Göğüs Kalp Damar Anestezi ve Yoğun Bakım Derneği
20. Ulusal KONGRESİ
17-20 Nisan 2014
Grand Yazıcı Turban Otel - Marmaris
www.gkda2014.com

Kalp cerrahisi anestezisi sırasında (ve sonrasında) **koruyucu ventilasyon**

Mert Şentürk

İSTANBUL ÜNİVERSİTESİ
İSTANBUL TIP FAKÜLTESİ

Ajanda

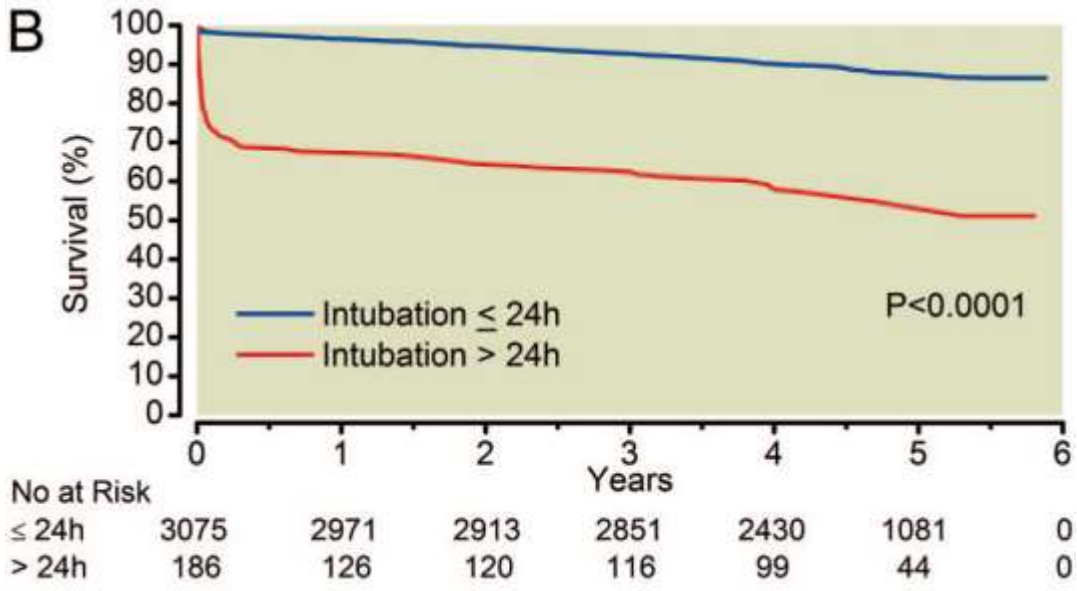
- CPB sırasında
- CPB sonrasında

- Akciğer işlevleri ile ilgili
- Akciğer ile ilgili
- Kalp ile ilgili

Önemli mi?

- Atelektazi ve hipoksemi, en sık ve en önemli solunumsal komplikasyon

% 60-90 Scherer 2009; Figureiredo 2008



Lellouche 2012

Niçin oluşuyor? #1

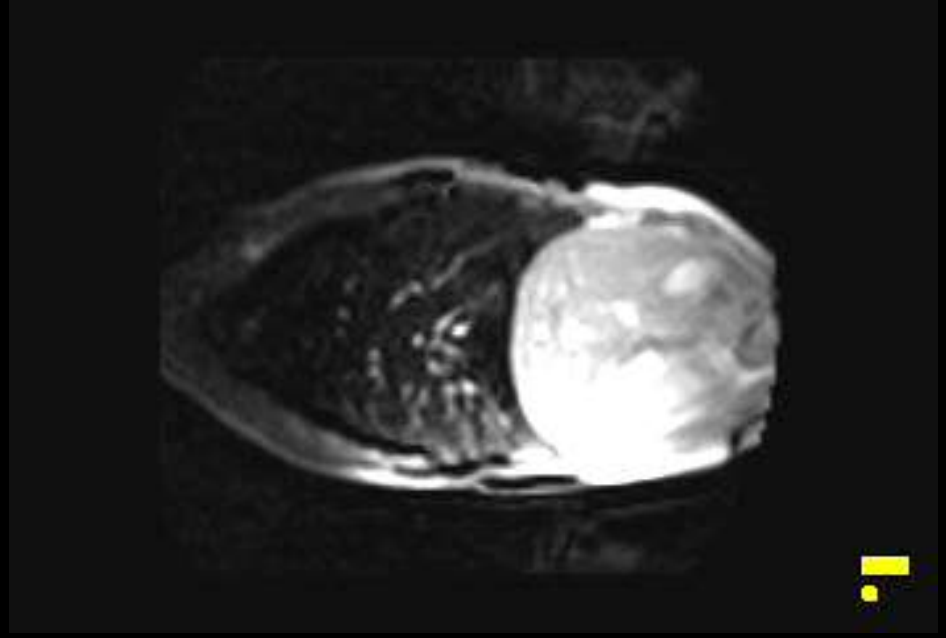
- Akciğer volümlerindeki değişiklikler (FRK)

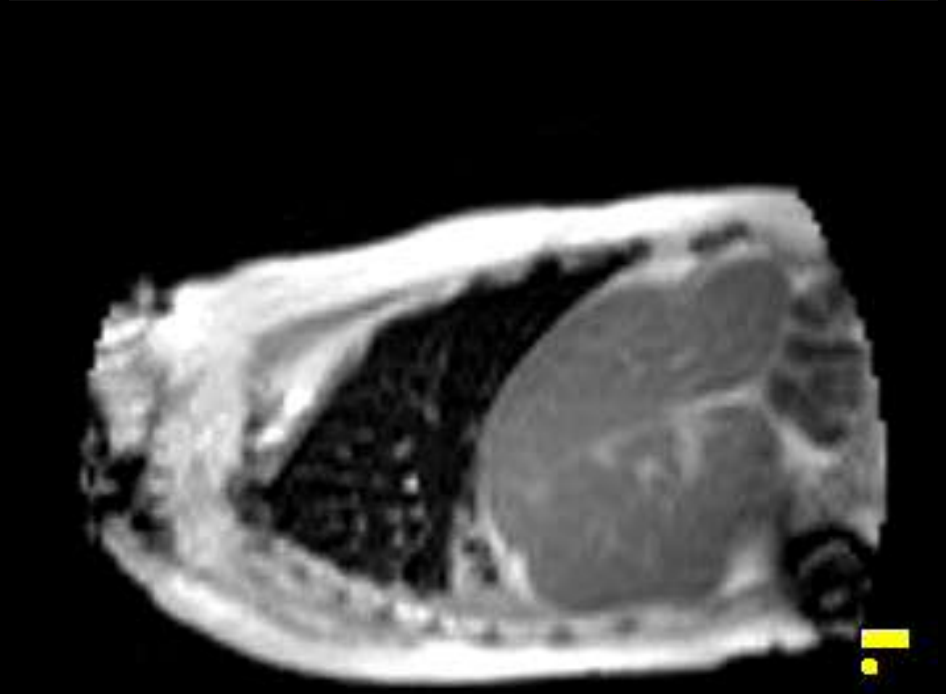
Kompresyon atelektazisi

- Gaz bileşimindeki değişikler (O2)

Rezorpsiyon atelektazisi

- Diğer faktörler :
  - HPV inhibisyonu
  - Sürfaktan kaybı vb





Niçin oluşuyor? #2

- Ekstrakorporeal dolaşım
- Plevral kavitede manuplasyon
- Farklı ventilasyon *alışkanlıkları*
  - FiO2
  - PEEP
  - TV

Apostolakis *et al. Journal of Cardiothoracic Surgery* 2010, **5**:1
http://www.cardiothoracicsurgery.org/content/5/1/1

JCTS JOURNAL OF CARDIOTHORACIC SURGERY

REVIEW Open Access

Strategies to prevent intraoperative lung injury during cardiopulmonary bypass

Efstratios E Apostolakis[1], Efstratios N Koletsis[1], Nikolaos G Baikoussis[1,2*], Stavros N Siminelakis[2], Georgios S Papadopoulos[3]

Off-pump
Yeni EC devreleri
Ultrafiltrasyon
Lökosit deplesyonu
Farmakolojik önlemler
ECC sırasında ventilasyon

Stratégie ventilatoire peropératoire en chirurgie cardiaque : vers une approche multimodale

Intraoperative ventilatory strategy in cardiac surgery: towards a multimodal approach

A. Ouattara[a, b, c*], P. Sarrabay [a, b]

Annales Françaises d'Anesthésie et de Réanimation 31 (2012) S2-S4

CPAP

- (sadece) Kısa dönemde oksijenizasyon daha iyi; FiO2'den bağımsız. Berry BJA 1993
- Sadece CPAP için yeterli kanıt YOK.

  (!!!: eski çalışmalar)
- Perfüzyonu devam ettirmek düşünülebilir.

Pompa sonrası ventilasyon (operasyon sırasında ve sonrasında)

- Mod: **PCV** vs VCV
- Tidal volüm: **Düşük** vs yüksek
- **PEEP** vs ZEEP
- FiO2: **Düşük** vs Yüksek
- **ARM**

High Tidal Volumes in Mechanically Ventilated Patients Increase Organ Dysfunction after Cardiac Surgery

Copyright © 2012, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins. Anesthesiology 2012; 116:1072–82

François Lellouche, M.D., Ph.D.,* Stéphanie Dionne,† Serge Simard, M.Sc.,‡ Jean Bussières, M.D.,§ François Dagenais, M.D.§

	Tidal Volumes (ml/kg of PBW)			
	Less Than 10 (n = 724)	10–12 (n = 1,567)	More Than 12 (n = 1,143)	*P* Value
Any organ failure, n (%)	82 (11)	230 (15)	206 (18)	<0.001 (†)
Multiple organ failure, n (%)	21 (2.9)	74 (4.7)	70 (6.1)	0.006 (†)
ICU length of stay (days)	1.0 (1.0–2.2)	1.2 (0.9–2.6)	1.8 (1.0–3.0)	<0.001 (†, ‡)
ICU length of stay more than 24 h, n (%)	478 (20)	1,036 (45)	814 (35)	0.003 (†, ‡)
ICU length of stay more than 48 h, n (%)	225 (31)	518 (33)	447 (39)	<0.001 (†, ‡)
ICU length of stay more than 7 d, n (%)	19 (16)	46 (38)	57 (47)	0.005 (†, ‡)
Hospital length of stay (days)	6 (5–8)	6 (5–8)	7 (5–9)	0.06
ICU mortality, n (%)	13 (1.8)	30 (1.9)	29 (2.5)	0.44
Hospital mortality, n (%)	22 (3.0)	49 (3.1)	43 (3.8)	0.59
Hospital and late mortality, n (%)	91 (13)	208 (13)	154 (13)	0.85
Outcome Data				
Duration of mechanical ventilation (hours)	6.0 (5–12)	6.5 (4.5–13)	7.4 (4.8–14.9)	<0.001 (†)
Reintubation, n (%)	25 (3.5)	72 (4.6)	64 (5.6)	0.10
Intubation more than 24 h, n (%)	31 (4.3)	84 (5.4)	87 (7.6)	0.006 (†)
Intubation more than 48 h, n (%)	11 (1.5)	46 (2.9)	44 (3.9)	0.01 (†)
Intubation more than 7 d, n (%)	3 (0.4)	9 (0.6)	11 (1.0)	0.30
Hemodynamic instability, n (%)	39 (5.4)	124 (7.9)	115 (10.1)	0.001 (†)
Renal failure, n (%)	57 (7.9)	163 (10.4)	145 (12.7)	0.004 (†)
Hemodialysis, n (%)	9 (1.2)	47 (3.0)	36 (3.2)	0.02 (*, †)

High Tidal Volumes in Mechanically Ventilated Patients Increase Organ Dysfunction after Cardiac Surgery

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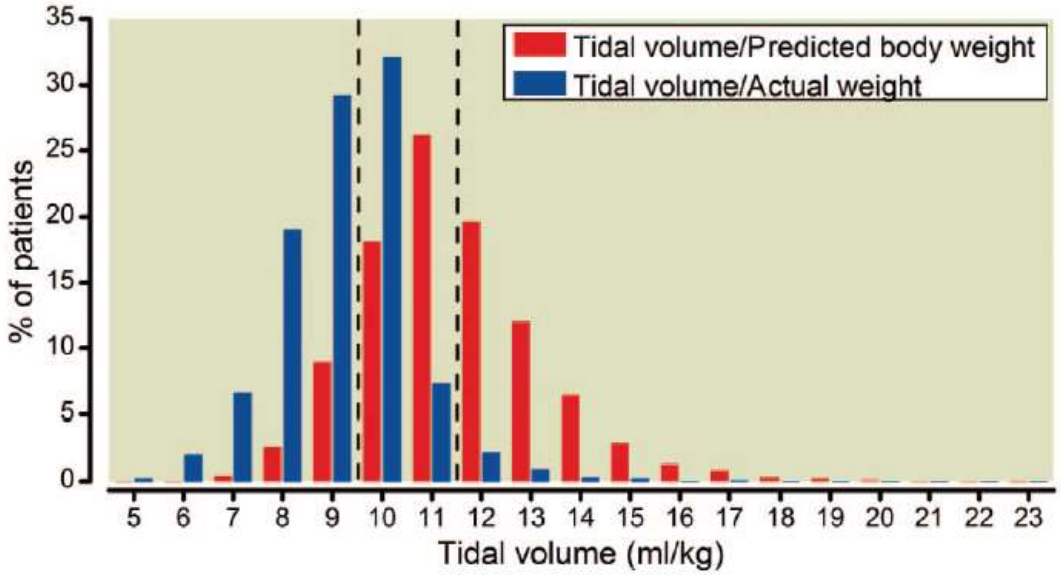
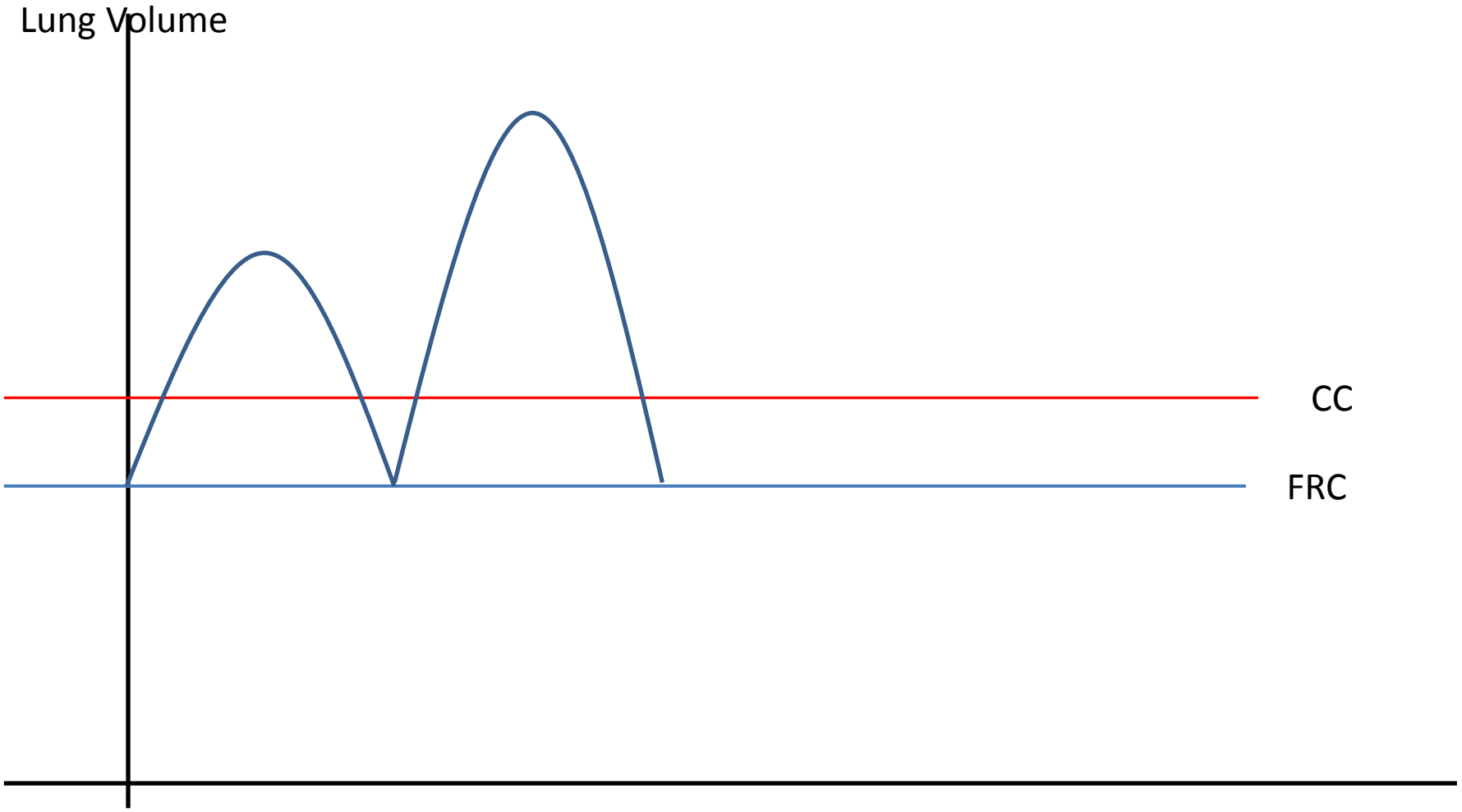
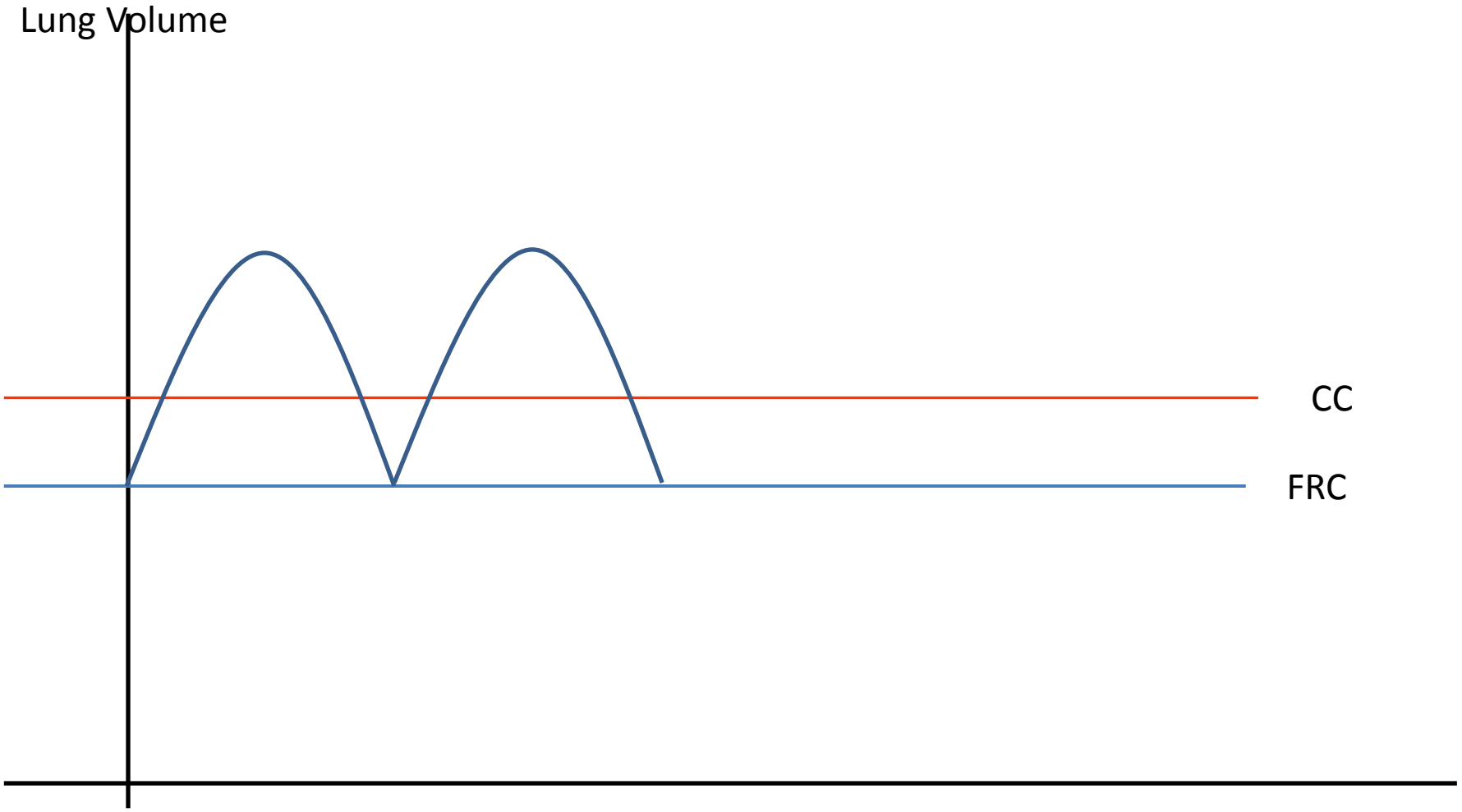


rate usually set at 10 breaths/min, the positive end-expiratory pressure (PEEP) at 5 cm H_2O, and fraction of inspired oxygen (F_{IO_2}) ranged from 70 to 100%, as recommended in anesthesiology textbooks.[14,15] Patients were managed using


Lung Volume
CC
FRC


Lung Volume
CC
FRC

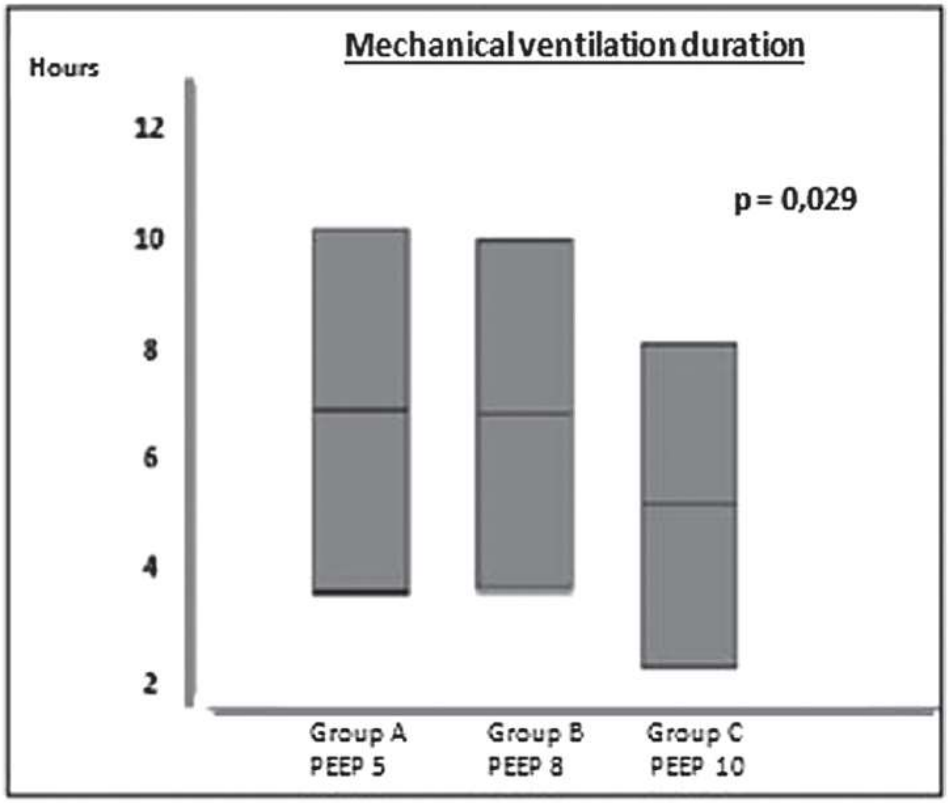
Ann Thorac Cardiovasc Surg Advance Published Date: October 3, 2013

doi: 10.5761/atcs.cr.13-0006

Case Report

Effects of Positive End-Expiratory Pressure on Mechanical Ventilation Duration after Coronary Artery Bypass Grafting: A Randomized Clinical Trial

Daniel Lago Borges, PT, MS,[1] Vinícius José da Silva Nina, PhD,[2] Thiago Eduardo Pereira Baldez, PT,[1] Marina de Albuquerque Gonçalves Costa, PT,[1] Natália Pereira dos Santos, PT,[1] Ilka Mendes Lima, PT,[1] and Josimary Lima da Silva Lula, Psy[3]



Comparison of Positive End-Expiratory Pressure of 8 versus 5 cm H2O on Outcome After Cardiac Operations.
Hansen ve ark 2014; J Intensive Care med

8 PEEP ile sadece hastanede kalış süresi kısalıyor; bunun da klinik olarak anlamlı olmadığı düşünülüyor.

The Pulmonary and Hemodynamic Effects of Two Different Recruitment Maneuvers After Cardiac Surgery

Serdar Celebi, MD*
Özge Köner, MD†
Ferdi Menda, MD*
Kubilay Korkut, MD‡
Kaya Suzer, MD‡
Nahit Cakar, MD§

BACKGROUND: The aim of our study was to evaluate the pulmonary and hemodynamic effects of two different recruitment maneuvers after open heart surgery.
METHODS: Sixty patients undergoing coronary artery bypass surgery were randomized into three groups after operation: recruitment maneuver with continuous positive airway pressure (CPAP) (CPAP-40 group, $n = 20$), recruitment by positive end-expiratory pressure (PEEP) (PEEP-20 group, $n = 20$), and 5 cm H_2O PEEP (PEEP-5 group, $n = 20$). In the CPAP-40 group, 40 cm H_2O peak inspiratory pressure was applied for 30 s, then PEEP was reduced to 20 cm H_2O and ventilation was continued with baseline variables with PEEP decreased until the best Pao_2 was achieved. In the PEEP-20 group, 20 cm H_2O PEEP was set for 2 min, tidal volume was adjusted to achieve a peak inspiratory airway pressure of 40 cm H_2O during the maneuver, then PEEP was decreased until the best Pao_2 had been achieved. In the PEEP-5 group, 5 cm H_2O PEEP was applied postoperatively.
RESULTS: The mean arterial blood pressure of the CPAP-40 group was lower than that of the PEEP-20 ($P < 0.01$) and PEEP-5 groups ($P < 0.01$) during the interventions. Oxygenation was higher in both recruitment groups than in the PEEP-5 group during the mechanical ventilation period. There was no signiticant difference among the groups beyond that period. The atelectasis score of the PEEP-5 group (1.3 ± 0.9) on postoperative day 1 was higher than that of the CPAP-40 (0.65 ± 0.6; $P = 0.01$) and PEEP-20 (0.65 ± 0.5; $P = 0.01$) groups.
CONCLUSIONS: The recruitment techniques with postmaneuver PEEP increased oxygenation and decreased atelectasis equally, whereas PEEP-20 provided more stable hemodynamic conditions than the CPAP maneuver.
(Anesth Analg 2007;104:384–90)

Pulmonary Effects of Noninvasive Ventilation Combined with the Recruitment Maneuver After Cardiac Surgery

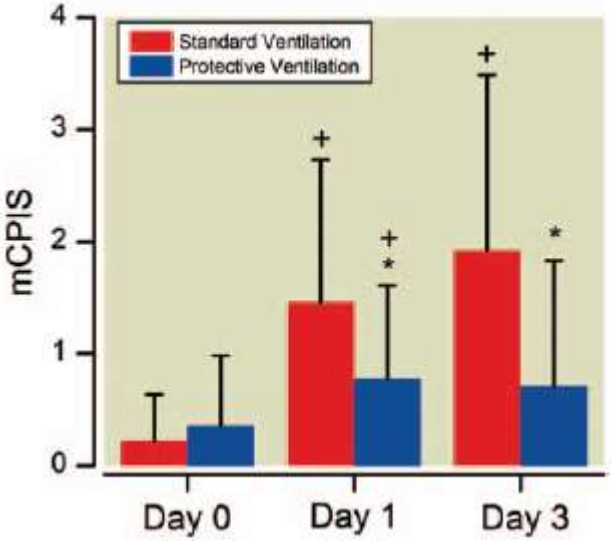
Serdar Celebi, MD*
Özge Köner, MD†
Ferdi Menda, MD†
Oğuz Omay, MD‡
Ilhan Günay‡
Kaya Suzer, MD§
Nahit Cakar, MD‖

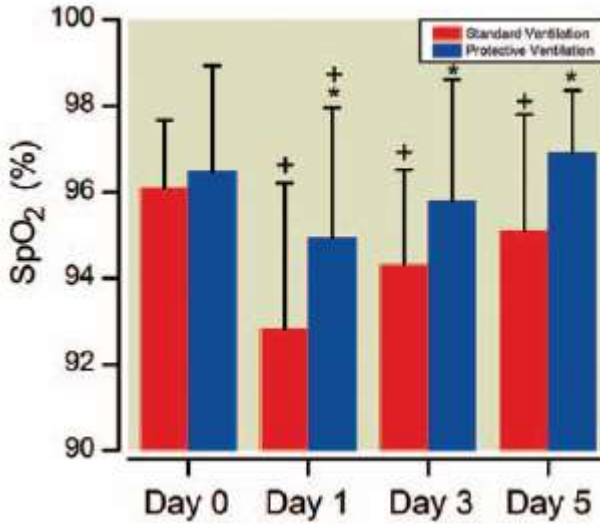
BACKGROUND: The aim of our study was to evaluate the pulmonary effects of noninvasive ventilation (NIV) with or without recruitment maneuver (RM) after open heart surgery.
METHODS: One-hundred patients undergoing coronary artery bypass surgery were randomized into four groups after the operation: 1) RM with sustained inflation during mechanical ventilation postoperatively (RM group, $n = 25$); 2) RM combined with NIV applied for 1/2-h periods every 6 h in the first postoperative day after tracheal extubation (RM-NIV group, $n = 25$); 3) NIV after tracheal extubation (NIV group, $n = 25$); and 4) a control group consisting of patients receiving neither RM nor NIV (control group, $n = 25$). Pulmonary function tests, oxygenation index, and atelectasis on chest radiograph were evaluated and compared among the groups.
RESULTS: RM provided higher arterial oxygen levels during mechanical ventilation and after tracheal extubation compared to other interventions. Oxygenation was better in the RM-NIV and NIV groups than in the control group ($P = 0.02$ and $P = 0.008$, respectively) at the end of the study. The postoperative atelectasis score of the control group (median: 1) was higher than those of the RM (1; $P = 0.03$), RM-NIV (0; $P < 0.01$) and NIV (0; $P < 0.01$) groups. Pulmonary function of the NIV groups on postoperative day 2 was better than in the other groups, whereas the tests were similar among the groups on postoperative day 7.
CONCLUSIONS: NIV associated with RM provided better oxygenation both during and after the mechanical ventilation period. NIV either alone or in combination with RM provided lower atelectasis scores and better early pulmonary function tests compared to the control group, without a significant difference regarding the duration of mechanical ventilation, intensive care unit stay, and the length of hospitalization. NIV combined with RM is recommended after open heart surgery to prevent postoperative atelectasis and hypoxemia.
(Anesth Analg 2008;107:614–9)

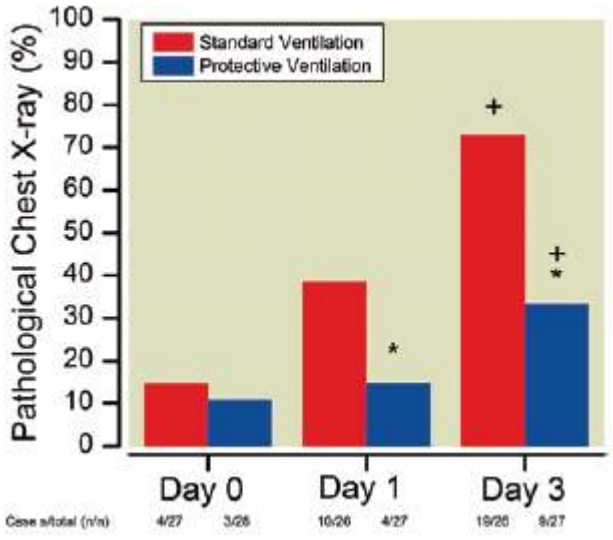
Protective Mechanical Ventilation during General Anesthesia for Open Abdominal Surgery Improves Postoperative Pulmonary Function

Anesthesiology, in press

Paolo Severgnini, M.D.,* Gabriele Selmo, M.D.,* Christian Lanza, M.D.,* Alessandro Chiesa, M.D.,*
Alice Frigerio, M.D.,* Alessandro Bacuzzi, M.D.,* Gianlorenzo Dionigi, M.D., Ph.D.,‡
Raffaele Novario, P.H.,§ Cesare Gregoretti, M.D.,|| Marcelo Gama de Abreu, M.D., Ph.D.,#
Marcus J. Schultz, M.D., Ph.D.,** Samir Jaber, M.D., Ph.D.,†† Emmanuel Futier, M.D.,‡‡
Maurizio Chiaranda, M.D., Ph.D.,§§ Paolo Pelosi, M.D.,||||



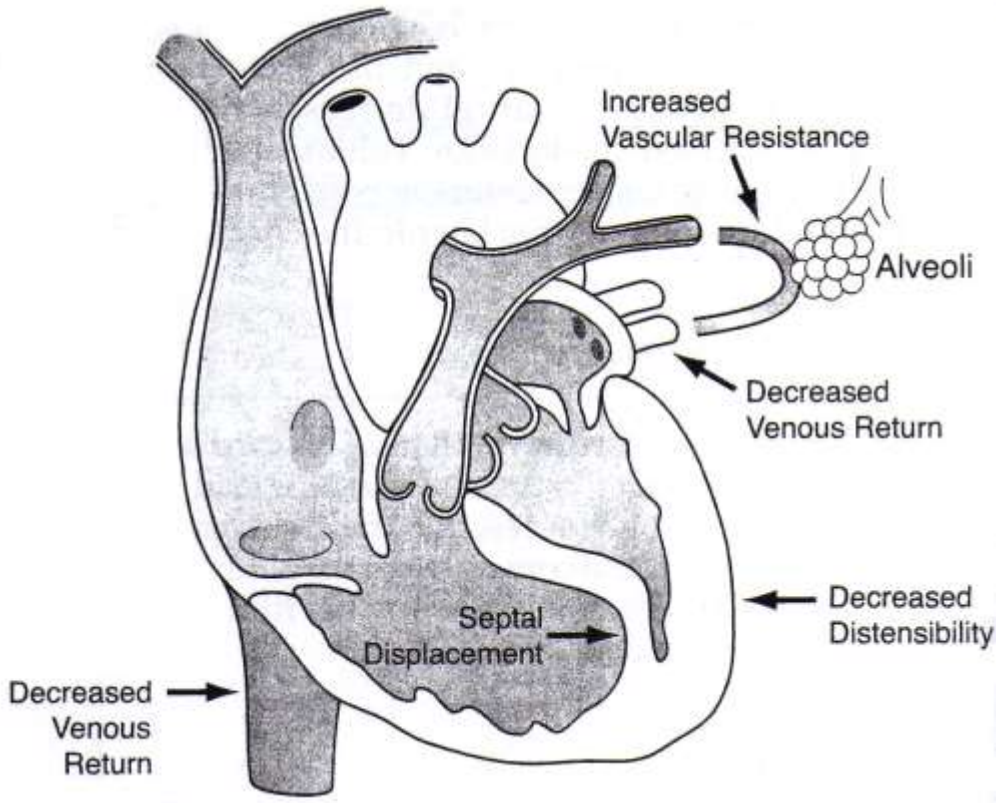




56 Hasta
Standard: TV: 9 ml/kg; ZEEP
Protektif: TV: 7 ml/kg; 10 PEEP; RM

PEEP, kalp debisini azaltır

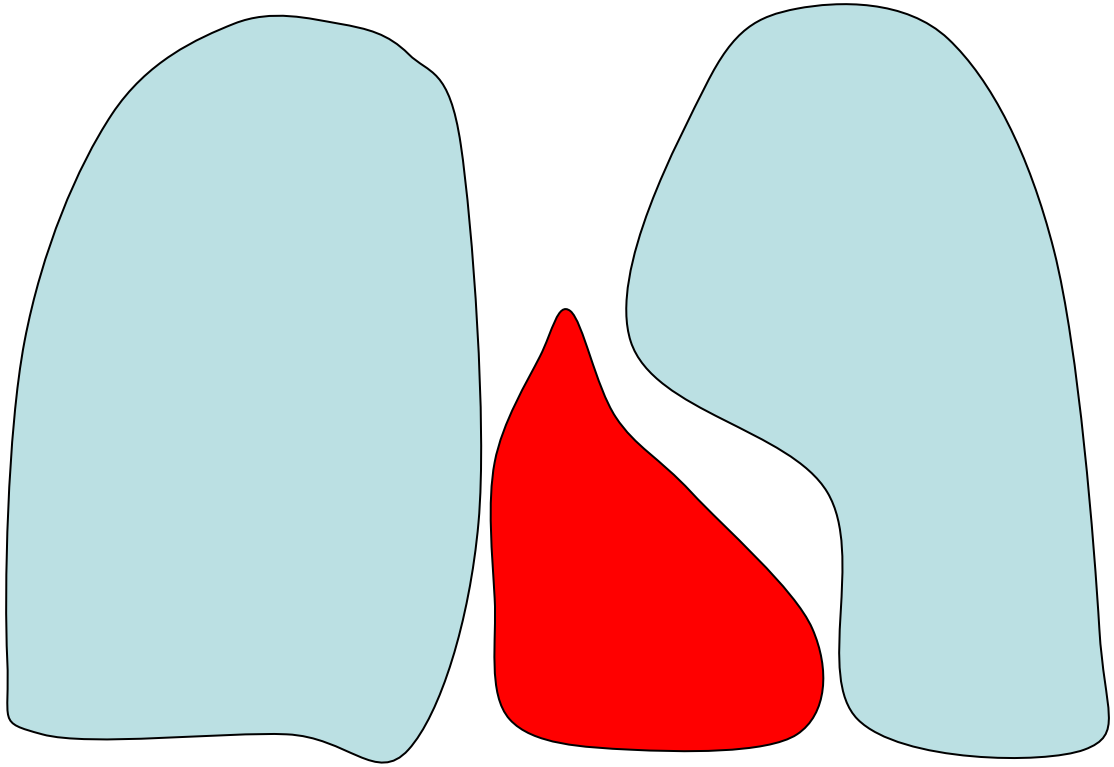
Cournand, Am J Physiol 1948



The ICU Book, Marino

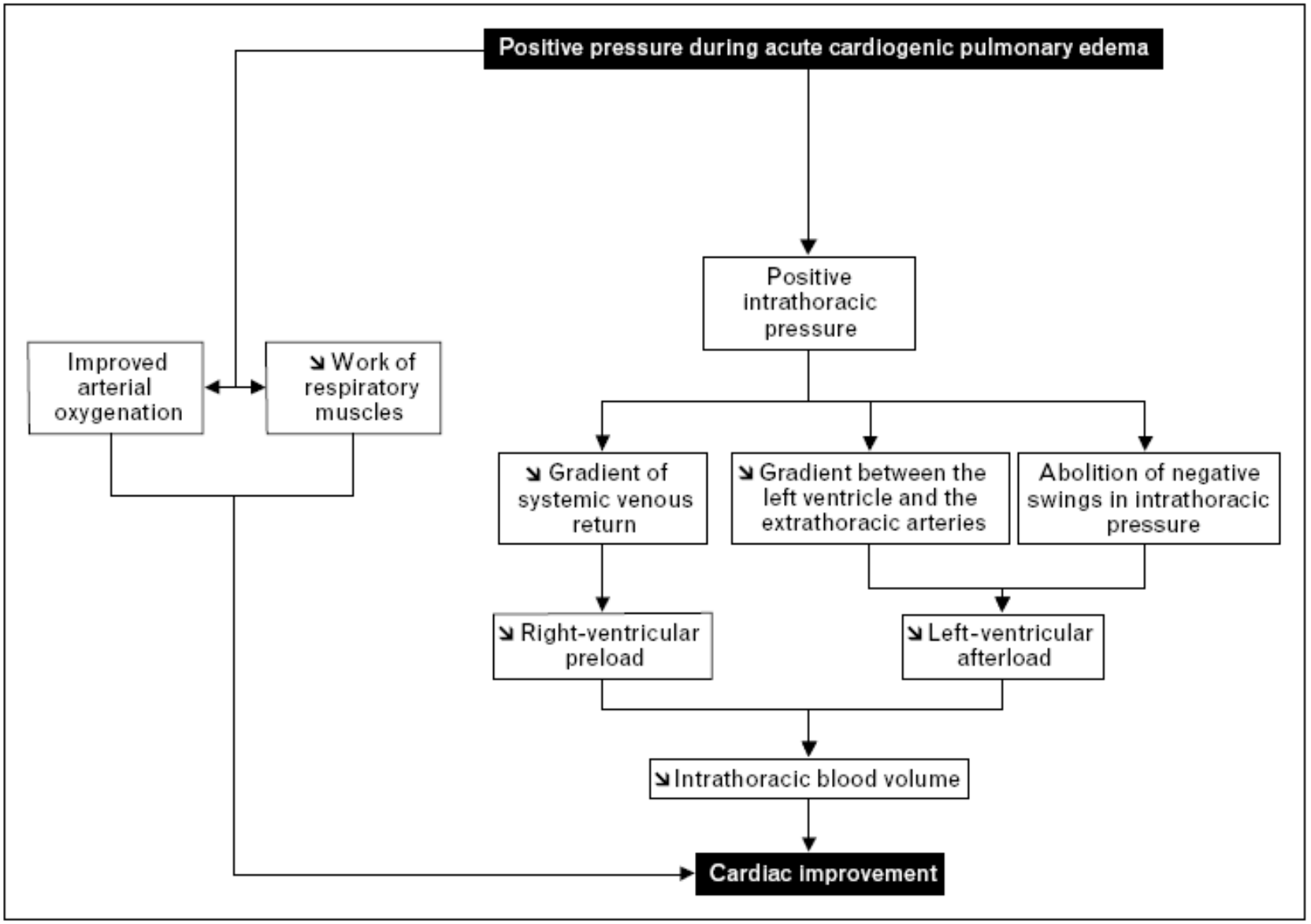
Kapalı bir basınç odası içinde iki farklı basınç sistemi

Luecke, Pelosi Crit Care 2005



Kompliyans
Direnç
Akciğer volümleri
Atelektazi
Overdistansiyon

Preload
Afterload
Kontraktilite



Monnet et al, Curr Opin Crit Care 2007

Positive End-expiratory Pressure Influences Echocardiographic Measures of Diastolic Function

A Randomized, Crossover Study in Cardiac Surgery Patients

Copyright © 2013, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins. Anesthesiology 2013; 119:1078-86

Peter Juhl-Olsen, M.D.,* Johan Fridolf Hermansen, B.M.Sc.,† Christian Alcaraz Frederiksen, M.D.,* Linda Aagaard Rasmussen, M.H.S.,‡ Carl-Johan Jakobsen, M.D,§ Erik Sloth, Ph.D.‖

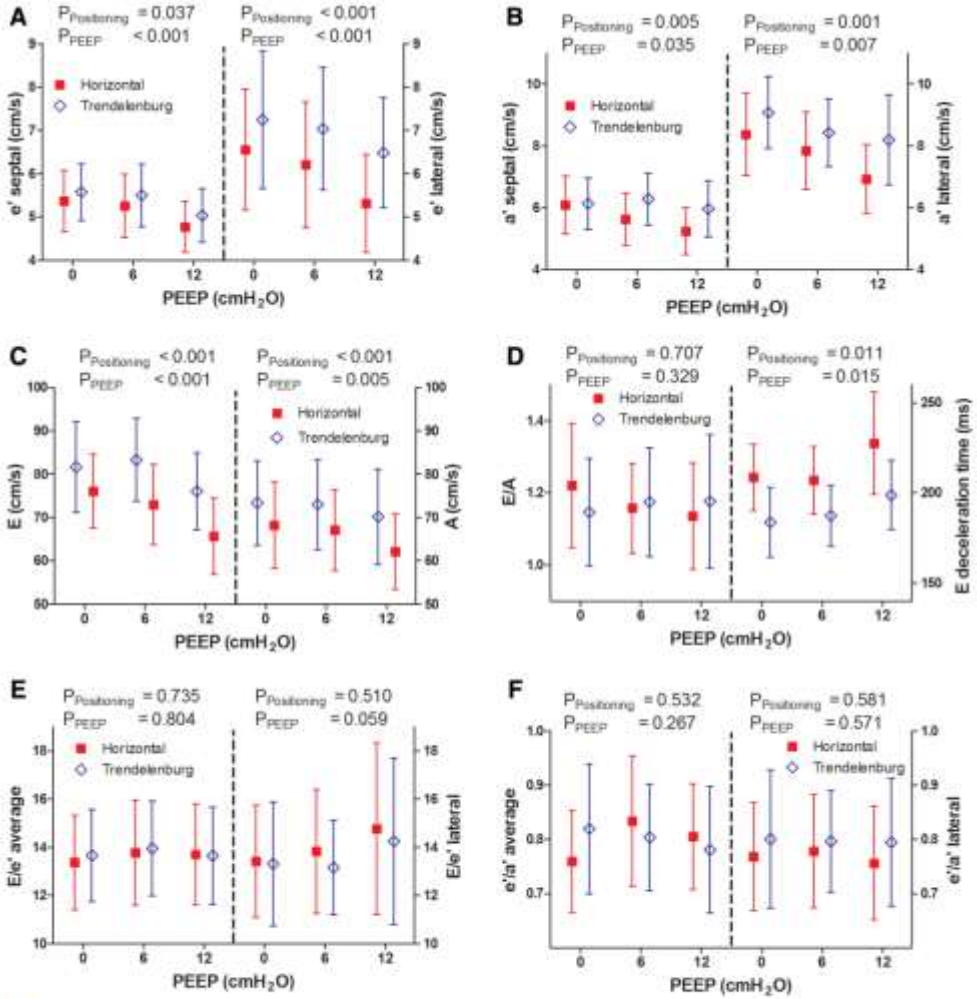


Fig. 2. The effects of positioning (horizontal and Trendelenburg) and positive end-expiratory pressure (PEEP) on echocardiographic indices of diastolic function including tissue Doppler peak early (e') and atrial (a') diastolic velocities of the mitral valve annuli (*A* and *B*), pulsed Doppler peak early (E) and atrial (A) diastolic transmitral flow (*C*) and E deceleration time (*D*). In addition, the effects of positioning and PEEP on the composite ratios E/A, E/e', and e'/a' are shown (*D–F*). ANOVA, P_{PEEP} = *P* values of PEEP, ANOVA; Average = averaged from the septal and lateral mitral valve annuli; $P_{positioning}$ = *P* values of positioning.

Sonuç

- «multimodal» yaklaşım:
  - Düşük tidal volüm
  - Düşük FiO2
  - «amaca yönelik» PEEP
  - RM
  - Postop erken dönem non-invazif ventilasyon