Arrêt cardiaque : Oxygénation passive ou active?

Pr Patrick PLAISANCE, M.D., Ph.D.

Service des Urgences-SMUR, Hôpital Lariboisière
Université Paris Diderot (Paris VII)

Conflits d'intérêt

- Consultant :
  - Dräger Medical
  - Laerdal
  - VYGON Value Life
  - Weinmann
  - Zoll

Importance des CT

- Recommandations 2015 – RCP de haute qualité:
  - Importance de l'hémodynamique
  - Défibrillation précoce
- Quid de la ventilation?
  - Obligatoire?
  - RCPb ou/et RCPs?
  - Continue ou discontinue?
  - Passive ou active?

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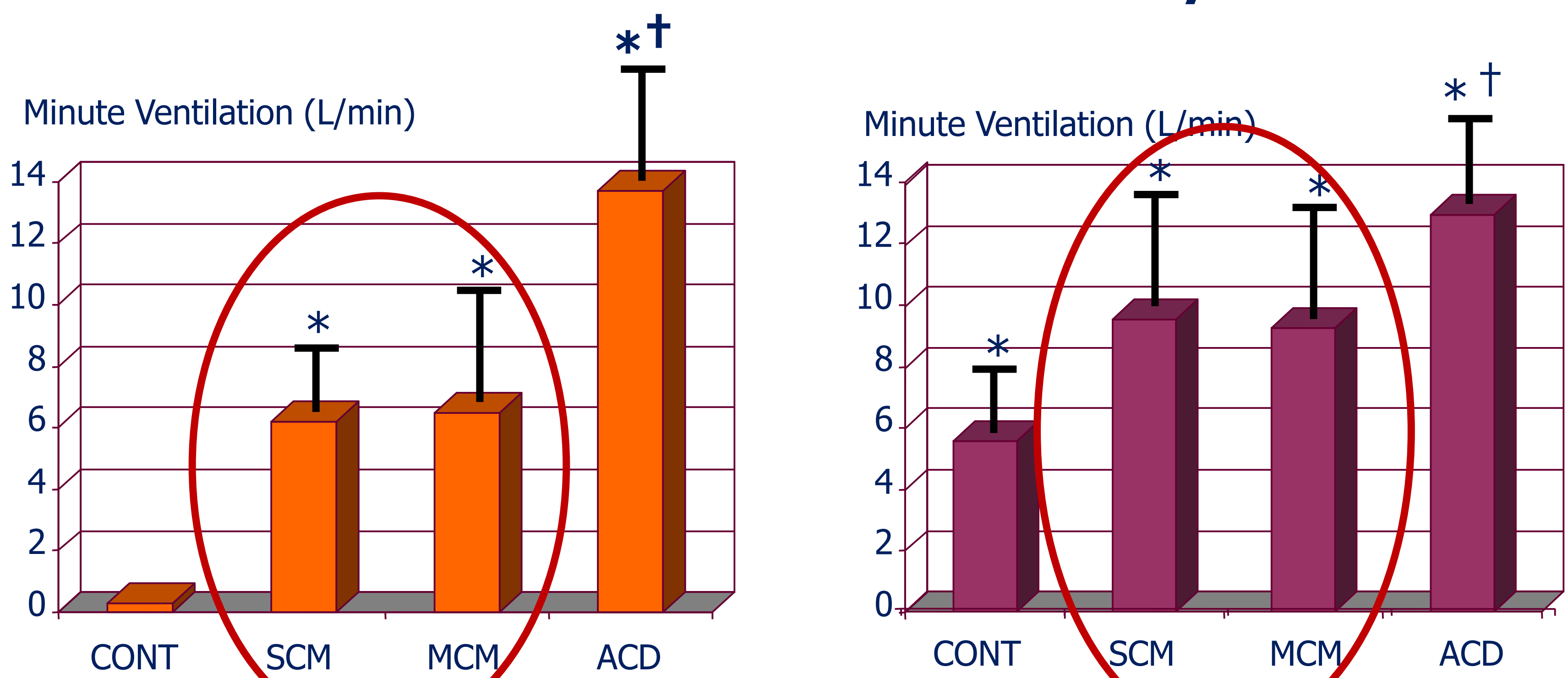
Besoin de ventilation ?

Not Ventilated | **Mechanically Ventilated**



* p < .05 versus control condition (without CPR)
† p <.05 versus SCM

Carli et al. *Ann Emerg Med* 1994

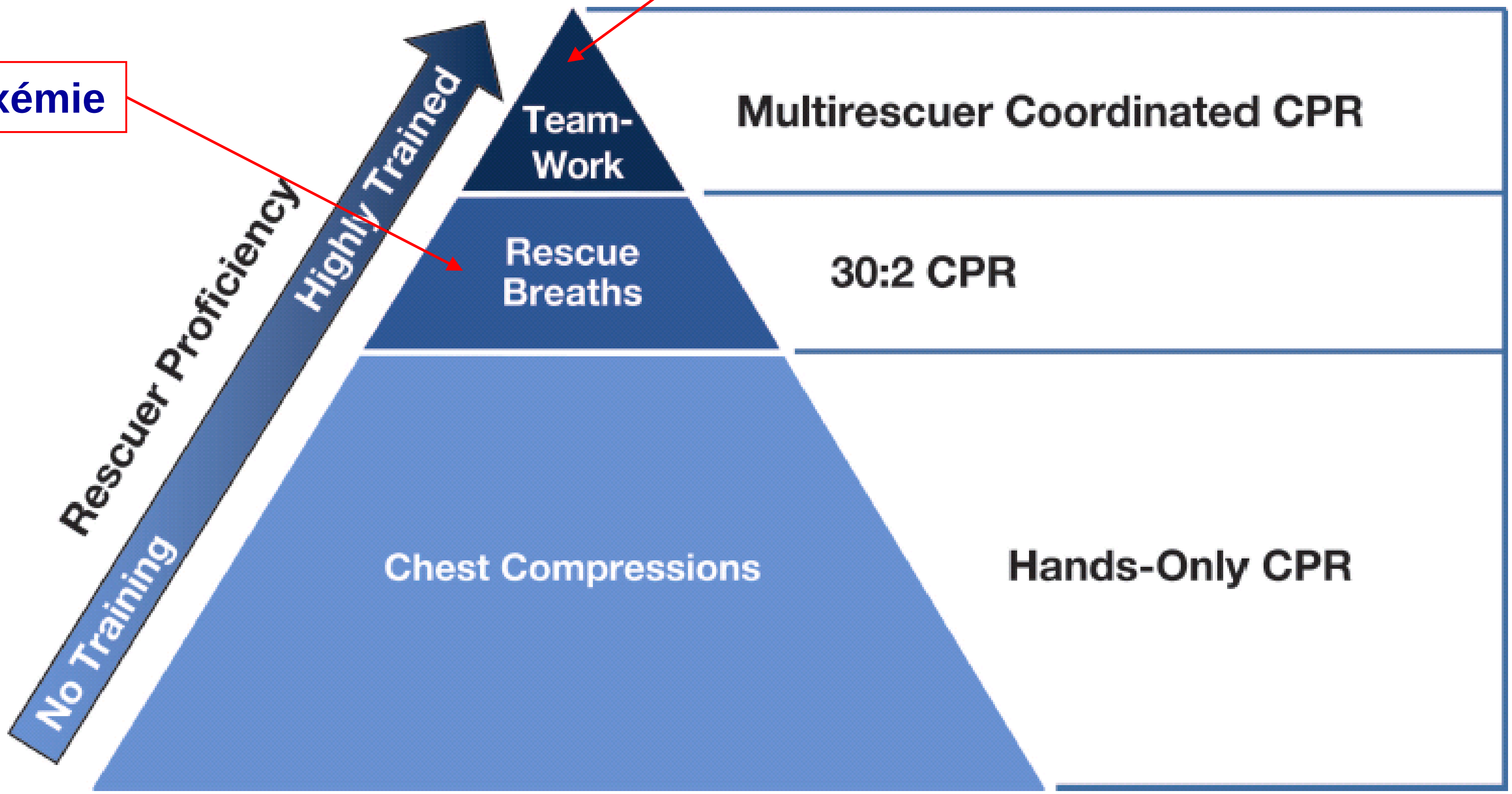
Besoin de ventilation ?

Shultz et al. Circulation 1994	ACD CPR	STD CPR	p
Minute ventilation L/min (n = 7)	13.5±5.5	7.8±5.3	<.001
Negative inspiratory pressure mmHg (n = 6)	-11.4±6.3	- 0.8±4.8	<.04
Positive expiratory pressure mmHg (n = 6)	17±16.8	18±15.3	.51
Esophageal manometry mmHg (n = 6)			
Compression	8.1±3.6	7.9±2.4	.86
Decompression	-5.9±2.7	-3.6±3.5	<.02

Besoin de ventilation ?

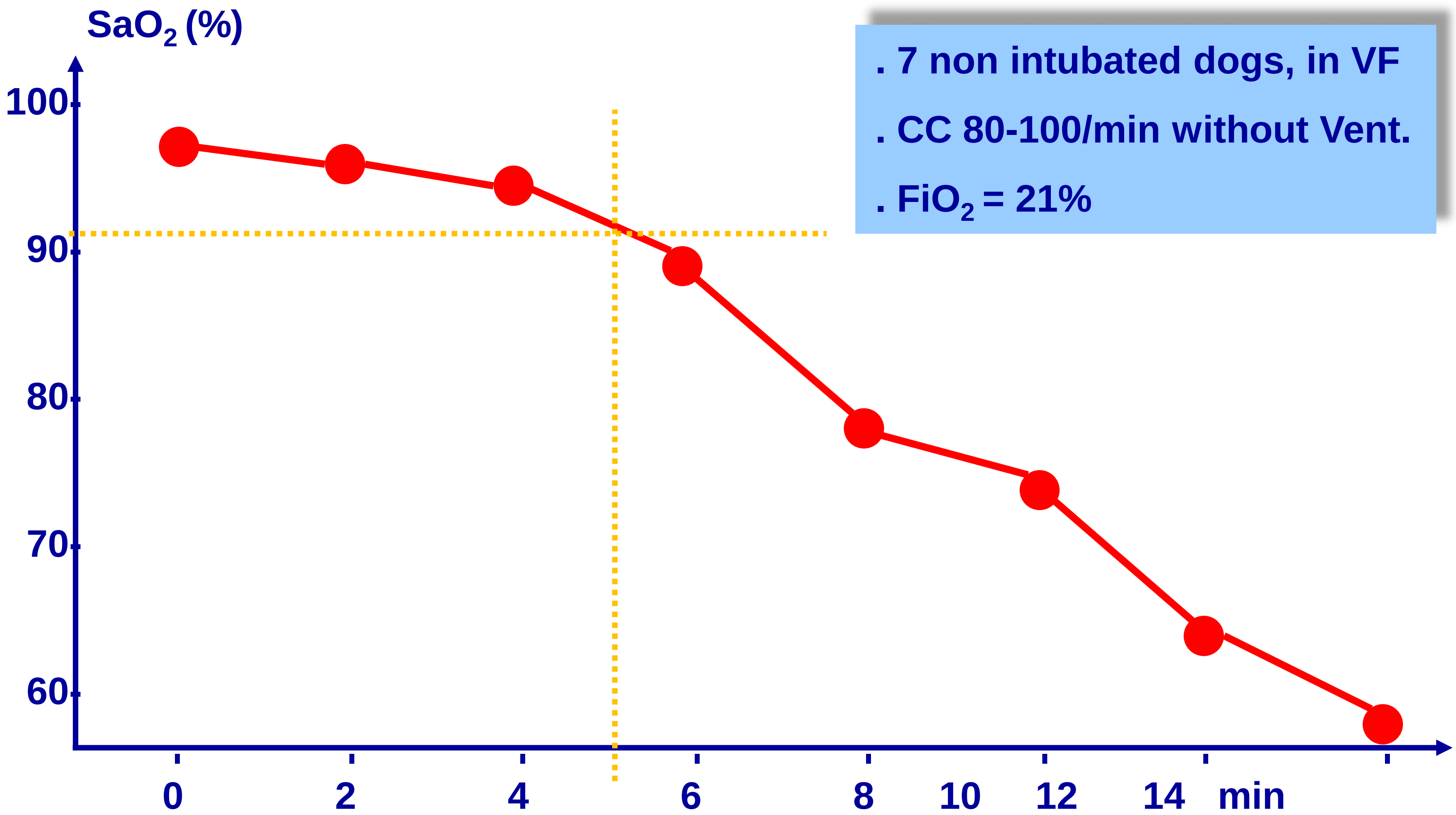
Ventilation synchrone puis asynchrone 8-10/min

Hypoxémie



International Guidelines 2015

Ventilation ou oxygénation ?



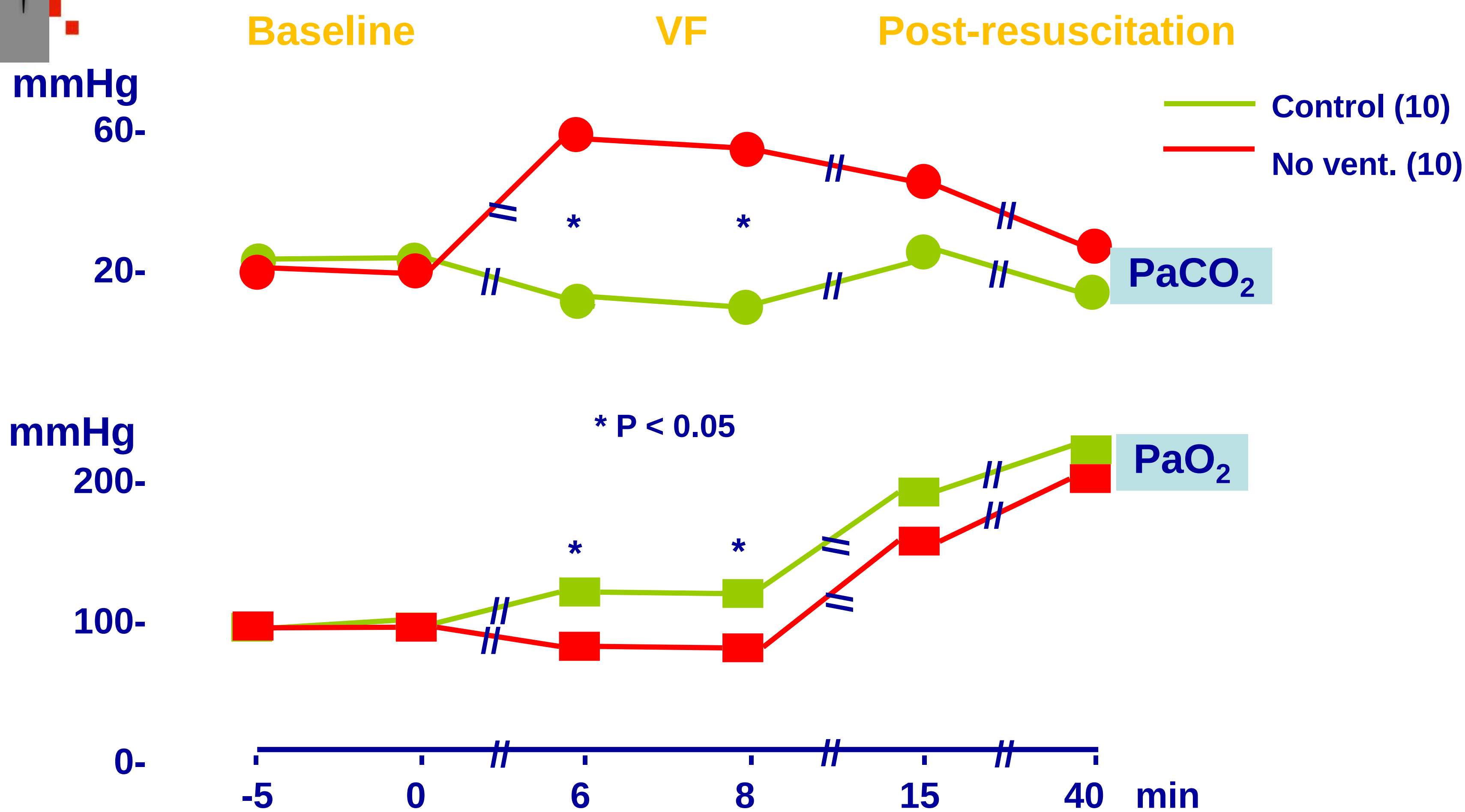
. 7 non intubated dogs, in VF

. CC 80-100/min without Vent.

. FiO_2 = 21%

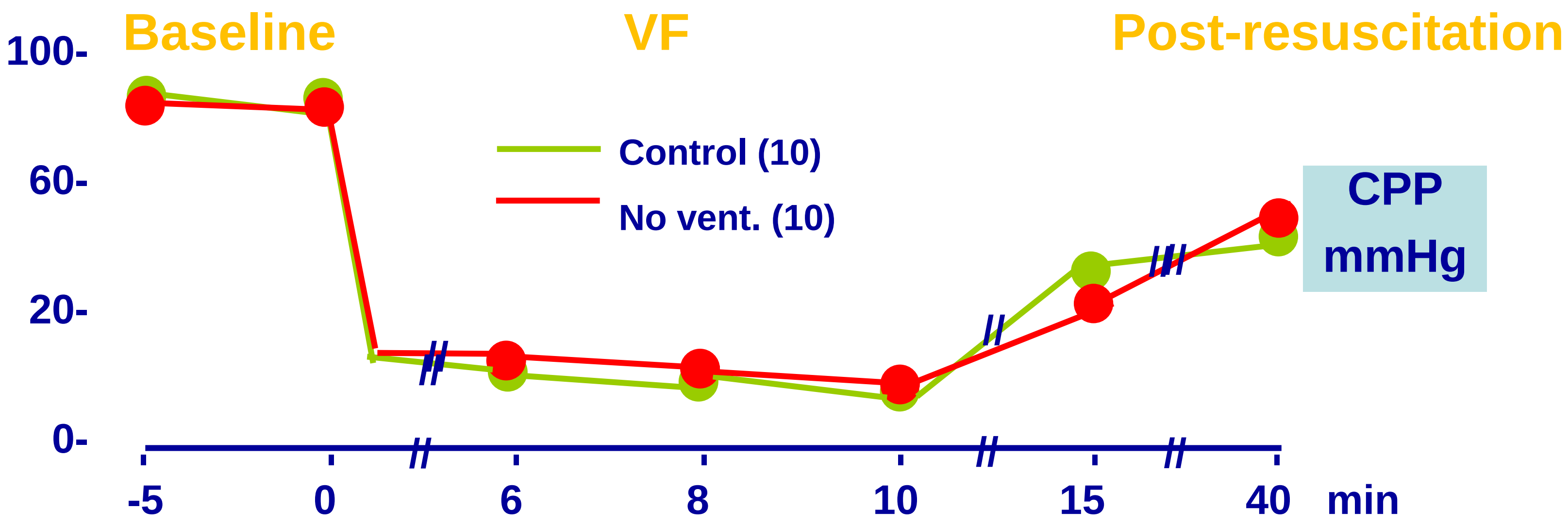
Chandra NC, Circulation 1994

CT + FiO_2 = 1 sans et avec VM



Tang et al, *AJRCCM* 1994

CT + FiO_2 = 1 sans et avec VM



Tang et al, *AJRCCM* 1994

Passive Oxygen Insufflation Is Superior to Bag-Valve-Mask Ventilation for Witnessed Ventricular Fibrillation Out-of-Hospital Cardiac Arrest

Outcomes	PV (n=459), n/N (%)	BVM (n=560), n/N (%)	Adjusted OR (95% CI)
ROSC	123/459 (26.8)	169/560 (30.2)	0.8 (0.7–1.0)
Adjusted neurologically intact survival to hospital discharge	46/459 (10.0)	53/560 (9.5)	1.2 (0.8–1.9)
Adjusted neurologically intact survival with witnessed VF/VT	39/102 (38.2)	31/120 (25.8)	2.5 (1.3–4.6)
Adjusted neurologically intact survival with VF/VT, not witnessed	3/41 (7.3)	8/58 (13.8)	0.5 (0.2–1.6)
Adjusted neurologically intact survival with nonshockable rhythm	4/316 (1.3)	14/381 (3.7)	0.3 (0.1–1.0)

ROSC, Return of spontaneous circulation; *VF*, ventricular fibrillation; *VT*, ventricular tachycardia.

Bobrow et al. *Ann Emerg Med* 2009

Ventilation : sujet difficile

The NEW ENGLAND JOURNAL of MEDICINE

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Trial of Continuous or Interrupted Chest Compressions during CPR

Graham Nichol, M.D., M.P.H., Brian Leroux, Ph.D., Henry Wang, M.D., Clifton W. Callaway, M.D., Ph.D., George Sopko, M.D., Myron Weisfeldt, M.D., Ian Stiell, M.D., Laurie J. Morrison, M.D., Tom P. Aufderheide, M.D., Sheldon Cheskes, M.D., Jim Christenson, M.D., Peter Kudenchuk, M.D., Christian Vaillancourt, M.D., Thomas D. Rea, M.D., Ahamed H. Idris, M.D., Riccardo Colella, D.O., M.P.H., Marshal Isaacs, M.D., Ron Straight, Shannon Stephens, Joe Richardson, Joe Condle, Robert H. Schmicker, M.S., Debra Egan, M.P.H., B.S.N., Susanne May, Ph.D., and Joseph P. Ornato, M.D., for the ROC Investigators*

- **114 Structures d'urgence préhospitalières**
- **23.711 patients**
- **4 ans d'étude**

BACKGROUND

During cardiopulmonary resuscitation (CPR) in patients with out-of-hospital cardiac arrest, the interruption of manual chest compressions for rescue breathing reduces blood flow and possibly survival. We assessed whether outcomes after continuous compressions with positive-pressure ventilation differed from those after compressions that were interrupted for ventilations at a ratio of 30 compressions to two ventilations.

METHODS

This cluster-randomized trial with crossover included 114 emergency medical service (EMS) agencies. Adults with non–trauma-related cardiac arrest who were treated by EMS providers received continuous chest compressions (intervention group) or interrupted chest compressions (control group). The primary outcome was the rate of survival to hospital discharge. Secondary outcomes included the modified Rankin scale score (on a scale from 0 to 6, with a score of ≤3 indicating favorable neurologic function). CPR process was measured to assess compliance.

RESULTS

Of 23,711 patients included in the primary analysis, 12,653 were assigned to the intervention group and 11,058 to the control group. A total of 1129 of 12,613 patients with available data (9.0%) in the intervention group and 1072 of 11,035 with available data (9.7%) in the control group survived until discharge (difference, −0.7 percentage points; 95% confidence interval [CI], −1.5 to 0.1; P=0.07); 7.0% of the patients in the intervention group and 7.7% of those in the control group survived with favorable neurologic function at discharge (difference, −0.6 percentage points; 95% CI, −1.4 to 0.1, P=0.09). Hospital-free survival was significantly shorter in the intervention group than in the control group (mean difference, −0.2 days; 95% CI, −0.3 to −0.1; P=0.004).

CONCLUSIONS

In patients with out-of-hospital cardiac arrest, continuous chest compressions during CPR performed by EMS providers did not result in significantly higher rates of survival or favorable neurologic function than did interrupted chest compressions. (Funded by the National Heart, Lung, and Blood Institute and others; ROC CCC ClinicalTrials.gov number, NCT01372748.)

Ventilation : sujet difficile

Nichol et al. *NEJM* 2017

Outcome	Intervention Group (N=12,653)	Control Group (N=11,058)	Adjusted Difference (95% CI)	P Value
Effectiveness population				
Primary outcome: survival to discharge — no./total no. (%)	1,129/12,613 (9.0)	1072/11,035 (9.7)	−0.7 (−1.5 to 0.1)	0.07
Transport to hospital — no. (%)	6686 (52.8)	6066 (54.9)	−2.0 (−3.6 to −0.5)	0.01
Return of spontaneous circulation at ED arrival — no./total no. (%)	3,058/12,646 (24.2)	2799/11,051 (25.3)	−1.1 (−2.4 to 0.1)	0.07
Admission to hospital — no./total no. (%)	3,108/12,653 (24.6)	2860/11,058 (25.9)	−1.3 (−2.4 to −0.2)	0.03
Survival to 24 hr — no./total no. (%)	2,816/12,614 (22.3)	2569/11,031 (23.3)	−1.0 (−2.1 to 0.2)	0.10
Hospital-free survival — days†	1.3±5.0	1.5±5.3	−0.2 (−0.3 to −0.1)	0.004
Discharge home — no./total no. (%)	844/12,613 (6.7)	794/11,034 (7.2)	−0.5 (−1.2 to 0.2)	0.15
Modified Rankin scale score‡				
≤3 — no./total no. (%)	883/12,560 (7.0)	844/10,995 (7.7)	−0.6 (−1.4 to 0.1)	0.09
Mean	5.63±1.29	5.60±1.35	0.04 (0.0 to 0.08)	0.04

Ventilation : sujet difficile

Nichol et al. *NEJM* 2017

Characteristic	Intervention Group (N=12,653)	Control Group (N=11,058)	P Value
First rhythm — no./total no. (%)			0.71
Ventricular tachycardia, ventricular fibrillation, or shockable	2,836/12,651 (22.4)	2501/11,056 (22.6)	
Nonshockable	9,640/12,651 (76.2)	8406/11,056 (76.0)	
Chest-compression fraction‡	0.83±0.14	0.77±0.14	<0.001
Median	0.90	0.82	
Interquartile range	0.82–0.96	0.74–0.89	
No. of pauses >2 sec	3.8±2.6	7.0±4.3	<0.001
Compression rate — no. of compressions/min	110±11	109±12	0.82
Compression depth — mm	48±12	49±12	0.03
Pause — sec			
Before shock	12±10	12±11	0.70
After shock	6±9	6±14	0.47

Ventilation active synchrone et RCPb
Effets secondaires

- Inflation gastrique :
  - Régurgitation, inhalation, pneumopathie
  - Ascension du diaphragme, ↓ compliance pulmonaire
- ↓ % de CT

Ventilation active synchrone et RCPb

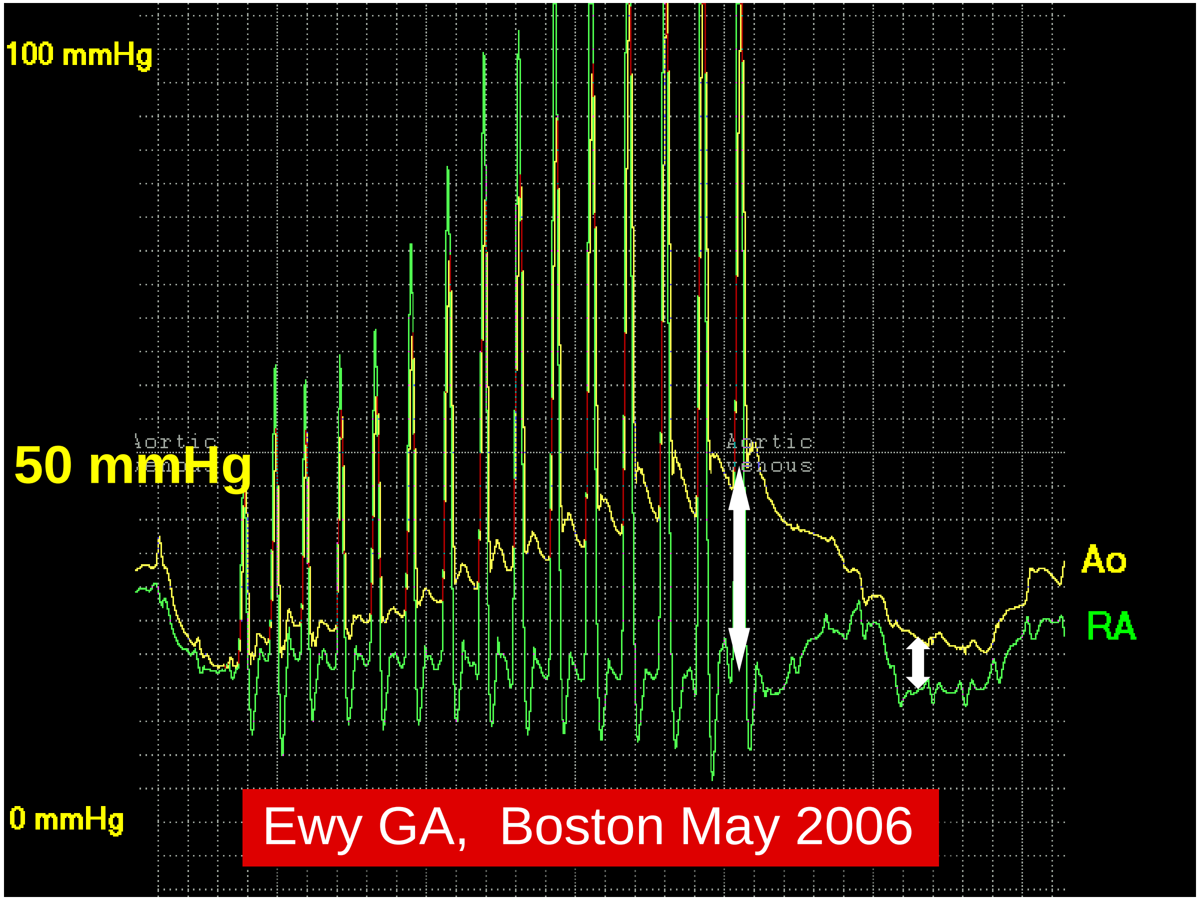
Effets secondaires

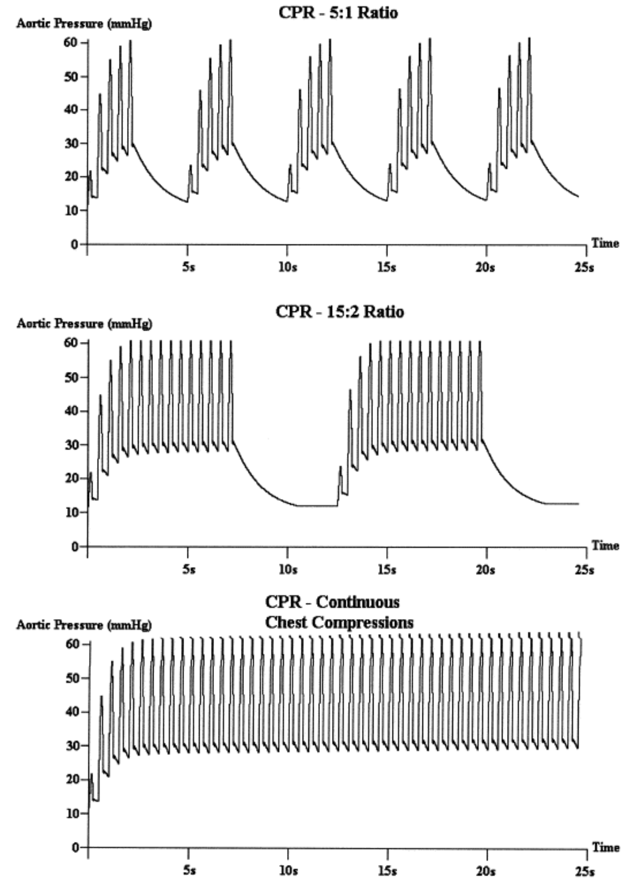
Volume in the gastric bag (mL)		
	t zero	*t* + 6 min
Patient 1	200	5560
Patient 2	200	6000
Patient 3	200	6200
Patient 4	200	6000
Patient 5	200	6550
Patient 6	200	500
Patient 7	200	7000
Mean ± SD	200	5401 ± 2208

Segal et al. *Resuscitation* 2015

Ventilation active synchrone et RCPb

Effets sur l'hémodynamique

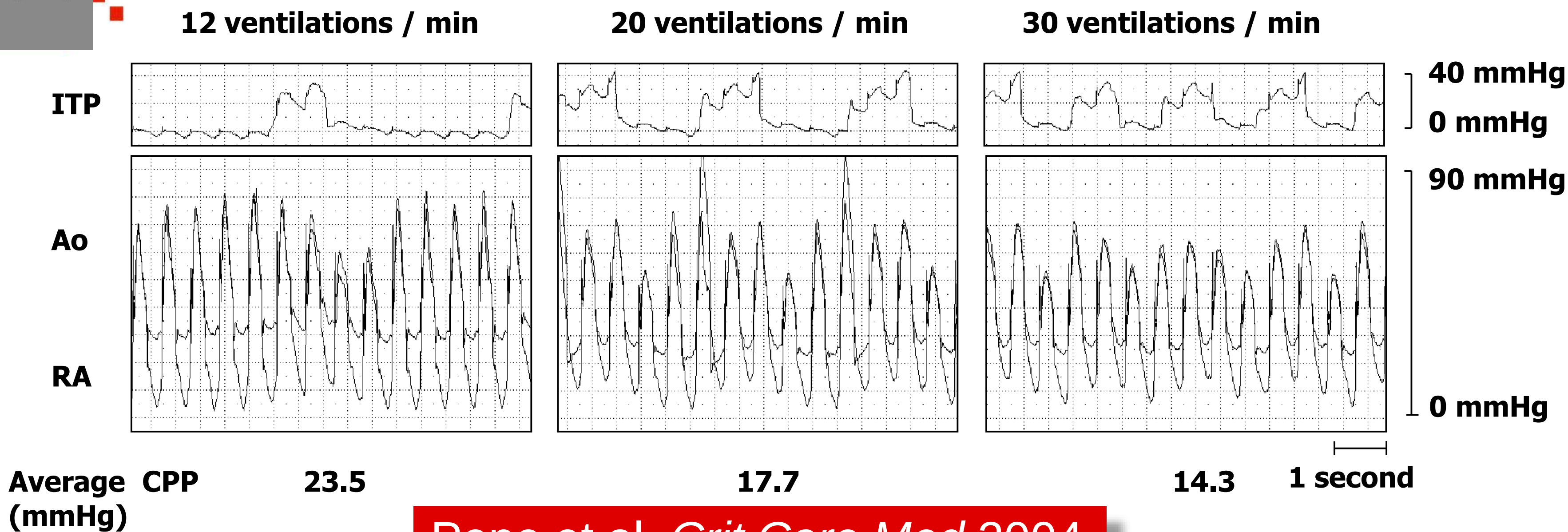




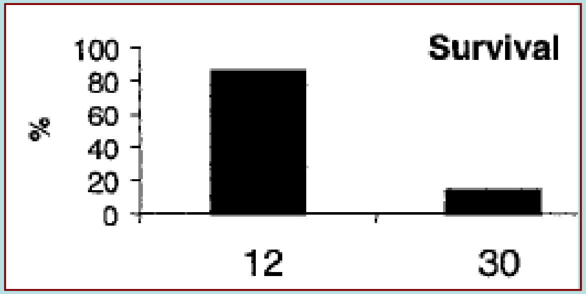
Tuner 2002

Ventilation active asynchrone et RCPs

Attention à la fréquence



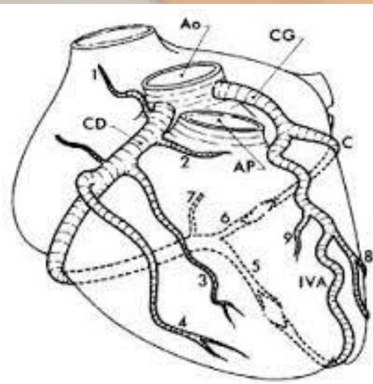
Pepe et al. *Crit Care Med* 2004

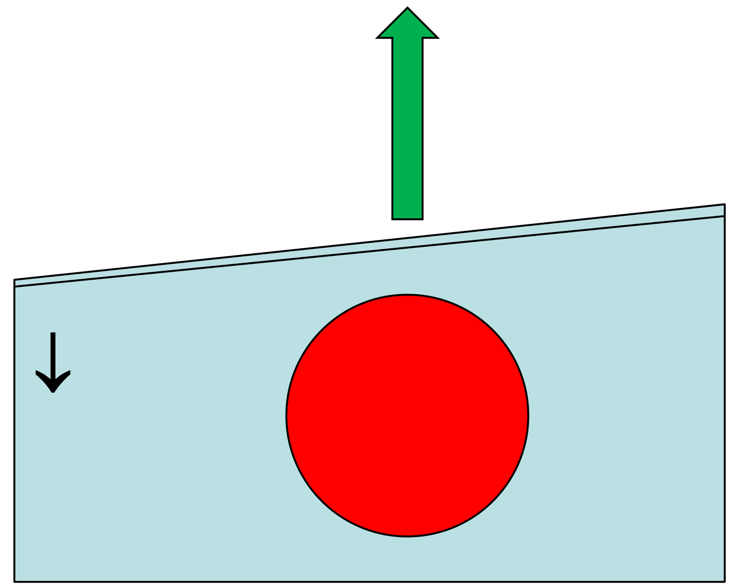


Aufderheide et al. *Circulation* 2004

Ventilation active asynchrone et RCPs

Interaction cœur-poumons

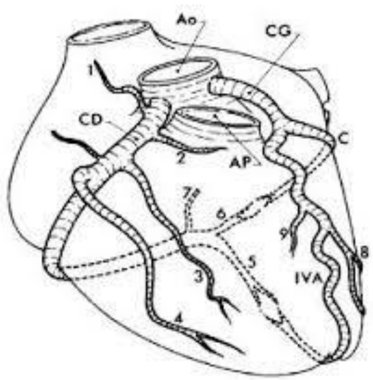


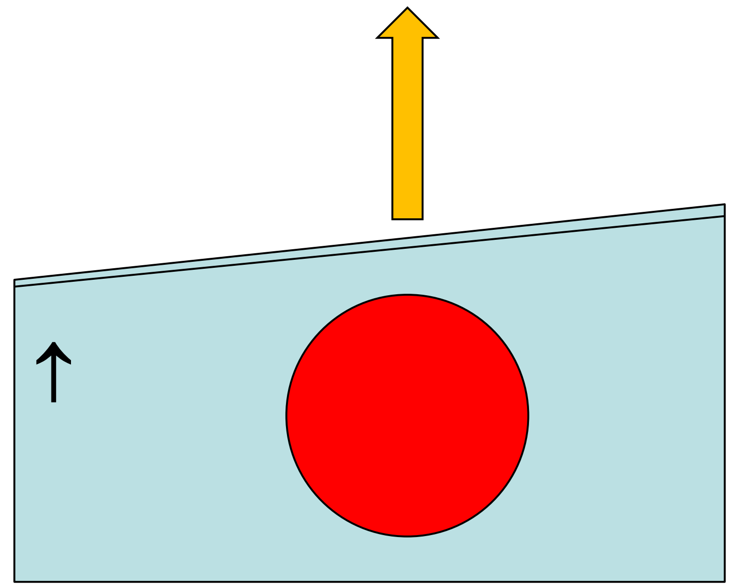


$$PPC = P_{art} - P_{OD}$$

↑ (PPC) ↓ (P_{OD})

Ventilation active asynchrone et RCPs
Interaction cœur-poumons

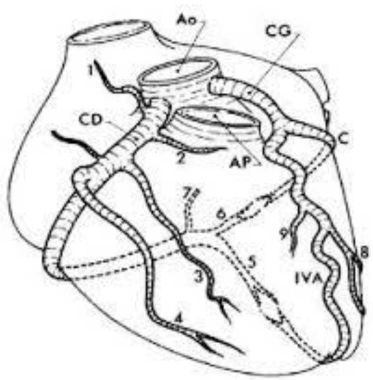


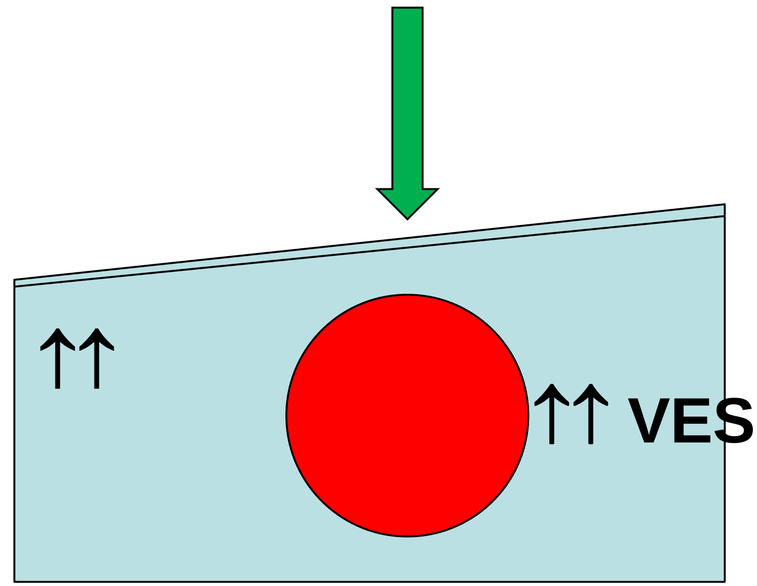


$$PPC = P_{art} - P_{OD}$$

P_{art} ↓ P_{OD} ↑

Ventilation active asynchrone et RCPs
Interaction cœur-poumons





Ventilation active synchrone ?

Daniel Davis.
Université de San Diego

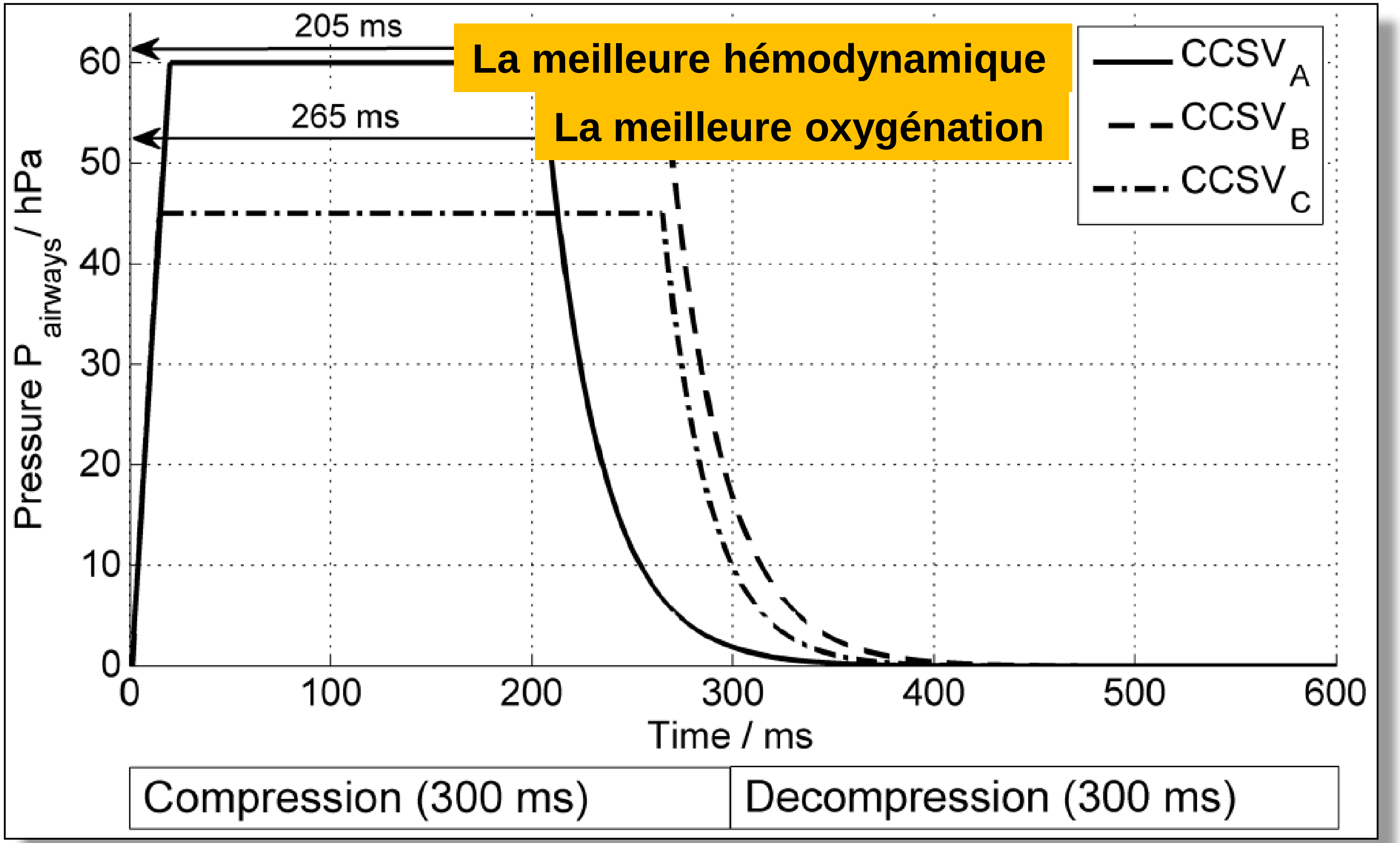
"For patients with ongoing CPR and an advanced airway in place, a simplified ventilation rate of 1 breath every 6 seconds (10 breaths/min.) is recommended."

Highlights of the 2015 AHA Guidelines

Ventilation active synchrone et RCPs

- G.D. Perkins et al. / *Resuscitation* 2015 :
  - “*During CPR in intubated humans, however, the median tidal volume per chest compression was only about 40 mL, insufficient for adequate ventilation*”
- Nouvelle idée ! :
  - Décompression pendant l’exsufflation
  - Compression pendant l’insufflation

Ventilation active synchrone et RCPs



Kill et al. *Plos One* 2015

Oxygénation, ventilation passive, active? Place de l'insufflation continue ?

- *“ Where EMS systems have adopted bundles of care involving continuous chest compressions, **the use of passive ventilation techniques may be considered** as part of that bundle for victims of OHCA.”*
- *“ **For witnessed OHCA with a shockable rhythm**, it may be **reasonable** for EMS systems with priority based, multitiered response **to delay positive-pressure ventilation (PPV)** by using a strategy of up to 3 cycles of 200 continuous compressions with **passive oxygen insufflation and airway adjuncts**.”*

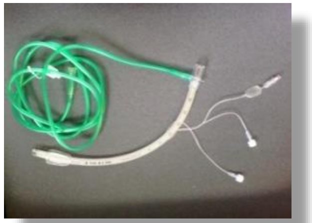
Highlights of the 2015 AHA Guidelines Update for CPR and ECC

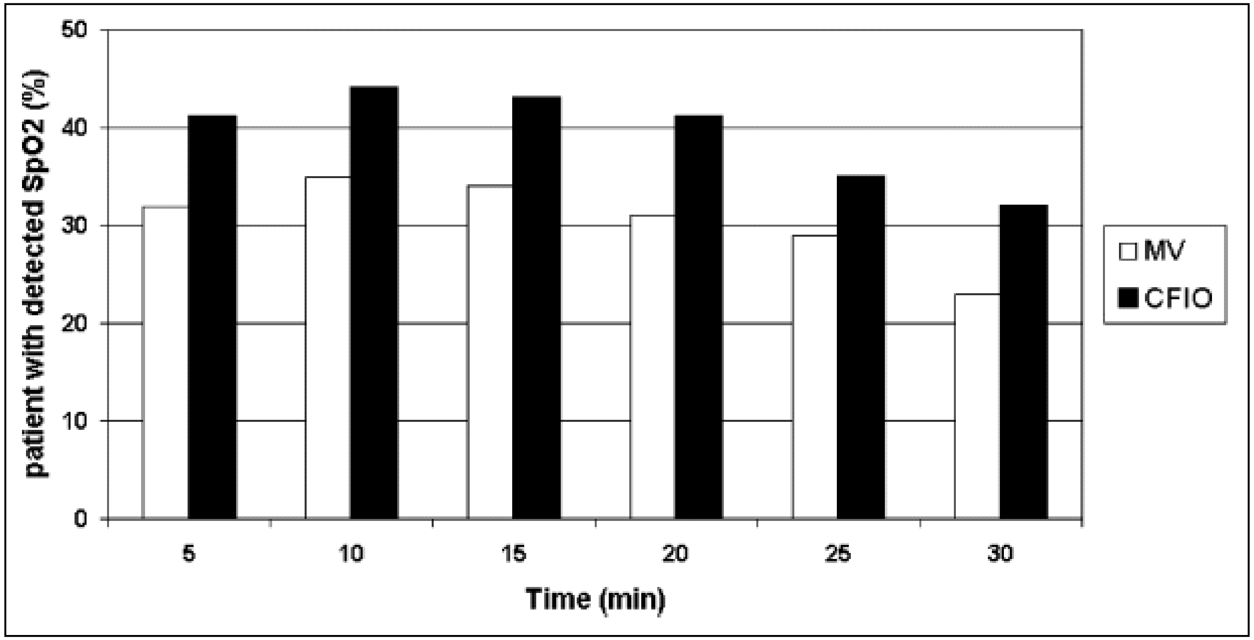
Intérêt de l'Insufflation Continue d'O_2
Effet PEP?

- Idris et al, *Resuscitation* 1994 (cochons curarisés):
  - ↓ V/mn après 10' de MCE + VM → atélectasies, ↓ compliances thoracique et pulmonaire
- Hevesi et al, *Anesthesiology* 1999 (CPAP vs VM):
  - Hémodynamique = idem
  - ↑ PaO_2
  - $PaCO_2$ = idem
- Effet protecteur de l'ICO contre :
  - les atélectasies per-MCE,
  - contusion pulmonaire,
  - OAP

Insufflation continue et RCPs

- Moins de complications
- Pas d'amélioration de survie



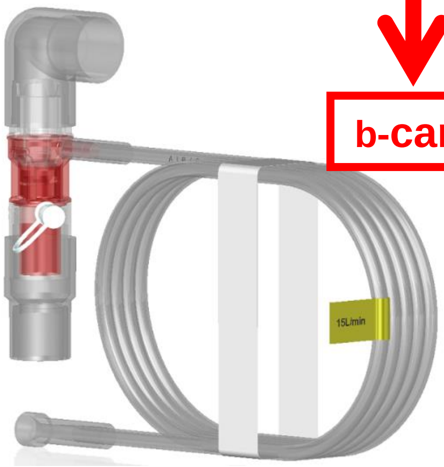


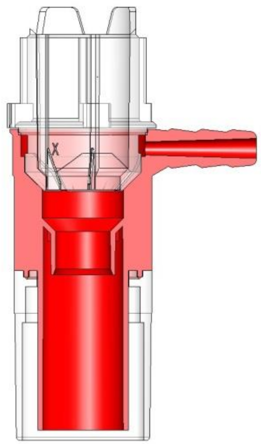
Bertrand et al, *Intensive Care Med. 2006*

Insufflation continue et RCPb

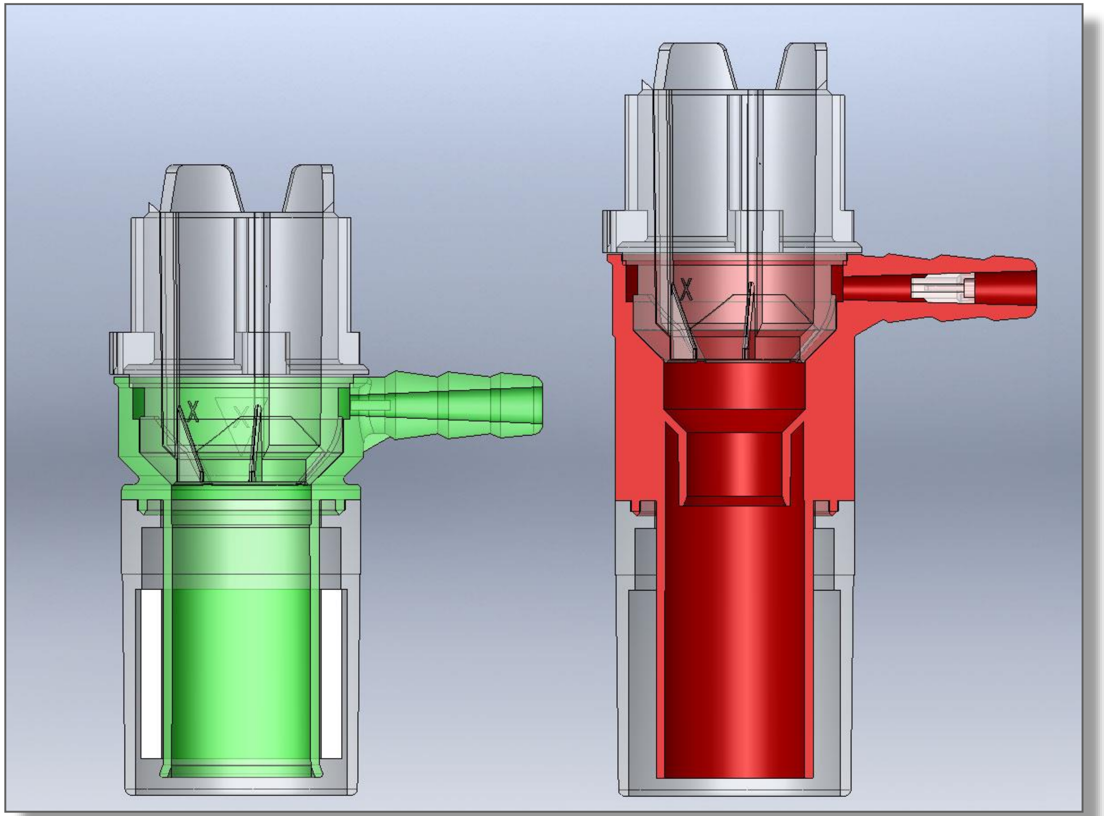
Boussignac Cardiac Arrest Resuscitation Device

b-card



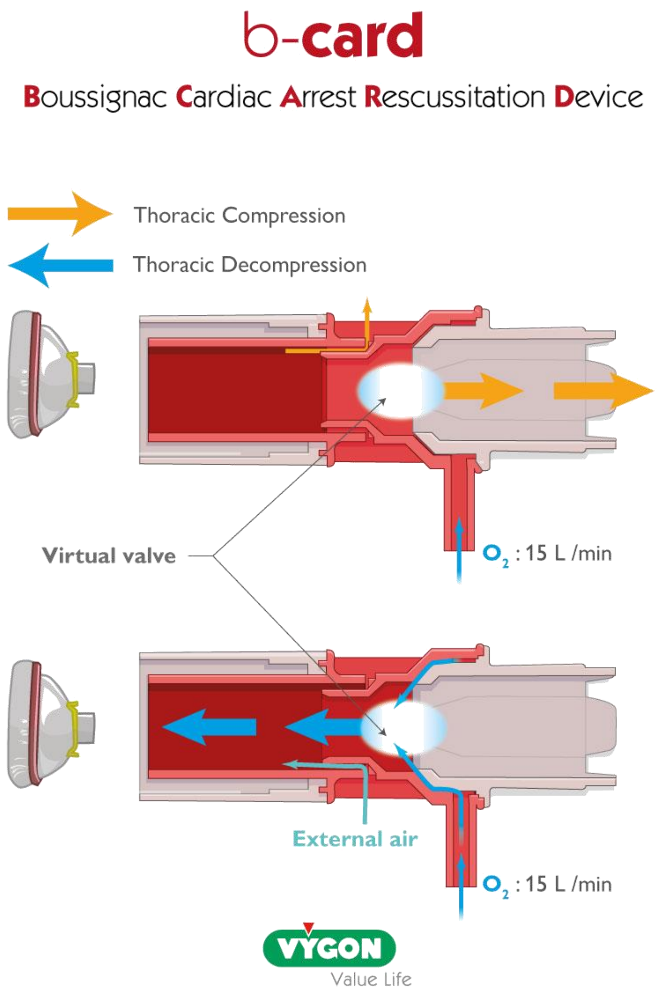


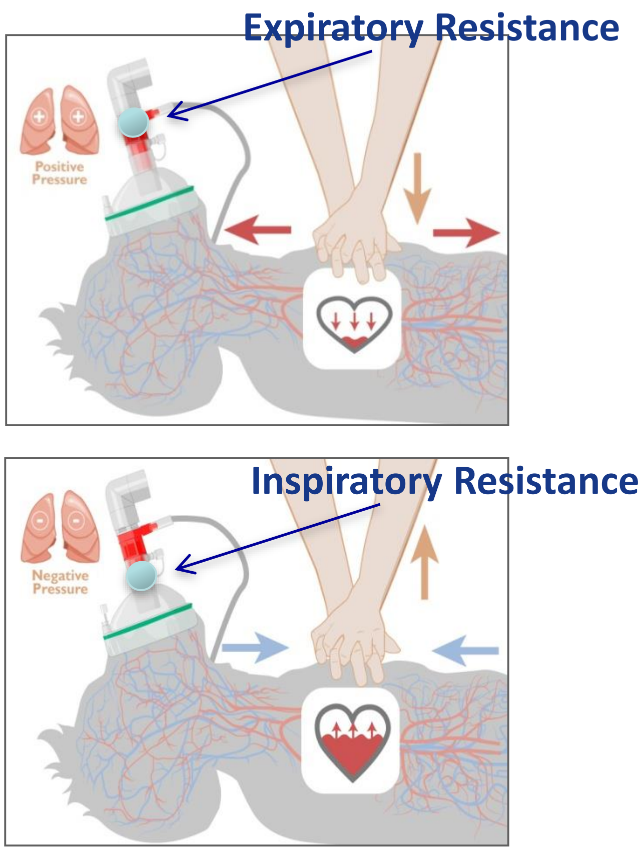
La b-card n'est pas la b-CPAP



b-CPAP b-card

Le principe de la b-card





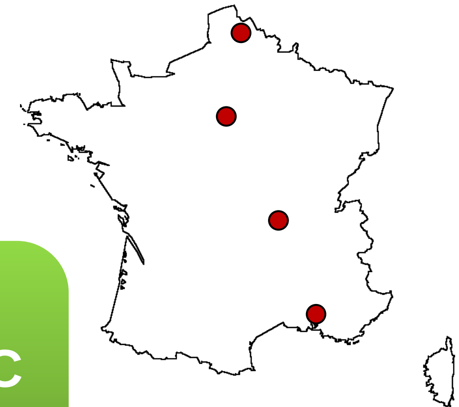
Insufflation continue et RCPb

Table 1
Gas volume in the gastric bag; intramask and intratracheal pressure with the continuous oxygen insufflation. Standard-CardioPulmonary Resuscitation: S-CPR.

	Volume in the gastric bag (mL)				Intramask pressure with the continuous oxygen insufflation (cmH_2O)	Intratracheal pressure with the continuous oxygen insufflation (cmH_2O)
	Continuous external chest compression plus continuous oxygen insufflation—CPR		S-CPR			
	t zero	*t* + 6 min	*t* zero	*t* + 6 min		
Patient 1	200	390	200	5560	4	4
Patient 2	200	250	200	6000	3	3
Patient 3	200	350	200	6200	4	6
Patient 4	200	150	200	6000	5	3
Patient 5	200	10	200	6550	3	5
Patient 6	200	150	200	500	4	4
Patient 7	200	250	200	7000	5	6
Mean ± SD	200	221 ± 130	200	5401 ± 2208	4.0 ± 0.8	4.4 ± 1.2

Segal et al. *Resuscitation* 2015

Etude multicentrique française



CA

BLS

ALS

No-flow

CPR with COI & CCC

Boussignac valve

CPR with COI & CCC

Boussignac tube

S-CPR

BVM ventilation

Comp./ventil. ratio 30/2

S-CPR

Standard ETT

Comp./ventil. ratio asynchrony

Randomisation Cluster

n ~ 1100 patients per group

Conclusion

- Pas de réponse claire à la question posée
- L'oxygénation simple ne suffit pas
- Besoin d'une technique :
  - interagissant de façon optimale avec les CT
  - permettant de protéger les poumons
  - permettant d'optimiser l'oxygénation et l'hémodynamique

Merci de votre attention !