

Bronchoalveolar lavage (BAL) with surfactant in pediatric ARDS

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ARDS triggered by aspiration or pneumonia

Background

- Aspiration and severe pneumonia can inactivate and inhibit surfactant creating a reduction in quantity and quality
- Type II pneumocytes are damaged from direct noxa
- Alveolo-capillary barrier is damaged
- Edema (fluid rich in proteins), inflammatory cells and foreign matter are present in bronchioles and alveoli creating lung collapse and reducing ventilating areas

Bronchoalveolar lavage – BAL

Aims of the study

- To assess the effect of porcine surfactant administered during and after bronchoalveolar lavage - BAL
- Removal of inactivating material present in the lung and specifically in the alveoli and bronchioles
- Possibility of lung recruitment, surfactant supplementation and its better distribution

Case materials

	Age	Weight
10 children	2 mths – 8 yrs	2400 g – 25 kg

- Aspiration syndrome (6 cases)
- Plurilobar pneumonia (4 cases)
- ❖ Time elapsed from admission prior to surfactant administration: 1 – 36 hours

Protocol for admission

- Patients needing and/or under artificial ventilation
- $V_t \geq 20$ ml/kg, PEEP ≥ 8 cm H₂O
- Presence of pathologic secretions (blood, gastric material, etc.) in the lung shown from bronchosuctioning
- Pathology confirmed by chest x-ray and/or CT scan
- Progressive deterioration of gas exchanges under artificial ventilation with reduction in paO_2 leading to necessity to increase $FiO_2 > 0.6$

Methods

Steps of procedure

- Sedation and muscle paralysis
- Endotracheal intubation
- In cases of clear monolateral lung pathology BAL was performed using
 - Selective bronchial intubation with conventional endotracheal tube (2 cases)
 - Double lumen tube (1 case)
 - Fibro-bronchoscopy (2 cases)
- Preliminary BAL with normal saline solution 5 ml
- Bronchosuctioning

BAL

Steps of procedure

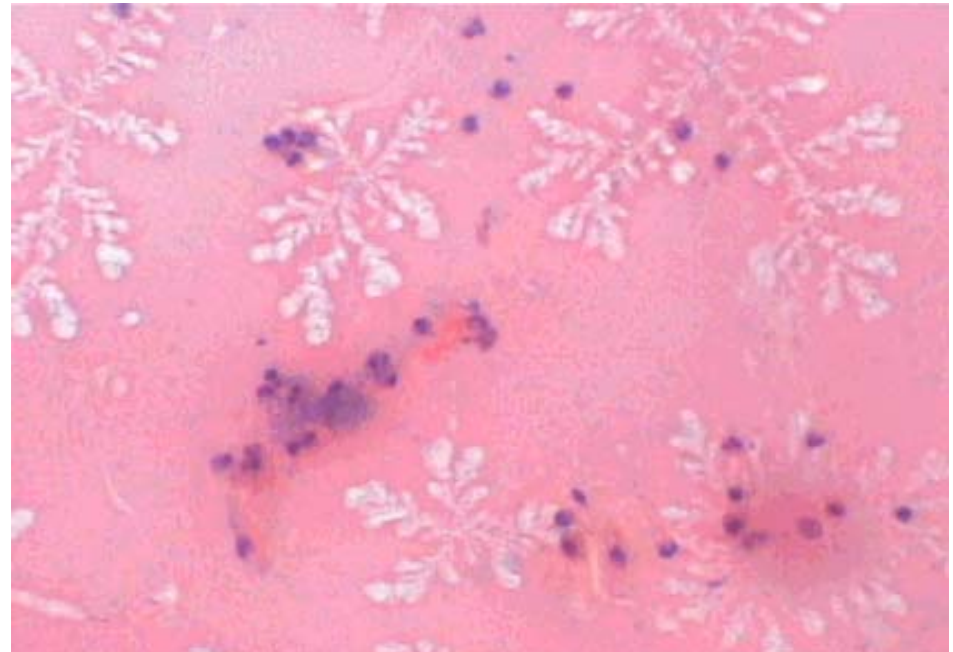
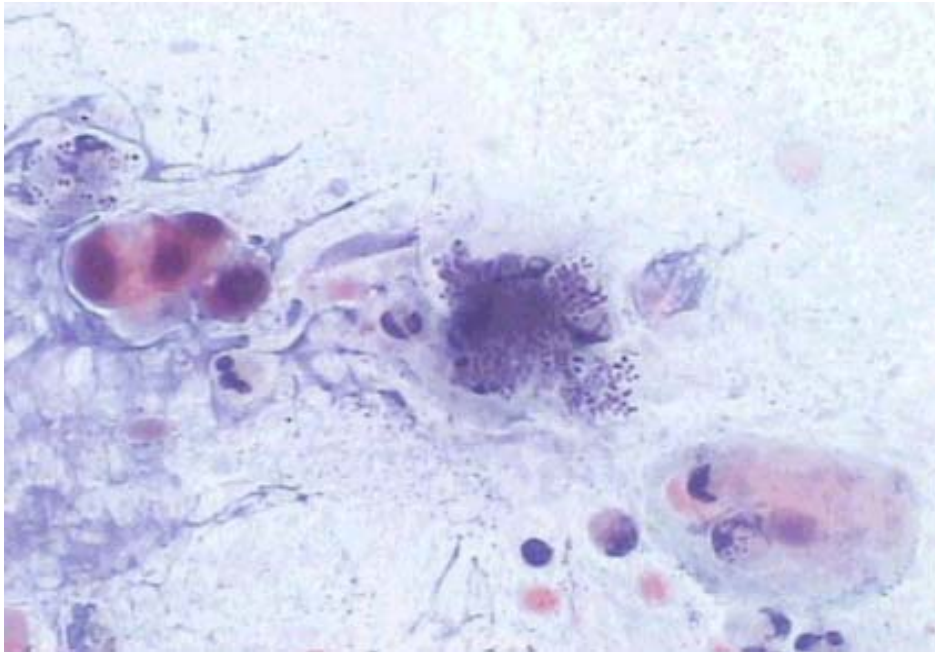
- Normal saline quantity: 1/3 of Functional Residual Capacity
- Surfactant dose: 5 mg/ml
- Total fluid amount distributed in 3–5 equal aliquots
- Manual ventilation FiO_2 1 before, during and after BAL
- Bronchosuctioning immediately after BAL

BAL

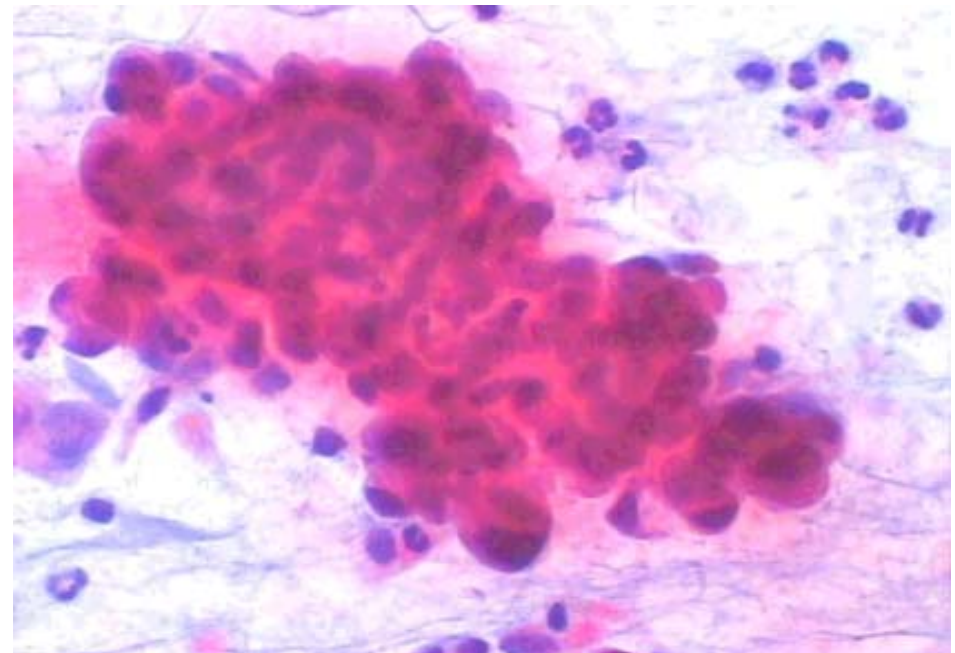
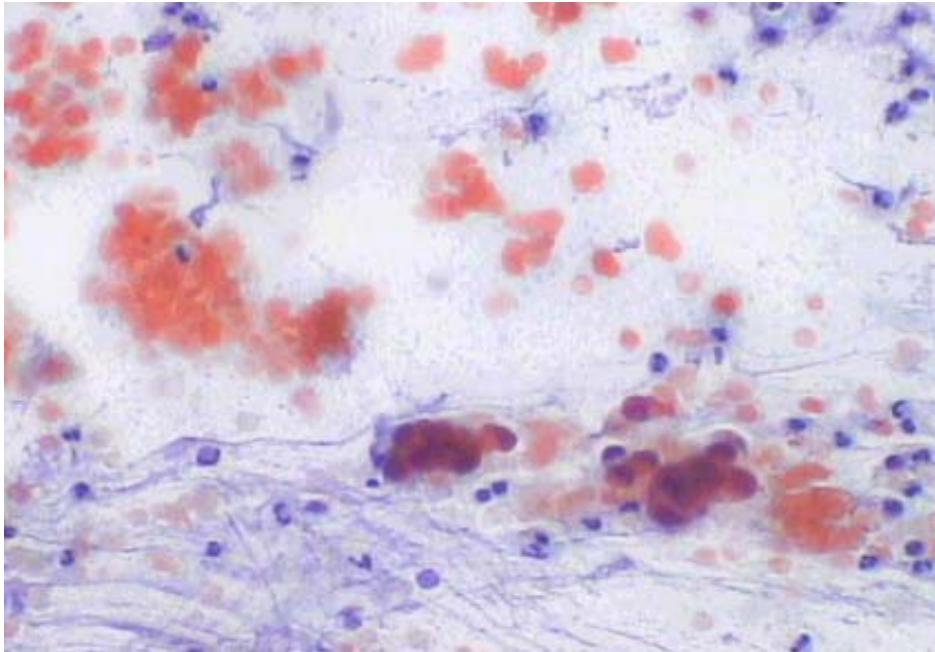
Steps of procedure

- Quantity of material recovered: 45 – 55% of administered fluid
- Mean duration of procedure: 45 minutes
- Surfactant suppletive dose 5 mg/kg bolus was administered 15 min after BAL

BAL in aspiration syndrome

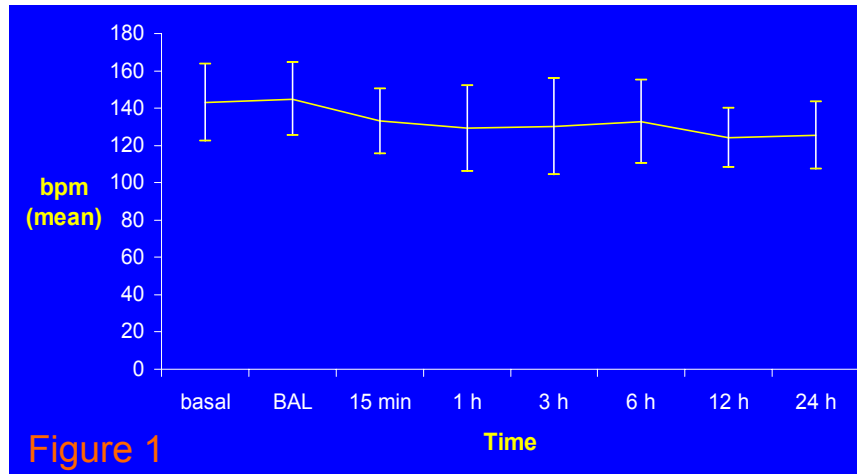


BAL in pneumonia

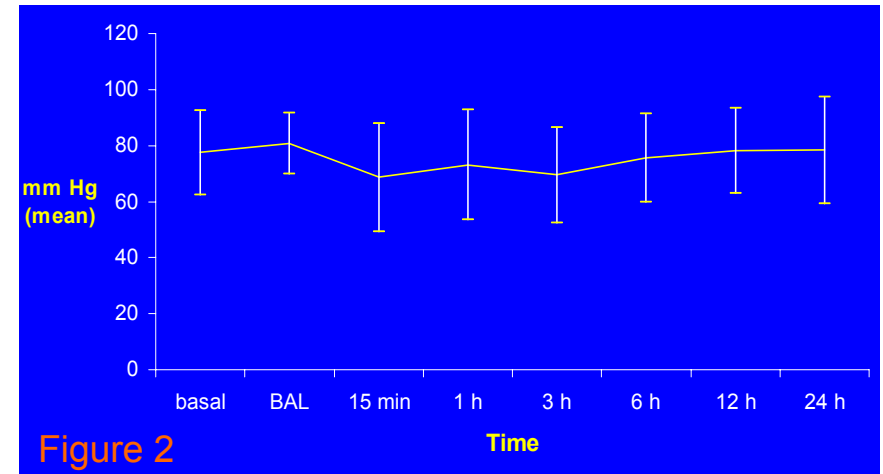


BAL with surfactant

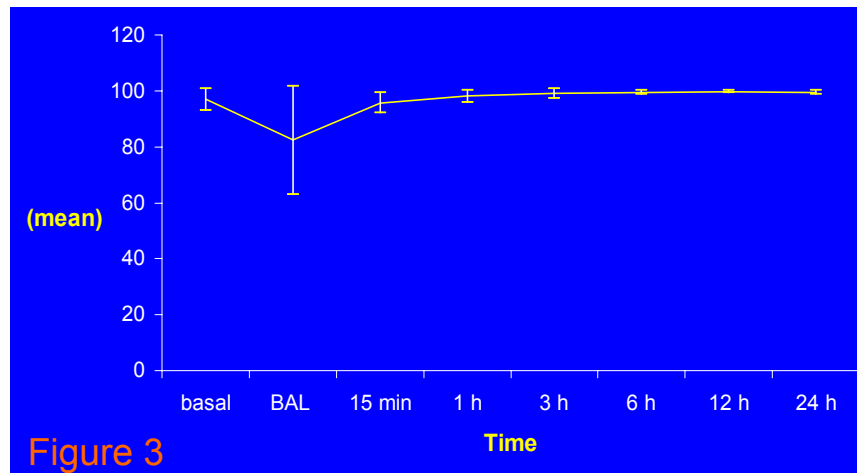
Heart Rate



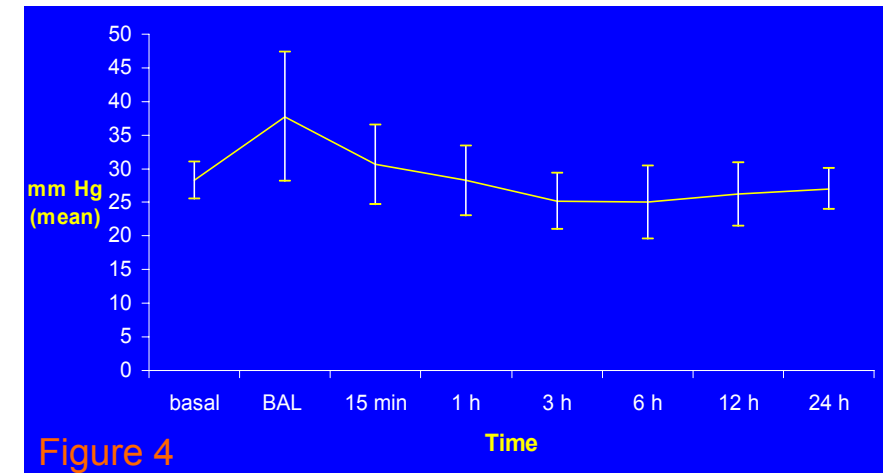
Mean Arterial Pressure



SpO₂

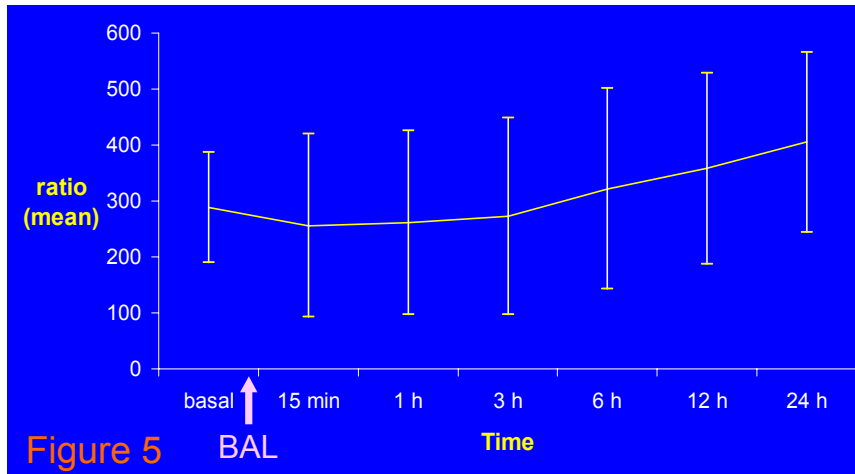


EtCO₂

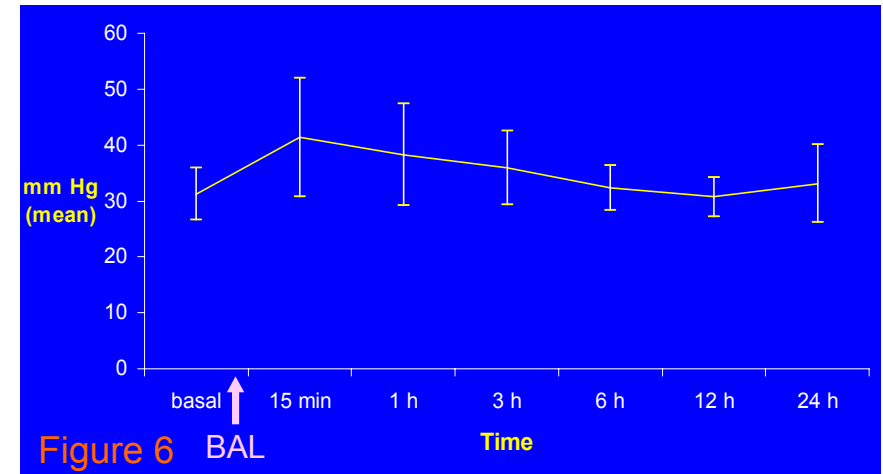


BAL with surfactant

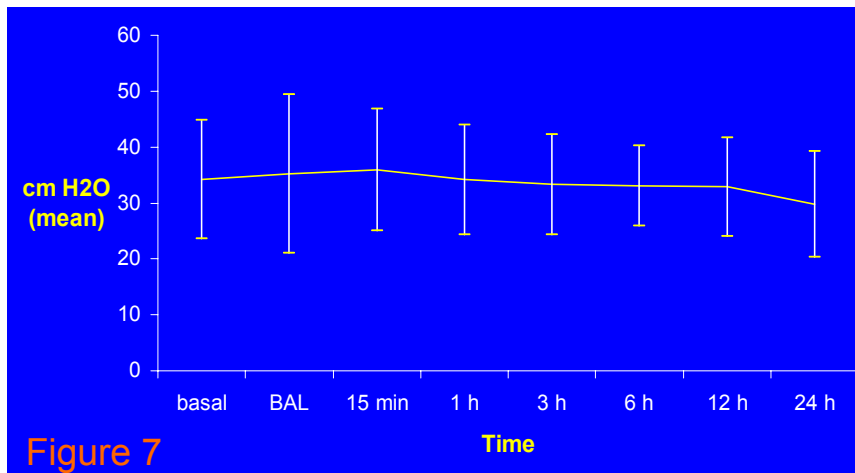
$\text{PaO}_2 / \text{FiO}_2$



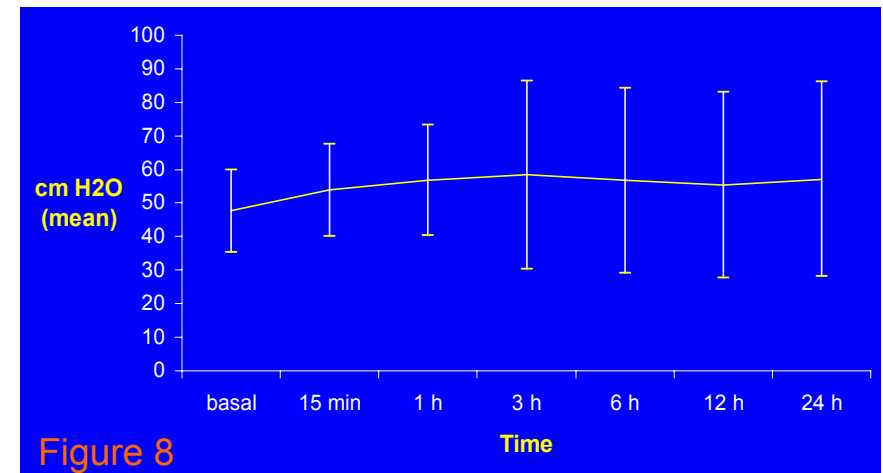
PaCO_2



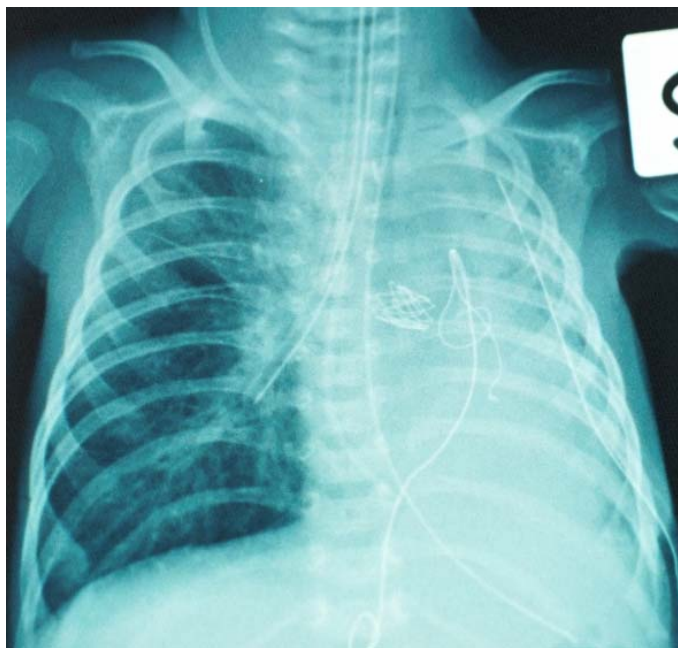
Peak Inspiratory Pressure



Compliance



Aspiration syndrome after thoracic surgery

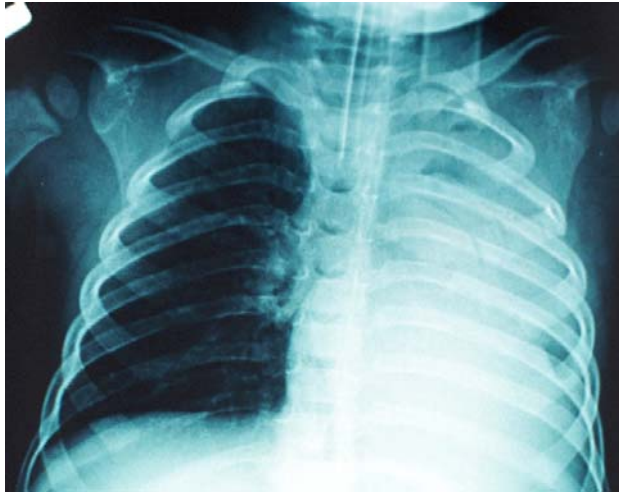


➤ Selective right bronchial intubation and ILV Chest X-Ray



➤ 48 hours after BAL

Aspiration syndrome in severely neurologically damaged child



➤ Basal condition



➤ Selective left bronchial intubation and ILV



➤ 48 hours after BAL

Results

- All children survived and no air leaks, haemodynamic or other complications were observed during or after BAL (Figures 1, 2)
- A decrease in SpO₂ was noted during BAL that recovered spontaneously at the end of manoeuvre (Figure 3)
- A slight increase in EtCO₂ and a marked increase in airway resistance were observed during BAL (Figure 4)
- A significant improvement in PaO₂/FiO₂ ratio was noted from 1 hour after BAL and surfactant supplementation (Figure 5)
- Better elimination of CO₂ was achieved from 3 hours (Figure 6)
- On completion of procedure a significant reduction in resistance and improvement in compliance were observed (Figures 7, 8)

Speculation

- Bronchoalveolar lavage with saline solution and surfactant can lead to
 - Improvement of lung pathology, respiratory mechanics and gas exchange
 - Reduction of complications typical of ARDS
 - Shortening of artificial ventilation and ICU stay