Effects of lateral position and open chest on lung and chest wall resistance during thoracic surgery

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Introduction

Airway-pressure (Paw) based respiratory mechanics guides mechanical ventilation during anesthesia.

However, altered properties of the chest wall may significantly influence the interpretation of Paw, especially in settings in which an alteration of chest physiology occurs.

Aim of the present study was to investigate the resistive behavior of lung and chest wall during different phases of thoracic surgery.

Methods

Subjects undergoing thoracotomic pulmonary resection were enrolled.

Double-lung ventilation (DLV): tidal volume (TV) 8 ml/kg, PEEP 8 cmH2O, FiO2 and respiratory rate to maintain SaO2 94-98% and EtCO2 30-35 mmHg.

One-lung ventilation (OLV): TV 5 ml/kg and respiratory rate increased accordingly. Esophageal pressure as a surrogate for pleural pressure.

Maximal respiratory system resistance (Rmax,rs): difference of peak and plateau airway pressure divided by inspiratory flow. Rmax,rs includes flow resistance of airways (Rmin,rs) and that caused by stress relaxation/time constant inequalities within the tissues (DR,rs). Each resistance was partitioned into their respective lung/chest wall component (Rmax,l; Rmin,l; DR,l; Rmax,cw). See figure 1

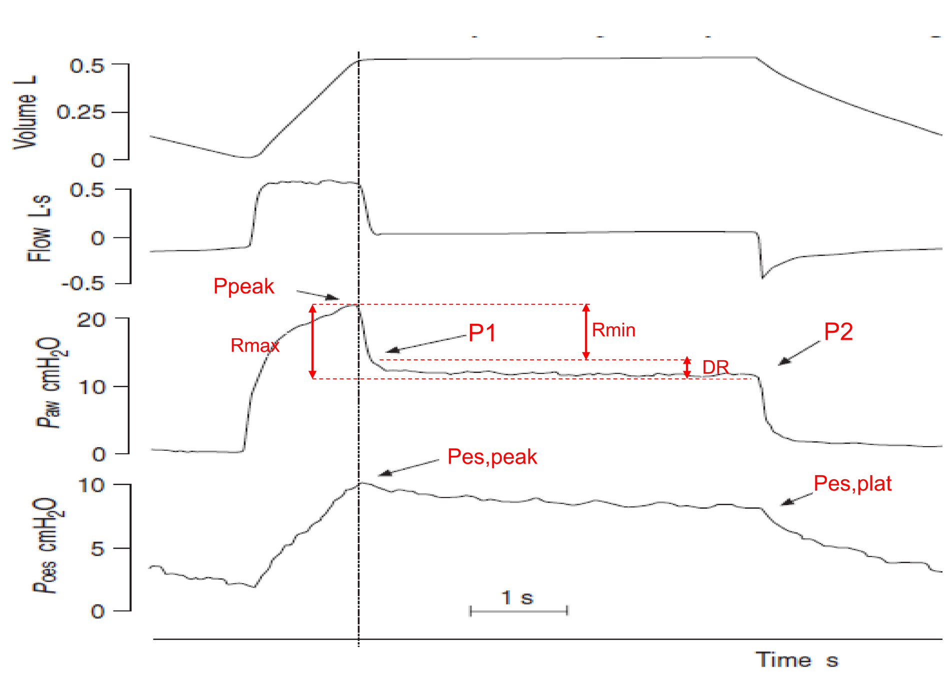


Figure #1

Measurements were repeated during DLV in supine and lateral decubitus, OLV in lateral decubitus during closed and open chest conditions (figure 2)

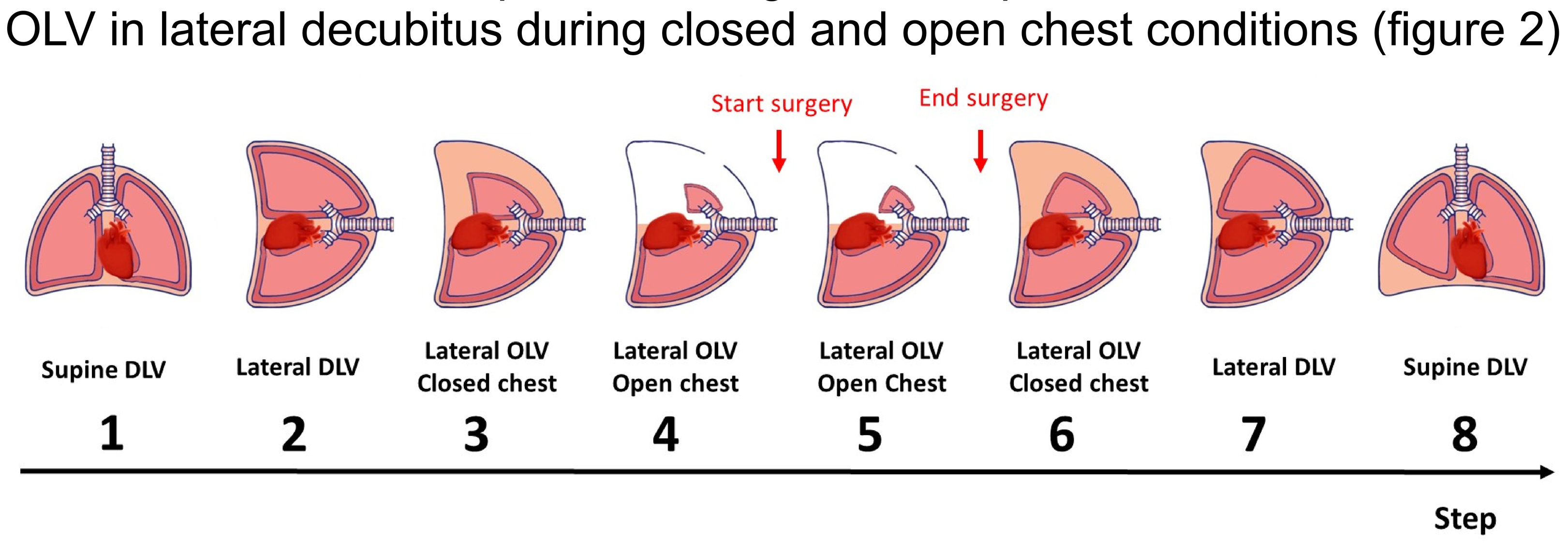


Figure #2

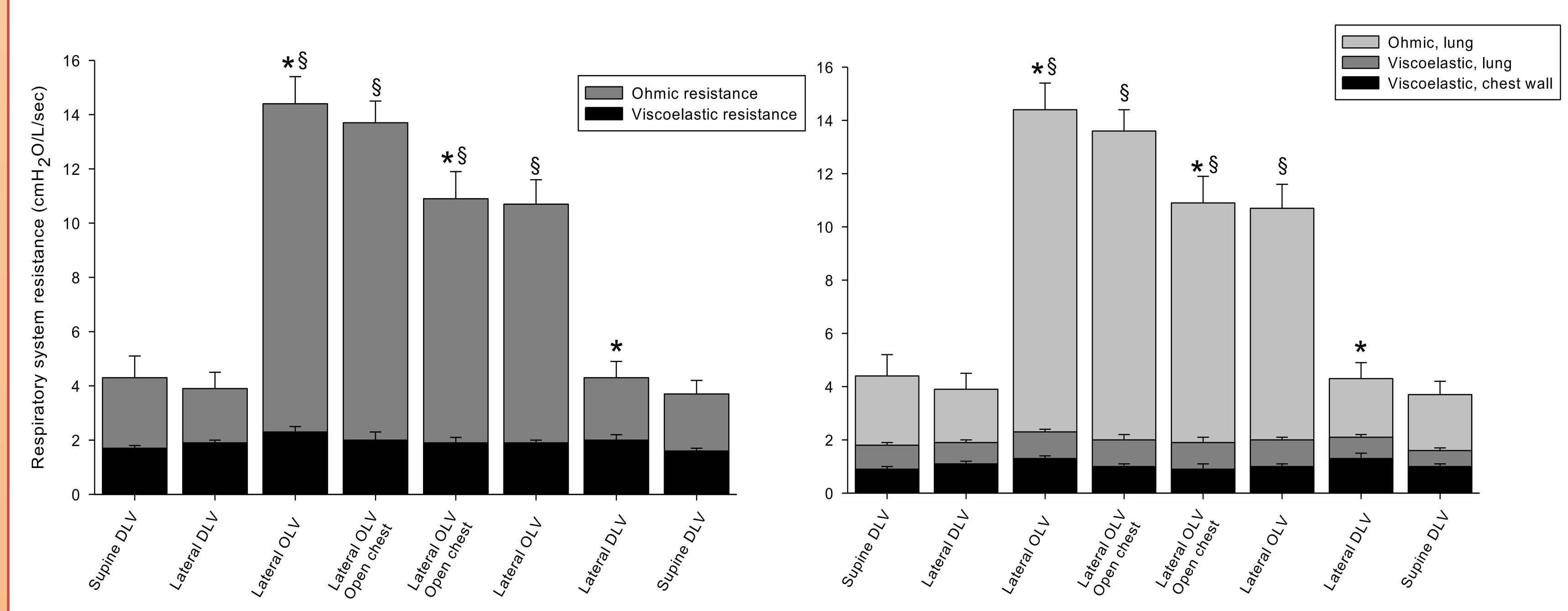
Results

30 patients were enrolled,
18 males (60%), age 68±10 years.

ASA physical status (n°. %)	
Class I-II	16 (53.3%)
Class III-IV	14 (46.7%)
Underlying diseases (n°. %)	
Hypertension	18 (60%)
Coronary artery disease	1 (3.3%)
Diabetes	5 (16.7%)
Active Smoker (n°. %)	9 (30%)
Pulmonary function (% of predicted)	
Forced vital capacity	99.2±17.7
Forced expiratory volume in 1 sec	91.4±17.5
FEV1/FVC	96.3±12.5
Carbon monoxide diffusion capacity	71.3±18.5
Chronic lung disease (n. %)	
Obstructive	6 (20%)
Restrictive	1 (3.3%)
Previous lung surgery (n°. %)	5 (16.7%)
Lung surgery (n°. %)	
Wedge resection	14 (47%)
Lobectomy	16 (53%)
Decubitus (n°. %)	
Left side	19 (63%)
Right side	11 (37%)
Intraoperative timing (min)	
Anaesthesia length	201±52
Surgery length	138±39
One-lung ventilation length	137±35

Figure 3 shows the respiratory system, lung and chest wall resistances partitioned into their Ohmic and viscoelastic components during the different study steps

Figure #3



* p<0.05 vs. previous step, § p<0.05 vs. supine DLV

Conclusions

Unexpected decrease in Rmax, rs after lung resection: Possible increase in the radial traction acting on the airways after lung re-expansion, increasing their diameter, then reducing resistance.

A similar phenomenon was seen in lung volume reduction surgery: parenchymal resection brings to an increased slope of the recoil pressure - maximum flow relationship (greater flow at the same pressure), then leading to increased airway conductance

Paw-based monitoring of resistance during the different phases of thoracic surgery does not allow to differentiate the cause of an alteration. In this context, we suggest that partitioning of respiratory mechanics may give a deeper insight into the resistive behavior of the lung and the chest wall.

References

1. *Pelosi, Anesth Analg 1995*
2. *Barnas, J Cardiothorac Vasc Anesth 1997*
3. *Gelb, Am J Respir Crit Care Med. 1996*