would be ideal. While these data would be helpful for transplant surgeons to decide optimal mode of support, most surgeons would agree that in patients who can tolerate it, no support is best.

References

1. Machuca TN, Collaud S, Mercier O, Cheung M, Cunningham B, Kim SJ, et al. Outcomes of intraoperative extracorporeal membrane oxygenation versus cardiopulmonary bypass for lung transplantation. *J Thorac Cardiovasc Surg.* 2015;149:1152-7.
2. Taka H, Miyoshi K, Kurosaki T, Douguchi T, Itoh H, Sugimoto S, et al. Lung transplantation via cardiopulmonary bypass: excellent survival outcomes from extended criteria donors. *Gen Thorac Cardiovasc Surg.* 2019;67:624-32.
3. Hoetzenecker K, Schwarz S, Muckenhuber M, Benazzo A, Frommlet F, Schweiger T, et al. Intraoperative extracorporeal membrane oxygenation and the possibility of postoperative prolongation improve survival in bilateral lung transplant. *J Thorac Cardiovasc Surg.* 2017;155:2193-206.
4. Loor G, Huddleston S, Hartwig M, Bottiger B, Daoud D, Wei Q, et al. Effect of mode of intraoperative support on primary graft dysfunction after lung transplant. *J Thorac Cardiovasc Surg.* 2022;164:1351-61.e4.
5. Diamond JM, Lee JC, Kawut SM, Shah RJ, Russell Localio A, Bellamy SL, et al. Clinical risk factors for primary graft dysfunction after lung transplantation. *Am J Respir Crit Care Med.* 2013;187:527-34.

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Commentary: Why a routine venoarterial extracorporeal membrane oxygenation support strategy is a good idea in lung transplantation

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CENTRAL MESSAGE

A strategy of routine intraoperative VA ECMO use leads to extremely low rates of primary graft dysfunction and translates into improved survival compared with off-pump concepts.

Loor and colleagues¹ addressed the still controversial issue of intraoperative mechanical circulatory support during lung transplantation (LTx). For this purpose, the authors performed a retrospective analysis of a registry initiated by 10 high-volume transplant centers. We would like to congratulate the authors for their enormous effort to shed further light on this important topic in clinical LTx.

Once more, this multicenter approach confirmed previous reports on the inferiority of cardiopulmonary bypass (CPB) as the primary support device.²⁻⁶ CPB is associated

with a higher risk of postoperative bleeding, a higher risk of severe primary graft dysfunction (PGD), higher risk for renal failure, longer intensive care unit and hospital stays.⁷ Based on this profound body of evidence, it is hardly justifiable anymore to cling onto CPB for mere intraoperative haemodynamic support during LTx.

However, the extracorporeal membrane oxygenation (ECMO) results presented by Loor and colleagues¹ require a closer look. As acknowledged by the authors, this retrospective dataset is quite heterogenous and therefore difficult to interpret. Firstly, the study did not distinguish between routine or selective ECMO use. Secondly, study sites did not apply uniform indications for ECMO. Thirdly, the

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ECMO group comprised venovenous as well as venoarterial (VA) strategies, peripheral and central cannulations, different protocols for anticoagulation, and no uniform flow or reperfusion strategy. Lastly, there was a fundamental selection bias toward low-risk transplantations being done off-pump and higher risk procedures being done with extracorporeal life support without any intention-to-treat analysis. It is not surprising that the interpretation of such an ECMO potpourri is difficult.

It is well known that the Vienna Lung Transplant Program is among the proponents of liberal intraoperative ECMO use. We believe that the routine application of VA ECMO has 4 big advantages: it provides hemodynamic stability, especially when the surgical access to the hilar structures is difficult; it facilitates lung protective ventilation strategies with low inspired oxygen fraction and low driving pressures; it guarantees prolonged controlled reperfusion of the newly implanted graft; and it minimizes right heart strain while the pulmonary artery is clamped. Ever since a routine VA ECMO support strategy was implemented in our unit over a decade ago, PGD rates have significantly decreased, and the overall survival significantly improved. In a retrospective analysis of propensity matched cohorts we confirmed the superiority of ECMO over off-pump LTx.⁷ Results from this retrospective study were later confirmed by a prospective observational cohort study, which showed PGD3 rates of only 1.3% at 72 hours—a rate far lower than the rates published in the current report.⁸

As the authors allude, the only way to ultimately answer the questions if and when to use ECMO is through a

randomized controlled trial with an intention to treat breakdown. In the meantime, the concept of routine VA ECMO is increasingly adopted by lung transplant centers worldwide because surgeons uniformly report facilitated transplant procedures and excellent primary graft functions with such a support strategy.

References

1. Loor G, Huddleston S, Hartwig M, Bottiger B, Daoud D, Wei Q, et al. Effect of mode of intraoperative support on primary graft dysfunction after lung transplant. *J Thorac Cardiovasc Surg.* 2022;164:1351-61.e4.
2. Aigner C, Wissner W, Taghavi S, Land G, Jaksch P, Czyzewski D, et al. Institutional experience with extracorporeal membrane oxygenation in lung transplantation. *Eur J Cardiothorac Surg.* 2007;31:468-73.
3. Ius F, Kuehn C, Tudorache I, Sommer W, Avsar M, Boethig D, et al. Lung transplantation on cardiopulmonary support: venoarterial extracorporeal membrane oxygenation outperformed cardiopulmonary bypass. *J Thorac Cardiovasc Surg.* 2012;144:1510-6.
4. Machuca TN, Collaud S, Mercier O, Cheung M, Cunningham V, Kim SJ, et al. Outcomes of intraoperative extracorporeal membrane oxygenation versus cardiopulmonary bypass for lung transplantation. *J Thorac Cardiovasc Surg.* 2015;149:1152-7.
5. Bermudez CA, Shiose A, Esper SA, Shigemura N, D'Cunha J, Bhama JK, et al. Outcomes of intraoperative venoarterial extracorporeal membrane oxygenation versus cardiopulmonary bypass during lung transplantation. *Ann Thorac Surg.* 2014;98:1936-42.
6. Biscotti M, Yang J, Sonett J, Bacchetta M. Comparison of extracorporeal membrane oxygenation versus cardiopulmonary bypass for lung transplantation. *J Thorac Cardiovasc Surg.* 2014;148:2410-5.
7. Hoetzenecker K, Schwarz S, Muckenhuber M, Benazzo A, Frommlet F, Schweiger T, et al. Intraoperative extracorporeal membrane oxygenation and the possibility of postoperative prolongation improve survival in bilateral lung transplantation. *J Thorac Cardiovasc Surg.* 2018;155:2193-206.e2193.
8. Hoetzenecker K, Benazzo A, Stork T, Sinn K, Schwarz S, Schweiger T, et al. Bilateral lung transplantation on intraoperative extracorporeal membrane oxygenator: an observational study. *J Thorac Cardiovasc Surg.* 2020;160:320-7.e321.