Sudden Coma and Quadriplegia in a Hemodialysis Patient

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Case Description
A 90-year-old man with a 5-year history of ESKD presented with sudden coma and quadriplegia. It turned out that the patient had cut his long-term hemodialysis catheter, and the lumens were exposed directly to air. A 1-minute epileptic myoclonus occurred 7 hours later, and occasional tremors followed. Brain computer tomography showed multiple air emboli in the bilateral brain hemispheres, especially in the right basal ganglia and vessels over the bilateral cerebral surface. Clusters of bubbles were also seen in the superior sagittal sinus (Figure 1). There were emboli in the right internal jugular vein, right brachiocephalic vein, and superior vena cava. Neurologic examination revealed limbs spasticity and diffuse areflexia, yet brainstem reflex was preserved. Hypoxic ischemic encephalopathy was diagnosed. Acute myocardial infraction occurred 1 day later. He did not recover from coma and died from respiratory failure 2 weeks later.

The distribution of air emboli suggests that emboli migrated retrogradely from the vascular access to the brain. According to the medical record, he had also pulled out his hemodialysis catheter 1 month before.

Discussion
In hemodialysis-related air embolism, air bubbles may arise from incomplete priming or a loosened tube connection and then enter the extracorporeal circuit (1). Nowadays, life-threatening air embolism during hemodialysis is rare due to the addition of air bubble detectors and air chamber to modern hemodialysis machines. However, air embolism may still occur during placement of a hemodialysis catheter, with accidental disconnection, or at its removal (1). Air embolism is due to the suicidal cutting of catheter in this patient.

There are three migration pathways of air bubbles (2): retrogradely to the cerebral venous system, to pulmonary circulation, and paradoxically to systemic circulation or coronary arteries. The distribution of the cerebral air embolism indicates retrograde migration mechanism in this patient. The retrograde air embolism could be facilitated by the patient’s upright posture and valvular insufficiency and may cause severe neurologic sequelae: alerted consciousness, seizure, focal neurologic deficit, and brain edema (2). Most of these signs are compatible with our patient. No trapped air was found in the pulmonary vessels or right ventricular outflow tract in the computer tomography pulmonary angiogram, which excluded the prominent air migration to pulmonary circulation in this patient. The paradoxical arterial air embolism, which is associated with massive air in pulmonary circulation or cardiac septal defect, may cause myocardial infarction. However, the following ST-elevation myocardial infarction (STEMI) in this patient may have been unrelated to paradoxical arterial air embolism due to infarction in single coronary territory (V2–V6), preexisting atherosclerosis, and lack of cardiac septal defect.

In terms of management, further entry of gas should be prevented after the diagnosis of air embolism is considered. Supportive care with oxygen and intravenous fluid should be offered. Oxygen therapy may reduce the size of emboli, and intravenous fluid may increase the venous pressure and prevent further entry of gas (3). Finally, our patient underlines that late-life depression, especially in groups with ESKD, should be identified and managed with proper support (4).

Teaching Points
- Venous air embolism in patients on dialysis is a rare but serious complication in the modern dialysis era, which may occur during catheter placement, accidental disconnection or catheter cutting, or removal of catheter.
- The retrograde air embolism may cause severe neurologic sequelae, such as alerted consciousness, seizure, focal neurologic deficit, and brain edema.

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Author Contributions
C.-H. Yu developed the hypothesis and wrote the original draft; H.-W. Huang was responsible for image interpretation; and J.-M. Sung conducted the study and validated the manuscript.

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Figure 1. Retrograde cerebral air embolism in the hemodialysis patient. Brain computer tomography showed multiple air emboli in the bilateral brain hemispheres, including vessels over the bilateral cerebral surface (A and B) and clusters of bubbles noted in superior sagittal sinus (C; yellow arrows).