Section: Adult Medical
Subject: DECOMPENSATED CONGESTIVE HEART FAILURE / ACUTE CARDIOGENIC PULMONARY EDEMA
Section #: 340.19
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Approved By: Michael Lozano Jr., MD, FACEP HCFR Medical Director

1. Clinical Intent: The management of acute exacerbations of heart failure has evolved in recent years. It is important to understand that shortness of breath doesn't always fit into neat categories and there is frequently difficult to diagnose overlap between pulmonary congestion caused by systolic dysfunction, diastolic dysfunction, valvular heart disease, cor pulmonale, and dyspnea of a primary pulmonary nature in a patient who happens to also have a history cardiac disease. Our intent is to impact most favorably in those patients who are experiencing distress due to acute pulmonary congestion, and minimize the potential for harm in those whose condition mimics it. The clinical goal of this protocol is the resolution of the patient's respiratory distress.

2. This is an HCFR protocol where the treatments are listed in the preferred order of administration.

3. Basic ALS Treatment must include a 12 lead EKG and oxygen therapy
    a. If available, continuous wave capnography monitoring should be used

4. Cardiovascular support is initially achieved through the use of Nitroglycerin (NTG)
    a. Determine if there is a contraindication to the use of NTG (see QA points below and Section 348 – Drug Reference)
        i. If NTG is contraindicated, move immediately to CPAP therapy
    b. Administration of nitroglycerin depends upon the patient's systolic blood pressure (SBP)[1]
        i. For SBP >140 mmHg administer NTG 0.8 mg SL q5 minutes provided that the systolic BP remains >140 mmHg
        ii. For SBP between 100 and 140 mmHg administer NTG 0.4 mg SL q5 minutes provided that the systolic BP remains >100 mmHg
        iii. For SBP less than 100 mmHg administer normal saline 200 mL IV bolus once.

5. Ventilatory support is achieved through CPAP therapy[2] [3] and can be instituted at the same time as the nitroglycerin therapy
    a. Indications
        i. Moderate to severe respiratory distress (usually with tachycardia or hypertension)
        ii. Tachypnea (RR > 24 breaths/min)
        iii. Accessory muscle use or abdominal breathing
    b. Contraindications
        i. Apnea, respiratory arrest or ineffective spontaneous respirations
        ii. Medically unstable (SBP <100 mmHg; think cardiogenic shock (HCFR CARDIOGENIC SHOCK protocol)
        iii. Unable to protect airway
        iv. Excessive secretions
        v. Uncooperative or agitated

[1] Collins S, Storrow AB, Kirk JD, et al. Beyond pulmonary edema: diagnostic, risk stratification, and treatment challenges of acute heart failure management in the emergency department. Ann Emerg Med 2008; 51:45–57.

[2] Mal, S., McLeod, S., Iansavichene, et al. (2014). Effect of out-of-hospital noninvasive positive-pressure support ventilation in adult patients with severe respiratory distress: a systematic review and meta-analysis. Annals of emergency medicine, 63(5), 600-607.

[3] Goodacre, S., Stevens, J. W., Pandor, et al. (2014). Prehospital Noninvasive Ventilation for Acute Respiratory Failure: Systematic Review, Network Meta-analysis, and Individual Patient Data Meta-analysis. Academic Emergency Medicine, 21(9), 960-970.

vi. Unable to fit the mask or to keep it on continuously
vii. Recent (<30 days) upper airway or upper gastrointestinal surgery

c. Start at 5 cm H_2O, and increase in increments of 2 cm H_2O, as tolerated by the patient
   i. Use the lowest amount of pressure that produces an improvement in symptoms
   ii. The target goal of therapy is a respiratory rate <25 breaths/min and oxygen saturation >90%, with hemodynamic stability; however, patient comfort or preference may be just as important an outcome measure.[4]
d. Use continuous wave capnography, if available, to better monitor the clinical course
e. If the patient's condition deteriorates to the point that they have developed a contraindication to its use, then discontinue CPAP therapy immediately

6. Maintenance nitrate therapy may be used if the patient responded well to NTG SL
   a. IV Nitroglycerin (Tridil®) may be started if there is sufficient SBP, and you anticipate a long transport
      i. Use of an IV pump is required for administration of Tridil®
      ii. It is highly recommended that two paramedics accompany the patient in the back of the rescue when infusing Tridil®
      iii. The starting dose in 10 mcg/min IV by infusion
      iv. Increase by 10 mcg/min IV q5 minutes and titrate to symptoms and clinical response
      v. There is no maximum dose assuming the patient's SBP can tolerate it
      vi. If the SBP drops below 100 mmHg:
         1. Pause the infusion and administer normal saline 200 mL IV bolus once
   b. Nitroglycerin paste can be used as an alternative if Tridil® is unavailable
      i. The does depends upon the SBP:
         1. For SBP > 100 and < 160 mmHg apply 1" to the chest
         2. SBP > 160 and < 200 mmHg apply 1.5" to the chest
         3. SBP > 200 mmHg apply 2" to the chest

7. Bronchospasm
   a. If there is wheezing (bronchospasm) present that has not fully responded to CPAP administer Ipratroprium bromide 0.5 mg (500 mcg) mixed with albuterol 2.5 mg via nebulizer.
      i. May be repeated two (2) times q20 minutes if there has been a response to the initial treatment
      ii. Total dose maximum dose of 1.5 mg (1500 mcg) of ipratroprium bromide and 7.5 mg of albuterol
   b. If the patient's tidal volume is inadequate then consider administering ipratroprium bromide and albuterol via BVM with in-line nebulizer or ETT after securing the airway.
   c. Use continuous wave capnography, if available, to better monitor the clinical course

8. Consider intubation if no response to any therapy and deterioration is noted.
   a. See HCFR RAPID SEQUENCE INTUBATION (RSI) protocol when indicated

[4] Panacek EA, Kirk JD. Role of noninvasive ventilation in the management of acutely decompensated heart failure. Rev Cardiovasc Med. 2002; 3 Suppl 4:S35-40.

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9. Hypotension with signs of shock
    a. If the patient's SBP falls below 90 mmHg initiate **dopamine**
        i. Start at 5 mcg/kg/min IV/IO infusion
        ii. Increase by 5 mcg/kg/min q5 minutes titrating to effect
        iii. Maximum infusion rate is 20 mcg/kg/min.
    b. Go to HCFR CARDIOGENIC SHOCK protocol.

10. QA Points
    a. Whereas in the past it was allowable with direct Medic-1 approval, **nitroglycerin** in all forms is now *contraindicated* in HCFR patients who have recently taken medications for erectile dysfunction. Because of their respective half-lives and duration of action, "recently" is defined for this protocol as being 24 hours for **sildenafil (Viagra®)**, and 48 hours for **vardenafil (Lavitra®)** or **tadalafil (Cialis®)**.
    b. Carefully monitor the level of conscious, BP and respiratory status with these patients
    c. Appropriate use of **CPAP therapy** can often stave off respiratory failure and the need for intubation.[5] [6]
    d. Allow the patient to be in a position of comfort to maximize breathing effort
    e. If CHF or cardiogenic shock resulting from an inferior (II,III,aVF) MI, **nitroglycerin** may cause hypotension requiring fluid bolus. Use caution, and monitor closely.
    f. When using **Tridil®** or **nitroglycerin paste** do not continue to use **nitroglycerin** SL.
    g. **Furosemide (Lasix®)** used to be a mainstay in the EMS treatment of CHF, but in the past decade its appropriateness in the EMS setting has been challenged.[7] Recent research has shown that its routine use in this setting is associated with a 15% greater risk of an adverse effect if the patient doesn't have CHF. In the same study, paramedics were only able to identify true decompensated CHF 40% of the time.[8]

[5] Rasanen J, Heikkila J, Downs J, et al. Continuous positive airway pressure by face mask in acute cardiogenic pulmonary edema. Am J Cardiol. 1985; 55:296–300.

[6] Lin M, Chiang HT. The efficacy of early continuous positive airway pressure therapy in patients with acute cardiogenic pulmonary edema. J Formos Med Assoc. 1991; 90:736–43.

[7] Jaronik J, Mikkelson P, Fales W, et al. Evaluation of prehospital use of furosemide in patients with respiratory distress. Prehospital Emergency Care. 10(2):194-197, 2006.

[8] Pan, A., Stiell, I. G., Dionne, R., Maloney, J. Prehospital use of furosemide for the treatment of heart failure. Emergency Medicine Journal, 2015; 32(1), 36-43.