Ventilation Non Invasive

Aux Urgences?

Dr. Abdo Khoury

Inserm CIC- IT 808

Pôle Urgences, Samu, Réanimation Médicale

Centre Hospitalier Régional Universitaire, Besançon, France

akhoury@chu-besancon.fr

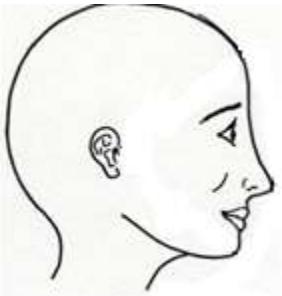

Norwegian Sea
ICELAND
NORWAY
FINLAND


UNITED KINGDOM
FLANDERS
BELGIUM
Lille
GERMANY
Amiens
PICARDY
Le Havre
Rouen
LUXEMBOURG
Channel Islands (UK)
Reims
Metz
Caen
NORMANDY
PARIS
LORRAINE

Conflits d'intérêt

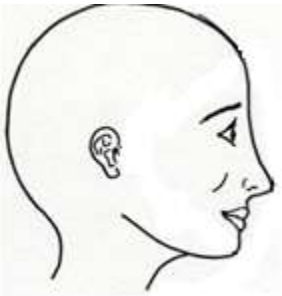
- Aucun pour cette présentation

Mechanical Ventilation



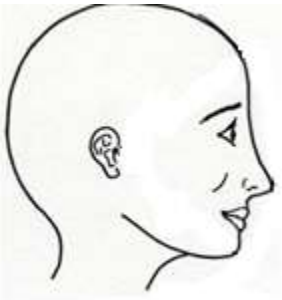
Patient ⟷ **Interface** ⟷ **Circuit** ⟷ **Respiratory Device**

Non Invasive Mechanical Ventilation



Patient ⟷ Interface ⟷ Circuit ⟷ Respiratory Device

Le patient

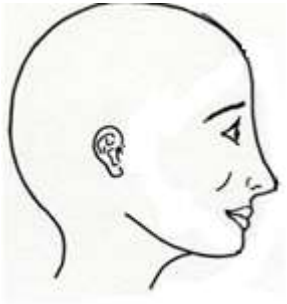


Patient

Le patient: Quelles 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)



Le patient: Quelles Indications?

Grade 1	Exacerbation BPCO OAP cardiogénique
	Décompensation de maladies neuromusculaires chroniques et autres IRC restrictives Mucoviscidose décompensée *Forme apnéisante de la bronchiolite aiguë* *Laryngo-trachéomalacie*
Aucun avantage démontré Il ne faut probablement pas faire (G2-)	Pneumopathie hypoxémiante SDRA Traitement de l' IRA post-extubation Maladies neuromusculaires aiguës réversibles
Situations sans cotation possible	Asthme Aigu Grave Syndrome d'obésité-hypoventilation *Bronchiolite aiguë du nourrisson (hors forme apnéisante)*

SRLF, SFAR, SPLF, Paris Octobre 2006

Le patient: Quelles Indications?

- Exacerbation BPCO (Brochard NEJM 90, 95)
- OAP Cardiogénique Hypercapnique (Masip, Lancet 2001; Nava AJRCCM 2004)
- Hypoxémie:
  - Hématologie (Hilbert, NEJM 2001)
  - Extubation précoce (Girault, AJRCCM 98)
  - Prophylaxie en post extubation pour détresse respiratoire (Nava CCM 2005; Ferrer AJRCCM 2006)
- **Post-op (préventive, curative)**

Le patient: Quelles Contrindications?

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

Environment inadapté, expertise insuffisante de l'équipe

Patient non coopérant, agité, opposant à la technique

- sepsis sévère
- im
- pr

Coma (sauf coma hypercapnique de l'insuffisant respiratoire chronique (IRC)

- 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

Les Appareils Ventilatoires

Patient

Respiratory Device

Les appareils Ventilatoires: Quels Modes?

- AI + PEP
  - BPCO **grade 1**

- AI + PEP ou CPAP
  - OAP Cardiogénique **grade 1**

(+ traitement médical optimal!!!)

- BiPAP
- VAC

PRICE

ELISEE 370

ELISEE 350

ELISEE 250

EV 2D

EV XL

PB840

E500

EV4

GALILEO GOLD

SERVO i

HORUS

SAVINA

OXYLOG 3000

LTV 1000

RAPHAEL COLOR

HORUS COLOR SC (Extend)

RAPHAEL COLOR+SC

HT 50

TBIRD

OSIRIS 2/3

CARACTERISTICS

Aide Inspiratoire
VS + AI + PEP

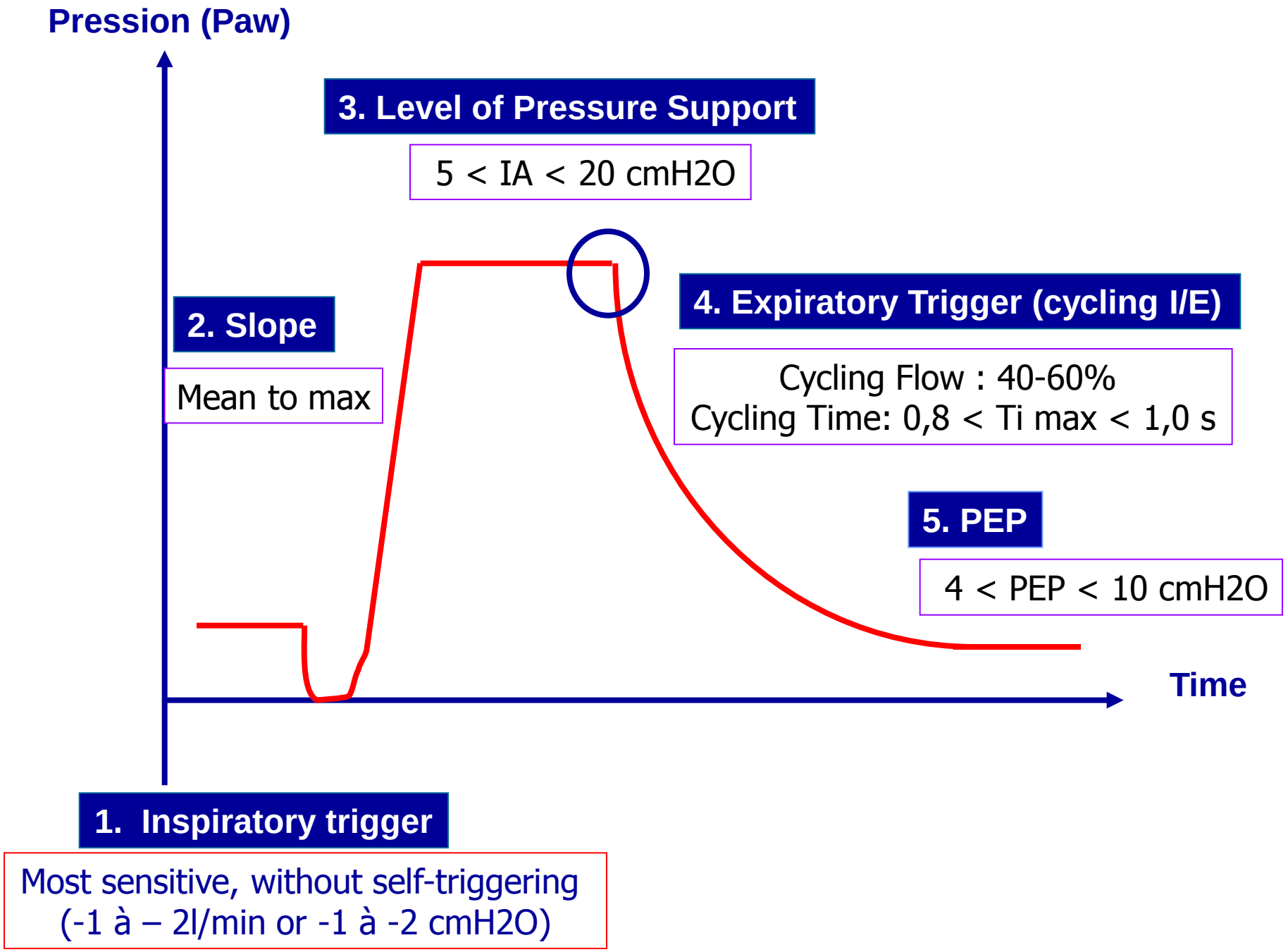
- Mode de ventilation à Débit limité
- Délivre une Pression inspiratoire jusqu'à ce que le débit max diminue à un pourcentage prédéterminé de sa Ppeak (souvent 25%)

- Réglages:
  - AI
  - Trigger
  - Débit inspiratoire
  - PEEP
  - FiO2

Pressure Support (PSV)

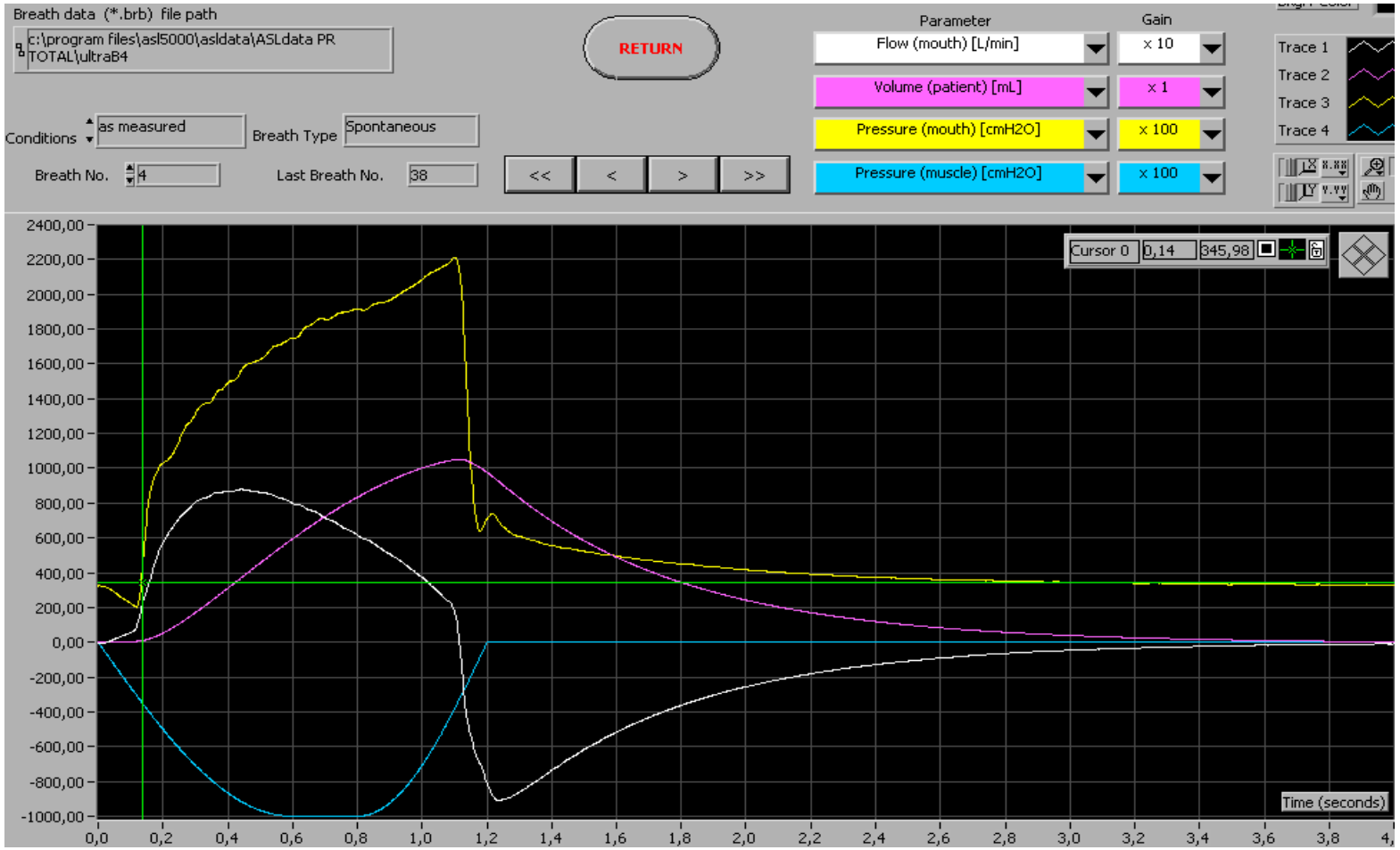
Breath	Trigger	Limit	Cycle
Supported	Pressure, Flow/Volume	Pressure	Flow

Control Variable: Pressure, Flow/Volume


Pression (Paw)
3. Level of Pressure Support
5 < IA < 20 cmH2O
2. Slope
Mean to max
4. Expiratory Trigger (cycling I/E)
Cycling Flow : 40-60%
Cycling Time: 0,8 < Ti max < 1,0 s
5. PEP
4 < PEP < 10 cmH2O
Time
1. Inspiratory trigger
Most sensitive, without self-triggering
(-1 à – 2l/min or -1 à -2 cmH2O)

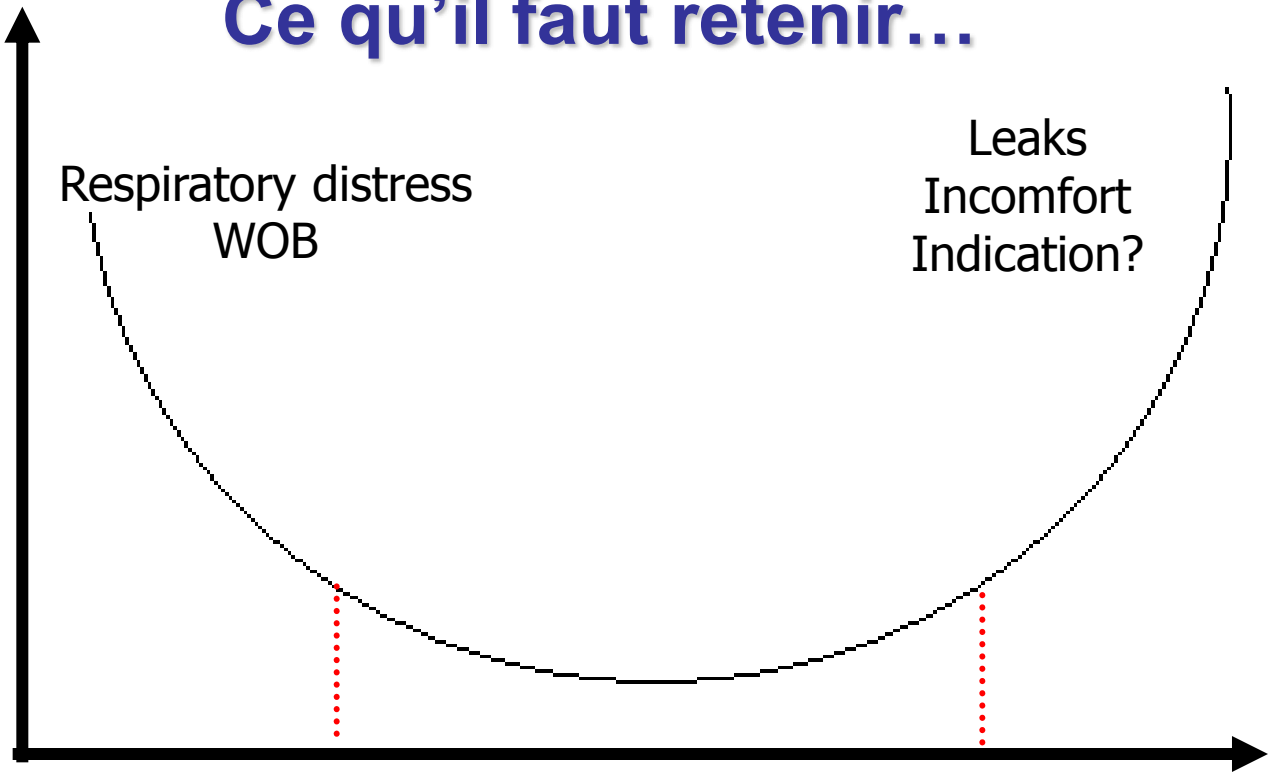
Aide Inspiratoire

Ce qu'il faut retenir…



Aide Inspiratoire

Ce qu'il faut retenir…

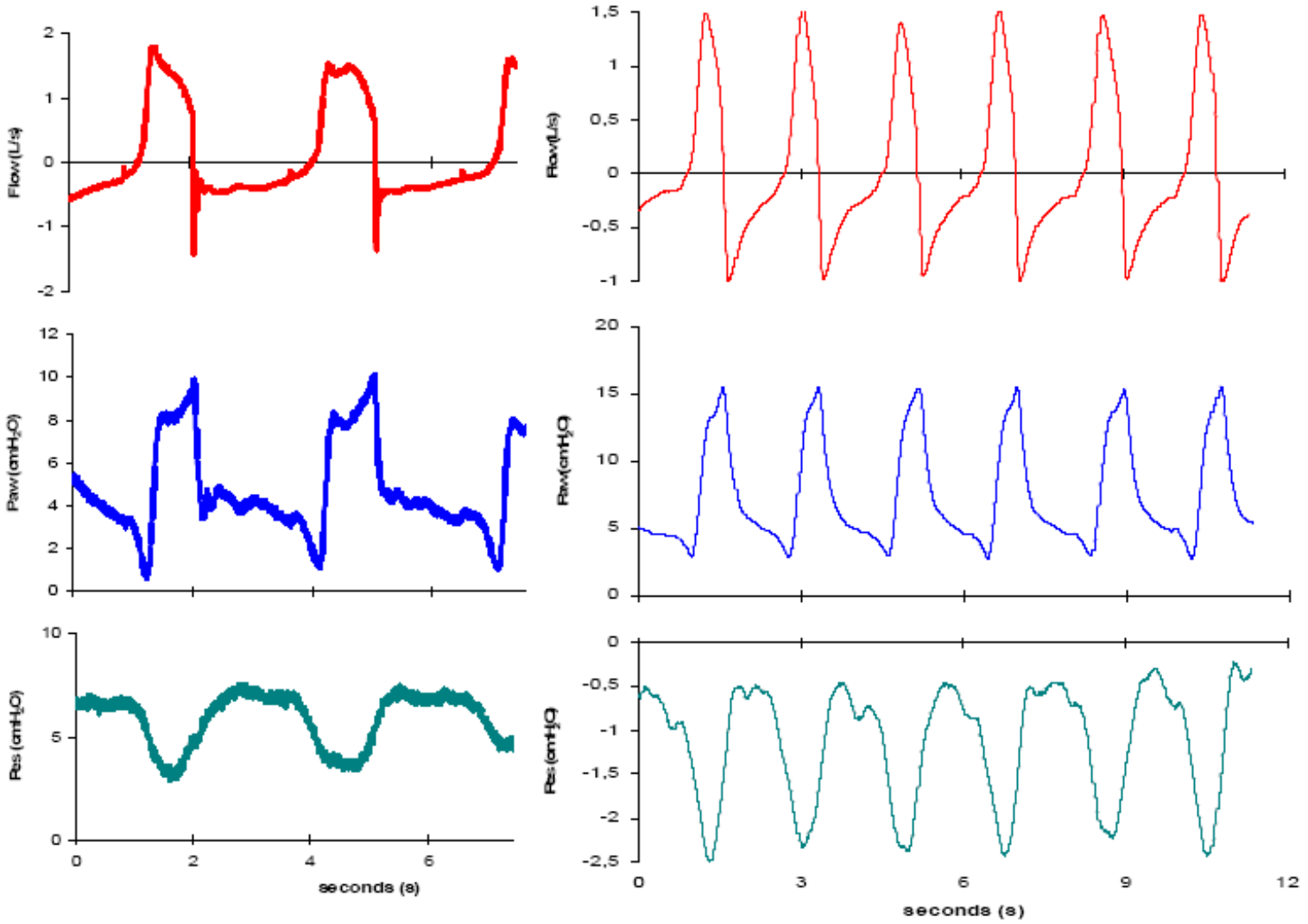


PS **5** ⟷ **20 cmH2O**

+

PEEP **5** ⟷ **10 cmH2O**

Total = PS+PEEP **10** ⟷ **25 cmH2O**



PS 0 **PS 15**

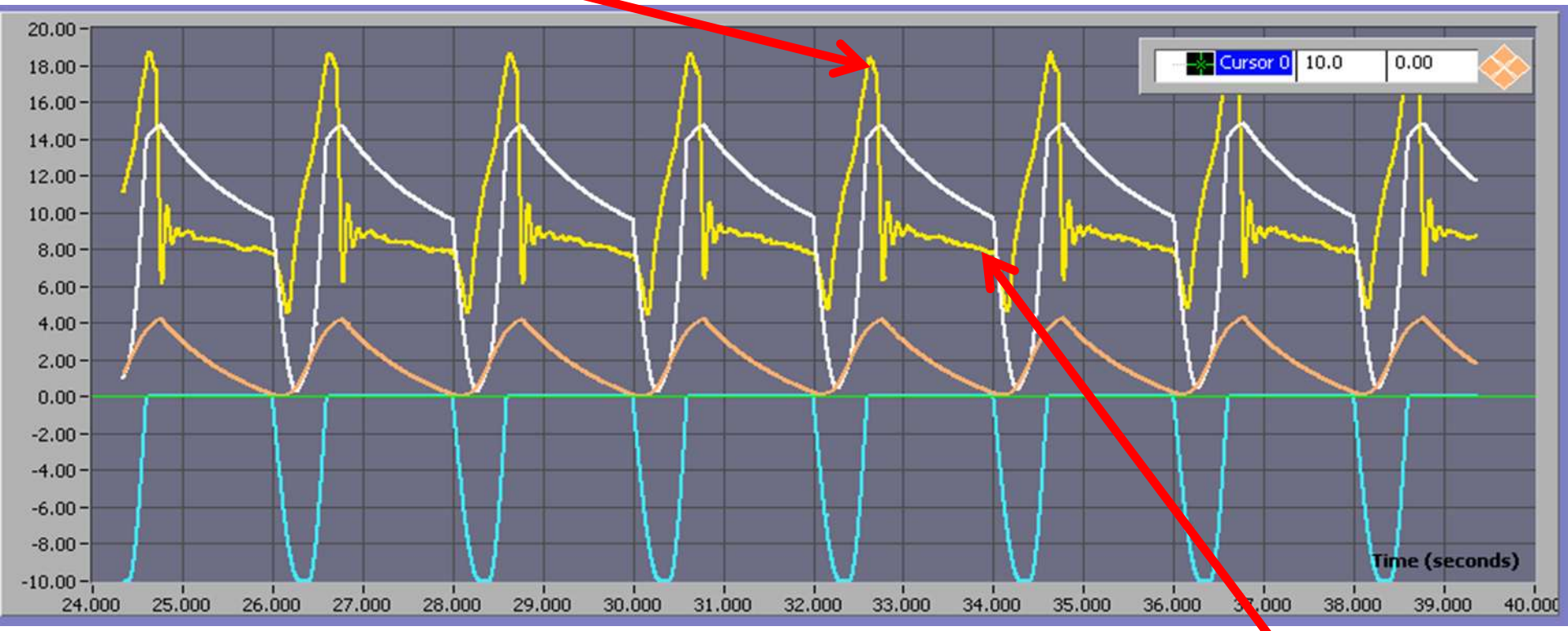
Brochard L et al. ARRD 1989; 139:513-521

Bilevel Positive Airway Pressure (BIPAP)

- Delivers a preset:
  - Inspiratory positive airway pressure (IPAP)
  - Expiratory positive airway pressure (EPAP)
- VT correlates with the difference between the IPAP and the EPAP
- Most BIPAP devices also permit a backup respiratory rate to be set

Bilevel Positive Airway Pressure (BIPAP)

IPAP = 18

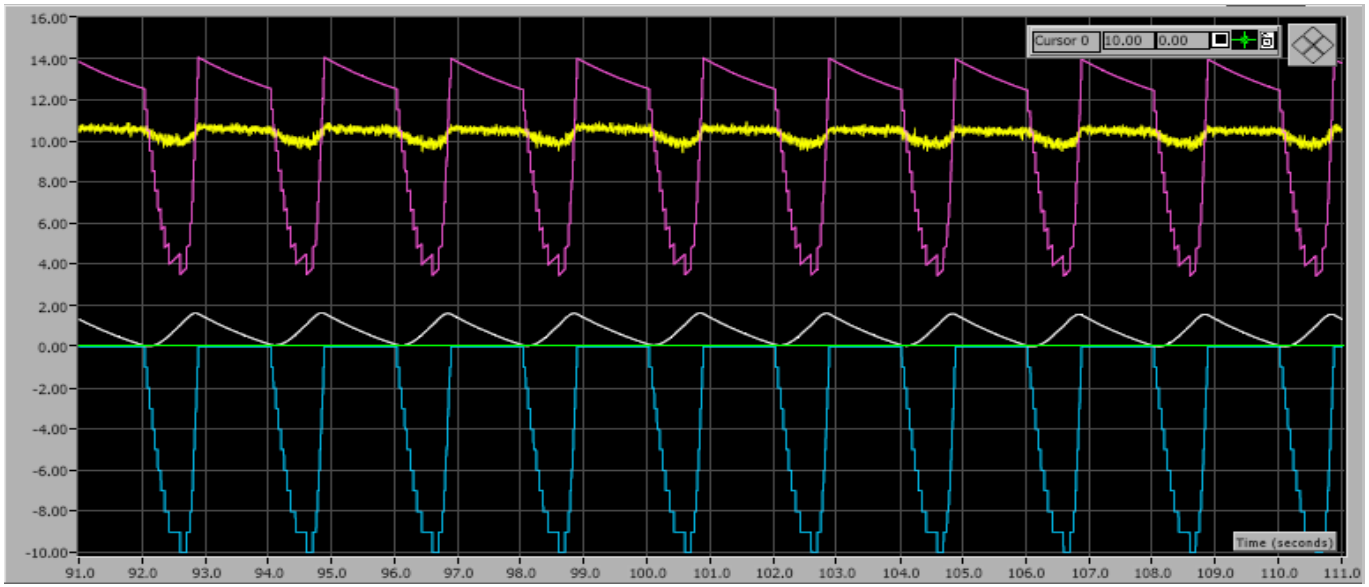


EPAP = 8

CPAP

Ventilator

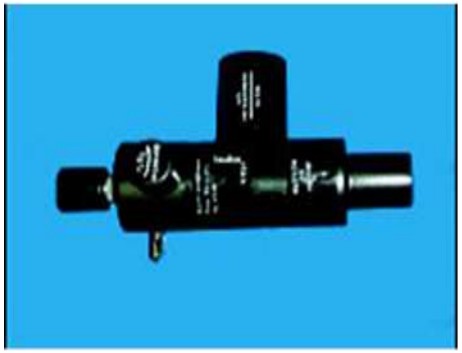
Continuous Flow Device



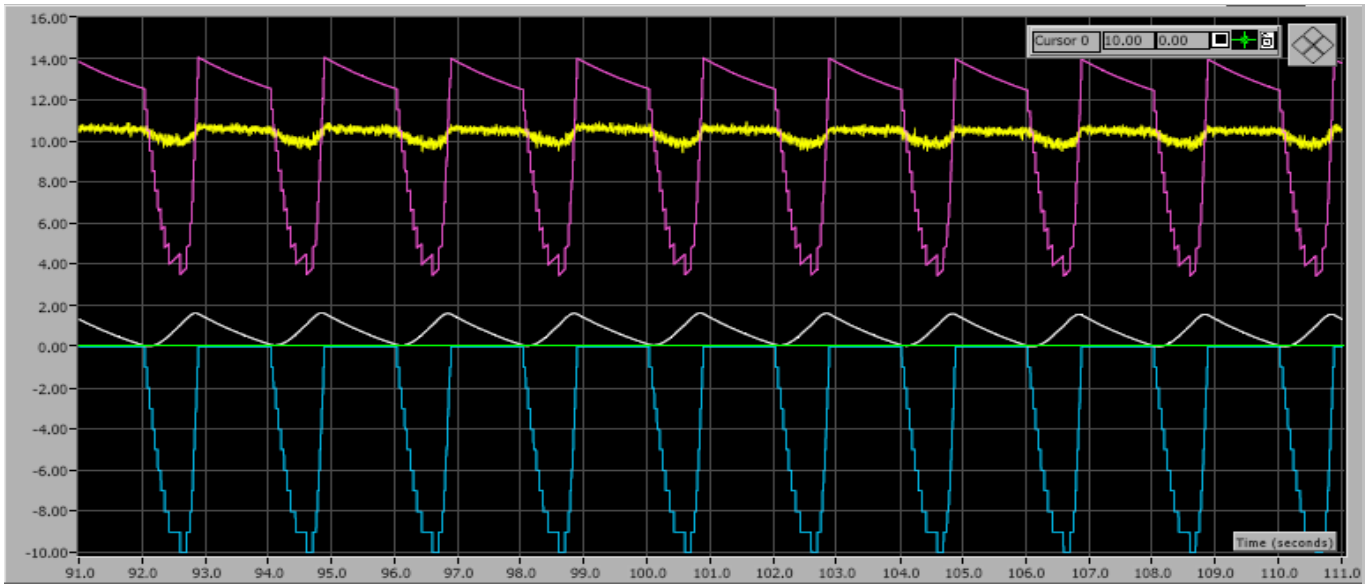
Dr A. Khoury

A. Khoury, EuSEM, Munich Sept 2008

CPAP



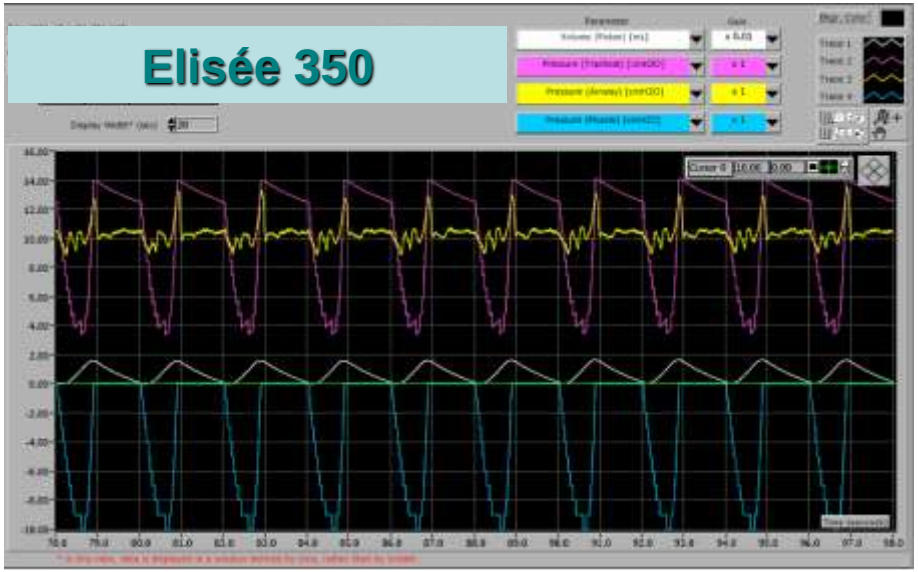
Continuous Flow Device

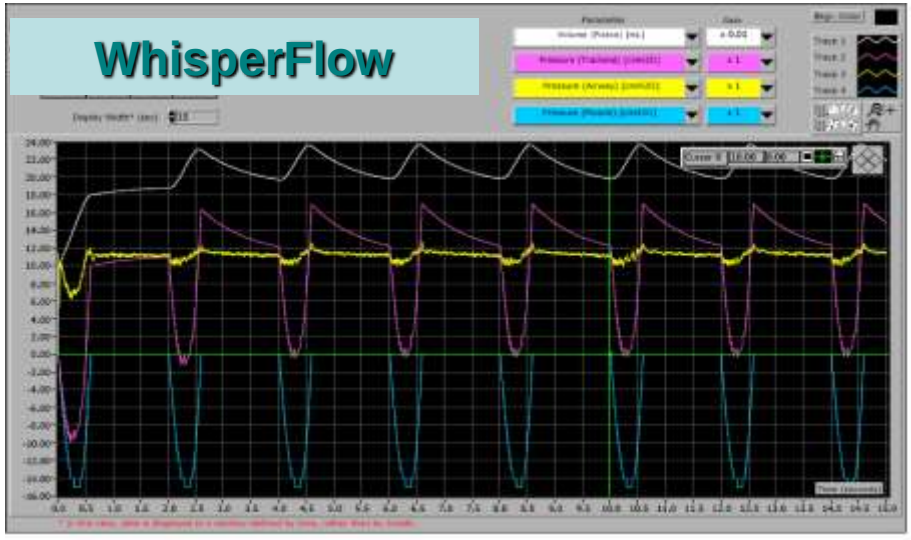


Dr A. Khoury

A. Khoury, EuSEM, Munich Sept 2008

Continuous Positive Airway Pressure CPAP





Dr A. Khoury

OAP Cardiogénique:

Aide Inspiratoire v/s CPAP

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).

Decreasing the intubation rate, the hospital mortality & the occurrence of MI

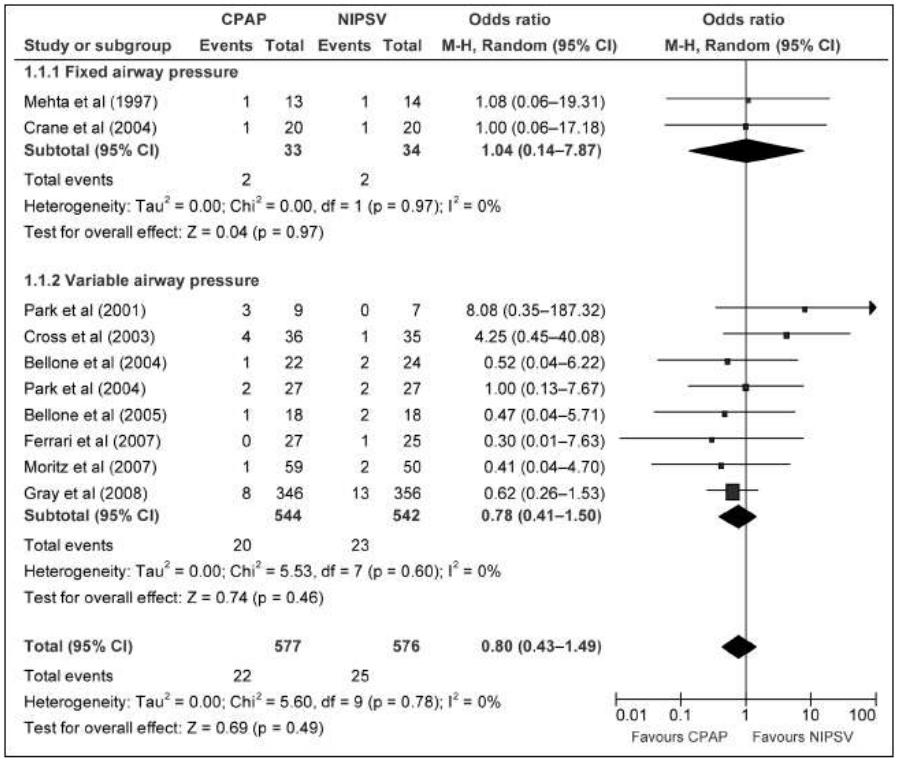
Agarwal R, Aggarwal A N, Gupta D, Singapore Med J 2009; 50(6) : 595

NIPSV as effective and safe as CPAP in CPE ?

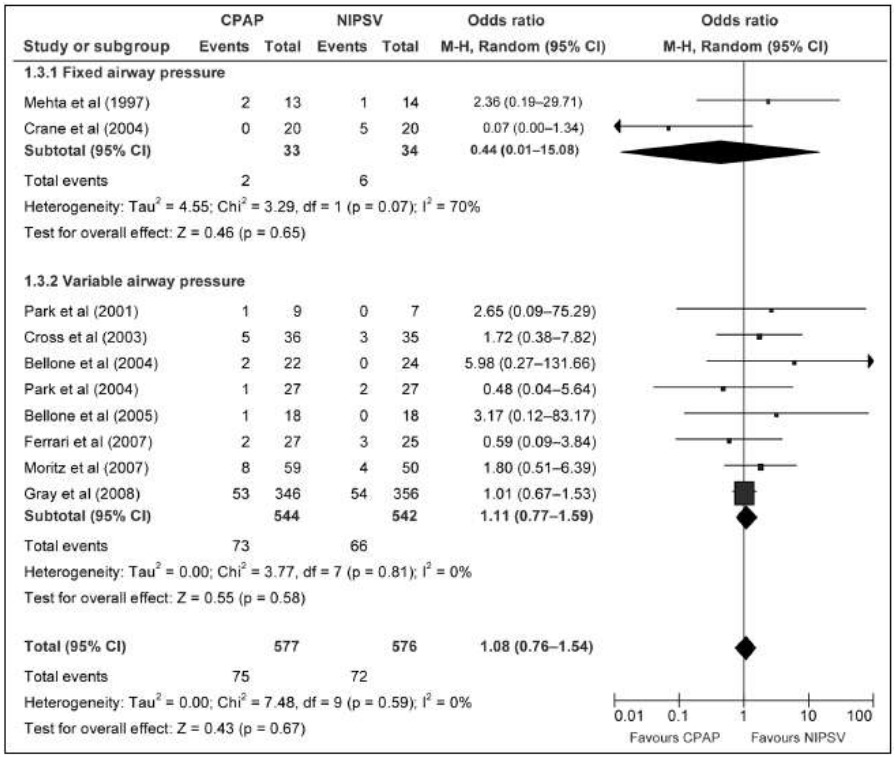
- Mehta S. Crit Care Med 1997; 25:620-8
- Park M. Arq Bras Cardiol 2001; 76:221-30
- Cross AM. Emerg Med J 2003; 20:531-4.
- Bellone A. Crit Care Med 2004; 32:1860-5
- Crane SD. Emerg Med J 2004; 21:155-61
- Park M. Crit Care Med 2004; 32:2407-15
- Bellone A. Intensive Care Med 2005; 31:807-11
- Ferrari G. Chest 2007; 132:1804-9
- Moritz F. Ann Emerg Med 2007; 50:666-75
- Gray A. N Engl J Med 2008; 359:142-51

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

NIPSV as effective and safe as CPAP in CPE ?



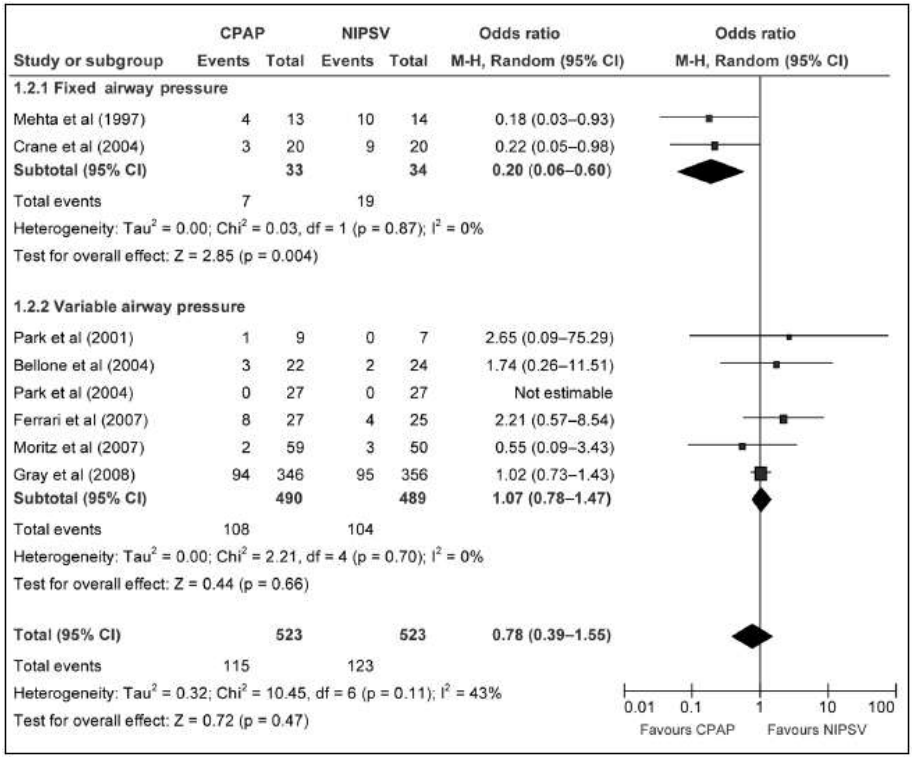
↓Intubation Rate



↓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 ?



Study or subgroup	CPAP Events	CPAP Total	NIPSV Events	NIPSV Total	Odds ratio M-H, Random (95% CI)
1.2.1 Fixed airway pressure					
Mehta et al (1997)	4	13	10	14	0.18 (0.03–0.93)
Crane et al (2004)	3	20	9	20	0.22 (0.05–0.98)
Subtotal (95% CI)		**33**		**34**	**0.20 (0.06–0.60)**
Total events	7		19		
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.03$, df = 1 (p = 0.87); $I^2 = 0\%$					
Test for overall effect: Z = 2.85 (p = 0.004)					
1.2.2 Variable airway pressure					
Park et al (2001)	1	9	0	7	2.65 (0.09–75.29)
Bellone et al (2004)	3	22	2	24	1.74 (0.26–11.51)
Park et al (2004)	0	27	0	27	Not estimable
Ferrari et al (2007)	8	27	4	25	2.21 (0.57–8.54)
Moritz et al (2007)	2	59	3	50	0.55 (0.09–3.43)
Gray et al (2008)	94	346	95	356	1.02 (0.73–1.43)
Subtotal (95% CI)		**490**		**489**	**1.07 (0.78–1.47)**
Total events	108		104		
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 2.21$, df = 4 (p = 0.70); $I^2 = 0\%$					
Test for overall effect: Z = 0.44 (p = 0.66)					
Total (95% CI)		**523**		**523**	**0.78 (0.39–1.55)**
Total events	115		123		
Heterogeneity: $Tau^2 = 0.32$; $Chi^2 = 10.45$, df = 6 (p = 0.11); $I^2 = 43\%$					
Test for overall effect: Z = 0.72 (p = 0.47)					

Myocardial Infarction

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

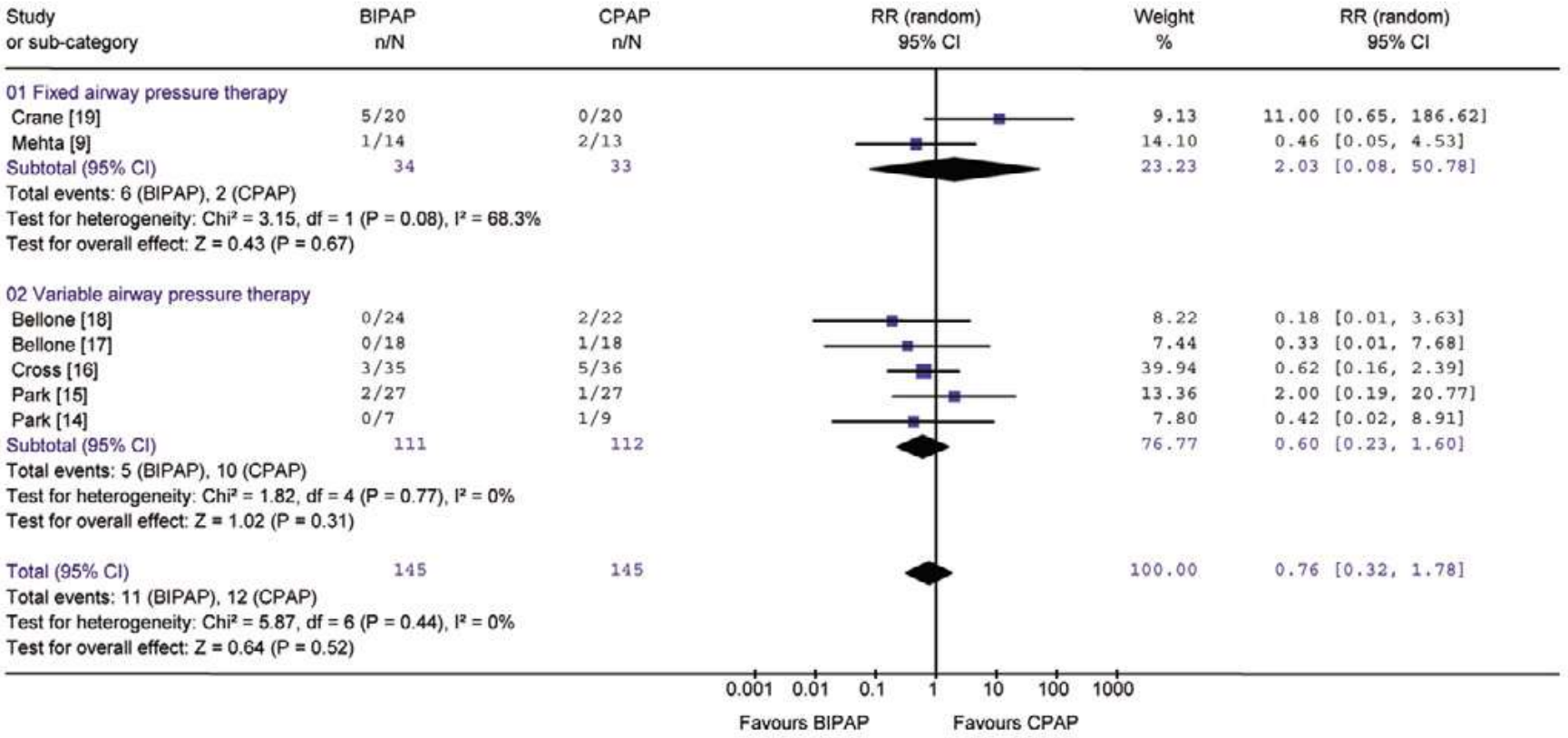
Comparison between CPAP & BIPAP in ACPE

- Medline, Embase & cochrane randomised Clinical trials from 1966 till end nov 2005
- 7 studies
- 290 patients
- Decreasing the intubation rate, the hospital mortality & the occurrence of MI

Kwok M Ho and Karen Wong, Critical Care 2006, 10:R49

Comparison between CPAP & BIPAP in ACPE

CRITICAL CARE IMPACT FACTOR 4.55

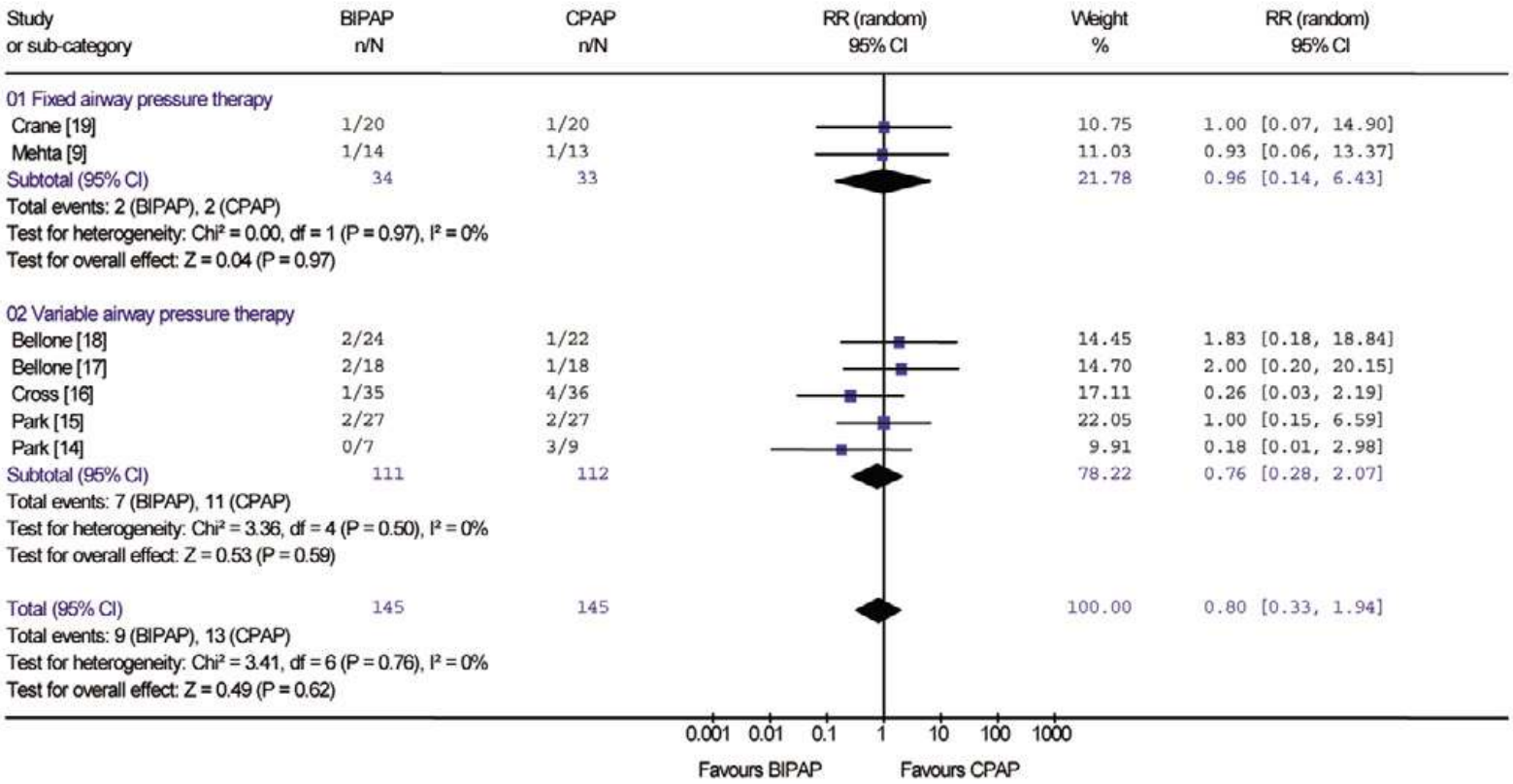


↓Hospital Mortality

Kwok M Ho and Karen Wong, Critical Care 2006, 10:R49

Comparison between CPAP & BIPAP in ACPE

CRITICAL CARE IMPACT FACTOR 4.55

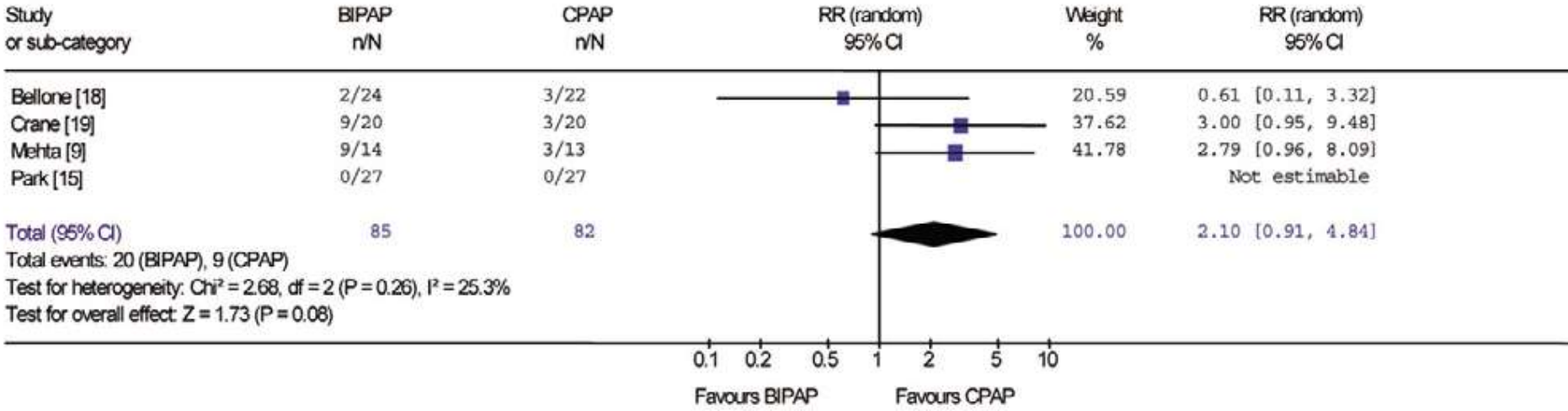


Invasive Mechanical Ventilation

Kwok M Ho and Karen Wong, Critical Care 2006, 10:R49

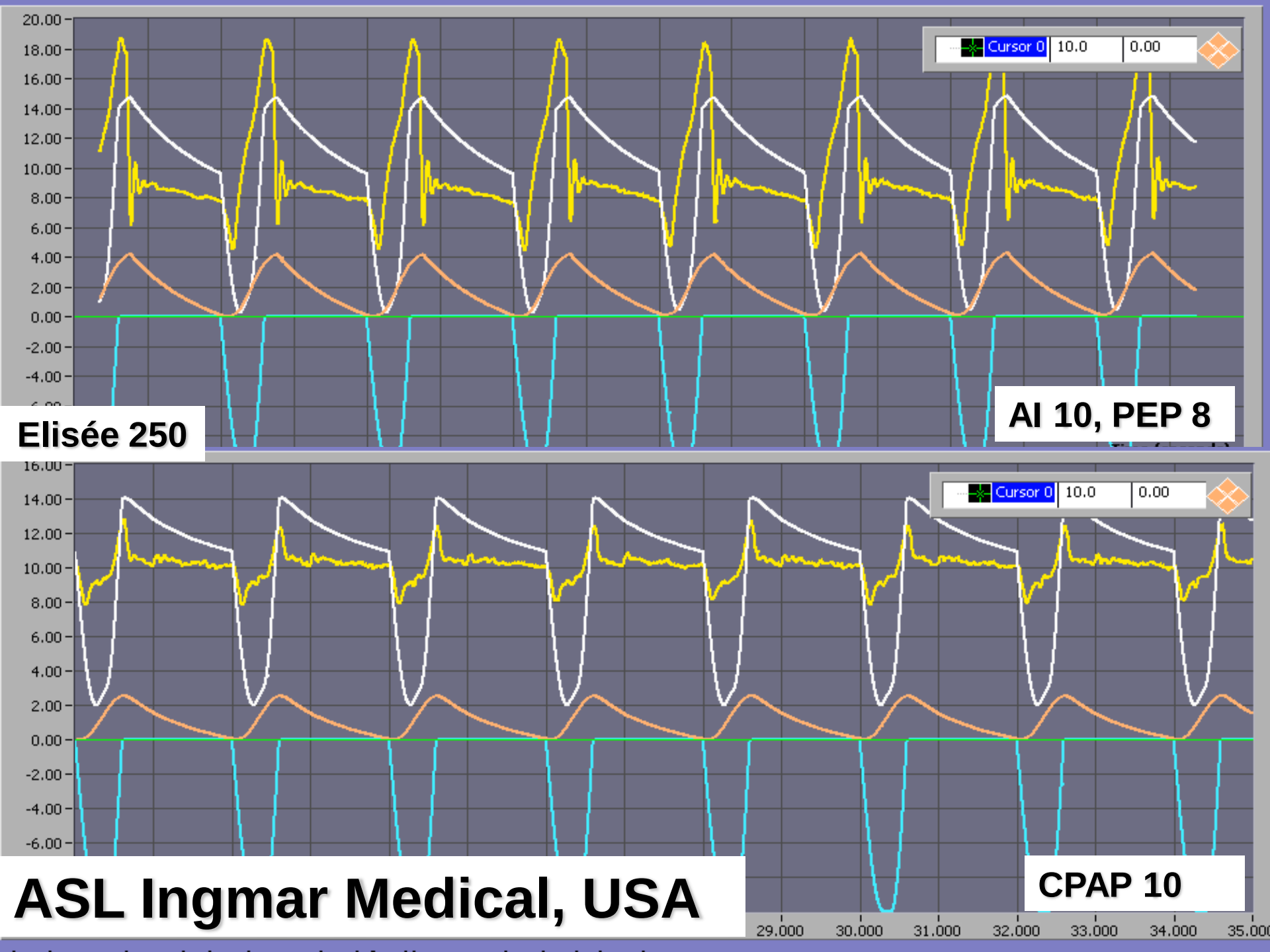
Comparison between CPAP & BIPAP in ACPE

CRITICAL CARE IMPACT FACTOR 4.55



Myocardial Infarction

Kwok M Ho and Karen Wong, Critical Care 2006, 10:R49


Cursor 0
10.0
0.00
Elisée 250
AI 10, PEP 8
Cursor 0
10.0
0.00
ASL Ingmar Medical, USA
CPAP 10
29.000
30.000
31.000
32.000
33.000
34.000
35.000

Quel Circuit?

Patient

Circuit

Respiratory Device

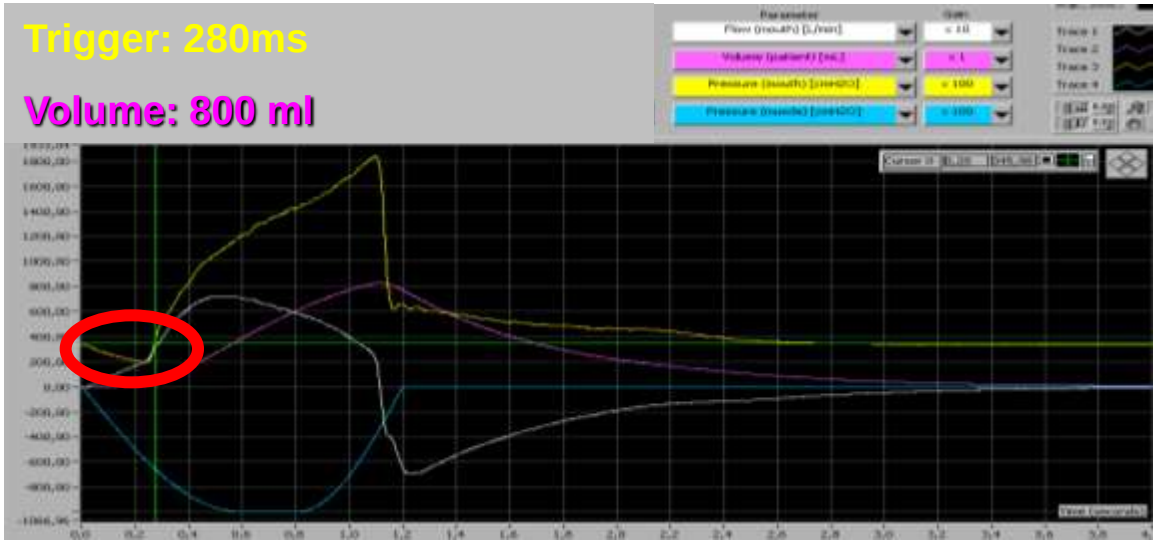
Quel Circuit?

PS **BIPAP**

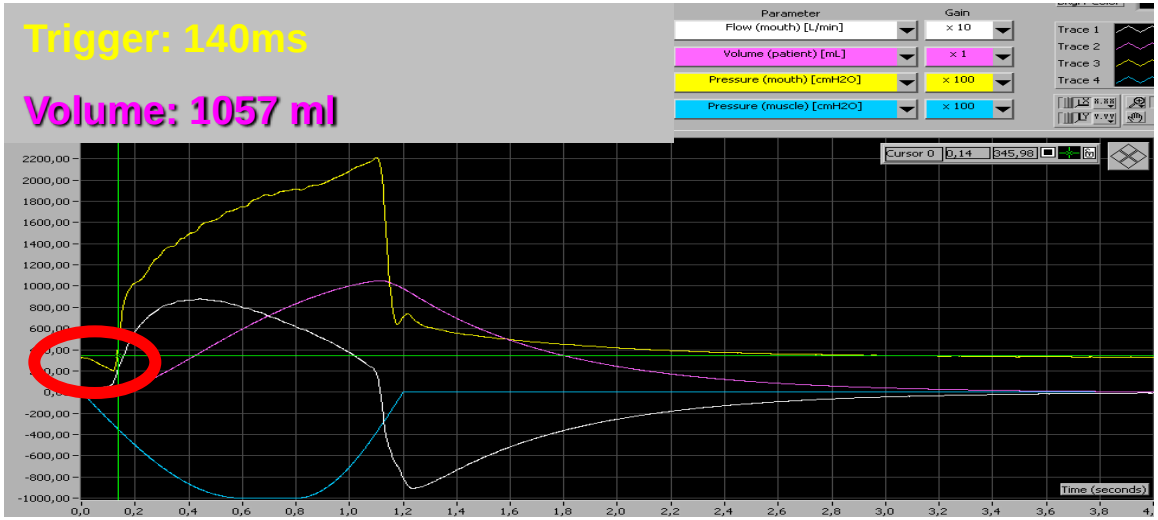
	Valve	Leakage	p
T Trg msec	226 ±162	347±107	$< 10^{-6}$
P min Trg cm H2O	-1,35±0,28	-0,96±0,2	$<10^{-6}$
PTP Trigger	141±123	198±55	$< 10^{-3}$
Tinsp msec	1±0,2	1±0,2	NS
VT insp ml	723±227	562±155	$< 10^{-6}$
T 90% PEP msec	138±197	146±304	NS

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

BIPAP (leakage)



PPSV (valves)



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

Quelle Interface

Patient | Interface | Circuit | Respiratory Device

Quelle Interface

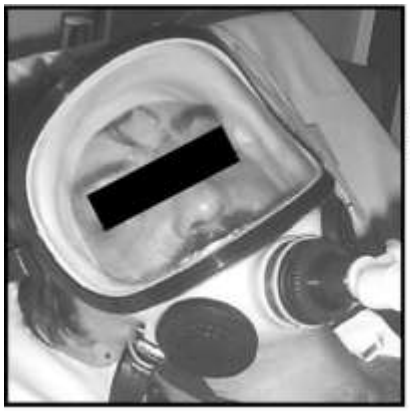
Explain the process & present the equipment

Stay with the patient the first minutes

Make the patient participate in the positioning of the mask
Explain that we can always take it out or change it

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 oro-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

Where?

- Monitoring Available !! especially the first hour
- Repeated RR, HR, BP, SpO2

- ABGs (systematically after one hour of initiation)

- Monitoring of the **expired VT ++++**

- Detect Leakage & asynchronie

Where?

- Dedicated personnel
- Specific Training of the team +++ (RN, Physiotherapist…)
- Clear guidelines for implementing NIV
- Key determinant in success

Possible in ED ???

Aux Urgences…

Several patients

Not enough personnel

Quick Turnover

Dr A. Khoury

Aux Urgences…

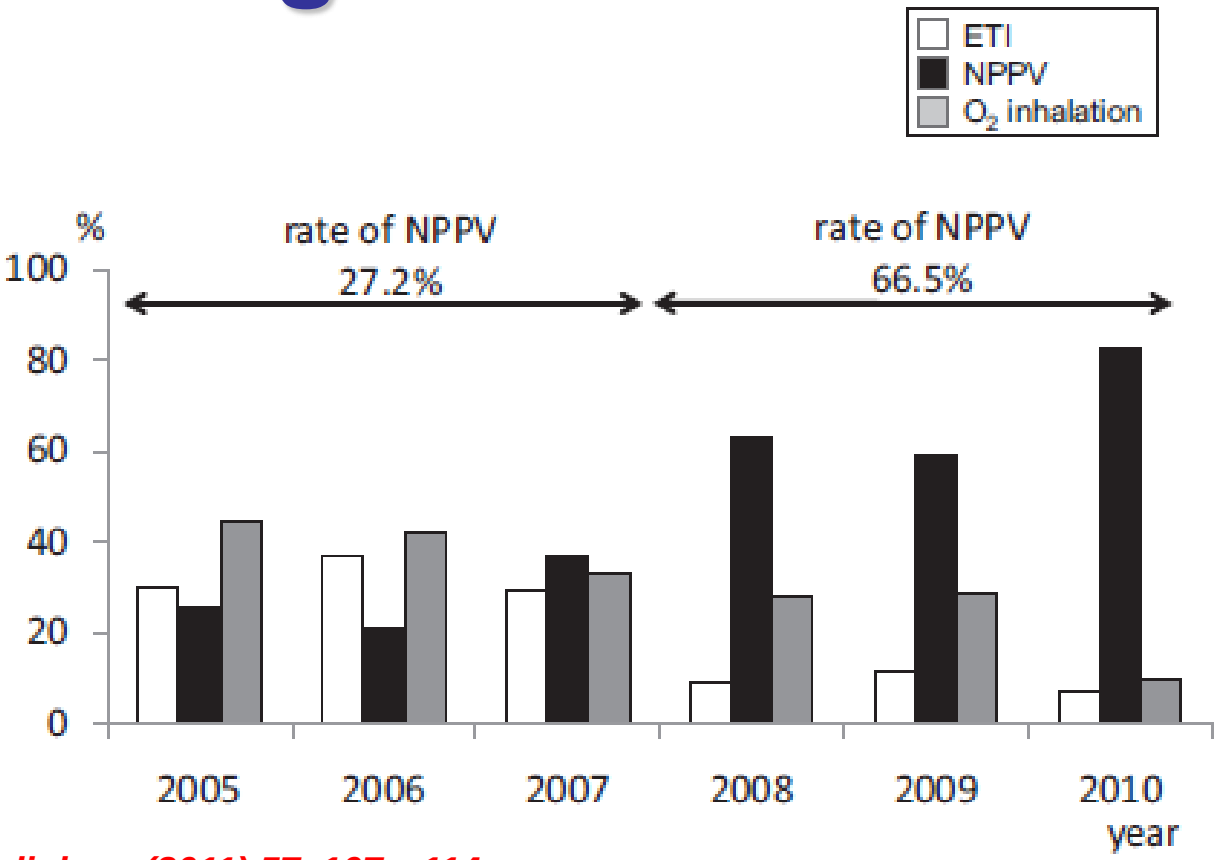
- **Yes but…**
- By whom ?

- Experienced physicians
- Work load in ED
- Adapted environment & structure
- Good quality Ventilators

Aux Urgences…

- **Yes !!!!**

Heart Failure

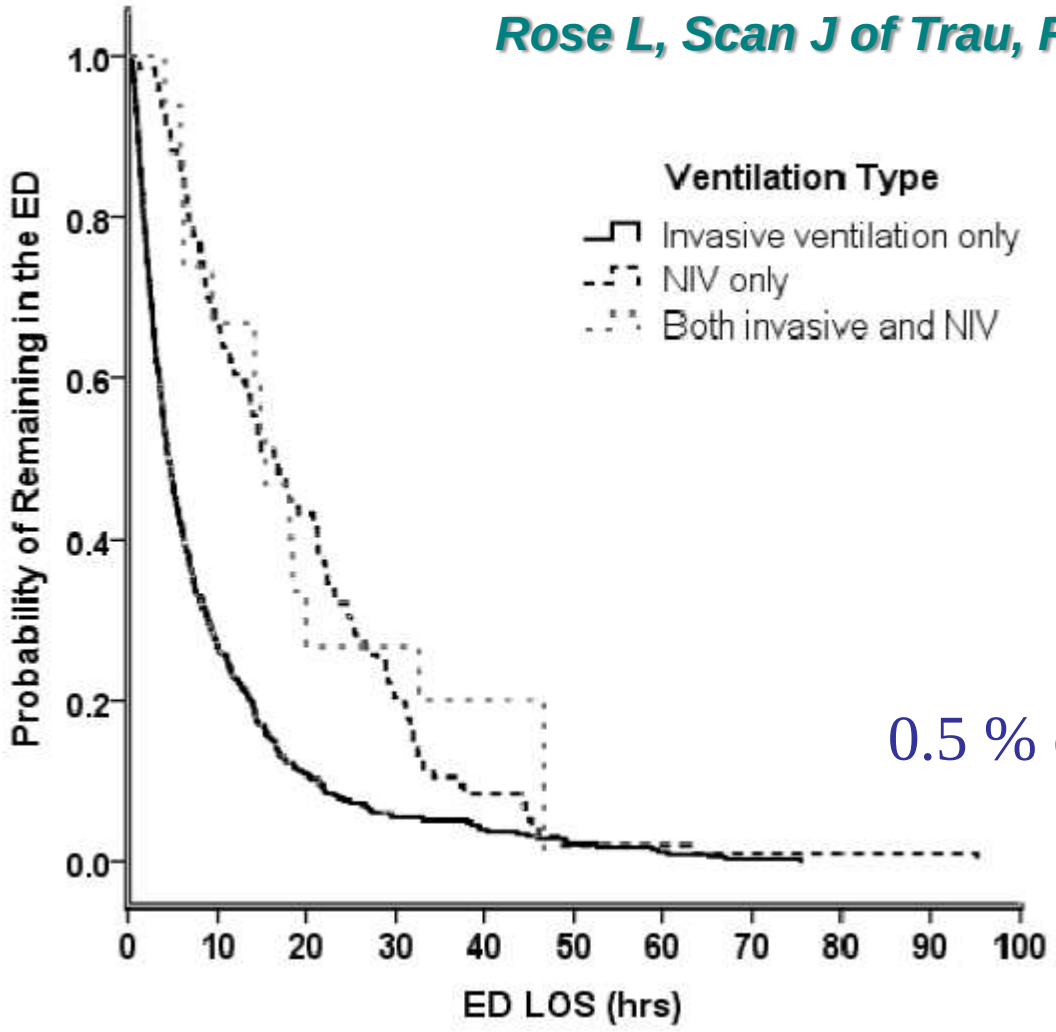


Akihiro Shirakabe, Journal of Cardiology (2011) 57, 107—114

Emergency department length of stay for patients requiring mechanical ventilation: a prospective observational study

SCANDINAVIAN JOURNAL OF trauma, resuscitation & emergency medicine

Rose L, Scan J of Trau, Resuscitation and EM 2012,20:30



618 patients
484 (78.3 %) IV
118 (19.1 %) NIV;
16 (2.6 %) NIV + IV
0.5 % of the 135,352 patients at ED

Aux Urgences…

SAUV

Dedicated Area in the ED

Dedicated personnel

Pre hospital ?

Author	No of patients	Study design	Mode of NIV	Primary outcome	Secondary outcomes
Thompson 2008[3]	71	RCT	CPAP	Rate of intubation	Inhospital mortality Hospital LOS CCU LOS Changes in physiological variables
Weitz 2007[2]	23	RCT	Bi-level NIV	Oxygen saturation improvement	Inhospital mortality Dyspnoea score Changes in physiological variables
Plaisance 2007[4]	124	RCT	CPAP	Patient-reported dyspnoea score	Inhospital mortality Need for inotropic support Intubation Changes in physiological variables
Hubble 2006[6]	215	Prospective parallel cohort study	CPAP	Rate of intubation	Inhospital mortality Changes in physiological variables Hospital LOS
Foti 2009[5]	121	Non-parallel prospective cohort study	CPAP	Improvement in physiological variables	ICU admission Inhospital mortality Intubation Changes in physiological variables
Kosowsky 2001[10]	19	Prospective case series	CPAP	Feasibility	Intubation Changes in physiological variables
Kallio 2003[9]	121	Retrospective case series	CPAP	Oxygen saturation improvement	Intubation Mortality Changes in physiological variables
Dieperink 2009[12]	32	Prospective case series	CPAP	Oxygen saturation improvement	Patient-reported experience with CPAP Clinician experience with CPAP
Templier 2003[11]	50	Prospective case series	CPAP	Technical feasibility	N/A
Taylor 2008[14]	264	Retrospective observational study	N/A	No of patients who could potentially benefit from prehospital NIV	Effectiveness of existing paramedic treatment regimes Paramedic management times
Bruge 2008[8]	138	Prospective case series	Bi-level NIV	Failure rate of bi-level NIV therapy (defined as the need for inhospital or out-of-hospital endotracheal intubation)	Arterial blood gases No of inhospital days on bi-level NIV No of deaths
Hubble 2008[13]	N/A	Economic model of cost effectiveness	N/A	N/A	N/A

ACPO, acute cardiogenic pulmonary oedema; CCU, critical care unit; CPAP, continuous positive airway pressure; ICU, intensive care unit; LOS, length of stay; NIV, non-invasive ventilation; RCT, randomised controlled trial.

Simpson P, Emerg Med J 2011;28:609-612

Pre hospital ?

NIV for ACPO

- Some evidence in significant improvements in shortterm mortality.
- Good evidence decrease the need for endotracheal intubation.
- Early NIV before arrival at the ED does improve acute in regard to decreases in patient-reported dyspnoea and improvements in vital signs.
- A large RCT powered to detect a meaningful difference in mortality is required

Simpson P, Emerg Med J 2011;28:609-612

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

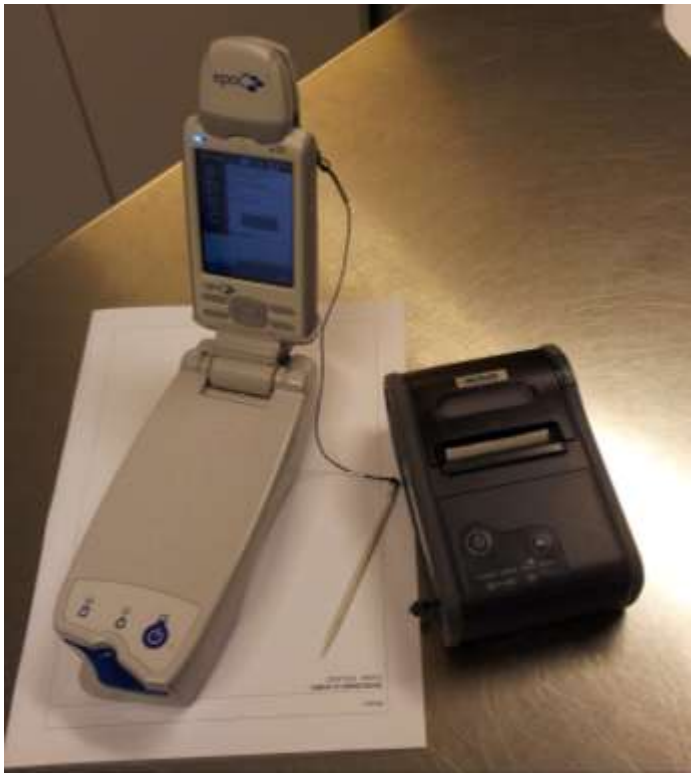
Pre hospital ?

Mobile Intensive Care Unit (SAMU)

- Dedicated Personnel
- Trained

- Indications

- Lab facilities (EPOC)



Pre hospital ?

CPAP Devices

- **Boussignac® (Vygon)**
- **CPAP Systems (Vital Signs, inc)**
- **WhisperFlow® (Respironics)**

Pre hospital ?

Weinmann medumat

Monnal T 60

Elisée 250

Hamilton T1

Oxylog 3000

In practical

- Know the **indications**
- Baseline clinical and **ABG's** parameters
- Careful setting of the Ventilator
- **Reassess** the patient and modify settings if required (trigger +++)
- Repeat clinical assessment and **blood gas** analysis at 1hour

Conclusion

- Oui c'est possible aux urgences
- Il faut avoir l'expertise et le temps dans une zone dédiée

- BPCO & OAP cardiogénique >> indications ++++

- Le plus tôt c'est instauré, le mieux est le résultat
- Impact la survie au long cours

- **Ne pas s'acharner !!!!!!!!**

Thank you for your attention…

Acknowledgement:

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