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Stent assisted coiling technique for anterior communicating artery aneurysms treatment

A. Chiriac, Giorgiana Ion[1], N. Dobrin[1], I. Poeata

"Grigore T. Popa" University of Medicine and Pharmacy, Iasi, ROMANIA
[1]"Prof. Dr. N. Oblu" Clinic Emergency Hospital, Iasi, ROMANIA

Abstract: The anterior communicating artery was reported as the most common location for intracranial aneurysm by most clinical trials in literature. The use of intracranial stent detachment at the anterior communicating artery complex for treatment of wide-neck aneurysms with this location is increasingly reported. In this article we present the various management strategies for stent assisted coiling treatment of the anterior communicating artery aneurysms, their limits and complication.

Key words: anterior communicating artery, wide-neck aneurysm, stent-assisted technique

Introduction

The anterior communicating artery aneurysm was described in literature as the most common location for intracranial aneurysms responsible for up to 40% of the subarachnoid haemorrhages in adults. Microsurgical clipping or endovascular coiling are both techniques alternatives for the treatment of intracranial aneurysm with this location. The inconveniences due to deep lesion location, unfavorable projections or anatomical complexity of anterior communicating artery complex region have made the endovascular treatment the first choice. With the introduction of the stent-assisted embolization technique for resolving wide-neck aneurysms, this was also considered for the treatment of complex aneurysms of the anterior communicating artery. The development of new types of intracranial stents allowed the successful use of single or double stent techniques for coil embolization of anterior communicating artery aneurysms.

Endovascular treatment techniques

The low invasiveness, high feasibility and effectiveness of endovascular embolization of anterior communicating aneurysms made this treatment the prime method in most of the neurosurgical centres. The primary technique for endovascular occlusion of ACoA is represented by the coil embolization. However, the high rate of small and complex aneurysm for this location and adjacent anomalies of the ACoA segment made this

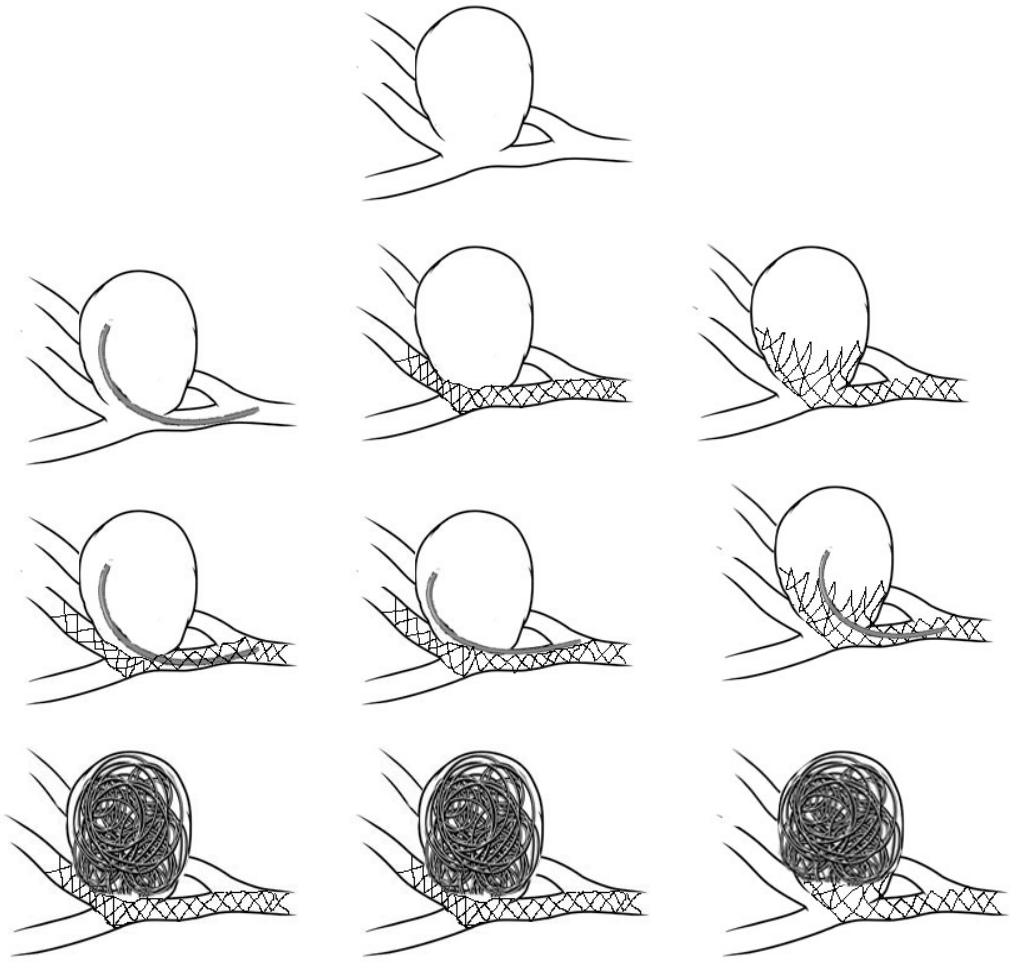
first option technique more difficult to be applied. It is well known the difficulty of coil embolization of wide-neck aneurysm. For these challenging situations a variety of adjuvant techniques and devices were developed. The remodelling techniques with balloon or microguidewire, and stent assisted technique are the most widespread. Detachment of coils in the aneurysmal sac under the protection of a temporarily inflated balloon over the aneurysmal neck has been shown to be associated with lower rate of progression of occlusion and higher rate of retreatment and procedural complication for ACoA location.

The stent assisted technique consists in deployment of a self-expandable stent in the parent artery over the aneurysm neck. The stent serves as a scaffold to prevent the coil protrusion into the parent artery or the thromboembolic event due to en earlier coil migration into the parent vessel. Also, the stents contributes to en earlier thrombosis of the aneurysmal sac by its hemodynamic effects of blood flow redirection and neointimal overgrowth stimulation by its biological properties.

There were described various intervention strategies regarding the time of stent deployment in relation with coiling. Thus, the stents can be detached before or after the microcatheter is placed into the aneurysm sac. In so called "jailing" technique the microcatheter is introduced into the aneurysm before the stent deployment. By this method, the microcatheter is placed between the vascular wall and the stent, which gives it a good stabilization during coiling. In the "trans-cell" technique, the microcatheter is placed into the aneurysm sac through the mesh of stent [1,2,4,7,8].

In particular cases of aneurysm incorporating both A2 and ACoA or in acute angles configuration between the parent and distal arteries, the "waffle-cone" technique is the best alternative. This method consists in deployment of the distal end of the stent into the aneurysm lumen and the proximal end in the afferent vessel. The major advantage of this method is the preservation of the parent artery patency.

Complex wide-necked ACoA aneurysm may also be endovascular treated by the "dual stent" technique. In this method 2 stents are deployed in X or Y configuration at the anterior communicating artery (ACoA) complex. The dual stent X-configuration is an optimal method in cases of large neck aneurysm involving both A1-A2 junctions, with ACoA partially incorporated within the sac and both A2s originating from the aneurysm. In such arrangement the first stent is deployed from the contralateral A2 to the ipsilateral A1 segmeng, crossing through the ACoA and the second stent is crossed from the other side. Usually, the side with the smaller angle between the A1-ACoA and contralateral A2 is stented first. The dual stent X-configuration could also be applied in two techniques: - the "kissing" technique with the stent deployed in a parallel fashion; - the "crossing" technique with the second stent is passed through the first stent interstices [1,2,4,7,8,9].



"jailing" technique "trans-cell" technique "waffle-cone" technique

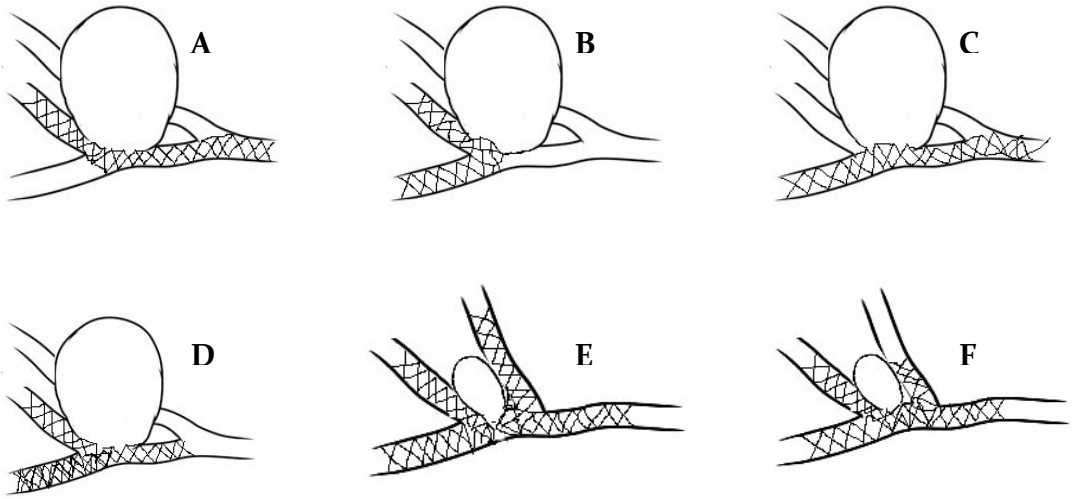


Figure 1 - Single stent possible configurations A – ipsilateral A1 to contralateral A2; B – ipsilateral A1 to A2; C-ipsilateral A1 to contralateral A1; Double stent configurations D – Y configuration; E – X / kissing configuration; F – X / crossing configuration [8,9]

If the X configuration technique is indicated in patients with both normal caliber A1, the dual stent Y-configuration is reserved for patients with hypoplasia/aplasia A1 on one side, and the aneurysm neck involving the ipsilateral A2 and ACoA. In this technique stents are deployed through the large-sized A1 in the bilateral A2 artery[8,9].

Stent assisted coil Procedure

The procedure is performed with the patient under general anesthesia. The double anti-platelet medication is mandatory initiated before the procedure. The loading dose varies depending on the treatment of a ruptured or unruptured aneurysm. 75 mg of acetylsalicylic acid and additional 75 mg clopidogrel were administrated daily for 7 to 10 days before endovascular procedure in patients harbouring unruptured aneurysm. In case of patients presenting subarachnoid haemorrhage a "shock dose" of 300 mg acetylsalicylic acid administrated 30 minutes before starting the procedure followed by 5000UI heparin after the introducer sheath placement are performed. Both conventional and rotational intra-arterial digital subtraction angiography is performed for 3D reconstruction. The planning procedures imply complete evaluation of aneurysmal dome, neck size and anterior communicating complex configuration.

A 6F introducer sheath is placed usually into right femoral artery. A 6F Impulse guiding catheter (Boston Scientific) is then navigated into the internal carotid artery to obtain a stable position. The right or left side is chosen depending on the dominant A1 segment, calibre of the anterior communicating artery and predominant side of aneurysm injection. Then, a Excelsior SL-10

microcatheter (Stryker Neurovascular) with support of Transend 0.014 microguidewire (Boston Scientific) is introduced distally in the ipsilateral or contralateral A2 segment. The microguidewire is retired and a Neuroform Atlas stent (Stryker Neurovascular) is advanced into microcatheter and deployed when the precisely targeted location is confirmed. The deployment microcatheter is easy advanced over the stent delivery wire until it reached the neck aneurysm level. At this moment the stent delivery wire is retired and the 0.014 microguidewire is introduced into the microcatheter and navigated until the aneurysm dome. The aneurysm is catheterised via stent mesh and subsequently coiled with GDC-10 coils (Stryker Neurovascular). At the end control angiography images are performed to confirm the complete aneurysm occlusion. The microcatheter is then carefully retired followed by the guiding catheter and introducer sheath.

During the procedure heparinised saline is continuously administrated via a venous line. The patient is transferred to intensive care unit for clinical monitoring. The dual antiplatelet treatment is continued postoperatively for at least 2 month followed my mono- antiplatelet therapy.

Case report

A 52-year-old woman presented with sudden onset of worst headache of his life followed by single grand mall seizure. On admission to our emergency room the patient was confuse, agitated and vomiting. There were no focal deficits during neurological examination. Initial computed tomography (CT) scan showed thin subarachnoid hemorrhage into the base of the interhemispheric cistern. Three-dimensional (3D) CT angiography revealed an ACoA aneurysm with a bleb. Emergency endovascular coil embolization was decided to be performed. The diagnostic 3D digital subtracted angiography (DSA) showed ACoA aneurysm of which maximum diameter was 3.0 mm with broad-neck and a fragile bled on top. The initial coil embolization, was conceive to occlude the ruptured point of the aneurysm, was performed by the simple technique utilizing 1.5/2 mm nano platinum coils. After safety coil deployment the microcatheter is retracted from aneurysmal sac and guided to proximal part of left A2 segment. A 3/2.4 mm Neuroform Atlas stent was deployed from left A2 over the aneurysm neck and distal part of left A1 segment. Using a trans-cell technique the microcatheter is inserted again to aneurysmal sac. The aneurysm was completely angiographic occluded by deployment of two more coils. There were no peri-procedural complications or postoperative sever vasospasm. Follow-up CT scan was performed on postoperative day 14, revealing no ischemic or hydrocephaly signs.

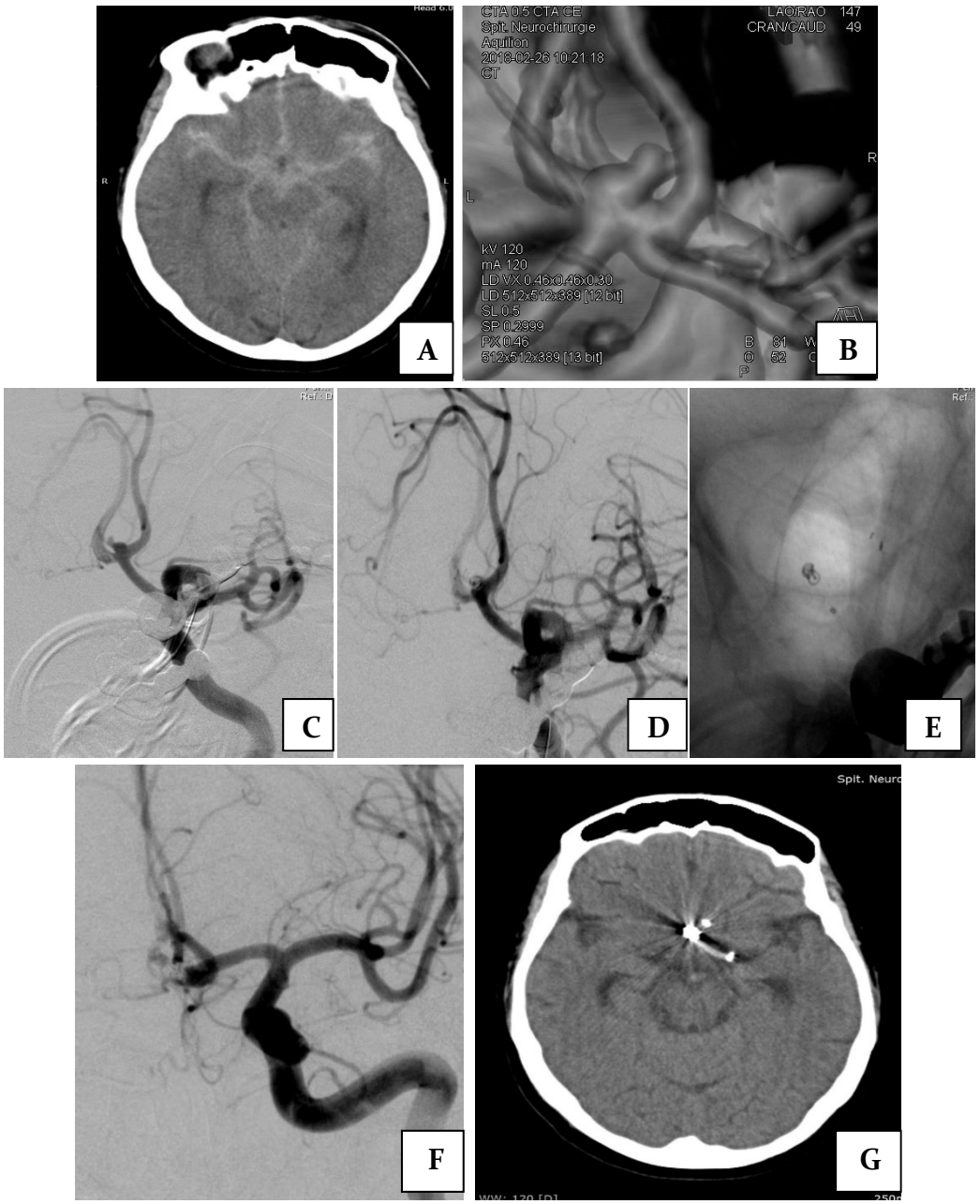


Figure 2 - A – Diagnosis CT scan showing SAH; B – 3D reconstruction of CTA; C- Diagnosis DSA; D – DSA control after first coil deployment; E – Fluoroscopy for stent complete deployment control; F – Control DSA after complete aneurysm coil occlusion; G – Postoperative CT scan control

Techniques complications

The thromboembolic events are the most common cause of morbidity and mortality associated to stent-assisted coiling technique. The literature studies reported values of rates of thromboembolic complications related to stent-assisted coiling technique ranging from 4.2 % to 17.1% [2,8,9]. Usually, these events are minor complications clinically silent or causing transient neurological symptoms. They may be diagnosed on later MRI investigation as a high-signal intensity lesion on diffusion-weighted image (DWI). However, the correct and careful use of double antiplatelet therapy significantly reduces intra and post procedural thromboembolic risks. The debates are still existing concerning this therapy in patients with subarachnoid haemorrhage and unprotected aneurysm in which an accidental intraprocedural rupture occurs.

Delayed in-stent stenosis is a rare event that can be clinically silent which may require sometime additional treatment. The rate of in-stent stenosis was reported between 2.5% (Biondi et al) and 29.7% (Wingspan) and a percutan transluminal angioplasty was performed in majority of cases[6,8].

Stent dislodgement is another complication reported during treatment. This technical problem may be caused by aneurysm catheterization through the stent struts and by retrieving the coiling catheter jailed between the stent and vessel wall. In most of the reported cases the stent still covered the aneurysm neck and procedure was completed successfully. In case of exposure of a portion of aneurysm neck with the possible risk of coil herniation into the parent artery, a secondary stent was deployed across the aneurysm neck.[8]

The intraprocedural aneurysm perforation is another important complication reported for stent-assisted coiling technique. Disastrous clinical outcome were reported by the most studies in this situation. The coil protrusion between the stent and the parent artery wall with a reduction of distal outflow was also reported as technical complication of this procedure.

The long-term aneurysm recanalization was reported by literature studies but with lower rate (13.1%) suggesting that this technique is an effective and durable treatment for complex AcoA aneurysms. In this regard, most authors argued that stenting in aneurysms confer a protective effect, stopping especially minor recanalization and thus avoiding the need for additional treatment.[2,10,11]

Discussions

Complex anterior communicating artery aneurysms are still challenging lesion for both surgical or endovascular approaches. Because most of the studies of anterior circulation aneurysms show for anterior communicating artery aneurysm the higher incidence of postoperative morbidity, the endovascular approaches became the main treatment option. Unlike other intracranial aneurysms, the embolization of anterior communicating artery aneurysms are more challenging due to increased incidence of small and complex aneurysm configuration and common anatomical vascular variants. In these

situations, the endovascular treatment requires application of adjuvant technique like stent-assisted coil embolization. First described by Higashida in 1997, as treatment option for wide-necked aneurysm was also applied for complex anterior communicating artery aneurysms[2,8,9].

Besides the role of mechanical support for the colis arrangement into aneurysm, hemodynamic and biologic favourable effects of intracranial stenting were highlighted in the literature.

The jailing technique and the trans-cell technique are the two type of stent-assisted coiling intervention used by the interventionists. Numerous studies have shown the efficiency of using both techniques with the limits and benefits of each [3,4,5].

Most of the literature reports showed that stent-assisted coil embolization of intracranial aneurysms lead to a lower rate of immediate complete aneurysm occlusion compared with simple coiling technique. The main cause associated with these results was the more limited manoeuvrability of the coiling microcatheter after the stent deployment due to its fixation between the wall stent and arterial lumen, or passing through the stent struts.

The anatomy of the anterior communicating artery complex plays an important role in stent assisted treatment of anterior cerebral circulation aneurysms. The presence of hypoplastic A1 segment, small AcoA and difficult angles between A1, AcoA and A2 are important factors for stent placement.

The double stent placement has been described in some series for the treatment of complex and wide-neck aneurysms. The two stent may be used in X or Y configuration. X and Y stent-assisted coiling of AcoA aneurysms is an effective technique, leading to long-term stability of aneurysm occlusion. Nevertheless, a higher rate of technical failures and clinical complications were reported compared with those of other endovascular techniques, such as single stent–assisted coiling or balloon-assisted coiling[9].

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