Surgical Neurology International

OPEN ACCESS

For entire Editorial Board visit : http://www.surgicalneurologyint.com

Editor-in-Chief: **James I. Ausman**, MD, PhD University of California, Los Angeles, CA, USA

Case Report

Successful treatment of a traumatic carotid pseudoaneurysm with the Pipeline stent: Case report and review of the literature

Peter S. Amenta[1], Robert M. Starke[1,3], Pascal M. Jabbour[1], Stavropoula I. Tjoumakaris[1], Luis. Fernando Gonzalez[1], Robert H. Rosenwasser[1], Edmund A. Pribitkin[2], Aaron S. Dumont[1]

Departments of [1]Neurological Surgery, and [2]Otolaryngology, Thomas Jefferson University, Philadelphia, Pennsylvania, [3]Department of Neurological Surgery, University of Virginia, Charlottesville, Virginia

E-mail: Peter S. Amenta - peter.amenta@jefferson.edu; Robert M. Starke - bobby.starke@gmail.com; Pascal M. Jabbour - pascal.jabbour@jefferson.edu; Stavropoula I. Tjoumakaris - Stavropoula.Tjoumakaris@jefferson.edu; Luis. Fernando Gonzalez - fernando.gonzalez@jefferson.edu; Robert H. Rosenwasser - Robert.Rosenwasser@jefferson.edu Edmund A Pribitkin - edmund.pribitkin@jefferson.edu;
*Aaron S. Dumont - aaron.dumont@jefferson.edu
*Corresponding author

Received: 06 September 12 Accepted: 13 November 12 Published: 26 December 12

This article may be cited as:
Amenta PS, Starke RM, Jabbour PM, Tjoumakaris SI, Gonzalez LF, Rosenwasser RH, *et al.* Successful treatment of a traumatic carotid pseudoaneurysm with the Pipeline stent: Case report and review of the literature. Surg Neurol Int 2012;3:160.
Available FREE in open access from: http://www.surgicalneurologyint.com/text.asp?2012/3/1/160/105099

Abstract

Background: Traumatic intracranial pseudoaneurysms remain one of the most difficult vascular lesions to treat. In the case of traumatic pseudoaneurysms that may not be treated with parent vessel sacrifice, some flow diversion strategy such as stent-assistance or use of a flow diversion device is usually necessary.

Case Description: In this study we describe endovascular parent vessel wall-remodeling/endoluminal reconstruction and traumatic pseudoaneurysm thrombosis through the use of the Pipeline stent and review recent reports concerning indications, safety, and efficacy for alternative pathology.

Conclusion: Although currently not routinely employed in the treatment of traumatic pseudoaneurysms, the Pipeline stent may represent a safe and effective treatment alternative achieving complete endoluminal reconstruction of the damaged vessel wall.

Key Words: Aneurysm, endoscopic, flow diversion, hemorrhage, pipeline, pseudoaneurysm, sinusitis, sphenoidostomy, subarachnoid, trauma

Access this article online

Website: www.surgicalneurologyint.com

DOI: 10.4103/2152-7806.105099

Quick Response Code:

INTRODUCTION

Accounting for less than 1% of all aneurysms, traumatic intracranial pseudoaneurysms represent a class of relatively rare lesions.[1,12,24] These aneurysms are the result of blunt or penetrating trauma to the head and, as in our case, may be due to inadvertent surgical injury. Clinical presentations vary depending on the location and size of the aneurysm and whether or not rupture has occurred. Although shrinkage and spontaneous resolution of intracranial pseudoaneurysms has been documented, clinical series have reported rupture rates of up to 60% prior to definitive treatment.[12-14,21,23] Rupture of intracranial pseudoaneurysms is associated with a mortality rate ranging from 31% to 54%.[12-14,21,23] Consequently, prompt definitive surgical intervention has been established as the standard of care. Traditionally, these lesions were treated with open vessel deconstruction of the parent vessel with or without intracranial bypass. Intervention via the endovascular route now allows for minimally invasive parent vessel deconstruction with or without intracranial bypass. In this case, the parent vessel

can be preserved and the aneurysm excluded from the circulation with an endoluminal reconstruction strategy using flow diversion. We describe endovascular parent vessel wall-remodeling/endoluminal reconstruction and traumatic pseudoaneurysm thrombosis through the use of the Pipeline stent (ev3 Neurovascular, Irvine, CA).

CASE REPORT

The patient is a 64-year-old female initially admitted with left-sided chronic maxillary, ethmoidal, and sphenoidal sinusitis. She underwent endoscopic left ethmoidectomy, maxillary antrostomy, and sphenoidostomy. During dissection of the sphenoid mucosa, pulsatile bleeding was observed through a punctate hole in the carotid canal, raising concern for injury to the internal carotid artery. Hemostasis was achieved with an Afrin-soaked pledget and pressure. The patient awoke neurologically intact and an immediate postoperative computed tomography angiogram (CTA) showed no evidence of contrast extravasation or pseudoaneurysm [Figure 1a].

A CTA repeated one week later, revealed a 2 × 1.4 mm pseudoaneurysm arising from the left internal carotid artery at the level of the carotid canal dehiscence [Figure 1b]. Angiography confirmed the presence of the pseudoaneurysm, [Figure 2a] and she passed a test balloon occlusion with hypotensive challenge [Figure 2b]. The patient was counseled in regard to both deconstructive treatment options and vessel preservation with the Pipeline stent. Ultimately, the patient was loaded with 600 mg of Plavix and 325 mg of aspirin. At the time of treatment, the pseudoaneurysm had enlarged to 2.8 mm [Figure 3a].

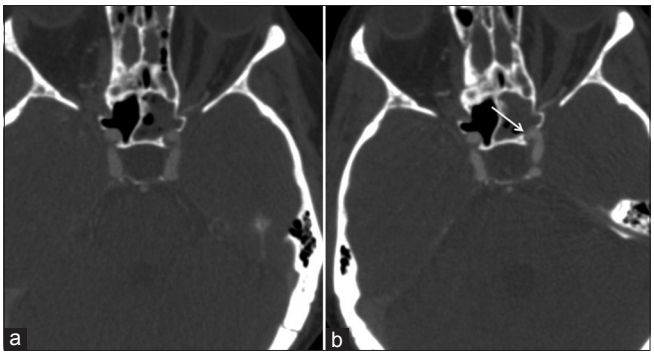

Figure 1: (a) Postoperative CT angiogram (CTA) showed no evidence of contrast extravasation or pseudoaneurysm. (b) A CTA repeated one week later, revealed a 2×1.4 mm pseudoaneurysm arising from the left internal carotid artery at the level of the carotid canal dehiscence

Figure 2: (a) Angiography demonstrating traumatic pseudoaneurysm. (b) Angiogram demonstrates demonstrating balloon occlusion (6×9 mm), which the patient passed with hypotensive challenge

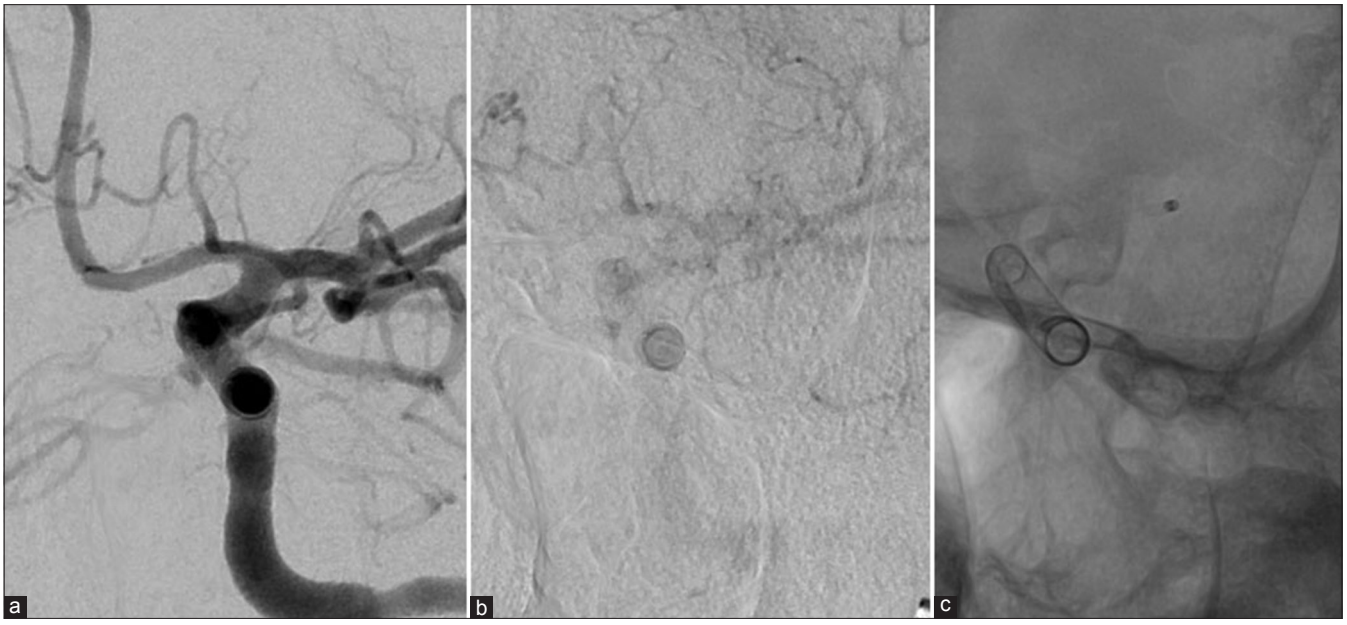

Figure 3: (a) At the time of treatment, the pseudoaneurysm had enlarged to 2.8 mm. (b) A 4×16 mm Pipeline stent was deployed across the pseudoaneurysm and the control angiogram demonstrated contrast stasis within the aneurysmal dome. (c) A 4×14 mm Pipeline stent was placed within the first stent to reinforce the construct and the final control angiogram revealed further stasis

A 4 × 16 mm Pipeline stent was deployed across the pseudoaneurysm and the control angiogram demonstrated contrast stasis within the aneurysmal dome [Figure 3b]. A 4 × 14 mm Pipeline stent was placed within the first stent to reinforce the construct and the final control angiogram revealed further stasis [Figure 3c]. Four-month follow-up angiogram showed complete obliteration of the pseudoaneurysm and successful reconstruction of the left internal carotid lumen [Figure 4]. The patient has remained neurologically intact and has been maintained on daily aspirin 81 mg and Plavix 75 mg. The Plavix was stopped at 6 months and no significant epistaxis was encountered in the postoperative period.

DISCUSSION

By definition, intracranial pseudoaneurysms lack a true wall due to the transmural nature of the preceding injury and thus, are only contained by a friable layer of connective tissue.[11] Additionally, these lesions typically lack a true neck and possess a fusiform morphology. As a result, manipulation of traumatic pseudoaneurysms is associated with a high risk of intraoperative rupture, thereby previously rendering parent vessel deconstruction technique as the most commonly employed approach. Open surgical intervention with parent vessel sacrifice with or without bypass was long considered the standard of care. With the advent of endovascular intervention, endovascular occlusion of the parent vessel in a patient with adequate collateral circulation became a less invasive alternative approach and can be performed following a bypass in those with inadequate collateral circulation.

Recently, parent vessel preservation through endovascular intervention has gained increasing popularity, as coil, stent, and liquid embolic agent technology continue to evolve. The majority of existing literature regarding endovascular vessel preservation of traumatic pseudoaneurysms is comprised of case reports and series, each of which state various rates of success and aneurysm recurrence. Yuen *et al*. reported coil compaction and regrowth of a traumatic pericallosal pseudoaneurysm that required clip ligation.[26] Fulkerson *et al*. presented three pediatric patients successfully treated for proximal traumatic intracranial aneurysms with either coiling or stent-assisted coiling.[10] Two of these patients developed coil compaction and recurrence requiring additional coiling procedures. Cohen *et al*. in one of the largest series, presented a 4 year experience of 13 traumatic pseudoaneurysms treated via the endovascular route.[4] One patient underwent coiling with complete obliteration and no recurrence found on periodic follow-up CTA, while three patients were treated via stent-assisted coiling. One of these patients was found to have aneurysm recanalization on the 6-month angiogram and was definitively treated with endovascular coil occlusion of the carotid and superficial temporal artery-middle cerebral artery bypass. In 2012, Lim *et al*. reported complete obliteration of a traumatic pseudoaneurysm and preservation of flow through the carotid artery using a stent-in-stent-assisted coil embolization.[15] At the one-year follow-up angiogram, the pseudoaneurysm was found to be entirely occluded. Medel *et al*. reported successful embolization of a traumatic orbitofrontal artery pseudoaneurysm with Onyx, a liquid embolic agent.[17] No recurrence was found at the four-month follow-up angiogram. In our experience, the treatment of pseudoaneurysms (particularly traumatic pseudoaneurysms) without parent vessel sacrifice or some flow diversion strategy (such as stent-assistance or use of a flow diversion device) should be used cautiously. We have seen patients with traumatic cavernous carotid injuries following transsphenoidal surgery treated with coils alone, experience coil extrusion through the nose and massive epistaxis.

Figure 4: Angiogram at 4-month follow-up showed complete obliteration of the pseudoaneurysm and successful reconstruction of the left internal carotid lumen

The Pipeline stent is a flow diversion and vessel remodeling device composed of cobalt chromium and platinum tungsten arranged in a 48-strand braided design. The stent reduces blood flow into the aneurysm, thus promoting thrombosis, while also providing a scaffold for endothelialization and reconstruction of the vessel wall. Due to these properties, the Pipeline stent has developed into a treatment option for aneurysms difficult to treat via clipping or coiling, such as, giant and fusiform aneurysms and those located at the skull base.

Chitale *et al*. reported the treatment of 42 aneurysms with the pipeline embolization device (PED) (41 anterior circulation, 1 vertebrobasilar junction) and experienced a symptomatic complication rate of 13.9%.[3] Szikora *et al*. reported the treatment of treatment of 19 wide-necked aneurysms with complete occlusion in 18 of 19 aneurysms at 6 month follow-up, and a transient complication rate related to stenting in 5.2% of cases.[22] Colby *et al*. reported

a successful deployment rate of 97% and an immediate flow disruption rate of 97% and 3% rate of major stroke.[5] Others have reported similar occlusion and complication rates with the use of PED in the treatment of intracranial aneurysms.[2,7,9,16,19,20] A systematic review of the literature demonstrated a complication or poor outcome rate of 11.5% with PED for intracranial aneurysms.[18]

Flow-diversion devices have also been utilized in the treatment of spontaneous dissecting aneurysms. Yeung *et al*. reported successful obliteration of four dissecting vertebral artery aneurysms with flow diversion.[25] Ducruet *et al*. reported the use of the PED to treat a ruptured dissecting vertebral artery aneurysm with preservation of flow through a covered posterior inferior cerebellar artery.[8] This strategy also preserved endovascular access for the treatment of severe posterior circulation vasospasm. De Barros Faria *et al*. reported the use of PED to treat 23 dissecting aneurysms of which 91% were in the posterior circulation. Total occlusion increased from 69.5% to 87.5% at 3 month follow up with smaller lesions achieving higher occlusion rates.[6]

Traumatic intracranial pseudoaneurysms remain one of the most difficult vascular lesions to treat by either open or endovascular techniques. Although the PED has been shown to successfully obliterate complex aneurysms, there is a lack of literature regarding the use of this device in the treatment of traumatic pseudoaneurysms. Our case reports the novel use of the PED for successful obliteration of a traumatic pseudoaneurysm resulting from intraoperative injury during endoscopic sinus surgery. Complete exclusion of the pseudoaneurysm at 4-month follow up angiogram supports the possible durability of PED repair achieving endoluminal reconstruction of the damaged vessel. A limitation of the PED is that decreased flow into aneurysms may not provide immediate thrombosis, and it may take a number of weeks for complete occlusion. This may leave a patient at risk for rupture during this interim. Future investigations into the utility of the PED in the treatment of traumatic pseudoaneurysms are necessary in order to define the feasibility, durability, and complications associated with this treatment option.

CONCLUSION

Traumatic pseudoaneurysms remain rare, but challenging lesions treated via the open or endovascular route traditionally with parent vessel deconstruction. The PED has been shown to be effective in the treatment of simple and complex aneurysms. Although currently not routinely employed in the treatment of traumatic pseudoaneurysms, the PED may represent a safe and effective treatment alternative achieving complete endoluminal reconstruction of the damaged vessel wall.

REFERENCES

1. Benoit BG, Wortzman G. Traumatic cerebral aneurysms. Clinical features and natural history. J Neurol Neurosurg Psychiatry 1973;36:127-38.
2. Briganti F, Napoli M, Tortora F, Solari D, Bergui M, Boccardi E, *et al*. Italian multicenter experience with flow-diverter devices for intracranial unruptured aneurysm treatment with periprocedural complications-a retrospective data analysis. Neuroradiology 2012;54:1145-52.
3. Chitale R, Gonzalez LF, Randazzo C, Dumont AS, Tjoumakaris S, Rosenwasser R, *et al*. Single center experience with pipeline stent: Feasibility, technique and complications. Neurosurgery 2012;71:679-91.
4. Cohen JE, Gomori JM, Segal R, Spivak A, Margolin E, Sviri G, *et al*. Results of endovascular treatment of traumatic intracranial aneurysms. Neurosurgery 2008;63:476-85.
5. Colby GP, Lin LM, Gomez JF, Paul AR, Huang J, Tamargo RJ, *et al*. Immediate procedural outcomes in 35 consecutive pipeline embolization cases: A single-center, single-user experience. J Neurointerv Surg 2012. [In press]
6. de Barros Faria M, Castro RN, Lundquist J, Scrivano E, Ceratto R, Ferrario A, *et al*. The role of the pipeline embolization device for the treatment of dissecting intracranial aneurysms. AJNR Am J Neuroradiol 2011;32:2192-5.
7. Deutschmann HA, Wehrschuetz M, Augustin M, Niederkorn K, Klein GE. Long-term follow-up after treatment of intracranial aneurysms with the Pipeline embolization device: Results from a single center. AJNR Am J Neuroradiol 2011;33:481-6.
8. Ducruet AF, Crowley RW, Albuquerque FC, McDougall CG. Reconstructive endovascular treatment of a ruptured vertebral artery dissecting aneurysm using the Pipeline embolization device. J Neurointerv Surg 2012. [In press]
9. Fischer S, Vajda Z, Aguilar Perez M, Schmid E, Hopf N, Bazner H, *et al*. Pipeline embolization device (PED) for neurovascular reconstruction: Initial experience in the treatment of 101 intracranial aneurysms and dissections. Neuroradiology 2011;54:369-82.
10. Fulkerson DH, Voorhies JM, McCanna SP, Payner TD, Leipzig TJ, Scott JA, *et al*. Endovascular treatment and radiographic follow-up of proximal traumatic intracranial aneurysms in adolescents: Case series and review of the literature. Childs Nerv Syst 2010;26:613-20.
11. Hemphill JC 3rd, Gress DR, Halbach VV. Endovascular therapy of traumatic injuries of the intracranial cerebral arteries. Crit Care Clin 1999;15:811-29.
12. Holmes B, Harbaugh RE. Traumatic intracranial aneurysms: A contemporary review. J Trauma 1993;35:855-60.
13. Larson PS, Reisner A, Morassutti DJ, Abdulhadi B, Harpring JE. Traumatic intracranial aneurysms. Neurosurg Focus 2000;8:e4.
14. Lempert TE, Halbach VV, Higashida RT, Dowd CF, Urwin RW, Balousek PA, *et al*. Endovascular treatment of pseudoaneurysms with electrolytically detachable coils. AJNR Am J Neuroradiol 1998;19:907-11.
15. Lim YC, Kang JK, Chung J. Reconstructive stent-buttressed coil embolization of a traumatic pseudoaneurysm of the supraclinoid internal carotid artery. Acta Neurochir (Wien) 2012;154:477-80.
16. Lylyk P, Miranda C, Ceratto R, Ferrario A, Scrivano E, Luna HR, *et al*. Curative endovascular reconstruction of cerebral aneurysms with the pipeline embolization device: The Buenos Aires experience. Neurosurgery 2009;64:632-42. discussion 642-3; quiz N636.
17. Medel R, Crowley RW, Hamilton DK, Dumont AS. Endovascular obliteration of an intracranial pseudoaneurysm: The utility of Onyx. J Neurosurg Pediatr 2009;4:445-8.
18. Naggara ON, Lecler A, Oppenheim C, Meder JF, Raymond J. Endovascular treatment of intracranial unruptured aneurysms: A systematic review of the literature on safety with emphasis on subgroup analyses. Radiology 2012;263:828-35.
19. Nelson PK, Lylyk P, Szikora I, Wetzel SG, Wanke I, Fiorella D. The pipeline embolization device for the intracranial treatment of aneurysms trial. AJNR Am J Neuroradiol 2010;32:34-40.
20. Phillips TJ, Wenderoth JD, Phatouros CC, Rice H, Singh TP, Devilliers L, *et al*. Safety of the pipeline embolization device in treatment of posterior circulation aneurysms. AJNR Am J Neuroradiol 2012;33:1225-31.
21. Sim SY, Shin YS, Yoon SH. Endovascular internal trapping of traumatic pericallosal pseudoaneurysm with hydrogel-coated self-expandable coil in a child: A case report. Surg Neurol 2008;69:418-22. discussion 422.

22. Szikora I, Berentei Z, Kulcsar Z, Marosfoi M, Vajda ZS, Lee W, *et al*. Treatment of intracranial aneurysms by functional reconstruction of the parent artery: The Budapest experience with the pipeline embolization device. AJNR Am J Neuroradiol 2010;31:1139-47.
23. Uzan M, Cantasdemir M, Seckin MS, Hanci M, Kocer N, Sarioglu AC, *et al*. Traumatic intracranial carotid tree aneurysms. Neurosurgery 1998;43:1314-20. discussion 1320-2.
24. Voelker JL, Ortiz O. Delayed deterioration after head trauma due to traumatic aneurysm. W V Med J 1997;93:317-9.
25. Yeung TW, Lai V, Lau HY, Poon WL, Tan CB, Wong YC. Long-term outcome of endovascular reconstruction with the Pipeline embolization device in the management of unruptured dissecting aneurysms of the intracranial vertebral artery. J Neurosurg 2012;116:882-7.
26. Yuen CM, Kuo YL, Ho JT, Liao JJ. Rapid regrowth of a successfully coiled traumatic pericallosal aneurysm. J Clin Neurosci 2007;14:1215-9.