A 67-Year-Old Woman With Abnormal Lung Perfusion Scan Finding*

Samjot Singh Dhillon, MD; Remzi Bag, MD, FCCP; and Ron Fisher, MD

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A 67-year-old woman with multiple myeloma and recently treated left upper pneumonia was admitted to the hospital for acute-onset shortness of breath. Chest radiography showed a left upper lobe infiltrate. CT angiography revealed right-sided pulmonary embolus. IV heparin was started through a new right subclavian central venous catheter. The patient was then transferred to the Methodist Hospital for further care. Physical examination revealed BP of 106/60 mm Hg, pulse of 110 beats/min, respiratory rate of 24 breaths/min, and pulse oximetry showed 98% saturation on 4 L/min O2 by nasal cannula. The patient had a generalized tonic-clonic seizure on the second day of hospital admission, and MRI of the brain showed a small infarct in the right posterior temporal lobe. Serum electrolytes were within normal range, and workup for hyperviscosity syndrome and meningitis was not pursued as the patient had rapid resolution of symptoms.

A lung perfusion scan using IV 99mTc macroaggregated albumin (MAA) was performed, and images of the brain and kidney were obtained to look for a possible shunt. Perfusion scan showed marked tracer uptake in the right upper extremity, right cerebral hemisphere, and right cerebellum, but absence of perfusion to a majority of the left side of the brain, left face, left side of the neck (Fig 1), and left upper extremity (Fig 2).

*From the Department of Pulmonary and Critical Care (Drs. Dhillon and Bag) and Radiology (Dr. Fisher), The Methodist Hospital, Baylor College of Medicine, Houston, TX.
Dr. Dhillon is now with Lakes Region General Hospital, Laconia, NH.
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Correspondence to: Samjot Singh Dhillon, MD, Pulmonary Critical Care Medicine, 85 Spring St, Third Floor, Laconia, NH 03246; e-mail: samjot@yahoo.com

**What caused this abnormal perfusion scan finding?**
Diagnosis: Infusion of $^{99m}$Tc MAA into the right subclavian catheter that was in the subclavian artery with its tip in the brachiocephalic artery

$^{99m}$Tc MAA perfusion imaging is a noninvasive test to look for right-to-left shunt. MAA particles (20 to 60 $\mu$m) are trapped in the pulmonary microcirculation, and significant radiotracer uptake in extrapulmonary organs, such as the brain and kidney, is abnormal and suggests the presence of a right-to-left shunt.\textsuperscript{1,2} This patient had an abnormal perfusion scan result. Extra pulmonary radiotracer activity was noted in the brain, suggesting the presence of a shunt. However, there was no radiotracer uptake on the left side of the body and most of the left brain. This can be seen with obstruction of the left common carotid and subclavian artery, but this was not consistent with the clinical scenario.

The patient had a right subclavian central venous catheter inserted before she was transferred to our hospital. $^{99m}$Tc MAA was administered through this catheter. The chest radiograph showed that the subclavian central venous catheter was traversing the midline (Fig 3), suggesting that it was in the subclavian artery.\textsuperscript{3} Blood obtained from this central line revealed a PaO$_2$ of 86 mm Hg on 4 L/min of O$_2$ by nasal cannula, confirming arterial origin. The subclavian arterial placement of central venous catheter resulted in selective injection of $^{99m}$Tc MAA near the subclavian/brachiocephalic junction, explaining the abnormal perfusion scan. Note that in this patient the right internal carotid artery provides some collateral perfusion to the left cerebral hemisphere, but the right vertebral-basilar system does not supply collateral flow to the left cerebellum. The presence of tracer uptake in the lungs, albeit at much lower levels than found in a routine lung scan, is consistent with a small amount of left-to-right shunting, which has been found in many patients when arterial $^{99m}$Tc MAA injections were intentionally performed.\textsuperscript{4,5} Uptake is also demonstrated in the thyroid, which receives perfusion from the thyrocervical trunk that originates from the subclavian artery (Fig 2).

Subclavian venous catheter placement is a commonly performed procedure with a complication rate of < 5\%.\textsuperscript{6} Despite frequent malposition,\textsuperscript{7} the incidence of subclavian artery cannulation is low.\textsuperscript{6–8} However, subclavian arterial cannulation and catheter placement results in serious complications such as excessive bleeding, hemothorax, pseudoaneurysm, and various types of neurologic injuries.\textsuperscript{8} Thus, prompt recognition of this complication is important.

The subclavian vein joins the internal jugular vein to form the brachiocephalic vein that subsequently forms the superior vena cava. It normally remains on the right side of the mediastinum. The subclavian artery originates from the brachiocephalic artery, and a catheter placed in it will be above the clavicle (as it lies above and posterior to the vein) and will cross the midline.\textsuperscript{3} Accidental placement can also be recognized by rapid pulsatile bright-red blood flow, difficulty in administering fluids using gravity alone,
a very high central venous pressure reading, arterial wave tracings by using a transducer, and by comparing blood gas obtained from the central venous catheter with arterial blood gas.³

Neurologic complications such as encephalopathy, seizures, single or multiple cranial nerve palsy, spinal cord compression, and peripheral neuropathy are seen in multiple myeloma.⁹ The seizures have been attributed to infections such as meningitis, metabolic disorders such as hypercalcemia, uremia, hyperviscosity, or tissue amyloid deposition in brain.⁹ The abnormal MRI finding, normal serum chemistry, and quick resolution of symptoms suggest that the seizure in this patient was due to a right posterior temporal infarct. It is possible that the infarct was caused by an arterial embolism due to the malposition of central venous catheter, as this phenomenon has been well described in literature.¹⁰

References
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