C06: Acute Pulmonary Edema

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Introduction

Pulmonary edema is a clinical phenomenon where fluid accumulates in the alveoli in the lungs, resulting in impaired oxygen exchange and shortness of breath. Although pulmonary edema is associated with a number of clinical problems, in the out-of-hospital environment, it is most commonly the result of congestive heart failure (CHF). Impairment of ventricular function causes blood to accumulate in both the pulmonary and systemic circulation. Pulmonary edema as a result of CHF may develop slowly, over days, or very suddenly (also known as 'flash' pulmonary edema). Treatment options for pulmonary edema depend heavily on underlying cause, so careful assessment is required.

Essentials

- To the maximum extent possible, paramedics and EMRs/FRs should attempt to determine the origin of the fluid and differentiate between cardiogenic pulmonary edema, asthma, pneumonia, or chronic obstructive pulmonary disease.
- Consider cardiogenic shock if the patient: has a history of cardiac dysfunction; is experiencing chest pain with hypotension; has an altered level of consciousness, exhibits pale and cool skin, and/or has a decreased urine output.
- Position patients to limit venous return. Be aware that many patients with pulmonary edema will be unable to tolerate a supine or semi-recumbent position. Respiratory arrest may follow if patients are forced to lie down.
- Patients with impending respiratory failure (e.g., those with a respiratory rate and/or tidal volume that is decreasing and whose level of consciousness is falling) must be ventilated with a bag-valve mask (including a PEEP valve, if indicated).

Additional Treatment Information

- Cardiogenic pulmonary edema is often accompanied by significant hypertension. Nitroglycerin decreases systemic vascular resistance through a number of mechanisms. The decision to use nitroglycerin is complex, requires a thorough understanding of the pathophysiology of the underlying condition, and assesses multiple clinical variables. There are significant risks to the use of nitroglycerin in these cases.
- CPAP is a non-invasive device that uses positive pressure to improve oxygenation and is very effective in cases of pulmonary edema, regardless of the underlying cause. The greatest benefits of CPAP accrue from its use early in the disease course; paramedics should consider the use of CPAP as soon as pulmonary edema has been identified.

General Information

- *Pulmonary edema is not solely caused by congestive heart failure*. Exposure to toxic products (including smoke, bleach, or chlorine) can produce primary pulmonary edema due to epithelial damage. Pulmonary edema can also occur as a result of drug ingestion or submersion and drowning. These patients are generally not hypertensive, do not have a history of heart disease, and have a history of exposure. Although the in-hospital treatment of these patients is different from those with cardiogenic pulmonary edema, the principles remain the same: oxygen, supportive ventilation as required, and rapid conveyance. CPAP can be effective in these cases.
- Early stage pulmonary edema may present as wheezing ('cardiac asthma'). Salbutamol may alleviate some of these symptoms, however, the wheezes in these cases are associated with airway edema rather than bronchospasm. Salbutamol has sympathomimetic properties that increase the workload of an already dysfunctional heart. The risks and benefits of salbumatmol use must be considered for each individual patient.
- Diuretics are no longer considered a mainstay of out-of-hospital treatment for pulmonary edema.
- Some patients with pulmonary edema will require bag-valve mask ventilation, particularly after positional changes. Paramedics and EMRs must be prepared to intervene during or immediately after a transfer and should strive to minimize patient exertion during these maneuvers.

- Patients in respiratory failure, or who otherwise do not improve with CPAP, should be ventilated using a bag-valve mask. The use of positive end-expiratory pressure (PEEP) valves may be effective in improving both oxygenation and ventilation in these patients.

Interventions

First Responder

- Caution: Keep the patient at rest and avoid exertion during transfers. Bring equipment to the patient, including lifting and transfer devices.
- Position patient sitting upright with legs dependent.
- Keep the patient warm and protect from further heat loss
- Provide supplemental oxygen where indicated
  - → A07: Oxygen Administration
- Conduct ongoing assessment and gather collateral information, such as medications and identification documents
- Establish ingress and egress routes from the patient's location
- Communicate patient deterioration to follow-on responders
- Provide ventilation by bag-valve mask as required; addition of a high-flow nasal cannula may be necessary

Emergency Medical Responder – All FR interventions, plus:

- Provide supplemental oxygen to keep $SpO_2 \geq 94\%$
  - → A07: Oxygen Administration
- Convey early
- Consider intercept with additional resources

Primary Care Paramedic – All FR and EMR interventions, plus:

- Consider continuous positive airway pressure
  - → PR09: Continuous Positive Airway Pressure
- If positive pressure ventilation by bag-valve mask is required, consider use of PEEP valve (5 cmH_2O to start)
  - → PR10: Positive End Expiratory Pressure

Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

- Obtain vascular access; limit fluid administration to minimum required for drug administration and procedures
  - → D03: Vascular Access
- Obtain and interpret 12-lead ECG; correct and manage abnormalities, including arrhythmia and/or ischemia
  - → PR16: 12 Lead ECG
  - → C01: Acute Coronary Syndrome
  - → C02: Bradycardia
  - → C03: Narrow Complex Tachycardia
  - → C04: Wide Complex Tachycardia
- Consider treatment of hypertension:
  - Nitroglycerin
- Consider salbutamol for significant bronchospasm
- If unable to maintain oxygenation or ventilation through non-invasive methods, consider intubation:
  - → B01: Airway Management
  - → PR18: Anesthesia Induction
  - → PR23: Awake Intubation

Critical Care Paramedic – All FR, EMR, PCP, and ACP interventions, plus:

- Identify the probable cause of the pulmonary edema

- Respiratory support is the primary treatment for acute pulmonary edema but this is largely symptom relief. Specific diseases or injuries need to be addressed as the treatments will vary for the presenting clinical picture. (Cardiogenic vs non-cardiogenic)

- → PR27: Mechanical ventilation
  - Consider NPPV
    - High flow
    - BiPAP
    - CPAP
  - Consider Invasive ventilation
    - Consider use of ACV or PCV mode, targeting a Vt 6-8 mL/kg
    - Increase PEEP/FiO2 to SpO_2 ≥90% and/or PaO_2 ≥60 mmHg
    - Pplat < 30 cmH_2O
  - For persistent hypoxemia, consider (may require neuromuscular blockade):
  - Recruitment maneuver
  - Open lung ventilation strategy
  - Arterial and/or venous blood gas analysis may provide guidance for management
- Hemodynamic support (HFpEF vs HFrEF or non-cardiogenic)
  - Preload reduction
    - Furosemide
    - Fluid restriction
  - Afterload reduction
    - ACE inhibitor or ARB
    - MORPHine
  - Vasopressor support
    - NORepinephrine
    - Vasopressin
    - EpiNEPHrine
    - DOPamine
  - Inotrope support
    - Dobutamine
    - Milrinone
  - Consider albumin for hypoalbuminemia
- Treat the presenting disease/illness.

Evidence Based Practice

Pulmonary Edema (CHF)

Supportive

- NiPPV
- Nitroglycerin-IV
- 12-Lead ECG
- Oxymetry Monitoring

Neutral

- Diuretic
- Ultrasound
- Beta Agonist-MDI

- Beta Agonist-Nebulized
- Nitroglycerin-SL

Against

- Narcotic
- Oxygen

References

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Practice Updates

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