Abstract:

Conventional mechanical ventilation provides gas exchange in conditions of respiratory failure by application positive airway pressure in the respiratory system. Due to the significant change in pressure conditions inside the thorax during conventional artificial ventilation the circulation can be significantly affected. Recruitment maneuver (RM) techniques can be a part of ventilation strategy in patients with the Acute Respiratory Distress Syndrome (ARDS), that are used to re-aerate collapsed parts of the lung parenchyma. During these RMs a significantly higher airway pressure is used than in protective ventilation strategy, which can limit the flow through the lung capillary network and can significantly affect the systemic hemodynamics of the patient.

The aim of this work was to develop an optimized animation model of ARDS, then to compare the influence that has the application of different types of recruitment maneuvers on hemodynamics and to create a biomechanical simulation model of interaction and blood circulation and its verification with data obtained during the implementation of different types of RM in the experimental animal ARDS model.

Results from the experimental animal model and simulations performed on the biomechanical model show that hemodynamically the most serious impact has Sustain Inflation RM technique, where high overpressure limits blood flow through the lungs to 5 % of baseline. PVtool RM technique has a similar harmful haemodynamic impact where blood flow reaches only 6 % of baseline values.

After the onset of self-regulation, PCV-RM technique shows a decrease blood flow to 57 % of baseline value, as long as the inspiration / expiration time ratio is maintained 1:2 The shortening of relaxation time y prolongation of the inspiratory time by the change of I:E ratio to 1:1 results in a decrease blood flow to 53 % of the baseline

The staircase RM performed at the ART trial has, despite the high pressures used, a simulated reduction of the initial blood flow rate to 78 %, which is hemodynamically less harmful contrary to the one step increase during PCV-RM.

Key worlds: recruitment maneuver, ARDS - acute respiratory distress syndrome, protective ventilation strategies, animal model