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Research Article

CLINICAL STUDY OF INTERVENTIONAL THERAPY AND SURGICAL CLIPPING FOR INTRACRANIAL ANTERIOR, MIDDLE, POSTERIOR CEREBRAL ARTERY ANEURYSMS

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ABSTRACT

Method: This study was conducted from 20 January 2019 to 20 January 2020. A total of 350 patients with aneurysms of age <60 years and ≥60 years were treated with surgical clipping. Of these, 150 cases were identified with anterior cerebral artery aneurysms, 150 with middle cerebral artery aneurysms and 50 cases with posterior artery aneurysms. The choice of treatment strategies was selected by a team of, neurologists and interventional neuro-radiologists, and neuro-surgeons. It was based on clinical assessment and initial computed tomography and conventional cerebral angiography

Results: Anterior cerebral artery aneurysms (ACA): The most frequent affected part of ACA was ACOM in 72 (48%) patients followed by A1-segment 50 (33.3%), and A2-segment 28 (18.6%). The size of aneurysms was small in 107 (71.33%) patients, medium in 41 (27.3%) cases and large in 2 (1.3%) cases.

Middle cerebral artery aneurysms (MCA): The most frequent affected segment of MCA was M1 in 84 (56%) patients followed by M1-segment 66 (44%). The size of aneurysms was small in 92(61.3%) patients, medium in 42(28%) cases, and large in 16 (10.6%) cases.

Posterior cerebral artery aneurysms (PCA): The highly affected segment of PCA was P1 in 25 (50%) patients followed by P1/P2-junction 12 (24%) then P2 segments was affected in 8(16%) patients and P3 in 5(10%) cases. The size of PCA aneurysms was small in 30 (60%) patients, medium in 12(24%) cases, and large in 8 (16%) cases.

According to the World Federation of Neurosurgical Societies Scale (WFNS) and modified ranking scale for preoperative and post-operative, 170 (48.5%) cases were with good grade and 161 (46%) patients with a moderate grade and 19 (5.4%) patients with a poor grade. Total 17 (4.8%) patients dead. Surgical clipping of

ACA, MCA, and PCA aneurysms was performed in 252 patients of age <60 years and in 98 patients of age ≥60 years. 7 people die of age <60 years and 10 people die of age ≥60 years with a greater rate of mortality.

Conclusion: Finally, we concluded that good surgical clipping results are achieved for ACA and MCA aneurysms with greater 40 % improvement followed by PCA aneurysms.

Keywords: Anterior cerebral artery aneurysms (ACA), Middle cerebral artery aneurysms (MCA), Posterior cerebral artery aneurysms (PCA)

INTRODUCTION

Intracranial aneurysms are well, known dilatation of intracranial vessels that raise aneurysms and as a result of ruptured aneurysms hemorrhage into the subarachnoid space of the brain. Mostly saccular and fusiform aneurysms of cerebral arteries occurred while saccular is the most common type of intracranial aneurysms and recurrent cause of hemorrhage.[2] Several decades ago, surgical clipping has been considered the only treatment of intracranial aneurysms.[1] However, surgical clipping is a standard treatment of aneurysms almost 2.3% to 8.2% [5] and a higher percentage of treated aneurysms using neurosurgical treatment was 42%.[4] Simply, aneurysms treatment aims to preserve the parent artery with safe occlusion of the dome.[3] Aneurysms of distal internal carotid arteries, anterior, middle, posterior cerebral arteries can be treated viably but these reports are few in numbers.[6-8] Aneurysms of anterior cerebral arteries specifically located in the anterior communicating artery have a higher risk of hemorrhage than the other intracranial locations.[9] A research reported that anterior communicating artery aneurysms constitute the 30% t0 70% of intracranial aneurysms.[10] In case of ruptured cerebral aneurysms 20% t0 30% middle cerebral artery (MCA) aneurysms indicated. Although treatment of MCA aneurysms is a challenge for practitioners because of complex MCA bifurcation and trifurcation, greater chances of intraparenchymal hemorrhage, and the existence of a wider neck. Therefore, endovascular treatment has certain limitations for MCA aneurysms.[11] An attempt of randomized trial used the endovascular technique for the treatment of minor lesions of ruptured cerebral aneurysms.[12] Duly, lack of clinical equity between the both (endovascular and microsurgical) the treatments. MCA aneurysms also have been associated with the frequent development of a large number of multiple intracranial aneurysms.[30]

Posterior cerebral artery (PCA) aneurysms are rarely found around about 2% of all aneurysms and exhibit a low incidence. Therefore, studies reported on PCA had a lower number of cases in which largest study of 125 cases reported by Goehre et al., 2016.[13] Whereas on the base of segment origin PCA aneurysms divided into five different groups such as P1 aneurysms (P1-segment), P2 aneurysms (P2-segment), the P1/P2-junction (P1/P2 junction), P3 aneurysms (P3-segment), and P4 aneurysms (P4-segment).[14] Therapy of PAC is also a challenge due to the lengthy intravasal course to the last segment of the posterior circulation, deep location, and delicate neuroanatomic structure. Moreover, similarity with midbrain perforation and greater chances of fusiform shape brought the more complication in treatment strategies of PAC aneurysms.[15]

In this study, we will discuss the surgical clipping and their clinical outcomes of anterior, middle, and posterior cerebral artery aneurysms.

METHOD

This study was conducted from 20 January 2019 to 20 January 2020. A total of 350 patients of aneurysms of age <60 years and ≥60 years were treated with surgical clipping. Of these, 150 cases were identified with anterior cerebral artery aneurysms, 150 with middle cerebral artery aneurysms, and 50 cases with posterior artery aneurysms.

The choice of treatment strategies were selected by a team of, neurologists and interventional neuro-radiologists, and neuro-surgeons. It was based on clinical assessment and initial computed tomography and conventional cerebral angiography. After obtaining the equal remarks on a treatment, surgical clipping of anterior, middle, and posterior was performed. All the treatment options were informed to patients. The patient and his family were free to choose therapy. Before proceeding with the treatment a consent was signed by the patient's families.

The record of each surgically treated patient was searched to gain the complete detailed characteristics of aneurysms (size, shape), follow-up, complications, and treatment. The classification of aneurysms was also determined through morphology (saccular and fusiform) and location such as anterior cerebral artery aneurysms (A1, ACOM, and A2), middle (M1, and M2,) and posterior cerebral artery aneurysms (P1, P1-P2, P2, and P3).

World Federation of Neurosurgical Societies Scale (WFNS) was used for clinical classification of patient's condition.[16] Modified Ranking Scale[17] was used to grade the clinical outcomes. The outpatient clinic includes all the un-ruptured cases that had got the full assessment and their treatment was established after the complete multidisciplinary counseling. Patients with ruptured aneurysms of grade 1-3 (WFNS) was treated within 72 hours. The treatment of ruptured aneurysms was put off because of minor symptoms and greater comorbidity and late referral chance. According to grade 3-5 (WFNS), patients with poor clinical conditions were preferably treated for acute hydrocephalus the final decision was made for aneurysms treatment.

Exclusion criteria: All patients diagnosed with aneurysms of the internal carotid artery, basilar artery, superior cerebellar artery, vertebral artery were not part of the study. All the patients who chose the other treatment like endovascular, wrapping, and coiling are excluded from the study.

Statistical analysis:

Univariate analysis was performed for different variables by using X_2 analysis to find the covariates that show the significant outcomes of patients. P-value less than 0.05 was deemed as the significant and statistical analysis was performed by using spss version 25.

RESULTS

The obtained results of 350 patients of aneurysms show that 322 patients was presented with un-ruptured aneurysms and 28 patients with ruptured aneurysms (Table: 1).

Anterior cerebral artery aneurysms (ACA): A total of 150 patients out of 350 was diagnosed with ACA aneurysms in which 146 was un-ruptured and 4 with rupture aneurysms (Table: 2).35 male patients were with ACA in which one male patient with ruptured saccular ACA aneurysms, 26 male with unruptured saccular aneurysms, and 8 patients with un-ruptured-fusiform. 115 female patients in which 2 with ruptured saccular ACA aneurysms, 76 with unruptured saccular aneurysms, 1 with ruptured fusiform, and 36 with un-ruptured fusiform aneurysms. The most frequent affected part of ACA was ACOM in 72 (48%) patients followed by A1-segment 50 (33.3%), and A2-segment 28 (18.6%). The size of aneurysms was small in 107 (71.33%) patients, medium in 41 (27.3%) cases and large in 2 (1.3%) cases.

Middle cerebral artery aneurysms (MCA): 150 cases represented in table.3 as middle cerebral artery aneurysms out of 350 cases. 35 males were with MCA in which two males with ruptured saccular MCA aneurysms, 26 male un-ruptured saccular aneurysms, 1 patient shows ruptured-fusiform and 6 cases of un-ruptured-fusiform. 115 female patients in which 1 case with ruptured saccular MCA aneurysms, 88 females with unruptured saccular aneurysms, 1 with ruptured fusiform, and 25 females with un-ruptured fusiform MCA aneurysms.

The most frequent affected segment of MCA was M1 in 84 (56%) patients followed by M1-segment 66 (44%). The size of aneurysms was small in 92(61.3%) patients, medium in 42(28%) cases and large in 16 (10.6%) cases.

Posterior cerebral artery aneurysms (PCA):

Table.4 represented the 50 cases of PCA aneurysms out of 350 cases. 5 (30%) males were with PCA in which 5 males with ruptured saccular PCA aneurysms, 5 males with unruptured saccular aneurysms, 2 patient shows ruptured fusiform, and 3 cases of unruptured-fusiform. 35 (70%) female patients in which 6 cases with ruptured saccular PCA aneurysms, 13 females with un-ruptured saccular aneurysms, 6 cases with ruptured fusiform, and 10 females with un-ruptured fusiform PCA aneurysms.

The highly affected segment of PCA was P1 in 25 (50%) patients followed by P1/P2-junction 12 (24%) then P2 segments was affected in 8(16%) patients and P3 in 5(10%) cases. The size of PCA aneurysms was small in 30 (60%) patients, medium in 12(24%) cases, and large in 8 (16%) cases.

Clinical outcomes:

In table.5 the overall outcome of surgical treatment for the modified ranking scale of preoperative and post-operative were given such as 170 (48.5%) cases were with good grade and 161 (46%) patients with a moderate grade and 19 (5.4%) patients with a poor grade. Total 17 (4.8%) patients dead. Surgical clipping of ACA, MCA, and PCA aneurysms was performed in 252 patients of age <60 years and in 98 patients of age ≥60 years. 7 people die of age <60 years and 10 people die of age ≥60 years with a greater rate of mortality.

In 4 ruptured cases of ACA aneurysms 3 were with good outcomes had p-value 0.02 and one patient died. In 146 un-ruptured cases 139 (39.7%) survived and 7 (2.0%) dead. Five cases of ruptured MCA aneurysms, 3 (0.8%) with good outcome and 2 (0.5%) could not survive. 145 cases of unruptured MCA aneurysms in which 142 (40%) with good output and 3 (0.8%) dead. 19 patients with ruptured PCA in which 17 (4.8%) survived and 2 (0.5) could not survive. 31 patients with un-ruptured PCA in which 29 (8.2%) patients improved and 2 (05%) patients dead. For all the cases measured p-value was less than 0.05. (Table.6)

Vessel	Un-ruptured aneurysms n=322	Ruptured aneurysms n=28
Anterior cerebral artery	146	4
Middle cerebral artery	145	5
Posterior cerebral artery	31	19

Table 1: Distribution of Aneurysms (n=350)

Variables	Ruptured saccular aneurysms n=3	Un-Ruptured saccular aneurysms n=102	Rupture fusiform Aneurysms n=1	Un-ruptured fusiform n=44	Percentage n=150(%)
Gender					
Males	1	26	------	8	35 (23.3)
Females	2	76	1	36	115 (76.6)
Location					
A1	1	39		10	50 (33.3)
A2	……	13		15	28 (18.6)
ACOM region	2	50	1	19	72 (48)
Diameter (mm)					
Small (<7 mm)	…..	67	1	39	107 (71.3)
Medium (7-14 mm)	3	34	…..	4	41 (27.3)
Large (15-24 mm)	……	1	…..	1	2 (1.3)

Table 2: Characteristics of 150 patients of anterior cerebral artery aneurysms.

Variables	Ruptured saccular aneurysms n=3	Un-Ruptured saccular aneurysms n=114	Rupture fusiform aneurysms n=2	Un-ruptured fusiform aneurysms n=31	Percentage N=150(%)
Gender					
Males	**2**	**26**	**1**	**6**	**35 (23.3)**
Females	**1**	**88**	**1**	**25**	**115 (76.6)**
Location					
M1	**1**	**69**	**1**	**13**	**84 (56)**
M2	**2**	**45**	**1**	**18**	**66(44)**
Diameter (mm)					
Small (<7 mm)	**2**	**69**	**1**	**20**	**92 (61.3)**
Medium (7-14 mm)	**1**	**33**	**1**	**7**	**42 (28)**
Large (15-24 mm)	**....**	**12**	**.....**	**4**	**16(10.6)**

Table 3: Characteristics of 150 patients of middle cerebral artery aneurysms.

Variables	Ruptured saccular aneurysms n=11	Un-Ruptured saccular aneurysms n=18	Rupture fusiform aneurysms n=8	Un-ruptured fusiform aneurysms n=13	Percentage n=50 (%)
Gender					
Males	**5**	**5**	**2**	**3**	**15 (30)**
Females	**6**	**13**	**6**	**10**	**35(70)**
Location					
P1	**4**	**9**	**5**	**7**	**25(50)**
P1/P2	**2**	**4**	**3**	**3**	**12(24)**
P2	**3**	**3**	**...**	**2**	**8(16)**
P3	**2**	**2**	**....**	**1**	**5(10)**
Diameter (mm)					
Small (<7 mm)	**6**	**11**	**5**	**8**	**30(60)**
Medium (7-14 mm)	**3**	**4**	**2**	**3**	**12(24)**
Large (15-24 mm)	**2**	**3**	**1**	**2**	**8 (16)**

Table 4: Characteristics of 50 patients of posterior cerebral artery aneurysms.

Total patients 350	mRS 0-1 (good)	mRS 2-4 (Moderate)	mRS 5-6 (poor)	Dead patients
Patients with Ruptured saccular ACA aneurysms n=3	1	1	1	0
Patients with Ruptured saccular MCA aneurysms n=3	1	2	0	0
Patients with Ruptured saccular PCA aneurysms n=11	7	3	1	1
Patients with Ruptured fusiform ACA aneurysms, n=1	0	0	1	1
Patients with Ruptured fusiform MCA aneurysms n=2	0	0	2	2
Patients with Ruptured fusiform PCA aneurysms n=8	3	4	1	1
Patients with un-Ruptured saccular ACA aneurysms n=102	50	46	6	6
Patients with un-Ruptured saccular MCA aneurysms n=114	65	49	0	0
Patients with un-Ruptured saccular PCA aneurysms, n=18	10	6	2	2
Patients with un-Ruptured fusiform ACA aneurysms, n=44	18	23	3	1
Patients with un-Ruptured fusiform MCA aneurysms, n=31	5	25	1	3
Patients with un-Ruptured fusiform PCA aneurysms, n=13	10	2	1	0
Total 350	170 (48.5%)	161 (46%)	19 (5.4%)	17 (4.8%)

Table 5: Surgical clipping of 350 patients outcomes.

mRS, modified ranking scale.

variables	Total n=350	improved n (%)	Dead n (%)	P-value
Age				
<60 years	**252**	**245 (70)**	**7 (2)**	**0.04**
≥60 years	**98**	**88 (25.14)**	**10 (2.8)**	**0.01**
Presentation				
Ruptured ACA	**4**	**3 (0.8)**	**1 (0.2)**	**0.02**
Un-ruptured ACA	**146**	**139 (39.7)**	**7 (2.0)**	**0.05**
Ruptured MCA	**5**	**3 (0.8)**	**2 (0.5)**	**0.03**
Un-ruptured MCA	**145**	**142 (40)**	**3 (0.8)**	**0.02**
Ruptured PCA	**19**	**17 (4.8)**	**2 (0.5)**	**0.01**
Un-ruptured PCA	**31**	**29 (8.2)**	**2(0.5)**	**0.02**

Table 6: Summary of patients treated with surgical clipping

DISCUSSION

Two studies demonstrated that the rate of ACA aneurysms including anterior communicating artery aneurysms has been raised un-ruptured than in the ruptured cases.[18,19] In this study 146 cases of un-ruptured ACA aneurysms on different locations were surgically clipped and un-ruptured cases have high percentage than the ruptured. One more study of long-term follow-up of 1 year for ACA aneurysms with small size reported significant improvement with surgical clipping.[20]

MCA aneurysms required special deliberation for open microsurgery as compared to endovascular. Most probably in ruptured cases need to study the varied treatment strategies. The random trial was reported with low representation of ruptured aneurysms.[25,26] Three more studies were reviewed for MCA aneurysms treatment and got the high score of surgical clipping rather than coiling and endovascular therapies.[27-29] In our study MCA aneurysms were found with 40% good results. Van et al, 2011[24] recommended surgical clipping as the main treatment strategy for MCA aneurysms. The database analysis of the study shows that 151 back-to-back treated patients of MCA aneurysms and consistently reviewed during the 6 years. Long-term follow up was measured for 74 patients out of 78 patients and obtained 80% positive response with ruptured MCA aneurysms.[24]

The fusiform shape was frequently observed in posterior cerebral arteries in 7 people out of 29 and perforated branches also emerged from the affected part that made the clipping more complex.[21] Generally, PCA aneurysms were found with multiple aneurysms and a greater percentage of fusiform while 36% affected

portion consists on P1-P2 junction. A higher percentage (60%) of vascular lesions and 22% of fusiform aneurysms.[22] In our study 8 cases have an association with ruptured PAC fusiform and 13 cases of un-ruptured PAC fusiform aneurysms. Another study of 121 patients was attempted that shows 39% ruptured PCA and 82% un-ruptured PCA aneurysms. Aneurysms were identified at different locations such as P1 in 53 patients, P1/P2 (n=38), P2 (n= 28), and P3 (14). 63 cases were treated with microsurgery and 19 were with endovascular treatment. Surgical treatment response the good outcomes than endovascular treatment.[23] We have studied all 350 cases for surgical clipping and got a good outcome.

CONCLUSION

In this study we concluded that good surgical clipping results are achieved for ACA and MCA aneurysms with greater 40 % improvement followed by PCA aneurysms.

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