UNIWERSYTET
MEDYCZNY
W ŁODZI

Respiratory specifics in perioperative care of obese patients

Tomasz Gaszynski

Department of Anaesthesiology and Intensive Therapy,

Medical Univeristy of Lodz, Poland

Past Vice-President of European Society for Per-Operative Care of the Obese Patient

The European Society for Perioperative Care of the Obese Patient

ESPCOP

www.espcop.org

CONFLICT(S) OF INTEREST

Nothing to declare for this presentation

Pulmonary mechanics and ventilation in the obese

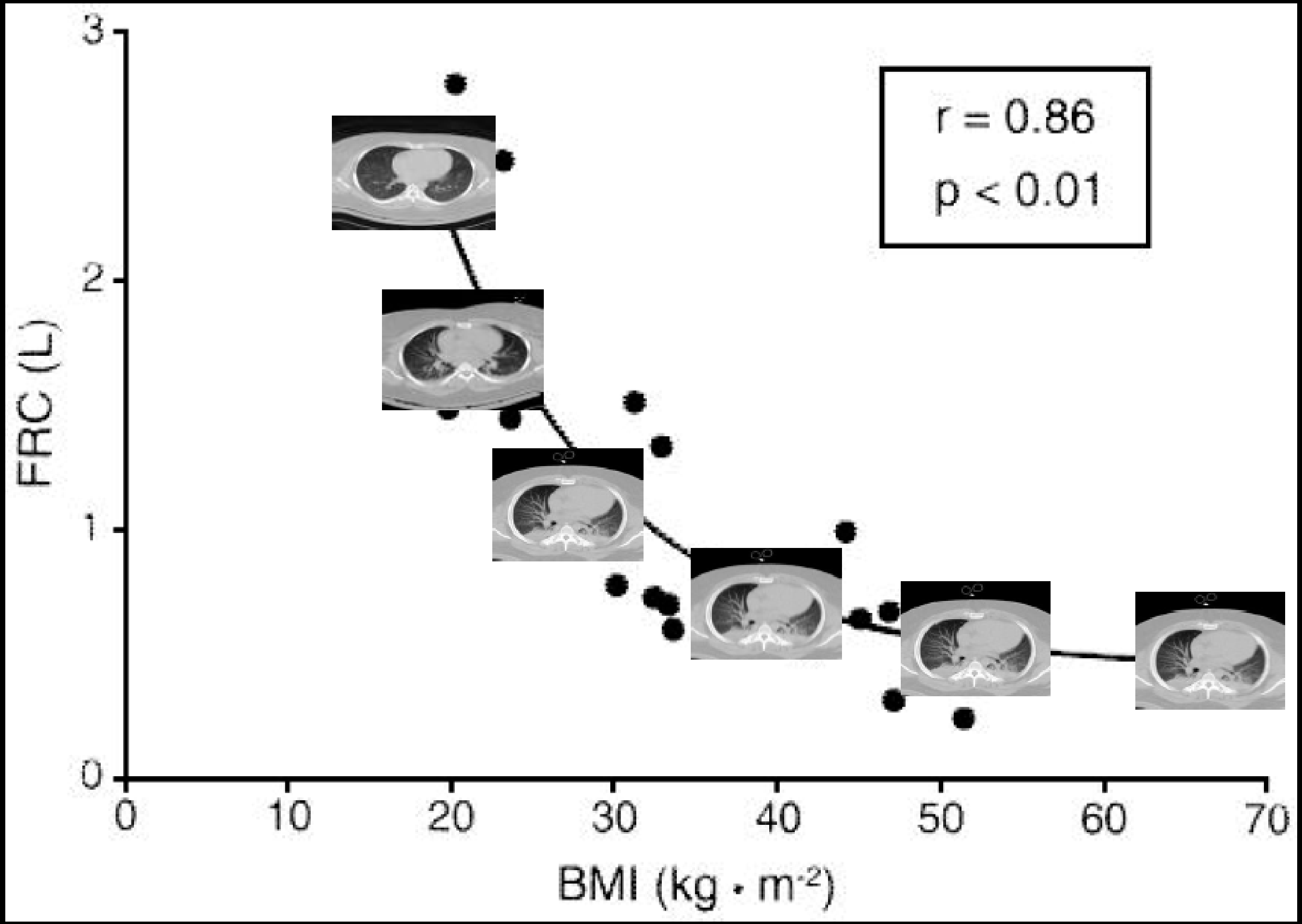
- The body mass effects significantly lung volumes, respiratory mechanics and gas exchange during general anesthesia.
- Obesity results in:

1. Reduced lung capacity, primary due to diminished functional residual capacity (FRC) and expiratory reserve volume (ERV)
2. Increased ventilation-perfusion mismatch
3. Increased chest wall resistance
4. Reduced respiratory system compliance
5. Higher intra-abdominal pressure

- Adequate mechanical ventilation in obese patient requires experience and penetrating observation of ventilation parameters.

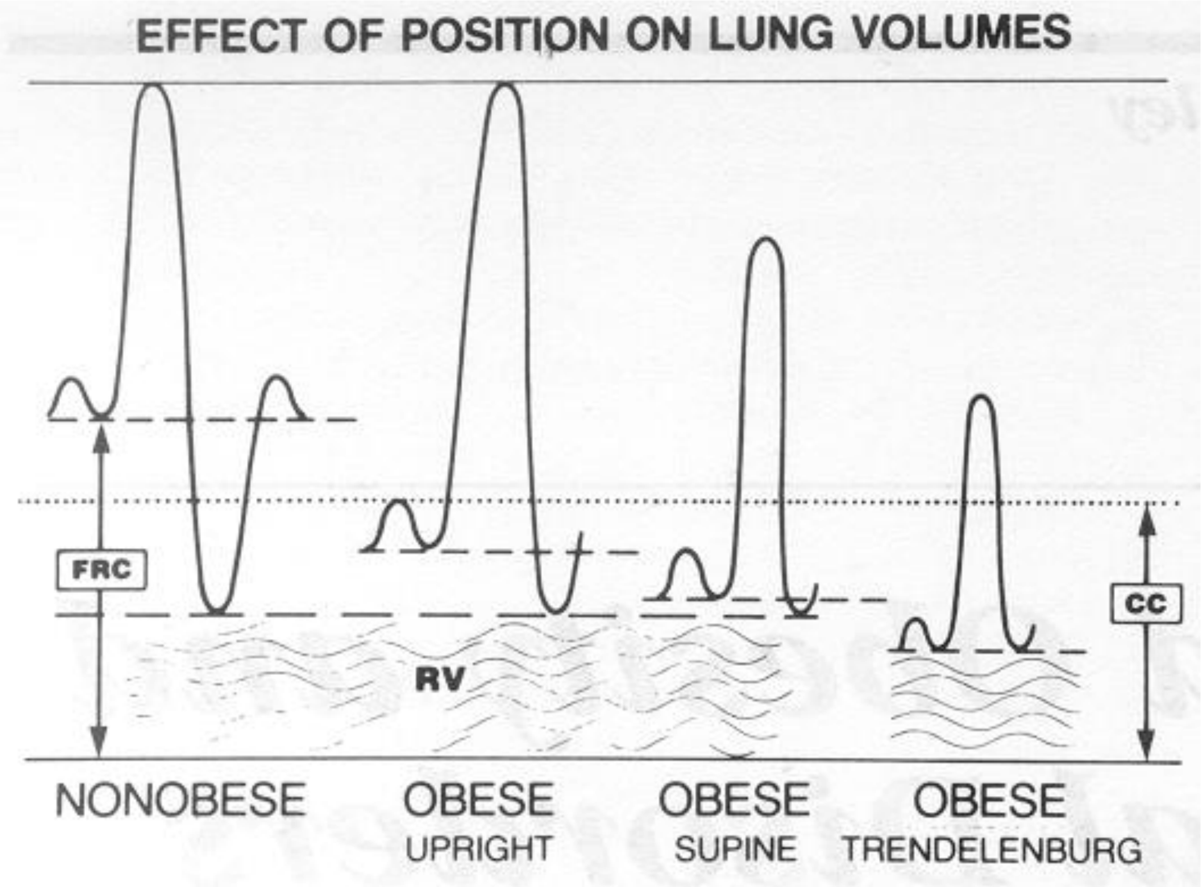
Lung volume as a function of obesity

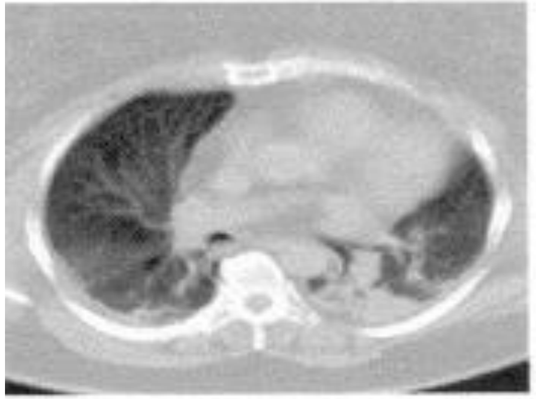
Pelosi P et al. Anesth Analg. 1998 Sep;87(3):654-60



Pulmonary mechanics and ventilation in the obese

- Because of this, obese patients are at higher risk for hypoxemia, both during and after surgery, and the formation of atelectasis.
- Because lung voulme is decreased and tidal volume is near closing capasity morbidly obese develop very fast atelectasis.

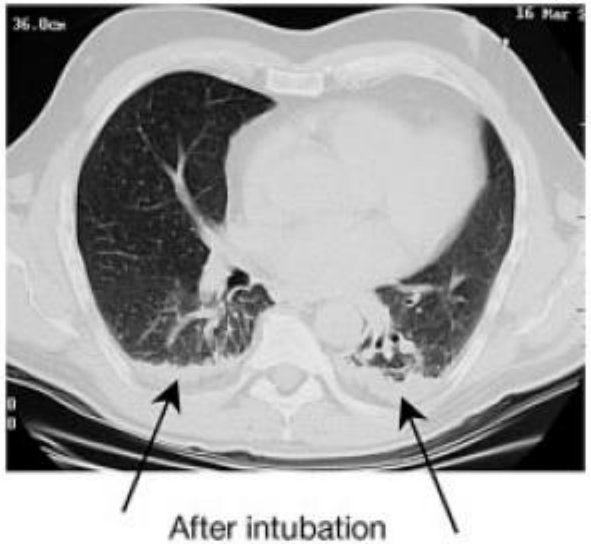

EFFECT OF POSITION ON LUNG VOLUMES
FRC
RV
CC
NONOBESE
OBESE
UPRIGHT
OBESE
SUPINE
OBESE
TRENDELENBURG



Intraoperative atelectasis

- Atelectasis forms very fast after induction to general anaesthesia in morbidly obese,
- Lower parts of lungs are worse ventilated and atelectasis occurs.

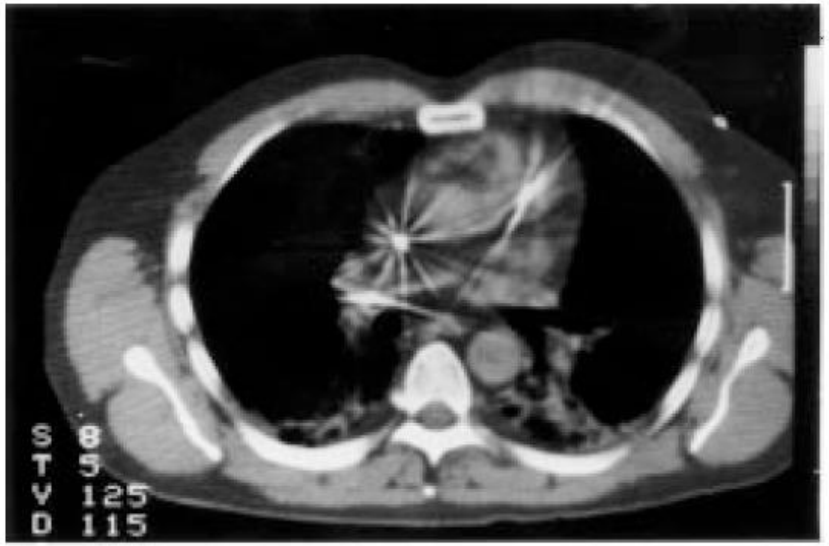
Before induction

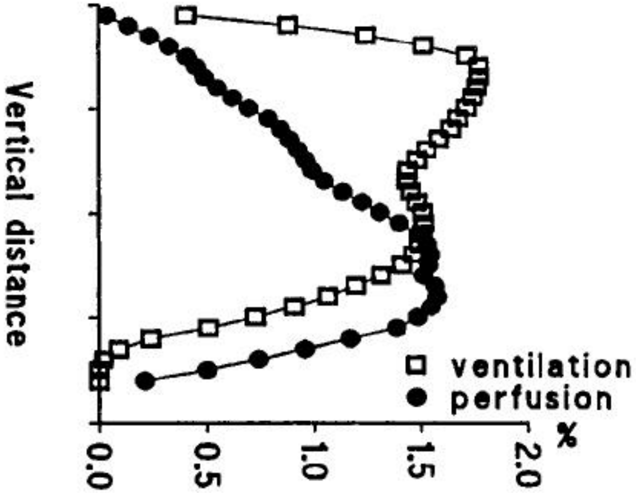


After intubation

Atelectasis and shunt

- During general anaesthesia with paralysis front parts of lungs (upper) are better ventilated than back parts (down – lung base regions),



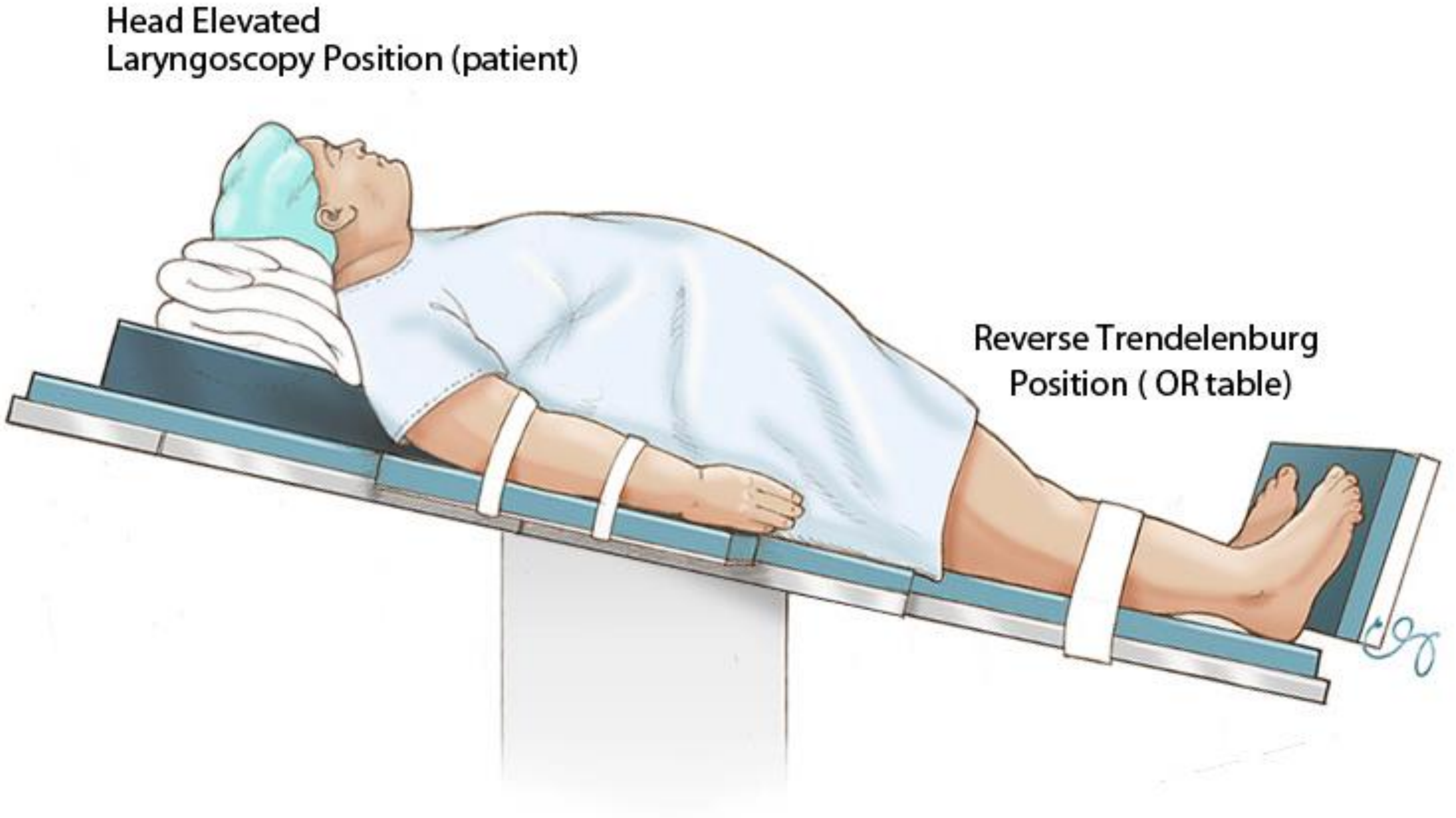


Pulmonary mechanics and ventilation in the obese

- Proper patient positioning may improve mechanical ventilation condition.
- In supine position heart work and pressure in lung artery are increased.
- The abdominal contents limit diaphragmatic movement, reducing FRC furthermore, increasing airway pressures.
- Supine position produces reduction in respiratory systems and pulmonary compliance and reduction in lung perfusion.
- Therefore it is advised to position obese patient in Fowler position (anti-Trendellenburg).

Airway Management In Obesity

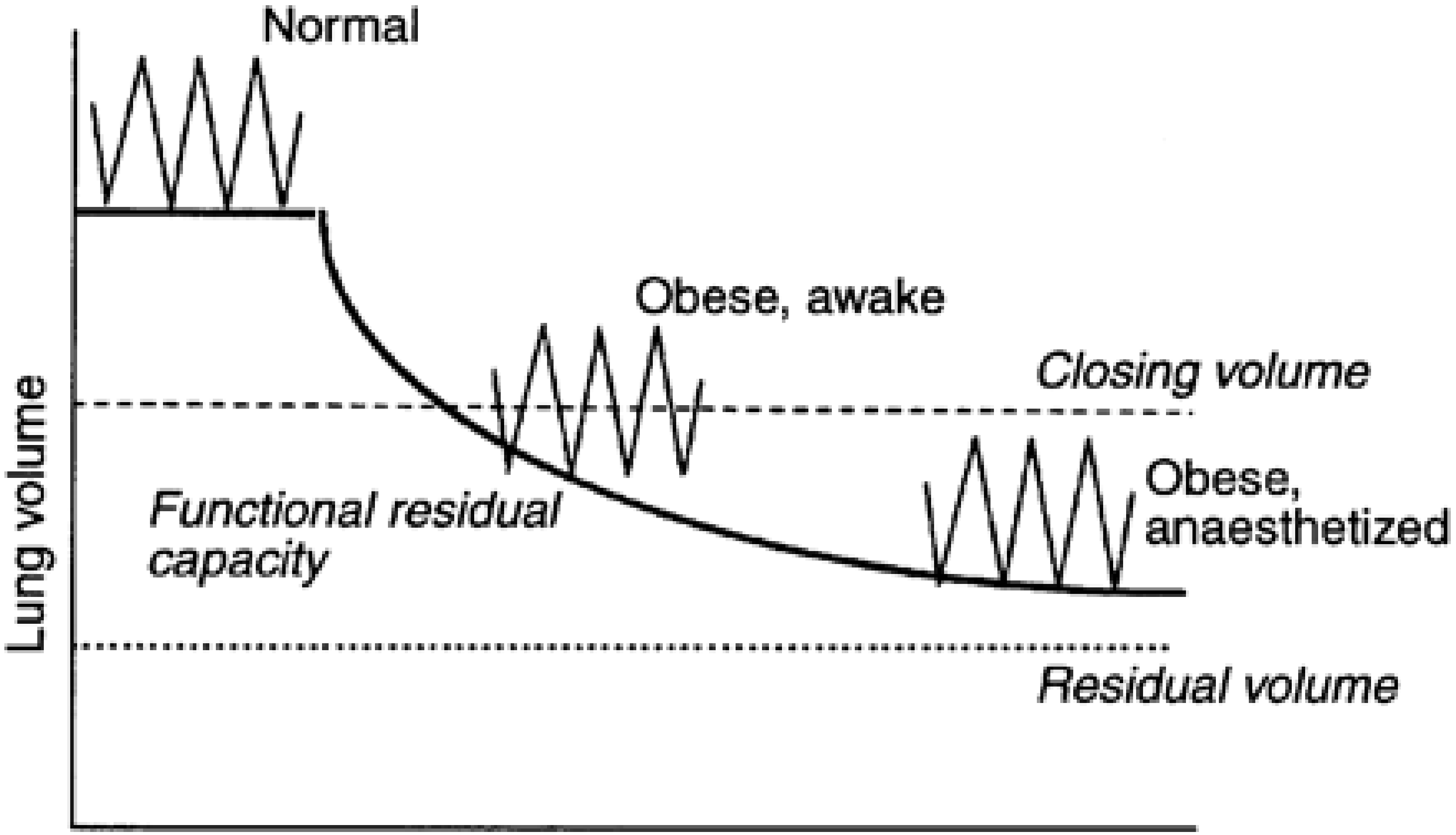
Thursday, April 03, 2014
By Jay B. Brodsky, MD
Are the airways of morbidly obese patients “difficult”? The answer to this question depends what aspect of airway management is being considered!



Pulmonary mechanics and ventilation in the obese

- General anaesthesia (GA) and muscle relaxation in morbidly obese makes more difficult mechanical ventilation.
- This is related to further decrease in FRC and worsening of proportion of ventilation to perfusion.

FRC



J. P. Adams and P. G. Murphy. Obesity in anaesthesia and intensive care British Journal of Anaesthesia, 2000, Vol. 85, No. 1 **91-108**

The effects of surgery procedure on lung physiology in patients with obesity

The Effects of Abdominal Opening on Respiratory Mechanics During General Anesthesia in Normal and Morbidly Obese Patients: A Comparative Study (Anesth Analg 2002;94:741–8)

José O. C. Auler, Jr., MD, PhD, Erika Miyoshi, MD, Cláudia R. Fernandes, MD,
Fábio E. Benseñor, MD, Luciana Elias, MD, and Jorge Bonassa, PhD

Department of Anesthesia, Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, São Paulo, Brazil

- As predicted, the mean values of Cst,L were significantly less in obese patients compared with normal-weight patients (*P* 0.05) at all time points of the study.
- Only in obese patients did Cst,L increase significantly 1 h after the peritoneum was opened, and it decreased again to the original values after the peritoneum had been closed.

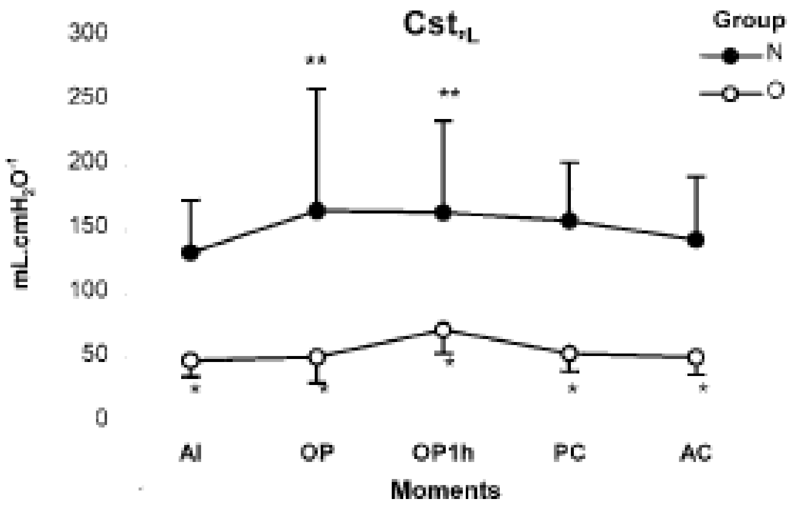


Figure 3. Static lung compliance ($C_{st,L}$). N = normal patients, O = obese patients, AI = anesthetic induction, OP = opened peritoneum, OP1h = 1 h open peritoneum, PC = peritoneum closed, AC = abdomen closed, measured in mL/cm H_2O. *$P < 0.05$, significant difference between groups; **$P < 0.05$, significant difference between measurements for obese patients (analysis of variance for repeated measures followed by the Tukey test).

Effects of abdominal opening on respiratory physiology in patients with obesity

- After abdominal opening,the mechanical ventilation conditions improved: increased lung compliance and decreased airway pressures.
- The difference was statistically significant in the entire population studied.
- After dividing the population into groups, however, the difference was no longer significant in patients with BMI >60.
- The most significant difference in peak and plateau pressures after abdominal opening was observed in patients with BMI <50.

Anesthesiol Inten Ther Oct-Dec;42(4):172-4.
The effects of abdominal opening on respiratory mechanics during general anaesthesia for open bariatric surgery in morbidly obese patients
Tomasz M Gaszyński

Influence of pneumoperitoneum on lungs physiology

- laparoscopic surgery requires controlled gas insufflation into the peritoneal cavity (pneumoperitoneum). For this purpose, carbon dioxide is regularly used under a pressure of 10–15 mmHg.
- Pneumoperitoneum distends the abdominal wall and cranially displaces the diaphragm, which diminishes lung volumes, including the functional residual capacity (FRC), and, thus, increases the amount of atelectasis, especially in the dependent zones of the lung .

REVIEW

The Physiologic Effects of Pneumoperitoneum in the Morbidly Obese

Ninh T. Nguyen, MD, FACS, and Bruce M. Wolfe, MD, FACS†*

Influence of pneumoperitoneum on lungs physiology

- Furthermore, the high intra-abdominal pressure (Pab) increases respiratory resistance and elastance (i.e., reduces compliance). As a result, airway pressure augments,
- Pneumoperitoneum rises respiratory system resistance mainly due to lung and chest wall viscoelastic properties and mechanical heterogeneities.

REVIEW

(*Ann Surg* 2005;241: 219–226)

The Physiologic Effects of Pneumoperitoneum in the Morbidly Obese

Ninh T. Nguyen, MD, FACS, and Bruce M. Wolfe, MD, FACS†*

Influence of pneumoperitoneum on lungs physiology

- Clinically, an increase in intrathoracic pressure can diminish cardiac output and trigger ventilator-induced lung injury (VILI).
- Although most patients can well tolerate these changes, clinically important consequences concerning the respiratory system may result in those with deranged baseline respiratory mechanics, e.g., with pneumopathies or obese.

REVIEW

The Physiologic Effects of Pneumoperitoneum in the Morbidly Obese

Ninh T. Nguyen, MD, FACS, and Bruce M. Wolfe, MD, FACS†*

Obesity and pneumoperitoneum

- the challenges presented by laparoscopy itself, there are anesthesiological issues characteristic of obese patients.
- Under baseline conditions they present increased chest wall and, possibly, pulmonary elastances , reduced lung volumes (including FRC), and higher closing capacity.
- As a result, V′/Q′ mismatch, impaired oxygenation and increased shunt can be found. These pathologic conditions worsen during general anesthesia.

REVIEW

The Physiologic Effects of Pneumoperitoneum in the Morbidly Obese

Ninh T. Nguyen, MD, FACS, and Bruce M. Wolfe, MD, FACS†*

Influence of pneumoperitoneum on lungs physiology

- Dynamic lung compliances were 44.6±7.8 SD, 31.8±5.5 and 44.5±8.3 cm/H_2O before, during and after PPM respectively with significant differences,
- Although significant decrease in lung mechanics was found in the present study, these variations were well tolerated in morbidly obese patients with PPM pressure of 15 mmHg.

El-Dawlatly, A.A., Al-Dohayan, A., Abdel-Meguid, M.E. *et al.* The Effects of Pneumoperitoneum on Respiratory Mechanics During General Anesthesia for Bariatric Surgery. *OBES SURG* **14**, 212–215 (2004). https://doi.org/10.1381/096089204322857582

Obesity Surgery, **14**, 212-215

The Effects of Pneumoperitoneum on Respiratory Mechanics During General Anesthesia for Bariatric Surgery

Abdelazeem Ali El-Dawlatly, MD[1]; Abdullah Al-Dohayan, FRCS[2]; Mohamed Essam Abdel-Meguid, MD[1]; Essam M. Manaa, MD[1]; Abdelkareem El-Bakry, FRCS[2]

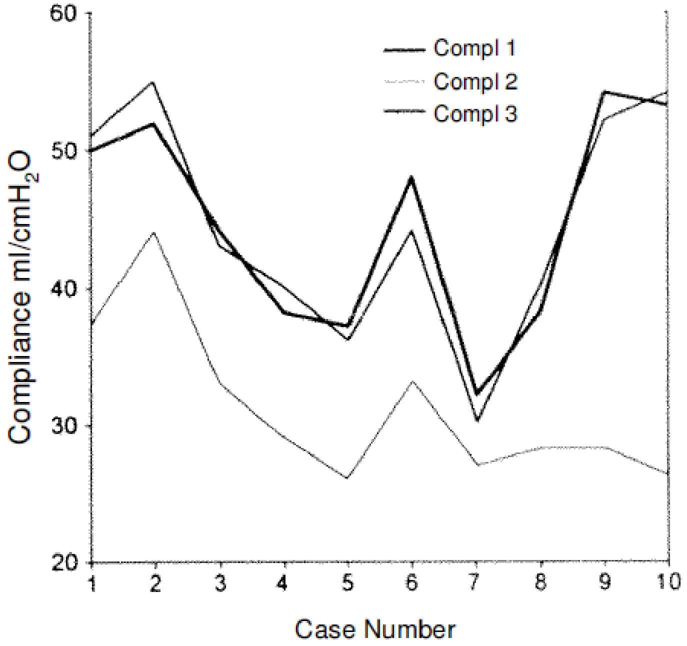


Figure 2. Dynamic lung compliance (DLC) changes before PMM (Compl 1), during PMM (Compl 2), after gas deflation (Compl 3).

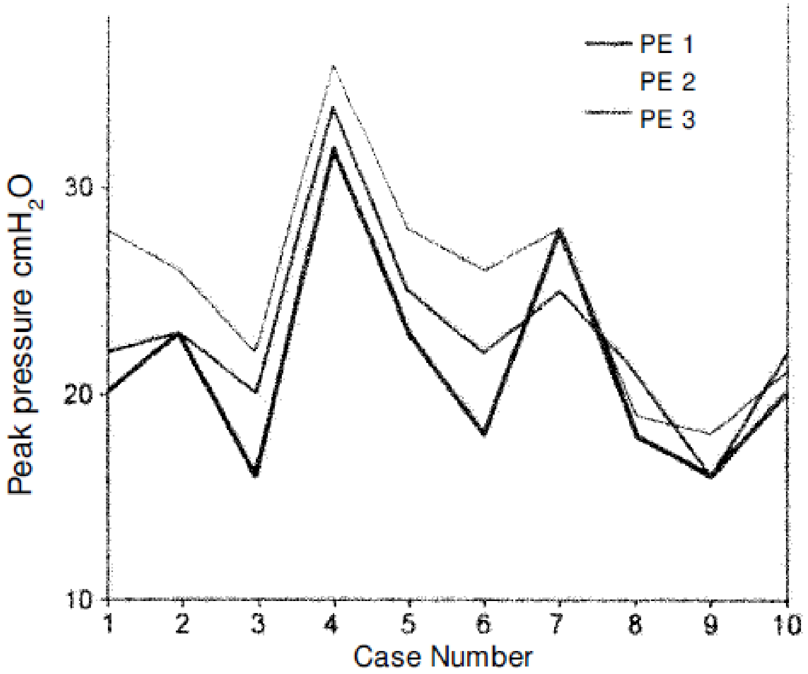


Figure 1. Peak airway pressure changes before PMM (PE 1), during PMM (PE 2) after gas deflation (PE 3). PE=peak airway pressure.

The Impact of Morbid Obesity, Pneumoperitoneum, and Posture on Respiratory System Mechanics and Oxygenation During Laparoscopy

(Anesth Analg 2002;94:1345–50)

Juraj Sprung, MD, PhD*, David G. Whalley, MB, ChB†, Tommaso Falcone, MD‡, David O. Warner, MD*, Rolf D. Hubmayr, MD§, and Jeffrey Hammel, MS||

*Department of Anesthesiology and §Thoracic Diseases Research Unit, Mayo Clinic, Rochester, Minnesota; †Department of Anesthesiology, Cleveland Clinic Florida, Naples, Florida; and ‡Obstetrics and Gynecology and Minimally Invasive Surgery Section and ||Department of Biostatistics and Epidemiology, The Cleveland Clinic Foundation, Cleveland, Ohio

- morbid obesity and pneumoperitoneum have significant effects on respiratory mechanics, whereas PaO_2 was adversely affected only by increased body weight.
- Repositioning the patient from the supine position into the Trendelenburg or reverse Trendelenburg position had no effect on PaO_2 either before or after abdominal insufflation.

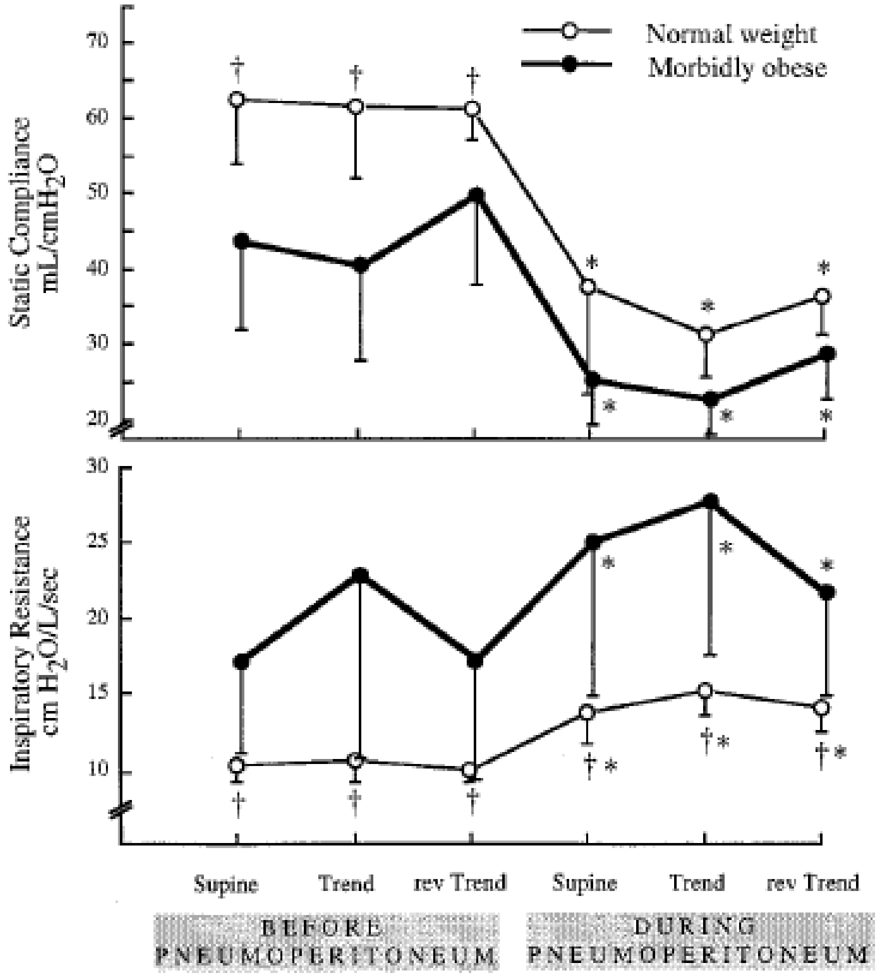


Figure 1. Effects of weight, body position, and abdominal insufflation on static respiratory system compliance and on inspiratory resistance. Rev = reverse; Trend = Trendelenburg. Data are means ± SD. †P from <0.01 to <0.001 versus the same body position in morbidly obese patients; *P from <0.01 to <0.001 versus the same group in supine and reverse Trendelenburg positions before pneumoperitoneum.

Valenza F, Vagginelli F, Tiby A, et al. Effects of the beach chair position, positive end-expiratory pressure, and pneumoperitoneum on respiratory function in morbidly obese patients during anesthesia and paralysis. Anesthesiology. 2007;107:725–732.

- Elastance does not vary among supine, Trendelenburg and anti-Trendelenburg positions, which represent body postures frequently used in laparoscopy surgery, even in obese patients.
- the beach chair position improves lung volumes, resistance and oxygenation in obese patients during pneumoperitoneum,

ANESTHESIOLOGY

Body Habitus and Dynamic Surgical Conditions Independently Impair Pulmonary Mechanics during Robotic-assisted Laparoscopic Surgery

A Cross-sectional Study

William G. Tharp, M.D., Ph.D., Serena Murphy, M.D., Max W. Breidenstein, B.Sc., Collin Love, B.Sc., Alisha Booms, M.A., Melissa N. Rafferty, M.D., Alexander F. Friend, M.Sc., Scott Perrapato, D.O., Thomas P. Ahern, Ph.D., Anne E. Dixon, M.A., B.M. B.Ch., Jason H. T. Bates, Ph.D., D.Sc., S. Patrick Bender, M.D., M.S.H.S.

ANESTHESIOLOGY 2020; 133:750–63

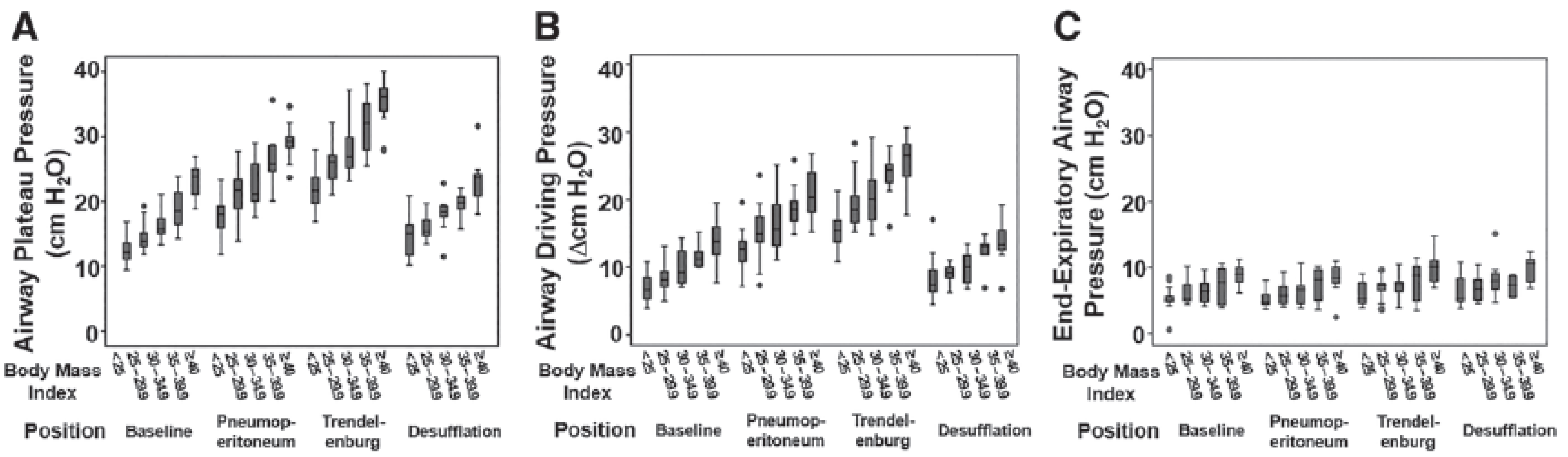
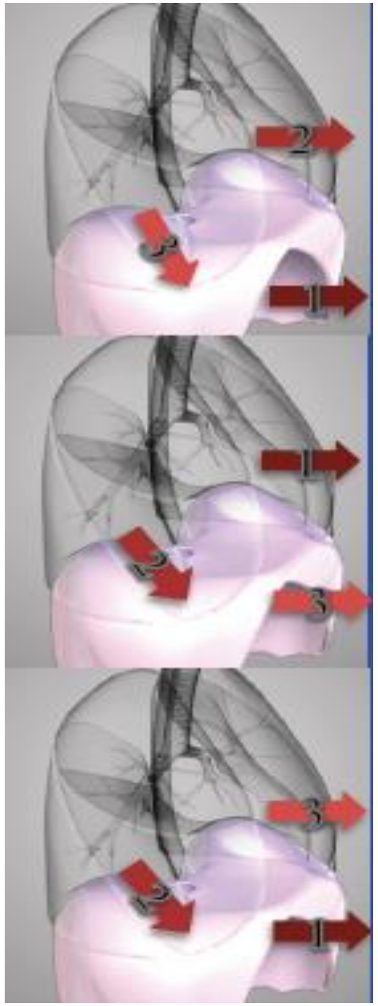


Fig. 1. Airway pressures. (*A–C*) Airway plateau pressures (*A*), airway driving pressures (*B*), and end-expiratory airway pressures (*C*) after intubation (*Baseline*), with abdominal insufflation (*Pneumoperitoneum*), in Trendelenburg with pneumoperitoneum (*Trendelenburg*), and after release of abdominal insufflation with a level bed (*Desufflation*). The data are stratified by body mass index (kg/m²). The *box plots* show the medians and the 25th and 75th percentiles, *whiskers* are the 10th and 90th percentiles, and *dots* represent the outliers.

Increasing body mass index induces significant alterations in lung mechanics during robotic laparoscopic surgery, but there is a wide range in the degree of impairment. Positive end-expiratory pressure settings may need individualization based on body mass index and surgical conditions.

Pneumoperitoneum expands chest



- Expanding the abdomen expands the thorax and forces the diaphragm down.
- Increasing the peep expands the thorax, forces the diaphragm down but also lifts the abdominal wall and thereby reduces the Intra Abdominal Pressure.
- Deep NMB reduces the IAP or allows more abdominal expansion that increases the basal lung space and facilitates ventilation.

Almarakbi WA, Fawzi HM, Alhashemi JA. Effects of four intraoperative ventilatory strategies on respiratory compliance and gas exchange during laparoscopic gastric banding in obese patients. Br J Anaesth. 2009;102:862–868

- Pneumoperitoneum can be handled with normal PEEP
- Obesity requires higher peep that reduces the IAP if deep NMB is used at the same time.
- LRM remains important before using PEEP
- Apple shaped intraabdominal obesity remains the most difficult to ventilate and to operate lap as peep is not lifting anymore the abdominal wall and diaphragm is not pushed down.

Ventilation strateges during anaesthesia for obese patient

- There is no evidence of differences between pressure control ventilation (PCV) and Volume control ventilation (VCV).

Costa Souza et al. BMC Anesthesiology (2020) 20:36
https://doi.org/10.1186/s12871-020-0936-y

BMC Anesthesiology

RESEARCH ARTICLE Open Access

Intraoperative ventilation strategies for obese patients undergoing bariatric surgery: systematic review and meta-analysis

Check for updates

George Márcio Costa Souza[1*], Gianni Mara Santos[2], Sandra Adriana Zimpel[1] and Tamara Melnik[3]

Ventilation strateges during anaesthesia for obese patient

- There is some evidence that the alveolar recruitment maneuvers associated with PEEP lead to better oxygenation and higher compliance.

Costa Souza *et al. BMC Anesthesiology* (2020) 20:36
https://doi.org/10.1186/s12871-020-0936-y

BMC Anesthesiology

RESEARCH ARTICLE **Open Access**

Intraoperative ventilation strategies for obese patients undergoing bariatric surgery: systematic review and meta-analysis

Check for updates

George Márcio Costa Souza[1*], Gianni Mara Santos[2], Sandra Adriana Zimpel[1] and Tamara Melnik[3]

Ventilation strateges during anaesthesia for obese patient

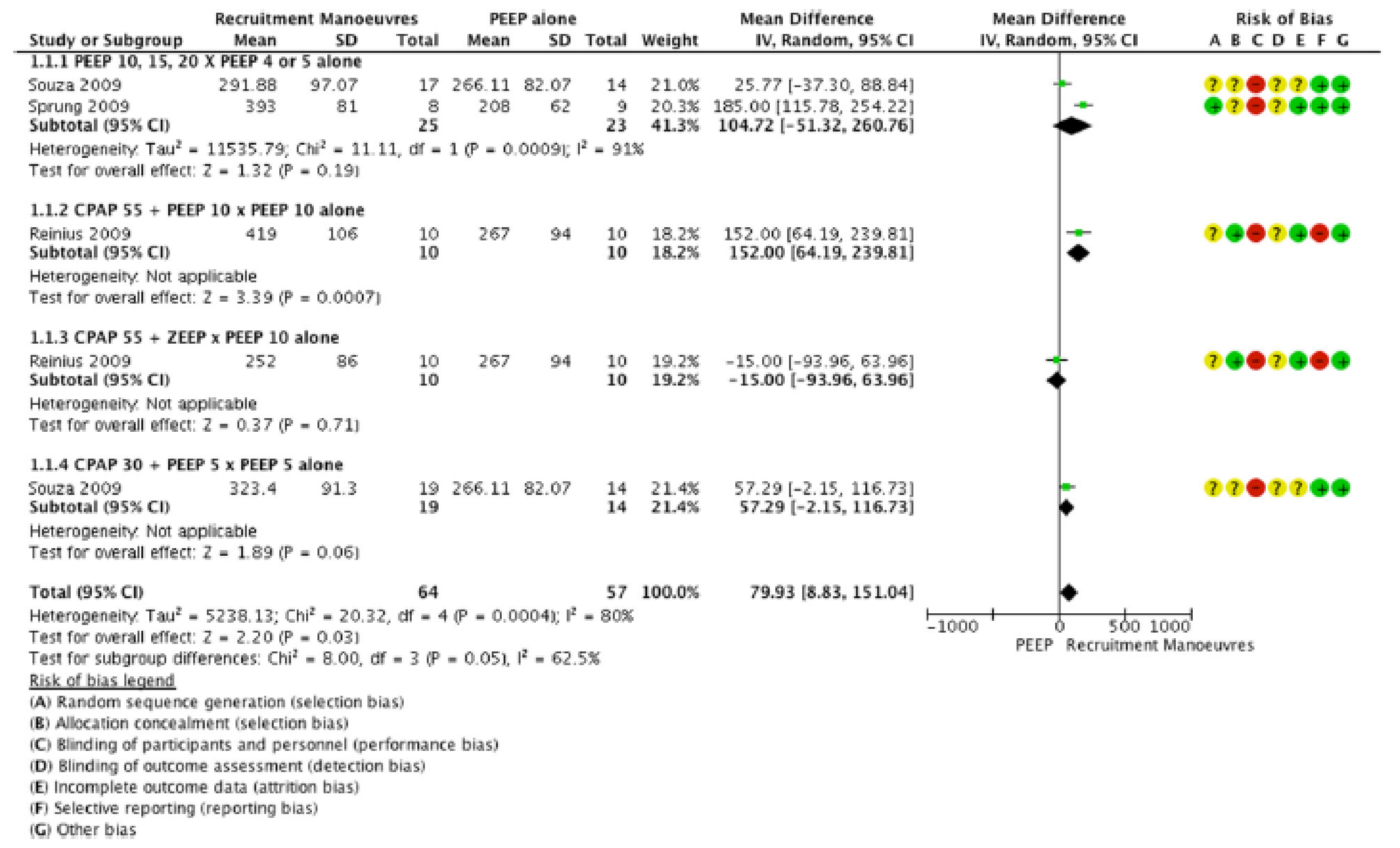


Fig. 3 Forest plot of recruitment manoeuvres x PEEP: Intra operative gas exchange - PaO_2/FiO_2


Costa Souza et al. BMC Anesthesiology (2020) 20:36
https://doi.org/10.1186/s12871-020-0936-y
BMC Anesthesiology
RESEARCH ARTICLE Open Access
Intraoperative ventilation strategies for obese patients undergoing bariatric surgery: systematic review and meta-analysis
George Márcio Costa Souza[1*], Gianni Mara Santos[2], Sandra Adriana Zimpel[1] and Tamara Melnik[3]

Individualized PEEP in obese

- In obese patients undergoing laparoscopic surgery better oxygenation, lower driving pressures, and redistribution of ventilation toward dependent lung areas can be achieved by measuring by electrical impedance tomography and counting using individualized PEEP.

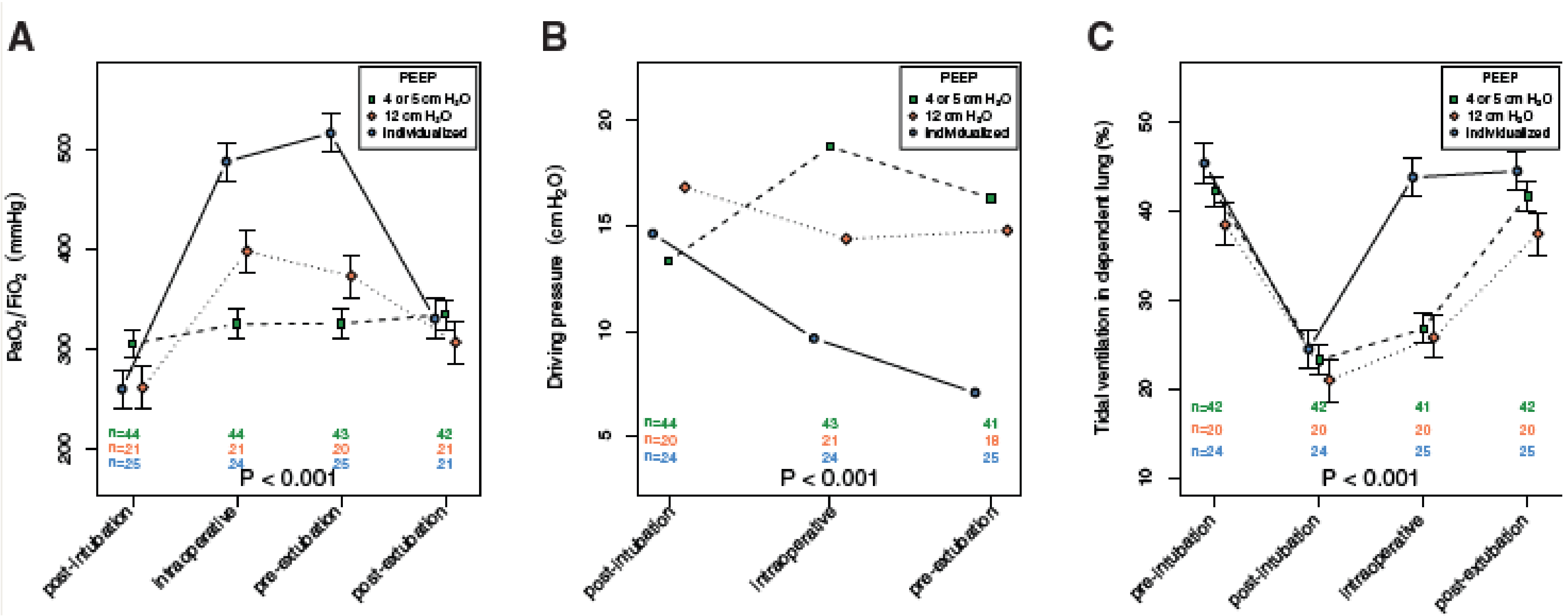
ANESTHESIOLOGY

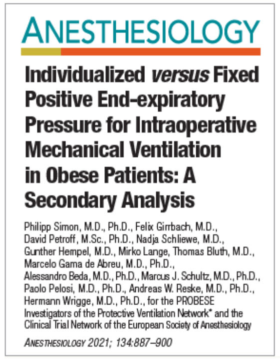
Individualized *versus* Fixed Positive End-expiratory Pressure for Intraoperative Mechanical Ventilation in Obese Patients: A Secondary Analysis

Philipp Simon, M.D., Ph.D., Felix Girrbach, M.D., David Petroff, M.Sc., Ph.D., Nadja Schliewe, M.D., Gunther Hempel, M.D., Mirko Lange, Thomas Bluth, M.D., Marcelo Gama de Abreu, M.D., Ph.D., Alessandro Beda, M.D., Ph.D., Marcus J. Schultz, M.D., Ph.D., Paolo Pelosi, M.D., Ph.D., Andreas W. Reske, M.D., Ph.D., Hermann Wrigge, M.D., Ph.D., for the PROBESE Investigators of the Protective Ventilation Network* and the Clinical Trial Network of the European Society of Anesthesiology

ANESTHESIOLOGY 2021; 134:887–900

Individualized PEEP in obese





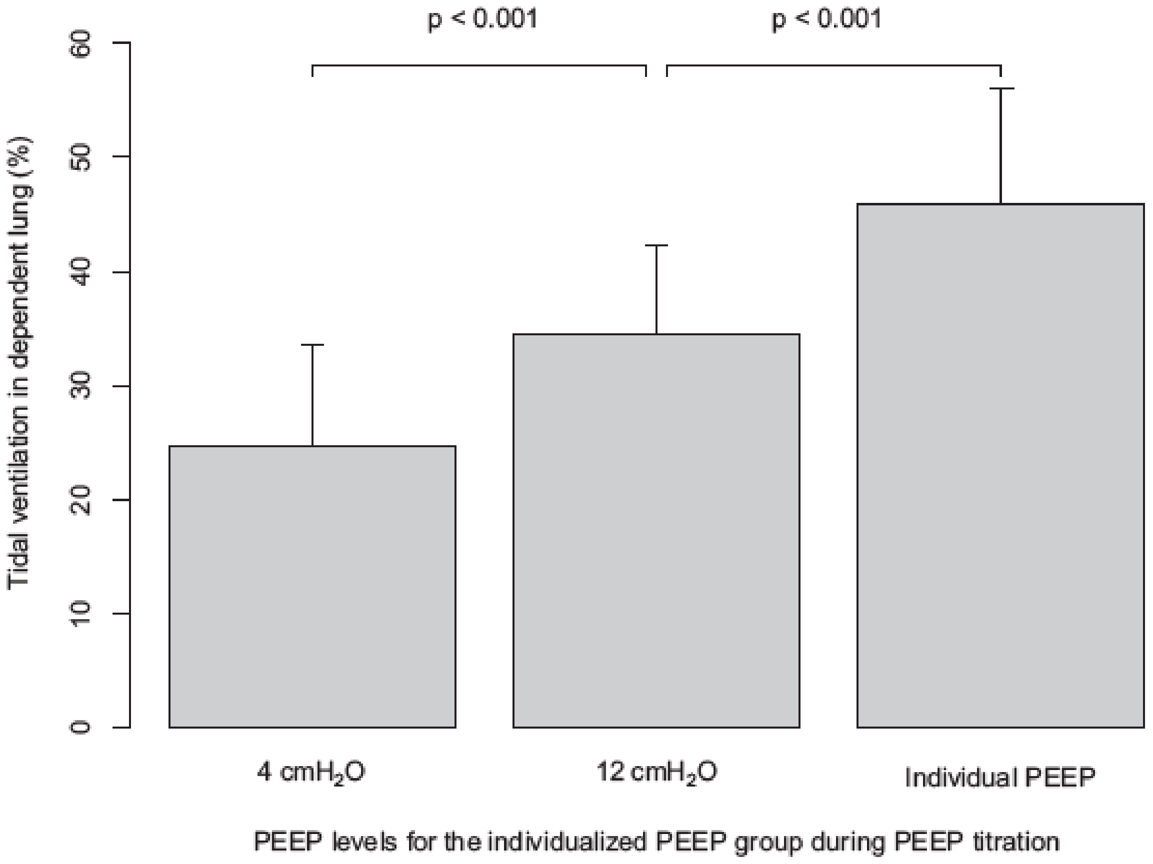
ANESTHESIOLOGY

Individualized *versus* Fixed Positive End-expiratory Pressure for Intraoperative Mechanical Ventilation in Obese Patients: A Secondary Analysis

Philipp Simon, M.D., Ph.D., Felix Girrbach, M.D., David Petroff, M.Sc., Ph.D., Nadja Schliewe, M.D., Gunther Hempel, M.D., Mirko Lange, Thomas Bluth, M.D., Marcelo Gama de Abreu, M.D., Ph.D., Alessandro Beda, M.D., Ph.D., Marcus J. Schultz, M.D., Ph.D., Paolo Pelosi, M.D., Ph.D., Andreas W. Reske, M.D., Ph.D., Hermann Wrigge, M.D., Ph.D., for the PROBESE Investigators of the Protective Ventilation Network* and the Clinical Trial Network of the European Society of Anaesthesiology

ANESTHESIOLOGY 2021; 134:887–900

Individualized PEEP in obese



ANESTHESIOLOGY

Individualized *versus* Fixed Positive End-expiratory Pressure for Intraoperative Mechanical Ventilation in Obese Patients: A Secondary Analysis

Philipp Simon, M.D., Ph.D., Felix Girrbach, M.D., David Petroff, M.Sc., Ph.D., Nadja Schliewe, M.D., Gunther Hempel, M.D., Mirko Lange, Thomas Bluth, M.D., Marcelo Gama de Abreu, M.D., Ph.D., Alessandro Beda, M.D., Ph.D., Marcus J. Schultz, M.D., Ph.D., Paolo Pelosi, M.D., Ph.D., Andreas W. Reske, M.D., Ph.D., Hermann Wrigge, M.D., Ph.D., for the PROBESE Investigators of the Protective Ventilation Network* and the Clinical Trial Network of the European Society of Anesthesiology

Anesthesiology 2021; 134:887–900

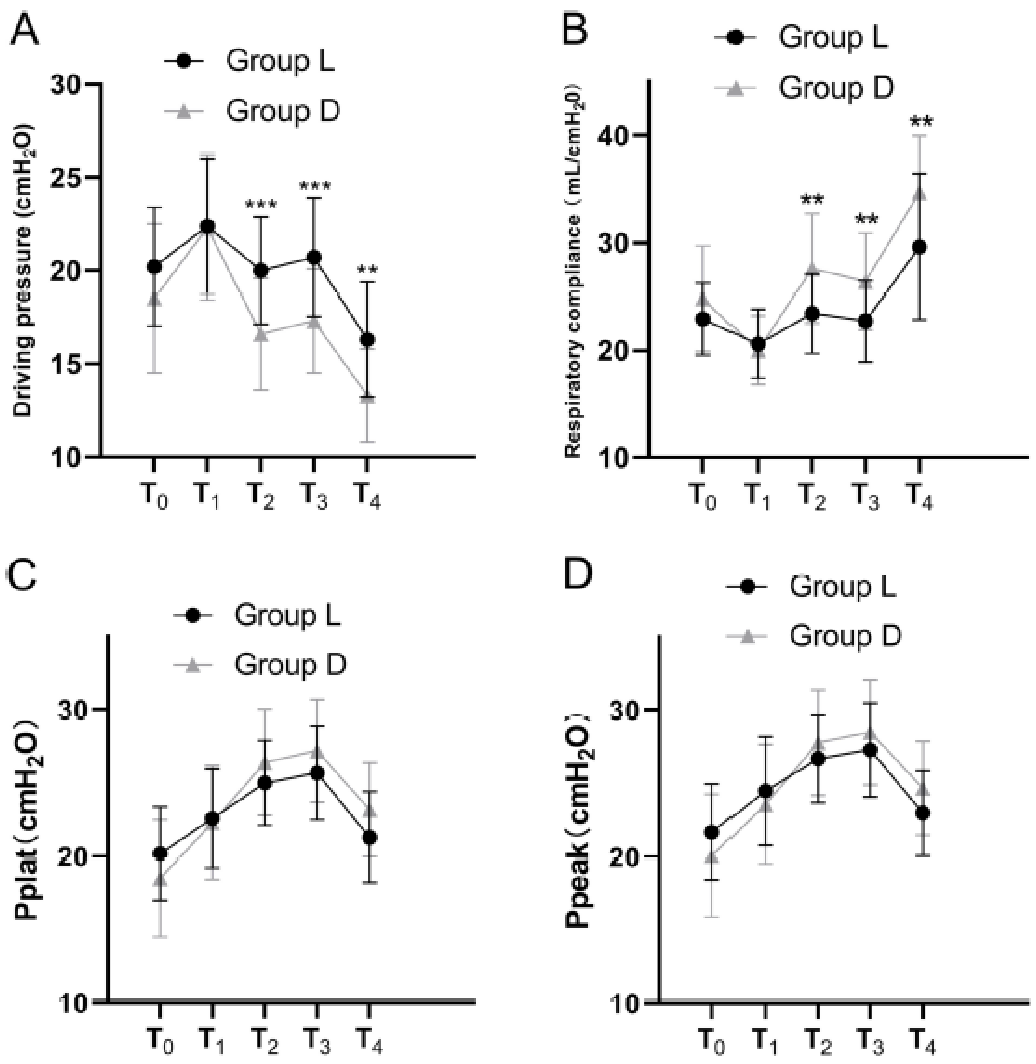
Diabetes, Metabolic Syndrome and Obesity
Diabetes, Metabolic Syndrome and Obesity 2023:16 1515–1523
Dovepress
open access to scientific and medical research
Open Access Full Text Article
ORIGINAL RESEARCH

Driving Pressure-Guided Ventilation in Obese Patients Undergoing Laparoscopic Sleeve Gastrectomy: A Randomized Controlled Trial

Guanyu Yang*, Pin Zhang*, Liumei Li, Jingjing Wang, Pengfei Jiao, Jie Wang, Qinjun Chu

An individualized peep-based driving pressure-guided ventilation strategy can reduce intraoperative driving pressure and increase respiratory compliance in obese patients undergoing LSG.

Group L: continous PEEP set at level of 5 cm H2O,
Group D: The PEEP was sequentially increased from 4 cm H2O to 12 cm H2O, The plateau pressure (Pplat) corresponding to respiratory cycle was recorded, and the driving pressure corresponding to respiratory cycles was calculated using a simplified algorithm of driving pressure (driving pressure = Pplat - PEEP)



Pulmonary mechanics and ventilation in the obese

- Protective lung ventilation is preferred and prevents from possible pulmonary complications.
- An increase in volume or respiratory rate does not improve oxygenation and elimination of CO_2 in this group of patients

Sprung J,Whalley D,Falcone T.The effects of tidal volume and respiratory rate on oxygenation and respiratory mechanics during laparoscopy in morbidly obese patients.Anesth Analg 2003;97 (1):268-74.

Lung protective ventilation in patients with obesity

Recommendations for the perioperative ventilation in obese patients:

- the use of protective ventilation with low tidal volumes (approximately 8 mL/kg, calculated based on predicted -not actual- body weight) to avoid volutrauma;
- a focus on lung recruitment by utilizing PEEP (8–15 cmH2O) in addition to recruitment maneuvers during the intraoperative period, as well as incentivized deep breathing and noninvasive ventilation early in the postoperative period, to avoid atelectasis, hypoxemia and atelectrauma;
- a judicious oxygen use (ideally less than 0.8) to avoid hypoxemia but also possible reabsorption atelectasis.

Fernandez-Bustamante *et al. BMC Anesthesiology* (2015) 15:56
DOI 10.1186/s12871-015-0032-x

BMC Anesthesiology

REVIEW Open Access

Perioperative lung protective ventilation in obese patients

Ana Fernandez-Bustamante[1,2*], Soshi Hashimoto[3], Ary Serpa Neto[4,5], Pierre Moine[1], Marcos F Vidal Melo[3] and John E Repine[2,6]

Review Article

Balonov K. Intraoperative protective lung ventilation strategies in patients with morbid obesity. Saudi J Anaesth 2022;16:327-31.

Intraoperative protective lung ventilation strategies in patients with morbid obesity

- Protective intraoperative ventilation should comprise a low Vt of 6–8 mL/kg of ideal body weight, the lowestpossible ΔP, ideally below 16 cm H_2O, and moderate-low PEEP levels except for laparoscopy and long surgical procedures that might benefit from a slightly higher PEEP.
- To prevent absorption atelectasis and oxygen toxicity, FiO_2 should be limited to the level required to maintain adequate oxygen saturation (SpO_2 >92%), ideally between 0.5 and 0.8.
- Recruitment maneuvers should be used judiciously in selected patients to improve oxygenation. The ventilator-based technique should substitute the conventional bag-squeezing.
- When possible, the head of the bed should be maintained in at least a 30° head-up position.

Balonov K. Intraoperative protective lung ventilation strategies in patients with morbid obesity. Saudi J Anaesth 2022;16:327-31.

Intraoperative protective lung ventilation strategies in patients with morbid obesity

- ventilator-based cycling maneuver is performed progressively by increasing VT until a Pplat of 30–40 cm H2O is reached, maintaining Pplat at this level for 3–4 respiratory cycles followed by decreasing the Vt to the desired target while titrating PEEP to achieve the best compliance of the respiratory system.
- There is not sufficient evidence to recommend the routine preventative use of RM.

frontiers | Frontiers in Immunology

TYPE Systematic Review
PUBLISHED 18 October 2022
DOI 10.3389/fimmu.2022.1032783

Check for updates

OPEN ACCESS

EDITED BY
Jihad Mallat,
Cleveland Clinic Abu Dhabi, United Arab Emirates

REVIEWED BY
Haobo Li,
Harvard Medical School, United States
Jie Yi,
Peking Union Medical College Hospital (CAMS), China

*CORRESPONDENCE
Cong Yu
500158@hospital.cqmu.edu.cn

†These authors have contributed equally to this work

This article was submitted to Inflammation,
a section of the journal
Frontiers in Immunology

Optimized ventilation strategy for surgery on patients with obesity from the perspective of lung protection: A network meta-analysis

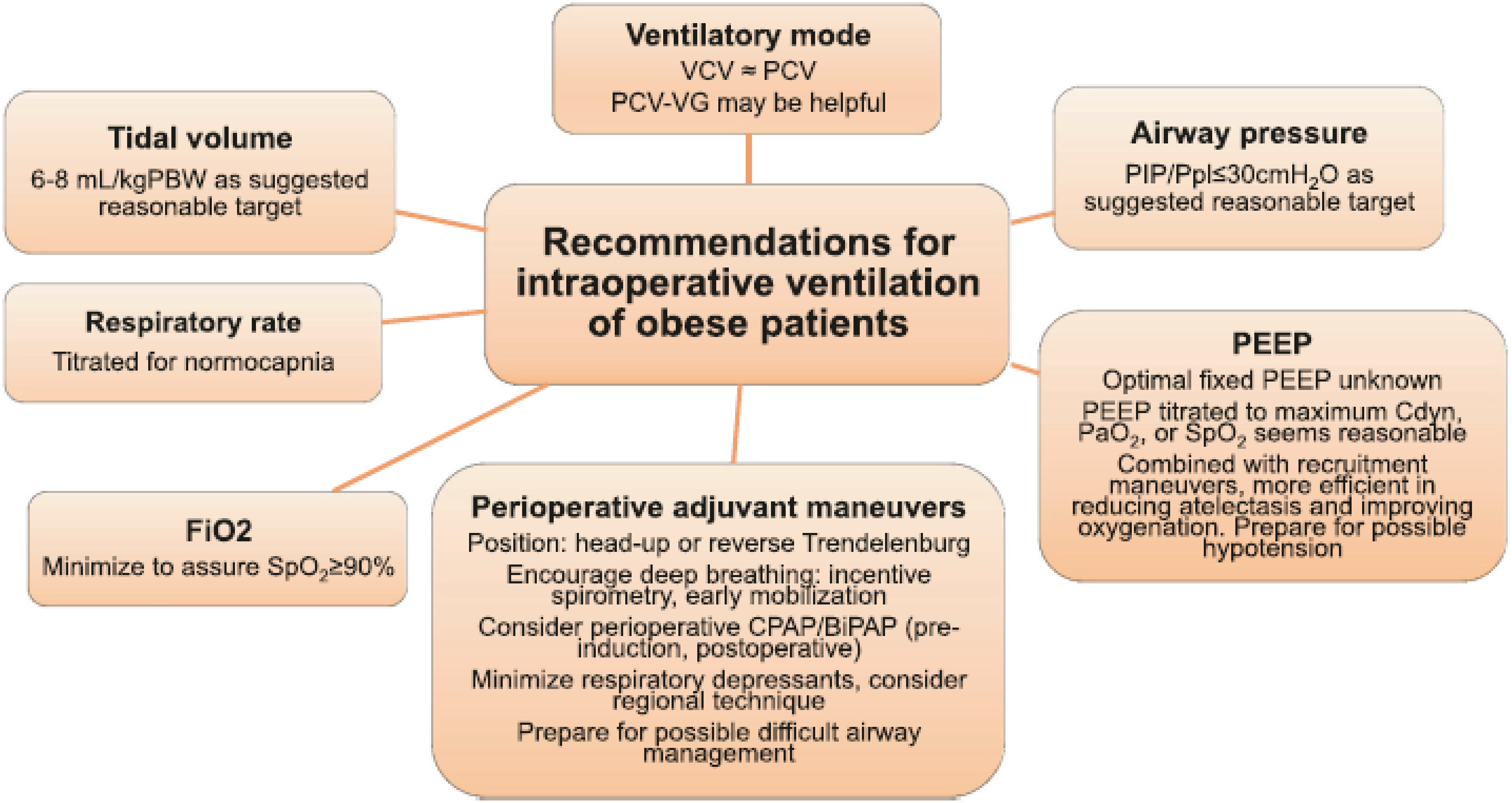
Jing Wang[1,2,3†], Jie Zeng[1,2,3†], Chao Zhang[1,2,3], Wenwen Zheng[1,2,3], Xilu Huang[1,2,3], Nan Zhao[1,2,3], Guangyou Duan[4] and Cong Yu[1,2,3*]

[1]Department of Anesthesiology, The Stomatology Hospital Affiliated Chongqing Medical University, Chongqing, China, [2]Chongqing Key Laboratory of Oral Diseases and Biomedical Sciences, Chongqing, China, [3]Chongqing Municipal Key Laboratory of Oral Biomedical Engineering of Higher Education, Chongqing, China, [4]Department of Anesthesiology, The Second Affiliated Hospital, Chongqing Medical University, Chongqing, China

VCV+PEEPind+RM is the optimal ventilation strategy for patients with obesity in increasing intraoperation PaO_2/FiO_2 and lung compliance, and among the five ventilation strategies for postoperative atelectasis, VCV+highPEEP+RM had the greatest potential to reduce atelectasis caused by inflammation.

Pulmonary mechanics and ventilation in the obese

- In obese with BMI over 50 kg/m^2 or those with SAS (sleep apnea syndrome) and OHS (obesity hypoventilation syndrome) permissive hypercapnia may be used because this is similar to physiological hypercapnia met in morbidly obese.
- Hypocapnia with pCO_2 under 30 mmHg may lead to increase in lung shunt.



(Cdyn=Dynamic compliance; BiPAP=Bilevel positive airway pressure; CPAP=Continuous positive airway pressure; FiO2=Inspiratory fraction of oxygen; PaO_2=Arterial oxygen partial pressure; PBW=Predicted body weight; PCV=Pressure controlled ventilation; PCV-VG=Pressure controlled ventilation volume guaranteed; PEEP=Positive end-expiratory pressure; PIP=Peak inspiratory pressure; Ppl=Plateau airway pressure; SpO_2=Peripheral saturation of oxygen by pulse oximetry; VCV=Volume controlled ventilation)

Figure 1 Practical recommendations for intraoperative ventilation of obese patients.

Fernandez-Bustamante *et al. BMC Anesthesiology* (2015) 15:56
DOI 10.1186/s12871-015-0032-x

BMC Anesthesiology

REVIEW Open Access

Perioperative lung protective ventilation in obese patients

Ana Fernandez-Bustamante[1,2*], Soshi Hashimoto[3], Ary Serpa Neto[4,5], Pierre Moine[1], Marcos F Vidal Melo[3] and John E Repine[2,6]

Summary

- Obese patients present specific lung physiology and mechanics characteristics, frequent respiratory comorbidities and increased risk of postoperative pulmonary complications.
- Intraoperatively, lung protective ventilation with low tidal volumes, recruitment maneuvers with greater PEEP levels and the judicious use of oxygen concentrations are recommended.
- Focused postoperative care seeking to minimize atelectasis formation is critical.

Fernandez-Bustamante *et al.* *BMC Anesthesiology* (2015) 15:56
DOI 10.1186/s12871-015-0032-x