ORIGINAL

Relationship between Constipation and Cerebral Vasospasm after Aneurysmal Rupture and Bowel Control in Patients with Vasospasm : Findings from a Retrospective Study

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Abstract : This study focused on bedside bowel movement-related information obtained during days 0 to 14 after the onset of subarachnoid hemorrhage (SAH) due to cerebral aneurysmal rupture, with the aim of examining its potential as a monitoring index for predicting vasospasm onset. This retrospective study covered April 2013 to December 2022. Data collected included age, sex, Hunt and Hess grade, and whether and how radical aneurysm treatment was performed, and patient characteristics were compared between those with and without vasospasm. Among 170 participants, no significant differences were observed in factors related to the gut-brain axis according to the presence of vasospasm. Subsequent descriptive analysis of vasospasm cases during post-SAH days 0 to 14 revealed that patients generally experienced constipation postoperatively while bedridden and received laxatives or bowel-stimulating medications. These findings suggest impaired bowel motility and possible involvement of the gut–brain axis in vasospasm onset. Although no numerically significant differences were demonstrated, the present results indicate a potential relationship between vasospasm and the gut–brain axis, warranting further investigation. J. Med. Invest. 73 : 135-142, February, 2026

Keywords **:** *Aneurysmal rupture, Constipation, Cerebral Vasospasm, Bowel control*

INTRODUCTION

In Japan, approximately 1.884 million patients receive treatment for cerebrovascular diseases, of whom 67,000 present with subarachnoid hemorrhage (SAH) (1, 2). About 85% of SAH cases are due to ruptured cerebral aneurysms (3), for which radical interventions are performed such as craniotomy with clipping or endovascular coil embolization (4). In the acute phase following intracranial hemorrhage including SAH, preventing re-rupture of cerebral vessels or aneurysms is of critical importance, as re-rupture carries a very high risk of mortality (5). Furthermore, a characteristic complication after SAH is cerebral vasospasm (referred to simply as "spasm" below). Spasm is a narrowing of cerebral vessels that typically occurs between days 4 and 14 after SAH onset, and may lead to cerebral infarction, thus constituting a major determinant of prognosis. Spasm can result from delayed, reversible constriction of major arteries around the circle of Willis following SAH (6). Spasm can lead to poor outcomes, with approximately 40% of patients requiring assistance or having worse ourtomes (7). Therefore, early detection of spasm has a substantial impact on activities of daily living (ADLs) and ultimately on quality of life (QOL). Although the high-risk period and factors for spasm onset have been clarified, reliable preventive and therapeutic strategies have not yet been established (8, 9).

Spasm can be detected and diagnosed by imaging modalities such as MRI and cerebral angiography, but in the early phase, information obtained through frequent monitoring of changes in consciousness and neurological findings is crucial (8-10). The observational skills of nurses performing bedside monitoring are therefore essential. Previous reports of bedside monitoring and care provided by nurses in patients with cerebral aneurysm rupture have focused on blood pressure fluctuations (11) and persistent headache (12). To provide optimal nursing support during the high-risk period for spasm, it is important to capture early, often subtle symptoms of spasm that are easily overlooked (13).

Recent studies have suggested that the intestine and brain exert mutual influences through the autonomic nervous system and humoral factors such as hormones and cytokines. This bidirectional relationship is referred to as the gut–brain axis (14). The concept gained worldwide attention following basic research in germ-free mice lacking intestinal microbiota (15), and stroke has been identified as one of the diseases associated with the gut–brain axis (16). In addition, a previous study investigating the incidence and outcomes of spasm after SAH reported that severe SAH and the occurrence of cerebral ischemia were significant factors associated with spasm (17). According to Mubarak (16), the gut–brain axis represents a non-invasive indicator with great clinical potential. Based on this, we hypothesized that bowel movement-related information, which nurses inevitably observe at the bedside, could be utilized as an indicator of the gut–brain axis.

The objective of this study was to examine whether bedside bowel movement-related information obtained during days 0 to 14 after SAH due to aneurysmal rupture could serve as a monitoring index for predicting spasm onset.

MATERIALS AND METHODS

Definition of terms

In this study, constipation was defined according to the Japanese Society of Internal Medicine as the absence of bowel movement for 3 consecutive days.

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Study participants

This retrospective study covering the period from April 2013 to December 2022 was based on the electronic medical records of male and female patients aged 40 years or older who had experienced SAH due to ruptured cerebral aneurysm, were admitted to the Stroke Care Unit of the study site, and underwent radical treatment (either craniotomy with clipping or coil embolization) or conservative management without active treatment. Based on previous studies, the period for data collection from electronic medical records was set at days 0 to 14 after SAH onset, when spasm is most likely to occur. Patients who underwent multiple treatment modalities or who died after admission to the patient ward or Stroke Care Unit were excluded.

Study description

The following pieces of information were collected from the electronic medical records : age, sex, severity of SAH at admission assessed by Hunt and Hess (HH) grade, whether and how radical aneurysm treatment was performed, blood pressure, presence/absence of headache, vomiting, nutritional status (form and content of meals), presence/absence of bowel movement and medications used, ADLs, and nursing interventions (digital disimpaction, enema).

First, descriptive analyses of collected data were performed to compare the characteristics of patients who experienced spasm following SAH and those who did not. Then, with spasm onset as the dependent variable, a Cox proportional hazard model was constructed with HH grade at admission, treatment, presence/absence of vomiting, and presence/absence of constipation lasting ≥3 days as covariates, and hazard ratios were calculated. Stata 16 MP was used for all statistical analyses. In addition, for patients with spasm, time-series data covering post-SAH days 0 to 14 were extracted from their medical records, including bowel movement, medications used, nutritional status, ADLs, and nursing interventions (digital disimpaction, enema). These gut–brain axis-related data were analyzed descriptively to capture interventions and changes over time in the clinical course.

Ethical considerations

This study was approved by the Ethics Committee of Tokushima University Hospital (approval date : May 27, 2024 ; approval number : 3329-5). An information disclosure document was posted on the website of the Department of Neurosurgery, Tokushima University Hospital. The data for patients who opted out of participation in the study were excluded from the analysis.

RESULTS

Patient's characteristics

The medical records of 175 patients were reviewed. The patient selection flow is shown in Fig. 1. First, in order to describe patient characteristics according to the presence or absence of spasm, patients who underwent multiple treatment modalities or who died after admission to the patient ward or Stroke Care Unit were excluded.

As shown in Table 1, among the 170 patients included in the study, 139 patients (81.8%) did not experience spasm within 0 to 14 days after SAH onset (non-spasm group ; mean age, 66.2 years), and 31 patients (18.2%) experienced spasm (spasm group ; mean age, 64.8 years). Among males, 53 (38.1%) were in the non-spasm group, while among females, 86 (61.9%) were in the non-spasm group.

Comparison of HH grade at admission showed that in the non-spasm group, 56 patients (40.3%) were Grade 1, 30 (21.6%) were Grade 2, 25 (18.0%) were Grade 3, 15 (10.8%) were Grade 4, and 13 (9.4%) were Grade 5, indicating that lower grades accounted for a greater proportion and fewer patients had greater grades. In contrast, the spasm group included 5 to 8 patients in each grade (16.1%-25.8%), showing a nearly uniform distribution. With respect to treatment, coil embolization accounted for 81 patients (58.3%) in the non-spasm group and 15 patients (48.4%) in the spasm group. Vomiting as a symptom of increased intracranial pressure due to hemorrhage from aneurysmal rupture was observed in 78 patients (56.1%) in the non-spasm group and 16 (51.6%) in the spasm group, exceeding half in both groups.

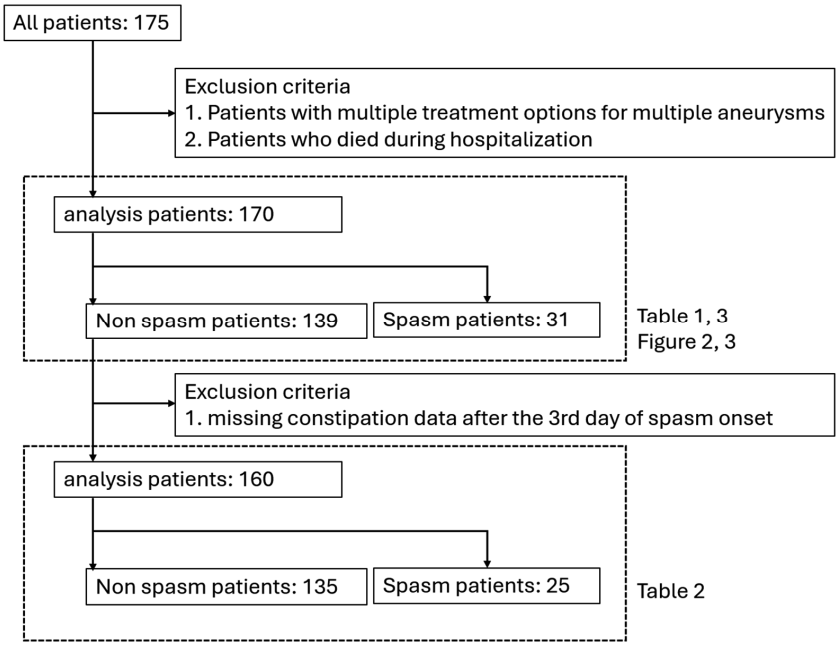

Figure 1. Patient selection flowchart

Constipation was observed in 99 patients (73.3%) in the non-spasm group and 20 (80.0%) in the spasm group, again exceeding half in both groups. The mean time to spasm onset was 9.29 ± 3.10 days. Because blood pressure exhibited wide variability making it difficult to establish consistent observation points, and because headache was difficult to assess objectively, these 2 variables were excluded from analysis. No significant differences were observed in any patient characteristics between the non-spasm and spasm groups.

Secondary analysis of time-to-event data

Figure 2 shows person-days data for the 170 participants, and Figure 3 presents hazard ratio estimates with spasm onset as the event. The risk for spasm onset increased from post-SAH day

Table 1. Characteristics of patients with and without spasm onset

Variable		Non-spasm	Spasm	p-value
		n=139 (81.8)	n=31 (18.2)	
Mean age (range), years		66.2 (43-93)	64.8 (43-90)	0.59[a]
Sex				0.10[b]
	Men	53 (38.1)	7 (22.6)	
	Women	86 (61.9)	24 (77.4)	
Hunt and Hess grade at admission				0.13[c]
	Grade_1	56 (40.3)	6 (19.4)	
	Grade_2	30 (21.6)	6 (19.4)	
	Grade_3	25 (18.0)	8 (25.8)	
	Grade_4	15 (10.8)	6 (19.4)	
	Grade_5	13 (9.4)	5 (16.1)	
Treatments				0.53[c]
	Clipping	45 (32.4)	12 (38.7)	
	Coiling	81 (58.3)	15 (48.4)	
	Other	13 (9.4)	4 (12.9)	
Vomiting				0.65[b]
	No	61 (43.9)	15 (48.4)	
	Yes	78 (56.1)	16 (51.6)	
Constipation ≥3 days (n=160) (third day or later after SAH onset)				1.00[c]
	No	36 (26.7)	5 (20.0)	
	Yes	99 (73.3)	20 (80.0)	
Mean time to spasm onset (SD)			9.29 (±3.10)	

Unless otherwise indicated, values are shown as n (%). *SD : Standard deviation.
[a]Mann-Whitney test. [b]Chi-square test. [c]Fisher's exact test.

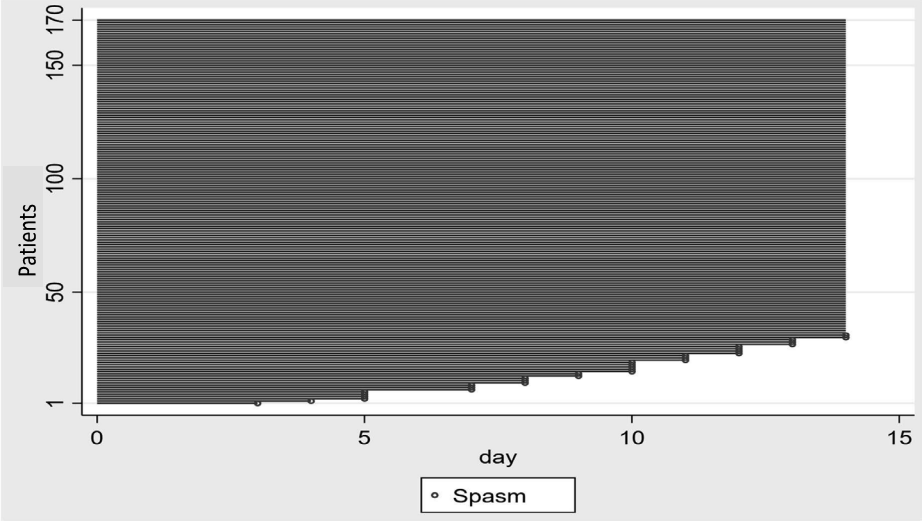

Figure 2. Person-day data for 170 persons

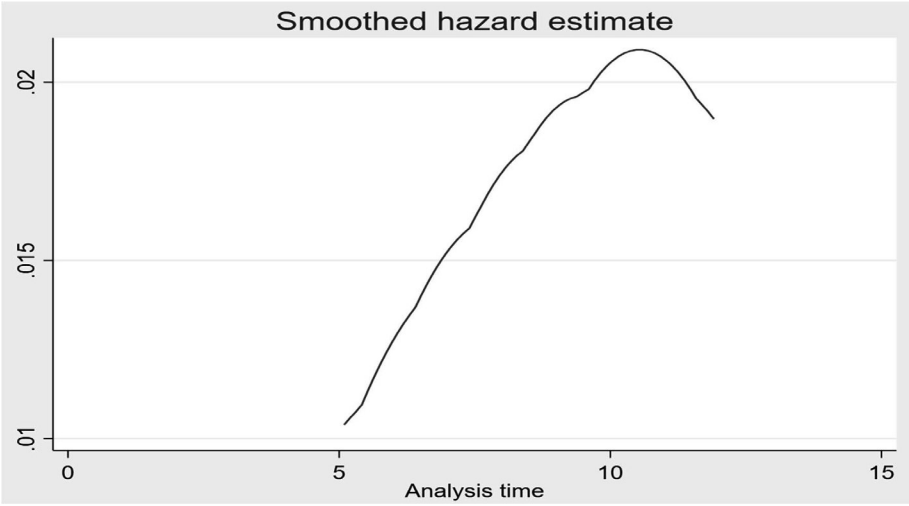

Figure 3. Hazard estimates for 170 patients with spasm onset as the event

Table 2. Hazard ratios estimated by the constructed Cox proportional hazard model n=160

	HR[a]	95% CI[b]	p-value
Hunt and Hess grade at admission			
1	1.00		
2	2.36	0.62-8.95	0.208
3	2.80	0.74-10.64	0.131
4	4.54	1.27-16.3	0.020
5	4.01	1.06-15.23	0.041
Treatment			
Clipping	1.00		
Coiling	0.56	0.24-1.28	0.168
Other	0.58	0.13-2.66	0.481
Vomiting			
No	1.00		
Yes	0.90	0.4-2.03	0.796
Constipation			
No	1.00		
Yes	1.17	0.42-3.24	0.767

[a]hazard ratio. [b]confidence interval.
A COX hazard model was constructed with the spasm as the dependent variable and HH grade, treatment, vomiting, and the constipation for 3 days or more as covariates.

5. Data on bowel movement immediately after SAH onset were frequently missing in the medical records, as the day of SAH onset was often the day of emergency admission, making history taking at admission difficult. Therefore, bowel movement status was assessed from post-SAH day 3 onward, and constipation was defined accordingly. Because 10 patients lacked sufficient bowel movement data to define constipation, they were excluded, leaving 160 patients for secondary analysis. Hazard ratios estimated by the Cox proportional hazard model with spasm onset as the dependent variable and HH grade at admission, treatment, presence/absence of vomiting, and presence/absence of constipation as explanatory variables are summarized in Table 2. Based on the HH grade at admission, HH grades 2–5 showed hazard ratios of 2.36, 2.80, 4.54, and 4.01, respectively, indicating an increased risk of spasm onset. In particular, grades 4 and 5 demonstrated statistically significant results. On the other hand, vomiting as a symptom of increased intracranial pressure and constipation as an indicator of the gut-brain axis were not significant risk factors.

Table3_1. Gut–brain axis-related information relative to the day of spasm onset in 31 patients with spasm

			Day of spasm onset																							
1	Bowel movement		–	–	–	–	–	●	●	●	–	●	–	–	–	●	–										
	Medication		–	–	–	–	Ma/1	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	–	–	Ma/3・Se/1	Ma/3	Ma/3・Se/1								
	Enteral nutrition		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–								
	ADL		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	●	–								
	Nursing intervention		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–								
2	Bowel movement						–						–	–	–	–	–	–	●	–	●	●					
	Medication						–						–	–	–	–	MY/2	MY/3・Pi/1	MY/3	MY/3	MY/3	MY/1・Bio1					
	Enteral nutrition						–						–	–	–	–	Ra/2	Ra/3	Ra/3	Ra/3	Ra/3	Ra/1・K-2S/2					
	ADL						–						–	–	–	–	–	–	–	–	–	–					
	Nursing intervention						–						–	–	–	–	–	–	–	–	–	–					
3	Bowel movement	–	–	–	–	●	–	–	–	–	–	●	●	●	●	●											
	Medication	–	–	–	–	–	–	–	Pi/1	Pi/1	Pi/1	–	–	●	–	–											
	Enteral nutrition	–	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Cont. AF・SD/2	SD/2	SD/2	SD/3	SD/3	–	SD/3	SD/2	SD/1・K-2S/2	K-2S/3											
	ADL	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–											
	Nursing intervention	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–											
4	Bowel movement									–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Medication									–	–	–	–	Ma/2	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3・Pi/1	Ma/3・Pi/1			
	Enteral nutrition									–	–	Cont. SD	Cont. AF・SD	Cont. AF・SD/1	AF/3	SD/3	SD/3	SD/3	SD/3	SD/3	SD/2	SD/3	SD/3			
	ADL									–	–	–	–	–	–	–	–	–	–	–	–	–	–			
	Nursing intervention									–	–	–	–	–	–	–	–	–	–	–	–	–	–			
5	Bowel movement						–	–	–	–	–	–	●	●	–	–	–	–	–	●							
	Medication						–	–	Ma/2	–	–	Pi/1	Pi/1	–	–	–	–	–	–	–							
	Enteral nutrition						–	–	SD/2	–	SD/3	SD/3	SD/3	SD/3	SD/1	SD/2	SD/3	SD/3	SD/2	SD/2							
	ADL						–	–	–	–	–	–	–	–	–	–	–	–	–	–							
	Nursing intervention						–	–	–	–	–	–	–	–	–	–	–	–	–	–							
6	Bowel movement												–	–	–	–	–	–	–	●							
	Medication												–	–	–	–	–	Pi/1	–	–							
	Enteral nutrition												–	AF/1	AF/3	AF/3	–	AF/1	AF/1	AF/1	AF/3						
	ADL												–	–	–	–	–	–	–	–	–						
	Nursing intervention												–	–	–	–	–	–	–	–	–						
7	Bowel movement						–	–	–	–	●	●	–	–	–	–	●	–	●	●							
	Medication						–	–	Ma/2	Ma/3	Ma/3	Ma/3	Ma/3	Ma/2	Ma/2	Ma/2	Ma/3	Ma/3	Ma/3	Ma/1							
	Enteral nutrition						–	–	–	–	–	–	–	–	–	SD/1	SD/3	SD/3	SD/3	SD/3							
	ADL						–	–	–	–	–	–	–	–	–	–	–	–	–	–							
	Nursing intervention						–	–	–	–	–	–	–	–	–	–	–	–	–	–							
8	Bowel movement						–	–	–	–	●	●	–	–	–	–	–	–	–								
	Medication						–	–	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3	Ma/3									
	Enteral nutrition						–	–	–	–	–	–	–	–	–	–	Mei/1	Mei/3									
	ADL						–	–	–	–	–	–	–	–	–	–	–	–									
	Nursing intervention						–	–	–	–	–	–	–	–	–	–	–	–									
9	Bowel movement						–	–	–	–	–	●	●	●	●	●	–	●	–	●							
	Medication						–	–	–	–	–	–	Bio/2	Bio/2	Bio/2	Bio/3	Bio/3	Bio/3	Bio/3	Bio/3							
	Enteral nutrition						–	–	–	Cont. AF	Cont. AF	SD/3	SD/3	SD/2	SD/3	Mei/3	Mei/3	Mei/3	Mei/3	Mei/3							
	ADL						–	–	–	–	–	–	–	–	–	–	–	–	–	–							
	Nursing intervention						–	–	–	–	–	–	–	–	–	–	–	–	–	–							
10	Bowel movement	●	–	–	–	●	●	–	–	–	–	●	–	–	–	●										
	Medication	–	–	–	–	–	–	–	–	Pi/1	–	–	Pi/2	–	–	–											
	Enteral nutrition	–	Cont. AF	Cont. AF	SD/3	SD/3	SD/3	SD/3	SD/2・Mei/1	Mei/3	Mei/3	Mei/1	–	–	–	–											
	ADL	–	–	–	–	–	–	–	–	–	–	●	–	–	–	–											
	Nursing intervention	–	–	–	–	–	–	–	–	–	Dig/1	–	–	–	–	–											
11	Bowel movement												–	–	–	–	–	–	●	●	–	●	●	●			
	Medication												–	–	–	–	–	–	–	–	–	–	–	–			
	Enteral nutrition												–	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Mei/2	Mei/3	Mei/3	Mei/3	Mei/3	Mei/3			
	ADL												–	–	–	–	–	–	–	–	–	–	–	–			
	Nursing intervention												–	–	–	–	–	–	–	–	–	–	–	–			
12	Bowel movement		–	–	–	●	–	–	–	–	●	–	–	–	–	●											
	Medication		–	–	–	–	–	–	–	Pi/1	–	–	–	–	–												
	Enteral nutrition		–	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Cont. AF	AF/3	SD/2	SD/3											
	ADL		–	–	–	–	–	–	–	–	–	–	–	–	–	–											
	Nursing intervention		–	–	–	–	–	–	–	–	–	–	–	–	–	–											
13	Bowel movement								–	–	–	–	–	–	–	–											
	Medication								–	–	–	–	–	–	–	–											
	Enteral nutrition								–	–	–	–	–	–	Cont. AF	Cont. AF	Cont. AF										
	ADL								–	–	–	–	–	–	–	–											
	Nursing intervention								–	–	–	–	–	–	–	–											
14	Bowel movement								–	–	–	–	–	–	–	–	●	–	●	●	–	●	–				
	Medication								–	–	–	–	–	–	DEG/2	DEG/3・Ma/3・Pi/1	DEG/3・Ma/3	DEG/3・Ma/3	DEG/3・Ma/3	DEG/3・Ma/3	DEG/3・Ma/3	DEG/3・Ma/3	Ma/3			
	Enteral nutrition								–	–	–	–	–	–	–	–	–	–	–	–	–	–	–			
	ADL								–	–	–	–	–	–	–	–	–	–	–	–	–	–	–			
	Nursing intervention								–	–	–	–	–	–	–	–	–	–	–	–	–	–	–			
15	Bowel movement												–	–	–	–	●	–	–	–							
	Medication												–	–	–	–	–	–	–	–							
	Enteral nutrition												–	–	–	–	–	–	–	–							
	ADL												–	–	–	–	–	–	–	–							
	Nursing intervention												–	–	–	–	–	–	–	–							

note
- The first column shows the patient number, the next column the variables, and the third column the day of SAH onset.
- Bowel movement : Yes ; ●, No ; –
- Medication : Magmitt (330), Ma ; Sennoside (12), Se ; Picosulfate (5–20 drops), Pi ; Miya-BM (1 tablet), MY ; Biofermin mixture powder (1 g), Bio ; Tsumura Daiokanzoto extract granules (1 packet), Dai ; Tsumura Rikkunshito extract granules (1 packet), Rik ; Tsumura Daikenchuto extract granules (2 packets), DEG ; Amitiza (24), Am
- Enteral nutrition : Peptamen AF, AF ; Peptamen SD, SD ; K-2S, K-2S ; Meibalance 1.5, Mei ; Racol, Ra ; Renalen MP3.5, Ren ; none, – ; continuous infusion, Cont. Numbers indicate frequency of infusion per day
- ADL : Out of bed (portable toilet, wheelchair, walker), ● ; in bed, –
- Nursing intervention : GE 60 mL, GE ; Resicarpone suppository (1 dose), Res ; digital disimpaction, Dig. Numbers indicate frequency of procedures per day
- Blank cells indicate pre-admission status.

Table3_2. Gut–brain axis-related information relative to the day of spasm onset in 31 patients with spasm

																Day of spasm onset											
16	Bowel movement															–	–										
	Medication															–	–										
	Enteral nutrition															–	–										
	ADL															–	–										
	Nursing intervention															–	–										
17	Bowel movement			–	–	–	–	–	●	●	–	–	–	–	–	–	–	–									
	Medication			–	–	Ma/1	Ma/2	Ma/2	Ma/2	Ma/2	Ma/2	Ma/2	Ma/2	Ma/2	Ma/2	Ma/2	Ma/2	Ma/2									
	Enteral nutrition			–	–	AF/1	–	–	–	–	–	–	–	–	–	–	SD/1	SD/3									
	ADL			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–									
	Nursing intervention			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–									
18	Bowel movement							–	–	–	–	–	–	●	–	–	●	●	–	–	–	–					
	Medication							–	–	–	–	–	–	–	–	–	–	–	–	–	–	–					
	Enteral nutrition							–	–	–	–	–	Cont. AF	Cont. AF	SD/2	SD/1	SD/2	SD/3	SD/3	SD/3	SD/3	SD/3					
	ADL							–	–	–	–	–	–	–	–	–	–	–	–	–	–	–					
	Nursing intervention							–	–	–	–	–	–	GE1	–	–	–	–	–	–	–	–					
19	Bowel movement															–	–	–	–	–	●	●	●	–	–	●	–
	Medication															–	–	Ma/1	Ma/3	Ma/3·Pi/1	–	–	–	–	Ma/2	Ma/3	–
	Enteral nutrition															–	–	–	–	–	–	–	–	–	–	–	–
	ADL															–	–	–	–	–	–	–	–	–	–	–	–
	Nursing intervention															–	–	–	–	–	–	–	–	–	–	–	–
20	Bowel movement						–	–	–	–	–	–	–	–	–	–	●	●	●	●	–						
	Medication						–	–	–	–	–	–	Ma/2	Ma/1	Ma/2·Pi/1	Ma/2·Se/1	Ma/2·Se/1	Ma/2·Dai/2	Ma/2·Dai/3	Ma/1·Dai/3	Ma/1·Dai/2						
	Enteral nutrition						–	–	–	–	–	–	–	–	–	–	–	–	–	–	–						
	ADL						–	–	–	–	–	–	●	–	–	–	–	–	–	–	–						
	Nursing intervention						–	–	–	–	–	–	–	–	–	–	Res/1·Dig/1	–	–	–	–						
21	Bowel movement	–	–	–	–	–	–	–	–	●	–	–	–	●	–	●											
	Medication	–	–	–	–	–	–	–	–	Ma/1	Ma/2	Ma/3	Ma/3	Ma/3	Ma/2	Ma/2											
	Enteral nutrition	–	–	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Cont. AF	Mei/3	Mei/3	Mei/3	Mei/3	Mei/3	Mei/3	Mei/3											
	ADL	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●											
	Nursing intervention	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–											
22	Bowel movement				–	–	–	–	●	–	●	●	●	●	●	–	●	●									
	Medication				–	MY/2	MY/3	MY/3	MY/3	MY/3·Rik/2	MY/3·Rik/3	MY/3·Rik/3	Ma/1·MY/3·Rik/3	Ma/1·MY/3·Rik/3	Ma/2·MY/3·Rik/3	Ma/3·MY/3·Rik/3	Ma/3·MY/3·Rik/3	Ma/3·MY/3·Rik/2									
	Enteral nutrition				Cont. SD	SD/2	SD/3	SD/3	SD/3	SD/3	SD/3	SD/2	SD/3	SD/3	SD/3	SD/3	SD/3	SD/3									
	ADL				–	–	–	–	–	–	–	–	–	–	–	–	–	–									
	Nursing intervention				–	–	–	–	–	–	–	–	–	–	–	–	–	–									
23	Bowel movement		–	–	–	–	–	–	–	–	●	●	●	●	●	●	●										
	Medication		–	–	–	–	–	–	Ma/2	Ma/2・Pi/1	Ma/2	–	Ma/1	–	–	–	–										
	Enteral nutrition		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–										
	ADL		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–										
	Nursing intervention		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–										
24	Bowel movement									–	–	–	–	–	–	–	–	–	–	●							
	Medication									–	–	Ma/2	Ma/3	Ma/3	Ma/3	Ma/2	Ma/3・Pi/1	Ma/3・Pi/1	Ma/3・Pi/1	Ma/3·Pi/1							
	Enteral nutrition									–	–	–	–	–	–	–	–	–	–	–							
	ADL									–	–	–	–	–	–	–	–	–	–	–							
	Nursing intervention									–	–	–	–	–	–	–	–	–	–	–							
25	Bowel movement						–	–	–	–	–	–	–	●	●	–	–	●	●	–							
	Medication						–	–	–	–	–	Pi/1	Pi/1	–	–	–	Pi/1	–	–	–							
	Enteral nutrition						–	–	Cont. SD	Cont. SD	Cont. SD	SD/2	SD/2	SD/3	SD/2	SD/3	SD/2	SD/2	SD/2	SD/3							
	ADL						–	–	–	–	–	–	–	–	–	–	–	–	–	–							
	Nursing intervention						–	–	–	–	–	–	–	–	–	–	–	–	–	–							
26	Bowel movement									–	–	–	–	–	–	–	–	●	●								
	Medication									–	–	–	Ma/1	Ma/3	Ma/3	Ma/1	Ma/3	Ma/1	Ma/1								
	Enteral nutrition									–	–	–	–	–	–	–	SD/2	SD/1・Mei/2	SD/1・Mei/2								
	ADL									–	–	–	–	–	–	–	–	–	–								
	Nursing intervention									–	–	–	–	–	–	–	–	–	–								
27	Bowel movement		–	–	–	●	–	●	–	–	–	–	–	–	–	●											
	Medication		–	–	–	Pi/1	Pi/1	–	–	–	–	Pi/1	–	–	–	–											
	Enteral nutrition		–	–	Cont. AF	Cont. AF	Cont. AF	K-2S/3	K-2S/1	–	K-2S/1	–	K-2S/3	K-2S/3	K-2S/1	K-2S/3											
	ADL		–	–	–	–	–	–	–	–	–	–	–	–	–	–											
	Nursing intervention		–	–	–	–	–	–	–	–	–	–	–	–	–	–											
28	Bowel movement							–	–	–	–	–	–	–	–	–	–	–	–	–	–						
	Medication							–	–	–	–	–	–	–	–	Pi/2	Pi/1	Se/1	Se/1	Se/1	Pi/1						
	Enteral nutrition							Cont. AF	Cont. AF	Cont. AF	Cont. SD	Cont. SD	Cont. SD	Cont. SD	Cont. SD	Cont. SD	Cont. SD	SD/2	Mei/3	Mei/3	Mei/3						
	ADL							–	–	–	–	–	–	–	–	–	–	–	–	–	–						
	Nursing intervention							–	–	–	–	–	–	–	–	–	–	–	–	–	–						
29	Bowel movement					●	–	–	–	–	–	–	–	–	–	–	–	–	–	–							
	Medication					–	–	–	–	–	Pi/1	–	–	–	–	–	–	–	Pi/1	Pi/1							
	Enteral nutrition					–	–	SD/1	SD/3	SD/3	SD/3	SD/3	SD/3	SD/3	SD/3	SD/2	SD/2	–	–	–							
	ADL					–	–	–	–	–	–	–	–	–	–	–	–	–	–	–							
	Nursing intervention					–	–	–	–	–	–	–	–	–	–	–	–	–	–	–							
30	Bowel movement					–	–	–	–	–	–	●	–	–	●	●	–	–	–								
	Medication					–	–	–	–	Ma/1·Am/1	Ma/2·Am/2	Am/2	Am/2	Am/2	Am/2	Ma/1·Am/2	Am/1	–	Am/1								
	Enteral nutrition					–	–	–	–	–	–	–	–	–	–	–	–	–	–								
	ADL					–	–	–	–	–	–	–	–	–	●	●	–	–	–								
	Nursing intervention					–	–	–	–	–	–	–	–	–	–	–	–	–	–								
31	Bowel movement											–	–	–	–	●	–	●	–	–	–	–	●	●	–		
	Medication											–	–	–	Ma/1	Ma/3	Ma/2·Pi/1	Ma/2	Ma/3	Ma/3·Pi/1	Ma/3·Pi/1	Ma/3	Ma/3	Ma/1	–		
	Enteral nutrition											SD/1	SD/3	SD/3	SD/3	SD/3	SD/1	SD/3	SD/3	SD/3	SD/3	SD/1・Ren/1	Ren/3	Ren/3	Ren/3		
	ADL											–	–	–	–	–	–	–	–	–	–	–	–	–	–		
	Nursing intervention											–	–	–	–	–	–	–	–	–	–	–	–	–	–		

note
- The first column shows the patient number, the next column the variables, and the third column the day of SAH onset.
- Bowel movement : Yes ; ●, No ; –
- Medication : Magmitt (330), Ma ; Sennoside (12), Se ; Picosulfate (5–20 drops), Pi ; Miya-BM (1 tablet), MY ; Biofermin mixture powder (1 g), Bio ; Tsumura Daiokanzoto extract granules (1 packet), Dai ; Tsumura Rikkunshito extract granules (1 packet), Rik ; Tsumura Daikenchuto extract granules (2 packets), DEG ; Amitiza (24), Am
- Enteral nutrition : Peptamen AF, AF ; Peptamen SD, SD ; K-2S, K-2S ; Meibalance 1.5, Mei ; Racol, Ra ; Renalen MP3.5, Ren ; none, – ; continuous infusion, Cont. Numbers indicate frequency of infusion per day
- ADL : Out of bed (portable toilet, wheelchair, walker), ● ; in bed, –
- Nursing intervention : GE 60 mL, GE ; Resicarpone suppository (1 dose), Res ; digital disimpaction, Dig. Numbers indicate frequency of procedures per day
- Blank cells indicate pre-admission status.

Gut–brain axis-related information relative to the day of spasm onset in spasm cases

Descriptive findings regarding bowel movement status, medications, nutrition, ADLs, and nursing interventions in patients with spasm are summarized in Table 3. Five patients who had bowel movements on the day before and the day of spasm onset (cases 3, 5, 9, 23 and 30) all received laxatives or bowel-stimulating agents. Of them, 3 (cases 3, 5 and 9) were on enteral nutrition, and all but 1 (case 30) were bedridden. Among 4 patients who had bowel movements on the day before but not on the day of spasm onset (cases 1, 10, 22 and 25), all received laxatives or bowel-stimulating agents, 3 (cases 10, 22 and 25) were on enteral nutrition, and all but one (case 10) were bedridden. Thirteen patients who had no bowel movements within 48 h before or after spasm onset (cases 4, 6, 7, 8, 11, 13, 14, 17, 24, 26, 28, 29 and 31) were all bedridden, and 6 of them (cases 4, 6, 11, 13, 14 and 28) had not received laxatives or bowel-stimulating agents prior to onset. Seven (cases 4, 6, 11, 13, 28, 29, 31) were on enteral nutrition. Of 11 patients without bowel movements within 48 h before spasm onset (cases 4, 12, 13, 14, 17, 20, 24, 26, 28, 29 and 31), all except one (case 20) were bedridden, 7 (cases 12, 17, 20, 24, 26, 29 and 31) had received laxatives or bowel-stimulating agents prior to onset, and 5 (cases 4, 12, 28, 29 and 31) were on enteral nutrition.

Thus, all but 2 patients (cases 10 and 30) were bedridden during the 48-h period around the spasm onset. Except for 2 patients who maintained regular bowel movement for 3 consecutive days before spasm onset (cases 22 and 23), the remaining 29 exhibited symptoms of constipation.

DISCUSSION

Baseline characteristics of study participants

Among the 170 participants of this study, 31 experienced spasm, yielding an incidence rate of 18.2%. Although postoperative systemic management differs among medical institutions, multiple recent reports analyzing prevention (18), occurrence (19), frequency (20) and treatment outcomes (21-23) of postoperative spasm in SAH patients have shown incidence rates ranging from 0% to 44.1%. The rate observed in the present study therefore fell within the previously reported range. Regarding the age and sex distributions of SAH patients, analyses of data from the Stroke Data Bank (24, 25) showed that in Japan, onset is most common in those in their 40s to 60s and that the male-to-female ratio is 1 : 2. Thus, the present findings were consistent with those of the general SAH patient population. These results suggest that the study population can be regarded as representative of the general population.

The analysis of time-to-event data showed that the risk of spasm increased from post-SAH day 5, consistent with the generally recognized risk period of 4 to 14 days. This also suggests that the pathological course of the study population does not deviate from that of the general population. In addition, a higher HH grade at admission was associated with a higher risk ratio for spasm onset, with a significant difference observed in Grade 4, indicating the association between higher severity of SAH and increased risk of spasm onset. A study examining risk factors for spasm (26) also identified higher severity as a significant factor. These findings, including patient characteristics and time-to-event data, indicate that the present study population did not deviate from the general SAH patient population in terms of background characteristics and pathological/clinical course, and thus can be regarded as representative.

Gut-brain axis in patients with spasm

Descriptive findings for patients with spasm indicated that most of them were bedridden for treatment, often resulting in constipation and the need for laxatives or bowel-stimulating agents. Recent studies on the intestinal environment have shown that, regardless of whether enteral or oral nutrition is provided, prolonged fasting or parenteral nutrition can disturb gut microbiota. Several reports in neurosurgery have also addressed this issue. In a study examining outcomes and related factors in postoperative SAH patients at acute care hospitals, approximately 60% of patients had low total protein/albumin levels at discharge, highlighting early improvement of nutritional status as an important challenge (27). Another report demonstrated that early postoperative intervention by a nutrition support team to initiate oral or enteral nutrition reduced the incidence of cerebral infarction due to spasm (28). In this study, although no numerically significant differences were demonstrated, the results indicate a potential relationship between spasm and the gut–brain axis, warranting further investigation.

Implications for nursing practice

The results of this study suggest that patients with higher HH grades and those who are bedridden may be predisposed to developing spasm. This indicates that nurses should not only observe the patient's condition at admission, but also recognize that the HH grade itself may serve as a potential high-risk factor when providing care. Furthermore, the bedridden state, which tends to reduce bowel motility, may also represent a predisposing factor for spasm. In addition to preventing disuse syndrome, early mobilization or in-bed rehabilitation may help reduce the risk of spasm onset. These findings highlight the need for bedside nursing care that proactively incorporates these preventive considerations.

Limitations

This was a single-center retrospective study conducted over a defined period, with a limited sample size. In addition, nursing records did not provide sufficient details about patient complaints related to bowel movement or about the continuous evaluation of or the reasons for medication use, procedures, and selection and modification of enteral nutrition formulas.

As the present findings are based on descriptive analyses in patients with spasm, future studies should prospectively investigate and actively explore potential influencing factors.

CONCLUSION

In this study examining the relationship between constipation and spasm in patients who had experienced cerebral aneurysm rupture, no significant differences were observed in factors related to the gut–brain axis between patients with and without spasm. However, descriptive analysis of spasm cases revealed that patients generally experienced constipation postoperatively while bedridden and received laxatives or bowel-stimulating medications. These findings may indicate a potential relationship between the gut–brain axis and spasm onset, although no significant differences were demonstrated.

CONFLICTS OF INTEREST

The authors declare that no conflicts of interest exist.

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