PRE HOSPITAL NON INVASIVE VENTILATION

Are we ready for prime time?

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My Interest In CPAP

- Experience through multiple EMS Conferernces looking at Pre Hospital CPAP
- Literature on **ER** use
- Own experience in **ER**
- Hyperventilation and tachypnea> a paramedic nightmare!!

My Own First Use Of CPAP!!

What Is PEEP?

Positive End Expiratory Pressure

- Mechanically maintaining airway pressure above atmospheric pressure at the end of exhalation.
- Decreases the shunting of blood through the lungs and improves gas exchange.
- PEEP is done in ARDS (acute respiratory failure syndrome) to allow reduction in the level of oxygen being given.

The equivalent in a spontaneously breathing patient is ……..

CPAP

Continuous

Positive

Airway

Pressure

CPAP vs. BIPAP

- What's the difference??
- CPAP> provides constant positive pressure during both inspiration and expiration phase of respiration
- BIPAP> provides ability for user to modify inspiratory and expiratory positive pressure as opposed to constant value used for CPAP
- Generally higher values for inspiratory pressure which further reduces work of breathing

Physiologically Both Techniques Provide:

- Improved blood oxygenation
- Decrease work of breathing
- Decrease preload and afterload in patients with acute pulmonary edema

Where Is The Evidence For Emergency Room CPAP Use?

SPECIAL CONTRIBUTIONS

EVIDENCE-BASED PERFORMANCE MEASURES FOR EMERGENCY MEDICAL SERVICES SYSTEMS: A MODEL FOR EXPANDED EMS BENCHMARKING

A STATEMENT DEVELOPED BY THE 2007 CONSORTIUM U.S. METROPOLITAN MUNICIPALITIES' EMS MEDICAL DIRECTORS (APPENDIX)

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ABSTRACT

There are few evidence-based measures of emergency medical services (EMS) system performance. In many jurisdictions, response-time intervals for advanced life support units and resuscitation rates for victims of cardiac arrest are the primary measures of EMS system performance. The association of the former with patient outcomes is not supported explicitly by the medical literature, while the latter focuses on a very small proportion of the EMS patient population and thus does not represent a sufficiently broad selection of patients. While these metrics have their place in performance measurement, a more robust method to measure and benchmark EMS performance is needed. *The 2007 U.S. Metropolitan Municipalties'*

INTRODUCTION

Evidence-based clinical measures of emergency medical services (EMS) system performance have been few in number, largely due to the limited quantity and quality of research committed to the prehospital arena.[1–4] Although there is a 9-1-1 call for EMS response every other second in the United States, and despite the fact that survival from various acute illnesses and injuries are determined in that prehospital setting, evidence for out-of-hospital emergency care procedures are clearly lacking.[1–3] This paucity of prehospital research is due to a number of factors,

of each individual suggested intervention, but, based on available science, the reported benefit may only be conferred if all elements of the bundle or management strategy are provided.

Additionally, in some clinical situations for which improved outcomes have been demonstrated in large-scale trials, the key issue is to provide the proven therapy, bundled or not, and to document its timely implementation. The treatment of ST-Elevation Myocardial Infarction (STEMI) is an exemplary consideration of bundling treatment interventions with applicable management strategies (e.g., destination hospital protocols) along with documentation of timely interventions.

ST-Segment Elevation Myocardial Infarction (STEMI) Performance Measures

Based on the best available evidence, the most recent *American College of Cardiology/American Heart Association* guidelines for the prehospital management of STEMI patients support the implementation of specific destination protocols for select patients.[44,45] In particular, patients at high risk of death, those in cardiogenic shock, and those with contraindications to fibrinolysis should be transported primarily (or secondarily transferred) to facilities capable of cardiac catheterization and rapid revascularization. Evidence also suggests that when STEMI patients can be transported promptly

TABLE 1. Key Treatment Elements for Various Clinical Entities Encountered by EMS Systems

Clinical Area	Elements in Model
ST-Elevation Myocardial Infarction (STEMI).	Aspirin (ASA), if not allergic
	12-Lead electrocardiograph (ECG) with prearrival activation of interventional cardiology team as indicated
	Direct transport to percutaneous coronary intervention (PCI) capable facility for ECG to PCI time < 90 minutes
Pulmonary edema	Nitroglycerin (NTG) in absence of contraindications
	Noninvasive Positive Pressure Ventilation (NIPPV) preferred as first-line therapy over endotracheal intubation
Asthma	Administration of beta-agonist
Seizure	Blood glucose measurement
	Benzodiazepine for status epilepticus
Trauma	Limit non-entrapment time to < 10 minutes
	Direct transport to trauma center for those meeting criteria, particularly those over 65 (with time consistent caveats for air medical transport situations)
Cardiac arrest	Response interval < 5 minutes for basic CPR and automated external defibrillators (AEDs)

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

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Objective: To compare the effects of oxygen, continuous positive airway pressure (CPAP), and bilevel positive airway pressure (bilevel-PAP) on the rate of endotracheal intubation in patients with acute cardiogenic pulmonary edema.

Design: Randomized, controlled trial.

Setting: Tertiary hospital emergency room.

Patients: We randomly assigned 80 patients with severe cardiogenic acute pulmonary edema into three treatment groups. Patients were followed for 60 days after the randomization.

Interventions: Oxygen applied by face mask, CPAP, and bilevel-PAP.

Measurements and Main Results: The rate of endotracheal intubation as well as vital signs and blood gases was recorded during the first 24 hrs. Mortality was evaluated at 15 days, at 60 days, and at hospital discharge. Complications related to respiratory support were evaluated before hospital discharge. Treatment with CPAP or bilevel-PAP resulted in significant improvement in the $Pa_{O_2}/F_{I_{O_2}}$ ratio, subjective dyspnea score, and respiratory and heart rates compared with oxygen therapy. Endotracheal intubation was necessary in 11 of 26 patients (42%) in the oxygen group but only in two of 27 patients (7%) in each noninvasive ventilation group ($p = .001$). There was no increase in the incidence of acute myocardial infarction in the CPAP or bilevel-PAP groups. Mortality at 15 days was higher in the oxygen than in the CPAP or bilevel-PAP groups ($p < .05$). Mortality up to hospital discharge was not significantly different among groups ($p = .061$).

Conclusions: Compared with oxygen therapy, CPAP and bilevel-PAP resulted in similar vital signs and arterial blood gases and a lower rate of endotracheal intubation. No cardiac ischemic complications were associated with either of the noninvasive ventilation strategies. (Crit Care Med 2004; 32:2407–2415)

KEY WORDS: pulmonary edema; respiratory failure; artificial respiration; congestive heart failure; mechanical ventilators; respiratory therapy

Acute cardiogenic pulmonary edema is a common cause of acute respiratory distress among patients presenting to the emergency department (1–6). Oxygen delivered through a face mask is the basic respiratory support suggested by American Heart Association guidelines cheal intubation with its associated complications (8).

Continuous positive airway pressure (CPAP) applied noninvasively by mask improves blood oxygenation, decreases breathing effort, and reduces left ventricular pre- and afterload in patients with cardiogenic pulmonary edema (9–17). monary edema is still controversial (22–24).

Two prospective randomized trials have evaluated the effects of bilevel-PAP in the treatment of acute pulmonary edema (4, 5). Mehta et al. (4) compared CPAP vs. bilevel-PAP, but the study had to be prematurely stopped due to a high

Key Findings!

- ER RCT
- 3 arm, 80 patients, severe acute pulmonary edema
- Oxygen, CPAP, BIPAP (Plus standard therapy)
- CPAP, BIPAP Groups lower PAO2/FIO2 ratio, dyspnea score, RR, HR
- Primary end point (intubation): O2 group 42%, CPAP/BIPAP group 7%!!
- Secondary end point (15 day mortality): significant increase in O2 group ($p<.05$)

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

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Study objective: Acute cardiogenic pulmonary edema is a common cause of respiratory distress in emergency department (ED) patients. Noninvasive ventilation by noninvasive positive pressure ventilation or continuous positive airway pressure has been studied as a treatment strategy. We critically evaluate the evidence for the use of noninvasive ventilation on rates of hospital mortality and endotracheal intubation.

Methods: We searched the databases of MEDLINE, EMBASE, and the Cochrane Library from 1980 to 2005. Additional sources included key journals, bibliographies of selected articles, and expert contact. We included studies that incorporated a randomized design; patients older than 18 years and with acute cardiogenic pulmonary edema; diagnosis and treatment initiated in the ED; noninvasive ventilation in addition to standard medical therapy compared to standard medical therapy alone, or noninvasive positive pressure ventilation compared to continuous positive airway pressure (both in addition to standard medical therapy); and data on hospital mortality or intubation. A random-effects model was used to obtain the summary risk ratios (RRs) and 95% confidence intervals (CIs) for hospital mortality and intubation.

Results: A pooled analysis of 494 patients suggested that noninvasive ventilation in addition to standard medical therapy significantly reduced hospital mortality compared to standard medical therapy alone (RR 0.61; [95% CI 0.41, 0.91]). Similarly, a meta-analysis of 436 patients suggested that noninvasive ventilation was associated with a significant decrease in intubation rates (RR 0.43; [95% CI 0.21, 0.87]).

Key Findings!

- Pooled analysis of 491 patients up to 2006
- Non invasive ventilation significantly reduced hosp mortality related to standard therapy
- Non invasive ventilation significantly reduced intubation rates
- **Conclusion:** early application of non invasive ventilation can **decrease** mortality by 39% and intubation rates by 57%

To Be Fair!

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema

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*The participants in the Three Interventions in Cardiogenic Pulmonary Oedema (3CPO) trial are listed in the Appendix.

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ABSTRACT

BACKGROUND

Noninvasive ventilation (continuous positive airway pressure [CPAP] or noninvasive intermittent positive-pressure ventilation [NIPPV]) appears to be of benefit in the immediate treatment of patients with acute cardiogenic pulmonary edema and may reduce mortality. We conducted a study to determine whether noninvasive ventilation reduces mortality and whether there are important differences in outcome associated with the method of treatment (CPAP or NIPPV).

METHODS

In a multicenter, open, prospective, randomized, controlled trial, patients were assigned to standard oxygen therapy, CPAP (5 to 15 cm of water), or NIPPV (inspiratory pressure, 8 to 20 cm of water; expiratory pressure, 4 to 10 cm of water). The primary end point for the comparison between noninvasive ventilation and standard oxygen therapy was death within 7 days after the initiation of treatment, and the primary end point for the comparison between NIPPV and CPAP was death or intubation within 7 days.

RESULTS

A total of 1069 patients (mean [±SD] age, 77.7±9.7 years; female sex, 56.9%) were assigned to standard oxygen therapy (367 patients), CPAP (346 patients), or NIPPV (356 patients). There was no significant difference in 7-day mortality between patients receiving standard oxygen therapy (9.8%) and those undergoing noninvasive ventilation (9.5%, P=0.87). There was no significant difference in the combined end point of death or intubation within 7 days between the two groups of patients undergoing noninvasive ventilation (11.7% for CPAP and 11.1% for NIPPV, P=0.81). As compared with standard oxygen therapy, noninvasive ventilation was associated with greater mean improvements at 1 hour after the beginning of treatment in patient-reported dyspnea (treatment difference, 0.7 on a visual-analogue scale ranging from 1 to 10; 95% confidence interval [CI], 0.2 to 1.3; P=0.008), heart rate (treatment difference, 4 beats per minute; 95% CI, 1 to 6; P=0.004), acidosis (treatment difference, pH 0.03; 95% CI, 0.02 to 0.04; P<0.001), and hypercapnia (treatment difference, 0.7 kPa [5.2 mm Hg]; 95% CI, 0.4 to 0.9; P<0.001). There were no treatment-related adverse events.

CONCLUSIONS

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. (Current Controlled Trials number, ISRCTN07448447.)

Why are the results different?

The NEW ENGLAND JOURNAL of MEDICINE

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.

Where Is The Evidence For CPAP In Pre Hospital Care!!

ORIGINAL CONTRIBUTIONS

EFFECTIVENESS OF PREHOSPITAL CONTINUOUS POSITIVE AIRWAY PRESSURE IN THE MANAGEMENT OF ACUTE PULMONARY EDEMA

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ABSTRACT

Objective. To compare the effectiveness of continuous positive airway pressure (CPAP) with standard pharmacologic treatment in the management of prehospital acute pulmonary edema. **Methods.** Using a nonrandomized control group design, all consecutive patients presenting to two participating emergency medical services (EMS) systems with a field impression of acute pulmonary edema between July 1, 2004, and June 30, 2005, were included in the study. The control EMS system patients received standard treatment with oxygen, nitrates, furosemide, morphine, and, if indicated, endotracheal intubation. The intervention EMS system patients received CPAP via face mask at 10 cm H_2O in addition to standard therapy. **Results.** Ninety-five patients received standard therapy, and 120 patients received CPAP and standard

Key words: EMS; emergency medical services; paramedic; continuous positive airway pressure; pulmonary edema; respiratory distress.

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INTRODUCTION

Respiratory distress is a frequently encountered complaint among patients treated by emergency medical services (EMS) systems. Thirteen percent of EMS responses are for respiratory distress, second only to minor trauma.[1] Of these, a substantial portion will be due to acute pulmonary edema (APE) secondary to congestive heart failure (CHF)

Key Findings!

- Paramedic clinical impression of Acute Pulmonary Edema
- 95 standard, 120 CPAP
- Intubation rate 25.3% control, 8.9% CPAP
- Mortality rate 23.2% control, 5.4% CPAP
- After logistic regression standard therapy OR 4.04 for intubation, 7.48 or for death!! Compared to CPAP
- Similar Prehospital scene times

Out-of-Hospital Continuous Positive Airway Pressure Ventilation Versus Usual Care in Acute Respiratory Failure: A Randomized Controlled Trial

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Study objective: Continuous positive airway pressure ventilation (CPAP) in appropriately selected patients with acute respiratory failure has been shown to reduce the need for tracheal intubation in hospital. Despite several case series, the effectiveness of out-of-hospital CPAP has not been rigorously studied. We performed a prospective, randomized, nonblinded, controlled trial to determine whether patients in severe respiratory distress treated with CPAP in the out-of-hospital setting have lower overall tracheal intubation rates than those treated with usual care.

Methods: Out-of-hospital patients in severe respiratory distress, with failing respiratory efforts, were eligible for the study. The study was approved under exception to informed consent guidelines. Patients were randomized to receive either usual care, including conventional medications plus oxygen by facemask, bag-valve-mask ventilation, or tracheal intubation, or conventional medications plus out-of-hospital CPAP. The primary outcome was need for tracheal intubation during the out-of-hospital/hospital episode of care. Mortality and length of stay were secondary outcomes of interest.

Highlights!

- Patients very ill (only 71 over three years!!)
- Two arms comparing usual care plus intubation vs. Usual care plus CPAP
- Usual care 17/34 intubated (50%), CPAP group 7/35 (20%) intubated
- Mortality 12/34 (35.3%) usual group, 5/35 (14.3%) CPAP group
- Scene time unchanged between two groups

NUMBER NEEDED TO TREAT!!

- NUMBER OF PATIENTS WHO NEED TO BE TREATED TO PREVENT ONE BAD OUTCOME
- EXAMPLES IN MEDICINE:
- ACE VS. PLACEBO IN ACUTE MI>210
- B BLOCKER VS. PLACEBO IN CHF>40
- ASA TO PRVENT DEATH FROM ACUTE MI/CVA>20-25
- THROMBOLYTICS IN ACUTE MI>40-50

WHAT ABOUT CPAP NNT??

- NUMBER OF TIMES CPAP NEEDS TO BE USED TO PREVENT ONE INTUBATION OR ONE DEATH!!
- FOR INTUBATION 6 IN HUBBEL, 3 IN PETRIE !!
- FOR DEATH 6 IN HUBBEL, 5 IN PETRIE

CPAP WILL BECOME THE STANDARD OF CARE FOR AIRWAY MANAGEMENT OF CRITICALLY ILL PATIENTS PRESENTING IN ACUTE RESPRIRATORY DISTRESS DUE TO:

- Acute pulmonary edema
- Acute on Chronic COPD
- Asthma??

Thank you!