Retrospective Analysis of Prognosis of Superiorly Projecting Anterior Communicating Artery Aneurysm with Respect to Position of A2 Anterior Cerebral Artery

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ABSTRACT

Introduction: Decision making regarding the surgical approach for ACOM artery is based on A1 dominancy, projection and how is the plane of the both A2 vessels. The present study was conducted with the aim to analyze the prognosis of superiorly projecting anterior communicating artery aneurysm with respect to position of A2 anterior cerebral artery.

Material and methods: The present retrospective analysis consisted of 543 cases of all cerebral aneurysms operated from Jan 2012 to December 2015 at Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Trivandrum. The open A2 plane was defined as when the A2 of the pterional approach side was present more posteriorly than the contralateral A2. All patients were evaluated through Glasgow outcome scale at the time of discharge. All the data obtained was arranged in a tabulated form and analyzed using SPSS software.

Results: The mean age of the subjects was 54.2 years. There were 63 males and 32 females. Among 95 patients, A1dominant was present in 83 patients and co-dominance was present in 12 cases. Out of 54 superiorly projecting aneurysms. Intraoperative rupture was present in the 18 patients (33.3%), Gyrus rectus aspiration was done in the 35 patients (64.9%), 1 patient had the perforator injury.

Conclusion: Surgical approach from the A2 posterior displacement side (the open A2 plane) in patients with superior projecting aneurysms allows neurosurgeon to secure aneurysm necks safely and prevent postoperative complications.

Keywords: Anterior Communicating Artery Aneurysm, Projections, Pterional Craniotomy, Approach.

INTRODUCTION

The detailed analysis of Anterior communicating complex shows that factors like A1 dominancy, anatomy of aneurysmal neck with A1 and A2 segment, perforators and presence of other vascular anomalies required to achieve precise clipping of the aneurysms.[1] The advances in the neuroimaging like magnetic resonance angiography (MRA), 3D CT angiography and 3D digital subtraction angiography demonstrate the detailed anatomy around the Anterior communicating complex before surgery.[2] Decision making regarding the surgical approach is based on A1 dominancy, projection and according to that projections how is the plane of the both A2 vessels. Yasargil[3]-studied the projection as a predominant anatomical factor. Inferiorly projecting aneurysms many a times adhere to the optic chiasm or nerve. The dissection of the arteries that comprising the Anterior communicating complex, recurrent arteries of heubner, and hypothalamic arteries from the neck of the aneurysm were all considered a source of complication. Furthermore, the premature rupture before complete dissection of the dominant A1 leads to bleeding. In these situations proximal control of same side of the A1 segment is the most important step, and thus the dominant A1 side is better for the approaching the aneurysm. However, there is no such specific approach for superiorly projecting Anterior communicating aneurysm. These type of aneurysms are buried in the interhemispheric fissure, and concealing the contralateral A1/A2 junction. These aneurysms partially embedded in the contralateral gyrus rectus. Thus, craniotomy on the side of A2 anterior displacement simplifies the securing of ipsilateral dominant A1. It is difficult to handle an aneurysm behind the ipsilateral A2, particularly when aneurysm adheres tightly to A2. So it is better to approach this type of aneurysm on the side of posterior displacement of A2 for visualizing the Anterior communicating complex. The present study was conducted with the aim to analyze the prognosis of superiorly projecting anterior communicating aneurysm with respect to position of A2 anterior cerebral artery.

MATERIAL AND METHODS

The present retrospective analysis consisted of 543 cases of all cerebral aneurysms operated from Jan 2012 to December 2015 at Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Trivandrum. Of these there were 168 patients had anterior communicating aneurysm. 22 cases were anterior communicating aneurysms with other associated aneurysms. This study was confined to the 95 of these cases, whose satisfactory diagnostic preoperative cerebral angiographic films were retrievable from the

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hospital data base system as it is mandatory for detailed review. Patient's demographics, angiographic features of aneurysms like size, projection, multiplicity, lobulations, dominance of circulations, plane of A2, and approach related complications. The open A2 plane was defined as when the A2 of the pterional approach side was present more posteriorly than the contralateral A2.The closed A2 plane was defined as being present when the ipsilateral A2 was located more anteriorly, because of this A1-A2 junction and A2 hide the aneurysmal neck. For SAH patients, we recorded condition at admission by WFNS scores, severity of hemorrhage by Fisher grade, and day of surgery relative to SAH onset. All patients were evaluated through Glasgow outcome scale at the time of discharge. All the data obtained was arranged in a tabulated form and analyzed using SPSS software.

RESULTS

The mean age of the subjects was 54.2 years. There were 63 males and 32 females.

Graph 1 elaborates the Operative results of the subjects.

		Side of approach				Total (N=95)		p
		Left (N=62)		Right (N=33)				
		N	%	N	%	N	%	
A1 Dominance	Left	55	88.7	2	6.1	57	60.0	<0.001
	Right	0	0.0	26	78.8	26	27.4	
	No dominance	7	11.3	5	15.2	12	12.6	
Projection	Superior	39	62.9	15	45.5	54	56.8	0.418
	Inferior	19	30.6	14	42.4	33	34.7	
	Anterior	3	4.8	3	9.1	6	6.3	
	Posterior	1	1.6	1	3	2	2.1	
A2 plane	Open	17	27.4	13	39.4	30	31.6	0.232
	Closed	45	72.6	20	60.6	65	68.4	

Table-1: Association between A1 dominance projection, A2 plane and side of approach.

Operative findings	N	%
IOR	18	33.3
Intra OP evidence of SAH	42	77.8
Gyrus rectus aspiration	35	64.8
Perforator injury	1	1.9
Temporary clipping	30	55.6

Table-2: Impact of superiorly projecting aneurysm and intra-operative complication

Outcome	N	%
death	4	7.4
Poor	2	3.7
Fair	10	18.5
Good	3	5.6
Excellent	35	64.8

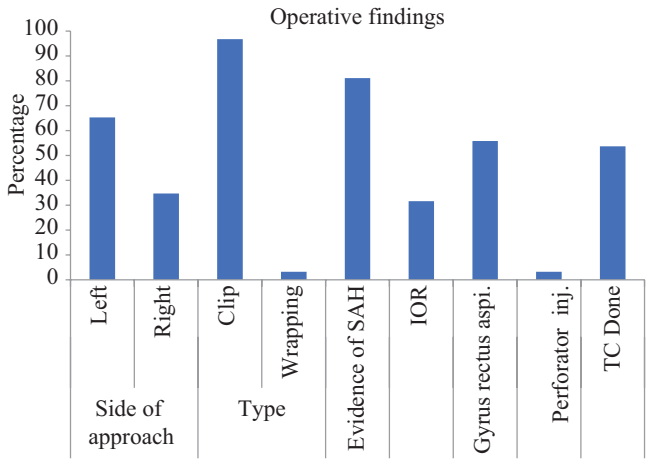
Table-3: Impact of superiorly projecting aneurysm and Out-come

	A2 plane				Total (N=54)		p
	Open (N=15)		Closed (N=39)				
	N	%	N	%	N	%	
IOR	5	33.3	13	33.3	18	33.3	1
Gyrus rectus aspiration	9	60	26	66.7	35	64.8	0.646
Perforator injury	0	0	1	2.6	1	1.9	0.531
Temporary clipping	8	53.3	22	56.4	30	55.6	0.839
Contusion	1	6.7	1	2.6	2	3.7	0.475
Infarction	5	33.3	11	28.2	16	29.6	0.712
Hematoma	2	13.3	5	12.8	7	13	0.96
CSF Diversion	0	0	1	2.6	1	1.9	0.531
DC compression	2	13.3	2	5.1	4	7.4	0.302

Table-4: Association between A2 plane and intraoperative and postoperative complication in superiorly projecting aneurysms.

	A2 plane				Total (N=54)		p
	Open (N=15)		Closed (N=39)				
GOS outcome	N	%	N	%	N	%	
death	2	13.3	2	5.1	4	7.4	0.505
Poor	1	6.7	1	2.6	2	3.7	
Fair	4	26.7	6	15.4	10	18.5	
Good	1	6.7	2	5.1	3	5.6	
Excellent	7	46.7	28	71.8	35	64.8	

Table-5: Association between A2 plane and outcome in superiorly projecting aneurysms



Graph-1: The Operative results of the subjects

Out of 95 patients, 92 Anterior communicating aneurysms were clipped and wrapping done in 3 patients. Intraoperative evidence of SAH was present in 77 patients (81.1%). Intraoperative ruptured of aneurysms during dissection was present in 30 patients (31.6%).Perforator injury was occurred in 3 patients(3.2%). Need for gyrus rectus aspiration in 53patients(55.8%). 51 patients(53.7%) underwent temporary clipping of dominant A1.The duration of temporary clipping of dominant A1was 1-20min(mean 6.9min).

Table 1 shows the association between A1 dominance projection, A2 plane and side of approach. Among 95 patients, A1dominant was present in 83 patients and co – dominance was present in 12 cases. Out of these left side A1dominance was present in 57 patient and right dominance in 26 patients. Out of 57 patients of left dominant- 55 patients had underwent from the left side and 2 had underwent from the right side. All 26 right dominance patients had underwent from the right side. The 2 cases which was underwent from the non-dominant circulation, both were anterio-inferiroly directing aneurysms.

Table 2 indicates the impact of superiorly projecting aneurysm and intraoperative complication. Out of 54 superiorly projecting aneurysms, intraoperative rupture was present in the 18 patients (33.3%), Gyrus rectus aspiration was done in the 35 patients (64.9%), 1 patient had the perforator injury. Temporary clipping applied in 30 cases.16 patients (29.6%) had infarction and 7 patients (13%) had postoperative hematoma. 2 patients (3.7%) had contusion.4 patients (7.4%) underwent to decompression due to postoperative infract and 1 patient underwent to CSF diversion due to hydrocephalus.

Table 3 indicates the impact of superiorly projecting aneurysm and Outcome. Among superior projecting aneurysms, there were 4 patient (7.4%) died.35 patients (64.8%) had excellent outcome.

Table 4 elaborates the association between A2 plane and intraoperative and postoperative complication in superiorly projecting aneurysms. Out of 54 superiorly projecting aneurysms, 15 cases had open A2 plane and 39 had closed A2plane at the operated side. 47 cases showed dominant circulation and 7 cases there were co-dominance. Out of these dominant circulation, 33 were present at the closed A2plane and 14 were present at the open A2 plane. In these closed A2 plane (n=39), IOR was present in 13 cases (33.3%), 1 case had perforator injury. Postoperative complication like infarction was present in 11 cases (28.2%), hematoma was present 5 cases (12.8%).1 case underwent CSF diversion and 2 cases underwent decompressive hemicraniectomy. In open A2 plane (n=15), IOR was present in 5 cases (33.3%), No cases had perforator injury. Postoperative infarction was present in 5 cases (33.3%), hematoma was present 2 cases (13.3%).2 cases underwent to decompressive hemicraniectomy. Thus, there were more surgical and postoperative complications in the cases of the closed A2plane at approached side. But in all parameters p value is not significant. The mean duration of the temporary clipping in open plane was 6.13min and 8.32min in closed plane. (p value=0.32)

Table 5 indicates the association between A2 plane and outcome in superiorly projecting aneurysms. Glasgow outcome scale at time of discharge of superiorly projecting aneurysm showed the 4 patient (7.4%) mortality.2 patients (5.1%) in closed A2plane and 2 patients (13.3%) in open A2 plane. Thus in our study there is no significant statistical difference in outcome between this two group.

DISCUSSION

The most important factors of microvascular surgery of Anterior communicating aneurysms is to conceptualize and to clarify the structure in 3D space, more often in superior and anterio-superiorly projecting aneurysm. In such projections the dome of aneurysm is intimately associated with A2segment and hiding the Acoma complex and adjacent to critical perforating arteries. One sided dominance can lead to development of Anterior communicating artery aneurysms. Cohen and Samson[4] reported that 57% of patients with Anterior communicating artery aneurysm had A1 dominance. Yasargill[3] found that 80% of patients with Anterior communicating artery aneurysms had A1dominance, and explains that an aneurysmal origin from the dominant A1, and also said that if the A1 supply is equal, the Anterior communicating artery aneurysm may originate from the middle of the Anterior communicating artery complex, suggests hemodynamic turbulence as predisposing factor. Lawton[5] reported 80% frequency of A1dominance and right sided approach was taken for symmetric A1 and in asymmetric A1, dominant A1was the criteria to approach the aneurysm. According to Hirotoshi Sano,[6] In the case of small- to large-sized aneurysms directed anteriorly the Al dominance should be the most important factor because it is sometimes difficult to secure the opposite side of Al. But there is no marked difference in surgical difficulty between the right and left approaches. S-J Hyun et al[7] found left A1 dominancy in 78.9% of patients with superior type compared to 51.5% reported previously. They selected right side approach in 36.8% and left side in 63.2%. Suzuki et al 20 said that the inferiorly projecting aneurysm were treated by A1 dominance and superiorly projecting aneurysm were treated by the A2 plane, they found A1dominance on right side 35.6% and left side 51.1% and no dominance on 13.3%

side of approach was selected according to A1dominance. Hernesniemi J et al[8] reviewed 921 cases of anterior communicating aneurysm and side selection for pterional approach was A1 dominnace. However, our study reported no statistical difference between right-sided and left-sided approaches. Moreover to avoid hazardous intraoperative rupture, care has been taken to identify which A1 side is dominant when selecting the approach.[9] Therefore, the A1 dominant side is the better Side.

Superior projections frequently associated with a dominant ipsilateral AI vessel, these lesions usually do not conceal the opposite optic nerve.[10] This project into the interhemispheric fissure and the contra lateral AI I A2 junction is concealed by the aneurysmal fundus. This is the most common direction of the projection of the aneurysmal fundus and may be partially embedded in contralateral gyrus rectus. These are generally more easily handled than aneurysms projecting in other positions. Gyrus rectus resection can be helpful to mobilize the fundus.[11] Hirotoshi Sano[6] suggests in the cases of aneurysms directed superiorly, the Al is bilaterally secured before approaching the aneurysm. Therefore, entry into the open part of the A2 fork (i.e., the side of A2 facing posteriorly) facilitates clipping. In the cases of aneurysms directed posteroinferiorly and back of neck, entry into the side of the A2 located more anteriorly is recommended. Suzuki et al[12] showed the higher requirements gyrus rectus aspiration, higher incidence of residual neck remnant in closed A2 plane ($p < 0.0001$) but no significant difference in associated vascular injury. There is significant difference in contusion was observed in patients with closed A2 plane. ($p<0.0092$). They consider the open A2 plane is distinct advantage in approaching the superiorly projecting Anterior communicating aneurysms. However, this study is limited by the inherent drawbacks of a retrospective analysis. Many of our patient's data were entered concurrently into computerized database, we also relied on operative and radiographic reports as well as other documentation. We were limited by incomplete information in some patients records. Only large prospective study can overcome these drawbacks.

CONCLUSION

Ruptured aneurysms need the proximal control, so approaching the Anterior communicating aneurysm from the side of dominance was selected. Surgical approach from the A2 posterior displacement side (the open A2 plane) in patients with superior projecting aneurysms allows neurosurgeon to secure aneurysm necks safely and prevent postoperative complications.

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