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Observational study of treated non-traumatic subarachnoid hemorrhage in nonagenarians

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ABSTRACT

Objective: With an aging society worldwide, we can expect an increased frequency of clinical therapeutic judgements for patients 90 years or older, nonagenarians, with subarachnoid hemorrhage. However, little evidence exists as to whether surgical treatment is safe for them and leads to increased survival rates. We thus report the possible therapeutic strategies and clinical features thorough this observational study.

Patients and methods: 15 consecutive cases at two centers were collected retrospectively. Treatment methods were divided into conservative therapy or aggressive surgery including clipping or coiling surgery. Data were calculated statistically using SPSS® version 21 (Japan IBM, Tokyo, Japan).

Results: The mean age of patients was 91.5 ± 1.7 years. The World Federation of Neurological Surgeons (WFNS) grade on arrival was 3.5 ± 1.4, and the average Fisher scale was 3.8 ± 0.4. Mortality of all patients was 66.7%. Symptomatic vasospasm was observed in one case. Five patients underwent surgical treatment, including clipping or coiling surgery. Mortality was 20.0% in those who represented WFNS grade 2/3 and received surgical treatment while 90.0% in those who represented WFNS grade 3 to 5 and received conservative treatment. Therefore, our results indicate that surgical intervention is associated with increased life expectancy in good WFNS grade. Furthermore, the modified Rankin Scale score in all patients deteriorated with the disease, while relatively more deaths have occurred in the non-treated patient population.

Conclusion: Considering clipping surgery or intervention in nonagenarians might be of benefit in favorable circumstances, *i.e.* WFNS grade 1, 2 or 3.

1. Introduction

On July 27, 2016, Ministry of Health, Labour, and Welfare of the Japanese government declared that the Japanese male or female average life span had increased to 80.79 and 87.50 years, respectively, in 2015 (Ministry of Health, Labour and Welfare; http://www.mhlw.go.jp/toukei/saikin/hw/life/life15/). An aging society is a worldwide problem. Non-traumatic subarachnoid hemorrhage (ntSAH) is one of the most severe diseases, and it affects all ages. Among a population of 100,000, 78 cases of subarachnoid hemorrhage (SAH) were reported in patients between 70 and 88 years old compared to 15 cases in patients between 30 and 59 years old [1,2]. With increase in the aging population, further increase in the incidence of elderly SAH can thus be expected. In general, elderly SAH (in those over 65 or 70 years old) is more severe than younger patients [3,4]. A benefit of surgical intervention for elderly SAH was not confirmed [5]. However, for patients between 80 and 90 years old, it has been recently reported that clipping or coiling surgery is available, and delayed time to treatment is considered a significant factor associated with neurological disability [6]. Aged ntSAH patients are generally treated conservatively; however, there is little evidence regarding SAH history in super-aged patients over 90 years old who are called 'nonagenarians'. The aim of present observational study is to report on a series of nonagenarians with ntSAH. Previously it was difficult to explain 90 older year ntSAH history and possible therapy due to the few number of the super-aged patients in the world. Our study is an initial report for aggressive treatment in nonagenarians with SAH, including clipping or coiling surgery. In this study, we infer their clinical features, therapeutic potential, and neurological outcomes after treatment.

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2. Patients and methods

Fifteen consecutive patients with ntSAH who were 90 years of age or older were reviewed retrospectively between January 2011 and March 2017 at two centers; Sonoda Daiichi Hospital (Adachiku, Tokyo, Japan) and Shirahigebashi Hospital (Renewal name; Tokyo Hikifune Hospital, Sumidaku, Tokyo, Japan). The collected data were approved by our institutional review board to protect patient privacy after informed consent was obtained. Present study was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). The diagnoses were performed using computed tomography (CT), and each patient was classified into Fisher scale Group 1 to 4 and World Federation of Neurological Surgeons (WFNS) grades 1 to 5. In 11 patients, 3D-CT angiography, MRA, or cerebral digital subtraction angiography detected aneurysms though the other patients could not be performed.

Aggressive treatment within 3 days of the SAH as an early treatment or conservative therapy was introduced though there was no evidence on 90 years or over SAH survival chance. In case that the family hoped an aggressive treatment after the explanation of younger indication of the operation, clipping surgery or coiling surgery was decided by brain surgeons and intravascular surgeons immediately. As a first choice in our institutions coiling surgery was considered for elderly patients. However, it was frequently expected that broad neck of aneurysm and tortuosity of vessels would make difficulty in the intervention from angiograms. Such case underwent a clipping surgery after the discussions by both neurosurgeons and interventionalists. Ten patients were treated observationally because the family did not agree for aggressive treatment or their systemic condition was too severe. Importantly severe SAH nonagenarians (WFNS grade 4/5) were not recommended to receive surgical therapy as same as younger generations, which leaded to major factor in selection bias of this study.

Neurological assessments were made at 3 time points using the modified Rankin Scale (mRS); pre-onset, on admission, and at the primary endpoint (death or discharge). Pre-onset mRS scores were evaluated using interviews with family members or close acquaintances.

Statistical analysis was performed using the statistical software SPSS version 21 (Japan IBM, Tokyo, Japan). Differences were considered significant for probability values of $P < 0.05$. A one-way ANOVA, Tukey's test was used to calculate differences in mRS scores.

3. Results

Clinical data for all patients is presented in Table 1. The mean age of patients was 91.5 ± 1.7 years (range, 90–95 years), and the sample included one man (6.7%) and 14 women (93.3%). The average WFNS grade on arrival was 3.5 ± 1.4 (range 2–5), including five patients with grade 2 (33.3%), four with grade 3 (26.7%), and six with grade 5 (40.0%). The average Fisher group was 3.8 ± 0.4 (range 3–4) and included 3 patients at Fisher group 3 (20%) and 12 patients at Fisher group 4 (80%). Mortality was 66.7% (10 deaths). One surviving patient had symptomatic vasospasm. The average admission duration was 18.2 ± 18.8 days (range 1–55 days).

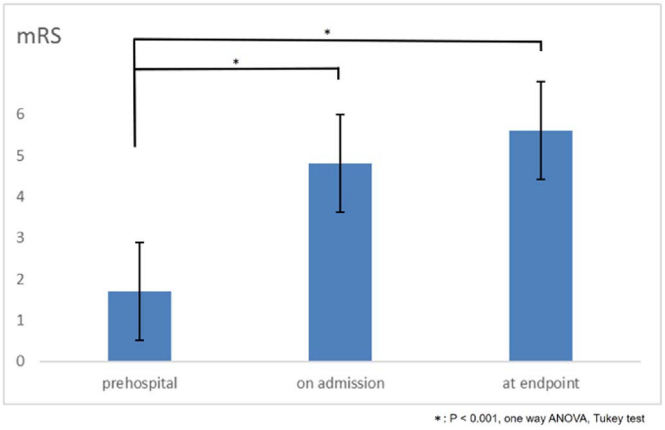

Fig. 1. Modified Rankin Scale scores of super-aged patients with SAH.
The modified Rankin Scale (mRS) score significantly worsened across the three-time points in patients aged 90 years or over with subarachnoid hemorrhage ($P < 0.001$, one way ANOVA, *post hoc* Tukey's tests).

The average mRS score at prehospital term was 1.7 ± 2.0 (range 0–5), and average mRS scores on admission and at endpoint were 4.8 ± 0.6 (range 3–5) and 5.6 ± 0.6 (range 4–6), respectively. Significant difference was detected between prehospital and on admission/at endpoint mRS ($P < 0.001$, one-way ANOVA, *post hoc* Tukey's tests; Fig. 1).

Concerning aneurysmal location, we noted 7 anterior circulation cases and 4 posterior circulation cases. Anterior circulation cases included 3 in the middle cerebral artery (MCA) (27%), 3 in the internal carotid artery (ICA) (27%), and 1 in the anterior cerebral artery (ACA) (9%), while posterior ones included 3 in the posterior inferior cerebellar artery (PICA) (27%) and 1 in the basilar artery (BA) (9%). Four aneurysms were small (< 5 mm), five were medium (6 to 10 mm), two were large (11 to 25 mm), and none were giant (> 25 mm). The

Table 1
Clinical data of super-aged patients with non-traumatic subarachnoid hemorrhage.

Patient	Sex	Age	mRS on pre-onset	mRS on admission	mRS at endpoint	Endpoint	Admission duration	Cons. level on admission	Fisher group	WFNS grade	Aneurysm location	Maximum diameter of aneurysm	Operation
1	F	90	0	5	6	Death	8	10	4	3	MCA	10	–
2	F	92	4	5	5	Discharge	29	14	3	2	IC-PC	3.5	–
3	F	93	1	5	6	Death	1	3	4	5	Unknown		–
4	F	90	5	5	6	Death	17	10	4	3	Distal PICA	4.5	Clipping
5	F	90	5	5	6	Death	3	3	4	5	Unknown		–
6	F	90	0	5	6	Death	3	11	3	3	Ba top	13	–
7	F	90	2	5	5	Discharge	53	14	4	2	Distal PICA	8	Coiling
8	M	91	4	5	5	Discharge	55	12	4	2	IC-PC	8	Clipping
9	F	92	0	5	6	Death	2	3	4	5	Unknown		–
10	F	93	0	5	6	Death	2	3	4	5	MCA	20	–
11	F	95	0	3	4	Discharge	40	14	3	2	MCA	6.5	Clipping
12	F	94	3	5	6	Death	12	7	4	3	VA-PICA	5	–
13	F	93	0	5	6	Death	3	4	4	5	IC bifurcation	4.3	–
14	F	90	0	5	6	Death	15	4	4	5	Unknown		
15	F	90	1	4	5	Discharge	30	14	4	2	Distal ACA	4.5	Coiling

Note: mRS: modified Rankin's Scale; WFNS: World Federation of Neurological Surgeons; MCA: middle cerebral artery; IC-PC: internal cerebral artery-posterior communication artery; PICA: posterior inferior cerebellar artery; Ba: basilar artery; VA: vertebral artery; ACA: anterior cerebral artery.