ORIGINAL ARTICLE

Percentage Difference in Angiographic Findings Vs Per-operative Findings and Their Implications in Surgical Management of Sub Arachnoid Haemorrhage

BABAR BUTT, MUHAMMAD ANWAR, NAVEED ASHRAF
Azhar Javed
Department of Neurosurgery Unit II, PGMI / Lahore General Hospital, Lahore

ABSTRACT

Aneurysmal subarachnoid haemorrhage is one of the major entities related to neurosurgical practice. It is notorious because of its high rate of mortality. Surgically it is important because once the aneurysm is detected and excluded from circulation successfully, it results in diffusion of the ticking bomb from brain for ever. We studied the surgical management related to anterior circulation because 85-90% aneurysms are located in this area and in Pakistan none such study was conducted before in which the aneurysms of anterior cerebral circulation were addressed in detail.

Objective: *To determine the frequency of different treatment modalities used for the exclusion of aneurysms from circulation, to determine the percentage difference between the angiographic findings and per-operative findings related to aneurysm and its surroundings and to determine the outcome of our surgical management.*

Results: *Out of 25 cases, maximum cases were recorded in 4^{th} and 5^{th} decade. Male to Female ratio remained (1:1.08). Hypertension is involved significant number of cases. The most common aneurysm was of anterior communicating artery aneurysm (55%). Percentage difference in angiogram and per-operative findings about the appearance of* ***perforators*** *was maximum i.e. in 6 (24%) cases. In 18 (72%) cases clipping was done while remaining 4 (16%) cases were treated with clipping and reinforcement and 1 (4%) each with wrapping, trapping and carotid ligation. At admission Twelve (48%) patients in* ***Grade-I;*** *according to WFNS scale and 10 (83.33%) made good recovery while 2 (16.66%) died.* ***In Grade-II;*** *we had 7 (28%) patients out of which 3 (42.85%) had good recovery, 3 (42.85%) in the state of moderate disability and 1 (14.28%) expired.* ***In Grade-III;*** *we received 6 (24%) patients out of which 4 (66.66%) made good recovery while 2 (33.33%) expired.* ***Overall results*** *when an overall picture was drawn to evaluate the percentage differences then we found that the maximum difference was present in the detection of perforators (24%) and shape of aneurysm (16%) followed by the size of aneurysm (12%) and neck of aneurysm (12%). Difference in the vasospasm of vessels remained (8%) and minimal difference was found in direction of fundus (4%). Recovery was recorded with the help of Glasgow outcome scale. Seventeen (68%) cases made good recovery, moderate disability was seen in 3 (12%) cases and mortality remained 20%, in 5 cases.*

Conclusion: *Results of surgical procedure i.e. clipping is good in good grade patients and surgeon must be prepared for any unseen event about aneurysm, vessels and surrounding tissue because significant difference may be present between the definitive investigation available (DSA) and per-operative findings. Maximum difference was seen in perforator 24%, shape of aneurysm 16% ,size of aneurysm 12% and size of aneurysm 12%.*

Key Words: *Aneurysmal subarachnoud haemorrhage, Good grade patients, timing of surgery, difference between angiography and operative findings, Treatment modalities, Surgical out come.*

Abbreviations: *KPS = Karnofsky's Performance Scale, G = Grade, GBM = Glioblastoma Multiformae.*

INTRODUCTION

An **aneurysm** can be defined as "an abnormal circumscribed dilatation of an artery"[1]. Subarachnoid hemorrhage (SAH), occurring secondary to a rupture of an aneurysm in the cerebral circulation is a relatively common problem, with an incidence of 08

per 100,000 population per year although regional variations exist.[2-5] The prognosis for patients with untreated saccular aneurysms that have ruptured is grim; 60 to 70% mortality at 6 months after hemorrhage. Although a major decline in mortality and morbidity brought about through improvements in diagnosis and management of patients with cerebral aneurysms had occurred over the past 30 years the mortality and morbidity associated with aneurysmal SAH, continued to be significant. Approximately one quarter to one third of patients with SAH die before reaching hospital had the mortality and morbidity in the remaining patients approaches 30 to 50%. Among patients reaching neurological centers alive, poor out come is due to episodes of aneurysmal rebleed and delayed ischemic neurological deficit.[6,8] Together these complications after primary aneurysmal SAH are responsible for more than 50% of mortality from SAH. Aneurysmal rebleeding can be effectively eliminated successfully obliterating the aneurysm from the cerebral circulation with modem surgical techniques.

Surgical management of the patient starts not only when the patient is shifted to the operation theater for some surgical procedure but the building block of this management includes the peri-operative care of the patient with SAH. The journey starts as the patient gets an ictus to hospitalization, assessment of grade with WFNS or Hunt and Hess grading system, getting a definitive picture of aneurysm through Digital subtraction angiography (DSA), Three Dimensional Computerized Tomographic Angiography (3 DCTA), Magnetic resonant angiography (MRA), looking after of the patient throughout the period of vasospasm starts from 3rd day of ictus and remains for 21 days,[9,10] education of the patient's attendants about the possible dangers along the course of the disease, choosing the proper timing of surgery and use of proper approach, gadgets and procedures.

In order to get good results from surgical management, it is important to choose special procedures at proper cases. The possible difference between the angiogram and per-operative picture of aneurysm, related vasculature and surrounding tissues must be kept in mind to have a better out come. Some times endovascular techniques, reinforcement, trapping, wrapping, carotid ligation, balloon occlusion are used to exclude the aneurysm from circulation.

In Pakistan unfortunately the statistics of SAH are not available. This study is a humble effort to get some know-how about the surgical management of aneurysmal SAH of anterior circulation, their investigations prospects and out come of different procedures done at Lahore General Hospital, Lahore.

PATIENTS AND METHODS

In the study period of one year, 39 cases of spontaneous subarachnoid haemorrhage presented in neurosurgery out door and emergency collectively. Using the strictly out lined inclusion and exclusion criteria 25 patients were selected for study. Ten patients were excluded because of their poor grade according to WFNS scale. None of the included patients was Angio —ve. Out of these fourteen patients 3 patients refused the treatment because they couldn't realize the gravity of situation even after detailed consulting with the patient and attendants while 1 patient was not systemically fit for surgical management.

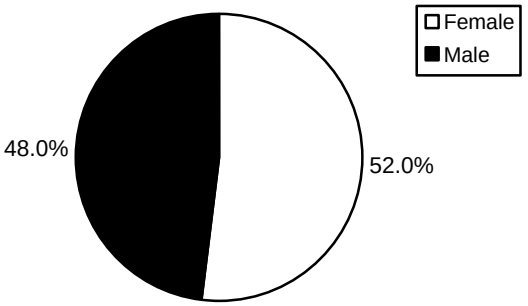
RESULTS

All the patients presented in our study came from the different region of Pakistan. Being a tertiary care centre these patient were referred from different peripheral centers after initial medical care. Some of the patients were shifted from the tertiary care centers of other cities because of lack of investigation facilities. Maximum patients presented in the 5th decade followed by 5 patients each in their 3rd and 6th decay of life. At the extreme age groups no case was recorded. The age of youngest patient was 16 years and oldest patient was 70 years while mean age remained 45.84 years. An over view of age distribution can be seen in Table 1. Out of 25 cases, 13 (52.0%) cases were female and 12 (48.0%) cases were male and male to

Table 1: *Age Distribution of the patients.*

Age of Patients in Years	Frequency	Percentage (%)
11 – 20	2	8.0
21 – 30	5	20.0
31 – 40	3	12.0
41 – 50	7	28.0
51 – 60	5	28.0
51 – 60	5	20.0
61 – 70	3	12.0
Total	25	100.0

female ratio was 1:1.08 (Graph 1). Maximum patients 22 (88.0%) cases presented with sudden severe headache followed by vomiting, 19 (76%) cases and visual deterioration only 4 (16.0%) cases. Over all view of all the presenting complaints can be seen in the Graph 2.

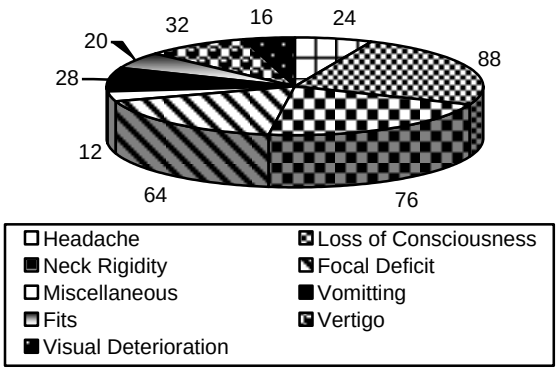


Graph 1: *Sex Incidence.*

Table 2: *Relation with Hypertension and Diabetes.*

Disease	Present	Absent
Hypertension	11 (44%) cases	14 (56%) cases
Diabetes	02 (08%) cases	23 (92%) cases

The relation of Sub Arachnoid Haemorrhage with Diabetes and Hypertension was analyzed and 11 (44%) cases of hypertension and only 2 (08%) cases of diabetes were positive. It shows the significance of hypertension in aneurysmal SAH. Table 2. All the



Graph 2: *Clinical Presentation.*

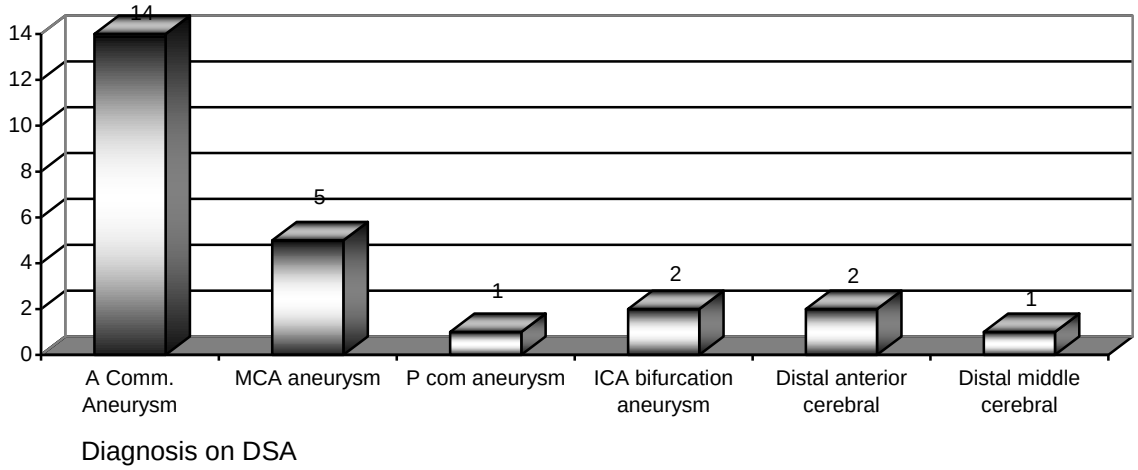
patients were subjected to CT scan brain plain and it was positive in all of our cases (100%). All the cases were then sent for conventional angiography or Digital Subtraction Angiography (DSA) which was available at the time of patients hospital stay, DSA gave us confirmation of diagnosis as well and we found 14 (56%) cases of anterior communicating artery aneurysm (A. Comm. Aneurysm) 5 (20%) cases of Middle cerebral artery aneurysm (MCA) aneurysm were diagnosed. Distribution of aneurysms along circle of Willis and anterior circulation is given in detail in the Graph 3.

Differences in Size

A. DSA Finding

According to the **size** of aneurysms, they were divided into small, large and giant aneurysms. We recorded

Diagnosis of Aneurysm on DSA (Conventional angiogram Frequency of Cases



Graph 3: *Distribution of Aneurysms on Circle of Willis.*

9 cases of small, 8 cases of large and 8 cases of giant aneurysms on angiography.

B. **Operative Finding**

Per-operatively theses figures were changed to 7 cases of small, 7 cases of large and 11 cases of giant aneurysms respectively. It shows that main difference lie in the giant aneurysm. On DSA one small and one large aneurysm were actually proven as giant aneurysms on per-operative examination, percentage difference remain (12%) Table 3.

Table 3: *Size of aneurysm on DS Vs Size of aneurysm (per-operative).*

Size of Aneurysm on DSA	Size of Aneurysm (per-operative)			
	Small	Large	Giant	Total
Small	7	1	1	9
Large		6	2	8
Giant			8	8
Total	7	7	11	25

Difference in the "Neck" of Aneurysm

Neck of aneurysm seen on DSA was divided in narrow and wide.

DSA revealed 14 cases of narrow and 11 cases of wide neck.

Table 4: *DSA and peroperative finding Difference in the Neck of aneurysm.*

Finding	Aneurysmal Neck Narrow	Aneyrysmal Neck Wide	Total
DSA	14	11	25
Operative	11	14	25

Table 5: *DSA and Peroperative Finding Difference on the Basis of Vasospasm.*

Finding	Vasospasm	Normal	Total
DSA	19 (76%)	6 (24%)	25
Per-operative	17 (68%)	8 (32%)	25

But in operation we found 11 cases of narrow neck and 14 cases of wide neck. This reversed figure can be visualized in Table 4. The percentage difference remains on the basis of 3 (12%) cases.

Difference of Vasospasm

State of the vessel is noted on angiography showed vasospasm in 19 (76%) cases and 6 (24%) were normal state while at the time of operation in 17 (62%) cases vasospasm was present. Therefore percentage difference in this variable remained (08%). Details are given by Table 5.

Difference of Direction

Direction of fundus was analyzed on the basis of DSA and total of 8 different directions were found. It shows that only one case which was suspected to be directed anteriorly and medially on DSA was actually directed superiorly. The percentage difference remained 4% only. Details of directions in both series are compared in Table 6.

Difference of "Shape" of Aneurysm

Shape of aneurysm as noted in DSA was saccular in 24 (96%) cases while only 1 (04%) was fusiform. In actual look these aneurysms were biolobed in 1 (04%) case and partially thrombosed in another case (04%) and 2 (08%) cases were actually fusiform aneurysms. Therefore 4 (16%) cases showed a significant difference into findings. Table 7.

Table 6: *Distribution of fundus on DSA Vs Direction of fundus (preoperative).*

	Direction									
Finding	Superior	Anterior	Posterior	Superior Medial	Anterior Medial	Anterior Lateral	Anterior Superior	Superior Lateral	Inferior	Total
DSA	9	2	1	2	1	2	4	3	1	25
Per-operative	10	2	1	2	0	2	4	3	1	25

Table 7:

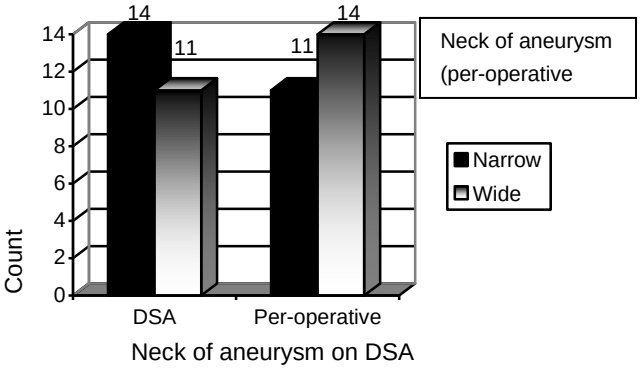
Findings	Saccular	Fusiform	Bilobed	Partially Thrombosed	Total
DSA	24 (96%)	1 (4%)	0	0	25
Per-operative	21 (84%)	2 (8%)	1 (4%)	1 (4%)	

Table 8: *Perforators Difference of DSA and Operative Finding.*

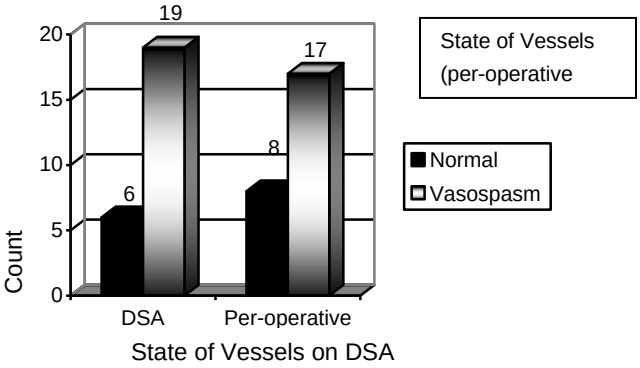
Perforators on DSA		Perforators (Peroperative)	
Findings	**No.**	**Present**	**Absent**
Present	5	4 (16%)	1 (4%)
Absent	20	7 (28%)	13 (52%)
Total	25	11 (44%)	14 (56%)

Table 9: *Glassgow Outcome Scale.*

Grade	Neurological Status
I	Good recovery; patients can lead a full and independent life with or without minimal neurological deficit
II	Moderately Disabled; patient has neurological of intellectual impairment but is independent
III	Severely disabled patient, conscious but totally dependent on others to get through daily activities
IV	Vegetative survival
V	Dead



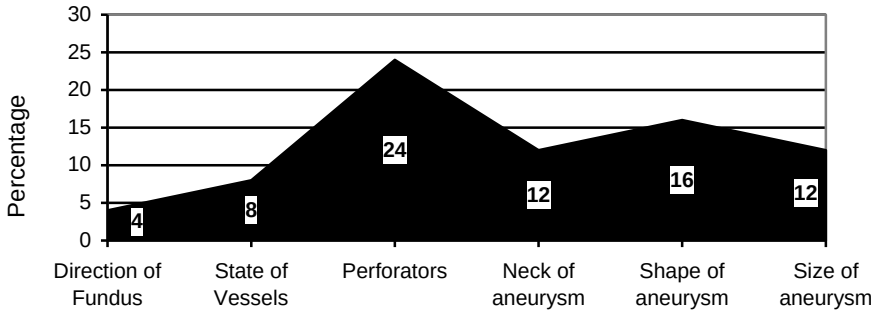
Graph 4: *Neck of Aneurysm on DSA Vs Per-operative aneurysm neck.*



Graph 5: *State of Vessels on DSA. State of Vesels Per-operative.*

Difference of Perforators

Perforators as seen over DSA gave the most unreliable picture. We suspect perforators in only 5 (20%) cases but preoperatively perforators were present in 11 (44%) cases. The percentage difference remained 6 (24%) cases as visible in Table 8).



Graph 6: *Percentage Difference Between Angiographic Vs Per-operative Findings of Various Variables.*

When an **overall picture** was drawn to evaluate the percentage differences then we found that the maximum difference was present in the detection of perforators (24%) and shape of aneurysm (16%) followed by the size of aneurysm (12%) and neck of aneurysm (12%). Difference in the State of spasm of vessels remained (8%) and minimal difference was found in direction of fundus (4%). Complete analysis is shown in Graph 6. The basis of

Glasgow out come scale (GOS). According to this scale five grades of recovery are defined as shown in Table 9. In our cases Good recovery without any problem was recorded in 17 (68%) cases. Moderate disability was present in 3 (12%) cases. While mortality remained 20% in 5 cases. The detailed analysis is given in Graph 4.

DISCUSSION

Maximum cases were recorded in 5th decay of life. Although several case reports are present internationally which denote the disease in first year of life11 and 3rd year of life but maximum cases were seen in the 4th and 5th decade of life.[10]

It is one of the important factor to be analyzes in this study and 18 (72%) aneurysms were clipped followed by 4 (16%) cases where clipping along with reinforcement was done so clipping was involved in total of 22 (78%) cases. Three aneurysms were not clipable so other modalities were used in these cases as seen in Graph 8. It is a recognized fact now through out the world that female is more prone to get aneurysms of anterior circulation. Nilsson and coworkers in their study evaluated the gender distribution in Sweden.[1] They define population of 1.14 million in Southern Sweden and found the females are more exposed to the SAH and their study revealed almost double incidence in female as compared to male. Australasian co-operative research on SAH study (ACROSS) narrates the same significance when they studied different parameters. About 64% female get the disease.[14] Kongable and coworker reported from USA that female gender is recognized risk factor for the occurrence of aneurysmal SAH. In their study the ratio between is 1:2.[15] In our study ratio between male to female remained 1:1.08. This relative low ratio as compared to international studies is because of the fact that female are not getting the same access to tertiary care centers as compared to male because of possible social problem.

One of the most important aim of our study was to observe the **percentage difference** regarding angiography and intraoperative findings in relation to **aneurysms** and **vessel.** Special attention was paid towards the **size**, **shape**, **direction** of fundus, **perforators** related to aneurysms and **state** of the vessels were studied in details. In our study **maximum difference** between angiographic and inter-operative findings was seen in the category of **perforator** where the difference calculated was in cases **(24%)**. It means that one must be careful during dissection around the vessels and aneurysms for the tiny perforators which play an important role in the postoperative prognosis of the patient even when these vessels are not visible on angiogram.[16]

In our study percentage difference for **vasospasm** in DSA Vs intraoperative findings remained **8%**. The criteria for calling a vessel in **spasm** is the radiological report given by neuroradiologist. Intra-operational observations are based on reduction of caliber of the vessel as seen under microscope. No. of cases observed in **vasospasm** was **less** in pre-operative findings. The possible reason is that it is routine in our unit to start injectable nimodipine or oral nimodipine therapy as indicated to avoid state of vasospasm. Perhaps is shows the effect and in 2 angiographically demonstrated cases of vasospasm were normal for vessels caliber as noted at the time of operation.

Shape of aneurysm revealed variation in 4 **(16%)** cases. Main reason was that thrombosed portion of secular aneurysm which was not detectable on angiography. This leads to abscured lobes and relative smaller size of large aneurysms. A similar case report was presented by Japanese neurosurgeon Koga, where he successfully treated case of ruptured anterior wall aneurysm of internal carotid artery (C_2 segment) which changed in form from blister like to saccular type.[17] In his article the author emphasized that sometimes we have to change our mind intraoperatively because the findings of angiography could not correlate with intraoperative findings.

In neck of aneurysm 3 (12%) cases difference seen and we found 3 wide neck aneurysms as compared to angiographic finding. In our study minimum difference of opinion was seen only in direction of fundus where in only one (04%) case an anteromedially directed aneurysm was superiorly directed. It means that three dimensional images taken in our DSA show a good planning picture of aneurysm.

In literature very little is available about the pitfalls of angiography and no comprehensive study is available which shows the analysis between the finding of different aspects of aneurysm preoperatively and as the surgeon look in the actual picture. In Pakistan our study is the first one which emphasizes the possible variation of angiographic Vs intra operative differences. On basis of these results it is evident that surgeon must be mentally prepared to see any difference which was previously not demonstrated by the gold standard i.e. angiography.[18,19]

CONCLUSION

In surgical management of the patients suffering from Sub Arachnoid Heamorrhage, it is important to have a complete information about the **surgical anatomy** of the Aneurysm itself which must include the **site**, **size**, **neck**, **fundus** of aneurysms. Some time the information given by the available investigations is **different** and surgeons may see a different picture peroperatively. This picture is maximally different regarding **perforators** as it is seen in our study. When an overall picture was drawn to evaluate the percentage differences then we found that the maximum difference was present in the detection of perforators (24%) and shape of aneurysm (16%) followed by the size of aneurysm (12%) and neck of aneurysm (12%). Difference in the State of vessels remained (8%) and minimal difference was found in direction of fundus (4%). Therefore we conclude.

1. Try to get maximum information about Aneurysms and surrounding structure to get good outcome of surgery. A proper information may also change the modality of Treatment as well.
2. Surgeon must be fully prepared to deal with some untoward scenario during surgery.
3. Good pre-opertive planning leads to best possible results.

Corresponding Address:
Babar Butt
Registrar Neurosurgery
Department of Neurosurgery
Lahore General Hospital, Lahore
E-mail: babarns73@hotmail.com

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