Selecting Coil Size for Transcatheter Embolization of a Large Pulmonary Arteriovenous Malformation: A Role for Three-Dimensional Computed Tomography

Chung-Lieh Hung, Charles Jia-Yin Hou, Hung-I Yeh, Yu-San Chou and Cheng-Ho Tsai

Treatment of pulmonary arteriovenous malformation (PAVM) depends on the size, total number, and even anatomical position or distribution of involved vessels. Both surgical approach and transcatheter coil embolization may be effective. We report a 49-year-old woman with recent onset of dyspnea on exertion. Pulmonary arteriovenous malformation was diagnosed. Transcatheter coil embolization was planned, but the distribution and size of the involved vessels made the technique and selection of the coil size difficult. Three dimensional multi-detector computed tomography of the malformation allowed precise selection of coil size and made transcatheter coil embolization possible. The embolization was then performed successfully without any complications.

Key Words: Pulmonary arteriovenous malformation • Transcatheter embolization • Multi-detector computed tomography

CASE REPORT

A 49-year-old woman complained of exertional dyspnea progressively since 2 months before. She was noted to have cyanosis of her lips and fingers in cold weather occasionally but denied any other systemic disease. On physical examination, she had no telangiectasia on the skin or mucous membranes. Her conjunctivae were pink. There was no jugular venous engorgement, and the chest and heart examinations were normal. However, her fingers were clubbed. Her SpO_2 on room air by pulse oximetry was 94%, and her hemoglobin was 12.0 g/dL. A chest x-ray revealed an opacified nodule apparently connected to the pulmonary vascular system in the right lower chest. Both electrocardiography and transthoracic echocardiography were within normal limits. The most likely diagnosis was pulmonary arteriovenous malformation (PAVM), and the patient was admitted for angiography.

The right femoral artery and vein were cannulated. There was no obvious pressure or saturation step-up throughout the entire examination. A selective right pulmonary arteriogram (Figure 1) revealed a vascular contour and morphology compatible with PAVM. The largest diameter of this malformation was 17 mm, and the pulmonary vein draining it was 8.7 mm in diameter. In addition, a small branch of the pulmonary artery was observed just near the orifice of the PAVM. The orifice of the interlobar pulmonary artery was less than 18 mm from the malformation. The large diameter of the PAVM and the very short distance from the interlobar pulmonary artery made transcatheter therapeutic approach risky. It seemed that surgery would be a safer option.

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Department of Cardiovascular Medicine; Mackay Memorial Hospital, Taipei, Taiwan.
Address correspondence and reprint requests to: Dr. Chung-Lieh Hung; Department of Cardiovascular Medicine; Mackay Memorial Hospital, 8F-1, No. 17, 93rd Lane, Sec. 2, Chung-Shan North Rd., Taipei, Taiwan. Tel: 886-2-2531-9260; Fax: 886-2-2543-3535-2459; E-mail: jotaro3791@yahoo.com.tw

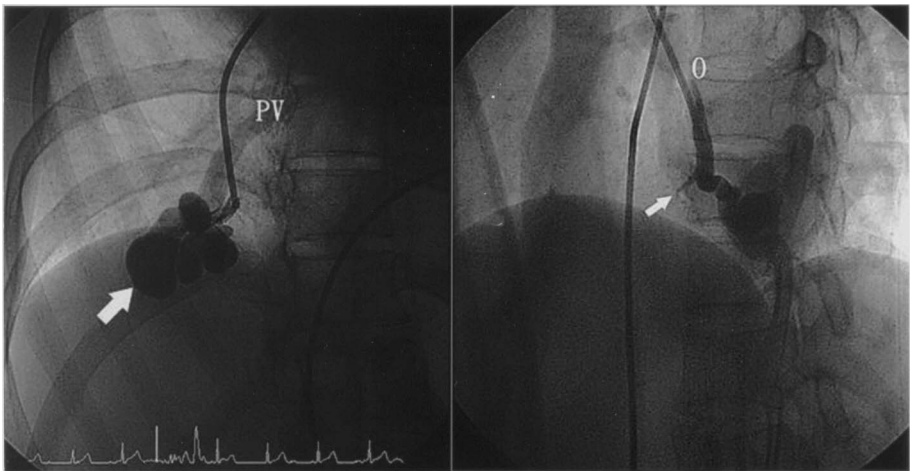

Figure 1. *Selective pulmonary arteriogram demonstrated the malformation (large white arrow). Left panel, RAO view; right panel, LAO view. The small white arrow (right panel) points to a small artery adjacent to the feeding artery. Note the short distance from the interlobar pulmonary artery to the orifice of the malformation. (PV: pulmonary vein; O: orifice of interlobar pulmonary artery)*

However, we decided to take a more detailed look at this lesion by using multi-detector computed tomography (MDCT, Sensation 16, Siemens, AG, Munich, Germany) with multiple sectional processing and three-dimensional (3D) imaging (Somaris/5 VA70C Syngo software). This examination demonstrated a huge, tortuous, grape-like PAVM (Figure 2). Although the malformation had quite a large diameter, MDCT revealed a narrow 4.9 mm isthmus within the PAVM that appeared to be amenable to transcatheter embolization (Figures 2, 3).

We chose a 9 × 15-mm coil (Cook, Bloomington, IN), and delivered it into the venous system using a 6 Fr Right Judkins 4.0 diagnostic catheter (Scimed, Boston Scientific, Maple Grove, MN) over a 0.035 × 260 cm guidewire (Terumo). The embolization procedure resulted in complete closure of the PAVM (Figure 4). All flow across the malformation disappeared, but the small side arterial branch was spared. After the procedure, the patient's SpO_2 was 98%. She has remained asymptomatic for 3 months after the procedure.

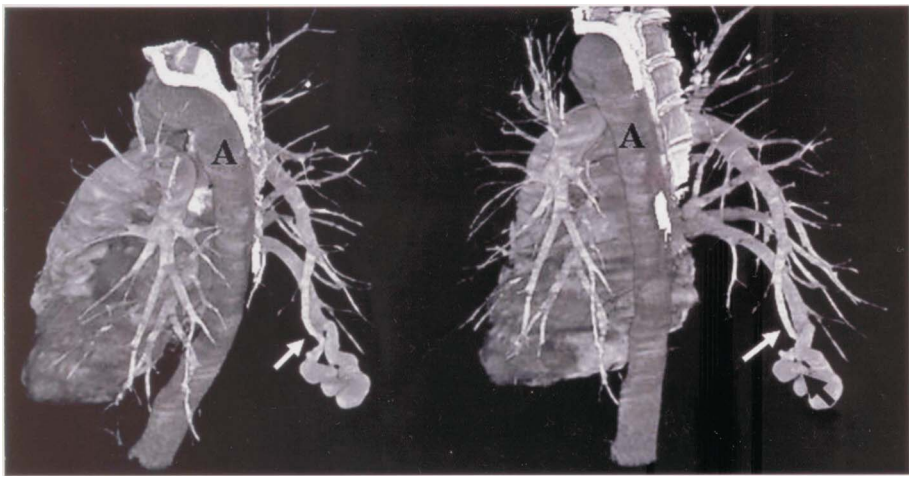

Figure 2. *Reconstructed 3D MDCT (from posterolateral view) revealing the huge, tortuous, grape-like PAVM. Small white arrow indicates feeding pulmonary artery of this PAVM, and dark arrow demonstrates clearly the narrow, isthmus-like portion within this PAVM, which made transcather coil embolization possible. (A: aorta)*

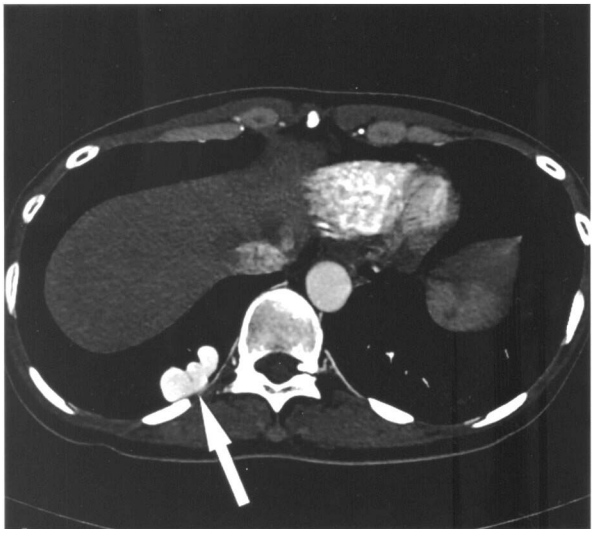

Figure 3. *3D MDCT cross-sectional view demonstrated a 4.9 mm in diameter "isthmus" (white arrow) within the PAVM.*

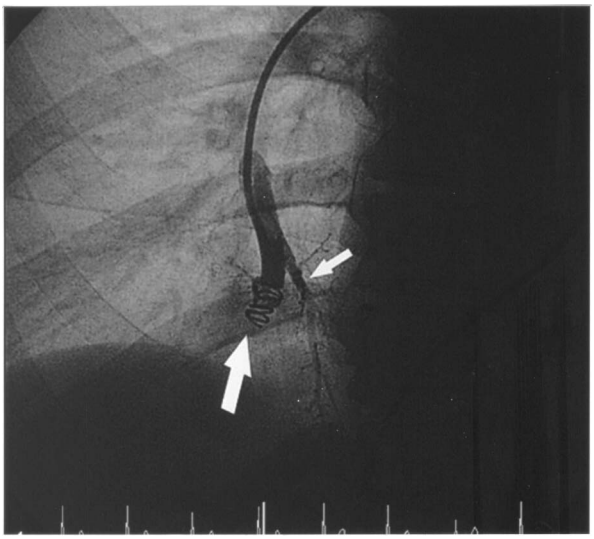

Figure 4. *After successful coil embolization, no more flow forward (large white arrow) was observed. The adjacent small artery has been spared (small white arrow), and the coil appears to be jammed just before the isthmus.*

DISCUSSION

PAVMs are relatively rare, which make diagnosis difficult.[1] Most are congenital, with about 60% of cases associated with Osler-Weber-Rendu syndrome.[2] Multiple lesions are present in half of all patients.[3] Patients may be asymptomatic except for only mild desaturation found by pulse oximetry. A small number of patients develop the classic triad of dyspnea on exertion, cyanosis, and clubbing fingers,[4] and our patient fit this pattern. A major risk associated with PAVM is paradoxical emboli, occurring often enough to make closure of the malformation essential.[4]

PAVMs may be found in any pulmonary segment, although most of them involve the lower lobes, especially the posterior side of the right lower pulmonary artery.[5] Contrast echocardiography is quite useful for diagnosis.[6] In this case, we performed 3D MDCT for definitive diagnosis and planning of treatment after angiography.

Transcatheter coil embolization is preferred to surgery, but there is a risk of systemic embolization which must be avoided.[7] But in cases with large or multiple PAVMs, surgery may be preferred.[7] In this case, angiographically determined diameters of both the pulmonary vein draining the PAVM (8.7 mm) and the malformation itself (17 mm) were large and made coil embolization technically difficult. A larger coil is usually recommended in such cases to avoid systemic embolization. However, we were concerned that the tail of a larger coil might protrude into the adjacent small artery and perhaps be dislodged into the right lower interlobar pulmonary artery trunk, leading to pulmonary infarction (Figure 1). Thus, surgical approach was considered in this case. It was only on 3D MDCT that we could discern the 4.9 mm isthmus within the PAVM, leading us to attempt closure with a relatively small coil, which indeed succeeded (Figures 2, 3).

Recurrence of symptoms has been observed in some patients secondary to an increase in the size of residual vascular lesions, so close follow-up is necessary even after successful treatment. Thus far at least, our patient has remained well, with normal O_2 saturation.

Angiography generally yields better spatial resolution of vascular lesions than does 3D MDCT. However, in this case, MDCT gave a detailed cross-sectional view of the patient's clustered, tortuous and highly angulated PAVM, allowing identification of an area narrow enough for successful embolization. We have been unable to find other similar cases reported in the literature. Our experience suggests that 3D MDCT may be useful in cases where it appears by angiography that transcatheter embolization is not suitable for treating PAVM.

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三維立體電腦斷層在巨大肺動靜脈畸型栓塞治療時的角色

洪崇烈　侯嘉殷　葉宏一　周友三　蔡正河
台北市　馬偕紀念醫院　心臟內科

肺動靜脈畸型的治療方式包括外科手術及經導管栓塞的術式，然其臨床上的選擇則根據動靜脈畸型本身的大小、總數目及解剖學的位置及分佈。在這裡我們報告一個以漸進式的運動時氣喘為表現的四十九歲女性案例，經由心導管的方式被診斷為肺動靜脈畸型。我們計劃由導管栓塞的術式來處理此動靜脈畸型，但是血管本身的分布、走向及大小使得正確的栓子尺寸選擇困難而面臨開刀的可能。最後我們經由立體電腦斷層的影像方式正確地選擇正確的栓子尺寸，而使得經導管栓塞成為可能。導管栓塞的術式最後被成功地施行且並未產生任何後遺症。

關鍵詞：肺動靜脈畸型、經導管栓塞、立體電腦斷層。