

Successful management of H1N1 related severe acute respiratory distress syndrome with noninvasive positive pressure ventilation

Karim Abdel Hakim, Abdulla Ismaeel Mohamed, Anis Chaari, Fatima N. Abulfateh, Khalid A. Alshaikh, William Francis Casey

Department of Intensive Care, King Hamed University Hospital, Al Muharaq, Kingdom of Bahrain

Correspondence to: Dr. Karim Abdel Hakim, MD. Department of Intensive Care, King Hamed University Hospital, building 234, Road 2835, Block 228, Bussaiten 24343, Kingdom of Bahrain. Email: karim_hakim2003@yahoo.com.

Abstract: Acute respiratory distress syndrome (ARDS) is a life threatening complication of H1N1 pneumonia. According to the Berlin conference guidelines, severe ARDS requires management with early invasive mechanical ventilation. Whether noninvasive positive pressure ventilation (NIPPV) should be attempted in patients with H1N1 pneumonia is still a matter of debate. We report the case of one patient with severe ARDS without other organ failure. The patient was managed successfully using NIPPV. Endotracheal intubation was avoided and the patient was discharged from the intensive care unit (ICU) after 10 days with a successful outcome. NIPPV can be useful in patients with isolated severe H1N1 ARDS provided early improvement of the oxygenation parameters is achieved. Patients with multiple organ failure or with persistent severe hypoxemia under noninvasive ventilation should be electively intubated and started on invasive mechanical ventilation.

Keywords: Acute respiratory distress syndrome (ARDS); H1N1 pneumonia; noninvasive positive pressure ventilation (NIPPV)

Submitted Mar 24, 2016. Accepted for publication Mar 29, 2016.

doi: 10.21037/atm.2016.03.52

View this article at: <http://dx.doi.org/10.21037/atm.2016.03.52>

Introduction

Acute respiratory distress syndrome (ARDS) is a common cause of acute respiratory failure in critically ill patients. It is induced by an acute injury of the alveolar-capillary barrier (1). Until recently, the most accepted definition of ARDS was that proposed in 1994 by the American-European Consensus conference (AECC) which defined it as an acute condition characterized by bilateral pulmonary infiltrates and severe hypoxemia involving a $\text{PaO}_2/\text{FiO}_2$ ratio ≤ 200 mmHg in the absence of evidence for cardiogenic pulmonary edema (2). As many issues regarding the validity and reliability of this definition have been raised, the European Society of Intensive Care Medicine with recommendations from the American Thoracic Society and the Society of Critical Care Medicine updated the definition of ARDS in 2011 and named it the Berlin definition (3). Based on this definition, patients with ARDS can be classified into three classes according to their level of hypoxemia, i.e., mild ($\text{PaO}_2/\text{FiO}_2$ ratio 200–300 mmHg

with positive end expiratory pressure (PEEP) or continuous positive airway pressure (CPAP) ≥ 5 cmH₂O), moderate ($\text{PaO}_2/\text{FiO}_2$ ratio 100–200 mmHg with PEEP ≥ 5 cmH₂O) and severe ($\text{PaO}_2/\text{FiO}_2$ ratio ≤ 100 mmHg with PEEP ≥ 5 cmH₂O) (3). Mechanical ventilation is an essential component of the management of patients with ARDS. According to Berlin classification, noninvasive positive pressure ventilation (NIPPV) should be attempted only in patients with mild ARDS whereas invasive mechanical ventilation should not be delayed in the moderate or severe classes (4). We herein report a case of a patient with H1N1 pneumonia who met the criteria of severe ARDS and who was successfully managed with NIPPV. Ethical approval was granted by the local ethical committee.

Case presentation

A 66-year-old female, who is known to have diabetes mellitus, hypertension and dyslipidemia, was presented



Figure 1 Chest computed tomography showing bilateral diffuse alveolar infiltrates.

to our hospital with a 2-day history of productive cough, shortness of breath and fever. She has never had symptoms suggestive of chronic respiratory disease. Her chest examination revealed bilateral coarse crepitation. Her oxygen saturation was initially 96% on 4 L/min of oxygen via nasal cannula. The chest X-ray showed bilateral heterogeneous opacities of the mid and lower zones. The throat swab results came out positive for H1N1 infection. The patient was initially admitted to the high dependency unit and she was started on oseltamivir, and levofloxacin.

On the third day of admission to the hospital, the patient's oxygen requirements significantly increased. NIPPV was commenced and she was subsequently transferred to the intensive care unit (ICU).

In the ICU, the patient was fully conscious, lying comfortably in bed. She was neither diaphoretic nor febrile. Her respiratory rate was 18 breaths per min, her heart rate was 93 beats per min and her blood pressure was 110/60 mmHg. She was maintained on NIPPV with the following settings: Bilevel positive airway pressure (BiPAP) mode, inspiratory positive airway pressure (IPAP) of 12 cmH₂O, expiratory positive airway pressure (EPAP) of 5 cmH₂O and FiO₂ of 60%. Her arterial blood gases showed a pH 7.50, PaO₂ 60 mmHg, PaCO₂ 34 mmHg and HCO₃ 27 mmol/L, which indicate a PaO₂/FiO₂ ratio of 100. The echocardiogram and the other laboratory work-up were unremarkable. A chest computed tomography (CT) revealed bilateral lower lobes, middle lobe and lingular segment dense ground glass opacities (*Figure 1*).

The patient's PaO₂/FiO₂ ratio continued to improve gradually during her 10-day stay in the ICU along with improvement in the chest X-ray findings (*Table 1*). She was gradually weaned off the NIPPV and transferred to the ward.

Discussion

Following the pandemic of the novel influenza A virus (H1N1) in April 2009, the available data suggests that the mortality rate in critically ill H1N1 infected patients is almost 17% (5). Most of these mortalities are due to refractory hypoxia related to ARDS followed by hemodynamic impairment and multi-organ failure (5,6).

Lung supportive therapies represent the mainstay of treatment of ARDS, including mechanical ventilation, prone ventilation and High frequency oscillating ventilation (7). Lung-protective ventilator strategies including low tidal volume ventilation of 6 mL/kg ideal body weight, plateau pressure <30 cmH₂O and the use of PEEP are considered standard practice in the care of patients with ARDS (8). However, only few studies investigated the effectiveness of noninvasive ventilation in ARDS patients (9-11). Our case report suggests that NIPPV can be attempted in well selected patients with severe ARDS. Rocker *et al.* (10) reported a similar result in a prospective study including 12 episodes of ARDS in 10 hemodynamically stable patients. In fact, the use of NIPPV was successful in 66% of the ARDS episodes. However, none of these patients had an influenza A H1N1 related ARDS. In a large prospective, observational and multicenter study including 685 patients with confirmed influenza A (H1N1) viral pneumonia, Masclans *et al.* (12) reported that NIPPV was successful in 40.7% of the 177 patients who were managed without immediate intubation. Lower APACHE II and SOFA scores, hemodynamic stability and the absence of acute kidney injury were identified as independent factors predicting NIPPV success. However, the proportion of the patients who met the criteria of severe ARDS was not mentioned.

In this case report, we are focusing on the importance of the patient's clinical parameters which are not considered in the Berlin criteria of ARDS. Our case has presented with a few days history of respiratory symptoms, her PaO₂/FiO₂ ratio was less than 100 mmHg with CPAP of more than 5 cmH₂O. Her chest X-ray showed bilateral infiltrates, and her echocardiogram was normal, which places her in the severe ARDS category of the Berlin definition.

Table 1 Serial oxygenation data during the ICU stay

Parameters	ICU admission day				
	1	5	6	8	10
PaO ₂ /FiO ₂ ratio	100	130	184	258	>300
Ventilation mode	BiPAP (IPAP 12; EPAP 5)	BiPAP (IPAP 14; EPAP 10)	Nasal cannula 6 L/min	BiPAP (IPAP 8; EPAP5)	Nasal cannula 2 L/min

BiPAP, bilevel positive airway pressure; IPAP, inspiratory positive airway pressure; EPAP, expiratory positive airway pressure

There was no associated organ failure and the oxygenation progressively improved after starting NIPPV.

Although the guidelines published on behalf of the European Respiratory Society and the European Society of Intensive Care Medicine were clearly indicating the use of mechanical ventilation for severe ARDS caused by H1N1 pneumonia (13), our case report, as well as other reports and studies (14-18), suggest that NIPPV can be useful in well selected patients. Hence, we postulate that the absence of other organ dysfunction associated with the acute respiratory failure as well as an early improvement of the oxygenation parameters with NIPPV may warrant an attempt of noninvasive ventilation as a first line ventilatory strategy to manage patients with severe influenza A H1N1 related ARDS. However, invasive mechanical ventilation should not be delayed once one of these two criteria are not verified.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Informed Consent: Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

References

- Curley GF, Slutsky AS. Year in review 2013: critical care--respirology. *Crit Care* 2014;18:577.
- Bernard GR, Artigas A, Brigham KL, et al. The American-European Consensus Conference on ARDS. Definitions, mechanisms, relevant outcomes, and clinical trial coordination. *Am J Respir Crit Care Med* 1994;149:818-24.
- ARDS Definition Task Force, Ranieri VM, Rubenfeld GD, et al. Acute respiratory distress syndrome: the Berlin Definition. *JAMA* 2012;307:2526-33.
- Ferguson ND, Fan E, Camporota L, Antonelli M, et al. The Berlin definition of ARDS: an expanded rationale, justification, and supplementary material. *Intensive Care Med* 2012;38:1573-82.
- Esquinas AM, Egbert Pravinkumar S, Scala R, et al. Noninvasive mechanical ventilation in high-risk pulmonary infections: a clinical review. *Eur Respir Rev* 2014;23:427-38.
- Bramley AM, Dasgupta S, Skarbinski J, et al. Intensive care unit patients with 2009 pandemic influenza A (H1N1pdm09) virus infection - United States, 2009. *Influenza Other Respir Viruses* 2012;6:e134-42.
- Fanelli V, Vlachou A, Ghannadian S, et al. Acute respiratory distress syndrome: new definition, current and future therapeutic options. *J Thorac Dis* 2013;5:326-34.
- Hess DR. Ventilatory strategies in severe acute respiratory failure. *Semin Respir Crit Care Med* 2014;35:418-30.
- Claesson J, Freundlich M, Gunnarsson I, et al. Scandinavian clinical practice guideline on mechanical ventilation in adults with the acute respiratory distress syndrome. *Acta Anaesthesiol Scand* 2015;59:286-97.
- Rocker GM, Mackenzie MG, Williams B, et al. Noninvasive positive pressure ventilation: successful outcome in patients with acute lung injury/ARDS. *Chest* 1999;115:173-7.
- Delclaux C, L'Her E, Alberti C, et al. Treatment of acute hypoxemic nonhypercapnic respiratory insufficiency with continuous positive airway pressure delivered by a face mask: A randomized controlled trial. *JAMA* 2000;284:2352-60.
- Maslans JR, Pérez M, Almirall J, et al. Early non-invasive ventilation treatment for severe influenza pneumonia. *Clin Microbiol Infect* 2013;19:249-56.
- Conti G, Larsson A, Nava S, et al. On the role of non-

- invasive (NIV) to treat patients during the H1N1 Influenza Pandemic. Available online: http://dev.ersnet.org/uploads/Document/63/WEB_CHEMIN_5410_1258624143.pdf
14. Mohapatra PR, Dutt N, Khanduri S, et al. Noninvasive ventilation in acute respiratory failure due to H1N1 influenza. *Lung India* 2011;28:49-51.
 15. Pichot C, Petitjeans F, Ghignone M, et al. Swift recovery of severe acute hypoxemic respiratory failure under non-invasive ventilation. *Anaesthesiol Intensive Ther* 2015;47:138-42.
 16. Nicolini A, Ferraioli G, Senarega R. Severe Legionella pneumophila pneumonia and non-invasive ventilation: presentation of two cases and brief review of the literature. *Pneumonol Alergol Pol* 2013;81:399-403.
 17. Frassanito L, Draisci G, Pinto R, et al. Successful application of helmet non-invasive ventilation in a parturient with acute respiratory distress syndrome. *Minerva Anesthesiol* 2011;77:1121-3.
 18. Luo J, Wang MY, Zhu H, et al. Can non-invasive positive pressure ventilation prevent endotracheal intubation in acute lung injury/acute respiratory distress syndrome? A meta-analysis. *Respirology* 2014;19:1149-57.

Cite this article as: Abdel Hakim K, Mohamed AI, Chaari A, Abulfateh FN, Alshaikh KA, Casey WF. Successful management of H1N1 related severe acute respiratory distress syndrome with noninvasive positive pressure ventilation. *Ann Transl Med* 2016;4(9):175. doi: 10.21037/atm.2016.03.52