Unusual Cerebral Metallic Emboli

Sir,

It is imperative to understand the underlying etiologies and manifestations of cerebral embolism. Most of the modern literature has primarily focused on Atrial fibrillation (AF), tumor, fat, and amniotic fluid as its potential cause.[1]Metallic fragments, as a source of cerebral embolism are rare and their awareness is must for the practicing neurologists as it is common to confuse these susceptibility artifacts with that of air, calcium or hemosiderin.[2] These are usually asymptomatic and can lead to difficulties in treatment and misdiagnosis. We hereby describe a case that was evaluated to ascertain the underlying etiology of stroke and was incidentally found to have unusual cerebral metallic emboli.

The case was of a 62-years-old, right-handed, gentleman with history of rheumatic heart disease. He underwent mitral and aortic valve replacement (Top Hat mechanical heart valve and On-X Mechanical prosthesis) in 2016 and was on treatment with Warfarin. Three years later he presented with left hemiparesis. CT head did not show any abnormality, angiogram of the Head and Neck revealed right Middle Cerebral Artery (MCA, m^2 branch) occlusion. Blood investigations, Chest X ray, and metabolic parameters were normal. 2D Echocardiogram demonstrated grossly normal left ventricular size and function. The right ventricle (RV) was mildly dilated with normal RV function. The right atrium was moderately dilated. The mitral and aortic valves were well seated. MRI done for stroke assessment showed acute infarct in the right MCA territory with incidental small well-defined rounded foci of susceptibility within the right cerebellum and left temporal lobe suggestive of embolic metallic fragments [Figure 1 a-d].

Magnetic susceptibility depends on the inherent magnetic property of a substance and is defined as its tendency and the extent to get magnetized in an applied external magnetic field.[3]In terms of their magnetic susceptibilities' substances can further be classified as Diamagnetic (like Bismuth), paramagnetic (like Platinum), and ferromagnetic (like Iron). Materials such as metal or air, which have different magnetic susceptibilities in comparison to the body tissues produce inhomogeneities in the magnetic field leading to susceptibility artifacts. These findings were first appeared in medical literature when Wingerchuk *et al*. described embolic ferromagnetic artifacts in the Brain caused by metal fragments from a prosthetic cardiac valve.[4]Although clinical significance and incidence of such lesions remains unknown, Naumann *et al*. described another patient who presented with Epilepsy and had similar findings on MRI. Whereas the embolic artifacts in Wingerchuk's report were presumed to arise from fracture prone BjorkShiley valve, embolic fragments shown by Nauman *et al*. were from a normal prosthesis. They also pointed out that metallic embolic artifacts might be more common after cardiac catheterization but go undetected as these patients cannot undergo MRIs' with prosthetic valves *in situ*.[5] Similar findings were reported in the cervical cord, post cardiac catheterization.[3]Jassal *et al*. further described multiple ferromagnetic hypointensities in MRI which could have occurred due to manipulation of angiographic guide wire as it passes through the femoral artery and the metallic microdeposits gain access to the systemic circulation.[6]A recent case series reported identical findings in patients who were treated with coil embolization for intracranial aneurysms. Postprocedural MRIs in their patients had shown embolic artifacts which remained stable over time and could not be detected on CT scans.[2]

Embolic metallic fragments arising from various sources are usually minute, as small as 0.01 mg and hence go undetected in plain X-rays of skull and CTs. The differentials for the above MRI findings include air, calcium and hemosiderin deposits. However, distinguishing imaging features in favor of metallic emboli are the unique hyperintense halos and a perfectly rounded contour [Figure 1a and b]. Also, calcium deposits which are large enough to produce such susceptibility artifacts can usually picked up on CT and hemosiderin deposits, which might be caused due vascular malformations or chronic intracranial bleeds do not exhibit the typical hyperintense halos of metallic artifacts.[4]

Our patient had history of Aortic and Mitral Valve replacement his MRI showed typical features suggestive of metallic embolic artifacts. There was no evidence air or calcium deposits on non-contrast CT [NCCT, Figure 1d].The findings

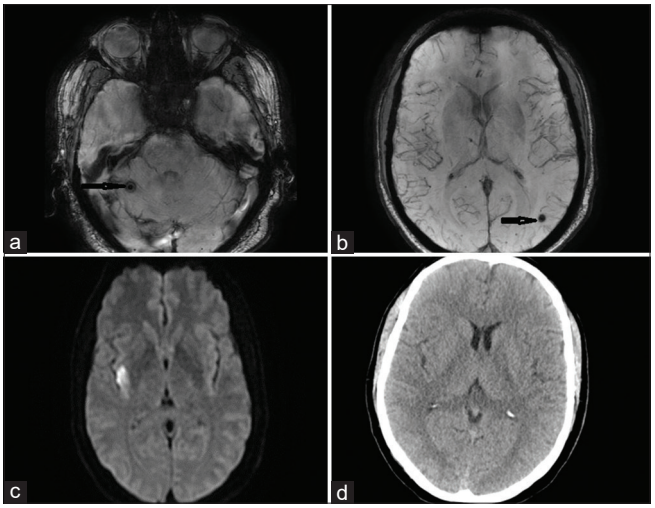

Figure 1: a) Susceptibility weighted images showing concentric rings of susceptibility consistent with embolic metallic fragments in the right cerebellum. b) Susceptibility weighted images showing concentric rings of susceptibility consistent with embolic metallic fragments in the left temporal lobe. c) DWI image showing acute infarct in the right MCA territory. d) CT head with no evidence of air or calcium deposits

of unusual metallic artifacts were incidental and in addition to the right MCA infarct [Figure 1c] which would explain his clinical symptoms. It is important for the Neurologists to get acquainted with these artifacts and avoid labeling them as microhemorrhages which could erroneously lead to stopping of antithrombotic medications or misdiagnosis of cerebral amyloid angiopathy (CAA).

To conclude, air, calcium, hemosiderin and metal should be considered as possible etiologies for hypointense spotty artifacts in susceptibility MRI. Artifacts due to air tend to normalize over time, calcium deposits can be picked up with NCCT, hemosiderin deposits lack the hyperintense halos and rounded contour that are found with metallic embolic artifacts. Also, the latter have been increasingly recognized after cardiac catheterization, implantation of prosthetic mechanical heart valves, and post aneurysmal coiling. It is worthwhile to consider these abnormalities while interpreting MRI scans and planning treatment for the patients.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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