M1 segment (Fig. 1C). At the time of arrival to our hospital, it was beyond the time window for intravenous administration of tissue plasminogen activator (tPA). In consideration of the severity of his symptoms and radiological confirmation of left proximal MCA occlusion, mechanical thrombectomy was considered as the best treatment option.

While he was intubated and was under general anesthesia, unilateral right femoral artery was accessed with a 6-Fr femoral sheath six hours after his initial symptom onset. Then, a 6-Fr guide catheter (Envoy, Cordis Endovascular, Miami Lakes, FL, USA) was placed in the left internal carotid artery. A cerebral angiogram revealed the occluded left proximal M1 segment (Fig. 1D). The diameter of the left MCA proximal to the occlusion site was 4.68 mm. A 0.014-inch guide wire (Transend; Boston Scientific, Natick, MA, USA) was carefully navigated and advanced through the thrombus in the M1 segment. This was followed by insertion of a Prowler 18 microcatheter (Cordis Endovascular, Miami Lakes, FL, USA) over the guide wire. After the microcatheter was placed distal to the thrombus, an angiogram was carried out through the microcatheter to confirm that the microcatheter had been placed properly in the true lumen. A 4 × 20 mm-sized Solitaire FR revascularization device (ev3 Inc., Irvine, CA, USA) was inserted through the microcatheter,

![Fig. 1. A 6-year-old boy with acute ischemic stroke. A, B. Diffusion-weighted imaging and apparent diffusion coefficient map shows acute infarction in the left middle cerebral artery territory (arrows). C. Contrast enhanced MR angiography shows proximal left M1 segment occlusion. D. Cerebral angiogram shows an occlusion in the proximal M1 segment of the left middle cerebral artery. E. Solitaire FR revascularization device (arrows) is deployed in the occluded M1 segment. F. Post-thrombectomy angiogram shows complete recanalization of the left proximal M1 segment (arrows).]
and then deployed in the occluded M1 segment (Fig. 1E). Three minutes later, the Solitaire revascularization device and the microcatheter were withdrawn together. The thrombus was successfully captured and removed. Post-thrombectomy angiogram demonstrated complete recanalization of the left proximal MCA, but the vascular flow was slightly slower than normal (TICI grade 2b) (Fig. 1F). The total procedure time from femoral arterial puncture to recanalization was 55 minutes.

After mechanical thrombectomy, he was transferred to the intensive care unit and extubated after 12 hours. His consciousness level improved slowly and gradually the next day after the procedure.

**DISCUSSION**

Pediatric AIS, with an estimated incidence of 2.4 to 13 per 100,000 children per year, is a relatively rare disease that remains one of the most common causes of death in childhood with a mortality rate of 0.6 per 100,000 children per year (5). Pediatric AIS differs from adult AIS with the respect to etiology, clinical presentation, management, and recovery. Common underlying etiologies for pediatric AIS include congenital or acquired cardiac diseases, trauma, vascular, hematologic, infectious and metabolic disorders (6). On the other hand, degenerative vascular disease, such as atherosclerosis may have a crucial role in adult AIS (7). Nevertheless, approximately one half of pediatric AIS occurs in children with unknown risk factors (8). Clinical presentation may vary based on the child's age. The younger the age of the child, the more nonspecific their symptoms may be (3). Although a focal neurologic deficit is the most common presentation of pediatric AIS, seizure, headache, language and speech difficulties, and altered mental status are also possible (7). Therefore, diverse clinical manifestations of pediatric AIS make it difficult to differentiate it from other causes of acute neurologic symptoms (9).

The principal goal of acute endovascular therapy for AIS is prompt recanalization of the occluded vessel and restoration of blood flow to the ischemic area of the brain. In adults with AIS, intravenous administration of tPA within 4.5 hours of symptom onset is recommended. Patients presenting outside this therapeutic window or those with a contraindication for intravenous tPA may benefit from intra-arterial pharmacological thrombolysis or mechanical thrombolysis/thrombectomy with a variety of endovascular devices (4). An international multicenter study, “TIPS” (thrombolysis in pediatric stroke) offered intravenous tPA within 3 hours of AIS onset, and intra-arterial tPA within 3–6 hours of onset (10). However, the exact diagnosis of pediatric AIS is often delayed beyond the 4.5 hour established time window since it is difficult to differentiate pediatric AIS from other causes of acute neurologic symptoms (9). Therefore, Ellis et al. (4) reported that endovascular therapy may be one of the most helpful options in pediatric AIS. According to them, children with significant and potentially disabling neurologic deficits and radiologically confirmed occlusion of a dominant cerebral artery should be considered for endovascular therapy (4). In this case study, endovascular therapy was preferentially considered initially due to the fact that 1) the child was admitted to our hospital five hours after symptom onset; and 2) the child had significant neurologic deficits, and showed an acute infarction of the left MCA territory on MRI and proximal left M1 segment occlusion on contrast-enhanced MRA. Ellis et al. (4) reported based on their analysis that mechanical thrombectomy was associated with a hemorrhage rate of 9.1%, while intra-arterial pharmacological thrombolysis yielded a hemorrhage rate of 30.4%. Thus, they recommended the use of mechanical thrombectomy alone, whenever possible. Huded et al. (6) also insisted that the use of mechanical thrombectomy should be considered as a treatment option for large vessel pediatric stroke.

In summary, the incidence of pediatric AIS is low and its diagnosis often delayed beyond the 4.5 hour established time window, which is regarded to be efficacious for intravenous tPA. Thus, mechanical thrombectomy using a new generation clot retrieval device should be carefully considered as a therapeutic alternative in children with large vessel occlusion.

**REFERENCES**

1. Giroud M, Lemesle M, Gouyon JB, Nivelen JL, Milan C, Dumas R. Cerebrovascular disease in children under 16 years of age in the city of Dijon, France: a study of incidence and clinical features from 1985 to 1993. J Clin Epidemiol 1995; 48:1343-1348
2. deVeber GA, MacGregor D, Curtis R, Mayank S. Neurologic outcome in survivors of childhood arterial ischemic stroke
혈전 제거술을 이용한 6세 남아의 급성 뇌경색의 치료: 증례 보고

김기홍1 · 이무숙1* · 양태기2

소아 급성 뇌 경색은 매우 드문 질환이나, 소아 사망의 원인이 되는 흔한 질환 중의 하나이고, 중증 장애를 일으킨다. 소아 뇌 경색은, 그 원인, 임상 중상 그리고 치료방법에 있어서 성인 뇌 경색과 차이가 있는데, 특히 성인 급성 뇌 경색의 치료 방법인 정맥 내 tissue plasminogen activator 주입, 동맥 내 혈전 용해술 그리고 기계적 혈전 제거술은 소아에게 일괄적으로 적용하는 것은 아직 논란이 있다. 이에 저자들은 Solitaire FR 혈관 재형성 기구를 이용해 성공적으로 급성 허혈성 뇌 경색을 치료한 6세 남아의 증례를 보고하고자 한다.

제주대학교 의학전문대학원 제주대학교병원 1영상의학과, 2신경외과