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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 Diepen et al., 2017).

Defining characteristics include:

- Hypotension
- Low cardiac output/index
- End-organ hypoperfusion (Brener et al., 2020)

Acute Myocardial Infarction (AMI) with left ventricular dysfunction is the leading cause of cardiogenic shock in the United States. (Mandawat & Rao, 2017)

Pathophysiological Processes

Signs and Symptoms

- Hemodynamic Criteria:
 - Systolic blood pressure (SBP) <90 mmHg for greater than 30 minutes
 - Use of vasopressors or inotropic support to maintain SBP >90 mmHG
 - Reduced cardiac output, 2.0-2.2 L/min/m² with vasopressor and/or inotropic support (Shah et al., 2019)
- Signs of end-organ hypoperfusion
 - Tachycardia
 - Low urine output
 - Altered mental status
 - Pale, cool, clammy peripheries
 - Increase lactate levels
 - Low mixed venous saturation (<65%)
 - Shortness of breath (Shah et al., 2019)

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 Diepen et al., 2017)
- Diminished cardiac output and hypotension refractory to fluid resuscitation lead to tissue hypoperfusion and ischemia (Vahdatpour et al., 2019)
- Tissue ischemia causes compensatory peripheral vasoconstriction that increases cardiac workload and worsens cardiac ischemia (Vahdatpour et al., 2019)
- Compensatory catecholamine release to stimulate cardiac contractility causes further stress upon the damaged myocardium (Vahdatpour et al., 2019)
- Increased cardiac workload and stress potentiates cardiac injury and ischemia causing worsened shock state (Noncoronary 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 upregulation of renin-angiotensin-aldosterone 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 (Vahdatpour et al., 2019). Continued and worsening damage of heart tissue exacerbates cardiac dysfunction causing vital 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 Diepen et al., 2017)
 - Supportive therapies include:
 - Oxygen administration and mechanical ventilation (Vahdatpour et al., 2019)
 - Medication and/or mechanical blood pressure support (Uhligh et al., 2020)
 - Mechanical support devices include:
 - Inta-aortic balloon pump (IABP)
 - Impella
 - Vascular assistive device (VAD)
 - Extracorporeal membrane oxygenation (ECMO)
 - Tandemheart
 - Fluid resuscitation with goal of euvolemia (Shah et al., 2019)
- Frequent monitoring of intra-cardiac pressures is recommended with the use of pulmonary artery catheter (Brener 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 Diepen et al., 2017)
- Tertiary care centers with cardiac specialists should be utilized as they have the expertise and resources available to treat the complexities of cardiogenic shock (van Diepen et al., 2017)

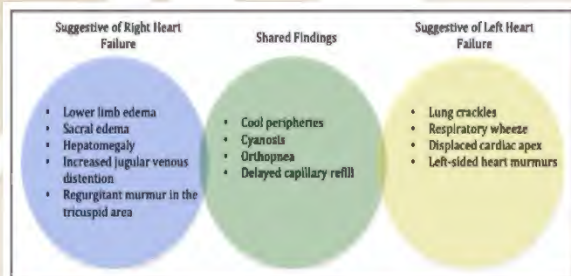
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Peripheral Circulation	Volume Status	
	Wet	Dry
Cold	Classic Cardiogenic Shock (↓CI; ↑SVRI; ↑PCWP)	Euvolemic Cardiogenic Shock (↓CI; ↑SVRI; ↔PCWP)
Warm	Vasodilatory Cardiogenic Shock or Mixed Shock (↓CI; ↓/↔SVRI; ↑PCWP)	Vasodilatory Shock (Not Cardiogenic Shock) (↑CI; ↓SVRI; ↓PCWP)

"Potential hemodynamic presentations of cardiogenic shock.

CI indicates cardiac index; PCWP, pulmonary capillary wedge pressure; and SVRI, systemic vascular resistance index" (Van Diepen et al., 2017, p. 235).



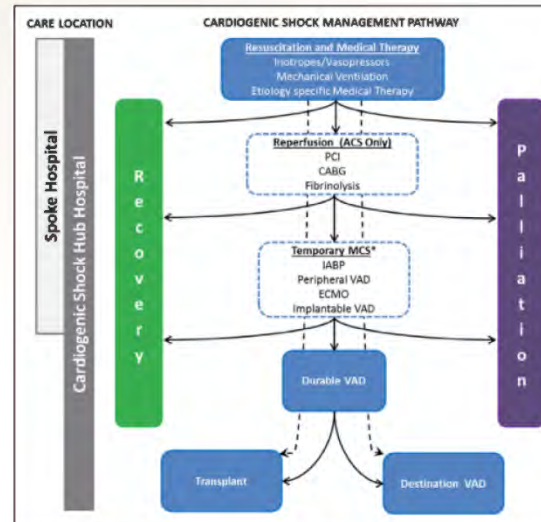
"Physical findings suggestive of the ventricle primarily involved in cardiogenic shock. Both sides often contribute to the clinical presentation and physical exam findings" (Vahdatpour et al., 2019, p.3).

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 precise evidence-based practice protocols that improve outcomes and lacks definitive treatment strategies (Uhligh 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 complexities involved.

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 issue and supportive therapies (van Diepen 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 (Uhligh et al., 2020)



"Potential cardiogenic shock care pathway" (van Diepen et al., 2017, p. 242).

