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Clipping of Middle Cerebral Artery Aneurysm –A Review Of 45 Cases

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Abstract: *Middle Cerebral Artery Aneurysm (MCAA) Accounts For Approximately 18-20 Percent Of All Intracranial Aneurysms. These Aneurysms Are Divided Into Three Categories According To Their Origin: Proximal Aneurysms, Which Are Located On The Main Trunk, M1 Segment (10-15%); Bifurcation Aneurysms, Which Are Located At The First Major Bifurcation Or Trifurcation (80-85%); And Distal Aneurysms Which Are Located Beyond The Major Bifurcation (5%). In Our Series Of 45 Patients, Total 52 Aneurysms Were Seen. Out Of Them, 12 Aneurysms Were Small Sized (2-7mm); 27 Aneurysms Were Medium Sized; 12 Aneurysms Were Large (15-25mm) Sized And 1(1.92%) Was Giant Aneurysm .We have treated all by surgical clipping of aneurysm. METHOD: Data Was Collected From The Admission Record Of The Patients Of Middle Cerebral Artery Aneurysms, Presented To The Department Of Neurosurgery At G. B. Pant Hospital, Delhi During Last 5 Years (Aug. 2003 To July 2008). Total 45 Patients Were Diagnosed To Have MCA Aneurysm And Were Managed In Our Department During This Period. We Retrospectively Reviewed The Records Of These Patients To Analyze Clinical Outcomes . RESULTS: Most Common Age Group Was 46-55 Years Which Included 14 Patients. Mean Age Group In Our Study Was 50 Years. 24 Patients Were In Age Group 36-55 Years. 11 Patients Were Included In Age Group Above 55 Years. At Presentation, 27patients Were In H&H Grade 1; 3 Were In H&H Grade 2; 11 Were In H&H Grade 3; 4 Patients Were In H&H Grade 4.There Was 8.33% Mortality In Small Sized Aneurysms; 37% In Medium Sized; 25% In Large Sized And 100% In Giant Aneurysm. Glasgow Outcome Scale Of 4 And 5 Was Seen In 44% Of Patients Presented With Proximal MCA Aneurysm And 60.5% In Those With Bifurcation And Trifurcation Aneurysm. Glasgow Outcome Scale Of 4 And 5 Was Seen In 28(62.2%) Patients While 13(28.8%) Died. CONCLUSION: To conclude, patients presenting with poorer Hunt and Hess grade, World Federation of Neurological Surgeons grade and Fisher grade on admission has poor outcome. Post operative check cerebral angiography is a good tool of assessing the effectiveness of clipping and distal cerebral circulation. The surgical outcome of our series is comparable to various international series. Surgical Clipping Continues To Be A Good Option For The Treatment Of Middle Cerebral Artery Aneurysm.*

Keywords: *MCAA -Middle Cerebral Artery Aneurysm ,H&H-Hunt and Hess,DSA- Digital Substraction Angiography, Glasgow Outcome Scale, Glasgow Coma Scale*

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I. Background

In neurosurgical practice, MCA aneurysms present as subarachnoid hemorrhage (SAH) or as an unruptured incidental aneurysm (UIA). Unruptured incidental MCA aneurysms usually present as a mass effect in the form of increased intracranial tension. MCA aneurysms may be diagnosed as part of routine screening as unruptured MCA aneurysms. Unruptured MCA aneurysms can produce symptoms like headache, temporal lobe epilepsy, visual field deficits and papilloedema. MCA aneurysms are the most common aneurysm manifesting with ischemic symptoms, which can be in the form of transient ischemic attacks and hemi paresis. Epilepsy and hemi paresis are most common disabilities, associated far more frequently with MCA aneurysms than with aneurysms at other sites[2]. Another well known presentation is subarachnoid hemorrhages (SAH) which manifest as headache, loss of consciousness and focal neurological deficit. Unilateral headache in MCA aneurysms rupture is almost always on the side of the aneurysm. Loss of consciousness is seen in about 60% and focal neurological deficit in about 80% of patient of MCA aneurysms[2]. The frequencies of intracerebral hematomas are more common in patients with MCA aneurysms than in patients with ruptured aneurysms at other sites. Most of the intracerebral hematomas occur in patients with MCA bifurcation aneurysms that are directed laterally[2].

An early Computed Tomography (CT) scan is must to establish the diagnosis of subarachnoid hemorrhages, to localize and quantitate the amount of blood in the cisterns, to predict the location of vasospasm, and to rule out an intracerebral hematoma. CT scan detects subarachnoid hemorrhage in 90-95 % of patients within the first 24 hours of the ictus. However CT angiography and Magnetic Resonance Angiography (MRA) are other diagnostic modalities. CT angiography is superior to Magnetic resonance angiography as its sensitivity varies from 96-100%. Cerebral Digital Substraction Angiography (DSA) is regarded as the gold standard for detection of middle cerebral artery aneurysms.

MCA aneurysms can be managed surgically or by endovascular means. Surgical approaches for management of MCA aneurysms are pterional or keyhole supraciliary fronto-lateral craniotomy. In the pterional approach, aneurysm can be dissected by opening the Sylvain fissure or through the superior temporal gyrus.

The reported causes of poor outcome in patient with MCA aneurysm are[1, 2-] (a) Severe primary bleeding (b) Subsequent bleeding. (c) Brain infarction due to vasospasm (d) Postoperative infection. (e) Pulmonary embolism. (f) Infarction due to main vessel occlusion. (g) Aneurysmal rupture (h) Postoperative hematoma. (I) Focal neurological deficit like dysphasia, visual field deficit.

Difficulty is encountered in management of middle cerebral artery aneurysms if there is[1, 2]:- (a) Association of intracranial hematoma usually of diameter $\geq$ 2.5 cm in patients with ruptured MCA aneurysms. (b) Pre-operative or admission Hunt and Hess grading is higher in patients with MCA aneurysms than in patients with ruptured aneurysms at other sites. (c) The lenticulostriate vessels exits mainly proximal to bifurcation and they are usually adherent to the aneurysm. (d) Calcification or atherosclerosis in the neck. (e) Adhesion of major divisions and sometimes small perforating vessels to the neck. (f) Presence of giant aneurysm which is approximately 9% as compared to 4% seen in other aneurysmal sites. (g) The neck of proximal MCA is often wide making them difficult to clip or coil. (h) Medially directed aneurysm which causes higher risk for perforator injury during surgery.

II. Pathophysiology Of Aneurysmal Rupture[28]

The consequences of SAH depend on the volume and location of the bleeding as well as the preexisting size of the cerebrospinal fluid (CSF) Space into which the aneurysm ruptures. There may be a very small SAH from the aneurysm that causes only a sudden severe headache and corresponds to a ‘’warning leak’’ or ‘’sentinel hemorrhage’. There is a general correlation between the volume of SAH and the clinical grade, risk of vasospasm, and other complication such as increased intracranial pressure, seizure and hydrocephalus.

The physiological changes such as reduced cerebral blood flow and metabolism, systemic alteration such as hyponatremia, hypovolemia, hyper-metabolism, catabolic state, cardiac arrhythmia, cardiac wall motion abnormality tends to increase with increasingly severe SAH. Bleeding stops by combination of tamponade due to the reduced transmural pressure gradient across the aneurysm and coagulation. The global increase in intracranial pressure which causes transient loss of consciousness does not occur in all patients with SAH.

There is a direct correlation between mean ICP increase and clinical grade, which is:-
a) Clinical grade 1 and 2-Mean ICP of 10 mmHg,b) Clinical grade 2 and 3-Mean ICP of 18mmHg ,c) Clinical grade 3 to 5 - Mean ICP of 29mm Hg At present, there are three MRI –compatible aneurysm clips in routine use:-A) Yasargil , B) Sugita , C) Spetzler clips. Common applicator in use is:- A) Olivecrona , B) Yasargil, C) Sugita.

III. Materials And Methods

This retrospective study of “Clipping of middle cerebral artery aneurysm-A review of 45cases: included patients admitted in neurosurgical ward of G.B Pant Hospital from August 2003-July 2008 with middle cerebral artery aneurysms. This included patients of any age, sex, caste and religion presented with sudden onset headache, vomiting and loss of consciousness. They were graded under subarachnoid hemorrhage Hunt and Hess grade 0-5, World Federation of Neurological Surgeons (WFNS) grade 1-5 and Fisher grade 1-4. All patients with subarachnoid hemorrhage were admitted and investigated and those diagnosed as having middle cerebral artery aneurysm were included in the study. Patients were subjected to pterional craniotomy in standard fashion and clipping was performed. Post operatively neurological status was graded according to Modified Rankin Scale (0-5) and Glasgow Outcome Scale (1-5) and patients were followed regularly. Check DSA was done 3 month after surgery in follow up. Digital Subs traction Angiography (DSA) was done in all patients except where it was not possible due to technical reasons. The CT Angiography and MR Angiography were the alternative modes of diagnosing the MCA aneurysm where DSA could not be done. Surgery was done at the earliest possible in all the patients. Pterional craniotomy and opening the Sylvian fissure by splitting the fissure in a medial to lateral direction. The internal carotid artery was identified and followed laterally along the MCA. This approach has the advantage of proximal control and exposing the neck before the dome. The disadvantage was that the dissection performed was relatively extensive and risks injury to the banks of the sylvian fissure.

PROCEDURE- CLIPPING:

Middle cerebral artery aneurysms are approached through either pterional or keyhole supraciliary front lateral craniotomy. Three approaches, which are based on the pterional approach that Yasargil popularized, can be used in surgical treatment of MCA aneurysms.

Clip Application:-

Clipping of MCA more commonly require reconstruction of the origins of the parent vessels at the aneurysm neck. Clip application parallel, as opposed to perpendicular to the axis of the vessels, is an important aspect of reconstruction. It can also be assisted by fenestrated clips. A flush reconstruction, compromises the flow within the lumina of the branch vessels, especially with atherosclerotic aneurysmal necks. Slimline aneurysmal clips are useful for MCA aneurysms particularly those arising from lenticulostriate perforators. The weight of larger clips predispose to avulsion of the aneurysm. It is important to note that how the sylvian fissure rest on the clip after removal of retractors. Larger clips can undergo torquing leading to stenosis or occlusion of the parent vessel.

Table 1: -Surgical approaches to middle cerebral artery aneurysm**.**

	Medial Transsylvian (Proximal to distal) approach	**Lateral Transsylvian (distal to proximal)Approach**	**Superior temporal gyrus approach**
Advantages	Early proximal control Exposure of aneurysm neck before the dome	Require less dissection to reach aneurysm complex	Require less brain retraction. Sylvian veins left undisturbed. Avoids dissection of circle of Willis and risk to perforators. Good visualization of the aneurysm complex between the neck and M2 branches.
Disadvantages	More extensive dissection	Proximal control not achieved early before aneurysm complex is identified. May be difficult to split the sylvian fissure distally in the setting of Subarachnoid hemorrhages and a swollen brain	Does not achieve early proximal control. Possible risk of inducing seizures. Requires slightly larger bone flap
Preferred approach for:	Most bifurcation/trifurcation aneurysms especially those with a short M1 segment aneurysms	Bifurcation aneurysm with a long M1 trunk. Aneurysms distal to the bifurcation	Aneurysms with temporal lobe hematomas particularly when swelling hinders ability to split the sylvian fissure
Contraindicated for:-		M 1segment aneurysm. Bifurcation aneurysm with a short M1	Bifurcation aneurysms with a short M1 Aneurysms that project back over the insula

Pterional Approach:-

1) Position of the patient:- The patient is positioned supine with the head on three-four point skeletal fixation devices like Mayfield-Kees or Sugita. A right sided craniotomy is preferred for right handed surgeon and right-sided lesion. The head is directed about 20° vertex down, elevated slightly, and rotated about 30° to the left to bring the malar eminence to the superior point of the operating field. This position will cause the operating field to incline slightly toward the surgeon, allowing the frontal lobes to fall away from the orbital roof. The sphenoid ridge will be directed vertically in the operating field. The skeletal fixation device should be placed with one prong behind the ear, just above the ipsilateral mastoid and with the two prongs on the left side of the head. The prongs should be high enough on the skull (above the linea terminalis) that they do not enter the temporalis muscle which will lead to instability as well as bleeding.

2) Skin Incision: Incision begins 1cm in front of the ear, extends upward to the temporal crest, then turns downwards and ends horizontally in one of the natural skin creases of the forehead. Damage to the temporalis muscle and the frontalis branch of the facial nerve must be avoided. Cutting across the muscle fibers produces the atrophy, leading to temporo-mandibular joint problems and a noticeable indentation in the temple. Damage to the temporalis branch of the facial nerve produces weakness of the frontalis muscle and causes the eyelid to droop, thus obscuring upward vision with a cosmetic anomaly. Elevating the temporalis muscle with the skin flap solves the problem. During closure, the muscle must be reattached to the cranium. Failure to reattach the muscle produces a bulge above the zygoma.

3) Craniotomy:- The bone flap is initiated with a frontal burr hole just superior to the frontal suture under the linea temporalis. A second hole is placed in the frontal bone 3-4cm superior to the first and 1-2cm above the orbital rim, avoiding if possible the frontal sinus. A third hole is positioned in the parietal bone along the linea-temporalis variably behind the coronal suture. The final corner of the bone flap is marked by a burr hole in the squamous temporal bone behind the spheno-temporal suture, about 4cm to the third and 3cm posterior to the first. In 1976, first electric powered drill which stops automatically as the dura is encounterd was employed. The squamous temporal bone and greater wing of sphenoid are rongeured further inferiorly toward the floor of the middle fossa (allowing more mobility of the temporal lobe) to reach the tentorial edge.

The posterior edge of the greater wing of sphenoid is progressively flattened until a small ridge representing the most lateral aspect of the lesser wing is reached. A small bridging vessel, the orbital–meningeal artery (anastomotic branch of the ophthalmic artery to the middle meningeal artery) is almost seen. Variable amounts of hemorrhagic ooze is expected from the middle of the sphenoid ridge in the distribution of two orbitomeningeal artery and from each side to the ridge along the spheno-squamous and sphenofrontal sutures in the area of two orbito-meningeal artery branches. The bleeding can be easily controlled by wax and cautery.

4) Dural opening:- The dura is opened in a semicircular fashion around the sylvian fissure, arched toward the sphenoid ridge and orbit. The frontal lobe is gently retracted allowing easy asses and entrance into the carotid, chiasmatic, and lamina terminalis cisterns, thereby releasing CSF and providing the room for easy dural tacking. The lamina terminalis can also be incised allowing CSF release from the third ventricle especially if the basal cisterns are blocked by adherent hematoma.
5) Arachnoid opening: Both the sylvian cistern between the basal frontal and temporal lobes and the whole lamina terminalis cistern adhering to the frontal lobes to the optic nerves and chiasm are opened.
6) Enlarging the apex of the pyramid:- Using the arachnoid knife, the sylvian cistern is entered at the level of the opercular frontal gyrus. The arachnoid of the sylvian cistern may be thin and transparent or may be milky, yellow, or even opaque following a subarachnoid haemorrhage. The superficial middle cerebral veins are one or more large venous channels that course on the temporal side of the sylvian fissure. They generally empty into the sphenoparietal or cavernous sinuses, but will occasionally continue around the temporal pole to the superior petrosal sinus. The arachnoids of the sylvian cistern should be opened on the frontal side of these veins so that they will not cross the sylvian fissure when the frontal lobe is retracted.
7) Aneurysm clipping:- The middle cerebral trunk is prepared for possible temporary occlusion before the aneurysm is dissected. A potential site should select for placement of temporary clips that avoids injury to the lenticulostriate perforating arteries. Aneurysm should be clipped under relative hypotension of systolic blood pressure of 100-120mm Hg. Dissection should begin at the aneurysm base because the body and dome are fragile and are the potential site of rupture. The aneurysm neck should be freed from adhesion to the surrounding arteries and the brain. Many MCA aneurysms are multilobulated or bulbous. Often they have broad neck, making clipping difficult. Using short burst of bipolar, aneurysmal tissue can be shrinked to make it clippable. Sclerotic, calcified and partially thrombosed aneurysm do not respond to cautery and they need thromboembolectomy.

Placing the blades of the clip exactly at the aneurysm-artery junction not only kinks or occludes the arterial branches but also causes aneurysm to tear at its base. After clipping, we may apply additional cautery to the aneurysm and reposition the clip until final position of the clip is achieved. Large, giant, or globular aneurysms have thick walls that prevent the tips of the aneurysm clip from closing. In these cases, we use Drake's tandem –clipping technique. Fenestrated clips are applied proximally and because the crotch of the fenestrated jaws is not held open by the aneurysm wall, the tips of the clip are able to close. A non fenestrated clip is used as a distal clip, which seals the proximal portion of the aneurysm that is missed by the fenestration of the proximal clip[22, 50].

TEMPORARY CLIPPING: Temporary clipping of intracranial vessels in aneurysm surgery was introduced by Pool in 1960.The use of temporary clipping has become an important tool in aneurysm surgery. The study included 62 patients, detailing operative protocols and results. Twenty-two had unruptured aneurysms (35%), 15 patients were in grade 1(24%), 16 patients were in grade II (25%), 5 patients were grade in III (8%) and 4 patients were in grade IV (7%).The aneurysms were mainly located in the MCA in 29 patients. 11 patients developed a new, persistent post-operative deficit. In 1 case (2%), temporary clipping resulted in the development of deficit. Overall 92% of his patients with temporary clipping had good to excellent outcome, with 3% mortality and 5% morbidity. Thus temporary clipping is a safe procedure. There were 29 patients requiring temporary clipping for MCA aneurysms. 25 were electively clipped, four after intra-operative rupture. 14 of the patients had giant MCA aneurysm, of which eight were clipped following subarachnoid haemorrhage.The median temporary clipping time of patients without deficit was 13 minute[6].

Sugita or Yasargil temporary clips (Downs, Aesculap) are used for temporary vascular occlusion. The measured blade pressure is 40-80g, depending upon the size of the particular artery to be occluded. For small vessels, Kleinert-Kurtz clips are applied. Usually for a vessel of 2.0mm or less, like the distal MCA or ACA, 40-g-force temporary clips are sufficient for occlusion. Large vessel like ICA, vertebral, basilar, M1 MCA requires 80-g force temporary clips[6].

(a) <u>Hunt and Hess grade</u>-

Unruptured Aneurysm -0

Asymptomatic or minimal headache and slight nuchal rigidity -1

Moderate to severe headache, nuchal rigidity, no neurological deficit other than cranial nerve palsy. -2

Drowsiness, confusion , mild focal deficit. -3

Stupor, moderate to severe hemiparesis, possibly early decerebrate rigidity and vegetative disturbances -4

Deep coma, decerebrate rigidity, moribund appearance -5

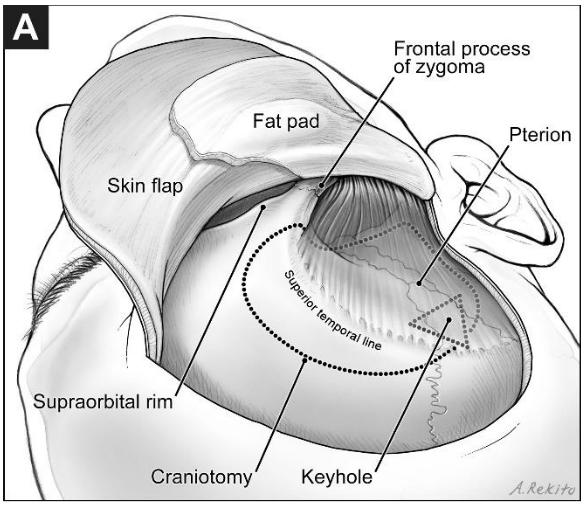
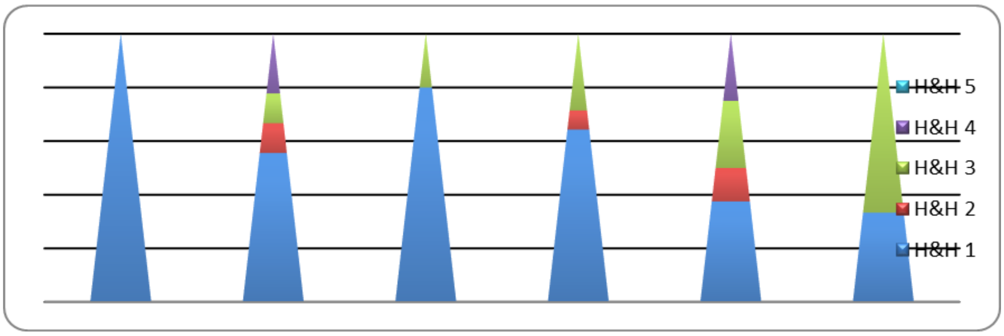


Table 1: Age v/s Hunt & Hess grade at admission

Age	H&H 1	H&H 2	H&H 3	H&H 4	H&H 5	Total
Age 15-	01	00	00	00	00	01
Age 26-35	05	01	01	02	00	09
Age 36-	08	00	02	00	00	10
Age 46-55 yrs(n=14)	09	01	04	00	00	14
Age 56-65	03	01	02	02	00	08
Age 66-75	01	00	02	00	00	03
Total	27	03	11	04	00	45

Data was available for 45 patients taken in the study.27 patients were in H&H grade 1 at admission, 3 patients were in grade 2, 11 were in grade 3, 4 patients were in grade 4 and no patients were in grade 5. Most common age group was 46-55 years which included 14 patients. Mean age group in our study was 50 years. 24 patients were in age group 36-55 years. 11 patients were included in age group above 55 years. Only 1 patient was in age group of 15-25 years.

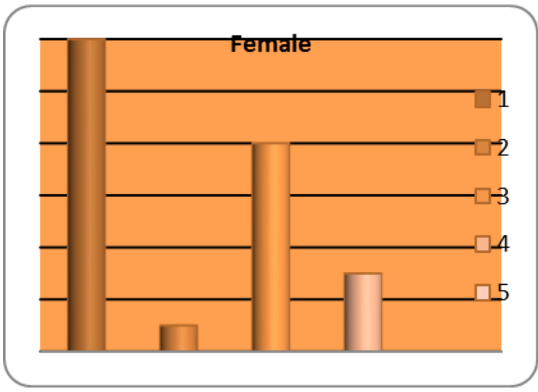


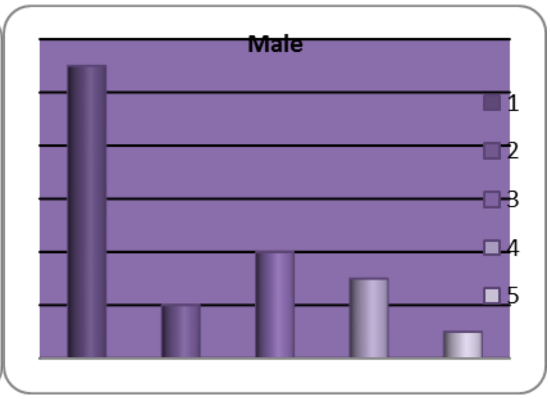
Age v/s Hunt&Hess at admission

Table2: Distribution of patients according to WFNS grading on admission in accordance with age.

WFNS GRADING	Total	Male	Female
1(n=23)	23	11	12
2(n=3)	03	02	01
3(n=12)	12	04	08
4(n=6)	06	03	03
5(n=1)	01	01	00
Total	45	21	24

Data was available for 45 patients in accordance with WFNS grading of patients at the time of presentation. It was seen that 23 patients were in WFNS grade 1 at admission and among them 11 were male and 12 were female. 7 patients were in WFNS grade 4 and 5 at admission and among them 4 were male and 3 were female. 12 patients were in WFNS grade 3 at admission and among them 8 patients were female and 4 were male.



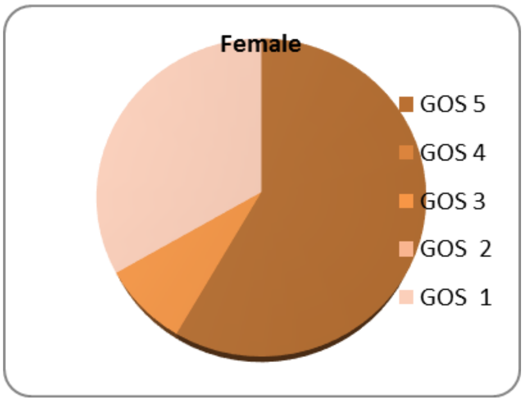


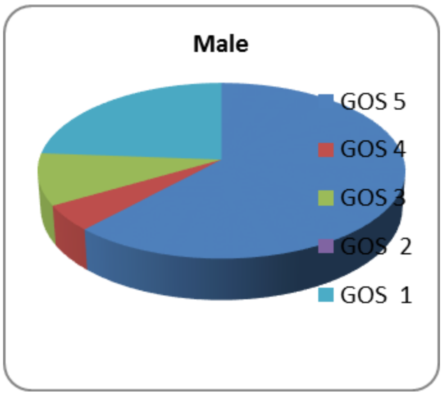
WFNS grading v/s Relation

Table 3: Sex v/s Outcome

Sex	Glasgow outcome scale					Total
	GOS 5	**GOS 4**	**GOS 3**	**GOS 2**	**GOS 1**	
Male(n=21)	13	01	02	00	05	21
Female(n=24)	14	00	02	00	08	24
Total	27	01	04	00	13	45

Data was available for 45 patients for analysis of sex v/s outcome. 21 patients were male in the series while 24 were female. Out of 21 male patients, 14 patients were in GOS of 4 and 5 after clipping while 5 patients died. Among 24 female patients, 14 patients were in GOS of 4 and 5 while 8 patients died after their surgery. Thus outcome was nearly equal in both sexes.





Sex v/s outcome

Glasgow Outcome Scale:

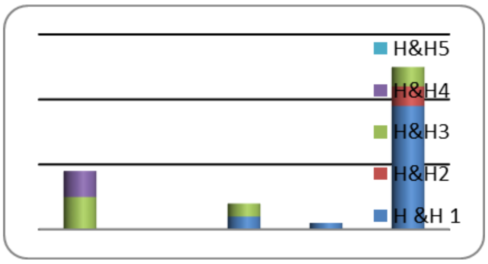
* Good Recovery- Resumption of normal life despite minor deficit. -5
* Moderate Disability (disabled but independent)-Travel by public transportation, can work in sheltered setting- 4 -

* Severe disability (conscious but disabled)-dependent for daily support.-3
* Persistent vegetative state-unresponsive and speechless; after 2-3weeks, may open eyes and have sleep/wake cycles-2.
* Death **-1**

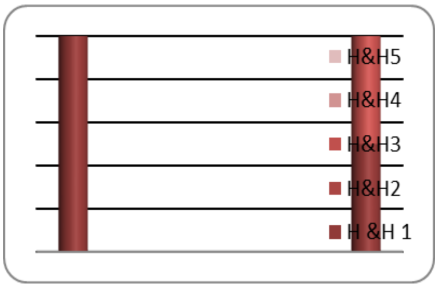
Table 4: Temporary Clipping, H&H grade and cross tabulation with Glasgow Outcome Scale.

			Glasgow Outcome Scale(GOS)					**Total**
Temporary Clipping			1	2	3	4	5	
Yes	H&H At admission	1	00	00	02	01	19	22
		2	00	00	00	00	03	03
		3	05	00	02	00	03	10
		4	04	00	00	00	00	04
		5	00	00	00	00	00	00
	Total		09	00	04	01	25	39
No	H&H At admission	1	04	00	00	00	01	05
		2	00	00	00	00	00	00
		3	00	00	00	00	01	01
		4	00	00	00	00	00	00
		5	00	00	00	00	00	00
	Total		04	00	00	00	02	06

In this series of 45 patients, temporary clipping was used in 39. In those in whom temporary clipping was used, GOS of 4 and 5 was seen in 26 while 9 patients died. All 4 patients died in those with H&H grade 4 and 5 on admission and in whom temporary clipping was used. Out of 10 with grade 3 H&H at presentation, 5(50%) died with no mortality in grade 1 and 2 H&H. Temporary clipping was not used in 6 patients and among them 2 survived with GOS of 4 and 5 while 4 died.



Temporary Clipping Done



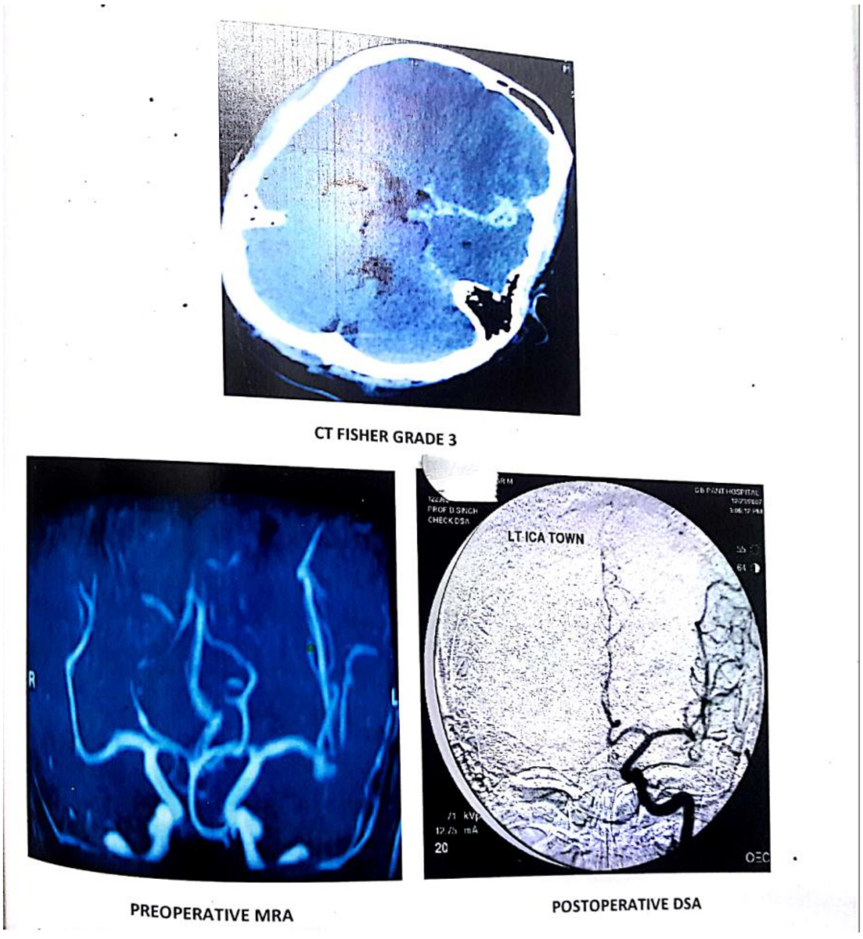
Temporary Clipping not done

IV. Discussion

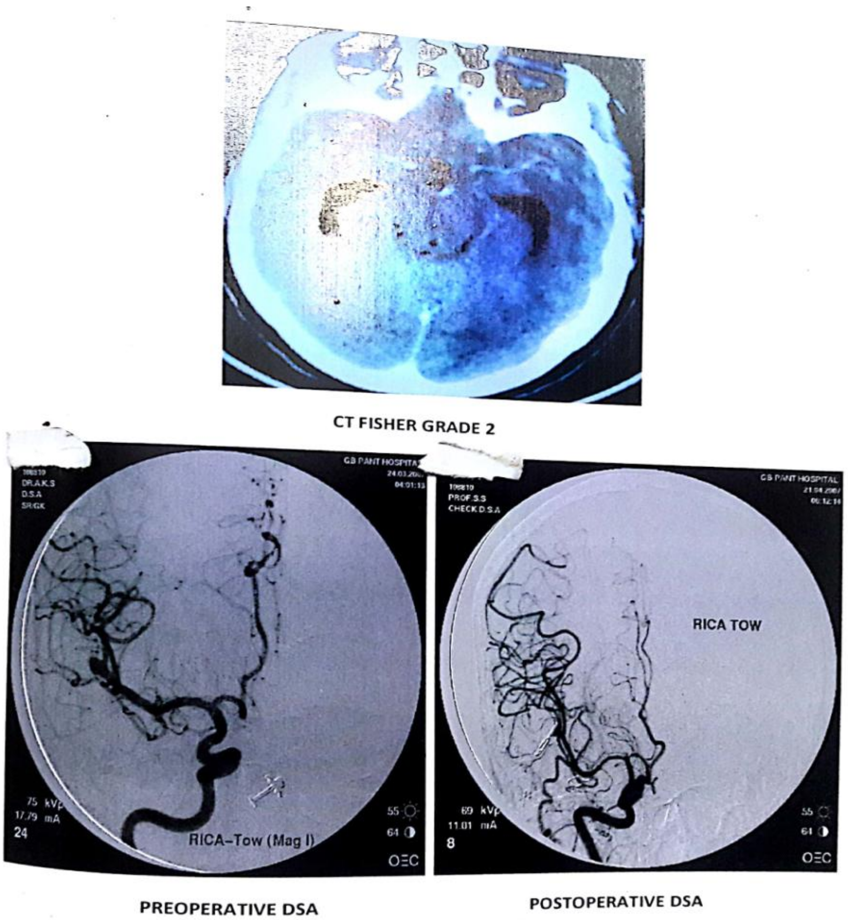
Middle Cerebral artery aneurysm is the third most common intracranial aneurysms. In our series, most common age group was 46-55 years which included 14 patients. Mean age group in our study was 50 years. 24 patients were in age group 36-55 years. Total numbers of aneurysms were 52 due to the fact that 7 patients had two aneurysms. Proximal MCA aneurysms were seen in 9(18%) patients; bifurcation/trifurcation aneurysms were seen in 38(73%) patients and distal MCA aneurysm in 5(9.6%) patient .Mirror image aneurysm was seen in 5 cases. Single MCA aneurysms were seen in 38(84.4%) and multiple in 7(15.5%) of patients .Pure mirror image MCA aneurysms were seen in 5(11.1%) patients and all were situated at bifurcation. 12 aneurysms were small sized (2-7mm); 27 aneurysms were medium sized; 12 aneurysms were large (15-25mm) sized and 1(1.92%) was giant aneurysm. Headache was seen in 43, vomiting in 30, loss of consciousness in 18(40%). Meningism was seen in nearly all patients and altered sensorium in 7. Other symptoms and signs like seizures, hemiparesis and aphasia were seen in 15.Temporary vascular occlusion was used in 66(35%) patients during aneurysmal surgery. Out of this, 16(8.6%) patients with middle cerebral artery aneurysms required temporary arterial occlusion during their operation. Occlusion time ranged from 1.5min to 40 min [51].Temporary clipping was used in 39(86%). Median temporary clipping time was 6 min. Out of 10 patients with grade 3 H&H at presentation, 5(50%) died with no mortality in grade 1 and 2 H&H. All 4 patients died in those with H&H grade 4 and 5 on admission and in whom temporary clipping was used. One patient was operated on the basis of MRA due to non availability of DSA machine. In 44(97.7%) patients DSA could well elucidate the site, size, shape and direction of aneurysm and also the associated vasospasm. Check DSA was performed in 15(33.3%) patients only and complete occlusion was achieved in all. In rest 30(66.6%), check DSA could not be performed either due to lost follow up (12 patients who were called but did not turn up in spite of repeated correspondence/telephone) or death after operation (13 patients). 5 patients did not give consent for check angiogram. 20(74%) showed good recovery (GOS of 4 and 5) while 4(15%) died in patients with grade 1H&H. The outcome in 1(25%) showed good recovery while 3(75%) died in grade 4 and 5 H&H. In the whole series, Glasgow Outcome Scale of 4 and 5 was seen in 28(62.2%) patients while 13 (28.8%) patients died with 21% mortality in grade1 and 59% in grade 3 WFNS. Outcome was good (GOS of 4 and 5) ranging from 44% in proximal to 60.5% in bifurcation /trifurcation aneurysm and 80% in distal MCA aneurysm. There was 8.33% mortality in small sized aneurysms; 37% in medium sized; 25% in large sized and 100% in giant aneurysm. The most common cause of death in patients in our series was severe subarachnoid hemorrhage, Rebleeding and associated vasospasm which comes out to be 8(61.5%) of total death. 28(62.2%) had good recovery while 13(28.8%) died.

V. Conclusion

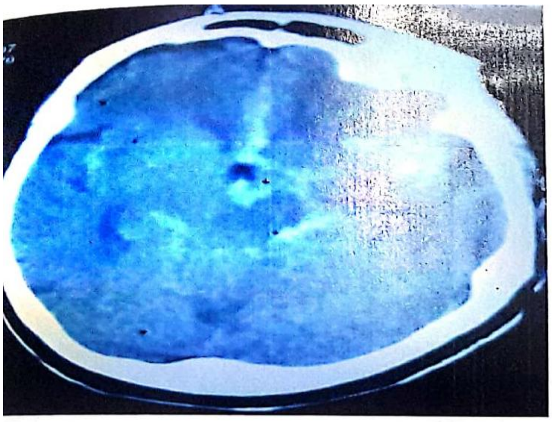
To conclude, patients presenting with poorer Hunt and Hess grade, World Federation of Neurological Surgeons grade and Fisher grade on admission has poor outcome. Post operative check cerebral angiography is a good tool of assessing the effectiveness of clipping and distal cerebral circulation. The surgical outcome of our series is comparable to various international series.



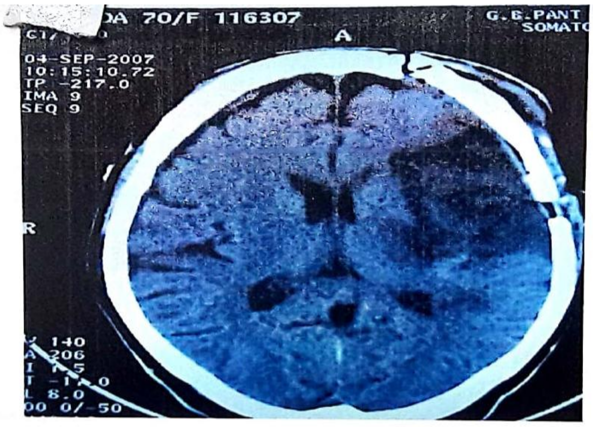
49 YEAR MALE, ADMITTED WITH FISCHER GRADE 3 , H AND HESS GRADE 1, WFNS GRADE 1. ON DSA LEFT MCA TRIFURCATION SMALL SIZE ANEURYSM DIRECTED ANTERO SUP,. CLIPPING DONE. POSTOP GCS 5 ANS MRS 0. CHECK DSA – REVEALED NO ANEURYSM



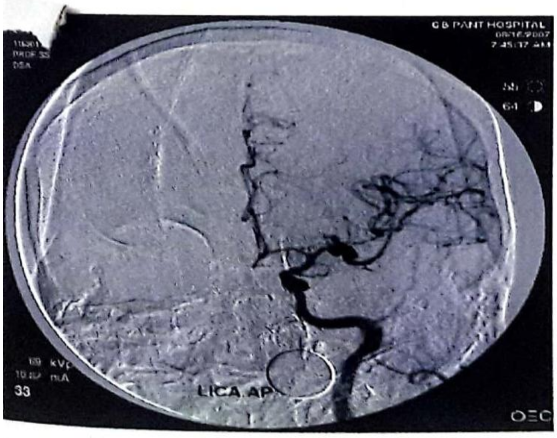
45 YEAR MALE WITH FISCHER GRADE 2, H AND HESS 1, WFNS-1. DSA-REVEALED TWO MCA ANEURYSM SMALL SIZED. (1) 4X5 MM AT BIFURCATION, (2) 4X4MM AT M2 . CLIPPING DONE. POSTOP GOS WAS 3 ANS MRS 0. CHECK ANGIO REVEALED NO ANEURYSM.



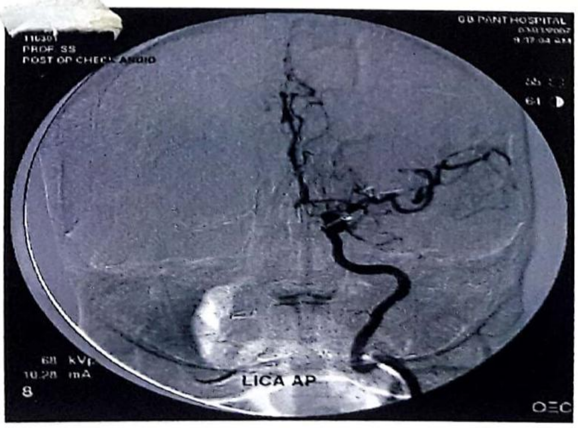
C T SCAN (FISHER GRADE-4



POSTOPERATIVE CT SCAN

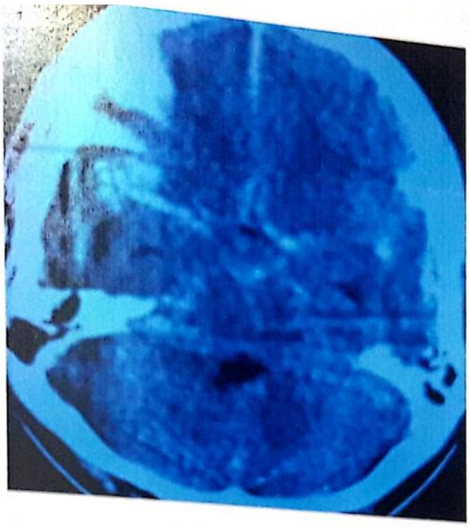


PREOPERATIVE DSA

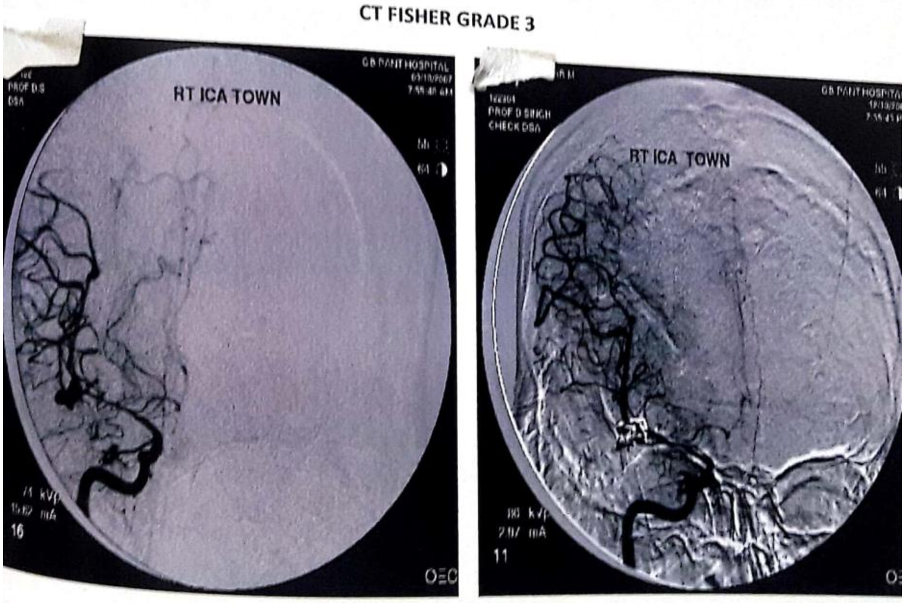


POSTOPERATIVE CHECK DSA

70 YEAR MALE WITH FISHER GRADE 4, HUNT AND HESS-3 AND WFNS-4. DSA REVEALED LEFT MCA BIFURCATION 8.6X5.3MM DIRECTED ANTERO-INF-LATERALLY. CLIPPING. POST OP GOS-3 AND MRS-5. CHECK ANGIO –NO ANEURYSM



CT FISHER GRADE 3



PREOPERATIVE DSA POSTOPERATIVE DSA

38 YEAR MALE WITH FISCHER GRADE -3, HUNT AND HESS-1, WFNS-1, DSA REVEALED RIGHT MCA BIFURCATION 20X14 MM ANEURYSM DIRECTED ANTERO-SUPERO-LATERALLY. CLIPPING DONE, POST-OP GOS-5 AND MRS-0. CHECK DSA REVEALED NO RESIDUAL ANEURYSM OR NECK

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