One-Stop Management of Acute Ischemic Stroke Using an Angio-CT System: A Case Report

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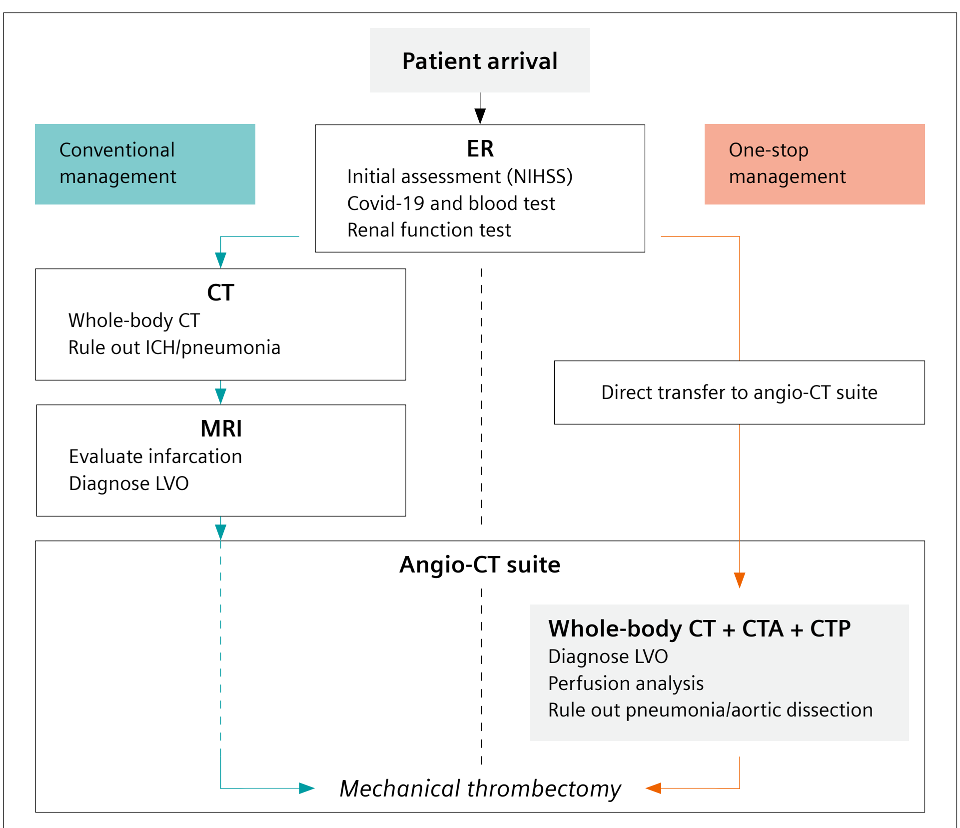
Introduction

The COVID-19 pandemic created significant challenges in managing acute ischemic stroke (AIS), as infection assessments and pneumonia screening – though essential for safety – often delayed diagnosis, treatment initiation, and onset-to-recanalization times [1–4]. To address this, protocols were modified to minimize delays while maintaining safety. Previous reports have emphasized the need to balance effective AIS treatment with infection prevention by integrating imaging, adapting workflows, and reducing transfers [5]. Although the public health emergency has ended, developing new protocols remains important to prepare for future pandemics.

The information in this paper is based on research results that are not commercially available.

Mechanical thrombectomy (MT) is highly effective for AIS and can be performed up to 24 hours after onset with perfusion imaging [6–12]. However, outcomes remain time-dependent, making rapid recanalization critical. Thus, even during the pandemic, minimizing delays while assessing infection status was essential for achieving optimal outcomes.

The Nexaris Angio-CT system, which combines biplane angiography and CT imaging in one suite, enables one-stop AIS management (Fig. 1), pneumonia assessment, perfusion analysis, and endovascular therapy without patient transfer. We demonstrate its impact on treatment efficiency and patient outcomes [13].



1 One-stop management workflow. After initial neurological assessment, the patient was transferred directly to the angio-CT suite, where whole-body CT, CT perfusion (CTP), and CT angiography (CTA) were performed to confirm large vessel occlusion and to exclude aortic dissection or pneumonia.

Angio-CT system

This angio-CT system consists of a biplane angiography unit (Artis zee biplane; Siemens Healthineers, Forchheim, Germany) and a CT scanner, separated by a movable wall. For suspected stroke, the wall was removed and the angiography table rotated 180° for CT use, enabling one-stop diagnosis and treatment (Fig. 2). The suite, located in the emergency department, is also used for trauma, acute myocardial infarction, and other urgent vascular diseases.

CT perfusion and 3D CT angiography

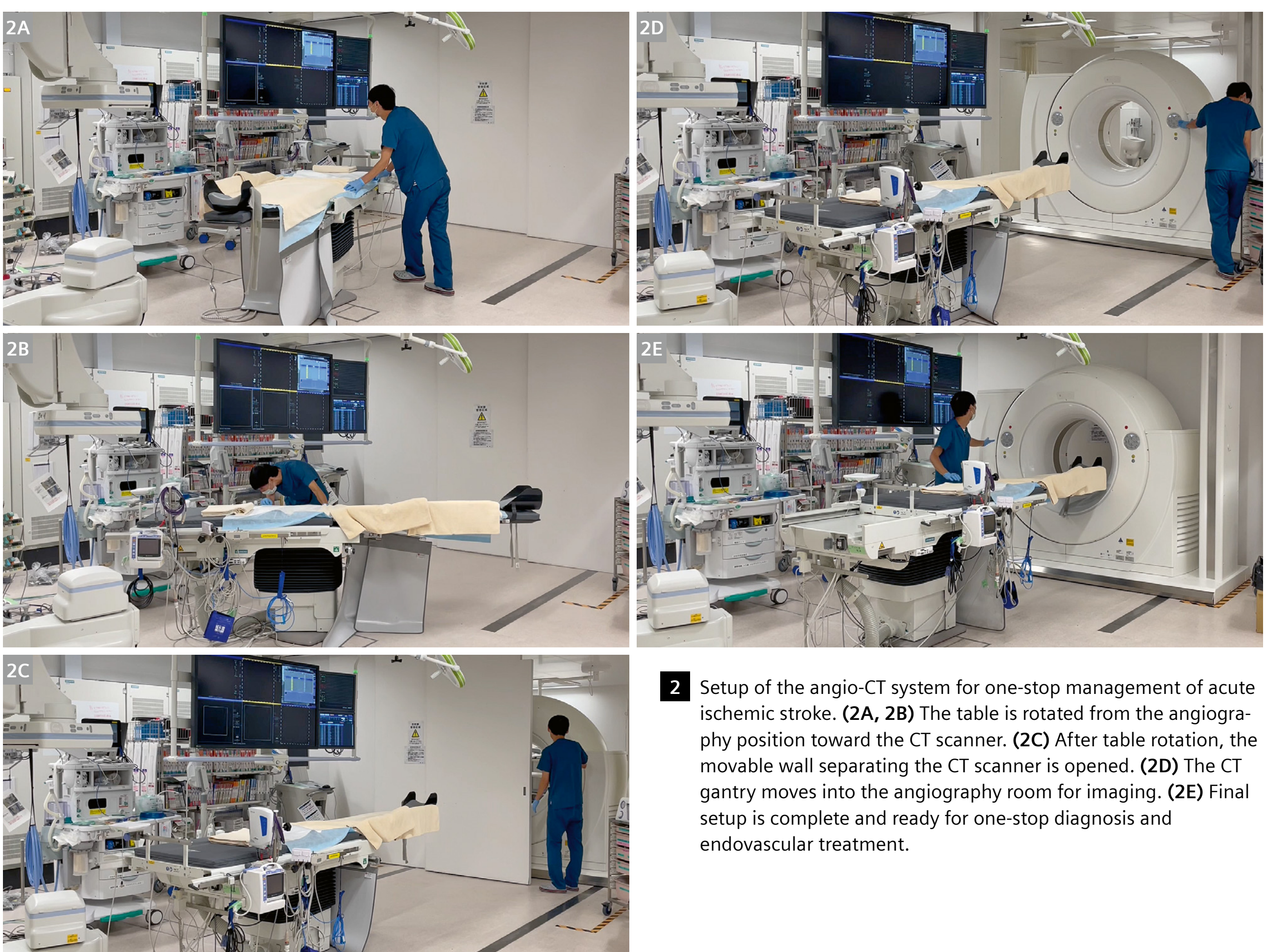
CT scans were performed on a SOMATOM Definition AS with Sliding Gantry (Siemens Healthineers, Forchheim, Germany). After excluding hemorrhage and pneumonia on non-contrast CT, we performed contrast-enhanced perfusion CT and 3D CT angiography. Contrast medium (35 mL, Iopamiron 370; Schering, Osaka, Japan) was injected at 6 mL/s, followed by saline. Imaging parameters were 80 kV, 200 eff mAs, 0.3 s rotation, and a 96 mm scan range. 3D CT angiography provided vascular information from the aorta to the intracranial arteries and ruled out aortic dissection.

Parameter analysis and treatment decision

All imaging data were transferred to a clinical workstation (syngo.via; Siemens Healthineers, Forchheim, Germany) and analyzed with syngo.CT Neuro Perfusion VB50 to generate multiparameter perfusion maps for ischemic core and penumbra assessment to guide treatment decisions.

Case presentation

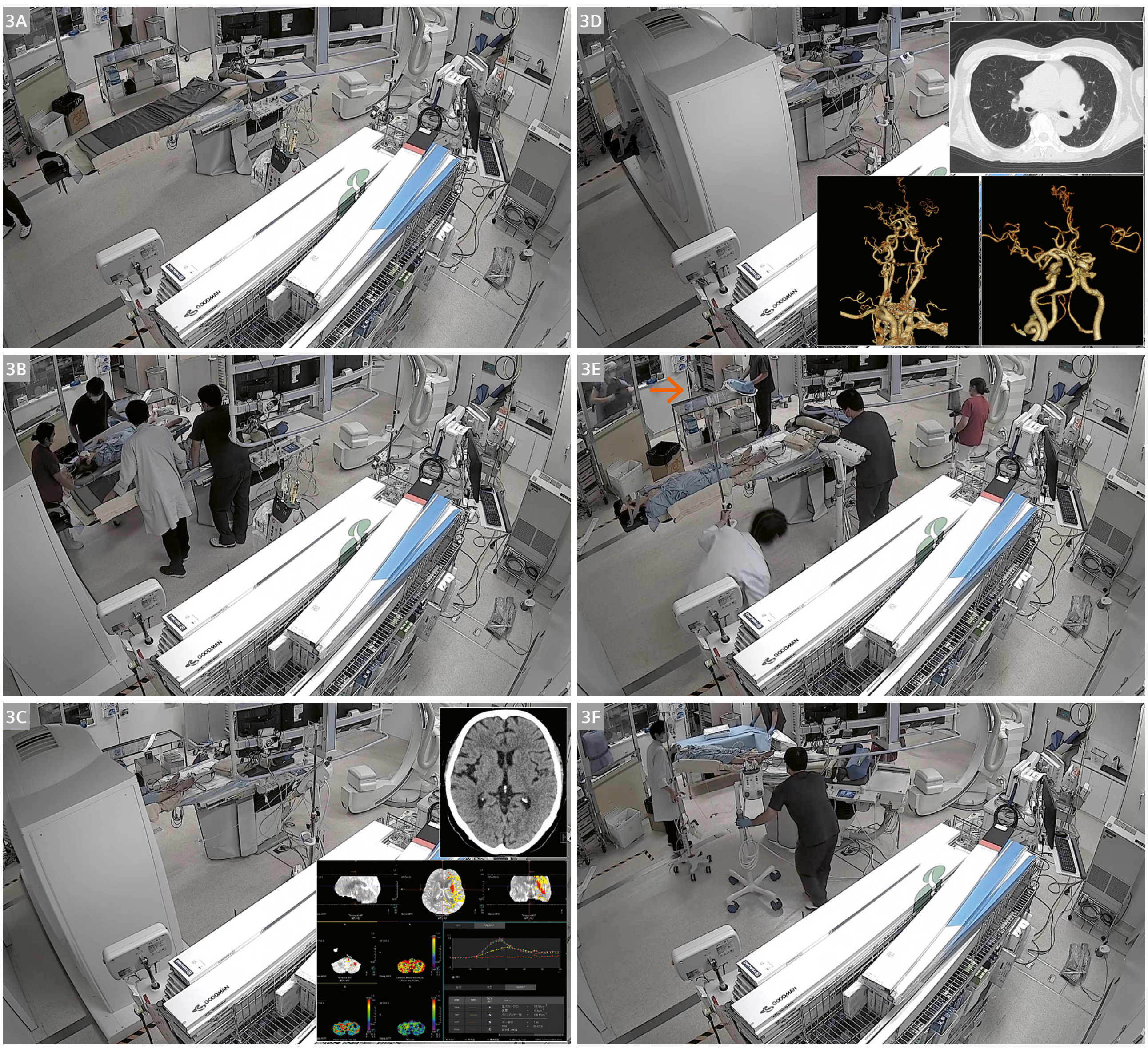
A 64-year-old woman with a past medical history of hypertension presented to our hospital with sudden-onset left hemiparesis and dysarthria, 89 minutes after symptom onset. On arrival, her blood pressure was 238/134 mmHg and her cardiac rhythm was sinus. Neurological examination demonstrated left hemiparesis and left conjugate gaze deviation.



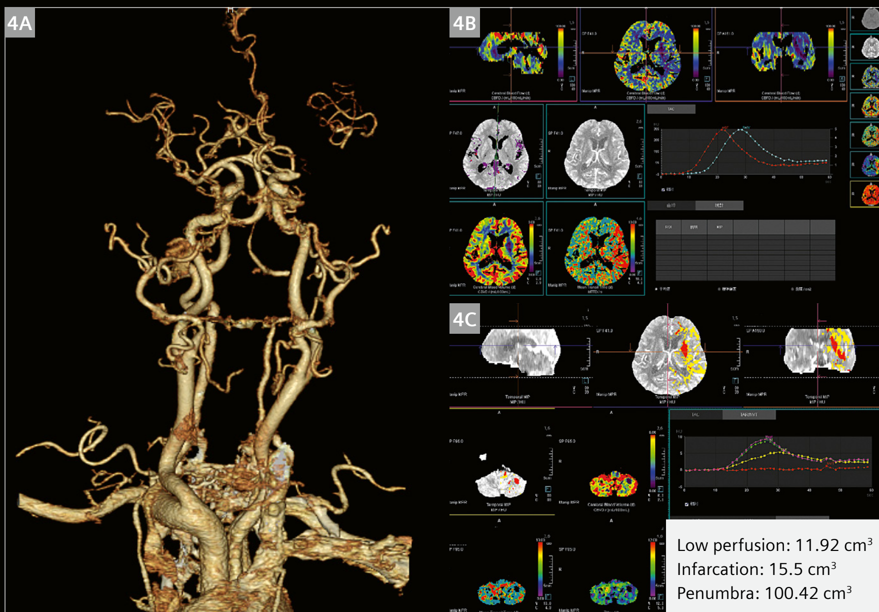
2 Setup of the angio-CT system for one-stop management of acute ischemic stroke. **(2A, 2B)** The table is rotated from the angiography position toward the CT scanner. **(2C)** After table rotation, the movable wall separating the CT scanner is opened. **(2D)** The CT gantry moves into the angiography room for imaging. **(2E)** Final setup is complete and ready for one-stop diagnosis and endovascular treatment.

One-stop acute ischemic stroke management

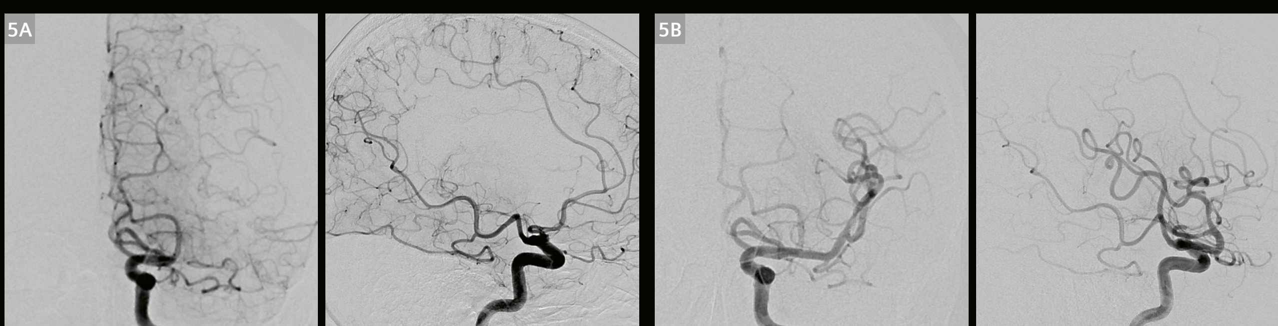
After receiving a transport notification from the emergency medical services (EMS), the radiology technologist pre-rotated the angiography table in preparation for the patient's arrival. The patient arrived at 6:29 a.m. After neurological assessment, laboratory tests, and COVID-19 screening, imaging was initiated at 6:37 a.m. (Fig. 3). The patient was deemed eligible for MT based on initial imaging, which revealed a left middle cerebral artery (M1) occlusion and a large ischemic penumbra (Fig. 4). Arterial puncture was performed at 6:58 a.m., and endovascular treatment with an aspiration catheter and stent retriever achieved complete recanalization (a Thrombolysis in Cerebral Infarction (TICI) score of 3) with a single pass at 7:32 a.m. (Figs. 5, 6).



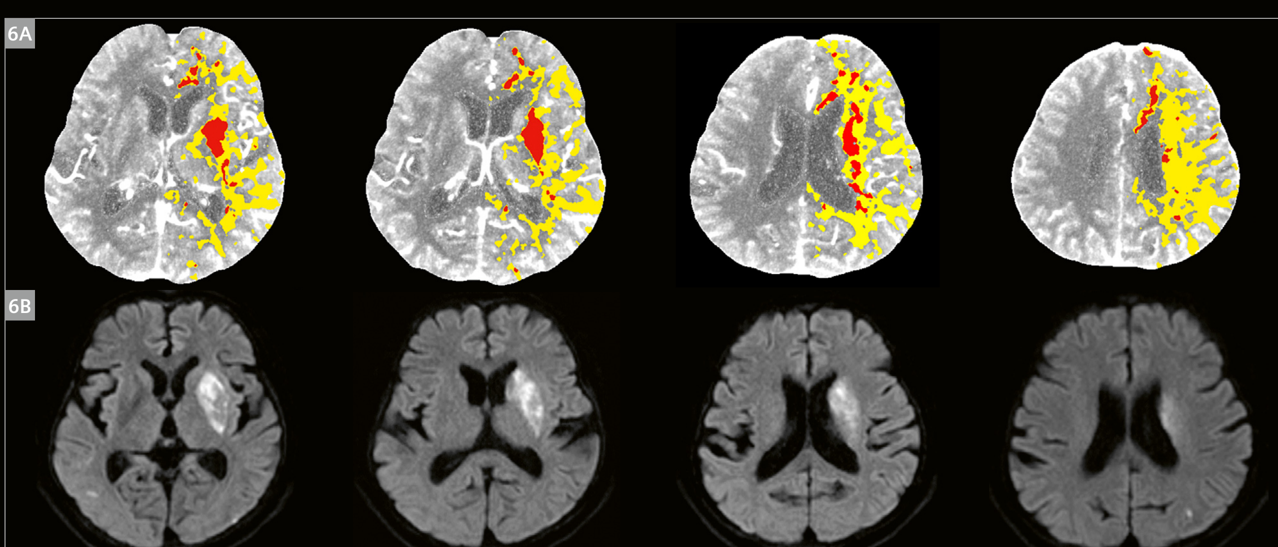
3 Imaging workflow of CT perfusion and 3D CT angiography in the angio-CT suite. **(3A)** The examination table is pre-rotated in preparation for the patient's arrival. **(3B)** The patient is transferred onto the angiography table. **(3C)** An initial non-contrast head CT is performed to rule out hemorrhage, followed by CT perfusion (approximately 1 minute and 20 seconds) to assess cerebral ischemia. **(3D)** A chest CT is performed to check for COVID-19-related pneumonia. While the chest CT is being acquired, the CT perfusion images are reviewed. A 3D CT angiography (approximately 2 minutes) is then performed to evaluate the aortic arch and intracranial vessels. **(3E, 3F)** After imaging, the examination table is rotated back to the treatment position, and preparation for endovascular treatment begins immediately (arrow). The time from patient arrival to the start of treatment preparation is approximately 12 minutes, and arterial puncture is achieved within 30 minutes of arrival.



4 Initial imaging findings in a representative case. 3D CT angiography and CT perfusion demonstrate a left middle cerebral artery (M1) occlusion **(4A)** with a large ischemic penumbra and a small infarction core **(4B, 4C)**. On the perfusion map **(4C)**, the infarction core is shown in red and the penumbra in yellow. The low-perfusion volume was 115.9 cm^3, the infarction core volume was 15.5 cm^3, and the penumbra volume was 100.4 cm^3. Based on these findings, the patient was deemed eligible for mechanical thrombectomy.



5 Pre- and post-treatment angiographic findings. **(5A)** Pre-treatment angiogram showing occlusion of the left middle cerebral artery (M1 segment). **(5B)** Post-treatment angiogram demonstrating complete recanalization of the occluded vessel following mechanical thrombectomy.



6 Comparison of pre-treatment CT perfusion and post-treatment MRI findings. **(6A)** Pretreatment CT perfusion maps showing the ischemic core and penumbra. **(6B)** Diffusion-weighted imaging (DWI) obtained on the day after thrombectomy. The infarction area on DWI corresponds closely to the ischemic core identified on CT perfusion before treatment, confirming the accuracy of the perfusion-based assessment.

Post-treatment course

The patient's neurological symptoms improved immediately after the procedure, and she achieved full recovery without residual deficits within a few days. Transthoracic echocardiography revealed a patent foramen ovale, and paradoxical embolism was considered the cause of the stroke.

Discussion

This case highlights the effectiveness of one-stop management using an angio-CT system with biplane angiography for AIS. Integrating angiography and CT in a single suite enabled rapid diagnosis, perfusion assessment, and endovascular therapy without patient transfer, thereby streamlining the workflow in emergency settings.

Compared with flat-panel CT in direct-transfer-to-angio-suite (DTAS) protocols, our multidetector CT system provided higher-quality imaging of intra- and extracranial vessels as well as perfusion data, allowing for more reliable patient selection [14–16]. Perfusion imaging was particularly useful for patients with unknown onset time, consistent with evidence supporting thrombectomy in the extended window. The system was also applicable to patients contraindicated for MRI and did not increase procedural complications.

During the COVID-19 pandemic, angio-CT enabled simultaneous infection screening with whole-body CT, minimizing delays while maintaining safety. However, limitations include the need for contrast, which is unsuitable for some patients, and potential technical inaccuracies due to arrhythmia or arterial stenosis [17–19].

In summary, one-stop management using an angio-CT system provides a safe and efficient workflow that may improve outcomes in AIS and offers additional advantages in high-risk emergency settings.

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