impact on Pa_{O_2}). Therefore, this mechanism (altered RER) should not be invoked as a cause of deteriorating Pa_{O_2} after initiation of $ECCO_2R$ therapy. ■

Author disclosures are available with the text of this letter at www.atsjournals.org.

Marc L. Dickstein, M.D.*
Columbia University
New York, New York

*Corresponding author (e-mail: mld2@cumc.columbia.edu).

References

1. Abrams D, Schmidt M, Pham T, Beitler JR, Fan E, Goligher EC, *et al*. Mechanical ventilation for acute respiratory distress syndrome during extracorporeal life support: research and practice. *Am J Respir Crit Care Med* 2020;201:514–525.
2. West JB. Respiratory physiology: the essentials, 6th ed. Baltimore, MD: Lippincott Williams and Wilkins; 2000.

Reply to Dickstein

From the Authors:

We appreciate Dr. Dickstein's physiologically nuanced point in calling attention to the complete alveolar gas equation (AGE) in West's Respiratory Physiology primer (1) in response to our review, "Mechanical Ventilation for Acute Respiratory Distress Syndrome during Extracorporeal Life Support" (2). The extra term in the complete AGE does, in fact, account for a portion of the decrease in oxygenation that would be anticipated with the introduction of extracorporeal CO_2 removal ($ECCO_2R$). Indeed, at high levels of FI_{O_2}, the difference between the calculated partial pressure of alveolar oxygen (PA_{O_2}) based on the abbreviated and complete versions of the AGE is more pronounced but of less clinical significance, with PA_{O_2} well above 200 mm Hg at an FI_{O_2} at or above 0.5. However, at lower FI_{O_2}, which may be more relevant when $ECCO_2R$ is used for patients with hypercapnia with relatively preserved oxygenation, the difference between the PA_{O_2} in the abbreviated and complete AGE is less pronounced. This results in more clinically significant decreases in PA_{O_2} when the respiratory exchange ratio (RER) is decreased in the context of $ECCO_2R$, regardless of which formula is used. For example, at FI_{O_2} of 0.3, the partial pressure of alveolar carbon dioxide (PA_{CO_2}) 40 mm Hg, and RER of 0.8, the PA_{O_2} in the abbreviated AGE would be 164 mm Hg, and with the complete AGE, it is nearly identical at 166 mm Hg; when RER is decreased to 0.4, the PA_{O_2} would be

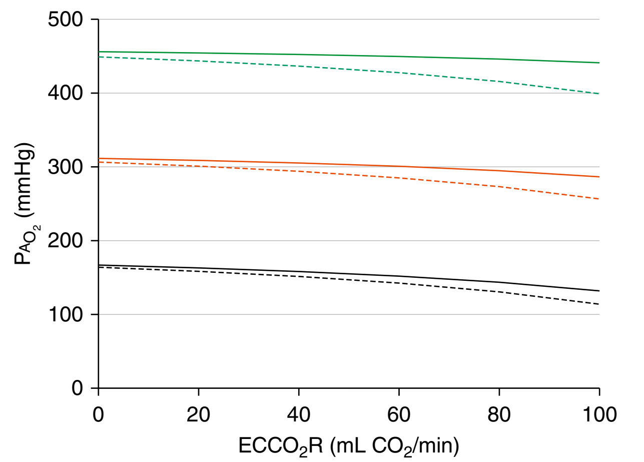

Figure 1. The partial pressure of alveolar oxygen (PA_{O_2}) was calculated using the simplified alveolar gas equation (dashed lines) and the complete equation (solid lines) at 3 different levels of FI_{O_2} (0.7 [green lines], 0.5 [red lines], and 0.3 [black lines]) and across a range (from 0 to 100 ml) of CO_2 elimination via $ECCO_2R$. Baseline respiratory exchange ratio = 0.8. Note that at lower FI_{O_2}, the PA_{O_2} curves from the simplified and complete equations become closer in approximation, with a substantial reduction in PA_{O_2} as CO_2 elimination via $ECCO_2R$ increases. $ECCO_2R$ = extracorporeal CO_2 removal.

114 mm Hg with the abbreviated AGE and 131 mm Hg with the complete AGE, so the PA_{O_2} does still decrease, just to a lesser degree than would be expected from the abbreviated AGE (Figure 1). There remains a notable decrease in PA_{O_2} regardless of which AGE is used, which poses a real risk of leading to hypoxemia. This decrease in PA_{O_2} because of reductions in RER could be overcome with an increase in FI_{O_2}, as the author demonstrates in his figure.

Also, the concept of passive movement of fresh gas into the alveolus, as a consequence of the difference between inspired volume and expired volume, must be put into context. The extreme example is zero expired gas flow, which amounts to apneic oxygenation and, in principle, no change in PA_{O_2}. However, this passive flow requires specific conditions to be maintained. Under normal conditions, it might take place at low RER, but under pathological conditions (e.g., chronic obstructive pulmonary disease or the acute respiratory distress syndrome), with low RER usually associated with a low $\dot{V}/\dot{Q}$, the risk of alveolar collapse will be much higher, depending on mixed venous gas content and the presence of nonhomogeneous distribution of $\dot{V}/\dot{Q}$ (3), also potentially contributing to hypoxemia. The portion of hypoxemia due to shunt physiology will, notably, not be overcome by increasing FI_{O_2}. ■

Author disclosures are available with the text of this letter at www.atsjournals.org.

Darryl Abrams, M.D.
Columbia University College of Physicians and Surgeons
New York, New York
and
New York-Presbyterian/Columbia University Irving Medical Center
New York, New York

Originally Published in Press as DOI: 10.1164/rccm.202005-1923LE on June 5, 2020

Antonio Pesenti, M.D.
University of Milan
Milan, Italy
and
Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico Milan
Milan, Italy

Laurent Brochard, M.D.*
University of Toronto
Toronto, Ontario, Canada
and
St. Michael's Hospital
Toronto, Ontario, Canada

Daniel Brodie, M.D.‡
Columbia University College of Physicians and Surgeons
New York, New York
and
New York-Presbyterian/Columbia University Irving Medical Center
New York, New York

*L.B. is Deputy Editor of *AJRCCM*. His participation complies with American Thoracic Society requirements for recusal from review and decisions for authored works.
‡Corresponding author (e-mail: hdb5@cumc.columbia.edu).

References

1. West JB. Respiratory physiology: the essentials, 6th ed. Baltimore, MD: Lippincott Williams and Wilkins; 2000.
2. Abrams D, Schmidt M, Pham T, Beitler JR, Fan E, Goligher EC, *et al*. Mechanical ventilation for acute respiratory distress syndrome during extracorporeal life support: research and practice. *Am J Respir Crit Care Med* 2020;201:514–525.
3. West JB. State of the art: ventilation-perfusion relationships. *Am Rev Respir Dis* 1977;116:919–943.

Too Many Calories for All?

To the Editor:

In a recent paper published in the *Journal*, Deane and colleagues (1) explored the effects of two different strategies of caloric intake (70% vs. 100%) in critically ill patients undergoing invasive mechanical ventilation. The main hypothesis was that optimal energy delivery, or approximately 100% of recommended caloric intake, impacted long-term mortality, quality of life, returning to work, and disability. The authors stated that no approach was used to estimate individual caloric needs. Instead, study participants were randomly assigned to an energy-dense (1.5 kcal/ml) or to a regular (1.0 kcal/ml) enteral formula with similar protein contents and then received an infusion at a rate of 1 ml/kg/h on the basis of calculated ideal body weight. Accordingly, the mean total energy provided for the intervention and control groups resulted in, respectively, 30.2 and 21.9 kcal/kg of ideal body weight/d or 24.0 and 17.4 kcal/kg of actual body weight/d. Because a sizeable proportion of participants (30%) had obesity and the mean body mass index was 29.2 kg/m^2, we are concerned that the arms represented overfeeding rather than standard nutrition. Energy supply exceeded recommendations of current nutritional guidelines (2, 3) in the so-called 100%-calorie-requirements group, particularly considering the short median duration of the enteral trial, which was 6 days.

From our standpoint, the aim of a modest goal for caloric intake during the acute phase of critical illness is no longer debatable (2–4). An energy target of at least 70% of the estimated requirements still confers a survival advantage (5), and overfeeding is notably detrimental in critically ill individuals with obesity (2). So, we disagree that control individuals in the aforementioned trial (1) had been truly underfed. Moreover, a smaller but well-powered study (6) has already addressed physical quality of life at 6 months after ICU admission by comparing two different strategies of energy provision, in which the control group received 64% of the calories administered to the intervention group, and found no superiority for the latter. Therefore, we believe that future trials should investigate whether adequate and individually tailored nutritional management beyond the 5–7 days of an ICU stay leads to better functional outcomes. ■

Originally Published in Press as DOI: 10.1164/rccm.202004-1496LE on June 9, 2020

Author disclosures are available with the text of this letter at www.atsjournals.org.

Ana Carolina Peçanha Antonio, M.D., Ph.D.*
Hospital de Clínicas de Porto Alegre
Porto Alegre, Brazil

Sergio Henrique Loss, M.D., M.Sc.
Hospital de Clínicas de Porto Alegre
Porto Alegre, Brazil
and
Universidade Federal do Rio Grande do Sul
Porto Alegre, Brazil

Luciana Verçoza Viana, M.D., Ph.D., M.Sc.
Universidade Federal do Rio Grande do Sul
Porto Alegre, Brazil

ORCID ID: 0000-0001-6146-1247 (A.C.P.A.).

*Corresponding author (e-mail: ana.carolina.antonio@gmail.com).

References

1. Deane AM, Little L, Bellomo R, Chapman MJ, Davies AR, Ferrie S, *et al*. Outcomes six months after delivering 100% or 70% of enteral calorie requirements during critical illness (TARGET): a randomized controlled trial. *Am J Respir Crit Care Med* 2020;201:814–822.
2. McClave SA, Taylor BE, Martindale RG, Warren MM, Johnson DR, Braunschweig C, *et al*.; Society of Critical Care Medicine; American Society for Parenteral and Enteral Nutrition. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). *JPEN J Parenter Enteral Nutr* 2016;40:159–211.