

CASE REPORT

Reperfusion therapy of acute ischemic stroke in an all-in-one resuscitation room called a hybrid emergency room

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Abstract

Acute ischemic stroke (AIS) caused by major vessel occlusion has potentially poor outcomes. Early successful recanalization after symptom onset is an important factor for favorable outcomes of AIS. We present the case of a 74-year-old man with AIS who underwent the entire process from diagnosis to thrombolysis and endovascular treatment in a hybrid emergency room (ER) equipped with a multidetector computed tomography (CT) scanner and an angiography suite set-up. A hybrid ER can facilitate evaluation and definitive interventions in patients with AIS more quickly and safely and in one place, without the requirement for transfer to a CT scanner or angiography suite set-up. In the present case, the door-to-puncture time and door-to-reperfusion time were 85 and 159 min, respectively, which were shorter than those in the group conventionally treated for stroke in our institution. Further study is needed to confirm the effect of the hybrid ER system.

INTRODUCTION

Acute ischemic stroke (AIS), caused by major vessel occlusion, has potentially poor outcomes [1]. Early recanalization by performing endovascular thrombectomy could rescue the penumbra around the infarction area and is an important factor for a favorable outcome [2–4].

A novel type of emergency room (ER), equipped with a sliding computed tomography (CT) scanner system with interventional radiology features, called a hybrid ER, is becoming widespread

in Japan. Eliminating patient transfer enables initial evaluation, life-saving procedures such as airway management, CT scanning and interventional radiology to be performed in one place (Fig. 1) [5, 6]. The hybrid ER is associated with reduced mortality, as a consequence of the reduction in the time required for the diagnosis and treatment of trauma patients [5]. The combination of immediate diagnosis and rapid recanalization without patient transfer could lead to progress in AIS and trauma management. To the best of our knowledge, no case report or study has reported about AIS treatment in a hybrid ER to date.

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Figure 1: Photograph showing the sliding CT scanner system with interventional radiology features in the ER. Acute procedures for ischemic stroke, including airway management and angiography, can be performed on the table, without patient transfer. (A) Sliding CT scanning device, (B) movable C-arm, (C) monitoring screen, (D) mechanical ventilator with anesthesia apparatus and (E) CT examination and intervention table.

Herein, we describe the case of a patient with AIS who underwent the entire process from diagnosis to endovascular treatment in a hybrid ER.

CASE REPORT

A 74-year-old man with history of hypertension developed sudden-onset left-sided hemiplegia and aphasia. He was transported to our hospital 42 min after symptom onset. We treated the patient in a hybrid ER. The patient's vital signs at presentation were as follows: heart rate, 91 bpm with regular rhythm; blood pressure, 170/106 mmHg; and respiratory rate, 20 breaths/min. The Glasgow Coma Scale score was E4V3M6. Neurological physical examination revealed left hemiplegia, dysarthria and aphasia. The National Institutes of Health Stroke Scale (NIHSS) score was 17 points. Head CT 17 min after hospital arrival showed a hyperdense middle cerebral artery sign (Fig. 2A, blue arrow) and early CT sign at the right cerebral cortex, which indicated an Alberta Stroke Programme Early CT Score of 7 points (Fig. 2B and C, red arrow head) [7]. CT angiography revealed right internal carotid artery terminus occlusion (Fig. 2D, red arrow).

After confirming that the laboratory data including platelet count, activated partial thromboplastin time and prothrombin time was within normal limits, intravenous thrombolysis using a tissue plasminogen activator was performed 39 min after arrival. Because symptom improvement did not occur even after initiation of intravenous thrombolysis, angiography for mechanical thrombectomy was performed in the hybrid ER 85 min after arrival. The angiography confirmed total occlusion of the right internal carotid artery terminus (Fig. 3A, arrow). A Solitaire™ (6 × 30 mm²) stent retriever device (Medtronic Corp, Dublin, Ireland) was introduced through a microcatheter and expanded with the proximal part of the device aligned with the proximal part of the occlusion. The thrombus was removed, and the door-to-reperfusion time was 159 min. The following angiogra-

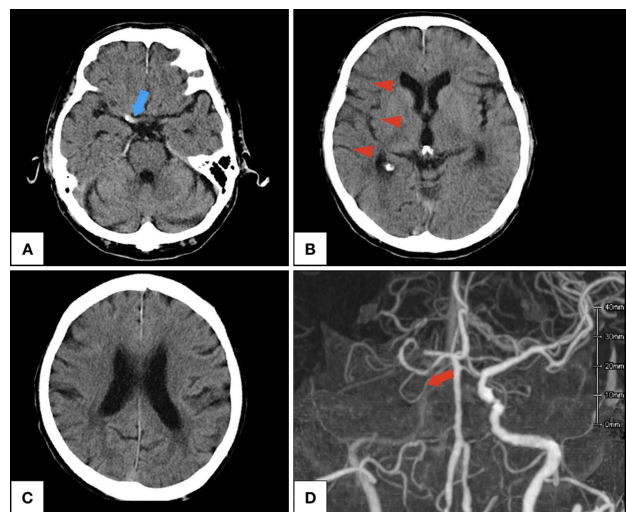


Figure 2: Head CT on admission. (A) The plain head CT shows a right hyperdense middle cerebral artery (blue arrow). (B) The plain head CT shows hypoattenuating brain tissue in the right hemisphere (red arrow heads). (C) The plain head CT shows no other hypoattenuating brain tissue in the right hemisphere. (D) CT angiography shows right internal carotid artery terminus occlusion.

phy showed recanalization of the right internal carotid artery (Fig. 3B). The patient's hemiplegia improved, and the NIHSS score had improved to 13 points shortly after the procedure. The time course of the initial treatment is depicted in Fig. 4.

The patient was then admitted to the stroke-care unit. Brain magnetic resonance imaging performed on the second day after admission showed a high-intensity area in the left cortex cerebri without any lesion in the nucleus basalis on diffusion-weighted imaging. The patient was transferred to the rehabilitation hospital on Day 35. At discharge, his modified Rankin scale score was 3.

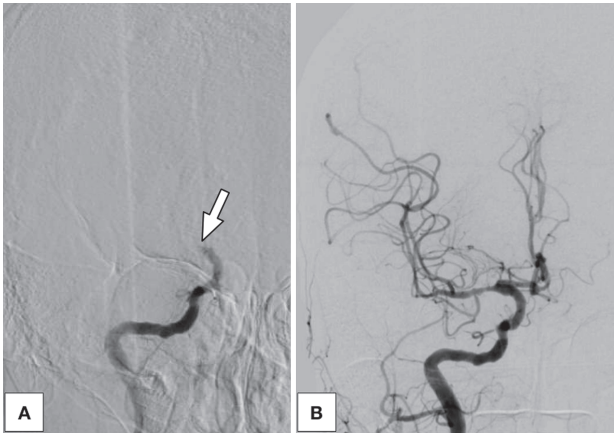


Figure 3: Angiography results. (A) Angiography confirming total occlusion of the right internal carotid artery terminus (arrow). (B) Angiography showing recanalization of the right internal artery and the right middle cerebral artery.

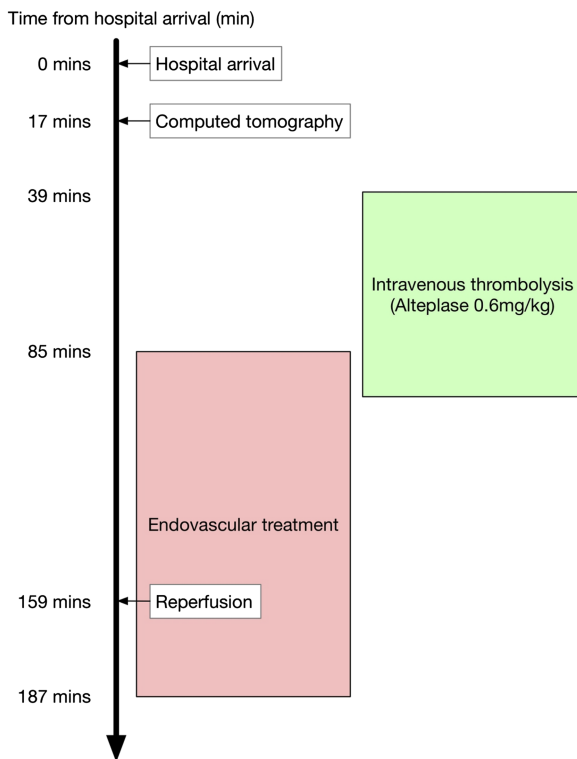


Figure 4: Treatment followed in the hybrid ER. The door-to-puncture time and door-to-reperfusion time were 85 and 159 min, respectively.

DISCUSSION

Our patient underwent initial physical examination, CT, intravenous thrombolysis and endovascular thrombectomy in a hybrid ER, without the requirement for unnecessary transfers.

Recent randomized trials have shown that endovascular thrombectomy is beneficial for achieving recanalization and favorable neurological outcomes [3, 4]. Early identification of the occlusion site and recanalization are very important factors in AIS [2]. A hybrid ER can facilitate evaluation and definitive interventions in patients with AIS more quickly and safely and in

one place, without the requirement for transfer to a CT scanner or an angiography suite set-up.

An observational study showed that a hybrid ER, which enables immediate CT diagnosis and rapid bleeding control without patient transfer, reduced mortality in cases of severe trauma [5]. Owing to early identification of the bleeding site and hemostasis without patient transfer, the odds ratio for deaths from exsanguination was 0.17 in that study [5]. In the present case, the door-to-puncture time and door-to-reperfusion time were 85 and 159 min, respectively. The median times of door-to-puncture and door-to-reperfusion were 112 min (interquartile range 89–169 min) and 213 min (interquartile range 166–250 min) in 12 cases undergoing the conventional treatment flow in our institution. Therefore, initial management of AIS in a hybrid ER may have the advantage of reducing unnecessary time loss as well as trauma.

Management of AIS in a hybrid ER has additional advantages. The on-site emergency physician can respond to a sudden deterioration in the patient's condition, such as agitation, change in vital signs and angialgia at removal of the embolus. Therefore, the endovascular therapist can concentrate on the procedure, which can thus be performed more safely. However, emergency physicians should be prompt in diagnosis and treatment planning, considering that the transfer time is eliminated. In our case, the door-to-puncture time was 85 min, which is not sufficiently short. There are two possible reasons: firstly, we initiated intravenous thrombolysis after confirming laboratory data. Secondly, we performed endovascular treatment after no improvement was seen even on initiating intravenous thrombolysis. Therefore, a smooth strategy of AIS treatment in the hybrid ER should be established. Moreover, a multidisciplinary team, including emergency physicians, neurologists, endovascular therapists, nurses, radiological technologists and other paramedical staff, should be trained to shorten the door-to-recanalization time [6]. However, initial management in a hybrid ER is novel and an ideal situation for AIS patients.

However, AIS treatment in a hybrid ER has a potential disadvantage. When we deal with stroke patients, including those undergoing endovascular therapy, in the hybrid ER, the patients tend to occupy the ER for several hours necessitating the use of the conventional ERs for other patients presenting to our institution.

In conclusion, a hybrid ER is a novel ER for AIS patient care that allows the entire evaluation and treatment to be completed in one room, without patient transfer. Building a multidisciplinary team is essential for effective ischemic stroke care. However, further study will be needed to confirm the effects of a hybrid ER system.

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CONFLICT OF INTEREST STATEMENT

None declared.

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ETHICS APPROVAL

This case report was approved by the institute's Institutional Review Board.

CONSENT

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

GUARANTOR

Masahiro Kashiura is the guarantor of this article.

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