



Mechanical Ventilation in Acute Heart Failure

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IEMCC Istanbul 2013

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Conflicts of Interest

None for this presentation



Acute Heart Failure



European Journal of Heart Failure (2012) **14**, 803–869
doi:10.1093/eurjhf/hfs105

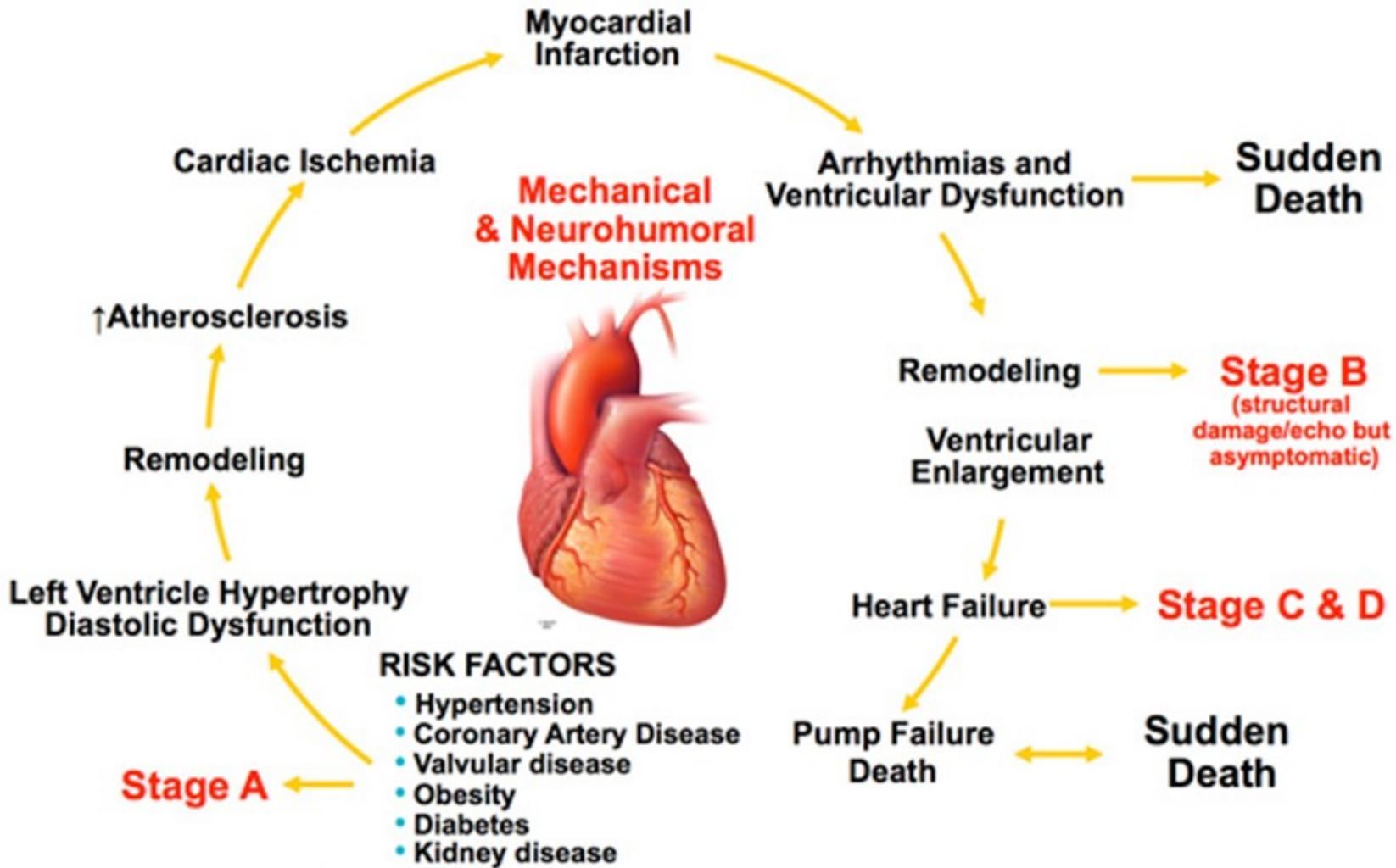
ESC GUIDELINES

ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2012

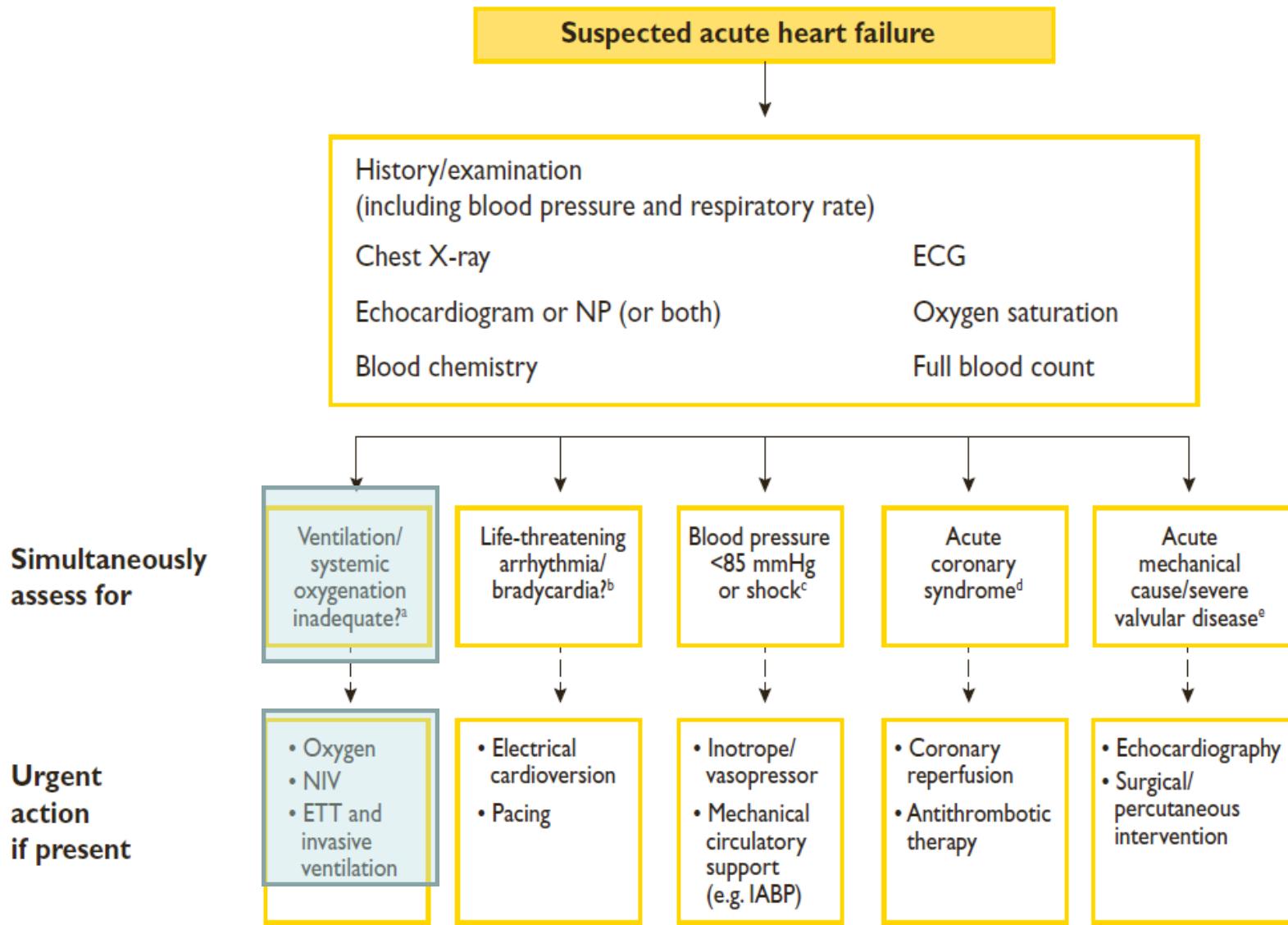
The Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2012 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association (HFA) of the ESC

Authors/Task Force Members: John J.V. McMurray (Chairperson) (UK)*, Stamatis Adamopoulos (Greece), Stefan D. Anker (Germany), Angelo Auricchio (Switzerland), Michael Böhm (Germany), Kenneth Dickstein (Norway), Volkmar Falk (Switzerland), Gerasimos Filippatos (Greece), Cândida Fonseca (Portugal), Miguel Angel Gomez-Sánchez (Spain), Tiny Jaarsma (Sweden), Lars Køber (Denmark), Gregory Y.H. Lip (UK), Aldo Pietro Maggioni (Italy), Alexander Parkhomenko (Ukraine), Burkert M. Pieske (Austria), Bogdan A. Popescu (Romania), Per K. Rønnevik (Norway), Frans H. Rutten (The Netherlands), Juerg Schwitter (Switzerland), Petar Seferovic (Serbia), Janina Stepinska (Poland), Pedro T. Trindade (Switzerland), Adriaan A. Voors (The Netherlands), Faiez Zannad (France), Andreas Zeiher (Germany).

European Journal of Heart Failure (2012) 14, 803–869



McMurray JJ, N Engl J Med 2010;362: 228–238
Shah AM, Lancet 2011;378:704–712



European Journal of Heart Failure (2012) 14, 803–869

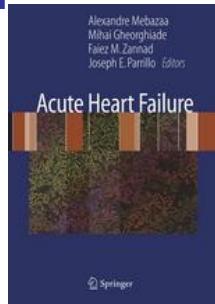
Acute Respiratory Failure

In Heart Failure

It is due to:

- Hypoxemia (intrapulmonary shunt)
- Increased work of breathing
- Augmented O₂ consumption
- and ultimately leads to muscle fatigue

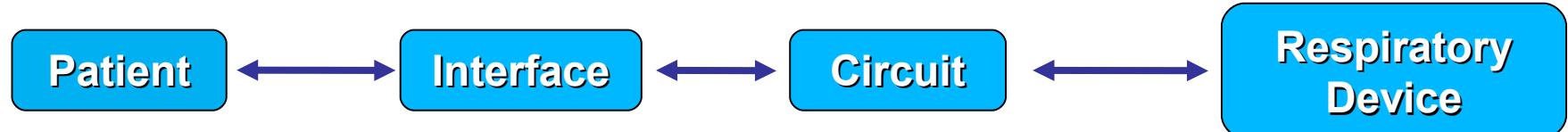
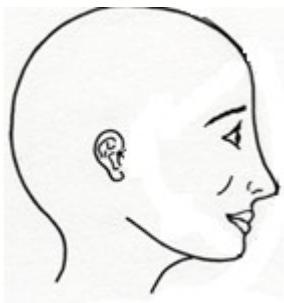
Effect of Mechanical Ventilation



- Reduced work of breathing from improved pulmonary compliance
- Increased cardiac output from reduced pre-load and after-load
- Reduced mitral regurgitation
- Unloads the respiratory muscles

Mehta, RESPIRATORY CARE • FEBRUARY 2009 VOL 54 NO 2

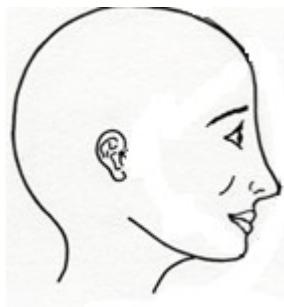
Mechanical Ventilation



The patient: Which Indications?

Noninvasive positive pressure ventilation in acute respiratory failure: report of an International Consensus Conference in intensive care medicine, Paris, France, 13–14 April 2000*

Critical Care Assembly of the American Thoracic Society (ATS)
European Respiratory Society (ERS)
European Society of Intensive Care Medicine (ESICM)
Société de Réanimation de Langue Française (SRLF)



organisée conjointement par
la SFAR, la SPLF et la SRLF

Ventilation Non Invasive
au cours de l'insuffisance respiratoire aiguë
(nouveau-né exclu)

Avec la participation de la SFMU,
du SAMU de France,
du GFRUP
et de l'ADARPEF

Le 12 octobre 2006
Paris, Institut Montsouris
42, boulevard Jourdan
75014 Paris

Paris

12 October, 2006

3^e Conférence de Consensus commune

The logo for the SRLF consists of a stylized letter 'S' inside a square frame with horizontal lines extending from the top and bottom.

The patient: Which Indications?

Grade 1

Exacerbation of COPD
Cardiogenic PE

	Décompensation de maladies neuromusculaires chroniques et autres IRC restrictives Mucoviscidose décompensée <i>Forme apnésante de la bronchiolite aiguë</i> <i>Laryngo-trachéomalacie</i>
Aucun avantage démontré Il ne faut probablement pas faire (G2-)	Pneumopathie hypoxémiantre SDRA Traitement de l' IRA post-extubation Maladies neuromusculaires aiguës réversibles
Situations sans cotation possible SRLF, SFAR, SPLF, Paris Octobre 2006	Asthme Aigu Grave Syndrome d'obésité-hypoventilation <i>Bronchiolite aiguë du nourrisson</i> <i>(hors forme apnésante)</i>

Jean-Damien Ricard and Damien Roux 2007

Mehta, RESPIRATORY CARE • FEBRUARY 2009 VOL 54 NO 2

European Journal of Heart Failure (2012) 14, 803–869

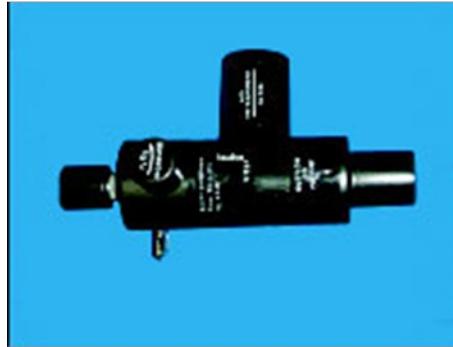
The respiratory devices: Which Modes?

- PPSV mode
 - COPD **grade 1**
- PPSV mode or CPAP (together with optimal medical treatment!!!)
 - Cardio PE **grade 1**
- BiPAP
- VAC

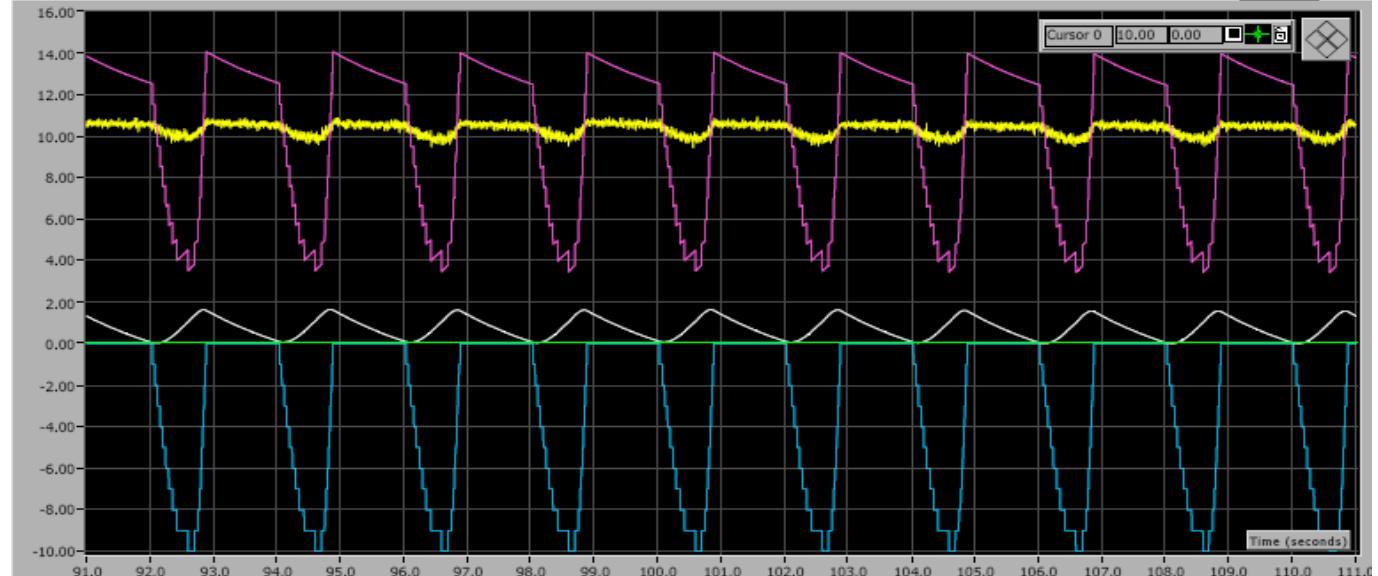


SRLF, SFAR, SPLF, Paris Oct 2006

CPAP



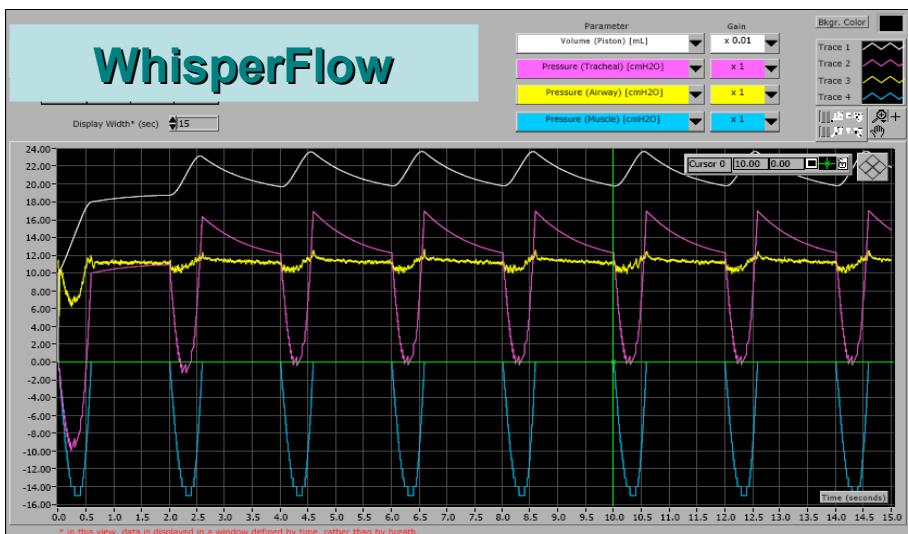
Continuous Flow Device



Dr A. Khoury

A. Khoury, EuSEM, Munich Sept 2008

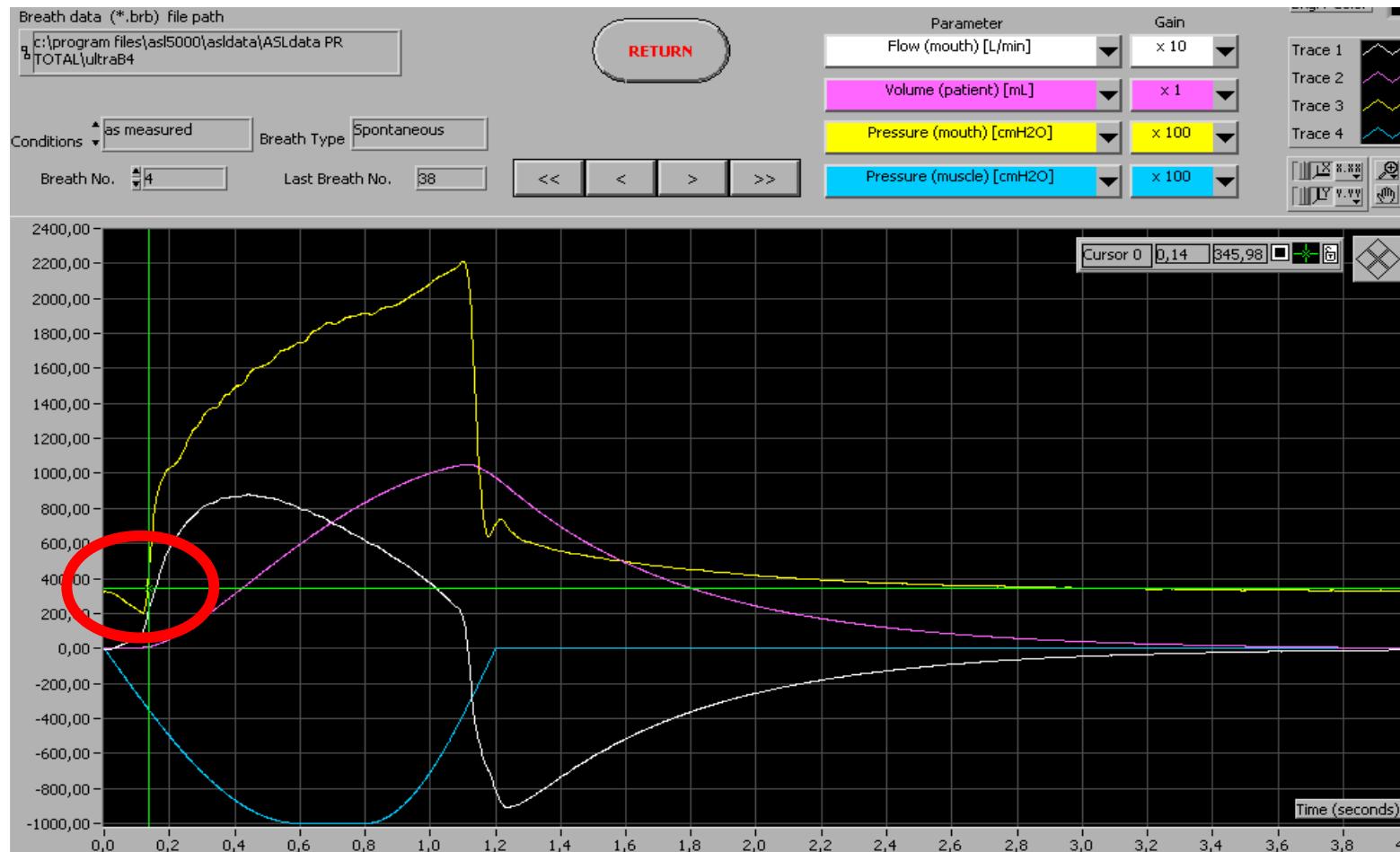
Continuous Positive Airway Pressure CPAP



Dr A. Khoury

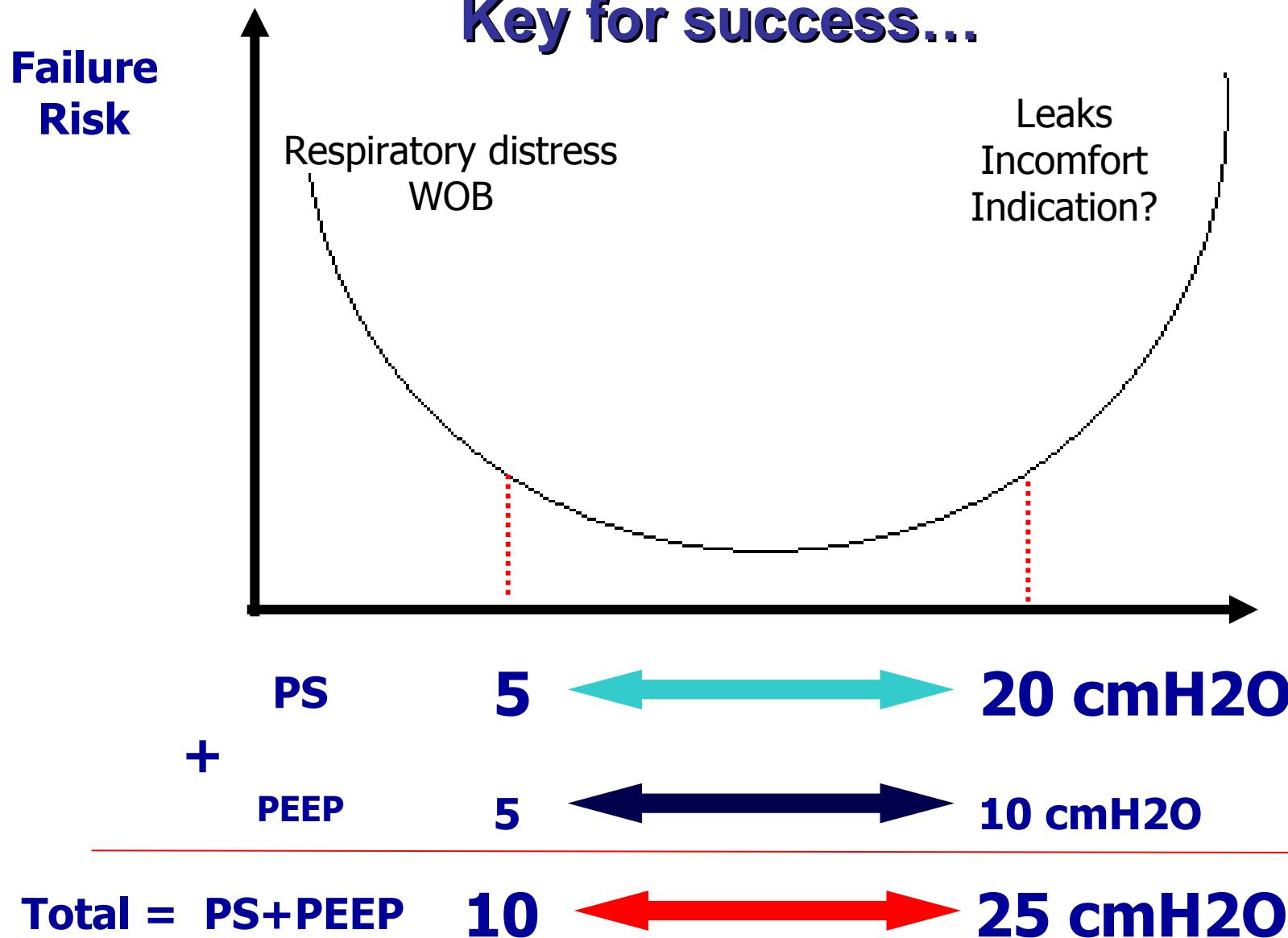
A. Khoury, EuSEM, Munich Sept 2008

Pressure Support Ventilation



PSV

Key for success...



Which Contra-Indications

- environnement inadapté, expertise insuffisante de l'équipe
 - patient non coopérant, agité, opposant à la technique

Inadequate environment, insufficient expertise

- coma (sauf coma hypercapnique de l'insuffisance respiratoire chronique [IRC])

Non compliant, agitated patient reluctant to the technique

- état de choc, troubles du rythme ventriculaire graves

Coma (but hypercapnic of CRespF patient)

- immédiatement après un arrêt cardio-respiratoire

- pneumothorax non drainé, plaie thoracique soufflante
- obstruction des voies aériennes supérieures (sauf apnées du sommeil, laryngo-trachéomalacie)
- vomissements incoercibles
- hémorragie digestive haute
- traumatisme crânio-facial grave
- tétraplégie traumatique aiguë à la phase initiale **SRLF, SFAR, SPLF, Paris Octobre 2006**



Cardiogenic Pulmonary Edema:

PPSV v/s CPAP



Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema

Systematic Review and Meta-analysis

Josep Masip, MD

Marta Roque, BSc

Bernat Sanchez, MD

Rafael Fernandez, MD

Miria Subirana, RN

José Angel Exposito, BSc

Context In patients with acute cardiogenic pulmonary edema noninvasive ventilation may reduce intubation rate, but the impact on mortality and the superiority of one technique over another have not been clearly established.

Objective To systematically review and quantitatively synthesize the short-term effect of noninvasive ventilation on major clinical outcomes.

Data Sources MEDLINE and EM BASE (from inception to October 2005) and Cochrane databases (library issue 4, 2005) were searched to identify relevant randomized controlled trials and systematic reviews published from January 1, 1988, to October

Open Access

Research

A comparison of continuous and bi-level positive airway pressure non-invasive ventilation in patients with acute cardiogenic pulmonary oedema: a meta-analysis

Kwok M Ho^{1,2} and Karen Wong¹

www.elsevier.com/locate/ijcard

Review

Positive pressure ventilation in the management of acute and chronic cardiac failure: a systematic review and meta-analysis

Sunil Nadar^a, Neeraj Prasad^a, Rod S. Taylor^b, Gregory Y.H. Lip^{a,*}

Effect of non-invasive positive pressure ventilation (NIPPV) on mortality in patients with acute cardiogenic pulmonary oedema: a meta-analysis

John Victor Peter, John L Moran, Jennie Phillips-Hughes, Petra Graham, Andrew D Bersten

REVIEW

Non-invasive ventilation in acute cardiogenic pulmonary oedema

R Agarwal, A N Aggarwal, D Gupta, S K Jindal

Postgrad Med J 2005;81:637–643. doi: 10.1136/pgmj.2004.031229

CARDIOLOGY/ORIGINAL RESEARCH

The Use of Noninvasive Ventilation in Emergency Department Patients With Acute Cardiogenic Pulmonary Edema: A Systematic Review

Sean P. Collins, MD, MSC

Lisa M. Mielniczuk, MD

Heather A. Whittingham, MD

Mark E. Boseley, MD

David R. Schramm, MD

Alan B. Storrow, MD

From the Department of Emergency Medicine, University of Cincinnati, Cincinnati, OH (Collins); the Division of Cardiology, Brigham and Women's Hospital, Boston, MA (Mielniczuk); the Division of Pulmonary Critical Care, University Health Network, University of Toronto, Toronto, Ontario, Canada (Whittingham); the Department of Otolaryngology and Laryngology, Massachusetts Eye and Ear Infirmary, Boston, MA (Boseley); the Department of Otolaryngology, University of Ottawa, Ottawa, Ontario, Canada (Schramm); and the Department of Emergency Medicine, Vanderbilt University, Nashville, TN (Storrow).

Open Access

Research

Efficacy and safety of non-invasive ventilation in the treatment of acute cardiogenic pulmonary edema - a systematic review and meta-analysis

João C Winck¹, Luís F Azevedo^{2,3}, Altamiro Costa-Pereira^{2,3}, Massimo Antonelli⁴ and Jeremy C Wyatt⁵

NIPSV as effective and safe as CPAP in CPE ?

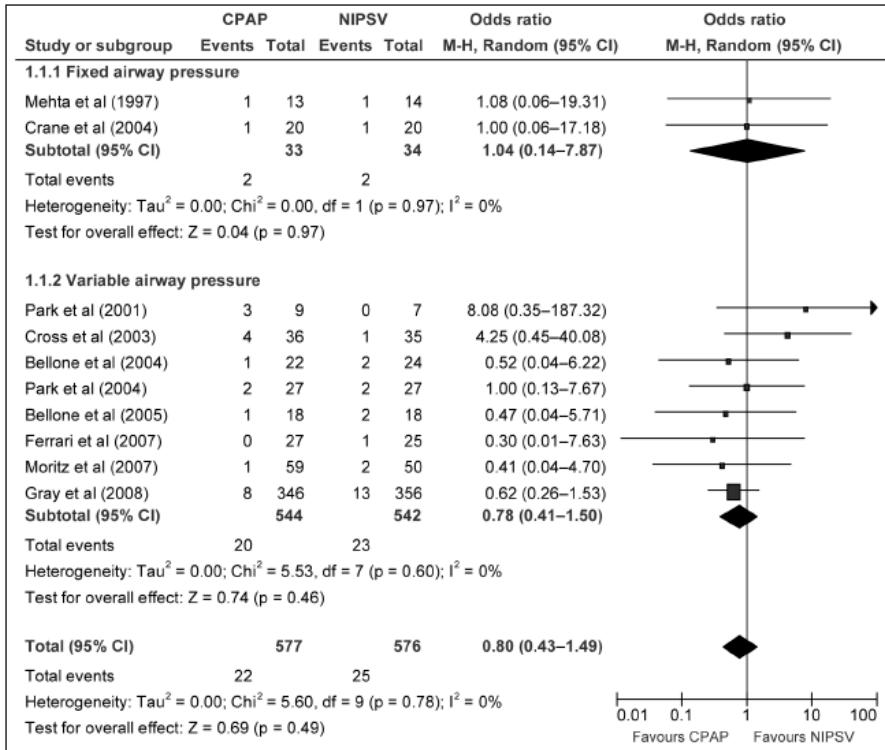


- Medline & Embase randomised Clinical trials from 1980 till 2008
- 10 studies
- 1153 patients
- 3 different statistical models (fixed effects, random effects and exact method).

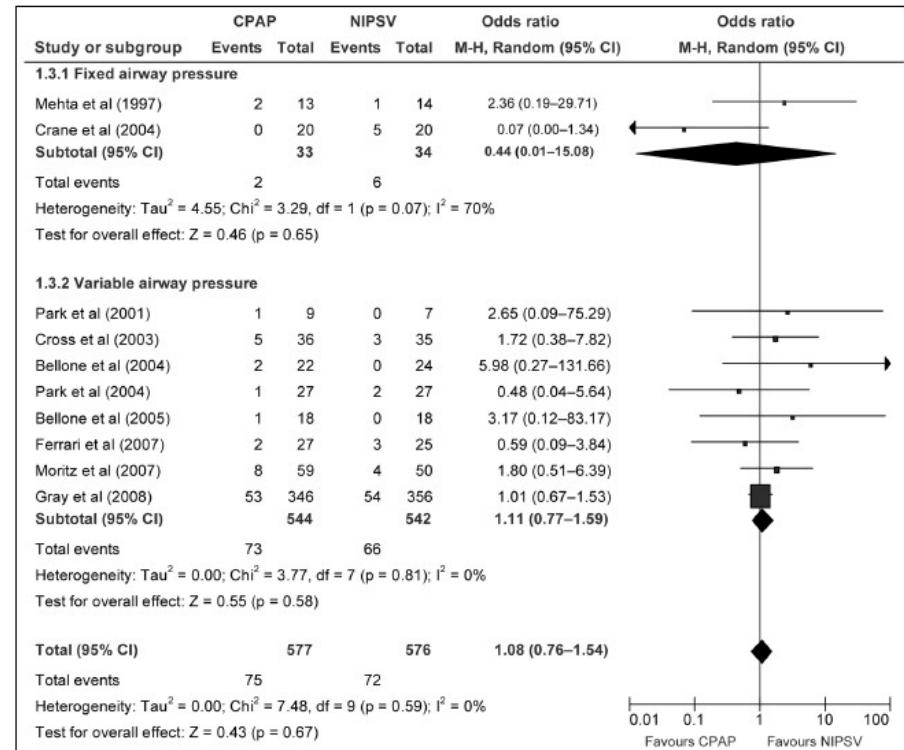
Outcome : intubation rate, the hospital mortality & the occurrence of MI

Agarwal R, Aggarwal A N, Gupta D, Singapore Med J 2009; 50(6) : 595

NIPSV as effective and safe as CPAP in CPE ?



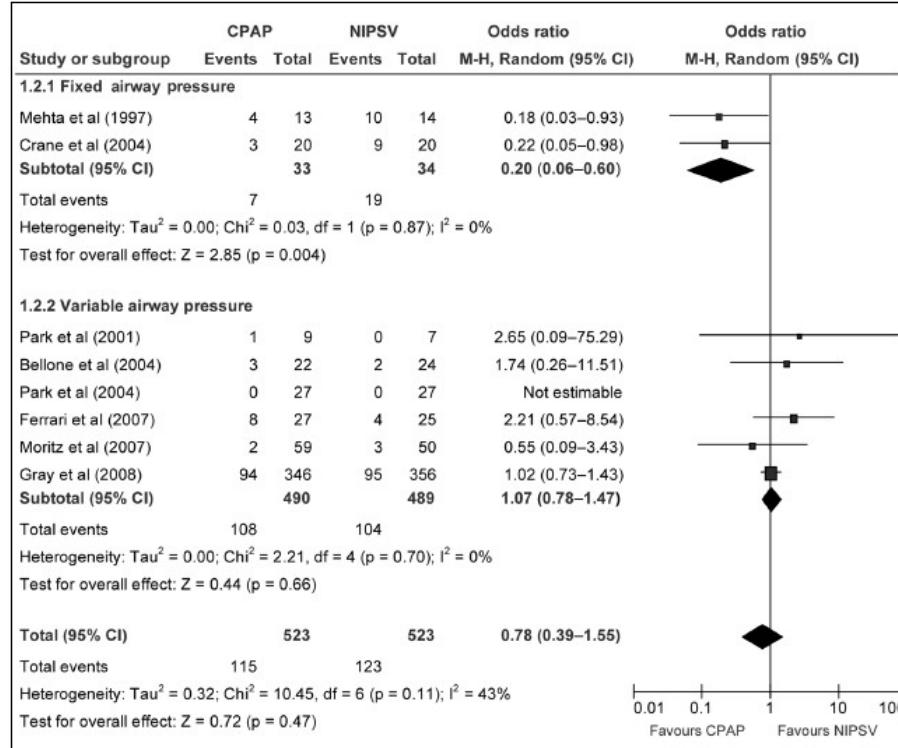
↓Intubation Rate



↓Hospital Mortality

Agarwal R, Aggarwal A N, Gupta D, Singapore Med J 2009; 50(6) : 595

NIPSV as effective and safe as CPAP in CPE ?



Less Myocardial Infarction

Agarwal R, Aggarwal A N, Gupta D, Singapore Med J 2009; 50(6) : 595

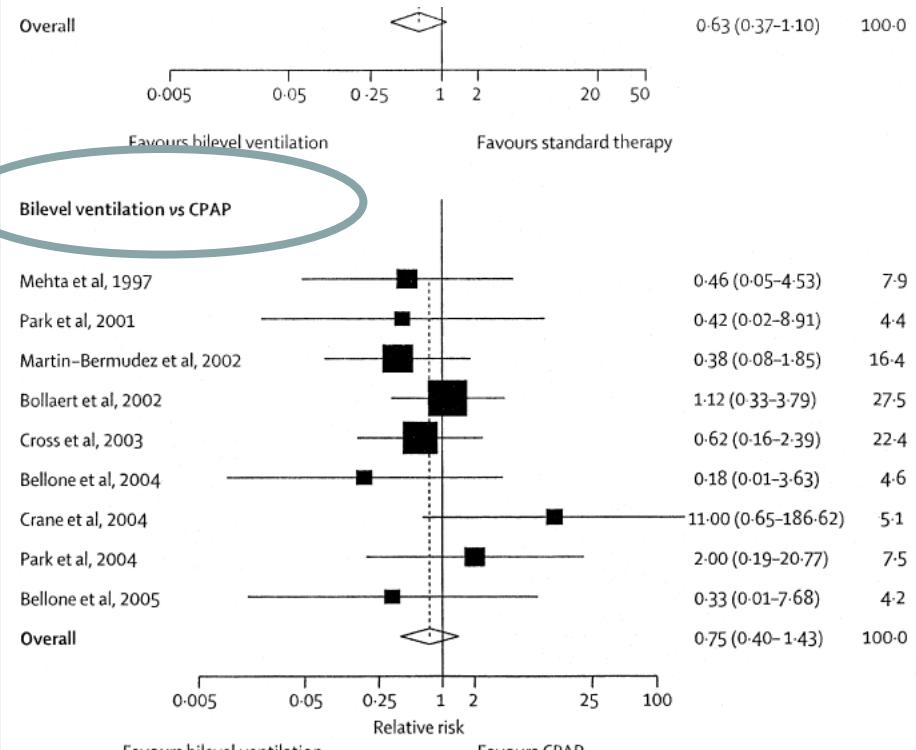
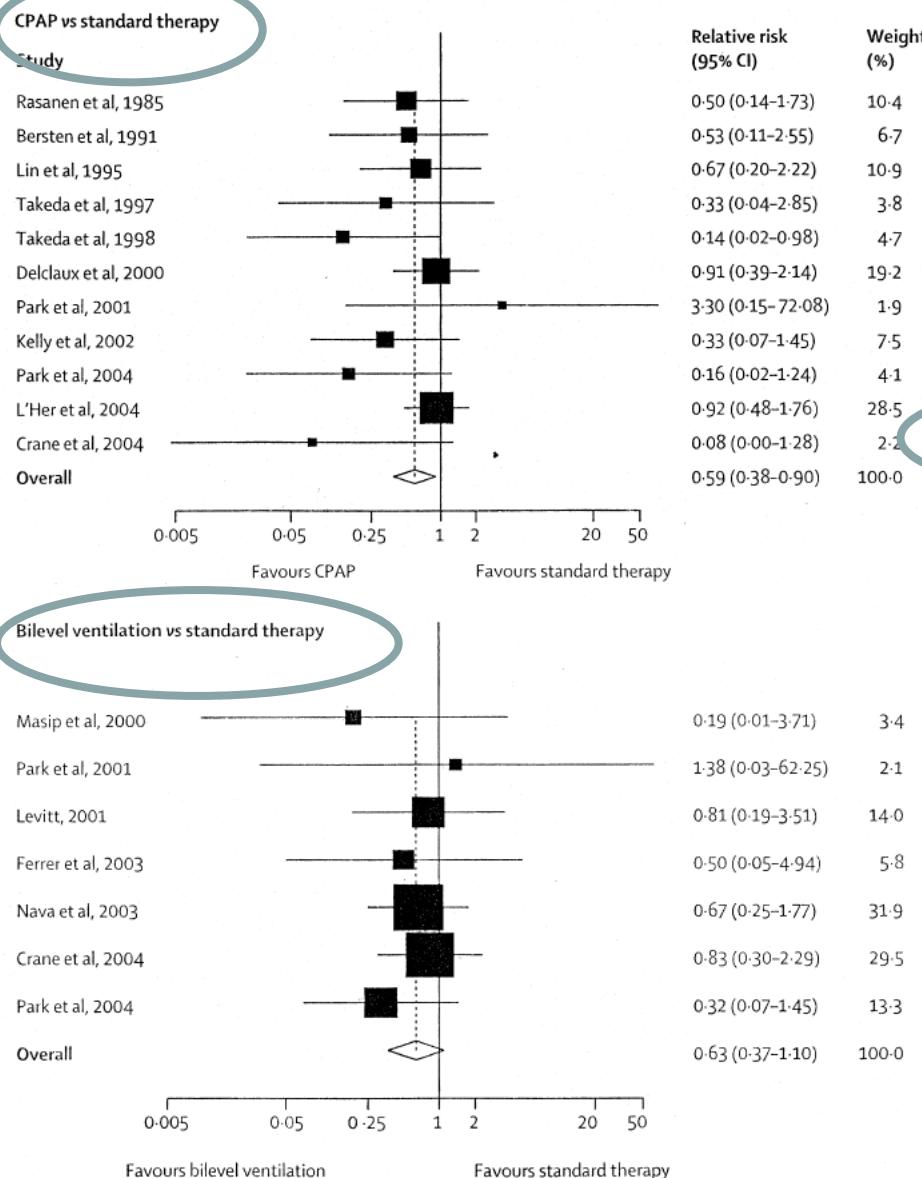
Conference Proceedings

Noninvasive Ventilation in Patients With Acute Cardiogenic Pulmonary Edema

Sangeeta Mehta MD FRCPC, Abdul Hakeem Al-Hashim MD FRCPC,
and Sean P Keenan MD FRCPC MSc

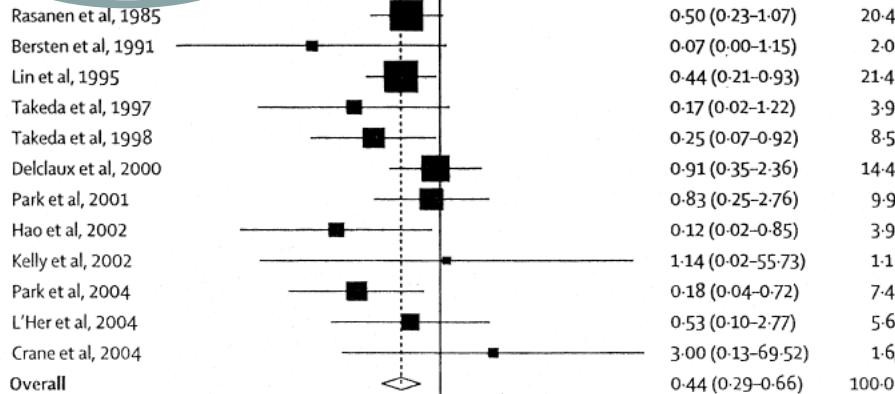


Mortality

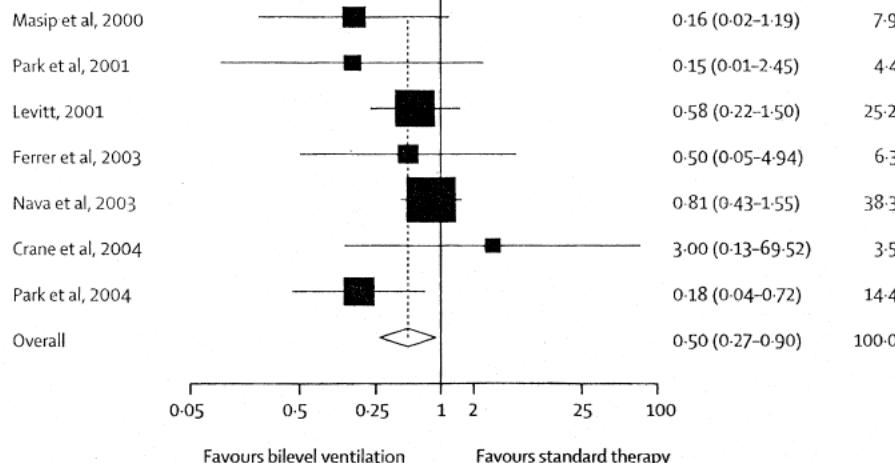


Intubation Rate

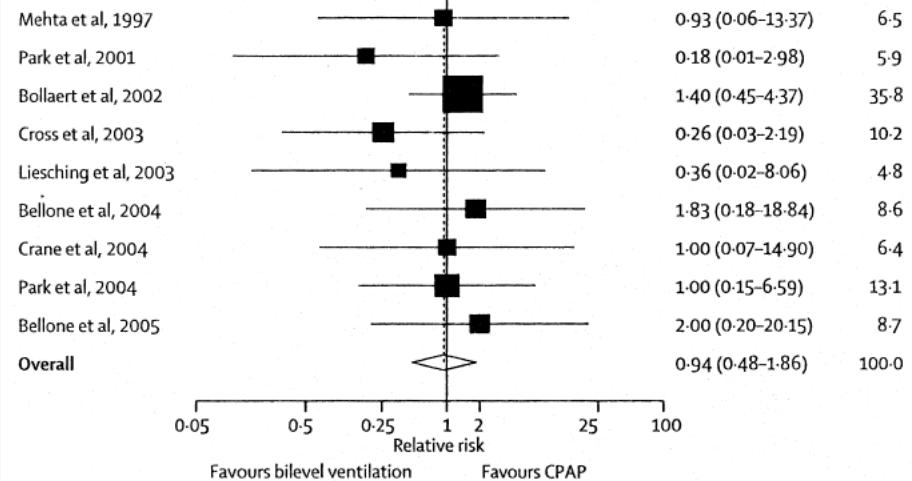
CPAP vs standard therapy
Study



Bilevel ventilation vs standard therapy



Bilevel ventilation vs CPAP



Conference Proceedings

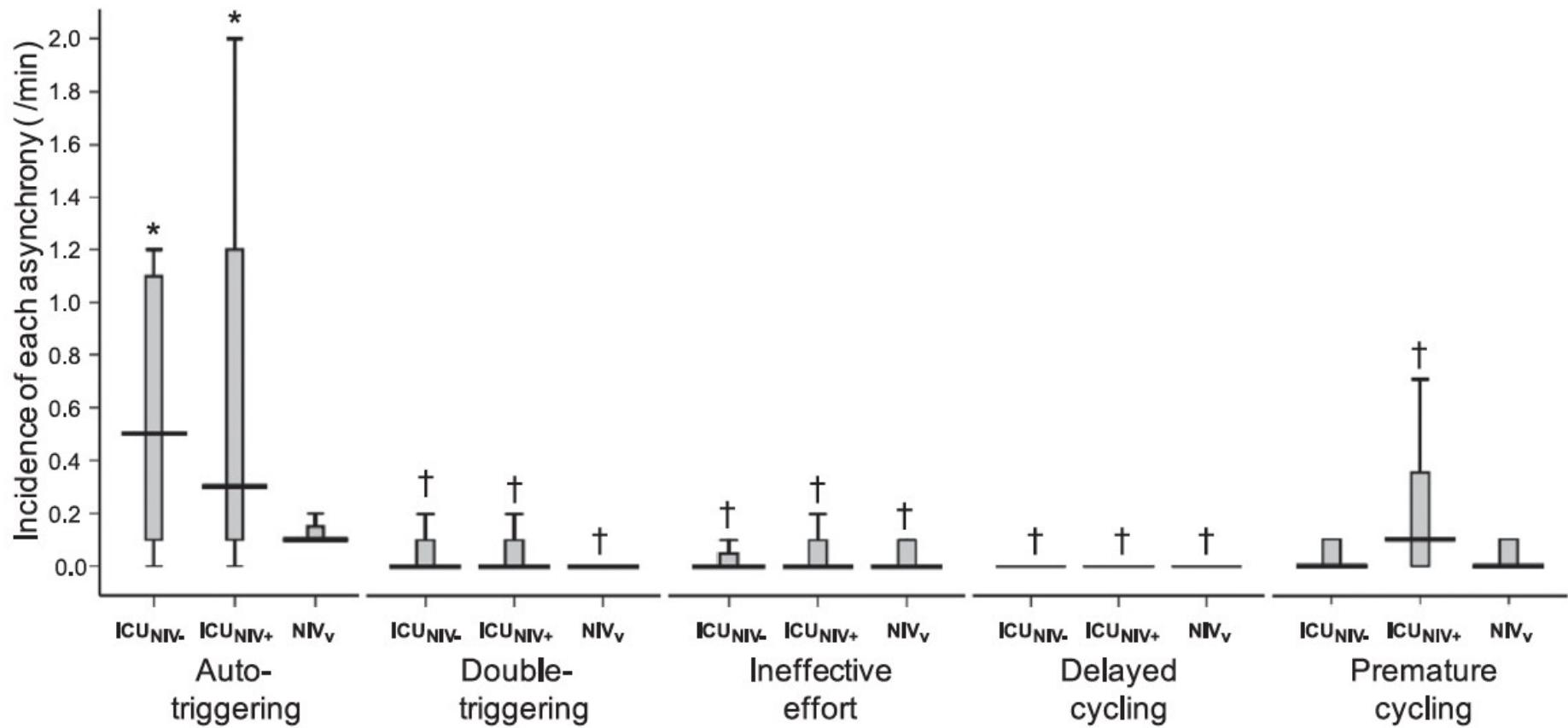
Noninvasive Ventilation in Patients With Acute Cardiogenic Pulmonary Edema

Sangeeta Mehta MD FRCPC, Abdul Hakeem Al-Hashim MD FRCPC,
and Sean P Keenan MD FRCPC MSc

There were **important methodological limitations** in many of the trials, such as lack of blinding and inclusion of only a proportion of patients who presented with ACPE, which restricts the generalizability of these results to all patients with ACPE.

It remains to be determined in the current era of ACPE therapy whether CPAP or NIV confer a mortality benefit. **At this time we cannot conclude that NIV offers any advantages over CPAP.**

Type of ventilator



Carteaux, Chest 2012; 142(2):367–376



Respiratory Circuit?

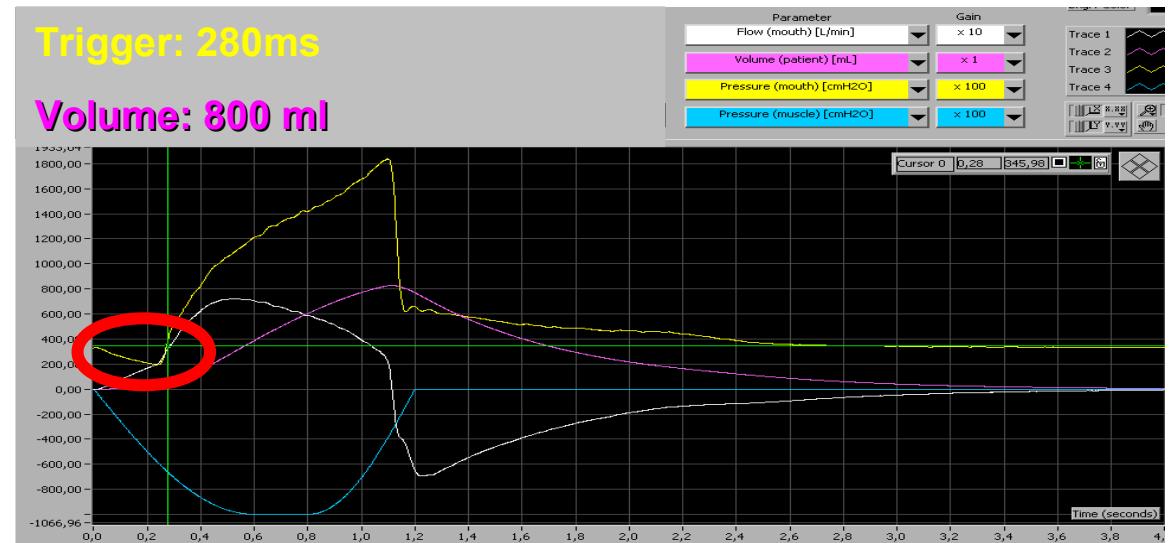
PS

BIPAP

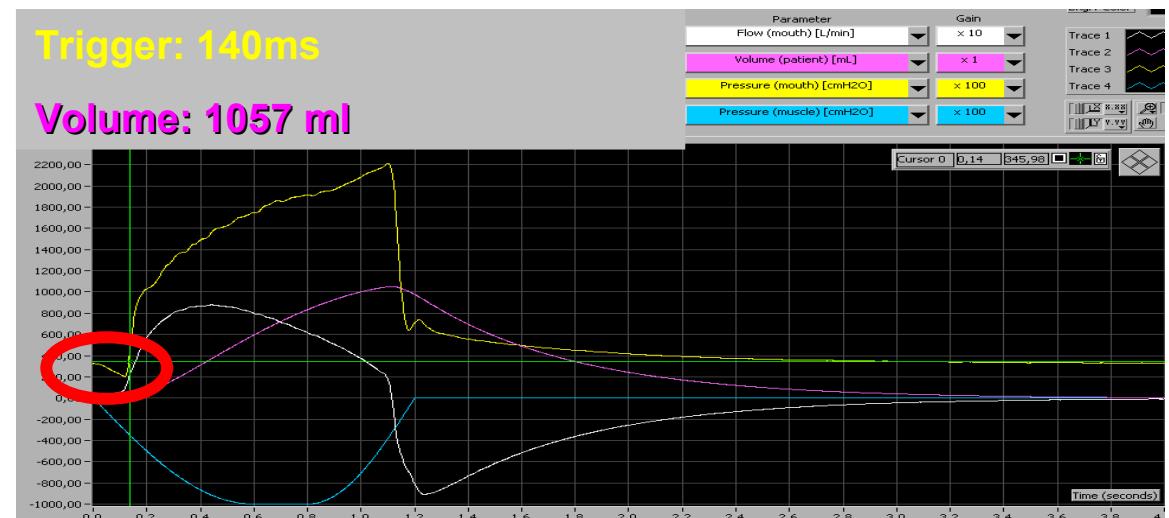
	Valve	Leakage	p
T Trg msec	226 ±162	347±107	< 10 ⁻⁶
P min Trg cm H2O	-1,35±0,28	-0,96±0,2	<10 ⁻⁶
PTP Trigger	141±123	198±55	< 10 ⁻³
Tinsp msec	1±0.2	1±0.2	NS
VT insp ml	723±227	562±155	< 10 ⁻⁶
T 90% PEP msec	138±197	146±304	NS

A. Khoury J Crit Care. 2008 Sep;23(3):449

BIPAP (leakage)



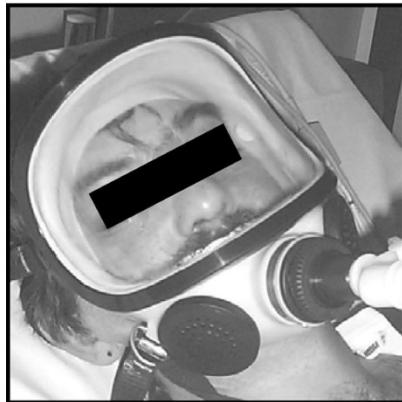
PPSV (valves)



A. Khoury J Crit Care. 2008 Sep;23(3):449

Physiological effects of different interfaces during noninvasive ventilation for acute respiratory failure*

Amanda Tarabini Fraticelli, MD; François Lellouche, MD; Erwan L'Her, MD;
Solenne Taillé, BioMedEng; Jordi Mancebo, MD; Laurent Brochard, MD



INSPIR'AID
Integral
mask with
the largest
internal
volume
(977 ml)



FULL FACE
Large or-
nasal mask
with a large
internal
volume
(163 ml)



AIRVIE
Small oro-
nasal mask
with a
moderate
internal
volume
(84 ml)



ORACLE
Mouth piece
without
internal
volume

**Crit Care Med 2009
Vol. 37, No. 3**

- The internal volume of the masks had no apparent short-term:
- dead space effect on gas exchange
- minute ventilation
- patient's effort

- So with the exception of mouthpiece, interfaces may be interchangeable provided adjustment of the ventilatory device parameters are performed.

Crit Care Med 2009 Vol. 37, No. 3



Where?

Key determinant for success

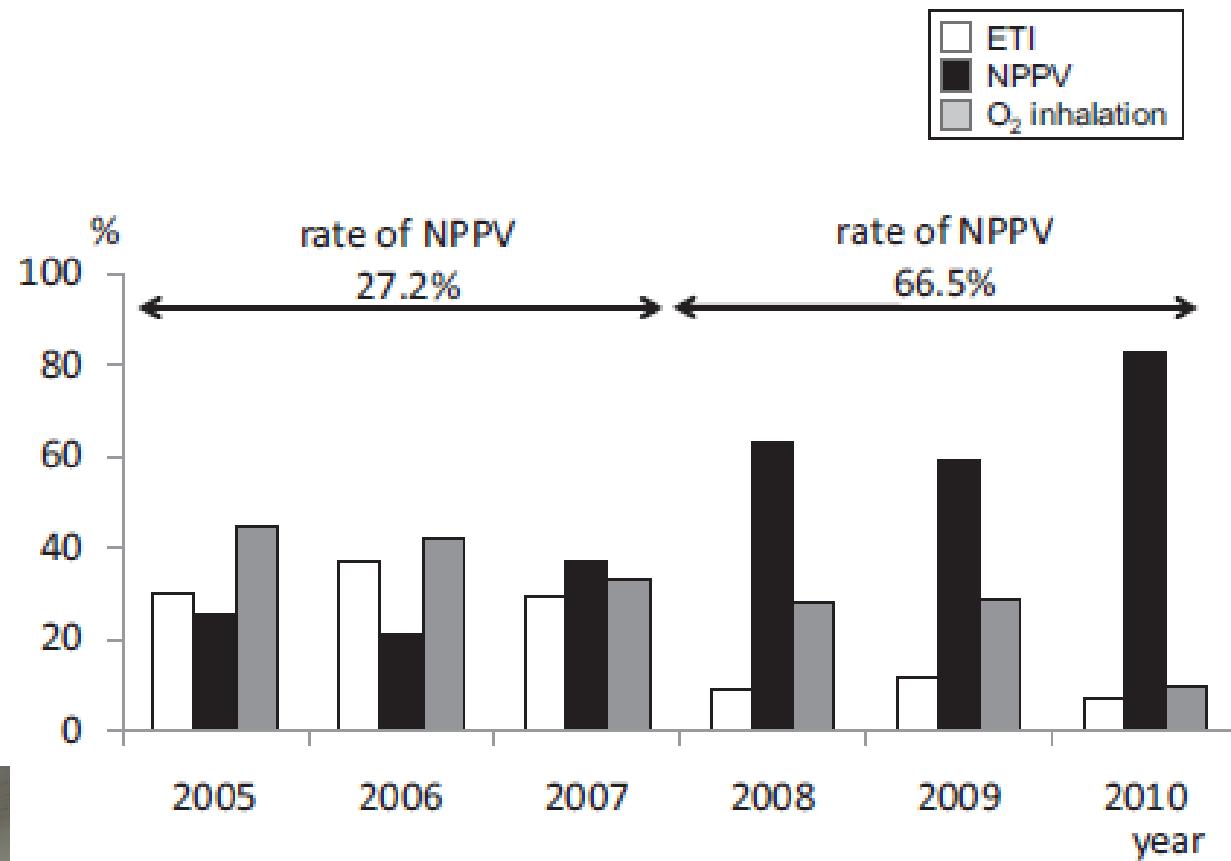
- Dedicated personnel
- Specific Training of the team +++ (RN, Physiotherapist...)
- Clear guidelines for implementing NIV

***Intensive Care Unit
Possible in ED ???***

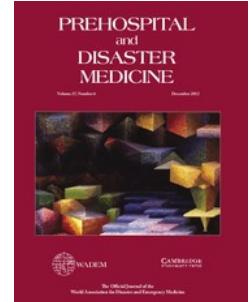
In the ED...

- Yes !!!!

Heart Failure



Akihiro Shirakabe, Journal of Cardiology (2011) 57, 107–114



Pre hospital ?

When Pressure is Positive: A Literature Review
of the Prehospital Use of Continuous Positive
Airway Pressure

Brett Williams, PhD; Malcolm Boyle, PhD; Nicole Robertson, BEH-P; Coco Giddings, BEH-P

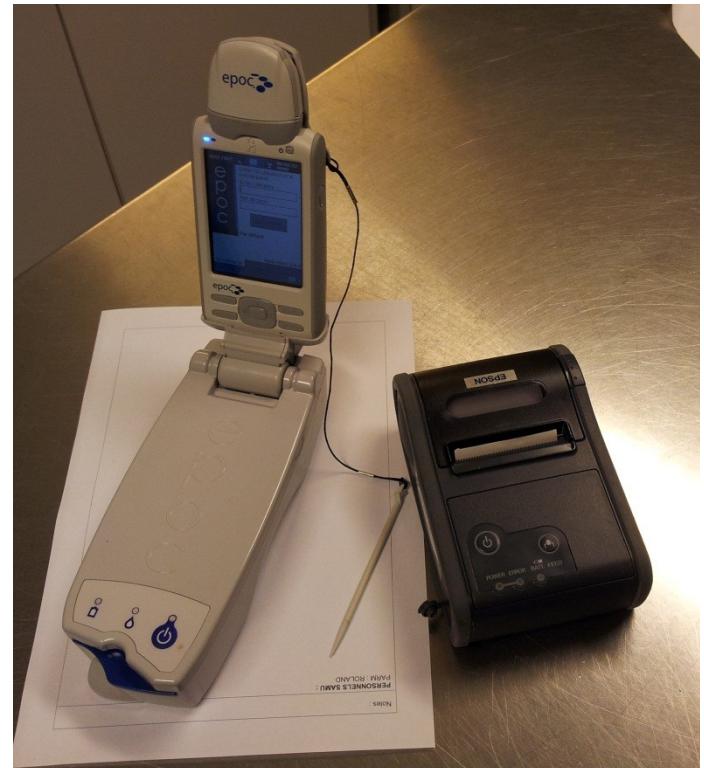
- Cochrane, Medline, EMBASE, and CINAHL >> end of May 2012.
- CPAP in the prehospital environment, specifically in the treatment of heart failure and ACPE
- 1,253 articles, 12 of which met the inclusion criteria.
- **Reduced short-term mortality** as well as reduced rates of endotracheal intubation
- **Improve patient vital signs** during prehospital transport and **reduce myocardial damage**.

Williams B, Prehosp Disaster Med. 2013;28(1):1-10, Epub, Ahead of print
Dr A. Khoury IEMCC Istanbul 2013

Pre hospital ?

Mobile Intensive Care Unit (SAMU)

- Dedicated Personnel
- Trained
- Indications
- Lab facilities (EPOC)



Pre hospital ?

CPAP Devices

- Boussignac®
(VYGON)
- CPAP Systems
(Vital Signs, inc)
- WhisperFlow®
(Respirronics)



Pre hospital ?



Weinmann
medumat



Monnal T 60



Elisée 250



Hamilton T1



Oxylog 3000

What about if NIV fails?

Intubation and invasive MV without delay if:

- ARF with respiratory exhaustion
- Hemodynamic instability
- Cardiogenic shock
- Impaired consciousness
- Severe cardiac arrhythmias



Invasive MV

3. Initial ventilatory parameters:
- VT: 6 to 8 mL/kg*
 - respiratory rate: 15 bpm
 - FiO₂: 100%
 - PEEP: 5 cm H₂O
 - I/E ratio: 1 : 1
 - Inspiratory flow: 40–60 L/min

5. Measure plateau pressure with initial parameters and adjust if pressure >30 cm H₂O

European Journal of Heart Failure (2012) 14, 803–869

Jean-Damien Ricard and Damien Roux 2007

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Conclusion

- NIV is an excellent indication for Heart Failure patients
- Unless contraindication
- Closely watch the initial phase of NIV to quickly predict success or failure
- The earliest its used, the better the outcomes
- Impacts long time survival



Thank you for your attention...



Acknowledgement:

Pr D. Robert; Pr G. Capellier; Pr Samir Jaber