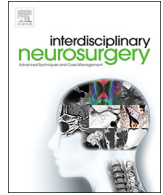




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Technical Notes &amp; Surgical Techniques

## Acute blood-pressure management and prognostic factors in patients with intracerebral hemorrhage

Tetsuhisa Yamada, M.D.<sup>a,\*</sup>, Yoshihiro Natori, M.D., Ph.D.<sup>b</sup><sup>a</sup> Department of Emergency Medicine, Iizuka Hospital, 3-83 Yoshiomachi, Iizuka-city, Fukuoka 820-8505, Japan<sup>b</sup> Department of Neurosurgery, Iizuka Hospital, 3-83 Yoshiomachi, Iizuka-city, Fukuoka 820-8505, Japan

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### ABSTRACT

**Objective:** We studied blood-pressure management and outcomes at discharge in patients with acute intracerebral hemorrhage.

**Methods:** We studied 704 patients with intracerebral hemorrhage were admitted to the Department of Neurosurgery of our hospital. We divided the patients into two groups according to the modified Rankin Scale score at discharge: a favorable outcome group (modified Rankin Scale score, 0–2) and an unfavorable outcome group (modified Rankin Scale score, 3–6). Univariate analysis was performed between the two groups, and good prognostic factors were extracted, and multivariate analysis was performed with the significant difference factors ( $p < 0.01$ ).

**Results:** The following variables differed significantly ( $p < 0.01$ ) between the favorable outcome group and the unfavorable outcome group on univariate analysis: younger age, higher height, heavier body weight, body-mass index of 18.5 or over, renal function of eGFR 60 or over, better consciousness level at arrival, lower diastolic blood-pressure 1 h after arrival, lower systolic blood-pressure 6 h after arrival, and lower systolic blood-pressure 24 h after arrival. The following variables differed significantly ( $p < 0.01$ ) between the groups on multivariate analysis: younger age, better consciousness level at arrival, and lower systolic blood-pressure 6 h after arrival.

**Conclusions:** In patients with intracerebral hemorrhage, predictors of poor outcomes at discharge were younger age, better consciousness level at arrival, and lower systolic blood-pressure 6 h after arrival. If intracerebral hemorrhage is diagnosed, antihypertensive therapy should be started immediately, and it is important to lower the blood-pressure within 6 h after arrival.

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### 1. Introduction

Blood-pressure (BP) management has an important role in the treatment of patients with acute intracerebral hemorrhage (ICH). Optimal recovery from ICH was observed in hypertensive patients who achieved the greatest systolic blood pressure (sBP) reductions ( $\geq 20$  mmHg) in the first hour and maintained for 7 days [1]. Also, intensive BP lowering have beneficial effects on physical functioning that manifests consistently through the early and later phases of recovery from ICH [2]. On the other hand, in INTERACT2 early intensive lowering of blood pressure did not result in a significant reduction in the rate of the primary outcome of death or major disability [3]. ATACH-2 result did not support the notion that acute reduction to a target systolic blood pressure of 110 to 139 mmHg in patients with intracerebral hemorrhage is more effective in improving functional outcome than a reduction to a target systolic blood pressure of 140 to 179 mmHg [4]. We studied BP

management and outcomes in patients with acute ICH who were admitted to our hospital.

### 2. Methods

A total of 1216 patients with ICH were admitted to the Department of Neurosurgery of our hospital from January 1, 2010 through December 31, 2014. We excluded patients who had arteriovenous malformation (AVM), cavernous angioma, or brain tumor. We studied patients who arrived at our hospital within 24 h after symptom onset, could independently perform activities of daily living before symptom onset, and received aggressive nonsurgical therapy within 24 h after arrival at the hospital. The aggressive nonsurgical therapy is a treatment of strict blood pressure management. Treatment started with BP reduction with nicardipine or diltiazem as early as possible after diagnosis of ICH, sBP targeted 140 mmHg or less. After 24 h of admission, oral antihypertensive drug (ARB or Ca-blocker) was used in combination and gradually switched from intravenous administration. All patients were admitted to a stroke care unit or emergency care unit.

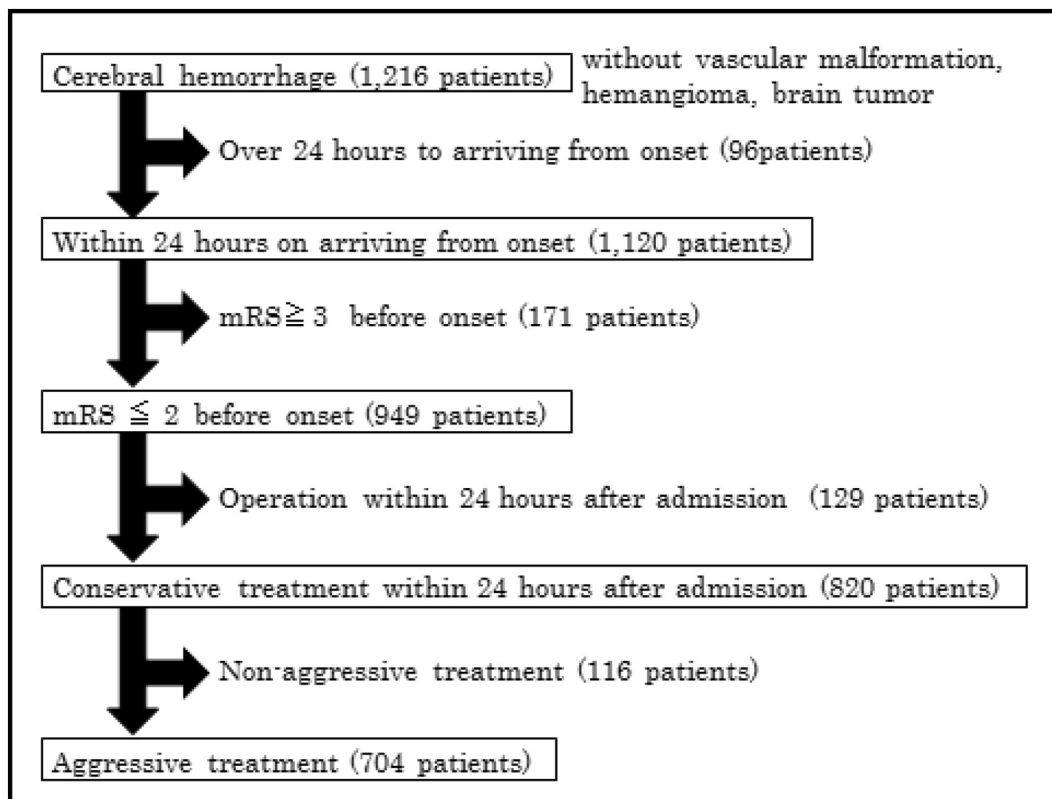
\* Corresponding author at: 3-83 Yoshiomachi, Iizuka-city, Fukuoka 820-8505, Japan.  
E-mail address: [tyamadah4@aih-net.com](mailto:tyamadah4@aih-net.com) (T. Yamada).

We divided the patients into two groups according to the modified Rankin Scale (mRS) score at discharge: a favorable outcome group (mRS score, 0–2) and an unfavorable outcome group (mRS score, 3–6). These two groups were then compared with respect to the following variables: age, sex, height, body weight, body mass index (BMI), past history (hypertension, diabetes mellitus, liver disorder, renal function, ischemic heart disease, stroke), anticoagulant drugs, antiplatelet drugs, level of consciousness at arrival, time from onset to arrival, hospitalization period, BP at arrival, BP 1 h after arrival, BP 6 h after arrival, BP 24 h after arrival, and BP at discharge. ICH was diagnosed on head computed tomography (CT). To exclude structural disorders, 3-dimensional computed tomographic angiography (3D-CTA), contrast CT, or magnetic resonance imaging (MRI) of the head was performed. The onset time was defined to be the last confirmation time before the onset of symptoms. An mRS score of 2 or less before symptom onset was assumed to indicate activities of daily living (ADL) independence. BMI was divided into three categories according to World Health Organization (WHO) standard: <18.5, 18.5 to <25, and 25 or higher. Renal function was evaluated on the basis of the estimated glomerular filtration rate (eGFR); an eGFR of <60 was considered to indicate renal dysfunction. The consciousness level at the time of arrival at our hospital was evaluated according to the Glasgow Coma Scale (GCS). This study was a retrospective analysis based on the patients' medical records. First, univariate analysis was performed to identify variables associated with good outcomes. Next, multivariate logistic regression analysis was performed to identify independent variables that were significantly related to outcomes. Statistical analyses were performed by chi-squared test or *t*-test and multivariate logistic regression analysis using Microsoft Excel and Excel software. *p* values of <0.01 were considered to indicate statistical significance. We used receiver-operating-characteristic (ROC) curves to estimate the candidate cutoff value of the sBP 6 h after arrival. The cut-

off value was determined at Youden Index. This study was approved by the Ethical Review Board of our hospital.

### 3. Results

After excluding patients with organic disease, a total of 1216 patients with ICH were admitted to our Department of Neurosurgery from January 1, 2010 through December 31, 2014. Ninety-six patients who arrived at our hospital >24 h after symptom onset were excluded; the other 1120 patients arrived at our hospital within 24 h after onset. Among these patients, 171 had an mRS score of 3 or higher before symptom onset and were excluded. The other 949 patients could independently perform ADL (mRS score, 2 or less) before onset. We then excluded 129 patients who underwent surgery within 24 h after arrival; the other 820 patients received conservative medical therapy within 24 h after arrival. However, 116 of these patients were excluded because they received non-aggressive treatment. The remaining 704 patients received aggressive treatment and comprised the study group (Fig. 1). The average age ( $\pm$  SD) of the 704 patients was 69.8 ( $\pm$  12.6) years. The male:female ratio was 1.29:1. The mRS score at the time of discharge was 0 in 42 patients, 1 in 104 patients, 2 in 179 patients, 3 in 123 patients, 4 in 217 patients, 5 in 20 patients, and 6 in 19 patients. The favorable outcome group comprised 325 patients, and the unfavorable outcome group comprised 379 patients. The patient background factors in each group are compared in Table 1. The favorable outcome group was younger ( $p < 0.01$ ), taller ( $p < 0.01$ ), and heavier ( $p < 0.01$ ), and included a low proportion of patients with a BMI of <18.5 ( $p < 0.01$ ). In addition, a high proportion of patients had normal renal function in the favorable outcome group ( $p < 0.01$ ). As for the consciousness level at arrival, in the favorable outcome group a high proportion of patients had a GCS score of 14 to 15 and a low proportion of patients had a GCS score of



**Fig. 1.** Patients with cerebral hemorrhage. 1216 patients were admitted to our hospital. In 96 patients, >24 h had elapsed from symptom onset to hospital arrival. 1120 patients arrived at the hospital within 24 h after symptom onset. 171 patients had an mRS score of 3 or higher before symptom onset, 949 patients had an mRS score of 2 or less before symptom onset. 129 patients underwent operation within 24 h after arrival. 820 patients received conservative treatment within 24 h after arrival. 116 patients received non-aggressive treatment. 704 patients received aggressive treatment.

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