Use of the MVP™ Micro Vascular Plug System as a Single Occlusion Device to Treat Pulmonary Arteriovenous Malformations

Real-world case reports demonstrating the unique benefits that this system offers to patients and operators.

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Pulmonary angiography and embolization comprise the first-line treatment for patients with pulmonary arteriovenous malformations (PAVMs). The decision to treat a patient with a PAVM should be based on a comprehensive preprocedure evaluation, including a detailed patient history and physical examination, screening for hereditary hemorrhagic telangiectasia (HHT), and high-quality CT pulmonary arteriography. This allows for the necessary preprocedural planning to identify each PAVM and provide the treating physician with an idea of which embolic device will be most beneficial. Although any PAVM can result in serious complications, the risk of a complication increases as the size of the feeding artery increases. Stroke, hypoxia, and in extreme cases, high output cardiac failure are all possible complications. Smaller PAVMs, particularly those measuring < 3 mm in diameter, should not be discounted as insignificant. In recent years, embolic devices have undergone significant advances, allowing for the treatment of feeding arteries (< 3 mm in diameter) that had previously generally been considered not treatable.

The ideal embolic device to treat PAVMs is easily deliverable, detachable, immediately occludes the feeding artery, and does not recanalize over time. At Johns Hopkins Division of Interventional Radiology, either detachable coils or detachable endovascular plugs are used to treat PAVMs. Once such device is the MVP™ micro vascular plug system (Medtronic). The MVP™ device is a nitinol plug that is partially covered with polytetrafluoroethylene (PTFE) and can be delivered through a microcatheter (MVP-3Q and MVP-5Q, Medtronic). The PTFE covering results in near-immediate occlusion of the feeding artery. The MVP™ device is detachable and can be resheathed up to three times if the operator is unsatisfied with the deployment (ie, if the plug is undersized or deployed in an undesired location). The MVP™ device comes in sizes that are large enough to treat vessels up to 9 mm in diameter, and it easily navigates tortuous anatomy, allowing for distal deployment in small PAVM feeding vessels. Long-term data regarding the recanalization rates of MVP™ devices for the treatment of PAVM have not been published.

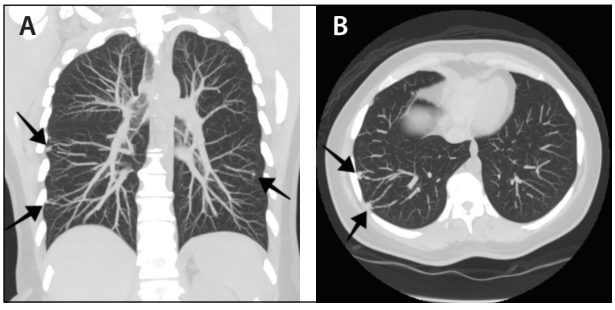

Figure 1. Coronal (A) and axial (B) maximum intensity projection images from a contrast-enhanced CT scan of the chest demonstrate numerous, small, peripheral PAVMs (black arrows).

The cases that follow illustrate the advantages of the MVP™ device in the treatment of PAVMs.

CASE 1

A 46-year-old woman was incidentally found to have multiple pulmonary nodules on a noncontrast-enhanced CT scan during the workup of renal calculi. A repeat CT scan of the chest with contrast confirmed that the nodules were PAVMs. She was referred to interventional radiology for further evaluation of the PAVMs, and on screening, met 4 of 4 Curaçao criteria, confirming the diagnosis of HHT. Further review of the chest CT scan demonstrated at least eight separate PAVMs, most of which were located in the right lung (Figure 1). The decision was made to proceed with pulmonary angiography and embolization due to the large number of PAVMs.

During the first embolization procedure, eight separate PAVMs were identified and embolized within the right lung. The size and location of the feeding arteries necessitated the use of a microcatheter for embolization. A total of 10 MVP™ devices were used to occlude the feeding arteries (Figure 2). The patient returned approximately 2 weeks later for a second pulmonary angiogram and embolization, and five additional PAVMs were embolized, again with MVP™ devices. Several additional PAVMs were noted during these procedures but were too small to treat. The patient tolerated both procedures well.

She was seen for follow-up approximately 6 weeks after the second embolization procedure and a repeat CT scan was performed, confirming an excellent treatment response with improvement of nearly every visible PAVM. The patient continues to follow up and has noted improved exercise tolerance since the embolization procedures. She will undergo a repeat CT scan of her chest at 1 year postembolization.

This case illustrates the versatility of newer embolization devices and the ability to treat numerous PAVMs in a single treatment session.

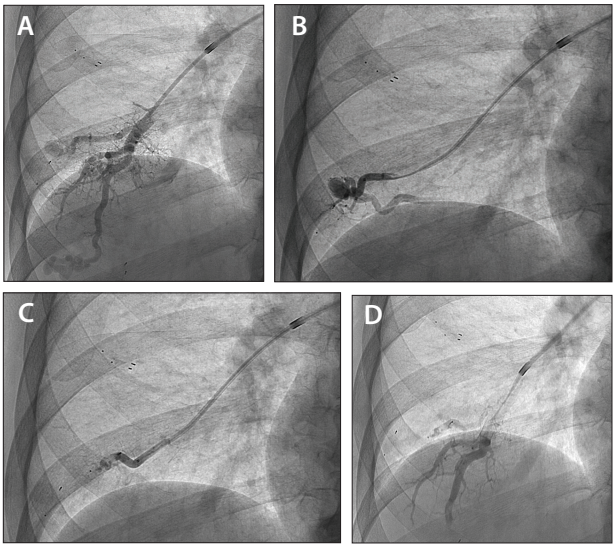

Figure 2. Images from the patient's first embolization procedure demonstrating multiple PAVMs (A). Pre- (B) and postembolization (C) images showing immediate occlusion of the vessel after deployment of a MVP™ device. Completion imaging after multiple vessels were embolized reveals no residual filling of the multiple treated PAVMs (D).

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CASE 2

A 34-year-old woman presented for evaluation of a suspected pulmonary arteriovenous shunt that was discovered on contrast-enhanced echocardiography during workup of a right posterior circulation stroke 6 months prior. She recovered well from the stroke with residual homonymous hemianopia and minimal left hemiparesis. She reported daily epistaxis and recurrent headaches and migraines but no breathlessness or previous history of hemoptysis. Her family history was significant for hereditary hemorrhagic telangiectasia affecting her mother and mother's siblings.

Clinical examination was unremarkable except for the residual neurologic deficit. Her oxygen saturation was 96% on room air. CT demonstrated multiple, simple PAVMs in both lungs (Figure 1). Three of these PAVMs were associated with a venous sac. Echocardiography and electrocardiography results were normal. Laboratory tests revealed microcytic anemia and a low ferritin level.

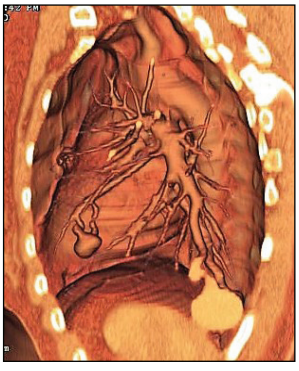

Figure 1. Three-dimensional volume-rendered CT pulmonary angiogram showing two PAVMs with associated venous sacs in the left lung.

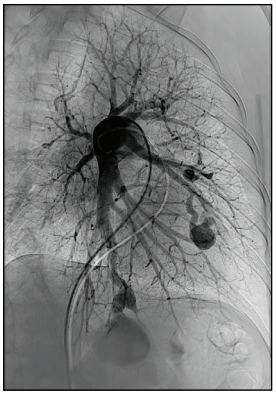

Figure 2. Left main pulmonary angiogram in the right anterior oblique projection demonstrating PAVMs in left lower lobe, left inferior lingular, left superior lingular, and superior segment of the left lower lobe.

Given her history of paradoxical embolism and stroke, the patient was offered embolization for treatment of these simple PAVMs. The procedure was performed under moderate sedation. Left pulmonary angiography demonstrated one small and three large PAVMs in the left lung (Figure 2). The left lower lobe segmental artery supplying the PAVM was selectively catheterized and angiography was performed. The feeding artery of the PAVM was occluded with a 9-mm-diameter MVP™ device deployed through a 5-F catheter (Figure 3). Similarly, the PAVM in the inferior lingular segment was occluded with a 7-mm MVP™ device (Figure 4) and the superior lingular PAVM was occluded with a 5-mm MVP™ device (Figure 5).

Postembolization left pulmonary angiography showed successful occlusion of all three large PAVMs (Figure 6).

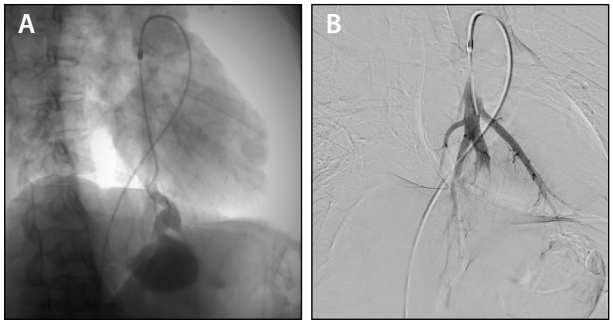

Figure 3. Selective left lower lobe segmental pulmonary angiogram demonstrating a large PAVM (A) that was successfully occluded with a MVP-9Q (B).

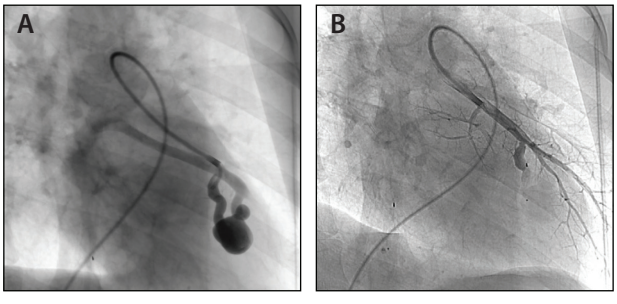

Figure 4. Selective left inferior lingular segmental pulmonary angiogram demonstrating a PAVM (A) that was successfully occluded with a MVP-7Q (B).

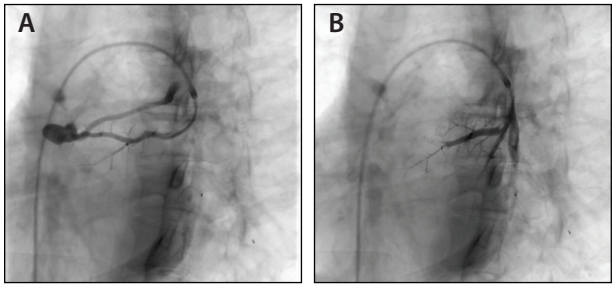

Figure 5. Selective left superior lingular segmental pulmonary angiogram demonstrating a PAVM (A) that was successfully occluded with a MVP-5Q (B).

The total fluoroscopy time was 30 minutes, with a cumulative air kerma of 1 Gy for the entire procedure. The smaller PAVM was later treated with a 3-mm MVP™ device that was deployed through a microcatheter (Figure 7).

Figure 6. Left pulmonary angiogram postembolization demonstrating successful occlusion of the three large PAVMs in the left lung.

This case illustrates the benefit of using MVP™ devices as the sole embolic material for treating PAVMs with feeding arteries of various diameters. Because these plugs allow easy and accurate deployment through a regular catheter and demonstrate immediate occlusion, multiple PAVMs can be treated during a single session with limited radiation exposure to the patient and the operator. ■

The Medtronic MVP™ micro vascular plug system is indicated to obstruct or reduce the rate of blood flow in the peripheral vasculature. This article is intended for US audience only.

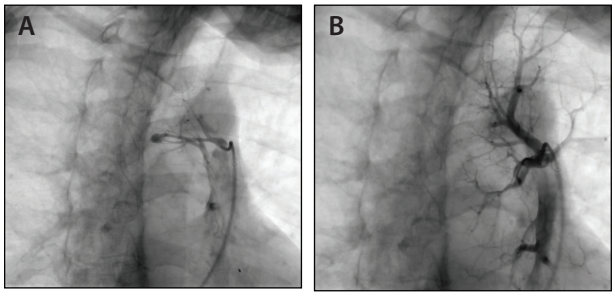

Figure 7. Selective left lower lobe superior segmental pulmonary angiogram demonstrating a small PAVM (A) that was successfully occluded with a MVP-3Q (B).

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