

PATIENT CASE REPORT. CATEGORY: ADULT IMPLEMENTING LUNG PROTECTIVE VENTILATION IN AN ARDS PATIENT.

Clinical Background and Situation:

A 30 year old woman was admitted to the ICU with severe community acquired pneumonia. Her previous medical history was unremarkable and she complained of a sore throat and flu-like symptoms that had begun five days before. At admission she was in respiratory distress with tachypnea and was maintaining SpO₂ of 90% on 50% oxygen. Non-invasive ventilation was initiated but tracheal intubation and invasive mechanical ventilation was decided 6 hours later due to hemodynamic instability and lack of respiratory improvement. She rapidly developed early multiorgan dysfunction with severe hemodynamic instability and ARDS. On 100% oxygen initial PaO₂ was 58 mmHg and PaCO₂ 54 mmHg corresponding to the frontal chest X-ray shown in Figure 1.

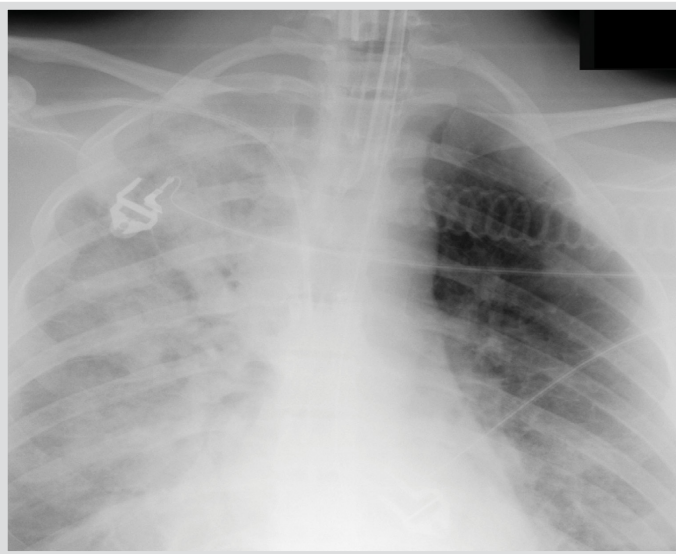


Figure 1 Chest X-ray taken after orotracheal intubation. The initial right upper-lobe infiltrate rapidly progressed to bilateral pulmonary alveolar infiltrates.

Interventions and course of therapy:

After initial stabilization, a lung recruitment maneuver (RM) was performed in pressure controlled ventilation exploring incremental pressure levels and reaching a maximum recruitment pressure of 60 cmH₂O with a PEEP level of 40 cmH₂O maintained for 2 minutes. Even at this pressure level recruitment criteria were not met as confirmed by a maximum PaO₂/FiO₂ of 68 mmHg. Immediately after recruitment a decremental PEEP trial (DPT) was performed and changes in dynamic compliance (C_{dyn}) were used trying to identify the level of open lung PEEP (Figure 2).

The initial PEEP level chosen was 26 cmH₂O and the driving pressure (end-inspiratory pressure – PEEP) needed to maintain a pH ≥ 7.2 was 10 cmH₂O resulting in a plateau pressure of 36 cmH₂O and a tidal volume of 5 mL/kg. Despite these settings and the use of an FiO₂ = 1, the patient remained severely hypoxemic so that increasing levels of PEEP were needed and prone position (periods of 12h) was added to the ventilatory treatment. Dependency on high levels of FiO₂ and PEEP remained during the first week of mechanical ventilation and recruitment maneuvers were used sporadically only during episodes of severe hypoxemia. After some respiratory improvement and stabilization on day seven, a new sequential RM was performed (reaching the same pressure as the previous one), this time fulfilling the criteria of full lung recruitment (PaO₂/FiO₂ > 350 mmHg) and an increase of more than 15% in C_{dyn}. The corresponding DPT is shown in Figure 3.

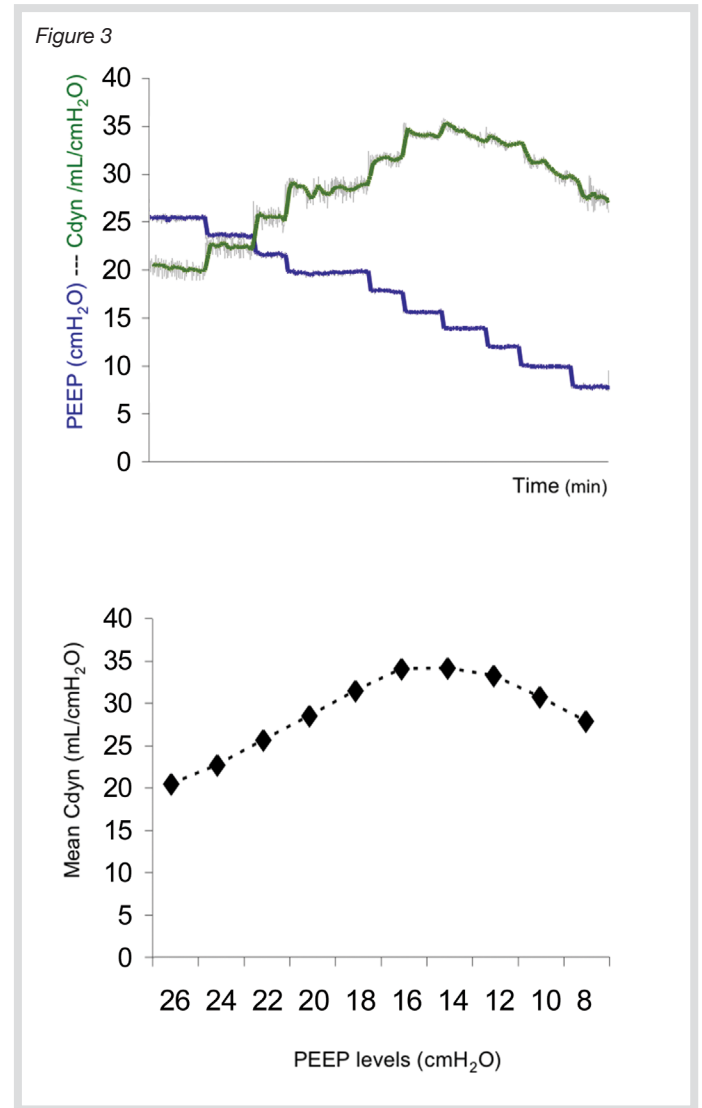
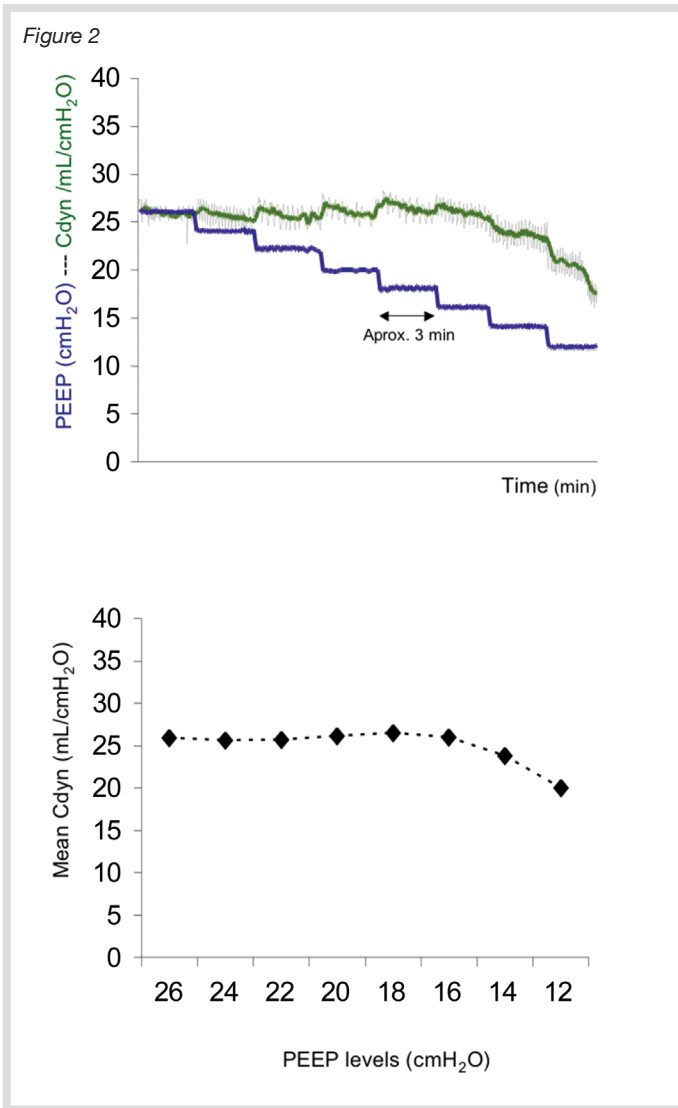


Figure 2 Decremental PEEP trial (DPT) after the first RM. Settings were pressure control, I:E 1:2, Starting at a PEEP level of 26, the lowest PEEP level maintained during the RM. Dynamic compliance (Cdyn) did not increase maintaining a plateau until a PEEP level of 14 cmH₂O when compliance started to decrease. According to this behavior it was impossible to determine the point of lung collapse (i.e the level of PEEP resulting in maximum Cdyn during a DPT) and hence open lung PEEP, a level 2 to 3 cmH₂O above the point of collapse) could not be established. This was because the lung could not be fully recruited and probably because the level of open lung PEEP was equal or above the initial DPT level of 26 cmH₂O.

Figure 3 Decremental PEEP trial (DPT) after full lung recruitment (confirmed by oxygenation criteria obtained just before the start of the DPT at a PEEP level of 26 cmH₂O), on the seventh day of evolution. Cdyn increased during the first decremental PEEP steps and reached a maximum (point of lung collapse) at 16 cmH₂O. The open lung PEEP was set at 19 cmH₂O.

Weaning process and results:

After this successful lung recruitment maneuver, PEEP could be progressively reduced and driving pressure was maintained around 12 cmH₂O. At day 14, weaning was initiated and mechanical ventilation was withdrawn on day 17. The patient was discharged from the ICU a few days later, needing only minimal supplemental oxygen. Figure 4 shows the evolution of ventilator parameters during the first 14 days of mechanical ventilation.

Case summary:

We were presented with a severe case of pulmonary ARDS in which lung protective ventilation was difficult to implement. The patient did not respond to lung recruitment initially and a compromise, non-conventional ventilation had to be used because of sustained extreme hypoxemia. Despite high levels of PEEP and plateau pressures, the driving pressure was strictly maintained at the lowest possible level (less than 15 cmH₂O). After one week, the lung could be fully recruited and the DPT could correctly identify the level of open lung PEEP using dynamic compliance. After this, ventilatory parameters could be progressively reduced until successful extubation and ICU discharge.

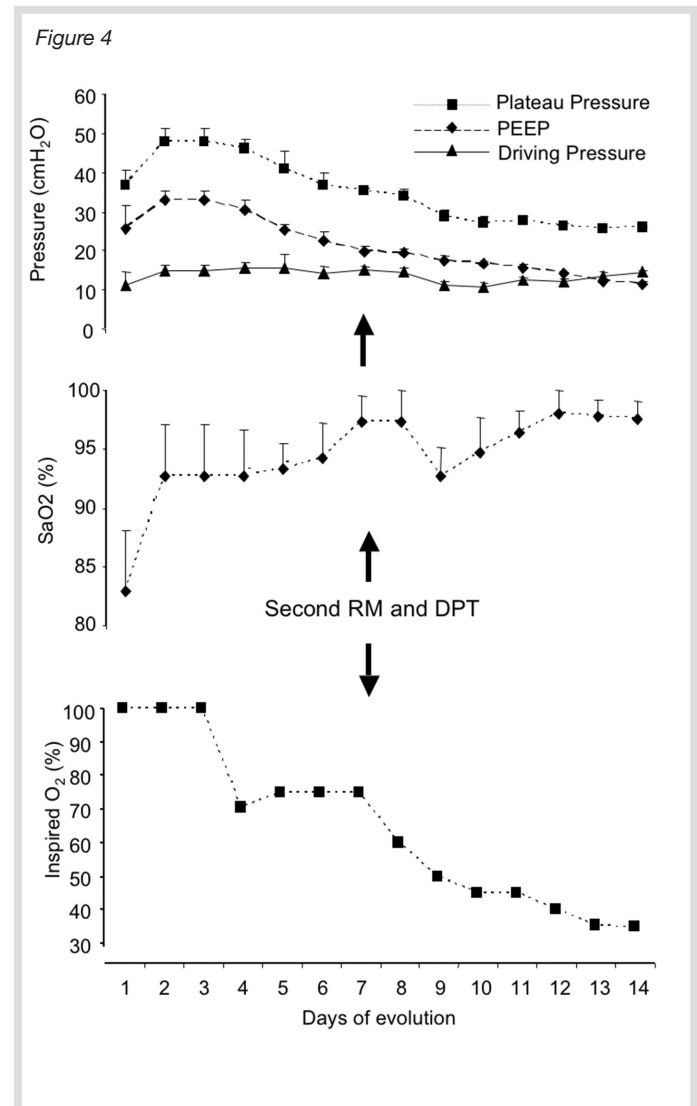


Figure 4 Ventilatory parameters during the first 14 days of mechanical ventilation. The data represents mean (\pm SD) daily values.

MAQUET

GETINGE GROUP

Maquet Critical Care AB
SE-171 54 SOLNA
Sweden

Phone: +46 10 335 73 00
www.maquet.com

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