4. Malbouisson LM, Muller JC, Constantin JM, Lu Q, Puybasset L, Rouby JJ; CT Scan ARDS Study Group. Computed tomography assessment of positive end-expiratory pressure-induced alveolar recruitment in patients with acute respiratory distress syndrome. *Am J Respir Crit Care Med* 2001;163:1444–1450.

Reply

From the Authors:

We thank Dr. Chen and colleagues for their interest in our article. Answering their questions and comments gives us the opportunity to better clarify some aspects of our article (1).

The questions and comments of Dr. Chen and colleagues focus on the use of a threshold of −500 Hounsfield units (HU) to define recruitment. The increase in poorly aerated tissue increasing positive end-expiratory pressure (PEEP) in the most severe patients is not a result of "derecruitment" but likely, as Dr. Chen and colleagues also suggested, of a transformation of not-aerated tissue (threshold of −100 HU) in poorly aerated tissue. Basically, in our study (*see* Table E6 in the online supplement [we are sorry for the wrong title]), we showed that a proper threshold for the voxel-by-voxel analysis is between −100 and −200 HU. Within this range, we measure the pulmonary units that would likely undergo opening and closing at PEEP lower than 15 cm H_2O. Lower levels of thresholds would be misleading, as shown in Figure 1.

Different is the use of −500 HU thresholds in the anatomy-based analysis of the original Rouby's method (2). Rouby's method

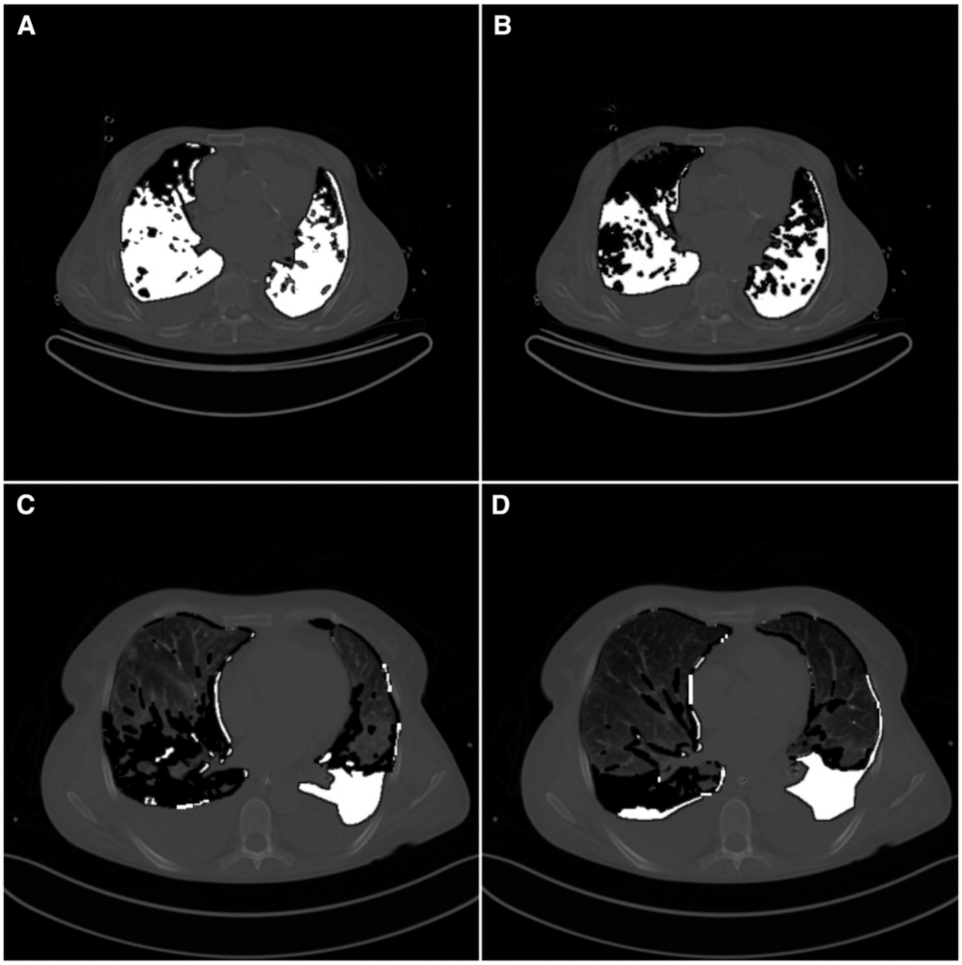

Figure 1. Examples of computed tomography (CT) scan images taken at 5 cm H_2O positive end-expiratory pressure (PEEP) (*A* and *C*) and at 15 cm H_2O PEEP (*B* and *D*). *White*, nonaerated tissue; *black*, poorly aerated tissue. *A* and *B* are from the CT scan of a patient with severe acute respiratory distress syndrome (Pa_{O_2}/Fi_{O_2} at 5 cm H_2O PEEP 86.5, first tertile); CT scan-based recruitment measured by not-inflated tissue only amounted to 245 g, whereas when adding poorly aerated tissue, it decreased to 86 g because of the 159 g increase of poorly aerated tissue from 5 to 15 cm H_2O PEEP. *C* and *D* are from the CT scan of a patient with mild acute respiratory distress syndrome (Pa_{O_2}/Fi_{O_2} at 5 cm H_2O PEEP 272.5, third tertile); CT scan-based recruitment measured by not-inflated tissue only amounted to −18 g, whereas when adding poorly aerated tissue, it increased to 98 g because of the 116 g decrease of poorly aerated tissue from 5 to 15 cm H_2O PEEP.

This letter has an online supplement, which is accessible from this issue's table of contents at www.atsjournals.org measures, in well-defined anatomical regions, the total amount of gas entering in previously nonaerated and poorly aerated regions. Therefore, this method roughly measures the same entity of the lung mechanics-based methods.

In conclusion, if the target is the measurement of the amount of pulmonary units, which likely undergo opening and closing at PEEP below 15 cm H_2O, the only method available is the computed tomography scan at threshold −100 HU (−200 HU could be tolerated). In contrast, if the target is the measurement of the total improvement of aeration, resulting from gas entering in the previously nonaerated regions and in the already aerated regions, the Rouby's method and lung mechanics–based methods are indicated. Therefore, the problem is not whether one method is better than the other but rather what we want to measure. ■

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

Luciano Gattinoni, M.D.
Georg-August University of Goettingen
Goettingen, Germany

Eleonora Carlesso, M.Sc.
Università degli Studi di Milano
Milan, Italy

Davide Chiumello, M.D.
Ospedale Maggiore Policlinico
Milan, Italy

Massimo Cressoni, M.D.
Università degli Studi di Milano
Milan, Italy

References

1. Chiumello D, Marino A, Brioni M, Cigada I, Menga F, Colombo A, Crimella F, Algieri I, Cressoni M, Carlesso E, *et al*. Lung recruitment assessed by respiratory mechanics and by computed tomography in patients with acute respiratory distress syndrome: what is the relationship? *Am J Respir Crit Care Med* 2016;193:1254–1263.
2. Malbouisson LM, Muller JC, Constantin JM, Lu Q, Puybasset L, Rouby JJ; CT Scan ARDS Study Group. Computed tomography assessment of positive end-expiratory pressure-induced alveolar recruitment in patients with acute respiratory distress syndrome. *Am J Respir Crit Care Med* 2001;163:1444–1450.

Apneic Oxygenation Has Not Been Disproven

To the Editor:

I read with interest the article on apneic oxygenation by Semler and colleagues (1). I argue that the study was severely underpowered to detect any clinically significant difference between the two study arms, and the negative findings are thus hardly surprising.

First, when a procedure is mostly safe, and the goal is to prevent rare catastrophes, median outcomes do not show the whole picture. Indeed, the median lowest arterial oxygen saturation was 90% in the usual care arm, which would have required an utterly implausible median lowest saturation of 95% in the intervention arm just to reach prespecified statistical significance.

Second, the authors did observe a huge difference (15.8% vs. 25.0%) in the incidence of saturation lower than 80% between the two groups. If this difference of 10% is real, it would obviously be clinically relevant. Statistical significance was not attained, however, simply because the sample was too small. If we were to design a trial to verify that this difference in proportion is real, a study of 150 patients would achieve a power of only 28% to detect a difference; 312 patients in each arm would be required to demonstrate a difference with the usual β of 0.2.

To state the same point in another way, in this study sample of 150 patients, when the usual care is associated with an incidence of 25% of saturation lower than 80%, apneic oxygenation needed to reduce this percentage to 8% or lower before achieving statistical significance; that is, the study was only powered to detect a difference of at least 17% in the rate of severe desaturation (or a proportional reduction of 68%).

Given these statistical limitations, a more rigorous conclusion would have been that apneic oxygenation does not seem to increase the mean lowest arterial oxygen saturation; it does not reduce the incidence of desaturation by more than 68%, although smaller reductions cannot be excluded. ■

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

Ivan Pavlov, M.D.
Hopital de Verdun
Montreal, Quebec, Canada

References

1. Semler MW, Janz DR, Lentz RJ, Matthews DT, Norman BC, Assad TR, Keriwala RD, Ferrell BA, Noto MJ, McKown AC, *et al*.; FELLOW Investigators and the Pragmatic Critical Care Research Group. Randomized trial of apneic oxygenation during endotracheal intubation of the critically ill. *Am J Respir Crit Care Med* 2016;193:273–280.

Reply

From the Authors:

We appreciate the interest demonstrated by Dr. Pavlov, and the airway management community in general (1), in our randomized trial of apneic oxygenation during endotracheal intubation of critically ill adults (2). Dr. Pavlov's primary concern is the power of our trial. Our sample size (150 patients) was selected using the same primary endpoint (lowest arterial oxygen saturation) and minimum clinically meaningful difference between groups (5%) as prior high-quality trials targeting desaturation during endotracheal intubation (3, 4). We observed a numerical difference in lowest oxygen saturation between the apneic oxygenation and usual care arms of just 2%, well short of clinical or statistical significance.

The authors were supported by an NHLBI T32 award (HL087738 09).