QMJ
A peer reviewed journal
QATAR MEDICAL JOURNAL

4th Annual ELSO-SWAC Conference Proceedings

Acute respiratory failure: From intubation to ECMO

Ibrahim Fawzy Hassan

Address for Correspondence:
Ibrahim Fawzy Hassan
Hamad General Hospital, Hamad Medical Corporation, Doha, Qatar.
www.hamad.qa
Email: ihassan@hamad.qa

http://dx.doi.org/10.5339/qmj.2017.swacelso.13

Cite this article as: Hassan IF. Acute respiratory failure: From intubation to ECMO, Qatar Medical Journal, 4th Annual ELSO-SWAC Conference Proceedings 2017:13 http://dx.doi.org/10.5339/qmj.2017.swacelso.13

QSCIENCE.com
An Initiative of Qatar Foundation

Introduction: Acute severe respiratory failure poses a major treatment challenge which stubbornly carries high mortality and morbidity rates. Here, we review PaO_2/FiO_2 (PF) ratio and disease severity, and discuss protective lung ventilation and the rescue therapies, and when to use what?

PF ratio alone is not sufficient to determine disease severity: A recent study by Villar and colleagues demonstrated that only 38% of patients who were classified as severe acute respiratory disease syndrome (ARDS) patients based on the PF ratio met the actual severe ARDS criteria after a standardized ventilator setting. In a recent trial conducted by Caironi[1] and colleagues, alteration in the positive end-expiratory pressure (PEEP) level affected the PF ratio and disease severity. Using the PF ratio alone as the major determinant for disease severity will increase the risk of selecting the wrong therapy for the patient.

Protective lung ventilation: Between 1998 and 2000, two prospective randomized controlled trials (RCT's) showed that lower tidal volumes (V_T) decrease mortality compared with higher V_T.[2,3] Retrospectively, plateau pressure (pPlat) $< 32\ cmH_2O$ was the major difference between survival and non-survival, hence V_T 4 – 6 mL/kg of predicted body weight (PBW) and pPlat $< 30\ cmH_2O$ became the standard of care.

Several papers challenged the pPlat value of 30; in 2005, Hager[4] and colleagues could not identify a safe upper limit for plateau pressures in patients with ARDS. Moreover, V_T reduction would have improved the outcome, even in patients who already had pPlat $< 30\ cmH_2O$. More recently, Amato[5] and colleagues demonstrated that driving pressure was the ventilation variable that best stratified risk independently of concomitant variations in PEEP and plateau pressure. This was supported by another retrospective study on ECMO patients by Serpa et al.[6] That opened the question: "What is protective lung ventilation?"

Rescue therapies: The two proven rescue therapies to date are: "Prone Position" and "ECMO".
Prone Position enhances lung recruitment in a potentially recruitable lung by various mechanisms, releasing the diaphragm, decreasing the effect of heart and lung weight and shape on lung tissue, decreasing the lung compression by the abdomen, and releasing the lower lobes, which improves gas exchange and decreases mortality in severe ARDS patients.*ECMO* provides extracorporeal gas exchange with no effect on lung recruitment. It affords lung rest and works well for the non-recruitable lung. It has been shown to improve survival for certain groups of patients in high-performance ECMO centers.[7] It is important to note that the delay in utilizing such rescue therapies worsen the outcome.
Discussion: PF ratio combined with standardized ventilator setting is superior to PF ratio alone to determine disease severity. This is essential to determine the correct therapy for the right patient.

Lung protective ventilation strategy remains the corner stone for decreasing morbidity and mortality in ARDS patients. However, the lung protective concept may require to be tailored to disease severity; pPlat of 30 cmH_2O might be safe for a patient with moderate ARDS but may be deleterious in the severe ARDS patient. Moreover, the driving pressure as the safety guard needs to be explored in more RCTs. Clear definition of "Failure of conventional ventilation" needs to be agreed upon and a clear pathway for trial of prone ventilation versus directly initiating ECMO therapy needs to be defined.

Keywords: ARDS, protective lung ventilation, driving pressure, severe respiratory failure, PF ratio, prone position, extracorporeal membrane oxygenation, ECMO

REFERENCES

1. Caironi P, Carlesso E, Cressoni M, Chiumello D, Moerer O, Chiurazzi C, Brioni M, Bottino N, Lazzerini M, Bugedo G, Quintel M, Ranieri VM, Gattinoni L. Lung recruitability is better estimated according to the Berlin definition of acute respiratory distress syndrome at standard 5 cm H2O rather than higher positive end-expiratory pressure: A retrospective cohort study. *Crit Care Med.* 2015;43(4):781 – 790, DOI:10.1097/CCM.0000000000000770.
2. Amato M, Barbas C, Medeiros D, Magaldi R, Schettino G, Lorenzi-Filho G, Kairalla R, Deheinzelin D, Munoz C, Oliveira R, Takagaki T, Carvalho C. Effect of a protective-ventilation strategy on mortality in the acute respiratory distress syndrome. *N Engl J Med.* 1998;338(6):347 – 354.
3. The Acute Respiratory Distress Syndrome Network. 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. Hager DN, Krishnan JA, Hayden DL, Brower RG, ARDS Clinical Trials Network. Tidal volume reduction in patients with acute lung injury when plateau pressures are not high. *Am J Respir Crit Care Med.* 2005;172(10):1241 – 1245, Epub 2005 Aug.
5. Amato MB, Meade MO, Slutsky AS, Brochard L, Costa EL, Schoenfeld DA, Stewart TE, Briel M, Talmor D, Mercat A, Richard JC, Carvalho CR, Brower RG. Driving pressure and survival in the acute respiratory distress syndrome. *N Engl J Med.* 2015;372(8):747 – 755, DOI:10.1056/NEJMsa1410639.
6. Serpa Neto A, Schmidt M, Azevedo LC, Bein T, Brochard L, Beutel G, Combes A. Associations between ventilator settings during extracorporeal membrane oxygenation for refractory hypoxemia and outcome in patients with acute respiratory distress syndrome: A pooled individual patient data analysis: Mechanical ventilation during ECMO. *Intensive Care Med.* 2016;42(11):1672 – 1684, Epub 2016 Sep 1.
7. Peek GJ, Mugford M, Tiruvoipati R, Wilson A, Allen E, Thalanany MM, Hibbert CL, Truesdale A, Clemens F, Cooper N, Firmin RK, Elbourne D, CESAR Trial Collaboration. Efficacy and economic assessment of conventional ventilatory support versus extracorporeal membrane oxygenation for severe adult respiratory failure (CESAR): A multicentre randomised controlled trial. *Lancet.* 2009;374(9698):1351 – 1363, DOI:10.1016/S0140-6736(09)61069-2.