A needle or a knife?

Nicholas Gerard Smedira, MD, MBA

From the Department of Thoracic and Cardiovascular Surgery, Heart and Vascular Institute, Cleveland Clinic, Cleveland, Ohio.

Disclosures: Author has nothing to disclose with regard to commercial support.

Received for publication March 27, 2018; accepted for publication March 29, 2018; available ahead of print June 9, 2018.

Address for reprints: Nicholas Gerard Smedira, MD, MBA, Cleveland Clinic, 9500 Euclid Ave, Cleveland, OH 44195 (E-mail: smedirn@ccf.org).

J Thorac Cardiovasc Surg 2018;156:684

0022-5223/\$36.00

Copyright © 2018 by The American Association for Thoracic Surgery

<https://doi.org/10.1016/j.jtcvs.2018.03.120>

Our daily practice of cardiothoracic surgery in many ways exists because of a tragic pulmonary embolus. It was in February of 1931 when John H. Gibbon, Jr, cared for a patient who after a cardiac arrest underwent an unsuccessful pulmonary embolectomy at Massachusetts General Hospital. Years later, he recalled that “during that long night, helplessly watching the patient struggle for life as her blood became darker and her veins more distended, the idea naturally occurred to me that if it were possible to remove some of the blue blood from the patient’s swollen veins, put oxygen into that blood and allow carbon dioxide to escape from it, and then to inject continuously the now-red blood back into the patient’s arteries we might have saved her life. We would have bypassed the obstructing embolus and performed part of the work of the patient’s heart and lungs outside of the body.”¹ Twenty-two years later, after numerous experiments, he performed the first clinical operation with a massive screen oxygenator. In this issue of the *Journal*, 87 years after that inspiration, Pasrija and colleagues² of the University of Maryland team are revisiting Gibbon’s thought experiment by reporting their use of a much smaller bypass system in an effort to improve the outcomes of patients with hemodynamically significant pulmonary emboli.

Because more than 25% of the protocol cohort had undergone or were undergoing cardiopulmonary resuscitation (CPR), it is worthwhile to examine the physiologic effects of CPR on pulmonary, systemic, and cerebral blood flows after a pulmonary embolus. Recent advances in the understanding of CPR physiology have shown that during CPR, the central venous pressure can match or exceed systemic pressures, resulting in suboptimal cerebral perfusion.³ Positive-pressure ventilation could worsen cerebral perfusion. In the setting of massive pulmonary embolism, the physiology is likely to be much worse than in patients without restriction of pulmonary blood flow and marked right ventricular afterload, promoting tricuspid regurgitation, limiting left ventricular filling, and together markedly diminishing cerebral perfusion.

John Gibbon, Jr, with original heart-lung machine, 1962, and CARDIOHELP System, 2018.

Central Message

In addition to eliminating hypoxemia and restoring systemic perfusion, early initiation of ECMO optimizes cerebral perfusion pressure and provides time for catheter-based therapies.

See Article page 672.

The fact that neurologic outcomes were improved in the protocol group and time to intervention was shorter by half supports the concept of keeping the “door to perfusion time” as short as possible. Rapid decompression of the venous system and systemic perfusion with extracorporeal membrane oxygenation (ECMO) will favorably impact cerebral perfusion pressure. This may explain the findings of Pasrija and colleagues² and support a much more aggressive use of ECMO in patients with decompensation after a pulmonary embolus.

Another surprising finding of this study is that half the patients in the protocol group avoided surgery. All types of catheter extractions and directed lysis can be performed while the patient is on ECMO support.

This is a small series, but the physiologic and clinical responses support the consideration of venoarterial ECMO as initial therapy in patients with hemodynamically significant pulmonary embolism. Instead of reaching for a scalpel, we can percutaneously initiate ECMO and watch the dark blood rapidly turn red.

References

1. Shumacker HB Jr. Development of the heart-lung machine: birth of the current era. In: Shumacker HB Jr, ed. *The evolution of cardiac surgery*. Bloomington, IN: Indiana University Press; 1992:242-55.
2. Pasrija C, Shah A, George P, Kronfli A, Raithe M, Boulos F, et al. Triage and optimization: A new paradigm in the treatment of massive pulmonary embolism. *J Thorac Cardiovasc Surg*. 2018;156:672-81.
3. Lurie KG, Nemergut EG, Yannopoulos D, Sweeney M. The physiology of cardiopulmonary resuscitation. *Anesth Analg*. 2016;122:767-83.