Doppler Ultrasound for Follow up of the Pipeline Embolization Device

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Learning Objectives

The learner will be able to describe the potential role of doppler ultrasound as it applies to long term follow up of the the Pipeline Embolization Device.

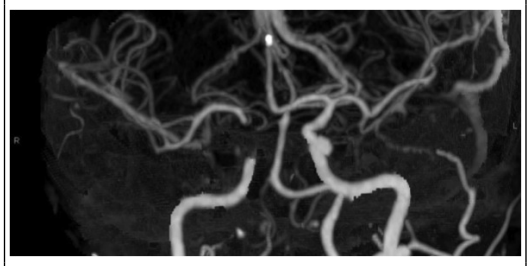
Introduction

The Pipeline embolization device (PED) is a relatively new device used to treat complex aneurysms. The optimal method of radiographic follow up for patients treated with the PED has not been established. The rate of in-stent stenosis is unknown.We evaluate the use of trans cranial doppler ultrasound (TCD) for detecting in-stent stenosis.

Methods

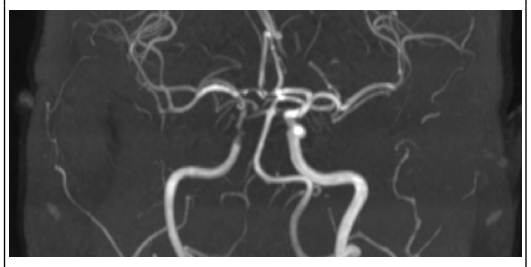
We analyzed 28 patients treated with the PED from January 2009 to June 2012. A standard conventional cerebral angiogram was preformed in all living patients. Two patients died before follow up;hemorrhage post op day 20 and brainstem infarct. One patient died of unrelated medical causes. One patient died of unknown causes. Of the remaining 24 living patients TCD studies were preformed in 23 patients as one patient refused follow up.
Angiographic stenosis was evlauated in a blinded fashion by an independent neuroradiologist (JR). TCD stenosis was classified as present or absent based on the ultrasonographer.Fisher's exact test was used to compare the results.

CTA



51y F with R paraophthalmic region aneurysm treated with PED. CTA does not address in stent stenosis

MRA

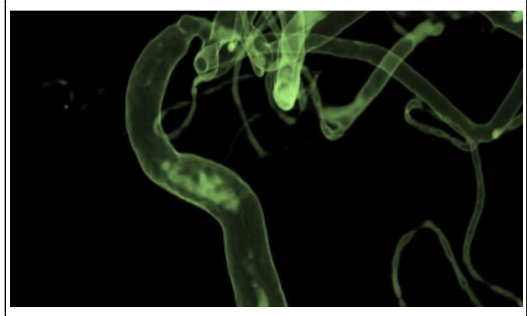


MRA of same patient overcalls stenosis

Results

Nineteen anterior circulation and 4 posterior circulation aneurysms were evaluated. Average patent age was 45. Average time from treatment to TCD was 17 months. Angiographic stenosis was seen in 34.8%(8/23). TCD stenosis was reported in 21.7% (5/23). 3 cases of false negative TCD reporting: 1- ICA blister type aneurysm with mild (<50%) stenosis not detected on TCD which resolved by 3 years. 2- Cavernous carotid aneurysm with severe stenosis (75%) TCD reported as "turbulent flow, cannot rule out stenosis". 3-Distal PCA aneurysm with mild stenosis (<50%) not detected on TCD.
Angiographic and US results were compared and found to be highly correlative (P<0.002)

DSA



3-D reconstruction shows moderate in stent stenosis

Discussion

There is a paucity of longterm followup data regarding in-stent stenosis for the PED necessitating careful followup. CT and MRI offer poor resolution secondary to metal artifact. Conventional cerebral angiography remains the gold standard but has a small yet well defined risk. TCD may be a reliable alternative for diagnosis and follow up of in stent stenosis.

Conclusions

There is excellent correlation between agiographically detected stenosis and TCD. Further study may reduce the need for some follow up angiography and provide a non-invasive means of assessing in stent stenosis.

References

1.Fiorella D LP, Szikora I, Kelly ME, Albuquerque FC, McDougall CG, Nelson PK. Curative cerebrovascular reconstruction with the Pipeline embolization device: the emergence of definitive endovascular therapy for intracranial aneurysms. J Neurointerv Surg 2009;1:56-65
2.Deutschmann HA WM, 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 2011;0195-6108
3.Chow M McDougall C M, O'Kelly C, Ashforth R, Johnson E, Fiorella D. Delayed Spontaneous Rupture of a posterior inferior cerebellar artery aneurysm following treatment with flow diversion: A clinicopathologic study. AJNR 2001
4.Martin A CJ, Matouk C, Spears J, Marotta T. The Pipeline Flow-Diverting Stent for Exclusion of Ruptured Intracranial Aneurysms With Difficult Morphologies. Operative Neurosurgery 2012;70
5.Fiorella D WH, Albuquerque FC, Nelson PK. Definitive reconstruction of circumferential, fusiform intracranial aneurysms with the pipeline embolization device. Neurosurgery 2008;62:1115-1120
6.Brinjikji W CH, Fiorella D, Lanzino G, Kallmes DF. Estimating the proportion of intracranial aneurysms likely to be amenable to treatment with the pipeline embolization device. J Neurointerv Surg 2011
7.Lubicz B CL, Raphaeli G, De Witte O. Pipeline flow-diverter stent for endovascular treatment of intracranial aneurysms: preliminary experience in 20 patients with 27 aneurysms. World Neurosurg 2011;76:114-119
8.Nelson PK LP, Szikora I, Wetzel SG, Wanke I, Fiorella D. The pipeline embolization device for the intracranial treatment of aneurysms trial. AJNR 2011;32:34-40
9.Lylyk P MC, Ceratto R, Ferrario A, Scrivano E, Luna HR, Berez Al, Tran Q, Nelson PK, Fiorella D. Curative endovascular reconstruction of cerebral aneurysms with the pipeline embolization device: the Buenos Aires experience. Neurosurgery 2009;64:642-643
10.McAuliffe W WV, Rice H, Phatouros C, Singh TJ, Wenderoth J. Immediate and midterm results following treatment of unruptured intracranial aneurysms with the pipeline embolization device.