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End-Tidal to Arterial PCO_2 ratio as guide to weaning from VV-ECMO

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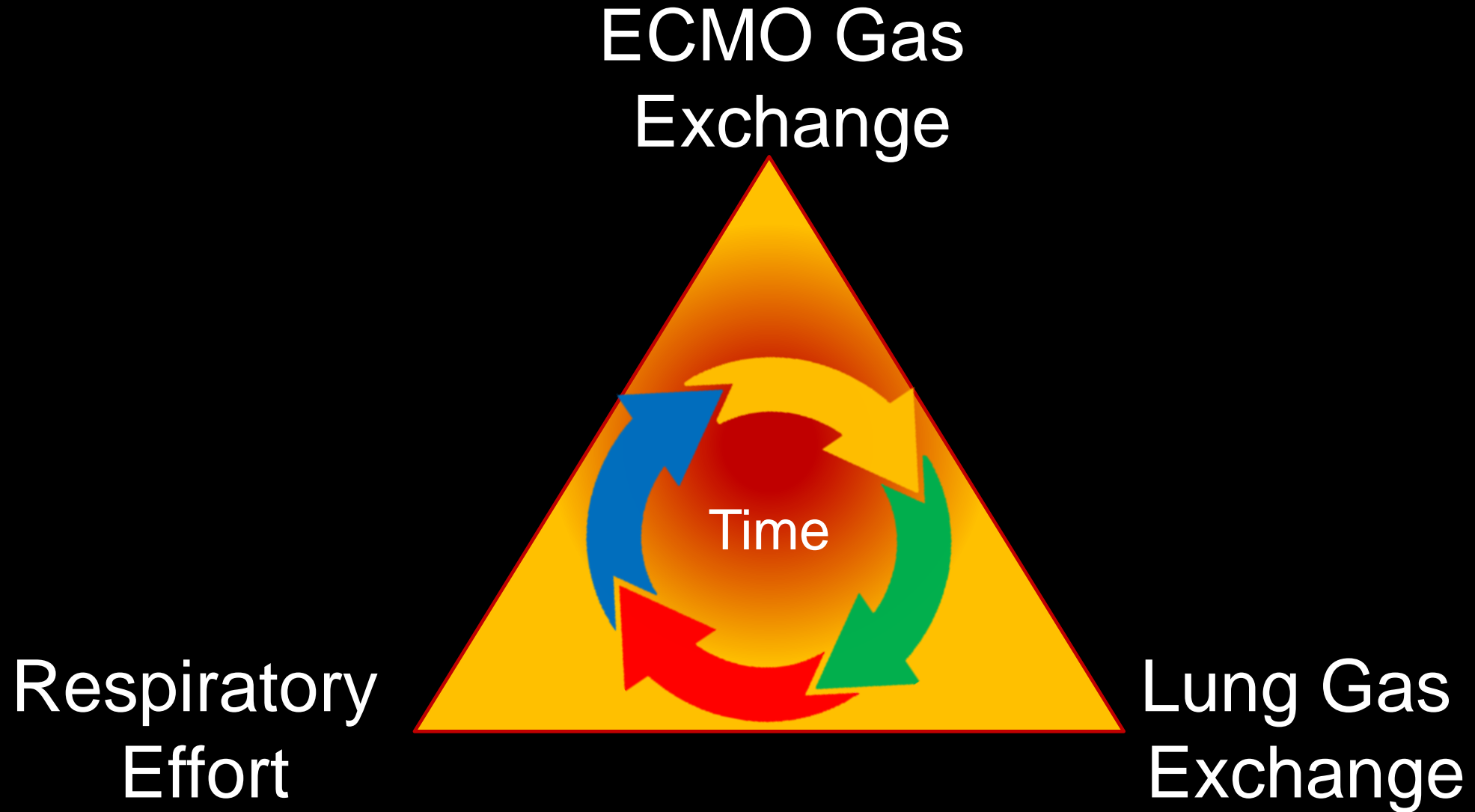
Centre of Human and Applied Physiology – KCL

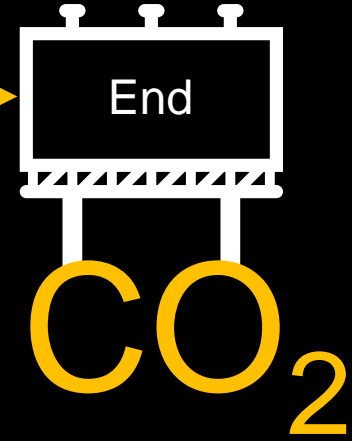
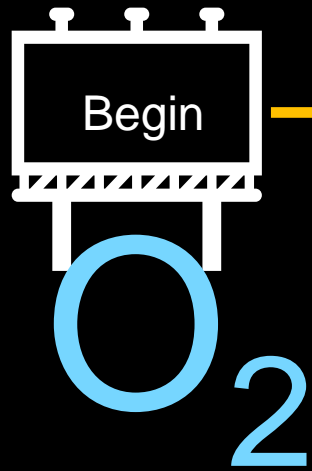
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Conflict of Interest

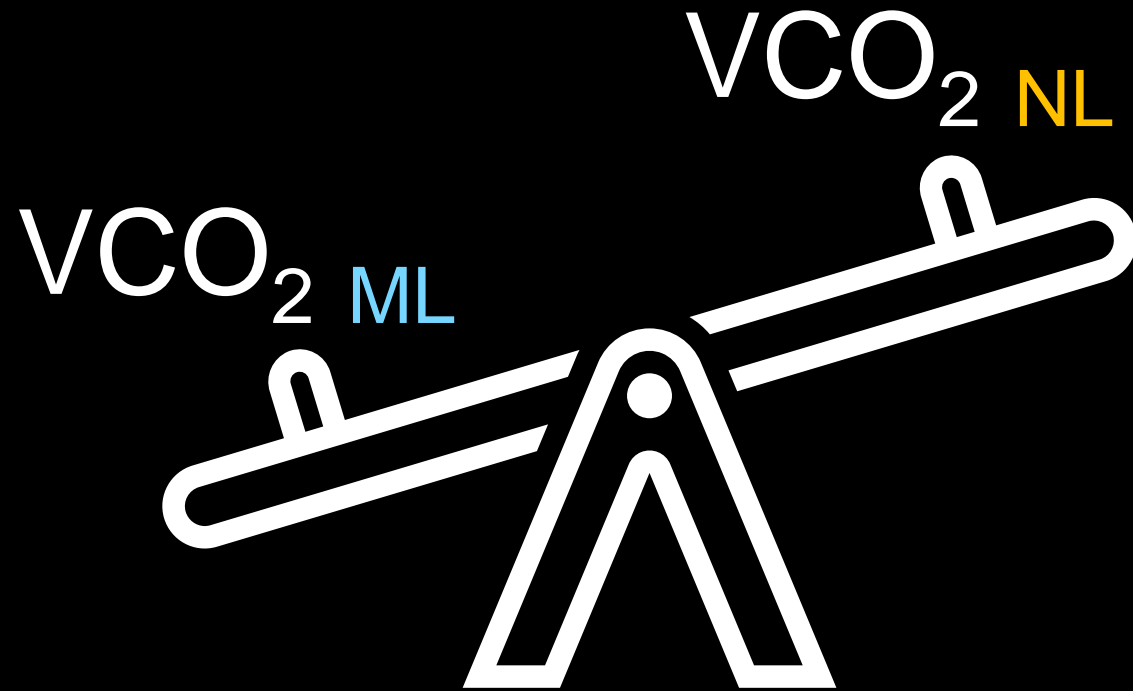
Dräger
Hamilton
Medtronic
Baxter
Fisher Paykel

Weaning and Liberation From ECMO



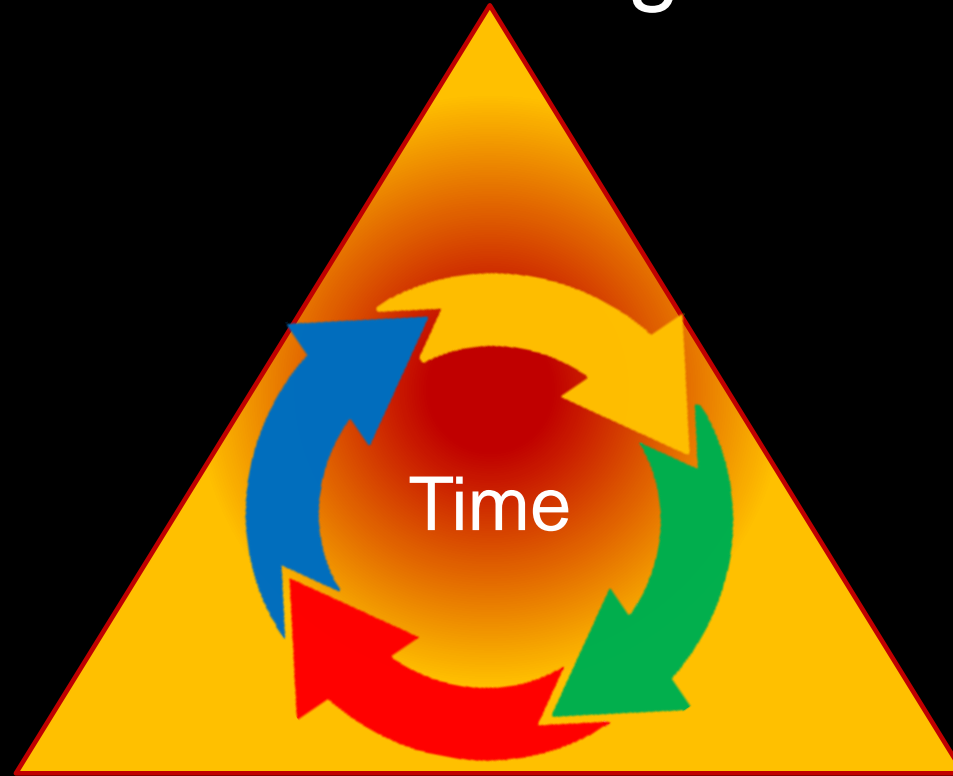


Process of Transferring VCO₂ to NL



Weaning and Liberation From ECMO

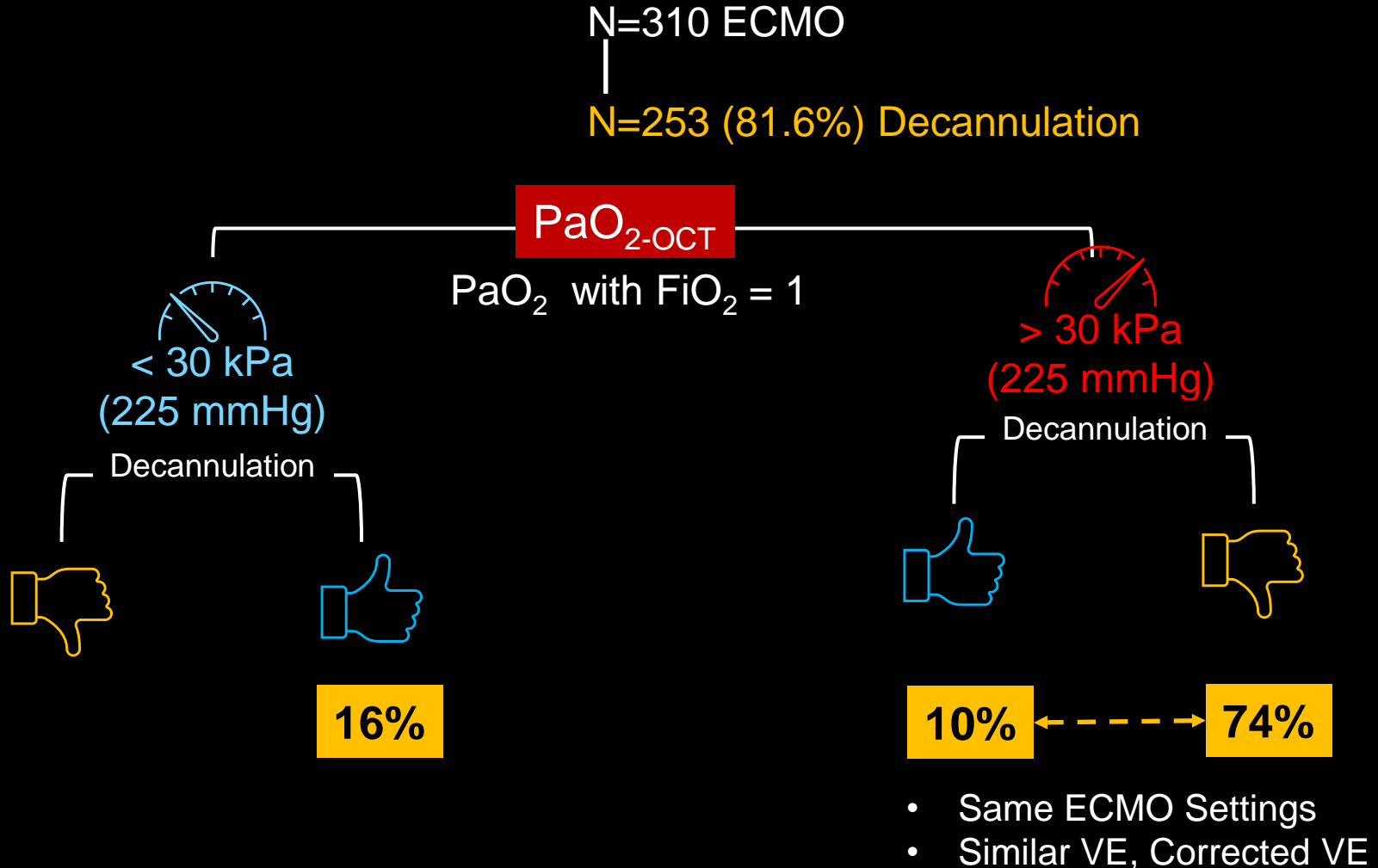
ECMO Gas Exchange



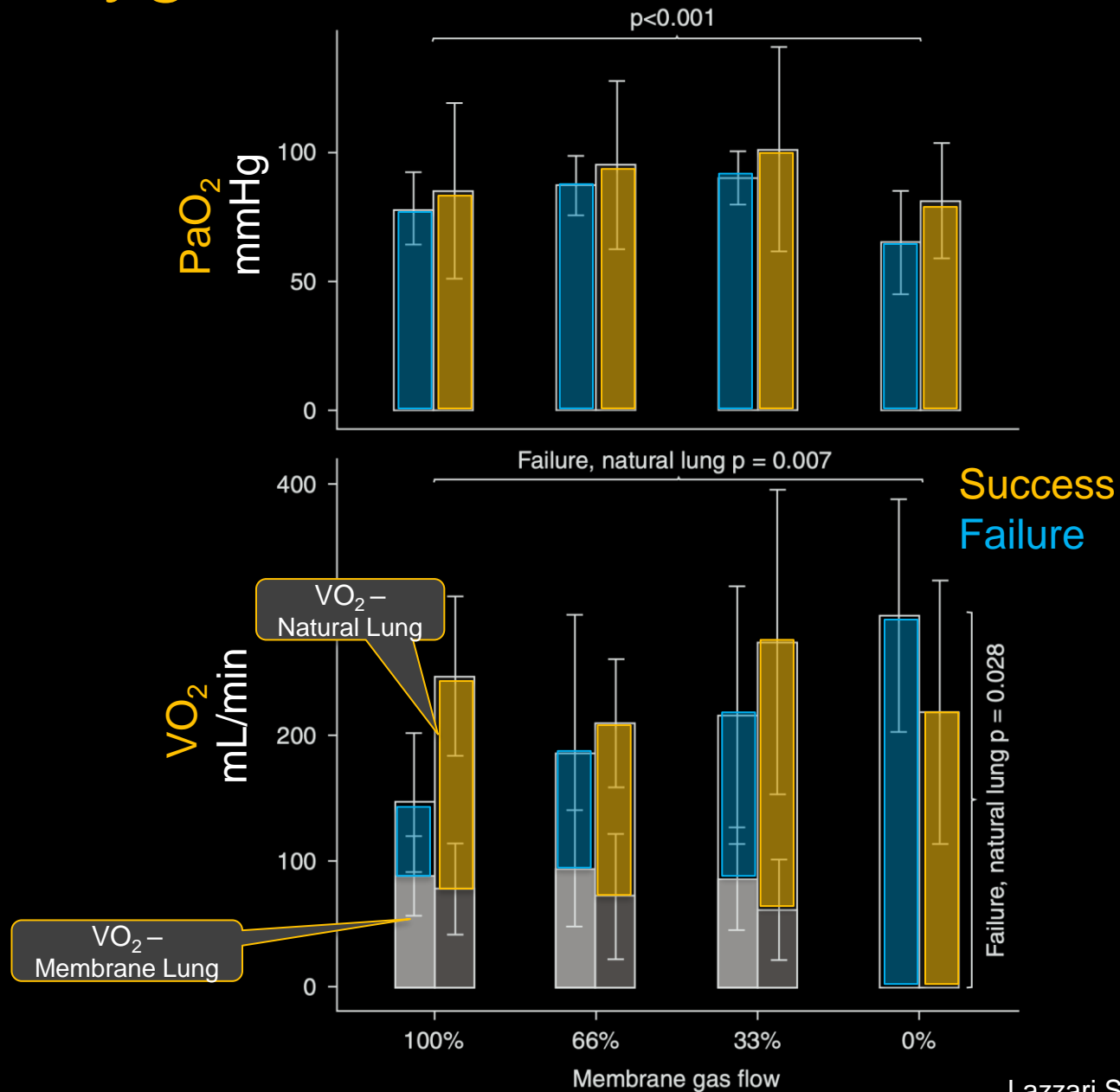
Respiratory Effort

Lung Gas Exchange

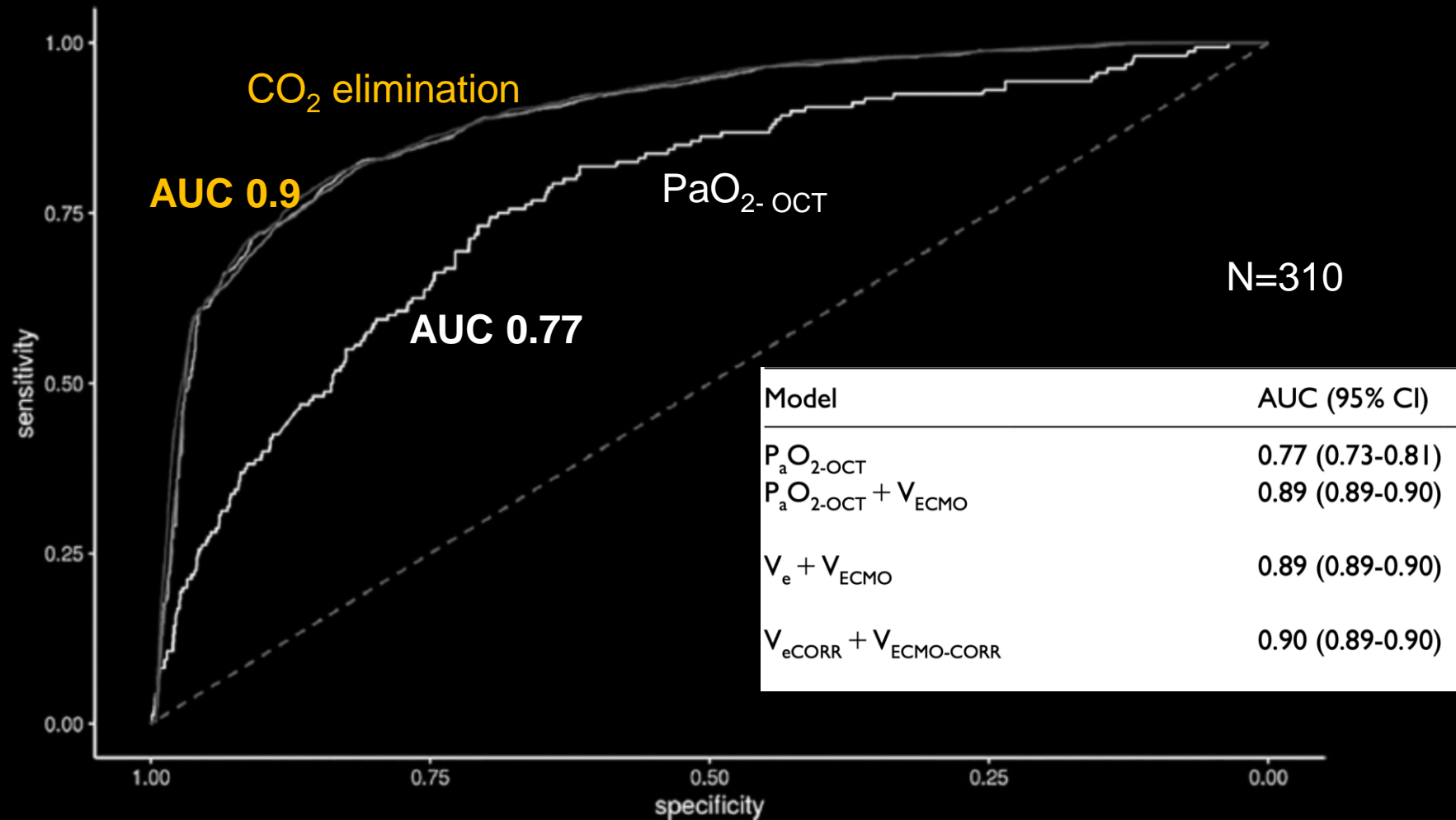
Oxygenation Indices do not predict successful weaning



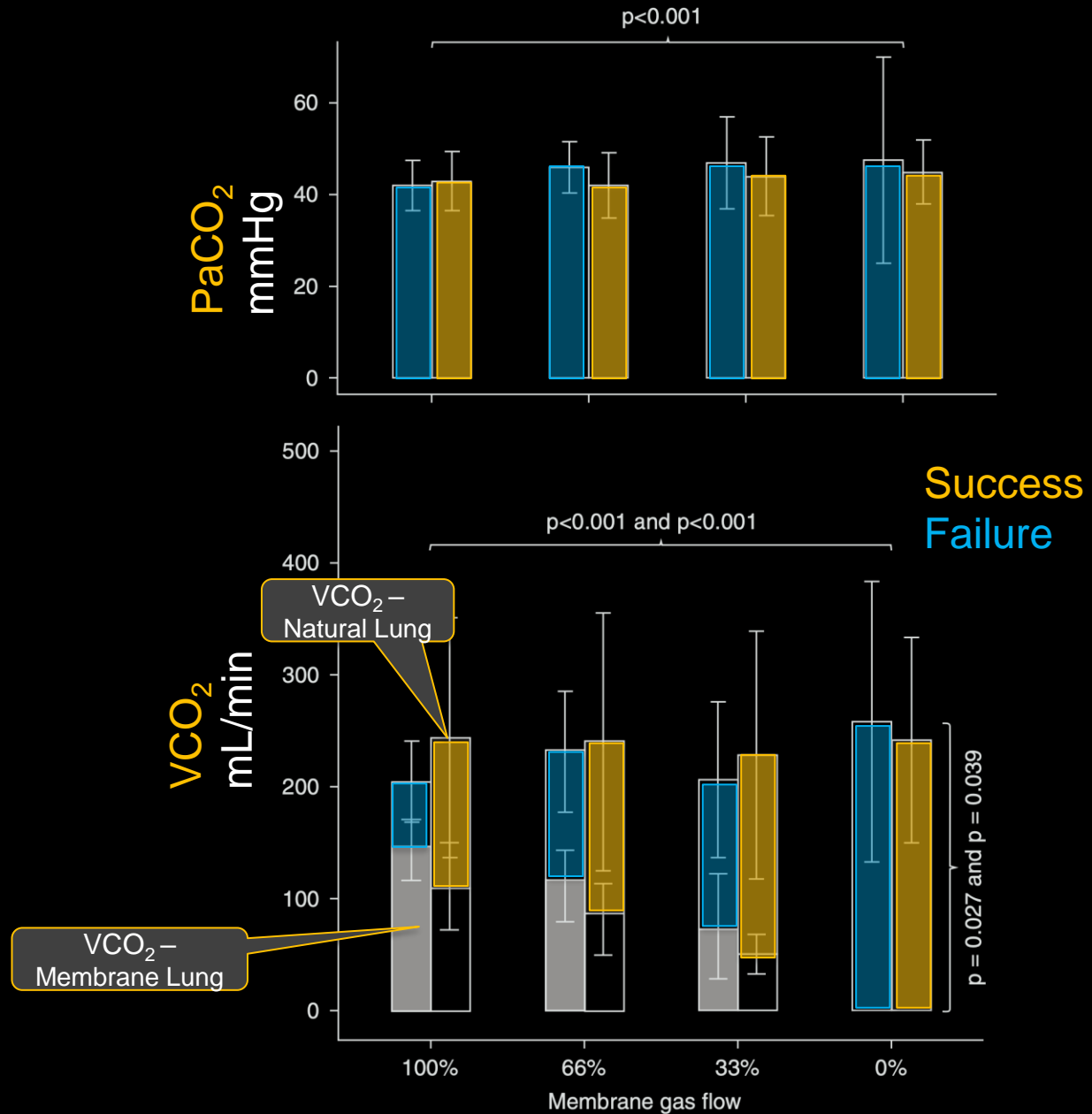
Oxygenation and ECMO weaning Outcome



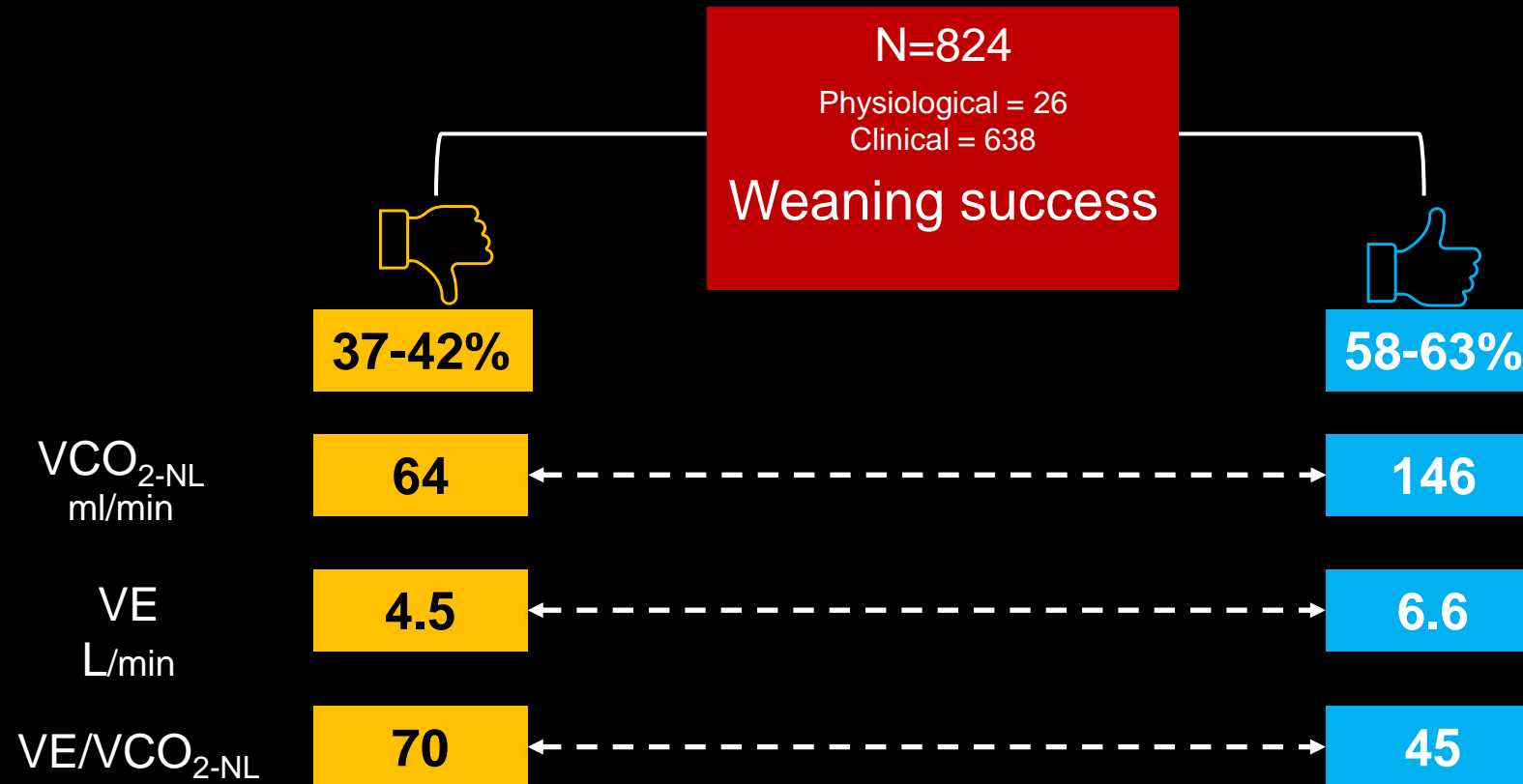
Oxygenation vs CO₂ elimination in ECMO-Weaning



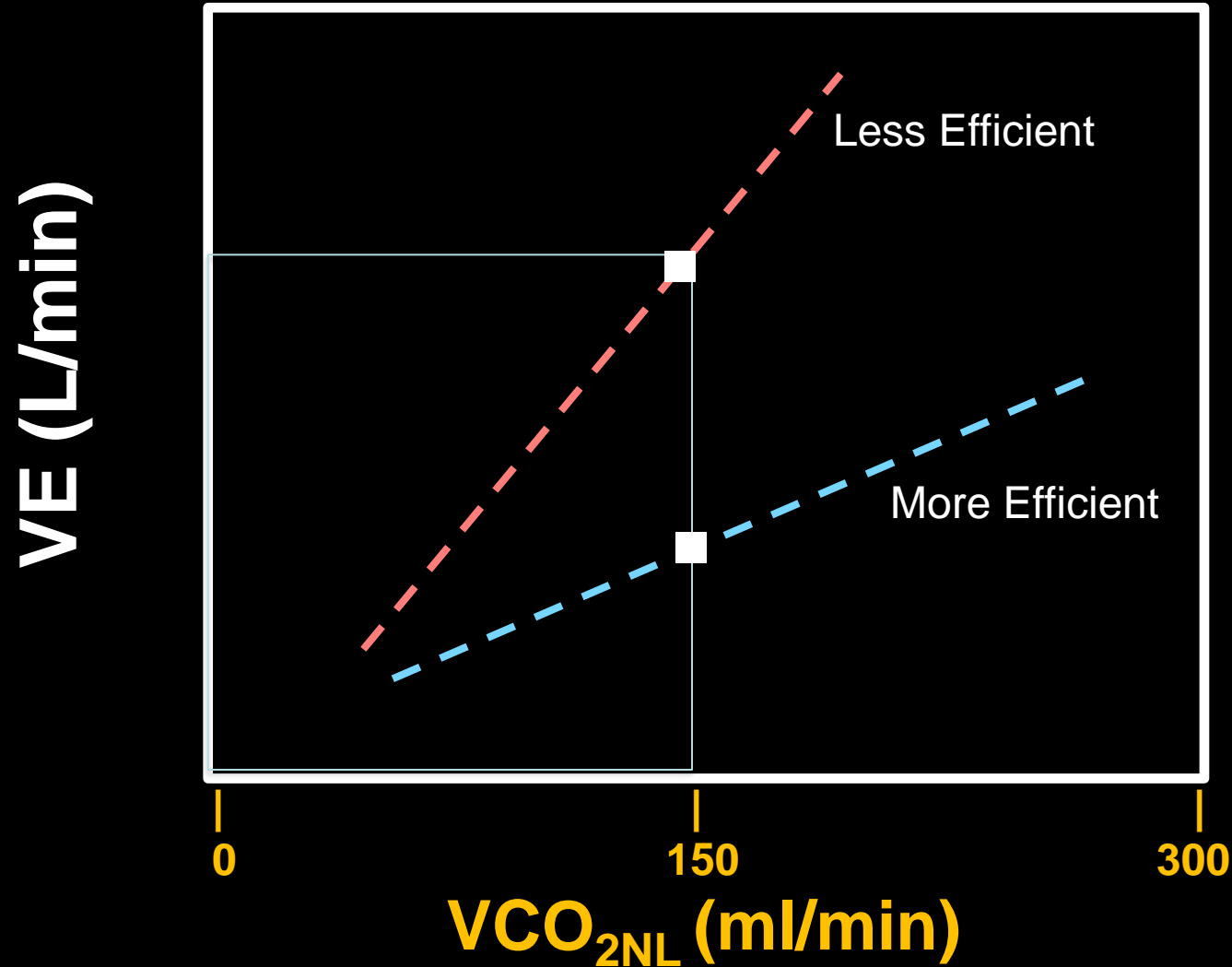
CO₂ Clearance and ECMO weaning Outcome



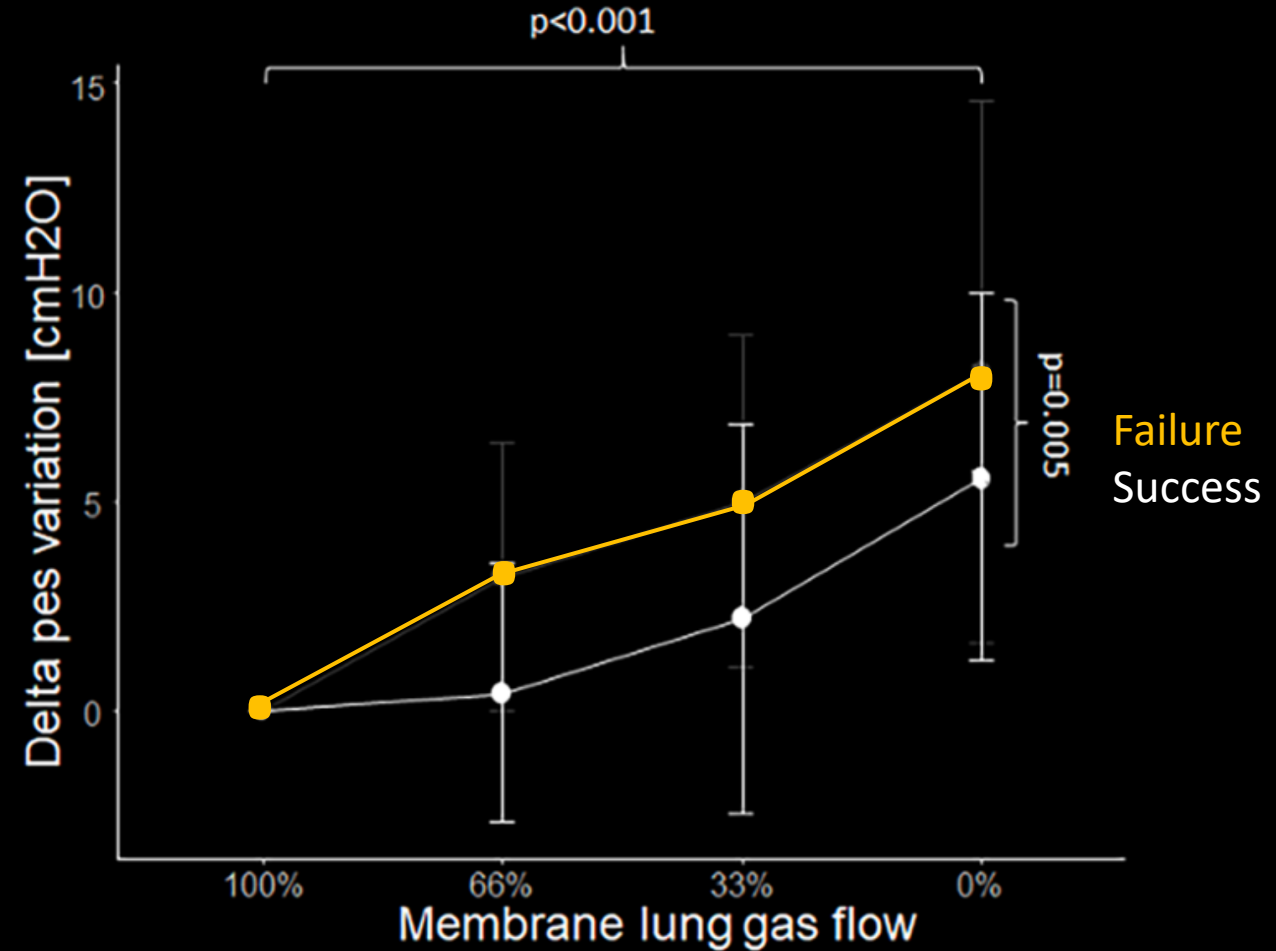
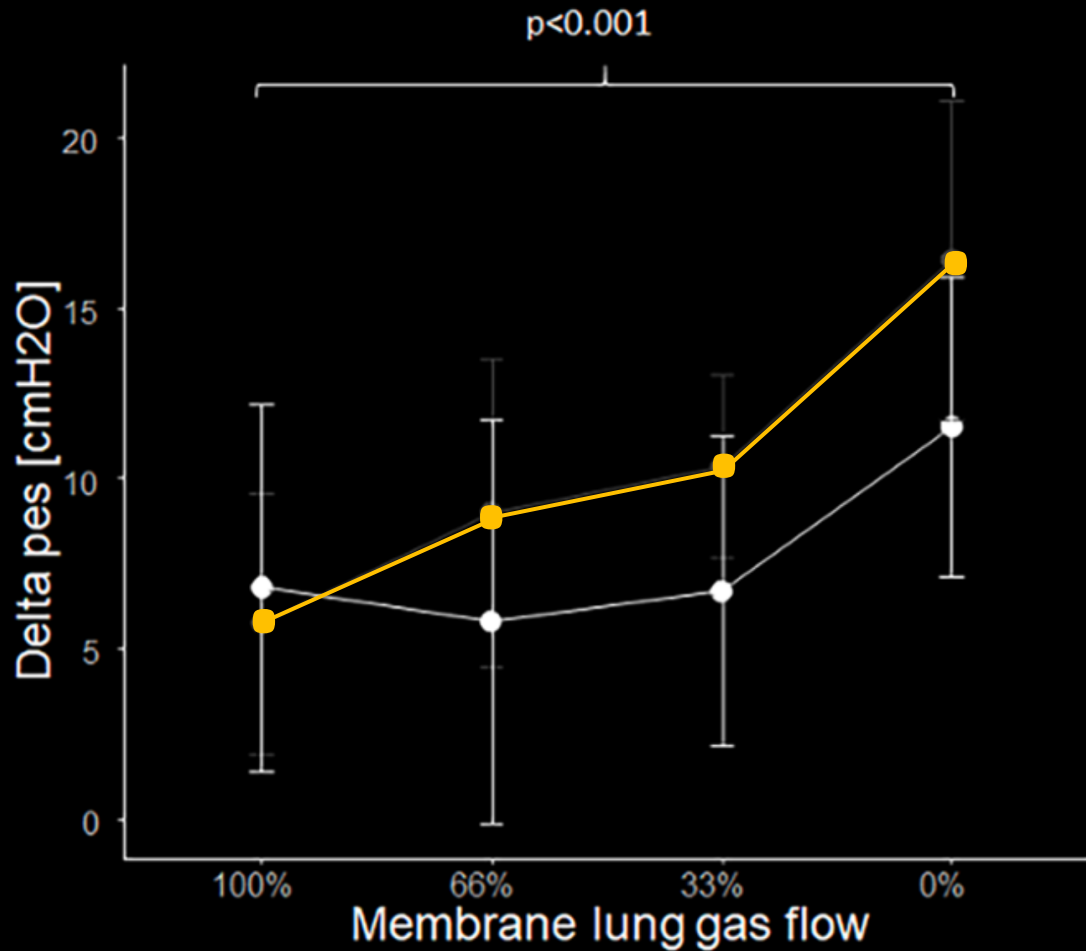
CO₂ elimination is a better predictor of successful weaning



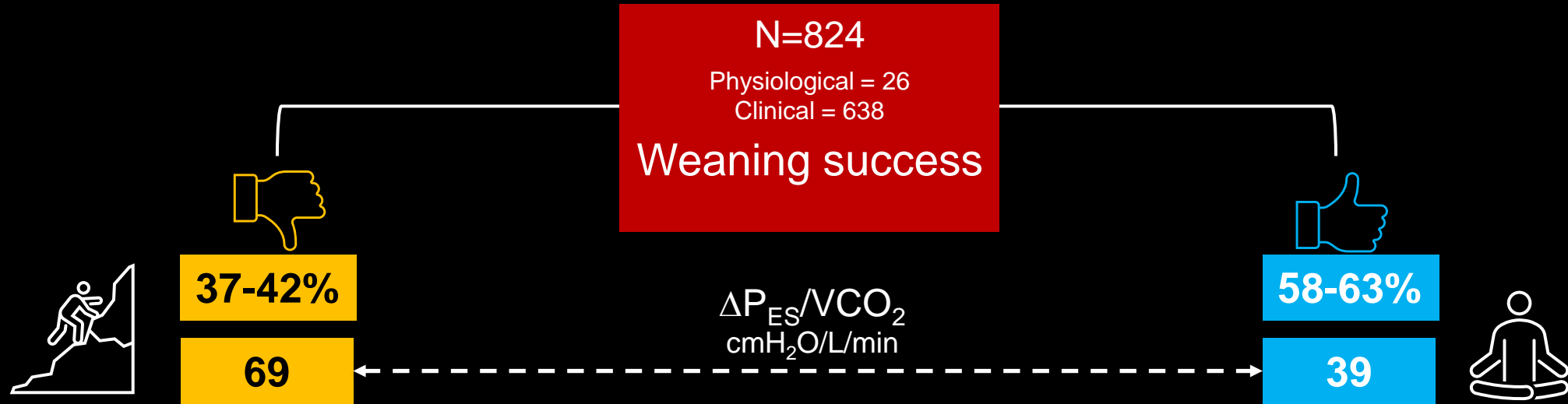
Lung Efficiency



Oesophageal Pressure: Inspiratory effort and weaning outcome

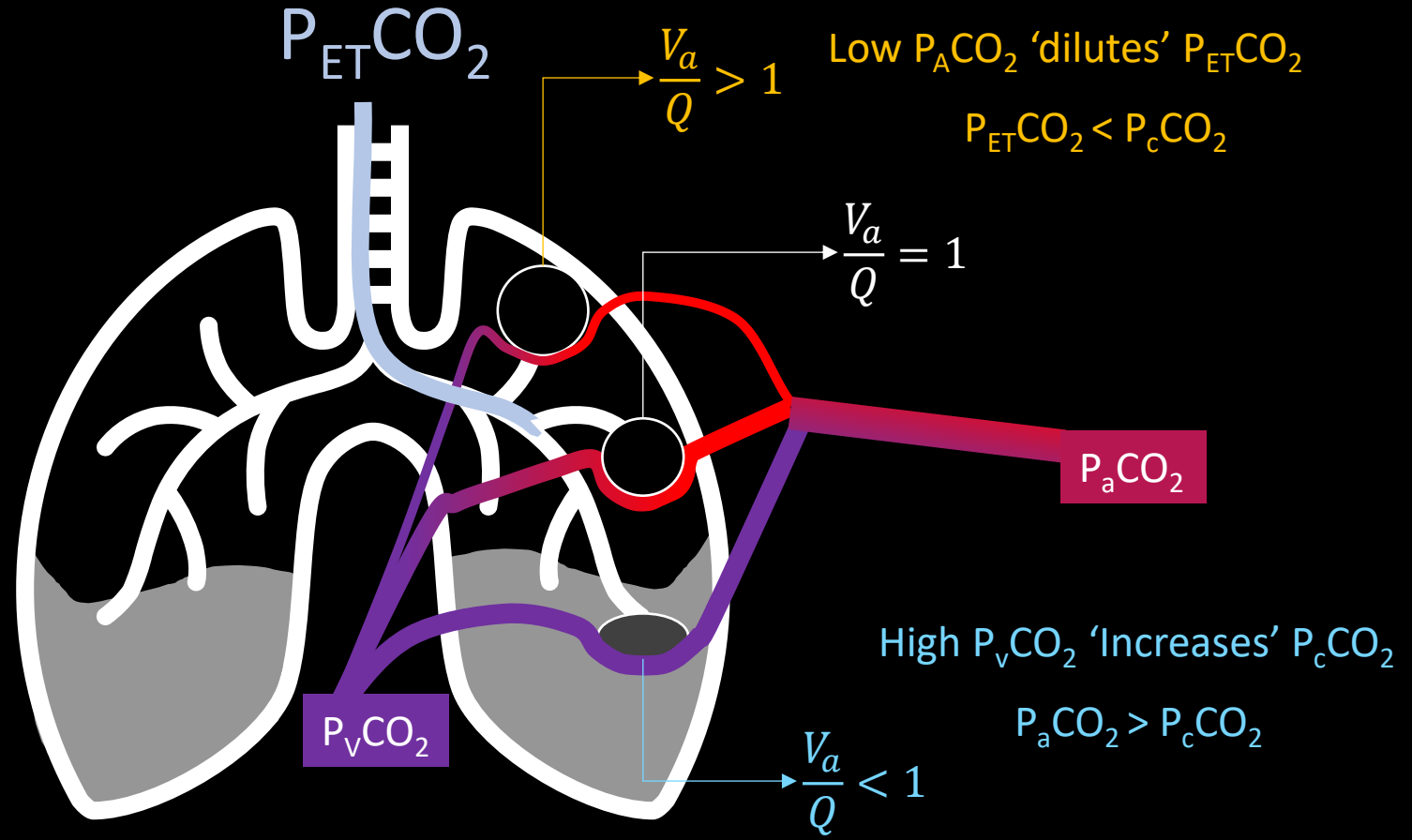
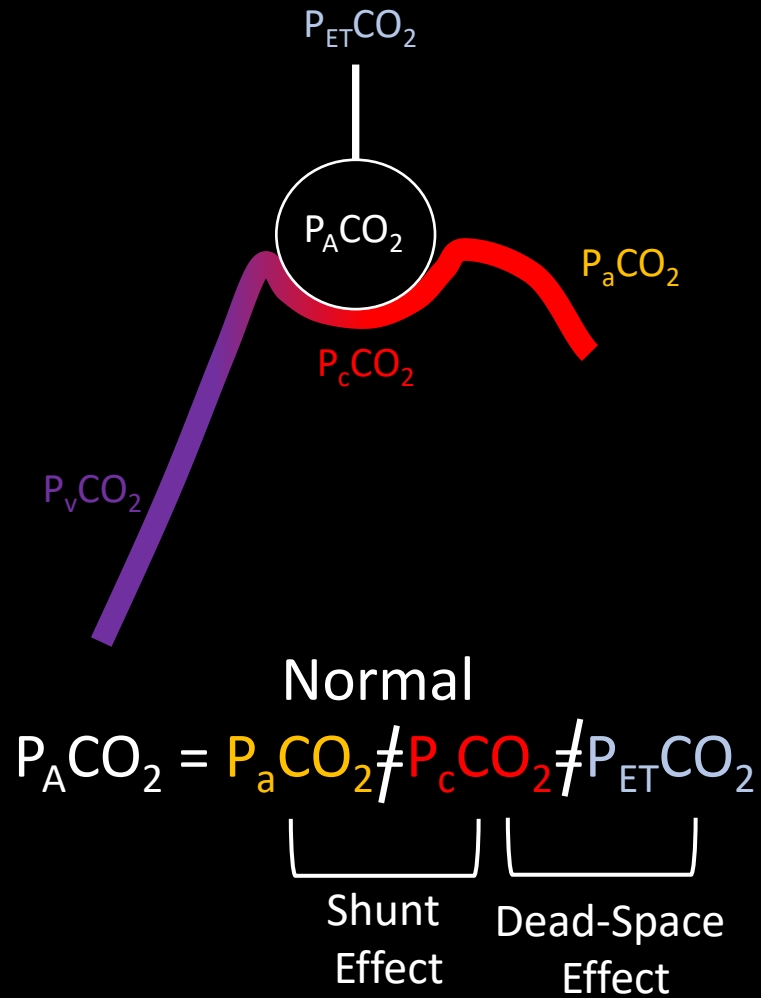


Indices associated with successful weaning



Meaning of
 $P_{ET}CO_2/PaCO_2$

ETCO₂/PaCO₂ ratio: expression of overall gas exchange



$$P_{ET}CO_2/P_aCO_2$$



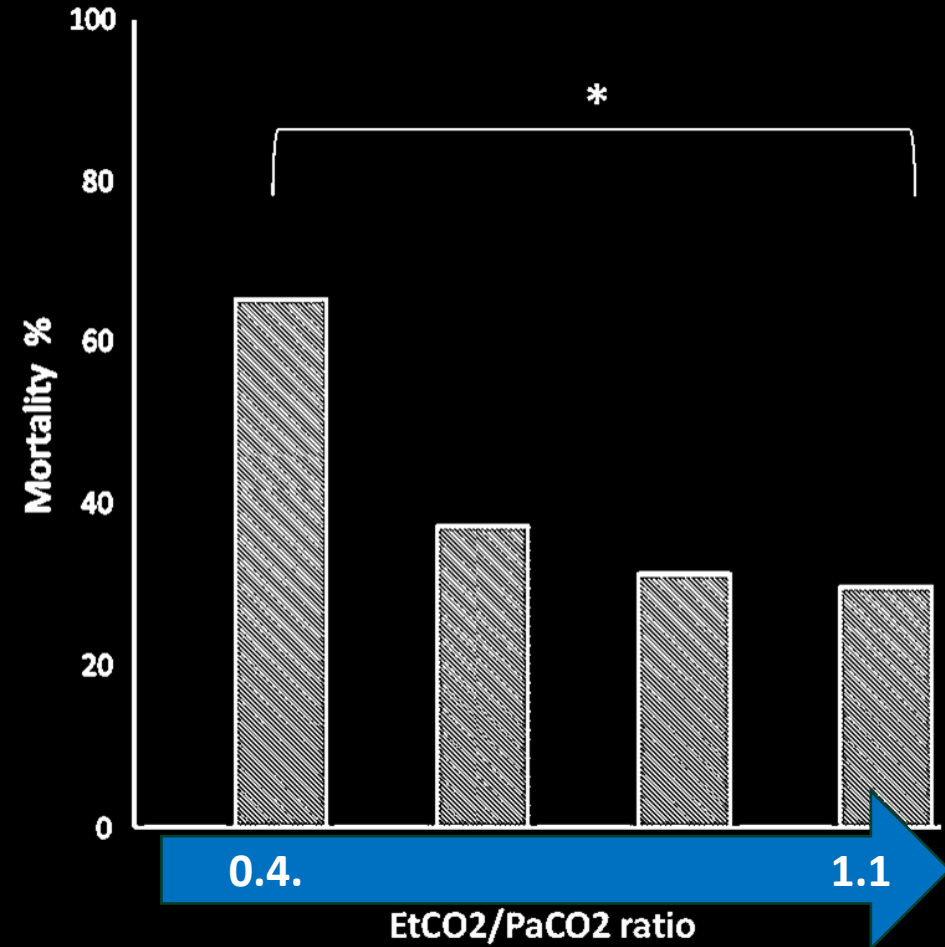
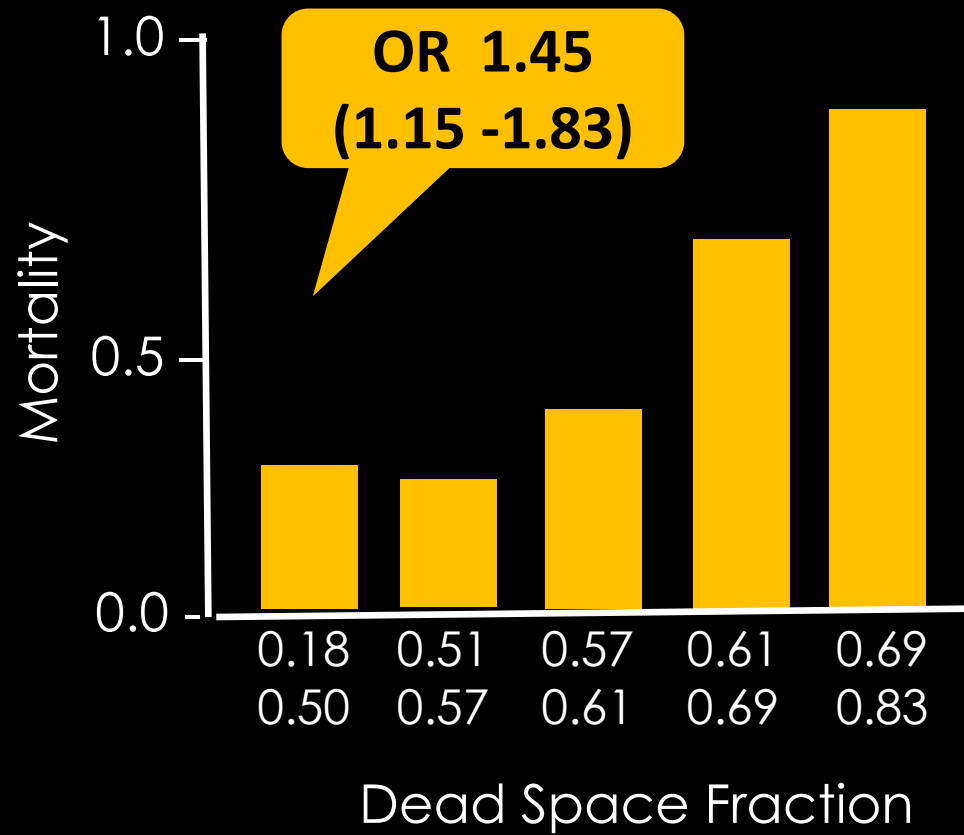
$P_{ET}CO_2$ ↓

Dead-Space Effect

P_aCO_2 ↑

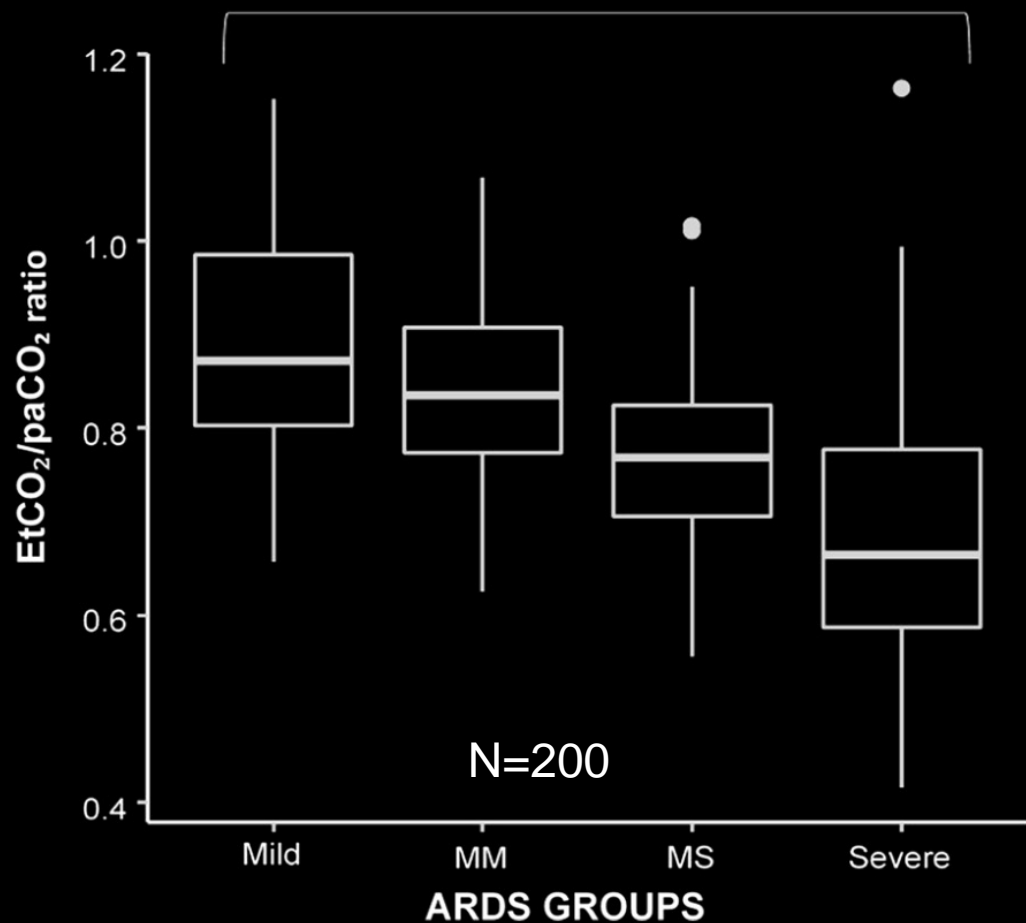
Dead-Space
Shunt Effect

Dead Space , $P_{ET}CO_2/PaCO_2$ and Mortality in ARDS

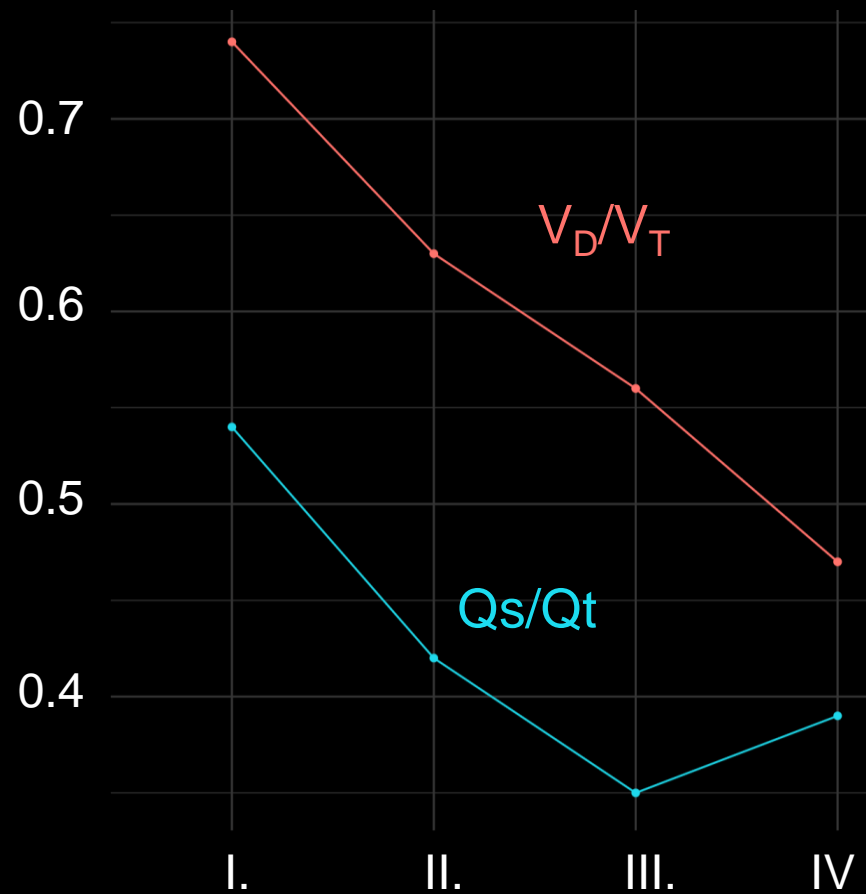


$$\text{Alveolar DeadSpace} = 1 - \left(\frac{ETCO_2}{PaCO_2} \right)$$

*



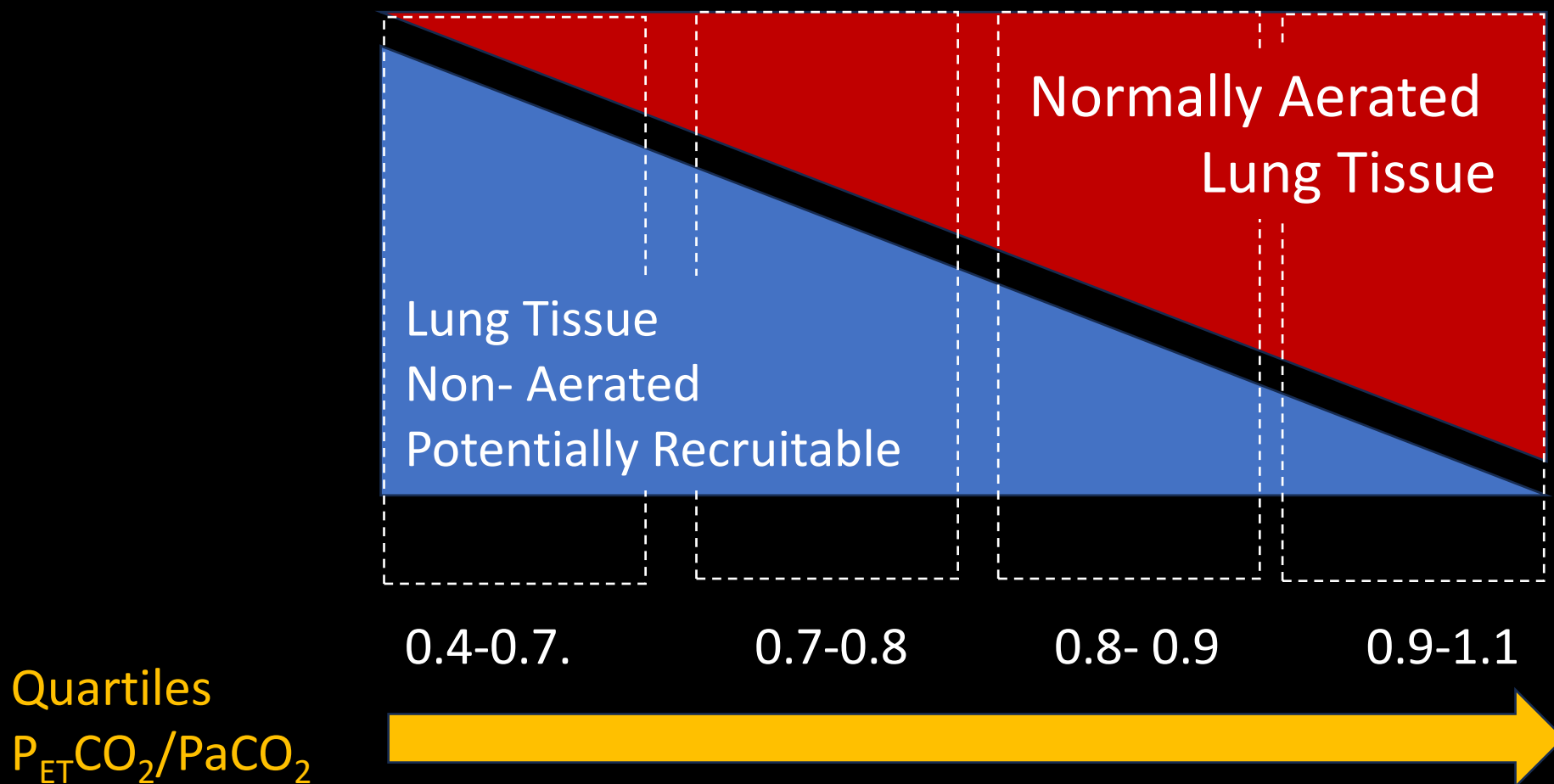
$$\text{Lung function} = \left(\frac{ETCO_2}{PaCO_2} \right)$$



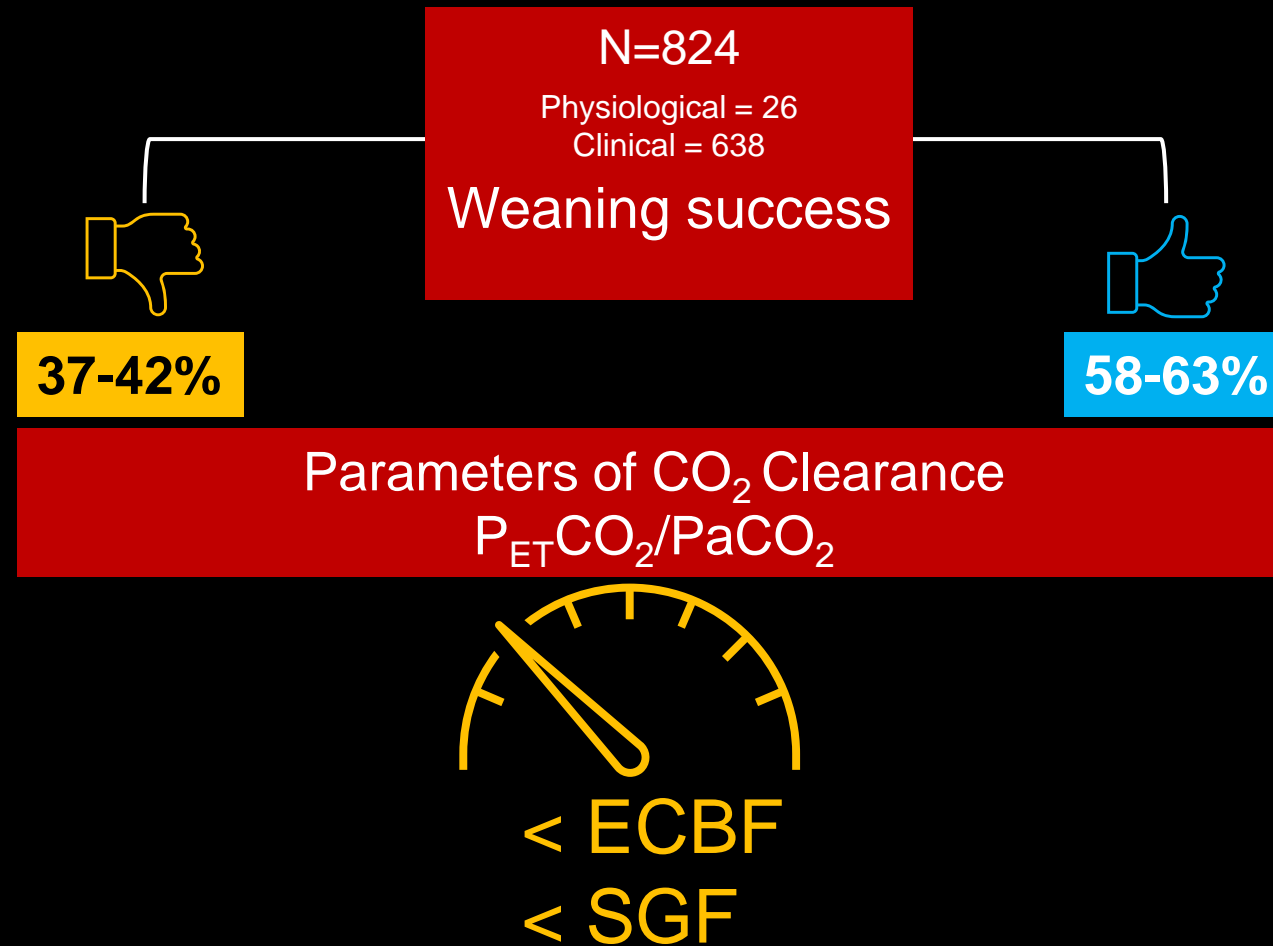
$P_{ET}CO_2/P_aCO_2$ and Physiological Parameters

$P_{ET}CO_2/P_aCO_2$ (quartiles)	V_A (L/min)	Qs/Qt (%)	Vd/Vt	VCO_2 (mL/min)	V_E (L/min)	V_E/VCO_2
0.4 - 0.7	3.18	0.54	0.74	117	8.64	73.85
0.7 - 0.8	3.99	0.42	0.63	144	8.32	57.78
0.8 - 0.88	4.25	0.35	0.56	164	8.16	49.76
0.89 - 1.1	4.72	0.39	0.47	180	8.1	45

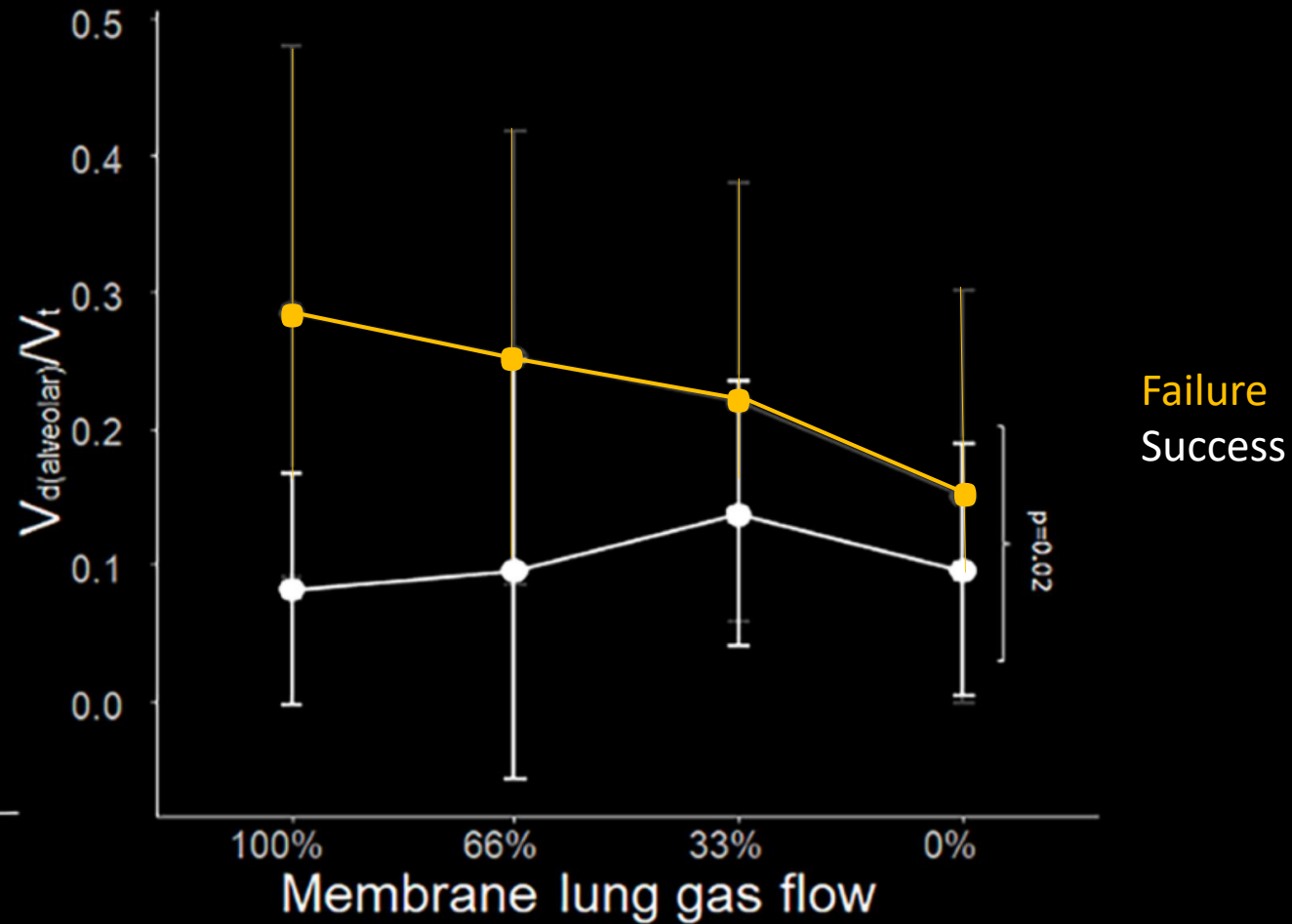
Association $P_{ET}CO_2/PaCO_2$ and Quantitative CT



$P_{ET}CO_2/PaCO_2$ associated with successful weaning



Alveolar Deadspace and ECMO weaning outcome



Inspiratory Effort and weaning from ECMO

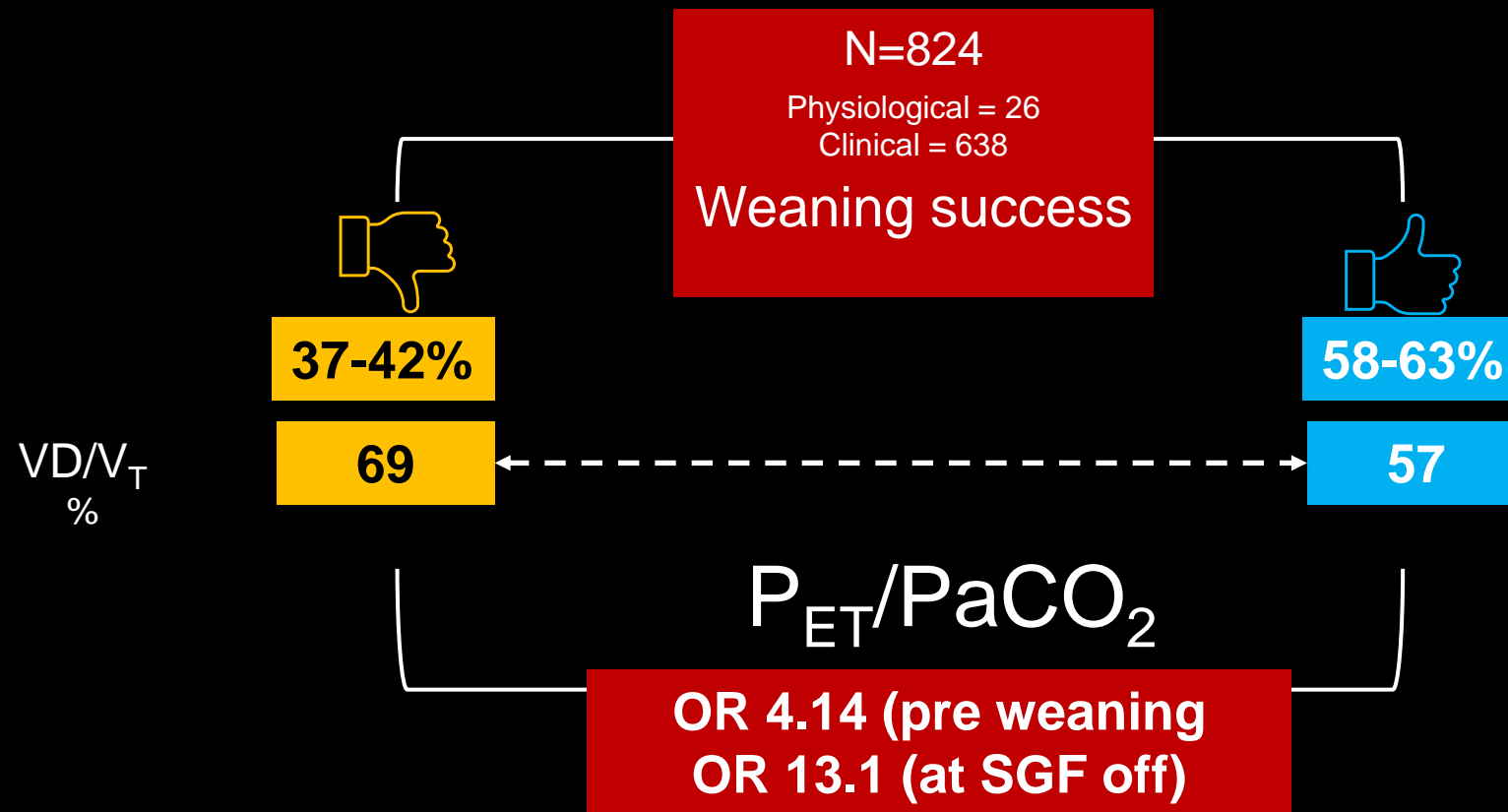
Higher inspiratory efforts (ΔP_{oes} 9 [7-13] vs 18 [7-25] cm H₂O) had and worse outcomes and failure to liberate from ECMO

Clinical variable	Optimal cutoff	Youden index	Sensitivity	Specificity	AUC
Tidal volume per predicted body weight, mL/kg	7.8	71.4	100	71.4	0.813
Heart rate, beats/min	110	57.1	71.4	85.7	0.820
Ventilatory ratio	2.3	81	100	81	0.891
Inspiratory pressure measured by esophageal pressure swing, cm H ₂ O	16	71.4	71.4	100	0.776

$P_{ET}CO_2/P_aCO_2$ and Physiological Parameters or ECMO Weaning Success or Failure

	Success		Failure
P_aO_2/F_iO_2	223		192
$PaCO_2$	42		43
RR	16		14
VCO_{2-Tot}	244		205
VCO_{2-nl}	146	*	64
V_d/V_t	0.57	*	0.69
ECBF	2		2
SGF	2		2.5
$P_{ET}CO_2/P_aCO_2$	0.91	*	0.71

Indices associated with successful weaning



Conclusions

- Successful weaning from VV-ECMO depends mainly on the ability to remove CO_2
- $P_{\text{ET}}\text{CO}_2/\text{PaCO}_2$ is a simple bedside marker that quantifies the overall gas exchange capability of the lung
- It seems able to predict success and failure before and after SGF

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