

# Coil-Assisted Flow Diversion in a Ruptured Basilar Top Aneurysm Using a Neqstent Endosaccular Device: A Novel Treatment

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**Abstract:** Ruptured basilar top aneurysms require immediate treatment as the risk of re-rupture is high. Different endovascular techniques are described for their management. This case report presents the details of a patient with a wide-necked basilar top aneurysm, ruptured 1 month earlier, which was managed using a new endosaccular device, Neqstent (Cerus Endovascular). We also discuss the procedure details with relevant literature. To the best of our knowledge, this is the first case report using this device for the treatment of brain aneurysms.

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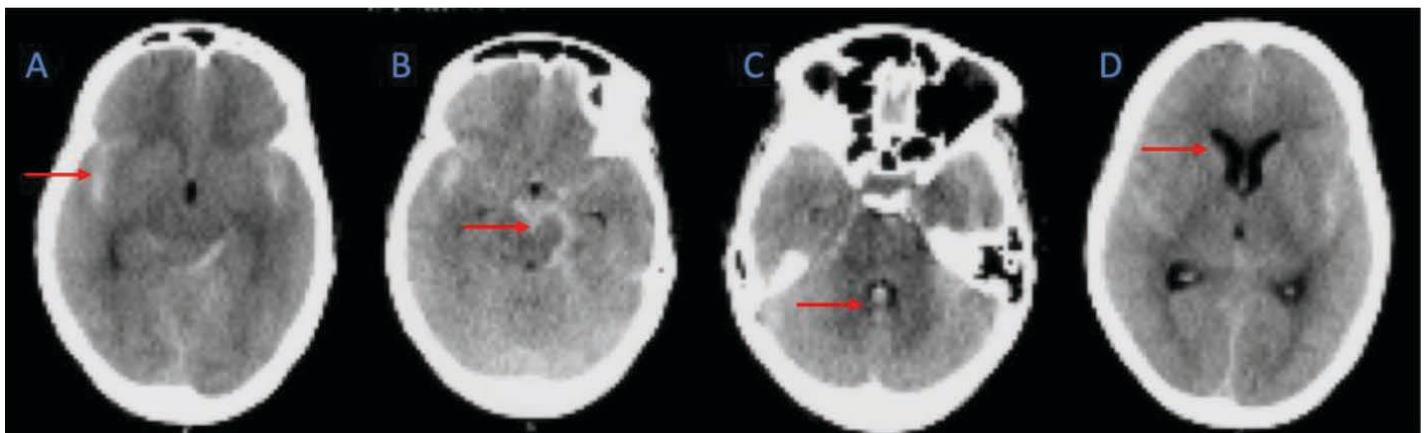
**Key words:** basilar top aneurysm, coiling and flow diversion, endosaccular, endovascular, Neqstent

## Introduction

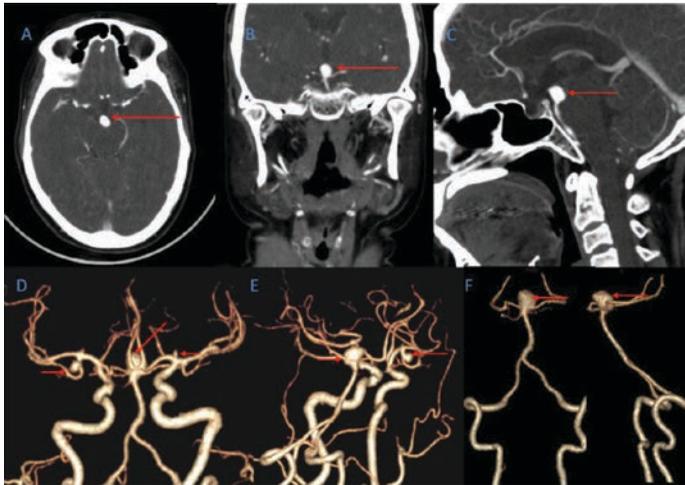
Intracranial aneurysm formation can be caused by multiple factors, including genetic, anatomical, and environmental.<sup>1</sup> Cigarette smoking and hypertension are acquired risk factors for development of intracranial aneurysms.<sup>1</sup> Basilar top aneurysms usually occur because of the hemodynamic flow directed toward the bifurcation.<sup>1</sup> Ruptured basilar top aneurysms may result in a fatal subarachnoid hemorrhage (SAH), and mortality could be as high as 23%.<sup>2</sup> Newer intrasaccular devices, such as the Woven EndoBridge (WEB) Embolization System (MicroVention) and the Contour Neurovascular System (Cerus Endovascular), have been introduced to treat wide-neck bifurcation aneurysms.<sup>3</sup>

## Case Report

A 46-year-old woman presented with sudden onset headache associated with 2 to 3 episodes of vomiting and giddiness. On examination, her Glasgow Coma Scale (GCS) was 15/15 and power in all four limbs was 5/5. A non-contrast CT brain scan (**Figure 1**) revealed a diffuse SAH more predominant in the basal cisterns on the left side with intraventricular extension into the 4th ventricle (Fisher grade 4). There was no hydrocephalus. A CT angiogram (**Figure 2**) and diagnostic cerebral angiogram (**Figure 3**) demonstrated 3 intracerebral aneurysms in the following locations: inferior division of the right middle cerebral artery (MCA), 4.3 x 5 x 3.6 mm (AP x ML x CC); A1 segment of the left anterior cerebral artery



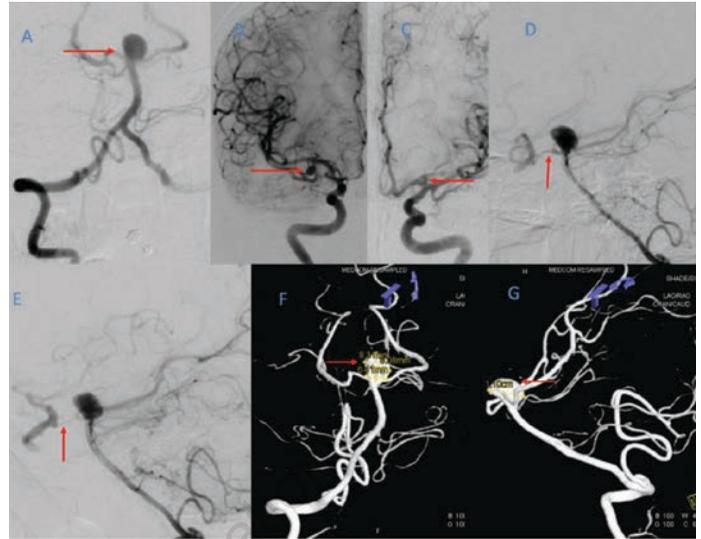
**Figure 1.** Non-contrast CT of the brain shows blood in the (A) sylvian fissures, (B) basal cisterns in the perimesencephalic location, (C) the fourth ventricle, and (D) no hydrocephalus.



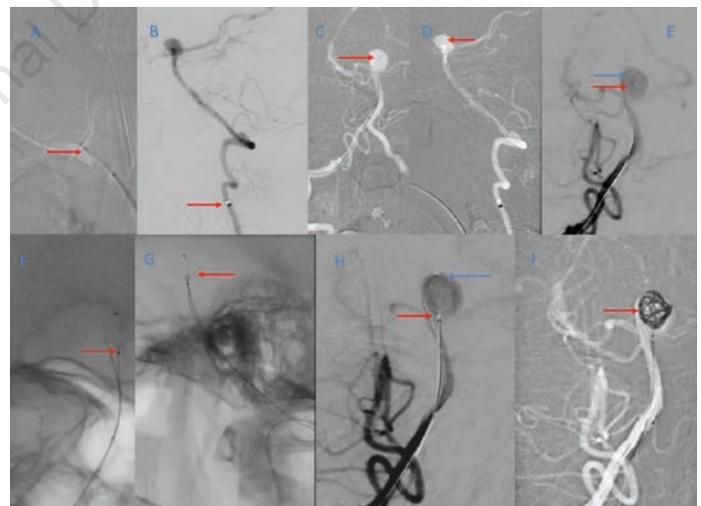
**Figure 2.** Contrast-enhanced CT of the brain with reconstructed images shows a basilar top aneurysm in the (A) axial, (B) coronal, and (C) sagittal planes. Reformatted images (D), (E), and (F) show other 2 aneurysms involving the inferior division of the right middle cerebral artery and the left A1 segment of the anterior cerebral artery.

(ACA), 2.1 x 2.2 x 1.4 mm; and basilar top, 11 x 8.1 x 8.3 mm with a neck measuring 6.8 mm. Based on the distribution of the SAH and morphology of the aneurysms, the basilar top aneurysm was assumed to be the cause of the SAH. Standard medical management included nimodipine, antiepileptics, antihypertensives, and analgesics.

Endovascular treatment of the aneurysm was planned. The procedure was done under general anesthesia using an Artis zee biplane (Siemens) digital subtraction angiography system (Figure 4 and Figure 5). The right femoral artery was accessed. The right vertebral artery angiogram showed no change in the aneurysmal morphology when compared with the previous diagnostic angiogram performed 6 days earlier. Intra-arterial nimodipine (2 mg) was injected slowly over 15 minutes. A 6 Fr Neuron MAX (0.088" x 80 cm) (Penumbra) long sheath was placed in the right subclavian artery at the vertebral artery origin. Using a 0.035" Glidewire (Terumo Interventional Systems) and a 6 Fr Navien (0.072" x 115 cm) (Medtronic) intermediate guiding catheter combination, the right vertebral artery was cannulated and the tip of the Navien was placed at the junction of the V2 and V3 segment over the wire. Using a Synchro (0.014" soft x 200 cm) (Stryker) microwire with an Echelon-10 (0.017") (Medtronic) microcatheter combination, the aneurysm was catheterized with a microcatheter within the sac; this was later used for coiling. With a Synchro 0.014" wire and NeuroSlider 0.021" (Acandis) microcatheter combination, the aneurysm was cannulated with a microcatheter tip just above the neck; this was used for the endosaccular device. A Neqstent endosaccular device (Cerus Endovascular) 11 mm was selected according to the chart provided by Cerus Endovascular. It was advanced through the NeuroSlider and deployed just above the aneurysm neck while the Echelon-10 microcatheter was jailed within the aneurysm sac.

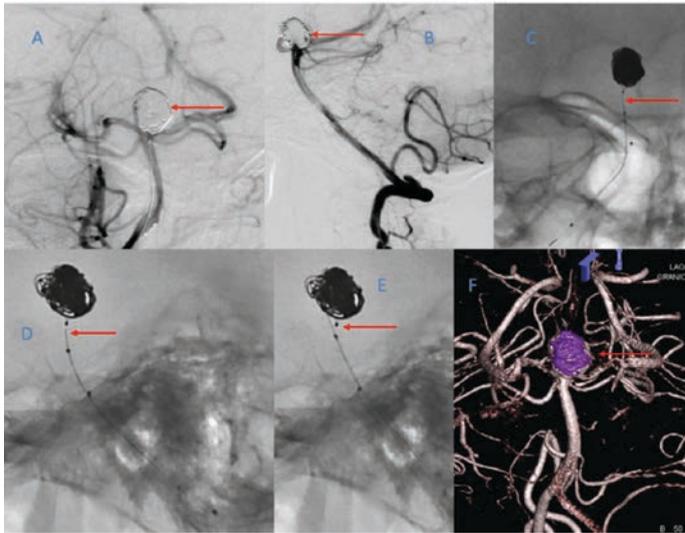


**Figure 3.** (A) Right vertebral artery catheter angiogram showing a wide-neck basilar top aneurysm. (B) Right internal carotid artery (ICA) angiogram showing an aneurysm arising from the inferior division of the right middle cerebral artery. (C) Left ICA angiogram showing a small narrow-necked aneurysm arising from the left A1 ACA. (D) and (E) Bilateral posterior communicating arteries are well demonstrated. (F) and (G) 3D reconstructed images showing a wide-neck basilar top aneurysm with its measurement.



**Figure 4.** Therapeutic steps shown above are (A) Neuron MAX long sheath near the right vertebral origin. (B) Navien guiding catheter in the distal V2 segment with contrast angiogram showing the aneurysm in the basilar top. (C) and (D) Echelon-10 microcatheter used to cannulate the aneurysm with its tip in the aneurysm sac on both the anterior-posterior lateral planes. (E) A NeuroSlider 0.021" microcatheter is used to cannulate the aneurysm for delivery of the Neqstent. (F), (G), and (H) show a deployed Neqstent with jailing of the Echelon microcatheter just above the neck of the aneurysm, however, not detached. (I) After proper positioning of the microcatheter and Neqstent, coiling was started.

Subsequently, coiling of the aneurysm sac was performed using multiple 3D framing and 2D filling coils (Axium Prime, Medtronic) 3D ev3 coils (8 mm x 20 cm and 6 mm x 20 cm; 2



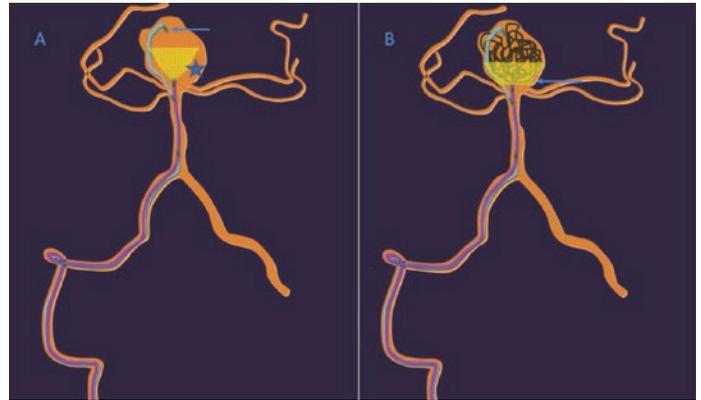
**Figure 5.** (A) and (B) Complete coiling of the aneurysm sac. (C) and (D) Neqstent still not deployed with the delivery wire in line with the implant radiopaque marker. (E) Neqstent deployed using electrolytic detachment system (arrow) showing the discontinuity between the delivery wire and implant radiopaque marker. (F) 3D reconstructed image showing normal opacification of bilateral posterior cerebral artery and superior cerebellar arteries and non-opacification of the aneurysm.

in number) and Axium Helix (Medtronic) 2D coils (4 mm x 10 cm, 3 mm x 10 cm, 3 mm x 8 cm, and 2.5 mm x 8 cm). Check angiograms were performed to look for the position of the Neqstent. Slight pull-and-push manipulation of the Neqstent was done after partial coiling so it formed a better shape snugly across the wide neck, providing better scaffolding for coiling. Once coiling was completed, the microcatheter was withdrawn from the aneurysmal sac. The Neqstent was detached using its electrolytic detachment system, after confirming its proper position. Post-coiling cerebral angiogram (**Figure 5**) showed complete occlusion of the basilar top aneurysm with good flow across the bilateral posterior cerebral arteries, the basilar artery, and its major branches. A simple line diagram (**Figure 6**) depicts the placement of a coiling microcatheter adjacent to the deployment of the Neqstent. Heparinization was maintained with 5000 IU of initial bolus and additional 1000 IU every hour.

The procedure was uneventful. Post-procedure GCS was 15/15 and power in all four limbs was 5/5. The patient was put on a single antiplatelet aspirin, 75 mg, for 3 months. She was discharged after 3 days and asymptomatic during the first follow-up after 1 week.

## Discussion

Basilar artery aneurysms constitute around 3% of intracranial aneurysms.<sup>1</sup> Compared with anterior circulation aneurysms, posterior circulation aneurysms have a higher risk of rupture.<sup>1</sup> The size and morphology of the aneurysm also contributes to its chances of rupture; aneurysms under 7 mm have a low risk



*Illustration by Kumar Muthukumar, MBBS, DMRD, DNB, FNVIR, FRCR, EDiR.*

**Figure 6.** (A) Line diagram showing coiling microcatheter (arrow) well within the aneurysm sac jailed by the side of the Neqstent (star), which is just above the aneurysm neck. (B) After partial coiling, slight manipulation of the Neqstent with gentle pull and push makes it sit well across the aneurysm neck before detaching it (arrow).

of rupture, and aneurysms over 25 mm have a 2.5% chance of rupture yearly.<sup>1,4,5</sup> Basilar top aneurysms usually present with chronic severe headache, transient dizziness, giddiness, gait disturbances, and in the case of rupture, an acute severe headache.<sup>4,5</sup> The patient may also present with transient ischemic attack, stroke, and mass effect.<sup>4,5</sup>

Ruptured basilar top aneurysms may result in a fatal SAH, and mortality could be as high as 23%.<sup>2</sup> The cumulative incidence of rebleeding after an SAH during the first 72 hours has been estimated to range from 8% to 23%. No difference in rebleeding rates between anterior circulation and posterior circulation aneurysms has been shown.<sup>6</sup> Treatment options for intracranial aneurysms are widely classified as surgical and endovascular therapies.<sup>2,4,6</sup> In the case of a basilar top aneurysm, surgical clipping is challenging owing to its proximity to the brainstem, difficulty in obtaining adequate exposure, and crowding of arteries in this region. The procedure-related mortality and morbidity could be 9% and 19.4%, respectively.<sup>2</sup> Aneurysms that are defined as giant and super giant are even more difficult for clipping.<sup>2,4,6</sup>

Endovascular options available for basilar top aneurysm treatment are mainly coiling, balloon-assisted coiling, stent-assisted coiling, flow diverters, and endosaccular flow disruptors.<sup>2,6</sup> Simple coiling is done when the neck of the aneurysm is narrow. However, basilar artery top aneurysms are usually wide-necked, involving the bifurcation, and not suitable for simple coiling. A high incidence of aneurysm recanalization (5% to 30%) has been reported with simple coiling due to inadequate neointimal growth across the aneurysm neck.<sup>7,8</sup> Balloon-assisted and stent-assisted coiling are done for wide-neck aneurysms. Balloons and stents are placed in such a way that the neck is covered, and they act as a scaffold for placing coils. Stent placement in the parent artery requires antiplatelet therapy before and after treatment. In cases where there is more than 1 aneurysm or with a recent acute SAH,

antiplatelet therapy may be challenging. Flow diverters play a role by vessel wall remodeling; however, there is a need for antiplatelet therapy.<sup>9,10</sup>

A newer development in the endovascular treatment of intracranial aneurysms is endosaccular flow disruptors.<sup>9,10</sup> These work by altering the hemodynamics within the aneurysmal sac, which lead to thrombus formation and neointimal formation near the neck of the aneurysm.<sup>9,10</sup> Examples of flow disruptors are the WEB Embolization System, Contour Neurovascular System, and Neqstent.<sup>9,10,11</sup> Endosaccular devices may be more advantageous in the acute setting of an SAH compared with stent-assisted coiling, as they require lesser antiplatelet cover.<sup>3</sup> Coil-assisted flow diversion using Neqstent is designed to assist the embolization of intracranial aneurysms focusing on treatment at the neck.<sup>10,11</sup> It is used in the treatment of a wide range of unruptured aneurysm morphologies, including wide-neck bifurcation and bifurcation aneurysms.<sup>10,11</sup> Compared with other endosaccular devices such as the WEB or Contour, which usually require multiple dimensions of the aneurysm sizes such as width, height, and neck to choose the correct device size, this device selection just requires the neck size of the aneurysm.<sup>11</sup> Neqstent is a Nitinol-based micro-braided mesh implant containing a platinum core wire for visualization.<sup>11</sup> The device is available in a range of 3 sizes, allowing for the treatment of small-to-medium aneurysms. It is compatible with 0.021" and 0.027" microcatheters.<sup>11</sup> Neqstent has minimal intra-arterial components and some flow-diverting properties to reduce coil compaction and recurrences.<sup>11</sup> It has a smooth and controlled delivery into the aneurysm sac and is delivered using established catheterization techniques; detachment is done by electrolytic method. Short-duration antiplatelet therapy is considered adequate. Additional endosaccular coiling has the potential to reduce the chances of re-rupture and recurrence.

We share the technical outcome of a basilar top aneurysm treated with Neqstent-assisted coiling. There is a paucity of literature on the use of this product, and to our best knowledge this is the first reported case using this technology for brain aneurysms. The device is a braided device that provides not only stable scaffolding across the neck of the aneurysm to perform coiling distal to the aneurysm but also an added degree of protection and flow diversion across the neck due to 48 wires across the neck of aneurysm. The device makes treatment of such aneurysms less complicated and prevents use of long-term antiplatelets.

An ongoing registry<sup>12</sup> was started on January 2020 with an estimated participation of 51 patients over 2 to 3 years. We require studies with larger numbers, long-term follow up, and comparison with other treatment modalities to assess its long-term efficacy.

## Conclusion

Treating wide-neck basilar top aneurysms is considered more challenging based on their location, proximity to the branches, and high rates of recurrence. The Neqstent device appears to be safe and effective based on early experience and can provide

a good option for treatment of complex wide-neck aneurysms by making the procedure simple and safe but still effective without using long-term antiplatelets. ■

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