Diagnosis and Management of Heart Failure

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Purpose

Heart failure is a chronic condition affecting millions of people today. Early diagnosis and treatment can help people who have heart failure live longer, more active lives. This continuing education course for healthcare professionals explores the causes, clinical presentation, diagnosis and management of heart failure.

Objectives

After successful completion of this course, you will be able to:

1. Identify the causative factors for heart failure
2. Describe the pathological changes associated with heart failure
3. Recognize the signs and symptoms of heart failure
4. Classify the stages of heart failure using the New York Heart Association (NYHA) functional classification system
5. Discuss some pharmaceutical interventions for managing heart failure
6. Outline the nursing care and management of a patient in heart failure

Introduction

Heart failure is a condition in which one or both ventricles cannot pump sufficient blood to meet the metabolic needs of the body (Centers for Disease Control (CDC), 2016). It is characterized by one or both of the following:

- Clinical indications of intravascular and interstitial volume overload (dyspnea, crackles and edema)
- Clinical indications of tissue hypoperfusion (fatigue and exercise intolerance)

Heart failure, also known as congestive heart failure, is a chronic condition that develops over time. As it progresses, the heart's pumping action grows weaker. In some cases, the heart can't fill with enough blood; in other cases, the heart can't pump blood to the rest of the body with enough force. The condition can affect the right side of the heart only, or it can affect both sides of the heart (most common).

Did You Know

Heart Failure in the United States

- About **5.7 million** adults in the United States have heart failure
- One in 9 deaths in 2009 included heart failure as contributing cause
- **About half** of people who develop heart failure **die within 5 years** of diagnosis
- Heart failure costs the nation an estimated **$30.7 billion** each year. This total includes the cost of health care services, medications to treat heart failure, and missed days of work.

(CDC, 2016)

Glossary

Afterload

This represents the force that the contracting heart must generate to eject blood from the left ventricle.

The main components of afterload are ventricular wall tension and the systemic vascular resistance (SVR).

There is an inverse relationship between afterload and ventricular emptying, such that elevated afterload impairs emptying and increases ventricular work.

Cardiac Contractility

This refers to the mechanical performance of the heart and the ability of the cardiac muscle to contract and shorten against a load.

Cardiac Output

Cardiac output (CO) is the amount of blood that the heart pumps out every minute. It reflects how often the heart beats per minute (HR) and how much blood the heart pumps out with each beat (stroke volume or SV).

Stroke volume is a function of preload, afterload and cardiac contractility.

$$CO=HR \times SV$$

Cardiac Reserve

The heart has the amazing capacity to adjust its activity to meet the demands of the body. This ability to increase cardiac output during increased activity is known as the cardiac reserve.

Preload
This term is used to describe the tension that exists in the walls of the heart because of diastolic filling. It reflects venous return and the work load that the heart encounters before it begins to contract.

Pulmonary capillary wedge pressure (PCWP) and central venous pressure (CVP) are used to assess preload.

Anatomy & Physiology of the Heart: A Quick Review

The human heart is a four-chambered pump made up of two receiving chambers (atria) and two pumping chambers (ventricles).

The right atrium receives oxygen-depleted blood returning from the body through the superior and inferior vena cava. It is a thin walled, low-pressure system, and is home to the sinoatrial (SA) node, which is the pacemaker of the heart.

The right ventricle is also a thin walled, low pressure chamber that receives blood from the right atrium when the atrioventricular valve (tricuspid valve) is open. When this valve is open, and the chamber is resting, or filling with blood (diastole), typical right ventricular pressures are equal to pressures in the right atrium. When the valve closes and contraction (systole) begins, pressures rises enough to pump blood forward to the lungs via the right and left pulmonary arteries. The blood is then oxygenated in the lungs.

The left atrium, another thin walled, low-pressure chamber, receives oxygen-rich, blood from the pulmonary circuit, via the right and left pulmonary veins. Since normal resting pressures (diastolic pressures) in the left atrium is less than the pressure in the lungs, blood is more easily returned from the higher pressure in the lungs to the lower pressure in the left atrium.

The left ventricle is a thick-walled chamber that receives blood from the right atrium. When the atrioventricular valve dividing the left atrium and ventricle (the mitral valve) closed and contraction (systole) begins, pressures must be generated within the left ventricle to overcome the body's systemic vascular resistance (SVR). When the ventricle generates enough pressure to overcome SVR, blood moves forward, out the semilunar valve (aortic valve) and into the aorta. There it is transported throughout the body and eventually returns to the right atrium where the oxygenation process begins again.

Types of Heart Failure

Let's examine the different types of heart failure and their causes.

Right-Side Heart Failure

- Also, known as a pump problem, occurs if the heart can't pump enough blood to the lungs to pick up oxygen

- Thus, fluid backs up into the extremities, causing peripheral edema
- An older term for right-sided heart failure is congestive heart failure

Left-Side Heart Failure
- Also, known as a filling problem, occurs if the muscles of the left ventricle cannot relax sufficiently to allow for adequate refilling
- Thus, the heart can't pump enough oxygen-rich blood to the rest of the body and fluid backs up into the lungs, causing pulmonary edema

Acute Versus Chronic Heart Failure

Acute Heart Failure

Is an emergency in which a patient with asymptomatic heart failure decompensates after an acute injury to the heart, such as a myocardial infarction (MI).

Chronic Heart Failure

A long-term syndrome in which the patient experiences persistent signs and symptoms over an extended period, likely because of a pre-existing cardiac condition.

Did You Know?

Heart failure does not mean that the heart has stopped; it means the heart cannot keep up with the work required of it (AHA, 2016c).

Common Causes of Heart Failure

Any condition that damage or overwork the heart muscle can cause heart failure over time. As the cardiac muscle weakens, its ability to fill with and/or pump blood diminishes. Certain proteins and other substances may be released into the blood. These substances have a toxic effect on the heart and blood flow, and they worsen heart failure.

The leading causes of heart failure are diseases that damage the heart. These include coronary artery disease (CAD), hypertension and diabetes.

Coronary Artery Disease (CAD)

Coronary Artery Disease, or CAD, is a condition in which plaque builds up inside the coronary arteries. Plaque is made up of fat, cholesterol, calcium, and other substances found in the blood, and narrows the arteries and reduces blood flow to the cardiac muscle. Atherosclerosis also increases the risk of blood clotting. CAD can lead to angina, myocardial infarction and even death (AHA, 2016b; AHA, 2016d).

Hypertension

Systemic or pulmonary hypertension increases the heart's workload, leading to hypertrophy of its muscle fibers. This hypertrophy may impair the heart's ability to fill properly during diastole, and the hypertrophied ventricle may eventually fail.

Blood pressure is considered elevated if it stays at or above 140/90 mmHg over time. If there are co-existing risk factors such as diabetes or chronic kidney disease, elevated high blood pressure is defined as 130/80 mmHg or higher (NIH, 2015a).

Diabetes

Diabetes is a disease in which the body's blood glucose, or blood sugar, level is too high. Normally, the body breaks down food into glucose and then carries it to cells throughout the body. The cells use insulin to turn the glucose into energy.

In diabetes, the body doesn't make enough insulin or doesn't use its insulin properly. Over time, high blood sugar levels can damage and weaken the heart muscle and the blood vessels around the heart, leading to heart failure (NIH, 2015b).

Cardiomyopathy

Cardiomyopathy may be idiopathic (cause unknown) or due to myocarditis. In this disease process, cellular necrosis and fibrosis lead to decreased contractility. Heart failure due to cardiomyopathy usually becomes chronic and progressive.

Cardiac Valvular Disease

Cardiac valvular disease can lead to heart failure. Cardiac valves ensure that blood flows in one direction.

In cardiac valvular disease, either the valve openings become too narrow and blood has a difficult time crossing the valves (stenosis) or the valves become incompetent, allowing blood to leak across the valves when they are supposed to be closed (regurgitation).

Valvular stenosis can cause "damming up" of the blood behind the valve. This damming up of blood leads to increased pressure in the cardiac chambers behind the valve.

Valvular regurgitation

Valvular regurgitation allows blood to wash backwards across the valve when the valve should be closed. This extra volume of blood produced by this backwash causes dilation of the cardiac chambers receiving the extra blood.

Increased pressures and increased blood volume

Both increased pressures and increased blood volume in any of the cardiac chambers can eventually produce permanent weakening of the cardiac muscle, and can ultimately lead to heart failure.

Other Factors

Other factors that can injure the heart muscle and lead to heart failure include radiation, chemotherapy, thyroid disorders, alcohol and cocaine abuse, HIV/AIDS and excessive vitamin E levels (NIH, 2015c).

Risk Factors for Heart Failure

1 in 5 Americans, aged 40 and over, will develop heart failure in their lifetime.
Nearly six million Americans are living with HF and the number is predicted to rise by 38% percent to almost eight million Americans by 2030 (AHA, 2016e).

Age

Heart failure is more common in people aged 65 or older, as aging can weaken the heart muscle.

Gender

Men have a higher rate of heart failure than women.

Race

African Americans are more likely than people of other races to have heart failure. They're also more likely to have symptoms at a younger age, have more hospital visits due to heart failure, and die from heart failure.

Weight

Excess weight puts strain on the heart. Being overweight also increases the risk of heart disease and type 2 diabetes.

Signs and Symptoms of Heart Failure

The most common signs and symptoms of heart failure are:

- Shortness of breath
- Fatigue
- Swelling in the ankles, feet, legs, abdomen, and veins in neck

Symptoms are the result of fluid buildup in the body. As the cardiac muscle grows weaker, symptoms get worse.

Fluid buildup from heart failure also causes weight gain, frequent urination, and a productive cough that's worse at night, when a patient is in the supine position. This cough may be a sign of acute pulmonary edema.

Additional Signs and Symptoms – Left Side

Additional signs and symptoms of left-sided heart failure may include:

- Dyspnea
- Orthopnea (shortness of breath when lying flat)
- Unexplained cough
- Pulmonary crackles in lung bases
- Low oxygen saturation levels

Additional Signs and Symptoms of Right-Sided

Additional signs and symptoms of right-sided heart failure may include:

- Lower extremity edema
- Ascites (accumulation of fluid in the peritoneal cavity)
- Hepatomegaly and splenomegaly
- Gastrointestinal symptoms such as nausea, appetite loss, abdominal pain
- Weight gain despite appetite loss, usually related to fluid overload
- Jugular venous distention

Warning Signs of Heart Failure

- Dyspnea or difficulty breathing at rest or with exertion is a frequent presenting symptom of heart failure. Usually as the patient's condition worsens, so does the progression of the dyspnea.
    - Nocturnal proximal dyspnea: shortness of breath that awakens the patient in the middle of the night.
- Anxiety and confusion may develop with the presence and severity of the client's condition. Neurological symptoms associated with CHF are often overlooked; however, they are important to the overall assessment of the condition.
- Edema (peripheral) edema of the lower extremities becomes evident as the patient is experience fluid overload.
- Respiratory distress may occur as the patient's ability to breathe comfortably is compromised. Patients experiencing respiratory difficulty may demonstrate nasal flaring and use of accessory muscles when breathing.

(American Heart Association, 2016a)

NYHA Functional Classification

To determine the best course of therapy, physicians often assess the stage of heart failure per the New York Heart Association (NYHA) functional classification system.

This system relates symptoms to everyday activities and the patient's quality of life.

Class I (Mild)

No limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, or dyspnea (shortness of breath).

Class II (Mild)

Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in fatigue, palpitation, or dyspnea.

Class III (Moderate)

Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity causes fatigue, palpitation, or dyspnea.

Class IV (Severe)
Unable to carry out any physical activity without discomfort. Symptoms of cardiac insufficiency at rest. If any physical activity is undertaken, discomfort is increased.
(AHA, 2016b)

Diagnosis
Medical and Family History
A comprehensive medical and family history can play a large part in accurately diagnosing heart failure.

The healthcare professional should obtain a thorough and in-depth history prior to performing a physical examination. Explore familial disease states and clarify patient symptoms. Address the type of symptom, when they occur, how long they have been present and how severe they are.

Early diagnosis and treatment can help people who have heart failure live longer, more active lives (NIH, 2010).

Purpose of the Health History
The health history should elicit information about hypertension, elevated blood cholesterol, heart murmurs, congenital heart disease, rheumatic fever and anemia. You will also want to ask about the patient's history of heart disease, when and how it was treated, last EKG, stress tests, and serum cholesterol levels.

Obtaining a Comprehensive Health History
Ask the patient the reasons for any previous hospitalizations and the nature of the treatments received while in the hospital. Ask about cardiac catheterizations, ECGs, stress tests, and cardiac surgeries.

Current lifestyle and psychosocial issues to explore when conducting your focused cardiovascular health history include nutrition, exercise, smoking, alcohol consumption and medication history.

Family history is another important component of the health history, and is useful in identifying your patient's risk for certain cardiovascular diseases (Shaw, 1998). Ask your patient about any cardiovascular family history such as hypertension, obesity, diabetes, coronary artery disease, or sudden death.

Physical Assessment
Performing a thorough physical assessment is essential to the proper diagnosis of chronic heart failure. Information obtained from the health history should focus on risk factors for the patient and any presenting signs and symptoms.

During the physical exam, the healthcare professional should:

- Auscultate cardiac sounds
- Auscultate the lungs for the sounds of extra fluid buildup

- Look for swelling in ankles, feet, legs, abdomen, and the veins in the neck

See RN.com's Assessment Series for additional information on performing a cardio-pulmonary assessment.

Performing a Physical Assessment
Begin the initial assessment by observing the patient's general appearance. Does the patient look distressed, fatigued or anxious? An acute exacerbation of heart failure can produce anxiety and fatigue.

Does the patient's body appear swollen? Generalized edema is another sign of worsening heart failure. Measure the patient's body weight and height. Small fluctuations in weight may indicate fluid retention and worsening of heart failure. Height is needed to accurate calculate medication dosage.

Examine the patient's hands and feet. Are the fingertips and toes swollen? Is there edema present in the lower extremities? If so, indicate which type (pitted or non-pitted) and degree (+1, +2, +3).

Measure vital signs. Elevated temperature may indicate cardiovascular inflammation or generalized infection. Peripheral hypertension may be detected. An increased pulse rate may be a compensatory mechanism and respirations may be labored when heart failure worsens.

All assessments should consider patient's privacy and foster open, honest patient communications.

Cardiovascular Assessment: The Neck
When performing the cardiovascular assessment, begin by examining the neck. Inspect the lateral neck bilaterally for distended jugular veins. This is a common finding in patients with right heart failure.

- Check the major arterial pulses for any abnormalities including bruits. Bruits over the carotid artery usually indicate atherosclerosis, which is a risk factor for heart failure. Weak pulses may indicate a low cardiac output.
- Note the skin color and temperature. Is cyanosis noted? Look on the underside of the tongue, buccal mucosa and conjunctiva. Central cyanosis, a condition resulting from a reduced oxygen intake or transport from the lungs to the bloodstream, may occur with CHF. Is the skin warm and dry or cool and clammy which is associated with vasoconstriction?
- Does capillary refill occur within 5 seconds or does it take longer? If it takes longer than 5 seconds this may be indicative of impaired cardiac function.

Cardiovascular Assessment: Auscultations
When assessing the cardiovascular system, be sure to auscultate the following areas:
A. Aorta
B. Left ventricle
C. Right ventricle
D. Pulmonary artery

When auscultating heart sounds, listen for extra heart sounds, known as ventricular gallops or S3 heart sounds. These are dull, low pitched sounds occurring early in diastole after S2 and is caused by the rapid rush of blood into a dilated ventricle. This is an abnormal finding in an individual after the age of 30, and is usually diagnostic of heart failure.

Respiratory Assessment
Respiratory assessment should include auscultation of the lungs, listening for rales, rhonchi or diminished breath sounds.

Note any nasal flaring or retractions - does the patient use his accessory muscles when breathing (this may indicate difficulty breathing).

Ask the patient if they experience shortness of breath or dyspnea either at rest or with exertion.

Does the patient suffer from nocturnal paroxysmal dyspnea or orthopnea?

Is there a productive cough and when did it start?

Any positive answers to the above questions require further investigation as it may suggest heart failure.

When assessing for orthopnea, key questions to ask would include:
- How many pillows do you sleep on at night? And for how long?
- Other important questions include asking the patient about frequent bouts of infection (bronchitis, upper respiratory infection, etc.).

Does the patient smoke? If the answer is yes, inquire how many cigarettes are smoked daily and how many years has the patient been a smoker. Discuss smoking cessation with the patient.

Diagnostic Tests
No single test can diagnose heart failure. A combination of tests is most effective in diagnosing heart failure.

EKG

The ECG of patients with CHF may reveal left ventricular hypertrophy (LVH), all types of atrial and ventricular arrhythmias, and may also show signs of a previous or current myocardial infarction, atrio-ventricular and intra-ventricular conduction blocks, and left and right atrial abnormalities. Almost any ECG tracing contained in a comprehensive electrocardiography text could be seen in a patient with CHF.

Classic examples of ECG abnormalities associated with CHF are LVH, evidence for left atrial abnormality, and atrial fibrillation.

Chest X Ray
Can show cardiac enlargement (cardiomegaly) or pulmonary congestion.

Pulmonary congestions show up on a chest x-ray as a cloudy area.

If evidence of cardiomegaly or pulmonary congestion are present, additional EKG testing is usually indicated.

BNP Blood Test

BNP is thus a useful tool in diagnosis of heart failure. An ideal BNP level is less than 100 PG/ML. The goal BNP level at hospital discharge of a patient with chronic heart failure is less than 500 PG/ML. A BNP level of greater than 700 PG/ML is indicative of decompensated congestive heart failure (Cleveland Clinic, 2016).
It is important to know the lab values of your facility for this test; be sure to check with your laboratory for normal values.

The cause of fluid retention with an elevated BNP level is most likely to be due to heart failure rather than due to lung disease.

Echocardiography (echo)

Uses sound waves to create a moving picture of the heart. The test provides information about the size and shape of the heart and how well the chambers and valves are working.

Echo can also identify areas of poor blood flow to the heart, areas of heart muscle that aren't contracting normally, and previous injury to the heart muscle caused by lack of blood flow.

Echo may be done before and after a stress test, and is known as a stress echo. A stress echo can show how well blood is flowing in various parts of the heart and/or how well the pumps blood when it beats.

The number most frequently quoted from the echo is the ejection fraction (EF), which is the measurement of how effectively the heart is pumping blood. An ejection fraction of 60% percent means that 60% of the total amount of blood in the left ventricle is pushed out with each heartbeat. A normal heart's ejection fraction may be between 55 and 70, but it is possible to have a normal ejection fraction reading and still have heart failure.

Tests

Doppler Ultrasound

Uses sound waves to measure the speed and direction of blood flow. This test often is done with echo to give a more complete picture of blood flow to the heart and lungs. Doppler ultrasound is often used to confirm right-side heart failure, when the heart can't fill with enough blood.

Holter Monitor

Records the heart's electrical activity for a full 24- or 48-hour period, while the patient goes about their normal routine.

Nuclear Heart Scan

Shows how well blood is flowing through the heart and how much blood is reaching the heart muscle. During a nuclear heart scan, a radioactive substance called a tracer is injected into the bloodstream through a vein. The tracer travels to the heart and releases energy. Special external cameras detect the energy and create images of the heart. A nuclear heart scan can show where the heart muscle is healthy and where it's damaged.

Positron Emission Tomography (PET) Scan
A type of nuclear heart scan that shows the level of chemical activity in the heart, and illustrates cardiac blood flow. A PET scan can show blood flow problems that other tests may not detect.

Cardiac Catheterization
The insertion of a long, thin, flexible catheter into a peripheral blood vessel in the arm, groin or neck and threaded into the heart. This allows visualization into the coronary arteries. In heart failure, there is an increase in cardiac pressures, and there may be evidence of valvular abnormalities with pressure gradients.

Coronary Angiography
Usually accompanies cardiac catheterization. A dye that can be seen on x ray is injected into the bloodstream through the tip of the catheter, and allows for better visualization of the heart muscle.

Stress Testing
The patient is monitored during exercise. Heart tests, such as nuclear heart scanning and echo, often are done during stress testing.

Cardiac MRI
Uses radio waves, magnets, and a computer to create pictures of the heart. The test produces both still and moving pictures of the heart and major blood vessels. A cardiac MRI can highlight damaged areas of the heart, and is useful in detecting early signs of heart failure before symptoms appear.

There are two well-accepted classification systems used to describe heart failure:
- The American College of Cardiology/American Heart Association stages of heart failure
- The New York Heart Association (NYHA) functional classification system

Additional Lab Tests
Additional lab tests will most likely include:
- Complete blood cell count (CBC)
- Complete metabolic panel (electrolytes, creatinine, glucose, and liver function studies)
- Urinalysis

Other lab tests that may be ordered to determine the cause of heart failure include:
- Thyroid function tests
- Fasting lipid profile

Nursing Diagnosis and Management
Once a complete nursing assessment has been conducted, the following nursing diagnoses can be made:
- Decreased cardiac output related to alterations in preload, afterload, contractility and heart rate.
- Impaired gas exchange related to intra-alveolar fluid.
- Fluid volume excess related to maladaptive compensatory mechanisms secondary to decreased cardiac output.

- Altered protection caused by electrolyte imbalances due to fluid retention and decreased renal perfusion.
- Activity intolerance related to decreased cardiac output and decreased tissue oxygen delivery.
- Sleep pattern disturbance related to dyspnea, anxiety and nocturia.
- Knowledge deficit related to disease process, therapy and recommended lifestyle changes.

In this section, we'll look at how to manage each of these diagnoses.

Decreased Cardiac Output

- Decreased cardiac output related to alterations in preload, afterload, contractility and heart rate.

Treat cause if possible.

Decrease myocardial oxygen consumption by:

- Maintaining physical & emotional rest: maintain bedrest for 24 hours, then slowly increase activity as tolerated. Explain procedures, provide for physical comfort, instruct in relaxation techniques & administer prescribed anxiolytics.
- Administering prescribed beta blockers for Class II & III heart failure. Monitor closely for decompensation as beta blocker therapy is initiated.
- Managing dysrhythmias: Administer anti-dysrhythmics as prescribed.
- Decreasing preload: Position in high fowlers, with legs dependent. Monitor sodium and fluid restrictions & administer diuretics as prescribed. Diuretics will decrease pulmonary congestion and preload. Anticipate possible need for dialysis if patient goes into renal failure.
- Decreasing afterload: Administering prescribed ACE Inhibitors and Calcium Channel Blockers. Anticipate possible need for insertion of intra-aortic balloon pump if severe left ventricular failure develops. This will increase coronary artery blood flow as well as increase blood flow to the renal arteries and lower extremities.
- Increasing contractility: Administer cardiac glycosides (digoxin) as ordered. Anticipate possible need for insertion of ventricular assist device (VAD).

Impaired Gas Exchange

- Impaired gas exchange related to intra-alveolar fluid.

Improve oxygenation: Oxygen by nasal cannula at 2-6 L/min to maintain arterial oxygen saturation of 95% (measured by pulse oximetry), unless contra-indicated. If necessary, intubation and mechanical ventilation with positive end-expiratory pressure (PEEP).

Fluid Volume Excess

- Fluid volume excess related to maladaptive compensatory mechanisms secondary to decreased cardiac output.

Strict intake and output monitoring. Administration and monitoring of diuretic therapy. Administration of sodium restricted diet.

Altered Protection

- Altered protection caused by electrolyte imbalances due to fluid retention and decreased renal perfusion.

Altered electrolyte balances may lead to dysrhythmias. Administer anti-dysrhythmics as prescribed and monitor rhythm strips continuously.

Activity Intolerance

- Activity intolerance related to decreased cardiac output and decreased tissue oxygen delivery. Maintain bedrest and slowly increase activity level as tolerated. Maintain call bell in close reach, offer commode on regular basis.

Sleep Pattern Disturbance

- Sleep pattern disturbance related to dyspnea, anxiety and nocturia.

Promote peaceful environment conducive to rest, including lights, temperature and noise control. Offer calm and reassuring explanations for medical interventions. Administer anxiolytics as prescribed.

Knowledge Deficit

- Knowledge deficit related to disease process, therapy and recommended lifestyle changes.

Begin discharge education as soon as patient is stabilized. Stress importance of lifestyle modification therapy including healthy eating, regular exercise, smoking cessation and stress management. Educate patient on disease process and management and refer to appropriate agencies and support groups for follow up post discharge.

Management of Heart Failure

Introduction

Early diagnosis and treatment can help people who have heart failure live longer, more active lives.

After treating the underlying causes, the most effective treatment for heart failure is lifestyle changes.

Goals

The goals of treatment for all stages of heart failure is to increase the lifespan and improve quality of life.

Lifestyle changes are the key to achieving these goals.

Lifestyle Changes

Lifestyle changes include diet, exercise, fluid intake and smoking cessation.

Diet

A balanced diet with varied nutrients can improve cardiac function.

A Heart Healthy Diet includes fruits, vegetables, whole grains, lean meats, poultry, fish, beans, and fat-free milk products. It is low in saturated fat, trans fat, cholesterol, sodium and sugar.

For more information about following a healthy diet, see the National Heart, Lung, and Blood Institute's Aim for a Healthy Weight web site.

Fluid Intake

Proper fluid intake is very important in heart failure to prevent fluid overload.

Alcohol consumption can be dangerous.

Potassium

Ensuring adequate potassium in the diet is an important consideration in heart failure patients, since ACE inhibitors and diuretics deplete potassium stores.

Potassium is found in foods like white potatoes and sweet potatoes, greens (such as spinach), bananas, many dried fruits, and white beans and soybeans.

Lack of potassium may cause arrhythmia and lead to sudden death.

Potassium is an important mineral that is needed to balance acid and water in the blood and body tissues, and break down amino acids and carbohydrates. Often, certain diuretics cause loss of potassium and so a high dietary potassium intake is recommended. On the other hand, angiotensin converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), and aldosterone inhibitors increase potassium levels and potassium may need to be restricted in the diet. A normal potassium level is between 3.5 and 5.0 mEq/L.

Exercise

Increasing physical activity decreases the risk of coronary artery disease, high blood pressure and diabetes, all of which contribute to heart failure.

Smoking

Smoking cessation reduces the incidence of coronary artery disease and high blood pressure, two known risk factors for heart failure.

Stress

Stress increases the risk of coronary artery disease, high blood pressure and heart failure. Complementary medical treatments such as yoga, massage, acupuncture, and stress management courses may decrease stress levels.

Weight

It is important to watch for signs that heart failure is getting worse, such as weight gain, which may indicate fluid retention.

Medications for Treating Heart Failure

Several drugs may be used for the medical management of heart failure, including ACE inhibitors, beta-blockers, and aldosterone antagonists.

ACE Inhibitors

Decreased renal perfusion occurs during heart failure as cardiac output decreases. With this decrease in renal blood flow, there is a progressive increase in levels of circulating angiotensin II levels.

The foundation of heart failure treatment is the Angiotensin Converting Enzyme Inhibitor (ACEI). ACE inhibitors work by blocking the effects of angiotensin which is a potent vasoconstrictor. Lower angiotensin levels decrease peripheral arterial resistance and decreases aldosterone secretion, which in turn, reduces sodium and water retention and lowers blood pressure .

Additional Examples of ACEIs include:

- benazepril (Lotensin®, Lotensin Hct®)
- captopril (Capoten®)
- enalapril (Vasotec®)
- fosinopril (Monopril®)
- lisinopril (Prinivil®, Zestri®)
- moexipril (Univasc®)
- perindopril (Aceon®)
- quinapril (Accupril®)
- ramipril (Altace®)
- trandolapril (Mavik®)

Unless contraindicated, every patient with an ejection fraction of less than 40% should receive an ACE inhibitor, which has been shown to improve ventricular function.

Nursing Alert! The major side effect of ACE inhibitors is hypotension. Therefore, healthcare professionals should be aware of the potential synergistic effects of ACE inhibitors with other medications.

ACE Inhibitors: Patient Education

- Instruct patient to report breathing difficulties, light-headedness, and dizziness.
- Advise patients to avoid salt substitutes, as these products may contain potassium, which could cause hyperkalemia.
- ACE inhibitors are contra-indicated during pregnancy

Angiotensin Receptor Blockers (ARBs)

Prevent angiotensin II from binding to the angiotensin II receptor on blood vessels and other tissues. Angiotensin II is a potent chemical that causes the muscles surrounding blood vessels to contract, thereby narrowing the blood vessels. This increases the pressure within the blood vessels and can lead to hypertension. Reducing the action of angiotensin II leads to dilation of blood vessels and reduces blood pressure.

ARBs are used alone or in combination with other drugs for controlling hypertension, managing congestive heart failure, preventing diabetes or high blood pressure-related kidney failure, and reducing the risk of stroke in patients with hypertension and an enlarged heart. ARBs also may prevent the recurrence of atrial fibrillation. Since ARBs have effects that are like ACE inhibitors, they are often used when ACE inhibitors are not tolerated by patients because of side effects.

All ARBs usually are administered once daily for treatment of hypertension. Some patients may benefit from twice daily dosing of losartan (Cozaar) if blood pressure is not controlled with once daily dosing.

Additional examples of ARBs include:

- candesartan (Atacand®)
- eprosartan (Teveten®)
- irbesartan (Avapro®)
- losartan (Cozaar®)
- olmesartan (Benicar®)
- telmisartan (Micardis®)
- valsartan (Diovan®)

ARBs: Patient Education:

- Instruct patients to report dizziness, headache, drowsiness, nausea or vomiting, diarrhea, cough, muscle or bone pain and skin rashes.
- ARBs can cause elevated potassium levels; therefore, regular lab testing is essential.
- Like other antihypertensives, ARBs are associated with sexual dysfunction.
- ARBs are usually not prescribed for pregnant patients because they are associated with birth defects.

Beta Blockers

Another important class of drugs in the management of heart failure is beta-blockers, such as Atenolol (Tenormin™). These drugs act by inhibiting the action of catecholamines such as adrenaline (Epinephrine™).

Unless contraindicated or not tolerated, a beta-blocker should be started for every heart failure patient with an ejection fraction (EF) of less than 40% due to the mortality benefit as shown in many randomized controlled trials (Colucci, 2016).

Beta blockers decrease symptoms of heart failure, improve left ventricular ejection fraction and are effective in decreasing mortality and morbidity.

Beta blockers should be used with caution in elderly patients because of their potential to cause confusion and hallucinations.

Beta Blockers: Patient Education

- Instruct patient to take the drug exactly as prescribed, at the same time every day
- Instruct patient on how to take a pulse & to withhold next dose if HR < 60 beats per minute
- Caution patients not to discontinue therapy abruptly

Diuretics: Loop Diuretics and Thiazides

Patients with symptoms of fluid retention should be placed on a diuretic to relieve fluid overload. The three main classes of diuretics used in the management of heart failure are:

- Loop diuretics: Example: furosemide (Lasix™)
- Thiazide diuretics: Example: metolazone (Zaroxolyn™)
- Potassium sparing diuretics: Example: spironolactone (Aldactone™)

Loop diuretics and thiazides act by inhibiting the reabsorption of sodium or chloride at specific sites within the tubule of the kidneys. This results in a diuresis that reduces the workload on the heart, thereby decreasing edema and pulmonary congestion.

Most elderly patients require a loop diuretic. Since diuretics can quickly lead to volume depletion and hypotension, postural blood pressure should be checked frequently and BUN/creatinine ratios monitored regularly to detect volume depletion.

Most patients on loop and thiazide diuretics will require regular potassium and magnesium supplementation. Patients may refuse to take diuretics because of diuretic-related incontinence. Diuretic medications should be scheduled to be given during waking hours.

Nursing Alert!

Furosemide may produce profound diuresis resulting in fluid and electrolyte depletion. This may induce acute hypotensive episodes, requiring close monitoring of blood pressure. The resultant hypovolemia may cause hemoconcentration, which could lead to circulatory collapse or thromboembolic episodes.

Pronounced reductions in plasma volume associated with rapid or excessive diuresis may also result in an abrupt fall in renal blood flow, which may be restored by fluid replacement. Furosemide may also produce hyperglycemia and glycosuria, possibly due to hypokalemia, in patients with predisposition to diabetes.

Loop Diuretics: Patient Education

- Advise patient to take drug with food to prevent GI upset
- Inform patient of need for potassium supplementation
- Teach patient to avoid direct sunlight because of risk of photosensitivity reactions

Diuretics: Aldosterone Antagonists

Loop and thiazide diuretics can cause potassium to be lost in the urine. Consequently, a potassium supplement or a diuretic that does not cause potassium loss (a potassium-sparing diuretic) may be given as well.

Aldosterone antagonists, such as spironolactone (Aldactone™), are potassium-sparing diuretics that act by antagonizing aldosterone in the distal renal tubules, increasing sodium and water excretion.
When potassium sparing diuretics such as spironolactone are used in combination with loop diuretics and ACE inhibitors, studies have shown decreased mortality.

An aldosterone antagonist may be added to the patient's pharmacologic therapy if the ejection fraction is less than 35%, and ACE inhibitor therapy has been initiated.

Aldosterone antagonists must be used cautiously in patients with renal function and potassium level.

Nursing Alert!

To prevent serious hyperkalemia, warn patients to avoid excessive ingestion of potassium rich foods (citrus fruits, bananas, dates and apricots), and to avoid using salt substitutes containing potassium.

Patients on aldosterone antagonists need to be monitored for hypotension, and the drug should be administered with food.

Aldosterone Antagonists: Patient Education

- Advise patient to avoid excessive consumption of potassium rich foods
- Instruct patient to take this drug in the morning to prevent nocturia
- Advise men of the possibility of breast tenderness or enlargement with drug therapy

Cardiac Glycosides

Lanoxin TM (digoxin) is derived from the foxglove plant and has been used for more than 200 years. Studies confirm that digoxin is useful in treating heart failure due to systolic dysfunction (HFSA, 2010).

Digoxin is a positive inotropic drug that acts by increasing the force of the contractility of the heart muscle.

The elderly often experience a reduction in renal function; therefore, patients should have a baseline BUN and creatinine clearance on file. Dosing of this medication should be based on therapeutic digoxin level and renal function. Periodic digoxin levels should be obtained to prevent digoxin toxicity and hyperkalemia.

Nursing Alert! Before giving drug, monitor apical pulse for a full minute. Excessively slow pulse (< 60 bpm) may be a sign of digitalis toxicity. Digoxin can also be used to control the rhythm of the heart (in atrial fibrillation).

Side effects of therapy can include arrhythmias, hypotension, hypokalemia, abdominal pain, nausea and vomiting and hypersensitivity reactions.

Digoxin: Patient Education

- Instruct patient to report a pulse rate less than 60 beats/min, or any rhythm changes
- Advise patients to immediately report any signs of drug toxicity such as nausea, vomiting, diarrhea or visual changes
- Inform patients to avoid substituting one brand for another
- Advise patients to avoid the use of herbal drugs

Natriuretic Peptides

When chronic symptoms of heart failure become acute, natriuretic peptides may be used to rapidly stabilize the patient. eta type natriuretic peptide (BNP) (Nesiritide^{TM}) is a more recently produced medication made with recombinant DNA technology.

BNP is usually produced by cardiac muscle in response to changes in blood pressure. When the heart has increased cardiac volume and increased filling pressures (as occurs in heart failure), BNP levels are increased in the bloodstream. BNP blood levels decrease when the heart failure condition is stable, although the overall

BNP level in a person with heart failure is still significantly higher than in a person with normal heart function. Natural BNP is increased with heart failure. Why additional BNP is detected is not totally understood.

Nursing Alert! This drug binds to heparin, so never administer this drug through a central heparin-coated catheter.

Side effects of natriuretic peptides include hypotension, bradycardia and atrial fibrillation, so close monitoring of vital signs is needed during therapy. Injection site reactions can occur, as well as leg cramps, insomnia, anxiety, nausea and vomiting.

Note that B-type Natriuretic Peptide (BNP) can also be used as a diagnostic tool for heart failure. The BNP blood test can be used to establish an initial diagnosis as well as monitor the progression of the disease.
Natriuretic Peptides: Patient Education

- Urge patients to report symptoms of hypotension, including dizziness, blurred vision or sweating
- Advise patient to any other adverse effects promptly
- Tell patient to report any discomfort at the IV site

Surgical Interventions
People who have severe heart failure symptoms at rest, despite other treatments, may need a mechanical heart pump, such as a left ventricular assist device. This device helps pump blood from the heart to the rest of the body, and may be used prior to surgery or as a long-term treatment.

A heart transplant may be performed as a life-saving measure for end-stage heart failure when medical treatment and less drastic surgery have failed. Studies are under way to see whether open heart surgery or angioplasty can reduce heart failure symptoms.

In heart failure, the right and left sides of the heart may no longer contract at the same time. This disrupts the pumping of the heart. To correct this problem, cardiac resynchronization therapy (CRT) may be performed whereby an implantable CRT device is inserted near the heart. This device acts as a pacemaker to co-ordinate simultaneous pumping of both the right and left sides of the heart.

CRT therapy also helps to minimize arrhythmias. An ICD monitors heart rate and uses electrical pulses to correct irregular heart rhythms.

Living with Heart Failure
Heart failure cannot be cured. Compliance with medications and lifestyle modifications can greatly influence quality of life.

Despite treatment, symptoms may get worse over time. Regular follow ups are important to assess compliance with treatment plans. Assessments should be made of daily activities of living and the patient should be educated on medication compliance and side effects, daily activities and exercise. Activity endurance will depend on the stage of heart failure.

Patient Education

Introduction
Patient education is an important compliance tool that is often left up to the nurse. A patient with heart failure should be educated about long term management of this chronic disease and steps to take in preventing progression of the disease.

Topics to Cover
Patients should be encouraged to take an active role in managing their health needs. Patient education should include:

- Follow Up Appointments
- Medication Management
- Monitoring Weight
- Diet and Exercise
- Emotional Issues and Support
- When to Contact a Doctor

Follow Up Appointments
Patients need to understand the importance of regular follow up visits and when to seek help.

Medication Management
Patients should be instructed to take all medications as prescribed by the physician.

- Explain the reason for each medication
- Tell the patient what to do if a dose is missed
- Reinforce the dosing schedule

Tell the patient to ensure that all their healthcare providers, including pharmacists, have a complete list of all of medications and over-the-counter products that they are taking.

Monitoring Weight
Patients need to be educated on the importance of monitoring weight fluctuations daily. Patients should:

- Measure and record daily weight (create a weight calendar)
- Report any weight gain of more than 2 pounds in one day
- Report a change in 5 pounds from their usual daily weight

Diet and Exercise
Explain to the patient the importance of diet and exercise to the management of their condition. Emphasize the importance of:

- Following an approved diet plan
- Maintaining a specific weight
- Participating in an approved routine exercise regime

Reinforce plans for diet and exercise to help the patient achieve goals.

Other Risk Factors
Other ways to modify risk factors include:
- State blood pressure goals and own BP
- Encourage the patient to stop smoking and provide resources to help them
- Diabetics should be encouraged to maintain HgA1c

Emotional Support
Living with heart failure may cause fear, anxiety, depression, and stress. Tell patients how they can obtain help from:
- Professional counselors
- Antidepressants
- Patient support groups

Contacting the Doctor
Patients should be encouraged to record and carry the names and phone numbers of their doctors. Patients should contact their doctor if:
- Their body temperature is elevated
- There is a change in medication administration and/or tolerance

Patients should be instructed to go to the emergency room if not feeling well.
Successful management of the patient is possible when all members of the healthcare team work together.

Core Measures: Heart Failure:

The Centers for Medicare and Medicaid (CMS) and The Joint Commission (TJC) have collaborated to define a set of criteria to be used to measure quality of patient care. These evidence-based criteria, known as Core Measures, are indicators of timeliness and effectiveness of care for certain specific conditions. They state key actions which have contributed to successful outcomes for these conditions.

The most recent Specifications Manual for National Hospital Inpatient Quality Measures contains categories of Core Measures including Acute Myocardial Infarction (AMI), Heart Failure, Pneumonia, Surgical Care Improvement, Immunization, Prevention, and other categories.

The three heart failure measures which must be documented are:

- Discharge instructions
- Evaluation of left ventricular systolic (LVS) function
- ACE inhibitor or angiotensin receptor blocker (ARB) for LVS dysfunction (LVSD)

Discharge Instructions

By the time of discharge, heart failure patients or their caregivers MUST receive written instructions or educational materials that include all the following aspects:

- Activity level
- Diet
- Discharge medications
- Follow-up appointment
- Weight monitoring
- What to do if symptoms worsen

Non-compliance with follow-up care threatens the patient's status and increases the likelihood of readmission and mortality. In addition to data related to Core Measures, CMS collects readmission and mortality data.

Left Ventricular Systolic (LVS) Function

LVS function is the single most important diagnostic test in the management of all patients with heart failure. The heart failure patient's record must document that LVS function was evaluated before arrival, during hospitalization, or is planned after discharge.

Angiotensin Converting Enzyme Inhibitor (ACEI) or Angiotensin Receptor Blockers (ARB) therapy

For the LVSD patient, the patient's record must document a prescription for an ACEI or ARB at hospital discharge. LVSD is defined as chart documentation of a left ventricular ejection fraction (LVEF) less than 40% or a narrative description of left ventricular systolic (LVS) function consistent with moderate or severe systolic dysfunction. ARBs are recommended for patients who are ACEI intolerant.

Heart Failure Core Measures: The Nurse's Role

The nurse plays a vital role in ensuring that heart failure patients receive comprehensive, organized and thorough care, that is well documented, as well as adequate preparation for discharge. The nurse's role includes:

- Providing and documenting patient teaching of all six required aspects. Use a "teach back" method to assure that the patient or caregiver has learned the information and can state it to you.
- Assuring that LVS function or plan for evaluation is documented.
- Assuring that an ACEI or ARB is ordered. During hospitalization, administer the medications as ordered. Document and provide patient teaching concerning these medications.

Adherence to the Core Measure standards, along with patient satisfaction data reported on the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, impact an organization's reimbursement for care and accreditation status. Therefore, knowledge about the Core Measures, what each one entails, and how the standards are satisfied, is critical to the organizations for which you work. Support your healthcare organization's achievement of high ratings on Core Measures.

Did You Know

The public may compare specific healthcare organizations' results on Core Measures at the TJC website and at the U.S. Department of Health and Human Services (USDHHS) Hospital Compare website.

Case Study

Mrs. Jenkins

The Complaint
Mrs. Jenkins is a 76 year-old Caucasian female, admitted to the emergency department with a diagnosis of heart failure. She was discharged 10 days ago, after being treated for an acute exacerbation of symptoms related to her chronic heart failure.

Her main complaint today is shortness of breath and severe swelling of her legs. She complains that it is difficult to move around "without losing her breath" and her feet are too swollen to fit her shoes.
She insists that she is compliant with prescribed fluid and sodium restrictions, yet reports that she is gaining "a pound or two" each day, since her discharge ten days ago!

On taking a detailed medication history, you discover that she is on the following medication:

- enalapril (Vasotec) 5 mg bid
- digoxin (Lanoxin) 0.125 mg qd
- rosiglitazone (Avandia) 4 mg
- furosemide (Lasix) 40 mg qd
- potassium Chloride (Apo-K) 20 MEq QD

The admitting physician orders all the above medications, but changes the furosemide to 40 mg intravenous push qd and orders a stat 80 mg intravenous push. What is the rationale for changing the route of administration of furosemide?

Answer
Furosemide (Lasix) is a loop diuretic that is not well absorbed orally in a patient in heart failure.
This drug may need to be given IV even if the patient is taking other oral drugs.

You administer 80 mg furosemide intravenously. Identify how you would monitor the effectiveness of this medication.

Monitor weight, blood pressure and pulse rate closely, as furosemide can lead to profound water and electrolyte depletion. Fluid intake / output, electrolyte, BUN (Blood Urea Nitrogen) and carbon dioxide levels must also be checked frequently.
Most heart failure admissions are related to fluid volume overload. Patients who do not require intensive monitoring can be treated with diuretics, oxygen and ACE Inhibitors.
How do ACE Inhibitors help in congestive heart failure?

Answer
ACE Inhibitors prevent the conversion of angiotensin I to angiotensin II, a potent vasoconstrictor.
Less angiotensin II decreases peripheral arterial resistance, decreasing aldosterone secretion, reducing sodium and water retention and lowering blood pressure.

Mrs. Jenkin's symptoms improve with intravenous diuretics. She is ordered back on oral furosemide once her weight loss is determined to be sufficient.

What will determine if the oral dose is adequate to consider her for discharge?

Answer
Dosage needs to be adjusted based on response.

Sodium and fluid restrictions should be monitored carefully, with sodium intake not exceeding 2g/d and free water not exceeding 1500 mLs in a 24-hour period. In addition, weight gain should level off and remain at less than 2 pounds per day.

Mrs. Jenkins is now ready for discharge. Use the acronym MAWDS to plan her discharge education to prevent a relapse.

Answer
Medications: Patient education regarding dosage, drug interactions, side effects and contraindications should be given prior to discharge.
Activity: Bedrest is not recommended after the first 24 hours following an acute attack. Activity should be progressive and tailored to meet the needs of the individual.
Weight: Must be tracked daily. Someone who gains two pounds overnight or five pounds in a few days is probably retaining fluid.
Diet: Encourage the consumption of a heart healthy diet that is low in sodium.
Symptoms: Educate patients to monitor for signs or symptoms of worsening heart failure such as weight changes, swelling of the legs, hands or abdomen, a persistent cough or chest congestion, intermittent or mild shortness of breath, dizziness, increasing fatigue, abdominal bloating, loss of appetite or nausea.

Conclusion

- Chronic heart failure can be deadly. An insidious onset of symptoms can manifest slowly and evolve into life threatening health crises.

- Learning to accurately assess a patient for the signs and symptoms of chronic heart failure is the first step in developing a plan of care that will reduce the potential of worsening heart failure.

- Providing patients with opportunities to learn how to take an active role in staying healthy is also an important part of effectively teaching patients to help care for themselves.

Resources:

Patient education materials are available from the American Association of heart failure nurses at AAHFN.site-ym.com

NHLBI Resources:

Cardiovascular Information for the Public

Heart Transplant (Diseases and Conditions Index)

Implantable Cardioverter Defibrillator (Diseases and Conditions Index)

Pacemaker (Diseases and Conditions Index)

Ventricular Assist Device (Diseases and Conditions Index)

"Your Guide to a Healthy Heart"

"Your Guide to Living Well with Heart Disease"

Non-NHLBI Resources

Heart Failure (MedlinePlus)

Heart Failure: Interactive Tutorial (MedlinePlus)

American Heart Association

Heart Failure (Insert hyperlink to: http://www.heart.org/HEARTORG/Conditions/HeartFailure/Heart-Failure_UCM_002019_SubHomePage.jsp)

Patient Education Resources for Healthcare Professionals (Insert hyperlink to: http://www.heart.org/HEARTORG/Conditions/Patient-Education-Resources-for-Healthcare-Professionals_UCM_441960_SubHomePage.jsp)

British Columbia's Heart Failure Network (BCHFN):

Heart Failure Practice Resources (Insert hyperlink to: http://www.bcheartfailure.ca/for-bc-healthcare-providers/practice-resources/)

Centers For Disease Prevention & Control (CDC):

Educational Materials For Professionals: http://www.cdc.gov/heartdisease/materials_for_professionals.htm)

Clinical Trials

Current Research (ClinicalTrials.gov)

Patient Recruitment for Studies Conducted by NHLBI, NIH

References:

At the time this course was constructed all URL's in the reference list were current and accessible. RN.com is committed to providing healthcare professionals with the most up to date information available.

American Heart Association (AHA). 2016a. Warning signs of heart failure. Retrieved from: http://www.heart.org/HEARTORG/Conditions/HeartFailure/WarningSignsforHeartFailure/Warning-Signs-of-Heart-Failure_UCM_002045_Article.jsp

American Heart Association (AHA). 2016b. Classes of heart failure. Retrieved from: http://www.heart.org/HEARTORG/Conditions/HeartFailure/AboutHeartFailure/Classes-of-Heart-Failure_UCM_306328_Article.jsp

American Heart Association (AHA). 2016c. What is heart failure? Retrieved from: http://www.heart.org/HEARTORG/Conditions/HeartFailure/AboutHeartFailure/What-is-Heart-Failure_UCM_002044_Article.jsp

American Heart Association (AHA). 2016d. Atherosclerosis. Retrieved from: http://www.heart.org/HEARTORG/Conditions/Cholesterol/WhyCholesterolMatters/Atherosclerosis_UCM_305564_Article.jsp

American Heart Association (AHA). 2016e. Understand your risk for heart failure. Retrieved from: http://www.heart.org/HEARTORG/Conditions/HeartFailure/CausesAndRisksForHeartFailure/Understand-Your-Risk-for-Heart-Failure_UCM_477645_Article.jsp

American Association of Heart Failure Nurses. (2016). What is heart failure. Retrieved from: aahfn site-ym.com/mpage/what_is_hf

Centers for Disease Control and Prevention (CDC). 2016. Heart failure fact sheet. Retrieved from: https://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_heart_failure.htm

Cleveland Clinic. (2016). Be-type Natriuretic Peptide (BNP) blood test. Retrieved from: http://my.clevelandclinic.org/health/articles/b-type-natriuretic-peptide-bnp-bloodtest

Colucci, W. (2016). Use of beta blockers in heart failure with reduced ejection fraction. Retrieved from: http://www.uptodate.com/contents/use-of-beta-blockers-in-heart-failure-with-reduced-ejection-fraction

National Institute of Health (NIH), 2015a. Description of high blood pressure. Retrieved from: https://www.nhlbi.nih.gov/health/health-topics/topics/hbp

National Institute of Health (NIH), 2015b. Diabetes. Retrieved from: https://www.niddk.nih.gov/health-information/diabetes

National Institute of Health (NIH), 2015c. What causes heart failure. Retrieved from: https://www.nhlbi.nih.gov/health/health-topics/topics/hf/causes#OtherFactors

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