

Aneurysmal Subarachnoid Hemorrhage; 4 years study at Lahore General Hospital

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This study was conducted in unit I, during the last 4 years. Total admissions of patients with subarachnoid hemorrhage have been 267. Clinical presentation of 267 patients with subarachnoid hemorrhage (SAH) was classical. There was history of attack during stressful conditions or during sleep, after day's stress. Headache, vomiting, neck stiffness was present in 240(90%) patients. Hypertension was known in 133(50%) patients. During 2004 there were 88 patients, while in 2001 there were 42 admissions with the condition. Maximum number of cases, 29(58%) belonged to 40-60 years of age. There was slight female preponderance. The patients were evaluated according to WFNS grading system. Majority 128(80%) belonged to poor Grade III on admission. Some 69(26%) patients, died before angiography, while 37(14%) died after angiography, before surgery. Anterior Cerebral Artery aneurysms, were the commonest 91(57%) aneurysms. Total surgeries done were in 160 patients. Delayed surgery with optimal delay of 6-14 days was done in majority of cases. Surgical approaches were Pterional, Subfrontal and Frontolateral approaches. Intracranial complications of 267 patients, were rebleed in 53(20%) patients, vasospasm in 27 patients(10%), hydrocephalus in 27(10%) patients. Extracranial complications included, myocardial infarction in 11(4%), cardiac arrhythmias in 21(8%), pulmonary edema in 16(6%) and stress ulcers in 37(14%) patients. Peroperative complications included, aneurysm rupture in 30% and aneurysm avulsion in 1 case. Operative mortality was 13% (21 patients). In 267 SAH cases, management mortality has been 48% (79 patients). Outcome of 160 operated cases was encouraging as good recovery (employment) in 80 (50%) patients: The incidence/Diagnosis of aneurysmal SAH, is increasing in our setup. Aneurysmal SAH also occurs in younger age group. Prognostic factors include early presentation and good WFNS grade on admission

Key words: Subarachnoid Hemorrhage, Intracranial aneurysms, Cerebrovascular accident

Intracranial aneurysms are seen in 1% of autopsies. World literature has shown aneurysm rupture to be 2-6/100000/year The condition is known to have high morbidity and mortality as 15% die before arriving hospital, 15% die within 24 hours of hospitalization, 15% die between 24 hours and 2 weeks. Another 15% die between 2 weeks and 2 months and lastly, another 15% die before 2 years have passed¹. These figures are from western countries, where patient transfer and referral facilities are well established and there is no delay in any level. In our setup, patient's arrival to tertiary care center like ours is much delayed, at each step. The diagnosis is getting more frequent due to availability of CT scan and trained neurosurgeons in all the major districts of Punjab. In 1923, SAH due to aneurysm was identified by Symmonds for the first time. Moniz. Developed angiography in 1927. First aneurysm on angiography, was seen by Dott. in 1931 and wrapping was done. Pterional approach, to clip the aneurysm was done by Dandy in 1938. In 1956, grading system by Botterell et al. helped in evaluation of patients and in 1964 operating microscope was used by Adam & Witt. In 1973 invention of CT scan made diagnosis of aneurysmal SAH much easier¹.

Patients and methods:

This study was conducted in Lahore General Hospital, unit I, department of Neurosurgery, starting from Jan 2001 till Dec 2004. The patients who presented with suspicion of aneurysmal subarachnoid bleed were investigated and once

diagnosis was confirmed on CT or angiography patients were included in the study.

Results:

Total number of patients admitted with aneurysmal SAH was 267. Total surgeries done were in 160 patients. Every year number of cases admitted was changing. During 2004 there were 88 patients, during 2003 we had 74 cases, in 2002 there were 62 and in 2001, we had 42 patients admitted. (Table 1).

Table.1: Annual incidence

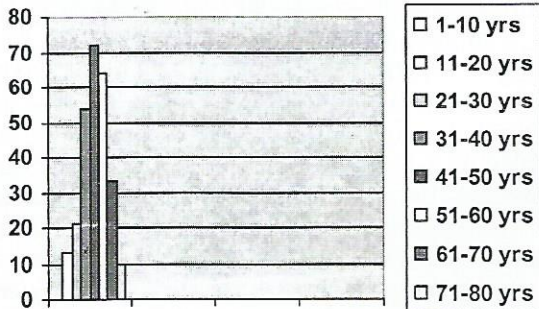
Year of study	n=
2001	42
2002	62
2003	74
2004	88

Clinical presentation in 267 patients with aneurysmal SAH was typical. It occurred during stressful conditions, or during sleep, after day's stress in all the cases. The signs and symptoms have been as below.

- Headache, vomiting, neck stiffness - 240(90%) patients
- Loss of consciousness - 133(50%) patients.
- Hypertension - 133(50%) patients.
- Epilepsy - 80(30%) patients.
- Sentinel hemorrhage - 53(20%) patients.
- Compression of adjacent structures in - patients.

Age incidence among 267 patients with interesting. Since birth upto 10 years, no patient, between 11-20 years, 13(5%) patients, between 21-30 years, 21(7%) cases, between 31 to 40 years, 54(20%), between 41-50 years, 72(27%), between 51 to 60 years 64(24%) and from 61-70 years 33(12%) and between 71 to 80 years 10(4%) patients were admitted. The incidence is depicted in the graph below.

Age incidence of 267 patients with aneurismal SAH.



Incidence in both sexes was compared.

Sex ratio of 267 SAH patients has been as below.

Below 40 years, 69 cases male 46%, female 54%.

Above 40 years, 198 cases male 32%, female 68%.

The patients were evaluated according to WFNS grades. It was noticed that majority belonged to poor WFNS grades (Table 2).

Table 2: WFNS grades of patients on admission.

WFNS grade	GCS	Motor system	Patients
I	15	-	32(12%)
II	14-13	-	49(18%)
III	14-13	+	53(20%)
IV	12-7	-/+	69(26%)
V	6-3	-/+	64(24%)

After angiography was done, it was noticed that Anterior cerebral artery complex(ACA) aneurysms were the commonest, followed by Middle cerebral artery(MCA).The incidences are as follows.

ACA aneurysms	-	91(57%),
(A com 86, Pericallosal 5).		
MCA aneurysms	-	37(23%).
ICA aneurysms	-	32(20%),
P com	-	16,
Carotid bifurcation	-	5
Ant choroidal	-	5
Ophthalmic	-	6

Vertebrobasilar aneurysm - 2

Some rare presentations were also seen which are as follows.

- Multiple aneurysms - 2 patients
- Associated with AVM - 1 patient
- Giant aneurysm (ICA) - 2 patients.

Bilateral aneurysms - 1 patient.

Timing of surgery

Early surgery (within 3 days), Grade I & II, good medical status - 32(20%).

Delayed surgery (delay 6-14 days), Grade III and higher Poor medical condition - 128(80%).

Surgical approaches

Our surgical cases were operated upon through Pterional Subfrontal., Frontolateral approaches.

Intracranial complications of 267 SAH patients.

Rebleed - 53(20%) patients, within 2 weeks

Vasospasm - 27 patients(10%).

Hydrocephalus - 27(10%) patients

Early - 17

Late(after 1 month) - 10

Shunt needed in all.

Extracranial Complications, in 267 Patients with aneurysmal SAH include following complications

MI - 11(4%)

Arrythmias - 21(8%)

Pulmonary edema - 16(6%)

Stress ulcers - 37(14%)

Intraoperative complications in 160 surgically treated patients are shown.

Aneurysm rupture - 30%

Aneurysm avulsion -1 case

Intracranial complications in our 160, operated pts

Meningitis 8(5%) patients.

Epilepsy 16(10%) patients.

Subdural, epidural, intracerebral bleed - 5(3%)

patients.

Outcome was analysed and the findings are as under

Died before angiography - 69(26%).

Died after angiography before - surgery 37(14%).

Operative mortality - 21 (13%).

Management mortality - 79(48%).

Functional outcome in 160 operated Cases has been encouraging as, good recovery or employment was possible in 80 (50%) patients.

Discussion:

Clinical presentation: In Pakistan we do not have a central registry so the exact incidence of aneurysmal SAH would not be possible to know. In other developing countries, disease seems to be getting more diagnosed as shown by a study in Nigeria².(Ogungbo et al). In our study there were 267 cases and maximum number of cases 29(58%), belonged to 40-60 years of age. We noticed that younger patients, below 20 years of age are also affected by it. Youmans et al¹ have established that SAH is uncommon in children and adolescents but in SAH cases of this age group, 36-52% may have aneurysms¹.

Classical presentation of SAH is sudden severe headache, vomiting and neck stiffness, which was present in 240(90%) patients. History of loss of consciousness was

present in 133(50%) patients. Compression of adjacent structures as III cranial nerve compression in posterior communicating artery aneurysms was seen in 19(7%) of patients. According to literature, some 33% may have minor leaks or sentinel hemorrhages. In our series 53(20%) had sentinel hemorrhage.

Botterell and Hunt and Hess classifications have been used to evaluate the patients with SAH. We prefer WFNS grading system because it is simple but comprehensive.

According to Krisna et al³, in patients under 18 years of age, there is a male predominance; a higher incidence of seizures. The Internal carotid artery (ICA) bifurcation formed the most frequent site. In adults, AcoA (Anterior communicating artery) was the commonest site. Rebleeding and delayed ischaemic deficits have been the major causes of morbidity. Outcome after surgery in young patients was better in comparison to adult.

In world literature incidence of giant aneurysm has been 5-7%¹. In our series we had 2 patients with giant aneurysms. Familial aneurysms occur in 6% of all aneurysms¹ while in our study there was no familial aneurysm. Multiple aneurysms can occur in 20% of patients who experience subarachnoid hemorrhage¹ and in our series only 1 patient had multiple aneurysms.

Pathophysiology: Aneurysms in the intracranial vessels have known to have degenerative and developmental origin. In Hypoplastic vessels, at points of division there is hemodynamic stress, which leads to atherosclerotic degeneration of tunica media and internal elastic lamina. It progresses to development of aneurysm⁴. Rare association of coronary artery aneurysms, abdominal aortic coarctation with intra cranial aneurysms has been noticed⁵. Vascular disorders as Behrvarsigmaet's disease has been also reported⁶. Patients with autosomal dominant polycystic kidney disease have 5 times more often intracranial aneurysms⁷. Traumatic origin is also reported⁸. Two genes have recently been identified with intracranial aneurysms⁹.

Angiography: Angiography is the diagnostic mainstay. It has role is not only preoperative diagnosis but is used peroperatively and postoperatively. It shows site, size, shape, direction of the aneurysms. Size, and anomalies of vessels as well as collateral circulation.

Not all aneurysms identified on angiography rupture. Decision making in unruptured aneurysms is difficult¹⁰. According to House et al¹¹, shape is more effective than size in discriminating between ruptured and unruptured aneurysms. Risk of rupture is for 5 mm and above size of the aneurysm is higher¹.

Peroperative use of angiography is increasing. Different modifications and alternatives have been tried. ICG angiography using a surgical microscope is used for intraoperative imaging¹². 3D DSA is a new technique^{13,14}. IMD is a feasible, safe, and very reliable compared to angiography¹⁵. Post embolisation angiography or

Contrast-enhanced MR angiography shows success of the procedure¹⁶.

Surgical procedure: The mainstay treatment available in our setup is clipping of the aneurysm neck. Surgery should be performed within 24 to 48 hours. Surgery done after this time period is risky because of brain edema and high risk of vasospasm. Optimal delay of 7-10 days is employed so that before rebleede aneurysm is clipped. Early surgery was our first choice and was successfully done on Grade I & II, good medical status patients, these were 32(20%) in number. In the majority, 128(80%) patients, only delayed surgery (Optimal delay 6-14 days), was possible because of Grade III and poor medical condition.

Intraoperative nimodipine infusion may prevent cerebral vasospasm¹⁸. Most of the anterior circulation aneurysms are accessible through pterional route¹⁹. Majority of the neurosurgeons are comfortable with this route. WE have used subfrontal and frontolateral approaches in selected cases only. Intraoperative rupture occurred in 30% of our cases. Incidence of rupture is dependent upon aneurysm location, amount of subarachnoid hemorrhage, and temporary arterial occlusion²⁰.

Thrombotic aneurysms can be treated with conventional clipping. In unclippable thrombotic aneurysms favorable results are achieved with bypass and aneurysm occlusion than with hrombectomy and clip reconstruction²¹. We successfully treated 1 of our giant aneurysms with carotid ligation.

Embolisation: World wide interest in endovascular management of aneurysms is developing. It is well established and is considered as the first choice in selected cases^{22,23,24}. In Pakistan trained interventional neuroradiologists are not available. There are occasional attempts in different radiology centers to address this issue but no system has been developed yet. Success of endovascular procedure can be confirmed by angiography²⁴.

Different materials for embolisation have been used with variable results. Embolization with GDC-10s of aneurysms has been useful²⁵. With a liquid embolic to treat aneurysms unsuitable for coiling as large and giant aneurysms²⁶. Wide-necked aneurysms treated with the Neuroform2 Treo, even through tortuous intracranial vessels²⁷. Embolisation is effective even in small lumen vessels as pericallosal artery aneurysms²⁸.

Post op complications: Our patients get antibiotic cover with IIIrd generation cephalosporins, peroperatively. In spite of this 8(5%) of our patients developed meningitis. Epileptic fits may start with the presence of subarachnoid blood. It is not possible to comment that in 16(10%) patients who had epileptic fits these were due to subarachnoid bleed or surgical procedure itself. Perioperative central hyperthermia has also been reported 29. Hematomas related to surgery happened in 5(3%) of our cases.

Rebleed: Highest incidence of rebleed is between 5-9th day¹. Rebleeding occurs in 6.9% of patients Poor Hunt-Hess grade and larger aneurysm size predispose to rebleed³⁰. In our series rebleeding occurred in 53(20%) patients. Since we were unable to operate within first 24 hours of admission because of delayed presentation our rebleed rate has been higher than international studies.

Vasospasm: Vasospasm in the parent or adjacent vessels occurs as long as there is blood in the subarachnoid space. The risk starts increasing on 3rd day and reaches maximum till day 7th. The condition can be diagnosed on angiography. Clinical judgment can be reliable most of the times when angiography is not available. Vasospasm can be predicted by the severity of bleeding, excess weight, duration of temporary artery occlusion, and occurrence of nocturnal aneurysm rupture³¹. In our series vasospasm occurs in 10% of cases which is comparable to international literature.

Morbidity and mortality: The patients arrived in our tertiary care center after gap period of days. Diagnosis and management were already delayed. This led to poor WFNS grades on admission. In our series 69(26%) patients died before angiography was done. Due to inherent complications of angiography being an invasive procedure, it is done only when patients have improved to WFNS grade 2. Similarly 37(14%) died while awaiting surgery after angiography. The causes of death have been both intracranial and extracranial as cardiovascular and respiratory tract problems. Our mortality and morbidity figures are much higher than world literature but the reasons are already explained.

Procedural morbidity and mortality rates are highest in ruptured aneurysms and lowest in unruptured aneurysms. Morbidity rates are highest in re-treated aneurysms. The main cause of morbidity and mortality has been thromboembolism³². According to Kim et al³³, a single graded scale does not address all aspects of recovery. We evaluated whether the patient was able to start any kind of work and we called it good grade recovery.

Conclusion:

Incidence/Diagnosis of aneurysmal SAH, is increasing in our setup. Aneurysmal SAH also occurs in younger age group. Prognostic factors include early presentation and good WFNS grade on admission

References:

1. Youmans JR et al.: Neurological surgery. WB Saunders company NY. 1990, p1645-1695
2. Ogungbo B, Mendelow AD, Walker R. The epidemiology, diagnosis and treatment of subarachnoid haemorrhage in Nigeria: Br J Neurosurg. 2004 Aug;18(4):362-6.
3. Krishna H, Wani AA, Behari S, Banerji D, Chhabra DK, Jain VK. Intracranial aneurysms in patients 18 years of age or under, are they different from aneurysms in adult population? Acta Neurochir (Wien). 2005 Apr 4;

4. Sadatomo T, Yuki K, Migita K, Taniguchi E, Kodama Y, Kurisu K. Evaluation of relation among aneurysmal neck, parent artery, and daughter arteries in middle cerebral artery aneurysms, by three-dimensional digital subtraction angiography. Neurosurg Rev. 2005 Mar 17
5. Harikrishnan S, Stigimon J, Tharakan; Intracranial aneurysms, coronary aneurysms and descending aortic coarctation, unreported association. Int J Cardiol. 2005 Mar 18;99(2):329-30.
6. Zsigmond P, Bobinski L, Bostrom S. Behvarsigmaet's disease, associated with subarachnoidal heamorrhage due to intracranial aneurysm. Acta Neurochir (Wien). 2005 Apr 4;
7. Kanne JP, Talner LB. Autosomal dominant polycystic kidney disease presenting as subarachnoid hemorrhage. Emerg Radiol. 2004 Dec; 11 (2) : 110 - 2.
8. Cohen JE, Rajz G, Itshayek E, Shoshan Y, Umansky F, Gomori JM.; Endovascular management of traumatic and iatrogenic aneurysms of the pericallosal artery. Report of two cases. J Neurosurg. 2005 Mar ; 102 (3) : 555-7.
9. Ruigrok YM, Rinkel GJ, Wijmenga C. Genetics of intracranial aneurysms. Lancet Neurol. 2005 Mar ; 4 (3) :179-89
10. Wiebers DO. Neuroepidemiology of unruptured intracranial aneurysms: implications for decision making regarding patient management. Neurosurg Clin N Am. 2005 Apr; 16 (2) :309-12,
11. House PA, Couldwell WT .: De novo fenestration of the optic nerve. Case illustration. J Neurosurg. 2005 Feb; 102 (2) :390
12. Raabe A, Beck J, Seifert V. Zentralbl Technique and image quality of intraoperative indocyanine green angiography during aneurysm surgery using surgical microscope integrated near-infrared video technology Neurochir. 2005 Feb;66(1):1-6.
13. Lauriola W, Nardella M, Strizzi V, Cali A, D'Angelo V, Florio F. 3D angiography in the evaluation of intracranial aneurysms before and after treatment. Initial experience Radiol Med. 2005 Jan-Feb; 109 (1-2) : 98-107.
14. Yamura M, Hirai T, Korogi Y, Ikushima I, Yamashita Y, Oishi S. Pseudostenosis in vessels adjacent to intracranial aneurysms on volume-rendered 3D angiograms: a phantom study Acad Radiol. 2005 Mar;12(3): 305 - 8.
15. Marchese E, Albanese A, Denaro L, Vignati A, Fernandez E, Maira wG. Intraoperative microvascular Doppler in intracranial aneurysm surgery. Surg Neurol. 2005. Apr ;63 (4) : 336-42
16. Gauvrit JY, Leclerc X, Pernodet M, Lubicz B, Lejeune JP, Leys D, Pruvo. Intracranial aneurysms treated with Guglielmi detachable coils: usefulness of 6-month imaging follow-up with contrast-enhanced MR angiography. Am J Neuroradiol. 2005 Mar; 26 (3) :515 - 21.
17. Han RQ, Wang BG, Li SR, Wang EZ, Liu W, Wang S, Zhao JZ. Zhonghua Wai Ke Za Zhi. The effect of intraoperative continuous nimodipine infusion on cerebral vasospasm during intracranial aneurysm surgery 2004. Dec 22 ;42(24):1489-92.
18. Nishizawa S No Shinkei Geka. . Surgical anatomy and techniques in Dolenc approach. 2005 Feb;33(2):119-30
19. Leipzig TJ, Morgan J, Horner TG, Payner T, Redelman K, Johnson CS. Analysis of intraoperative rupture in the surgical treatment of 1694 saccular aneurysms. Neurosurgery. 2005 Mar; 56(3) : 455 -68;

20. Lawton MT, Quinones-Hinojosa A, Chang EF, Yu T ;Thrombotic intracranial aneurysms: classification scheme and management strategies in 68 patients. *Neurosurgery*. 2005 Mar; 56(3):441-54
21. Kanaan Y, Kaneshiro D, Fraser K, Wang D, Lanzino G. Evolution of endovascular therapy for aneurysm treatment. Historical overview. *Neurosurg Focus*. 2005 Feb 15;18(2):.
22. Hanel RA, Lopes DK, Wehman JC, Sauvageau E, Levy EI, Guterman LR, Hopkins LN Endovascular treatment of intracranial aneurysms and vasospasm after aneurysmal subarachnoid hemorrhage. *Neurosurg Clin N Am*.2005 Apr ;6 (2) :317-53,
23. Sandalcioglu IE, Wanke I, Schoch B, Gasser T, Regel JP, Doerfler A, Forsting M, Stolke D. Zentralbl. Endovascularly or surgically treated vertebral artery and posterior inferior cerebellar artery: clinical analysis and results *Neurochir*. 2005 Feb; 66 (1):9-16.
24. Gonzalez NR, Patel AB, Murayama Y, Vinuela F. Angiographic evidence of aneurysm neck healing following endovascular treatment with bioactive coils. *Am J Neuroradiol*. 2005 Apr; 26 (4) : 912 - 4
25. Kai Y, Hamada J, Morioka M, Yano S, Kuratsu J. Evaluation of the stability of small ruptured aneurysms with a small neck after embolization with Guglielmi detachable coils: correlation between coil packing ratio and coil compaction. *Neurosurgery*. 2005 Apr ;56 (4): 785-92.
26. Lubicz B, Piotin M, Mounayer C, Spelle L, Moret J. Selective endovascular treatment of intracranial aneurysms with a liquid embolic: a single-center experience in 39 patients with 41 aneurysms. *Am J Neuroradiol*. 2005 Apr; 26(4) :885-93.
27. Lylyk P, Ferrario A, Pasbon B, Miranda C, Doroszuk G. Buenos Aires experience with the Neuroform self-expanding stent for the treatment of intracranial aneurysms. *J Neurosurg*. 2005 Feb;102 (2):235-41.
28. Josephson SA, Johnston SC. Aneurysms following atrial myxoma. The endovascular management of pericallosal artery aneurysms *Neurology*. 2005 Feb 8;64(3): 526.R.
29. Murakawa T, Sakai I, Matsuki A.. Central hyperthermia suspected of malignant hyperthermia in a patient undergoing radical neck clipping for cerebral aneurysm. *Masui*. 2005 Jan;54(1):49-53.
30. Naidech AM, Janjua N, Kreiter KT, Ostapkovich ND, Fitzsimmons BF, Parra A, Commichau C, Connolly ES, Mayer SA. Predictors and impact of aneurysm rebleeding after subarachnoid hemorrhage. *Arch Neurol*. 2005 Mar; 62 (3) : 410-6
31. Juvela S, Sijronen J, Varis J, Poussa K, Porras M. Risk factors for ischemic lesions following aneurysmal subarachnoid hemorrhage. *J Neurosurg*. 2005. Feb; 102 (2): 194-201.
32. Park HK, Horowitz M, Jungreis C, Genevro J, Koebe C, Levy E, Kassam A. *AJNR Am J Neuroradiol*. 2005 Mar; 26 (3): 506-14.
33. Kim DH, Haney CL, Van Ginhoven G. Periprocedural morbidity and mortality associated with endovascular treatment of intracranial aneurysms complications. *Stroke*. 2005 Apr; 36 (4):792-6.