CASE REPORT

Late recurrence of a completely occluded large intracranial aneurysm treated with a Tubridge flow diverter

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SUMMARY

We report a rare case of recurrence of a large intracavernous aneurysm after angiography proved complete occlusion. The aneurysm was treated by a combination of a Tubridge flow diverter and coils, and balloon angioplasty, after flow diverter devices deployment for parent vessel stenosis. Six month angiographic follow-up demonstrated complete occlusion. Unfortunately, obvious aneurysm recurrence was confirmed on 2 year angiographic follow-up. The probable mechanism of recurrence was analyzed.

BACKGROUND

Flow diverter devices (FDDs) are new generation stents to disrupt intra-aneurysmal flow, thus inducing intra-aneurysmal thrombosis.¹ Although no randomized controlled trials have been reported, the present clinical evidence states that FDDs have comparable morbidity and mortality but higher complete occlusion rates compared with stent assisted coiling,² especially in large and giant intracranial aneurysms.³ With FDD treatment, the rate of aneurysm occlusion progressively increases during follow-up.⁴ The recurrent rate during long term follow-up is very low after FDD treatment, especially in cases of complete occlusion.

No case of recurrent aneurysm following FDD treatment, which was proved to be completely occluded by follow-up angiogram, has been reported previously. We report a rare recurrent case after FDD treatment. The probable mechanism is analyzed, which may be helpful in providing further insight into FDDs.

CASE PRESENTATION

A patient in their 60s complained of headache and paroxysmal unconsciousness. Unenhanced CT scan showed a large hyperdense mass (2.6×2.9 cm) with rim calcification (figure 1A).

TREATMENT

The patient was prescribed double antiplatelet treatment (aspirin 300 mg daily and clopidogrel 75 mg daily) 3 days before Tubridge deployment which was maintained for 6 weeks. Aspirin was then reduced to 100 mg. Clopidogrel was discontinued 3 months after the procedure.

During DSA examination, injection into the right internal carotid artery demonstrated an intracavernous aneurysm with an opacified lumen significantly smaller than the size of the entire aneurysm,

as well as stenosis of the parent vessel. Under general anesthesia and systemic heparinization, a 5 F catheter assisted by a 7 F guide catheter was advanced into the right internal carotid artery. Control injections demonstrated good flow and no vasospasm surrounding the guiding catheter. Anteroposterior view, lateral view (figure 1B, C), and three-dimensional reconstruction angiography (figure 1D) were performed to measure the actual size of the aneurysm (neck=8.66 mm, maximum diameter=22.03 mm) and the parent vessel (proximal=3.57 mm, distal=3.20 mm).

Under roadmapping, an Endopipe microcatheter was navigated far into the middle cerebral artery assisted by a microwire (Transcend EX Platinum 0.014 inch). A microcatheter for coil embolization (Echelon-10) was advanced into the aneurysmal sac. The Tubridge embolization device (diameter 4.0 mm; length 35 mm; MicroPort, Shanghai, China) (figure 1E) was then deployed from the C7 segment of the internal carotid artery to the C4 segment. Twelve coils were deployed (figure 1F). The immediate result was Raymond III occlusion (figure 1H). For stenosis of the parent vessel, balloon angioplasty (Gateway 2.5/9 mm) was performed to prevent in-stent stenosis or vessel occlusion.

The patient continued to improve while in the neurological ward, and oculomotor paralyses were relieved. Secondary hypopituitarism was treated with hormone replacement.

OUTCOME AND FOLLOW-UP

During 6 months of follow-up, the patient was asymptomatic and DSA (figure 2A, B) demonstrated complete occlusion of the aneurysm and good reconstruction of the parent vessel. However, the patient complained of three episodes of syncope at the 2 year follow-up. DSA showed obvious recurrence at the aneurysm neck (figure 2). Compared with the 6 month follow-up (figure 2B), no coil compaction or in-stent stenosis was noted (figure 2D).

DISCUSSION

FDDs, with high neck coverage, have become a promising alternative, with various studies documenting efficacy and safety.⁵ Although the complete occlusion rate for FDDs vary in different series, it progressively increases through remodeling the parent vessel over time. O'Kelly *et al*⁶ reported an increasing complete occlusion rate from 65% at

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Figure 1 Unenhanced axial CT showing the presence of frontal compression. (A) Right internal carotid artery selective injection, anteroposterior view, (B) lateral view (C), and three-dimensional rotation angiography (D), depicting a right intracavernous aneurysm and decreased flow velocity of the distal parent vessel. The aneurysm was treated with a Tubridge stent (4.0/35 mm) (E) and coils (Coil×12). (F) A balloon (Gateway 2.5/9 mm) was deployed with 5 atm to open the stent. (G) The aneurysm was sub-complete occluded (Raymond class III occlusion) and flow velocity was significantly increased (H).

6 months to 90% at 12 months. The rates reported by Yu *et al*⁷ at 6, 12, and 18 months were 55.7%, 81%, and 84%, respectively.

The Tubridge flow diverter is a braided self-expanding device with flared ends, and is available in various diameters (2.5–6.5 mm) and lengths (12–45 mm). Tubridge flow diverters harbor a pore size of 0.040–0.050 mm² at the nominal diameter to provide high metal coverage (approximately 30.0–35.0%) at the aneurysmal neck after expansion. A complete occlusion rate for anterior circulation aneurysms treated with Tubridge stents after an average of 19.0 months of follow-up was 72%,⁸ and that for posterior circulation aneurysms at a median of 26.0 months of follow-up 83%.⁹

Compared with FDDs alone, conjunctive coils would significantly reduce re-treatment rates. Concerning obvious intra-aneurysmal thrombus and stenosis of the parental vessel in this patient (figure 1D), FDDs in conjunction with coils were deployed for a better embolization effect. Balloon angioplasty was also performed to achieve optimal stent apposition. Six month angiography revealed complete aneurysm occlusion and satisfactory reconstruction of the parent vessel.

As physicians' preference is a key feature of deployment of novel technologies, patterns of complications and mechanisms of failure and recurrence remain paramount to improve the rational application of these devices and prevention of complications. FDDs, as a novel treatment for previously untreated and recurrent aneurysms, present a satisfactory short term outcome, corroborated by an increasing number of studies. Some long term follow-up reports are also available—for example, a prospective multicenter clinical trial⁷ with an average of 17.6 months of follow-up. The complete occlusion rate of the enrolled 178 aneurysms at 18 months was 84%. Another retrospective single center study¹⁰ reported 39 aneurysms treated

with Silk and Pipeline. The average follow-up time was 41 months and a complete occlusion rate at the final follow-up was 94.3%.

On the other hand, research and clinical cases on the probable mechanisms of aneurysm recurrence after FDD treatment have rarely been reported. Several mechanisms underlying FDD recurrence or failure have been put forward: endoleak of the aneurysm sac¹¹; FDD deformation leading to increased pore size and persistent blood entry into the aneurysm¹²; FDD deformation caused by inappropriate device diameter and length of the landing zone leading to deformation related complications; and failure of FDDs, which was proved by in vitro research.¹³

However, the recurrence mechanism for FDDs and coil embolization may be different because of different treatment concepts. Mechanisms underlying late recurrence of coiled aneurysms include regrowth of the aneurysm, poor organized or unorganized thrombus, continued transmission of blood pulsation, lack of neointima formation across the neck of the aneurysm,¹⁴ and formation of new vessels inside the aneurysm lumen.¹⁵ For FDD treatment, it may be important to reduce the shear stress in the vessel wall to allow vessel remodeling. Our previous hemodynamic study showed a decrease in wall shear stress, inflow volume, an increase in relative residence time, and a change in inflow stream induced by FDD implantation. Also, higher relative residence time increment, percentage of inflow volume reduction, and location of the stream inlet near the central part of the neck may be closely related to healing.¹⁶ The causes of FDD treatment failure may include malapposition of the FDD, or incomplete or low neck coverage. However, whether persistent high shear stress in the vessel leads to aneurysm recurrence after FDD treatment needs further study.

Figure 2 Six month follow-up DSA demonstrated complete occlusion and smooth blood flow in the parent vessel. (A) The shape of the coils was not altered. (B) Two year follow-up DSA demonstrated delayed filing of the residual aneurysmal neck. (C, D) The shape of the coils appeared similar at the 6 month and 2 year follow-ups (B, D).

Learning points

- ▶ This report illustrates a rare case of a recurrent large intracavernous aneurysm, which was proved to be completely occluded on 6 month DSA.
- ▶ We reported this case to provide further insight into the recurrence mechanisms of intracranial aneurysms. Flow diverter devices are still relatively new, and more clinical evidence, especially mechanisms of recurrence, is required.

Contributors XZ: data collection, writing, and editing. NL: editing, illustrations, and figures. CW: data collection. WC: illustrations and figures. JL: final editing. QH: final editing.

Competing interests None declared.

Ethics approval The study was approved by Changhai Hospital affiliated to the Second Military Medical University.

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