CASE REPORT

Flow diverter assisted coil embolization of a very small ruptured ophthalmic artery aneurysm

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SUMMARY

Small ruptured aneurysms present a unique problem to endovascular therapy. We report a case in which a patient presented with subarachnoid hemorrhage and a very small ruptured ophthalmic artery aneurysm, for which endovascular therapy was preferred secondary to severe cardiac comorbidities. Due to the aneurysm size, a small 1.5 mm coil was needed, but presented a significant risk of migration. Conventional stent assisted coiling was considered suboptimal as the small coil could have easily migrated through the strut. We present a novel technique of flow diverter assisted coil embolization in which a coil was placed within the aneurysm and a pipeline embolization device was then partially deployed, jailing the microcatheter and coil mass. Once in place, the coil was detached, securing the aneurysm, and preventing coil migration. Through the use of a flow diverter, some degree of aneurysm protection would still be expected in the event of coil migration toward the ophthalmic artery origin.

BACKGROUND

The treatment modalities for small ruptured aneurysms (defined as ≤ 3 mm) has remained controversial as early studies, such as the International Subarachnoid Aneurysm Trial,¹ excluded these aneurysms from their population. Traditionally, microsurgery has been favored for small aneurysms as endovascular embolization has been associated with an increased risk of procedure related rupture compared with larger aneurysms.²

In addition to simple coiling, stent or balloon assistance for small aneurysm treatment has shown benefit when required by aneurysm morphology.³ Several cases have also shown the advantages of pipeline embolization devices (PEDs) in the treatment of small ruptured aneurysms when not suitable for coil embolization,^{4–8} although risks of rehemorrhage are present and the need for dual antiplatelet therapy remain problematic.

We report a case featuring the use of flow diverter assisted coil embolization for the treatment of a small ruptured aneurysm in a patient with multiple comorbidities and severe cardiopulmonary dysfunction, providing adequate protection from rehemorrhage and coil migration.

CASE PRESENTATION

A 42-year-old man presented with a Fischer grade III, Hunt–Hess grade 1, subarachnoid hemorrhage (figure 1A) without evidence of aneurysm on CT angiography. In addition to a history of

hypertension and coronary artery disease, 1 month prior to presentation he suffered an acute myocardial infarction with ST segment elevation, resulting in ischemic cardiomyopathy with an ejection fraction of 20%. This necessitated the placement of a bare metal stent and treatment with aspirin and plavix. He was also found to have a left ventricular mural thrombus, requiring treatment with warfarin.

INVESTIGATIONS

An initial diagnostic cerebral angiogram at the time of admission was performed during which no aneurysm or other abnormalities were documented. Repeat angiography revealed a very small ophthalmic artery aneurysm (<2 mm) (figure 1B).

TREATMENT

Due to severe cardiopulmonary dysfunction, the patient was deemed medically unfit for open microsurgery, and the decision was made to proceed with endovascular treatment. Due to the small aneurysm size, a 1.5 mm $\times$ 2.0 cm coil was the only viable option for successful placement within the aneurysm. Once positioned and prior to coil detachment, a 4 mm $\times$ 16 mm PED device was inserted and partially deployed to cover the ophthalmic artery and the aneurysm while temporarily jailing the microcatheter. The coil was then detached, and the remainder of the stent was deployed, preventing migration of the coil mass and providing some degree of aneurysmal protection from rehemorrhage in case of coil migration into the ophthalmic origin.

OUTCOME AND FOLLOW-UP

At the 1 year follow-up, the patient was at his previous baseline with a modified Rankin Scale score of 0. Follow-up angiography revealed a patent stent, complete aneurysmal occlusion, and patency of the ophthalmic artery (figure 1C).

DISCUSSION

Due to the severity of our patient's cardiopulmonary dysfunction, we elected to pursue endovascular treatment; however, the aneurysm size and morphology significantly limited our options. Endovascular treatment of very small aneurysms is associated with an increased intraprocedural rupture risk.^{2 3 9} Flow diversion with PEDs decreases aneurysmal blood flow, promoting stagnation and thrombosis^{6 10}; however, in the context of aneurysmal rupture, immediate protection is incomplete, and the risk of dual antiplatelet regimens is significant.

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Figure 1 (A) Head CT revealing a Fischer grade III subarachnoid hemorrhage. (B) Diagnostic cerebral angiography demonstrating a small (<2 mm) aneurysm (white arrow) at the origin of the ophthalmic artery. (C) Follow-up angiography revealing complete aneurysmal occlusion (black arrow) and patency of the flow diverter and ophthalmic artery.

Despite this risk, PEDs have been utilized for aneurysm treatment in subarachnoid hemorrhage.^{5–8 10} In our case, the patient's recent bare metal stent placement required dual antiplatelet therapy, further promoting an endovascular approach. The small coil size (1.5 mm) needed would be prone to migrate and embolize distally, and conventional stent porosity would not provide significant protection against coil migration, prompting the use of a lower porosity PED. While uncommon, flow diversion has been described in aneurysmal subarachnoid hemorrhage. One case series demonstrated their successful use in the subacute setting, 3–5 weeks after rupture.¹⁰ In acute hemorrhage, however, the use of PEDs has mainly been limited to blister or dissecting aneurysms.^{5 8} A systematic review of aneurysm treatment with PEDs found that only 3.6% of PEDs were used acutely after rupture, with a mortality rate of 12.5%, compared with 0.8% mortality in the non-ruptured group.⁶

In our case, with the small aneurysm size and the 1.5 mm coil needed for embolization, simply coiling the aneurysm without a scaffolding mechanism would leave the risk of distal migration unacceptably high. The use of stent assisted coiling was also considered; however, the higher stent porosity would not optimally protect from coil migration either distally or into the ophthalmic artery origin. Furthermore, if coil placement was unsuccessful, safe aneurysm access would likely have been lost without providing adequate protection against rehemorrhage. In order to protect against rehemorrhage, we placed a small 1.5 mm coil and used the PED as a scaffold, effectively securing the coil, completely preventing distal migration, and offering some protection from migration toward the origin of the ophthalmic artery. The combined use of both modalities, the coil mass and the PED, provided immediate protection from rehemorrhage, while also providing long term protection through remodeling of the parent vessel.^{6 8 10} To our knowledge, this is the first reported case of pipeline assisted coiling of a very small (<2 mm) ruptured aneurysm without prior treatment. Through partial PED deployment prior to coil detachment, we secured both the aneurysm and coil, preventing coil migration and rehemorrhage. This provides a novel technique for the treatment of small ruptured aneurysms not amenable to microsurgical clipping or routine endovascular techniques.

Learning points

- ▶ Small ruptured aneurysms can be effectively treated by endovascular means, of which flow diversion has shown promise.
- ▶ Pipeline embolization devices effectively treat small aneurysms but their use in the setting of subarachnoid hemorrhage is limited.
- ▶ The technique of 'jailing' a microcatheter with a low porosity pipeline embolization device prior to coil detachment effectively protects against coil migration.
- ▶ Using pipeline assisted coiling for small ruptured aneurysms secures the aneurysm and prevents coil migration or rehemorrhage.

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Competing interests None.

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