



# Updates in the Management of ARDS

Written by Emma Hitt Nichols, PhD

Acute respiratory distress syndrome (ARDS) causes substantial morbidity and mortality in patients in the intensive care unit (ICU); the only clinical intervention that has demonstrated efficacy in patients with ARDS has been lung protective ventilation. Studies report a wide variety of mortality rates, which despite use of medical therapy can be as high as 70% [Zambon M, Vincent J-L. *Chest*. 2008], with up to 60% of patients dying before hospital discharge. An update to the 1994 consensus definition of ARDS was published in 2012 and is referred to as the Berlin definition. Patients are categorized into 3 stages: mild, moderate, and severe [ARDS Definition Task Force. *JAMA*. 2012]. Abdelbaset M. Saleh, MD, Mansoura University, Mansoura, Egypt, presented data from a retrospective observational study [Saleh AM et al. *Egypt J Chest Dis Tuberc*. 2014] of outcomes following the implementation of the Berlin criteria.

The study was conducted in the adult ICU at the Saudi German Hospital in Saudi Arabia and analyzed records and data of 41 patients with ARDS according to the Berlin definition. Patients with a history or evidence of congestive heart failure, bronchogenic carcinoma, pulmonary metastasis, or other neoplasm, or who had died within 24 hours of the ARDS diagnosis, were excluded from the study. All patients were managed with lung protective ventilation. The overall mortality rate was 29.27%; risk factors that were associated with mortality are shown in Table 1.

In addition, higher partial pressure of carbon dioxide ( $p\text{CO}_2$ ) and higher fraction of inspired oxygen were associated with mortality, as were lower diastolic blood pressure and lower Glasgow Coma Scale. An early diagnosis and ICU admission, as well as using lung protective ventilation, resulted in improved outcomes.

Jared Michael Radbel, MD, Rutgers Robert Wood Johnson Medical School, New Brunswick, New Jersey, USA, presented data from an analysis of over 850 000 admissions from the National Inpatient Sample (NIS) database that indicated a decline in ARDS mortality. Over the past several decades, advances have been made in the treatment of ARDS; however, meta-analyses during this time period have shown conflicting results regarding mortality rates. The purpose of this study was to assess the mortality rate of ARDS between 1996 and 2011 in a large patient sample.

The NIS represents a stratified sample of 20% of US community hospitals. Patients included those with ICD-9 codes for pulmonary insufficiency secondary to surgery or trauma or to an unknown cause, ARDS, and ventilator support. Patients were excluded if they had ventilator support of unknown duration. Although causes of mortality were not part of this study, results showed that the mortality rate of patients with ARDS dramatically declined, from >45% in 1996 to <35% in 2011.

Other studies have suggested that improved hygiene, restrictive transfusion protocols, prophylactic measures, sepsis identification and treatment, glucose control, and nutritional support may be important factors [Erickson SE et al. *Crit Care Med*. 2009; Zambon M, Vincent J-L. *Chest*. 2008]. Although ARDS mortality was decreasing prior to 2000, a sudden and sharp decline was observed from 2000 to 2005, which may be attributed to the publication in 2000 of a study showing the benefit of low tidal volume ventilation [ARDS Network. *N Engl J Med*. 2000].

Nirmal S. Sharma, MD, University of Alabama at Birmingham, Birmingham, Alabama, USA, presented data from a survey of perspectives of critical-care physicians on the role of extracorporeal membrane oxygenation (ECMO) in the management of refractory ARDS. There is a wide variation in how intensivists manage patients with severe or refractory ARDS and a lack of definitive guidelines for severe/refractory ARDS if conventional mechanical ventilation fails to achieve a response. The purpose of this survey was to determine the current practices of intensivists when managing patients with severe/refractory ARDS.

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Table 1. Risk Factors Associated With Mortality in ARDS

	Total (n = 41)	Survivors (n = 29)	Nonsurvivors (n = 12)	P Value
Age, y	45.01 ± 17.14	35.90 ± 9.19	67.33 ± 9.54	< .001
Gender, male no. (%)	33 (80.50%)	21 (72.40%)	12 (100.00%)	> .05
BMI, kg/m <sup>2</sup>	32.36 ± 5.48	32.16 ± 3.46	32.83 ± 8.84	> .05
Smoking, smokers no. (%)	9 (22.00%)	2 (6.90%)	7 (58.3%)	< .001
Duration of illness before ICU admission, d	6.87 ± 3.95	5.41 ± 3.35	10.41 ± 2.97	< .001
Duration of ICU stay, d	27.61 ± 9.26	25.55 ± 5.552	32.58 ± 13.98	< .05
Comorbidities, no. (%)				
DM	11 (26.8%)	2 (6.9%)	9 (75.0%)	< .001
Hypertension	8 (19.5%)	0 (0.0%)	8 (66.7%)	< .001
Cardiac problems	3 (7.3%)	0 (0.0%)	3 (25.0%)	< .05
Liver cirrhosis	1 (2.4%)	0 (0.0%)	1 (8.3%)	—
Chronic renal impairment	1 (2.4%)	0 (0.0%)	1 (8.3%)	—

ARDS, acute respiratory distress syndrome; BMI, body mass index; DM, diabetes mellitus; ICU, intensive care unit.

Adapted from Saleh AM et al. After implementation of a lung protective ventilation strategy, what are the outcome improvement predictors in acute respiratory distress syndrome? *Egypt J Chest Dis Tuberc.* 2014;63:995-1001. With permission from The Egyptian Society of Chest Diseases and Tuberculosis.

The majority of survey respondents (72%) manage patients with severe ARDS at least 3 to 4 times per month. If conventional mechanical ventilation did not achieve a response, respondents used strategies such as ECMO (68%), inhaled nitric oxide or prostacyclin (65%), airway pressure release ventilation (APRV; 64%), prone positioning (45%), and high-frequency oscillatory ventilation (29%).

In addition, fellows were more likely to use ECMO, whereas pulmonary and critical-care specialists preferred inhaled nitric oxide. ECMO was available at 80% of the represented institutions; where ECMO was not available, 43% of respondents never and 42% rarely transferred patients to the nearest facility with ECMO.

There were several barriers associated with use of ECMO. A majority of respondents (87%) indicated that ECMO technology was not available in most institutions, and 83% felt that there was not enough experience or

training for use of ECMO among critical-care physicians. In addition, only 30% of respondents indicated that ECMO should be favored over other modalities for the treatment of refractory ARDS. Surprisingly, almost half of respondents thought that ECMO was associated with high costs and poor outcomes among patients with refractory ARDS.

Shehabaldin Alqalyoobi, MD, University of Missouri Kansas City School of Medicine, Kansas City, Missouri, USA, presented data from a study that evaluated the use of an angiotensin II receptor blocker (ARB) in a rat model with fat embolism (FE).

Although the mortality rates of ARDS have sharply declined, it is still quite high despite recent advances. In addition, there are misconceptions about advances in the treatment of refractory ARDS. Continued improvement in current techniques and the management of ARDS is needed, as well as more advances for treatment of the disease.