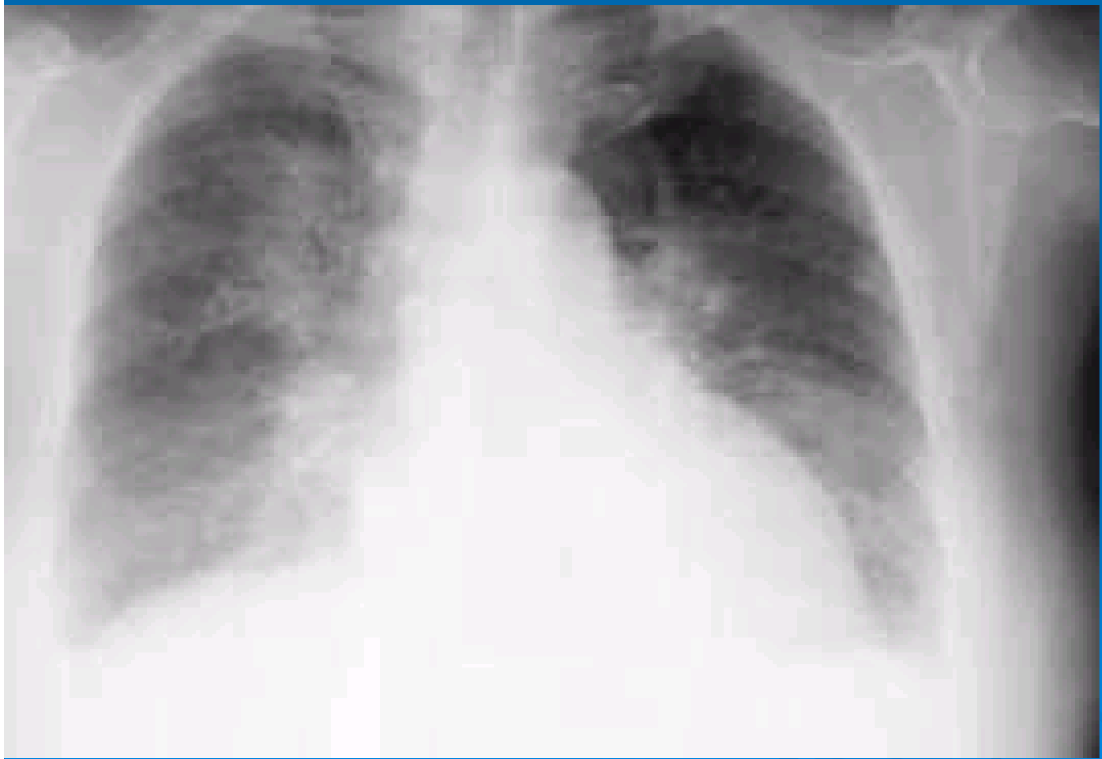
ΑΘΗΝΑ 2011

ΚΑΡΔΙΟΓΕΝΕΣ ΠΝΕΥΜΟΝΙΚΟ ΟΙΔΗΜΑ :

ΜΗΧΑΝΙΚΗ ΥΠΟΣΤΗΡΙΞΗ ΤΗΣ ΑΝΑΠΝΟΗΣ



Ε ΖΑΚΥΝΘΙΝΟΣ
ΚΛΙΝΙΚΗ ΕΝΤΑΤΙΚΗΣ ΘΕΡΑΠΕΙΑΣ
ΠΑΝΕΠΙΣΤΗΜΙΑΚΟ ΝΟΣΟΚΟΜΕΙΟ ΛΑΡΙΣΑΣ

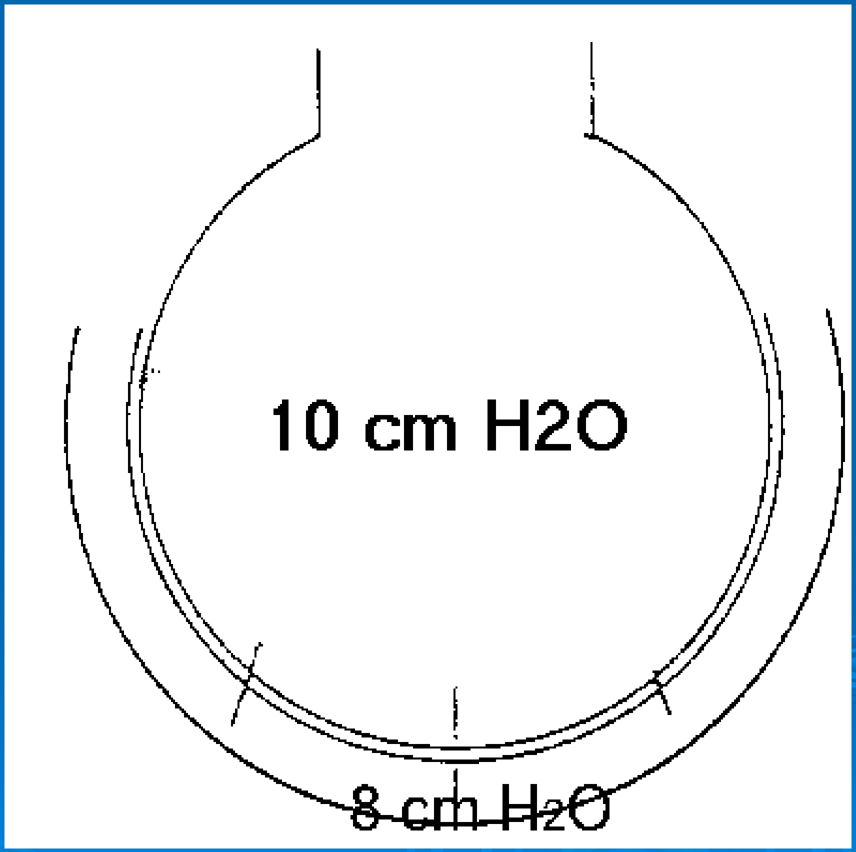
Acute Pulmonary Edema

a true life-threatening emergency

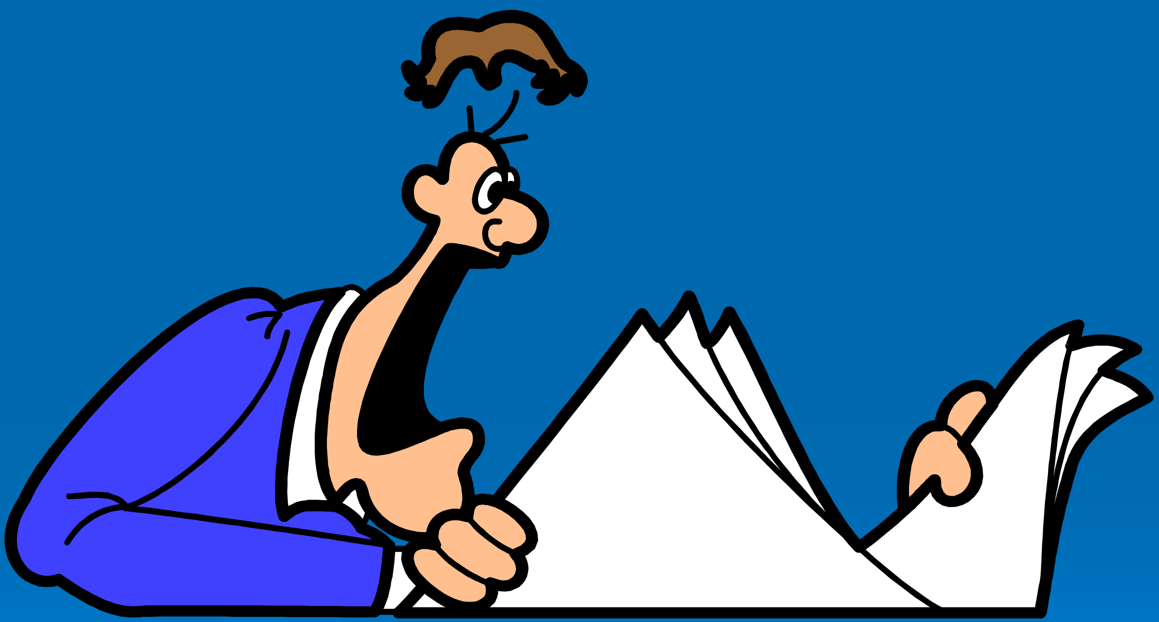
Non invasive ventilation

CPAP Mechanism

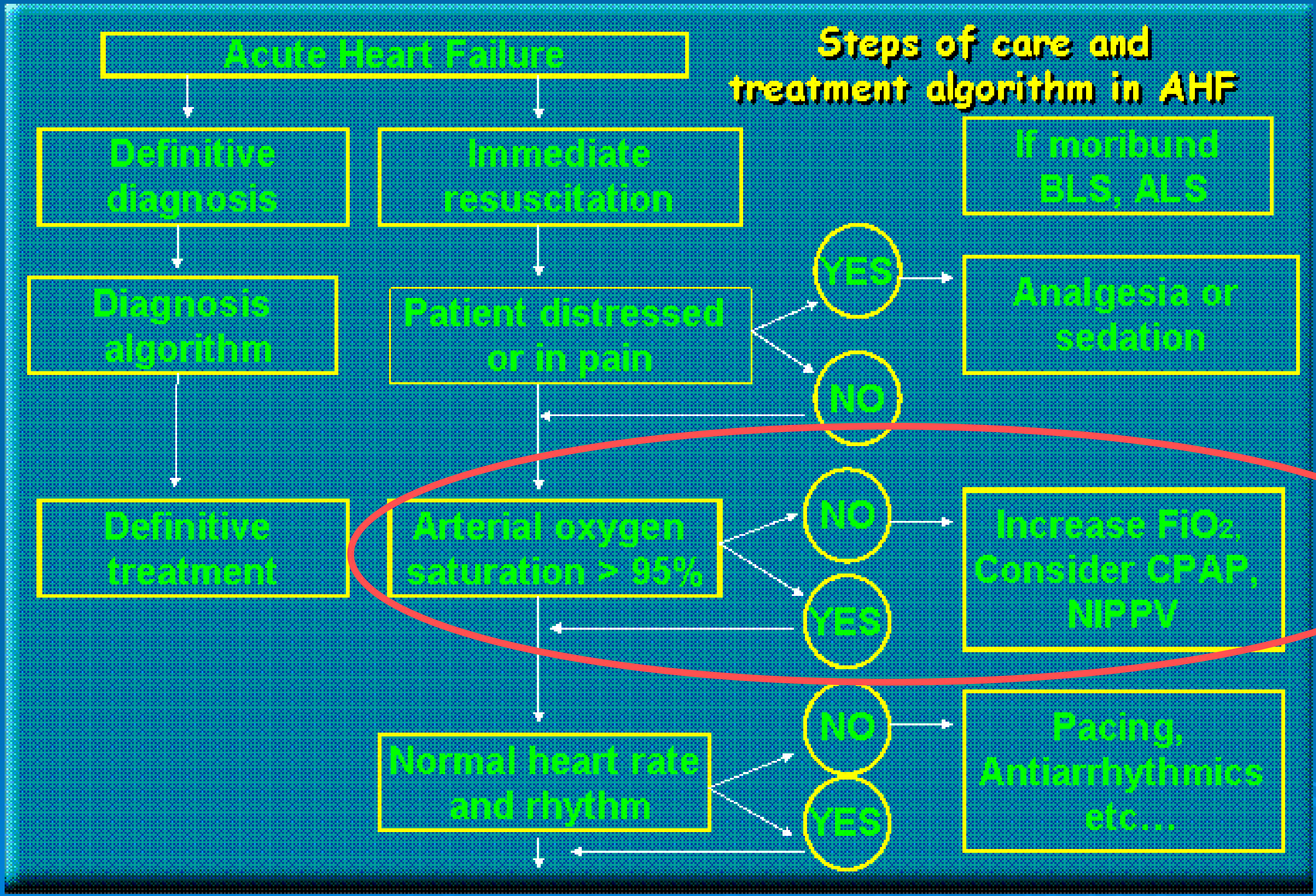
- Increases pressure within airway.
- Airways at risk for collapse from excess fluid are stented open.
- Gas exchange is maintained
- Increased work of breathing is minimized



ESC GUIDELINES, 2005



ESC GUIDELINES, 2005



http://www.escardio.org/knowledge/guidelines/guidelines_list.htm

POSITIVE PRESSURE VENTILATION: WHAT TELL US THE PHYSIOLOGY AND THE PATHOPHYSIOLOGY ?

EXPERIMENTALLY OR IN THE HEALTHY VOLUNTEER,

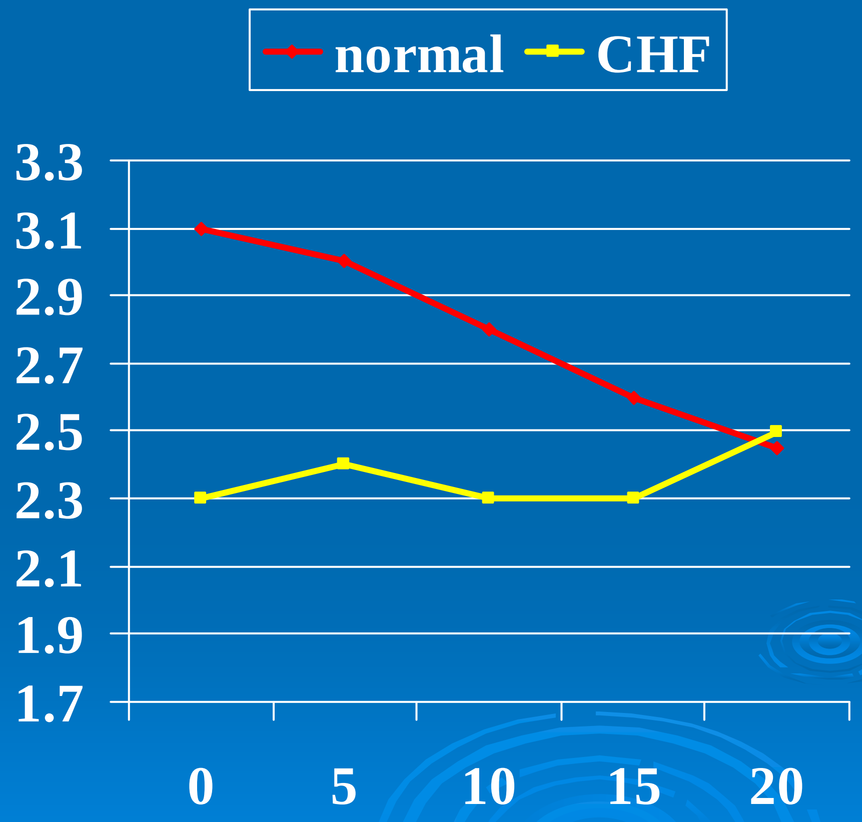
- **INTRATHORACIC PRESSURE** ⬆
- **VENOUS RETURN** ⬇
- **ENDDIASTOLIC FILLING PRESSURES** ⬇
- **STROKE VOLUME** ⬇
- **MYOCARDIAL OXYGEN CONSUMPTION** ⬇
- **CARDIAC WORK** ⬇

UNDER POSITIVE PRESSURE VENTILATION

Peters J et al. J Appl Physiol 1988;64:1518-26

Haemodynamic effect of CPAP in healthy volunteers / pts with congestive cardiac failure

- **Effects of CPAP on cardiac index**
  - **12 patients with normal left ventricular function and CI ≥ 2.5 L/min/m²**
  - **12 patients with chronic congestive cardiac failure and CI ≤ 2.5 L/min/m²**



Kotanidou A et al. J Crit Care 1997;12:101-11

Pathophysiology

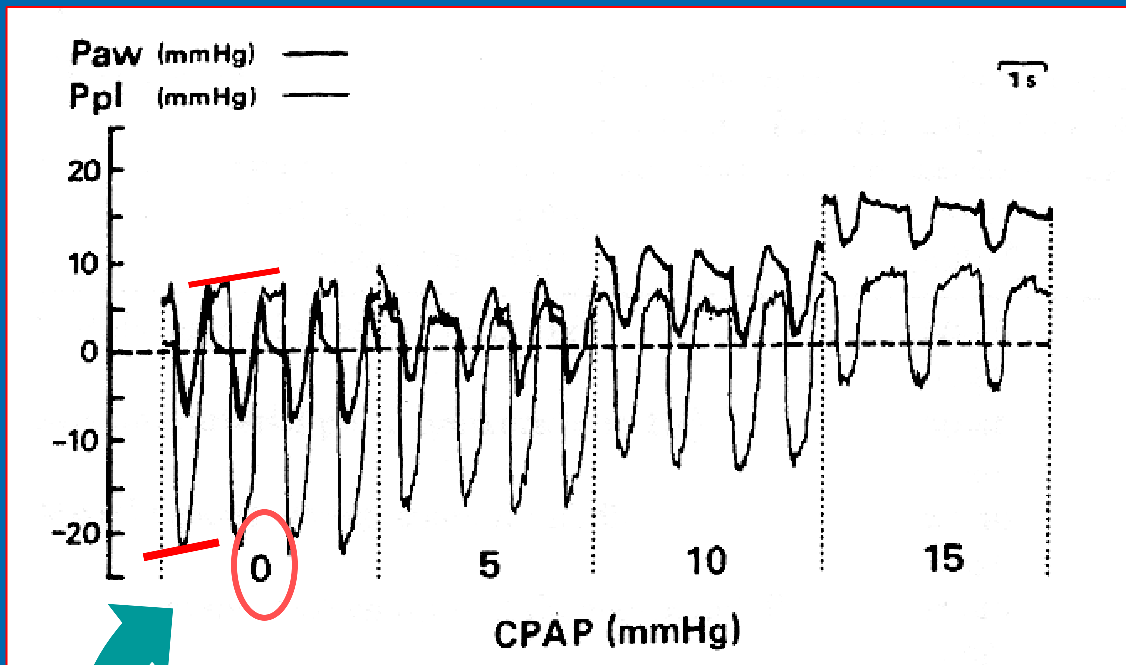
RESULTS:

- INCREASED PULMONARY CAPILLARY PRESSURES
- PULMONARY FLUID TRANSUDATION
- INCREASED PAP, DECREASED COMPLIANCE, BRONCHOSPASM

↑Elastic work (stiff lungs)

↑Resistive work (airway obstruction)

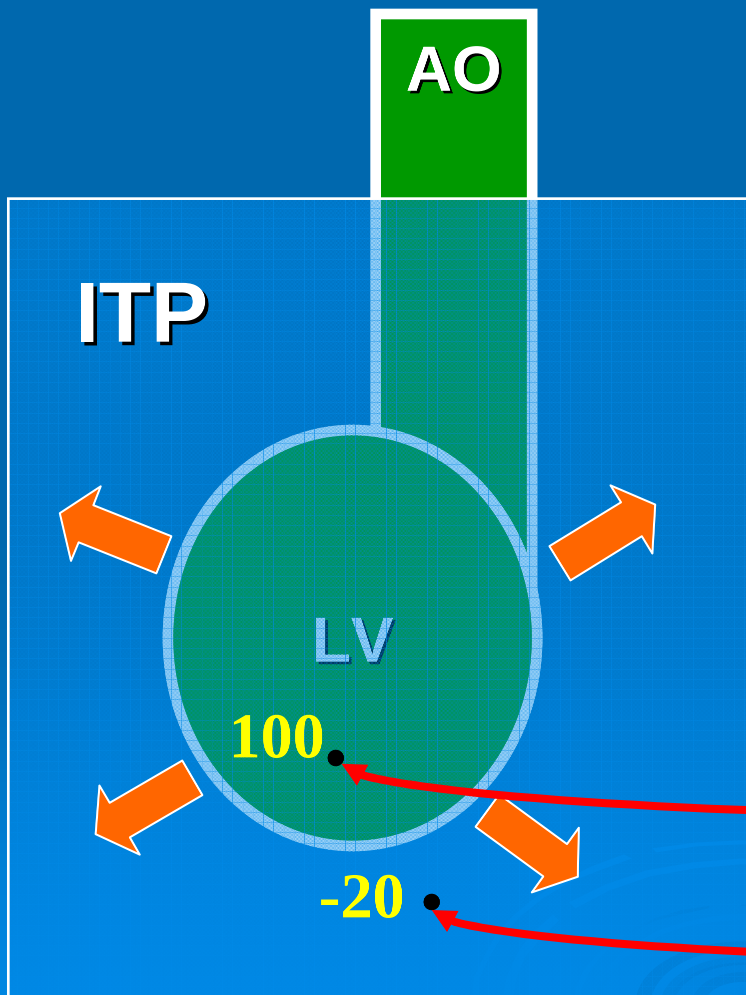
CPAP IN CARDIOGENIC PULMONARY EDEMA



Spontaneous ventilation, without CPAP

Räsänen J et al. Chest 1985, 87:158-162

Intrathoracic Pressures and LV Function: spontaneous ventilation without CPAP



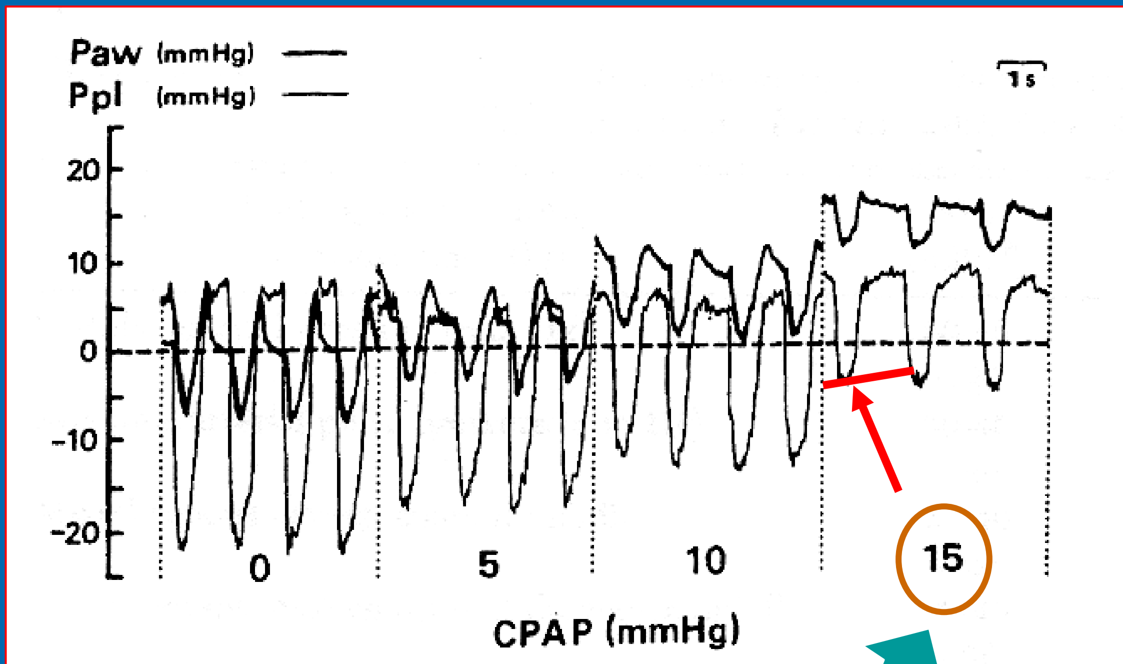
Ptm = 100-(-20) = 120 mmHg

↑ effort = ↓ ITP = ↑Ptm

↓

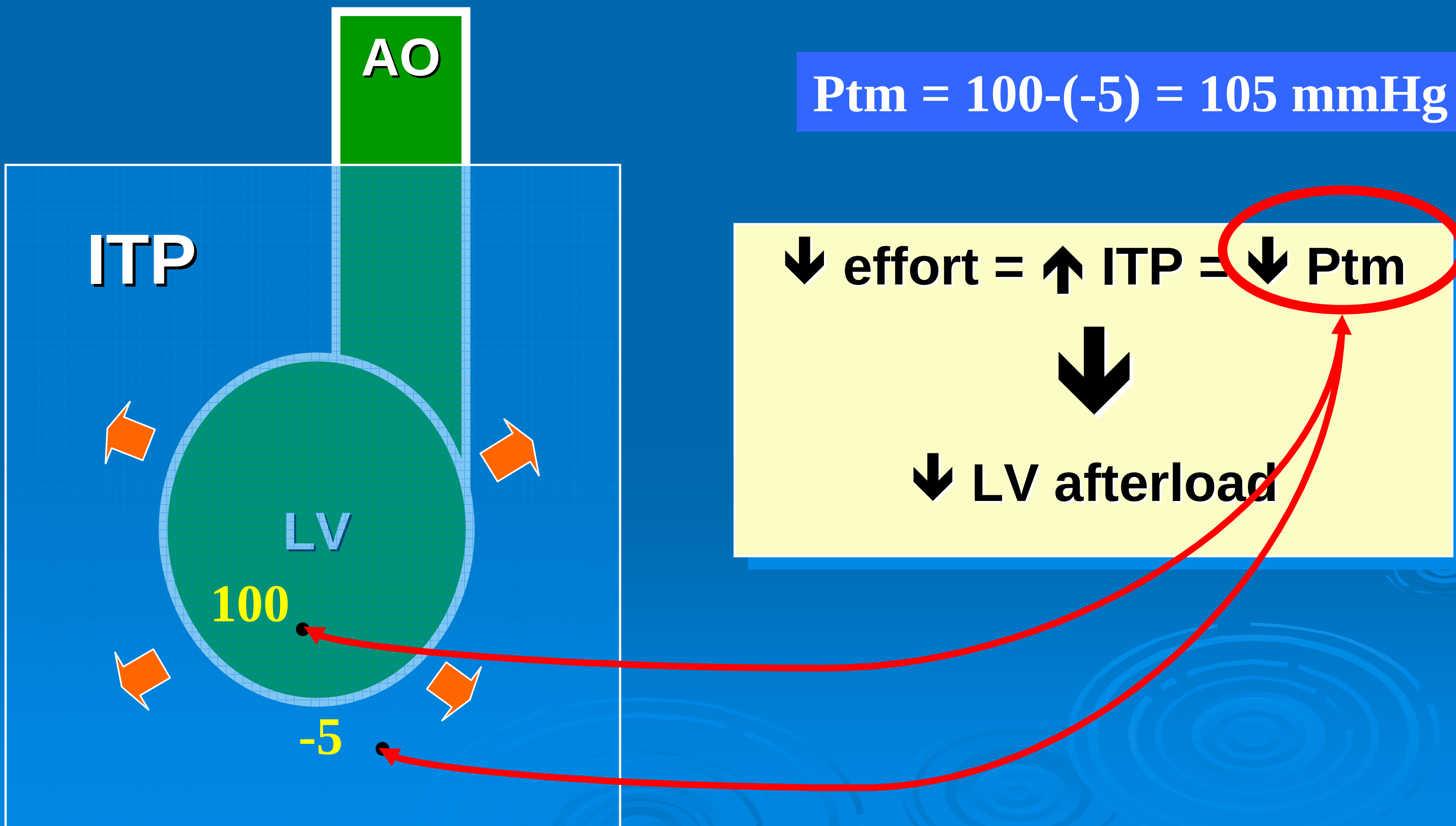
↑ LV afterload

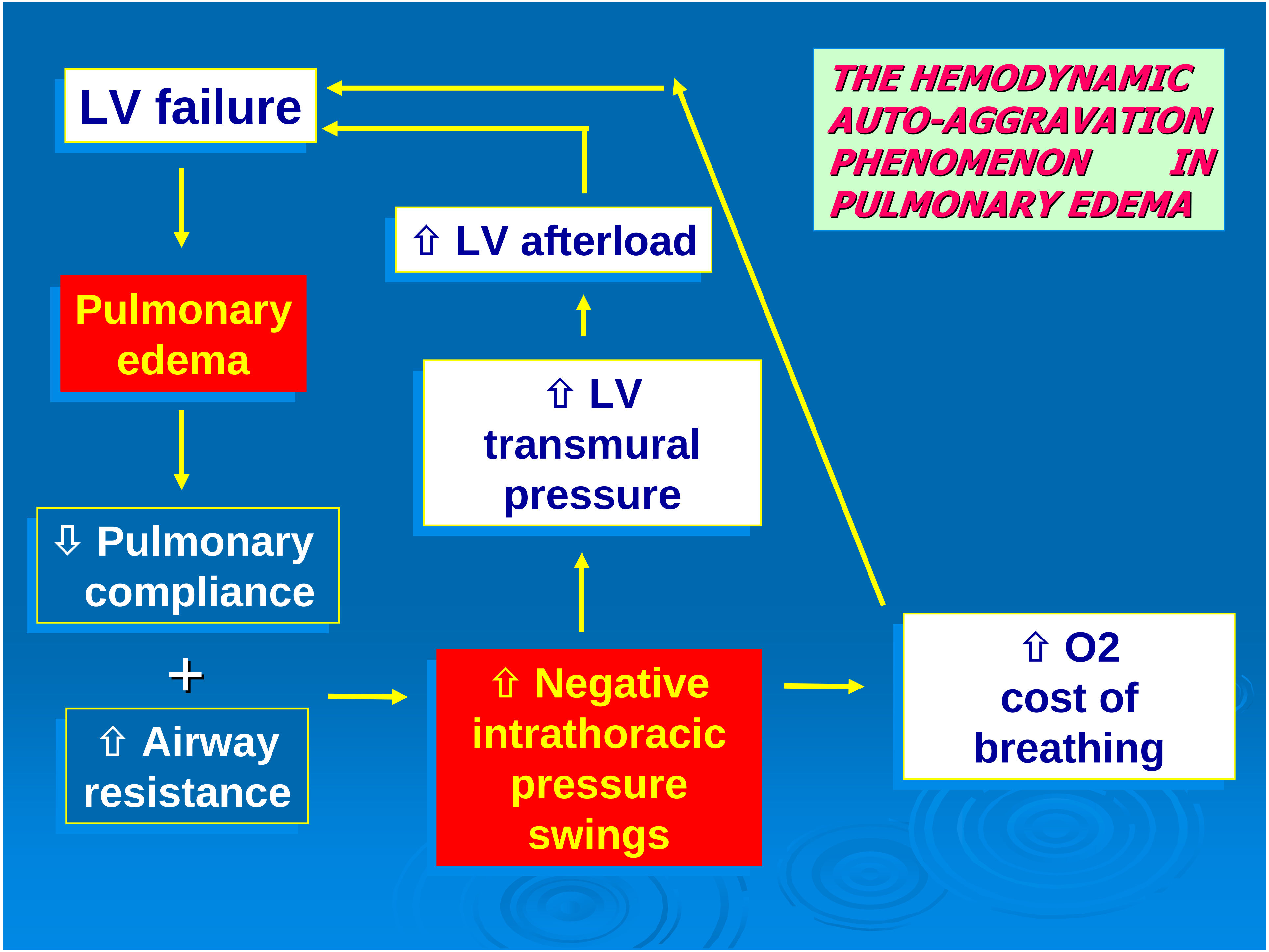
CPAP IN CARDIOGENIC PULMONARY EDEMA

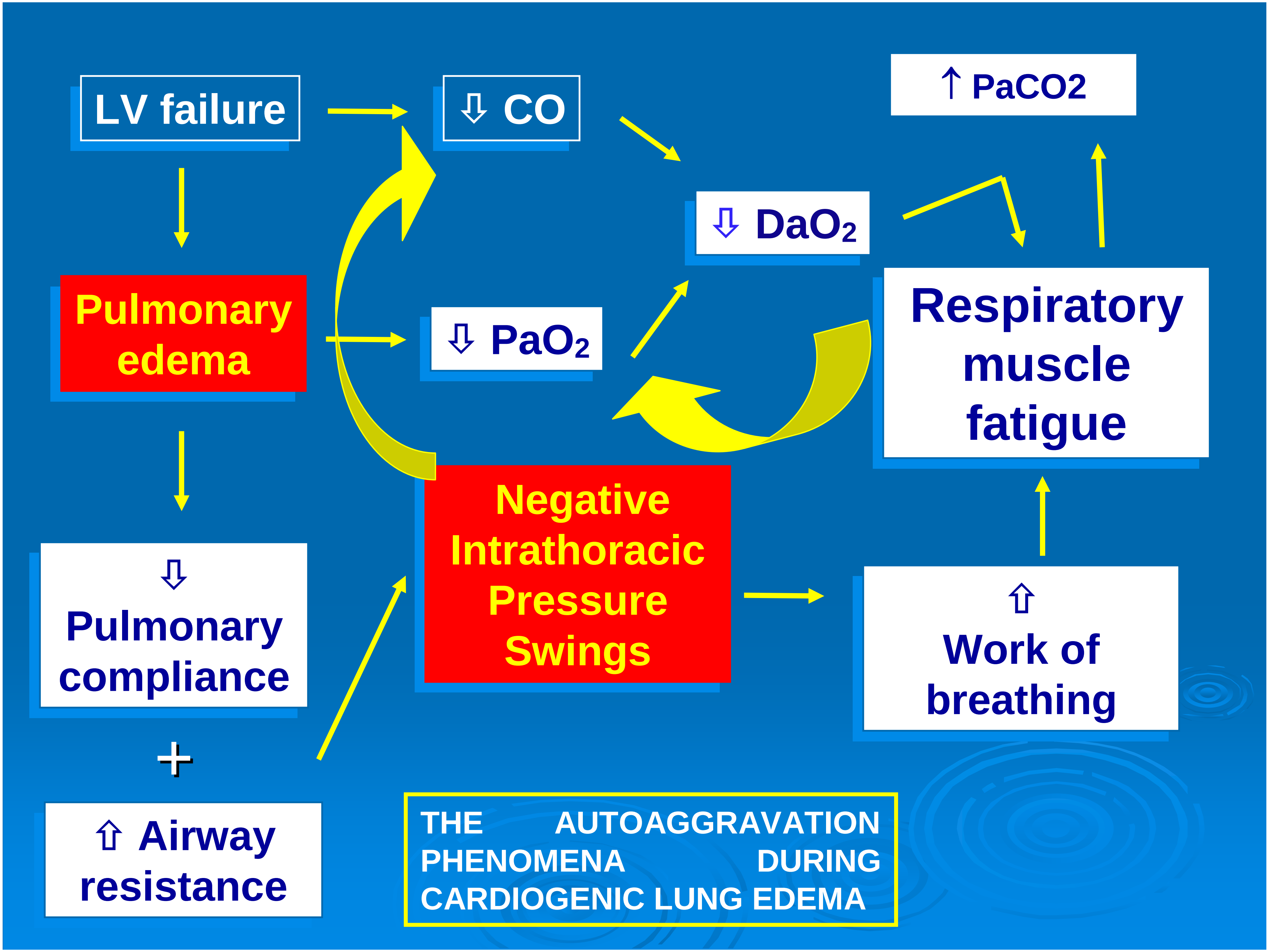


Räsänen J et al. Chest 1985, 87:158-162

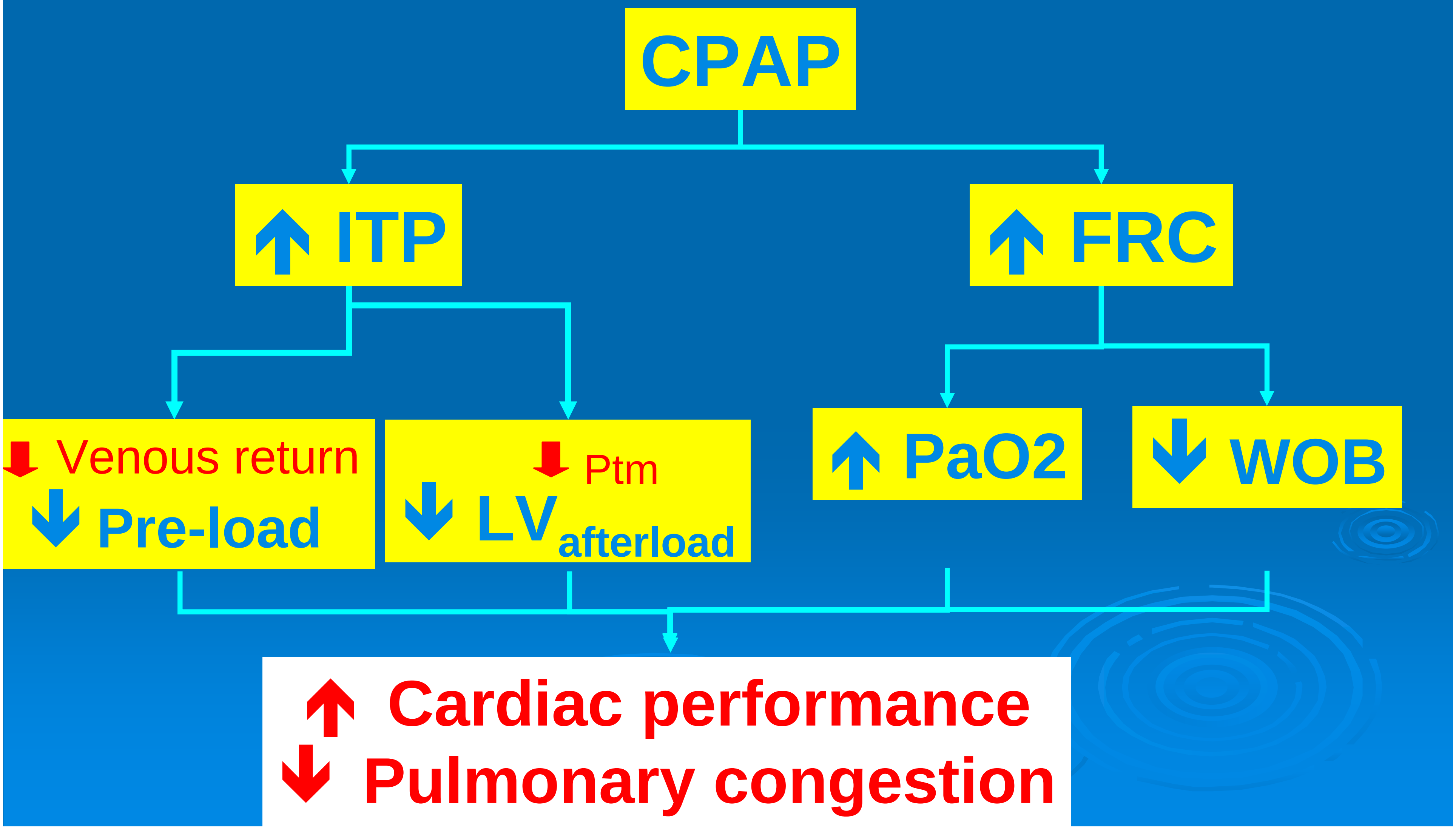
Intrathoracic Pressures and LV function: CPAP 15 mmHg




THE HEMODYNAMIC AUTO-AGGRAVATION PHENOMENON IN PULMONARY EDEMA
LV failure
Pulmonary edema
⇩ Pulmonary compliance
+
⇧ Airway resistance
⇧ Negative intrathoracic pressure swings
⇧ LV transmural pressure
⇧ LV afterload
⇧ O2 cost of breathing


LV failure
⇩ CO
↑ PaCO2
⇩ DaO_2
Pulmonary edema
⇩ PaO_2
Respiratory muscle fatigue
Negative Intrathoracic Pressure Swings
⇩ Pulmonary compliance
+
⇧ Work of breathing
⇧ Airway resistance
THE AUTOAGGRAVATION PHENOMENA DURING CARDIOGENIC LUNG EDEMA

HEMODYNAMIC AND RESPIRATORY EFFECTS OF CPAP

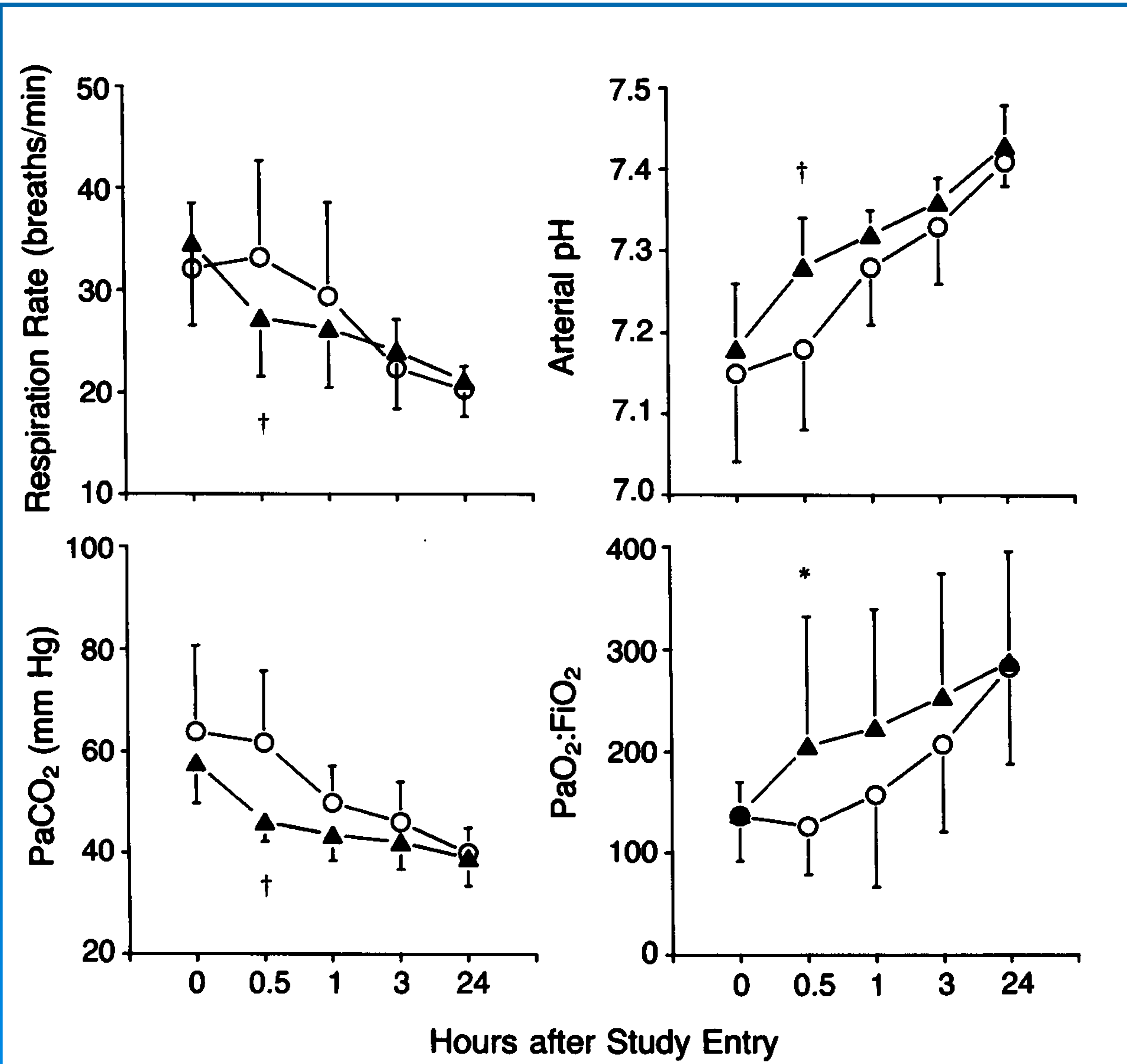


The New England
Journal of Medicine

Volume 325 DECEMBER 26, 1991 Number 26

TREATMENT OF SEVERE CARDIOGENIC PULMONARY EDEMA WITH CONTINUOUS POSITIVE AIRWAY PRESSURE DELIVERED BY FACE MASK

ANDREW D. BERSTEN, M.B., B.S., ANDREW W. HOLT, M.B., B.S., ALNIS E. VEDIG, M.B., B.S.,
GEORGE A. SKOWRONSKI, M.B., B.S., AND CHRISTOPHER J. BAGGOLEY, M.B., B.S.

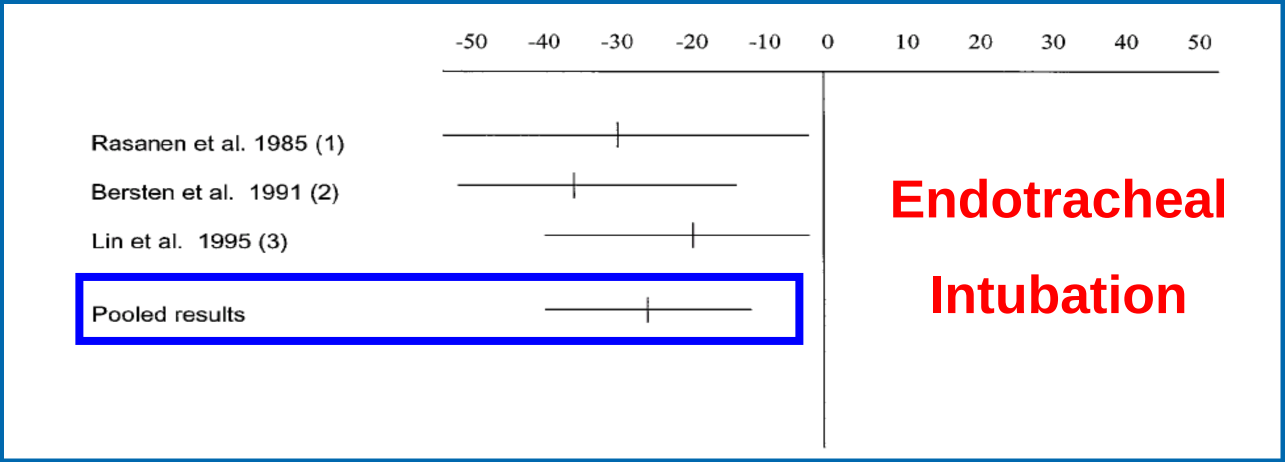


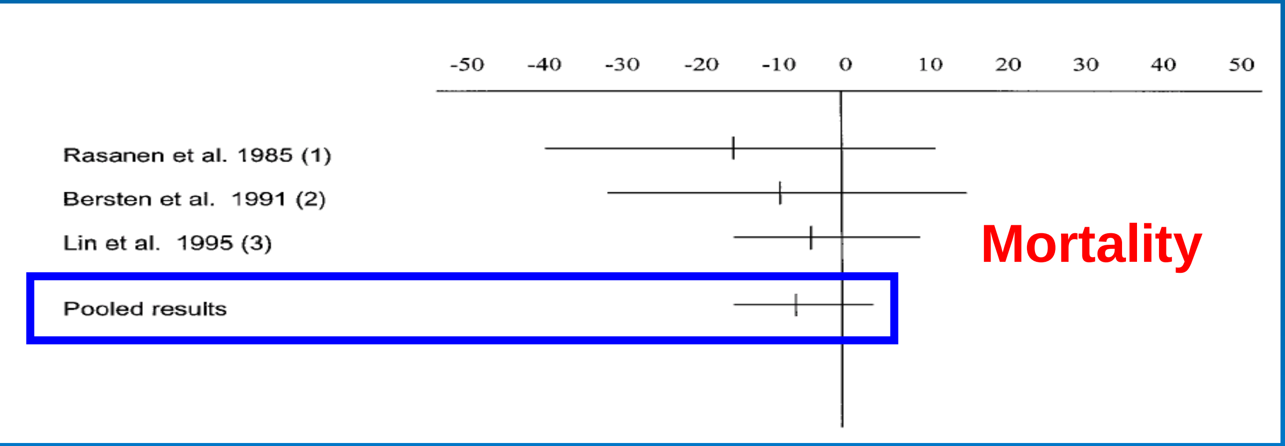
Respiration Rate (breaths/min)
50
40
30
20
10
†
Arterial pH
7.5
7.4
7.3
7.2
7.1
7.0
†
PaCO2 (mm Hg)
100
80
60
40
20
†
PaO2:FiO2
400
300
200
100
0
*
0
0.5
1
3
24
0
0.5
1
3
24
Hours after Study Entry

Conclusions. Continuous positive airway pressure delivered by face mask in patients with severe cardiogenic pulmonary edema can result in early physiologic improvement and reduce the need for intubation and mechanical ventilation. This short-term study could not establish whether continuous positive airway pressure has any long-term benefit or whether a larger study would have shown a difference in mortality between the treatment groups. (N Engl J Med 1991;325:1825-30.)

CPAP vs standard treatment]

CPAP in CARDIOGENIC PULMONARY EDEMA





Favors CPAP

Favors conventional treatment

Pang et al. Chest 1998;114: 1185-1192

CPAP or BiPAP IN ACUTE CARDIOGENIC LUNG EDEMA ??

Rusterholtz T et al. Intensive Care Med 1999; 25: 21-28
[n = 26 , some hypercapnic]

" Among patients with acute cardiogenic lung edema, those who are hypercapnic could benefit more from NIPSV.
NIPSV should be avoided in patients with AMI ".

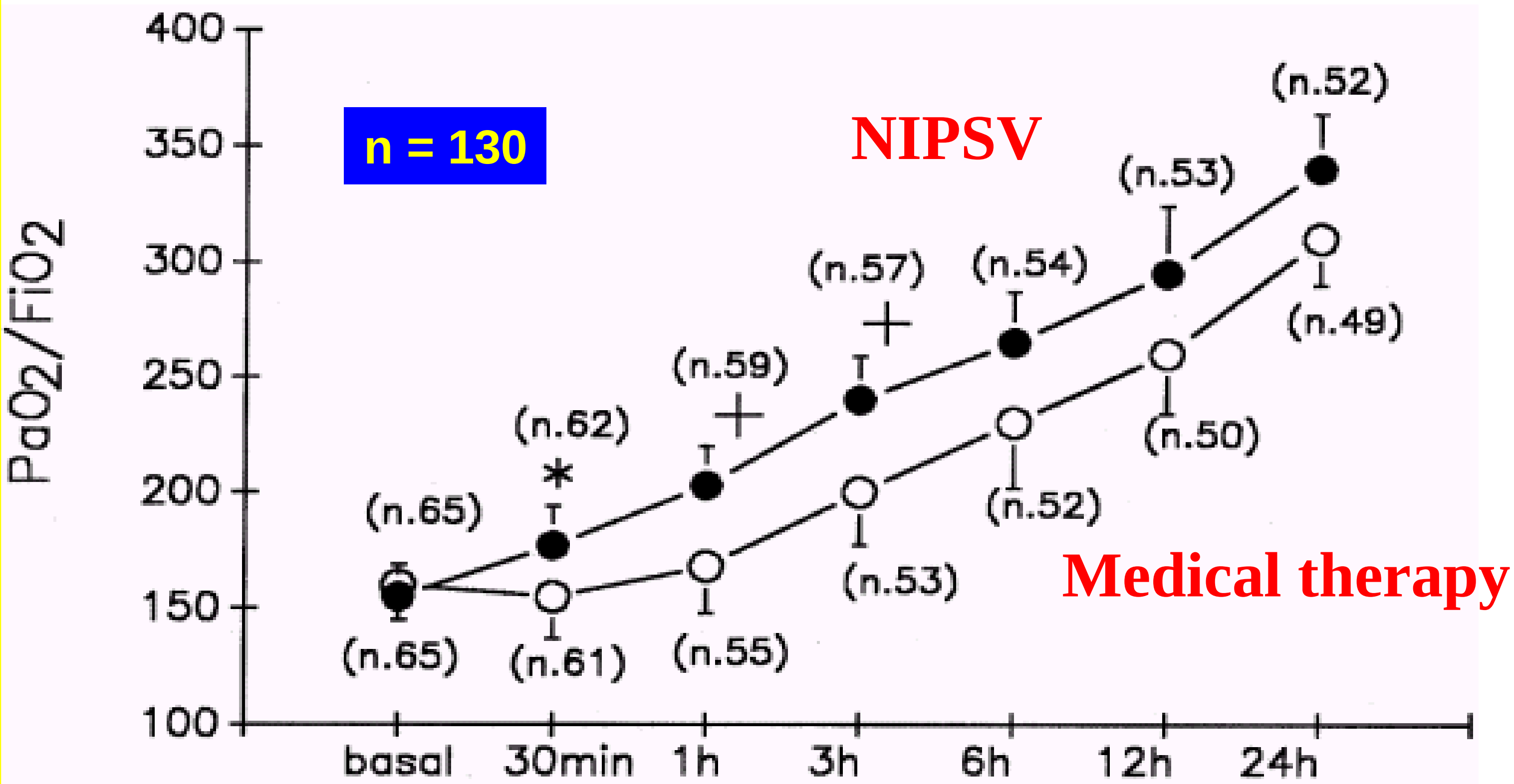
MESSAGE 1: HYPERCAPNIA MAY PREDICT NIPSV-SUCCESS
MESSAGE 2: BE CAREFUL IN PATIENTS WITH AN ONGOING AMI

Noninvasive Ventilation in Cardiogenic Pulmonary Edema

A Multicenter, Randomized Trial

Stefano Nava, Giorgio Carbone, Nicola DiBattista, Andrea Bellone, Paola Baiardi, Roberto Cosentini, Mauro Marenco, Fabrizio Giostra, Giulio Borasi, and Pietro Groff

Am J Respir Crit Care Med Vol 168. pp 1432–1437, 2003



Noninvasive Ventilation in Cardiogenic Pulmonary Edema

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Am J Respir Crit Care Med Vol 168. pp 1432–1437, 2003

n=130

TABLE 2. INTUBATION RATE AND IN-HOSPITAL MORTALITY

	Standard Treatment	NPSV	p Value	OR
Intention to Treat				
Intubated	16/65 (25%)	13/65 (20%)	0.530	1.30
Died	9/65 (14%)	6/65 (8%)	0.410	1.58
Subgroup Analysis				
Pa_{CO_2} > 45 mm Hg				
Intubated	9/31 (29%)	2/33 (6%)	0.015	6.34
Died	5/31 (16%)	1/33 (3%)	0.100	6.15
Pa_{CO_2} < 45 mm Hg				
Intubated	7/34 (21%)	11/32 (34%)	0.210	0.40
Died	4/34 (12%)	5/32 (15%)	0.650	0.72

Definition of abbreviations: NPSV = noninvasive pressure support ventilation; OR = odds ratio.

MESSAGE: NIPSV IN ACUTE CARDIOGENIC LUNG EDEMA WORKS BETTER IN PATIENTS PRESENTING WITH HYPERCAPNIA

Andrea Bellone
Marco Vettorello
Alessandra Monari
Francesca Cortellaro
Daniele Coen

Noninvasive pressure support ventilation vs. continuous positive airway pressure in acute hypercapnic pulmonary edema

Intensive Care Med 2005; 31: 807-811

Elegibility	**60 pts**
Randomized	**36 pts**
CPAP [*10 cm H2O*]	**18 pts**
BiPAP [*15 IPAP and 5 EPAP*]	**18 pts**

Exclusion:

Pts requiring immediate intubation
Impaired level of consciousness
Pts with $PaCO_2 \leq 45$ mmHg
COPD
SBP<90 mmHg

THE STUDY WAS POWERED TO DETECT A 10- MIN DIFFERENCE IN "CLINICAL RESOLUTION OF CPE" [clinical improvement, RR less than 30 breaths/min and Sp02 ≥96%]

IS THERE AN ADVANTAGE OF NIPSV AGAINST CPAP IN HYPERCAPNIC PATIENTS WITH CPE ?

Table 3 Patient outcomes

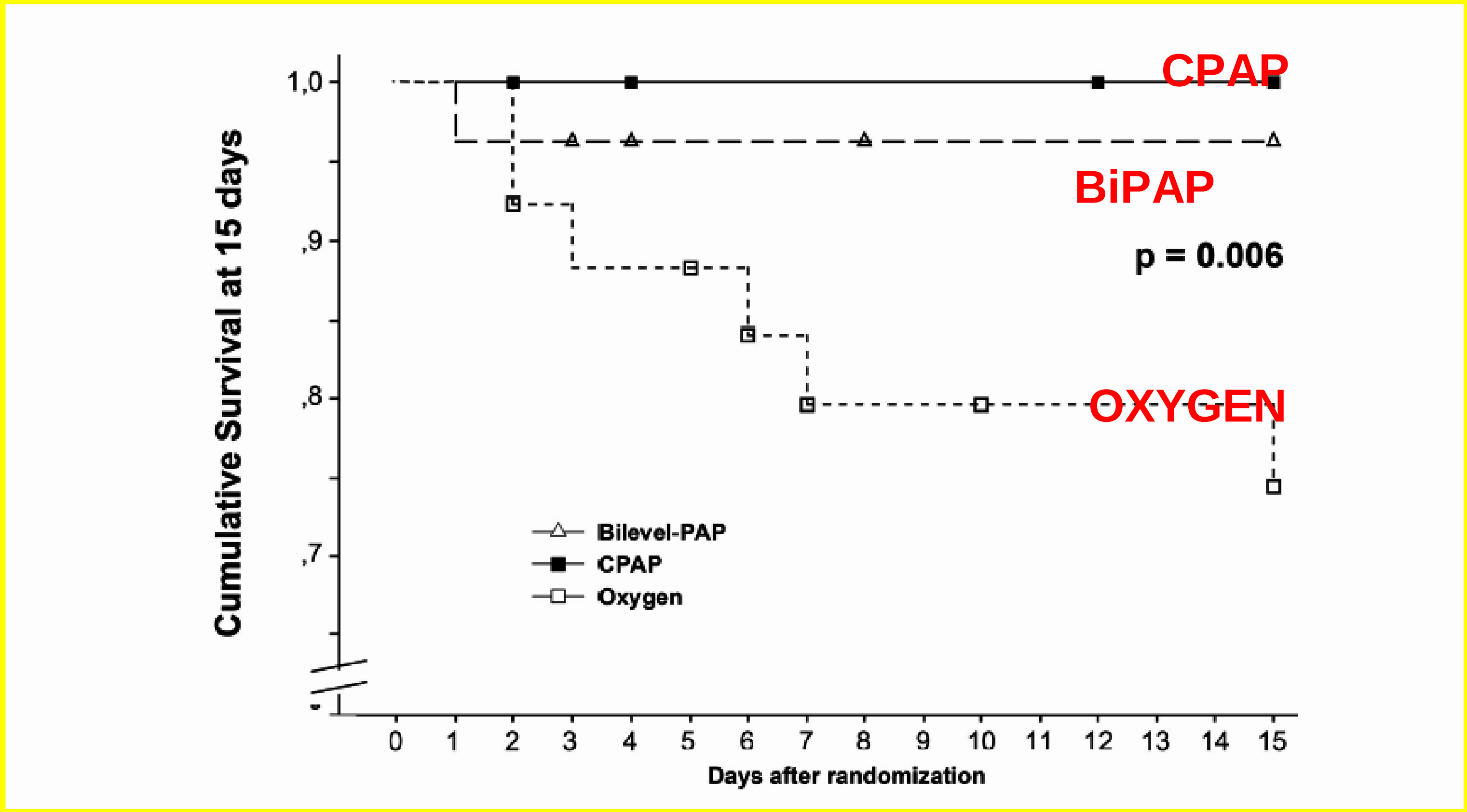
	CPAP (n=18)	NIPSV (n=18)	p
Endotracheal intubation	1 (5.5%)	2 (11.1%)	0.5
In-hospital death	1 (5.5%)	0 (0%)	0.5
Resolution time	29±18	30±16	0.87

As a *conclusion*, the Aa pointed out that CPAP proved as effective as NIPSV even in the treatment of hypercapnic pts with acute PE

Randomized, prospective trial of oxygen, continuous positive airway pressure, and bilevel positive airway pressure by face mask in acute cardiogenic pulmonary edema*

Marcelo Park, MD; Marcia C. Sangean, RT; Marcia de S. Volpe, RT; Maria I. Z. Feltrim, RT; Emilia Nozawa, RT; Paulo F. Leite, MD; Marcelo B. Passos Amato, MD; Geraldo Lorenzi-Filho, MD

CUMULATIVE SURVIVAL AT 15 DAYS



None developed AMI after randomization

Table 3. General outcomes of the study groups

Outcome	Oxygen n = 26	CPAP n = 27	Bilevel-PAP n = 27	*p* Value
Intubation rate, no. (%)	11 (42)	2 (7)	2 (7)	.001[a]
Time until intubation, mins, mean ± SD	17 ± 10	24 and 135[b]	25 and 9	
Intubation cause, no. (%)[c]				
Impaired level of consciousness	4 (36)	1 (50)	1 (50)	
Unrelenting respiratory distress	7 (64)	1 (50)	1 (50)	
Time to hospital discharge, days, mean ± SD	12 ± 8	11 ± 8	10 ± 7	.854
Procedures after 12 hrs, no. (%)				
Surgical myocardial revascularization	3 (12)	0 (0)	5 (19)	.073
Angioplasty	0 (0)	2 (7)	2 (7)	.363
Cardiac valvular surgery	1 (4)	3 (11)	4 (15)	.401
Complications, no. (%)[d]	7 (27)	4 (15)	5 (19)	.455
Cause of in-hospital death, no. (%)[c]				
Refractory septic shock	4 (67)	1 (100)	1 (50)	
Refractory cardiogenic shock	2 (33)	0 (0)	1 (50)	
Hospital mortality, no. (%)	6 (23)	1 (4)	2 (7)	.061

MESSAGE: CPAP AND BiPAP ARE EQUIVALENT EFFICIENT TECHNIQUES

Original Article

Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema

Alasdair Gray, M.D., Steve Goodacre, Ph.D., David E. Newby, M.D., Moyra Masson, M.Sc., Fiona Sampson, M.Sc., Jon Nicholl, M.Sc., for the 3CPO Trialists

N Engl J Med
Volume 359(2):142-151
July 10, 2008

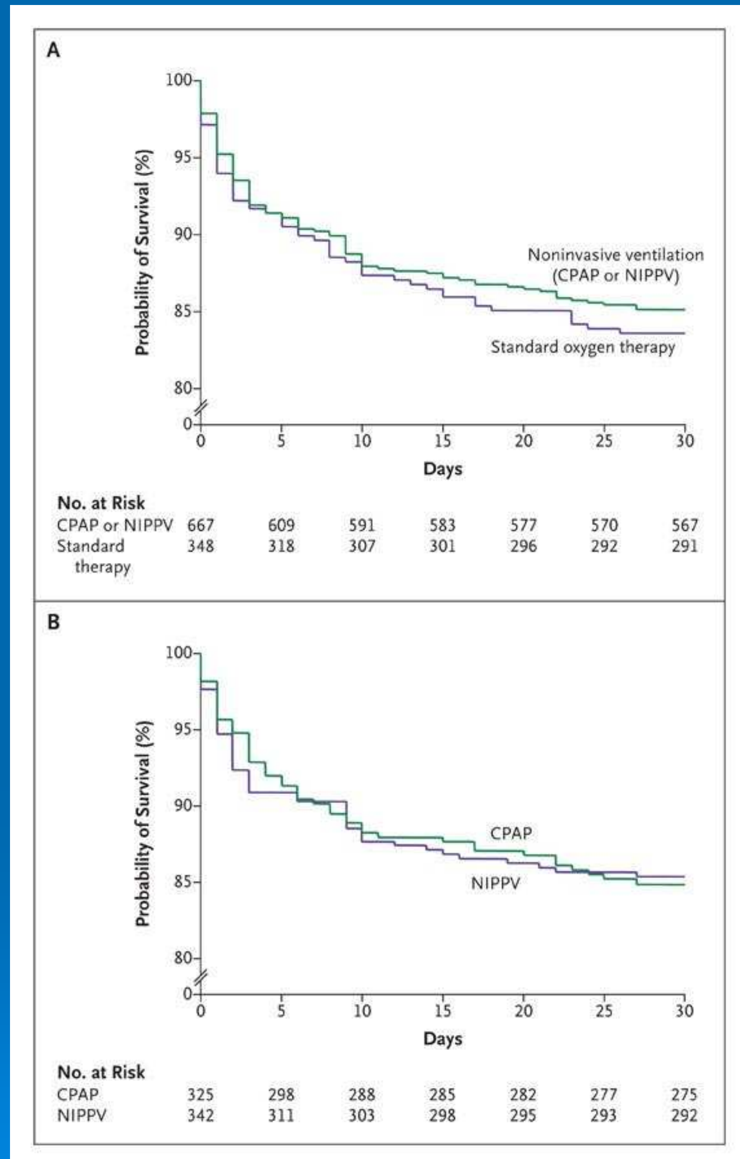
The NEW ENGLAND JOURNAL of MEDICINE

Study Overview

- Noninvasive ventilation (either continuous positive airway pressure or noninvasive intermittent positive-pressure ventilation) had **no effect on 7-day or 30-day mortality** in patients with cardiogenic pulmonary edema, as compared with standard oxygen therapy
- Noninvasive ventilation should be used only to relieve symptoms and correct metabolic disturbances

The NEW ENGLAND JOURNAL of MEDICINE

Kaplan-Meier Survival Curves



Gray A et al. N Engl J Med 2008;359:142-151

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Primary and Secondary End Points for Patients Receiving Standard Oxygen Treatment and Those Receiving Noninvasive Ventilation (CPAP or NIPPV)

Table 3. Primary and Secondary End Points for Patients Receiving Standard Oxygen Treatment and Those Receiving Noninvasive Ventilation (CPAP or NIPPV).*

Variable	Standard Oxygen Treatment (N=367)	CPAP or NIPPV (N=702)	Odds Ratio (95% CI)	P Value
Death within 7 days (% of patients)	9.8	9.5	0.97 (0.63 to 1.48)	0.87
Death within 30 days (% of patients)	16.4	15.2	0.92 (0.64 to 1.31)	0.64
Intubation within 7 days (% of patients)	2.8	2.9	1.05 (0.49 to 2.27)	0.90
Admission to critical care unit (% of patients)	40.5	45.2	1.21 (0.93 to 1.57)	0.15
Myocardial infarction (% of patients)				
WHO criteria	24.9	27.0	1.12 (0.84 to 1.49)	0.46
Universal criteria	50.5	51.9	1.06 (0.82 to 1.36)	0.66
			Difference between Means (95% CI)†	
Mean length of hospital stay (days)	10.5	11.4	0.9 (−0.2 to 2.0)	0.10
Mean change at 1 hr after start of treatment‡				
Dyspnea score§	3.9	4.6	0.7 (0.2 to 1.3)	0.008
Pulse rate (beats/min)	13	16	4 (1 to 6)	0.004
Blood pressure (mm Hg)				
Systolic	34	38	3 (−1 to 8)	0.17
Diastolic	22	22	0 (−3 to 3)	0.95
Respiratory rate (breaths/min)	7.1	7.2	0.2 (−0.8 to 1.1)	0.74
Peripheral oxygen saturation (%)	3.5	3.0	−0.4 (−1.4 to 0.6)	0.41
Arterial pH	0.08	0.11	0.03 (0.02 to 0.04)	<0.001
Arterial PaO_2 (kPa)	0.7	−0.6	−1.2 (−2.6 to 0.1)	0.07
Arterial $PaCO_2$ (kPa)	0.8	1.5	0.7 (0.4 to 0.9)	<0.001
Serum bicarbonate level (mmol/liter)	1.7	1.8	0.1 (−0.7 to 1.0)	0.77

* CI denotes confidence interval, CPAP continuous positive airway pressure, NIPPV noninvasive intermittent positive-pressure ventilation, $PaCO_2$ partial pressure of arterial carbon dioxide, PaO_2 partial pressure of arterial oxygen, and WHO World Health Organization. To convert values for PaO_2 and $PaCO_2$ to mm Hg, multiply by 7.50062.
† The difference between means may not equal the difference between the two means for each category of change because of rounding.
‡ Positive values in the Standard Oxygen Treatment and CPAP or NIPPV columns represent improvement in the variable.
§ The patients reported their degree of dyspnea on a visual-analogue scale ranging from 0 (no breathlessness) to 10 (maximal breathlessness).

Gray A et al. N Engl J Med 2008;359:142-151

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Primary and Secondary End Points for Patients Receiving CPAP and Those Receiving NIPPV

Table 4. Primary and Secondary End Points for Patients Receiving CPAP and Those Receiving NIPPV.*

Variable	CPAP (N=346)	NIPPV (N=356)	Odds Ratio (95% CI)	P Value
Death or intubation within 7 days (% of patients)	11.7	11.1	0.94 (0.59 to 1.51)	0.81
Death within 7 days (% of patients)	9.6	9.4	0.97 (0.58 to 1.61)	0.91
Death within 30 days (% of patients)	15.4	15.1	0.98 (0.64 to 1.49)	0.92
Intubation within 7 days (% of patients)	2.4	3.5	1.48 (0.60 to 3.67)	0.40
Admission to critical care unit (% of patients)	44.5	45.8	1.06 (0.78 to 1.43)	0.73
Myocardial infarction (% of patients)				
WHO criteria	27.2	26.8	0.98 (0.70 to 1.37)	0.90
Universal criteria	49.1	54.7	1.25 (0.93 to 1.69)	0.14
			Difference between Means (95% CI)†	
Mean length of hospital stay (days)	11.3	11.5	0.2 (−1.1 to 1.5)	0.81
Mean change at 1 hr after start of treatment‡				
Dyspnea score§	4.7	4.5	−0.2 (−0.8 to 0.4)	0.52
Pulse rate (beats/min)	17	15	−2 (−5 to 1)	0.26
Blood pressure (mm Hg)				
Systolic	38	37	−1 (−6 to 5)	0.77
Diastolic	23	21	−2 (−6 to 2)	0.31
Respiratory rate (breaths/min)	7.3	7.1	−0.1 (−1.2 to 1.0)	0.82
Peripheral oxygen saturation (%)	3.5	2.6	−0.9 (−2.2 to 0.3)	0.14
Arterial pH	0.12	0.10	−0.01 (−0.02 to 0.00)	0.05
Arterial PaO_2 (kPa)	−1.1	0.0	1.2 (−0.5 to 2.8)	0.16
Arterial $PaCO_2$ (kPa)	1.5	1.4	−0.1 (−0.3 to 0.2)	0.67
Serum bicarbonate level (mmol/liter)	2.3	1.3	−0.9 (−1.8 to 0.0)	0.04

* CI denotes confidence interval, CPAP continuous positive airway pressure, NIPPV noninvasive intermittent positive-pressure ventilation, $PaCO_2$ partial pressure of arterial carbon dioxide, PaO_2 partial pressure of arterial oxygen, and WHO World Health Organization. To convert values for PaO_2 and $PaCO_2$ to mm Hg, multiply by 7.50062.

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‡ Positive values in the CPAP and NIPPV columns represent improvement in the variable.

§ The patients reported their degree of dyspnea on a visual-analogue scale ranging from 0 (no breathlessness) to 10 (maximal breathlessness).

Gray A et al. N Engl J Med 2008;359:142-151

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Conclusion

- In patients with acute cardiogenic pulmonary edema, noninvasive ventilation **induces a more rapid improvement in respiratory distress** and metabolic disturbance than does standard oxygen therapy but has **no effect on short-term mortality**

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Treatment of Patients

Table 2. Treatment of Patients.*

Variable	Standard Oxygen Treatment (N=367)	CPAP (N=346)	NIPPV (N=356)	All Patients (N=1069)	P Value†
Initial treatment — % of patients					
Nitrates	93	88	91	90	0.11
Diuretics	90	89	89	89	0.89
Opioids	55	50	49	51	0.31
Inspired oxygen — liters/min	12±4	12±4	12±4	12±4	0.44
Ventilation pressure — cm of water	—	10±4	Inspiratory 14±5, expiratory 7±3	—	
Started assigned treatment — no./total no. (%)‡	365/366 (99.7)	337/343 (98.3)	344/354 (97.2)	1046/1063 (98.4)	0.02
Completed assigned treatment — no./total no. (%)§	298/363 (82.1)	285/340 (83.8)	267/352 (75.9)	850/1055 (80.6)	0.02
Changed to new treatment — no.					
Intubation	3	1	4		
CPAP	43	—	12		
NIPPV	13	5	—		
Standard treatment	—	31	49		
New treatment not stated	6	18	20		
Reason for not completing assigned treatment — no. (%)¶					
Patient discomfort	1 (0.3)	18 (5.2)	30 (8.4)		<0.001
Worsening arterial blood gas values	26 (7.1)	10 (2.9)	15 (4.2)		0.03
Respiratory distress	31 (8.4)	5 (1.4)	12 (3.4)		<0.001
Other	18 (4.9)	24 (6.9)	29 (8.1)		0.21

* Plus–minus values are means ±SD. CPAP denotes continuous positive airway pressure, and NIPPV noninvasive intermittent positive-pressure ventilation.
† P values are for the comparison among the three groups.
‡ Data were missing for six patients.
§ Data were missing for 14 patients.
¶ A patient may have had more than one reason for not completing the assigned treatment.

Gray A et al. N Engl J Med 2008;359:142-151

The NEW ENGLAND JOURNAL of MEDICINE

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ORIGINAL

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CPAP for acute cardiogenic pulmonary oedema from out-of-hospital to cardiac intensive care unit: a randomised multicentre study

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CPAP collaborative study group members are given in the Appendix.

Electronic supplementary material
The online version of this article (doi:10.1007/s00134-011-2311-4) contains supplementary material, which is available to authorized users.

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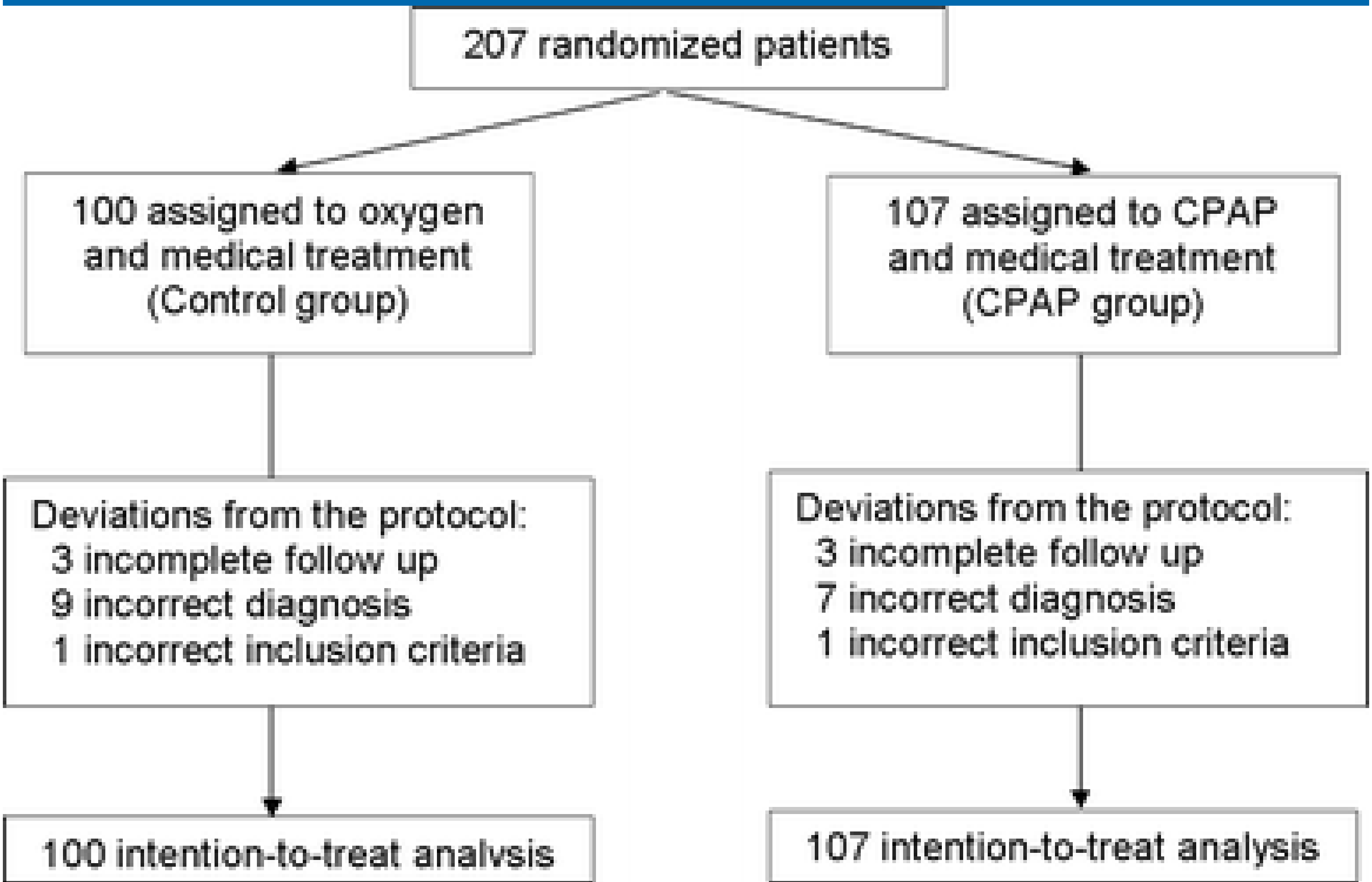
Abstract *Purpose:* Continuous positive airway pressure (CPAP) is a useful treatment for patients with acute cardiogenic pulmonary oedema (CPE). However, its usefulness in the out-of-hospital setting has been poorly investigated and only by small and single-centre studies. We designed a multicentre randomised study to assess the benefit of CPAP initiated out of hospital. *Methods:* A total of 207 patients with CPE were randomly allocated by emergency mobile medical units to receive either standard treatment alone or standard treatment plus CPAP. CPAP was maintained after admission to the intensive care unit (ICU). Inclusion criteria were orthopnoea, respiratory rate greater than 25 breaths/min, pulse oximetry less than 90% in room


207 randomized patients
100 assigned to oxygen and medical treatment (Control group)
107 assigned to CPAP and medical treatment (CPAP group)
Deviations from the protocol:
3 incomplete follow up
9 incorrect diagnosis
1 incorrect inclusion criteria
Deviations from the protocol:
3 incomplete follow up
7 incorrect diagnosis
1 incorrect inclusion criteria
100 intention-to-treat analysis
107 intention-to-treat analysis

- CPAP was used for 60 min [40, 65] (median [Q1, Q3]) in the pre-hospital setting and 120 min [60, 242] in ICU and was well tolerated in all patients. **Treatment was successful in 79% of patients in the CPAP group and 63% in the control group (*p* = 0.01),** especially for persistence of inclusion criteria after 2 h (12 vs. 26%) and for intubation criteria (4 vs. 14%). CPAP was beneficial irrespective of the initial PaCO2 or left ventricular ejection fraction.
- **Conclusion**
- Immediate use of **CPAP in out-of-hospital treatment** of CPE and until CPE resolves after admission significantly improves early outcome compared with medical treatment alone.

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ORIGINAL

Is helmet CPAP first line pre-hospital treatment of presumed severe acute pulmonary edema?

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Abstract *Purpose:* Non-invasive continuous positive airway pressure (CPAP) is effective in reducing intubation rate and mortality of patient with acute cardiogenic pulmonary edema (ACPE). We report our experience on pre-hospital application of CPAP by helmet as an adjunct to medical therapy or as a stand alone procedure in patient with presumed ACPE. *Methods:* In pre-hospital treatment of 62 patients with presumed ACPE, CPAP was added to standard medical treatment while in another 59 patients, CPAP was used as a sole therapy. *Results:* Helmet CPAP was feasible in all patients. No patient required pre-hospital intubation. In both groups, CPAP significantly improved oxygenation (SpO_2 went from 79 ± 12 to from 30 ± 9 to 22 ± 8 bpm) and improved hemodynamics, with a more pronounced decrease in blood pressure in the group with medical treatment than in the one without it. In the two cohorts, four and five patients were, respectively, intubated in Emergency Department and 11 and 9 eventually died.
Conclusions: Helmet CPAP is feasible, efficient and safe in pre-hospital treatment of presumed ACPE. A significant improvement of physiological variables was observed also in the group treated with CPAP in the absence of a drug therapy. We propose helmet CPAP as first line pre-hospital treatment of presumed severe ACPE.

Keywords Pulmonary edema ·

NIPSV

Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema: A Meta-Analysis of Randomized Controlled Trials

J Mariani et al

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- **At total of 34 studies (3,041 patients) were included. In direct comparisons, both CPAP and NIPPV reduced the risk of death (relative risk [RR] 0.64, 95% CI 0.44–0.93; RR 0.80, 95% CI 0.58–1.10; respectively) compared with ST, although only CPAP had a significant effect. There were no significant differences between NIPPV and CPAP. Pooled results of direct and adjusted indirect comparisons showed that compared with ST, both CPAP and NIPPV significantly reduced mortality (RR 0.63, 95% CI 0.44–0.89; RR 0.73, 95% CI 0.55–0.97; respectively).**
- **Conclusions**
- **Our findings suggest that among ACPE patients, NIV delivered through either NIPPV or CPAP reduced mortality.**

ESC GUIDELINES, 2008

IIa

Non-invasive ventilation

NIV with positive end-expiratory pressure (PEEP) should be considered **as early as possible** in ACMO and hypertensive AHF as it improves clinical parameters including respiratory distress

NIV should be used with caution in cardiogenic shock and right ventricular failure.
Class of recommendation IIa, level of evidence B

Key points
Intubation and mechanical ventilation should be restricted to patients in whom oxygen delivery is not adequate by oxygen mask or NIV, and in patients with increasing respiratory failure or exhaustion as assessed by hypercapnia.

Contraindications

- **Patients who cannot cooperate** (unconscious patients, severe cognitive impairment, or anxiety)

- **Immediate need of endotracheal intubation** due to progressive life-threatening hypoxia

- Caution in patients with severe obstructive airways disease

Long-term ventilation

non-invasive

- wake and co-operative patients
- patients should be able to swallow and cough
- patients with the ability of spontaneous breathing of up to 4 hours

invasive

- patients being 24 h ventilator dependent
- patients who are not awake
- patients with insufficient or no ability to swallow or to cough
- extreme production of secretions

switching is possible at any time

How to use non-invasive ventilation Initiation

A PEEP of 5–7.5 cmH2O should be applied first and titrated to clinical response up to 10 cmH2O; FiO2 delivery should be 0.40.

Duration

Usually 30 min/h **until patient's dyspnoea and oxygen saturation remain improved** without continuous positive airway pressure (CPAP)

Summary

- CPAP provides an adjunct between oxygen by NRB and endotracheal intubation
- Reduces length of hospital admission
- Reduces trauma of intubation
- Reduces costs
- Mortality ?

ΕΥΧΑΡΙΣΤΩ ΓΙΑ ΤΗΝ ΥΠΟΜΟΝΗ ΣΑΣ