sessment of how clinicians set up and manage APRV. With a 3% representation of a small subpopulation of therapists, can we truly assess how bedside clinicians are using APRV from this survey?

Why should APRV be held to a different standard than conventional ventilation or HFOV? We can't reach consensus on any ventilator settings, so why should/would APRV be any different? I also suggest that the agreement on APRV settings among clinicians might actually be higher than what would be found in conventional ventilation or HFOV, given the high degree of scrutiny it has endured over the years.

Aaron Light DHSc RRT-ACCS
Allied Health
Ozarks Technical Community College
Springfield, Missouri

Dr Light discloses a relationship with Dräger.

DOI: 10.4187/respcare.05980

REFERENCES

1. Miller AG, Gentile MA, Davies JD, MacIntyre NR. Clinical management strategies for airway pressure release ventilation: a survey of clinical practice. Respir Care 2017;62(10):1264-1268.
2. Chang SY, Dabbagh O, Gajic O, Patrawalla A, Elie MC, Talmor DS, et al.; United States Critical Illness and Injury Trials Group: Lung Injury Prevention Study Investigators (USCIITG-LIPS). Contemporary ventilator management in patients with and at risk of ALI/ARDS. Respir Care 2013; 54(4):578-588.
3. Nguyen AP, Schmidt UH, MacIntyre NR. Should high-frequency ventilation in the adult be abandoned? Respir Care 2016;61(6):791-800.
4. Jain SV, Kollisch-Singule M, Sadowitz B, Dombert L, Satalin J, Andrews P, et al. The 30-year evolution of airway pressure release ventilation. Intensive Care Med Exp 2016;4(1):11.
5. Modrykamien A, Chatburn RL, Ashton RW. Airway pressure release ventilation: an alternative mode of mechanical ventilation in acute respiratory distress syndrome. Cleve Clin J Med 2011;78(2):101-110.
6. Amato MB, Meade MO, Slutsky AS, Brochard L, Costa EL, Schoenfeld DA, et al. Driving pressure and survival in the acute respiratory distress syndrome. N Engl J Med 2015;372(8):747-755.
7. Sasidhar M, Chatburn RL. Tidal volume variability during airway pressure release ventilation: case summary and theoretical analysis. Respir Care 2012;57(8): 1325-1333.
8. Kollisch-Singule M, Emr B, Smith B, Roy S, Jain S, Satalin J, et al. Mechanical breath profile of airway pressure release ventilation. JAMA Surg 2014;149(11): 1138-1145.
9. Kollish-Singule M, Jain S, Andrews P, Smith BJ, Hamlington-Smith KL, Roy S, et al. Effect of airway pressure release ventilation on dynamic alveolar heterogeneity. JAMA Surg 2016;151(1):64-72.
10. Hess DR. Recruitment maneuvers and PEEP titration. Respir Care 2015;60(11): 1688-1704.

Airway Pressure Release Ventilation Letter—Reply

We thank Dr Light for his insights on airway pressure release ventilation (APRV)[1] and will address his comments one by one below. However, we first re-emphasize that the purpose of our study[2] was not to address the clinical value of APRV—that can only be accomplished with randomized clinical trials. In contrast, our goal was to illustrate the current practice of experienced clinicians using APRV and to point out that APRV is not a simple "on–off" switch; rather, it utilizes 4 non-conventional settings that can be adjusted over wide ranges. We believe we have shown that there is considerable practice variability among experienced APRV users when using the mode, and that there is the potential for untoward consequences.

Our thoughts on the specific points raised by Dr Light:

With regard to conventional ventilation settings, while we agree that settings for conventional mechanical ventilation (loosely defined as mimicking the normal breathing pattern) often lack consensus, there is a considerable evidence base driving consensus on ventilator management of the acutely injured lung. Starting with the ARDS Network's small tidal volume (V_T) trial[3] and followed by several subsequent trials,[4] a strong consensus has emerged to limit V_Ts and the end-inspiratory airway plateau pressures to physiologic ranges. Recent large surveys indicate that most ICUs have adopted this approach.[5]

With regard to similarities between APRV and high-frequency oscillatory ventilation (HFOV), we agree that similarities exist between APRV and HFOV and thank Dr Light for highlighting this point. Both strategies are based on CPAP principles, and both manipulate CPAP in non-conventional ways: APRV with periodic brief releases, HFOV with superimposed small-amplitude oscillations. Moreover, with both modes there are non-conventional settings that can be manipulated in multiple ways that, depending on patient characteristics, can clearly affect outcomes. Underscoring this point is the recent meta-analysis of adult randomized clinical trials demonstrating that, while HFOV may be an effective rescue strategy in very severe lung injury, it can cause considerable harm when delivered inappropriately to subjects doing well on conventional ventilation.[6]

With regard to the P_{high} setting, given that existing APRV guidelines[7,8] recommend limiting P_{high} to $<$30–35 cm H_2O (in agreement with many conventional ventilation guidelines), we were concerned that 36% of our respondents accepted values above that level. This result also heightened our concern that many respondents may not fully appreciate that spontaneous efforts occurring during P_{high} will add to the maximal transpulmonary pressure, further increasing the risk of lung injury.

With regard to the T_{low} setting, while it is always possible that respondents may have misunderstood our question regarding the initial T_{low} setting, we believe that most would interpret our question to be addressing the setting at which the patient is started and then is followed for a period of time before reassessing. We stand by our interpretation that there is limited consensus on whether to use an absolute time setting or to use a variety of expiratory flow analyses to set T_{low}.

With regard to tidal pressure and V_T, large changes in tidal pressure and V_T clearly affect ventilator-induced lung injury. Indeed, the whole basis for the initial ARDS Network trial[3] was to limit V_T to the physiologic range of 4–8 mL/kg predicted body weight. We agree that this approach does not address V_T distribution in heterogeneous lung injury, and we also agree that driving pressure (end-inspiratory pressure − end-expiratory pressure) might be a better V_T target.[9] However, our concern from the responses to our survey was that there seemed to be a number of respondents for whom tidal lung distention was not important with APRV (ie, accepting $V_T > 8$ mL/kg predicted body weight).

With regard to T_{low} versus set PEEP, our survey and analysis of responses were designed to illustrate current APRV clinical practice and was not designed to compare APRV approaches to other strategies for setting expiratory pressure. We agree that there is a lack of consensus on setting the best PEEP with conventional ventilation in many diseases. PEEP/F_{IO_2} tables targeting both P_{aO_2} and plateau pressure limitations are commonly used with conventional ventilation. A recent meta-analysis of high versus low PEEP/F_{IO_2} tables in ARDS suggests that more aggressive PEEP appears to work better in very severe injury and that less aggressive PEEP appears to work better in less severe injury.[10] However, whether these approaches to setting applied PEEP are better than manipulating T_{low} and auto-PEEP with APRV requires randomized clinical trials.

Finally, with regard to respondent numbers, we certainly agree that 60 respondents is a low number. However, APRV is routinely used in only a small fraction of institutions and thus clinicians comfortable with the mode are likely few in number.[11] Importantly, we feel that respondents from the AARC Adult Acute Care Section likely represent a subset of respiratory therapists with significant interest in and experience with APRV.

In summary, Dr Light makes a number of important points, and we appreciate the opportunity to discuss them. We certainly do not want to be viewed as "taking shots" at APRV. We are only reporting current clinical practice. APRV has intriguing physiologic features that are worthy of serious study and discussion. However, our results show that there is currently substantial variability in its application and support the notion that APRV's ultimate value will require well-conducted clinical trials using consistent approaches to management.

Neil R MacIntyre MD FAARC
Andrew G Miller RRT-ACCS RRT-NPS
Michael A Gentile MBA RRT FAARC
John D Davies MA RRT FAARC
Duke University Medical Center
Durham, North Carolina

Dr MacIntyre discloses relationships with InspiRx Pharmaceuticals, Breathe Technologies, Ventec Life Support, Alana Healthcare, and Pulmonx. Mr Davies discloses a relationship with ResMed. Mr Gentile discloses relationships with Medical Dynamics and Dräger. Mr Miller has no conflicts to disclose.

DOI: 10.4187/respcare.06014

REFERENCES

1. Light A. Why All the Shots at Airway Pressure Release Ventilation When Conventional Ventilation Doesn't Have Consensus (letter)? Respir Care 2018;63(1):127-128.
2. Miller AG, Gentile MA, Davies JD, MacIntyre NR. Clinical management strategies for airway pressure release ventilation: a survey of clinical practice. Respir Care 2017;62(10):1264-1268.
3. Acute Respiratory Distress Syndrome Network, Brower RG, Matthay MA, Morris A, Schoenfeld D, Thompson BT, Wheeler A. Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. N Engl J Med 2000;342(18):1301-1308.
4. Del Sorbo L, Goligher E, McAuley DF, Rubenfeld GD, Brochard LJ, Gattinoni L, et al. Mechanical ventilation in adults with acute respiratory distress syndrome: summary of the experimental evidence for the clinical practice guideline. Ann Am Thorac Soc. 2017;14(Suppl 4):S261-S270.
5. Bellani G, Laffey JG, Pham T, Fan E, Brochard L, Esteban A, et al. Epidemiology, patterns of care, and mortality for patients with acute respiratory distress syndrome in intensive care units in 50 countries. JAMA 2016;315(8):788-800.
6. Meade MO, Young D, Hanna S, Zhou Q, Bachman TE, Bollen C, et al. Severity of hypoxemia and effect of high-frequency oscillatory ventilation in acute respiratory distress syndrome. Am J Respir Crit Care Med 2017;196(6):727-733.
7. Habashi NM. Other approaches to open-lung ventilation: airway pressure release ventilation. Crit Care Med 2005;33(3 Suppl):S228-S240.
8. Modrykamien A, Chatburn RL, Ashton RW. Airway pressure release ventilation: an alternative mode of mechanical ventilation in acute respiratory distress syndrome. Cleve Clin J Med 2011;78(2):101-110.
9. Amato MB, Meade MO, Slutsky AS, Brochard L, Costa EL, Schoenfeld DA, et al. Driving pressure and survival in the acute respiratory distress syndrome. N Engl J Med 2015;372(8):747-755.
10. Briel M, Meade M, Mercat A, Brower RG, Talmor D, Walter SD, et al. Higher vs lower positive end-expiratory pressure in patients with acute lung injury and acute respiratory distress syndrome: systematic review and meta-analysis. JAMA 2010;303(9):865-873.
11. Gonzalez M, Arroliga AC, Frutos-Vivar F, Raymondos K, Esteban A, Putensen C, et al. Airway pressure release ventilation versus assist-control ventilation: a comparative propensity score and international cohort study. Intensive Care Med 2010;36(5):817-827.