Sub-Study

The impact of protective ventilation with higher versus lower PEEP during general anesthesia on postoperative lung function as assessed by spirometry in morbidly obese patients undergoing surgery

proposed by

L. de Baerdemaeker

Ghent University Hospital, Belgium

Department of Anesthesiology and Intensive Care Medicine

Correspondence:
Marcelo Gama de Abreu, MSc MD PhD DESA
Principal Investigator
University Hospital Dresden
Department of Anesthesiology
and Intensive Care Medicine
Fetscherstr. 74
01307 Dresden
Germany
E–mail: mgabreu@uniklinikum-dresden.de

Rationale

Few data are available on the effects of RM and PEEP on lung spirometry when morbidly obese patients are ventilated with small tidal volumes.

Studies performed in morbidly obese patients undergoing laparoscopic surgery have demonstrated that the recruitment maneuver (RM) seems to be most effective in reversing atelectasis (1). In morbidly obese (MO) patients undergoing laparoscopic surgery, recruitment of lung volume during surgery improves intraoperative respiratory mechanics and oxygenation (2,3).

However, whether these benefits persist into the postoperative period is unknown.

Hypothesis

We would like to test the hypothesis that intraoperative RMs associated with PEEP improve the recovery of postoperative spirometry and reduce the incidence of postoperative hypoxemia in MO patients undergoing different types of abdominal surgery.

The null-hypothesis is that there is no difference in the postoperative spirometry values between groups.

Study design

International multicenter Prospective double blinded randomized controlled trial

Study population

Obese patients with BMI ≥ 35 kg/m2 at intermediate–to–high risk for PPCs scheduled for surgery under general anesthesia.

Group 1: Morbidly obese patients from the PROBESE trial receiving ventilation with low tidal volume and PEEP of 12 cmH_2O plus RM

Group 2: Morbidly obese patients from the PROBESE trial receiving ventilation with low tidal

volume and PEEP of 4 cmH_2O, but without RM

Primary endpoint

The change in the spirometry values (FVC, FEV1, PEFR, MEF 25-75) from preoperative day up to postoperative day 5 (or day of discharge from hospital)

Secondary endpoints

SpO_2, VAS dyspnea and pain scores, chest X-ray in the postoperative days

Methods (when and how measurements will be performed)

To evaluate the recovery of the respiratory function, spirometry will be performed using a bedside spirometer (Spiropro, SensorMedics, Bilthoven, The Netherlands) in envelope mode by the same blinded anesthesiologist throughout the study. Spirometry will be standardized with each patient in a 45° head-up position. After demonstration of correct usage during pre-anesthetic visit, baseline measurement of forced vital capacity (FVC), forced expiratory volume in 1s (FEV1), peak expiratory flow rate (PEFR) and mid-expiratory flow rate (MEF 25-75) were performed. In the postoperative days, measurements will be repeated.

In order to analyze additional data from other centers using a different type of spirometer, we suggest analyzing the percentage change compared to pre-operative baseline values.

Gaussian distribution will be tested using the Kolomogorov-Smirnov test. Between groups, spirometry data will be analyzed by unpaired student's t-test or Mann-Whitney test, where appropriate. Within group statistics will be done using repeated measures ANOVA statistics or Friedman's test. Categorical data will be analyzed using Fisher’s Exact test. All statistical tests Will be performed using SPSS v 11.0 (SPSS Inc, Chicago, IL, USA). Significance level will be set at 5% unless otherwise reported.

A similar study on spirometry data comparing standard ventilation to protective ventilation performed in non-obese undergoing open laparotomy by Severgnini et al (Anesthesiology 2013;118:1307-21) revealed that protective ventilation with RM/PEEP led to improved pulmonary function tests up to 5 days after surgery.

Table 5. Perioperative Pulmonary Functional Tests on Days 1, 3, and 5

	Day 0		
	Standard Ventilation (n = 27)	Protective Ventilation (n = 28)	*P* Value
FEV_1, l (mean ± SD)	2.02 ± 0.78	1.97 ± 0.68	0.72
FEV_1 (% predicted), l (mean ± SD)	77.2 ± 22.2	75.4 ± 20.9	0.77
FVC, l (mean ± SD)	2.53 ± 0.86	2.53 ± 0.80	0.87
FVC (% predicted), l (mean ± SD)	75.9 ± 2.0	77.5 ± 18.2	0.85
FEV_1/FVC, % (mean ± SD)	78.3 ± 11.1	77.1 ± 13.3	0.74

Values are given as mean and SD.

Group effect was performed by repeated two-way ANOVA. The individual pair-wise comparisons (Bonferroni corrected) show statistical significance as follows: **P* < 0.0001 *vs.* FEV1 on day 0. +*P* < 0.0002 *vs.* FEV1 on day 0. §*P* < 0.0098 *vs.* FEV1 on day 0. **P* < 0.0001 *vs.* FEV1 (% predicted) on day 0. +*P* < 0.0001 *vs.* FEV1 (% predicted) on day 0. §*P* < 0.0001 *vs.* FEV1 (% predicted) on day 0. **P* < 0.0001 *vs.* FVC on day 0. +*P* < 0.009 *vs.* FVC on day 0. §*P* < 0.009 *vs.* FVC on day 0. **P* < 0.0001 *vs.* FVC (% predicted) on day 0.

FEV1 = forced expiratory volume in 1 s; FVC = forced vital capacity.

Table 5. (*Continued*)

Day 1		Day 3		Day 5		
Standard Ventilation (n = 26)	Protective Ventilation (n = 27)	Standard Ventilation (n = 26)	Protective Ventilation (n = 27)	Standard Ventilation (n = 26)	Protective Ventilation (n = 25)	Group Effect *P* Value
1.00 ± 0.36*	1.18 ± 0.42*	1.14 ± 0.45+	1.45 ± 0.51+	1.23 ± 0.42§	1.63 ± 0.55§	<0.001
40.2 ± 13.7*	46.48 ± 17.1*	44.5 ± 16.4+	56.4 ± 18.1+	47.9 ± 15.7§	62.6 ± 16.0§	0.002
1.31 ± 0.39*	1.48 ± 0.54*	1.45 ± 0.46+	1.78 ± 0.54+	1.57 ± 0.47§	2.02 ± 0.52§	<0.001
41.6 ± 12.1*	47.2 ± 21.7*	45.1 ± 13.3	55.1 ± 17.9	49.0 ± 14.3	61.8 ± 13.4	<0.001
75.8 ± 12.8	82.1 ± 14.2	77.5 ± 10.4	81.29 ± 11.2	77.4 ± 10.5	78.8 ± 13.6	0.124

Presuming a similar effect in obese, based on these data of table 5 and taking into account a Beta error of 20% with an alfa error of 5%, a sample size of 18-20 patients in each group can be calculated.

References

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