Is venoarterial extracorporeal membrane oxygenation the first-line therapy for massive pulmonary embolus with end-organ dysfunction?

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Central Message

Patients with massive pulmonary emboli and evidence of end-organ damage may be better served with VA-ECMO than open pulmonary embolectomy. Half of these patients will require no further treatment.

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The spectrum of acute pulmonary embolism encompasses low-risk pulmonary embolism, submassive pulmonary embolism, and massive pulmonary embolism (MPE). Although national societal guidelines¹ recommend systemic thrombolytics in combination with anticoagulation and supportive care and possibly surgical or catheter embolectomy for MPE, multiple case reports and small case series suggest that venoarterial extracorporeal membrane oxygenation (ECMO) is effective and should be considered for these patients with MPE. In their report in this issue of the *Journal* of a single-arm trial comparing an intervention group with historical controls, Pasrija and colleagues² provide data strongly supporting early implementation of venoarterial ECMO in patients with MPE who have evidence of end-organ dysfunction or uncertain neurologic status. This small, retrospective review, however, compared only 27 historical control patients with 29 patients in the protocol group. All patients in the control group underwent emergency open pulmonary embolectomy. Of greatest interest was that in the protocol group of patients receiving venoarterial ECMO support, half the patients required anticoagulation alone. The other half underwent staged pulmonary embolectomy. The 1-year survival in the historical control group was significantly lower than that in the protocol group (emergency embolectomy survival of 73% vs initial venoarterial ECMO survival of 96%).

This use of venoarterial ECMO was reserved for patients with MPE, characterized by hypotension secondary to right ventricular pressure overload. Although the 2 groups were treated during different timeframes, they remained comparable. All patients with MPE who were not treated according to the protocol were taken for emergency open pulmonary embolectomy. Venoarterial ECMO was performed in a standard femorofemoral fashion with

distal perfusion through the superficial femoral artery. Anticoagulation was performed to maintain a therapeutic partial thromboplastin time. ECMO support was continued until neurologic status was clarified and end-organ function was optimized. Heparin appeared to be associated with endogenous fibrinolysis after 3 to 7 days. In the subset of patients with continued right ventricular dysfunction and clot burden, open pulmonary embolectomy was performed in a standard fashion. Median time on venoarterial ECMO support in the protocol group was 5.8 days.

Pasrija and colleagues² are to be commended for the outstanding 1-year survivals in both groups, regardless of treatment, in this very high-risk patient cohort. Of note, in the protocol group, the lone death (a neurologic death) was that of a patient who required more than 60 minutes of cardiopulmonary resuscitation before consultation. The immediate benefits of the venoarterial ECMO protocol approach were to carefully select those patients who would most benefit from open pulmonary embolectomy and to allow them the time needed for multisystem recovery in preparation for this procedure. Cardiac surgeons are well aware of the difficulties of weaning from cardiopulmonary bypass after successful pulmonary embolectomy when faced with severe right ventricular dysfunction. Of interest, 50% of the patients with significant right ventricular dysfunction had spontaneous clot burden resolution with mechanical support and systemic anticoagulation alone. The venoarterial ECMO approach also allowed a significant

reduction in time from cardiac arrest to intervention in this subset of patients. Most of these patients engaged in physical therapy, including ambulation, while awaiting decannulation or subsequent pulmonary embolectomy.

The findings of Pasrija and colleagues² have significant implications and obvious limitations. The small sample size and the use of historical controls may have resulted in inaccurate point estimates and increased type 1 error. The study had a retrospective approach, and the protocol group underwent care during the last 2 years, whereas the historical control group included the previous 5 years. Surprisingly, the mortalities observed in this population with MPE were significantly less than reported in other trials. Although encouraging, these results should be considered as preliminary, because the small sample size limits any meaningful assessment of safety evaluation. Future randomized, controlled studies, although certainly very difficult to design, may better delineate differences between these 2 treatment strategies. In addition, better outcomes are noted at high-volume ECMO centers, potentially limiting the generalizability of these results. Our analysis suggests that when considering all the available information presented, the results in favor of early

venoarterial ECMO are strong for life-threatening MPE, and this course may be considered until therapeutic and mechanical thrombolysis can be achieved. Further investigation is needed, however, before recommending venoarterial ECMO as routine first-line therapy for patients who present with MPE. Transfer of these patients to regional ECMO centers after initiation of support therapy may be indicated.³ With further studies, we may see ECMO being considered less as a salvage procedure than as a bridging or even therapeutic intervention for this MPE population. However, further investigation is needed before recommending ECMO as first-line therapy for patients who present with MPE.

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