1. Establish the diagnosis of pulmonary edema.
2. Determine whether pulmonary edema is the result of acute ischemia.
3. Determine the severity of pulmonary edema.

### Definition
Pulmonary edema is a life-threatening syndrome caused by accumulation of fluid within the alveoli, leading to disruption of the normal gas exchange process. Severe hypoxemia, failure of tissue oxygenation, acidosis, and widespread organ failure if untreated, rapidly progresses to death.

### Pulmonary Edema: Chest X-ray Appearances
(i) Distended upper lobe veins
(ii) Kerley B lines which are short horizontal lines at the periphery of the lower zone
(iii) Kerley A lines are long fine lines in the upper zone
(iv) Diffuse hazy shadowing from the hilar region ('bat's wing')
(v) Small pleural effusions
(vi) Cardiac enlargement

### Pathophysiology
#### Specific Investigation
- fluid movement = k[(Pc + OSMi) - (Pi + OSMc)]
- Pulmonary edema presents as shortness of breath, orthopnoea, PND, & a cough productive of pink frothy fluid
- Clinical findings are of fine inspiratory crackles on auscultation

#### General
- Age, male sex, lower weight, hypotenremia, and reduced hemoglobin and renal function have been correlated with worse outcome.
- Admission blood pressure is also an important sign of disease severity; however, its correlation with outcome is "U"-shaped.

### General Approach
1. Improving Systemic Oxygenation
2. Arrhythmia Control
3. Intravenous Furosemide and Morphine
4. Intravenous Nitrates
5. Mechanical Ventilation
6. Rule out significant valvular and mechanical cardiac causes of pulmonary oedema

### Pulmonary Edema: Clinical Features
1. Improving Systemic Oxygenation
2. Arrhythmia Control
3. Intravenous Furosemide and Morphine
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6. Rule out significant valvular and mechanical cardiac causes of pulmonary oedema

### Pulmonary Edema: Causes
- Higher admission blood pressure is usually correlated with higher vascular resistance and, hence, worse outcome.
- On the other hand, low blood pressure (<120 mm Hg systolic) on admission is correlated with decreased left ventricular contractility and is a negative prognostic sign.

### Pulmonary Edema: General
- As a patient's condition stabilizes, long-term medical treatment should be established.
- Patients with obvious ischemia, coronary angiography and revascularization should be performed as soon as possible.
- Intravenous nitrates should be administered to all patients with cardiogenic pulmonary edema with a systolic blood pressure of greater than 120 mm Hg on admission.

### Cardio-Pulmonary Oedema

<table>
<thead>
<tr>
<th>Immediate Stabilisation</th>
<th>General Approach</th>
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<tbody>
<tr>
<td>- Intravenous Furosemide and Morphine</td>
<td>- After the initial stabilization, as vascular resistance decreases toward normal values, cardiac index increases, and wedge pressure decreases, the main goals of treatment shift from rapid arterial and venous dilatation to preventing recurrence.</td>
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<tr>
<td>- Intravenous Nitrates</td>
<td>- Because decreased left ventricular contractility and increased systemic vascular resistance are important in the pathogenesis of pulmonary edema, traditional treatments employed during this time period are directed toward rapid increase in left ventricular contractility, prevention of recurrent vasodilatation, and enhancement of diuresis.</td>
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<tr>
<td>- Mechanical Ventilation</td>
<td>- Patients not responding to medical treatment including non invasive ventilation within 10 to 20 minutes, as evident by an increase in arterial oxygen saturation to more than 90%, accompanied by decreased tachypnea and blood pressure, are suffering from refractory pulmonary edema and should be treated by mechanical ventilation.</td>
</tr>
</tbody>
</table>

### Pulmonary Edema: Treatments
#### General
- As a patient's condition stabilizes, long-term medical treatment should be established.
- In patients with obvious ischemia, coronary angiography and revascularization should be performed as soon as possible.
- Patients without clinical evidence of ischemia should be scheduled for a noninvasive test to assess the presence of ischemia and viability, either by radionuclide techniques or by dobutamine stress echo.
- Intravenous nitrates should be administered to all patients with cardiogenic pulmonary edema with a systolic blood pressure of greater than 120 mm Hg on admission.
- Intravenous furosemide and morphine are effective in the rapid development of tolerance, limiting their effectiveness to 16 to 24 hours only.
- Intravenous nitrates are the only treatment modality that has been shown in a prospective randomized study to improve the outcome of patients admitted with pulmonary edema by averting respiratory failure and reducing the need for mechanical ventilation.

### Pulmonary Edema: Pathophysiology
#### General
- Admission blood pressure is also an important sign of disease severity; however, its correlation with outcome is "U"-shaped.
- Higher admission blood pressure is usually correlated with higher vascular resistance and, hence, worse outcome.
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