Cardiogenic Shock Pathophysiology

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Cardiogenic Shock
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Introduction
What is Cardiogenic Shock?
• Cardiogenic shock is defined as a state in which ineffective cardiac output leads to inadequate tissue perfusion (van Diesen et al., 2017).
• Defining characteristics include:
  • Low cardiac output
  • Low perfusion
  • Low tissue oxygenation
  • Acute myocardial infarction

Pathophysiology Processes
Signs and Symptoms
• Hemodynamic Criteria:
  • Systolic blood pressure (SBP) < 90 mmHg for greater than 30 minutes
  • Use of inotropes or vasoactive support to maintain SBP > 90 mmHg
  • Reduced cardiac output, 2.0-2.2 L/min/m² with vasoactive and/or inotropic support (Shah et al., 2019)
  • Signs of end-organ hypoperfusion
  • Tachycardia
  • Low urine output
  • Altered mental status
  • Pale, cool, clammy peripheries
  • Increased lactate levels
  • Low mixed venous saturation (<90%)
  • Shortness of breath

Underlying Pathophysiology
• Acute myocardial infarction (AMI) accounts for 80% of cardiogenic shock cases (Brener et al., 2020)
• Cardiac ischemia secondary to AMI causes left ventricular dysfunction/failure and decreased cardiac stroke volumes (van Diesen et al., 2017)
• Diminished cardiac output and hypotension refractory to fluid resuscitation lead to tissue hypoperfusion and ischemia (Valdavuto et al., 2019)
• Tissue ischemia causes compensatory peripheral vasconstriction that decreases cardiac workload and worsens cardiac ischemia (Valdavuto et al., 2019)
• Compensatory catecholamine release to stimulate cardiac contractility causes further stress upon the damaged myocardium (Valdavuto et al., 2019)
• Increased cardiac workload and stress potentiates reperfusion injury and ischemia causing worsened shock state ()
• Necrocardiac related myocardial injury to valves, pericardium, or electrical pathways can also lead to impaired cardiac function and cardiogenic shock (Brener et al., 2020)
• Chronic heart failure (CHF) with acute decompensation may also present in cardiogenic shock state
• In CHF, chronic spongiosis of remod-antigens-adalastin system causes ventricular hypertrophy leading to cardiac dysfunction (Brener et al., 2020)

Significance of Pathophysiology
The cyclical nature of cardiogenic shock leads to progressive cardiac dysfunction and worsened cardiac and tissue ischemia (Shah et al., 2019) in normal cardiac physiology, the supply and demand of oxygen to the heart and body is autoregulated by multiple compensatory mechanisms. In cardiogenic shock, homeostasis is disrupted and compensatory mechanisms such as peripheral vasoconstriction and catecholamine release cause increased myocardial demand which worsens primary insult to the heart (Valdavuto et al., 2019). Continued and worsening damage of heart tissue exacerbates cardiac dysfunction causing total end-organ failure and high mortality rates (Shah et al., 2019)

Treatment
• Treatment of cardiogenic shock focuses on treating/reversing the underlying causative process and supportive therapies
• Coronary reperfusion and revascularization for acute myocardial infarction related cardiogenic shock (van Diesen et al., 2017)
• Supportive therapies include:
  • Oxygen administration and mechanical ventilation (Valdavuto et al., 2019)
  • Medication and/or mechanical blood pressure support (Ulbig et al., 2020)
  • Mechanical support devices include:
    • Intra-aortic balloon pump (IABP)
    • Impella
    • Vascular assisted device (VAD)
    • Extracorporeal membrane oxygenation (ECMO)
    • TandemHeart
  • Fluid resuscitation with goal of euvolemia (Shah et al., 2019)
• Frequent monitoring of intra-cranial pressures is recommended in the use of pneumatically assisted catheter (Brener et al., 2020)

Conclusion
• Cardiogenic shock is a complex state of hypotension and low cardiac output leading to tissue hypoperfusion (Brener et al., 2020)
• Treatment of the cyclical nature of cardiogenic shock is focused on fixing the underlying tissue and supportive therapies (van Diesen et al., 2017)
• Further research is necessary to understand cardiogenic shock and evaluate evidence-based interventions that improve the high mortality rates of cardiogenic shock (Ulbig et al., 2020)

Implications for Nursing Care
• Admission to critical care unit is essential to treat and monitor hemodynamic instability in addition to general critical care interventions (Shah et al., 2019)
• Early identification and treatment of cardiogenic shock are paramount to the success of interventions (Mandawat & Rao, 2017)
• Models of care should include a multidisciplinary care team specifically designated for patients with cardiogenic shock (van Diesen et al., 2017)
• Tertiary care centers with cardiac specialists should be utilized as they have the expertise and resources available to treat the complications of cardiogenic shock (van Diesen et al., 2017)

References

Additional Sources

Why Cardiogenic Shock?
• Despite advances in modern medicine, mortality in patients with acute myocardial infarction complicated by cardiogenic shock is approximately 50% (Shah et al., 2019).
• In contrast to other acute cardiac conditions, cardiogenic shock does not have proven evidence-based practice protocols that improve outcomes and lacks definitive treatment strategies (Ulbig et al., 2020)
• Continued research is necessary to advance current clinical practices and treatment options (Shah et al., 2019)

Clinicians who manage patients with cardiogenic shock must be aware of the complications involved.

“Potential hemodynamic presentations of cardiogenic shock” (van Diesen et al., 2017, p. 235).

“potential findings suggestive of the ventricle primarily involved in cardiogenic shock. Both sides often contribute to the clinical presentation and physical exam findings” (Valdavuto et al., 2019, p. 2).