

on the mechanical ventilator. There have also been series evaluating ambulatory ECMO, allowing patients to be extubated and to participate in physical therapy to avoid deconditioning.⁵ In the current study, data on the duration of mechanical ventilation were not available, making it more difficult to determine the degree of deconditioning in the 2 cohorts.

Frailty matters, and assessing and preventing deconditioning in ventilated patients is critical, as these patients continue to have worse survival than nonventilated patients following transplant. While survival has improved in patients on mechanical ventilation pre-lung transplant, it continues to be survival of the fittest.

See Article page 1385.



Commentary: Rage against the machine (ventilator that is)

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Although mechanical ventilation (MV) support pre-lung transplant remains a relative contraindication to lung transplantation, recipient bridging strategies including MV and veno-venous extracorporeal membrane oxygenation (ECMO) continue to expand.¹⁻³ In the current issue of the *Journal*, Hamilton and colleagues⁴ analyze the outcomes of 21,375 patients following lung transplantation with a focus on patients requiring preoperative mechanical ventilation. The authors performed a retrospective analysis of data from the Organ Procurement and Transplantation Network registry from the United Network for Organ Sharing. Objectives posed in the study included the change in outcomes for MV recipients over time; recipient baseline characteristics associated with 30-day mortality; and MV



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CENTRAL MESSAGE

Despite improvements in recipient survival following lung transplant with pretransplant mechanical ventilation, the quest for better bridging strategies continues.

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recipient outcomes compared with non-mechanically ventilated recipients (NMV). Recipients were categorized into 2 separate eras, an early era (462 recipients transplanted 2005-2011) and a modern era (424 recipients transplanted 2011-2018). Using propensity matching, the authors demonstrate a significant reduction of death (hazard function) in the modern-era MV recipients at specified time points (30-day and 4 and 14 months). A notable 72% lower hazard of death at 30 days was observed in the modern-era MV recipients compared with the early era. Long-term mortality (3 and 5 years) was also lower in modern-era recipients.

MV recipients were also compared with NMV (modern era). Lung allocation score, days from admission to transplant, incidence of hypercarbia, and hospital length of stay were all increased in the MV recipients versus NMV cohort. Despite the improved outcomes in MV recipients over time, 30-day mortality was greater in MV recipients (compared with NMV) in the modern era.

The authors' analysis clearly demonstrates that lung transplant centers increasingly list and transplant sicker patients than previously reported, and this is particularly apparent in MV recipients. Despite this patient acuity, survival in the MV recipient has significantly improved! The authors suggest that improvements in intensive care unit (ICU) management, including minimizing patient sedation, aggressive mobilization while on support (MV, ECMO), less-traumatic ventilator management, and evolving treatments for reperfusion injury have contributed to these survival benefits. In addition, we attribute the improved outcomes to the development of specific multidisciplinary teams. Teams of physicians/surgeons with both ICU and lung transplant expertise manage these patients on a continuous basis in ICU/inpatient and outpatient settings—the practice at our institution.

The limitations of the study include unaccounted for immunosuppression changes in the modern era,⁵ lack of data on pretransplant MV time, and the limits of the Organ Procurement and Transplantation Network registry. Ultimately, lung transplant following MV support in the modern era does not appear as disparagingly poor as previously published. The authors have provided support

for less “rage against the machine” as part of contemporary pre-transplant management for potential lung transplant recipients. However, albeit much improved, the risk of 30-day mortality in lung recipients with pre-transplant MV was still greater than those without MV. Therefore, the quest for better bridging strategies to lung transplantation continues. In our institution, as well as several others, experience with awake, ambulatory ECMO shows promise as an alternative bridging strategy.^{2,6,7}

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