Clinical Characteristics and Outcome of Patients with Distal Anterior Cerebral Artery Aneurysms

Sandeep Bohara,[1] Amit Bahadur Pradhanang,[1] Gopal Sedain,[1] Mohan Raj Sharma[1]

[1]Department of Neurosurgery, Tribhuvan University Teaching Hospital.

ABSTRACT

Background: Distal anterior cerebral artery aneurysms account for 3% to 7% of intracranial aneurysms. They have increased risk of premature rupture during surgery and tend to have a higher morbidity. We aim to determine the clinical characteristics, management strategies and outcomes of patients with these aneurysms who underwent microsurgical clipping at a major university hospital in Nepal.

Methods: This is a retrospective study of patients with distal anterior cerebral artery aneurysms who underwent microsurgical clipping between 2012-2022. Demographic data and clinical-radiological factors like Hunt and Hess grade, aneurysm location, and modified Rankin scale score at three, six, and 12 months were collected.

Results: A total of 26 aneurysms were microsurgically clipped in 20 patients in ten years. Most patients presented with Hunt and Hess grade II. Of the 26 aneurysms, 16 (62%) were in A3 segment. Six patients had associated anterior communicating artery aneurysm, two patients had middle cerebral artery aneurysm and two patients had associated arteriovenous malformation. Sixteen patients (80%) had a favorable outcome (modified Rankin scale ≤2) at 12 months follow-up.

Conclusions: Aneurysms in the distal anterior cerebral artery locations are a challenging subset of aneurysms to treat. The majority of the patients had aneurysms in A3 segment and 80% patients had a favourable outcome at 12 months follow up period.

Keywords: Aneurysm; distal anterior cerebral artery; outcome; subarachnoid haemorrhage.

INTRODUCTION

Distal anterior cerebral arterial (DACA) aneurysms account for 3-7% of all intracranial aneurysms. [1,2] According to Fischer, the ACA is divided into 5 segments: A1-A5. The majority of the DACA aneurysms arise in the A3 segment and 67% are less than five mm in diameter. [3,4] These aneurysms are frequently associated with parenchymal hemorrhage, often co-exist with other aneurysms, and have an increased chance of intraoperative rupture posing a technical challenge during surgery. [5,6]

There are few published studies on the characteristics and outcomes of patients with DACA aneurysms from the South Asian region. [7-9] To date, none have been published from Nepal, exclusively looking at the cohort of patients with DACA aneurysms based on Pubmed, Google scholar and Nepjol search. The aim of this study is to describe the clinical characteristics, management strategy and outcomes of patients with DACA aneurysms who underwent microsurgical clipping at our center.

METHODS

This is a retrospective study with a prospectively collected database of all patients who underwent microsurgical clipping of DACA aneurysms by two neurosurgeons between August 2012 to July 2022. Ethical approval was taken from the institutional review committee of our institute. Patients who underwent endovascular treatment of DACA aneurysms were excluded from the study.

The diagnosis of subarachnoid hemorrhage (SAH) was based on positive findings on admission Computed Tomography (CT) scan head. Aneurysm was confirmed by Digital Subtraction Angiography (DSA) or Computerized

Correspondence: Dr Sandeep Bohara, Department of Neurosurgery, Tribhuvan University Teaching Hospital. Email: sandeepbohara@gmail.com Phone: +9779841221577.

Tomographic Angiography (CTA). The patients were admitted to Intensive Care Unit (ICU) or high-care ward as per the condition of the patient. The patients were optimized before surgery. All patients who presented in good grades (Hunt and Hess I-III) were offered early surgery (≤3 days) and those in high grades (Hunt and Hess IV-V) or with significant co-morbidities underwent delayed surgery (>3 days). Post-operative management included carefully titrated blood pressure, euvolemia, and regular monitoring of vasospasm. The patients underwent CTA or DSA before discharge from the hospital to confirm the obliteration of the aneurysm.

Demographic data in terms of age, sex, ictal day to presentation, and ictal day to surgery were collected. Similarly, clinicoradiological factors such as Hunt and Hess grade at presentation, morphometric characteristics of the aneurysm, intraoperative events, and postoperative complications were collected. The outcomes of the patients were measured with modified Rankin scale (mRS) at three, six, and 12 months. The favorable outcome was defined as an mRS score of 0-2.

The data was analyzed in IBM SPSS version 24. Continuous variables were summarized using means and categorical variables were expressed as counts and percentages.

RESULTS

A total of 20 patients with 26 DACA aneurysms were included in the study (Table 1). The mean age of the study population was 55.8 (±10.6) years with a range of 22-71 years. There was a stronger female sex predilection with a male-to-female ratio of 1:4.

Table 1. Characteristics of patients included in the study. (n=20)

S. No.	Age (years)	Sex	Ictus to presentation (days)	Ictus to surgery (days)	Hunt and Hess grade at presentation	Part of DACA involved	Associated lesions	mRS at 3 months	mRS at 6 months	mRSat 12 months
1	45	Male	4	24	IV	A2	AVM	4	3	3
2	56	Female	3	15	I	A3	None	0	0	0
3	22	Female	3	7	II	A3	MCA aneurysm, PCoMA aneurysm	3	3	2
4	56	Female	3	15	III	A3, A2	None	2	1	1
5	54	Female	6	14	II	A2	None	0	0	0
6	56	Female	3	15	I	A3, A2	None	1	0	0
7	56	Female	3	15	II	A3, A2	None	1	0	0
8	50	Female	1	26	III	A2	ACoMA aneurysm	4	4	4
9	56	Female	1	21	IV	A2, A3	ACoMA aneurysm	4	3	3
10	56	Male	3	15	III	A3	None	2	1	1
11	56	Female	3	15	II	A3	None	1	1	0
12	56	Female	3	15	II	A3	None	0	0	0
13	63	Female	2	5	IV	A2, A3	ACoMA aneurysm	4	3	3
14	70	Male	3	15	II	A2, A3	ACoMA aneurysm	2	2	1
15	56	Female	3	15	I	A3	None	0	0	0
16	71	Male	3	15	II	A3	ACoMA aneurysm	1	0	0
17	56	Female	3	15	II	A3	None	0	0	0
18	71	Female	2	11	II	A2	ACoMA aneurysm	1	1	0
19	48	Female	3	14	II	A3	AVM	2	1	1
20	63	Female	6	16	II	A3	MCA aneurysm	1	0	0

Abbreviations: DACA= Distal Anterior Cerebral Artery, mRS= Modified Rankin Scale, AVM= Arteriovenous Malformation, MCA= Middle Cerebral Artery, PCoMA= Posterior Communicating Artery, ACoMA= Anterior Communicating Artery, A2= 2nd segment of anterior cerebral artery, A3= 3rd segment of anterior cerebral artery

The majority of the patients (55%) presented to us with Hunt and Hess grade of II (Figure 1). Seventeen patients (85%) presented within three days of ictus and the remaining three patients (15%) presented between four and 10 days of

ictus. However, 18 patients (90%) were operated after 10 days of ictus.

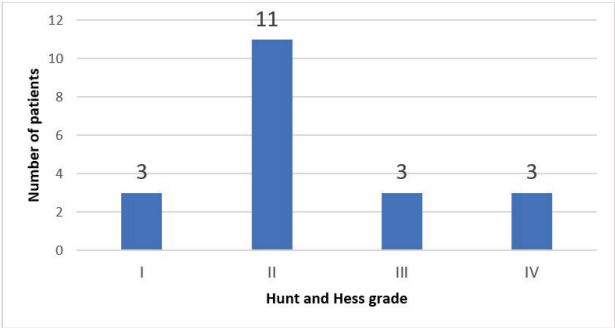

Figure 1. Hunt and Hess grades of the patients at presentation.

Of the total population, nine patients (45%) had single aneurysm, seven patients (35%) had two aneurysms and four patients (20%) had three aneurysms. The type of aneurysm and the number of patients are listed in Table 2. The angiogram of the patients did not show any anomaly of ACA in our series.

Table 2. Distribution of patients according to the multiplicity of aneurysms and association with arteriovenous malformation.

Type of aneurysm	Number of patients
1 aneurysm	
DACA	7
DACA, AVM	2
2 aneurysms	
DACA, DACA	3
DACA, ACoMA	3
DACA, MCA	1
3 aneurysms	
DACA, MCA, PCoMA	1
DACA, DACA, ACoMA	3
Total	20

Abbreviations: AVM = arteriovenous malformation, DACA= distal anterior cerebral artery, ACoMA= anterior communicating artery, PCoMA= posterior communicating artery, MCA= middle cerebral artery

Of 26 DACA aneurysms, 16 (62%) were in the A3 segment and 10 (38%) were in the A2 segment of the anterior cerebral artery.

One patient had an unruptured DACA aneurysm. Two patients with a single aneurysm had an associated arteriovenous malformation (AVM). Two patients presented with a lobar hematoma.

Eight patients underwent DSA, seven CTA, and five required both CTA and DSA for better confirmation of the aneurysm. The subfrontal approach was utilized in thirteen patients (65%) whereas four (20%) underwent anterior interhemispheric approach and three (15%) had combined subfrontal and anterior interhemispheric approach for tackling the aneurysm.

None of the patients included in the study had intraoperative aneurysm rupture. Temporary clipping was utilized in two patients before definite clipping for one minute 48 seconds and three minutes 20 seconds.

Postoperative complications were noted in four patients (20%). Temporary cognitive decline, pneumonia, motor weakness, and surgical site infection were seen in each patient.

The outcome of individual patients is depicted in Tables 1 and 3. A favorable outcome was achieved in 16 patients (80%) in one year. There was no mortality in our study.

Table 3. Outcome of the patients at different periods.

	Number of patients		
Outcome	**3 months**	**6 months**	**12 months**
Favourable (mRS 0-2)	15 (75%)	15 (75%)	16 (80%)
Unfavourable (mRS 3-6)	5 (25%)	5 (25%)	4 (20%)

Abbreviations: mRS= Modified Rankin Scale

DISCUSSION

Aneurysms in the DACA location are infrequent, comprising approximately six percent of all intracranial aneurysms.[2,10-12] The unique features of DACA aneurysms are their frequent coexistence with other aneurysms, association with intracerebral hemorrhages, and technical challenges during surgery. The reported incidence of multiplicity in DACA aneurysms 25-55%,[2,3-5,10] In previous publication on multiple intracranial aneurysms, 6 out of 26 (23.1%) patients had a DACA aneurysm as part of multiple aneurysms.[13] Multiple aneurysms were seen in our study such as MCA (10%), PCoMA (5%), and ACoMA (30%) aneurysms. DACA aneurysms are also often associated with various anomalies of the ACA.[3,12,15,16] These anomalies

most likely result into increased blood flow and stress on the arterial wall leading to aneurysm formation.[17,18] However, no anomalies of the ACA were seen in our study. Also, DACA aneurysms occasionally co-exist with cerebral arteriovenous malformations (AVMs) (0-15%).[2,3,15,16] We encountered two patients with associated AVM in our study.

The demographic characteristics of our study population were similar to those observed in other series with a peak age in the 50s and a strong female predilection. [1,3] The majority of the patients presented with headache. All but one patient presented with a rupture. 55% of the patients were in Hunt and Hess grade II which is slightly higher than those reported by Proust et al, (37.1%) [1] and Monroy-Sosa et al (32.4%).[19] This higher number of patients in good grade is probably due to those in poor grades not making to the hospital. [20,21]

The majority of the aneurysms were in the A3 segment of ACA (62%) followed by the A2 segment (38%) in our study. The largest series on DACA aneurysms published to date by Lehecka et al showed 80% of the aneurysms in the A3 segment of ACA. [3] Istemen et al also reported A3 segment of ACA involved in 90% of the aneurysms in their study. [22] Double DACA aneurysms are very rare in literature and are reported in 7% of patients.[23-27] Six patients (30%) in our series had double DACA aneurysms. This may be due to a small sample size.

65% of our patients underwent a subfrontal approach. Shukla et al in the Indian population used three approaches: frontotemporal, combined subfrontal and interhemispheric, and interhemispheric with the majority (48.5%) undergoing combined subfrontal and interhemispheric approach. [27] Lehecka et al in their series used the anterior interhemispheric route for the majority of their patients. [3] Yasser in his study of 15 patients in the Middle Eastern population, used a unilateral interhemispheric approach in 14 (93%) patients while a pterional approach was used in only one (7%) patient.[28]

The majority of the patients in our study had favorable outcomes (mRS score 0-2) at three, six, and 12 months (75%, 75%, and 80% respectively). This is similar to the study from India, which showed 74.8% favorable outcome.[27] Istemen et al had a favorable outcome in 85% of patients in their study at the time of discharge.[22]

Our study is a retrospective study with a small sample size. Hence, the results may not be generalized.

CONCLUSIONS

Aneurysms in the distal ACA, though uncommon, are a challenging subset of aneurysms to treat. The majority of the patients in our study presented with Hunt and Hess grade II and most of the patients had A3 segment aneurysm. About 80% of the patients had favouable outcome at 12 months follow up period.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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