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Coil entrapment in temporary stent-assisted coiling of wide-neck aneurysm: a case report

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Abstract

Background Endovascular treatment of the wide-necked aneurysm is still challenging. Temporary stent-assisted coiling (TSAC) was introduced to manage the ruptured wide-necked aneurysms to avoid the long-term use of dual antiplatelets as well as improving aneurysm filling with coils.

Case presentation Here, we reported a case of the coil entrapment into the stent device during TSAC for the treatment of a wide-necked large ruptured aneurysm. Patient presented with loss of consciousness following diffuse subarachnoid hemorrhage due to a wide-necked large aneurysm located in the left ICA bifurcation. During treatment of aneurysm with TSAC technique, the stent could not retrieve and re-sheath because of coil entrapment in the stent struts. Consequently, the stent was released by cutting the pushing wire at the puncture site.

Conclusion Entrapment of coils in the stent struts is a very rare technical complication of TSAC method. It is essential to be aware of this side effect and how to avoid.

Keywords Subarachnoid hemorrhage, Cerebral aneurysm, Temporary stent, Solitaire, Coil embolization

Background

In wide-neck aneurysm, preservation of parent arteries is technically challenging by endovascular treatment (EVT). Various techniques were developed, including remodeling balloon and stenting, to prevent prolapse of coils into parent arteries [1]. In stent-assisted coiling, long-term dual antiplatelets are usually required to prevent in-stent clot formation and thromboembolic complications [2]. During acute phase of subarachnoid hemorrhage [3], antiplatelets could be dangerous and jeopardize the outcome of other neurosurgical procedures, such as external ventricular drainage (EVD) and decompressive craniectomy [4]. In place of permanent stenting, some authors proposed and stablished temporary stent-assisted coiling (TSAC) to remodeling the aneurysm neck avoiding the coil protrusion into the parent artery [5]. As the stent is removed at the end of procedure, patients do not usually require long-term antiplatelet drugs after procedure. However, potential coil entrapment in the stent struts and thromboembolic events could be a rare but a major complication of this technique. Here in, we present this rare devastating complication of TSAC, performed for the treatment of a ruptured aneurysm in acute phase of SAH and also how to prevent their occurrence.

Case presentation

A 46-year-old female presented with sudden loss of consciousness (World Federation of Neurosurgical Surgeon 4, GCS 8). Brain computed tomography scan (Fig. 1A) and brain computed tomography angiography showed diffuse SAH and a large aneurysm, located in the left terminal ICA. She was intubated, and EVD was immediately

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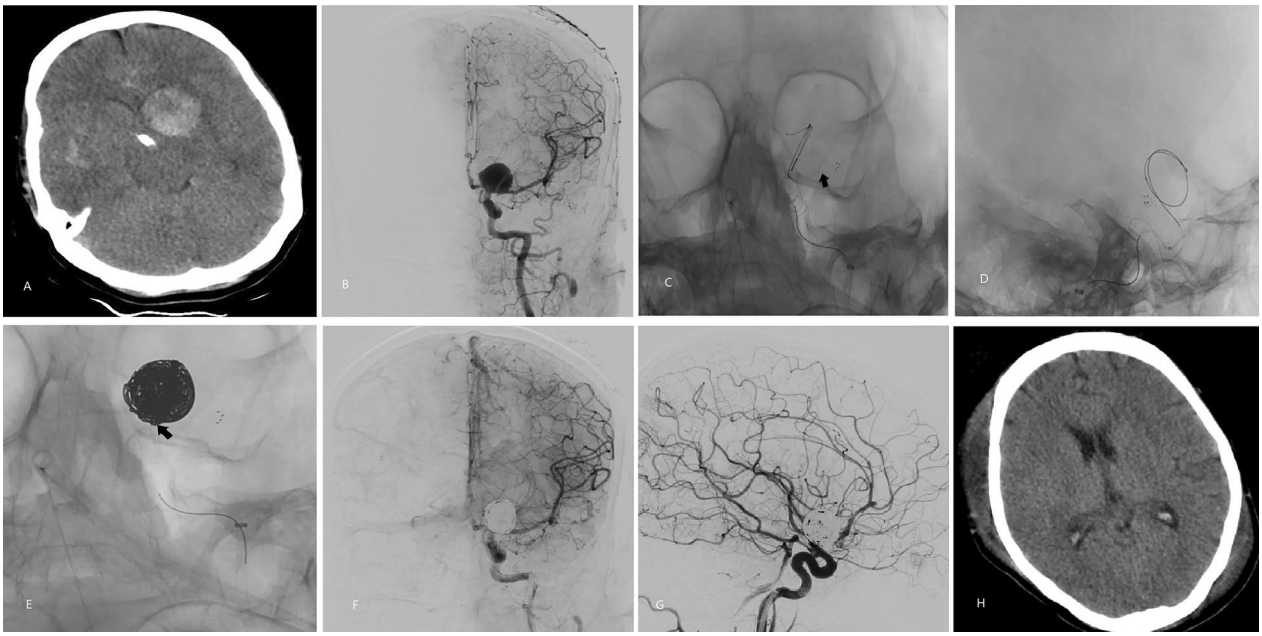

Fig. 1 **A** Brain CT scan showed diffuse SAH and aneurysm (arrow), **B** brain angiogram (AP) showed a large aneurysm in the left ICA bifurcation, left ACA junction, and left MCA bifurcation, **C**, **D** single shot during angiogram showed solitaire FR, deployed in parent artery across the aneurysm neck (arrow), **E** probable site of coil entrapment in solitaire FR (arrow), **F**, **G** brain angiogram (AP and lateral) after aneurysm closure with coils at the end of procedure, and **H** brain CT scan at day 4th, showing no infarct

inserted. She was transferred to intensive care unit (ICU) and remained intubated and full-sedated. Sixty-mg nimodipine every 6 h were started. Systolic blood pressure was maintained under 160 mmHg. After discussion with her family, it was decided to treat the aneurysm with endovascular approach in a multidisciplinary meeting. Before procedure, 180-mg ticagrelor and 80-mg ASA were given to patients through nasogastric tube. Three-dimensional rotational cerebral angiography and cerebral angiogram showed a large aneurysm, located in the left terminal ICA with size of 16 in 15-mm width (Fig. 1B). Aneurysm neck was 8 mm. Due to aneurysm structure and parent arteries; it was decided to treat the aneurysm by TSAC technique. For the endovascular treatment, an angiographic biplane (Artis Zee with PURE®, Siemens Healthcare GmbH, Germany) was utilized. The radial approach was used, and guiding catheter was navigated into high cervical part of the left internal carotid artery. The Echelon 10 is navigated into the aneurysm. Then, Rebar 18 is navigated into left middle cerebral artery, and solitaire FR 4*20 (Covidien, Irvine, CA) was implanted across the neck of aneurysm, jailing the Echelon microcatheter (Fig. 1C and D). Then, the aneurysm was completely closed by 9 Target coils (Neurovascular Stryker, Fremont, USA) (Fig. 1E–G). After completely impacting the aneurysm with coils, it was tried to recapture the solitaire FR that was unsuccessful. With each attempt to recapture the stent with the Rebar microcatheter, the microcatheter could not advance over the stent as the coils blocked its way. Then, it was tried to retrieved solitaire FR without re-sheathing it that was unsuccessful as each time the pulling back of the stent induced the dramatic drawback of the coils and aneurysm with stent. After multiple unsuccessful attempts, it was decided to leave the stent in place. As the stent was solitaire FR and it was not possible to detached the stent from the push wire, the wire is cut at the wrist leaving the wire all the way from the ICA to radial artery puncture site. Twelve mg of eptifibatide was infused immediately. The patient was transferred to ICU. 7.5-mg eptifibatide was infused hourly for 6 h in ICU. Nimodipine 60 mg every 6 h was continued with maintaining ICP under 20 mmHg using CSF drainage by EVD. Next day she became more alert without any apparent neurological deficit. Two days after EVT, she experienced active bleeding from a laceration in base of her tongue. The lesion was sutured to stop the bleeding. In day 4th, brain CT scan was unchanged without any ischemia (Fig. 1H). In day 5th, she experienced fever, tachycardia, tachypnea, hemoptysis, and hypoxia (O_2 saturation of 76%). Laboratory tests showed a high WBC of 15,500/mm^3 with 89% neutrophils. Lung CT scan showed bilateral multiple consolidations suggesting acute aspiration pneumonia and acute respiratory distress syndrome. The patient was treated with appropriate

mechanical ventilatory support (high PEEP and low tidal volume) and broad-spectrum antibiotic therapy. In day 6th, she died due to respiratory failure despite treatment.

Discussion

EVT of wide-neck aneurysms is usually challenging for preservation of the parent arteries as the coils could protrude into parent arteries. Therefore, various strategies were introduced. The most common strategies are permanent stenting of parent/branch arteries, balloon remodeling technique, or combine. While stent-assisted coiling (SAC) results in higher rate of aneurysm occlusion and lower risk of recanalization, it has two drawbacks. First, it has a higher risk of thromboembolic events [6]. Second, it mandated the long-term use of dual antiplatelets to prevent in-stent thrombosis and thromboembolic events [7]. Contrary balloon remodeling, another wonderful approach for EVT of wide-neck aneurysm, eliminates the need of the long-term dual antiplatelets [8]. However, balloon has its disadvantages. Like stent, it has higher risk of thromboembolic events [8]. Moreover, it is more rigid than the delivery microcatheter of stents and sometimes could not navigate in the tortuous arteries to reach to distal arteries [9]. In addition, it may be large to fit very small arteries for covering the neck of aneurysm without endangering the parent artery [9]. Furthermore, when aneurysm neck is largely involved both branch arteries, balloon may not sufficiently cover the neck and may not protect the parent and branch arteries [8]. In latter situation, two balloons could be mounted to protect both parent and branch arteries, but it could also increase the complication [10].

TSAC has been introduced to bring the benefits of both balloon and stent simultaneously and reduced the risk of thromboembolic complications as well as bleeding events due to dual antiplatelet therapy [1, 5, 9, 11, 12]. In this technique, the stent is partially or completely delivered to protect the aneurysm neck during coiling, and at the end of procedure, the stent is completely removed. Various stents or stent-like devices were used for this technique that could be divided to detachable stent and non-detachable stent. The first group includes Barrel stent (Medtronic), Enterprise (Codman Neurovascular, Raynham, MA, USA), Leo (Balt, Montmorency, France), and solitaire AB (Medtronic, Minneapolis, Minnesota, USA). They could be removed or delivered permanently at the end of procedure. The second group includes solitaire FR (Covidien, Irvine, California), Comaneci device (Rapid Medical, Yokneam, Israel), and Cascade (Perflow, Israel). These devices could not be detached and implanted permanently in place and should be removed at the end of procedure. While the procedure was reported successful in more than 90% of the patients [1, 5, 11, 13], the operators were obliged to permanently implant the stent in few occasions to prevent the protrusion or migration of coils into the parent arteries [1, 11]. Technically, the studies showed that stent could be recaptured without any complication in the majority of TSAC procedures. However, there is usually concern about entrapment of coils in the strut of stent-like devices and snaring of coils during stent recapturing. In our knowledge, our case was the first case in the literature, in whom the entrapment of coils in the stent prevented the advancement of microcatheter over the stent (solitaire FR) to re-sheathing and also prevented to retrieve the stent due to the pulling back of the coils and aneurysm (Fig. 2). When the strut is large as in the stent of solitaire AB/FR, the risk of coil entrapment could be higher. With smaller struts in the Cascade or Comaneci devices [14, 15], the risk seems to be lower than solitaire AB/FR [11, 14]. Moreover, a large aneurysm with very wide-neck could have more risk of coils entrapment than small wide-necked aneurysms. Large aneurysms need larger coils that could easily protrude from their wider neck into the stent and entrapped in the stent struts. The risk may be more during the first coils when the neck of aneurysm is usually framed and also during the last coils as microcatheter is around the neck and small coils could easily bulge into the stent struts. We think that the entrapment of coils could be avoided if the stent is re-captured across the neck of aneurysm after deployment of each coil and before its detachment to assess the re-sheathable of stent especially for the first and the last coils in the large aneurysm. Although there

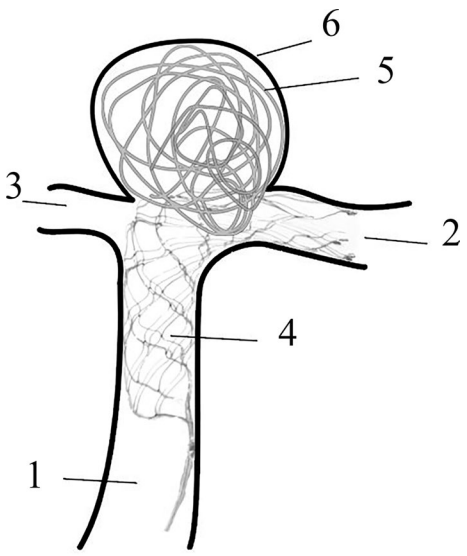

Fig. 2 Schematic illustration showing entrapment of coils in the stent struts. 1. Internal carotid artery, 2. Middle cerebral artery (M1), 3. Anterior cerebral artery (A1), 4. Solitaire FR stent, 5. Coils, and 6. Aneurysm

is usually the potential of protrusion of the coils during re-sheathing the stent. This complication could jeopardize the whole procedure when the stent could not detach like solitaire FR, Comaneci device, and Cascade. In this situation, the only option is cutting the pushing wire at the puncture site and leaving the wire all the way from the parent artery to skin. The remained stent and pushing wire could increase the risk of thromboembolic events not only in the brain but also in other part of body. While antiplatelet should be administered intravenously after the deployment of stent, the long-term dual antiplatelets are mandatory. In the patients with ruptured aneurysms, dual antiplatelets could increase the risk of bleeding following neurosurgical operation, like external ventricular drainage insertion and complicating the treatment of these patients [4, 9, 16]. Maybe it is reasonable that the detachable stent device is used for TSAC procedure in patients with wide-necked large aneurysm, who could have high risk of coil entrapment. Furthermore, it could be reasonable to discuss and consider the surgical approach, its advantages and its disadvantages, in complex ruptured aneurysms both in multidisciplinary meeting and with the patient and/or the patient's family.

Conclusion

We present a case of coil entrapment in the stent device following TSAC technique for the treatment of a large ruptured aneurysm. Although TSAC has a high successful rate, our case showed a rare but severe drawback of this technique mainly when a nondetachable stent device is used. The operators who used TSCA technique for the treatment of ruptured aneurysm need to be aware of this potential risk especially in the wide-necked large aneurysms. It could be prevented with re-sheathing the stent device before deployment of each coil and repositioning the coil if the microcatheter could not advance over the stent.

Abbreviations

EVD	External ventricular drainage
EVT	Endovascular treatment
ICU	Intensive care unit
SAC	Stent-assisted coiling
TSAC	Temporary stent-assisted coiling
SAH	Subarachnoid hemorrhage

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Author contributions

HB designated the work. FQMS, FE, SN, and ME collected the data. HB and FQMS analyzed the data. FQMS and HB wrote the manuscript draft. HB, FE, and SN reviewed the manuscript critically. HB was the supervision of study. All authors reviewed the results and approved the final revision of final manuscript.

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Availability of data and material

None applicable.

Declarations

Ethics approval and consent to participate

All procedures performed in this case report involving human participant were in accordance with the ethical standards of the institutional and/or national research committee of Mashhad University of Medical Sciences ethical committee approved the study (http://ethics.research.ac.ir/IR.MUMS.REC.1401.139).

Consent for publication

The patient provided written informed consent and consented to the submission of the case report to the journal.

Competing interests

The authors declare that they have no competing interests.

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