

Two Strokes of Luck: Unusual Recurrent Paradoxical Embolic Stroke and Patent Foramen Ovale

Ethan A Miller¹; Amre Nouh¹; FAHA Tapan Mehta¹; Augusto Parra FAHA¹; David I Silverman²; Sean R McMahon²; Bryan J Piccirillo²; Hossein Ouranos²; Sheelagh M Pousatis³

¹Department of Neurology, Hartford Hospital/University of Connecticut, USA.

²Department of Cardiology, Hartford Hospital, USA.

³Department of Cardiothoracic Surgery, Hartford Hospital, USA.

Received Date : May 11, 2022
Accepted Date : June 28, 2022
Published Date : July 19, 2022
Archived : www.jcmimagescasereports.org
Copyright : © Amre M Nouh 2022

***Corresponding Author:** Amre M Nouh, System Director of Stroke and Cerebrovascular Disease – Hartford HealthCare Division head-Vascular Neurology & Director of the Comprehensive Stroke Center, Hartford Hospital Associate Professor of Neurology- University of Connecticut/ Hartford Hospital Vascular Neurology Fellowship Program Director – University of Connecticut, Hartford Hospital 80 Seymour street Hartford CT, 06115 Tel: 860-972-0343.
Email: amre.nouh@hhchealth.org

Abstract

Introduction: Stroke is a leading cause of neurologic disability in the United States with the majority of cases a consequence of ischemia.

Case Report: We present a case about a young woman with a past medical history of polysubstance use and prior stroke with patent foramen ovale (PFO) closure who presents with a right middle cerebral artery syndrome. She was found to have a large vessel occlusion necessitating emergent neurologic intervention that aborted a potentially devastating stroke. Etiology was suspicious for an embolic source and she underwent extensive workup ultimately requiring the expertise of cardiology and cardiothoracic surgery in addition to vascular neurology and interventional neurology.

Conclusion: This case highlights the rare finding of thrombus formation found on both sides of a PFO closure device two years after placement. There is a paucity of literature that illustrates this unique case, and therefore highlighting the need for PFO closure surveillance.

Keywords: Stroke; patent foramen ovale; large vessel occlusion; echocardiogram.

Introduction

Stroke is a leading cause of disability in the United States, with approximately 795,000 individuals affected annually [1]. Strokes can be categorized into ischemic or hemorrhagic, with 87% being ischemic [1]. Stroke is a neurologic emergency that warrants emergent neurologic evaluation when symptom onset is within 24 hours. After patients are deemed candidates for acute intervention, the next steps in management is determining etiology of the stroke. The various etiologies of stroke was defined by the Trial of Org 10172 in Acute Stroke Treatment (TOAST). TOAST classified stroke into large vessel disease, small vessel disease, cardioembolic, embolic stroke of undetermined source (ESUS), and cryptogenic [1]. We present a young patient who was found to have had a large vessel occlusion in the setting of a patent foramen ovale (PFO).

Case Presentation

A 35-year-old woman presented to the emergency department after waking up at 5:30am with left sided facial droop, dysarthria, and left hemiparesis. She was last known to be well the night prior to presentation at midnight. She reported current tobacco use and past phencyclidine use and non-compliance with any prescribed medications including aspirin. Upon arrival, blood pressure was 148/89 mmHg, was in normal sinus rhythm, euglycemic, with oxygen saturation 98% on room air. The neurology team was immediately contacted and the national institute of health stroke scale revealed a score of 10 for left facial droop, dysarthria, left upper extremity and left lower extremity weakness, and left sided sensory loss. Motor assessment of LUE was graded 0/5 and LLE graded 3/5. Cardiac evaluation revealed no murmurs, rubs, or gallops. Patient was emergently brought to CT scanner.

Citation: Amre M Nouh. Two Strokes of Luck: Unusual Recurrent Paradoxical Embolic Stroke and Patent Foramen Ovale. J Clin Med Img Case Rep. 2022; 2(4): 1195.

PMH

The patient has a history of prior M1 occlusion of the right middle cerebral artery status post mechanical thrombectomy without any residual deficits, deep vein thrombosis, pulmonary embolism, and patent foramen ovale closure 2 years prior to current presentation.

Investigations

A non-contrast computed tomography of the head showed no acute infarction or hemorrhage. Computed tomography angiography of the head and neck showed an occlusion of the M2 segment of the right middle cerebral artery. Computed tomography perfusion scan showed a favorable penumbra to core ratio. Laboratory results were unrevealing for any significant abnormalities. Electrocardiogram revealed normal sinus rhythm without any ischemic changes.

Management

The patient was deemed a candidate for mechanical thrombectomy and the procedure produced a thrombolysis in cerebral infarction (TICI) score of 2B. Magnetic resonance imaging (MRI) brain did not show any restricted diffusion in the territory of the occlusion nor any T2 FLAIR changes. With immediate neurologic intervention, an ischemic stroke was prevented. Following successful intervention, the patient underwent traditional stroke workup including HgA1c and lipid panel. Given her young age, she also underwent hypercoagulable workup including protein C and S antigens, lupus anticoagulant, factor II prothrombin gene mutation, factor V Leiden gene mutation, MTHFR gene mutation, homocysteine, lipoprotein (a), anti-nuclear antibody, and cardiolipin antibody which were all unremarkable. She underwent a urine toxicology screen which was negative. Given her history of patent foramen ovale, she also had undergone duplex imaging of her lower extremities which ruled out any deep vein thrombosis. MRV did not reveal any thrombus nor suggest May-Thurner Syndrome. Transthoracic echocardiogram (TTE) revealed a normal left ventricular ejection fraction of 55-60%, normal left atrial size, and no valvular abnormalities. A 25mm Gore cardioform occluder device was visualized in place with 2 large echodensities on the interatrial septum suggestive of thrombus on either side of the device.

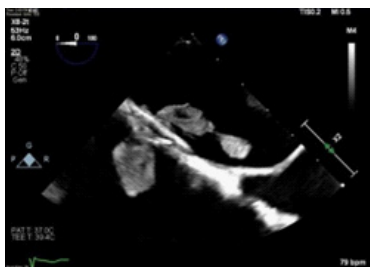


Figure 1: Transesophageal image demonstrating a large fixed thrombus adherent to the right side of the atrial occluder, and a second highly mobile thrombus adherent to the left side.

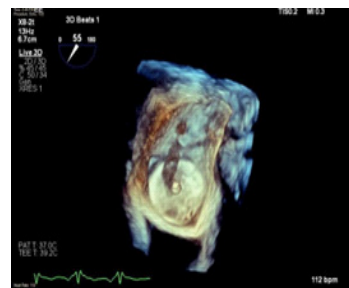


Figure 2: 3D transesophageal image of the left atrial thrombus demonstrates its attachment site near the center of the occluder.

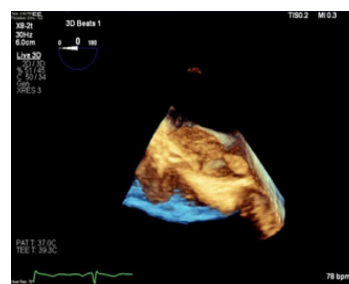


Figure 3: A 3D transesophageal image demonstrates prolapse of the thrombus into the left ventricular inflow tract.

The patient was then initiated on a heparin drip. Subsequently, the patient underwent a transesophageal echocardiogram (TEE) to better visualize the echodensities on TTE. TEE confirmed 2 large pedunculated thrombi on both sides of the closure device. The Left thrombus was noted to be highly mobile and bouncing off of the mitral valve. No residual shunt was observed. The vascular neurology, cardiology, and cardiothoracic teams convened and deemed the patient a candidate for emergent surgical intervention for device removal, thrombectomy, and atrial septal defect repair with a bovine pericardial patch.

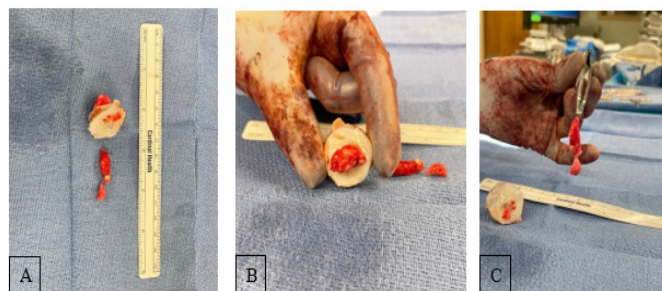


Figure 4: Resected PFO closure device with thrombus (A,B,C)

The septal occluder device was epithelialized completely except in two locations; one at the center on the right atrial side and one at the center on the left atrial side. There are large circular metal rings at this location on the Gore Cardioform device and they appeared to be the nidus for thrombus formation/attachment.

The patient tolerated the procedure well without any immediate complications.

Follow up

The patient was ultimately discharged home on post-operative day five without any neurologic deficits. Her NIHSS was 0 and she was started on aspirin 325mg daily while hospitalized which was decreased to 81mg upon discharge for her PFO bovine patch closure. She was also started on metoprolol tartrate

25mg twice a day. Hematology and oncology team advised the patient to begin anticoagulation with apixaban 10mg twice a day for 7 days and then to continue 5mg twice a day. She was also advised to refrain from any substance use and educated on the importance of medication compliance. She is scheduled to follow up with cardiology, cardiothoracic surgery, and vascular neurology as an outpatient.

Discussion

A patent foramen ovale (PFO) occurs when the two membranes of the atrial walls, septum primum and septum secundum, fail to fuse and form the atrial septum [2]. PFO closure usually occurs after birth, but can persist in approximately 20-34% of the general population. Usually, the negative intrathoracic pressure occurs with an infant's initial breaths resulting in closure of the foramen ovale [3]. Most individuals will be unaware of their PFO and this will be discovered incidentally during a cardiac evaluation such as an echocardiogram [3]. However, there are instances in which the PFO will serve as a conduit through which thrombi might travel. In such events, patients may present with ischemic strokes in the setting of a paradoxical embolus [3].

Therefore, patients who present to hospital with acute stroke deemed to be in the setting of a PFO, cardiology should be consulted and the possibility of PFO closure should be considered. The Risk of Paradoxical Embolism (RoPE) score has been proposed to predict the probability that the PFO is "causally-related" to a patient's stroke [4]. In a pooled analysis published in *Stroke*, the three trials CLOSURE-I, RESPECT, PC were examined to evaluate the treatment effect of PFO closure and relative risk reduction (RRR) in PFO closure across various RoPE scores [4]. The study illustrated that the RRR was 69% in patients with a RoPE score of 7 or greater whereas the RRR was only 18% in RoPE score of less than 7 [4]. Furthermore, certain stroke characteristics suggest paradoxical embolic stroke in the setting of PFO. These include cortical infarcts, multiple vascular distribution strokes, and multiple strokes at different ages in the same vascular territory [5]. Moreover, other possible etiologies such as arterial dissection, cardioembolism, atrial fibrillation, atherosclerosis, and hypercoagulable states should be ruled out [5]. Although PFO closure may be indicated, this does not come without risks.

Complications are not common, but could include device embolization, residual shunt, device erosion and cardiac perforation, atrial fibrillation, and thrombus formation [5]. In the RESPECT, REDUCE, and CLOSE trials, the incidence of atrial fibrillation was 1.2%, 6.6%, and 2.5%, respectively [5]. A PFO closure device, like any foreign body, is thrombogenic. The RESPECT trial did not detect any PFO device thrombus formation, however, in the REDUCE trial, 0.5% of patients were discovered to have developed a device thrombus [5]. Thrombus formation is uncommon and ranges from 0.7-1% and has been documented to occur during implantation and post-procedurally. Most commonly detected 4 weeks after implantation [6]. An article published in the *Journal of American College of Cardiology* examined 1000 patients who underwent closure of a PFO or atrial septal defect (ASD). A thrombus was formed in 1.2% of ASD closure patients and 2.5% of PFO closure patients [7]. Interestingly, 1.1% of patients had a left atrial thrombus and 0.6% of patients had a right atrial thrombus. 0.3% percent were found to have thrombus formation on both sides of the

of the closure device [7].

Conclusion

The presence of a PFO in a patient who presents with stroke should prompt the clinician to further evaluate the likelihood of paradoxical embolism. The assistance of medical specialists with scoring systems in place, are useful to assess the need for PFO closure. We present an interesting and rare case of thrombus formation on both sides of a PFO closure device. There is a paucity of literature that describe such cases, and due to its rare occurrence, we feel that there is no indication to change the current recommended surveillance guidelines following PFO closure.

References

1. Kleindorfer DO, Towfighi A, Chaturvedi S, Cockroft KM, Gutierrez J, Lombardi-Hill D, et al. Guideline for the Prevention of Stroke in Patients With Stroke and Transient Ischemic Attack: A Guideline From the American Heart Association/American Stroke Association. *Stroke*, 2021; 52(7). <https://doi.org/10.1161/STR.0000000000000375>
2. Ioannidis SG and Mitsias PD. Patent Foramen Ovale in Cryptogenic Ischemic Stroke: Direct Cause, Risk Factor, or Incidental Finding? *Front. Neurol.* 2020; 11: 567. [DOI: 10.3389/fneur.2020.00567].
3. Giblett JP, Abdul-Samad O, Shapiro LM, Rana BS & Calvert PA. Patent Foramen Ovale Closure in 2019. *Interventional cardiology (London, England)*, 2019; 14(1): 34-41. <https://doi.org/10.15420/icr.2018.33.2>
4. Kent D M, Saver JL, Ruthazer R, Furlan AJ, Reisman M, Carroll JD, et al. Risk of Paradoxical Embolism (RoPE)-Estimated Attributable Fraction Correlates With the Benefit of Patent Foramen Ovale Closure: An Analysis of 3 Trials. *Stroke*, 2020; 51(10): 3119-3123. <https://doi.org/10.1161/STROKEAHA.120.029350>
5. Collado FMS, Poulin MF, Murphy JJ, Jneid H, Kavinsky CJ. Patent Foramen Ovale Closure for Stroke Prevention and Other Disorders. *J Am Heart Assoc.* 2018 Jun 17; 7(12): e007146. [PMID: 29910192; PMCID: PMC6220531 DOI: 10.1161/JAHA.117.007146].
6. Hossain NA, Kariyanna PT, Hossain NA, Chowdhury YS, Enoru ST, Jayarangaiah A, et al. Large Left Atrial Thrombus on Amplatzer Septal Occluder Secondary to Medication Nonadherence. *American journal of medical case reports*, 2020; 8(7): 197-201.
7. Krumsdorf U, Ostermayer S, Billinger K, Trepels T, Zadan E, et al. Incidence and clinical course of thrombus formation on atrial septal defect and patient foramen ovale closure devices in 1,000 consecutive patients. *Journal of the American College of Cardiology*, 2004; 43(2): 302-309. <https://doi.org/10.1016/j.jacc.2003.10.030>