



ORIGINAL RESEARCH PAPER

Neurosurgery

THE OPERATIVE OUTCOME OF DISTAL ANTERIOR CEREBRAL ARTERY ANEURYSMS IN A HIGH VOLUME CENTER OF SOUTHERN INDIA.

KEY WORDS:

Bimal Kumar Sahoo*

Department of Neurosurgery ,Ashwini Hospital, Cuttack, Odisha, India.
*Corresponding Author

Mathew Abraham

Department of Neurosurgery Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Thiruvananthapuram, Kerala, India.

INTRODUCTION-

Distal anterior cerebral artery aneurysms (DACA aneurysms) are uncommon and constitute 2-6% of all aneurysms¹. DACA aneurysms resemble other intracranial aneurysms being saccular and flow related. Relative small size at the time of presentation, frequent association with other aneurysms and vascular anomalies makes the aneurysm unique. Again difficult location of the aneurysm deep in the anterior interhemispheric space needs meticulous microsurgical approach. Being fragile in nature they have a high tendency to rupture during exposure itself. They are associated with higher morbidity and mortality than predicted from the angiogram¹.

Most series reports fewer than 30 patients. Largest series consists of 501 patients has been reported by Lehecka et al. This study was based on all DACA aneurysms from two neurosurgical centres in Finland from 1980 to 2005¹. In India the data about DACA aneurysms are meagre. Two large studies in India are by Chhabra et al who studied 67 patients² and Shukla et al studied 132 patients³. In this study we have included 40 cases of DACA aneurysms in Department of Neurosurgery, SCTIMST operated over 10yrs. The different parameters studied were demographic distribution of the aneurysm, spectrum of presentations, associated aneurysms, vascular anomalies, aneurysm characteristics, surgical management and outcome.

MATERIAL AND METHODS-

We collected the patient details including clinical presentations, imaging, intra operative findings and post-operative events using electronic medical records and picture archiving and communication system. These data were then analysed and compared to the outcome using modified Rankin scale (mRS). The outcome was assessed at the time of discharge and at 6 months of follow up. For patients not turning up for follow up the discharge outcome was considered to be final. Modified Rankin scale 0-2 was taken as good outcome while mRS 3-6 was poor outcome.⁴

RESULTS-

In 10yrs of study period total 40 DACA aneurysms were operated. Patient details are described in Table 1. Female outnumbered male constituting 65% (n=26) of total number of patients and median age of presentation was 55yrs (ranged from 28 to 84yrs). At the time of presentation 55% (n=22) were with WFNS grade 1, 5% (n=2) were with WFNS grade 2, 25% (n=10) were with WFNS grade 3, 15% (n=6) were with WFNS grade 4. History of typical thunderclap headache was present in 87.5% (n=35) patients while history of loss of consciousness was present in 52.5% (n=21), seizure in 7.5% (n=3) and limb weakness in 30% (n=15) cases. Median duration of time since bleed to surgery was 7days (range 0-28days). Imaging showed in 15% per cent of patients (n=6) had Fischer grade 1, 17.5% (n=7) had Fischer grade 2, 37.5% (n=15) had Fischer grade 3 and 30% (n=12) patients had Fischer grade 4 sah. Right sided DACA aneurysm were found in 35% (n= 14) of cases, in 62.5% (n=25) cases it was left sided while in one case (2.5%) bilateral mirror aneurysms were

found. In our 40 patients total 43 DACA aneurysms were found. Out of which 51.16% (n=22) were at A2 segment, 46.52% (n=20) were at A3 segment and 2.32% (n=1) was found on A4 segment. No A5 segment aneurysm was found. Anomalous circulations were associated with 25% (n=10) of DACA aneurysms. This study had 17.5% (n=7) patients with bilobed aneurysms while 20% (n=8) cases had multilobed aneurysms (≥3) rest (62.5%, n= 25) had non lobulated aneurysms(Figure-2). Thirty five per cent (n=14) patients had multiple aneurysms. In our study 71.8% (n=28) patients had small (<7mm) DACA aneurysms, with maximum dome diameter less than 7mm while 28.2% (n=11) patients it was ≥7mm. In 1 patient data was not available. All DACA aneurysms were clipped using microsurgical technique, additional muscle wrapping was done in 10% (n=4) cases. Intra operative rupture of aneurysm occurred in 12.5% (n=5) case and intra operative temporary clipping was needed in 52.5% (n=21) cases. Symptomatic post-operative vasospasm occurred in 22.5% (n=9) cases. Post-operative infarct was found in 18% (n=8) cases. Operative site haematoma occurred in 12.5% (n=5) cases. Post-operative csf diversion was needed in only 1(2.5%) patient. One patient (n=2.5%) died due to pulmonary embolism. Median number of hospital stay post-surgery was 10.0 days (ranged from 6-78 days). Final outcome (included the condition at 6 month follow up and discharge mRS score for patient who didn't come for follow up) was good in 77.5% (n=31) of cases.

Table-1. Characteristics Of Patients Under Study

Age in years median(range)	55(28-84)
Gender: Ratio male to female	1:1.86
Presentations	
Headache	87.5%(n=35)
Loss of consciousness	52.5%(n=21)
Limb weakness	30%(n=12)
Seizures	7.5%(n=3)
Median duration since bleed to surgery in days(Range)	7days(0-28 days)
WFNS Grade	
Grade I	55%(n=22)
Grade II	5% (n=2)
Grade III	25% (n=10)
Grade IV	15%(n=6)
Fisher Grade	
Grade I	15%(n=6)
Grade II	17.5%(n=7)
Grade III	37.5%(n=15)
Grade IV	30%(n=12)
Side of aneurysms	
Right	35%(n=14)
Left	62.5%(n=25)
Bilateral	2.5%(n=1)
Lobularity of aneurysms	
Non lobulated	62.5%(n=25)
Bilobed	17.5%(n=7)
Multilobed	20%(n=8)
Size of aneurysms	
<7mm	70%(n=28)
>7mm	30%(n=12)

Treatment provided	
Clipping	100%(n=40)
Additional wrapping	10%(n=4)
Intra operative rupture	12.5%(n=5)
Temporary clipping	52.5%(n=21)
Vasospasm	22.5%(n=9)
Post operative hospital stay in days	10 (6-78)
Final good outcome	77.5%(n=31)

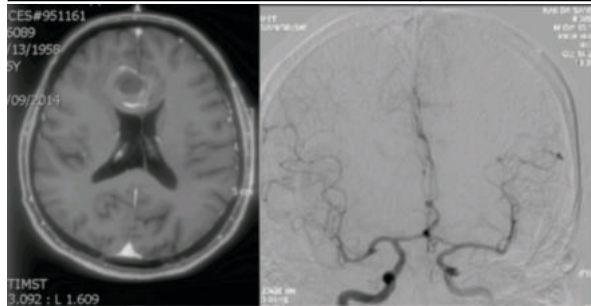


Fig. 1A **Fig. 1B**
Figure-1(A)A case of giant DACA aneurysm with intramural thrombus
 (B)Four vessel angiogram of the above mentioned patient not showing the full aneurysm due to presence of thrombus

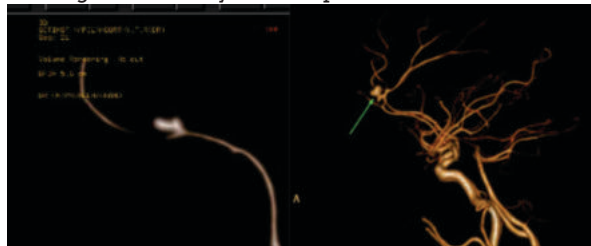


Fig. 2A **Fig. 2B**
Figure-2(A)A case of bilobed DACA aneurysm
 (B)A case of multilobed DACA aneurysm

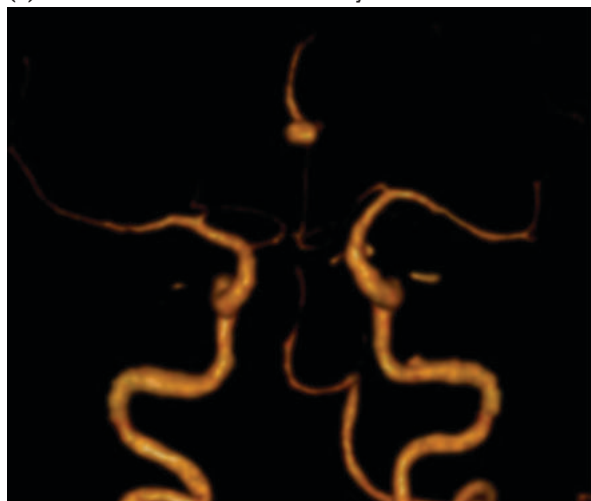


Figure-3 A case of DACA aneurysm showing its origin from the azygous ACA

DISCUSSION-

DACA aneurysms are relatively rare when compared to incidence of other intra cranial aneurysms. Female sex has always been considered to be a risk factor for intracranial aneurysms. Study shows risk of rupture increases in post-menopausal age group probably due to absence of the protective sex steroids⁵. In our study female outnumbered male but we found no significant correlation (p=0.168) between female gender and outcome. Many studies show poor outcome in female patients⁵. Lehecka et al found similar results with female preponderance without any significant correlation with the outcome¹.

DACA aneurysm presents more commonly in 5th to 6th decade of life. Median age of presentation in our study was 55yrs (range 28-84yrs). With increased age there was increased association with other comorbidities. Age as per had no significant association with poor outcome but presence of diabetes mellitus and/or hypertension significantly increased the risk of poor outcome (p≤0.05).

Typical thunderclap headache due to sah is the most common presenting feature of DACA aneurysm. Spectrum of other presentations varies from lower limb weakness, seizures, behavioural changes, cognitive deficit to akinetic mutism due to mass effect on frontal lobe and cingulate gyrus. In our series 87.5% (n=35) patients presented with thunder clap headache. Lower limb weakness was found in 30% (n=12) of patients during admission.

Preoperative clinical grade has been considered as strong predictor of overall outcome. Various studies have associated poor condition at the time of admission with poorer outcome of surgical treatment⁷⁸. Our study also replicated similar results with higher the WFNS grade higher was the morbidity (p=0.01).

Fischer grade and recently modified Fischer grade are best system to assess the severity of aneurysmal bleed on the basis of CT scan. We didn't find a significant relation between the Fischer grade and outcome. Lehecka et al showed favourable outcome in 45% versus 93% in patients with and without ICH or IVH respectively¹. Higher the Fischer grade higher is the risk of vasospasm and poorer outcome.

Presence of hydrocephalus can be seen in one fifth of patients with sah early in the course (acute≤3days, sub acute 4-14 days) while 10-15% cases hydrocephalous can be seen later on⁹. Twenty per cent (n=8) of our patients had hydrocephalous but only in 1 patient hydrocephalus was severe enough to need csf diversion. Studies have correlated hydrocephalous with unfavourable outcome¹.

In our 40 patients total 43 DACA aneurysms were found. Out of which 97.7% (n=42) were found over A2 or A3 segments and 2.32% (n=1) was found on A4 segment. No A5 segment aneurysm was found. Two patients had tandem double DACA aneurysms while one patient had A3 segment mirror aneurysms. Aneurysms were bilobed in 17.5 % (n=7) patients while multilobed in 20% in cases (n=8). Left sided aneurysms tend to be associated with more morbidity and mortality but in DACA aneurysms results may not be similar. DACA aneurysm bleed are more cortical as compared to other aneurysms where bleed is more centrally located and also inter hemispheric bleed may exert equivalent pressure on both sides.

Lobularity of DACA aneurysms has not been well described in literature, but lobular aneurysms may need extra precaution during clipping. Literature about the DACA aneurysm morphological characteristics is meagre. Our study didn't show any significant correlation between lobularity, side and segment of origin with outcome. As well studied in literature DACA aneurysms are notorious to bleed at a very small size^{2,7,10,11}. Aneurysms which arises from distal ACA experiences more wall tension when compared to aneurysms from other larger arteries as explained by Laplace law¹². Bleeding occurs irrespective of size because of lack of arachnoid membranes at the level of pericallosal cisterns¹¹. In our study 71.8 % (n=28) patients had aneurysms with maximum dome diameter less than 7mm while 28.2 % (n=11) patients it was ≥7mm. In 1 patient data was not available. There was no significant correlation between dome diameters with the outcome.

Giant DACA aneurysms (> 25mm in diameter) are extremely rare as DACA aneurysms have a high tendency for early

rupture. Gelfenbeyn et al reported 26 cases of giant DACA aneurysms¹³. Kawashima et al reported 7 cases of giant DACA aneurysm¹⁴. Clipping may be difficult in many cases because of large neck diameter associated thrombus and may need a bypass. In our study we found a single case of giant DACA aneurysm with a maximum dome diameter of 35mm (Figure-1). The patient presented with left frontal lobe infarct and opposite side lower limb weakness. Favourable neck allowed successful microsurgical clipping and didn't need a bypass.

Anomalous circulations are commonly seen to be associated with DACA aneurysms. Different anomalies of ACA have been seen in 7-35% of patients. Presence of azygous anterior cerebral artery aneurysm(ACA) is found in 3-22% case while bihemispheric ACA in 0.2-12% patients of DACA aneurysm and triplication of ACA in 3-13% cases¹⁵. Associated anomalous circulation was found in 25 % (n=10) of our patients. Azygous ACA was found in 2(5%) patients (Figure-3), one patient had ipsilateral hypo plastic A1. Other anomalies were fetal PCA, vertebral artery anomaly. We didn't find any case of bihemispheric ACA. Multiple aneurysms have been found in 25-55% of patients with DACA aneurysm as compared to 28-35% in other aneurysms¹⁶. There were 35 % (n=14) cases with multiple aneurysms in our study but it didn't have any significant impact on the outcome.

Median time since bleed to surgery in our patients was 7 days (ranged from day 0 to day 27). We didn't find a significant correlation between time since bleed and surgical outcome. Adequate sized craniotomy, minimum brain retraction, csf drainage, judged temporary clipping, early proximal control and sharp dissection are crucial for aneurysm surgery. We used precoronal parasagittal craniotomy for isolated DACA aneurysms while large pterional craniotomy crossing the sagittal plane was used for patients with other anterior circulation aneurysms. Interhemispheric approach was used for approaching all DACA aneurysms.

In our group 12.5% (n=5) patients had intraoperative rupture of aneurysm but this didn't affect the outcome. Literature suggests the relation between the intraoperative rupture to outcome depends on the stage at which the aneurysm ruptures. If an aneurysm ruptures before achievement of proximal control or very early during brain retraction it is definitively associated with poor outcome¹⁷. It is also studied that blunt dissection leading to rupture is associated with unfavourable outcome as compared to sharp dissection¹⁸. In our patients two patients had controlled rupture while others had ruptured during fundus dissection.

Temporary clipping is an important tool for adequate dissection of an aneurysm, for delineating anatomy and in adverse situations like intra op rupture. Temporary clipping transiently compromises blood circulation to brain parenchyma. Literature suggests elective temporary clipping reduces the risk of intra op rupture and overall decreases the need for prolonged temporary clipping. When intermittently applied the duration can safely be extended up to 20 minutes¹⁹. In our study 52.5% patients needed temporary clipping with a median duration of 3mins 40secs (range 1min to 28mins). No significant relation was found between the temporary clipping and the outcome.

Post-operative vasospasm and infarct were an important deciding factor for poor outcome in our study (p<0.05). Vasospasm not only deteriorates the patient neurologically but prolongs the ICU stay which further increases the morbidity. In our study, 22.5 % (n=9) patients developed vasospasm which was documented with transcranial Doppler, 4 vessel angiogram or clinical deterioration which improved with triple H therapy. Both patients in our study with azygous ACA with DACA aneurysm had severe vasospasm and later developed delayed ischemic deficit. In our study 20% patients (n=8) had post op infarct.

Dorsh et al showed an incidence of 32.5% of symptomatic vasospasm in post op intracranial aneurysms with 10% mortality due to vasospasm²⁰ while Shukla et al reported 27.3% incidence of vasospasm in DACA aneurysm³. Both vasospasm and delayed ischemic deficit were counter productive for good outcome in our study (p≤0.05).

At the time of discharge disabling motor deficit was found in 35% (n=14) cases which included persistent pre op cases with motor deficit (n=4). Most of the patients showed gradual improvement on follow up. In 12.5 % (n=5) patients re-surgery was needed. Three patients were re-explored for haematoma while rest two needed surgery for post op infarct with malignant brain edema.

Comparison With Other Series

Lehecka et al in his largest case series of 501 patients reported a favourable outcome (Glasgow outcome scale≥4) in 74% of patients and mortality in 13% of cases. He correlated the poor outcome of DACA aneurysm surgery to the advanced age, pre-operative Hunt and Hess grade≥III, rebleeding before surgery, intraventricular, intracerebral hematoma and severe pre-operative hydrocephalus¹. De Sousa et al found 87.5% favourable outcome and 6.94% mortality. He related the multiple intracranial aneurysms operated in one stage to be the reason for the poor outcome²¹.

In India data about DACA aneurysms are meagre. A study conducted by Chhabra et al over 67 DACA aneurysms showed a favourable outcome only in 57.1% cases and mortality rate as high as 28.6%. In this study outcome was influenced by pre-operative clinical grade, presence of multiple aneurysms and presence of post-operative infarct². Shukla et al found the favourable outcome in 87.5% cases with an in hospital mortality rate of 4.5%³.

In our study we found a favourable outcome (mRS ≤2) in 70% of cases at the time of discharge while final follow up outcome improved to 77.5%. One (2.5%) mortality in case of azygous ACA aneurysm that developed delayed bilateral frontal infarct and hospital course was further complicated by pulmonary embolism, deranged liver function and uncontrolled blood sugar. We found preoperative clinical grade, associated comorbidities, post op vasospasm and infarct significantly affecting the outcome. In our study presence of multiple aneurysms didn't affect the outcome although all cases with multiple aneurysms except one were operated in one stage.

Limitations

The main limitation our study was the retrospective nature and relatively smaller sample size. The low incidence of DACA aneurysms makes it difficult to get adequate sample size from a single centre.

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