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Case Report

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Prone ventilation revisited in H1N1 patients

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Abstract

Two cases of H1N1 patients are presented here, who developed acute respiratory distress syndrome with severe hypoxemia and were refractory to maximum ventilatory maneuvers and inhaled nitric oxide. Placing these two patients in prone position rapidly improved oxygenation, raising the hypoxic ratio from fifties to reach approximately 200. Both patients survived, with no respiratory squeals.

Introduction

The H1N1 virus causing influenza pneumonia is associated with high morbidity and mortality as it rapidly progress to acute respiratory distress syndrome (ARDS) with multi-organ affection (1). Despite the great progress in the management of ARDS using antimicrobial drugs, extracorporeal membrane oxygenation, prostaglandins, nitric oxide, prostacyclin, and exogenous surfactant administration, supportive advanced mechanical ventilation seems to be the most important for the prognosis.

Prone ventilation is considered one of the ventilatory maneuvers that greatly improves oxygenation and has been extensively cited in literature in ARDS but with no clear mortality benefits (2). These were two cases who suffered from H1N1virus managed successfully with prone ventilation and aggressive intensive care management.

Case 1:

A male patient aged 41 years old, he is a known case of hypertension complaining of shortness of breath, cough and fever for few days. He reached the hospital emergency department with Fever 39º C and tachypnea with respiratory rate (RR) of 35/min. He had a Glasgow coma scale (GCS) of 15/15, Blood Pressure (BP) of 135/75, tachycardia of 120 beats/ min and his oxygen saturation (SaO_2) was 76% on room air. Arterial Blood Gases (ABG) showed: pH 7.34, PaO_2 50.2 mmHg, $PaCO_2$ 27 mmHg, HCO_3 18 mmol/l, base deficit -8.8

Immediate non invasive ventilation with CPAP mask was done to the patient with FIO_2 1.0 but SaO_2 reached 85%. Fluids as crystalloids started then central venous line was inserted to keep central venous pressure (CVP) between 3-4 cmH_2o (restricted fluid management). Broad spectrum antibiotics (Meropenam, linezolid, and Tamiflu) were started after all essential cultures and throat swap were obtained. ABG repeated after two hours showed PH 7.39, PaO_2 60 mmHg, $PaCO_2$ 25.5, HCO_3 20 mmol/l, base deficit -5

Patient was then transferred to the Intensive Care Unit (ICU) , intubated and ventilated because of persistent hypoxemia and agitation on non invasive ventilation (NIV).Ventilation settings on P-SIMV (PEEP 12, PC 20, Fio_2 1.0, RR 12) and ABG done was then showed in table 1.

Fig (1): shows Case 1 prior to prone position.

Patient was still hypoxic on the second day despite FiO_2 1.0 , increasing PEEP and inverse inspiratory expiratory ratio (Inverse I: E ratio) after heavy sedation and paralysis due to persistent hypoxemia (P-SIMV , PEEP 14 , PC 20 , FiO_2 1.0 , I:E 2:1). The patient proved to be H1N1 positive in second day of admission to ICU.

Nitric Oxide was then started and titrated up to 40 ppm due to persistent hypoxia non responsiveness to maximum ventilator support. CVP guided fluids challenge as crystalloids and vasopressor in the form of nor-adrenaline was started because of hypotension (BP 85/45) aiming to keep mean arterial BP 65 mmHg.

Prone ventilation started on 4^{th} day of admission keeping ventilator strategy of ARDS as a target of low tidal volume (5-6 ml/kg of ideal body weight), plateau pressure of 28 to 30 cm H_2O, high PEEP of 12-15 cmH_2O.

Patient was ventilated in prone position for 16 hours/ day for 5 successive days under heavy sedation with gradual improvement of ventilation and of hypoxic ratio PaO_2/FiO_2 with titrating down ventilator parameters.

Table 1: Parameters of multi- organ affection, ventilatory settings and ABG in supine and prone ventilation.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
	Supine position			Prone position				
Ventilator setting (mode, PEEP, FiO_2)	(P-SIMV, 12, 1.0)	Inverse I: E ratio. (P-SIMV, 14,1.0)	Inverse I: E ratio. Nitric Oxide (P-SIMV, 14, 1.0)	Inverse I: E ratio. Nitric Oxide. (P-SIMV, 14, 1.0)	Inverse I: E ratio. Stopped Nitric Oxide. (P-SIMV, 12, 0.8)	I: E ratio 1:1. (P-SIMV, 12, .7)	I: E ratio 1:1.5. (P-SIMV, 10, 0.6)	I: E ratio 1:1.5. (P-SIMV, 10, 0.45)
pH	7.35	7.3	7.33	7.4	7.35	7.37	7.4	7.43
PCO_2 (mmHg)	25.5	45	33.75	37.5	38.9	33.2	32.1	31.7
PaO_2 (mmHg)	51.75	54	63.75	92.25	112	112	118	112.5
PaO_2/FiO_2 (mmHg)	51.75	54	63.75	92.25	140	160	196.66	250
HCO_3 (mmol/l)	18	21	22	24	23	25	23	24
Base deficit	-6	-4	-2	-1.5	-1	-.6	-1.3	-.7
Platelet count ($\times 10^9$/l)	118	100	90	95	93	107	113	145
INR	1.4	1.6	1.6	1.6	1.5	1.3	1.27	1.18
Serum Creatinine (µmol/l)	157	180	199	210	206	187	150	110

Prone position was done repeatedly for 5 days with progressive titration of FiO_2 to reach 45%, PEEP 10, I: E ratio 1:1.5, and no nitric oxide. Progressive weaning maneuver was done after 3 days of stopping prone ventilation and marked patient improvement regarding ABG and chest x- ray (CXR) and the patient was weaned from vasopressor. Patient was finally extubated after 11 days of admission.

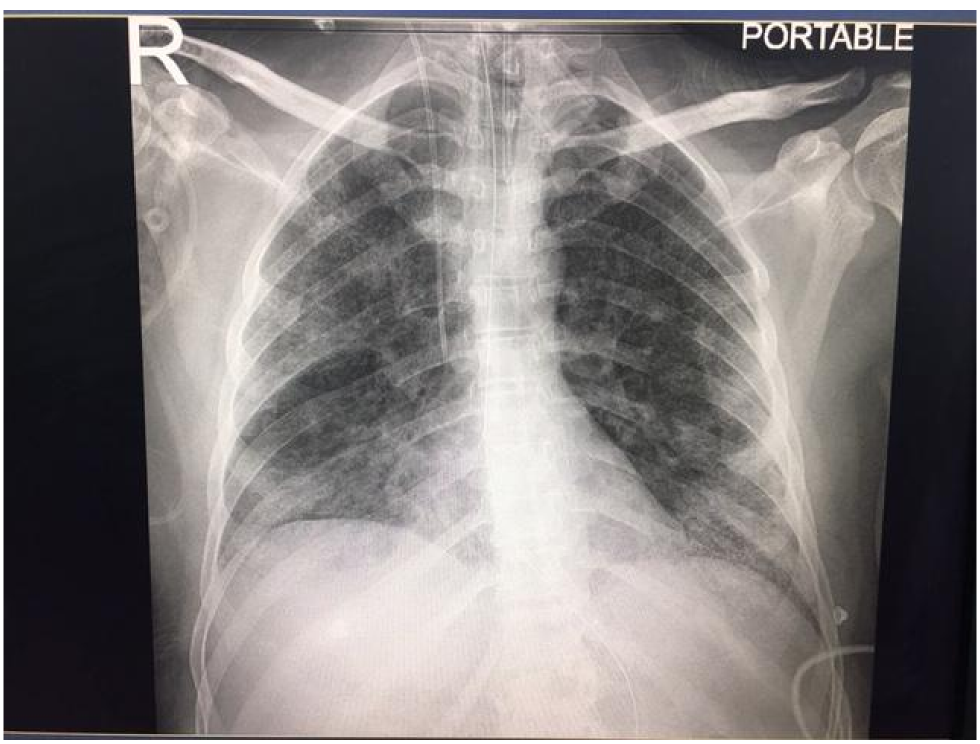

Fig (2): showing case 1 after prone position.

ABG before extubation on PS 12, PEEP 6, FiO_2 45% was PH 7.42, $PaCO_2$ 32 mmHg, PaO_2 134 mmHg, HCO_3 23 mmol/l. Oxygen requirement was titrated down from non- rebreather face mask to simple face mask, then to nasal cannula. The patient was discharged to the ward after 19 days of admission.

Case 2

A female patient aged 44 years old, a known case of hypertension and patent foramen oval (PFO) complaining of shortness of breath, cough and fever for few days. She reached the hospital emergency department with Fever 40º C and tachypnea RR was 40/min.

She had a GCS of 15/15, BP of 115/65, tachycardia of 125 beat/ min, SaO_2 was 70% on room air. She was connected to non- rebreather mask with oxygen 15 L/min. ABG showed: PH 7.33, PaO_2 48.75 mmHg, $PaCO_2$ 25.5 mmHg, HCO_3 16.2 mmol/l, and base deficit of -9.6.

The patient received the same management of the first case with fluids, vasopressor, broad spectrum antibiotics (Meropenam and levofloxacin and Tamiflu) were started after all essential cultures and throat swap were obtained which also proved the patient to be H1N1 positive on the second day of admission. Patient was also transferred to ICU, intubated ventilated because of persistent hypoxemia and agitation on NIV.

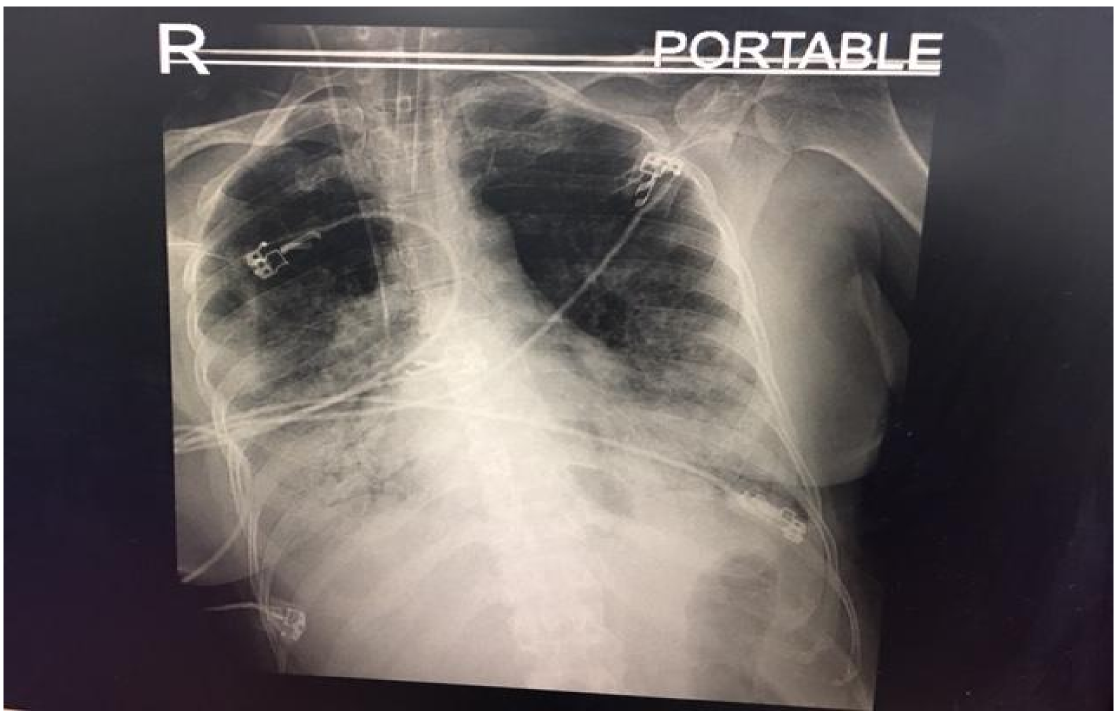

Fig (3): shows case 2 before prone position.

Second day patient still hypoxic instead of FiO_2 1.0 , increasing PEEP and Inverse I: E ratio, nitric oxide on maximum ventilator parameters (P-SIMV , PEEP 14 , PC 18 , FiO2 1.0 , I:E 2:1). Prone ventilation was started on 3rd day of admission keeping ventilator strategy of ARDS for 16 hours under heavy sedation with improvement of ventilation and improvement of hypoxic ratio PaO_2/FiO_2.

Table 2: Parameters of multi organ affection, ventilatory settings and ABG in normal and prone ventilation.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
	Supine		Prone position			
Ventilator settings (mode, PEEP, FiO_2)	Inverse I:E ratio (P-SIMV, 14, 1.0)	Inverse I: E ratio. Nitric Oxide (P-SIMV, 14,1.0)	Inverse I: E ratio. Nitric Oxide. (P-SIMV, 14, 1.0)	Inverse I: E ratio. Stopped Nitric Oxide. (P-SIMV, 14, 0.9)	I: E ratio 1:1.5 (P-SIMV, 12, 0.75)	I: E ratio 1:2 (P-SIMV, 12, 0.6)
pH	7.26	7.31	7.33	7.33	7.37	7.37
PCO_2 (mmHg)	30.7	36	37.75	37	32.1	31.2
PaO_2 (mmHg)	50.5	55	73.79	105	120	123
PaO_2/FiO_2 (mmHg)	50.5	55	73.79	116.66	160	205
HCO_3 (mmol/l)	16	18	20	23	22	23
Base deficit	-9	-7	-4	-1	-2	-.4
Platelet count ($\times 10^9$/l)	206	180	182	157	170	167
INR	1.1	1.4	1.3	1.3	1.31	1.27
Serum Creatinine (µmol/l)	192	220	222	208	200	179

Prone position was done repeatedly for 4 days with progressive titration of FiO_2 to reach 0.5, PEEP 12, I: E ratio 1:2, and no nitric oxide. 2 days after stopping prone ventilation patient was weaned from mechanical ventilation based on ABG and CXR. Oxygen requirement was also titrated down until patient was discharged to the ward after 15 days of admission.

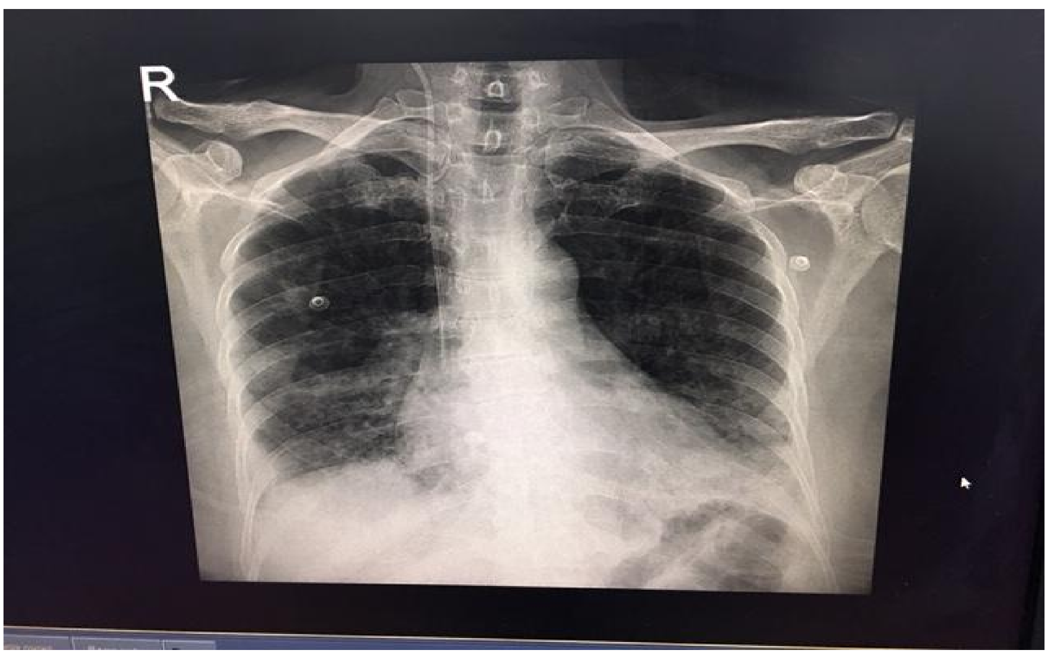

Fig (4): shows case 2 after prone position and extubation

Discussion

Acute respiratory distress syndrome (ARDS) is a clinical condition with a high mortality rate reaching between 29% and 40% as recent studies showed (3), and it always requires aggressive ventilatory management. The overall management becomes a huge challenge especially when it compounded with a picture of septic shock and multi-organ failure (MOF) like that occurring in patients with H1N1. The ICU mortality of H1N1 patients with severe ARDS is about 10-38% and increases up to 58% in patients requiring invasive mechanical ventilation (4). Organ support, invasive monitoring, treatment of sepsis and use of unique ventilatory strategies like prone ventilation can help in saving some patients. Prone ventilation helps improving ventilation perfusion mismatch, recruiting dependent lung areas, reducing shunting, postural drainage and less compression of the lungs by the heart (2).

Prone positioning may be associated with risks; including inadvertent extubation, and pressure sores, requiring the use of appropriate cushioning of the dependent portions of the body to avoid pressure ulcers. However, it can be done safely by trained critical care staff who are aware of its potential benefits to the critically ill patients with refractory hypoxemia.

As prone ventilation is still not routinely used in ARDS treatment, it actually proved extremely beneficial and marked improvement was attained, in these two cases of H1N1, who required a very high PEEP and did not improve with nitric oxide and optimum ventilatory management. The prone position immediately and markedly improved oxygenation allowing the decrease in mechanical respiratory assistance. A recent meta-analysis suggests improved outcomes using this approach in patients with severe ARDS (5).

Several studies and meta analysis were done on using prone position in ARDS patients, some of which done on H1N1 patients, their data confirmed a significant improvement in oxygenation and support the use of prone position ventilation as a rescue strategy in patients with severe hypoxemia, despite no significant effect on mortality reduction (6,7).

This case report conclude that prone position can be a simple and useful therapeutic measure to improve oxygenation in ARDS patients with H1N1that have refractory hypoxemia and should be employed early for optimum results.

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Conflicts of interest:

There are no conflicts of interest.

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