



The use of life-saving extracorporeal membrane oxygenation (ECMO) for pregnant woman with status asthmaticus

Carolyn Steinack MD, Renato Lenherr MD, Heidy Hendra MD & Daniel Franzen MD

To cite this article: Carolyn Steinack MD, Renato Lenherr MD, Heidy Hendra MD & Daniel Franzen MD (2017) The use of life-saving extracorporeal membrane oxygenation (ECMO) for pregnant woman with status asthmaticus, Journal of Asthma, 54:1, 84-88, DOI: 10.1080/02770903.2016.1193871

To link to this article: <http://dx.doi.org/10.1080/02770903.2016.1193871>



Accepted author version posted online: 24 Jun 2016.
Published online: 24 Jun 2016.



Submit your article to this journal [↗](#)



Article views: 134



View related articles [↗](#)



View Crossmark data [↗](#)



STATUS ASTHMATICUS

The use of life-saving extracorporeal membrane oxygenation (ECMO) for pregnant woman with status asthmaticus

Carolin Steinack, MD^a, Renato Lenherr, MD^b, Heidy Hendra, MD^c, and Daniel Franzen, MD^a

^aDivision of Pulmonology, University Hospital Zurich, Zurich, Switzerland; ^bSurgical Intensive Care Unit, University Hospital Zurich, Zurich, Switzerland; ^cAcute Care Common Stem, Broomfield Hospital, Chelmsford, UK

ABSTRACT

Introduction: Status asthmaticus can develop into a life-threatening disorder that requires mechanical ventilation. Severe respiratory failure during pregnancy can worsen maternal and fetal outcomes. Previous case studies have demonstrated extracorporeal membrane oxygenation (ECMO) as a life-saving measure for pregnant women with acute respiratory distress syndrome (ARDS) as well as non-pregnant patients with status asthmaticus. **Case study:** A 25-year-old woman, who was 5 weeks pregnant, was admitted with status asthmaticus and severe hypercapnic respiratory failure. Despite rescue therapies such as pressure control ventilation with high inspiratory pressures, inhaled beta2 agonists and antimuscarinic drugs, intravenous salbutamol, methylprednisolone and magnesium sulfate, her condition gradually deteriorated. Veno-venous ECMO was initiated for respiratory support and the patient's clinical condition as well as the gas exchange improved within the next few days. ECMO was removed and the patient was extubated after 2 days. Sonography, however, revealed a retrochorial hematoma; the patient was diagnosed with abortus imminens and successfully treated with magnesium substitution and bed rest. Finally, she gave birth to a healthy boy at 38 weeks of gestation. **Conclusions:** This is the first case report on the successful use of ECMO in a pregnant woman with severe respiratory insufficiency due to status asthmaticus, who failed to respond to invasive mechanical ventilation and maximum pharmacological treatment. Despite this life-threatening condition, the use of ECMO in our patient has greatly improved the chance of survival for the mother and the baby, who was born without any complications.

ARTICLE HISTORY

Received 26 March 2016
Revised 20 May 2016
Accepted 21 May 2016

KEYWORDS

Status asthmaticus;
respiratory failure;
mechanical ventilation;
pregnancy; extracorporeal
membrane oxygenation
(ECMO)

Introduction

Status asthmaticus is a severe life-threatening asthma exacerbation requiring extended treatment and intensive care management [1]. Reports on the use of veno-venous extracorporeal membrane oxygenation (ECMO) for status asthmaticus are limited, however it seems to be a life-saving therapeutic option for those who were unresponsive to pharmacological treatment and ventilatory support [2–13].

In pregnancy, status asthmaticus is a very rare, but potentially lethal, complication of long-standing bronchial asthma [14]. The use of ECMO during pregnancy has been relatively limited [15,16]. To the best of our knowledge, this is the first report of a successful use of ECMO in a pregnant woman with status asthmaticus.

Case report

A 25-year-old woman with bronchial asthma, which was diagnosed in her childhood, had sudden onset of dyspnea during her sleep. An ambulance was called as there was

no improvement in her symptoms after inhaled salbutamol and 50 mg oral prednisolone. Additionally diarrhea occurred. The ambulance arrived 15 minutes later and she was found unconscious (Glasgow coma scale 5) with a peripheral capillary oxygen saturation (SpO₂) of 45% on air. After tracheal intubation and commencement of mechanical ventilation with 100% oxygen, she was transferred to the emergency department. The patient's medical history revealed multiple food allergies and history of bronchial asthma since her childhood with the last exacerbation during her first pregnancy 24 months prior. Pregnancy test was positive. On lung auscultation there was bilateral wheezing; a chest X-ray showed an elevated right diaphragm, correct position of the tracheal tube and no sign of pneumothorax (Figure 1).

Diaphragm elevation is only moderate, caused by atelectasis of the right lung base. However, a repeat chest X-ray revealed complete resolution of this finding. Arterial blood gas analysis showed pH of 6.84, pCO₂ of 135 and pO₂ of 168 mmHg. Despite significantly high inspiratory pressures up to 50 cmH₂O, tidal volumes only ranged from 200 to 280 ml and arterial oxygen

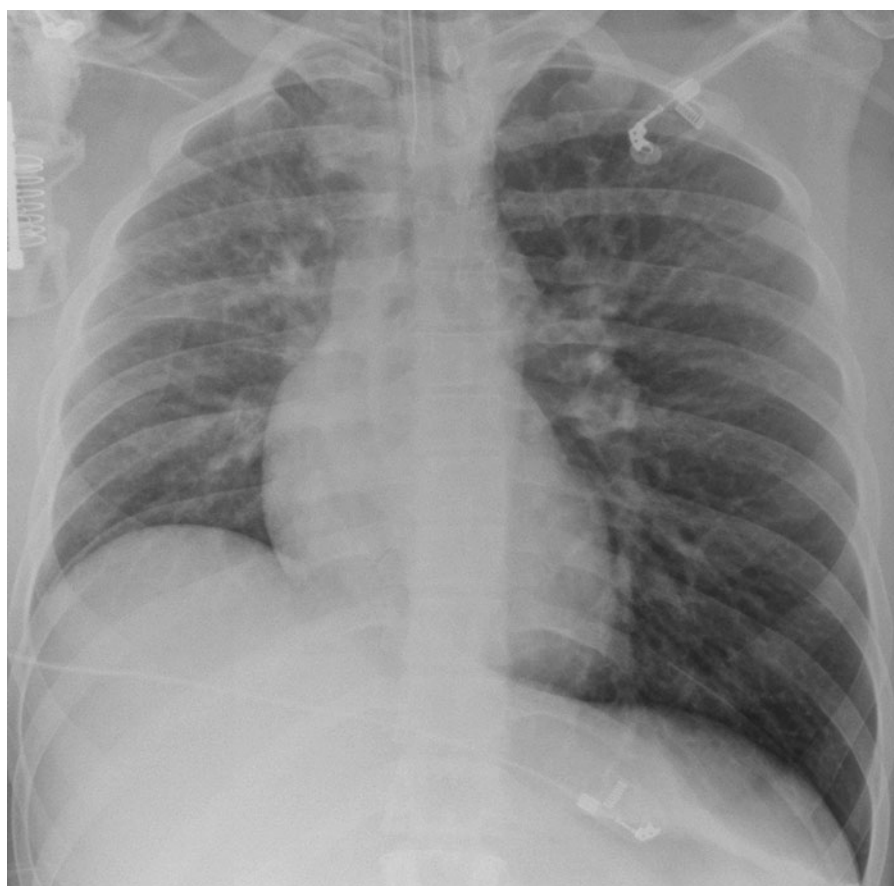


Figure 1. Initial chest X-ray shows correct position of the tracheal tube and an elevated right diaphragm without signs of pneumothorax or infiltrates.

saturation eventually declined. Reduction of inspiratory pressure to a level lower than 40 cmH₂O resulted in an immediate oxygen desaturation with tidal volumes reduction to 100 ml. Since her clinical condition and the gas exchange did not improve to an acceptable value despite maximum pharmacological therapy (inhaled beta2 agonists and antimuscarinic drugs, intravenous salbutamol, methylprednisolone, and 2.5 g magnesium sulfate), the decision was made to initiate respiratory support with veno-venous ECMO. A 24 F drainage cannula was placed in the right femoral vein and an 18 F cannula was placed into the right internal jugular vein.

A Rotaflow console/ drive unit with PLS-system (Maquet) was used for ECMO, the initial pump flow was set to 3.4 L/min and 100% oxygen supply. Using

this method, gas exchange and acidosis could be corrected rapidly under protective ventilation (Table 1). A flexible bronchoscopy was unremarkable and no cause of atelectasis was identified. The patient was anticoagulated with intravenous unfractionated heparin titrated to an active clotting time between 120–180 seconds. Sedation was maintained with midazolam, propofol and sufentanyl. Blood pressures remained stable with continuous norepinephrine infusion with a maximum dosage of 12 µg/min. An empiric antibiotic therapy with amoxicillin/clavulanate was initiated; bronchodilator therapy with salbutamol, ipratropium and methylprednisolone was continued.

In the course of the following 2 days, the recovery of the lungs allowed a continuous reduction of pump

Table 1. Serial arterial blood gas values over time.

	Arrival at ER	30 min before ECMO insertion	04.30 h–05.00 h am	10 min after ECMO insertion	90 min after ECMO insertion	9 h after ECMO insertion
pH	6.84	6.95	Insertion of ECMO	7.01	7.26	7.28
pCO ₂ , mmHg	136	115		32	46	33
pO ₂ , mmHg	168	92		391	125	113
HCO ₃ ⁻ , mmol/l	21.5	23.9		9.8	20.2	23.1
Lactate, mmol/l	4.4	1.5		0.6	1.2	2.3

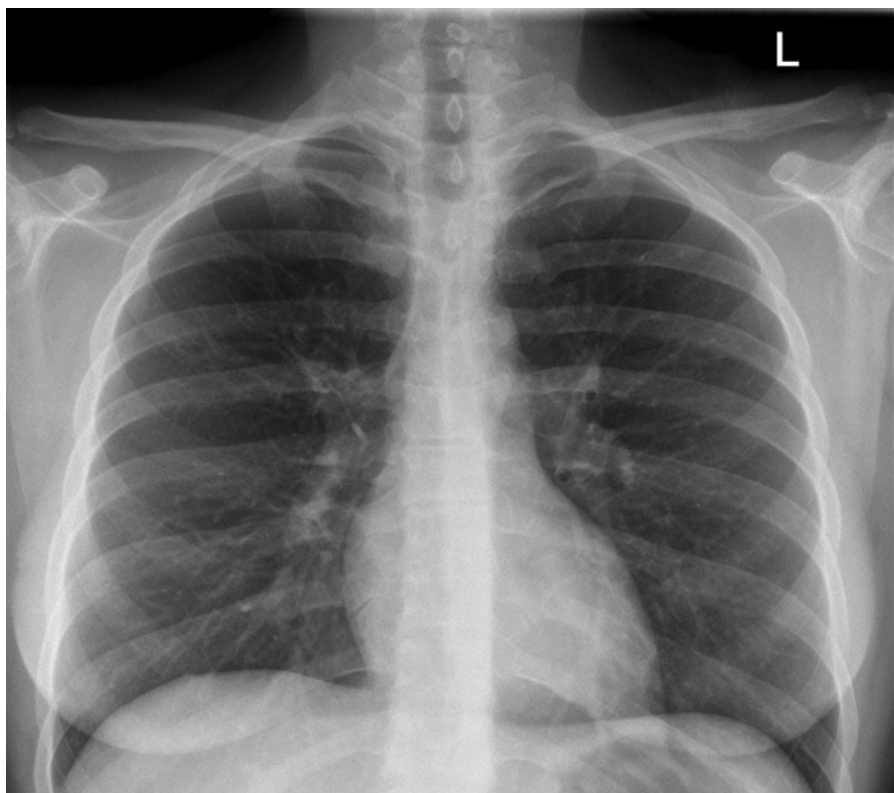


Figure 2. Before discharge from hospital finding of chest X-ray was normal. The elevated right diaphragm declined.

flow and oxygen supply, enabling an early de-cannulation from ECMO. A few hours later the patient was extubated and she was transferred to the respiratory ward. Chest X-ray was normal without signs of diaphragm elevation (Figure 2). Intravenous corticosteroids were switched to oral prednisolone (40 mg per day) and patient was started on regular inhalative budesonide/formoterol. Pregnancy at 5 weeks of gestation was confirmed by obstetrical ultrasound; however, it also showed a retrochorial hematoma and an abortus imminens was diagnosed. After magnesium substitution and bed rest the hematoma was resolved, she was discharged home after 9 days of hospital stay.

Three weeks after being discharged from hospital, her pulmonary function test revealed normal lung volumes without signs of bronchial obstruction, and the measurement of fractional exhaled nitric oxide (FeNO) showed only mildly elevated values (27 ppb). Weekly pulmonary follow-up examinations during the time of pregnancy were uneventful, allowing gradually tapering of the daily prednisolone dose. Because of full controlled asthma oral prednisolone was stopped, but inhaled budesonide 200 μ g combined with formoterol 6 μ g bi-daily was continued. The obstetrical follow-up examinations were unremarkable, and she gave birth to a healthy baby at 38 weeks of gestation. Ten weeks thereafter, there were still no respiratory symptoms and peak flow values were

stable, thus the inhalation therapy was changed to an on-demand mode. In the following 2 years, this on-demand therapy was used only about one per month.

Discussion

We describe the case of a successful use of ECMO in a pregnant woman with hypercapnic and hypoxic respiratory failure due to status asthmaticus, which could not be sufficiently controlled with mechanical ventilation and pharmacological therapy. The abrupt onset of shortness of breath and diarrhea during the sleep in this patient with food allergies and known asthma could demonstrate a severe anaphylactic reaction with delayed bronchospasm. Other causes of respiratory failure such as pulmonary embolism seemed unlikely, since pretest probability by using the Geneva score was low, and the patient had typical obstructive lung auscultation and hypercapnic respiratory failure. On chest X-ray there was no evidence of pneumothorax or infiltrates. In the first hours after initiation of ECMO low dose vasopressor treatment for low was required, which was most possibly due to impaired left cardiac output caused by asthma-related hyperinflation. Anaphylactic shock could be another reason for arterial hypotension in this scenario. However, lactate levels were only moderately elevated and decreased after initiation of ECMO.

ECMO is an established treatment option in patients with cardiogenic shock or respiratory failure like acute respiratory distress syndrome (ARDS), unresponsive to medical therapy [17,18]. ECMO can be applied by two ways for cardiac or respiratory failure. The arterio-venous bypass, used in life-threatening cardiac failure like a cardiac shock or decompensated cardiac myopathy provides simultaneously pulmonary support. ECMO can also be inserted in a veno-venous access supporting oxygenation for pulmonary failure as in severe cases of pneumonia, ARDS or as a bridge to lung transplantation [15,16]. As a temporary respiratory support, ECMO stabilizes gas exchanges while reducing lung injuries induced by mechanical ventilation [2,5,6].

Presently reports about pregnant patients requiring ECMO support because of respiratory failure are rare. King et al. reported on a successful use of ECMO in a woman at 25 weeks of gestation who suffered from an ARDS [17]. Another successful application of ECMO was published only recently by Grasselli et al. in a woman at 27 weeks suffering from ARDS due to H1N1 infection [18]. The Australian ANZIC group reported in their cohort study, that 9 of 64 pregnant women with H1N1 infection received ECMO support with an overall survival of 67% (6 of 9 patients) [19]. The main complications related to the use of ECMO were hemorrhagic diathesis and difficult access to vessels due to caval compression by the gravid uterus [20].

Pregnancy in asthmatic patients is a known risk factor for asthma exacerbations and worsening asthma symptoms [14]. However, there is no data about the use of ECMO in pregnant woman with status asthmaticus. The successful use of ECMO in non-pregnant patients with status asthmaticus have been already reported [2–13]. Status asthmaticus is a reversible pulmonary disease but could be life-threatening when it is unresponsive to mechanical ventilation and maximal pharmacological therapy [5]. Barotrauma and subcutaneous emphysema due to hyperinflation by high positive airway pressure ventilation and hypotension induced to low venous return limit the use of mechanical ventilation in status asthmaticus [9]. ECMO not only prevents these adverse effects, it also enables pulmonary hygiene that could be life-saving in the case of an asthma-associated plastic bronchitis [12]. Several published cases reported the use of ECMO for status asthmaticus between 1981 and 1997 with duration between 8 hours and 8 days. Adverse effects were subcutaneous hematoma and massive intrapulmonary hemorrhage [6]. The use of ECMO in status asthmaticus as a potentially reversible pulmonary disease seems to be associated with improved survival compared to other indications for ECMO [8]. Although potential adverse effects induced by ECMO such as hemolysis, hemorrhage, and

thrombus formation persist, further studies to investigate if the early initiation of ECMO before intubation should be considered are required [13].

Conclusion

Referring to our case, we recommend the use of ECMO as a life-saving therapeutic measure in pregnant women with status asthmaticus, when respiratory impairment cannot be controlled, despite optimal pharmacological therapy and mechanical ventilation. The risk of haemorrhagic complications such as retrochorial hematoma needs to be taken into account.

Declaration of interest

The authors report no conflicts of interest.

References

1. Young DJ, Salzman GA. Status asthmaticus in adult patients. *Hosp Phys* 2006;24:13–19.
2. Peris A, Cianchi G, Biondi S, Bonizzoli M, Pasquini A, Bonacchi M et al. Extracorporeal life support for management of refractory cardiac or respiratory failure: initial experience in a tertiary centre. *Scand J Trauma Resusc Emerg Med* 2010;18:28.
3. Hebbbar KB, Petrillo-Albarano T, Coto-Puckett W, Heard M, Rycus PT, Fortenberry JD. Experience with use of extracorporeal life support for severe refractory status asthmaticus in children. *Crit Care* 2009;13(2):R29.
4. Ju MH, Park JJ, Jhang WK, Park SJ, Shin HJ. Extracorporeal membrane oxygenation support in a patient with status asthmaticus. *Kor J Thorac Cardiovasc Surg* 2012;45(3):186–188.
5. Iwamoto T, Ikeda K, Nakajima H, Suga M, Kumano K, Hiraguri M, et al. Extracorporeal membrane oxygenation is indicated for status asthmaticus refractory to maximal conventional therapy. *Ann Allergy Asthma Immunol* 2013;110(4):300–301.
6. Leiba A, Bar-Yosef S, Bar-Dayana Y, Weiss Y, Segal E, Paret G, et al. Early administration of extracorporeal life support for near fatal asthma. *Isr Med Assoc J* 2003;5(8):600–602.
7. Jung C, Lauten A, Pfeifer R, Bahrman P, Figulla HR, Ferreri M. Pumpless extracorporeal lung assist for the treatment of severe, refractory status asthmaticus. *J Asthma* 2011;48(1):111–113.
8. Mikkelsen ME, Woo YJ, Sager JS, Fuchs BD, Christie JD. Outcomes using extracorporeal life support for adult respiratory failure due to status asthmaticus. *ASAIO J* 2009;55(1):47–52.
9. Kukita I, Okamoto K, Sato T, Shibata Y, Taki K, Kurose M, et al. Emergency extracorporeal life support for patients with near-fatal status asthmaticus. *Am J Emerg Med* 1997;15(6):566–569.
10. King D, Smales C, Arnold AG, Jones OG. Extracorporeal membrane oxygenation as emergency treatment for

- life-threatening acute severe asthma. *Postgrad Med J* 1986; 62(731):855–857.
11. Brenner K, Abrams DC, Agerstrand CL, Brodie D. Extracorporeal carbon dioxide removal for refractory status asthmaticus: experience in distinct exacerbation phenotypes. *Perfusion* 2014;29(1):26–28.
 12. Tonan M, Hashimoto S, Kimura A, Matsuyama H, Kinose H, Sawada M, et al. Successful treatment of severe asthma-associated plastic bronchitis with extracorporeal membrane oxygenation. *J Anesth* 2012;26(2):265–268.
 13. Aniset L, Kalenka A. Status asthmaticus. Role of extracorporeal lung assist procedures. *Anaesthesist* 2010;9(4):327–332.
 14. Chan AL, Juarez MM, Gidwani N, Albertson TE. Management of critical asthma syndrome during pregnancy. *Clin Rev Allergy Immunol* 2015;48(1):45–53.
 15. King PT, Rosalion A, McMillan J, Buist M, Holmes PW. Extracorporeal membrane oxygenation in pregnancy. *Lancet* 2000;356(9223):45–46.
 16. Grasselli G, Bombino M, Patroniti N, Giuffrida A, Marcolin R, Vergani P, et al. Use of extracorporeal respiratory support during pregnancy: A case report and literature review. *ASAIO J* 2012;58(3):281–284.
 17. Terragni PP, Birocco A, Faggiano C, Ranieri VM. Extracorporeal CO₂ removal. *Contrib Nephrol* 2010;165:185–196.
 18. Marasco SF, Lukas G, McDonald M, McMillan J, Ihle B. Review of ECMO (Extra Corporeal Membrane Oxygenation) support in critically ill adult patients. *Heart Lung Circ* 2008;17(4):S41–47.
 19. ANZIC Influenza Investigators and Australian Maternity Outcomes Surveillance System: Critical Illness due to 2009 A/H1N1 influenza in pregnant and postpartum women: Population based cohort study. *BMJ* 2010;340:c1279.
 20. Nair P, Davies AR, Beca J, Bellomo R, Ellwood D, Forrest P, et al. Extracorporeal membrane oxygenation for severe ARDS in pregnant and postpartum women during the 2009 H1N1 pandemic. *Intens Care Med* 2011;37:648–654.