Con il patrocinio di

REGIONE LIGURIA

IRC Italian Resuscitation Council

CONGRESSO NAZIONALE IRC 2017

13 • 14 OTTOBRE

DALL'EVIDENZA **AI TRATTAMENTI FUTURI**

CENTRO CONGRESSI MAGAZZINI DEL COTONE

PORTO ANTICO GENOVA

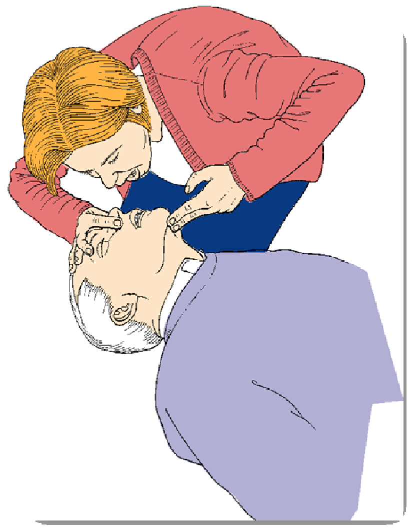
Uso della ventilazione meccanica durante RCP: che modalità ventilatoria?

Andrea Scapigliati

Istituto di Anestesia e Rianimazione, Università Cattolica del S. Cuore

Polo di Scienze Cardiovascolari, Fondazione Policlinico Gemelli, Roma

B



C

Perchè?

Dall'evidenza…

Part 4: Advanced Life Support
2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations

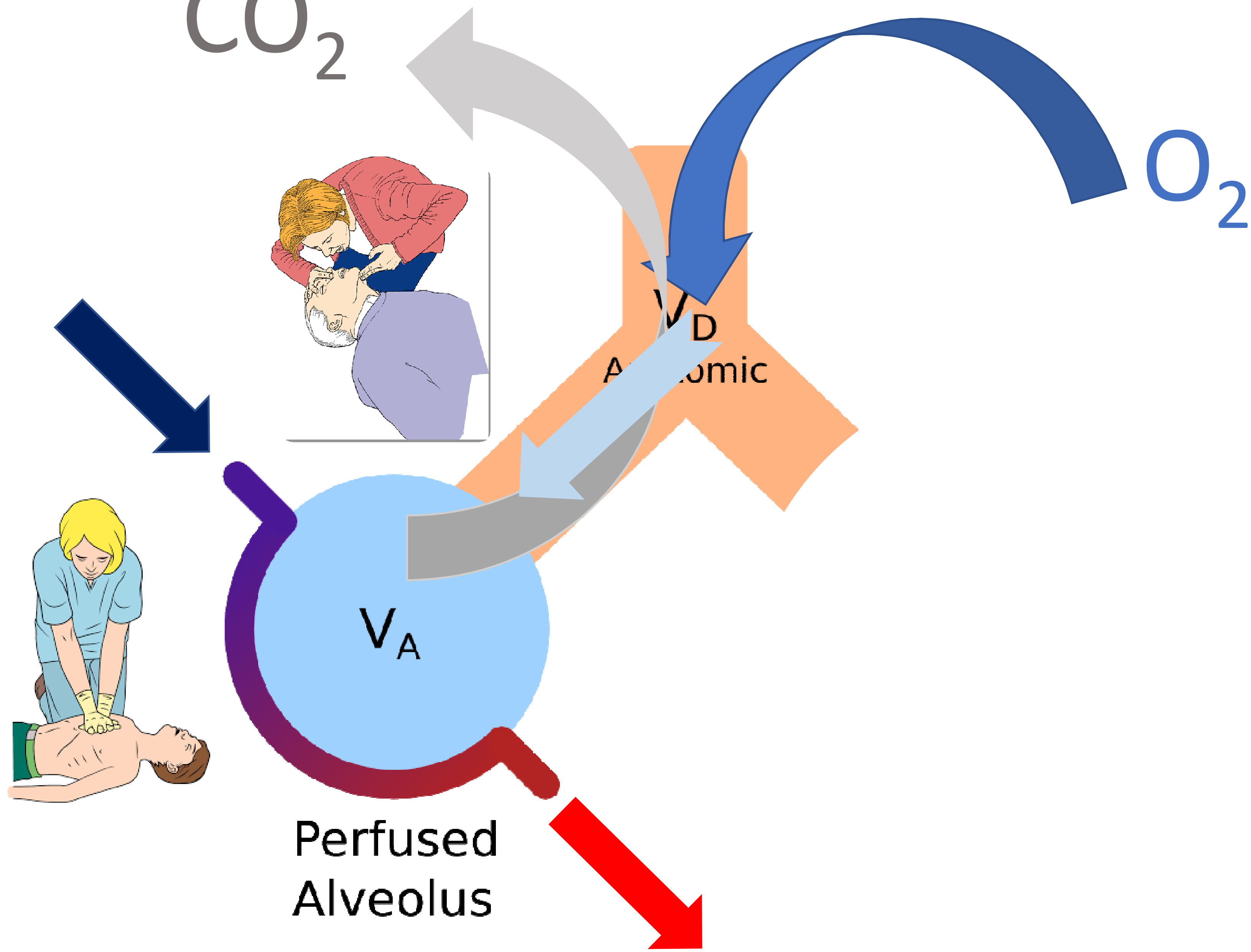
Airway, Oxygenation, and Ventilation

- Oxygen dose during CPR (ALS 889)
- Basic versus advanced airway (ALS 783)
- Supraglottic airways (SGAs) versus tracheal intubation (ALS 714)
- Confirmation of correct tracheal tube placement (ALS 469)
- Ventilation rate during continuous chest compressions (ALS 808)

Treatment Recommendation:

We suggest a ventilation rate of **10 breaths/min** in adults with cardiac arrest with a secure airway receiving continuous chest compressions (**weak recommendation, very-low-quality evidence**).

We have valued the need to suggest **a ventilation rate that is already in use…**. We did **not assess** effect of **tidal volume** and **any other** ventilation **variables** during CPR and have therefore not addressed these in the treatment recommendation.



CO_2
O_2
V_D
A omic
V_A
Perfused
Alveolus

Eppure…

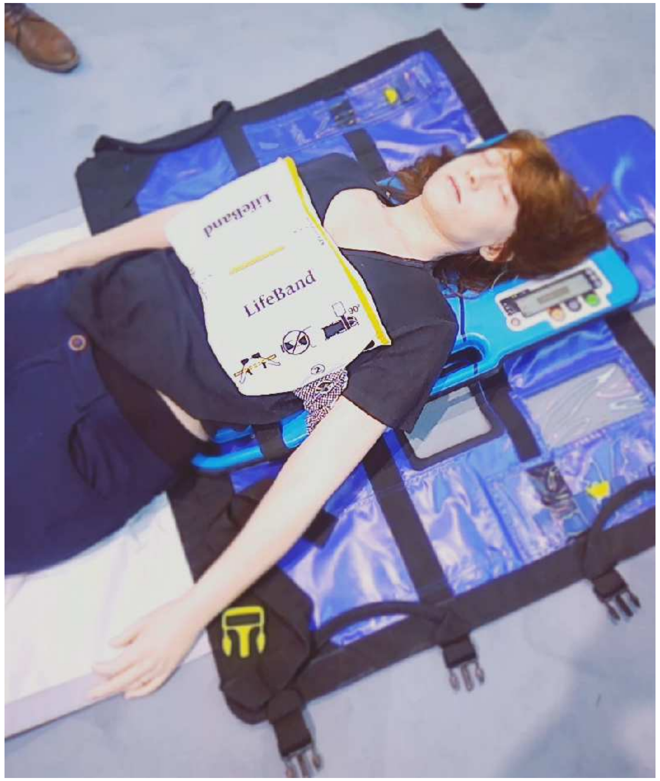


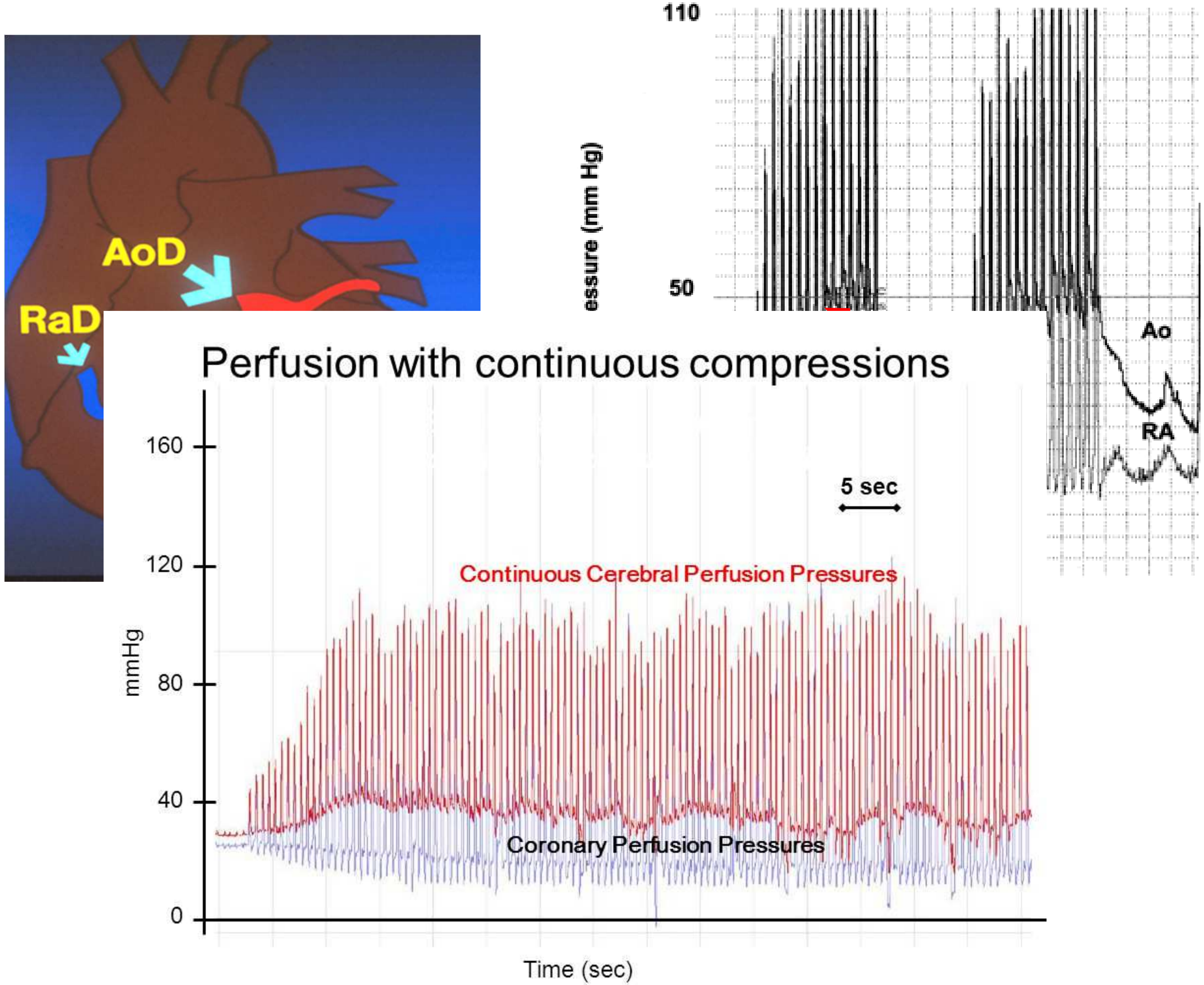




filmed at the
Baltimore City Hospitals
in
1957/58 and 1961
as part of a Research Project

Cosa non va nella ventilazione?


LifeBand



Ewy GA, Zuercher, M. Hilwig, R.W. et al ***Circulation*** *2007;116:2525*

The first quantitative report of ventilation rate during in-hospital resuscitation of older children and adolescents☆

Andrew D. McInnes[a,*], Robert M. Sutton[a,b], Alberto Orioles[a], Akira Nishisaki[a,b], Dana Niles[a,b], Benjamin S. Abella[c], Matthew R. Maltese[c], Robert A. Berg[a,b], and Vinay Nadkarni[a,b]

Conclusions—During in-hospital pediatric cardiac arrest, rescuers frequently provide artificial ventilations at rates in excess of AHA guidelines, with twenty percent of CPR time having ventilation rates double that recommended. Excessive ventilation was particularly common during CPR events that occurred on nights/weekends.

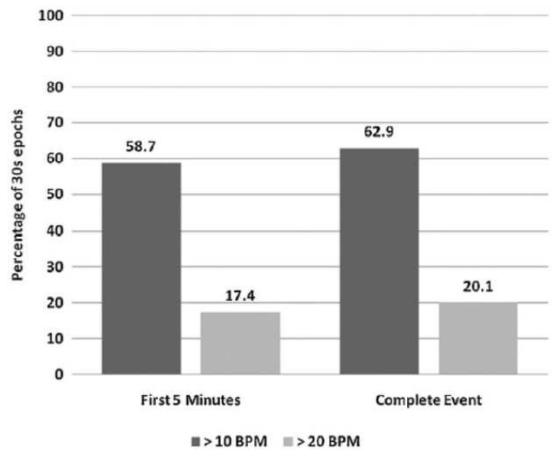
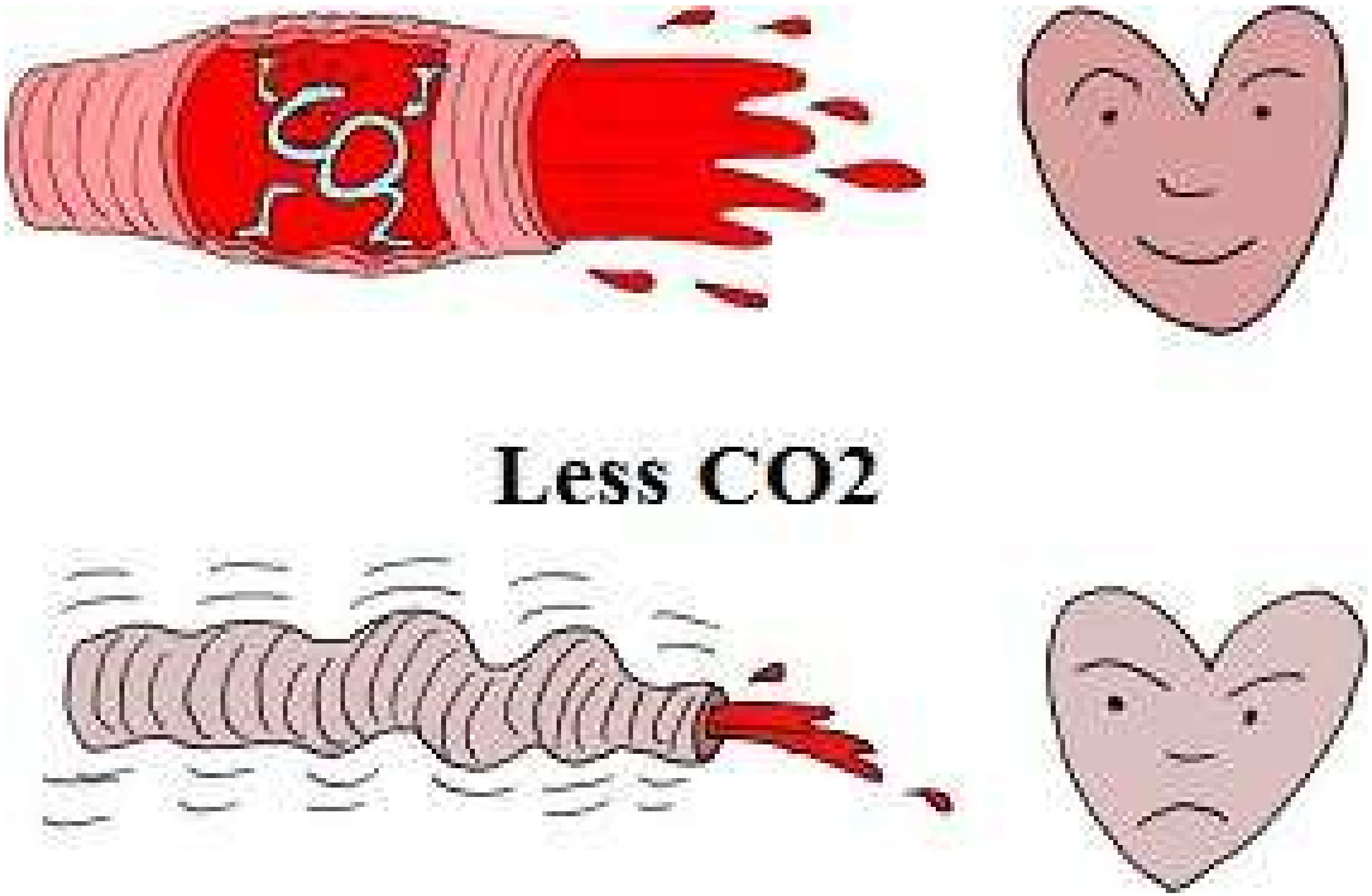
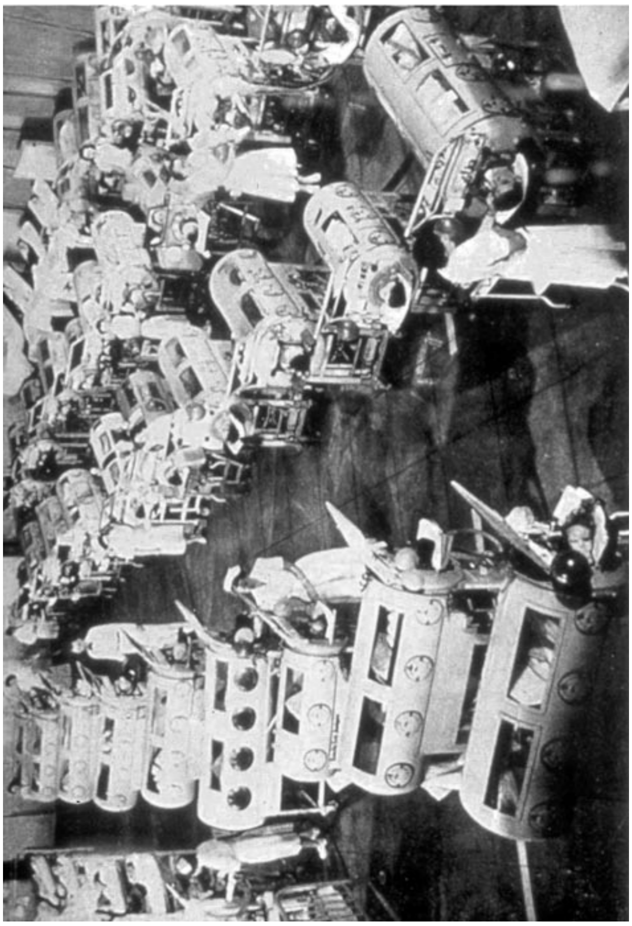


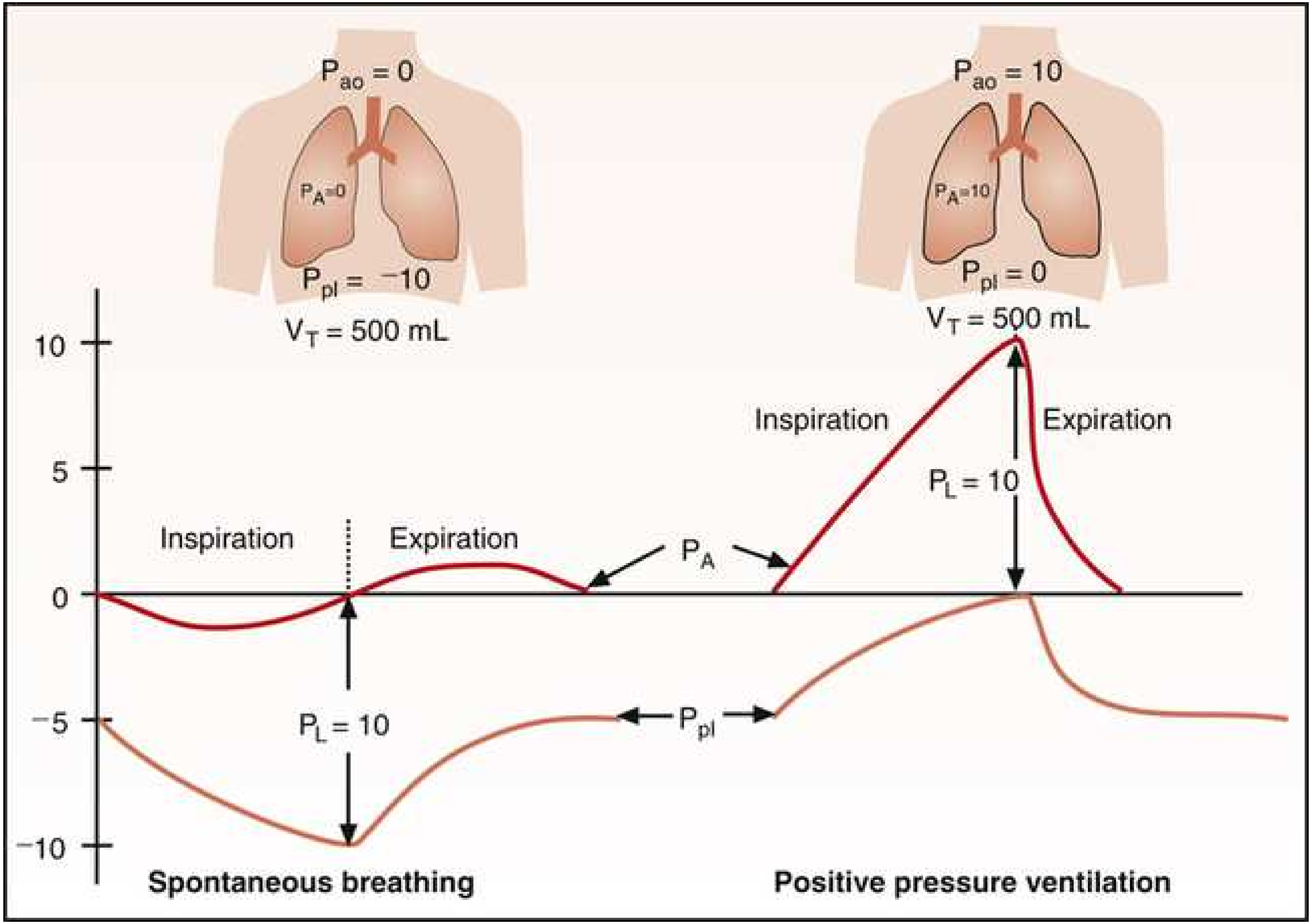
Fig. 2.
The proportion of CPR time with excessive ventilation (30 s epochs) with a ventilation rate >10 bpm (dark gray) and > 20 bpm (light gray). CPR time is reported as the first 5 min of the CPR event and the complete CPR event.

Resuscitation. 2011 August ; 82(8): 1025–1029. doi:10.1016/j.resuscitation.2011.03.020.

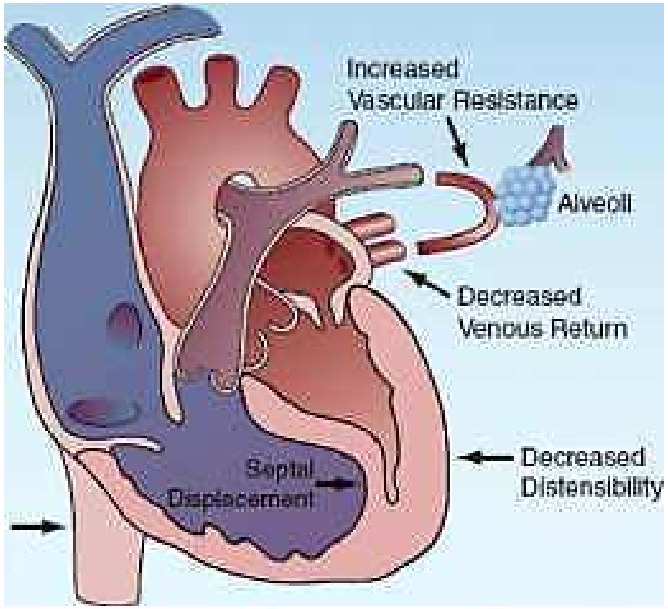
Iperventilazione = meno flusso al 



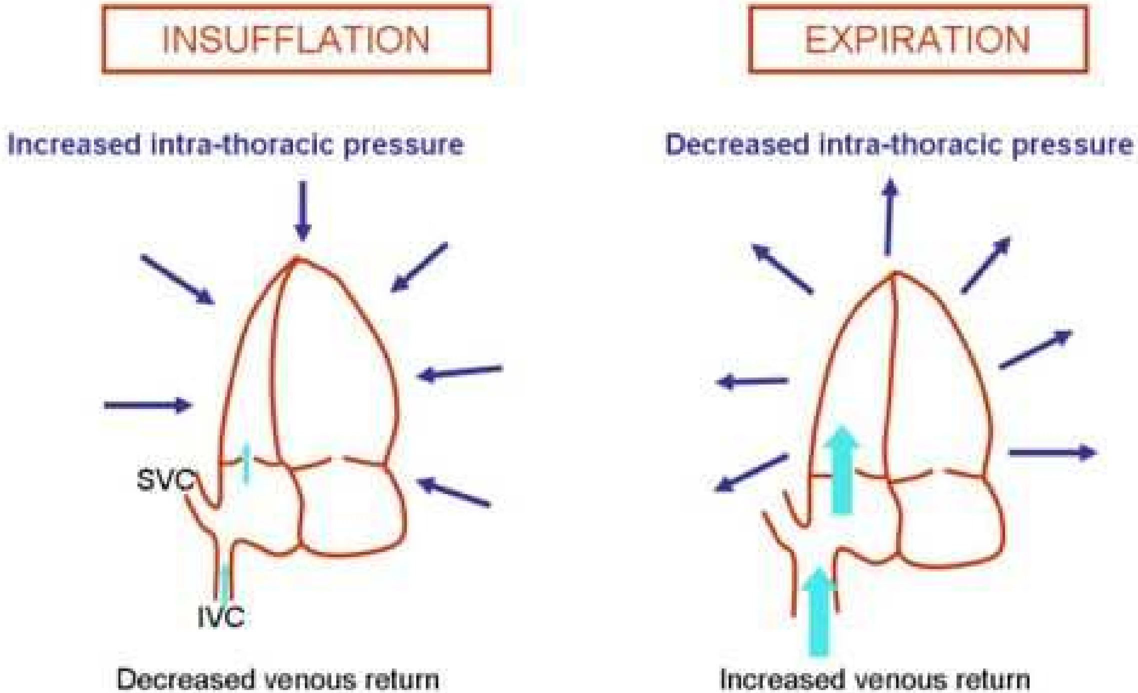




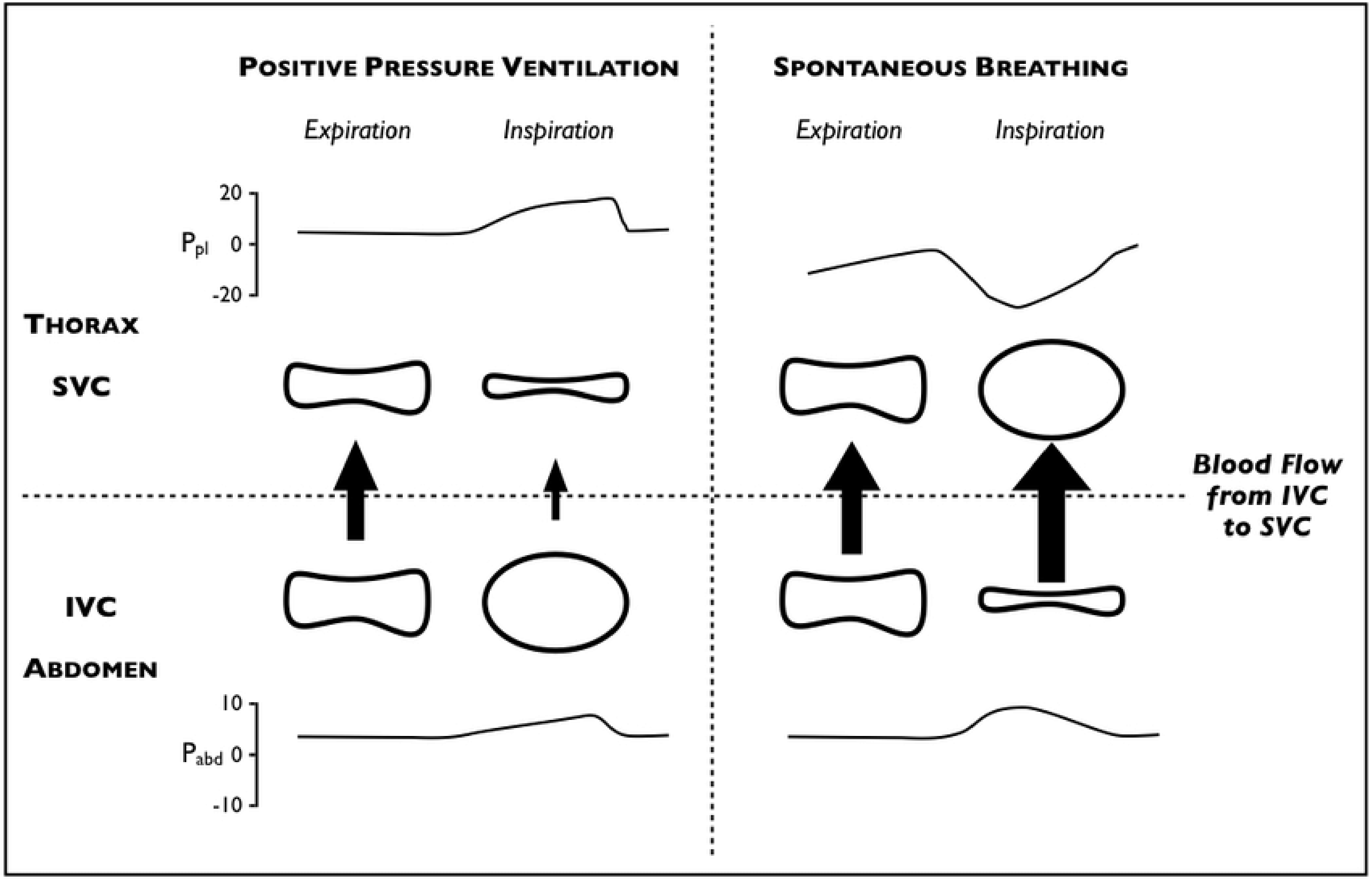
Pao = 0
PA=0
Ppl = −10
VT = 500 mL
Pao = 10
PA=10
Ppl = 0
VT = 500 mL
10
5
0
−5
−10
Inspiration
Expiration
PA
Inspiration
Expiration
PL = 10
PL = 10
Ppl
Spontaneous breathing
Positive pressure ventilation



Increased
Vascular Resistance
Alveoli
Decreased
Venous Return
Septal
Displacement
Decreased
Distensibility



INSUFFLATION
Increased intra-thoracic pressure
SVC
IVC
Decreased venous return
EXPIRATION
Decreased intra-thoracic pressure
Increased venous return


POSITIVE PRESSURE VENTILATION
SPONTANEOUS BREATHING
Expiration
Inspiration
Expiration
Inspiration
20
P_pl 0
-20
THORAX
SVC
Blood Flow from IVC to SVC
IVC
ABDOMEN
10
P_abd 0
-10

Acad. Emerg. Med. 1995; 2:719–724.

Out-of-hospital Ventilation: Bag–Valve Device vs Transport Ventilator

Jay A. Johannigman, MD, Richard D. Branson, RRT, Daniel J. Johnson, MD, Kenneth Davis, Jr., MD, James M. Hurst, MD

Conclusions: In this sample, ET intubation was the most frequently used airway by EMS providers. When ET intubation was accomplished, adequate ventilation could be achieved using either bag–valve ventilation or a transport ventilator. Ventilation via the EOA proved inadequate.

Comparison of ventilation and cardiac compressions using the Impact Model 730 automatic transport ventilator compared to a conventional bag valve with a facemask in a model of adult cardiopulmonary arrest☆,☆☆,◊

Nichole Salas[a,1], Bernadette Wisor[a,1], Janice Agazio[b], Richard Branson[c,2], Paul N. Austin[a,*]

Resuscitation (2007) 74, 94—101

Conclusion: Compared to the BVM, the Impact 730 is as effective, easier to use and limits the amount of gas entering the stomach when used during adult CPR in a simulated setting.

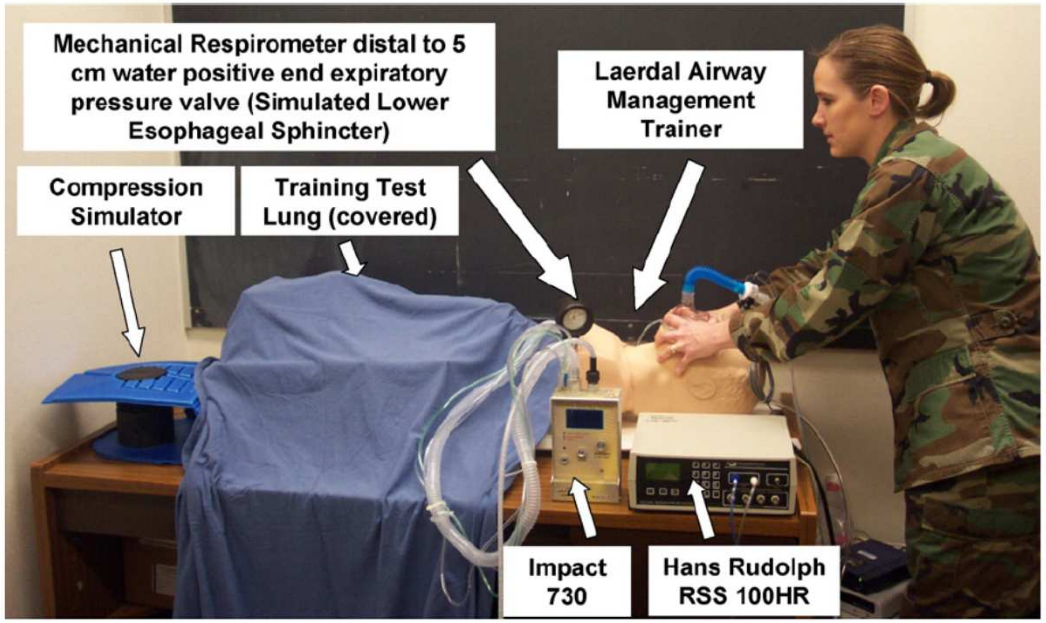


Figure 1 Experimental setup.

Comparison of different inspiratory triggering settings in automated ventilators during cardiopulmonary resuscitation in a porcine model

Dingyu Tan[1©], Jun Xu[1©], Shihuan Shao[1©], Yangyang Fu[1], Feng Sun[1], Yazhi Zhang[1], Yingying Hu[1], Joseph Walline[2], Huadong Zhu[1]*, Xuezhong Yu[1]*

PLOS ONE | DOI:10.1371/journal.pone.0171869 February 10, 2017

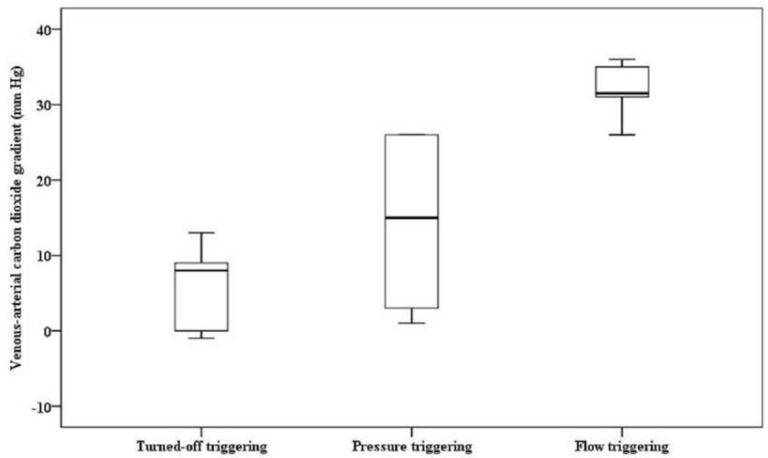


Fig 3. Venous-arterial CO_2 gradients in Group trig-20 (median, 25/75% percentiles, min/max) [mmHg].

doi:10.1371/journal.pone.0171869.g003

- La decompressione delle CC fa da **trigger del VM = ↑ RR**
- Il trigger (P e F) provoca **iperventilazione** con **↑Paw, ↓AoP e CPP**
- Solo **Trigger off o un trigger di P -20 cmH20** evitano l'iperventilazione

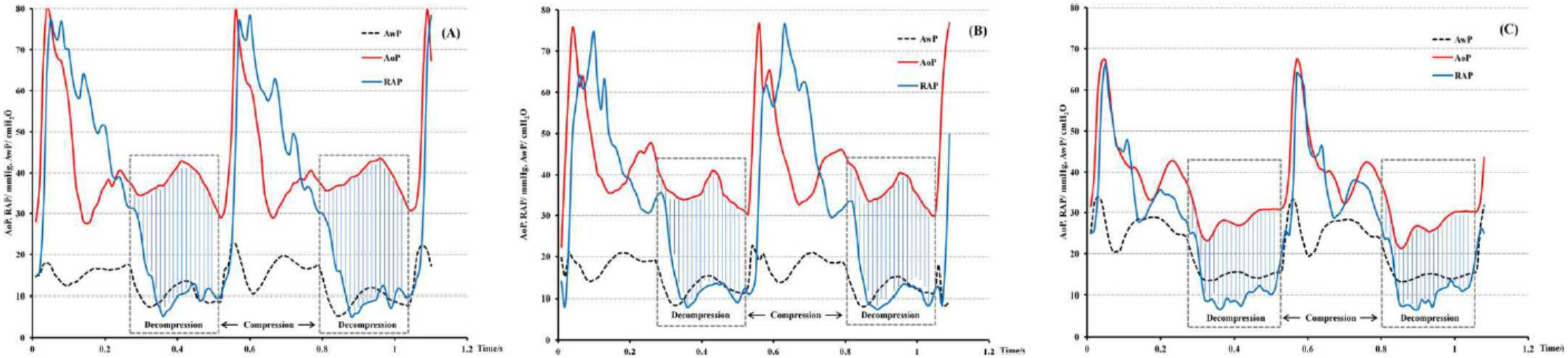


Fig 2. Aortic blood pressure, right atrial pressure and mean airway pressure during the inspiratory phase of an animal in Group trig-20. The period indicated by dotted box is the decompression phase of chest compressions. Coronary perfusion (shadow area) is indicated by the area between red and blue line in the dotted box. (A), Turned-off triggering. (B), A pressure-triggering of 20 cmH_2O. (C), A flow-triggering of 20 L/min.

Part 6: Alternative Techniques and Ancillary Devices for Cardiopulmonary Resuscitation

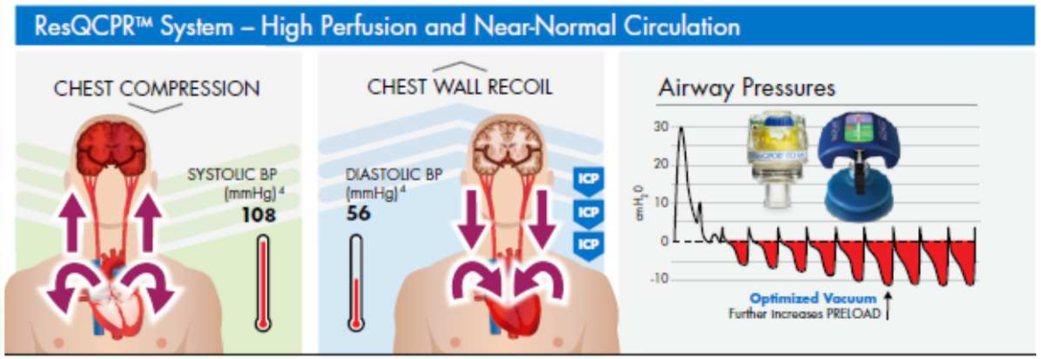
2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Steven C. Brooks, Chair; Monique L. Anderson; Eric Bruder; Mohamud R. Daya; Alan Gaffney; Charles W. Otto; Adam J. Singer; Ravi R. Thiagarajan; Andrew H. Travers

(*Circulation*. 2015;132[suppl 2]:S436–S443.

2015 Guidelines Update: Part 6 Recommendations

Year Last Reviewed	Topic	Recommendation	Comments
2015	Devices to Support Circulation: Impedance Threshold Device	The routine use of the ITD as an adjunct during conventional CPR is not recommended (Class III: No Benefit, LOE A).	new for 2015
2015	Devices to Support Circulation: Active Compression-Decompression CPR and Impedance Threshold Device	The existing evidence, primarily from 1 large RCT of low quality, does not support the routine use of ACD-CPR+ITD as an alternative to conventional CPR. The combination may be a reasonable alternative in settings with available equipment and properly trained personnel (Class IIb, LOE C-LD).	new for 2015



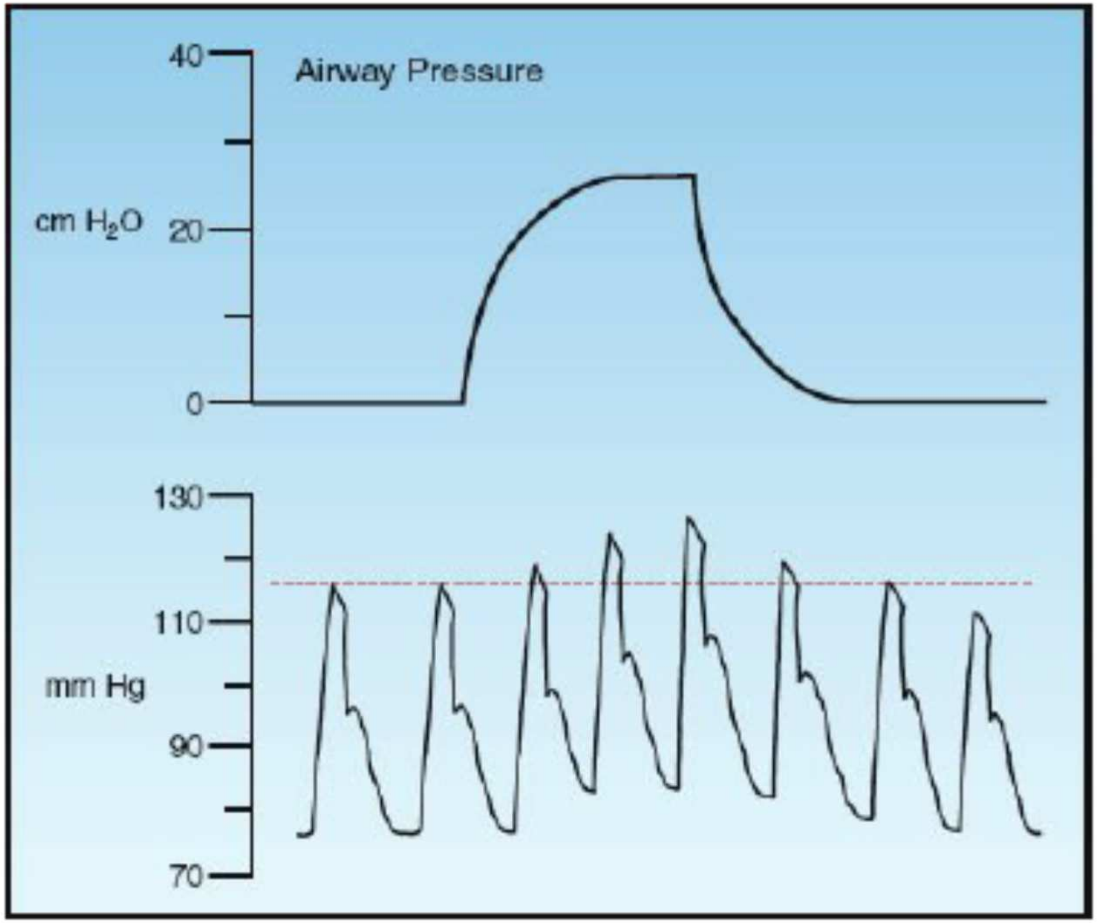


FIGURE 9.8 Changes in arterial blood pressure in response to a positive-pressure breath.

Chest Compression Synchronized Ventilation versus Intermitted Positive Pressure Ventilation during Cardiopulmonary Resuscitation in a Pig Model

Clemens Kill[1,2]*, Monika Galbas[1], Christian Neuhaus[4], Oliver Hahn[1], Pascal Wallot[1], Karl Kesper[3], Hinnerk Wulf[1], Wolfgang Dersch[1,2]

PLOS ONE | DOI:10.1371/journal.pone.0127759 May 26, 2015

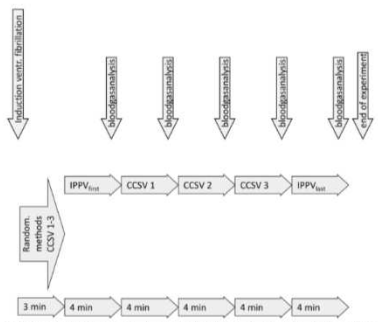


Fig 2. Timeline of experimental procedure. Timeline of induction of cardiac arrest followed by five ventilation periods using IPPV and CCSV.

doi:10.1371/journal.pone.0127759.g002

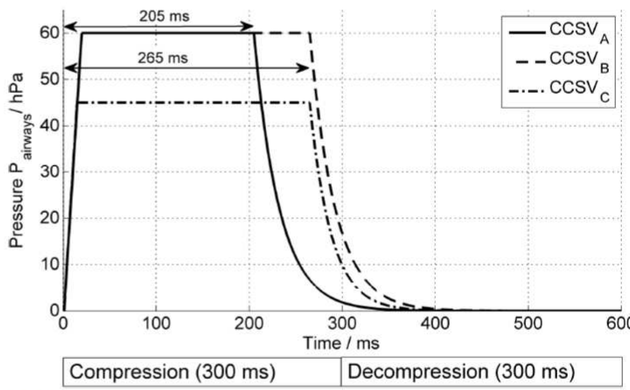


Fig 1. Pressure-time-curves of CCSV. Pressure-time-curves of the three presets of Chest Compression Synchronized ventilation $CCSV_A$, $CCSV_B$, and $CCSV_C$ depending on compression-decompression-cycle.

doi:10.1371/journal.pone.0127759.g001

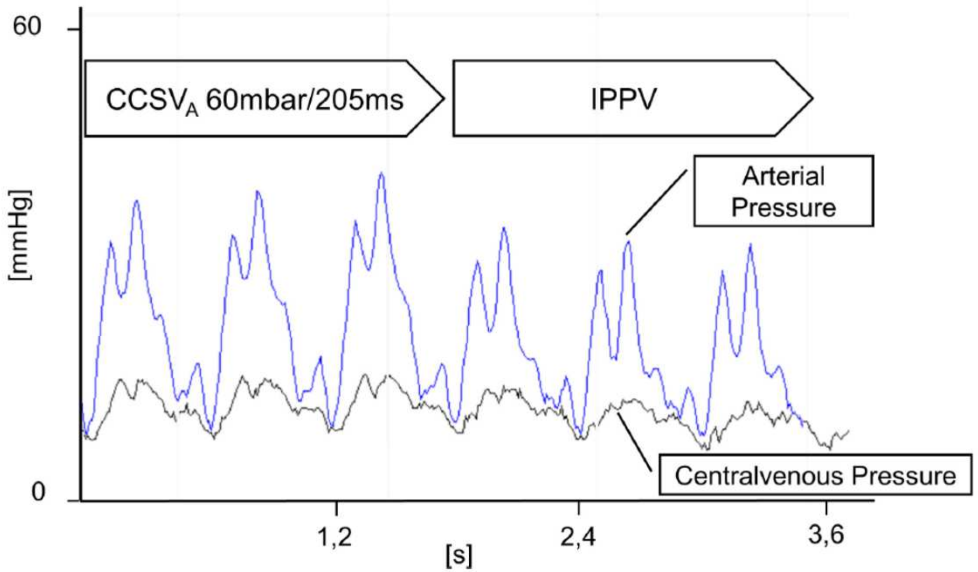


Fig 5. Arterial and centralvenous pressure curves. Arterial and centralvenous pressure curves of experiment No. 2 at t = 19min showing the change of ventilation mode from $CCSV_A$ (with an inspiratory peak pressure of 60mbar and inspiratory time of 205ms) to IPPV mode.

doi:10.1371/journal.pone.0127759.g005

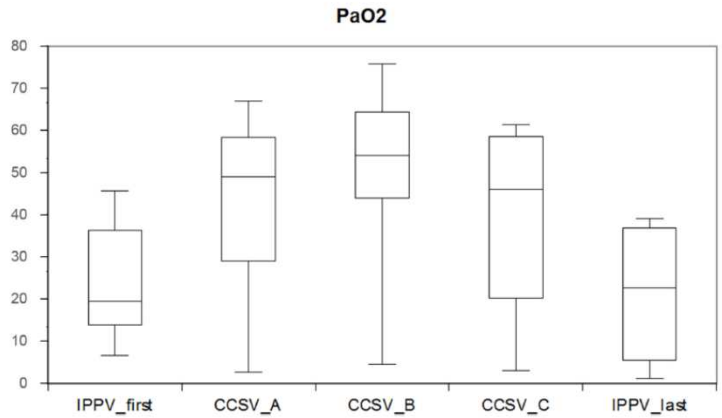


Fig 3. Results of PaO_2. Results of PaO_2 of $IPPV_{first}$, $CCSV_A$, $CCSV_B$, $CCSV_C$, and $IPPV_{last}$ (median, 25/75% percentiles, min/max) [kPa].

doi:10.1371/journal.pone.0127759.g003

Atelettasia e PEEP

J Appl Physiol 120: 196–203, 2016.
First published November 19, 2015; doi:10.1152/japplphysiol.00632.2015.

Impact of ventilation strategies during chest compression. An experimental study with clinical observations

Ricardo L. Cordioli,[1,2,3] Aissam Lyazidi,[1,4,5] Nathalie Rey,[6] Jean-Max Granier,[1] Dominique Savary,[7] Laurent Brochard,[8,9,10] and Jean-Christophe M. Richard[7,10]

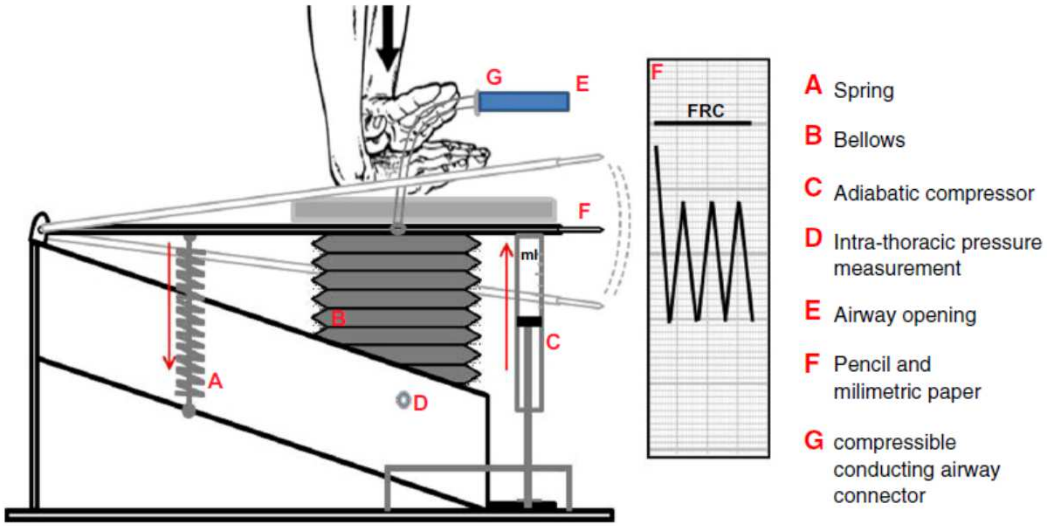


Fig. 1. Schema of the mechanical lung model designed to reproduce the physical proprieties of thoracic compartment and to perform chest compression. FRC, functional residual capacity.

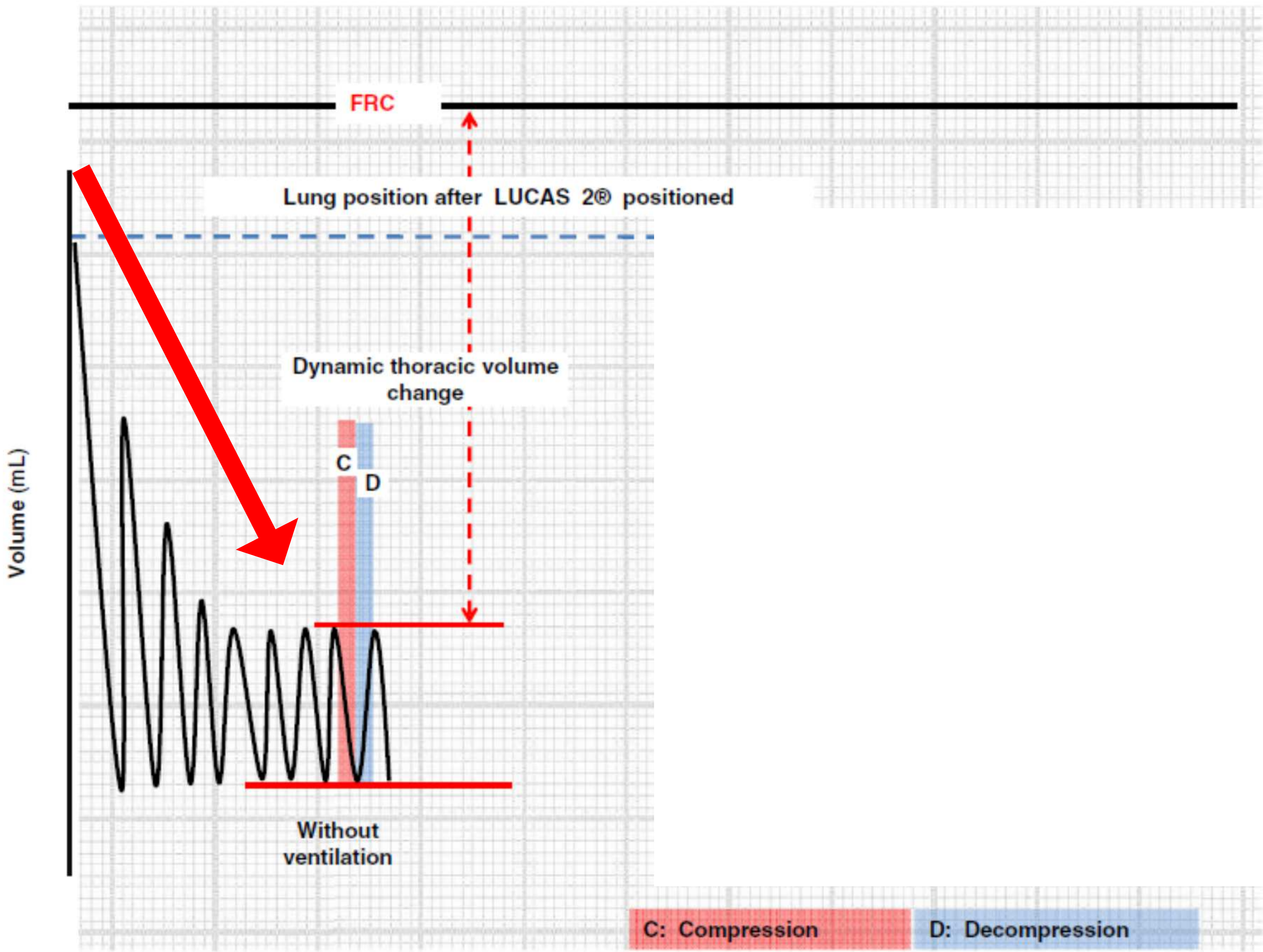


Fig. 2. Schema of pencil movement on millimeter paper during chest compression. This recording allowed us to measure the initial FRC, the dynamic lung volume changes, and the mobilized volume related to chest compression according to different cardiopulmonary resuscitation (CPR) strategies. CFI, continuous flow insufflation.

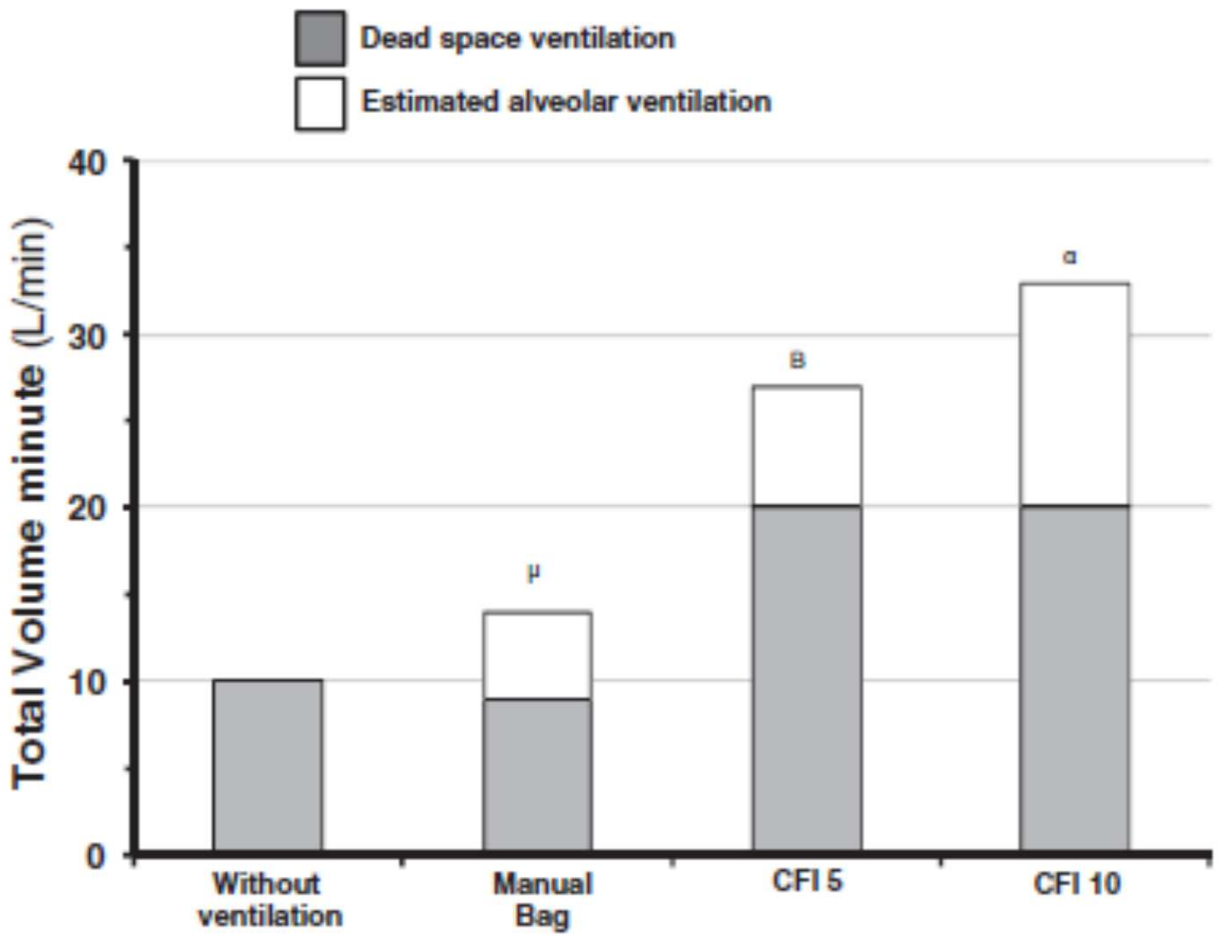


Fig. 4. Volume mobilized and alveolar ventilation estimated during each CPR strategy. For alveolar ventilation, Friedman's test, $P < 0.05$; Tukey's test post hoc analysis; α, CFI 10 is statistically different from CFI 5, manual bag, and no ventilation ($P < 0.01$); β, CFI 5 is statistically different from manual bag and no ventilation ($P < 0.01$); μ, manual bag is statistically different from no ventilation ($P < 0.01$).

Four ways to ventilate during cardiopulmonary resuscitation in a porcine model: a randomized study

Kjærgaard *et al. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* (2016) 24:67
DOI 10.1186/s13049-016-0262-z

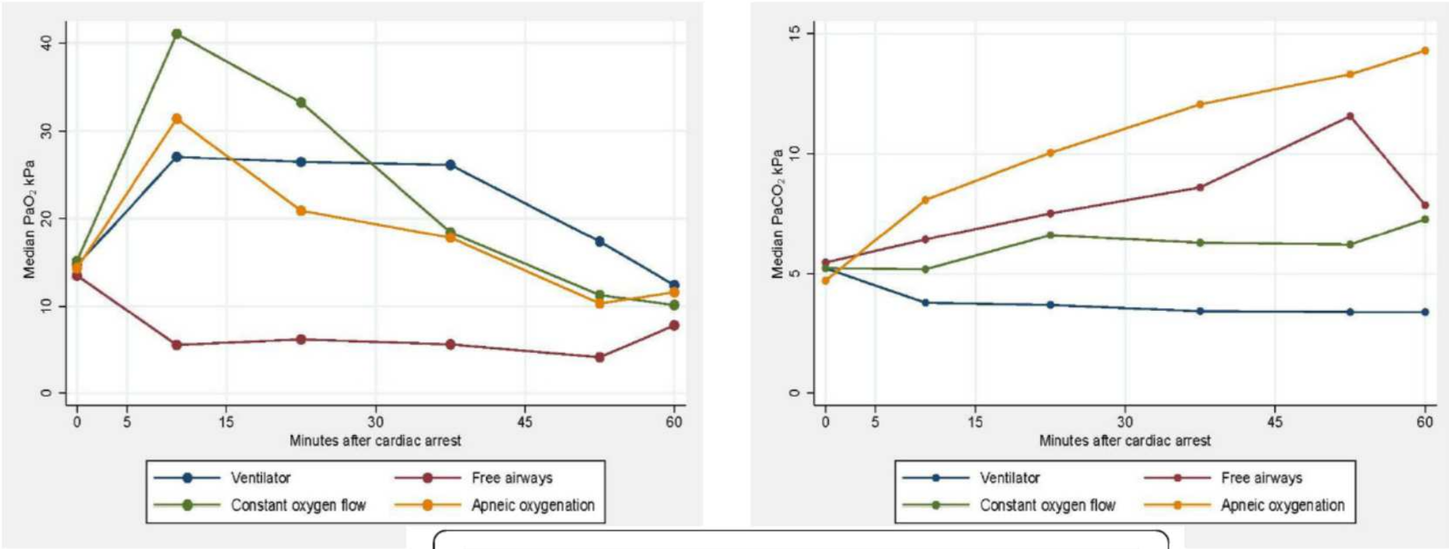


Fig. 3 Arterial oxygen and carbon dioxide ... an arterial tensions for each 15 minutes of cardiac compressions

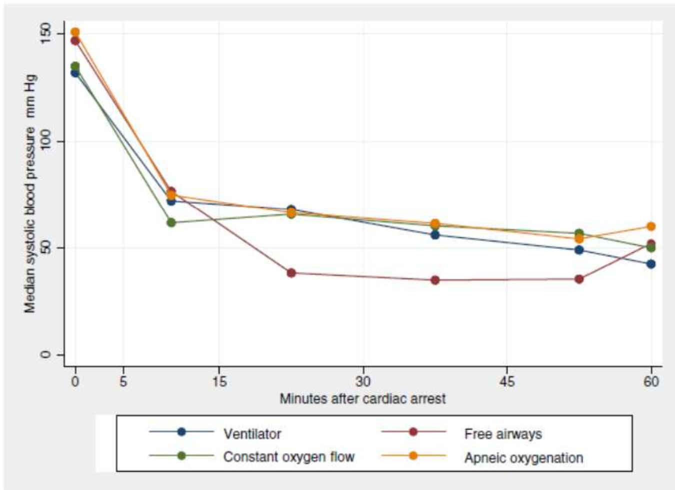


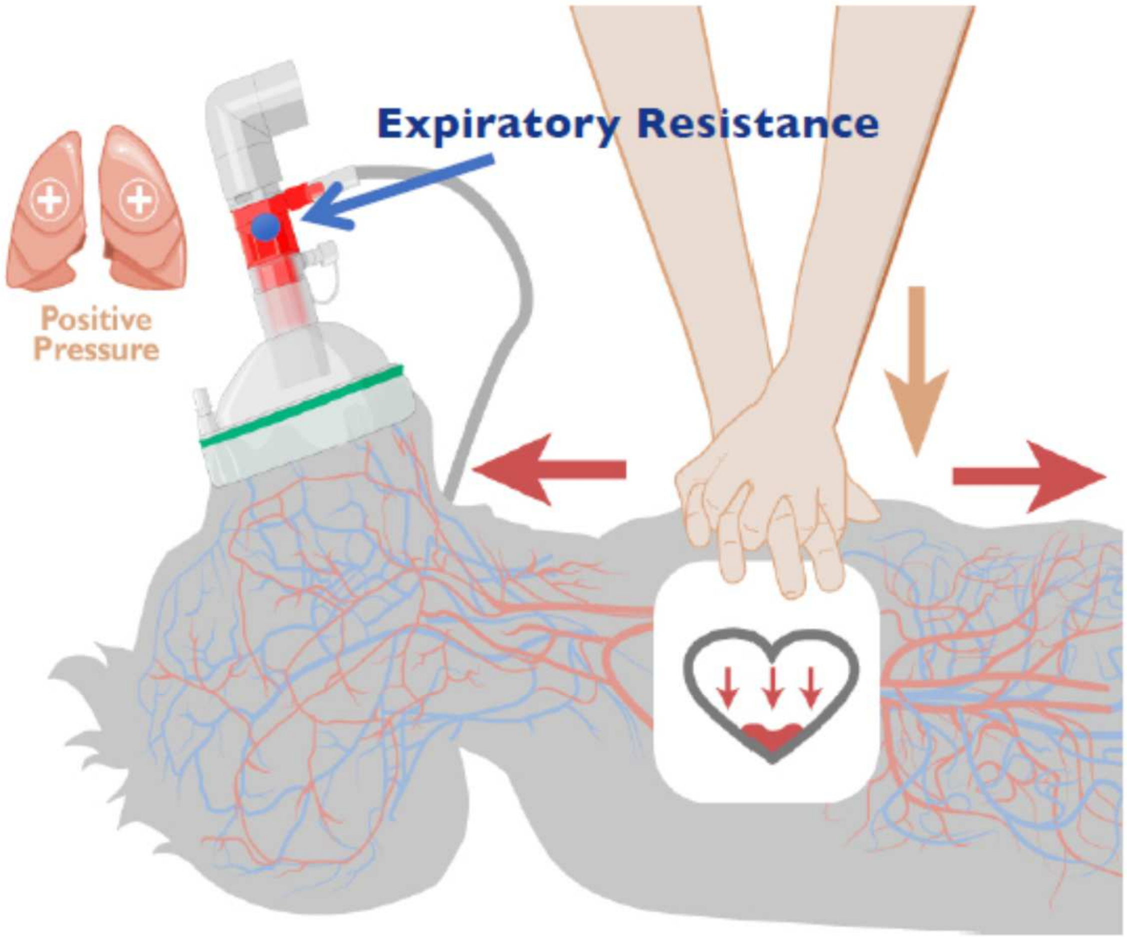
Fig. 5 Systolic blood pressure during 60 minutes of cardiac compressions

Insomma, la ventilazione ideale deve:

- Non interrompe le compressioni > **vie aeree sicure**
- Non iperventilare > **ventilatore senza trigger**
- Non interferire col ritorno venoso > **trigger su compressioni**
- Migliorare la perfusione > **trigger su compressioni**
- Reclutare lo spazio morto > **CPAP e CFI**
- Essere semplice e maneggevole > ?
- Migliorare la prognosi > ?

Ritorno al futuro

Use of b-card

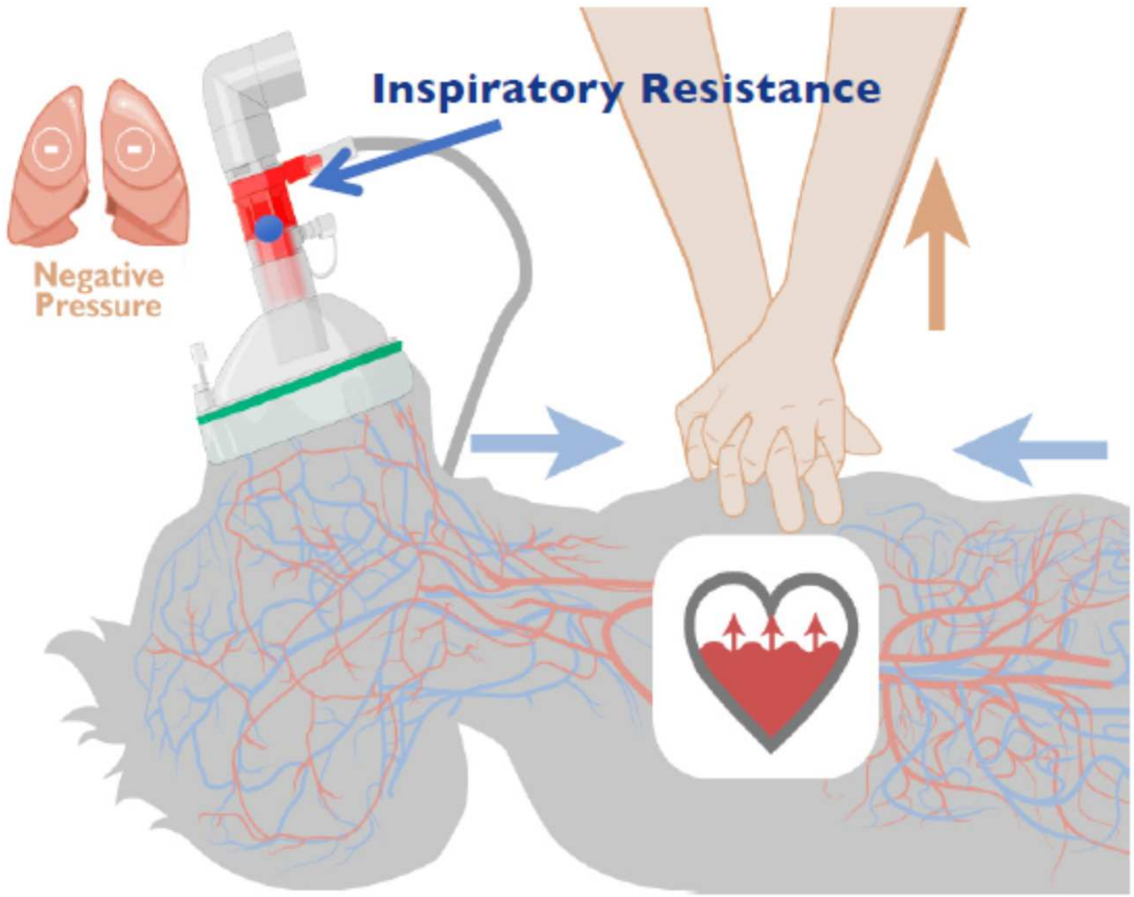


During Chest Compression

Optimised energy transmission from chest compressions to the circulatory system

Increased Intrathoracic Pressure

Improved Heamodynamics



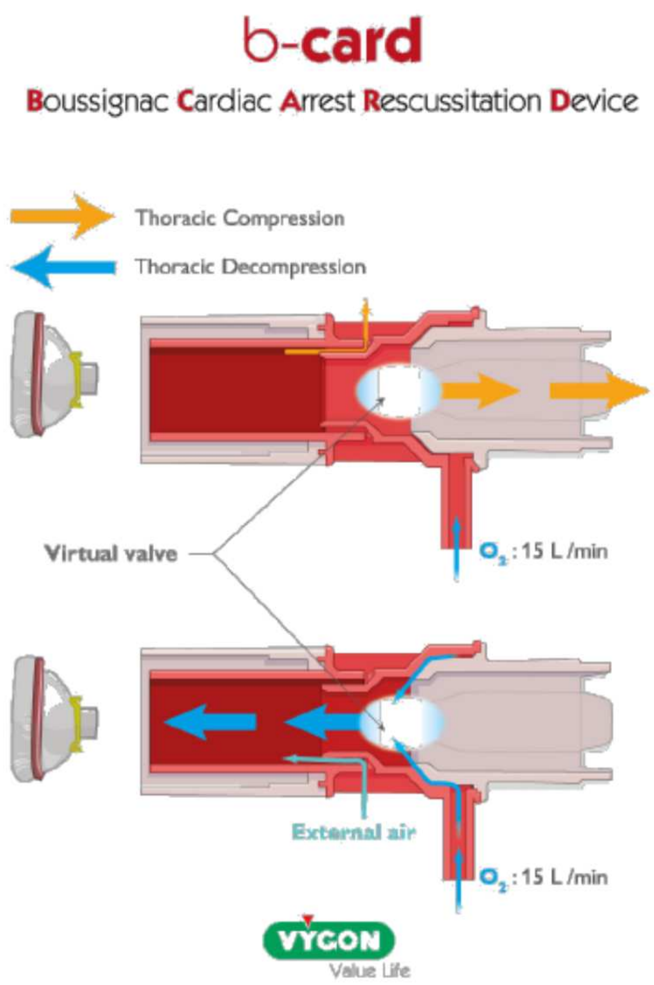
During Chest Decompression

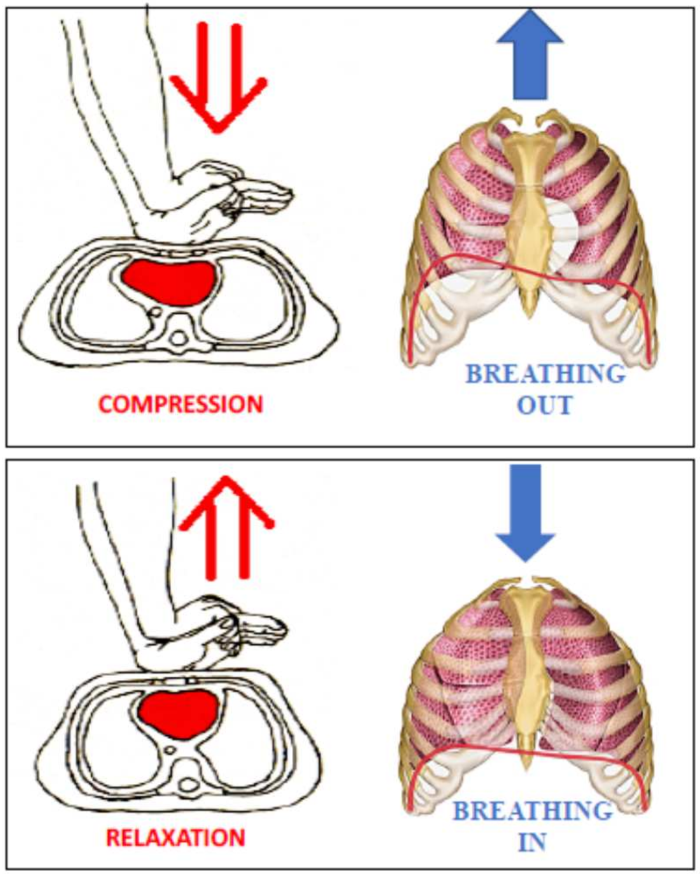
Negative Intrathoracic Pressure

Venous return

Increased pre-load and coronary perfusion

Increased cardiac output





- This report proves that b-card creates a positive intra-thoracic pressure at compression and a negative intra-thoracic pressure at decompression which helps improve the venous return and hemodynamics to the whole body.
- Secondly, the tidal volume delivered is improved compare to Intermittent Positive Pressure Ventilation with Bag-Valve Mask (BVM). Indeed, the volume delivered at decompression is minimum 315 ml and maximum 369 ml.

[redacted]

C

B

Esempio di brutta diapositiva che serve a riassumere

- La ventilazione meccanica a vie aeree protette è raccomandate per **ridurre il rischio di iperventilazione** (con ventilazione manuale)
- L'iperventilazione è dannosa per l'ipocapnia, la vasocostrizione cerebrale e la **riduzione del ritorno venoso**
- I trial clinici sui dispositivi che inducono una pressione intratoracica negativa non hanno dimostrato benefici sulla sopravvivenza
- Viene consigliata una ventilazione con **10 atti/minuto** e un volume corrente di **6 ml/kg**
- Evidenze sperimentali consigliano di **eliminare il trigger** o portarlo a 20 cm H2O per evitare iperventilazione indotta dalla compressioni
- L'aumento della pressione toracica può avere un effetto positivo sul postcarico (**P transmurale**) che supera quello negativo sul precarico (ritorno venoso)
- Evidenze sperimentali confermano l'effetto positivo di una ventilazione ad alta frequenza e bassi volumi **sincronizzata** con la fase di compressione
- L'assenza di respiro spontaneo e le CC inducono rapidamente **atelettasie** con conseguente aumento dello spazio morto
- Evidenze sperimentali dimostrano che una pressione positiva nelle vie aeree prossimali prodotta da un **flusso continuo di gas** (O2) riduce lo spazio morto e permette una ventilazione efficace con le sole compressioni
- L'aggiunta di una **valvola inspiratoria/espiratoria** mette insieme tutto: precarico, postocarico, ossigenazione, ventilazione (decarbossilazione)

KIDS SAVE LIVES

Grazie