

# Outcome and Factors Associated with Poor-Grade Subarachnoid Hemorrhage: A Longitudinal Study

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## ABSTRACT

**Aim:** To assess the factors which determine the outcome of poor-grade subarachnoid hemorrhage.

**Study design:** A longitudinal study

**Place and Duration:** This study was conducted at Pakistan Surgical Center Islamabad Pakistan from April 2020 to April 2021

**Methodology:** The current study involved 19 patients who had a poor-grade aneurysmal subarachnoid hemorrhage and their different factors were assessed. The inclusion criteria for the study was a diagnosis of poor grade aneurysmal subarachnoid hemorrhage (grade IV or grade V as defined by World Federation of Neurological Surgeons) at the time of admission, confirmation and grading of aneurysmal subarachnoid hemorrhage by CT scans (Fisher grading system), and the aneurysm's presence has been further confirmed by four-vessel angiography.

**Results:** The incidence of poor-grade patients among all the patients admitted for aneurysmal subarachnoid hemorrhage was 11.89% in our study. We observed that out of 19 patients, 13 had surgeries, and among that, a good outcome was observed in 53.8% of patients. Whereas the 7 patients who were conservatively treated died.

**Conclusion:** If patients with poor-grade aneurysmal subarachnoid hemorrhage are operated (craniotomy with clipping of aneurysm) on within 3 days, they have a 50% chance of giving rise to favorable outcomes.

**Keywords:** Aneurysmal subarachnoid hemorrhage, Poor grade, Glasgow outcome scale

## INTRODUCTION

The 40-60% mortality associated with aneurysmal subarachnoid hemorrhage is because of the initial bleeding whereas further 20-25% mortality is associated with poor medical conditions in patients who are also called poor grade patients.<sup>1</sup> Management of poor grade aneurysmal subarachnoid hemorrhage is quite complicated and controversial and is also associated with etiology which include vasospasm, intraventricular hemorrhage, intracerebral hemorrhage, and hydrocephalus and rebleeding.<sup>2</sup> However, sometimes it is unclear to identify the cause among the poor grade patients of aneurysmal subarachnoid hemorrhage just by observing the images. Although, there are different studies that provide details about this cause, still, there is a need to recognize certain factors for the timely management of poor-grade patients and carrying out immediate surgical procedures in order to minimize the chances of mortality.<sup>3</sup> The current study involves the identification of certain factors, by literature review and analyzing the data of poor-grade patients, which can affect the functional outcome and help in designing a management protocol for such patients.

## METHODOLOGY

The current study involved 19 patients admitted in the in our hospital during the assigned period due to aneurysmal subarachnoid hemorrhage. Permission was taken from the ethical review committee of the institute. The inclusion criteria for the study was a diagnosis of poor grade aneurysmal subarachnoid hemorrhage (grade IV or grade V as defined by World Federation of Neurological Surgeons (WFNS) Subarachnoid Hemorrhage (SAH) Grading) at the time of admission, confirmation and grading of aneurysmal subarachnoid hemorrhage by CT scans (Fisher grading system), and the aneurysm's presence has been further confirmed by four-vessel angiography. Patients were graded using the Fisher grading system as follows: Grade 1: There is no blood. Grade 2: Diffuse or thin blood layer less than 1 mm thick (interhemispheric, insular, or ambient cisterns), Grade 3: Localized clots and/or blood layers bigger than 1 mm thick in the vertical plane, and Grade 4: Intracerebral or intraventricular clots with diffuse or absent blood in basal cisterns. Patients were classified as Grade 1: GCS score of 15 without focal deficit, Grade 2: GCS

score of 13 or 14 without focal deficit, Grade 3: GCS score of 13 or 14 with focal deficit, Grade 4: GCS score of 7-12, and Grade 5: GCS score of 3-6, according to the World Federation of Neurological Surgeons.

All the subjects were managed according to the standardized protocol which includes aggressive resuscitation both before and after surgery, immediate surgery, and aggressive treatment and prevention of vasospasm and intracranial hypertension. The management before surgery included ventilation with mannitol, nimodipine, and phenytoin, and intubation given in ICU or in the emergency ward where patients were admitted for the time being before surgery. Four vessel angiogram and CT scans were immediately performed once the patients were stable. For patients who exhibited intraventricular hemorrhage or ventriculomegaly, external ventricular drainage was placed in the operation theatre. For the surgery, once craniotomy with clipping of aneurysm was complete, the brain was relaxed by diuresis. During the entire procedure, normotension was maintained. To eradicate the aneurysm, magnification and standard microvascular techniques were used in all cases. If the brain got tensed at any point using the pericranial flap during the surgery lax duraplasty was used and replacement of bone flap was done. Once the surgery was completed, hypertension, hemodilution, and hypervolemia were given to all patients. CT scans were obtained on a regular basis and if any patient exhibited new hypodensities, they were characterized as having symptomatic vasospasm and for that intracisternal papaverine (1 mg) was given to them with an 8 hours interval till clinical improvement was observed. If the use of endotracheal tube was continued for more than 4-5 days then tracheostomy was performed for easing the bronchial toileting. Once the patients were discharged, their outcomes were assessed using the Glasgow outcome scale after 1, 3, 6, and 12 months. When the score of the Glasgow outcome scale was 4 or 5, the outcome was considered favorable, however, it was considered unfavorable if the patients had died or were not able to continue living independently. SPSS version 23 was used for data analysis.

## RESULTS

The current longitudinal study involved 19 patients who were admitted because of having a poor-grade aneurysmal subarachnoid hemorrhage. The incidence of poor-grade patients

among all the patients admitted for aneurysmal subarachnoid hemorrhage was 11.89% in our study. The Majority of patients (52.6%) belonged to the age group 41-60 years, whereas 26.3% of patients were older than 60 years, the mean age of patients was 51.3 years. There were 11 females and 8 males in the study; with a male to female ratio of 1:1.4. Among females, the recorded mean age was 55.3 and among males, it was 44.4 years. The mean duration of seizures recorded was 5.94 days and the majority of the cases i.e. 68.4% were admitted somewhat between the 5 days of seizures. The surgery timing was classified depending upon the days; if surgery was performed in less than 3 days, it was classified as acute, early if done in 4-7 days, and late if performed in more than 7 days. There were only 30.8% of patients who were operated on during 3 days of seizures whereas the remaining 61.5% were operated after 7 days as indicated in Table number 1. The maximum time observed between the seizures and surgery was 28 days with a mean duration of 11.3 days whereas the earliest surgery was performed on day 1. According to the WFNS grading system, aneurysmal subarachnoid hemorrhage was graded in which 18 cases belonged to grade 4 whereas 1 patient was placed in grade 5 of WFNS. On the basis of CT scans the patients were graded according to the Fishers grading system. Around 36.8% of patients belonged to Fisher's grade 3 whereas 63.2% of patients belonged to Fisher's grade 4. Out of all the patients, 13 had comorbidities such as hypertension which was most commonly observed and was present in 12 patients. Along with hypertension, there was diabetes mellitus, cerebrovascular accident, and coronary arterial disease. There was only 1 patient who had all these 4 co-morbidities collectively present. Four vessels cerebral digital subtraction angiogram was done in 17 patients. Similarly, out of 19 aneurysms, 7 patients had anterior communicating artery aneurysm, 5 had middle cerebral artery, 3 had internal cerebral artery, 3 had posterior circulation and 1 had the aneurysm of a distal anterior cerebral artery. The vasospasm before surgery was observed in 8 patients. Out of 19 cases, 13 were operated whereas 6 were not operated for different reasons. Among the 13 patients who were operated 13 had pterional craniotomy, 3 had a fronto-temporo-orbital craniotomy, and 1 patient had their surgery by the far lateral approach. Almost 15.4%

of cases didn't undergo temporary clipping whereas it was done in 84.6% of cases. In 3 patients cerebral edema was observed during the surgery. In order to facilitate clipping in 2 patients, Gyrus rectus was resected. Extra ventricular drainage was performed in 5 patients out of which 4 exhibited signs of improvement. Using the Glasgow outcome scale, the outcomes of all patients were analyzed at the time of discharge and after 1, 3, 6, and 12 months as exhibited in Table 1-3. According to the Glasgow outcome scale, the most common score was 1 at the time of discharge in 9 cases whereas it was 4 in 4 cases and the remaining 6 cases had an equal distribution in grades 2, 3, and 5. Similarly, the 4<sup>th</sup> and 5<sup>th</sup> grades were observed in 7 patients who were operated on. The patients who belonged to grades 1, 2, and 3 had unfavorable outcomes whereas 4 and 5 exhibited favorable outcomes. Patients were not operated on due to the poor hemodynamic status, absent brain stem reflexes, and lack of consent as described in Table number 1. No correlation was observed between patients' age and functional outcome at the time of discharge or after 6 months of the discharge as obtained p-value was 0.568. Similarly, no significant difference in the outcomes was observed when they were compared with the gender as the obtained p-value was 0.267. Vasospasms were present in 8 cases out of 17 as observed by the angiogram conducted before surgery. No significant correlation was present in the discharge time and outcome with a p-value of 0.667 or after 6 months with a p-value of 0.75. Similarly, no correlation was present in the patients having Fisher grades 3 and 4 and discharge time or after 6 months. The intracerebral hematoma was present in 31.6% of patients, however, no correlation was present here either. No correlation was present in the outcome at the discharge time and 9 patients who had intraventricular hemorrhage with a p-value of 0.667. There were 3 patients who had low-density changes and no correlation was present as the p-value obtained was 0.625. The absence of low-density changes was significantly associated with good outcomes after 6 months as obtained p-value was 0.004. There were 9 patients having intraventricular hemorrhage and 5 patients who required intervention for extra ventricular drainage. It was observed that the route of surgery had no effect on the outcome of patients but the patients who were not operated on died when discharged.

Table 1: Details of the data of study participants

Age	Gender	Day of operation	Aneurysm site	Vasospasm	Fisher Grade	IVH/ ICH	Infarcts	Brain swelling	Temporary Clipping	GOS Discharge	1	3	6	12
60	F	3	A.com	No	4	IVH	No	No	Yes	3	3	4	4	5
62	F	14	A.com	No	4	IVH	No	No	Yes	3	3	4	4	5
35	M		A.com	Yes	3	No	No	No	No	1	1	1	1	1
65	F	18	Left M1	Yes	4	IVH	No	No	Yes	2	1	1	1	1
42	M	2	A2	No	4	ICH	No	No	Yes	3	1	1	1	1
65	M	28	A.com	No	4	ICH	No	Yes	Yes	5	5	5	5	5
40	M	9	Right P1	Yes	3	No	No	No	Yes	2	3	1	1	1
54	F	16	Left M1	Yes	3	No	Yes	No	Yes	2	1	1	1	1
60	F		Right P.com Left MCA	No	4	IVH/ICH	No			1	1	1	1	1
45	F		Basilar	Yes	4	IVH	No			1	1	1	1	1
35	F	3	Left M1	Yes	4	ICH	No	No	No	3	3	3	4	4
63	F	4	Right V4	No	3	No	No	No	Yes	4	4	4	1	1
52	M	17	A.com	Yes	4	IVH/ICH	No	No	Yes	4	4	5	5	5
50	F		Left P.com	No	3	No	No			1	1	1	1	1
63	M	1	Left M1	No	4	ICH	No	Yes	Yes	4	5	5	5	5
58	F	22	Left ICA	No	4	IVH	No			1	1	1	1	1
57	F	10	Left A1, Left DACA	Yes	3	IVH	No	Yes	Yes	4	5	5	1	5
55	F	4				IVH	Yes			1	1	1	1	1
14	M	3				No	Yes			1	1	1	1	1

Table 2: Outcome after surgery

Outcome	Frequency	Percentage
Good	7	53.8
Poor	6	46.2
Total	13	100

The patients who had encountered cerebral edema exhibited good outcomes at the time of discharge or after 6 months but it was not statistically significant. During the surgery, temporary clippings were done in 11 patients but no correlation was present between the two at the time of discharge or after 6 months as the obtained p-value was 0.228 and 0.538 respectively.

Table 3: GOS score at different months after discharge

GOS grade	1	3	6	12
5	3	4	4	6
4	2	3	3	1
3	4	1	0	0
2	0	0	0	0
1	10	11	12	12
Total	19	19	19	19

## DISCUSSION

The current study was done in a prospective manner which was conducted to evaluate the management system of 19 patients suffering from poor-grade aneurysmal subarachnoid hemorrhage. The patients were graded according to the WFNS grading system and 38.3% grade IV and V patients had exhibited good outcomes whereas the other 53.8% patients who were operated on exhibited favorable outcomes. The outcome is largely dependent on the initial hemorrhage and its effective management, the patients who are more likely to be benefitted from the surgery are still difficult to evaluate. The incidence of poor grade condition varies from 25-45% whereas in the current study it was 12%.<sup>4</sup> It was observed that the mean age of patients was 51.3 years which also didn't coincide with the mean age present in literature; as researchers have linked the advanced age with the poor outcome of the disease.<sup>5</sup> We also observed that no association existed between poor outcomes and advanced age. Different co-morbidities were also associated with the poor outcome. We observed that hypertension and diabetes were the most common co-morbidities present and had a significant correlation between the outcomes and co-morbidities. It was observed in other studies that more than 90% of patients having poor-grade aneurysmal subarachnoid hemorrhage die if left untreated or if the treatment is delayed unfavorable outcomes are commonly observed. We observed that 5 patients had early surgeries out of which 4 exhibited favorable outcomes at the time of discharge but 3 of them died after 6 months. We concluded that amount of blood, hypodensities, and hydrocephalous was associated with a poor outcome. Our results were similar to the results of Le Roux et al where they also

reported that the route of approach has no effect on the outcome.<sup>6</sup> We also observed that patients who had their surgeries within 4 days of seizures had no effect on the outcome of discharge but after 6 months a significant difference was observed. It has been suggested that craniotomy helps in relaxing the tensed brain and also assists in tackling the raised intracranial pressure.

## CONCLUSION

Our study concluded that if patients having poor-grade aneurysmal subarachnoid hemorrhage are operated (craniotomy with clipping of aneurysm) on within 3 days, they have a 50% chance of giving rise to favorable outcomes.

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**Ethical approval:** The study was ethically approved by the ethical review committee of the institute.

**Conflict of interest:** None

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