Images of septic thromboembolism from superior vena cava to lung

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A 68-year-old woman with end-stage renal disease was started on regular hemodialysis with a tunneled cuffed catheter through the right internal jugular vein for 2 months. She entered our emergency department with complaints of fever, shortness of breath, and chest pain of 2 days duration. On arrival, she was febrile, tachycardic, tachypneic, and had a normal blood pressure. No erythema, swelling, heat, or tenderness was observed at the insertion site of the dialysis catheter. No abnormal breath sounds or audible heart murmurs were detected. Oxygen saturation was 88 % while breathing room air. The electrocardiogram revealed sinus tachycardia. Laboratory examination revealed leukocytosis, thrombocytopenia, and elevated C-reactive protein. An initial chest radiograph (Fig. 1) showed multiple ill-defined opacities in the right lung and the tip of the dialysis catheter was placed in the right atrium (RA). Based on the clinical manifestations and chest radiographic findings, a dialysis catheter-related infection with septic pulmonary embolism (SPE) was suspected. The patient was treated with empirical vancomycin. Contrast-enhanced computed tomography (CT) (Fig. 2a–c) performed after dialysis catheter removal revealed that the thrombi were in the superior vena cava (SVC), RA, right

ventricle (RV), and right interlobar pulmonary artery branch. CT findings on lung window setting (Fig. 3a–d) showed different types of SPE. A transthoracic echocardiography revealed a 45 × 26 mm thrombus within the RA, which was attached to the wall of the atrium, and protruded into the RV (Fig. 2d). The RA and RV were of normal size. Mild tricuspid regurgitation and mild pulmonary hypertension (estimated pulmonary artery systolic pressure 32 mmHg) were detected. Anticoagulation therapy was initiated. The catheter tip culture and three pairs of blood cultures were positive for oxacillin-sensitive *Staphylococcus aureus*. Based on radiographic evidence of thrombi and positive blood culture results, the diagnoses of septic thrombophlebitis of the SVC, septic thrombosis of the RA with pulmonary embolism (PE), and SPE were confirmed.

In a previous study, approximately 12.5 % of patients exhibit thrombus at the tip of catheter within 6–8 weeks of catheter insertion, and all thrombi are found in those patients with the catheter tip position in the RA, in contrast to none in those with the catheter tip position in the SVC [1]. The likely mechanism of thrombus formation at this location is related to friction of the catheter on the atrial endocardium [2, 3]. The endothelial damage induced by trauma results in platelet aggregation and thrombus formation [4]. An adherent infected thrombus in the RA may become dislodged, and lead to PE and SPE. Great diversity of SPE can be found in CT findings, including a feeding vessel sign, nodules with or without cavities, pleural effusions, peripheral wedge-shaped opacities, patchy ground-glass opacities, lung abscesses, and focal consolidations [5].

A chest radiograph can assist in diagnosis of this disease, as seen in the present case. A possible diagnosis of dialysis catheter-related SPE from a chest radiograph may

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Fig. 1 A chest radiograph showing multiple ill-defined opacities (arrowheads) in the right lung. The tip (arrow) of the dialysis catheter is placed in the right atrium (RA)

direct the physician to search for right heart thrombus, particularly in a patient with the tip of the dialysis catheter placed in the RA. A CT scan should follow the chest radiograph to identify PE, SPE, and the presence of thrombosis in the SVC or RA. An echocardiography (transthoracic or transesophageal) should be performed to detect and assess right heart thrombus in such a case. An echocardiography can define the size, mobility, and site of attachment of right heart thrombus. The present case is valuable as a reference because the thrombi in the SVC, right heart, and interlobar pulmonary artery branch are clearly identified, and protean presentations of SPE are visualized.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Statement of human and animal rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional or national research committee

Fig. 2 Contrast-enhanced CT images showing that filling defects are in **a** the superior vena cava (arrow), right interlobar pulmonary artery branch (curved arrow), **b** RA (arrow), and **c** right ventricle (RV) (arrow), which are suggestive of thrombi. **d** Two-dimensional

transthoracic echocardiography (modified apical 4-chamber view) shows a 45 × 26 mm thrombus (arrow) within the RA, which is attached to the wall of the atrium, and protrudes into the RV. LA left atrium, LV left ventricle

Fig. 3 CT findings on lung window setting show **a** a peripheral wedge-shaped opacity abutting pleural surface (*arrow*), **b** a focal consolidation with air-bronchogram (*arrow*), **c** a nodule with a

feeding vessel sign (*arrow*), a nodule with cavity (*curved arrow*), **d** a focal ground-glass opacity (*arrow*), and left pleural effusion

and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

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