# Intracranial Stenting as a Rescue Therapy in Patients with Stroke-in-Evolution

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*Background:* The feasibility and efficacy of intracranial stenting were evaluated for patients with a stroke-in-evolution after the time window for thrombolysis. *Methods:* Patients with symptomatic intracranial steno-occlusive disease with progressive or fluctuating symptoms were treated using intracranial stenting after the time window for hyperacute thrombolysis. *Results:* Within the study period, we identified 10 patients (7 men, 62.5 ± 11.3 years old) who were eligible for inclusion. The median onset-to-arrival time was 5.8 hours (range: .6-144 hours), and the median onset-to-procedure time was 33 hours (range: 8-346 hours). Only 1 patient previously received intravenous thrombolysis using alteplase. The symptomatic occlusive artery was the right middle cerebral artery, left middle cerebral artery, and basilar artery in 3, 1, and 6 patients, respectively. The median initial National Institutes of Health Stroke Scale (NIHSS) score was 4 (range: 0-6), and the median NIHSS score measured immediately before the procedure was 8 (range: 4-26). All but 1 patient underwent successful angioplasty and stenting using a Wingspan stent. Reocclusion of the stented artery occurred in 1 patient, and his neurological status deteriorated to coma. A favorable outcome (modified Rankin Scale ≤2) at 3 months was noted in 7 patients (70%). *Conclusion:* Intracranial stenting could be considered an alternative strategy for treating patients with medically intractable stroke-in-evolution. **Key Words:** Brain infarct—stents—neurological deterioration—outcome.


## Introduction

Ischemic stroke is defined as a neurological deficit attributed to an acute focal injury of the central nervous system with a vascular cause.[1] The etiology of ischemic stroke is one of the most important clinical determinants of patient outcome. Intracranial atherosclerotic stenosis (ICAS) is one of the major causes of ischemic stroke, and its high prevalence among Asians in comparison to other ethnic groups increases its clinical importance for the Asian population.[2] Patients with a history of stroke and ICAS have a higher risk of early neurological deterioration, recurrent stroke, or mortality.[3,4] Recent improvements in endovascular treatment for acute stroke have resulted in overwhelming changes in clinical practice and better clinical outcomes for patients with hyperacute stroke treated within the acute revascularization time window.[5] However, there is no consensus concerning the management of patients whose symptoms progress or fluctuate after the acute revascularization time window. For symptomatic carotid stenosis, recent guidelines recommend carotid endarterectomy or carotid artery stenting within 2 weeks to prevent early recurrent stroke or stroke progression.[6] In contrast to carotid artery disease, intracranial steno-occlusive disease is treated differently. After the failure of the stenting versus aggressive medical therapy for intracranial arterial

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stenosis (SAMMPRIS) trial,[7] concern about the risk of intracranial revascularization has grown, and physicians are hesitant to perform intracranial angioplasty and stenting. However, intracranial angioplasty and stenting can change the clinical course for patients with symptomatic ICAS that is medically intractable. In this study, we describe our experience with intracranial angioplasty and stenting for patients with stroke-in-evolution or fluctuating symptoms.

## Methods

We collected data on patients who experienced a stroke and underwent intracranial arterial stenting between 2008 and 2015 from the Korea University Stroke Registry (KUSR) Guro-arm. In brief, KUSR is a prospectively collected, tertiary hospital-based acute stroke registry that contains information of demographics, vascular risk factors, clinical features, radiological findings, and management decisions. Ischemic stroke was defined as focal neurological symptoms with relevant positive imaging findings. The inclusion criteria in this study were an acute stroke caused by ICAS (>70%) or occlusive disease, treatment via intracranial stenting, and a progressive or fluctuating neurological deficit before intracranial stenting. A progressive or fluctuating neurological deficit was defined as newly developed cerebral hemispheric cortical symptoms, such as neglect, aphasia, hemianopsia with or without motor weakness in the case of anterior circulation infarct, and decreased consciousness or newly developed brainstem signs or symptoms originating from a new brainstem segment or the contralateral side in the case of posterior circulation infarct (Fig 1). Patients who presented with hyperacute stroke (<6 hours) and underwent intracranial artery stenting for acute recanalization were excluded from this study. We described demographics, vascular risk factors, the involved lesion and arterial territory, and medical treatment for each patient. In addition, details of interventional treatment were also presented. Neurological status was evaluated using the National Institutes of Health Stroke Scale (NIHSS) on admission, before the procedure, and 24 hours after the procedure. A favorable functional outcome was defined as modified Rankin Scale (mRS) 0-2 at 3 months after stroke onset.

All interventional procedures were performed under local anesthesia in an angiography suite equipped with a biplane digital subtraction angiography system (AXIOM Artis dBA, Siemens, Munich, Germany). After the placement of a 6- to 8-French sheath in the common femoral artery, a 6-French guiding catheter (Envoy, Codman, Raynham, MA, USA) was advanced and positioned in the distal cervical segment of the internal carotid artery or vertebral artery. For patients with occlusion in noninvasive images, we reviewed the angiography images meticulously to clarify the presence of delayed filling of the distal segment by an occlusive lesion. Then, we carefully introduced the microwire across the suspicious occlusive segment. After confirming the distal segment by microcatheter angiography, the final decision for angioplasty and stenting was made. Intracranial navigation was performed using a microcatheter (Echelon 10, MicroTherapeutics, Irvine, CA, USA) over a .014-inch microwire (Transend, Boston Scientific Corporation, Natick, MA, USA). After measurement of the lesion's length and the arterial diameter in a normal neighboring arterial segment, the sizes of the prestenting angioplasty balloon and stent were decided. Before stent placement, percutaneous balloon angioplasty was performed using a Gateway balloon (Boston Scientific Corporation). Usually, we selected an oversized stent and slowly deployed this

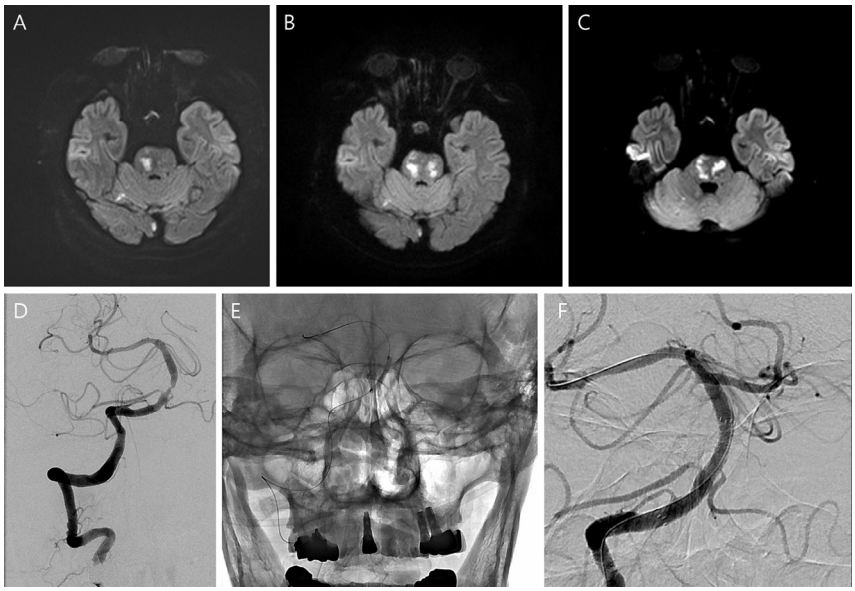


**Figure 1.** *Illustrative case. A 74-year-old man (case number 9) reported recurrent loss of consciousness and dizziness. Diffusion-weighted images obtained on (A) the first, (B) third, and (C) eighth days of hospitalization reveal a new pontine lesion. (D) Right vertebral arteriography demonstrates severe stenosis in the mid-basilar artery. The procedure was repeated (E) after balloon angioplasty and (F) following successful intracranial stenting by using a Wingspan stent. The NIHSS score improved from 26 before the procedure to 2 at 24 hours after the procedure. Abbreviation: NIHSS, National Institutes of Health Stroke Scale.*