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Società Medico Chirurgica di Ferrara dal 1846

# *Approccio anestesiologico nella pz obesa e con co-morbidità*

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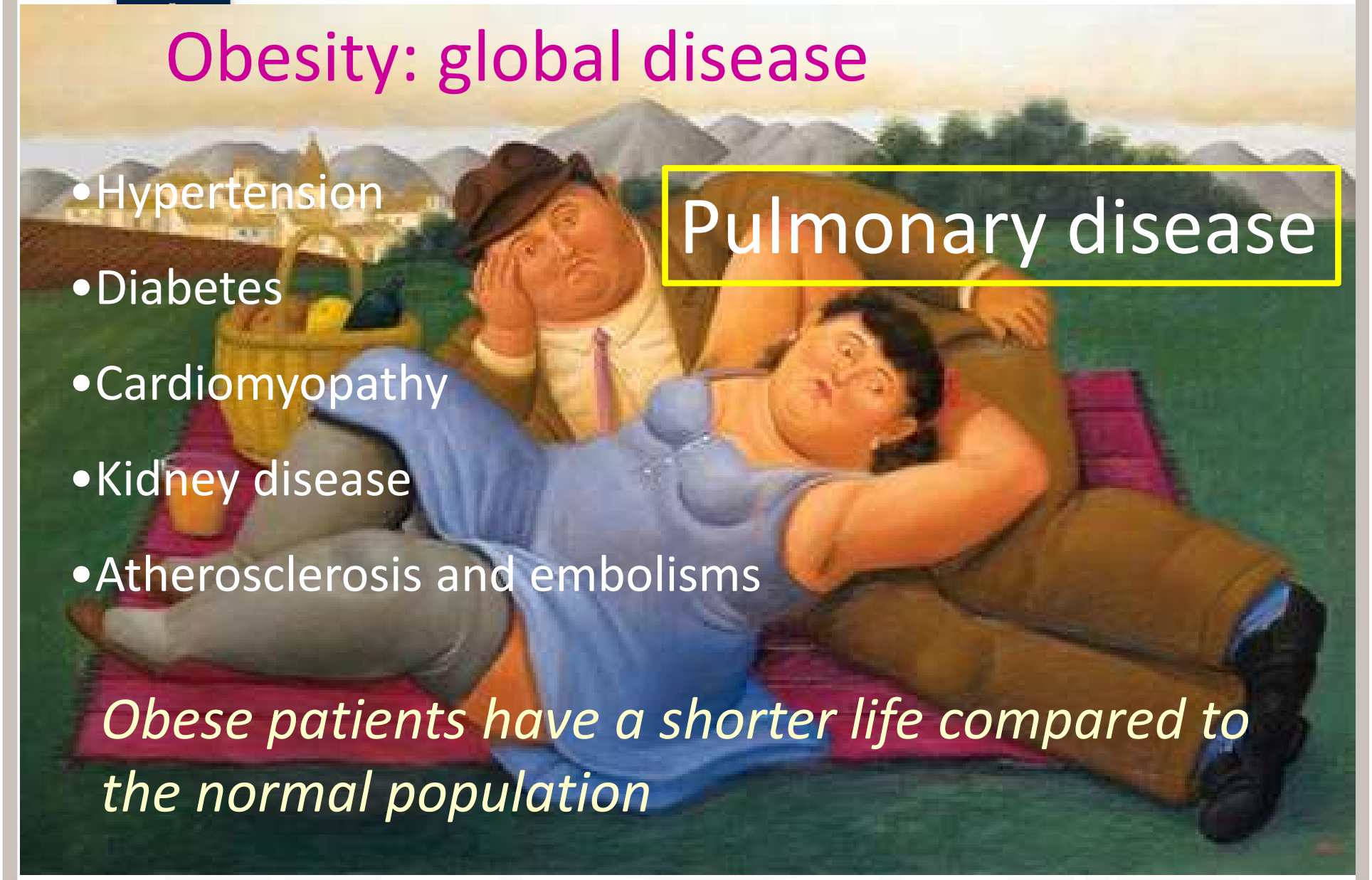
# Obesity: global disease



- Hypertension
- Diabetes
- Cardiomyopathy
- Kidney disease
- Atherosclerosis and embolisms

**Pulmonary disease**

*Obese patients have a shorter life compared to the normal population*

# Complications after major abdominal surgery

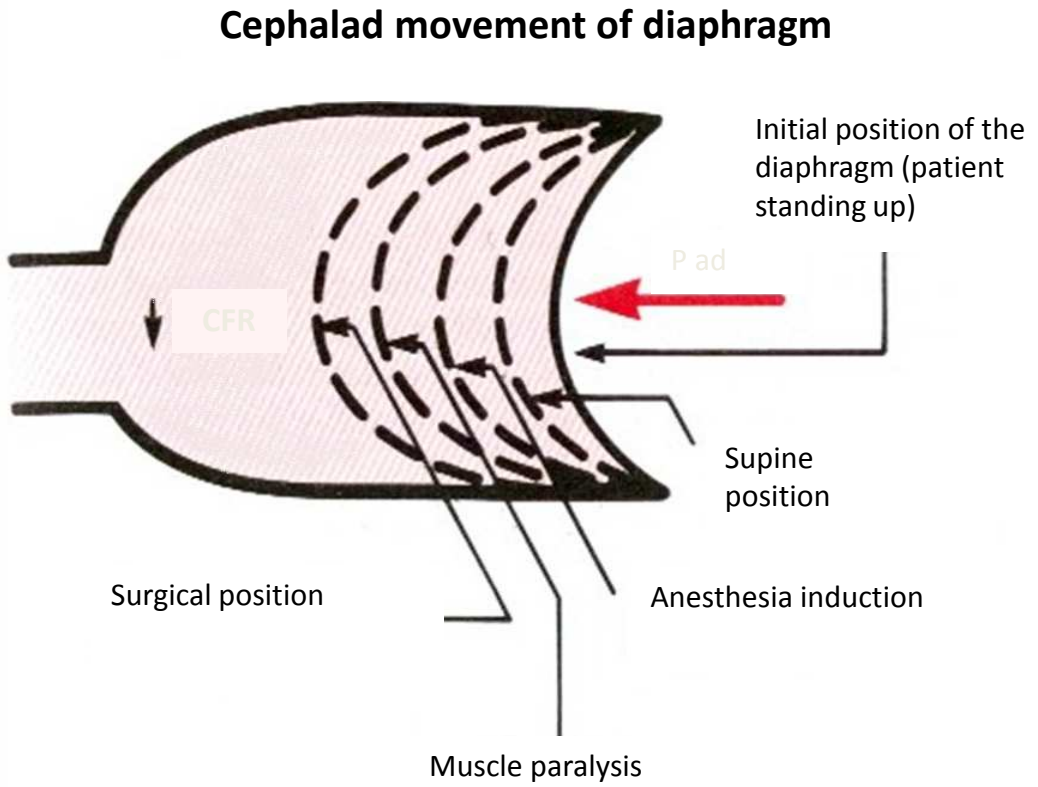
- *Postoperative pulmonary complications (PPCs) are a major cause of postoperative morbidity, mortality, and increased length of hospital stay (Smetana NEJM, 1999)*
- Several risk factors have been associated with PPCs, including *age, chronic obstructive pulmonary disease, cigarette use, congestive heath failure, functional dependence, **obesity**, and obstructive sleep apnea*
- Risk factors for PPCs are not consistent across studies
- Even in those studies in which risk factors for PPCs were identified, the odds ratio was relatively low, suggesting a weak predictive ability
- Although the reason why risk factors for PPCs are inconsistent between studies is unclear, differences in patient population, *underlying disease*, drugs used, and new surgical and anesthesiological techniques may all play a role

# Lets start from the beginning…
# Effects of anesthesia on respiratory function

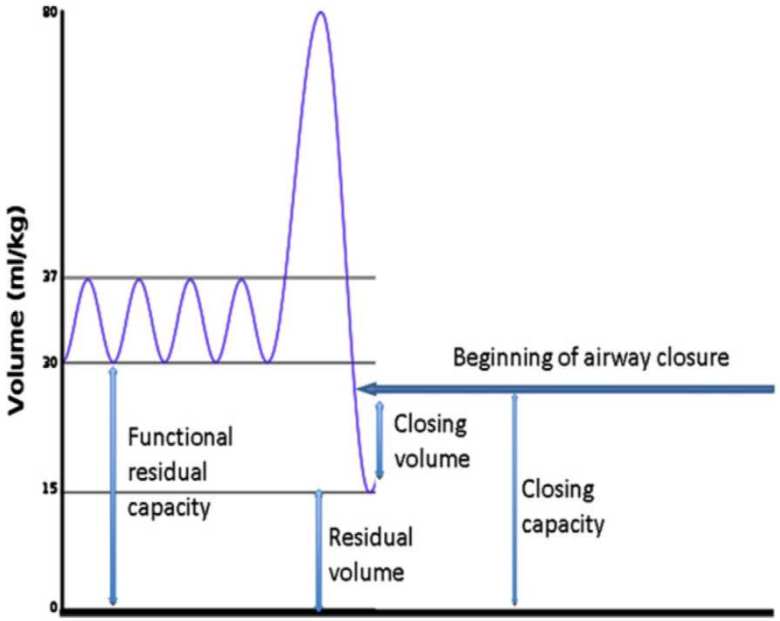
General anesthesia

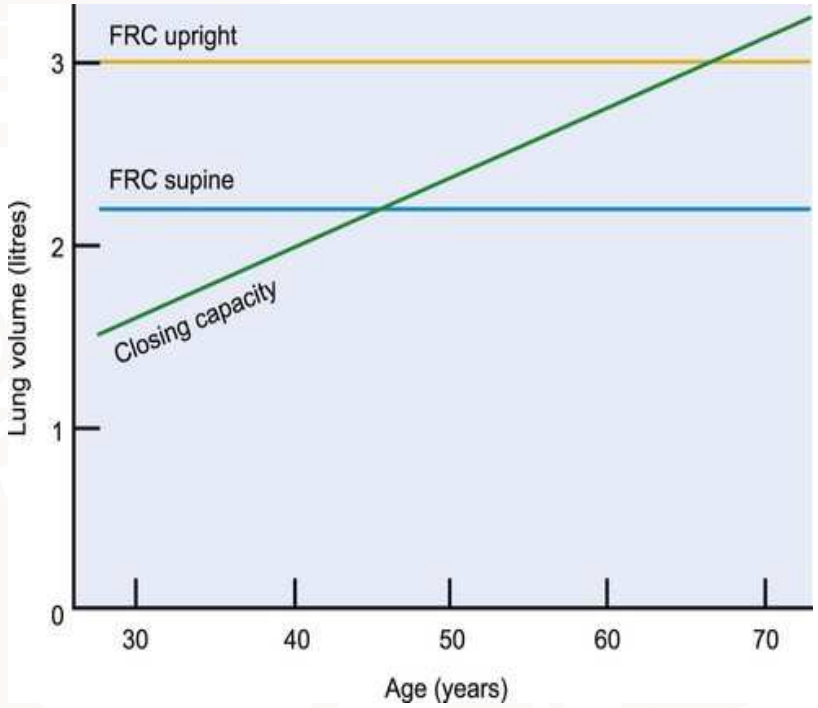
↓

FRC (~ 16 - 20%)



# (Small) Airway closure, atelectasis and gas exchange




Milic- Emili J Appl Phys 1970

# Effects of general anesthesia on respiratory function

General anesthesia

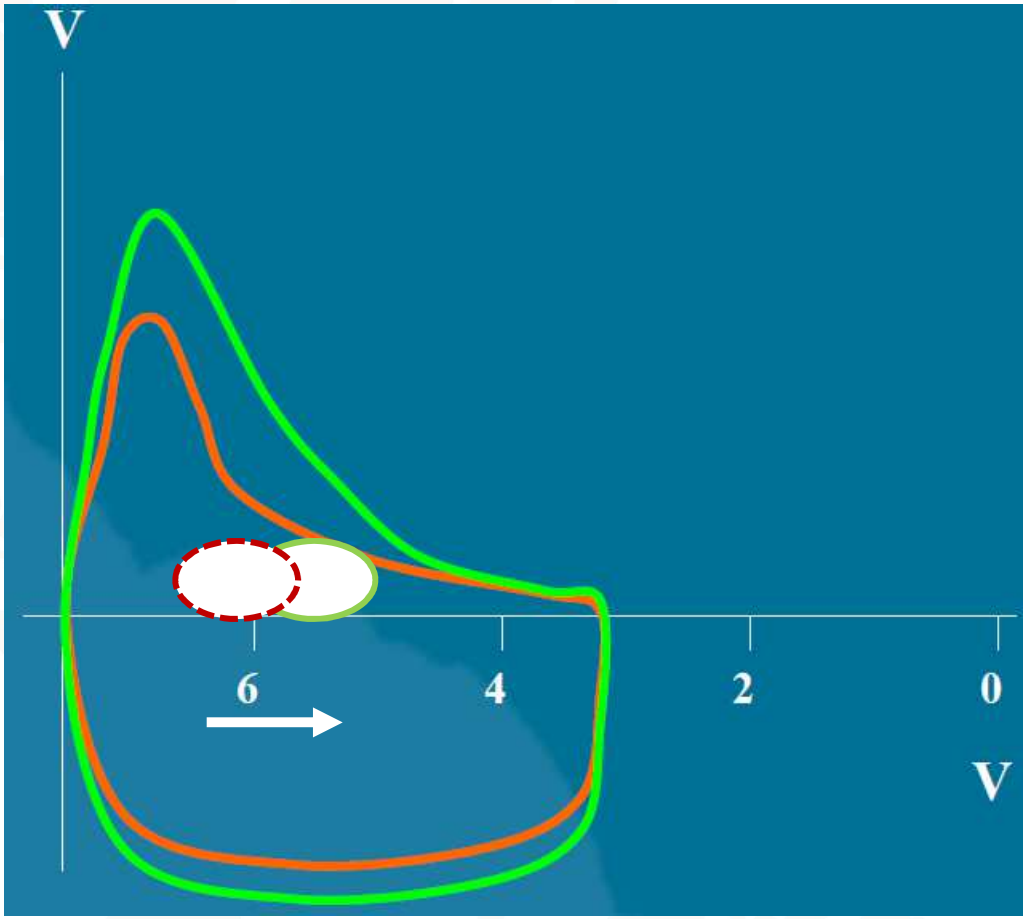
↓

FRC (16 - 20%)

*Reduction of FRC :*
*maximal expiratory flow is equal of expiratory flow during tidal ventilation*

↓

This is the definition of expiratory flow limitation (EFL)



# EFL during anesthesia: does it matter?

- *FRC reduction leading to EFL: cyclic opening / closure of the small airways associated with hypoxiemia and ventilation – perfusion mismatch.*
- *cyclic opening / closure of the small airways every breath: inflammation leading to pulmonary infection* (Hedenstierna, 2012)
- *Small airways closure: gas reabsorption lading to atelectasis.* (Hedenstierna et al., 2010)
- *Atelectasis* → *shunt and hypoxia and post-obstructive infection* (van Kaam AH et al., 2004)

# EFL after anesthesia: does it matter?

The presence of EFL after major abdominal surgery:

- ✓ Reduction of expiratory flow and the inability to increase the expiratory flow by the expiratory muscle decrease the efficacy of cough and secretion removal (Alvisi V et al., 2012)
- ✓ Retention of secretion favor the development of atelectasis, bronchitis and pneumonia. (Kiwerski JE., 1993)
- ✓ Atelectasis; hypoxiemia and pulmonary infections

# Expiratory Flow Limitation as a Risk Factor for Pulmonary Complications After Major Abdominal Surgery

Savino Spadaro, MD,* Gaetano Caramori, MD,† Chiara Rizzuto, MD,* Francesco Mojoli, MD,‡ Gianluca Zani, MD,* Riccardo Ragazzi, MD,* Giorgia Valpiani, StatD,§ Francesca Dalla Corte, MD,* Elisabetta Marangoni, MD,* and Carlo Alberto Volta, MD*

RESULTS: *Of the 330 patients enrolled, 31% exhibited expiratory flow limitation. On univariate analysis, patients with expiratory flow limitation were more likely to have postoperative pneumonia (5% vs 0%, P < .001) and acute respiratory failure (11% vs 1%, P < .001) and a longer length of hospital stay (7 vs 9 days, P < .01). Multivariate analysis identified that expiratory flow limitation increased the risk of developing postoperative pulmonary complications by >50% (risk ratio, 2.7; 95% confidence interval, 1.7–4.2). Age and Medical Research Council dyspnea score were also significant multivariate risk factors for pulmonary complications.*

**CONCLUSIONS:** Our results show that intraoperative expiratory flow limitation correlates with that of postoperative pulmonary complication after major abdominal surgery. Further work is needed to better understand the relevance of expiratory flow limitation on postoperative pulmonary outcomes. (Anesth Analg 2016;XXX:00–00)

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**Table 3. Association Between Baseline Characteristics of Patients and Development of PPCs According to Logistic Regression Analysis Adjusted for Potential Confounders**

| | Univariate Analysis | | | Multivariate Analysis | | |
|---|---|---|---|---|---|---|
| | Crude Odds Ratio | 95% CI | *P* | Adjusted Odds Ratio | 95% CI | *P* |
| EFL (reference: absence) | | | | | | |
| Presence | 5.1 | 2.9–8.9 | <.0001 | 4.2 | 2.3–7.6 | <.0001 |
| Age (years; reference: <65 y) | | | | | | |
| ≥65 | 2.5 | 1.4–4.5 | .001 | 2.1 | 1.1–4.1 | .023 |
| ASA (reference: <3) | | | | | | |
| ≥3 | 2.4 | 1.4–4.3 | .002 | 1.9 | 1.0–3.6 | .059 |
| MRC (reference: <3) | | | | | | |
| ≥3 | 3.5 | 2.0–6.0 | <.0001 | 2.6 | 1.4–4.8 | .002 |
| Length of surgery (reference: <240 min) | | | | | | |
| ≥240 min | 2.2 | 1.2–4.0 | .010 | 1.9 | 1.0–3.7 | .059 |
| Sex (reference: male) | | | | | | |
| Female | 1.2 | 0.7–2.0 | .545 | | | |
| Smoking history (reference: absence) | | | | | | |
| Presence | 0.8 | 0.5–1.3 | .372 | | | |
| Preoperative $Spo_2$ (reference: $Spo_2$ >96%) | | | | | | |
| ≤96% | 1.8 | 1.0–3.3 | .055 | | | |
| Lung disease (reference: absence) | | | | | | |
| Presence | 1.2 | 0.6–2.4 | .549 | | | |

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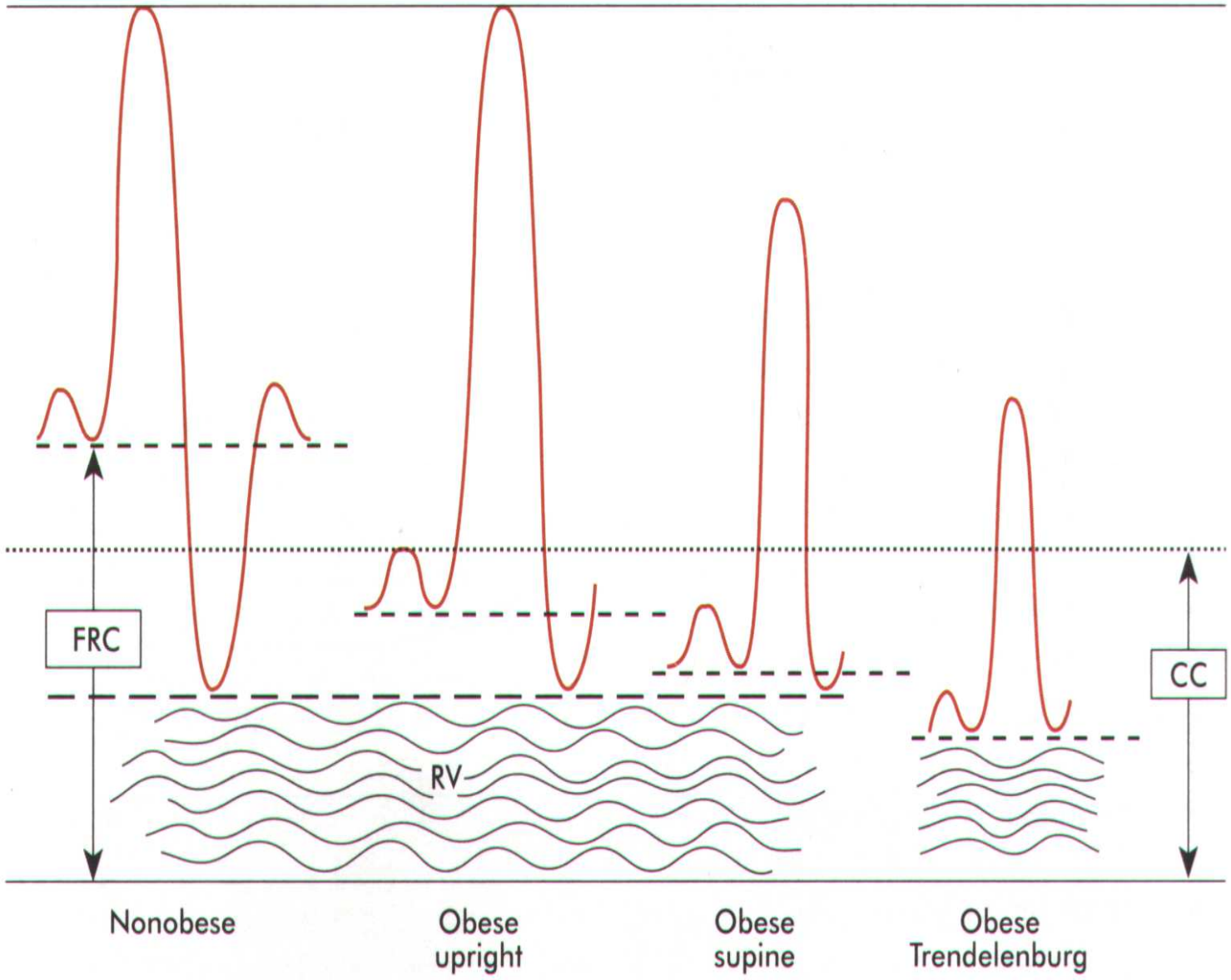
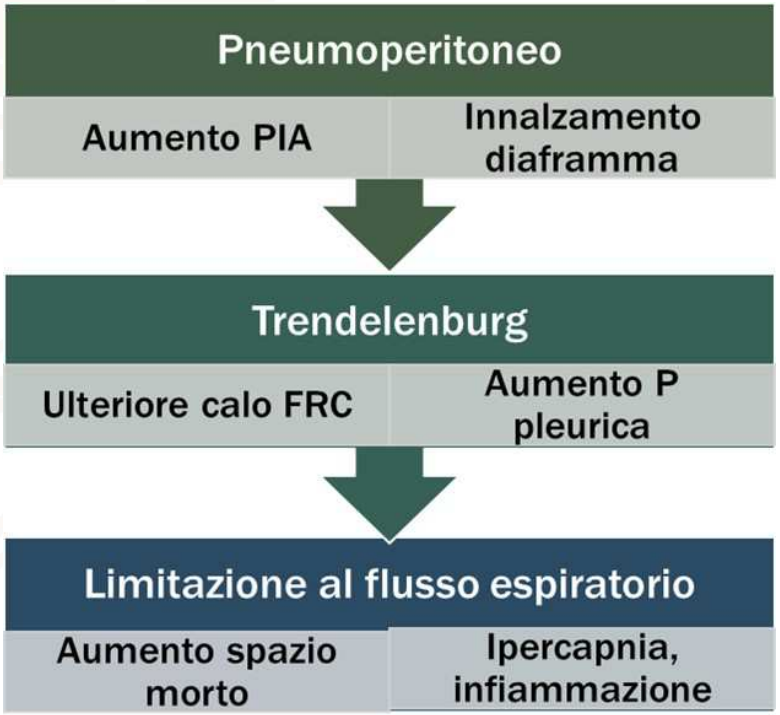
*«…patients who exhibit EFL during surgery should be managed more cautiously. Great effort should be made to prevent postoperative hypoxia, retention of secretions, and respiratory infections (Table 2). Additional pulmonary therapy such as aggressive pulmonary toilet and/or greater monitoring may also have benefit.»*


FRC
RV
CC
Nonobese
Obese upright
Obese supine
Obese Trendelenburg

# Mechanical ventilation during gynecologic surgery

Risk factors

- BMI >30
- Co-morbidities
- Duration of Trendeleburg position



# Clinical implication of obesity + Pneumoperitoneum + Trendelemburg position

Development of EFL (7 over 10 patients enrolled)
Hypercapnia
Worse V/Q ratio
Severe reduction of maximal expiratory pressure

*“those patients developing EFL during anesthesia performed much worse even if EFL disappeared at the end of anesthesia”*

# Best PEEP…

| | PEEP 5 | BEST PEEP | RM + BEST PEEP | p |
|---|---|---|---|---|
| N° patients | 15 | 16 | 15 | |
| Age (years) | 74 ± 15 | 69 ± 11 | 71 ± 11 | ns |
| BMI | 29 ± 4 | 33 ± 7 | 33 ± 7 | ns |
| MRC | 1.9 ± 0.7 | 2.0 ± 0.9 | 2.2 ± 0.8 | ns |
| ASA | 2.8 ± 0.6 | 2.9 ± 0.5 | 3.1 ± 0.5 | ns |
| Vt/kg | 6.5 ± 1.3 | 6.0 ± 1.1 | 6.0 ± 1.3 | ns |
| Duration of anesthesia (min) | 188 ± 54 | 210 ± 78 | 180 ± 41 | ns |
| Fluids (ml) | 2075 ± 1240 | 1823 ± 889 | 1876 ± 1007 | ns |
| BEST PEEP ($cmH_2O$) | 6.8 ± 2.2 | 7.2 ± 2.5 | 7.6 ± 2.1 | ns |

# *Risk factors for development of perioperative EFL*

| | Multivariate analysis | | |
|---|---|---|---|
| | **Adjusted Odds Ratio** | **95% CI** | **P** |
| Age ≥ 65 | 2.3 | 0.9–5.6 | 0.077 |
| ASA ≥ 3 | 0.4 | 0.2–0.9 | 0.048 |
| BMI ≥ 30 | 6.0 | 2.4–14.3 | <0.0001 |
| Duration of surgery ≥ 180 min | 0.3 | 0.1–0.7 | 0.006 |
| $SpO_2$ preop ≤ 96 % | 1.3 | 0.5–3.5 | 0.600 |
| BPCO | 5.9 | 2.2–15.3 | <0.0001 |
| Fluid balance i.o. (ml/kg/hour) | 3.0 | 2.3–3.9 | <0.0001 |

# CONCLUSIONS…

- *The presence of EFL is the best predictor of PPCs*
- *Patients with EFL have a more severe impairment of respiratory function*
- *Obese patients are more prone to develop EFL*
- *The use of PEEP helps to reduce the incidence of EFL and to reduce PPCs*
- *Optimization of ventilation during surgery allows surgeon to use the techniques that they consider the best for the type of surgery*
- *Obesity and fluid therapy are the strongest determinant of EFL during anesthesia*