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 prehospital 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 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, or if chest pain is present with hypotension, an altered level of consciousness, pale and cool skin, and/or 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 – i.e., those whose respiratory rate and/or tidal volume are 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 and requires a thorough understanding of the pathophysiology of the underlying condition, and an assessments of multiple clinical variables. There are significant risks to the use of nitroglycerin in these cases.
- CPAP is a form of non-invasive device that uses positive pressure to improve oxygenation, and is very effective in cases of pulmonary edema, regardless of 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 and 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 transport. 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 prehospital treatment for pulmonary edema.
- Some patients with pulmonary edema will require bag-valve mask ventilation, particularly after position changes. Paramedics 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

- 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
- Supplemental oxygen as required
  - → A07: Oxygen and Medication Administration
- Provide intermittent positive pressure 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 ≥ 94%
  - → A07: Oxygen and Medication Administration
- Transport early
- Consider ACP intercept

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

- Consider continuous positive airway pressure (requires CliniCall consult)
  - → 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:

- Consider etiology of restrictive lung and correct if possible (e.g., restrictive straps, circumferential burns, pneumo- or hemothorax)
- Improve oxygenation: consider BiPAP, intubation, and mechanical ventilation
  - Consider use of ACV mode, Vt 6-8 mL/kg
  - Increase PEEP/FiO2 to SpO_2 ≥ 90% and/or PaO_2 ≥ 60 mmHg

- For persistent hypoxemia, consider (may require neuromuscular blockade):
  - Recruitment maneuver
  - Open lung ventilation strategy
  - Pressure control ventilation (inverse ratio)
  - Permissive hypercapnia
- Arterial and/or venous blood gas analysis may provide guidance for management
- In air transport, consider a reduced cabin altitude where possible

Evidence Based Practice

Pulmonary Edema (CHF)

References

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