

# Neurovascular News

WINTER 2020



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## Spontaneous Cervical Artery Dissection

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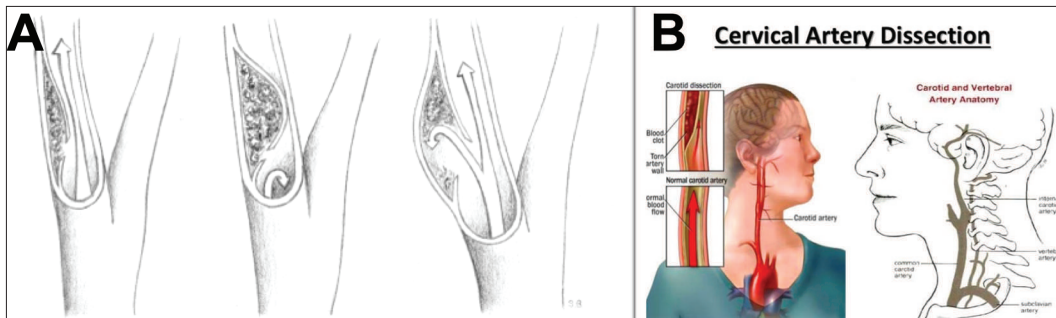
### Background

An acute and spontaneous compromise of the arterial wall of cervical vessels can lead to what is known as a cervical artery dissection (CAD). This entity is part of the differential diagnosis among patients that suffer from an ischemic stroke. CAD is a common underlying cause (up to 20%) of ischemic strokes among young individuals, but it can occur at any age. A dissection within the arterial wall of extracranial vessels in the neck, such as in the cervical portion of the internal carotid artery or the vertebral artery, can be a consequence of a traumatic event (e.g. accidents, chiropractic maneuver involving abrupt neck movements). However, a high proportion of dissection cases are spontaneous in nature, and this is thought to be due to an underlying connective tissue disorder. Previous reports have also examined the degree of tortuosity in cervical vessels, hypothesizing that having a tortuous vessel might be a phenotypic expression of an undetected connective tissue disorder (Fig. 1).

### Clinical Presentation and Diagnosis

Once a dissection takes place, some patients remain asymptomatic, while others develop symptoms which range from mild localized pain or headaches, to transient ischemic attacks or an ischemic stroke. This hemodynamic compromise happens as a result of a gradual stenosis or occlusion within the vessel intimal layer, which leads to a gradual decrease in the vessels luminal area and therefore, cerebral hypoperfusion. This clinical scenario of the dissection can occur within hours to days. Additionally, the dissection itself can lead to activation of clotting factors and result in embolic events. Touzé et al. reported their findings from 457 patients that had a CAD, and after a follow-up of almost 3 years, they observed 4 ischemic strokes and 8 TIAs, which resulted in a reported risk of 0.9% and 1.8%, respectively.

Suspicion of a cervical dissection usually arises whenever a patient has a sudden onset headache, localized neck pain, ischemic symptoms or a given localized neurologic deficit, such as Horner's syndrome ipsilateral to a dissection. Once this diagnosis is considered, we usually perform a CTA or MRA. The treating



▲ **Figure 1. Cervical artery dissection.** Panel A, left-to-right. A cervical artery dissection with stenosis, an occlusive dissection, and an aneurysmal dissection. Panel B, showing the level of a cervical artery dissection.

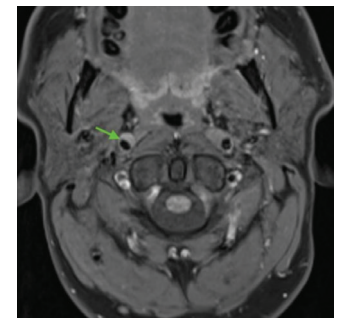
neurosurgeon looks for the integrity of the entire cerebral vasculature, both intracranial and extracranial. To diagnose a cervical dissection, we look for specific findings on imaging, such as luminal narrowing, or radiographic changes suggestive of arterial wall expansion or a hematoma within the layers of the vessel wall (crescent sign) on axial imaging (Fig. 2).

### Treatment

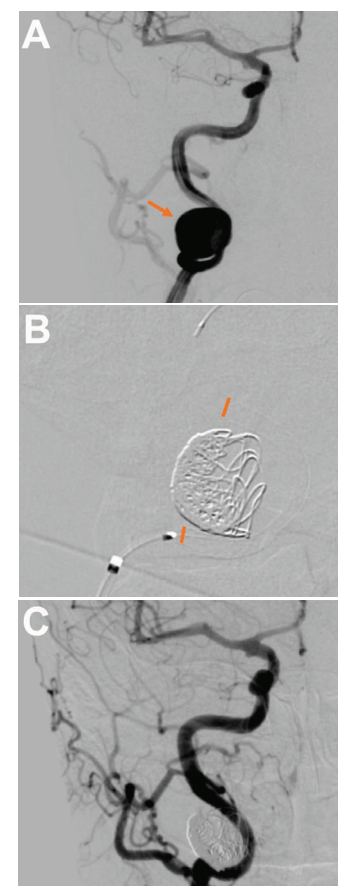
The primary purpose of treating a patient with a cervical dissection is to avoid ischemic complications, such as embolic events due to increased localized coagulation at the place of dissection. The recurrence of extracranial dissections is not well described, and treating these patients is primarily focused on avoiding thrombi formation and prevent an ischemic event. Patients that present with an ischemic symptom can be treated with either anticoagulation or antiplatelet therapy. Both type of agents demonstrate adequate safety without any significant effect in terms of enlargement of the intramural hematoma at the extracranial dissection site. Nonetheless, the effectiveness of such treatments still remains controversial. The largest trial evaluating both anticoagulation and antiplatelets found that the rate of recurrent stroke did

not differ between therapies, showing no significant superiority between modalities. On the other hand, patients that lack ischemic symptoms are usually treated with antiplatelet therapy. As for duration of treatment and follow-up protocol, most dissections tend to resolve within 3 to 6 months and it is current practice to follow-up these patients for assessment of the affected vessel at 3-6 months after dissection onset. The majority of patients with a spontaneous extracranial dissection have a favorable prognosis with a relative low rate of recurrence. Occasionally, a pseudoaneurysm will enlarge after dissection and require treatment (Fig. 3).

At Beth Israel Deaconess Medical Center, we are designing a multicenter study to assess the correlation between the development of cervical dissections and the cervical tortuosity index, which is a factor known to be correlated with an underlying connective tissue disorder. This study will compare the mentioned index between patients with a CAD and those with healthy cervical vessels. Furthermore, this index will be utilized to evaluate procedure related outcomes (e.g. time-to-recanalization, change in endovascular approach) in stroke patients that undergo mechanical thrombectomy.



▲ **Figure 2. Crescent sign in a patient with a cervical artery dissection.** A magnetic resonance angiography showing a right-sided cervical artery dissection with a “crescent sign” which represents a higher signal within the vessel wall due to the formation of a mural thrombus.



▼ **Figure 3. Angiographic studies of a right-sided cervical pseudoaneurysm.** Panel A, demonstrates a diagnostic angiography with a 15 x 15 x 15 mm distal cervical pseudoaneurysm secondary to an internal carotid artery dissection; Panel B, shows a lateral intra-procedural angiographic image demonstrating a deployed pipeline embolization device along the lumen of the right-sided cervical internal carotid artery. The orange lines delineate the limits of the flow diverting device; Panel C, a follow-up angiographic image at six months demonstrating a successfully treated pseudoaneurysm without any filling remnant.

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## Partially Thrombosed Aneurysms

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Partially thrombosed intracranial aneurysms (PTIA) represent a unique subset of intracranial aneurysms with an ill-defined natural history, posing challenges to standard management strategies. These aneurysms are often large or giant in size and while they can present with aneurysmal subarachnoid hemorrhage (aSAH), a more insidious presentation due to mass effect is more common.<sup>1</sup>

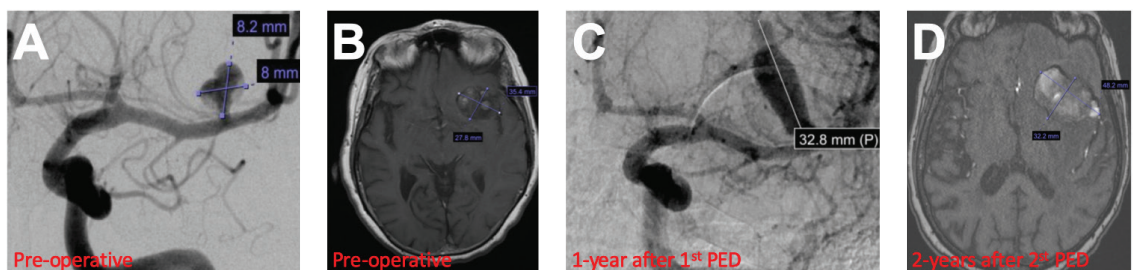
Their size coupled with the presence of organized thrombus makes surgical obliteration challenging and can require advanced techniques complicated by mortality rates of 6%, and unfavorable outcomes in 18%. Standard endovascular embolization with detachable coils has also yielded unsatisfactory long-term results due to continued aneurysm growth and recanalization rates as high as 78%.<sup>2</sup>

Placement of flow diverting stents within the parent artery obviates the need to enter or manipulate the PTIA, potentially reducing complication rates. The durability of aneurysm occlusion following parent artery reconstruction also has the potential to

overcome shortcomings of traditional endovascular techniques while avoiding parent artery occlusion. However, continuous thrombosis has been thought to lead to destabilization of aneurysm wall and predispose to rupture, and the effect of pre-existing thrombus on this risk is not known.

At the Beth Israel Deaconess Medical Center Brain Aneurysm Institute, we sought to answer this question. To this end, we organized a multicenter collaboration including five major academic institutions in the United States. The study was designed as a retrospective review of consecutive patients with a partially thrombosed intracranial aneurysm treated with a flow diverting stent between 2009-2018.

The findings of this study, recently published in the neurosurgical literature,<sup>3</sup> consists of 50 patients with 51 PTIAs and represents the largest series of partially thrombosed intracranial aneurysms treated with placement of flow diverting stents to date. This series observed a complete occlusion



**▲ Figure 1. Radiologic appearance of a thrombosed intracranial aneurysm with flow diversion:** Panel A demonstrates an angiographic study with an 8 mm intracranial aneurysm arising from the left middle cerebral artery; Panel B, shows a magnetic resonance image demonstrating the thrombosed portion of the intracranial aneurysm, revealing larger than 3 cm aneurysmal sac; Panel C, demonstrates persistent filling portion of the aneurysm after flow diversion treatment at 1 year follow-up; Panel D, magnetic resonance study showing the thrombosed aneurysm and progressive enlargement of the aneurysmal sac.

rate of 77% over a median follow-up of 25 months. There were 5 ischemic neurologic complications, 4 patients developed new symptoms, and 2 mortalities occurred. Therefore, flow diversion treatment of partially thrombosed intracranial aneurysms carries adequate efficacy along with a reasonable safety profile. Additionally, aneurysms with more than 50% thrombosis prior to treatment were associated with lower rates of complete occlusion compared to aneurysms with less than 50% thrombosis (58.8 vs 87.1%,  $p = 0.026$ ). PTIAs have a unique pathophysiology and their development and growth is hypothesized to contribute to the reduced efficacy when compared to treatment of “berry aneurysms”. Considering the challenges of treating large and giant partially thrombosed aneurysms, the results support the use of flow diverting stent for these aneurysms.

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## Trends of Ruptured and Unruptured Aneurysms Treatment in the United States: A Decade of National Data

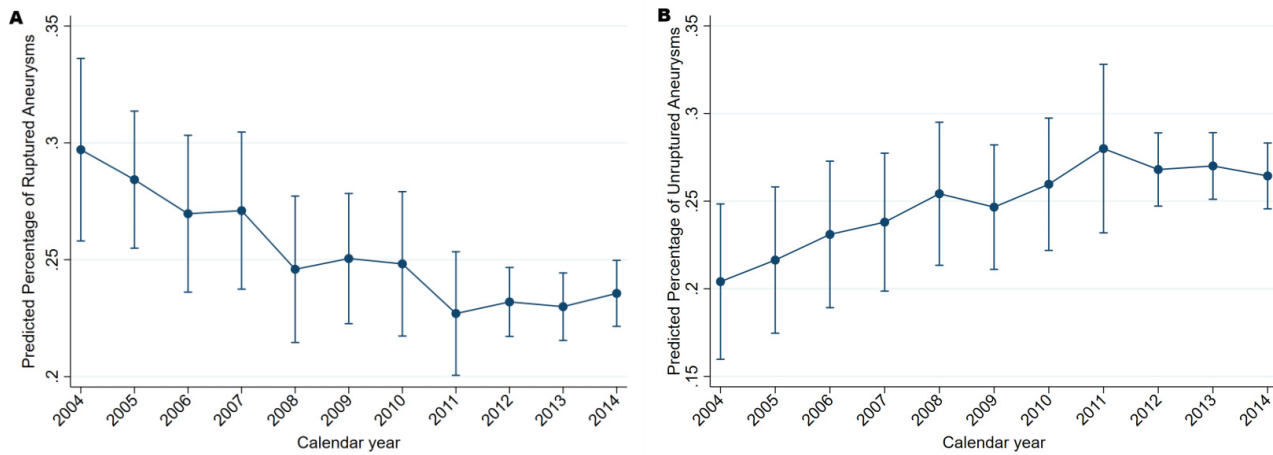
Mohamed M. Salem, MD, MPH, Christopher S. Ogilvy, MD, Ajith J. Thomas, MD, Justin M. Moore, MD, PhD

Spontaneous subarachnoid hemorrhage (SAH) is a devastating condition after which approximately one third of patients die and another third become severely disabled<sup>1</sup>. Intracranial aneurysm rupture (aSAH) is the most common cause, accounting for approximately 80% of cases<sup>1</sup>, is the most common cause. Increased access to high quality intracranial imaging has resulted in an exponential increase in the rate of diagnosis of incidental unruptured intracranial aneurysms. Recently, techniques for treating both unruptured and ruptured aneurysms have undergone a paradigm shift with publication of the results of the International Subarachnoid Aneurysm Trial (ISAT), which supported the use of novel endovascular procedures for the treatment of ruptured aneurysms<sup>2</sup>. Previous data using the National Inpatient Sample (NIS) found that between 1998 and 2007, there was a significant increase in the number of interventions being performed on unruptured aneurysms, while the rate of ruptured aneurysms treated remained stable<sup>3</sup>. While this work has not recently been updated, it is likely that this trend has continued with further technological advancements in both radiological imaging and endovascular interventions.

The indications and method of treatment depend on a variety of well-documented factors including

age, co-morbidities, family history, aneurysm angioarchitecture (size, morphology and location), and previous aneurysmal rupture. Nevertheless, to date, only generic guidelines are available to inform surgeons, leading to significant intra-institutional variations in treatment protocols. It is unclear whether the increase in unruptured aneurysm treatments has led to a reduction in aSAH, the primary aim of such treatment, and whether unruptured aneurysms are being overtreated exposing patients to unnecessary procedural risks. At Beth Israel Deaconess Medical Center, the neurovascular research group sought to answer this by simultaneously quantifying the rates of interventions for unruptured cerebral aneurysms and aSAH presentation over an 11-year period. The aim is to assess if there has been an association between the current treatment trends of unruptured intracranial aneurysms and the incidence of ruptured aneurysms nationwide, in the setting of the post-ISAT trial era.

Using the National Inpatient Sample (2004-2014), which contains around 8 million admissions data annually from hospitals all over the United States, we found that for each year passing after 2004 (two years after publication of the findings from the ISAT trial), there was a significant decrease in the risk of



**▲ Figure 1.** Predicted percentages of patients hospitalized for ruptured (A) and unruptured (B) intracranial aneurysms, compared to matched control of patients hospitalized for other indications, over the period of 2004–2014. Predictions were made using univariable logistic regression for the relative risk ratio of each aneurysm hospitalization category against the matched control, and the margin plots were derived using predicted probabilities. Analyses were adjusted for the National Inpatient Sample (NIS) database survey design.

being hospitalized for subarachnoid hemorrhage secondary to ruptured intracranial aneurysm, when compared to being hospitalized for any other cause, and accounting for differences in hospital size, region and type (Fig. 1A). In contrast, for patients with an unruptured intracranial aneurysms, we found that each year passing after 2004 brought a non-significant increase in the risk of being hospitalized for treatment of an unruptured aneurysm, when compared for any other cause, accounting for hospital size, region and type (Fig. 1B).

While direct causality cannot be confirmed, these findings indirectly suggest that the decrease in treated aSAH is potentially the result of selective targeting of the “high-risk” unruptured aneurysm population to undergo treatment and thus potentially preventing their progression towards rupturing. This decrease corresponds with a higher incidence of unruptured aneurysm procedures over the past years and may be an indirect indication of the effectiveness of such procedures. These findings must be interpreted with caution, given the nature of the NIS data and its inherent limitations. Our data is consistent with the underlying clinical assumption, that treating unruptured aneurysm ultimately will reduce the risk of aSAH.

The fact that subarachnoid hemorrhage procedures have been on the decline over the past few years serves as a promising indication for both the public and the neurovascular medical communities, that the current practices of unruptured aneurysm clipping and coiling are becoming more effective and may be conferring a degree of protection to the population captured by the National Inpatient Sample database. This evidence serves to reinforce current policies and guidelines for treating unruptured intracranial aneurysms.

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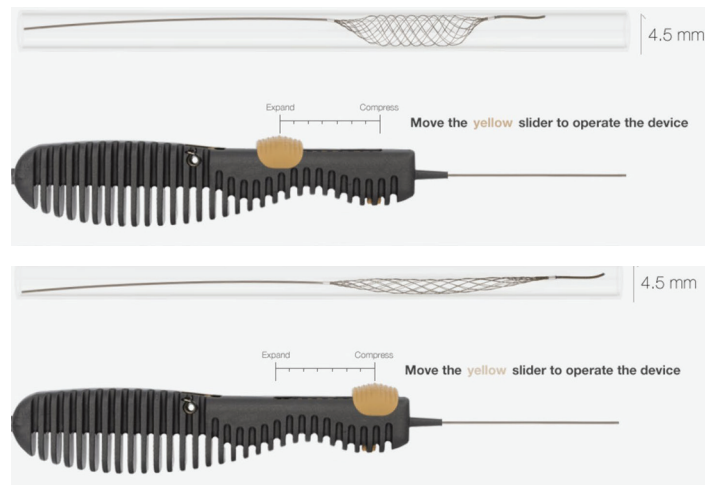
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# New Device to Help in the Treatment of Wide Necked Aneurysms

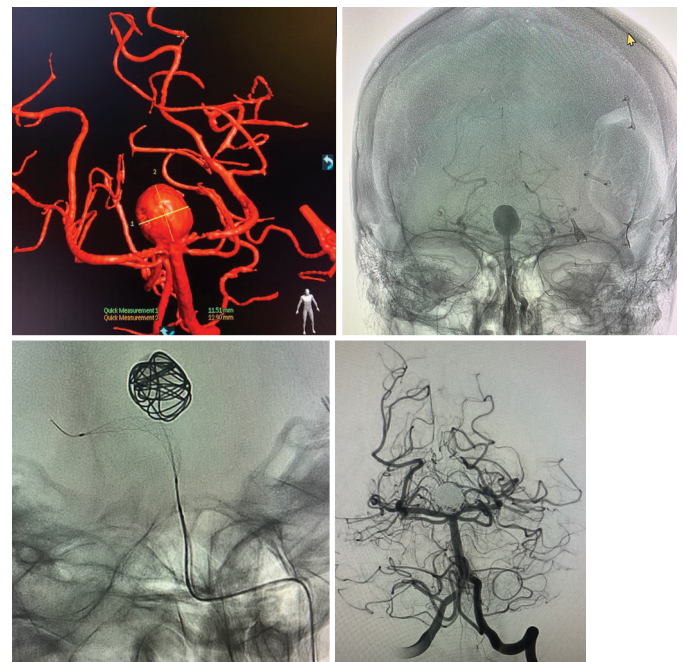
T. Matthew Robinson, MD, Ajith Thomas, MD, Christopher S. Ogilvy, MD

The types of devices available for treating intracranial aneurysms continue to evolve. One concept for 'wide necked' aneurysms is to use a stent in the artery to provide a scaffold to help coils that fill the aneurysm stay well placed in the aneurysm. The stent stays in place permanently and dual antiplatelet therapy is needed. Another technique to help with wide necked aneurysms is to temporarily inflate a balloon in the parent artery while coiling the aneurysm. One downside of this technique is vessel occlusion leading to ischemic stroke. A new concept to help and treat wide necked aneurysms is to use a stent across the neck during coil deployment and then remove the stent. This allows for bloodflow in the artery while coiling. The Comaneci device (Rapid Medical) is just such a temporary coil embolization assist system. (Fig. 1)

The BIDMC Brain Aneurysm Institute recently performed an endovascular embolization of an unruptured brain aneurysm using this system. The patient was facing chemotherapy for a treatable lymphoma and dual antiplatelet therapy was to be avoided. This was the first use of this device in Boston, MA. The device received FDA clearance in May 2019. The Comaneci device is designed as a compliant mesh used to temporarily bridge the neck of the aneurysm to support coil occlusion without compromising flow in the parent artery.<sup>3</sup> Patients harboring wide necked aneurysms traditionally pose a higher risk of treatment with endovascular therapy due to the requirement for an adjuvant device.<sup>1</sup> This becomes a particular challenge in patients with ruptured wide necked aneurysms in whom microsurgical clipping may be a technical challenge due to the location of the aneurysm or the neurological status of the patient. Although adjuvant devices have been used, it has been shown that there is an increased incidence of hemorrhagic complications when using dual antiplatelet agents in the ruptured setting.<sup>2</sup> Balloon remodeling is more commonly used but leads to flow arrest to the territory of the brain which may place the patient at a higher risk for ischemic injury.<sup>1</sup> The Comaneci device has a compliant neck bridge and allows for continuous diameter and radial force adaptation. The user can control the amount of pressure applied on the neck, allowing for variable expansion. The Comaneci device provides similar benefits to the balloon remodeling while alleviating the associated time contrasts.<sup>4</sup>



▲ **Figure 1.** The Comaneci device has a 'trigger' that allows the stent to be opened or contracted by moving a slider



▲ **Figure 2.** Patient with a wide based basilar tip aneurysm (3-D view upper left panel, AP angiogram upper right panel) treated using the Comaneci device. The lower left panel shows the device deployed with the stent open. The lower right panel shows the AP angiogram of the final result.

Importantly, safety of the device has been demonstrated in the literature. Gupta et. al. demonstrated in 2014, in pre-clinical studies, that there were no differences in endothelial injury, aneurysm occlusion rates or distal embolization between Comaneci and balloon remodeling.<sup>3</sup> Additionally the device has been available in Europe since 2015 with numerous case reports demonstrating safety in both the ruptured and unruptured settings.<sup>2,4-7</sup> More recently it has been shown effective to use dual devices in a Y-fashion for treatment of more complex or difficult wide necked aneurysms.<sup>7</sup> Other potential applications of the device are in the setting of delayed cerebral ischemia after subarachnoid hemorrhage. Cerebral vasospasm is a sequela of subarachnoid hemorrhage and typically occurs between days 3-21 after rupture leading to delayed cerebral ischemia.<sup>8</sup> Intraarterial therapy with vasodilator medication or balloon-angioplasty have been used in refractory cerebral vasospasm. Kung et.al. demonstrated safety and efficacy of the use of a retrievable stent.<sup>9</sup>

Comaneci will not replace balloon assisted coiling, or angioplasty. Nor will it replace stent assisted coiling. What the device does provide is an additional tool in the neurovascular armamentarium in the treatment of wide necked aneurysms particularly in patients where dual antiplatelet therapy is not desired.

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## News & Events



Neurosurgeons and BIDMC Brain Aneurysm Institute leaders Ajith J. Thomas, MD (co-director), and Christopher S. Ogilvy, MD (director), were guest editors of a 116-page Neurosurgery supplement entitled “Flow Diversion

for Intracranial Aneurysm Treatment,” which was published in January 2020. The supplement is a repository of current knowledge on flow-diverter therapy, which is the subject of more than 600 papers in peer-reviewed literature. The BIDMC Brain Aneurysm Institute has one of the largest experiences with flow-diverter technology in the world.

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### SAVE THE DATE

## Ischemic and Hemorrhagic Update: Current Practices and Future Directions

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