

## Obstructive Shock

Obstructive shock occurs when there is impaired ventricular filling or an anatomic blockage of the great vessels of the heart, leading to decreased cardiac output despite normal heart function and blood volume.

### Pathophysiology

The central pathophysiological mechanism of obstructive shock is a dramatic decrease in cardiac output (CO) due to impaired preload, increased afterload, or both.

- **Impaired Preload:** In conditions like cardiac tamponade and tension pneumothorax, the external pressure on the heart or great vessels prevents the ventricles from filling adequately. This leads to a low end-diastolic volume, a low stroke volume (SV), and thus, a low CO.
- **Increased Afterload:** In PE, a large clot in the pulmonary artery or its branches creates a significant increase in pulmonary vascular resistance. This forces the right ventricle to work harder to pump blood into the lungs, eventually leading to right ventricular failure and a drastic drop in left ventricular preload and cardiac output.

### Causes

Most common causes include:

- Pulmonary embolism (PE)
- Cardiac tamponade
- Tension pneumothorax
- Constrictive pericarditis

Other causes include:

- Severe pulmonary hypertension
- Acute obstruction of the pulmonic or tricuspid valve
- Venous air embolus
- Hemothorax
- Restrictive cardiomyopathy
- Severe dynamic hyperinflation due to mechanical ventilation
- Left or right ventricular outflow tract obstruction
- Abdominal compartment syndrome

## Diagnosis

- Patient history: Shortness of breath, chest pain or pressure, pleuritic chest pain, recent chest injury, penetrating chest wound, recent cardiac surgery, mechanically ventilated patients with high airway pressures, risk factors for PE including history of blood clots, malignancy, prolonged immobility or recent surgery.
- Physical exam findings (in addition to systemic signs of hypoperfusion):
  - Signs of tension pneumothorax include severe dyspnea, unilateral diminished or absent breath sounds, tracheal deviation away from the affected side, and jugular venous distention (JVD).
  - Signs of cardiac tamponade include:
    - Beck's triad, which consists of hypotension, muffled heart sounds, and JVD.
    - Pulsus paradoxus, a significant drop in systolic blood pressure (greater than 10 mmHg) during inspiration.
  - Signs that may indicate PE include dyspnea, and unilateral leg swelling or tenderness, as PE's often originate from deep venous thrombosis in the legs.
- Diagnostic evaluation:
  - EKG may show sinus tachycardia, low voltage or a classic tamponade finding called electrical alternans (alternating size of the QRS complexes). In PE, it might reveal right-sided heart strain.
  - Chest X-ray can show a tension pneumothorax.
  - Bedside ultrasound will identify pericardial effusion, right ventricular dilation or dysfunction, and pneumothorax.
  - CT pulmonary angiography (CTPA) is the gold standard for diagnosing pulmonary embolism.
  - CT scan of the chest can also identify an aortic dissection or other masses causing obstruction.

## Treatment

- Rapid simultaneous resuscitation and assessment
- Secure the airway, provide supplemental oxygen, and establish IV access.
- Administer intravenous fluids to improve blood pressure and cardiac output. However, this must be done with caution, as excessive fluid in some forms of obstructive shock (e.g., tension pneumothorax or cardiac tamponade) can worsen the patient's condition. A fluid challenge with a smaller volume (e.g., 250-500 mL) can be used to assess the patient's response.
- Vasopressors may be used to increase blood pressure and organ perfusion.

- Once the specific cause of the obstructive shock is identified, the definitive treatment can begin.
  - Tension Pneumothorax: needle decompression allows the trapped air to escape from the pleural space, decompressing the chest cavity and restoring venous return. A rush of air is a positive sign. After needle decompression, a chest tube (tube thoracostomy) is inserted to provide continuous drainage of air and prevent recurrence of the pneumothorax.
  - Cardiac Tamponade:
    - Pericardiocentesis: a needle is inserted into the pericardial sac, often with the guidance of an ultrasound, to aspirate the fluid.
    - Pericardial window or surgical drainage: In cases of traumatic tamponade, loculated effusions, or when pericardiocentesis is unsuccessful, a surgical approach may be necessary. This involves creating a "pericardial window" to allow for continuous drainage or a formal surgical drainage procedure.
  - Massive PE: For a hemodynamically unstable patient with a massive PE, systemic thrombolytic therapy (e.g., alteplase) is the standard first-line treatment. Surgical embolectomy or catheter directed thrombolysis are other options. Once stabilized, long term anticoagulation is necessary to prevent future clot formation.

### Nursing Considerations

- Recognize the specific signs of each type of obstructive shock.
- Anticipate and prepare the patient for an emergency procedure to relieve the obstruction.
- Monitor vital signs, mental status and urine output frequently.
- Place 2 large bore IV lines for fluids and vasopressors.
- Titrate vasopressors to maintain systolic or mean arterial pressure targets.
- Provide emotional support and patient education.

### References

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