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A Case of Cerebral Infarction with Favorable Outcome that Occurred while Climbing a 2400m Mountain —Successful Prehospital Emergency Medical Service of Mountain Rescue—

Hiroshi TAKAYAMA

Department of Emergency and Critical Care Medicine, Shinshu University School of Medicine

Here we report a case of ischemic stroke in a 55-year-old man climbing a mountain 2400m above see level alone who successfully recovered after treatment with reperfusion therapy. He experienced an ischemic stroke on a snowfield at an altitude of 2400m while climbing the 3180m Mt. Yarigatake in May. A nearby climber reported the incident by cellular phone. The patient was rescued by a Nagano Prefecture Emergency Management Air Corps helicopter and transported to our hospital 1 h after stroke onset. On arrival, his National Institutes of Health Stroke Scale (NIHSS) score was 25. At 2 h 9 min after onset, the recombinant tissue plasminogen activator alteplase was administered intravenously and his NIHSS score improved to 2. The patient was transferred to another hospital on day 19 after onset with a modified Rankin Scale score of 2 and a Barthel Index score of 100. He returned to work 78 days after onset. This is the first case report in Japan about the successful treatment of cerebral infarction that occurred on a mountain at 2400m. While good weather and various other favorable conditions helped to improve the patient's prognosis, other factors, such as the good communication infrastructure and the coordination between the aeromedical service system and hospital, played a major role in mountain rescue of this patient. *Shinshu Med J 65 : 259—265, 2017*

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Key words : mountain rescue helicopter, stroke, rt-PA

I Introduction

Mountaineering accidents are becoming increasingly frequent in Japan. In 2015, a record high of 2508 persons across Japan were involved in mountaineering accidents. One prominent trend is the increase in middle-aged and elderly adults in this group. Adults aged≥40 years accounted for 76.7% of persons involved in all mountaineering accidents, 91.6% of those died or went missing. Causes of mountaineering accidents include not only factors specific to mountain climbing, for example, changes in weather and getting lost, but also injuries and illness. Illness was the fourth most common cause at 7.6% (232 persons). The prefecture with the most accidents was Nagano[1]. According to Nagano Prefectural Police statistics in 2015, 32 persons (11.7%) had accidents caused by illness[2].

There are few reports of stroke during mountain climbing in the medical literature[3)-6)]. Noguchi et al. reported 3 cases of cerebral ischemia. One case was diagnosed as having cerebral infarction by autopsy, and the others were considered transient ischemic attacks. However, we were unable to find any reports of treatment in patients with stroke occurring during mountain climbing.

The prognosis of patients with cerebral infarction has improved in recent years due to the introduction of thrombolysis and endovascular therapy. However,

* Corresponding author : Hiroshi Takayama
Department of Emergency and Critical Care Medicine, Shinshu University School of Medicine, 3-1-1 Asahi, Matsumoto, Nagano 390-8621, Japan
E-mail : takayama@shinshu-u.ac.jp

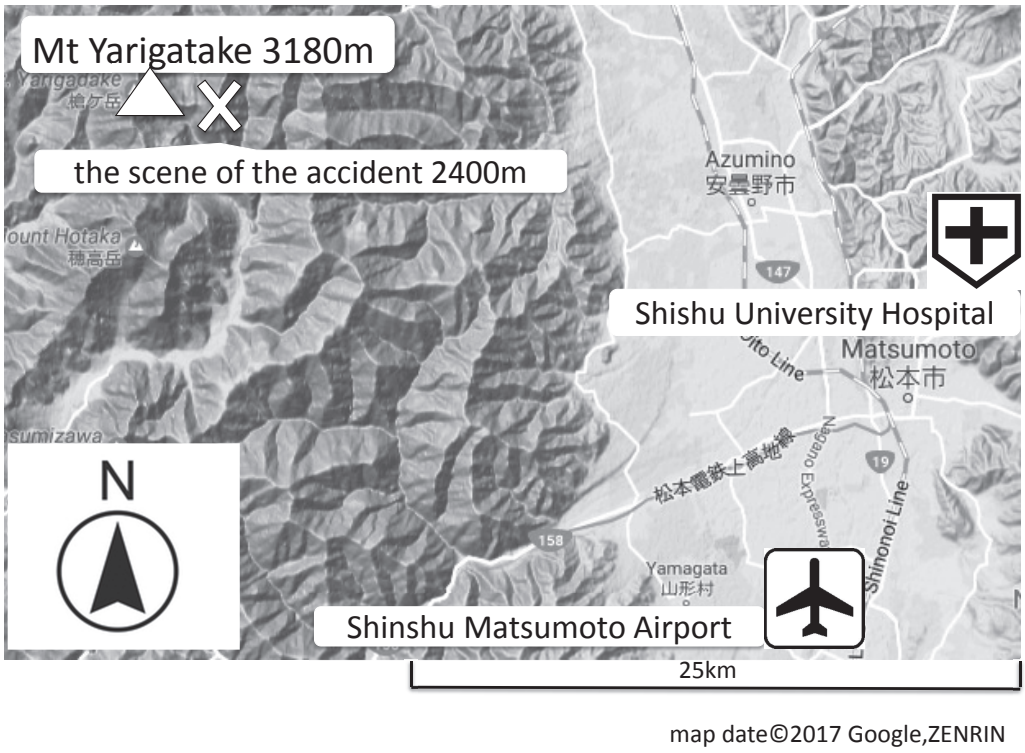

Fig. 1　Map of Mt. Yarigatake and the surrounding area.

it is important to perform these treatments at an early stage, which makes it difficult to realize their benefits when the patient cannot be rapidly transported to a medical facility.

Here we report a case of cerebral infarction occurring on a snowy mountain with successfully treatment. The effective communication infrastructure and coordination between the aeromedical service system and hospital contributed to the success.

Ⅱ　Case

A 55-year-old man collapsed while climbing Mt. Yarigatake (**Fig. 1**) alone in May 2013. nearby climber witnessed the event and immediately reported it by calling 119 (the emergency number in Japan) at 9：22A.M. A Nagano Prefecture Emergency Management Air Corps helicopter was dispatched to the location and spotted the patient on a snowfield at an altitude of about 2400m (**Table 1**). A crew member was lowered on a hoist, rescued the patient, and brought him into the helicopter. The patient was transported to the Advanced Emergency and Critical Care Center at Shinshu University Hospital.

The physical examination on admission showed Glasgow Coma Scale of E4V1M5, respiratory rate of 21 breaths/min, oxygen saturation of arterial blood measured by pulse oximeter (SpO_2) of 96% (with O_2 8 L/min supplement), blood pressure of 136/86 mmHg, heart rate of 74 beats/min (regular) and body temperature of 32.5℃ (tympanic). The thoracic and abdominal findings were normal. Global aphasia, and no anisocoria (right pupil 3.5 mm, left 3.5 mm) were observed. Light reflex was prompt in both eyes. Right hemiparesis and right hemispatial neglect were observed but eye deviation and sensory disturbance were not observed. National Institute of Health Stroke Scale (NIHSS) score was 25 points. Blood examinations, plain chest X-ray, and electrocardiogram showed no abnormal results. Non-contrast brain CT revealed no high density area. Early ischemic changes were not observed (**Fig. 2**). A diagnosis of cerebral infarction was made.

The patient was initially hypothermic, but body temperature soon increased with normal warming procedures. There was no obvious association between level of consciousness and body temperature.

Table 1　Timeline

time	elapsed time	event
9 : 22	0 : 00	The patient had a stroke and collapsed on the snow. Other climber nearby the patient watched him and did emergency call with his cellular phone.
9 : 52	0 : 30	Nagano prefectural rescue helicopter "Alps" took off from Shinshu Matsumoto Airport
10 : 05	0 : 40	Alps arrived at the site.
10 : 11	0 : 46	Aips rescued the patient.
10 : 22	1 : 00	Alps transported the patient to advanced emergency and critical care center of Shinshu university
10 : 30	1 : 08	NIHSS was 25 points. CT scan was taken and no high density area was found.
11 : 31	2 : 09	tPA was administrated.

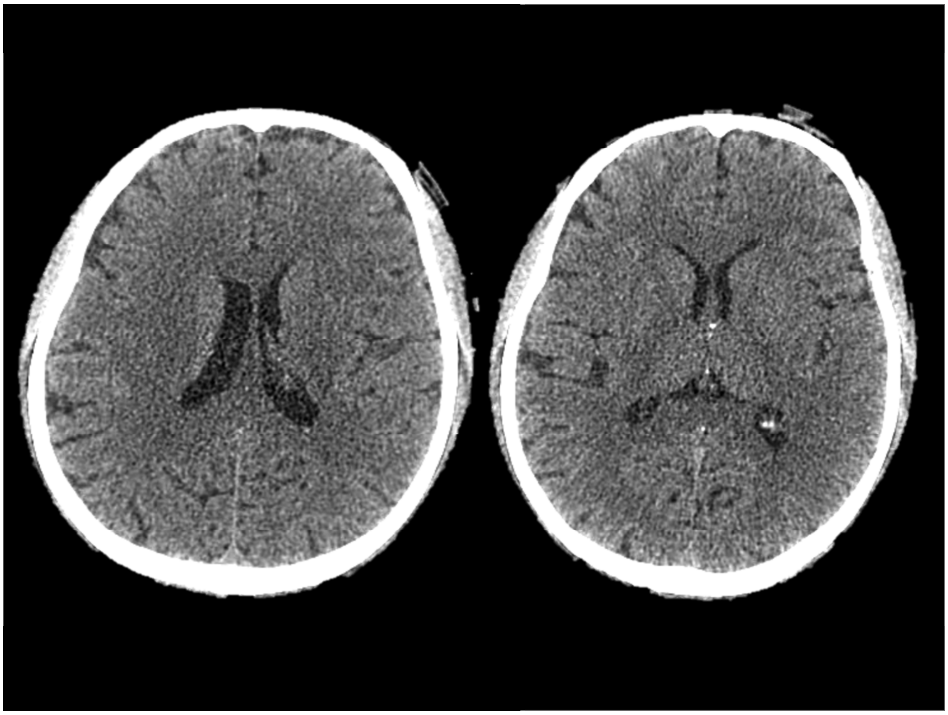

Fig. 2　Brain CT scan. High density area and early ischemic changes were absent.

We could contact his family by telephone before his arrival at the hospital and so knew his past history. The patient had no allergy history and a health check-up reportedly indicated suspected Wolff-Parkinson-White syndrome but he did not take any medicine. The patient had an active lifestyle, including competing in triathlons, and had considerable mountain climbing experience. The patient had no contraindications for thrombolysis, for example no intracranial hemorrhage on CT, no history of intracranial hemorrhage, and so on. He had an NIHSS score of 25 and exhibited severe neurologic symptoms, but had no contraindications for alteplase and did not meet criteria for careful administration for alteplase (severe renal failure, uncontrollable diabetes, etc.). Informed consent was obtained without delay because we could talk with his family by telephone. Intravenous administration of alteplase was started approximately 2 h 9 min after the onset of cerebral infarction. **(Table 1)**

Symptoms promptly improved after the start of administration. The patient's NIHSS score improved to 2 points, and his only remaining symptoms were mild dysarthria, mild aphasia, and Barré's sign (only pronator drift of the right upper arm).

After thrombolysis, diffusion-weighted brain mag-

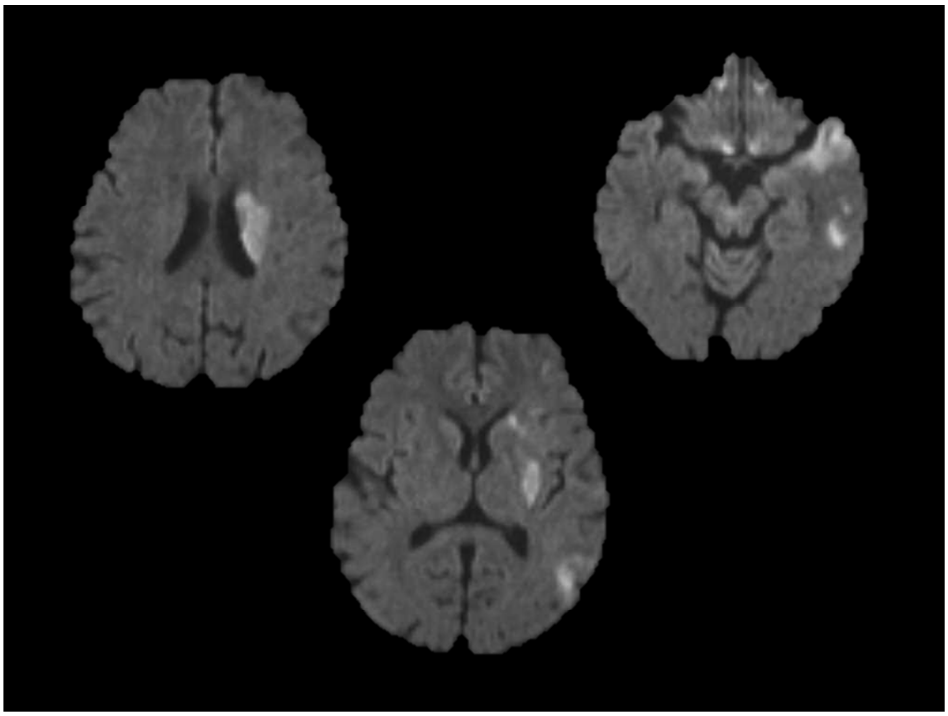

Fig. 3　Brain magnetic resonance imaging. Diffusion-weighted imaging showed a high-intensity area along the left middle cerebral artery.

netic resonance (MR) imaging showed high-intensity areas in the left corona radiata, the left parietal lobe, and the left temporal lobe (**Fig. 3**). Brain MR angiography showed stenosis of the distal branch of the left middle cerebral artery, but no encasement of any other area, including the carotid artery (**Fig. 4**). On the basis of neurologic and MR imaging findings of the infarcted area, it was concluded that the initial obstruction occurred at the main trunk of the middle cerebral artery; remnants of the thrombus were found at the distal branch after thrombolysis and reperfusion was achieved by administering alteplase. No abnormalities such as a left atrial thrombus or patent foramen ovale were observed on transthoracic or transesophageal echocardiography. Moreover, arrhythmias such as atrial fibrillation and delta waves were not observed while the patient was hospitalized. The absence of atherosclerotic lesions in the carotid artery and aorta indicated that the cerebral infarction was more likely cardioembolic than atherothrombotic, so administration of dabigatran was started on the day after admission.

On day 19 after onset, the patient's Barthel Index was 100 points, indicating no impact on activities of daily living. The only remaining symptoms were mild sensory aphasia and reduction in high order brain function (e.g., attention deficit). He was transferred to a hospital close to his home for the purpose of rehabilitation for high order brain function. He was discharged after 75 days and returned to work 78 days after onset.

Ⅲ　Discussion

This is the first report from Japan of successful treatment by thrombolytic therapy of a patient who experienced cerebral infarction while climbing a snowy mountain alone. Mt. Yarigatake, where this stroke occurred, is a mountain in the southern part of Japan's Northern Alps and is the fifth highest peak in Japan at 3180m in altitude. It is not easy to climb in May because the snow cap is not yet melted. The direct distance to the scene of stroke from Shinshu-Matsumoto Airport and our hospital is 32 km, and it would probably take≥10 hrs to reach the point on the mountain from the trailhead on foot.

In this case, the patient was climbing this snowy

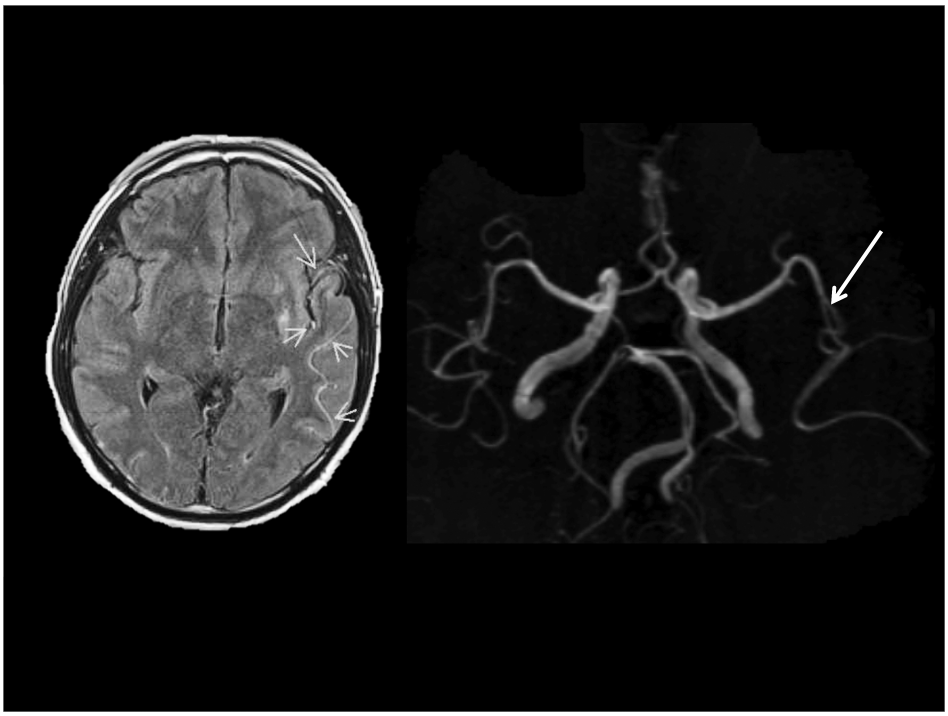

Fig. 4 Brain magnetic resonance angiogram. Left is magnetic resonance angiogram source image. Narrowing of the left middle cerebral artery is evident (arrow).

mountain at an altitude of 2400m alone when the stroke occurred. A mountain is a harsh environment for medical care, making it difficult to manage severe medical emergencies[2)7)-9)]. The good communication infrastructure, aeromedical service system, and successful coordination with the hospital were the reason for this good outcome.

This incident was reported by cellular phone. The area of Mt. Yarigatake near where the incident occurred was within the wireless coverage area. This is because NTT Docomo built a cellular phone base station at Jonen hut in the Northern Alps, which has been operating every year between May and November since 2002. At present, more than 60% of mountaineering accident reports are made by cellular phone. In some cases, 110 or 119 operators can track report locations using GPS, which makes it easier to find the ill or injured person[10)].

Emergency Management Air Corps helicopters can communicate directly with the hospital using the fire radio communication system. This allows the hospital to begin preparing for the expected situation before admission of the patient. This was also helpful in this case, as we were able to prepare the necessary procedures such as CT because we could anticipate the need for intravenous administration of alteplase before the patient arrived at the hospital.

Areas where mountaineering accidents are likely to occur need to have emergency centers with heliports so that patients can be transported directly to the hospital after being rescued by helicopter. Shinshu University Hospital has an Advanced Emergency and Critical Care Center and a roof heliport on the premises. It has accepted patients transported by helicopter after becoming ill or injured in a mountaineering accident

Prompt treatment can improve the functional prognosis for cerebral infarction. According to clinical studies and postmarketing surveillance from Japan, 33% to 37% of patients who undergo thrombolysis with rt-PA have a favorable outcome (0-1 on the modified Rankin scale)[11)-13)]. However, few patients receive the thrombolysis[14)-17)]. Shiotsuki et al reported that it was only used in an estimated 4.6% of all patients with cerebral infarction[18)].

A smooth transition from the mountain rescue and

pre-hospital emergency care to acute-phase treatment and successful reperfusion of the obstructed cerebral artery by prompt administration of rt-PA were carried out. All of this contributed to the favorable outcome in this case despite the stroke occurring while the patient was climbing a snowy mountain alone.

In recent years, the main method of rescuing people involved in a moderate to severe mountaineering accident has shifted from ground teams to helicopter teams. The number of helicopter rescues for mountaineering accidents has been increasing year by year. Of the 300 mountaineering accidents in Nagano prefecture in 2013, a helicopter was dispatched for 243 (81%), and 230 patients were admitted to a hospital emergency department.

Crewmembers aboard prefectural police helicopters, which perform 80% of helicopter rescues, take rescue training courses on first aid. However, their main duty is search and rescue, so they are limited in their ability to make medical observations and provide care. In addition, these teams cannot communicate directly with the accepting hospital through prefectural police radio, which means that the hospital may likely not receive sufficient information about the patient before arrival. Measures for providing prompt medical treatment to patients transported by prefectural police helicopter after a mountaineering accident should be considered in the future.

Ⅳ Conclusion

We treated a patient who experienced cerebral infarction while climbing a 3000m class mountain alone in early spring and obtained a favorable outcome. Factors that contributed to this outcome were the good communication infrastructure, the aeromedical service system, and effective coordination with the accepting hospital. We hope that information about this case will contribute to the recovery of other patients who experience an acute event such as cerebral infarction while mountain climbing.

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