

# Left ventricular hemodynamics with veno-arterial extracorporeal membrane oxygenation

Kalra et al. *Catheterization and Cardiovascular Interventions* 2024. | <https://doi.org/10.1002/ccd.30951>

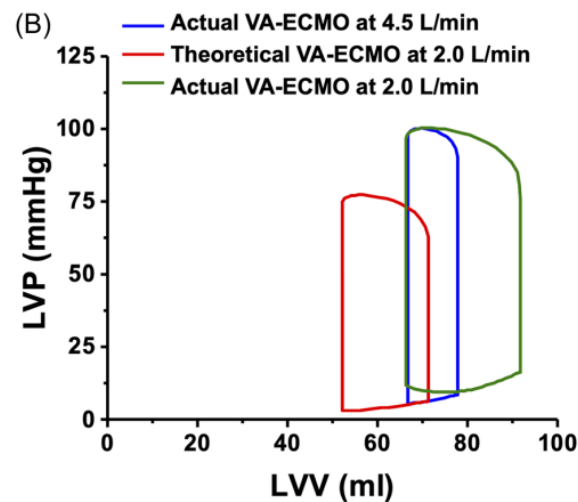
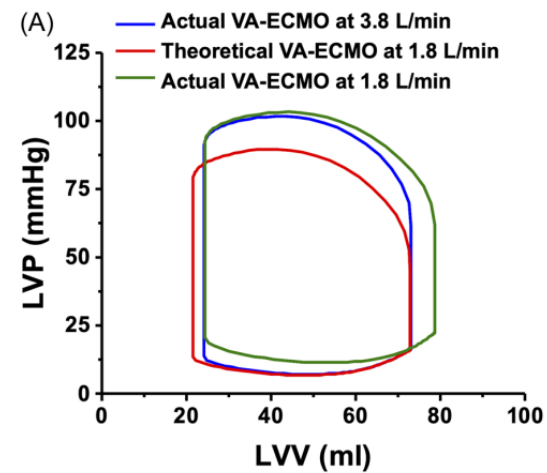
## Study Highlights

**Objective:** Evaluate the changes in left ventricular (LV) function, volumes, and work in patients treated with VA-ECMO using invasive LV catheterization and three-dimensional echocardiographic volumes.

**Methods:** Patients on VA-ECMO underwent invasive hemodynamic evaluation due to concerns regarding candidacy for decannulation. Hemodynamic parameters were reported as means ± standard deviations or medians (interquartile ranges) after evaluating for normality. Paired comparisons were done to evaluate hemodynamics at the baseline (highest) and lowest tolerated levels of VA-ECMO support

**Results:** Twenty patients aged  $52.3 \pm 15.8$  years were included. All patients received VA-ECMO for refractory cardiogenic shock (5/20 SCAI stage D, 15/20 SCAI stage E). At 3.0 (2.0, 4.0) days after VA-ECMO cannulation, the baseline LV ejection fraction was 20% (15%, 27%). The baseline and lowest VA-ECMO flows were  $4.0 \pm 0.6$  and  $1.5 \pm 0.6$  L/min, respectively. Compared to the lowest flow, full VA-ECMO support reduced LV end-diastolic volume [ $109 \pm 81$  versus  $134 \pm 93$  mL,  $p = 0.001$ ], LV end-diastolic pressure ( $14 \pm 9$  vs.  $19 \pm 9$  mmHg,  $p < 0.001$ ), LV stroke work ( $1858 \pm 1413$  vs.  $2550 \pm 1486$  mL\*mmHg,  $p = 0.002$ ), and LV pressure-volume area (PVA) ( $4507 \pm 1910$  vs.  $5193 \pm 2388$ ,  $p = 0.03$ ) respectively. Mean arterial pressure was stable at the highest and lowest flows ( $80 \pm 16$  vs.  $75 \pm 14$ , respectively;  $p = 0.08$ ) but arterial elastance was higher at the highest VA-ECMO flow ( $4.9 \pm 2.2$  vs lowest flow  $2.7 \pm 1.6$ ;  $p < 0.001$ ).

**Conclusions:** High flow VA-ECMO support significantly reduced LV end-diastolic pressure, end-diastolic volume, stroke work, and PVA compared to minimal support. The Ea was higher and MAP was stable or minimally elevated on high flow.



**Legend:** Invasive & theoretical LV pressure-volume loops at high/low VA ECMO flow

## Reviewer's Comments

- This data challenges the current dogma that increased VA-ECMO flow worsens LV loading.
- The proposed mechanism is that increased VA ECMO flow causes a more significant effect through reduction of transpulmonary blood flow and preload compared to any increased afterload.
- Therefore, further consideration needs to be given to who actually needs additional unloading strategies, and reducing VA flow may not be the correct intervention to unload the LV.

## Limitations

- Small number of 20 patients included in analysis
- This study looked at patients who were unable to wean rather than at immediate onset of cardiogenic shock.
- All patients underwent "aggressive volume removal" not otherwise quantified; the state of fluid balance at time of study would likely have significant impact on loading conditions.
- 75% were able to decannulate from VA ECMO so this cohort maybe significantly different from for example and advance heart failure bridge to transplant population

# Impact of intraoperative therapeutic plasma exchange on bleeding in lung transplantation

S. Saddoughi, et al. *J Heart Lung Transplant* Oct 2023 | <https://doi.org/10.1016/j.healun.2023.10.003>

## Study Highlights

**Objective:** Perioperative therapeutic plasma exchange (TPE) for desensitization appears to mitigate poor outcomes in cross-match positive lung transplants (LTX). Concern remains about increased bleeding with intraoperative TPE (iTPE). This study aimed to understand the impact of iTPE on perioperative bleeding.

### Methods:

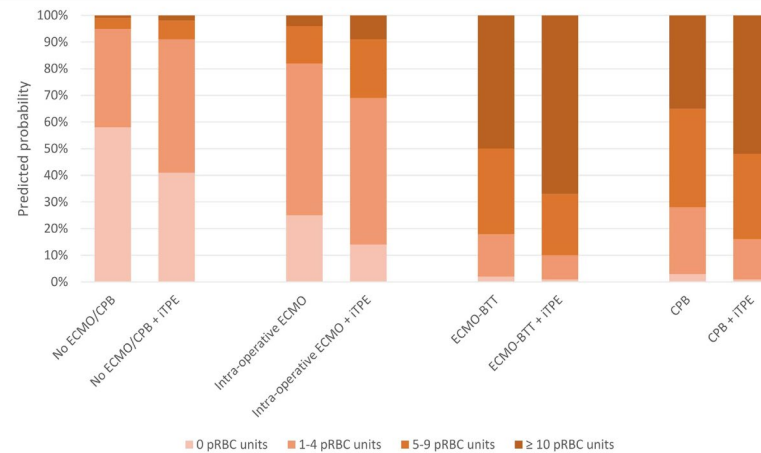
- Single center retrospective study of LTX from 2014-2019 (n=897) excluding redo or multiorgan transplants.
- Cohorted into iTPE (n=142), and no iTPE (n=755).
- Primary outcome was large volume perioperative RBC transfusion (LVT) of > 5u RBCs between POD 0-1

### Results:

- iTPE patients more likely female (p<0.001), with restrictive disease (p=0.011), and receiving ECMO/CPB (p=0.004)
- Patients receiving iTPE had more frequent LVT (OR 1.9, p=0.007), but no differences in surgically salient hemothorax (p=0.988) or 30-day mortality (p=0.358).
- In modeling of bilateral LTX for restrictive disease stratified by need for ECMO or CPB, iTPE increased the predicted range of transfusions for all except those receiving ECMO

**Conclusions:** iTPE increased likelihood of LVT, but not surgically salient hemothorax or 30-day mortality. This was modest compared to other factors like need for ECMO/CPB.

	Multivariable		
	OR	95% CI	p-value
iTPE use: No iTPE	Reference		
iTPE	1.9	1.2-2.9	0.007
Transplant type: Single lung transplant	Reference		
Double lung transplant	1.5	0.8-2.8	0.212
Disease type: Obstructive lung disease	Reference		
Pulmonary vascular disease	2.9	1.3-6.8	0.012
Cystic fibrosis	1.9	1.0-3.7	0.044
Restrictive lung disease	1.1	0.7-1.8	0.717
ECMO/CPB requirement: None	Reference		
Intra-operative ECMO, ECMO-BTT or CPB use	12.0	6.5-22.1	<0.001



**Legend (top):** multivariate associations with large volume transfusion (LVT)

**Legend (bottom):** Predicted probabilities of perioperative transfusion requirements in double lung transplant for restrictive disease by iTPE

## Reviewer's Comments

- iTPE is one approach for expanding organ access for highly sensitized candidates at expert centers, and may minimize potential recipient immune activation
- While this study suggests iTPE may increase perioperative bleeding and pRBC resuscitation requirements in the OR and ICU, it appears to not impact certain short-term outcomes
- This study is larger than others with a clear patient-oriented definition of hemothorax requiring operative repair
- Future investigation about other clinical outcomes related to perioperative bleeding such as vasopressor burden, need for renal replacement therapy, or rates of PGD in this larger population are needed

## Limitations

- Single center study at a high-volume program with procedural expertise may limit generalizability
- Retrospective study where clinicians were not blinded to iTPE could have subtle influence on the number of transfusions given
- Cases with iTPE more frequently involved ECMO/CPB which are known to impact transfusion requirements
- Postoperative TPE (n=25, 3%) was counted in the "no iTPE group" which may bias towards the null

# Diaphragm Dysfunction Predicts Weaning Outcome after Bilateral Lung Transplant

Boscolo A, et al. *Anesthesiology* 2024. | <https://doi.org/10.1097/ALN.0000000000004729>

## Study Highlights

**Objective:** Among recipients of bilateral-lung transplantation (1) assess the prevalence of difficult weaning from mechanical ventilation; (2) assess the prevalence of diaphragm dysfunction; (3) determine whether diaphragm dysfunction can be an effective predictor of difficulty weaning.

**Methods:**

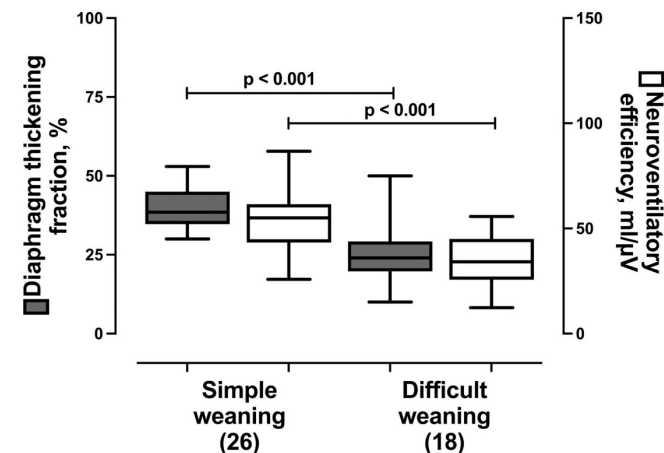
- Single-center prospective trial
- Diaphragm thickness fraction, neuroventilatory efficiency, and number of extubation attempts were measured in 44 consecutive adult bilateral-lung transplant patients

**Results:**

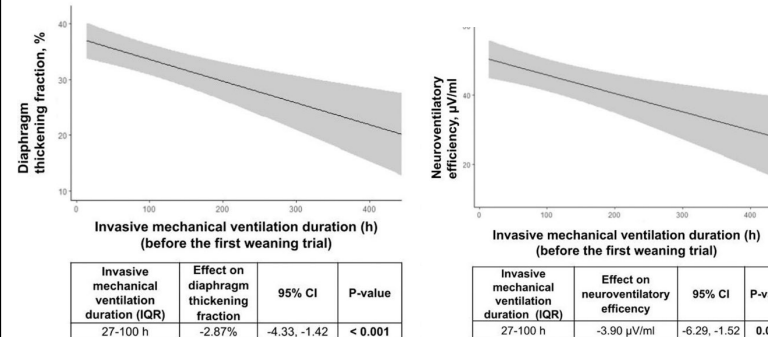
- 100% of patients with diaphragmic dysfunction (n=18) experienced difficulty weaning, significantly higher than the rate among patients with normal diaphragmic function (13%).
- Both diaphragmic thickening ratio smaller than 29% (sens = 0.78, spec = 1) and neuroventilatory efficiency 48mL/μV (sens = 0.97, sepc = 0.70) strongly predict difficult weaning.
- Greater duration of mechanical ventilation before the first weaning trial correlates with worse diaphragm function.

**Conclusions:** Diaphragm dysfunction is prevalent among recipients of bilateral lung tx and significantly contributes to difficulty weaning from mechanical ventilation.

## Distribution of diaphragm function among patients with simple vs difficult weaning



## Correlation between duration of mechanical ventilation before first weaning attempt and diaphragmic function



## Reviewer’s Comments

- Weaning outcome was defined and categorized as simple, difficult or prolonged (failed or >7 days)
- Both diaphragmic dysfunction and difficulty weaning from mechanical ventilation are more prevalent among recipients of bilateral lung transplant
- Diaphragmic dysfunction strongly predicts extubation outcome and is useful in post-operative management
- Increased time on mechanical ventilator support is associated with worsened diaphragm function

## Limitations

- Generalizability is limited by: 1. single-center study 2. the use of dexmedetomidine (0.7 to 1.2 mcg/kg/h), and thoracic epidural analgesia in all patients at the start of the ventilator weaning trial
- Reproducibility may be limited by operator-dependent measurements of diaphragm thickness and lack of blinding
- Uncertain clinical implication of the relationship between duration of mechanical ventilation and diaphragmic dysfunction due to lack of causal link