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## Case Report

# Prone ventilation and critical care management of severe ARDS and multiorgan failure in a young patient

Lt Col Parikshit Singh<sup>a,\*</sup>, Col Rajshree Ramasethu<sup>b</sup>, Col Amit Sharma<sup>c</sup><sup>a</sup> Classified Specialist (Anaesthesiology & Critical Care), Command Hospital (CC), Lucknow 226002, India<sup>b</sup> Senior Advisor (Medicine & Nephrology), INHS Asvini, Colaba, Mumbai, India<sup>c</sup> Senior Advisor (Anaesthesiology), Command Hospital (CC), Lucknow 226002, India

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## Case report

A 26 year old male was found lying unconscious in his room after having consumed unquantified amount of liquor. He was initially diagnosed as alcohol intoxication with likely aspiration and was transferred to the nearby tertiary level hospital, performing a 3 h road journey.

On reaching this hospital ICU, he had a Glasgow Coma Score (GCS) of 3/15 (E1M1V1), non-reacting pinpoint pupils, fever (101 °F), tachycardia (HR 140/min), hypotension (invasive arterial BP – 90/54 mmHg with a mean arterial pressure or MAP of 66 mmHg), tachypnea (RR-40/min), hypoxemia and severe uncompensated metabolic acidosis on arterial blood gas (ABG) (Table 1). He was immediately intubated and put on ventilator P-SIMV mode (Pressure-Synchronized Intermittent Mandatory Ventilation). Central venous access was secured via the right internal jugular vein and a central venous pressure (CVP) of 8 mmHg was noted. ICU protocol, all essential cultures and all samples for toxicology screen were obtained. There were traces of UGI bleed which was attributed to erosive gastritis.

A CVP guided fluid challenge was given in the form of 2.5 l of IV fluids and broad-spectrum antibiotics were started. He did not show much improvement and developed further hypotension (78/48 mmHg with a MAP of 58 mmHg) for which vasopressor support in the form of noradrenaline infusion was started. A high dose of 0.3 mcg/kg/min was reached before achieving a target MAP of 65 mmHg. Antibiotic cover

## Introduction

Acute respiratory distress syndrome (ARDS), a clinical entity with a high mortality rate, requires aggressive ventilatory management. With a picture compounded with features of septic shock and multiorgan failure (MOF) the overall management becomes a huge challenge indeed. Timely intervention by the critical care team in the form of organ support, intensive invasive monitoring, control of sepsis and use of unique ventilatory strategies like prone ventilation can, however, help salvage some patients.

This was a case of acute alcohol intoxication leading to aspiration, severe ARDS and MOF managed successfully with prone ventilation and aggressive intensive care.

\* Corresponding author.

E-mail address: [drparikshitsingh@yahoo.co.in](mailto:drparikshitsingh@yahoo.co.in) (P. Singh).

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**Table 1 – Parameters depicting the multiorgan derangement, the ventilatory settings (in normal and prone ventilation) and ABG pattern in the initial days of admission.**

Ventilatory settings (Mode/PEEP/FiO <sub>2</sub> )	Day 1	Day 2	Day 3		Day 4
	(P-SIMV/8/0.6)	(P-SIMV/12/1.0)	Before proning (P-SIMV/12/1.0)	During prone position (P-SIMV/15/0.8)	After proning (P-SIMV/12/0.7)
pH	7.13	7.30	7.35	7.36	7.40
pCO <sub>2</sub>	34	39	42	40	42
pO <sub>2</sub>	53	160	100	240	180
PaO <sub>2</sub> /FiO <sub>2</sub> ratio	200	150	100	300	250
HCO <sub>3</sub>	11.3	21.5	23.0	24.5	25.0
Base deficit	–17.9	–5.7	–2.1	–0.5	0.0
Platelet count	1,10,000	42,000		95,000	1,15,000
INR	1.51	1.88		1.42	1.26
S.creatinine	2.0	2.9		7.06	6.4

was augmented to Inj Meropenem, Teicoplanin, and Clindamycin. Also administered were IV Soda Bicarb, Thiamine, Naloxone, Pantocid and Hydrocortisone. After 24 h the acidosis improved, hemodynamic parameters stabilized and vasopressor support reduced. He, however, showed evidence of multiorgan dysfunction (Table 1) with acute kidney injury (AKI), oliguria, coagulopathy with thrombocytopenia, and pulmonary bleed (needing one unit of single donor platelet and two units of FFP 8 hourly). CT scan revealed mild cerebral edema.

He was transported to the dialysis center while being ventilated on the way. A heparin-free hemodialysis (HD) was given with an ultrafiltrate of 1.5 l. However he continued to be hypoxemic with radiological evidence of aspiration (right sided), and ARDS with a PaO<sub>2</sub>/FiO<sub>2</sub> ratio of less than 150. A further worsening of lung picture with increasing PEEP requirement (12 cm H<sub>2</sub>O) was instrumental in deciding upon a prone ventilation trial to recruit the dependent lung zones.

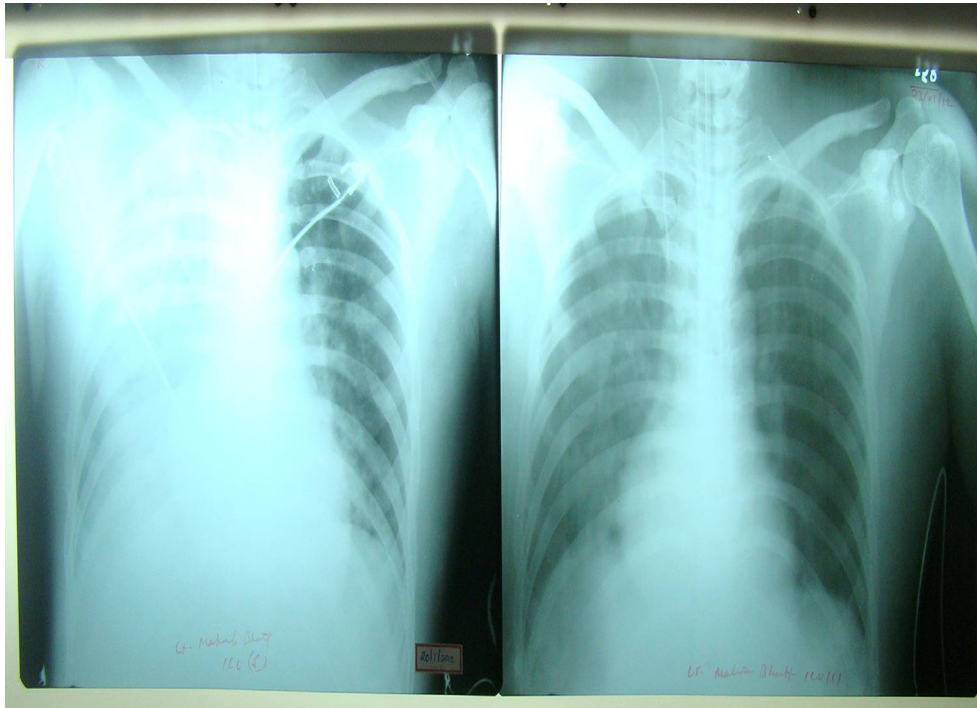
Proning was done on third day of admission (Fig. 1). Keeping ARDS ventilatory strategy in mind a target of low tidal volume (6 ml/kg of predicted body weight), plateau pressure (P<sub>plat</sub>) of ≤30 cm H<sub>2</sub>O, pH ≥ 7.15, permissive hypercapnia and

a high optimal PEEP of 15 cm H<sub>2</sub>O the patient was ventilated in the prone position for 12 h, overnight, under heavy sedation. ABG was done every 2 hourly. By the end of first session of prone ventilation his PaO<sub>2</sub>/FiO<sub>2</sub> ratio improved to 300 (Table 1). In the morning he was made supine, taken up for another HD session and prone again within 48 h to further enhance lung recruitment. After the second session the patient started to show gradual improvement in his lung status with evidence of significant radiological clearing on chest X-ray (Fig. 2) though he continued to have low-grade fever. His requirement of PEEP came down to 8 cm H<sub>2</sub>O.

By day 07 he exhibited an improving sensorium and was able to recognize his relatives. Ryles tube feeds were started for him which he tolerated. For his anuric state he continued to be transported daily for HD while being ventilated and his renal function started to recover. In view of slow weaning off the ventilator and slow healing of lungs with significant neuromuscular weakness, bedside percutaneous tracheostomy was performed on day 09.

There was a major setback in the patient's condition on day 12 following a transfusion reaction to FFP soon after his tenth session of HD. He developed high-grade fever with tachycardia, tachypnea, and bilateral basal crepts. ABG

**Fig. 1 – Patient being invasively ventilated in prone position.**



**Fig. 2 – Radiological picture before (left) and after a session of prone position ventilation (right). Significant lung clearance can be appreciated.**

picture revealed severe respiratory acidosis and hypoxemia ( $\text{PaO}_2/\text{FiO}_2 < 70$ ) despite high ventilatory supports (PEEP 12 and  $\text{FiO}_2$  1.0). Chest X-ray showed extensive bilateral infiltrates and total leukocyte count (TLC) was 27,800/cumm. Following no improvement in oxygenation and inability to effectively ventilate the patient in supine position, he was once again made prone as a last resort and ventilated for 18 h. The outcome was favorable with a dramatically improved ABG picture. His HD sessions were discontinued and lasix infusion was started. Prone ventilation was repeated again on the next day. He showed improved  $\text{PaO}_2/\text{FiO}_2$  ratios ( $>330$ ), bilateral infiltrates decreased, urine output increased to 150 ml/h with reduced creatinine levels, TLC and fever.

At the end of 02 weeks since admission, the patient showed signs of recovery from ARDS and AKI. He had spikes of fever though and a bronchial lavage aspirate revealed acinetobacter baumannii sensitive to only Piperacillin–Tazobactam which the patient was already on but not responding. A higher end carbapenem in the form of Inj Doripenem was added to combat the multidrug resistant (MDR) strain. He responded very well to the therapy.

Over the next week the lung picture improved significantly with near resolution of lung consolidation and patient began tolerating spontaneous modes of ventilation. Creatinine levels normalized. He had severe neuromuscular weakness and features of dysautonomia (tachycardia, hypertension and sweating on mild stress) but this gradually settled down.

After 01 month of admission, the patient was taken off the ventilator. The tracheostomy tube was gradually downsized and the patient was decannulated successfully. Gradually ambulation, physiotherapy sessions and high protein diet

resulted in good recovery. The patient was shifted to the ward on day 40.

## Discussion

Recent studies report mortality of ARDS between 29% and 40%.<sup>1</sup> Institutions across the world, though, are experiencing a decline in the overall mortality, likely due to better general care for critically ill patients and, importantly, improved strategies of mechanical ventilation.<sup>2</sup> Mostly sepsis-related multiple organ failure is the main reason for mortality in ARDS.<sup>3</sup> Early goal directed therapy (EGDT) recommended by the 'Surviving sepsis' campaign guidelines were initially applied on this patient for hemodynamic resuscitation in the initial hours.<sup>4</sup> This included adequate volume resuscitation to restore mean circulating filling pressure, use of noradrenaline to maintain a mean arterial pressure of at least 65 mmHg, use of suitable antibiotics, and utilization of optimal ventilator PEEP to increase oxygenation.

Prone ventilation has been extensively cited in literature in improving oxygenation in ARDS but with no clear mortality benefits. The physiological mechanisms postulated are: improvement in ventilation perfusion mismatch, recruitment of dependent lung areas, reduction in shunt, postural drainage as well as causing less compression of the lungs by the heart.<sup>5</sup> While prone ventilation cannot be recommended for routine ARDS treatment, a recent meta-analysis suggests improved outcomes using this approach in patients with severe ARDS.<sup>6</sup> The 'open lung' approach calls for using higher levels of PEEP to keep alveoli open and prevent their collapse at end-expiration. A PEEP of 15 cm  $\text{H}_2\text{O}$ , while prone, was

reached in this case before attaining any oxygenation benefits. High PEEP arm while maintaining low tidal volumes during mechanical ventilation has been shown to improve oxygenation.<sup>7</sup> Expertise is required in performing prone ventilation but at no additional cost.

Antibiotic regime followed was largely empirical since all culture reports in the initial weeks were negative. Only one report of bronchoscopic aspirate revealed MDR acinetobacter for which Doripenem was added. It is a relatively newer carbapenem which has shown promise in combating MDR gram-negative pathogens in ICUs.<sup>8</sup> The lung was the likely source of sepsis in this case and the drug showed a good response.

There was, surprisingly, no neurological deficit or evidence of hypoxic cerebral injury to the patient despite the initial severely hypoxemic state. Interestingly, upon being asked later, the patient recollected consuming ten pegs before falling unconscious.

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### Conflicts of interest

All authors have none to declare.

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