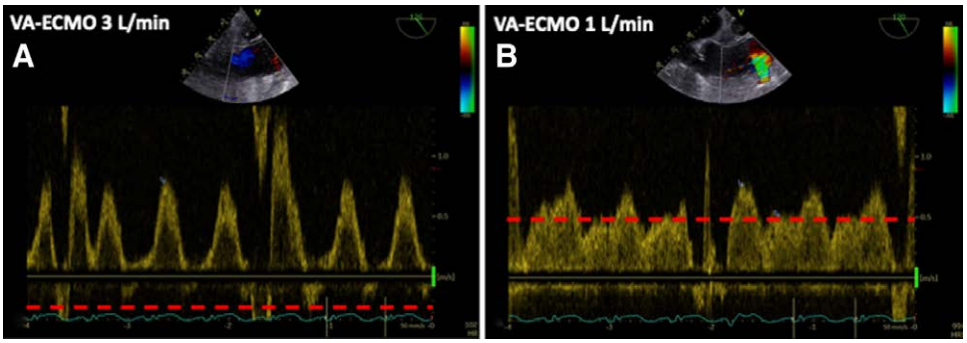
Using Left Ventricular Assist Device Doppler Assessment to Understand Pump–Patient Interactions during a Venous Arterial–Extracorporeal Membrane Oxygenation Weaning Trial

Simon P. De Ridder, M.D., Steven Jacobs, M.D., Ph.D., Dieter F. Dauwe, M.D., Ph.D.



The left ventricular assist device–outflow Doppler trace contains useful information. We analyze this signal during a venous arterial–extracorporeal membrane oxygenation (VA-ECMO) weaning trial in a patient after left ventricular assist device replacement (Heartmate-III; Abbott, USA), complicated by right ventricular dysfunction necessitating VA-ECMO support.

Compared to the left ventricle, a centrifugal continuous-flow left ventricular assist device pump is more afterload-sensitive but only minimally preload-responsive.[1,2] The amount of flow generated at fixed pump speed (revolutions per minute) is inversely proportional to the pressure gradient across the pump head.[3]

Reducing VA-ECMO flow during a weaning trial dramatically decreases afterload to the left ventricular assist device, resulting in increased left ventricular assist device flow by reducing the pressure gradient across the pump head. This is reflected by an increase in the pulsed-wave Doppler baseline (Panels *A* and *B*, *dashed lines*; Supplemental Digital Content 1, http://links.lww.com/ALN/C511) and density of the spectral envelope. Conversely, an increase in afterload due to VA-ECMO flow increase can significantly reduce left ventricular assist device flow and may ultimately result in (intermittent) flow reversal, as noted in this patient during diastole at maximal ECMO flow (Panel *A*, *dashed line*). This is of clinical importance as a decrease in left ventricular assist device flow reduces "unloading" of the left heart, increasing myocardial wall tension and left atrial/pulmonary venous pressures.

Coordinating left ventricular assist device and ECMO flow is an intricate interplay. VA-ECMO provides gas exchange and unloads the right heart and pulmonary circulation but increases left ventricular afterload. Left ventricular assist device support unloads the left heart but does not provide direct right ventricular support. Total systemic blood flow is provided by the combination of left ventricular assist device and ECMO flow, with/without contribution of residual left ventricular function. Upon recovery of right ventricular and pulmonary function, VA-ECMO flow is gradually reduced, increasing preload to the left heart/left ventricular assist device. This allows increasing left ventricular assist device flow (revolutions per minute) to maintain adequate total systemic flow.

Research Support

Support was provided solely from institutional sources. A conventional transesophageal echocardiography probe

Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are available in both the HTML and PDF versions of this article. Links to the digital files are provided in the HTML text of this article on the Journal's Web site (www.anesthesiology.org).

Published online first on November 23, 2020. From the Department of Intensive Care Medicine (S.P.D.R., D.F.D.) and Department of Cardiac Surgery (S.J.), University Hospitals Leuven, Leuven, Belgium; and the Department of Intensive Care Medicine, Lausanne University Hospital, Lausanne, Switzerland (S.P.D.R.).

 Anesthesiology 2021; 134:248–9. DOI: 10.1097/ALN.0000000000003615

(Philips Healthcare, The Netherlands) was used for obtaining the transesophageal echocardiography images. No additional funding was required.

Competing Interests

The authors declare no competing interests.

Correspondence

Address correspondence to Dr. Dauwe: dieter.dauwe@uzleuven.be

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