CASE REPORT

Rivaroxaban lessens the number of thrombi in the left atrium and right lower pulmonary vein, as illustrated by transoesophageal echocardiography but not 80-MDCT

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SUMMARY

Stroke is a clinically important problem. A left atrial thrombus is known as a cause of ischaemic stroke. A pulmonary vein thrombus (PVT) is thought to be rare; however, PVT is common in elderly patients. Additionally, images of PVT with transoesophageal echocardiography (TEE) following treatment have not been well contrasted with that from either 64 or 80-slice multidetector CT (80-MDCT). The images of such changes depicted by TEE remain unknown. An 87-year-old man with hypertension was examined by 80-MDCT and TEE to check the cardiac thrombus. Although 80-MDCT did not depict the thrombus, TEE depicted the thrombus in the left atrium and right lower pulmonary vein (RLPV) clearly. After 6 months of rivaroxaban treatment, the thrombus in the RLPV decreased slightly and the thrombus in the left atrium became small and lucent, as estimated with TEE. Rivaroxaban decreased the size of the thrombus and changed the quality of the thrombus.

BACKGROUND

Stroke is an important clinical problem. Stroke is the second largest common cause of death in many developed countries and causes long-lasting serious effects such as paralysis, work disability, dementia and age-related cognitive decline.¹ Preventing primary and secondary ischaemic stroke is crucial. A left atrial appendage thrombus and a left atrial thrombus are known causes of ischaemic stroke. A pulmonary vein thrombus (PVT) has the potential to cause systemic embolisation such as ischaemic stroke and acute myocardial infarction. PVT and left atrial thrombus are common in elderly patients.^{2 3}

Transoesophageal echocardiography (TEE) is the most common method to detect thrombi in the left atrium and left atrial appendage. However, few cases have shown a PVT with TEE.

Rivaroxaban is a novel oral anticoagulant (NOAC) that inhibits Xa and decreases the occurrence of ischaemic stroke. However, the mechanisms of its efficacy are not fully understood. Several reports have demonstrated that NOACs such as dabigatran and rivaroxaban can resolve a thrombus in the left atrium and left atrial appendage.⁴ Several reports have demonstrated that dabigatran can partially resolve a thrombus in the pulmonary vein,² but few reports have demonstrated that rivaroxaban

can resolve a thrombus completely in the pulmonary vein.

Dabigatran is reported to resolve a PVT partially, as assessed using 64-slice multidetector CT (64-MDCT). However, assessment of the thrombi after drug treatment has not been previously carried out with TEE.

CASE PRESENTATION

An 87-year-old man with hypertension was examined with 80-slice multidetector CT (80-MDCT) and TEE to check for a cardiac thrombus and a pulmonary vein thrombus.

He had no symptoms of tachypnoea, fever, cough, sputum or cerebral infarction. Respiratory examination showed no decreased breath sounds, lung crackles or wheezing. The cardiac examination demonstrated a pansystolic heart murmur but did not demonstrate arrhythmia. His body mass index was 20.4, and the volume of his left atrium was 44.3 mL. The chest roentgenogram exhibited no lung cancer and no cardiomegaly. No previous treatment with warfarin had been performed. The ECG indicated a sinus rhythm with complete right bundle branch block, and the patient's heart rate was 88 bpm. The serum D-dimer level was 0.8 µg/mL (normal; <1.0 µg/mL), the activity of protein S was 92% (normal; 60–127%), and the activity of protein C was 130% (normal; 64–135%). The homocysteine level was 18.1 nmol/mL (normal; 5–15 nmol/mL), and the brain natriuretic peptide level was 21.2 pg/mL (normal; 0–18.4 pg/mL).

Transthoracic echocardiography (TTE) demonstrated no thrombus in the left atrium. 80-MDCT demonstrated a small dark area around the exit of the right lower pulmonary vein (RLPV) in the left atrium and a small dark RLPV that looked like an artefact or nothing (figure 1). To scrutinise the thrombus in the left atrium and RLPV, TEE was performed. TEE showed the presence of a thrombus in the left atrium (figure 2). Furthermore, TEE clearly demonstrated a thrombus in the RLPV that could not be clearly detected with 80-MDCT (figure 3). Video images showed the thrombus clearly. Colouring, generally observed for blood flow from the right upper pulmonary vein and around the thrombus was not observed (video 1). Video images without Doppler colouring revealed the thrombus more clearly (video 2).

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Figure 1 The axial images depict no thrombus in the left atrium and right lower pulmonary vein clearly. There is a small dark area in the left atrium around the exit of the right lower pulmonary vein (arrow). The colour of the right lower pulmonary vein is very dark. DAo: descending aorta, LA: left atrium, RLPV: right lower pulmonary vein.

Figure 2 Transoesophageal echocardiography images showing a thrombus in the left atrium (arrow). The thrombus is attached to the wall of the left atrium and consists of two parts. One is a white thrombus that is attached to the left atrium wall (arrow), and the other is a darker one (arrow head). LA: left atrium, RLPV: right lower pulmonary vein, RUPV: right upper pulmonary vein.

Figure 3 Transoesophageal echocardiography images showing a clear thrombus (7.9x3.4 mm) in the exit of the right lower pulmonary vein (arrow). The image of the thrombus is similar to that of the pulmonary vein wall. LA: left atrium, RLPV: right lower pulmonary vein, RUPV: right upper pulmonary vein.

Video 1 Transthoracic echocardiography images showing a thrombus in the left atrium that was depicted as a white mass, and blood flow from the right upper pulmonary vein was disturbed around the thrombus, indicating some thrombi were located there.

Video 2 Transthoracic echocardiography images showing a thrombus in the left atrium that was depicted as a white mass. The thrombus is mainly composed of two parts. One is white and attached to the wall of the left atrium, and the other is a rather dark thrombus attached to the white thrombus.

After 6 months of rivaroxaban treatment, 80-MDCT showed no thrombus in the RLPV and in the left atrium (figure 4). TEE depicted no thrombus in the left atrium directly; however, blood flow from the right upper pulmonary vein showed the existence of the thrombus as a lack of colouring (figure 5). Additionally, TEE revealed a thrombus in the RLPV that was smaller than before the treatment of rivaroxaban (figure 6), an observation that could not be illustrated with 80-MDCT (figure 4). Video images showed the existence of the thrombus in the left atrium more clearly as a lack of colouring (video 3).

TREATMENT

Rivaroxaban, 10 mg once daily.

DISCUSSION

In this case, TEE demonstrated the presence of a thrombus in the left atrium before and after 6 months of rivaroxaban treatment (figure 2 and figure 5). However, the thrombus was depicted as a small dark area with 80-MDCT before rivaroxaban treatment (figure 1); after treatment, it could not be detected (figure 4). Furthermore, before rivaroxaban treatment, TEE revealed a thrombus in the RLPV (figure 2) that could not

Figure 4 The axial images depict no thrombus in the left atrium and right lower pulmonary vein. DAo: descending aorta, LA: left atrium, RLPV: right lower pulmonary vein.

Figure 5 Transoesophageal echocardiography images showing no thrombus in the left atrium directly; however, the blood flow from the right upper pulmonary vein is not able to surround where the thrombus (arrow) was located. LA: left atrium, RUPV: right upper pulmonary vein.

Figure 6 Transoesophageal echocardiography images show a thrombus (5.2x4.4 mm) at the entrance of the right lower pulmonary vein (arrow) that seems to be smaller than that before rivaroxaban treatment. LA: left atrium, RLPV: right lower pulmonary vein, RUPV: right upper pulmonary vein.

Video 3 Transthoracic echocardiography images after 6 months of rivaroxaban treatment showing a thrombus in the left atrium depicted as a lack of blood flow from the right upper pulmonary vein, indicating that a thrombus was located there. The location of the lack of colouring is similar to the white part of the thrombus in the left atrium.

be detected with 80-MDCT clearly ([figure 4](#)); after rivaroxaban treatment, TEE revealed a thrombus in the left atrium ([figure 5](#)) that could not be detected with 80-MDCT ([figure 4](#)), indicating that 80-MDCT may underestimate a thrombus in the left atrium or the pulmonary vein. Although the thrombus in the RLPV became smaller ([figure 6](#)), the thrombus in the left atrium became lucent ([figure 5](#)). The quality of the thrombus in the left atrium and RLPV may differ greatly. Both thrombi were not identified with 80-MDCT, indicating 80-MDCT was unable to detect these changes after treatment.

The thrombus in the left atrium can be detected using TEE, as shown in [figure 2](#) ([videos 1 and 2](#)). Furthermore, in observing the images of [video 1](#) more closely, the disturbance area of the blood flow is wider than the thrombus images in [figure 2](#). There is a possibility that the thrombus in [figure 2](#) had some unseen thrombi around the detected thrombus in [figure 2](#). The thrombus may be composed of three components, white parts, small dark parts, and lucent parts ([figure 2](#)). After 6 months of rivaroxaban treatment, the small dark parts and lucent parts were resolved ([figure 5](#)), and the blood flow area was increased ([video 3](#)).

Rivaroxaban resolved the thrombus in the left atrium almost entirely and caused the thrombus in the left atrium to change from white to lucent. However, rivaroxaban resolved the thrombus in the RLPV only partially, and most parts of the thrombus in the RLPV could not be resolved. The effects of rivaroxaban on both thrombi were clearly different. The quality of the thrombi in the left atrium and RLPV may be different. More studies are required to clarify the effects of rivaroxaban on both thrombi.

The risk of stroke increases with age, and risk factors include chronic heart failure, cigarette smoking, obesity, physical inactivity, diabetes mellitus, hypertension, atherosclerosis, atrial fibrillation and a family history of stroke or a previous stroke or TIA; however, many relevant phenomena remain unexplained. Hyperhomocysteinemia is associated with the severity of cognitive dysfunction and dementia, and hyperhomocysteinemia is considered a primary risk factor for vascular diseases, including stroke.⁵ In this case, the patient had hyperhomocysteinemia, so the thrombus formation in the left atrium and in the pulmonary vein may be associated with

hyperhomocysteinemia, and the thrombus may cause ischaemic stroke eventually.

Learning points

- ▶ Rivaroxaban partially resolved the thrombi in the left atrium and right lower pulmonary vein.
- ▶ Eighty-slice multidetector CT may underestimate a thrombus in the left atrium and pulmonary vein.
- ▶ The quality of the thrombus in the left atrium and right lower pulmonary vein may be different.
- ▶ Rivaroxaban changes the images of the thrombus from white to lucent in the left atrium, indicating that it changes the quality of the thrombus.
- ▶ A small dark and lucent area of the thrombus in the left atrium was resolved more easily.

Competing interests None declared.

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REFERENCES

- 1 O'Donnell MJ, Xavier D, Liu L, *et al*. INTERSTROKE investigators. Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the INTERSTROKE study): a case-control study. *Lancet* 2010;376:112–23.
- 2 Takeuchi H. High prevalence of pulmonary vein thrombi in elderly patients with chest pain, which has relationships with ageing associated diseases. *IJC Heart Vessels* 2014;4:129–34.
- 3 Takeuchi H. Nearly all left atrial thrombi may be extended from pulmonary vein thrombi. *IJC Heart Vasculture* 2015;7:9.
- 4 Lip GYH, Hammerstingl C, Marin F, *et al*. Left atrial thrombus resolution in atrial fibrillation or flutter: results of a prospective study with rivaroxaban (X-TRA) and a retrospective observational registry providing baseline data (CLOT-AF). *Am Heart J* 2016;178:126–35.
- 5 Wald DS, Law M, Morris JK. Homocysteine and cardiovascular disease: evidence on causality from a meta-analysis. *BMJ* 2002;325:1202.

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