Go with the flow, but do not get mixed up

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Central Message

Heterogeneous opacification of the ascending aorta on CT imaging in patients with ECMO support may produce radiographic findings similar to those seen in acute ascending aortic dissection.

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Extracorporeal membrane oxygenation (ECMO) offers lifesaving technology for acute refractive cardiogenic shock. This form of mechanical support has seen explosive clinical growth¹ but is potentially associated with significant morbidity and altered flow patterns. In the current issue of the *Journal*, Mizuno and colleagues² describe a patient given ECMO support on an emergency basis because of pulseless electrical activity, with subsequent computed tomographic scan of the chest revealing ascending aortic dissection. The patient was taken to the operating room, where an intraoperative transesophageal echocardiography was inconclusive, but thoracic exploration and epiaortic ultrasound confirmed no presence of acute aortic pathology.

The pitfalls of computed tomographic imaging in patients receiving ECMO support are surfacing in the literature^{3,4} as clinical experience is accumulating. Supported patients have variable levels of flow assistance, myriad cannulation strategies, and a wide range of native cardiac function during their clinical course, all of which may potentially affect interpretation of imaging studies. In the case presented by Mizuno and colleagues,² the patient had little native cardiac output, was cannulated peripherally in an emergency setting, and was supported with retrograde ECMO flow. In this setting, blood mixing in the ascending aorta between retrograde ECMO flow and sluggish native cardiac output may be expected. Computational fluid dynamics studies have demonstrated that the location of the mixing zone between native and retrograde ECMO flow is dependent on native function and level of ECMO support.⁵ ECMO flow of at least 90% was required to establish the mixing zone in the proximal aortic arch whereas ECMO support of 70% or less shifted the mixing zone to the descending aorta. Changes in hemodynamic conditions may thus contribute to abnormal contrast mixing, which could be further influenced by site and rate of radiographic agent administration. Heterogeneous enhancement of the aorta in a patient supported by ECMO can be related to native ejection fraction, proportion of contrast delivered as left

ventricular versus ECMO preload, volume of contrast administered, and scan time delay. Pseudo filling defects and contrast-blood layering in the heart, aorta, and major vessels of patients supported by ECMO have been described.³ Administration of contrast through the ECMO circuit has been advocated as a possible solution to avoid contrast layering.⁶

The clinical case presented by Mizuno and colleagues² is a timely reminder of the imaging hazards encountered when examining patients receiving extracorporeal support. Against the backdrop of a salvage procedure, the observed imaging findings of aortic dissection are quite plausible, either as primary etiology or as a consequence of peripheral ECMO cannulation, and Mizuno and colleagues² were correct to persist in excluding the diagnosis. Although computed tomographic findings can be explained on the basis of abnormal flow patterns, lack of a definite diagnosis with transesophageal echocardiography is somewhat surprising. As in most centers in the United States, in my institution we perform confirmatory intraoperative transesophageal echocardiography on all patients with a diagnosis of type A aortic dissection before surgical skin incision. How flow zone mixing affects echocardiographic imaging in the setting of ECMO, however, remains to be characterized. Repeated CT imaging with reduced ECMO flow or administering contrast through the circuit might have provided clarity and avoidance of surgical exploration. Yet an appropriate balance between diagnostic vigilance and dismissal of inconvenient imaging findings must be

achieved, because aortic dissections represent lethal clinical pathology. Mizuno and colleagues² give us pause to consider radiographic artifact in the differential diagnosis of a type A aortic dissection in patients receiving ECMO support, but aggressive multimodality diagnostic workup of exclusion should be carried out in every case.

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