Original Article

Study of Patient Characteristics/Profile and Factors Determining the (Immediate) Outcome in Spontaneous Subarachnoid Hemorrhage

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Abstract

Aims and Objectives : The aims of the study were to delineate the risk factors, type and location of underlying pathology, outcome and the determinants of outcome in patients with spontaneous subarachnoid hemorrhage.

Material and Methods : Forty consecutive patients with spontaneous subarachnoid hemorrhage on neuroimaging scan were recruited over a period of 1 year. Risk factors profile, site and type of pathology seen on angiography were assessed in all patients. Patient outcome at the end of hospital stay was assessed using the Glasgow Outcome Scale (GOS) and was analysed with respect to demographic factors, premorbid risk factors, initial WFNS scoring, neuroimaging findings and complications during in-hospital stay.

Results : Of the total 40 patients in the study, 43% were males and 57% were females. The mean age in study group was 49.63 yrs (SD 13.12). Fifty percent patients were hypertensive, 22.5% were smokers and alcohol intake was reported by 17.5%. Saccular aneurysms were seen in 80% patients and arteriovenous malformations in 7.5%. Aneurysms were more common in the anterior circulation than in the posterior circulation. Poor outcome was associated with higher age, hyponatremia, higher World Federation of Neurosurgeons (WFNS) grade on admission, presence of vasospasm on angiography, fever any time during the course in hospital and requirement of ventilatory support.

Conclusion : Gender, site of aneurysmal bleeding (anterior/posterior circulation) and procedure performed (coiling/clipping) do not influence the immediate outcome of patients with subarachnoid hemorrhage. Further studies on Indian subset of patients are necessary to determine the patient characteristics and factors influencing the long term outcome in spontaneous subarachnoid hemorrhage.

Introduction

Hemorrhagic stroke commonly occurs as a result of hypertensive intracerebral bleed, ruptured saccular aneurysm and with the use of anticoagulants. Subarachnoid hemorrhage may result from head injury or occur spontaneously, usually from a ruptured cerebral aneurysm or arteriovenous malformation (AVM). Subarachnoid hemorrhage produces a relatively large burden of premature mortality and morbidity because of relatively young age of onset and poor outcome.[1] It is a medical emergency and can lead to death or severe disability even when recognized and treated at an early stage.

The leading cause of nontraumatic subarachnoid hemorrhage is rupture of an intracranial aneurysm, which accounts for 85% of cases and has a high rate of death and complications.[2] Unruptured aneurysms are asymptomatic making it difficult to identify the patients with unruptured aneurysms and prevent subarachnoid hemorrhage.

Several studies have helped in understanding the risk factors and improving the outcome of patients with subarachnoid hemorrhage. There have been many advances in the treatment of aneurysmal SAH with endovascular coiling and surgical clipping of the aneurysm. The treatment of AV malformation with glue embolisation is evolving. These advances in endovascular techniques, diagnostic methods, and surgical and perioperative management of subarachnoid hemorrhage have led to decrease in the complications after SAH and modest improvement in the overall outcome.[3] Nevertheless, outcome for patients with SAH remains poor.

Most deaths after subarachnoid hemorrhage occur very rapidly and are due to the initial hemorrhage.[4] Major improvement in terms of SAH can therefore be achieved only by reducing the incidence of aneurysmal rupture. To achieve primary prevention, knowledge of modifiable risk factors for SAH is essential. Earlier studies have suggested genetic susceptibility as an important risk factor for aneurysmal SAH. However, most instances of SAH can be attributed to lifestyle exposures. Prevention of subarachnoid hemorrhage can be achieved by reducing these risk factors, timely diagnosis and early treatment.

Data available on subarachnoid hemorrhage in Indian subset of patients is limited. Maximum data available pertains to western countries. Identification of risk factors, profile characteristics and prognostic factors for SAH will help in reducing the incidence, morbidity and mortality from the disease.

The aims of the study were to delineate the risk factors, type and location of underlying pathology, outcome and the determinants of poor outcome in serially recruited patients with spontaneous subarachnoid hemorrhage.

Material and Methods

The study was carried out at a tertiary care hospital from January 2009 to December 2009. Patients more than 18 years of age with spontaneous subarachnoid hemorrhage on neuroimaging scan were included in the study.

Patients with traumatic subarachnoid hemorrhage, past neurological disease with residual deficit, severe co-morbid disease of other organ system(s) and pregnant patients were excluded from the study. Patients with neuroimaging showing additional pathology other than subarachnoid hemorrhage were also excluded from the study. The study was approved by the Ethics Committee of the hospital.

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Table 1: Pathology on angiography study

Pathology	No. of patients	Percentage
Saccular aneurysm	32	80
Arteriovenous malformation	3	7.5
Mycotic aneurysm	1	2.5
Idiopathic	3	7.5
Angiography not done	1	2.5
Total	40	100

Table 2 : Sites of aneurysm

Cerebral circulation	Site of aneurysm	No. of Patients
Anterior circulation	Anterior communicating artery (ACOM)	11
	Internal carotid artery (ICA)	6
	Middle cerebral artery (MCA)	6
Posterior circulation	Posterior cerebral artery (PCA)	2
	Basilar artery (BA)	3
	Posterior communicating artery (PCOM)	3
Ant. + Post. circulation	Multiple	2
	Total	33

In the study, 40 consecutive patients with spontaneous subarachnoid hemorrhage who fulfilled the inclusion and exclusion criteria were recruited over a period of 1 year. A detailed history and physical examination was carried out in every patient. Clinical symptoms at presentation and details of the risk factors for subarachnoid hemorrhage such as hypertension, smoking, alcohol and diabetes mellitus were assessed in all patients.

Every patient underwent initial neurological scoring using the clinical grading scale of the World Federation of Neurosurgeons based on Glasgow coma score (GCS) and focal neurological deficit.[5] All patients underwent routine investigations like CBC, renal function tests, liver function tests, blood sugar, ECG, chest X-ray. Details of the specialized neuroimaging studies done like CT scan, MRI, 4-vessel DSA including the type and location of the underlying pathology seen on angiography were recorded. Head CT Grade[6] and complications seen on CT scan such as intraventricular extension, intracerebral bleed and hydrocephalus were also recorded. Data pertaining to treatment details of the patient including coiling/clipping procedure was collected. Patients were investigated and treated as per the treating (attending) physicians' decision.

Patients were followed up regularly during the hospital stay. Patient outcome was assessed using the Glasgow outcome scale (GOS).[7] Unfavourable outcome was defined as death, vegetative, or severely disabled state (GOS score 1-3). Favorable outcome was defined as moderate to minimal disability and good recovery (GOS score 4-5). The outcome at the endpoint was analysed with respect to demographic factors, premorbid risk factors, initial WFNS scoring, neuroimaging findings and complications during in-hospital stay. End points of the study were death during hospital stay or recovery to GOS score 5 or discharge from the hospital, whichever was early.

Results

Of the total 40 patients in the study, 17 (43%) were males and 23 (57%) were females. The Male to Female ratio was 1:1.3. The mean age in study group was 49.63 yrs (SD 13.12) & highest number of patients were present in the age group of 41-50 yrs

Table 3 : Glasgow outcome score

Glasgow outcome score	No. of patients	Percentage
1	14	35
2	2	5
3	2	5
4	5	12.5
5	17	42.5
Total	40	100

Table 4: Outcome in the Intervention groups

Intervention Procedure	Favorable outcome, n (%)	Unfavorable outcome, n (%)	Mean GCS score	Total, n
No Intervention	6 (46.2)	7 (53.8)	11	13
Intervention done	16 (59.3)	11 (40.7)	12	27
Coiling	11 (68.8)	5 (31.2)	11	16
Clipping	4 (40)	6 (60)	12	10
Embolisation	1 (100)	0	15	1

(30%). Study of the risk factor profile revealed 50% patients to have hypertension. Alcohol intake was reported was by 17.5% patients and smoking by 22.5%. Only 7.5% patients had diabetes mellitus.

Saccular aneurysm was the commonest identified pathology on angiography study (Table 1). In the study, 33 patients had aneurysmal subarachnoid hemorrhage out of which 32 had saccular aneurysms and 1 patient had mycotic aneurysmal bleed with underlying aortic prosthetic valve endocarditis. Arteriovenous malformations were seen in 3 patients. Aneurysms were more common in the anterior circulation than in the posterior circulation (Table 2).

Forty percent patients underwent catheter-based coiling procedure (n=16) whereas 25% patients underwent neurosurgical clipping (n=10). One patient underwent Glue embolisation of the AV malformation. Thirteen patients did not undergo any procedure and were treated conservatively. Out of the 40 patients in the study, 35% (n=14) patients expired (GOS score 1) whereas 45% (n=18) patients had unfavorable outcome (Table 3). According to the Glasgow outcome scale, 42.5% patients in the present study had good recovery with GOS score 5. 12.5% patients had GOS score 4 and were able to live independently; while 5% patients had GOS score 3 with severe disability and were unable to live independently. Five percent patients remained in vegetative state.

There was no statistically significant difference in outcome between patients who had undergone an intervention procedure (either coiling, clipping or embolisation) and those who did not undergo any intervention procedure (Table 4, p=0.435 for intervention done vs. no intervention group).

Predictors for unfavorable outcome were analysed to find whether there was statistically significant difference in patients with favorable outcome versus unfavorable outcome with respect to various variables included in the study. Fisher's exact test was used to find the p-value for categorical variables and t-test was used for continuous variables. Significant difference was found in patients with favorable outcome versus unfavorable outcome with respect to age, serum sodium, WFNS grade on admission, GCS on admission, presence of vasospasm on angiography, fever at any time during the course in hospital and requirement of ventilatory support (Table 5). The mean age in patients with favorable outcome was significantly lower as compared with the patients having unfavorable outcome (p=0.028, Table 5). Similarly, mean serum Sodium in patients with favorable outcome was significantly higher as compared with the patients

Table 5: Prognostic Factors for unfavorable outcome

Variable	Favorable Outcome	Unfavorable Outcome	p-value (<0.05=significant)
Age			
Mean	45.55	54.61	0.028
Standard deviation	9.81	15.10	
Sex			
Male	9	8	0.822
Female	13	10	
Hypertension			
absent	11	9	1.0
present	11	9	
Diabetes			
absent	21	16	0.433
present	1	2	
Alcohol			
absent	17	16	0.336
present	5	2	
Smoking			
absent	17	14	0.970
present	5	4	
RBS			
Mean	98.73	112.50	0.199
Standard deviation	26.73	39.66	
Sodium			
Mean	140.09	131.78	<0.001
Standard deviation	6.69	6.83	
GCS on admission			
Mean	13.73	9.61	<0.001
Standard deviation	1.86	3.29	
WFNS grade			
1-3	16	4	0.001
4-5	6	14	
CT Grade			
1-2	8	3	0.165
3-4	14	15	
Hydrocephalus			
absent	20	12	0.057
present	2	6	
Pathology			
Anterior circulation	11	10	0.54
Posterior circulation	7	4	
Vasospasm			
absent	19	10	0.03
present	3	8	
Fever			
absent	21	6	<0.001
present	1	12	
Ventilator			
absent	22	6	<0.001
present	0	12	
Procedure			
clipping	4	6	0.148
coiling	11	5	

having unfavorable outcome (p=0.0001, Table 5).

There was no statistically significant difference in the outcome groups with respect to gender, hypertension, diabetes, alcohol, smoking, RBS, head CT grade, anterior/posterior circulation bleeding and procedure performed.

Discussion

Most clinical series of subarachnoid hemorrhage reveal that it occurs most commonly between 40 and 60 years of age (mean age ≥50 years) but SAH can occur from childhood to old age.[3] In the present study, the mean age of the patients included was 49.63 years (SD 13.12) and the highest number of patients were present in the age group of 41-50 yrs (30%). Male to female ratio in the present study was 1:1.3 which is comparable to earlier epidemiological studies on subarachnoid hemorrhage. In a previous study, Linn *et al* reported that subarachnoid hemorrhage is ≈1.6 times higher in women than in men.[8]

Earlier studies have shown hypertension and smoking as important risk factors for subarachnoid hemorrhage.[9,10] In the present study, 50% of the patients were hypertensive, 22.5% of the patients were smokers and 17.5% were alcoholic. In the study done by Qureshi AI *et al* on risk factors for subarachnoid hemorrhage, 54% patients were hypertensive, 46% current smokers, and 39% were previous smokers.[9] They had concluded that hypertension and cigarette smoking increase the risk for development of SAH.

In the present study, aneurysms were more common in the anterior circulation than in the posterior circulation. Anterior communicating artery was the commonest site of aneurysm which is similar to the observations from previous studies on subarachnoid hemorrhage. According to earlier reported studies, approximately 80–85% of aneurysms are in the anterior cerebral circulation, and the rest are in the posterior circulation; cerebral aneurysms are multiple in 10-15% of cases.[11,12] The two most common sites are the proximal portions of the anterior communicating artery and at the origin of the posterior communicating artery from the stem of the internal carotid.[12]

Outcome in the present study was assessed using the 5-point Glasgow outcome scale. There was no significant difference in outcome between the clipping and coiling groups (p=0.148, Table 5). Similarly, there was no statistically significant difference in outcome between patients who had undergone intervention procedure (coiling, clipping, embolisation) and those who did not undergo any intervention procedure (p=0.435, Table 4).

In a previous study by Langham J *et al* on outcome after subarachnoid hemorrhage across Neurosurgical Units in UK and Ireland, unfavorable outcome was present in 34.6% in aneurysm repaired group and 81.0% in unrepaired aneurysm patient group.[13] No significant difference in outcome was observed between patients who had their aneurysms clipped and those who had their aneurysms coiled.

Study of prognostic factors in the present study revealed significant difference in patients with favorable outcome versus unfavorable outcome with respect to age, serum sodium, WFNS grade on admission, presence of vasospasm on angiography, fever any time during the course in hospital and requirement of ventilatory support (P<0.05, Table 5). Higher age and hyponatremia were poor prognostic factor for outcome in the study. Poor WFNS grade on admission (4-5) correlated with unfavourable outcome in the study. All patients who required ventilatory support had unfavorable outcome.

There was no statistically significant difference in the outcome groups with respect to gender, hypertension, diabetes, alcohol, smoking, RBS, head CT grade, anterior/posterior circulation bleeding and procedure performed in the present study (Table 5).

Rosengart AJ *et al* had done a study to describe prognostic factors for outcome in a series of patients undergoing neurosurgical clipping of aneurysms after subarachnoid hemorrhage.[14] They reported unfavorable outcome on the GOS

score at 3 months after surgical treatment of aneurysmal SAH to be associated with advancing age, worse WFNS grade, more SAH on admission CT scan, posterior circulation aneurysm, larger aneurysm, increased on-admission systolic blood pressure, intracerebral hemorrhage, intraventricular hemorrhage, temperature ≥38°C eight days after SAH and acute vasospasm. The most important factors reported in the study were cerebral infarction, WFNS grade, age, temperature on the 8th day ≥38°C, and symptomatic vasospasm.

In the above study by Rosengart AJ *et al*,[14] posterior circulation aneurysm and more SAH on admission CT scan were associated with poor outcome. This is in contrast to the present study where there was no statistically significant difference in the outcome groups with respect to head CT grade and anterior/posterior circulation bleeding. Aneurysms in the posterior cerebral circulation are frequently more difficult to treat with surgery, and endovascular embolization is a better competitive alternative to direct surgical clipping in these locations.[15] Poor outcome in posterior circulation aneurysm group in the above study could be because all the patients included in the study underwent surgical clipping of aneurysms.

Torner JC *et al* in the cooperative aneurysm study had analysed preoperative prognostic factors for rebleeding and survival in aneurysm patients receiving conservative therapy.[16] Factors significantly related to death in the patients entered into this cooperative aneurysm study were admission neurological grade, diastolic blood pressure, interval to treatment, vasospasm, and medical condition. These patients did not undergo aneurysm treatment. In the study, aneurysm site was not significantly associated with death which is similar to the present study. Age was not significant in these patients treated conservatively, which could be because of intervention procedure increasing the risk of poor outcome among older patients if they undergo any aneurysm treatment procedure. In contrast, 67.5% patients underwent intervention procedure in the present study and higher age was associated with poor outcome.

In another study by Niskanen MM *et al*, one-year outcome in 929 patients with aneurysmal SAH was analyzed.[17] Factors associated with poor outcome were increased age, worse neurological grade, more blood on CT scan, intraventricular hemorrhage, and angiographic vasospasm. Inclusion of per- and postoperative factors also identified ligation of a major artery, temporary clipping, hypodense areas on postoperative CT, postoperative intracranial hemorrhage, and cardiopulmonary event as factors associated with poor outcome.

In conclusion, some unfavorable prognostic factors for outcome such as higher age and high WFNS grade are present on admission and are not modifiable. Nonetheless, outcome is also influenced by factors developing after admission such as hyponatremia, vasospasm, fever and requirement of ventilatory support. Correction or prevention of emergence of these factors and complications will help to improve the outcome in patients with subarachnoid hemorrhage. Gender, site of aneurysmal bleeding (anterior/posterior circulation) and procedure performed (coiling/clipping) do not influence the immediate outcome of patients with subarachnoid hemorrhage.

Limitations of the study include smaller number of patients with spontaneous subarachnoid hemorrhage recruited in the study. Secondly, amount of hemorrhage on neuroimaging studies was not quantified. Instead, head CT grade was used for grading the amount of bleed. Also, data after long term follow up of the patients included in the study is lacking. Further studies on Indian subset of patients are necessary to determine the patient characteristics and factors influencing the long term outcome in spontaneous subarachnoid hemorrhage.

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