Heart Failure with Reduced Ejection Fraction

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Heart Failure with Reduced Ejection Fraction
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Introduction
Heart failure (HF) is a complex disease that requires a high level of understanding of pathophysiology and physics. The basic idea behind HF is an inadequate flow of oxygenated blood forward due to failure of the heart to pump effectively. As the disease progresses to an advanced stage, it can be increasingly devastating to patients’ activities of daily living.

Advanced stage heart failure is defined by Scirto et al. as an unstable condition that no longer responds to standard treatment (2017). Tracing end stage heart failure can be both complex yet common in the intensive care so it’s important for nurses to work together to understand the pathophysiology of the disease. Death often occurs in this stage without early intervention to decrease symptoms and prolong a patient’s lifespan.

Heart failure has been significantly studied but is a difficult topic for students to understand. With increasing number of admissions nurses need a deeper understanding of the disease process.

Heart failure accounts for an abundance of hospital admissions and mortality yearly; however, as HF continues to deform it’s time to advance, inclusive of death continues to decline (Lummet et al., 2018).

The late stages of heart failure can require drastic changes in quality of life (Scirto et al., 2018). This is an inevitable stage when medication alone don’t work in a heart overtaxed, patients lose autonomy, or palliative care (Scirto et al., 2019).

Signs and Symptoms
Many of the signs and symptoms are related to a backup of blood flow from the congested venous side of the heart. The congestion specifically related fluid overload into the body while left sided fluid creates fluid buildup into the lungs. These congestive symptoms are however interrelated with the heart failure in the failure of the other. Bouch et al. noted that while both HF with reduced EF and HF with preserved EF had left sided failure, the reduced EF group had a worsened symptoms (2017).

Left sided
Congestive congestion
Cough
Dyspnea
Fatigue
Orthopnea
Pallor
Romans
Exertional dyspnea
Cyanosis

Pathophysiology
The Pathophysiology of heart failure with reduced EF is related to an impaired cardiac contractile function. The most common cause of this type of heart failure is myocarditis but myocardiolysis and cardiomyopathies, increased myocardial wall tension and decreased cardiac output (Maceama & Huerther, 2018). The right side of the heart does not improve properly a decrease cardiac output occurs creating a backup in oxygenated blood flow. As the disease worsens more systems begin to suffer from lack of oxygen and the body goes into cardiogenic shock.

Cardiogenic shock is determined by the volume of blood pumped out of the left ventricle (LV) divided by heart rate to determine the liters per minute (Maceama & Huerther, 2018). Cardiac output is further determined by three key values, preload, contractility, and afterload. Preload is defined as the stretch or length of the ventricle muscle fibers at end-diastolic (Colaco & Cohn, 2020). Contractility is defined as the force generated at any given preload (Colaco & Cohn, 2020). Afterload is defined as the impedance during ejection (Colaco & Cohn, 2020).

Classification
New York Heart Association (NYHA)
1. No limitation of physical activity
1a. Fatigue, palpitations, or dyspnea (I)
1b. Limitation of physical activity, ordinary amount of activity causes fatigue, palpitations, dyspnea (II)
2. Inability to carry on any physical activity, ordinary amount of activity causes fatigue, palpitations, dyspnea, or orthopnea (III)
3. Need to avoid exercise, presence of symptoms at rest (IV)

Testing
• Vital signs to assess dyspnea, tachycardia, tachypnea
• EKG to assess ischemia and ventricular hypertrophy
• Right heart catheterization to measure heart chamber pressure

Scirto et al. (2018) noted that the time it takes to achieve the desired pressure in the right pulmonary artery when vasodilation alone don’t work is a heart overtaxed, patients lose autonomy, or palliative care (Scirto et al., 2019).

Pathology
Left sided heart failure with reduced ejection fraction (EF) is defined as EF ≤ 40% with an inability of the heart to produce a cardiac output that adequately perfuses organs (Maceama & Huerther, 2018). When the left side of the heart doesn’t pump properly a decrease cardiac output occurs creating a backup in oxygenated blood flow. As the disease worsens more systems begin to suffer from lack of oxygen and the body goes into cardiogenic shock. Cardiogenic shock is determined by the volume of blood pumped out of the left ventricle (LV) divided by heart rate to determine the liters per minute (Maceama & Huerther, 2018). Cardiac output is further determined by three key values, preload, contractility, and afterload. Preload is defined as the stretch or length of the ventricle muscle fibers at end-diastolic (Colaco & Cohn, 2020). Contractility is defined as the force generated at any given preload (Colaco & Cohn, 2020). Afterload is defined as the impedance during ejection (Colaco & Cohn, 2020).

Nursing Implications
• Nurses are first line caregivers and therefore recognize changes in patients prior to others. Heart failure can be decompenstate quickly, the nurse can recognize the signs and symptoms and call the appropriate provider as soon as possible to avoid organ damage or increase mortality rate. Preventive care measures are beneficial to reduce the risk of hospitalization and mortality rates (Colaco & Cohn, 2020).

• Understanding the concepts of preload, contractility, and afterload as well as how each measurement affects the heart can lead to better patient outcomes (Stauner et al., 2019).

• Nurses need an in-depth hemodynamic understanding to titrate medications based on each patient’s condition.

• PALLIAVE – beneficial for those who already have diffused end organ damage and need advanced therapies (Servertino et al., 2019).

Medications
Preload reduction
Diuretic therapy (Loop diuretic, Thiazide diuretic, and Angiotensin receptor antagonist) – decreases total body fluid (Dunley & Colaco, 2020)

Afterload Reduction
• Angiotensin receptor-neprilysin inhibitors (ARNIs) or converting enzyme (ACE) inhibitor or angiotensin receptor blocker (ARBs) – One of these agents help a patient at time to slow the remodeling of the left ventricle upon a patient (Meyer, 2020). Should be used in patients with systolic heart failure (Turgason et al., 2019)
• Diuretic therapy – benefits heart failure with reduced EF patients who already have fluid overload and high sodium levels (Green, 2018)

Dunley & Colaco, 2020)

Conclusion
• Heart failure is never going to be eradicated; however, the current understanding of the disease process, prescribed treatments, and interventions need to continue to improve to cure more lives.

• As the population continues to grow-older, more instances of heart failure will occur.

• A deep understanding of physiology and pathophysiology can help a nurse provide appropriate care for the diverse spectrum of the disease process and medications involved.

• The pathophysiology includes an initial sympathetic and hormonal response, over-long of these responses may lead to cardiac remodeling, lead to additional fluid overload, and eventually failure to compensate for demand (van Dillen et al., 2018)

• Sarcoidosis and diabetes (ETRE) – AHF has shown to reduce mortality and hospitalizations compared with the process dose of ACE inhibitors (Meyer, 2020)

• A LVAD can improve quality of life and increase lifespan compared to standard therapy treatment of end stage heart failure, however they do have adverse risks (Gummert et al., 2019).

• Heart transplant is the gold standard treatment (Gummert et al., 2019).

• Palliative Care can be beneficial for those patients whose pathophysiology is too complex to be treated to the whole body to reverse (Servertino et al., 2019).

Physiology
Poiseuille’s law demonstrated that the largest impact on resistance to flow is the radius of viscosity (2017). Ohm’s equation is rewritten in applied physics to demonstrated that the resistance to the flow. Poiseuille’s law demonstrated how resistance to flow can be both complex and inadequate in fluids. Patients’ activities of daily living. Resistance to flow, shown increasing in sodium, water, and blood pressure, but mechanisms further worsen preload and afterload. The heart then begins to compensate by allowing transforming of the myocytes that enhances the ejection fraction (Colaco & Cohn, 2020). The Law of Laplace describes wall thickness being indirectly related to wall stress therefore increasing the size of the muscle decrease the stress planed on the heart to reverse. This unfortunately decreases the amount of blood that can fit in the ventricle further complicating the EF.

References
Gummert et al. (2019).
Dunley & Colaco, 2020)

Dunley & Colaco, 2020)

Mccance & Cohn (2020).

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Stauner et al., 2019)

Servertino et al., 2019)

Gummert et al., 2019.

Gummert et al., 2019.

Gummert et al., 2019.

Lummet et al., 2018.

Stauner et al., 2019)