Turk J Anaesthesiol Reanim 2018; 46: 62-5 DOI: 10.5152/TJAR.2017.33044

Case Report / Olgu Sunumu

Management of Acute Respiratory Distress Syndrome with H1N1 Influenza Virus in Pregnancy: Successful Mechanical Ventilation and Weaning with Airway Pressure Release Ventilation

Gebelikte H1N1 İnfluenza Virusu ile Gelişen Akut Respiratuvar Distres Sendromu Olgusunun Yönetimi: "Airway Pressure Release Ventilation" ile Başarılı Mekanik Ventilasyon ve "Weaning"

Mehtap Pehlivanlar Küçük, Çağatay Erman Öztürk, Nazan Köylü İlkaya, Selin Eyüpoğlu, Fatma Ülger, Ali Haydar Şahinoğlu

Department of Anaesthesiology and Reanimation, Division of Intensive Care Medicine, Ondokuz Mayıs University School of Medicine, Samsun, Turkey

Cite this article as: Pehlivanlar Küçük M, Öztürk ÇE, Köylü İlkaya N, Eyüpoğlu S, Ülger F, Şahinoğlu AH. Management of Acute Respiratory Distress Syndrome with H1N1 Influenza Virus in Pregnancy: Successful Mechanical Ventilation and Weaning with Airway Pressure Release Ventilation. Turk J Anaesthesiol Reanim 2018; 46: 62-5.

ORCID IDs of the authors: M.P.K. 0000-0003-2247-4074; Ç.E.Ö. 0000-0001-6959-1695; N.K.İ. 0000-0002-4891-0818; S.E. 0000-0003-2132-4605; F.Ü. 0000-0001-5366-532X; A.H.Ş. 0000-0002-2022-738X.

Abstract / Öz

In pregnancy, infection with H1N1 influenza virus may produce symptoms similar to infection with seasonal influenza virus. Patients may rarely come with a clinical condition causing severe acute respiratory distress syndrome (ARDS) and death. Therefore, mechanical-ventilation strategies to manage these events are vital. We report a case of ARDS after an infection with H1N1 influenza A in a 33-year-old patient pregnant at 27-weeks. The ARDS was successfully managed by airway pressure release ventilation (APRV). APRV can be used successfully as an alternative to conventional mechanical ventilation modes in pregnant patients experiencing severe respiratory failure.

Keywords: Acute respiratory distress syndrome, pregnancy, airway pressure release ventilation, influenza-A

Gebelikte gelişen influenza A virüs (H1N1) enfeksiyonları mevsimsel influenza virüs enfeksiyonlarına benzer semptomlar oluşturabilir. Daha nadiren de şiddetli Akut Respiratuvar Distres Sendromu'na (ARDS) ve ölüme yol açabilen bir klinikle karşımıza gelebilir. Bu olguların yönetiminde kullanılacak mekanik ventilasyon stratejileri hayati önem taşır. Otuz üç yaşında, 27 haftalık gebe hastada influenza A (H1N1) enfeksiyonu sonrası gelişen ARDS'nin "Airway pressure release ventilation" (APRV) modu kullanılarak yönetildiği bir olgu sunulmuştur. APRV, ağır solunum yetmezliği gelişmiş gebe hastalarda konvansiyonel mekanik ventilasyon modlarına alternatif olarak başarılı bir şekilde uygulanabilir.

Anahtar Kelimeler: Akut solunum sıkıntısı sendromu, gebelik, havayolu basınç salıvermeli ventilasyon, influenza-A

Introduction

The risk of H1N1 influenza-A complications are higher in some populations. During pregnancy, both the mother and fetus are at an increased risk when infected with H1N1 influenza-A. Most pregnant women have acute respiratory distress syndrome (ARDS) requiring mechanical ventilation. Airway pressure release ventilation (APRV) can be effective in the re-expansion of the collapsed lung tissue, and it can maintain the maximum alveolar re-expansion in patients with ARDS. We present a pregnant woman who developed severe ARDS after H1N1 influenza-A virus infection and was successfully managed with APRV.

Case Presentation

A 33-year-old, 27-week pregnant woman presented to a health institution with complaints of fever, fatigue, malaise and dyspnoea. Upon physical examination in the emergency department, there were no abnormal findings except for rales at the base of both lungs. A chest X-ray showed bilateral scattered bronchopneumonia (Figure 1).

The patient was admitted to the Infectious Diseases Department with a pre-diagnosis of H1N1 influenza-A virus pneumonia/community-acquired pneumonia. Polymerase chain reaction test of a throat swab sample was positive for H1N1 influenza. Laboratory test results were as follows: white blood cell count: 2.400 μL^{-1}, C-reactive protein: 13.8 mg dL^{-1}, sedimentation rate: 33 mm h^{-1}, arterial blood gas analysis pH: 7.51, pO_2: 57.7 mmHg, pCO_2: 28.7 mmHg, base excess (BE): -0.8

Address for Correspondence/Yazışma Adresi: Mehtap Pehlivanlar Küçük E-mail: mehtap_phlvnlr@hotmail.com

Received / Geliş Tarihi : 12.04.2017
Accepted / Kabul Tarihi : 30.11.2017

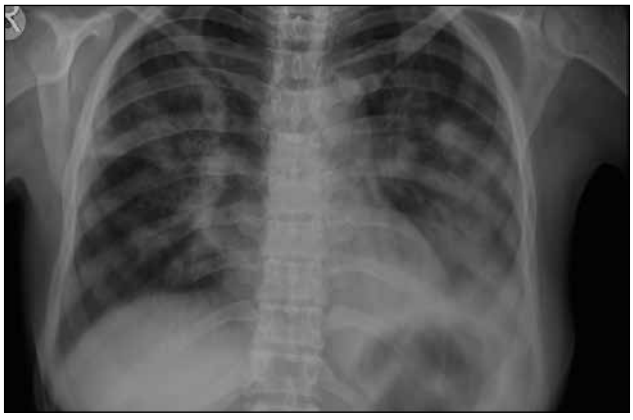

Figure 1. First chest X-ray showed bilateral scattered bronchopneumonia

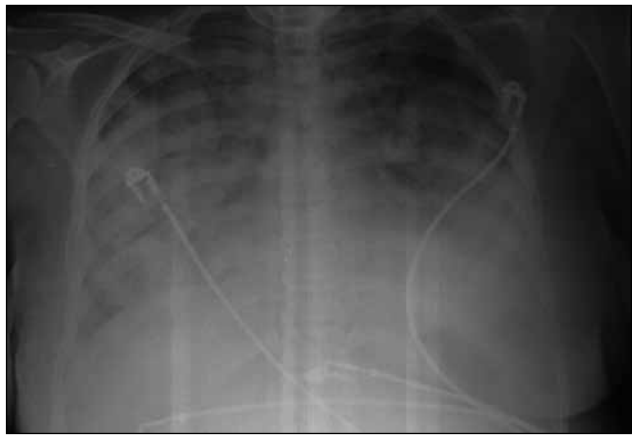

Figure 2. Chest X-ray after 24 hours of application, with bilateral infiltrates

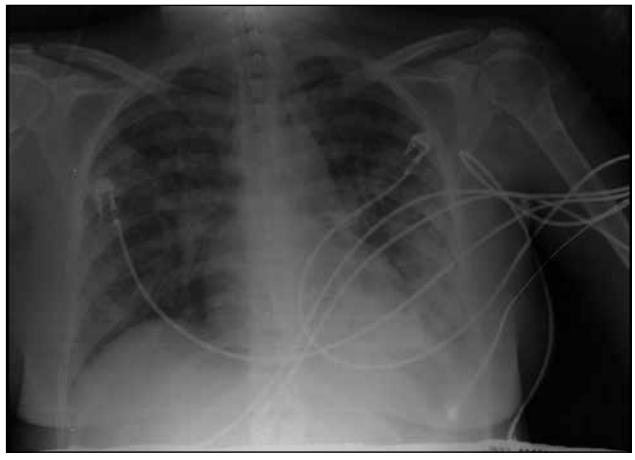

Figure 3. After 24 hours of airway pressure release ventilation administration

mmol L^{-1}, HCO_3: 24.4 mmol L^{-1} and SpO_2: 87.5%. Treatment with intravenous twice-daily 1 gr ceftriaxone (Food and Drug Administration [FDA] pregnancy-related drug category B), 250 mg azithromycin (FDA category B) and per-oral 75 mg oseltamivir (FDA category C) twice daily was initiated. Oxygen therapy was started. On the second day of follow-up, the patient experienced increased respiratory distress and desaturation. After few hours following the chest X-ray, she was admitted to the Intensive Care Unit (ICU) with bilateral pulmonary infiltrates, completely covering the middle and lower zones of both lungs and wiping the heart borders (Figure 2). Both lungs had rales in the lower two-thirds, and bronchial breath sounds were identified in the left lung base. The patient's APACHE-II score was 14 and SOFA score was 11 upon ICU admission. A treatment plan was formed considering severe ARDS with rapidly progressive bilateral pulmonary infiltrates and a PaO_2/FiO_2 ratio of 53.

Despite a high flow (8–10 L min^{-1}) of oxygen and a non-invasive ventilation (NIV) treatment, on the second day of ICU follow-up, the patient needed intubation due to the deterioration of the respiratory pattern and blood gas values during NIV (pH: 7.48, pO_2: 59.7 mmHg, pCO_2: 27.7 mmHg, BE: -6.3 mmol L^{-1}, HCO_3: 20.0 mmol L^{-1} and SpO_2: 82%). High positive end-expiratory pressure (PEEP) in the conventional mode was attempted for a short time, at the maximal level of 10 cmH_2O, but it produced no response and caused haemodynamic deterioration. Consequently, the APRV mode was applied. A mechanical ventilator support was initiated using the following settings: P_{high}: 28 cmH_2O, P_{low}: 0 cmH_2O, T_{high}: 4.0 sec, T_{low}: 0.8 sec, I/E: 5/1, and FiO_2: 80%.

Maintaining the peak inspiratory level below 30 cmH_2O was aimed. Sedation and analgesia were achieved with propofol 2 mg kg^{-1} h^{-1}, midazolam 0.05 mg kg^{-1} h^{-1} and fentanyl 1 µg kg^{-1} h^{-1}. Mechanical ventilation was continued for 8 days. After 24 hours of APRV application, significant improvements were observed in oxygenation and chest X-ray findings (Figure 3).

On her sixth day of hospitalization, the patient had a fever of 38.1°C; hence, meropenem (FDA category B) was added to the treatment. As the blood culture was positive for *Staphylococcus epidermidis*, teicoplanin (FDA category C) was also added to the treatment.

Over several days, the ventilator support was gradually reduced to P_{high}: 15 cmH_2O, P_{low}: 0 cmH_2O, T_{high}: 10.0 sec, T_{low}: 0.8 sec and FiO_2: 35% (Table 1). On the tenth day, the patient was extubated after continuous positive airway pressure training using t-tube. During her stay in ICU, there were no pathological conditions in terms of the pregnancy or foetus. At 39 weeks gestation, the patient underwent an uncomplicated, elective caesarean delivery of a healthy infant under general anaesthesia.

Discussion

Since the 2009 H1N1 influenza-A pandemic, pregnancy has been considered among the major risk factors that increase the morbidity and mortality rates. Influenza virus infection symptoms are often attributed to pregnancy, which may cause delays in diagnosis and treatment. In cases of severe ARDS, the strategy of low tidal volume (6 mL kg^{-1}, using the patient's ideal weight) may be insufficient to restore appropriate arterial oxygenation. Furthermore, there are concerns for foetal CO_2 transport and foetal acidaemia secondary to the

Table 1. Configuration of APRV mode and blood gas analyses

Day	Mod	PaO_2/ FiO_2	P_{high}/ cmH20	P_{low}/c mH20	T_{high}/ sec	T_{low}/ sec	pH	pO_2/ mmHg	pCO_2/ mmHg	BE	SO_2	FIO_2 lt/O_2
1	Mask O_2	53					7.42	32.6	38	-1	86	8–10
2, second hour	APRV	101	28	0	4.0	0.8	7.37	81.9	41.3	-2	94	90
2, sixth hour	APRV	121	28	0	4.0	0.8	7.36	85.3	41.8	-2	94	75
3	APRV	308	25	0	4.0	0.8	7.37	185	40.2	-2	96	60
4	APRV	370	20	0	6.0	0.8	7.48	185	38	3.1	98	50
5	APRV	640	17	0	8.0	0.8	7.49	192	33.4	4.9	98	35
6	APRV	513	15	0	10.0	0.8	7.51	154	39.8	6.8	99	30

APRV: Airway pressure release ventilation; BE: base excess; P_{high}: pressure high; P_{low}: pressure low; T_{low}: time low; T_{high}: time high

maternal acidaemia due to permissive hypercapnia (1). It can be assumed that pCO_2 levels below 60 mmHg do not cause adverse foetal effects but values above this should be avoided (while maintaining maternal pH values of 7.25-7.35). For adequate foetal oxygenation, maternal pO_2 should be higher than 70 mmHg (2).

Airway pressure release ventilation is a type of inverse-ratio, pressure-controlled, intermittent mandatory ventilation mode. APRV contains a prolonged continuous high-pressure phase (P_{high}) followed by a short release phase (P_{low}), thus creating an inverse-ratio ventilation strategy. Spontaneous breathing can occur at any time during the respiratory cycle. The goal of ventilation with APRV is to remain on the steep portion of the compliance curve between the lower and upper inflection points to prevent atelectrauma and barotraumas. This can be achieved by setting the P_{high} limit below the upper inflection point on the curve and limiting the release time, thus creating an intentional auto-PEEP (3).

We selected the APRV mode as the primary mode of ventilation because of its ability to rapidly correct oxygenation, enable the patient to breathe spontaneously, reduce sedation requirements, improve the ventilation/perfusion (V/Q) ratio and enhance cardiac performance. The APRV mode enables a pregnant patient's average airway pressure to be increased without large pressure changes. It also causes continuous distension pressure, which increases the gas exchange in the alveolar fluid, thereby easily achieving the desired result by preventing de-recruitment of alveoli (4, 5). In a study of APRV, Li et al. (6) showed that it decreased central venous pressure and systemic vascular resistance, increased cardiac index, improved central venous oxygen saturation and decreased sedation requirements and ICU stay. The major difference between APRV and conventional modes is that in this mode, the mean inspiratory pressure is maximised, and the end-expiratory pressure is due to intentional auto-PEEP (7). The major advantages over other modes of conventional ventilation are the preservation of spontaneous unassisted ventilation throughout the entire ventilation cycle and maintenance of long inflation time (8).

However, data related to the use of APRV mode in pregnancy are scarce. In 2009, Hirani et al. (9) presented two cases of successful treatment of ARDS developed during pregnancy. In 2010, Zen et al. (10) used APRV mode to successfully treat a 25-year-old woman who was 30 weeks pregnant and had severe ARDS. Finally, Folk et al. (11) suggested that APRV may be a good option for pregnant patients.

During mechanical ventilation, balanced sedation must be applied to allow spontaneous breathing and enable the patient to cooperate. Although APRV reduces the need for sedation, it may still be needed, particularly in the acute phase. The FDA defined the pregnancy categories of fentanyl, propofol and benzodiazepines used for our patient, as categories C, B and D, respectively. However, some studies have reported the use of drugs according to their benefit and harm to critically ill patients (12, 13). After birth, the mother and child were followed for any long-term effects of the sedative/analgesic drugs. The mother is healthy, and the baby is 8 months old and in a normal growth percentile.

Conclusion

Pregnancy causes physiological changes that make respiratory management more difficult, especially when the lung compliance decreases due to ARDS. In pregnant women with ARDS due to H1N1 influenza-A, APRV may be used as an alternative to conventional mechanical ventilation modes as it allow spontaneous ventilation while recruiting collapsed lung areas.

Informed Consent: Written informed consent was obtained from patient who participated in this case.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – M.P.K.; Design – M.P.K.; Supervision – F.Ü., A.H.Ş.; Resources – Ç.E.Ö.; Materials – S.E.; Data Collection and/or Processing – N.K.İ., Ç.E.Ö.; Analysis and/or Interpretation – M.P.K., F.Ü., A.H.Ş.; Literature Search – M.P.K., Ç.E.Ö., N.K.İ., S.E.; Writing Manuscript – M.P.K.; Critical Review – A.H.Ş., F.Ü., Ç.E.Ö., S.E., N.K.İ.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

Hasta Onamı: Yazılı hasta onamı bu olguya katılan hastadan alınmıştır.

Hakem Değerlendirmesi: Dış bağımsız.

Yazar Katkıları: Fikir – M.P.K.; Tasarım – M.P.K.; Denetleme – F.Ü., A.H.Ş.; Kaynaklar – Ç.E.Ö.; Malzemeler – S.E.; Veri Toplanması ve/veya İşlemesi – N.K.İ., Ç.E.Ö.; Analiz ve/veya Yorum – M.P.K., F.Ü., A.H.Ş.; Literatür Taraması – M.P.K., Ç.E.Ö., N.K.İ., S.E.; Yazıyı Yazan – M.P.K.; Eleştirel İnceleme – A.H.Ş., F.Ü., Ç.E.Ö., S.E., N.K.İ.

Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Finansal Destek: Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

References

1. Catanzarite V, Willms D, Wong D, Landers C, Cousins L, Schrimmer D. Acute respiratory distress syndrome in pregnancy and the puerperium: causes, courses, and outcomes. Obstet Gynecol 2001; 97: 760-4. [CrossRef]
2. Schwaiberger D, Karcz M, Menk M, Papadakos PJ, Dantoni SE. Respiratory Failure and Mechanical Ventilation in the Pregnant Patient. Crit Care Clin 2016; 32: 85-95. [CrossRef]
3. Ferdowsali K, Modock J. Airway pressure release ventilation: improving oxygenation: indications, rationale, and adverse events associated with airway pressure release ventilation in patients with acute respiratory distress syndrome for advance practice nurses. Dimens Crit Care Nurs 2013; 32: 222-8. [CrossRef]
4. Saddy F, Sutherasan Y, Rocco PR, Pelosi P. Ventilator-associated lung injury during assisted mechanical ventilation. Semin Respir Crit Care Med 2014; 35: 409-17. [CrossRef]
5. Roy S, Habashi N, Sadowitz B, Andrews P, Ge L, Wang G, et al. Early airway pressure release ventilation prevents ARDS-a novel preventive approach to lung injury. Shock (Augusta, Ga) 2013; 39: 28-38. [CrossRef]
6. Li JQ, Li N, Han GJ, Pan CG, Zhang YH, Shi XZ, et al. Clinical research about airway pressure release ventilation for moderate to severe acute respiratory distress syndrome. Eur Rev Med Pharmacol Sci 2016; 20: 2634-41.
7. Modrykamien A, Chatburn RL, Ashton RW. Airway pressure release ventilation: an alternative mode of mechanical ventilation in acute respiratory distress syndrome. Cleve Clin J Med 2011; 78: 101-10. [CrossRef]
8. Daoud EG, Farag HL, Chatburn RL. Airway Pressure Release Ventilation: What Do We Know? Respir Care 2012; 57: 282.
9. Hirani A, Marik PE, Plante LA. Airway pressure-release ventilation in pregnant patients with acute respiratory distress syndrome: a novel strategy. Respir Care 2009; 54: 1405-8.
10. Zein J, Jamaleddine G. Successful Use Of Airway Pressure Release Ventilation (APRV) In A Pregnant Patient With Severe ARDS. Am J Respir Crit Care Med 2010; 181.
11. Folk JJ, Landsberg DM, Robinson KA, Spector LA. Airway pressure release ventilation and respiratory failure during pregnancy. A report of three cases. J Reprod Med 2015; 60: 65-70.
12. Tajchman SK, Bruno JJ. Prolonged propofol use in a critically ill pregnant patient. Ann Pharmacother 2010; 44: 2018-22. [CrossRef]
13. Pacheco LD, Saade GR, Hankins GD. Mechanical ventilation during pregnancy: sedation, analgesia, and paralysis. Clin Obstet Gynecol 2014; 57: 844-50. [CrossRef]