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CASE REPORT

Novel Cause of Late Atrial Septal Defect Devices Embolization

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Abstract

Transcatheter closure of septal defects using specialized devices is a common procedure that has a high success rate. Embolization of Atrial septal defect devices is a known complication seen at a rate of 0.5%. We report a case of late ASD device occluder embolization immediately after brain MRI with clinical consequences and intraoperative evidence of right atrial wall thermal injury. To our knowledge Atrial septal occluder (ASO) device embolization post magnetic resonance imaging (MRI) was not reported before, although theoretically possible and that's why six to eight weeks post device implantation MRI is prohibited even with current MRI compatible devices.

Keywords: MRI safety, ASD device, Embolization, Thermal, Overheating, Atrial, Arrhythmia, ASD

1. Introduction

Atrial septal defects device closure is a common successful procedure (98%) [1,2]. Complications include embolization 0.2−0.43%, cardiac erosions 0.05−0.46%, atrial arrhythmia 11%, atrioventricular block (AV block) 0.22−1% and thromboembolism 0.03−2.0% [3].

Safety of magnetic resonance imaging (MRI) in patients with implanted devices is a concern.

2. Case

A ten year old boy with small patent ductus arteriosus (PDA) and large secundum Atrial septal defect (ASD) plus benign brain tumor resection with secondary seizures.

On 4th April 2021, patient underwent PDA device closure using duct occluder II 3 × 4 mm and ASD closure using 24 mm Atrial septal occluder (ASO) Amplatzer device as the ASD measures about 20 mm, total septal length was 40 mm with good rims. Closure went smoothly and device position was confirmed by Minnesota wiggle technique then by 2D Echocardiogram after device deployment (Fig. 1). Second day 2D Echocardiogram confirmed a well seated ASD device with no residual.

Sixteen weeks later on clinic follow up, Chest X ray showed ASD device projecting over upper mediastinum (Fig. 1). 2D Echocardiography showed embolization of ASD device into main pulmonary artery (Figs. 2 and 3). Mother gave history that the patient developed peripheral cyanosis and shortness of breath after brain MRI that was done four weeks prior to the clinic visit. Cyanosis lasted for one day and then resolved spontaneously but shortness of breath persisted.

Trial of the ASD device retrieval by catheterization failed due to a device adherence to MPA (Fig. 4). Surgical removal of the device and closure of the ASD was done. During surgery, the surgeon

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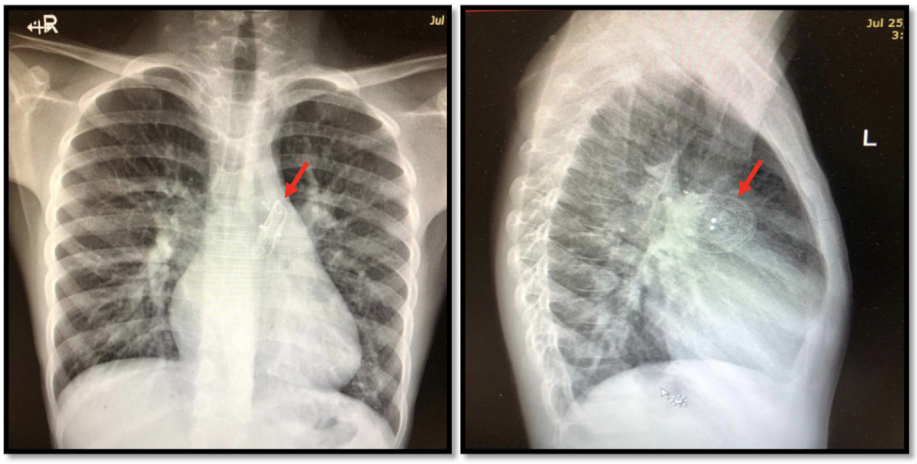

Fig. 1. AP and lateral chest X ray showed embolized device (Red arrow).

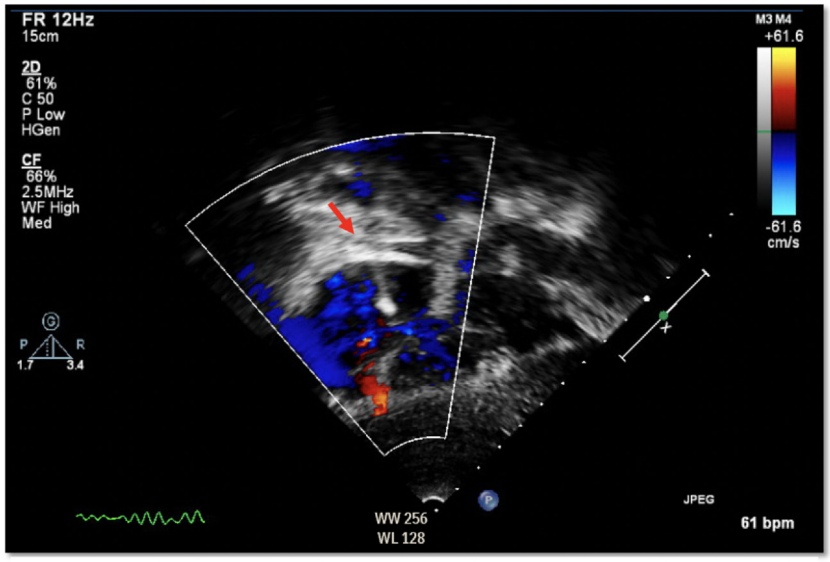

Fig. 2. Subcostal view in 2D electrocardiogram demonstrate atrial septal defect device still attached to the catheter (red arrow) in proper position.

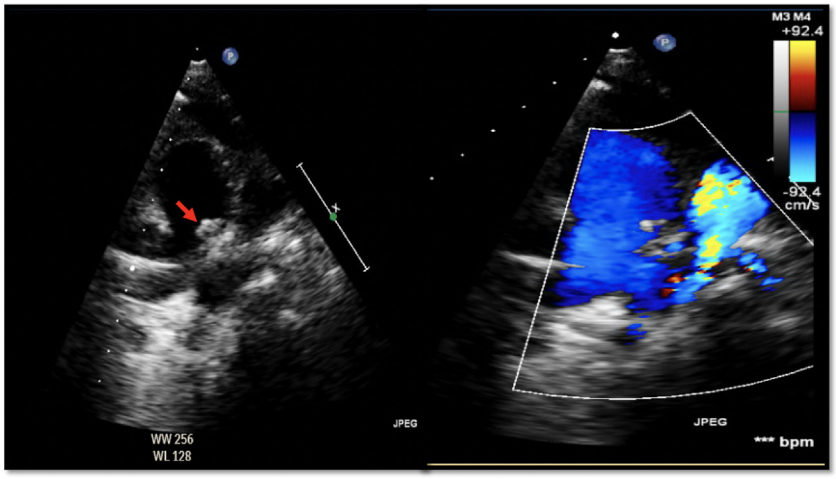

Fig. 3. Parastemal view in 2D echocardiogram demonstrate embolized atrial septal defect device (red arrow) in the main pulmonary artery above it's burification.

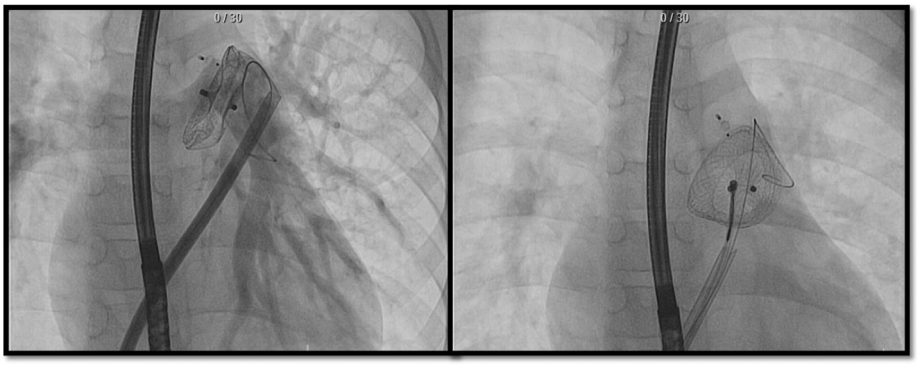

Fig. 4. Trials for atrial septal defect device retrieval during cardiac catherization.

noticed thermal burn in the right atrium wall possibly secondary to local overheating of the device during MRI exposure (Fig. 5). Upon discharge, 2D Echocardiogram showed no residual ASD and good biventricular systolic function. Electrocardiogram showed sinus regular rhythm.

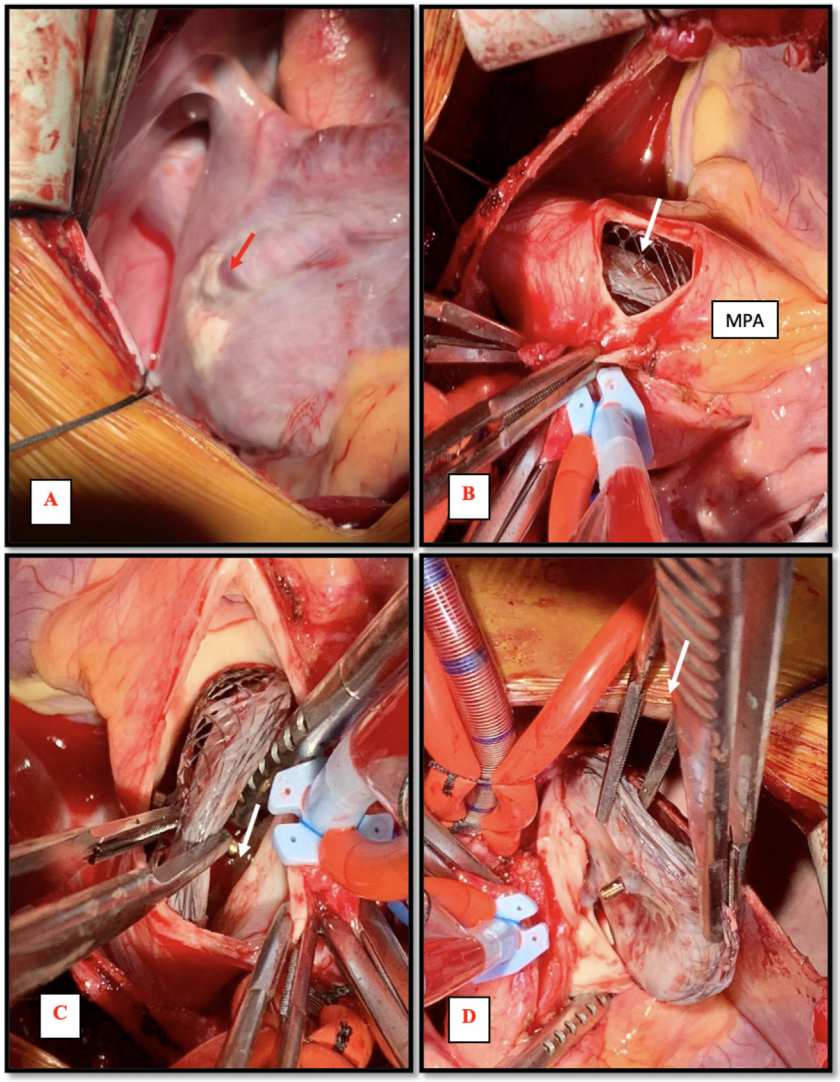

Fig. 5. A burned area in the right atrium wall (red arrow). B, C & D: ASD device (white arrow) surgical removal from main pulmonary artery (MPA).

3. Discussion

AMPLATZER Septal Occluder devices are made of Nitinol and have a metallic hub with expandable double umbrella-shape and a wide waist that centers the device and fills the ASD for optimal occlusion.

This procedure has excellent safety and efficacy, Yet device embolization remains a complication [4]. Previously reported common causes of device embolization post ASD device closure include undersized occluder, deficient atrial septal rims and Large defect >30 mm [5].

As these implants contain metallic materials, there is concern with the safety of magnetic resonance imaging (MRI) procedures in patients with these devices, especially considering MR systems that operate at 3 T.

The primary concerns regarding MRI in patients with atrial septal defect (ASD) devices include:

- The radiofrequency field can cause tissue heating and certain metallic devices may concentrate radiofrequency energy resulting in local heating [6].
- Torsion forces resulting in rotational movements that align the device in the direction of the magnetic field and traction forces causing shifting movements of the ferromagnetic object proportionally to the mass of the device [7,8].

ASD devices securely adhere to the inter atrial septum after six to eight weeks. Accordingly, MR safety of these devices have been evaluated [9]:

- Non-ferromagnetic devices considered safe for patients undergoing MR imaging up to 1.5 T immediately after implantation.
- Weakly ferromagnetic devices e.g. certain stainless steels, a period of sex to eight weeks is still recommended to allow for tissue growth [9].

By reviewing MR safety for ASD AMPLATZER device that was used in our patient, it was MR conditional which mean:

- Static magnetic field of 3 T or less.
- Spatial gradient magnetic field of 720 G/cm or less.
- Maximum MR system-reported, whole-body-averaged specific absorption rate (SAR) of 3 W/kg for 15 min of scanning.

In our case, despite the patient have been exposed to MRI at 1.5 T for ten minutes twelve weeks after device implantation, the device was dislodged after causing thermal burn in the right atrium due to local heating. The patient became symptomatic immediately after MRI exposure which supports it is the likely time of embolization causing sudden significant short lived right sided cardiac output limitation.

This case raises the concern about MRI safety with implanted cardiac devices, especially ASD closure devices even late after the closure. Possibly suggesting no MRI exposure till full endothelization six months after device implantation.

4. Conclusion

With the growing number of patients undergoing transcatheter closure of septal defects using specialized devices, It is important to assure safety MRI usage and for the time being t is logical to recommend no elective MRI exposure post ASD device closure until the six month period has passed.

Author contribution

Conception: WB-A, HG.
Literature review: WB-A, HG, AJ, JA-A.
Methodology: WB-A, HG, AJ, JA-A.
Software: WB-A, HG, AJ, JA-A.
Analysis and/or interpretation: WB-A, HG, AJ, JA-A.
Investigation: WB-A, HG, AJ, JA-A.
Resources: WB-A, HG, AJ, JA-A.
Data collection and/or processing: WB-A, HG.
Writer-original draft: WB-A, HG.
Writing-review & editing: AJ, JA-A.
VisualizationI: WB-A, HG, AJ, JA-A.
Supervision: JA-A.
Others: WB-A, HG, AJ, JA-A.

Conflict of interest

None.

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