Heart Failure Pathophysiology and Drug Treatment for Advanced Practice Nurses

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Types and Risk Factors of Heart Failure

According to research, heart failure causes substantial burdens in healthcare settings, which leads to an increase in mortality, morbidity, and the cost of healthcare. Heart failure is one of the leading causes of death, killing approximately 610,000 people in the United States annually. Globally, the disease kills about 26 million per year. There are four types of heart failure: systolic, diastolic, right-sided, and congestive heart failure. In systolic failure, the left ventricle loses its capability of contracting normally, and thus, the blood pumping pressure from the heart reduces. Therefore, the heart fails to pump enough blood for circulation. On the other hand, in diastolic failure, the left ventricle loses its ability to relax normally. As a result, the heart fails to be filled with enough blood during the rest period, which occurs between two consecutive beats.

The right-sided heart failure, also known as right ventricular (RV) heart failure, arises from the failure of proper functioning of the left ventricle. The failure of the left ventricle leads to the transfer of increased fluid pressure back to the lungs and this finally leads to damage to the right side of the heart. The injury of the right ventricle results in loss of its pumping power, forcing blood to flow back to the veins. The disorder leads to swelling of the legs, ankles, and abdomen, like the liver and GI tract.

Congestive heart failure (CHF) is caused by the slowing of the blood flowing out of the heart, forcing the blood to return to the heart via the veins back up, leading to congestion in body tissues. CHF leads to swelling (edema), which is most common in the legs and ankles but can also be seen in other parts of the body. Sometimes, there is a collection of fluid in the lungs, which inhibits proper breathing, hence resulting in shortness of breath. This is known as pulmonary edema and can lead to respiratory distress if left untreated. Moreover, heart failure hinders the capability of the kidneys to dispose of water and sodium in the body. The retained water also elevates the swelling of body organs (edema). Study shows that the risk of developing congestive heart failure (CHF) is about 20% for both men and women.

Heart failure kills millions of people each year, and thus, it is essential to understand the risk factors and characteristics of the disorder. Risk factors are categorized into two classes, namely modifiable risks and non-modifiable risks. Modifiable risk factors can be controlled and include things such as obesity, high intake of fats, and smoking. In contrast, non-modifiable risk factors consist of things that we have no control over, and these are gender, age, and heredity. According to studies, heart disease results from injuries that occur to the inner layers and linings of the arteries. The damage to these

arteries leads to a build-up of plaques, especially in areas where the damage has occurred. Factors contributing to heart injuries include smoking, sugar elevation in the blood arising from diabetes or insulin resistance, inflammation of blood vessels, increased quantities of cholesterol in the blood, and high blood pressure. The purpose of this paper is to conduct in-depth research on heart failure based on the setting of the ethnopharmacological foundation for advanced practice nurses.

Disease Processes

There are various disease processes causing heart failure. Some of these include diastolic, systolic, right ventricular, and congestive heart failure. Both systolic and diastolic lead to failure of the left ventricle. A person suffers from systolic heart failure when the heart muscles lose their capability of contracting normally. It is important for the heart to undergo contraction to pump oxygenated blood out to the body. However, the weakening and enlarging of the heart result in this condition, which in turn leads to the inability of the heart to pump enough blood for circulation. According to research, this condition is more common in men than women. Conversely, diastolic heart failure, also known as diastolic dysfunction, takes place when the muscles of the heart become stiffer than usual. The stiffness inhibits the filling of the heart with blood which leads to a lack of proper supply of blood to the rest of the body organs. Studies show that diastolic dysfunction is more common in women than in men.

Right ventricular heart failure occurs when the right side of the heart fails to execute its functions properly. Research shows that this condition is usually triggered by the failure of the left side of the heart. Blood accumulation in the lungs as a result of left-sided heart failure forces the right ventricular to work harder in unfavorable conditions. Consequently, the right side of the heart strains, leading to right ventricular heart failure. Research also points out that right ventricular heart failure may arise from other conditions like lung disease. Mayo Clinic shows that right ventricular heart failure is marked by swelling, which occurs in the lower extremities. The swelling arises from fluid backup in the feet, legs, and abdomen.

Congestive heart failure interferes with the pumping power of the heart muscles. The condition mostly refers to the stage in which there is a building up of fluids around the heart, which inhibits the proper pumping of blood from the heart to the other body organs. Science proves beyond doubt that CHF occurs when the ventricles fail to pump sufficient volumes of blood to the body tissues. If left untreated, the end result is the backing of blood in the liver, lungs, abdomen, and lower body, which can lead to death. Therefore, it is advisable for anyone suspected of having this condition to seek immediate medical assistance before the disorder grows to a life-threatening stage.

A.1. Pathophysiology

Heart failure manifests itself in clinical settings when the heart fails to supply sufficient quantities of

blood for maintaining metabolic requirements for systemic venous return. The disorder results from various mechanisms like salt and water retention disorders, pump function disorders, and neuro-hormonal activation disorders (Palazzuoli, 2010). The disease establishes itself in the body when the cardiac muscles function abnormally, causing the heart not to pump the required volumes of blood. There are numerous factors that lead to injury of the heart, which include smoking, blood vessel inflammation, high blood pressure, and increased quantities of cholesterol in human blood.

Research shows that in a period of one year, the heart experiences four million beats. These beats are enough to pump enough blood to fill an oil tanker during the lifetime of human beings. The heart consists of striated cardiac muscles and receives the supply of oxygen and nutrients from the coronary arteries. The damage to cardiac muscles takes place with time in some people leading to the weakening of the ability of the heart to pump blood. The inadequate pumping of blood forces a fluid build-up in the liver, lungs, legs, and other vital body organs.

There are other disorders that lead to heart failure. Some of these include anemia, diabetes, obstructive sleep apnea, obesity, cardiac muscle disease, and cardiomyopathy. Furthermore, heart valve disorders can also cause heart failure. Valves that are leaking or even damaged force the heart to pump blood harder than normal. The primary pathologies of heart failure include the lowered output of cardiac muscles, which causes an increase in the heart rate, a reduced reserve of cardiac muscles, blood overloading of the ventricle during diastole, hypertrophy, and a decrease of stroke volume as the ventricle rises at the end of systole.

A2. Standard of Practice

The Clinical Practice Guidelines, which have been published by the National Guideline Clearinghouse (NGC), drive the national standard of practice for heart failure. The NGC offers recommendation guidelines on current evidence-based practices that assist healthcare professionals in providing safe and effective care to individuals suffering from heart failure. The evidence-based practice guidelines are potentially useful in maximizing patient outcomes.

The American College of Cardiology recommends that any patient suspected to suffer from heart failure should undergo a thorough history and physical examination which should be conducted by a physician. The diagnosis will help in the identification of any cardiac or non-cardiac disorders and any potential behavior that may lead to the progression of the disorder in the human body. Additionally, the American College of Cardiology provides that physicians should assess volume status and other essential signs as well as the weight of the patient, presence of peripheral edema and Orthopnea, and jugular venous pressure because they account for some of the fluid retention symptoms. Besides, healthcare professionals should record risk scores upon patient assessment as this aids in estimating the risk of mortality in patients living with heart disease.

Patients showing signs and symptoms of heart failure should undergo initial laboratory tests such as

complete blood count, serum creatinine, serum electrolytes, glucose, liver function tests, troponin, urinalysis, bun, fasting lipid profile, and thyroid stimulating hormone tests. Research is still in progress to improve the outcomes of the therapies already proposed since heart failure is associated with high mortality rates, increased rates of hospitalization, and a decrease in the quality of life. The effect of therapies may not be easily noticeable because heart failure is a chronic condition.

A2a. Pharmacological Treatments

There are various drugs used in the treatment of heart failure. Some of these include cardiac glycosides, diuretics, aldosterone receptor antagonists, beta-adrenoceptor antagonists, angiotensin-converting enzyme inhibitors (ACE), angiotensin II receptor blockers, and anti-thrombotic agents. Some of these medications are discussed below.

Cardiac Glycosides

These drugs are manufactured from the foxglove plant (*Digitalis purpurea*). William Withering was the first one to describe the therapeutic benefits of digitalis in 1875. The drugs were originally used to treat dropsy, which is another name for edema. Scientific research has established that digitalis is most useful for treating edema arising from a weakened heart. These medications function by inhibiting Na^+/K^+-ATPase, which moves sodium ions inside the cell and potassium ions outside the cell. Cardiac glycosides lead to an increase in sodium concentration since they inhibit Na^+/K^+-ATPase. The process leads to intracellular calcium accumulation via the Na^+-Ca^+ exchange system. Increased intracellular calcium in the heart results in more release of sarcoplasmic reticulum. As a consequence, more calcium is available to bind to troponin-C, hence increasing contractility (inotropy). Na^+/K^+-ATPase inhibition in the vascular smooth muscles increases depolarization resulting in smooth contraction of muscles and vasoconstriction.

Diuretics

Diuretics have been popular for many centuries, and research shows that they were the first therapeutic interventions for CHF. Mercurial-based diuretics were in use for the treatment of edema as early as the 1600s. In the 20th century, the carbonic anhydrase inhibitor was invented, followed closely by thiazide diuretics and, finally, loop diuretics. Research shows that diuretics are the most commonly prescribed drug for treating heart failure in the United States. They are integral components in treating chronic heart failure. Furosemide, bumetanide, ethacrynic and torsemide are the most common loop diuretics. The diuretics work by inhibiting Na-K-2Cl cotransporter in the loop of Henle’s thick ascending limb. In the act of hindering the reabsorption of sodium, these drugs also reduce the reabsorption of water.

Aldosterone Receptor Antagonists

Aldosterone is a hormone that is secreted by the zona glomerulosa found in the adrenal glands. The hormone was initially isolated by Simpson and Tait about 150 years ago. Studies have established that the hormone enhances the reabsorption of potassium and sodium in the kidney. Therefore, it is classified as a mineralocorticoid hormone. A decrease in renal perfusion through angiotensin II, adrenocorticotropic hormone, and hyperkalemia stimulates the release of aldosterone. Aldosterone receptor antagonists function by binding of mineralocorticoid in the renal epithelial cells. According to research, aldosterone increases coronary inflammation, myocardial fibrosis, ischemic, cardiac hypertrophy, ventricular arrhythmias, and necrotic lesions. Spironolactone and eplerenone are the two main aldosterone antagonists that are commercially available. The difference between the two forms of drugs lies in the fact that spironolactone is nonselective whereas eplerenone is selective to the aldosterone receptor. Studies show that the two drugs improve the mortality and morbidity of patients with advanced heart failure.