



## February 2014 Up2Date

### Influenza & H1N1 meet ECMO.....a Perfect Match?

#### Introduction

Here's a quick review on the differences and similarities between H1N1 and the seasonal flu, followed by a little more detail on ECMO therapy. The common flu symptoms consist of fever, cough, sore throat, runny nose, body aches, chills and fatigue. Most people can recover from the flu at home without any additional medical treatment. The presence of fever can help distinguish influenza over the more typical cold viruses.

In addition to traditional "flu-like" symptoms, patients with H1N1 may present with diarrhea and vomiting. In a subset of patients, deterioration begins around day 3 to 5 from onset of symptoms, with rapid progression leading to respiratory failure within 24 hours. These patients are immediately admitted to ICU, with most patients requiring mechanical ventilation for respiratory failure. Unfortunately, in some cases, conventional ventilator support simply isn't enough for recovery. If initiated in a timely manner, ECMO therapy has proven to be effective in patients that have not responded to conventional management.

Extracorporeal membrane oxygenation, known as ECMO, is defined as long term support for respiratory and/or cardiovascular recovery. "Extracorporeal" means that the blood circulates outside of the body with the help of a machine. "Membrane Oxygenation" means that the blood is oxygenated in the machine's special membrane and carbon dioxide is removed, thus functioning like artificial lungs. ECMO does not heal the heart and/or lungs; it simply allows the body time to recover over a period of time. Several different

types of ECMO can be utilized based on patient diagnosis and condition. Venoarterial (VA) ECMO is used for heart failure patients, whereas Venovenous (VV) ECMO is used more commonly for severe respiratory failure patients. The focus of this document is on Influenza and H1N1 patients in hypoxic respiratory failure; therefore, VV ECMO will be discussed further. VV ECMO therapy is commonly used for hypoxic respiratory failure when conventional ventilator management is failing, severe hypercarbic respiratory failure and chronic lung disease patients awaiting a transplant. A few contraindications may be in cases where anticoagulation is not indicated, neurologic dysfunction or if the respiratory cause(s) are irreversible.

## Discussion

For the purpose of this document, the details of the case presentations are summarized. Please consider reviewing the full articles, as listed in the reference section below, for comprehensive case details.

### **Case Presentation #1:**

Healthy 15 year old male presents to ED with fever, lethargy and emesis after 1 week of flu like symptoms. Examination on arrival reveals altered mental status, ataxia, hypotension and mottled extremities. Also, noted to have diminished breath sounds and bilateral lower extremity edema. Chest x-ray shows consolidation and collapse of right lower lobe. Transthoracic cardiac ultrasonography shows poor cardiac contractility and estimated left ventricular ejection fraction (LVEF) of 31%. Vitals: Temp-39.8C, BP-80/40, HR-115, RR-30, O2sat-92% with supplemental oxygen. Patient is on multiple antibiotics and intubated on admission day one. Within a few hours in the ICU, patient became oliguric, repeat x-ray shows marked increase in alveolar bilateral infiltrates and CT shows bilateral pleural effusions. VV ECMO therapy was chosen and initiated for worsening hypoxia and hypercapnia. What's the diagnosis?

### **Case Presentation #2:**

20 year old female college student presented with a 2-week history of fatigue, cough, sinus congestion, and rhinorrhea, followed by 2 days of vomiting, diarrhea and abdominal pain. With the onset of frequent, loose, non-bloody bowel movements the patient presented to urgent care. She reported abdominal pain related to emesis, however denied dyspnea, chest pain, fever or chills. EMS notified for Systolic BP 60-70's and HR 130. Patient was transported to hospital, en route 2 liters NS administered. On arrival to ED vital signs were: Temp-34.7C, BP-99/52, HR-126, RR-18, O2sat-100% room air. Labs significant for Albumin 1.4, Lactate 5.5, BNP 271, Troponin 0.36 and Myoglobin 58.9. Chest x-ray shows no air space disease or cardiac enlargement. Echo shows systolic ejection fraction of 52%, and both ventricles appear thick and edematous. Patient was admitted to ICU, on Levophed gtt and 6 liters fluid administered for ongoing hypotension.

Next morning, repeat echo shows deterioration with LVEF of 24%. Patient had sustained confusion and was intubated for airway protection. IV Dobutamine started for ongoing hypotension. Patient was transported to tertiary center for specialty management. On arrival, she was cold, with weak pulses, HR 144 and BP 77/49. ABG: pH 7.24/CO<sub>2</sub> 27/pO<sub>2</sub> 140 Lactate 12.8. Troponin 4.3 and total creatine kinase 5883. Decision for ECMO immediately initiated, pericardial effusion treated with pericardial window, and continuous renal-replacement therapy (CRRT) was initiated soon after admission to treat acute tubular necrosis.

### **Case Presentation #3 (Flight Transport):**

36 year old female presented to ED with report of fever, cough, sore throat and malaise for the past 3 days. Patient arrived to hospital hypoxic and hypotensive, in ED treated with Tamiflu and 1.5 liter fluid bolus. Labs significant for ALT 4284, CRP 35.4, AST 9259, and Cr 2.8. Air transport requested. Upon crew arrival, patient was hypoxic, hypotensive and lethargic. SpO<sub>2</sub> high 80's on NRB and SBP in the 70's. Fluid bolus, duo nebs and levophed gtt initiated. With improved blood pressure, patient was successfully intubated and transported to tertiary center. En route, mechanical ventilation support provided with initial vent settings: PRVC, FiO<sub>2</sub> 100%, Rate 14, PEEP 6, TV 420, PIP 32.

## Conclusion

### **Case #1 outcome:**

#### **Diagnosis: H1N1 in refractory ARDS.**

- VV ECMO applied 24 hours after admission. Normal LVEF documented by day 2. Significant pulmonary improvement by day 4. ECMO removed by day 6. Successfully weaned from ventilator by day 9, and discharged home completely recovered by day 15.

### **Case #2 outcome:**

#### **Diagnosis: Fulminant Myocarditis, Cardiogenic Shock, Influenza A subtype H3N2.**

- On the day after admission to the tertiary center, positive results reported for Influenza A. Appropriate cultures, inotropes and antibiotics obtained and administered. After 5 days of ECMO support, repeat echo showed recovery of left ventricular systolic function, she was then weaned from ECMO. Inotropes and vasopressors were tapered and discontinued over next several days, followed by

extubation and return of normal kidney function. She was discharged home on day 23, followed by a normal, 4 month post discharge check-up.

### **Case #3 outcome:**

#### **Diagnosis: Influenza A with Pneumonia.**

- Patient transported to tertiary center without complication. Ventilator settings adjusted periodically en route to support respiratory needs. FiO<sub>2</sub> 100% and PRVC mode remained unchanged throughout flight. PEEP increased from 6 to 10 en route to support oxygen saturation and maintain alveolar recruitment. In addition TV and rate slightly adjusted from original values to provide best ventilator support en route. ECMO therapy was not available at designated tertiary center; however patient is under the specialized care of a Critical Care Intensivist.

### **References:**

1. Bonacchi, M., Ciapetti, M., Lascio, G., et al. Atypical clinic presentation of pandemic influenza A successfully rescued by extracorporeal membrane oxygenation – Our experience and review of the literature. *Interv med Appl Sci*. 2013 December; 5 (4): 186-192. \*Case Presentation #1\*
2. Levenson, J. MD, Kaul, D. MD, Saint, S. MD, et al. A Shocking Development. *The New England Journal of Medicine*. December 2013; 369:2253-2258. \*Case Presentation #2\*
3. \*Case Presentation #3\* Retrieved data on January 26, 2014 from Goldenhour chart flight 353-14-7652.
4. Extracorporeal membrane oxygenation. August 2013. Retrieved data on January 27, 2014 from [www.medscape.com](http://www.medscape.com)
5. Extracorporeal membrane oxygenation (ECMO) in adults. Retrieved data on January 27, 2014 from [www.uptodate.com](http://www.uptodate.com)
6. WHO World Health Organization. Pandemic (H1N1) 2009 briefing note 13 Clinical features of severe cases of pandemic influenza. 16 October 2009 / GENEVA