

Sequential Changes in the Platelet Count in Patients with Symptomatic Vasospasm after Subarachnoid Hemorrhage

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Abstract

The platelet count in 110 patients with subarachnoid hemorrhage (SAH) was analyzed retrospectively. Changes in the platelet count in 102 patients undergoing intracranial aneurysm surgery showed that the minimum platelet count was similar in patients with and without symptomatic vasospasm, but the minimum occurred later in symptomatic vasospasm patients, regardless of Hunt and Hess grade or operation timing. Sixty-five of 67 non-symptomatic vasospasm patients (97%) showed the minimum platelet count within 4 days of SAH and two (3%) on the 5th day. In contrast, only 10 of 35 symptomatic vasospasm patients (29%) showed a minimum platelet count within 4 days after SAH and 25 (71%) between the 5th and 11th days. Analysis of the eight patients not receiving surgery showed that the minimum platelet count occurred 2 days after SAH in two non-symptomatic vasospasm patients, but after the 5th day in five of six symptomatic vasospasm patients. Therefore, monitoring of the platelet count can provide an indicator of the occurrence of symptomatic vasospasm.

Key words: subarachnoid hemorrhage, symptomatic vasospasm, platelet

Introduction

Cerebral vasospasm following subarachnoid hemorrhage (SAH) may cause delayed ischemic deterioration, resulting in disability or death of the patient.^{8,13)} The etiology and pathogenesis of cerebral vasospasm after SAH are unclear, preventing the development of effective treatment. However, earlier prediction of the onset of symptomatic vasospasm (SV) might allow prophylactic therapy to be effective.^{1,12)}

Aggregation of platelets on the damaged endothelium of arteries around ruptured intracranial aneurysms has been observed,⁹⁾ and adventitial blood causes intimal platelet accumulation in cerebral arteries.¹⁴⁾ Some intraluminal platelet consumption may occur in cerebral arteries after SAH. Platelets contain a number of vasoactive substances which can cause contraction of vascular smooth muscle, including thromboxane A₂, noradrenaline, 5-hydroxytryptamine, and platelet-derived growth factor.^{2-4,10,11)} Therefore, the release of various

substances from the aggregating platelets will then promote further platelet aggregation and local vasoconstriction.⁹⁾

In this study, we analyzed the sequential changes in the platelet count in 110 SAH patients to assess whether platelet count is a predictor of SV.

Clinical Materials and Methods

This retrospective study included 110 of 166 SAH patients with ruptured cerebral aneurysms admitted to the Department of Neurosurgery of Toyama Medical and Pharmaceutical University between January 1, 1985 to December 31, 1990. Fifty-six patients were excluded, because they died within 4 days of SAH, were admitted more than 4 days after SAH, or developed delayed neurological deterioration due to hydrocephalus or other hemorrhagic lesions.

The 110 patients consisted of 38 males and 72 females, aged 35-86 years (median, 56.86 yrs). They were divided into two groups by presence or absence of SV (SV and non-SV groups). SV was defined as a delayed neurological deterioration such as hemiparesis and aphasia occurring more than 4

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Table 1 Characteristics, timing of operation, and outcome of 110 patients with SAH

	SV patients	Non-SV patients
Clinical grade on admission*		
I	6 (15%)	9 (13%)
II	12 (29%)	36 (52%)
III	12 (29%)	14 (20%)
IV	9 (22%)	9 (13%)
V	2 (5%)	1 (1%)
Location of ruptured aneurysm		
ICA	13 (32%)	16 (23%)
AcomA	14 (34%)	23 (33%)
ACA	4 (10%)	4 (6%)
MCA	5 (12%)	23 (33%)
VBA	5 (12%)	3 (4%)
Operation timing		
no	6 (15%)	2 (3%)
0-24 hrs	19 (46%)	41 (59%)
24-48 hrs	8 (20%)	11 (16%)
48-72 hrs	1 (2%)	5 (7%)
3-4 days	1 (2%)	4 (6%)
4-5 days	1 (2%)	0
5-6 days	0	3 (4%)
6-7 days	1 (2%)	0
7-8 days	1 (2%)	1 (1%)
≥8 days	3 (7%)	2 (3%)
Outcome**		
GR	13 (32%)	46 (67%)
MD	12 (29%)	12 (17%)
SD + VS	5 (12%)	3 (4%)
D	11 (27%)	8 (12%)
Total	41 (100%)	69 (100%)

*According to Hunt and Hess scale.⁵⁾ **According to Glasgow Outcome Scale.⁶⁾ GR: good recovery, MD: moderate disability, SD: severe disability, VS: vegetative state, D: death. ACA: anterior cerebral artery, AcomA: anterior communicating artery, ICA: internal carotid artery, MCA: middle cerebral artery, VBA: vertebrobasilar artery.

Table 2 Distribution of SV and non-SV patients in four groups according to grade on admission and operation timing

Group	Clinical grade	Operation timing	SV patients	Non-SV patients
A	I, II	<48 hrs	14	32
B	III-V	<48 hrs	13	21
C	I, II	≥48 hrs	4	12
D	III-V	≥48 hrs	4	2
Total			35	67

days after SAH. Table 1 shows the clinical status graded on admission according to the Hunt and Hess scale,⁵⁾ the location of the ruptured aneurysm, timing of surgery after SAH, and the outcome at discharge according to the Glasgow Outcome Scale.⁶⁾

Sequential changes in platelet counts, including the minimum count and the day of minimum count, were compared between the SV and non-SV groups. Hematocrit values were also analyzed simultaneously to exclude hemoconcentration or hemodilution effects on the platelet count. No patient received aspirin, nonsteroidal anti-inflammatory drugs, or anti-platelet agents such as ticlopidine. 102 of the 110 patients underwent intracranial aneurysm surgery, and were divided into four groups according to Hunt and Hess grade and operation timing (Table 2). Eight patients were treated conservatively.

To evaluate the effect of surgery on the platelet count, we surveyed an additional 55 patients who had operations for neurosurgical conditions other than SAH between January 1, 1990 and December 31, 1990. Twelve patients (8 males and 4 females, aged 38-72 yrs with a median of 57.0 yrs) had brain tumors, 12 (7 males and 5 females, aged 49-87 yrs with a median of 66.7 yrs) had hypertensive intracerebral hematomas, 16 (11 males and 5 females, aged 17-75 yrs with a median of 50.6 yrs) had traumatic intracranial hematomas, and 15 (3 males and 12 females, aged 33-66 yrs with a median of 54.1 yrs) had various other neurosurgical conditions.

Data were expressed as means ± SEM, and analyzed using Student's t-test to compare the minimum platelet counts, and the Wilcoxon U test to compare the distribution of the day of minimum platelet count.

Results

Thirty-five SV and 67 non-SV patients received surgery. The platelet count in these patients showed an early decrease followed by an increase, reached the maximum between days 10 and 16 postictus, and thereafter gradually fell again (Fig. 1). The minimum occurred later in the SV patients than in the non-SV patients in all four groups ($p < 0.01$) (Fig. 2). In non-SV patients, the minimum platelet count occurred within 4 days of SAH in 65 (97%) and on the 5th day in two (3%). In contrast, the minimum in SV patients was within 4 days of SAH in 10 (29%) and between the 5th and 11th days in 25 (71%). However, the minimum platelet counts in the non-SV ($16.1 \pm 0.60 \times 10^4/\text{mm}^3$, $n = 67$) and the SV groups ($15.2 \pm 0.80 \times 10^4/\text{mm}^3$, $n = 35$) showed no sig-

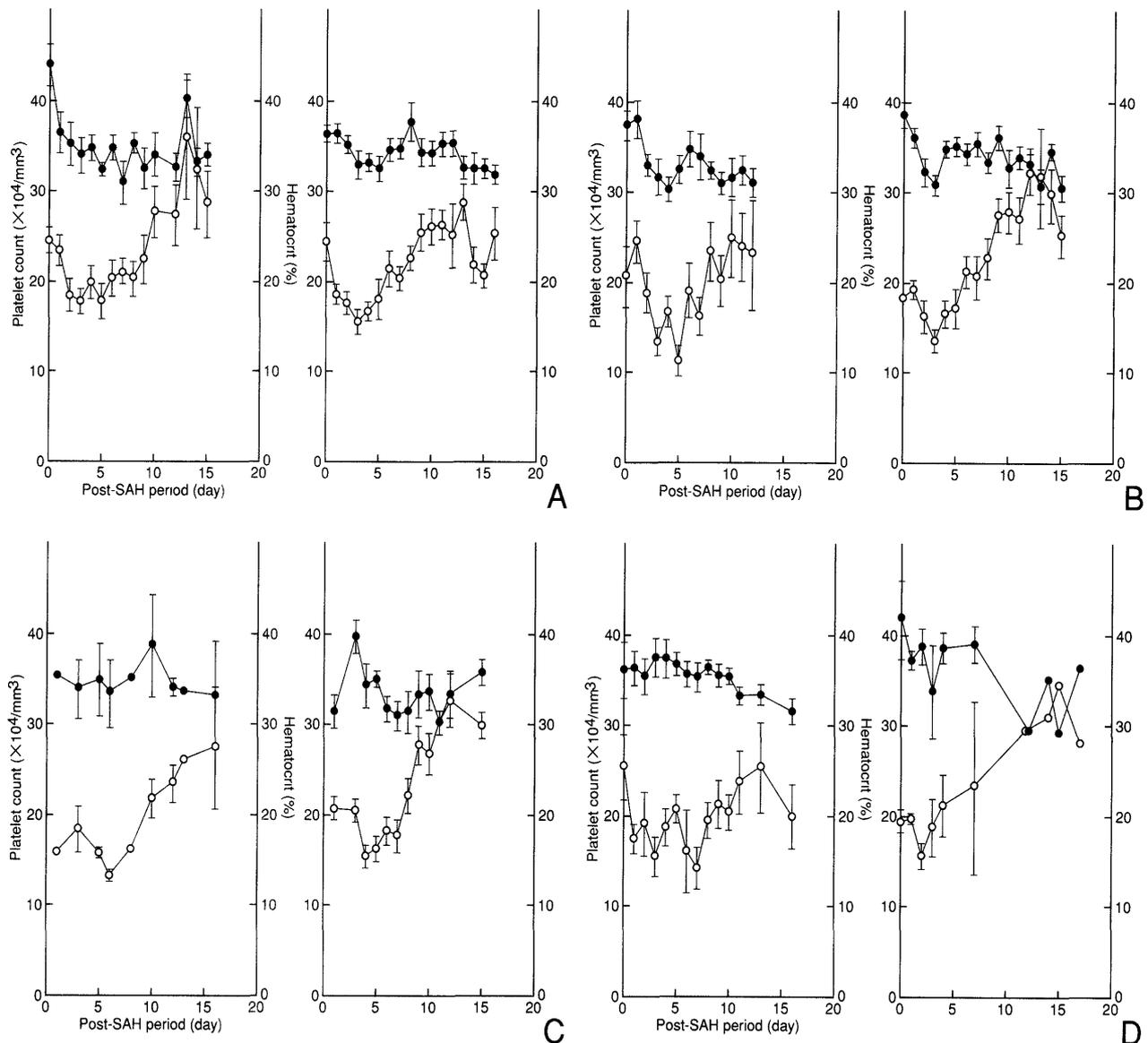


Fig. 1 Sequential changes in the platelet count (○) and hematocrit value (●) after SAH in SV (left) and non-SV patients (right) treated surgically. A: Group A, B: Group B, C: Group C, D: Group D. Groups A-D are presented in Table 2.

nificant difference ($0.05 < p < 0.25$). The sequential changes in hematocrit values showed no correlation with platelet variation.

Platelet counts in the patients receiving operations for other conditions showed that all patients (100%) with brain tumors, 92% with hypertensive intracerebral hematoma, 94% with traumatic intracranial hematoma, and 93% with other neurosurgical conditions demonstrated a minimum platelet count within 4 days of operation. Only one of 67 non-SV patients (1%) had a minimum platelet count more than 5 days after operation. In contrast, 18 of 35 SV patients (51%) had a minimum more

than 5 days after operation. Five SV patients demonstrated a minimum within 4 days of operation and a second, lower minimum later (data not shown). The other SV patients had the minimum count between the 5th and 16th days after operation.

Two non-SV and six SV patients did not have surgery. The minimum platelet count occurred 2 days after SAH in the two non-SV patients (data not shown). In contrast, the six SV patients showed a delayed minimum platelet count (on the 3rd day in 1 patient, 5th day in 1, 6th day in 2, 7th day in 1, and 8th day in 1) (Fig. 3).

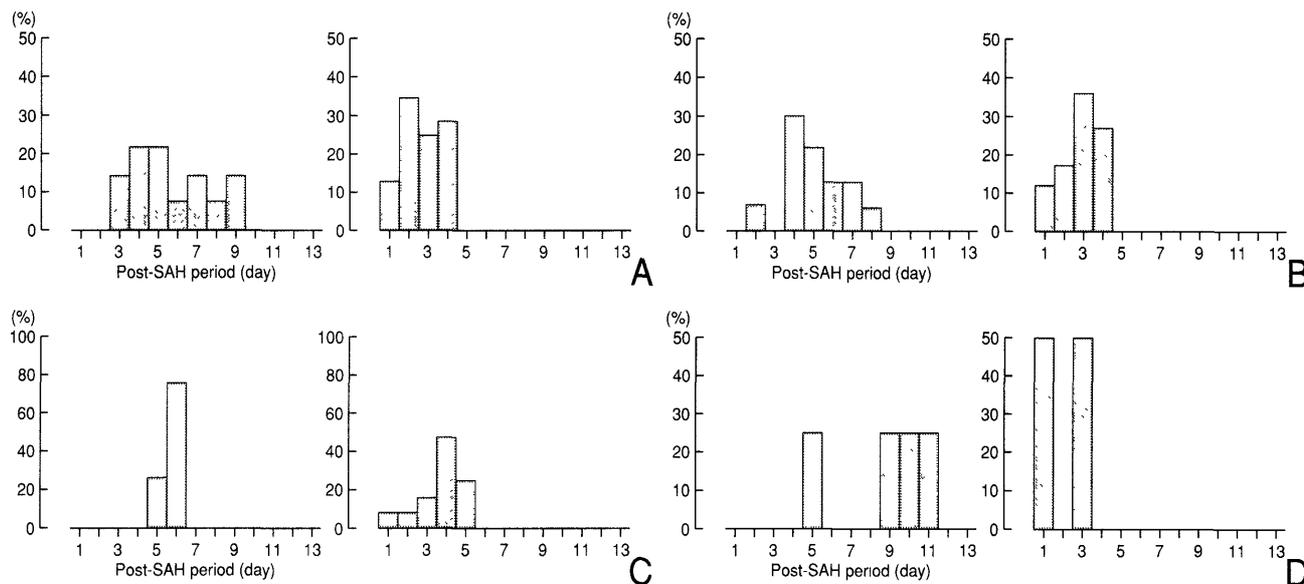


Fig. 2 Distribution of the day of minimum platelet count after SAH in SV (*left*) and non-SV patients (*right*) treated surgically. A: Group A, B: Group B, C: Group C, D: Group D. Groups A-D are presented in Table 2.

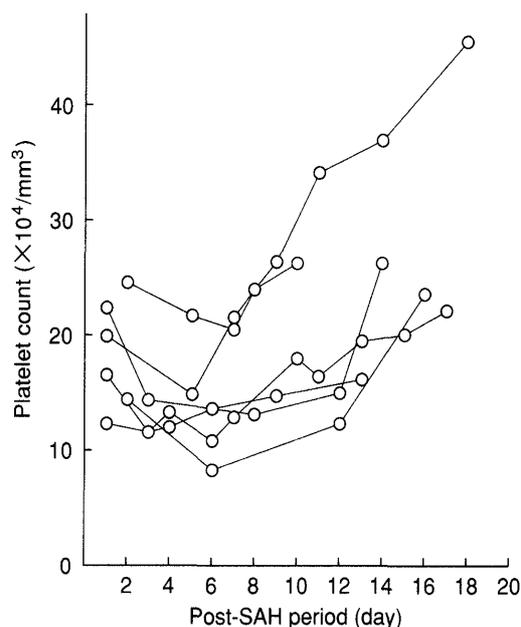


Fig. 3 Sequential changes in the platelet count after SAH in SV patients treated conservatively.

Discussion

Juvela *et al.*⁷⁾ reported that the platelet count increased for 3 weeks after SAH, but our results demonstrated a different response. SAH patients with or without surgical intervention demonstrated a decreased platelet count in the early period, followed

by an increase over 2 weeks to much higher than the usual level, and then a gradual return to normal. The minimum platelet count occurred later in the SV patients than in the non-SV patients, although there was no difference in the minimum platelet count. These trends were similar in patients with different clinical grading and operation timing.

The decrease in platelet count may be due to the consumption of platelets for hemostasis after surgery. Almost all 55 patients undergoing surgery for other neurosurgical conditions showed a minimum platelet count within 4 days of operation. The hemostatic effect of surgery on the platelet count appears to occur during this 4-day postoperative period. The occurrence of minimum platelet count after surgery was essentially the same pattern in the non-SV patients. These data suggest that the decrease in platelet count in the non-SV patients is therefore due to the hemostatic consumption of platelets.

However, many SV patients showed a minimum count more than 5 days after operation. This suggests that factors related to vasospasm also induce decreased platelet count. In fact, some SV patients demonstrated a minimum within 4 days postoperatively and a second minimum later. The first nadir may be due to the effect of surgery and the second to some unknown factors related to vasospasm. Five of the six SV patients treated conservatively also showed a minimum count after 5 days.

Our study shows that sequential measurement of

platelet count can provide an indicator for predicting SV. Although 27 and 3% of patients with SAH showed false negative and false positive results, respectively, prophylactic treatment can be recommended if the minimum platelet count does not occur within 4 days of SAH.

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