2008 Maine EMS CPAP Training Program Lesson Plan

Lesson Plan

Introduction:

For the past 6 years Maine EMS has evaluated Continuous Positive Airway Pressure (CPAP) for treatment of Acute Pulmonary Edema (APE). By the conclusion of the pilot project, nearly 20 services were involved and nearly 300 patients had been evaluated. The results fell short of a miracle cure, but clearly indicated that CPAP was a safe intervention that and a valuable additional tool in the treatment of APE.

In the 2008 Protocol Revision, CPAP was added as an optional treatment of APE for providers at or above the intermediate level. This course is designed as an addition to the existing MEMS protocol revision training and is designed for those services and providers who choose to utilize CPAP as a treatment.

Requirements:

This course is divided between a series of didactic and psychomotor objectives. A power point presentation has been constructed, but it should be noted that not every instructor will utilize it. Furthermore, instructors may tailor this presentation to meet the educational needs of a specific CPAP device or the license level or educational background of the targeted audience. Minimum objectives must be met.

Equipment

This course requires the use of a CPAP system. Instructors should have access to an appropriate number of devices such that practical sessions can be employed and each student will have the opportunity to familiarize him/herself with the a device per the psychomotor objectives listed above.. Facilitated group sessions would be a typical format. Note also that each approved CPAP system is powered by oxygen. Therefore instructors must have appropriate quantities of oxygen and the required delivery devices on hand for the course.

Maine EMS has approved a number of approved CPAP devices. Instructors may choose to focus on the specific device selected by a service or review the operation of multiple devices. However, it should be noted that prior to using CPAP a provider must be able to demonstrate the psychomotor competencies outlined above on the specific device his service chooses to utilize.

A Note on specific CPAP delivery devices: This lesson plan is designed to be a general review of CPAP and is not intended to be specific to any one system. When teaching with a specific device, instructors must tailor their presentation and the required psychomotor objectives to the manufacturer’s guidelines for the use of the individual device.

Instructor Preparation:

To teach this course, an instructor must be licensed at or above the level they intend to teach. The instructor also must be approved by their regional office to teach CPAP. This approval standard will include those providers already approved as pilot project trainers or those instructors that can demonstrate appropriate and specific MEMS CPAP training such that the Regional staff feels they are prepared to teach this unique skill.
Learning Objectives:

At the end of this class the student will be able to:

1. Identify the major components of the upper airway
2. Identify the major components of the lower airway
3. With regard to the respiratory system, compare and contrast oxygenation and ventilation
4. Define functional residual capacity
5. Define peak inspiratory flow
6. Define and provide an example of an obstructive disorder
7. Define and provide an example of a restrictive disorder
8. List three negative physiologic effects of exacerbation of COPD
9. List three negative physiologic effects of acute pulmonary edema
10. List at least three signs/symptoms used to diagnose acute pulmonary edema
11. List three focused history questions a provider might use to effectively identify acute pulmonary edema
12. Define the letters in the pneumonic CPAP
13. Define PEEP
14. List at least three positive physiologic effects of CPAP
15. List at least two specific, therapeutic benefits of CPAP for the acute pulmonary edema patient
16. List at least four precautions for the use of CPAP
17. List at least four components of the exclusion criteria for the use of CPAP
18. List the components of the MEMS acute pulmonary edema protocol
19. Given a CPAP device, demonstrate the correct assembly prior to patient administration
20. Given a CPAP device, demonstrate proper placement on a simulated patient (to include proper mask seal)
21. List at least three suggested components of CPAP documentation

Content:

Respiratory A & P

- Pathway review
- Components of the upper airway
- Components of the lower airway
- Ventilation and perfusion matching at the alveoli

Notes:

- This section is designed as a review only. Instructors should base the depth of this lesson on the preparation of the students. That said, it is not intended for the CPAP class to become a detailed respiratory A & P course.

Oxygenation and Ventilation

- Lung volume and Capacity
- Functional Residual Capacity
  - “Also known as FRC, this is the lung volume at the end of a normal expiration, when the muscles of respiration are completely relaxed; at FRC and at FRC only, the tendency of the lungs to collapse is exactly balanced by the tendency of the chest wall to expand.” http://oac.med.jhmi.edu/res_phys/Dictionary.HTML
- Peak Inspiratory Flow
  - “Take a deep breath in: you have probably just inspired 1 liter of air in about 1 second. Your inspiratory flow rate is thus approximately 60 liters per minute during this deep breath. Every breath you take varies in depth and volume, but if you were in respiratory failure you may well require flow
rates of this magnitude (or more). To be guaranteed a FiO₂ appropriate to your flow demand, a fixed performance flow-generating device must be placed at your airway with a flow rate of 60 or so liters of oxygen-air (mixed as required) to satisfy demand. To be a fixed performance device, the gas flow must exceed the patient’s peak inspiratory flow.

http://www.ccmtutorials.com/rs/oxygen/page13.htm

- Pressures
  - Respiration is mitigated by pressure. Negative pressure is created to pull air into the chest (and to some extent blood into the heart) and positive pressure is created to push air out. Pressure also mitigates the hydrostatic gradient between alveolar space and the vascular space. (Eg: in left ventricular failure, the increased vascular pressure compared to the relatively low intra-alveolar pressure creates a hydrostatic gradient that essentially pulls fluid from the vascular space to the alveolar space).

Notes:
The function of this section is assure that students understand the physiology of respiration and in particular the physiology that CPAP will effect. This lesson plan will employ later the terminology discussed in this section so it is important to ensure comprehension.

Respiratory Dysfunction
- Obstructive vs. Restrictive Disorders
  - Obstructive = air impeded from moving through airways. Increased airway resistance causing reduced expiratory airflow rates
  - Restrictive = limited lung expansion, reduced lung volumes
- Exacerbation of COPD (Obstructive)
  - Bronchoconstrictive issues
  - “Floppy Airways”
  - Poor Gas Exchange
  - Accessory Muscle Use/Muscle Tiring
- Acute Pulmonary Edema (Restrictive)
  - Altered pressure gradients
  - Fluid Shift
  - Ventilation/Perfusion V/Q Mismatch
- Severe Distress/Sympathetic Discharge

Notes:
This section is designed to briefly review the pathophysiology of the most common respiratory disfunctions. By reviewing the key negative side effects of each, providers will be better prepared to understand the most effective treatments (such as CPAP). As with other sections, it is not the intention of this lesson plan to become an in depth discussion of respiratory disorders, but rather to be a brief and pointed overview.

Diagnosis of APE
- Common Findings
- Symptoms
  - Shortness of breath (especially acute onset SOB)
  - Consider other “cardiac related symptomology to be suspicious
    - C/P, Acute onset N/V, Syncope
- Physical exam findings
  - Rales, legs
    - Be aware that a lack of rales does not rule out APE
2008 MEMS CPAP Training Lesson Plan 6/30/08

- Cardiac dysrhythmias
- JVD
- Pedal Edema
  - Note JVD and pedal edema note only a history of CHF and do not necessarily correlate to the acute event of APE
- Chest XRay findings for CHF
- Echocardiograms: Low ejection fraction/poor contractility (hypocontractility)

**Notes:**
The differential diagnosis of APE is a difficult process. This section was added to the pilot project training after our data reflected problems with providers making this decision. Consideration should be made with regard to the intended audience as to how much time the instructor will spend on this subject. Furthermore, instructors should note that the intermediate level has very few learning objectives with regard to CHF. Therefore, an audience composed primarily of intermediates will require a great deal more detail in this section than a group of paramedics.

**Continuous Positive Airway Pressure (CPAP)**
- What is it?
  - Mask delivered continuous positive airway pressure.
    - *Breathing Against A Threshold of Resistance*”
      - Putting a light wall of air up against which the patient will breath
    - *Pneumatic Splinting of Airways*”
      - The wall of air creates a back pressure to keep open small airways and alveoli
    - *Oxygen Therapy In It’s Most Efficient Form*”
      - High pressure oxygen
- Practical Application
  - At this point a devices should be demonstrated pointing out the specific components
    - Mask
    - Tubing
    - Gas source
    - PEEP Valve (if present)
      - Positive End Expiratory Pressure
        - The increase in pressure at exhalation
        - A PEEP valve regulates this to assure continuous airway pressure
        - Often this valve is nothing more than a simple “pop-off” valve
        - PEEP valves should be adjusted to 10mmHg for MEMS
      - Downs flow generator/venturi system (if present)

**Notes:**
This section will provide an overview of the concept of CPAP and a brief overview of a specific device. Although a much more in depth practical session will come later, it is useful to apply concepts to equipment in this section.

Instructors should use this opportunity to note that MEMS has adopted 10mmHg as the desired level of PEEP when using CPAP. Although not all approved systems are capable of delivering 10mmHg, it is important to reinforce this concept.

**Effects of CPAP**
- Increases functional residual capacity.
  - The pressure simply puts more air in the lungs
- Increases alveolar surface area available for gas exchange.
  - By preventing atelectasis, more alveoli are available
- Increases oxygen diffusion across alveolar membrane.
  - Pressure pushes oxygen
• Reduces work of breathing.
  o The pneumatic splint of CPAP prevents the patient from having to exert energy to do it themselves
• CPAP in Acute Pulmonary Edema
  o Changes pressure gradient, prevents the influx of fluid.
  o Reduces work of breathing may help avoid intubation, reduces sympathetic discharge.
  o CPAP therapy can improve A.P.E. patients in 90 seconds
    ▪ CPAP should be initiated in APE regardless of transport time
  o Can decrease preload.
    ▪ Positive pressure in chest can impact filling of the heart and therefore drop preload
    • Beware a subsequent drop in cardiac output (evidenced by a fall in BP)
• Misdiagnosis
  o We note a European study here that noted improvement after CPAP administration even though there was a high misdiagnosis rate (84/121).
    ▪ Kallio, T. et al. Prehospital Emergency Care. 2003. 7(2)
  o The purpose of this slide is to encourage providers to be aggressive with CPAP but at the same time instructors should restate that CPAP is intended for the APE and not intended as a first line for other respiratory disorders.

**Notes**
*Because it can be truly therapeutic CPAP is intended for the APE patient. Although other respiratory disorders may see benefit from the more palliative effects, it should be noted that CPAP IS NOT a substitute form bronchodilator therapy in broncho-constriuctive events*

**Limitations of CPAP**
• CPAP is not mechanical ventilation!
  o Instructors MUST emphasize that a patient must have a patent airway and reasonable respiratory effort to be a candidate for CPAP.
  o CPAP is NOT a ventilator and those patients needing such mechanical ventilation or airway control are NOT candidates for CPAP
• CPAP may drop BP due to increased intrathoracic pressure.
  o A patient must have a systolic BP of at least 100mmHg to be a candidate for CPAP
  o Providers should be comfortable giving a CPAP patient NTG-If they are too hypotensive for NTG, then they are too hypotensive for CPAP.
• Patients may not improve, reassess, reassess, reassess.
• Patients must accept and fit mask
  o There is a psychologic (claustrophobic) component
  o Some will exclude themselves
• Risk of pneumothorax
  o Increased intrathoracic pressure=increased risk
• Risk of corneal drying
  o High volumes of air blowing at eyes, especially on long transports. Providers should beware.
• Large oxygen source demand
  o CPAP is powered by oxygen

**Notes**
*Although airway and breathing issues are absolute contraindications, the other issues tend to be relative concerns and may in some cases be device specific. Again, instructors should cite manufacturers guidelines and assure providers are aware of the dangers of the use of CPAP.*

**Maine EMS CPAP Contraindications/Exclusion Criteria**
• <18 yrs
Utilizing CPAP precludes the usual, psychomotor evaluation and control. However, providers should carefully assess any mental status change to assure it has not impacted airway patency or respiratory effort. Patients with such severe alterations in mental status are not candidates for CPAP.

- Facial Trauma or Impossible Facial Seal On Mask

**Protocol**
- CPAP is a standing order for providers at or above the intermediate level.
- Review CPAP as an addition to the MEMS Acute Pulmonary Edema protocol
  - Note that CPAP does not take the place of pharmacology
  - Note that although CPAP is listed at the end of a linear list, it need not be interpreted that all other interventions must be completed prior to its use. Providers should use good clinical judgment to determine at what point in the course of the various therapies CPAP should be initiated.
- Aggressive airway evaluation and control.
  - Not all patients will improve
  - Providers must be prepared to discontinue CPAP and initiate more aggressive steps in decompensating patients.
    - ****ALERT** for circumstances in which the patient continues to deteriorate despite CPAP and/or medicative therapy, terminate CPAP administration and perform BVM ventilation and/or endotracheal intubation if necessary.

**Psychological Therapy**
- Claustrophobia is a common complaint with CPAP masks
  - Don’t give up to early but know when to give up
  - It is recommended that in the case of a claustrophobic patient that they be allowed to hold the mask and remove it if necessary. It is common that as the benefits are felt, patients will be inclined to keep the mask on their face. Straps can then be attached as the patient becomes more comfortable
  - Note that some patients will not tolerate the mask and should not be forced.

**Reassess, Reassess, Reassess**
- Slowing respirations do not necessarily indicate improvement
- Be cognizant of hypotension.
- As usual, be aggressive with airways.

**Maine EMS Approved CPAP System**
This section is designed for the instructor to provide a more detailed review of the selected system. This session precludes a psychomotor session for the students to at this point psychomotor objectives should be reviewed. Utilizing the selected CPAP system and following manufacturers guidelines, instructors should review:
- Packaging
- Assembly (if necessary)
- Adjustment (as appropriate for the selected device)
  - Oxygen liter flow and connection
  - PEEP valves
  - Downs flow generator controls
  - Venturi controls
• Application to a patient
• Securing the device including strap placement

Notes
During this section the instructor should demonstrate each of the above criteria. For larger groups, assistant instructors and additional devices may be necessary.

It is typical for manufacturers to supply standard competency sheets for using their device. Sales representatives may be able to provide such sheets for use in this class.

Instructors must be familiar with the specific operation of the device they are demonstrating

Practical Session
Sample devices should be distributed and small groups should be facilitated to assure each student can demonstrate the following psychomotor objectives for the specific device:
• Demonstrate the correct assembly prior to patient administration
• Given a CPAP device, demonstrate proper placement on a simulated patient (to include proper mask seal)

Notes
Although students must demonstrate appropriate psychomotor competency, instructors should note that students should continue to practice and increase their comfort level with devices beyond the time frame of this class.

Instructors should note that there is more than one approved CPAP device in MEMS and regardless of what device was demonstrated in this session, providers must be competent with their service’s selected device prior to utilizing it in a patient care setting.

Any necessary remediation plan will be developed by the instructor.

CPAP Data Collection
• Instructors should emphasize the importance to documenting the following elements related to the application of CPAP:
  o Initial Assessment including the Modified Borg Scale (see Appendix 1)
  o System used
  o 5 minute assessment
  o Arrival assessment

Notes
Instructors should note that MEMS and or the Regional Offices may require further documentation as part of ongoing State and or Regional Quality Assurance
Appendix 1
Modified Borg Scale

“On a scale of one through ten, ten being the worst shortness of breath you have ever had, how would you rate your shortness of breath today?”

Modified Borg Scale
“0”-No breathlessness at all
“1”-Very slight
“2”-Slight breathlessness
“3”-Moderate
“4”-Somewhat severe
“5”-Severe
“7”-Very severe
“9”-Very, very severe (Almost maximum)
“10”-Maximum