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ENDOVASCULAR TREATMENT OF INTRACRANIAL ANEURYSMS BY FLOW-DIVERTER IN A RESOURCE LIMITED SETUP :A CASE SERIES

Dr. SudhirSuggala	M.B.BS, MS, MCH (Neurosurgery), F.I.N.R (S.KOREA) Dr.PSIMS&RF ,Vijayawada, India.
Dr. Manoharsha Gannena*	Post Graduate M.S(GEN.SURG) Dr.PSIMS&RF ,Vijayawada, India. *Corresponding Author
Dr. R S K Karthik Nerusu	Post Graduate M.S (GEN.SURG) Dr.PSIMS&RF ,Vijayawada, India.

ABSTRACT

OBJECTIVE: Endovascular coil embolization has become an effective treatment modality for most intracranial aneurysms [1]. However, complex aneurysms including large and giant aneurysms, fusiform shaped aneurysms, wide necked aneurysm, or small aneurysm that are unsuitable for coil embolization are still a formidable challenge. Flow diverters (FD) have been developed to treat intracranial aneurysms. These devices are placed in the artery and take advantage of changing the hemodynamics at the aneurysm/parent vessel interface leading to gradual thrombosis of the aneurysm occurring over time while preserving perforators and side branches in most cases. Flow diverters have allowed treatment of previously untreatable wide neck and giant aneurysms. It is a novel concept that is applied in the treatment of these complex intracranial aneurysms.

METHODS: We review the results and important features of five aneurysms in four patients who underwent endovascular treatment by using the flow diverter device.

DISCUSSION: We suggest that treatment with flow diverters is a safe and effective treatment modality in a resource limited set up with a cath lab fulfilling essential requirements for flow diverter placement.

KEYWORDS : Endovascular, Digital substraction angiography (DSA), Sub arachnoid hemorrhage (SAH), Flow-diverter (FD), Complex Aneurysm

INTRODUCTION

Endovascular coil embolization and open microsurgical clipping have become an effective treatment modality for most of the intracranial aneurysms. Complex aneurysms including giant aneurysms, fusiform shaped aneurysms,wide necked and blister aneurysms that are unsuitable for coil embolization are still formidable to treat with either surgical or endovascular technique due to their high morbidity and mortality[4, 6,7]. These aneurysms also have significant recurrence rates and poor outcomes[2,3]. Several reports have also described the use of FDs to treat recently ruptured aneurysms, particularly those that are difficult to treat by other endovascular or open microsurgical techniques. Flow diverters are stent-like devices that are deployed endovascularly which allow endoluminal reconstruction rather than endosaccular filling. Flow diverters alter the parent artery/aneurysm sac interface to induce aneurysm thrombosis. Aneurysm thrombosis gradually ensues after device deployment. Subsequent neointimal growth covers the stent reconstructing the parent artery and eliminating the aneurysm sparing the origins of perforators. With time, the aneurysm shrinks and collapses around the device relieving symptoms from mass effect . In this current study, we report our experience at a single center using the flow diverter for the endovascular treatment of these aneurysms.

METHODS

A retrospective review of 4 patients who underwent endovascular treatment at our institution with the flow diverter therapy between Nov 2018 and May 2019 was performed. DSA Brain and device placement procedure was done under Philips AlluraXper FD 10 uniplane machine with road map facility used for cardiac interventions. Though a biplane cath lab with 3D rotation facility is ideal but we backed up the 3D information using CT Angiography . Aneurysms were categorized based on digital subtraction angiography (DSA), and computed tomography (CT) angiography . Clinical data, including the presence of subarachnoid hemorrhage (SAH), which was classified on CT scan with the Fisher Grade and angiographic data, were collected at the time of the procedure. Aneurysm size and location were recorded. The presence of contrast stasis after placement was noted.

PATIENT DATA

5 aneurysms were treated in 4 patients (1Male and 3 Females) . One aneurysmwas ruptured and 4 aneurysms were unruptured. The mean age was 44.50 years (range 23–65 years). All patients underwent DSA brain initially followed by endovascular treatment on later date. All patients presented primarily with severe headache . One patient presented with SAH and one patient with sixth cranial nerve palsy due to compressive effect.

ANEURYSM DATA

Four internal carotid artery , one vertebra basilar artery aneurysms were treated .One patient had two aneurysms which were treated by single flow diverter placement. One patient with giant supraclinoid ICA aneurysm also underwent placement of coils to enhance the stasis in the aneurysm. In another patient with giant cavernous segment ICA coils were not needed as the location was extradural. In two cases pipe flex embolization device(Ev3), and two cases Silk plus(Balt) type of flow diverters were used. The size of aneurysms was measured as <10 mm in three aneurysms, 10–25 mm in one aneurysm, and >25 mm in seven aneurysms. 1 aneurysm was extradural and other 4aneurysms were intradural. There were 1 ICA cavernous segment ,1 ICA supraclinoid segment, 1 ICA superior hypophyseal, 1 ICA carotid cave segment aneurysms. The vertebrobasilar aneurysm was fusiform whereas other aneurysms were saccular in our cases.

PROCEDURE

ANTIPLATELET REGIMEN: Premedication with 300 mg of Ecosprin and 180 mg of Ticagrelor was started 4 hours prior to the procedure. Daily dual antiplatelet therapy was continued after procedure for 6 months (Ecosprin 75 mg once daily, Ticagrelor 90mg twice daily) followed by Ecospirin alone daily for an additional 12 months. All patients received heparin during the procedure with an activated clotting time maintained at 2–2.5 times baseline. Flow diverter delivery was successful in all cases without any complication. There was no in-stent thrombosis or thrombotic complication that required lysis intra-operatively.

ANGIOGRAPHIC RESULTS

Immediate angiographic results are graded based on contrast stasis within the aneurysm [9]. Mild stasis is defined as contrast visualized in the aneurysm untilthe late arterial phase. Moderate stasis is defined as contrast visualized in the aneurysm until the capillary phase. Pronounced stasis is defined as contrast visualized in the aneurysm until the venous phase. 4 aneurysms showed pronounced stasis and the other one aneurysm showed moderate stasis immediately after Flow diverter placement.

DISCUSSION

Flow diverters have been introduced into the options for aneurysm treatment recently[7] . These devices are tubular stent-like implants with lowporosity. Two working mechanisms of FDs were identified as flow redirection and tissue overgrowth.FDs are mainly used in complex aneurysms including large and giant aneurysms, fusiform shaped aneurysms, wide-neck aneurysms, multiple aneurysms within a segmental diseased artery, and recanalized aneurysms after previous coiling. The common denominator of these aneurysms is their high morbidity associated with treatment and significant recurrence issues and poor outcomes irrespective of the treatment type, be it surgical or endovascular[2,3,5, 7,10]. Recently extension of the indications of FDs to small aneurysms that are untreatable by standard coiling technique including blister-like aneurysms and the aneurysm that have high rupture risk during aneurysm access or coil placement. Headache completely resoved in all of our patients. One patient with sixth nerve palsy did not show complete resolution in follow up. Visual field defect improved in one patient. Monteith et al. concluded that endovascular treatment of fusiform aneurysms with flow diversion appears to be safe and effective; however, the absolute risk of perforator occlusion was undetermined. In our case with left vertebral artery fusiform ruptured aneurysm which underwent flow diverter placement after 2 months of rupture had no intraprocedural complications. Two large or giant aneurysms were treated in our series who had symptomatic relief after treatment.

The main potential complications of FDs are thromboembolic events andintra-operative rupture . Although the risk of intraoperative rupture is reduced because of lack of endosaccular manipulations, the risk of thromboembolic events is higher as compared with standard coiling or balloon-assisted coiling (BAC) due to the fact that FDs are placed in the parent artery. To prevent thromboembolic events, the use of preoperative and postoperative single or dual antiplatelet treatment is currently recommended[5]. In our series, all patients received dual antiplatelet therapy Also Flow diverters have some unique complications, which are not observed with standard coiling i.e. delayed aneurysm rupture and remote parenchymal hematoma development. We did not observe any such complication in 8 months follow up of our patients . Another important point about the FDs is the patency of the perforating arteries and side branches covered by the device. Kulcsar et al. treated 12 basilar artery aneurysms with FDs[4,8,9] In their follow-up, small symptomatic lesions related to small perforator occlusion wasdetermined in two patients. In addition, an exceptional complication was reported by Fiorella et al. as very late (23 months after procedure) thrombosis of FDs [5,11]. Thus, long-term follow-up is warranted in these patients.

We think our overall results are favorable and in agreement with the currentliterature. Our study has some limitations. In order to evaluate the exact radiographic and clinical improvement with use of FD andassociated complications, larger studies with long-term follow-up are required. Because of financial constraints the patients could not get a CT angiography or DSA brain for follow up. But clinically symptomatic improvement is there in all our patients.

CONCLUSION

Flow diverters have expanded the options for treatment of cerebral aneurysms. Previously untreatable intracranial aneurysms can now be safely treated. The role of flow diverters is evolving and expanding. Parent artery reconstruction via flow diversion with the flow diverter is a valid and safe treatment modality with low morbidity for wide necked complex aneurysms and the aneurysms, which are not amenable for standard coiling procedures including small aneurysms. In order to evaluate the exact effectiveness and associated complications, larger studies with long term follow-up are required.

CASE 1

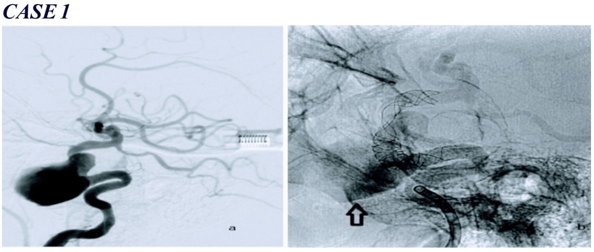

Fig. 1

a: Showing the giant saccular cavernous ICA segment aneurysm of size 25.64mm x 23.18mm x 14.63mm with neck of 19.43mm. **b** : Showing the flow diverter (silk plus) and arrow showing the contrast stasis in the aneurysm.

CASE 2

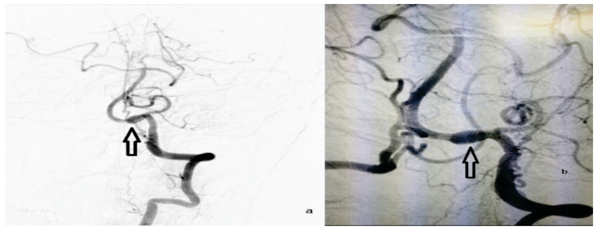

Fig. 2

a: Showing the fusiform aneurysm in the left V4 segment of vertebral artery of size 8.5mmx 4.2mm arising after the PICA origin. **b**: Showing the flow diverter (pipeline flex)

CASE 3

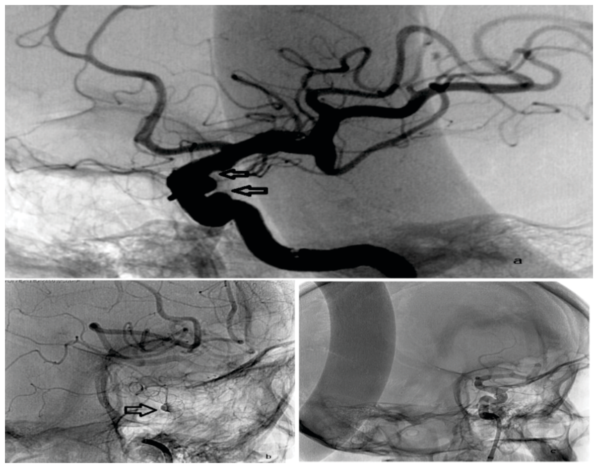

Fig. 3

a: Showing the aneurysm in the ICA superior hypophyseal region 4.54mm x 4.32mm x 3.87mm (neck) and ICA carotid cave 3.54mm x 3.44mm x 2.67mm (neck) **b**: Showing the contrast stasis in the aneurysm. **c**: Showing the well apposed flow diverter (Silk plus) in the parent vessel ICA.

CASE 4

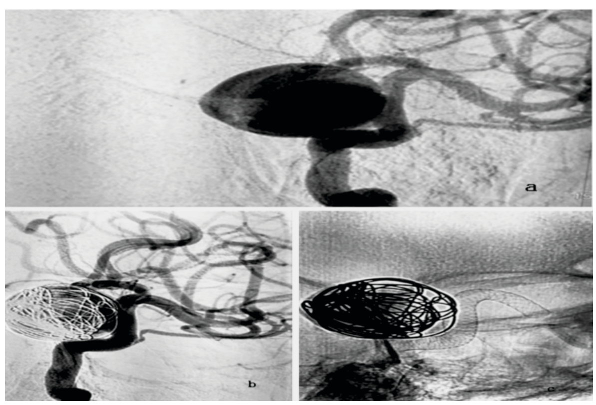

Fig. 4

a: Showing the giant saccular aneurysm in left supraclinoid ICA of size 22.05mm X16.19 mm x 6.07mm neck. **b**: Showing the partial coiling of the aneurysm to accelerate stasis **c**: Showing the flow diverter (pipeline flex) along with coil.

TABLES

TABLE 1 – PATIENT CHARACTERISTICS

Sex	
Male	1
Female	3
Age(yrs)	44.50(range 23-65 years)
Presentation	
SAH	1
Headache	4
Cranial nerve palsy	1
Visual Field Defect	1
SAH grade	
Grade 1	0
Grade 2	1
Grade 3	0
Grade 4	0

TABLE 2 – ANEURYSM CHARACTERISTICS

RUPTURED	1
UNRUPTERED	3
LOCATION	
EXTRADURAL	1
INTRADURAL	3
ICA CAVERNOUS SEGMENT	1
ICA SUPRACLINOID SEGMENT	1
ICA SUPERIOR HYPOPHYSEAL	1
ICA CAROTID CURVE	1
VERTIBROBASILAR	1
SIZE	
<10MM	3
10–25 MM	1
>25MM	1
SHAPE	
FUSIFORM	1
SACCULAR	4

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