Three-dimensional rotational angiography utility in imaging and intervention in a case of pulmonary arteriovenous malformation

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ABSTRACT

Pulmonary arteriovenous malformation (PAVM) is an abnormal communication between the pulmonary artery and the pulmonary vein. PAVMs are usually congenital in origin; however, they may be acquired. Three-dimensional rotational angiography (3DRA) is a technique used increasingly for imaging in congenital heart disease but to our knowledge has never been used in imaging and planning device closure of PAVM. We describe the use of 3DRA technique for imaging and planning device closure of PAVMs and discuss the advantages of this modality. 3DRA is an excellent tool for imaging of various vascular anomalies. It provides high-quality accurate images through a quick and safe procedure, it is also very useful in planning interventional procedures in PAVM, as it clearly delineates all feeders to PAVM and gives an exact view for analysis and intervention.

Keywords: Amplatzer Vascular Plug II, imaging, intervention, pulmonary arteriovenous malformations, three-dimensional rotational angiography

INTRODUCTION

First described in 1897, pulmonary arteriovenous malformation (PAVM) is an abnormal communication between the pulmonary artery and the pulmonary vein. PAVMs are usually congenital in origin; however, they may be acquired in a variety of conditions, such as hepatic cirrhosis, schistosomiasis, mitral stenosis, trauma, actinomycosis, and metastatic thyroid carcinoma.[1]

Contrast-enhanced computed tomography (CT) scanning remains the criterion standard in the diagnosis of PAVM. Although pulmonary angiography is less sensitive than contrast-enhanced CT scanning, it is performed to accurately define the anatomy, specifically before therapeutic embolization is performed.

Three-dimensional rotational angiography (3DRA) is a technique used increasingly for imaging in congenital heart disease but to our knowledge has never been used in imaging and planning device closure of PAVMs. Therefore, we present a case report where PAVM embolization was done using Amplatzer Vascular Plug (AVP) II with the help of 3DRA technique.

CASE REPORT

A 26-year-old female presented with complaints of difficulty in breathing, palpitation, cyanosis on exertion for 1 year and occasional episodes of epistaxis and presented with worsening of symptoms for the past 1 month. There was a positive family history; her sister, mother, and father were diagnosed with the arteriovenous malformations, and were suspected with hereditary hemorrhagic telangiectasia or Osler–Weber–Rendu syndrome. On examination, she had mucocutaneous telangiectases on lower lip, polycythemia, cyanosis, and Grade II clubbing. Her baseline saturation was 86%, other vitals were normal, and orthodeoxia test was positive, her cardiovascular system (CVS) examination showed cardiomegaly, no precordial murmur was noticed, there

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was a systolic murmur noted in right lower lung. Chest X-ray showed a round or oval mass of uniform opacity in the right lower lobe.

She was evaluated with transthoracic echocardiography which did not reveal any intracardiac anomaly, and a contrast echocardiography was done which showed spontaneous echo contrast in left atrium and left ventricle within three beats from right pulmonary veins [Figure 1].

To confirm and prepare the patient for device closure of PAVMs, CT pulmonary angiography was done which showed major PAVMs in right lung lower lobe arising from right lower inferior branch of right pulmonary artery (RPA), along with other PAVM, arising from next-generation right lower inferior branch of RPA with 2 feeders forming another segment of PAVMs [Figure 2]. After complete assessment and ruling out PAVMs on the left lung, she was planned for PAVMs device closure. With informed written consent and under general anesthesia, the patient was taken into catheterization laboratory.

Rotational Angiogram (Integrated Philips Allura Clarity) was done using a 5F pigtail catheter parked in the proximal branch of RPA [Figure 3]. During continuous projection data acquisition, the C-arm gantry was rotated around the object under investigation. Projection images were taken at a frame rate 30 frames/s. The whole rotation took 4 s, to optimize the dye. The dye used was undilutedand injected was at 8 cc/s (total of 32 ml was injected), It showed significant PAVMS in right lung lower lobe, with one feeder arising from right lower inferior branch of RPA and 2 other feeders arising from next generation of right lower inferior branch supplying another PAVM.

This enabled us to find the most useful projection for measuring the feeders and selecting the best implant device (AVP or Amplatzer Ductal Occlude device). The presence of multiple feeders suggested that multiple dumbbells and easily trackable AVP device would be better suitable than a duct occluder device. The exact oblique plane of the selected projection on rotational 3D reconstruction was replicated to obtain the best standard angiographic view of the feeders. Thus, an 18 mm AVP II device was selected and successfully implanted with excellent results [Figure 4].

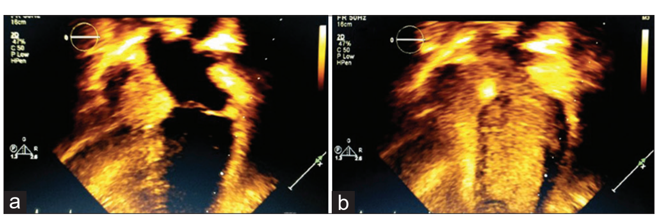

Figure 1: Transthoracic contrast echocardiography: (a) Demonstrates appearance of echo contrast in right atrium and right ventricle. (b) Shows appearance of contrast into left atrium and left ventricle from right pulmonary vein after 3 beats

DISCUSSION

3DRA is a technique used increasingly for imaging in congenital heart disease.[2,3] To the best of our knowledge, this is the first description of using this modality for imaging of PAVMs in general. The procedure can be performed under sedation or general anesthesia. In the latter, ventilator manipulation can further reduce respiratory variation artifacts. Although limited data has been published, studies suggest that this technique exposes the patient to lower radiation dose compared to CT angiography,[4,5] which is currently the most commonly used modality for imaging of in PAVMs.

Data acquisition and reconstructions are generated quickly (minutes),[6] and the image quality exceeds that of a classical cardiac CT.[5] Of note, the major limitations of this technique include the need for an invasive procedure and lack of imaging of the surrounding tissues.

Limitations of the present modalities of imaging are that they may not depict microscopic PAVMs, but the diagnostic yield with spiral CT scanning has been improving. Pulmonary angiography is less sensitive in identifying small or microscopic PAVMs, and MRI has significant limitations in screening for small lesions and in differentiating PAVM from lesions of other causes. We also conclude that 3DRA may also not depict microscopic PAVMs.

In conclusion, 3DRA is an excellent imaging technique that provides clear, accurate, and high-quality images in preparation for PAVMs device closure as it clearly

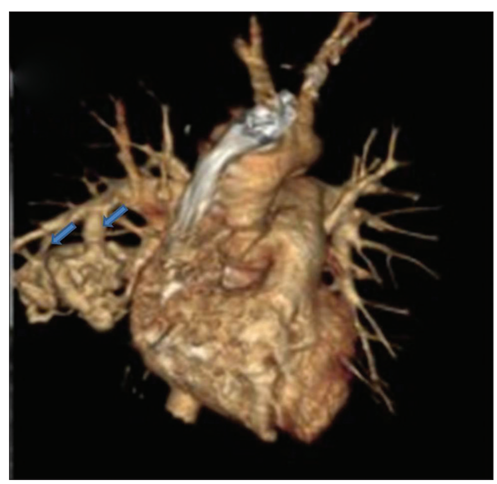

Figure 2: Three-dimensional reconstruction showing major pulmonary arteriovenous malformations in right lung lower lobe arising from right lower inferior branch of right pulmonary artery, along with other pulmonary arteriovenous malformation, arising from next-generation right lower inferior branch of right pulmonary artery with 2 feeders forming another segment of pulmonary arteriovenous malformations (highlighted by arrow)

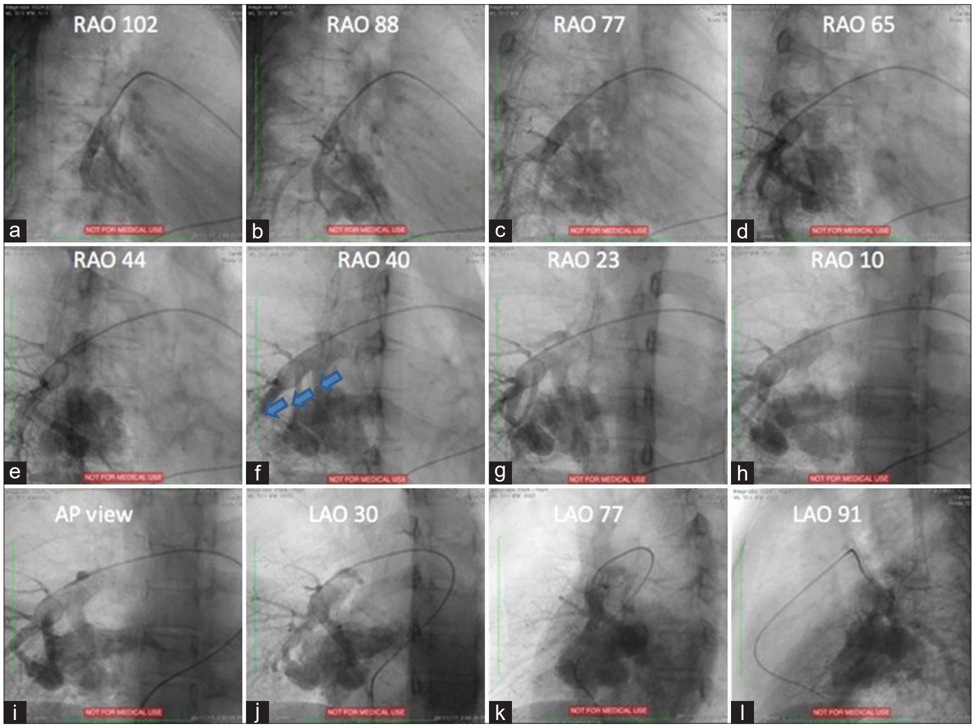

Figure 3: Right pulmonary artery rotational angiogram images from (a-l) showing significant pulmonary arteriovenous malformations in right lung lower lobe, with delineation of its feeders and pulmonary venous drainage (the feeders have been highlighted by arrow)

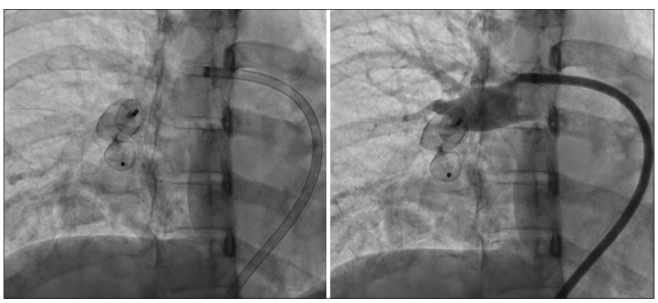

Figure 4: Device closure of second-generation right inferior branch of right pulmonary artery was done using Amplatzer Vascular Plug II. Postdevice closure angiogram showing complete obliteration of all feeders to pulmonary arteriovenous malformation

delineates all feeders to PAVM and gives an exact view for analysis and intervention.

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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