Current Status of Management for Poor-grade Patients with Ruptured Intracranial Aneurysm

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Summary: To establish a management strategies for poor-grade patients after aneurysmal subarachnoid hemorrhage (SAH), medical records were analyzed for 166 patients who were in Hunt and Hess Grade IV or V among 588 consecutive cases with ruptured intracranial aneurysm admitted during the past 5 years. Causes of unfavorable outcome (poor or dead) in those 166 patients were evaluated to improve the management outcome.

Overall management results of the 166 poor-grade patients were favorable (good or fair) in 71 (42.8%), unfavorable in 95 (78 dead, 17 poor). Direct clipping was performed in 90 patients, and the results were favorable in 69 (76.7%) and unfavorable in 21(23.3%). Surgery was not done in 76 patients because 41 were moribund on arrival, 15 deterioration due to rebleeding, 7 severe brain swelling, 5 serious medical illness, one severe delayed ischemic deficits (DID), and one cerebral infarction following angiography, and 6 refused surgery. Seven patients survived in non-surgery group (2 fair, 5 poor). Direct effects of aneurysm rupture (34.8%) and early rebleeding (34.8%) were the major causes of unfavorable outcome in Grade IV patients, while it was direct effect of aneurysm rupture (91.8%) in Grade V patients.

As rebleeding is the only preventable cause of unfavorable outcome, urgent management is necessary to prevent rebleeding, especially for grade IV patients. Grade IV patients should be treated aggressively with direct clipping for non-complex aneurysms or for patients with hematoma, and coil embolization for patients with poor surgical indication.

Key words:

- subarachnoid hemorrhage
- ruptured intracranial aneurysm
- poor-grade patients
- rebleeding

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Introduction

Aggressive management in poor-grade (Hunt & Hess Grade IV or V) patients remains controversial.²⁾³⁾⁴⁾¹⁰⁾¹²⁾¹⁴⁾¹⁵⁾¹⁸⁾¹⁹⁾ Poor-grade patients have been subjected to conservative management first mainly due to low probability of favorable outcome. The possibility of aggressive surgical management has been determined only after improvement of clinical grade.¹⁾⁶⁾¹⁸⁾ Difficulty in surgery, high mortality and morbidity, and low functional recovery make neurosurgeons reluctant to perform early direct surgery in poor-grade patients.⁶⁾¹⁸⁾ Recent reports of favorable results from early surgical management of the good-grade patients encourage neurosurgeons to manage the poor-grade patients in an active manner.³⁾⁹⁾¹²⁾¹⁴⁾ Despite of several

reports of favorable outcome in poor-grade patients with active management, this issue is still the focus of debate.¹⁾⁶⁾⁸⁾ This study is aimed to formulate management strategies for poor-grade patients after subarachnoid hemorrhage (SAH) by analyzing our experience during the past five years.

Clinical Material and Methods

Patient population

During the period between July 1, 1991, and June 30, 1996, 588 patients with aneurysmal SAH managed by the author were treated at our institution. Patients were assessed and graded according to the Hunt and Hess's grading scale within a few hours of admission.⁶⁾ The diagnosis of aneurysmal SAH was confirmed by computerized

tomography (CT) and the presence of an aneurysm on four-vessel cerebral angiography. One hundred and sixty-six patients, presented in poor-grade on admission, were subjected to retrospective analysis.

Management

Emergency surgery was performed for deteriorating patients with an intracerebral hematoma. The remaining patients were managed at the Neurosurgical Intensive Care Unit until improvement of neurological state. We used ventriculostomy for an acute hydrocephalus, mannitol for increased intracranial pressure, and nitroglycerin for hypertension. We performed surgical clipping of the ruptured aneurysm as soon as possible in patients who showed clinical improvement. Other categories of poor-grade patients requiring early surgery included acute hydrocephalus, and poorly controlled hypertension with agitation. Early clearance of subarachnoid clot on follow-up CT indicates slack brain at the time of early surgery and better outcome. Surgery was delayed in patients with a complex aneurysm where undue brain retraction and prolonged temporary arterial occlusion are anticipated. Ninety of the 166 poor-grade patients (54.2%) underwent surgical clipping of the ruptured aneurysm (within 72 hours in 29 patients, over 72 hours after the last rupture in 61 patients). Surgery was delayed in 25 patients due to a late presentation to our institution. After surgical clipping of the ruptured aneurysm, moderate hypertension was induced with dopamine or dobutamine, and the hematocrit was maintained at 25-33% for prevention or treatment of delayed ischemic deficits (DID). Intravenous use of a calcium antagonist, nimodipine was started routine base from the time of admission. Papaverine was infused into the

selected cerebral arteries when the patients develop post-operative vasospasm.

Data analysis

We analyzed data from medical records and imaging studies in regard to amount of hemorrhage, location of aneurysm, incidence of rebleeding and DID, and factors related to unfavorable outcome, and compared them between good and poor-grade patients. The results of treatment, causes of unfavorable outcome, and reason of non-surgery in Hunt and Hess Grade IV or V were also examined. Outcome (good, poor, fair or dead) was assessed at 3 months after the first rupture. The patients with independent daily activity with or without minor deficit were categorized as favorable outcome, and the patients who died or depended daily living as unfavorable outcome.

Results

Management outcome

Management results of the 166 poor-grade patients were favorable in 71 (42.8%) and unfavorable in 95 (78 dead, 17 poor) (57.2%) (**Table 1**). There was big difference in management results between Hunt and Hess Grade IV and V patients, 57.0% of Grade IV patients achieved favorable outcome, but it was only 17.0% in Grade V patients. Number of unfavorable outcome in Grade V patients doubled that of Grade IV patients (**Table 2**).

Results of surgery

Results of surgery in the 90 poor-grade patients were favorable in 69 (76.7%) and unfavorable in 21 (23.3%). Surgery of the 73 Grade IV patients resulted in 60 (82.2%) favorable outcome, but it was 9 (52.9%) of the 17 Grade V patients. Surgical mortality of Grade V patients was about four times higher than Grade IV patients (**Table 3**). Surgery was not done in 76 patients because 41 were moribund on arrival, 15 deterioration due to rebleeding, 7 severe brain swelling, 5 serious medical illness, one severe DID, and one cerebral infarction following angiography, and 6 refused surgery. Seven patients survived in non-surgery group (2 fair, 5 poor).

Rebleeding

Poor-grade patients (15.1%) re-bled about three times more than good-grade (5.9%) during hospital stay ($p < 0.05$). Early hospital rebleeding (within 72 hours after the admission) occurred in 18 patients (72.0%) of the 25 poor-grade patients with rebleeding, and 13 patients (72.2%) died. In contrast, early hospital rebleeding occurred in 9 (1.2%) of the 25 good-grade patients with rebleeding ($p <$

Table 1 Clinical grade and management outcome

Grade	Outcome (% in row)		Total
	Favorable	Unfavorable	
Good*	385 (91.2)	37 (8.8)	422
Poor**	71 (42.8)	95 (57.2)	166
Total	456 (77.6)	132 (22.4)	588

*Hunt and Hess Grade I, II, or III, **Hunt and Hess Grade IV or V

Table 2 Management outcome of poor-grade patients

Hunt and Hess grade	Outcome (% in row)		Total
	Favorable	Unfavorable	
IV	61 (57.0)	46 (43.0)	107
V	10 (17.0)	49 (83.0)	59
Total	71 (42.8)	95 (57.2)	166

Table 3 Hunt and Hess grade and results of surgery

Grade	Good	Outcome (% in row)			Total
		Fair	Poor	Dead	
I	85 (98.8)	1 (1.2)			86
II	145 (90.6)	5 (3.1)	8 (5.0)	2 (1.3)	160
III	116 (84.1)	11 (8.0)	9 (6.5)	2 (1.4)	138
IV	47 (64.4)	13 (17.8)	8 (11.0)	5 (6.8)	73
V	4 (23.5)	5 (29.5)	4 (23.5)	4 (23.5)	17
Total	397	35	29	13	474

0.05).

Delayed ischemic deficits

Incidence of DID in poor-grade patients was similar to good-grade patients. DID occurred in 41 (24.7%) of the 166 poor-grade patients, and 96 (22.7%) of the 422 good-grade patients. But DID was one of the major causes (7.4%) of unfavorable outcome in poor-grade patients.

Causes of unfavorable outcome

Major causes of unfavorable outcome in the 95 poor-grade patients were direct insult in 61 (64.2%) patients, 17 (17.9%) rebleeding, and 7 (7.4%) DID. Major causes of unfavorable outcome in Grade IV patients were direct insult (34.8%) and rebleeding (34.8%), while it was direct insults (91.8%) in Grade V patients (**Table 4**). Surgical complication was only a minor causes of unfavorable outcome.

Grade IV patients

Management results of the 107 Hunt and Hess Grade IV patients were 61 (57.0%) favorable and 46 (43.0%) unfavorable (33 dead, 13 poor). Twenty-three Grade IV patients underwent early surgery within 72 hours of the last rupture, and resulted in 18 (78.3%) favorable and 5 (21.7%) unfavorable outcome. The other 84 Grade IV patients were managed conservatively with or without following delayed surgery, and their results were 43 (51.2%) favorable and 41 (48.8%) unfavorable: (1) Twelve patients were improved by supportive care. Eleven of them underwent delayed surgery and resulted in 10 favorable and one unfavorable outcome. One additional favorable outcome was a patient who did not have surgery. (2) Forty-two patients did not improve with conservative care. Thirty-seven of them underwent delayed surgery and resulted in 31 favorable and 6 unfavorable outcome. The other 5 patients refused surgery and their results were unfavorable. (3) Thirty patients deteriorated during supportive care (2 of them underwent delayed surgery) resulted in one favorable and 29 unfavorable outcome. Causes of deterioration during

Table 4 Causes of unfavorable outcome in poor-grade patients

Cause	Grade IV	Grade V
Direct insult	16	45
Rebleeding	16	1
Delayed ischemic deficits	6	1
Medical illness	5	2
Surgical complication	1	
Others	2	

supportive care were rebleeding in 16 patients, 7 brain swelling, 4 medical illness, 2 DID, and one cerebral infarction following angiography.

Grade V patients

Management results of the 59 Hunt and Hess Grade V patients were 10 (17.0%) favorable and 49 (83.0%) unfavorable (45 dead, 4 poor). Fourteen of the 59 Grade V patients underwent emergency surgery, and resulted in 7 favorable and 7 unfavorable outcome. Forty-five patients had supportive care first. Only 4 of the 45 patients with supportive care improved; 2 of 3 patients with delayed surgery and a patient without surgery achieved favorable outcome. Forty-one patients who did not improve with supportive care died.

Discussion

Although the duration of conservative care was not determined, poor-grade patients were excluded from early surgery in the hope of spontaneous improvement to a better grade.¹¹⁾ But in the recent reports, the rate of favorable management outcome in poor-grade patients was improved from 20.2% to 42.6% with aggressive surgical management.³⁾¹⁰⁾¹⁴⁾¹⁵⁾ Le Roux *et al.* reported results of a retrospective study in the 159 aggressively managed poor-grade patients (surgery in 96.9%) with favorable outcome in 38.4%.⁹⁾ They could achieve favorable outcome in 53.9% of Grade IV, and 24.1% of Grade V patients. Our study in the 166 poor-grade patients (surgery in 54.2%) resulted overall favorable outcome in 42.8%; favorable outcome in

Table 5 Authors and results of management in poor-grade patients with aneurysmal SAH

Author	Year	No. of cases (% of Grade V)	No. of surgical cases (%)	Outcome in percent			
				Management		Surgery	
				Favorable	Mortality	Favorable	Mortality
Bailes <i>et al.</i> ³⁾	1990	54 (59.3)	35 (64.9)	42.6	50.0	65.7	22.9
Seifert <i>et al.</i> ¹⁴⁾	1990	74 (35.1)	36 (48.6)	20.2	67.4	41.7	NA
Nowak <i>et al.</i> ¹²⁾	1994	109 (61.5)	69 (63.3)	21.1	42.2	32.0	23.0
Steudel <i>et al.</i> ¹⁶⁾	1994	116 (73.3)	57 (49.1)	35.3	56.9	71.9	22.8
Ungersböck <i>et al.</i> ¹⁹⁾	1994	48 (39.6)	36 (75.0)	21.3	42.5	27.8	22.2
Le Roux <i>et al.</i> ⁹⁾	1996	159 (52.2)	154 (96.9)	38.4	43.4	NA	NA
Lee (present series)	1997	166 (35.5)	90 (54.2)	42.8	47.0	76.7	10.0

NA: Not applicable

57.0% of Grade IV, and 17.0% in Grade V patients. Therefore, it appears that management results in poor-grade patients are similar both in non-selective and selective aggressive management (Table 5).

Poor-grade patients have been often excluded from aggressive management on the basis of concepts that surgery and anesthesia would aggravate the brain damage.¹⁾⁶⁾¹⁸⁾ However, recent reports support that the risk of surgical complication is similar both in good and poor-grade patients undergoing surgical repair of ruptured anterior circulation aneurysms.¹⁰⁾¹⁶⁾

Steudel *et al.* reported that surgery was beneficial in the cases showing clinical improvement.¹⁶⁾ Patients with clinical improvement following ventriculostomy or conservative management showed favorable outcome in 89.5%.¹⁷⁾ The International Cooperative Study on the Timing of Aneurysm Surgery demonstrated that the risk of early surgery was equivalent to the risk of rebleeding and vasospasm in patients waiting for delayed surgery.⁸⁾ Seifert *et al.* reported that early surgery in Grade IV patients led to better overall mortality and morbidity than delayed surgery, and chance of survival in poor-grade patients without surgery is almost none existent.¹⁴⁾ In our study, 28.0% of Grade IV patients deteriorated during conservative management, and rebleeding was one of the main causes of deterioration. This results suggests that aggressive management is necessary for prevention of rebleeding.

Rebleeding within two weeks was more common in poor-grade (21.6%) than good grade (11.6%) patients.⁷⁾¹³⁾ Hillman *et al.* reported 79.2% mortality in the patients who had rebleeding within 24 hours.⁵⁾ This study also shows that rebleeding during hospital stay was more frequent in poor (15.1%) than good-grade (5.9%). Early rebleeding within 72 hours after the first rupture was more common and caused high mortality in the poor-grade patients. There was

a clear prognostic difference regarding unfavorable outcome between Grade IV and V patients.¹⁴⁾¹⁹⁾ As early rebleeding (28.0%) is one of the major causes of unfavorable outcome in Grade IV patients, urgent surgical intervention is necessary for these patients. Steudel *et al.* recommended early active surgery if Grade V patients with Glasgow Coma Scale above 4 improve after ventriculostomy.¹⁶⁾ Early active surgical treatment for all poor-grade patients decreased mortality without affecting favorable outcome.⁹⁾ Our experience favors early active surgery for Grade V patients with increased intracranial pressure caused by intracerebral hematoma or acute hydrocephalus. Selected poor-grade patients could be salvaged by ventriculostomy and subsequent surgical clipping or coil embolization. But increased risk of rebleeding among patients undergoing ventriculostomy was also reported.²⁾¹⁶⁾ Therefore it is necessary to protect from rebleeding as soon as patients improve with ventriculostomy.²⁾⁹⁾

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