ORIGINAL RESEARCH

A Study Of 125 Cases Of Non-Hypertensive Haemorrhagic Stroke In Patients Who Underwent Digital Subtraction Angiogram In Tertiary Care Hospital In Eastern India

[1]Dr. Surajit Swargiary, [2]Dr. Sanghamitra Sarkar, [3]Dr. Sumit Deb, [4]Dr. Rakesh Kumar Das

[1]Senior Resident, [2]Associate Professor, [3]Professor & Head of Department, [4]Junior Resident, Department of Neurosurgery, Calcutta National Medical College and Hospital, Kolkata, India

Corresponding author
Dr. Rakesh Kumar Das
Junior Resident, Department of Neurosurgery, Calcutta National Medical College and Hospital, Kolkata, India

Received: 29 November, 2023 Accepted: 22 December, 2023

ABSTRACT

Background- Digital subtraction angiogram is the gold standard test to evaluate vascular disorders of brain. It helps in diagnosis and to plan appropriate treatment. As it is an invasive technique, it carries a potential risk of complications.

Materials and methods- Retrospective analysis of 125 cases of non-hypertensive hemorrhagic stroke was done, comparing pre-procedural and post-procedural clinical status after DSA using a C- arm over a period of 2 years from 01/03/2021 to 28/02/2023.

Results-Inaseriesof125patients of non-hypertensive hemorrhagic stroke, subarachnoid hemorrhage (SAH) is the most common vascular disorder associated with intracranial aneurysm. Local complications which is more common, can be avoided with proper patient preparation and post-procedural management.

Conclusion- DSA is a gold standard method for detecting intracranial vascular lesions. With proper postoperative care and pre-operative preparation,this procedure can be done safely and complications can be avoided.

Keywords: Digital subtraction angiogram, vascular disorder, non-hypertensive stroke, C-arm,subarachnoid hemorrhage, complications, gold standard.

INTRODUCTION

Spontaneous, non-hypertensive intracerebral haemorrhage accounts from 25% to 50% of all acute stroke cases, depending on the population.[1] They can have disastrous effect and accounts for large proportion of morbidity and mortality among stroke patients. Annual incidence of stroke in India is 44.29 to 559/100000 persons in different parts of the country.[2]and thirty days case fatality rate is 41.08%.[3] Delay in treatment increases the mortality rate. There are many aetiologies for non-hypertensive haemorrhagic stroke like spontaneous rupture of intracranial aneurysm, AVM, intraparenchymal haemorrhage from tumour, cerebral venous sinus thrombosis, cerebral amyloid angiopathy, arteriovenous fistulas, coagulopathy etc.In young patients or those without identifiable risk factors, AVM are most common cause so, vascular imaging, such as conventional angiography or multidetector CT angiography, should be pursued to exclude the possibility of occult vascular abnormality.[4]

Digital subtraction angiogram (DSA) is one of the best methods to detect vascular lesions and plan operative management on basis of morphology and location of the lesions. Appropriate diagnosis on time and timely intervention has prognostic value in non-hypertensive haemorrhagic stroke. Advancement of CT angiogram (CTA) and MR angiogram (MRA), although increased their accuracy but they cannot replace DSA which is the gold standard procedure for detecting cerebrovascular disease.[5]It has lower false negative finding than MRA and CTA angiogram.A sound understanding of the principles and appropriate periprocedural care are essential.Basic knowledge on how to interpret these images and principles on how to perform a catheter angiogram is important to avoid complications.

OBJECTIVES

- To determine the nature of vascular disorder in cases of non-hypertensive haemorrhagic stroke on the basis of DSA finding.

- To determine the complications of intra-arterial digital subtraction angiography.

Inclusion criteria

- Patients with history and clinical findings suggestive of vascular disorders of brain.
- Patient with non-hypertensive spontaneous intracranial bleed referred from other departments of hospital.

Exclusion criteria

- Ischaemic stroke.
- Hypertensive bleed.
- Patients with history of renal insufficiency, cardiac disorders, hepatic failure etc.
- Patients with poor GCS <7 were not included.
- Any history of a severe anaphylactic reaction to the contrast medium.
- Coagulopathy with an increased risk of delayed haemostasis.
- Patient who has not given consent.

MATERIALS AND METHODS

We selected 125 cases of non-hypertensive hemorrhagic stroke who underwent DSA in our department. The pre-procedural neurological examination was compared to the post-procedural neurological examination and any differences noted. The time taken for the procedure, the intraoperative and post-operative complications were also noted. Post DSA diagnosis was recorded. Sedation used during the procedures isDexmedetomidine (loading dose 1µg/kg body weight over 10min then 0.5 µg /kg body weight to continue), side effects include hypotension, bradycardia. Contrast used is Iohexol, a low-osmolality, non-ionic contrast agent (NIOSCAN, 300 mg I/mL).C-arm with flat panel detector was used and 30-degree PA view, 30-degree oblique and lateral view angiograms were taken.

RESULT

In our study, in the age group less than 20 years, only 2(1.6%) patients; 20 to 40 years, 24 (19.2%) patients; 41 to 60 years, 73 (58.4%); and above 60 years, 26 (20.8%) patients were found respectively. (TABLE 1 & FIGURE 1)

Table 1: Showing age wise distribution of patients.

Age groups	Number of patients	Percentage
<20	2	1.6%
20-40	24	19.2%
41-60	73	58.4%
>60	26	20.8%
TOTAL	125	100%

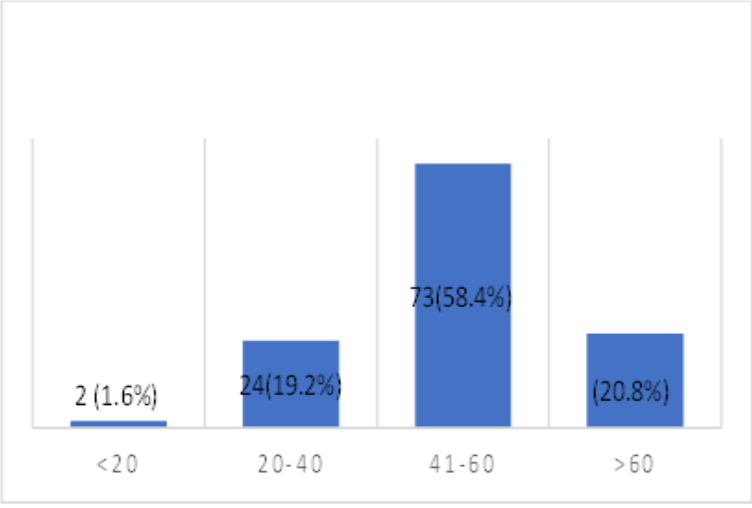

FIGURE 1: AGE WISE DISTRIBUTION OF PATIENTS.

Females outnumbered males in our study, with 68(54.4%) female and 57(45.6%) male patients. (TABLE 2 & FIGURE 2)

Table 2: showing realtionship of male and female associated with vascular lesions

Sex	Number	Percentage
Male	57	45.6%
Female	68	54.4%
Total	125	100%

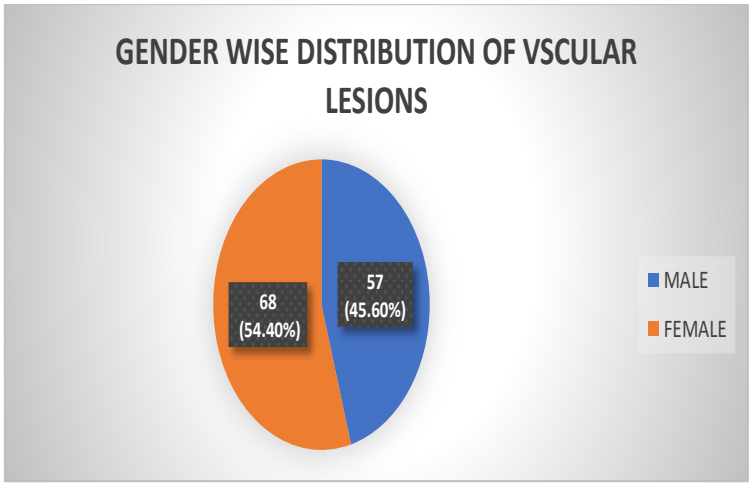

FIGURE 2: RELATIONSHIP OF MALE AND FEMALE ASSOCIATED WITH VASCULAR LESIONS

There were 100 cases of subarachnoid hemorrhage (SAH). In the age group less than 20, no cases of SAH were found;in age group of 20 to 40 years, 23 cases; 41 to 60 years 55 cases and above 60 years, 22 cases were found. (TABLE 3 & FIGURE 3)

Table 3: showing number of sah patients with male and female distribution.

SPONTANEOUS SAH (100)					TOTAL%
SEX/AGE	<20	20-40	41-60	>60	
MALE	0	11	23	11	45
FEMALE	0	12	32	11	55

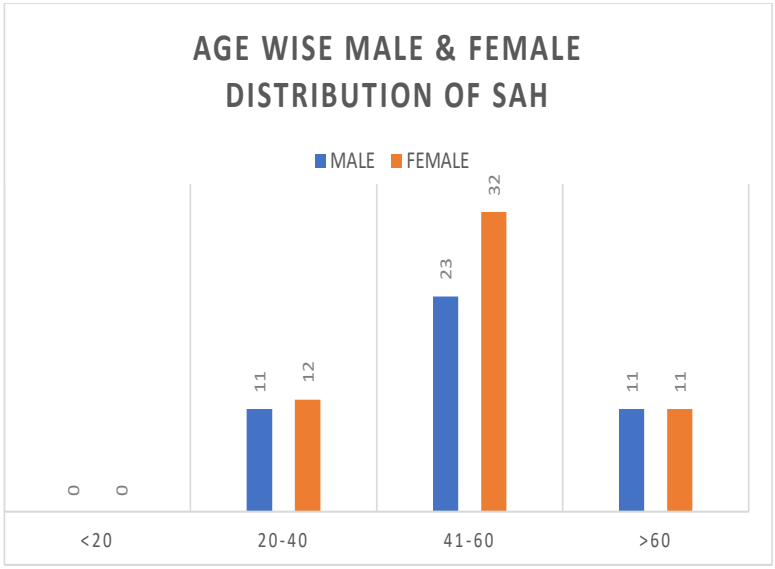

FIGURE 3: AGE WISE MALE & FEMALE DISTRIBUTION OF SUB-ARACHNOID HAEMORHAGE

In this study, ACOM aneurysm was diagnosed in 32 cases (25.6%), out of which 17(13.6%) were females and 15(12%)were males. DACA aneurysm was found in 3 (2.4%) patients, 1 (0.8%) female and 2(1.6%) males. There were 17(13.6%) cases of PCOM aneurysm, out of which 9(7.2%) were females and 8(6.4%) males.2(1.6%) cases of P2 segment aneurysmwere found, both male and female 1(0.8%) each. MCA aneurysm in 17(13.6%) patients,10(8%) females and7(5.6%) males.ICA bifurcation aneurysm in 7(5.6%) cases out of which 4(3.2%) werefemales and3(2.4%)were males. PICA aneurysm was detected in 1(0.8%)male patient. MOYA-MOYA disease was found in 3(2.4%) cases out of which, 2(1.6%) were

females and 1(0.8%) male. Intracranial AVM, 13(10.4%) cases, of which 3(2.4%) females and 10(8%) males. Carotid cavernous fistula in 1(0.80%) female patient. The Cases where no obvious abnormalitywasdetectedwere included in others 29(23.20%) cases, among which 21(16.8%) were females and 8(6.4%) males. (TABLE 4, FIGURE 4 &FIGURE 5)

TABLE 4: SHOWING DIFFERENT TYPE OF VASCULAR LESIONS DETECTED AFTER DSA

DIAGNOSIS	TOTAL	PERCENTAGE	FEMALE	%	MALE	%
ACOM ANEURYSM	32	25.6	17	13.6	15	12
DACA ANEURYSM	03	2.4	01	0.8	02	1.6
PCOM ANEURYSM	17	13.6	09	7.2	08	6.4
P2 SEGMENT ANEURYSM	02	1.6	01	0.8	01	0.8
MCA ANEURYSM	17	13.6	10	8	7	5.6
ICA BIFURCATION ANEURYSM	07	5.6	04	3.2	03	2.4
PICA ANEURYSM	01	0.8	00	0	01	0.8
MOYA-MOYA DISEASE	03	2.4	02	1.6	01	0.8
INTRACRANIAL AVM	13	10.4	03	2.4	10	8
CAROTID CAVERNOUS FISTULA	01	0.80	00	0	01	0.8
OTHERS	29	23.20	21	16.8	8	6.4

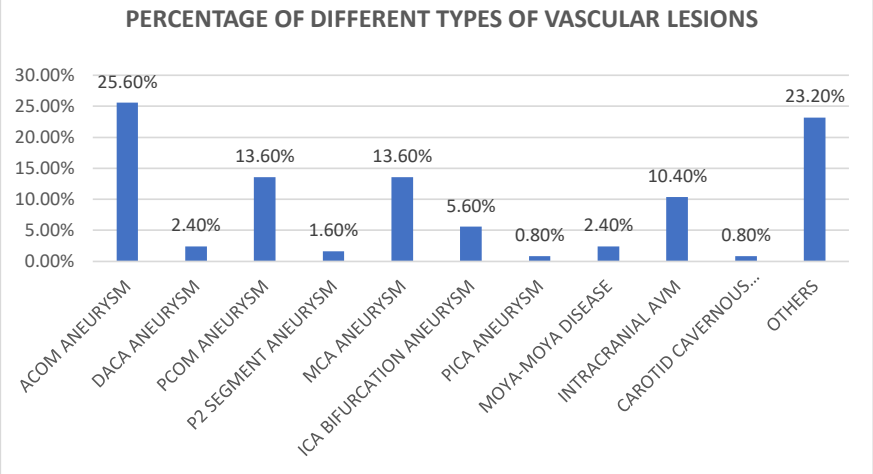

FIGURE 4: SHOWING PERCENTAGE OF DIFFERENT TYPES OF VASCULAR LESIONS

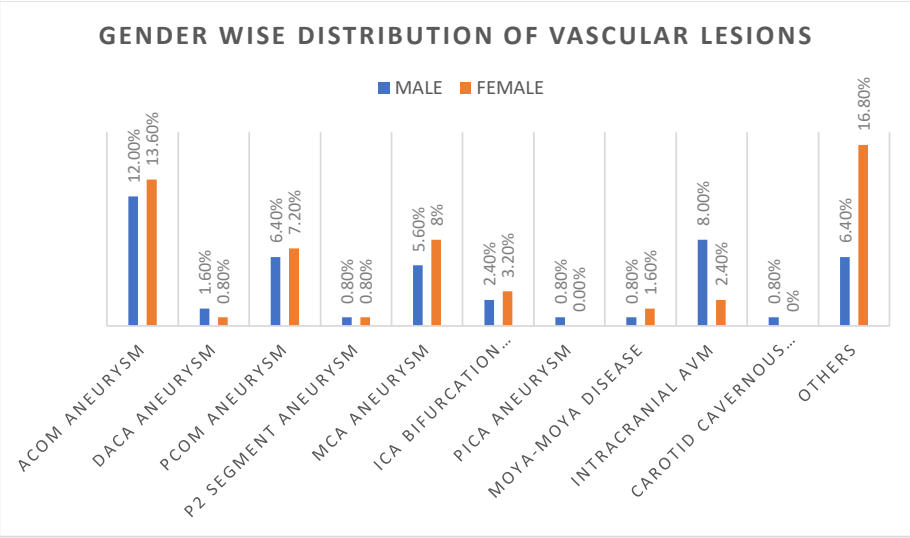

FIGURE 5: SHOWING GENDER WISE DISTRIBUTION OF DIFFERENT TYPES OF VASCULAR LESIONS

It was observed that out of 66 patients who had pre-DSA GCS 13-15,64 patients had maintained their GCS of 13-15 at the end of 6 hours and only 2 had fall in their GCS. Out of the 59 patients who had pre-DSA GCS 7-12, 52 patients had GCS between 7-12 and 7 patients had further fall in GCSat the end of 6 hours. (TABLE 5, FIGURE 6, TABLE 6 & FIGURE 7))

TABLE: 5 SHOWING FALL IN GCS AFTER DSA OF PATIENT HAVING PRE DSA GCS-OF 15-13

PRE DSA GCS-OF 15-13	AT 0 HOUR GCS OF 15-13	FALL IN GCS AT 0 HOUR	AT 1 HOUR GCS OF 15-13	FALL IN GCS AT 1 HOUR	AT 6 HOURS GCS OF 15-13	FALL IN GCS AT 6 HOUR
66	53	13	57	09	64	02

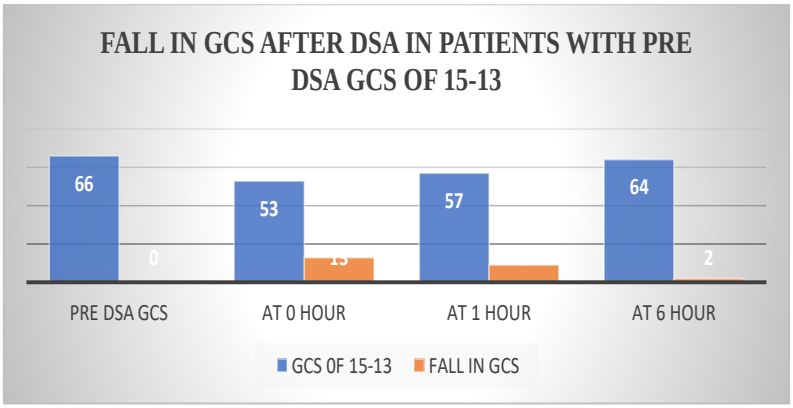

FIGURE 6: SHOWING FALL IN GCS AFTER DSA OF PATIENT HAVING PRE DSA GCS-OF 15-13

TABLE 6: SHOWING FALL IN GCS AFTER DSA OF PATIENT HAVING PRE DSA GCS-OF 12-7

PRE DSA GCS-OF 12-7	AT 0 HOUR GCS OF 12-7	FALL IN GCS AT 0 HOUR	AT 1 HOUR GCS OF 12-7	FALL IN GCS AT 1 HOUR	AT 6 HOURS GCS OF 12-7	FALL IN GCS AT 6 HOUR
59	38	21	52	07	52	07

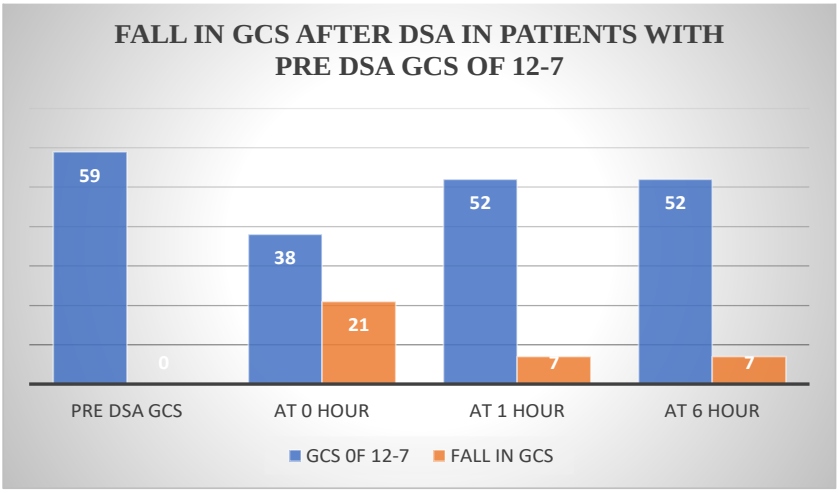

FIGURE 7: SHOWING FALL IN GCS AFTER DSA IN PATIENTS WITH PRE DSA GCS-12-7

The local complications observed following DSA were pain at injection site(8cases), hematoma at puncture site (4 cases) and diminished distal pulsation (2 cases). (TABLE 7)

TABLE 7: SHOWING COMPLICATIONS OF DSA

COMPLICATIONS AFTER DSA		
LOCAL	• PAIN AT INJECTION SITE	08
	• HEMATOMA AT PUNCTURE SITE	04
	• DIMINISHED DISTAL PULSATION	02
	• INFECTION	00
SYSTEMIC	• CONTRAST RELATED ALLERGY	00
	• CHEST PAIN	00
	• NAUSEA AND VOMITING	07
	• SHORTNESS OF BREATH	01
	• PULMONARY EDEMA	00
	• DRY THROAT	09
NEUROLOGICAL	• INFARCT	02
	• REBLEEDING	02
	• SEIZURE	03
	• DIZZY, FAINT, LIGHT-HEADED	14
	• HEADACHE	06
	• SYNCOPE	00
	• TRANSIENT VISION LOSS	00
	DETERIORATION OF PREVIOUS NEUROLOGICAL STATUS/ FALL IN PRE DSA GCS	09
	• HEMIPARESIS/APHASIA	02

The common systemic complications observed after DSA were nausea and vomiting (7 cases) and 1 patient developed shortness of breath. (TABLE 7)Common neurological complications observed were dizziness, light headedness and faintness which was seen in 14 cases, followed by deterioration of neurological status and fall in pre-DSA GCS in 9 cases, headache in 6 cases, seizure in 3 cases and infarct and rebleeding in 2 cases each. (TABLE 7)It is observed in the present study that in the majority of cases (56.8%) all the local, systemic and neurological complications which developed after DSA; occurred between 30-60 minutes following the procedure. (TABLE 8)

TABLE8: SHOWING TIME TAKEN FOR DSA PROCEDURE AND COMPLICATIONS

TIME TAKEN (MINUTE)	NUMBER OF CASES	COMPLICATIONS					
		LOCAL		SYSTEMIC		NEUROLOGICAL	
		NO.	%	NO	%	NO	TOTAL (%)
<30	40	5	4%	3	2.4%	2	1.6%
30-60	71	14	11.2%	11	8.8%	10	8 %
>60	14	3	2.4%	8	6.4%	7	5.6%

DISCUSSION

In our study, 125 patients were analyzed who underwent DSA over a period of 2 years from 01/03/2021 to 28/02/2023.

Patients were divided into 4 age groups, vascular lesions were less below 20 years of age(only2 cases of AVM), maximum cases were between 40 to 60 years followed by age groups > 60 years. (TABLE1) which is comparable with study done by Dakreet et al. [6]In our study, number of female patientswere more than males, with 54.4% females and 45.6% males (TABLE2). In study by Shahzad et al,[7] male were more than females.In our study, 32 (25.6%) cases of ACOM aneurysm were diagnosed out of which 13.6% were females and 12% males. 17 (13.6 %) cases of PCOM aneurysm with 7.2% females and 6.4% males. 17 (13.6%) cases of MCA aneurysms with 8% females and 5.6% males. 7 (5.6%) cases of ICA bifurcation aneurysm with 3.2% females and 2.4% males. DACA aneurysm, 3 cases (2.4%); P2 segment of PCA aneurysm, 2 cases (1.6%); PICA aneurysm, 1 case (0.8%), Moya-Moya disease, 3 cases (2.4%); Intracranial AVM 13 (10.4%) cases with 2.4% female and 8% male, carotico-cavernous fistula 1 case (0.8%). 29 cases (23.2%) cases where no abnormality was detected after DSA. In our study,aneurysms are more common in anterior circulation than posterior circulation. This is comparable with studydone by Prestigiacomo.[8] In our study, ACOM aneurysms were more common than PCOM aneurysms which is consistent with the study done by Shahzadet al[7]. In our study,intracranial aneurysm was found to be commoner in females than males. Similar results were obtained in study by Yuankuletet al. [9]The prevalence

of aneurysm becomeshigher in female as their age increases. The increase in female prevalence of cerebral aneurysms and SAH peaks between 50 and 59 years of age, in correlation with the fall in estrogen levels.[10]In our study,AVM's are more common in males and in younger age group. This is comparable with study of P. Oroszet al. [11]and Stapf C et al. [4]In our study, Subarachnoid haemorrhage is the most common clinical presentation of non-hypertensive vascular lesions. Prevalence of male is 45% and female is 55%. The most common age group is 41-60 years of age. This is consistent with the study done by Lee HS et al. [12]On the basis of pre-DSA GCS, patients were divided into two groups, first those having GCS between 15-13 (group1) and others having GCS between 12-7(group2). In group 1, (TABLE 5), 13 patients had fall in GCS after procedure at zero hour. 4 patients regained their initial GCS at 1 hour and 7 patients regained their initial GCS at 6 hours. Overall, 2 patients did not regain their initial GCS. These 2 patients were of subarachnoid haemorrhage, 1 patient hadrebleeding and 1 had seizure.In group 2 (TABLE 6), out of 59 patients, 21 had fall in GCS at zero hour. Out of which 14 patients regained their initial GCS and 7 patients could not regain their GCS even at 6 hours. Out of 7 patients, 5 were of subarachnoid haemorrhage and 1 lobar bleed and 1 intraventricular haemorrhage. 2 patients had global infarct, 1 had rebleeding, 2 had seizure and in 2 patients, no cause could be identified. Fall in GCS at zero hours may be attributed to oversedation which subsequently improved on post-procedural care. The 2 patients who had global infarct may be due to thrombus emboli and in these patients,the duration of procedure was more than 60 mins. Rebleeding has been observed to occur after 6 hours of DSA, so it may not be DSA induced.In our study (TABLE 8), average time taken for DSA was less than 30 minutes for 40 patients, 30 to 60 minutes for 71 patients and more than 60 minutes for 14 patients. It has been observed thatthe percentage of complications were more in patients with longer duration of DSA procedures. It is as comparable to study by Ho Hyun Nam et al. [11]Complications afterDSAwere categorized as local, systemic and neurological. Non neurological complication is defined as any complication occurring either locally at the puncture site or systemically. A neurologic complication is defined as any new neurological sign or symptom or worsening of a pre-existing neurological deficit. Local complications were noted in 14 patients and this is irrespective of time taken for the procedures whereas systemic complications were seen in 17 cases and neurological complications were noted in 19 cases.The count of neurological complications is more as some patients had more than one neurological complication (TABLE7). Most of the complications were reversible yet some irreversible complications were also noted.2 patientshad fall in GCS in group 1 (patient having pre-DSA GCS of 15-13) and 7 patients hadfall in GCS in group 2 (patient having pre-DSA GCS of 12-7). Overall, 9 out of 125 patients has fall in pre-DSA GCS and deterioration of previous neurological status. 2 cases had global infarct, among them one had generalized tonic-clonic seizure and another one developed post procedure hemiparesis and aphasia. The systemic and neurological complications are correlating with the time taken for the procedure. i.e., more time taken for the procedure, more systemic and neurological complications were observed.

CONCLUSION

Females suffered more from vascular lesions than male in our study. AVM'saremore common in young males.

Subarachnoid hemorrhage is the most common presentation of vascular lesions. Aneurysm was more common in anterior circulation of which ACOM aneurysm is the most common, followed by PCOM aneurysm.Fall in GCS after the procedures were mostly encountered in those patients in whom the procedures took more time. Also,the local, systemic and neurological complications were more common in procedures taking longer durations. So, it can be concluded that DSA is a safe procedure in expert hands, however few complications may still be encountered. Thus, DSA is still a gold standard procedure for detection of intracranial vascular lesions with minimal complications,although it is an invasive procedure.

LIST OF ABBREVIATIONS

1. AVM – Arteriovenous malformations
2. CT- Computed tomography
3. DSA – Digital subtraction angiography
4. CTA – Computed Tomography Angiography
5. MRA – Magnetic resonance angiography
6. GCS – The Glasgow Coma Scale
7. SAH – Subarachnoid hemorrhage
8. ACOM – Anterior communicating artery aneurysm
9. DACA – Distal anterior cerebral artery
10. PCOM – Poterior communicating artery
11. MCA – Middle cerebral artery
12. ICA – Internal carotid artery
13. PCA – Posterior cerebral artery
14. PICA – Posterior inferior cerebellar artery

AKNOWLEDGEMENT

It is a pleasure to acknowledge the help and constructive suggestions of all the faculty of the Department of Neurosurgery. We are thankful to the publisher and all OT nurses and C arm operators, all the supporting staffs, patients, attendants etc.

REFERENCES

1. Kase CS. Intracerebralhemorrhage: non-hypertensive causes. Stroke. 1986 Jul;17(4):590-5.
2. Kase CS, Shoamanesh A, Greenberg SM, Caplan LR. Intracerebralhemorrhage. In: Grotta JC, Albers GW,

Broderick JP, et al., editors. Stroke: pathophysiology, diagnosis and management. 6th ed. Philadelphia: Elsevier; 2016. p. 466–515.

3. Kamalakannan S, Gudlavalleti ASV, Gudlavalleti VSM, Goenka S, Kuper H. Incidence & prevalence of stroke in India: A systematic review. Indian J Med Res. 2017 Aug;146(2):175-185. doi: 10.4103/ijmr.IJMR_516_15. PMID: 29265018; PMCID: PMC5761027.
4. Banerjee TK, Mukherjee CS, Sarkhel A. Stroke in the urban population of Calcutta: an epidemiological study. Neuroepidemiology**.** 2001; *20*: 201–207
5. Stapf C, Khaw AV, Sciacca RR, Hofmeister C, Schumacher HC, Pile-Spellman J, Mast H, Mohr JP, Hartmann A. Effect of age on clinical and morphological characteristics in patients with brain arteriovenous malformation. Stroke. 2003 Nov 1;34(11):2664-9.
6. Tamdogan T, Turkoz D. Comparison of Computerized Tomographic Angiography (CTA) and Digital Subtraction Angiography (DSA) in patients with subarachnoid hemorrhage: A retrospective analysisy.
7. Dakre AR, Bhasme SN, Chhajed NA. Complications of intra-arterial digital subtraction angiography in patients investigated for cerebral vascular disease in Tertiary Care Hospital. International Journal of Health and Clinical Research. 2022;5(3):600–2.
8. Shahzad R, Younas F. Detection and characterization of intracranial aneurysms: magnetic resonance angiography versus digital subtraction angiography. J Coll Physicians Surg Pak. 2011 Jun 1;21(6):325-9.
9. Prestigiacomo CJ, Sabit A, He W, Jethwa P, Gandhi C, Russin J. Three dimensional CT angiography versus digital subtraction angiography in the detection of intracranial aneurysms in subarachnoid hemorrhage. J Neurointerv Surg. 2010 Dec;2(4):385-9. doi: 10.1136/jnis.2010.002246. Epub 2010 Jun 24. PMID: 21990653.
10. Cai Y, Liu Z, Jia C, Zhao J, Chai S, Li Z, Xu C, Zhang T, Ma Y, Ma C, Chen X. Comparison of Sex Differences in Outcomes of Patients With Aneurysmal Subarachnoid Hemorrhage: A Single-Center Retrospective Study. Frontiers in Neurology. 2022 Apr 28;13:615
11. Ghods AJ, Lopes D, Chen M. Gender differences in cerebral aneurysm location. Front Neurol. 2012 May 21;3:78. doi: 10.3389/fneur.2012.00078. PMID: 22661965; PMCID: PMC3356859.
12. Orosz P, Vadász Á, Veres DS, Berentei Z, Gubucz I, Nardai S, Kis B, Szikora I. Living with a brain AVM: a quality of life assessment. Trends in Cerebrovascular Surgery and Interventions. 2021 May 11:71-6
13. Lee HS, Kim YJ, You SH, Jang YG, Rhee WT, Lee SY. The incidence of aneurysmal subarachnoid hemorrhage in Youngdong district, Korea. Journal of Korean Neurosurgical Society. 2007 Oct;42(4):258.