EFFECT OF HEAD-UP DURING CHEST COMPRESSIONS ON LUNG VENTILATION DISTRIBUTION. AN ELECTRICAL IMPEDANCE TOMOGRAPHY PILOT STUDY

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Introduction

Chest compressions during head-up (head and thorax elevation) improves cerebral perfusion and survival in animal models of cardiac arrest. Its effect on lung ventilation is unknown. Therefore, our goal was to investigate the effects of head-up elevation during chest compressions on lung ventilation.

Methods

In seven fresh human cadavers lung ventilation was measured with electrical impedance tomography (EIT) before and during chest compressions at 100/min while mechanical ventilation was performed in volume control mode (tidal volume 8 ml/kg predicted body weight, FIO2 21%, respiratory rate 10/min). EIT was determined by using a ring of 16 electrodes around the thorax and the EIT signal recorded by the Gottingen High-Performance device. An experimental sequence consisted of the followings: chest compressions applied in flat position for 1 minute then continuously during head-thorax elevation from 18° to 35° achieved by an automatic device over 2 minutes and maintained at 35° for 1.30 minute. Each sequence was performed at positive end-expiratory pressure (PEEP) 0, 5 and 10 cmH_2O or when using an impedance threshold device at PEEP0, or without chest compressions. Therefore, each cadaver was subjected to 5 sequences applied in a random order. We calculated tidal ventilation (VTEIT in arbitrary units: a.u.), end-expiratory lung impedance (EELI), EELI/VTEIT and pendelluft. The median (1^{st}-3^{rd} quartiles) values of them were compared between flat, 18°, and 35° by mixed-effects model in each sequence.

Results

With chest compressions VTEIT decreased during head-thorax elevation in every sequence. At PEEP0 it was 12416 (10689;14442) a.u. in flat, 11239 (7667-13292) a.u. at 18° and 6457 (4631-9516) a.u. at 35° ($P<0.05$ between 35° and flat). Pendelluft did not change significantly with inclination in any sequence. EELI/VTEIT ratio increased at PEEP10 cmH2O from -1 (-1.23;-0.70) in flat to -2.80 (-3.00;-2.24) at 35° ($P<0.05$). Over all the sequences with chest compressions, EELI/VTEIT ratio significantly decreased from-0.30 (-0.40;-0.15) before to -1.13 (-1.70;-0.61) after the chest compressions ($P=0.0092$).

Conclusions

Head-thorax elevation decreased lung ventilation with chest compressions compared to flat position. Chest compressions are associated with decrease in EELI.