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Technical Notes & Surgical Techniques

Endovascular treatment of ruptured and unruptured intracranial dissecting aneurysms

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ABSTRACT

Objectives: Dissecting aneurysms are rare as contrasted with their saccular counterparts, yet they stay hard to treat and are related with high rates of rebleeding and morbidity.

Material & methods: In this study, we have reviewed dissecting aneurysms of both anterior and posterior circulation, both ruptured and unruptured, including natural history, endovascular treatment and clinical outcome. They account for 3–7% of cases of nontraumatic subarachnoid hemorrhage. Surgical treatment carries a significant risk of neurological complications predominantly lower cranial nerve deficits because of the close relationship of the posterior circulation aneurysm with the brain stem and cranial nerves.

Results: A total of 28 ruptured and unruptured dissecting aneurysms in both anterior and posterior circulation were treated endovascularly from January 2015 till October 2018. Out of 28, 23 of the aneurysms were in posterior circulation and 5 were in anterior circulation. All the cases were technically successful except in 1 case. Procedure related complications were seen in 9 patients which were transient except in one patient who died. Follow up studies showed stable and complete occlusion of aneurysms in all patients except in 1 case in which recanalization was seen.

Conclusion: Dissecting aneurysms are dynamic lesions with variable and unpredictable evolution and a through treatment is warranted. Endovascular treatment by coiling and parent artery occlusion is relatively safe and effective treatment of dissecting intracranial aneurysms.

1. Introduction

Dissecting aneurysm or arterial dissection has been known to happen in both the intracranial segment of the carotid circulation and vertebrobasilar circulation. [1]

As per the literature the hemorrhagic presentation happens in 20% of internal carotid artery dissections and half of vertebral artery dissections. In the initial 24 h the rate of rebreeding is more than 40%. The absence of an internal elastic membrane and thinned muscular layer and SAH. Subarachnoid hemorrhage happens when the dissecting lesion is between the media and either the adventitia or the transmural. [2] Due to pseudo aneurysm nature of dissecting aneurysms, direct microsurgical clipping is not possible most of the times. With the availability of endovascular treatments and the advantage of intra procedural anticoagulation, endovascular treatment has become the primary treatment modality for dissecting aneurysms [2].

In this study, we have retrospectively analysed, a consecutive series of 28 patients harbouring dissecting aneurysms of both anterior and posterior circulation allocated for endovascular treatment and long term clinical follow up.

2. Materials & methods

This retrospective study was conducted at our institution between January 2015 to October 2018.We collected data from interventional neuroradiology database of patients referred for evaluation and treatment of both ruptured and unruptured dissecting aneurysms.

Twenty-eight patients (10 males, 18 females) ranging in age from 12 years to 60 years, mean 36 were included. 25 cases presented with SAH. Three patients presented with compressive symptoms. One patient had Takayasu Arteritis.

All patients underwent catheter angiography prior deciding for endovascular treatment. In two cases dissecting aneurysms were spontaneously thrombosed with vessel occlusion evidenced on catheter

Abbreviations: SAH, Subarachnoid hemorrhage; PCA, Posterior Communicating Artery; BOT, Balloon Occlusion Test; ICA, Internal Carotid Artery; VA, Vertebral Artery; MR, Magnetic Resonant; MRA, Magnetic Resonant Angiography; GCS, Glasgow Coma Scale; DSA, Digital Subtraction Angiography; MCA, Middle Cerebral Artery; PVO, Parent Vessel Occlusion

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Table 1
Characteristics of dissecting aneurysms.

No	Age/Sex	Location	Ruptured/ Unruptured	Treatment	Immediate angiogram	Complication	Follow up	Long term clinical outcome mRS
1	50/F	MCA(M2-M3)	Ruptured twice	coiling	partial coiling [2]	rebleed after 2 months	MRA after 6 months/ Unremarkable	mRS 0
2	45/F	PCA (P2-P3)	Unruptured	Spontaneously thrombosed	thrombosed aneurysm with vessel occlusion	nil	MRA after 6 months/ Unremarkable	mRS 0
3	50/F	PICA (Origin)	Ruptured	Spontaneously thrombosed	Thromosed aneurysm with vessel occlusion	None	MRA after 6 months/ Unremarkable	mRS 0
4	58/F	PCA (P2-P3)	Ruptured	Coiling	Total occlusion [1]	no	MRA after 6 months/ Unremarkable	mRS 1
5	15/F	ICA (Cavernous Segment)	Unruptured	Flow reconstruction with partial coiling	Total occlusion [1]	III nerve Palsy	DSA after 6 months/Unremarkable	mRS 0
6	50Y/M	VB Junction	Ruptured	Coiling	Total occlusion [1]	No	MRA after 6 months/ Unremarkable	mRS 0
7	41Y/M	PCA (P2-P3)	Ruptured	Coiling	Bled intraoperatively/total occlusion 1	Slight visual blurring	MRA after 6 months/ Unremarkable	mRS 1
8	31Y/F	PCA (P2-P3)	Ruptured	Coiling	Total occlusion [1]	No	MRA after 6 months/ Unremarkable	mRS 0
9	55Y/F	PCA (P2-P3)	Ruptured	Coiling	Total occlusion [1]	No	MRA after 6 months/ Unremarkable	mRS 0
10	60/M	ACA (A1 Segment)	Ruptured	Coiling	Partial Occlusion [2]	No	MRA after 6 months/ Unremarkable	mRS 0
11	40Y/F	DACA Prior (A2-A3) segment	Ruptured	Conservative	Less than 2 mm size with total occlusion of underlying vessel	N	MRA after 6 months/ Unremarkable	mRS 0
12	24/F	PCA (P2-P3)	Ruptured	Coiling	Total occlusion [1]	Diplopia	MRA after 6 months/ Unremarkable	mRS 0
13	40Y/M	Distal SCA	Ruptured	Coiling	Partial Occlusion [2]	No	MRA after 6 months/ Unremarkable	mRS 0
14	27y/M	PCA (P2-P3)	Ruptured	Coiling	Total occlusion [1]	Vertigo & visual blurr	MRA after 6 months/ Unremarkable	mRS 1
15	50Y/M	Distal BA eccentric	Ruptured	Coiling	Partial Occlusion [2]	No	MRA after 6 months/ Unremarkable	mRS 1
16	48Y/M	BA (trunk)	Ruptured	PVO	Total occlusion [1]	Died		mRS6
17	25Y/F	BA (trunk)	Ruptured	PVO	Total occlusion [1]	Vomiting,basal nerve palsies	MRA after 6 months reveal total occlusion	mRS 3
18	52yF	MCA (M1 segment)	Unruptured	Coiling	Total occlusion [1]	None	MRA after 6 months/ Unremarkable	mRS 1
19	22Y/F	PICA (Origin)	Ruptured	Coiling	Partial Occlusion [2]	Vertigo,swaying towards one side	MRA after 6 months/ Unremarkable	mRS 2
20	34Y/F	VB Junction	Ruptured	Coiling	Total occlusion [1]	No	CTA after 6 months/Unremarkable	mRS 0
21	40Y/F	PICA (Origin)	Ruptured	Coiling	Total occlusion [1]	No	MRA after 6 months/ Unremarkable	mRS 0
22	60Y/M	Distal BA	Ruptured	Coiling	Partial Occlusion [2]	No	MRA after 6 months showed residual neck/stable	mRS 0
23	40Y/F	MCA (M1 segment)	Ruptured	Coiling	Total occlusion [1]	No	MRA after 6 months/ Unremarkable	mRS 0
24	22y/M	PCA (P2-P3)	Ruptured	Coiling	Total occlusion [1]	Visual blurring	MRA after 6 months/ Unremarkable	mRS 0
25	35Y/F	MCA (M2-M3)	Ruptured	Coiling	Total occlusion [1]	Hemiparesis	MRA after 6 months/ Unremarkable	mRS 2
26	12Y/M	PCA (P2-P3)	Ruptured	Coiling	Total occlusion [1]	NO	MRA after 6 months/ Unremarkable	mRS 0
27	35Y/F	BA Apex with TA	Ruptured/Twice	Coiling	Total occlusion [1]	No	DSA after 6 months/Unremarkable	mRS 0
28	17Y/F	ACA (A1 Segment)	Ruptured	Coiling	Partial Occlusion [2]	Headache	DSA after 1 year showed recurrent sac	mRS 0

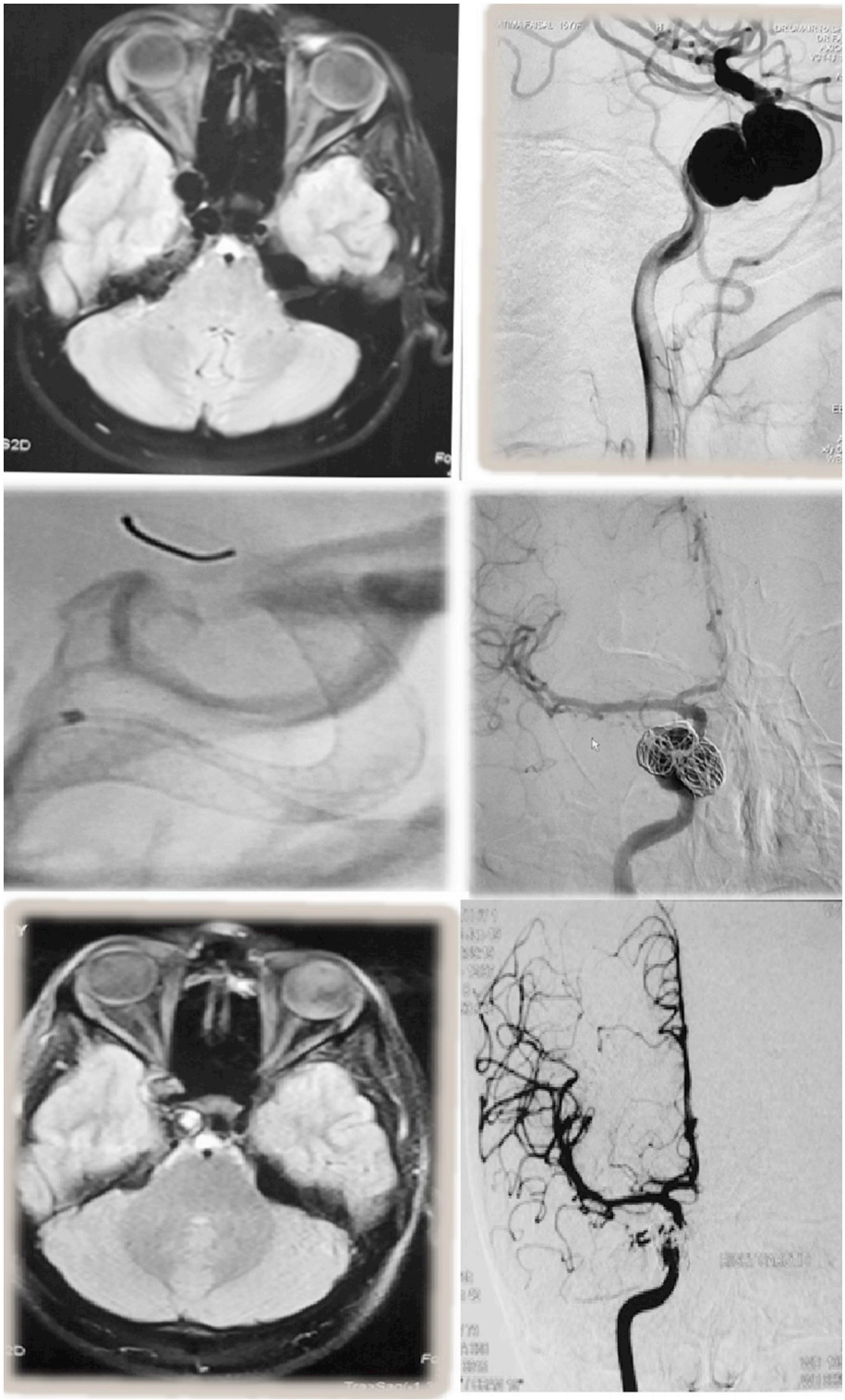

Fig. 1. ·A 15 years old female presented with headaches and progressive worsening of right eye vision. Magnetic resonant imaging showing right ICA aneurysm.
·Lateral projection cerebral angiogram demonstrates dissecting aneurysm of right internal carotid artery
·Unsubtracted image after deployment of flow diverter.
·Partial coiling with reconstruction of vessel done with flow diverter.
·Magnetic resonant imaging after 3 months demonstrating partial thrombosis of internal carotid aneurysm.
·Follow up cerebral angiogram after two years of initial treatment showing complete obliteration of aneurysm.

angiography. When parent vessel occlusion was contemplated, patients were evaluated for 20 to 30 min by using a non-detachable silicone balloon. This was done in cases where total occlusion of PCA, basilar artery segment was needed or in cases of contralateral hypo plastic or aplastic vertebral artery. Patients were strictly monitored neurologically during BOT, if they tolerated the procedure well and there was adequate collateral circulation, permanent embolization of the affected artery was performed. (Table 1).

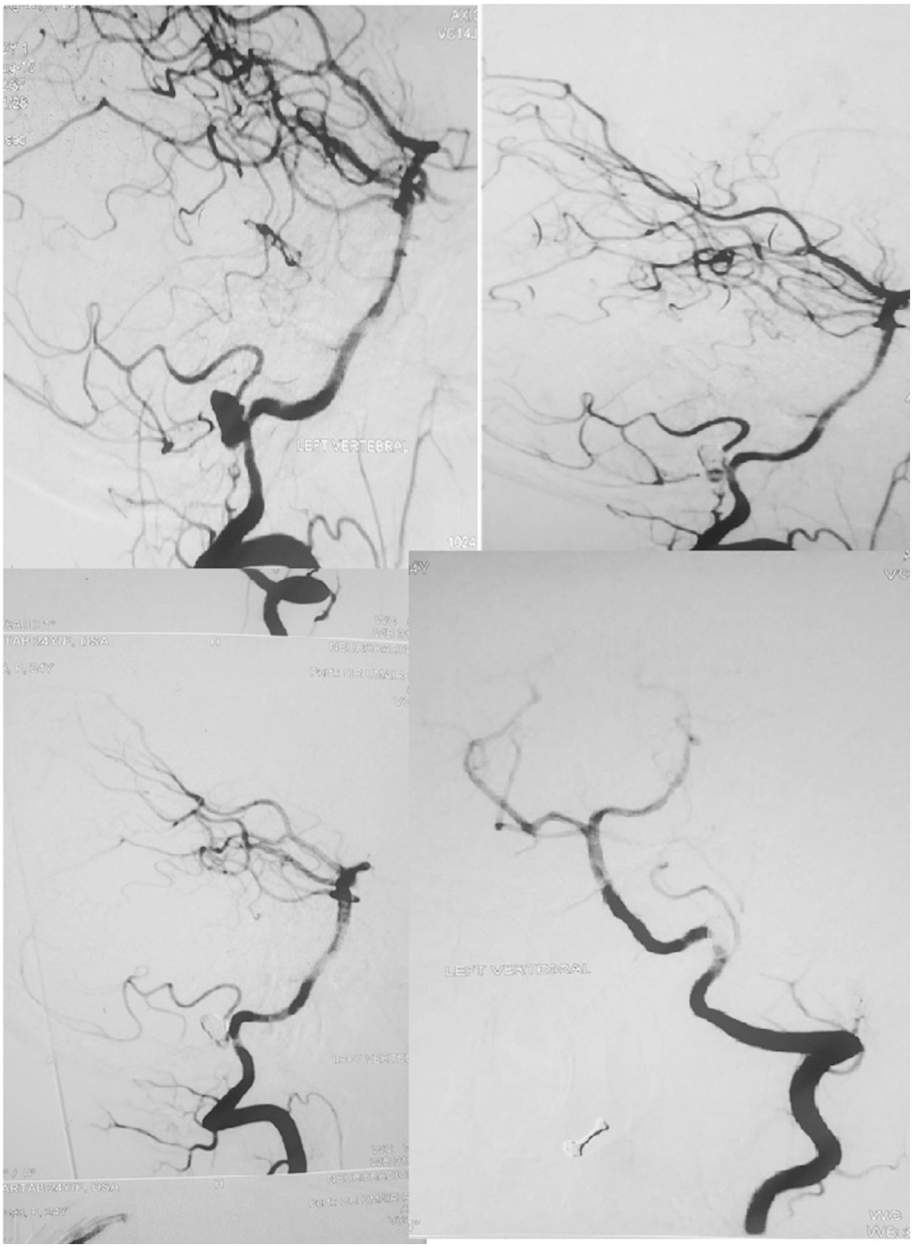

Fig. 2. ·A 22-year-old female presented with sudden onset of headache followed by loss of consciousness. Lateral projection of left vertebral angiogram showing a dissecting PICA aneurysm.
·Post coiling left vertebral angiogram showing residual neck.
·Follow up left vertebral angiogram after 1 year showing complete occlusion of the dissecting PICA aneurysm.
·Follow up Left vertebral angiogram AP View.

Shape, size and location of dissecting aneurysms were evaluated using angiograms with respect to major branches and collaterals. Extensions of dissection into surrounding arterial segments and association with underlying stenosis and dilatation of the parent vessel was also assessed.

Endovascular treatment was based on the configuration of the dissecting aneurysms. Total occlusion was done if the lesion did not incorporate any branch. If aneurysm incorporated important branches than proximal occlusion was done. All coiling procedures were performed by keeping the guiding catheter at petrous part of ICA in anterior circulation aneurysms and at proximal part of VA in posterior circulation lesions. In some cases assisted technique was also used.

Initial and follow up neurological examination at the time of discharge was done and Modified Rankin Scale was assigned (Table 1).

Follow up MR angiography performed in all cases six months after initial procedure to access the residual or recurrent sac. When there was suspicion, of residual aneurysm follow up catheter angiography performed after MRA.

Detailed neurological examination of the patient was done at each follow up visit. Further examination was carried out after 1 year, if needed.

Two experienced neurointerventionalist were involved in the procedure, retrieval of data and image analysis. All the clinical data was obtained from patient's medical records and all imaging data from hard films.

Fig. 3. ·A 34-year-old female with a grade 3 SAH. Anteroposterior CT angiogram showing dissecting vertebrobasilar junction aneurysm.
·Lateral diagnostic angiogram demonstrates dissecting aneurysm of dominant left vertebral artery involving the supra PICA segment and proximal basilar artery.
·Post coiling angiogram of the left vertebral artery shows occlusion of supra PICA segment of the vessel with preservation of flow in basilar artery.

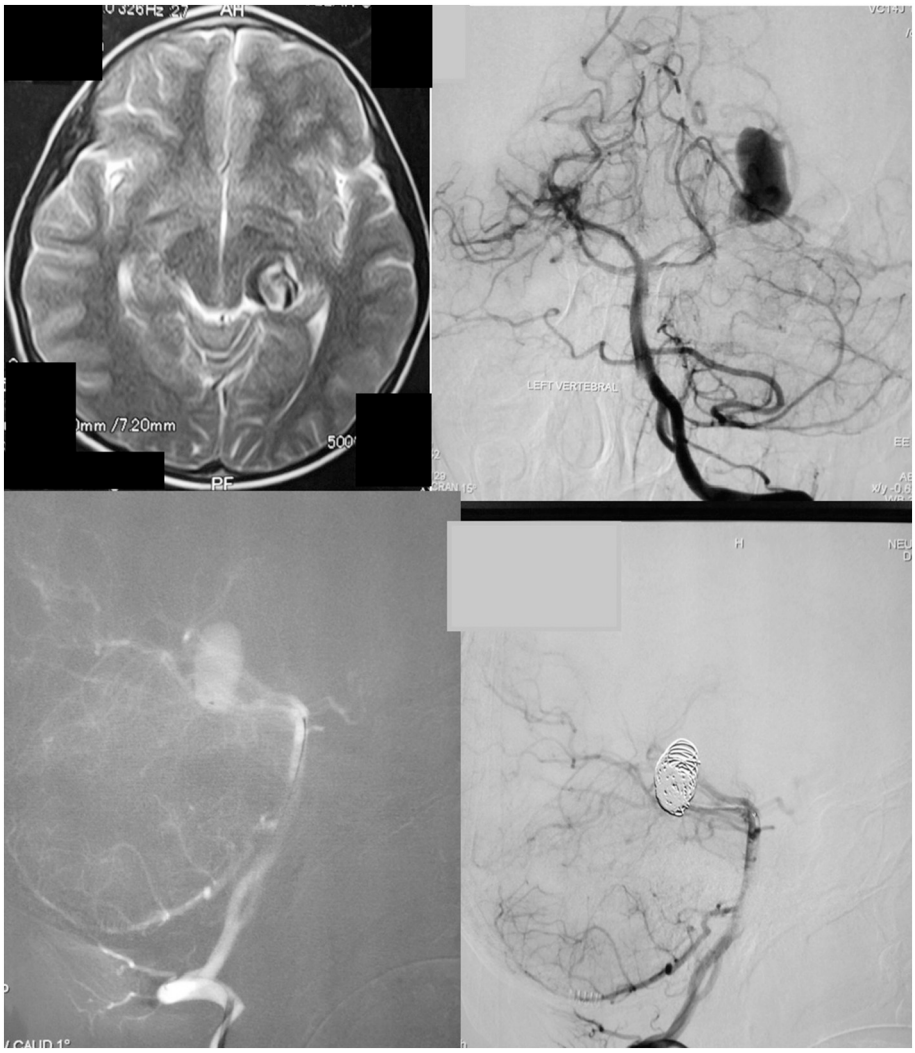

Fig. 4. ·A 12 years' male child had headache and blurring of vision on and off for 6 months. (a) Magnetic resonant imaging revealed partially thrombosed aneurysm causing mass effect on brain stem.
·Cerebral angiography showed a huge dissecting aneurysm arising from left posterior cerebral artery at P2-P3 segment with fenestration at vertebro basilar junction.
·Road map image showing microcatheter within the aneurysmal sac.
·Post coiling, a vertebral angiogram showed occlusion of the dissecting aneurysm and patency of distal branches of posterior cerebral artery.

3. Results

3.1. Illustrative cases

3.1.1. Case 5

This 15-year-old female presented with sudden onset of headache more on right temporal region. It was associated with deterioration of vision in right eye progressively over the past two years. There was no history of seizures or any episode of loss of consciousness. On examination she had no neurological deficit and her GCS was 15/15. The vision was 6/12 in right eye and 6/6 in left eye. MRI brain showed flow void signals at right ICA cavernous segment. Her DSA showed a dissecting giant right ICA aneurysm at cavernous segment with intradural extension. It was decided to put flow diverter with partial coiling. Post procedure angiogram showed total occlusion of aneurysmal sac with preservation of flow of ICA. The procedure was uneventful. After 3 weeks of initial procedure patient developed right eye ptosis due to 3rd nerve palsy. Immediately she was put on oral steroids and she recovered fully. She remained symptom free and had no problem on follow ups. Follow-up catheter angiography was done after 1 year which showed complete thrombosis of the aneurysm with the preservation of the parent vessel. (Fig. 1).

3.1.2. Case 19

This 22-year-old female presented with sudden onset of headache followed by loss of consciousness. On examination she had GCS of 14. She had no associated risk factors. Her CT showed SAH more pronounced in perimesencephalic cistern. DSA showed a dissecting aneurysm arising from the proximal PICA at its origin. It was decided to occlude the aneurysm using a coaxial technique, a microcatheter was taken into the aneurysmal sac and coiling done. The neck was not coiled as PICA was arising at the neck. The procedure was uneventful. The patient complained of diplopia and swaying towards one side while walking. The problems settled soon after follow ups. After 6 months follow up MRA was done which was unremarkable. 1 year after first follow up MRA, catheter angiography was repeated which showed complete occlusion of the aneurysm. (Fig. 2).

3.1.3. Case 20

A 34-year-old female presented with sudden loss of consciousness preceded by headache and vomiting episode. CT showed SAH in prepontine cistern. Digital Subtraction Angiogram was done and revealed a wide necked dissecting aneurysm arising at the vertebrobasilar junction. It was decided to occlude the aneurysm while preserving the parent artery. Post procedure angiogram showed total occlusion of the aneurysm with restoration of flow in the basilar artery. The procedure was uneventful and the patient fully recovered. Follow-up studies showed complete thrombosis of aneurysm. (Fig. 3).

3.1.4. Case 26

A 12-year-old male presented with recurrent headaches for the last one year with sudden exacerbation of symptoms resulting in loss of consciousness. CT reveled SAH in perimesencephalic cistern. DSA showed a dissecting aneurysm involving the P2-P3 segment of the let PCA. Incidental finding of fenestration was evident at the vertebrobasilar junction. Balloon test occlusion was performed and well tolerated by the patient. So the aneurysm was coiled and post procedure angiogram showed total occlusion of the aneurysm. Patient recovery was uneventful and he was discharged without deficit. (Fig. 4).

4. Discussion

Dissections in the intracranial arteries frequently include the vertebral and basilar arteries with dissection in the intracranial carotid and middle cerebral artery happening once in a while. PCA dissections are incredibly rare. (L) The precise meaning of dissecting aneurysms isn't defined in literature. They are for the most part dependent on the authors understanding of their angiographic appearance that has been portrayed as “pearl and string” or “blow out.” The natural history of these aneurysms is additionally not known. [4].

The yearly rate of spontaneous dissecting aneurysm is 1 to 1.5 per 100,000, and the lesion is known to be a significant reason for ischemic stroke in youthful and middle aged patients [3].

Very little is known about internal carotid dissecting aneurysms, only few case reports seen in the literature. Hiroki Ohkuma et al., reported 49 cases of intracranial carotid circulation and uncovered that the proportion of dissecting aneurysm of the intracranial carotid circulation to all intracranial dissecting aneurysms was 19.1% and that the proportion of SAH happening because of this disease to non-aneurysmal SAH was 6.2%, which recommended that dissecting aneurysms of the intracranial carotid circulation was not as uncommon true to form. As acknowledgment of this illness spreads, the reported occurrence of the disease will rise. Ming – Jung Chuang et al. evaluated 24 instances of MCA dissecting aneurysms and found that most studies have concentrated on dissecting aneurysms happening in the vertebrobasilar circulation, it's doubtful that the conclusion revealed regarding the vertebrobasilar circulation could likewise apply to carotid circulation. [5].

We need more studies to amplify the previous studies regarding intracranial carotid circulation dissecting aneurysms. In our study, we have encountered with 8 cases of dissecting aneurysms in carotid circulation, endovascular treatment appeared to be successful in all cases with minor deficits.

In comparison to our study, Wakhloo et al., found a higher recanalization rate in posterior circulation aneurysms following stent or stent assisted coiling (33% vs 6%). [6] In our study, we have treated 10 dissecting aneurysms of posterior circulation and have good results except in one case in which PVO done and patient could not survive due to hypo perfusion.

Dissecting intracranial aneurysms represent a huge extent of the patients with spontaneous SAH. Carefully chosen endovascular treatment can prompt better results like patients with saccular aneurysms.

5. Conclusion

A convincing argument for early NeuroIntervention likewise exists. Fragile and prone to rupture easily, dissecting aneurysms must have proximal occlusion of parent vessel by neuro intervention for maximum safety.

The overall results in our study was positive. Early treatment is advised for ruptured dissecting aneurysms to prevent early rebleeding. A subsequent angiography is mandatory to detect growth and further development of unruptured dissecting aneurysms. The treatment methodology of dissecting aneurysm ought to be chosen by the clinical characteristics of every patient and close coordination among neurosurgeons and neurointerventionists is fundamental to improve the clinical outcome.

Declaration of Competing Interest

There is no conflict of interest to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.inat.2019.100510.

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