

Successful visualization of pulmonary embolism using fluoroscopic video analysis in a patient with iodine contrast allergy: a case report

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Background

Contrast-enhanced computed tomography (CT) is commonly used to diagnose pulmonary embolism (PE). However, a history of iodine contrast allergy presents a dilemma in the management of patients with PE. As an alternative approach, X-ray fluoroscopic video analysis has been recently reported to be useful in diagnosing PE.

Case summary

A 78-year-old man with dyspnoea of 1-month duration visited our hospital. His oxygen saturation was 89%, and echocardiography demonstrated right heart strain. We could not perform contrast-enhanced CT because the patient had a history of contrast allergy and refused to undergo premedicated contrast CT with anti-histamine and/or corticosteroid. Therefore, a video analysis of pulmonary circulation using dynamic chest X-ray (DCR) was performed. The reconstructed pseudo-colour video showed defects of pulmonary circulation in both lung areas. We diagnosed PE and started anticoagulant therapy. Multiple segmental defects were also observed in pulmonary perfusion scintigraphy on Day 3, which confirmed the diagnosis of PE. He was discharged on Day 9, and an improvement of the pulmonary circulation as assessed with DCR was observed. He had no symptoms at the last follow-up visit at 1 year after discharge.

Discussion

We describe the successful visualization of PE using DCR in a patient with iodine contrast allergy.

Keywords

Dynamic chest radiography • Contrast allergy • Pulmonary embolism • Computed tomography • Pulmonary perfusion scintigraphy • Case report

ESC curriculum

2.1 Imaging modalities • 9.5 Pulmonary thromboembolism

Learning points

- Video analysis of dynamic chest radiography reveals alterations in pulmonary circulation.
- This novel analysis has the advantages of not requiring a contrast agent and entailing low radiation exposure.

Introduction

Dynamic chest radiography (DCR), which provides pulmonary circulation findings without contrast media, is a novel diagnostic method for detecting acute pulmonary embolism (PE).¹ Contrast-

enhanced computed tomography (CT) is frequently used for the diagnosis of PE; however, its use is problematic in patients with allergy to contrast media. This is one of the first reports in which PE was diagnosed using video analysis of DCR imaging without contrast.

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Timeline

1 month before admission	The patient had experienced exertional dyspnoea
Day 1	Dynamic chest X-ray images revealed areas of decreased perfusion. We diagnosed PE and started anticoagulant therapy
Day 3	Pulmonary perfusion scintigraphy revealed multiple segmental defects. This confirmed the diagnosis of PE
Day 9	The patient was discharged from our hospital
Day 13	Follow-up analysis using dynamic chest X-ray on
A month later	Day 13 and a month later showed an improvement of pulmonary circulation
1 year later	The patient had no symptoms at follow-up visit

Case presentation

A 78-year-old man with dyspnoea of 1-month duration was admitted to our hospital. His past medical history included hypertension and cerebral aneurysm. He did not have risk factors for PE such as recent air travel or major surgery. He was diagnosed with iodine allergy when he experienced an allergic skin reaction immediately after cerebral angiography. His vital signs at admission were as follows: blood pressure, 148/86 mmHg; heart rate, 63 beats/min; respiratory rate, 25 breaths/min; and peripheral oxygen saturation, 87%. His physical findings were normal, including the absence of lower extremity oedema or abnormal heart sounds.

Chest radiographs (Figure 1A) and electrocardiogram revealed normal findings. Blood tests revealed elevated D-dimer levels of 10.1 µg/mL

(reference value: <1.0 µg/mL). Cardiac ultrasonography (Figure 1B–D) revealed a high peak tricuspid regurgitation pressure gradient (TRPG: 75 mmHg) with normal left ventricular function, dilated right ventricle, and decreased systolic function. Deep vein thrombosis was not detected on lower extremity ultrasonography.

Non-contrast CT revealed high-density lesions suspected to be thrombi in the pulmonary arteries (Figure 1E and F). Contrast-enhanced CT with anti-histamine and/or corticosteroid premedication was recommended in a patient with contrast allergy; however, the patient did not consent to the recommendation because of fear of allergy recurrence. Therefore, we performed a video analysis using Radwisp (Paramevia Pte. Ltd, The central, Singapore), a novel fluoroscopic video analysis workstation, to visualize the pulmonary circulation with non-contrast cineradiography. Initially, the patient was placed in the supine position on a flat panel detector, and fluoroscopic images were obtained with a 5 s breath hold. Second, we analysed the pulmonary circulation via a Radwisp workstation comprising a fast Fourier transform filter and adjustment for heartbeats, using the phenomenon that pulmonary perfusion is slightly reflected on fluoroscopic images as radiographic density change signals. Finally, after a 10 min analysis, pulmonary circulation was displayed using a red-yellow-green colour scale. The absence of red colouring indicates poor pulmonary circulation, and areas with decreased perfusion are visualized as yellow in the right upper, right lower, and left lower fields (Figures 2A and 3A; Supplementary material online, Video S1).

From these findings, we diagnosed the patient with PE and started anticoagulant therapy with rivaroxaban 15 mg twice daily on Day 1. The patient was initiated on oxygen at 4 L/min. Since 2 days are required to prepare nucleotides, we performed pulmonary perfusion scintigraphy on Day 3. Multiple segmental defects were observed (Figure 2B), and this confirmed the diagnosis of PE.

Oxygen therapy was discontinued on Day 8, and the patient was discharged from our hospital on Day 9. Follow-up analysis using Radwisp on Day 13 revealed improvement in the peripheral pulmonary circulation (Figure 3B; Supplementary material online, Video S2). We decreased the dose of anticoagulant therapy with rivaroxaban to 15 mg once daily

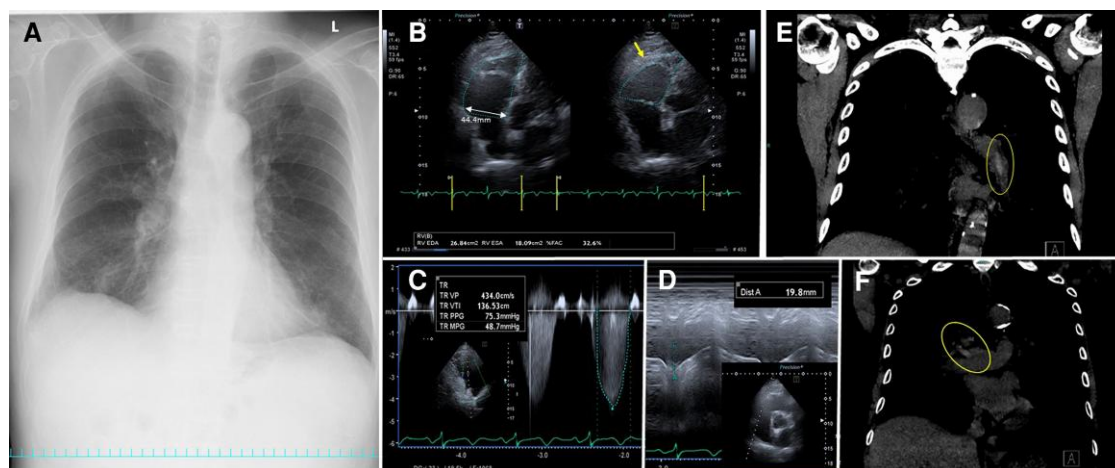


Figure 1 (A) Chest radiograph. No abnormality is detected. (B–D) Right ventricular systolic dysfunction is observed in cardiac ultrasonography. The right ventricular basal diameter is dilated to 44.4 mm (abnormal value; >42 mm), and McConnell sign is observed (arrow). Function area change is decreased at 32.6% (abnormal value; <35%). Tricuspid annular plane systolic excursion is 19.8 mm, which is within the normal range (abnormal value: <16 mm). (E and F) Non-contrast computed tomography images. In the right main pulmonary artery, higher-density lesions [73–76 Hounsfield unit (HU)] are observed, compared with those in the blood circulation (50 HU). In the left lower pulmonary artery, unenhanced computed tomography reveals a highly attenuated lesion suggestive of a clot (60 HU).

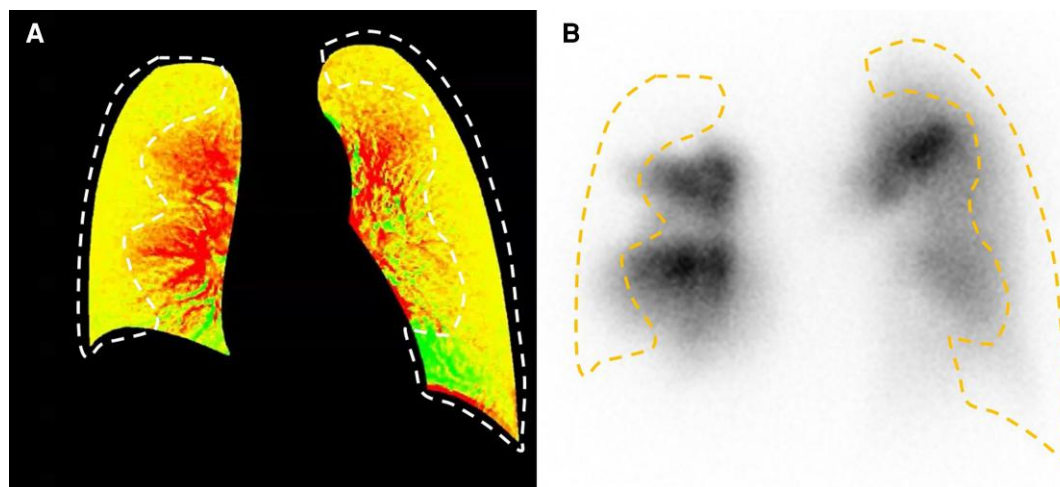


Figure 2 (A) Image of the pulmonary circulation created using the X-ray fluoroscopic video analysis workstation. The central fields of the right upper/lower and left upper segments are red, indicating good blood flow. Yellow or green areas, such as the distal fields of both lungs, suggest reduced blood flow. (B) Pulmonary perfusion scintigraphy reveals wedge-shaped defect indicating pulmonary embolism in both lungs. The results of the two methods are consistent (dotted line).

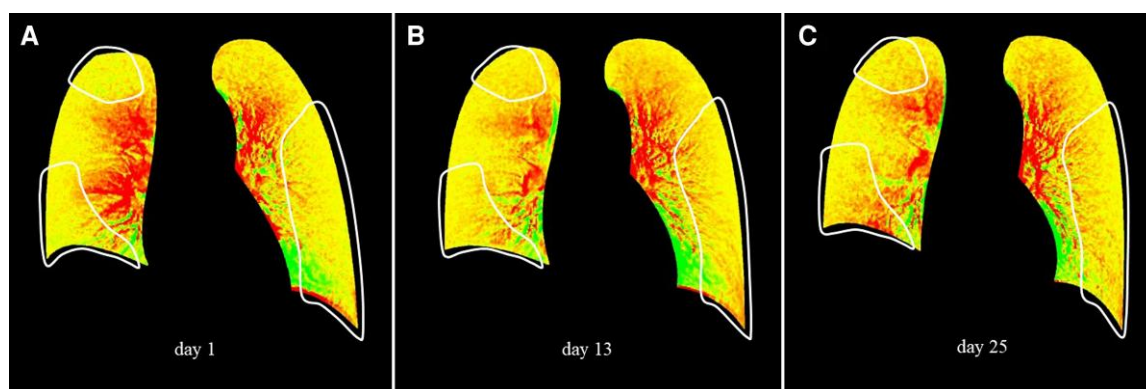


Figure 3 Colour mapping dynamic chest radiography images. (A) On Day 1. (B) On Day 13. (C) On Day 25. In the Day 1 image, good perfusion area is observed only in the central region of each lung. In the images from Days 13 and 25, the red regions expanded, especially in the surrounding area, suggesting gradual improvement in the lung perfusion.

at the Japanese standard dose after Day 21. On Day 25, TRPG decreased to 24 mmHg, and his symptoms completely resolved. Further improvements in pulmonary circulation were observed (Figure 3C; Supplementary material online, Video S3). He continued to take rivaroxaban and had no symptoms at the last follow-up visit at 1 year after discharge.

Discussion

Contrast-enhanced CT is the gold standard examination for the diagnosis of PE. However, it is contraindicated in patients with a history of serious and potentially life-threatening iodine contrast allergy or renal insufficiency.² In these situations, ventilation–perfusion scanning is the conventional investigation modality of choice.³ In hospitals where ventilation scanning cannot be used, the combination of X-ray/perfusion

scan is also useful for defining mismatched segmental perfusion defects.⁴ However, the diagnostic strategy with scintigraphy is time-consuming and cannot be performed in small hospitals. Unenhanced CT is sometimes utilized to detect the high attenuation of thrombi because of the higher level of haemoglobin in clots than in the circulating blood.⁵ In this case, we were able to identify hyperdense lesions in both pulmonary arteries; however, another examination was required because it was difficult to diagnose PE using unenhanced CT alone, and the Wells score⁶ of this patient was intermediate at three points. Because the patient declined to provide consent for premedicated contrast-enhanced CT, we analysed the data using Radwisp (Paramevia Pte. Ltd, The central, Singapore), which made a pseudo-colour video from the frequency component corresponding to heart-beat.⁷ The DCR analysis suggested a decrease in the perfusion signal in the peripheral regions of both lungs, which was consistent with pulmonary perfusion scintigraphy (Figure 2A and B). Dynamic chest

radiography analysis has the advantages of not requiring a contrast agent, and its radiation exposure is comparable with that of conventional chest radiography.⁸ Therefore, it may be more useful for patients with contraindication to contrast agents or for pregnant women. However, it has limitations, in that the sensitivity and specificity are unknown because this method is relatively new. Repeated DCR analysis can be easily used to evaluate improvements in pulmonary circulation, and it can detect worse pulmonary circulation or embolism promptly in follow-up after acute PE. However, further studies are needed to clarify the potential diagnostic role of this novel technique.

Conclusion

The dynamic X-ray fluoroscopic video analysis workstation is a novel diagnostic modality for detecting PE, which avoids the use of contrast media.

Lead author biography



Sadahiro Hijikata was born in Osaka in 1988. He became an interventional cardiologist because he felt working alongside the heart team to help patients was greatly rewarding. He graduated from Oita University in 2012. He became a junior resident in Showa General Hospital from 2012 to 2014 and then a senior resident in cardiology, Tokyo Medical and Dental University Hospital from 2014 to 2015. After working at the Japanese Red Cross Musashino Hospital from 2015 to

2018, he is now an interventional cardiologist in Shin-Yurigaoka General Hospital since 2019.

Supplementary material

[Supplementary material](#) is available at *European Heart Journal—Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

Consent: The authors confirm that written consent for the submission and publication of this case report, including the images and associated text, has been obtained from the patient as per the COPE guidelines.

Conflict of interest: None declared.

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