Mechanical ventilation associated lung injury (VALI) has been one of the main areas of research in the field of intensive care during the recent years. Convincing experimental data shows that positive pressure breathing can damage even normal, and especially, injured lung by several mechanisms. These include: overdistension (stretch injury), cyclic opening and reopening of lung units (atelectrauma) (1). As a consequence of these mechanically induced injuries there is also a third type of VALI; biotrauma. Experimental studies have provided evidence that injurious type of mechanical ventilation induces inflammatory response which can be seen both in lung and in systemic circulation. This inflammatory response is suggested to be related in the development of multiple organ failure (2).

Avoidance of lung overdistension is one method to minimize VALI in clinical setting. Several randomized, prospective clinical trials have tested the possible benefit of limitation of tidal volume. Largest trial in this field is NIH ARDSnet study, results of which will soon be published. In this study, tidal volume of 6 ml/kg was compared to conventional 12 ml/kg approach. Algorithms for PEEP- and FiO2-setting were similar in both groups. The results showed that mortality can be reduced by 22 % (From 39 % to 31% 180d mortality) in patients with ARDS by using this low-stretch ventilatory strategy (3).

Other aspects of VALI have also been tested in clinical setting. Amato et al. investigated the low stretch approach together with a strategy aimed at avoiding atelectrauma. In order to minimize cyclic opening and reopening during ventilatory cycle PEEP was individualized in each patient based on respiratory system mechanics, as assessed by the volume-pressure curve. In this study, mortality could be reduced by 40 % compared to conventional approach (4). Ranieri et al find that this kind of ventilatory strategy combining both minimization of overdistension and recruitment/derecruitment of the lung could attenuate cytokine response induced by acute lung injury (5).

In order to alleviate derecruitment/recruitment injury (atelectrauma) several recruitment manoeuvres have been proposed. Maybe, the most promising method is prone positioning. Prone positioning makes pleural pressure gradient more uniform, decreases shunt, and reduces ventilation-perfusion heterogeneity and thus improves oxygenation. These physiological effects resulted in a less severe and more homogenous distribution of VALI in dog-model (6). Clinical, prospective trials are ongoing to test potential role of prone positioning as a part of lung protective strategy.

Alternative ventilatory modes might also contribute in prevention of VALI. Maintaining spontaneous breathing efforts superimposed during mechanical ventilation has been shown to improve V/Q-matching, decrease posterobasal atelectasis and improve cardiac output. These findings have been confirmed with ventilatory modes like ARPV and BIPAP, where spontaneous breaths and mechanical cycles are uncoupled, whereas mechanical assistance of each inspiratory effort, as in pressure support ventilation, does not lead to these physiological benefits (7).

Strategy for lung protection in our unit is a combination of overnamed approaches. We measure lung mechanics on daily basis in patients with severe ALI/ARDS. For reconstruction of PV-loops we use slow-flow method described by Lu et al (8). We use...
pressure controlled modes and pressure limits are adjusted on a linear part of the PV-loop. Static inspiratory pressures over 35 cmH2O are never allowed, and tidal volumes are currently limited to 8-10 ml/kg. Static pressures and compliance are measured at least once per nurseshift. If PaO2/FiO2-ratio decreases below 200 mmHg in supine position after these ventilatory adjustments, we turn the patient prone for next 4-6 hours. This evaluation for prone positioning is done twice a day. For prone positioning we have only few absolute contraindications.

The effect of maintaining spontaneous breathing has been our investigational interest. Prospective, randomized clinical trial has been ongoing since 1998 comparing conventional pressure controlled mode to airway pressure release ventilation (APRV). Interim analysis, published as an abstract, showed that APRV with spontaneous breathing is feasible, even in very severe ARDS. APRV offers better oxygenation and length of mechanical ventilation might be shorter. In overall mortality (28% vs. 30%) there is no difference, though, but the study is still lacking power to show any possible difference (9).

References