CASE REPORT

How to find a thrombus in a small pulmonary vein that is not enhanced by contrast agents because of a lack of arterial blood flow

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SUMMARY

It is unknown how to identify a small pulmonary vein thrombosis that is not contrasted because of loss of blood flow. Ischaemic stroke is an important clinical problem, and its prevention is a clinical target for the treatment of atrial fibrillation (AF). Because cardiac thrombus, a thrombus in the left atrial appendage and the left atrium, is well known, pulmonary vein thrombosis is thought to be a rare complication following lung surgery and catheter ablation. However, we have reported some cases of pulmonary vein thrombus without surgery, indicating that pulmonary vein thrombosis is not rare. In this case, we provide the details of an unenhanced pulmonary vein thrombus on 64-slice multidetector CT, which was largely illustrated in our previous case report. Because we understand the processes of the formation of pulmonary vein thrombus, we recognise an important implication of pulmonary vein thrombus; it alters hypoxic circumstances and undernourished state.

BACKGROUND

Ischaemic stroke is a crucial clinical problem, and its prevention of it is an important clinical target. Although cardiac thrombus, which is a thrombus in the left atrial appendage (LAA) or the left atrium (LA), is well known, thrombus in the pulmonary vein is almost unknown. Pulmonary vein thrombosis is thought to be rare, but it is a potentially life-threatening condition. Furthermore, the details of pulmonary vein thrombus are unclear, so we commonly fail to diagnose pulmonary vein thrombus, which can cause ischaemic stroke.

Pulmonary vein thrombosis is recognised as a rare complication following lung surgery and catheter ablation. Patients with atrial fibrillation (AF) have been treated with warfarin for more than 50 years because LAA thrombi are known to cause ischaemic stroke; LAA resection is a therapeutic option therapy. Presently, we do not usually notice the existence of a pulmonary vein thrombus, and we do not know how to treat them. First, we should know how to identify a thrombus in the small pulmonary vein.

Sixty-four-slice multidetector CT (64-MDCT) has become an option for assessing coronary artery stenosis, and it can estimate coronary artery plaque. A 64-MDCT scan can more easily and completely assess not only coronary artery plaque but also the LAA and LAA thrombi¹ as well as pulmonary vein thrombus.^{2–5}

Recently, we demonstrated by 64-MDCT that a thrombus existed in the left lower pulmonary vein extending into the left atrium, by 64-MDCT, which was confirmed by transthoracic echocardiography (TTE).⁴ How pulmonary vein thrombosis is formed is not yet well understood. The images of the above patient illustrated in detail the formation of a pulmonary vein thrombus. The images showed the small pulmonary vein thrombus growing into the left lower pulmonary vein and into the left atrium.

CASE PRESENTATION

A 70-year-old man with angina pectoris, who had four stents in the coronary artery (#1, #6, #11 and high lateral), was referred to our hospital for the evaluation of restenosis of the stents in the coronary artery because he had recently experienced chest pain. The patient had no symptoms of tachypnoea, fever, cough, sputum or cerebral infarction. The lung examination did not show decreased breath sound, lung crackles or wheezing. The cardiac examination did not demonstrate a heart murmur or arrhythmia.

The chest roentgenogram showed no lung cancer. The patient had smoked one pack of cigarettes per day for approximately 20 years, from 20 to 40 years old. Laboratory investigation revealed anaemia with a haemoglobin level of 10.8 g/dL (13.5–17.6 g/dL), hyperuricaemia with a uric acid level of 8.9 mg/dL (3.0–7.2 mg/dL), hypoproteinaemia with a total protein of 6.1 g/dL (6.5–8.0 g/dL) and normal electrolytes.

The patient was treated with 100 mg of aspirin without warfarin. The ECG showed normal sinus rhythm, a normal axis and no ST-T changes, and his heart rate was 59 bpm. A large thrombus in the left lower pulmonary vein (LLPV) and in the LA was illustrated as a defect in enhancements by 64-MDCT scan, which was shown in our previous paper.⁴ In figures 1 and 2 small vessels merge into one main pulmonary vein, which grows into LLPV. The thrombus in LLPV is illustrated as a defect of contrast enhancements in figures 2 and 3. In figure 4, the LLPV is connected to the left upper pulmonary vein (LUPV) and LA. TTE demonstrated a thrombus in the LA.⁴ The patient had no thrombus in LAA.

DISCUSSION

It is difficult to detect pulmonary vein thrombi because the associated symptoms, such as dyspnoea, coughing, haemoptysis and pleuritic chest

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Figure 1 The three vessels were merged into the left lower pulmonary vein. Large and small enhanced pulmonary veins are illustrated as round shapes, and the third vessel is illustrated without contrast enhancement (arrowhead), which suggests the third pulmonary vein was almost completely occluded by a thrombus.

Figure 3 The three vessels formed one pulmonary vein, which had a thrombus inside the vessel, and a part of the thrombus looked like a tail (arrowhead).

pain, are non-specific. In this case, the patient reported chest pain similar to angina pectoris. When we examine patients with chest pain similar to angina pectoris, we should consider pulmonary vein thrombosis, perhaps a small pulmonary vein thrombosis, even if the patient has had no thoracic surgery, such as lung resection or catheter ablation.

The thrombus of this patient was reported previously to some extent.⁴ However, in the previous case report, the details of the thrombus in the pulmonary vein were insufficiently illustrated. In 1993, Kim *et al* reported a thrombus in the LA, illustrated by TTE, in a patient with lung cancer and paroxysmal atrial fibrillation (pAF). Furthermore, they reported that the mass appeared to obstruct the right superior pulmonary vein completely, without an identifiable point of attachment. Although they believed that the right upper pulmonary vein was obstructed by a thrombus, there was a possibility that it was obstructed by a tumour. It was impossible to identify whether the mass in the right pulmonary vein was a thrombus using only TTE. Using 64-MDCT could help to identify the difference between a tumour and a thrombus because there is the possibility that a tumour will be contrasted on 64-MDCT scans. In the present case, the thrombus was not contrasted at all. More studies of tumours in the pulmonary vein would also be desirable.

In the present manuscript, we provide the details of the formation of a LLPV thrombus. A large thrombus in the left lower pulmonary vein was detected on axial and sagittal images as a

defect of enhancements by a 64-MDCT scan. TTE demonstrated the thrombi in the LA.⁴ The details of the thrombus in LLPV were demonstrated. Figure 1 shows that three small vessels merged into one main pulmonary vein, which is LLPV. The thrombus in the LLPV is illustrated as a defect of contrast enhancements in figures 2 and 3. In figure 4, the LLPV is connected to the LUPV and the LA. It is difficult to estimate an occluded pulmonary vein because the pulmonary vein cannot be enhanced when occluded by a thrombus; thus, it will not be demonstrated by contrast enhancements. The small pulmonary vein (figure 1 arrowhead) was estimated to be occluded because it had some structure, and it was not enhanced by contrast agents.

An occluded small pulmonary vein (figure 1 arrowhead) offers special circumstances, such as hypoxia and undernourishment. It is unknown what effects occur on occluded pulmonary veins and the tissues around them. An occluded pulmonary vein could be very important because it is hypoxic and in an undernourished state, and it lacks metal ions such as calcium ions, ferrous ions and zinc ions. Under such abnormal circumstances, special transcription factors, such as hypoxia inducible factor-1, nuclear respiratory factor-1 and metal-responsive transcription factor-1 could be activated, and many pathological effects, such as pulmonary vein myocardium, might occur.

Figure 2 The size of the left lower pulmonary vein (LLPV) grew, with the thrombus inside the LLPV (arrowhead).

Figure 4 The LLPV, which had a thrombus (arrowhead), was connected to the LUPV broadly and to the LA finely. LA, left atrium; LAA, left atrial appendage; LLPV, left lower pulmonary vein; LUPV, left upper pulmonary vein.

Learning points

- ▶ It is important to understand small pulmonary vein thrombus and to elaborate on the effects of small pulmonary vein thrombosis. If a patient reports chest pain, then the cause of the chest pain could be pulmonary vein thrombosis.
- ▶ It is difficult to identify occluded pulmonary veins because they are not enhanced by contrast agents, but it is important to identify occluded pulmonary veins accurately.
- ▶ When we identify a contrast enhancement defect in the pulmonary vein by a 64-slice multidetector CT scan, it might not be cancer, but rather a thrombus, because cancer can be enhanced and pulmonary vein thrombosis cannot be enhanced.
- ▶ There is a possibility that a pulmonary vein thrombus transforms normal pulmonary vein cells into the pulmonary vein myocardium, which is necessary for the progression of atrial fibrillation by intermediation with some transcription factors, such as hypoxia inducible factor-1, nuclear respiratory factor-1 and metal-responsive transcription factor-1.
- ▶ It is important to dissolve a thrombus in the pulmonary vein, because doing so can prevent the production of the pulmonary vein myocardium. It is very important to prevent the formation of thrombus in the pulmonary vein.

Competing interests None.

Patient consent Obtained.

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