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Cerebral Granulomatous Inflammation Secondary to Hydrophilic Polymer Embolization Following Thrombectomy

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Conflict of interest: None declared

Patient: Female, 59
Final Diagnosis: Granulomatous response to microscopic polymer
Symptoms: Worsening neurologic deficit
Medication: —
Clinical Procedure: Mechanical thrombectomy
Specialty: Neurosurgery

Objective: Unusual or unexpected effect of treatment

Background: Given the recent completion of multiple trials demonstrating the benefit of endovascular mechanical thrombectomy for select patients with proximal large artery occlusive ischemic strokes, there has been a large increase in the performance of these procedures. In the context of increased thrombectomy performance, there have also been increased reports of rare occurrences of granulomatous inflammatory response to the hydrophilic polymer which coat many of these interventional devices.

Case Report: A 59-year-old female presented with a complete occlusion of her right proximal middle cerebral artery (MCA) and imaging showed a large area of penumbra. Cerebral angiogram and mechanical thrombectomy were successfully performed with reversal of clinical symptoms. Eight months following her stroke, she developed progressive recurrence of left-sided neurological deficits. After extensive workup culminating in tissue sampling, she was found to have developed granulomatous inflammation surrounding microscopic embolization of hydrophilic polymer, which is used to coat many interventional devices such as wires and catheters. The patient responded both clinically and radiographically to anti-inflammatory steroid therapy.

Conclusions: Recognizing the significant potential morbidity of a large vessel ischemic stroke and the expanded use of endovascular interventions aimed at staving off this disability, there are emerging and at times indolent complications from the use of hydrophilic polymer coated wires and catheters. This rare and potentially under-recognized complication should be considered in the differential for any patient with new neurological findings following cerebral intervention, especially given the consideration that this appears to a treatable complication.

MeSH Keywords: Neurology • Neuroradiography • Neurosurgical Procedures • Thrombectomy

Full-text PDF: <http://www.amjcaserep.com/abstract/index/idArt/902598>



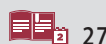
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Background

Endovascular intervention has become an important tool in the treatment of both arterial and venous thromboembolic events. With the recent publication of a number of multicenter, open-label, randomized controlled trials [1–5] that demonstrated the safety and efficacy of endovascular mechanical thrombectomy for select patients presenting with documented proximal large artery occlusive ischemic strokes in the anterior circulation, the utilization of the procedure as a viable adjunct to medical management in acute stroke will likely continue to increase in frequency. Hydrophilic polymers used to coat endovascular devices in order to reduce friction have been associated with embolization and subsequent complications. However, the frequency of these embolization events and complications remain undetermined. Given the widespread use of these procedures, certain complications are becoming more evident, including acute granulomatous inflammatory response to the hydrophilic polymer which often coats the devices used to perform these procedures. This phenomenon has been observed following endovascular interventions in the anterior and posterior cerebral circulation [6–13], pulmonary thrombectomy [14–16], cardiac catheterization [17–20], vascular catheterization with kidney involvement and acute renal failure [21,22], as well as

polymer embolization to the skin [23–25] and meninges [26]. This is often an acute response after catheter intervention. However, as shown in our case, as well as other documented cases [6,13,14,26], there is potential for delayed granulomatous inflammation occurring a few to several months following the intervention.

Case Report

Our patient was a 59-year-old female with a history of chronic headaches in addition to chronic neck and back pain, who presented to the emergency department with left-sided motor deficits. Initial imaging consisted of head CT showing a dense right middle cerebral artery (MCA) territory infarct, with CT perfusion studies suggesting a large area of penumbra. She received tissue plasminogen activator (tPA) two hours after symptom onset. Cerebral angiogram and uncomplicated thrombectomy were performed within four hours of symptom onset resulting in excellent reperfusion (Figure 1A, 1B). The procedure was conducted with a Neuron Max guide, 5MAX ACE, and a 3MAX cerebral reperfusion catheter over a Fathom guidewire by femoral artery access. The patient's post-operative course was complicated by a small hemorrhagic transformation two



Figure 1. Pre (A) and post (B) thrombectomy showing no post procedure filling defects or extravasation of contrast.

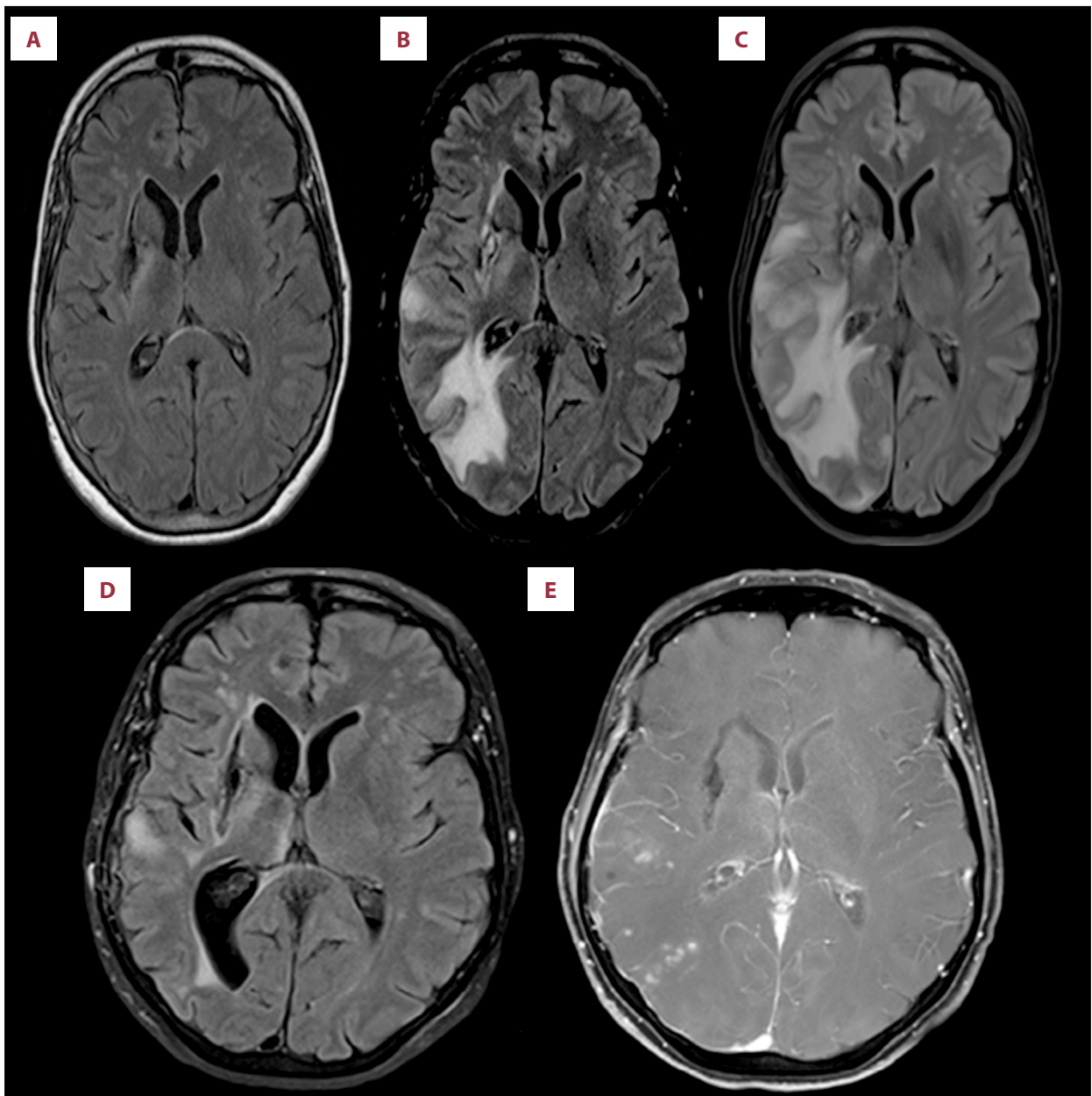


Figure 2. Shows T2 Flair at 6 months (A); 9 months (B) and 10 months (C) post-thrombectomy. Also shown are 6 weeks following high dose steroid regimen (D), and T1 post contrast at 9 months showing multifocal punctate enhancing lesions (E).

days following tPA and thrombectomy. Her ischemic cerebrovascular accident was attributed to paradoxical embolism after a transthoracic echocardiogram showed right to left shunting at the atrial septum and incidental left main pulmonary embolism detected on CT angiography of the neck. She subsequently underwent inferior vena cava (IVC) filter placement. Two months later, she had progressive left-sided weakness and was found to have a subdural hematoma, which was treated with a burr hole evacuation. Following this, she had resolution of left hemiparesis without any other observable deficit.

Four months after her stroke, she presented with worsening of left-sided weakness. Repeat magnetic resonance imaging (MRI) of the brain demonstrated no new ischemic insult and resolving changes from the initial infarct and hemorrhagic transformation (Figure 2A). This improved after narcotic medications were decreased and was attributed to recrudescence from medication side effect.

Eight months after her stroke, she developed progressive worsening of baseline headache and recurrence of left hemiparesis with new right gaze preference. Repeat MRI imaging

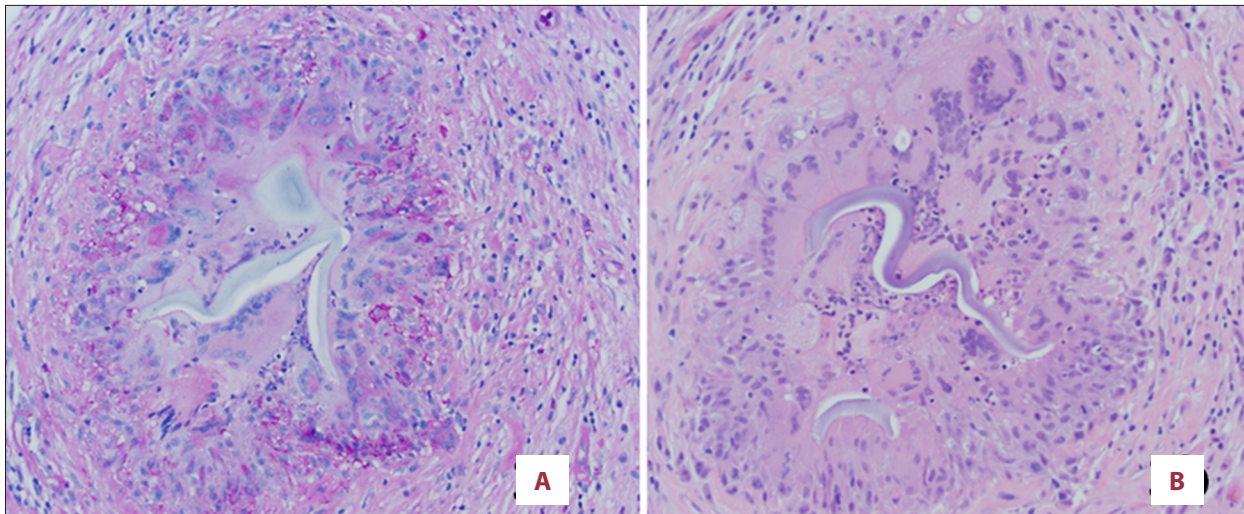


Figure 3. Acid Schiff (A) and H&E staining (B) showing non-polarizing intraluminal foreign bodies with surrounding granulomatous inflammation.

showed a lesion with progressive confluent T2 hyperintensity (Figure 2B, 2C) with greater than 30 admixed punctate areas of enhancement, involving cortex and white matter of the right parietal, temporal, and occipital lobes on T1 (Figure 2E). Diagnostic brain biopsy of the lesion was identified as necrotizing granulomatous inflammation secondary to hydrophilic polymer embolization (Figure 3A, 3B). She was treated with pulse dose methylprednisolone for five days followed by a slow taper of 60 mg prednisone daily dropping by 10 mg every three days to 20 mg daily. At the time of discharge, the patient had near complete recovery of her left lower extremity strength, partial recovery of left upper extremity strength, with recovery of headaches to near baseline. Follow-up imaging six-weeks after steroid therapy showed significant improvement of her inflammatory response with post inflammatory ex-vacuation (Figure 2D).

Discussion

Based upon the sheer number of enhancing T1 lesions, the lack of filling defects, and the presence of inflammation throughout the entirety of the MCA distribution, we felt that this patient case was likely the result of device showering emboli throughout the procedure rather than an isolated procedural event such as a shearing of a guide wire. Fortunately, many of the symptoms documented in our patient's case, and other reported cases, have responded to anti-inflammatory treatment, including steroid therapy. However, hydrophilic polymer associated embolization may be under recognized. It should be a consideration in all patients with meningitis, multifocal infarction, or multifocal enhancing lesions on MRI in a large artery vascular territory following endovascular procedures. With heightened awareness, early recognition and intervention, we

may be able to decrease medical costs, improve clinical outcomes, and decrease the extent of post-intervention complications. Despite the absence of a standard of care governing the manipulation of these intravascular devices and the treatment of granulomatous inflammatory complications, there are a few recommendations set forth by the FDA regarding periprocedure precautions interventionists can take to minimize hydrophilic polymer embolization. The recommendations include: avoiding use of catheters outside of their indication; leaving enough space between catheters and introducer sheaths; using care when maneuvering the devices; and replacing devices when needed to avoid overuse [27]. In our patient, high dose corticosteroid treatment with an initial pulse dose regimen of methylprednisolone followed by a slow taper, showed efficacy in decreasing the inflammation and improving symptoms. Lorentzen et al. [6] reported successful clinical response to methylprednisolone at 16 mg, four times a day administered for four weeks, in the case of a patient who sustained cerebral granulomatous inflammation at three-month post-hydrophilic polymer embolization which was reported three months post-intervention for cerebral aneurysm intervention. Shapiro et al. [26] discussed two cases where a right trigeminal and para-ophthalmic aneurysm repair through a femoral artery access resulted in neurological sequelae that manifested two months post-procedure. Both cases documented complete clinical resolution and absence of perilesional edema on follow-up imaging after treatment with a two-month course of dexamethasone. However, the duration and optimal dosing of corticosteroids to maintain sustained remission of this foreign body inflammatory response remains to be determined. The increasing incidence of this problem should prompt device makers to take this into account as they continue to develop this technology.

Conclusions

This rare and potentially under-recognized adverse reaction should be considered in the differential diagnosis of post-endovascular intervention patients who display new or worsening symptoms. The importance of early diagnosis lies in both the potential for palliating inadvertent procedure-associated complications and the severity of pathology if it remains unrecognized.

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Statement

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