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ABSTRACT

The advancement of intracranial stent technology and techniques has extended the applications of endovascular coiling methods for complex intracranial aneurysms. Coiling of wide-necked and complex bifurcation aneurysms usually requires double stent implantation. Different configurations for double stent-assisted coil embolization have been described. The T-configuration stent-assisted coiling procedure was recently described as a feasible, effective, and relatively safe endovascular technique used to treat wide-necked complex bifurcation aneurysms. In this article, we present the successful management of a complex wide-neck basilar tip aneurysm using a slightly modified T-configuration stent-assisted coiling technique

Keywords
T-configuration, double stent assisted coiling technique, intracranial aneurysm

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INTRODUCTION

Stent-assisted coiling is an increasingly used technique for the treatment of wide-necked intracranial aneurysms. Stents offers technical stability and durability of coil placement to prevent coil prolapse into the parent artery. However, a single-stent technique it can still be a challenge for the treatment of complex wide-necked aneurysms especially those in which the base of the aneurysm directly involves both bifurcation branches. Thus, in the case of these particular anatomical situations, endovascular treatment in optimal conditions requires the use of a double stent technique. The efficacy and safety of various configurations, such as X and Y stenting have been reported in the endovascular treatment of the complex intracranial aneurysm. In this study we describe the use of a particular T-configured double stent–assisted coiling technique for the treatment of wide-necked and complex basilar tip aneurysm. The efficacy and safety of this technique were also discussed referring to the few cases already presented in the literature [1,2].

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Case presentation

A female patient of 44-year-old was addressed to our emergency department for a subarachnoid haemorrhage revealed on cranio-cerebral CT scan. At admission she was in unconscious status with mild nuchal rigidity. The family declare severe headache suddenly installed a day ago. Her past medical history included hypertension with no regular treatment. The brain CT and CT angiography demonstrated a mild hydrocephalus and a complex basilar tip aneurysm as source of haemorrhage. The patient was intubated and immediately transferred to neurosurgery department for an external ventricular drain implantation.

The patient was proposed for an endovascular aneurysm occlusion for the next day. A written informed consent was signed by patient family after discussions with the operating team.

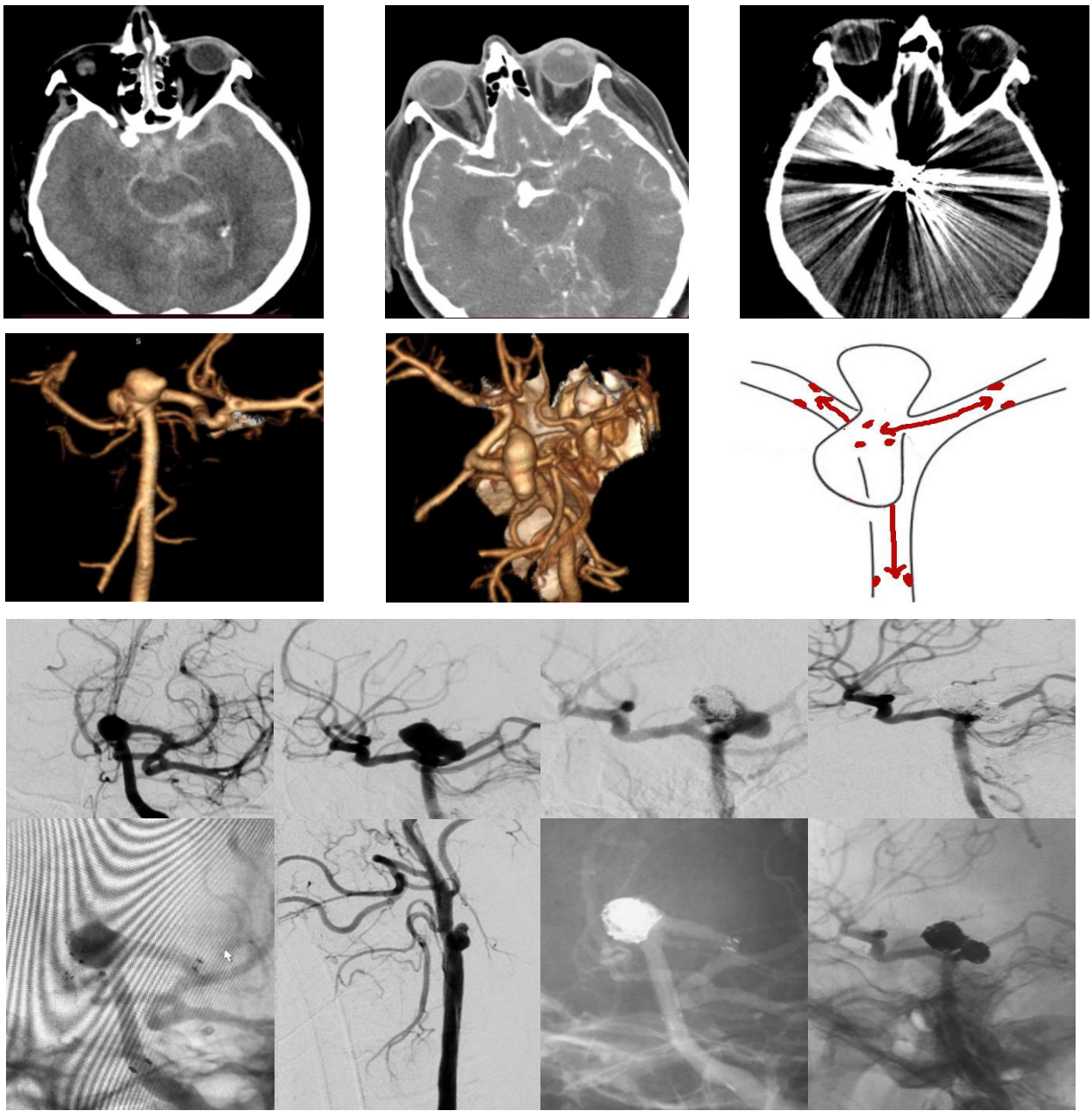

Figure 1. A, B - Brain CT diagnosis highlighting SAH and the aneurysm lesion; C - Post interventional barin CT control; D,E – Vascular 3D reconstruction showing the bilobate basilar tip aneurysm; F – Schematic image of the T-configuration double stent arrangement; G-N – Intraprocedural DSA images.

The procedure was performed on a biplane angiography system (INFINIX, Toshiba, Canon Medical System) and started with evaluation of both carotid and vertebral artery. The left ICA was founded obliterated and a total compensation of this vascular territory provided by the posterior circulation via a large left posterior communicating artery. The 3D DSA reconstruction image showed a large complex basilar tip aneurysm with two lobes in an hourglass anatomical configuration, a very wide neck involving both posterior cerebral artery junctions, originating from an asymmetric relation with the aneurysm sac. A dual stent support technique was deemed necessary for a safe endosaccular coiling and both PCA preservation (Fig 1).

The patient was premedicated with 150 mg aspirin before procedure and 5000 UI heparin after 6F femoral sheath (Merit Medical) placement. With the patient under general anaesthesia, the distal cervical part of left vertebral artery was catheterized with 6F Chaperon guiding catheter (Microvention) carefully advanced over 0.035 glidewire. A bolus dose of 2 mg of nimodipine (Nimotop, Bayer Health Care AG) diluted in 140 ml of 0.9% NaCl solution was infused through the guiding sheath for 10 minutes to prevent the development of vasospasm during the procedure. 3D angiographic imaging working projection was used for the guidance on roadmap images. We slightly modified the already reported T-configuration stent–assisted coiling technique by step-by-step catheterizing of the daughter branches and the aneurysm sac to avoid multiple catheter manoeuvring through the basilar trunk.

A Prowler Select Plus microcatheter (Codman J&J) was then very carefully advanced over a 0.014 Transed microwire (Boston Scientific) and positioned into the left posterior cerebral artery. At that point, the proximal end of the first stent, forming the short arm of the T configuration, was placed at the aneurysm neck, incorporating the corresponding daughter vessel. This branch was chosen for detachment of the first stent due to its closest relationship to the aneurysm neck and the tip of the basilar artery. Thus, the circumference of the distal end of this stent will be positioned so as not to overlapping (be under) the orifice of the second vascular branch of the bifurcation. To place the second stent, the right posterior cerebral artery was achieved carefully passing between the proximal end of the first deployed stent and the uncovered/unprotected aneurysmal neck of the Prowler Select Plus microcatheter over .014-inch microwire. The longer second stent was then fully deployed in the other daughter vessel, extending proximally into the basilar artery trunk. After the full deployment of the stents, a Prowler 10 microcatheter is placed into the aneurysm the anterior lobe of the aneurysm. After its complete angiographic occlusion, the microcatheter is positioned to the posterior lobe and the coiling of the aneurysm was continued until no further coils could be safely deployed within the aneurysm sac. Ffinal DSA images demonstrated a “Raymond class I” complete aneurysm occlusion with no neck remnant, coil herniation, clot formation or branch occlusion, and with no perioperative or perspective complications. The patient's evolution was slowly progressive, with suprimation of endotracheal intubation at 2 days postoperatively, and of the external drainage at 7 days. She was transferred to neurological recovery unit at three weeks presenting gait difficulties, dizziness and nystagmus.

Discussion

The endovascular treatment of wide-necked and complex bifurcation aneurysms which incorporates both vascular branches is still a challenge for endovascular neurosurgeons. Despite the progressive development of the new techniques for wide-necked aneurysm like double-balloon remodeling method or double-stent–assisted coiling technique, there are still complex anatomical situations that require continuous adjustment of them. In 2005 Chow et al. were among the first to describe the Y-stent–assisted coiling technique that greatly improved the ability to treat the wide-necked basilar bifurcation aneurysms. With this, the double-stent–assisted coiling procedures began to be used for wide-necked bifurcation aneurysms with various locations. However, subsequent studies have shown that Y-stenting may be associated with some technical risks and difficulties, especially when using 2 closed-cell stents. Thus, the need for catheterization of the second daughter vessel and passage of the second stent through the interstices of the first deployed stent may cause migration, dislocation, or deformation of the first stent. The occurrence of an hourglass-like deformation or stent narrowing at the point of intersection of the two

stents may induce thromboembolic events. Also, the intersection of the two stents at the level of the aneurysm neck may create technical difficulty for a possible subsequent catheterization of the aneurysm. Moreover, studies have shown that intraluminal crossing struts of 2 stents in a Y configuration are less susceptible to the progression of the endothelialization phenomenon, and may constitute a source of delayed thromboembolic complications [1,2,3].

Cho et al. reported for the first time the use of the T-configuration in the double stenting technique for the endovascular coiling treatment of wide-necked basilar bifurcation aneurysms. Inspired by the T-stent configuration used to treat coronary atherosclerotic bifurcation lesions, they attempted to resolve the safety issues associated with Y stenting. Thus, one of the main technical advantages of T stenting is represented by the elimination of risk of dislocation for the initial stent during the second stent passaging and deployment. Also, the T-stenting technique does not require any attempt of microcatheterization through the interstices of a crossing stents for coils placement in to the aneurysm. Furthermore, the presence of a total conformability with vascular anatomy and complete wall apposition of the stents increase proliferation of the endothelialization phenomenon on the entire surface of the implants, decreasing the risk of structural stenosis over time [2,5,6].

Generally, the technique of placing stents in T-configuration, means the deployment of a stent from one bifurcation branch to the wide aneurysmal neck and the second stent from the other opposite branch of the bifurcation into the parent trunk vessel. However, the technique of double T-stenting is a technical challenge, sometimes difficult or impossible to achieve, as in the case of large complex aneurysms with unfavorable anatomical configurations (sharp angles in the relationship between bifurcation vessels-carrier vessels - wide neck) as so called “arrow configuration”. The "anatomical T-shaped configurations" of the bifurcation aneurysms are the most accessible to use the double T-stenting technique even in the case of an asymmetry between the two origins of the bifurcation vessels towards the neck and the parent trunk vessel. However, of course, the placement of the stent in T-configuration should be reserved for patients with well-sized P1 vascular segments. Otherwise, placing a single stent in the large P1 is the option for patients with P1 hypoplasia / aplasia on one side. The simultaneous use of multiple microcatheters in the double stenting procedures may create a potential risk of thromboembolism. The possibility of application of a staged stenting by using a single microcatheter in the case of T-configuration stenting followed by the placement of coils only through the passage of the microcatheter through the interstices of a single stent can reduce this potential complication risk [2,3,4,6].

There are limited data in the literature regarding the safety and efficacy of the T-stent–assisted coiling technique. Aydin et all published in 2019 the largest series of patient treated by double T-stent–assisted coiling technique. They also present the successful applicability of T-stent–assisted coiling for the treatment of anterior circulation aneurysms. The immediate complete aneurysm occlusion rates reported was relatively high 83.3% compared with Y-stent–assisted coiling and close to the results of conventional single-stent–assisted coiling studies. At the last follow-up examinations, the complete occlusion was documented in 90.0% of patients. Regarding periprocedural complications, these were highlighted in 13.7% of cases, while delayed complications, generally represented by thromboembolic phenomena, were reported in only 3.9% of cases. Of these, only 1.9% led to permanent morbidity, and the death being registered in only 1% [1,2].

Conclusions

The T-configuration double stent–assisted coiling technique is a feasible and relatively safe endovascular procedure for the treatment of complex wide-neck cerebral aneurysms located at different bifurcation sites. However, a few aspects like the anatomy, angulation and take-off of the vessels may play a role in which technique to choose. Through this case report we showed that T-configuration stent-assisted coiling is an alternative successfully treatment for selected cases with favourable clinical outcomes and satisfactory midterm results.

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