Acute Hypercapnia and Gas Exchange in ARDS

To the Editor:

Sinclair et al\(^1\) recently reported in CHEST (July 2006) the effects of acute hypercapnia on ventilation-perfusion matching in an animal model of acute lung injury. The authors cited two studies\(^2,3\) of ARDS patients in which the effects of acute hypercapnia, produced by low-tidal volume ventilation, on gas exchange were examined. While in experimental models hypercapnia improves gas exchange in normal lungs (where $\text{CO}_2$ is usually added to inspired gases), hypercapnia as a consequence of protective lung ventilation led to impaired oxygenation as a result of increased shunting.\(^2,3\) In contrast, Mancini et al\(^4\) demonstrated improved oxygenation and reduced shunting in eight ARDS patients in whom hypercapnia had been induced by reducing tidal volumes from 10 to 12 mL/kg to 5 to 7 mL/kg. However, it would appear that improvement\(^4\) or deterioration\(^2,3\) in oxygenation and reduced shunting in patients in whom hypercapnia had been induced by reducing tidal volumes, PEEP, or mean airway pressure.

Sinclair et al\(^1\) hypothesized that the effects of hypercapnia on gas exchange in lung injury were largely unknown and may be beneficial, although they subsequently found no significant change. In their model, hypercapnia was induced by adding $\text{CO}_2$ to inspired gases or adjusting minute ventilation through changes in rate rather than tidal volume (keeping the mean airway pressure constant). In our institution, we have used another method, the addition of dead space, to induce hypercapnia in ARDS patients.\(^5\) This approach also has the advantage that mean airway pressure is unaltered. No significant alteration was observed in $\text{Pa}_\text{O}_2$, $\text{Pa}_\text{O}_2$/fraction of inspired oxygen ratio, or shunting when acute hypercapnia was compared to normocapnia.\(^6\) Sinclair et al\(^4\) postulated that lung injury produced by the homogenous depletion of a surfactant may abrogate the beneficial effects of $\text{CO}_2$ on gas exchange that is observed in normal lungs; however, hypercapnia may be advantageous in patients with heterogeneous lung injury such as that caused by pneumonia. Although only two patients in our study had pneumonia as a cause of ARDS, neither showed improvement in gas exchange when they were acutely hypercapnic.

George Findlay, MB ChB
Matt Wise, DPhil
University Hospital of Wales
Cardiff, Wales, UK

The authors have reported to the ACCP that no significant conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article. Reproduction of this article is prohibited without written permission from the American College of Chest Physicians (www.chestjournal.org/misc/reprints.shtml).

Correspondence to: Matt Wise, DPhil, University Hospital of Wales, Adult Critical Care, Heath Park, Cardiff, CF14 4XW, Wales, UK; e-mail: mattwise@doctors.org.uk

DOI: 10.1378/chest.130.6.1950

REFERENCES

5. Findlay GP, Smithies MN. The response to inhaled nitric oxide at normocapnia and hypercapnia [abstract]. Intensive Care Med 1997; 23(suppl):S20
therefore be difficult to make meaningful comparisons between these groups without some independent method of assessing gas exchange efficiency.

Scott E. Sinclair, MD, FCCP
University of Tennessee Health Sciences Center
Memphis, TN

The author has reported to the ACCP that no significant conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.

Reproduction of this article is prohibited without written permission from the American College of Chest Physicians (www.chestjournal.org/misc/reprints.shtml).

Correspondence to: Scott E. Sinclair, MD, FCCP, University of Tennessee, Department of Medicine, 956 Court Ave, H314, Memphis, TN 38163; e-mail: ssincla1@utmem.edu

DOI: 10.1378/chest.130.6.1950a

REFERENCES
4 Findlay GP, Smithies MN. The response to inhaled nitric oxide at normocarbia and hypercarbia [abstract]. Intensive Care Med 1997; 23:S20

Considerations About the Response Format of the Airways Questionnaire 20

To the Editor:

We have read with interest the recently published article by Chen et al in CHEST (June 2006)1 warning about the potential problems of the response format of the Airways questionnaire 20 (AQ20). The original AQ20 was a simple, reliable, and valid instrument,2–4 which allowed the following three possible responses: “yes”; “no”; and “not applicable” (with a score of 0 for the answer “not applicable,” which is equivalent to “no”). Patients with the greatest disability were more likely to respond “not applicable,” yielding a lower total score and, then, underestimating actual impairment.5

In order to correct this drawback, the authors modified seven activity-based items (items 3, 4, 10, 11, 12, 13, and 14) to include an “unable” response that was given a score of 1 (equivalent to “yes”). Only a minority of subjects (5.9%) in this study endorsed an “unable” response that was given a score of 1 (equivalent to “no”). Patients with the greatest disability were more likely to respond “not applicable,” yielding a lower total score and, then, underestimating actual impairment.5

In our Spanish validation study of the AQ20,6 in a sample of 208 patients with asthma and COPD we detected a high percentage of subjects who answered “not applicable,” particularly in two of the items modified by Chen et al6 (item 3, 43%; item 11, 56%). Choosing this response does not relate to the degree of impairment measured by the following other parameters: dyspnea MRQ; FEV1 percent predicted; illness severity, according to the Global Initiative for Asthma classification for asthma and the Global Initiative for Chronic Obstructive Lung Disease classification for COPD; the St. George Respiratory Questionnaire; the Juniper asthma quality of life questionnaire; the chronic respiratory disease questionnaire; and the short form-12 questionnaire (p > 0.05).

These results suggest that, despite the inclusion of the “unable” option, items 3 and 11 could also be representing a high rate of “not applicable” responses, so further studies are needed to investigate this subject in more detail.

Marina Blanco-Aparicio, MD
Hector Verea-Hernando, MD
Hospital Universitario Juan Canalejo
A Coruña, Spain
Isabel Vázquez, PhD
Santiago de Compostela University
Santiago de Compostela, Spain

The authors have reported to the ACCP that no significant conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.

Reproduction of this article is prohibited without written permission from the American College of Chest Physicians (www.chestjournal.org/misc/reprints.shtml).

Correspondence to: Marina Blanco-Aparicio, MD, Hospital Universitario Juan Canalejo, Pneumology, Xubias Arriba, 84, A Coruña 15006, Spain; e-mail: mba@mundo-r.com

DOI: 10.1378/chest.130.6.1951

REFERENCES
6 Blanco-Aparicio M, Vázquez I, Romero E, et al. Reliability and validity of the Spanish version of the Airways Questionnaire 20 (AQ20) in COPD patients. Paper presented at: 16th European Respiratory Society Annual Congress; September 2–6, 2006; Munich, Germany

To the Editor:

We appreciate the insightful comments provided by Blanco-Aparicio and Vázquez1 regarding our recent article in CHEST (June 2006). We agree that the frequency of “not applicable” responses is an interesting question. Among the seven modified items (n = 352 subjects), 391 of the 2,464 responses were “not applicable.” As reported in our original article,1 there were 39 “unable” responses. Thus, of all non-“yes/no” responses to the modified items nearly 10% were “unable.” Since we did not coadminister the Airways Questionnaire 20 (AQ20) and AQ20-revised, it is not possible to determine what proportion of subjects who responded “unable” would have chosen “not applicable” in the original format.

Consistent with the findings of Blanco-Aparicio and Vázquez,1 we observed a higher frequency of “not applicable” responses for item 3 (“gardening”) and item 11 (“activities at work”) relative to the other five modified items (Table 1). In addition, we also observed a high frequency of “not applicable” responses for item