Adaptive Support Ventilation: An Inappropriate Mechanical Ventilation Strategy for Acute Respiratory Distress Syndrome?

To the Editor:
Adaptive support ventilation (ASV) allows clinicians to set a maximum plateau pressure (PP) and a desired minute ventilation. Thus, ASV automatically determines the respiratory rate and tidal volume (VT) based on its algorithms and heretofore adjusts VT to keep PP below the set maximum. In a lung model with varying mechanics, all mimicking acute respiratory distress syndrome (ARDS), Sulemanji et al. compared ASV with conventional mechanical ventilation with a fixed VT of 6 ml/kg. Maximum airway pressure limit was 28 cm H2O in ASV. The major finding was that ASV “sacrifices” VT and minute ventilation to maintain PP in some scenarios (i.e., VT was <6 ml/kg, and minute ventilation was lower than desired). As such, ASV seems a safe mode of mechanical ventilation. However, their results also suggest that ASV may be unsafe in other scenarios. Indeed, although median-delivered VT was similar with ASV compared with conventional mechanical ventilation with a fixed VT of 6 ml/kg (6.27 vs. 6.08 ml/kg in the 60-kg group and 5.24 vs. 6.13 ml/kg in the 80-kg group), in certain scenarios, maximum-delivered VT could be as high as 9.0 and 8.3 ml/kg in the 60-kg group and the 80-kg group, respectively. Such large VT can and should never be seen as safe.

The commonly held view that large VT ventilation may be tolerated as long as the PP remains at less than 30–35 cm H2O has been questioned in a secondary analysis of the landmark study on lung-protective lower VT ventilation by the ARDS Network. To assess for independent effects of VT reduction on mortality, Hager et al. constructed a multivariable logistic regression model. For this, the study groups were stratified by quartiles of PP. Hager et al. identified groups of patients who would have had similar PP had they been randomized to the same VT strategy. The lower VT strategy was associated with a lower mortality than the traditional VT strategy in all PP quartiles. From this, we conclude that the beneficial effect of VT reduction from 12 to 6 ml/kg is independent of PP.

The same may apply for patients at risk for ARDS. Gajic et al. reported significant variability in the initial VT settings in mechanically ventilated patients without acute lung injury or ARDS at the onset of mechanical ventilation. Of the patients ventilated for more than 5 days, 25% developed lung injury within 5 days of mechanical ventilation. In this study, the main risk factors associated with the development of lung injury were the use of large VT, next to transfusion of blood products, acidemia, and a history of restrictive lung disease. The odds ratio of developing lung injury was 1.3 for each milliliter of VT above 6 ml/kg.

In this context, we would like to stress that the terminology chosen for lung-protective mechanical ventilation (using lower VT) is wrong and maybe even misleading. Instead of “lower” VT, we should use the term “normal” or “normally sized” VT. Let us compare “traffic speeding” with lung-injurious forms of mechanical ventilation: traffic speeding (using too high VT) during “rush hours” (ARDS) is dangerous, but traffic speeding (using too high VT) may always be dangerous, even when there are not so many other cars on the road (no ARDS); therefore, regulations (guidelines) mandate that we should drive not faster than the speed limit (6 ml/kg). “Sacrificing” lower VT with mechanical ventilation may be dangerous.

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References


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In Reply:

We thank Drs. Dongelmans and Schultz for their letter expressing interest in our recent publication on adaptive support ventilation (ASV). They correctly describe how ASV works but indicate that the ability of ASV to vary tidal volume in response to a changing clinical presentation is of concern especially if the tidal volume is allowed to exceed 6 ml/kg.

First, it is important to remember that the tidal volumes used by the Acute Respiratory Distress Syndrome Network in its landmark study varied between 4 and 8 ml/kg. Indeed, as we showed in our study, even though the average tidal volume delivered to patients in the low-tidal volume arm was about 6 ml/kg, tidal volume did vary between 4 and 8 ml/kg in many patients.

We believe that allowing tidal volume to increase while keeping plateau pressure at a minimum setting (<28 cm H2O in our study) is the major concern of Drs. Dongelmans and Schultz, and they reference Hager et al. to demonstrate their point. However, they failed to acknowledge the subse-
quently letter from Shiu and Rozen4 who determined from Hager’s data that no significant change in mortality was observed regardless of tidal volume once plateau pressure was less than 28 cm H2O. Drs. Dongelmanns and Schultz also referred to the article by Gajic et al., which was a retrospective review with plateau pressures available on only a few patients to illustrate the potential of large tidal volumes causing acute lung injury. The tidal volume range applied by ASV is essentially within the range of the lowest risk group (≤9 ml/kg) in the article by Gajic et al.1 In addition, there are numerous articles in the surgical literature that indicate that at least short-term application of large tidal volume does not result in lung injury.6–10 in patients without existing lung injury. As we noted in our discussion, the upper and lower limits on ASV may need to be adjusted, and we believe that the upper limit should be set for patients with acute lung injury or acute respiratory distress syndrome at 8 ml/kg. However, the concept of ASV is sound because if practitioners are left on their own to adjust tidal volume, even centers who participated in the Acute Respiratory Distress Syndrome Network trial do not always appropriately select low tidal volumes and plateau pressures.11

Where we believe the concept of ASV is most critical is in the patient where in spite of tidal volume being set at 6 ml/kg, plateau pressure exceeds 28 cm H2O. It is very clear that in these patients, the risk of increased mortality is real.3,12 ASV does in these patients what the clinician should do and that is to reduce the tidal volume to avoid overdistension. ASV may not have the absolute limits correct, but the concept of closed loop control of ventilation is the future!

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Low-lying Fruit or the Wrong Tree?

To the Editor:

I was intrigued by the use of the metaphor “Anesthesia’s Low-Lying Fruit” by Orkin and Duncan1 in their Editorial View entitled “Substrate for Healthcare Reform: Anesthesia’s Low-Lying Fruit.” I believe that it refers to the absence of data showing a major benefit conferred by anesthesiologists providing sedation for colonoscopy compared with other personnel using older drugs. The study for which the editorial was written, Alharbi et al.,2 did not attempt to look for any benefits (or harms) from anesthesiologist involvement in colonoscopy. That study looked strictly at the demographics of the providers of sedation for outpatient colonoscopy. The absence of documented benefits presumably provides the low-lying fruit for healthcare benefit crans to pluck. Orkin and Duncan state that “Anesthesiologist involvement in colonoscopy sedation in the absence of medical indication . . . may be one vignette among myriad throughout United States health care in which low-benefit services and procedures result in disproportionate expenditures.”

One place to start looking for benefits (or harms), rather than making assumptions from untested hypotheses, might be to ask the patients. Could a randomized controlled trial that compared midazolam and narcotic administered by registered nurses to the addition of propofol to that drug regimen by an anesthesiologist be performed? If such a trial included patient satisfaction as an outcome benefit, I will wager

The CNY Anesthesia Group, PC (Syracuse, New York), in which the author is a partner, receives remuneration for providing monitored anesthesia care for both colonoscopy and cataract surgery, as well as for all other forms of anesthesia for a myriad of operations.