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Cerebral Infarction after Spine Surgery: Report of Two Cases*

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ABSTRACT

There has been an increase in spinal surgery for the elderly, with a corresponding potential increase in perioperative complications. In our department, 1833 patients underwent spinal surgery under general anesthesia from April 2001 to October 2012, and 2 of 260 patients aged ≥75 years old had postoperative cerebral infarction. An analysis of the pathogenic mechanism and potential risk factors showed that a history of cerebral infarction was a significant risk factor. Blood pressure rapidly increased on arousal from anesthesia, and particularly on extubation. The change in blood pressure was examined as a potential risk factor for cerebral infarction, but no significant relationship was observed. This result requires further examination in more patients with cerebral infarction after spinal surgery.

Keywords: Cerebral infarction; Spine surgery; Complication

1. Introduction

Surgeries in elderly patients have increased with aging of the population. Many elderly patients have comorbidity such as hypertension and diabetes. Here, we report two cases of elderly patients who developed cerebral infarction after surgery, for which we examined the pathogenic mechanism and risk factors.

2. Materials and Methods

Postoperative cerebral infarction occurred in 2 of 1833 patients who underwent spinal surgery under general anesthesia in our department between April 2001 and October 2012. The two patients were aged 76 and 83 years old. No perioperative cerebral infarction was found in patients aged less than 75 years old. Therefore, the pathogenic mechanism and risk factors for postoperative cerebral infarction were examined in 260 patients aged ≥75 years old. The 260 patients had a mean age of 78.9 years old, BMI 23.9, mean surgical time 174.8 min, and mean blood loss 316.1 g. There were histories of hypertension in 108 patients, diabetes in 39, cerebrovascular disorder in 21 and ischemic cardiac disease in 18 (**Table 1**).

Multivariate analysis was conducted using age at surgery, sex, BMI, history of hypertension, diabetes, cerebrovascular disease and ischemic cardiac disease, surgical time, bleeding volume, and ratio of the systolic blood pressure preoperatively and at extubation. Preoperative systolic blood pressure was defined as the maximum blood pressure on rising after admission and systolic blood pressure on extubation as the maximum of sequential measurements of blood pressure.

Table 1. Baseline characteristics of the patoents (n = 260).

Characteristic	
• Age (years old)	78.9 ± 3.3
• BMI (kg/m^2)	23.8 ± 4.0
• Surgical time (min)	147.8 ± 81.0
• Blood loss (g)	316.1 ± 704.7
	(mean ± SD)
• Comorbidity	
Hypertension	108
Diabetes	39
Cerebrovascular disorder	21
Ischemic cardiac disease	17

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Multiple regression, multiple logistic regression and discriminant analyses were performed. The multiple logistic regression analysis was performed with binary variables established using a cut-off value (**Table 2**). Analyses were conducted using EXCEL Statistics (Social Survey Research Information Co., Ltd., Tokyo, Japan) for multiple logistic and multiple regression analyses and SPSS (IBM SPSS Statistics version 19, IBM Japan Ltd., Tokyo, Japan) for discriminant analysis.

3. Case Report

Case 1: The patient was a 83-year old man with cervical spondylotic myelopathy and lumbar spinal stenosis who underwent simultaneous cervical and lumbar laminoplasty. The surgical time was 290 min and the bleeding volume was 295 g. He had a history of prostatic hyperplasia and gastric ulcer. Blood pressure on rising on the operative day was 134/74 mmHg and that on extubation was 184/104 mmHg, giving a systolic blood pressure ratio (preoperative/extubation) of 0.73. Dysarthria occurred on extubation and arousal from anesthesia. Brain MRI was performed immediately and showed brainstem infarction, for which neuroprotective drugs were administered. Rehabilitation for swallowing was also started because dysphagia occurred. The symptoms gradually improved and the patient had no disturbance of activities of daily living (ADL) at about 6 months after surgery.

Case 2: The patient was a 76-year old man with cervical spondylotic amyotrophy who underwent foraminotomy. The surgical time was 132 min and the bleeding volume was 130 g. He had a history of diabetes and cerebrovascular disorder, but had not taken drugs for cerebrovascular disorder. Blood pressure on rising on the operative day was 132/62 mmHg and that on extubation was 177/100 mmHg. The systolic blood pressure ratio (preoperative/extubation) was 0.75. Marked dysarthria was found in arousal from anesthesia. Brain MRI was performed immediately and minor infarction was found in the midbrain, for which neuroprotective drugs were administered. The symptoms gradually improved and the patient had no disturbance of ADL at about 6 months after surgery.

Table 2. Binary variables.

- Age (0: <79 years old; 1: ≧79 years old)
- BMI (0: <25; 1: ≧25)
- Systolic blood pressure ratio (on rising/on extubation) (0: blood pressure ratio < 0.8; 1: blood pressure ratio ≧ 0.8)
- Diastolic blood pressure ratio (on rising/on extubation) (0: blood pressure ratio < 0.8; 1: blood pressure ratio ≧ 0.8)
- Surgical time (0: <150 min; 1: ≧150 min)
- Bleeding volume (0: <300 mL; 1: ≧300 mL)

4. Results

Multiple regression analysis was conducted using the stepwise selection method. Forward selection identified sex, low systolic blood pressure ratio (preoperative/extubation), and a history of cerebrovascular disorder as potentially important variables, but only a history of cerebrovascular disorder was significant ($p = 0.025$) (**Table 3**). Backward elimination identified these variables and surgical time, bleeding volume and history of hypertension, but similarly the only significant variable was a history of cerebrovascular disorder ($p = 0.021$) (**Table 4**).

In multiple logistic regression analysis, the only significant risk factor was a history of cerebrovascular disorder alone. In discriminant analysis, the 3 and 6 variables extracted in the respective multiple regression analyses were used for prognosis prediction. The predictive value, sensitivity and specificity of the 3 variables were lower than those of the 6 variables, indicating that the latter were effective for prediction of prognosis (**Table 5**). The findings were not significant because data were available for only 2 subjects with postoperative cerebral infarction, but these results support the findings from multiple regression analysis.

5. Discussion

The incidence of cerebral infarction after spinal surgery ranges from 0.3% to 1% [1,2]. In our department, 2 of 1833 patients (approx. 0.1%) developed cerebral infarction and the outcomes were better than those in previous case reports. The results of the study indicate that a history of cerebral infarction posed a risk for perioperative cerebral infarction, as also found in other case reports. A history of transient ischemic attack (TIA) is also a risk for perioperative cerebral infarction, and surgery 1 to 3 months after cerebral infarction should be avoided [3].

Continuous administration of anticoagulant and antiplatelet drugs causes no serious hemorrhagic complication and decreases the risk for perioperative cerebral infarction [4]. However, in our department, drug administration is usually discontinued 1 to 2 weeks before surgery and postoperative administration is resumed after extubation. The two patients with cerebral infarction were not given anticoagulant or antiplatelet drugs before surgery. Therefore, this issue was not examined in this study, but should be investigated in the future.

The onset of cerebral infarction was thought to have occurred during surgery in both cases. In our hospital, systolic blood pressure is controlled at ≤100 mmHg during surgery when possible to prevent intraoperative bleeding; however, a rapid increase in systolic blood pressure on extubation occurs in all patients. Reduction in perioperative variation of blood pressure decreases the

Table 3. Forward selection method.

	Partial regression coefficient	Standardized partial regression coefficient	T value	P value	decision
• Sex	0.0166	0.0948	1.5441	0.1238	NS
• Pre/postoperative blood pressure ratio	−0.0597	−0.0931	−1.5175	0.1304	NS
• Cerebrovascular discorder	0.0442	0.1378	2.2456	0.0256	*
• Constant term	0.0467		1.3674	0.1727	

Table 4. Backward elimination method.

	Partial regression coefficient	Standardized partial regression coefficient	T value	P value	decision
• Sex	0.0184	0.1049	1.7096	0.0886	NS
• Pre/postoperative blood pressure ratio	−0.0600	−0.0935	−1.5307	0.1271	NS
• Operating time	0.0001	0.1008	1.6228	0.1059	NS
• Hypertension	−0.0175	−0.0990	−1.5926	0.1125	NS
• Diabetes	0.0220	0.0898	1.4586	0.1459	NS
• Cerebrovascular discorder	0.0458	0.1429	2.3299	0.0206	*
• Constant term	0.0338		0.9597	0.3381	

Table 5. Discriminant analysis by major 6 variables in the backward selection including pre/post operative blood pressure ratio, operation time, hypertension, diabetes, cerebrovascular disorder and 3 variables in the forward selection including sex, pre/post operative blood pressure ratio, cerebrovascular disorder.

(a)

Postoperative onset of cerebral infarction		Actual result	
		no	yes
Prediction by major 6 variables	no	235	0
	yes	23	2

Predictive value: 91.2%.

(b)

Postoperative onset of cerebral infarction		Actual result	
		no	yes
Prediction by major 3 variables	no	236	1
	yes	22	1

Predictive value: 89.6%.

risk for cerebral infarction [5]; therefore, increased blood pressure on extubation may be associated with the onset of cerebral infarction. A significant relationship was not found due to the small number of subjects in the study, but the results suggested that increased blood pressure on extubation influenced postoperative cerebral infarction. Further studies in more patients with cerebral infarction are required to examine this finding.

6. Summary

1) We experienced two patients who developed cerebral infarction after surgery and examined the pathogenic mechanism and risk factors in these cases.

2) A history of cerebrovascular disorder posed a risk of onset of cerebral infarction.

3) A rapid increase in systolic blood pressure on extubation was a possible risk factor for onset of postoperative cerebral infarction.

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