LUNG DERECRUITMENT DURING GENERAL ANAESTHESIA WITH CONSTANT POSITIVE END-EXPIRATORY PRESSURE

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INTRODUCTION

The literature is controversy regarding the use of positive end-expiratory pressures (PEEP), failing to demonstrate, so far, reduction of postoperative pulmonary complications (PPCs). This pilot study aims to evaluate the behavior of pulmonary aeration in surgery under general anesthesia and mechanical ventilation with continuous use of PEEP.

METHODS

Pilot study with female patient, 39 years-old, ASA P2, underwent facial plastic surgery with general anesthesia during 9 hours and 30 minutes. Held mechanical ventilation (MV) volume-controlled, V_T 8 ml/kg of predicted body weight, PEEP 5 cmH₂O, FiO₂ 50% and respiratory rate to keep ET-CO₂ between 35 and 45 mmHg. Ventilation parameters (including V_T and PEEP) were kept constant throughout the anesthesia. It was not performed recruitment maneuvers. Regional lung aeration (dependent and non-dependent), inferred by the end-expiratory lung volume (EELV) was evaluated in real time with electrical impedance tomography (Enlight®, São Paulo, Brazil) during all procedure.

RESULTS

It was observed gradual reduction of EELV, with marked loss (487 mL) two minutes after anaesthetic induction and MV (Figure 1). After 1 hour under MV, EELV was reduced in 1224 mL. After this period, there was a decrease in the fall rate of the EELV until it reaches a loss of 2021 mL after 8 hours of MV. Dependent region aeration showed marked drop compared to the non-dependent region (Figure 1 and 2).

Figure 1. DEPENDENT AND NON-DEPENDENT LUNG AERATION

Figure 2. REGIONAL LUNG AERATION

At the end of surgery, the loss in the dependent region was 1,656 mL, or 82% of the total decrease of the EELV. The ΔZ (V_T) did not change significantly since it was kept constant all ventilation parameters. However, the distribution of ventilation between the regions non-dependent / dependent change after induction, from 44% / 56% to 64% / 36%. Lung compliance (Crs) tended to decrease during the intraoperative.

Table. Lung aeration measurements before, during and after mechanical ventilation

	NON DEPENDENT	DEPENDENT	p-value
Spontaneous	136.8 ± 26.9	-39.1 ± 28.5	0.0001
After induction	173.9 ± 12.5	-660.7 ± 9.9	0.0001
60 min	-113.8 ± 21.7	-1110.5 ± 17.6	0.0001
120 min	-223.3 ± 9.7	-1290.8 ± 4.7	0.0001
180 min	-321.5 ± 23.9	-1440.3 ± 10.8	0.0001
240 min	-513.1 ± 12.2	-1609.5 ± 9.2	0.0001
300 min	-440.5 ± 27.1	-1593.0 ± 9.5	0.0001
360 min	-296.5 ± 16.9	-1522.2 ± 6.5	0.0001
420 min	-361.8 ± 6.6	-1582.6 ± 6.4	0.0001
480 min	-364.5 ± 17.4	-1656.5 ± 6.8	0.0001
Extubation	207.3 ± 34.1	-661.2 ± 24.0	0.0001
PACU	22.4 ± 70.9	-886.6 ± 68.0	0.0001

* Variables are expressed as mean ± SD

After emergence from anaesthesia, there was a self-recruiting of 1360 mL during spontaneous ventilation. At discharge from PACU, dependent region still showed a decrease of 886 mL and non-dependent region an increase of 22 mL compared to preoperative values. A repeated measured analysis of variance (ANOVA) was performed to evaluate the loss of lung aeration among time-points (after intubation until the end of the surgery). Follow up comparisons indicated that each pairwise difference was significant, $p = 0.013$ (non-dependent region) and $p = 0.003$ (dependent region). There was a significant loss of lung aeration over time, despite the constant PEEP.

Figure 3. LUNG AERATION AT DIFFERENT TIME POINTS

Functional lung image acquired from EIT offline analysis. Regions with higher air represented in white, regions with less air in dark blue, regions not aerated in gray.

CONCLUSIONS

Anaesthesia causes abrupt loss of lung aeration and also causes ventilation redistribution from dependent to non-dependent region. PEEP of 5 cmH₂O was ineffective to maintain lung volume. Loss aeration occurs mainly in dependent region and it is more pronounced in the first hour of mechanical ventilation.