Impact of dynamic airway collapse and continuous flow insufflation on initial and dynamic lung volume changes and intrathoracic pressure variation during automated cardiopulmonary resuscitation

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Introduction: During CPR, chest compressions (CC) cause variations in intrathoracic pressure (P\textsubscript{IT}) that 1) allow blood circulation, 2) generates ventilation 3) reduce lung volumes below the functional residual capacity (FRC). During the decompression phase, the negative P\textsubscript{IT} favors venous return but also promotes airways collapse. During compression phase, positive P\textsubscript{IT} favors the heart ejection.

Objective: Study the effects of chest compression on intrathoracic pressure and lung volume changes relative to initial FRC.

Materials and methods: Original bench test comprising a CRF allowing to simulate or not a dynamic airway collapse while receiving mechanical chest compression (Lucas 2©). We simulated three different situations. 1) Simple model without collapse and in the absence of superimposed ventilation; 2) Simulation model with collapse and in the absence of superimposed ventilation; 3) Simulation model with collapse and application of a positive pressure of 10 cm H\textsubscript{2}O by continuous flow insufflation (CFI) with CPR Boussignac© tube.

Results: The addition of airway collapse (situation 2) results in: A) Significant reduction of lung volume relative to FRC at the end of the chest decompression phase; B) Significant reduction in the tidal volume mobilized; C) Decrease in maximum (red in the figure) and minimal (blue in the figure) P\textsubscript{IT}. The application of positive pressure via the CFI system partially restored the FRC, the minute ventilation and thoracic pressures compared to the situation 1 (without collapse).

Conclusion: Mechanical CC plus dynamic airway collapses reproduces minute ventilation and lung volume changes that better represent clinical observations. The application of a positive pressure system via CFI partly counteract negative effects of collapse thus allowing efficient ventilation and probably a better hemodynamic profile.