Pulmonary Edema

Patient Care Goals

1. Assure adequate oxygenation and ventilation.
2. Recognize impending respiratory failure.
3. Promptly identify and intervene for patients who require escalation of therapy.
4. Deliver appropriate therapy by differentiating likely cause of respiratory distress.
5. Alleviate respiratory distress.

Patient Presentation

Inclusion Criteria

1. Respiratory distress with presence of rales
2. Clinical impression consistent with congestive heart failure

Exclusion Criteria

1. Respiratory distress related to acute trauma
2. Respiratory distress due to a presumed underlying cause that includes one of the following
    1. Anaphylaxis
    2. Bronchiolitis (wheezing in patients less than 2 years of age)
    3. Croup
    4. Epiglottitis
    5. Foreign body aspiration
    6. Submersion/drowning
    7. Lower airway obstruction from malignancy (very rare)

Patient Management

Assessment

1. History
    a. Onset of Symptoms
        a. Weight gain
        b. Leg swelling
        c. Orthopnea
    b. Medication history including use of diuretics and compliance
    c. Treatments prior to EMS: Oxygen, inhaler, nebulizer, other treatments, chronic or recent steroids
    d. Hospitalizations: Number of emergency department visits in the past year, number of hospital admissions in the past year, number of ICU admissions (ever), previously intubated (ever)
2. Exam
    a. Breath sounds — crackles or rales
    b. Lower extremity edema
    c. JVD
    d. Cough and/or productive cough with pink and/or frothy sputum
    e. Diaphoresis
    f. Chest discomfort
    g. Hypotension
    h. Shock
    i. Respiratory distress, assess:
        a. Patient's ability to speak in full sentences
        b. Respiratory accessory muscle use

Treatment and Interventions

1. Manage airway as necessary.

2. Administer oxygen ***[EMR]*** as appropriate for dyspnea or distress with a target of achieving greater than 94-98% saturation for most acutely ill patients.
3. Continuous cardiac monitoring may be indicated in patients with respiratory distress associated with suspected acute or decompensated congestive heart failure (CHF) or dysrhythmia.
4. 12-lead EKG may be indicated to assess for dysrhythmia or ischemia, particularly in patients with risk factors for coronary artery disease and/or presentation consistent with CHF.
5. Establish IV access ***[AEMT].***
    1. SBP less than 100 mmHg: IV fluid bolus 250–500 mL
6. Consider **Nitroglycerin SL [AEMT], IV [PARA]** for patients with chest pain, moderate to severe respiratory distress or concern for flash pulmonary edema to obtain improvement/resolution of symptoms
    1. Sublingual
        - 0.4 mg SL, can repeat every 5 minutes for SBP greater than 100 mmHg [AEMT]
            - If initial SBP >= 160 mmHg or MAP greater than 120: consider initial dose of 0.8 mg SL, can repeat every 5 minutes for SBP greater than 100 mmHg
    2. IV: **20-40 mcg/min IV,** increase by 10-20 mcg/min q 5 min as long as SBP>100mmHg
7. Consider non-invasive positive pressure ventilation ***[EMT]***, non- visualized airway ***[EMR]***, or endotracheal intubation ***[PARA]*** for severe distress or if not improving with less invasive support.
8. Diuretics per sending facility **[PARA/Inter-facility]**
9. If progression to bradycardia and/or hypotension See SHOCK Protocol

Patient Safety Considerations

1. Normal EtCO2 (35–45 mmHg) with tachypnea and respiratory distress is an indicator of impending respiratory failure.
2. The use of nitrates should be avoided in any patient who has used a phosphodiesterase inhibitor within the past 48 hours. Examples are sildenafil, vardenafil and tadalafil, which are used for erectile dysfunction and pulmonary hypertension. Also avoid use in patients receiving intravenous epoprostenol or treporstenil which are used for pulmonary hypertension.

Notes and Educational Pearls

1. Differential:
    a. MI
    b. CHF
    c. Asthma
    d. Anaphylaxis
    e. Aspiration
    f. COPD
    g. Pleural effusion
    h. Pneumonia
    i. PE
    j. Pericardial tamponade
    k. Toxin exposure

Non-invasive positive pressure ventilation:

a. Contraindications:
    i. Hypoventilation
    ii. Altered level of consciousness
    iii. Airway compromise
    iv. Aspiration risk
    v. Pneumothorax
    vi. Facial trauma or burns
    vii. Systolic BP less than 90 mmHg
    viii. Recent oropharyngeal, tracheal, or bronchial surgery
b. Benefits:

i. Increased oxygenation and perfusion by reducing work of breathing
ii. Maintaining inflation of atelectatic alveoli
iii. Improving pulmonary compliance
iv. Decreases respiratory rate and the work of breathing, HR, and SBP
v. Improves delivery of bronchodilators
vi. Reduces preload and afterload, improving cardiac output

c. Complications:
    i. Anxiety (most common)
    ii. Theoretical risk of hypotension and pneumothorax as non-invasive positive pressure ventilation increases intrathoracic pressure which decreases venous return and cardiac output
    iii. Sinusitis
    iv. Skin abrasions
    v. Conjunctivitis — minimized with proper size mask
    vi. Potential for barotrauma — pneumothorax or pneumomediastinum (rare)
d. Positioning: Allow patient to remain in position of comfort — patients may decompensate if forced to lie down.

Common causes of pulmonary edema:

a. CHF (most common)
b. Medications
c. High altitude exposure
d. Kidney failure
e. Lung damage caused by gases or severe infection
f. Major injury

Key Considerations

1. Acute heart failure is a common cause of pulmonary edema – other causes include:
    1. Opioid overdose
    2. High altitude exposure
    3. Kidney failure or dialysis noncompliance
    4. Lung damage caused by gases or severe infection
2. Nitroglycerin reduces left ventricular filling pressure primarily via venous dilation. At higher doses the drug variably lowers systemic afterload and increases stroke volume and cardiac output.
3. Pulmonary edema is more commonly a problem of volume distribution than total body fluid overload, so administration of diuretics such as furosemide provide no immediate benefit for most patients and can cause significant harm. Inducement of inappropriate diuresis can lead to increased morbidity and mortality in patients with other disease processes such as pneumonia and sepsis.
4. Nitrates provide both subjective and objective improvement, and might decrease intubation rates, incidence of MIs, and mortality. High-dose nitrates can reduce both preload and afterload and potentially increase cardiac output and blood pressure.

Nitrates and phosphodiesterase inhibitors: The use of nitrates should be avoided in any patient who has used a phosphodiesterase inhibitor within the past 48 hours. Examples are: sildenafil (Viagra®, Revatio®), vardenafil (Levitra®, Staxyn®), tadalafil (Cialis®, Adcirca®) which are used for erectile dysfunction and pulmonary hypertension. Also avoid use in patients receiving intravenous epoprostenol (Flolan®) or treporstenil (Remodulin®) which is used for pulmonary hypertension. Administer nitrates with extreme caution, if at all, to patients with an inferior STEMI or suspected STEMI with right ventricular involvement because these patients require adequate RV preload.

Nitroglycerin: This drug reduces left ventricular filling pressure primarily via venous dilation. At higher doses the drug variably lowers systemic afterload and increases stroke volume and cardiac output. Although some have advocated early use of ACE inhibitors in patients with acute decompensated heart failure, we do not recommend this approach. There are limited data on the safety and efficacy of initiating new ACE inhibitors or angiotensin receptor blockers therapy in the early phase of therapy of acute

decompensated heart failure (i.e. the first 12 to 24 hours).

Furosemide (Lasix®): Use is not recommended in the prehospital setting. Pulmonary edema is more commonly a problem of volume distribution than overload, so administration of furosemide provides no immediate benefit for most patients. Misdiagnosis of CHF and subsequent inducement of inappropriate diuresis can lead to increased morbidity and mortality in patients.

Quality Improvement

Associated NEMSIS Protocol(s) (eProtocol.01)

- 9914137 – Pulmonary Edema/CHF

Key Documentation Elements

- Vital signs
- Oxygen saturation
- Time of intervention
- Response to interventions

Performance Measures

- Time to initiation of non-invasive positive pressure ventilation
- Number of CPAP/BiPAP patients who require intubation
- Time to clinical improvement
- Assessment/auscultation of lung sounds before and after each intervention

References

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