

REVIEW ARTICLE

Role of Clinical Pharmacist in Management of Congestive Heart Failure – A Brief ReviewK. Sravanthi^{1*}, Nayudu Teja²

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Received: 01 April 2020; Revised: 29 April 2020; Accepted: 01 July 2020**ABSTRACT**

Heart failure (HF) is a clinical condition occurs when cardiac output is insufficient to meet the demands of tissue perfusion or does so by elevating filling pressure. HF is due to either systolic or diastolic dysfunction which reduces ventricular filling (diastolic dysfunction) and/or myocardial contractility (systolic dysfunction). Clinically, cardiac disease prevalence increases with individual age. Cardiac dysfunction occurs due to change in blood volume, and neurohumoral transmission status these desirable mechanisms to maintain adequate cardiac output and arterial blood pressure. The activation of three compensatory neurohormonal systems triggers the cardiac dysfunction leads to HF. Clinical pharmacist plays a role in disease management by identifying the risk factors, stage of severity, educating the patients and health-care practitioners and implementing the awareness programs, and modification of lifestyle interventions with in health-care system beneficial to the community may reduce the progression of disease severity.

Keywords: Heart failure, clinical pharmacist, management, clinical pharmacy**BACKGROUND**

Heart failure (HF) is a clinical condition occurs when cardiac output is insufficient to meet the demands of tissue perfusion or does so by elevating filling pressure.^[1] It occurs due to abnormal functional defects in myocardium resulting in abnormal ventricular filling and ejection of blood. Congestive HF occurs mostly due to hypertension, diabetes mellitus, and hyperlipidemia. It is the inability to supply oxygen and nutrients to meet the required body needs.^[1] Heart pumping gets weaker in case of HF.^[2] Diseases that affect both ventricular diastole and systole, or both can lead to HF. It is due to ischemic disorders, inadequate development of the extracellular matrix, accelerated apoptosis, and genetic mutations.^[3]

INTRODUCTION TO CLINICAL PHARMACY AND CLINICAL PHARMACIST

It is defined as the branch of pharmacy that provides patient care and optimizes the patient therapy. Clinical pharmacists care for patients in all health-care settings. Clinical pharmacists' practice in health-care settings for better care.^[4] The clinical pharmacist trained in ward rounds for patient care, including hospitals, clinics, and a variety of other health-care systems. It is based on clinical pharmacist's knowledge on prescribing drug therapy and their experience in clinical aspects.^[5]

EPIDEMIOLOGY

HF is an epidemic public health problem in the United States. Approximately 5 million persons have HF, with approximately 400,000–700,000 new cases each year.^[6-9] And with HF affects approximately 1.5–2%

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of the population.^[6-8] At present, the prevalence in Americans older than 65 years is 6–10%, and this prevalence is expected to increase as the aged population grows and median life span increases.^[6-8] Despite the higher incidence of HF in men in every age group, the prevalence in women is approximately equal. The incidence of HF effects nearly 10% of persons over age 75.^[9] HF is more common in men when compared to women over age of 70, that reflects the greater incidence of coronary artery disease.^[9] These differences in HF incidence may be due to sex-based differences in the cause of HF because myocardial infarction (MI) is the leading cause in men, whereas hypertension is the leading etiology in women. HF also exacts a tremendous economic impact. Thus, HF is a major medical problem with substantial economic impact that is expected to become even more significant as the population ages.

ETIOLOGY

HF can result from any disorder that affects the ability of the heart to either contract or relax. The common cardiovascular diseases such as MI and hypertension can cause both systolic and diastolic dysfunction; thus, many patients have HF as a result of reduced myocardial contractility and abnormal ventricular filling. Coronary artery disease is the most common cause of systolic HF.^[10]

Causes of HF^[11]

Systolic dysfunction (decreased contractility)

- Reduction in muscle mass (e.g., MI).
- Dilated cardiomyopathies.
- Ventricular hypertrophy.
- Pressure overload (e.g., systemic or pulmonary hypertension, aortic, or pulmonic valve stenosis).
- Volume overload (e.g., valvular regurgitation, shunts, and high-output states).

Diastolic dysfunction (restriction in ventricular filling)

- Increased ventricular stiffness.
- Ventricular hypertrophy (e.g., hypertrophic cardiomyopathy).

- Infiltrative myocardial diseases (e.g., amyloidosis, sarcoidosis, and endomyocardial fibrosis).
- Myocardial ischemia and infarction.
- Mitral or tricuspid valve stenosis.

PATHOPHYSIOLOGY

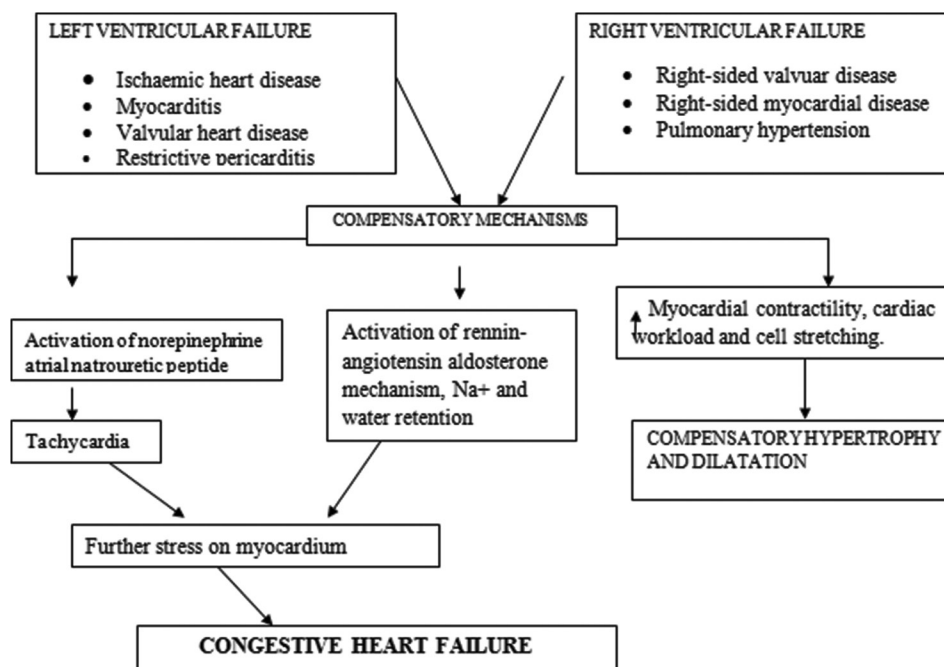
In healthy person, cardiac output at rest is approximately 5l/min with a mean heart rate of 70/min and stroke volume of 70 ml. Since the filled ventricle has a normal volume of 130 ml, the fraction ejected is over 50% of the ventricular contents with the remaining volume being approximately 60 ml. In left ventricular systolic dysfunction, the ejection fraction is reduced to below 45% and symptoms are common when the fraction is below 35% although some patients with a low ejection fraction can remain asymptomatic.^[12] When the ejection fraction falls below 10%, patients have the added risk of thrombus formation within the left ventricle and in most anticoagulation with warfarin are indicated. Left ventricular systolic dysfunction can result from cardiac injury, for example, MI or by exposure of the heart muscle to mechanical stress.

In diastolic dysfunction, there is impaired relaxation or reduced compliance of the left ventricle during diastole and therefore less blood in accommodated.

CLINICAL PRESENTATION^[12]

The primary manifestations of HF are as follows:

- Chest pain.
- Fatigue, which lead to exercise intolerance.
- Fluid overload, which can result in pulmonary congestion.^[13]
- Peripheral edema.
- Left ventricular failure (pulmonary congestion)
 - High jugular venous pressure, hepatic congestion, dependent peripheral edema, and right ventricular failure (systemic congestion).
- Dyspnea (with or without exertion).
- Orthopnea.
- Paroxysmal nocturnal dyspnea.
- Pulmonary edema.



Peripheral edema is a cardinal finding in HF. Edema usually occurs in dependent parts of the body and thus is seen as ankle or pedal edema in ambulatory patients.

TESTS AND DIAGNOSIS

- Blood tests: Sample of blood is collected from the patient to infections, inflammations, and to look of indicators for other diseases that affect the heart.
- Chest X-ray: The presence of HF, to check for fluid deposition in the lungs.
- Electrocardiogram: This test records the electrical activity of the heart. The electrodes attached to the skin. The impulses are recorded as waves.^[14]
- Echocardiogram: An echocardiogram uses sound waves to produce a video image of the heart. This test can help the physicians to check the size and shape, pumping effectiveness of heart.^[15]
- Cardiac computerized tomography (CT) scan and magnetic resonance imaging (MRI): This test can be used to investigate the physiological condition, anatomical positions of the working status of the heart to diagnose heart problems.

- Coronary angiogram: In this test, a thin flexible catheter is inserted into a blood vessel at the groin and then through the aorta into coronary arteries.^[16]
- Myocardial biopsy: In this test inserting a small, flexible biopsy card into a vein in the neck or and small pieces of the heart muscle is taken.^[17]
- Doppler imaging: This test uses sound waves to measure the speed and direction of blood flow and valves function.
- Holter monitor: A Holter monitor is a small box and is attached to electrodes that are placed on the chest which records the rhythm of the heart.
- Cardiac MRI: An MRI shows the structure and beating capability, contractions of heart, and signs of damage to heart.
- Positron emission tomography: It is used to see the blood is flow to the heart.^[18]
- Thyroid function tests: This test is performed to determine the causes of HF due to thyroid dysfunction or its abnormalities.

Clinical pharmacist intervention in the management of congestive cardiac failure

Eating a healthy and balanced diet

Choosing nutrient-rich foods which have vitamins, minerals, fiber, and other nutrients

1. Eating a diet containing low in salt, fat, saturated fat, and cholesterol.
2. Monitoring the salt intake.
3. Reducing the cholesterol levels in the body.
4. Reducing body weight.
5. Regular physical activity.^[19]

Avoiding the alcohol habit

1. Drinking too much alcohol can raise blood pressure, increase cardiomyopathy, stroke, cancer, and other diseases. It also increases triglycerides and produces irregular heartbeats. Excessive alcohol consumption leads to obesity, alcoholism, suicide, and accidents.
2. Avoiding the smoking habit.^[20]
3. Getting adequate relaxed sleep.
4. Maintaining the low sodium diet.
5. Exercising regularly.
6. Strict Medication adherence.
7. Stress management.^[21]

TREATMENT FOR CONGESTIVE HF

A variety of medicines are available to help and treat congestive HF. Some of the most frequently prescribed medications include:

Angiotensin-converting enzyme (ACE) inhibitors

ACE inhibitors are the cornerstone of pharmacotherapy of patients with HF. By blocking the conversion of angiotensin I to angiotensin II by ACE, the production of angiotensin II and, in turn, aldosterone is decreased but not completely eliminated.^[22-24] This decrease in angiotensin II and aldosterone attenuates many of the deleterious effects of these neurohormones, including reducing ventricular remodeling, myocardial fibrosis, myocyteapoptosis, cardiac hypertrophy, NE release, vasoconstriction, and sodium and water retention.^[22-25] Thus ACE inhibitor therapy appears to play an important role in preventing angiotensin II-mediated progressive worsening of myocardial function.

- Benazepril: Usual dose: 20–40 mg in a single or 2 divided doses.

- Captopril: Congestive HF/Hypertension: 6.25–12.5 mg 3 times a day.
- Enalapril: Congestive HF/Hypertension: 2.5–5 mg daily increased up to 40 mg/day.
- Fosinopril: Usual dose: 20–40 mg daily.
- Lisinopril: Dose range: 10–40 mg daily.
- Ramipril: Hypertension: 2.5–5 mg once daily.
- Trandolapril: 1 mg/day.

Angiotensin II receptor blockers (ARB)

ARBs are developed as alternative three to ACE inhibitors. The use of ARBS in HF has generated great interest. ACE inhibitors decrease angiotensin II production in the short-term, these agents do not completely suppress generation of this hormone. With chronic administration of ACE inhibitors, *ACE escape*, characterized by increases in circulating angiotensin II and aldosterone, often occurs. In addition, angiotensin II can be formed in a number of tissues, including the heart, through non-ACE-dependent pathways. Therefore, blockade of the detrimental effects of angiotensin II by ACE inhibition is incomplete.^[26] Angiotensin receptor blockers appear to be safe in HF patients. Angiotensin receptor blockers are only recommended if ACE inhibitors are not tolerated because of angioedema or cough.^[27]

- Candesartan: 4 mg, 8 mg, 16 mg, 32 mg.
- Irbesartan: 75 mg, 150 mg, 300 mg.
- Losartan: 25 mg, 50 mg, 100 mg.
- Telmisartan: 20 mg, 40 mg, 80 mg.
- Valsartan: 40 mg, 80 mg.

Beta-blockers

The use of beta-blockers is recommended for all patients with HF, irrespective to the severity of the condition but should be initiated when patient's condition is stable. This class of drugs slows heart rate and reduces blood pressure.^[28] Beta-blockers may reduce signs and symptoms of HF and improve heart function. Beta-blockers block the B1 and B2 adrenergic receptors that produce epinephrine, also known as adrenalin.

Commonly prescribed include: Bisoprolol, metoprolol, propranolol, atenolol, acebutolol, esmolol, and timolol.

- a. Acebutolol 200 mg
- b. Carvedilol 25 mg
- c. Nadolol 80 mg
- d. Atenolol 50 mg
- e. Labetalol 200 mg
- f. Pindolol 7.5 mg
- g. Bisoprolol 5 mg
- h. Metoprolol 100 mg
- i. Propranolol 80 mg.

Side effects

Rashes, tachycardia, weakness, nausea, vomiting, and abdominal discomfort.

Aldosterone antagonists commonly prescribed drugs include: spironolactone, and eplerenone

Spironolactone dosing information

- Usual adult dose for edema: 25–200 mg/day orally in 1 or 2 divided doses.
- Usual adult dose for hypertension: 25–200 mg/day orally in 1 or 2 divided doses.
- Usual adult dose for hypokalemia: 25–200 mg/day orally in 1 or 2 divided doses.
- Usual adult dose for primary hyperaldosteronism diagnosis: 100–400mg/day orally in 1 or 2 divided doses.
- Usual adult dose for hirsutism: 50–200 mg/day orally in 1 or 2 divided doses.
- Usual adult dose for congestive HF 25 mg/day orally.
- Eplerenone: 25 mg orally once daily.

Adverse effects

Lower back or side pain, lump in the breast or under the arm, muscle pain or cramps, and muscle spasms or twitching.

Diuretics

The compensatory mechanisms in HF stimulate excessive sodium and water retention, often leading to pulmonary and systemic congestion. Diuretic therapy, in addition to sodium restriction, is recommended in all patients with clinical evidence of fluid retention. Among the drugs used to manage HF, diuretics are the most rapid in producing symptomatic benefits.

Because diuretics do not alter disease progression or prolong survival, they are not considered mandatory therapy. Thus patients who do not have fluid retention would not require diuretic therapy.^[29]

Commonly prescribed include: Furosemide (Lasix), chlorothiazide, indapamide, bumetanide amiloride, metolazone, torsemide, hydro chlorothiazide, triamterene, and furosemide.

Dose

20 mg–0 mg.

Adverse effects

Sudden weakness, Electrolyte imbalance, kidney problems, and severe skin reactions.

Vasodilators

Nitrates exert their effect in HF predominantly venous system where they cause venodilation, thereby reducing the symptoms of pulmonary congestion.^[30] The preferred use of nitrates is in combination with an arterial vasodilator such as hydralazine, which reduces the after load to achieve a balanced effect on venous and arterial circulation.^[31]

- Isosorbide Mononitrate
Dose: 20 mg orally bid in 7 h intervals (max-120 mg).
ADR: Throbbing head ache, flushing of faces, dizziness, and tachycardia.
- Hydralazine (peripheral vasodilator)
Dose: 50–75 mg orally (initially).
- 200–600 mg daily (divided every 6–12 h) (max 3 g).

ADR: Tachycardia, edema, head ache, muscle cramps, and skin rashes.

Side effects of vasodilators may include

Chest pain, heart palpitations, rapid heartbeat, fluid retention, nausea, vomiting, dizziness, and headache.

Other medications that might be prescribed includes

Digoxin

Digoxin is a positive inotropic agent acts by increasing the availability of calcium within the

myocardial cell through an inhibition of sodium extrusion, thereby increasing the sodium exchange and leading to enhanced contractility of cardiac muscle.^[32]

Dosage Forms and Strengths: Oral solution: 0.05 mg/mL, injectable solution: 0.1 mg/mL.

Atrial fibrillation: Rapid digitalizing regimen: IV: 8–12 mcg/kg (0.008–0.012 mg/kg) total loading dose. PO: 10–15 mcg/kg total loading dose

Maintenance

PO: 3.4–5.1 mcg/kg/day or 0.125–0.5 mg/day PO. IV/IM: 0.1–0.4 mg q Day. HF; 0.125–0.25 mg PO/IV q Day.

Other category of drugs includes antiarrhythmic drugs,^[33-35] calcium antagonists,^[36-39] and inotropic drugs.

Adverse effects

Nausea, vomiting, diarrhea, loss of appetite, weakness, dizziness, headache, anxiety, depression, bradycardia, and skin rash.

SURGERY AND MEDICAL DEVICES FOR CONGESTIVE HF TREATMENT

In few cases, the patient is recommended for surgery to treat the underlying problem that lead to HF. It includes:

Coronary bypass surgery

Coronary bypass surgery is a surgical procedure that diverts the flow of blood around a section of a blocked artery in heart. By creating a new pathway to the heart, coronary bypass surgery improves blood flow to cardiac muscle.^[40]

- During coronary bypass surgery, a healthy blood vessel is taken from legs, chest connected to the other arteries in heart so that blood bypasses the diseased site.
- After coronary bypass surgery, symptoms, such as chest pain and shortness of breath due to poor blood flow to the heart, generally improved.

Heart valve replacement

Valve repair can usually be done on congenital valve defects and has a good success record with treating mitral valve defects. Severe valve damage consequences valve must be replaced includes the aortic or mitral valve.

- Two kinds of valves can be used for replacement:
 1. Mechanical valves are usually made from plastic, carbon, or metal. Mechanical valves are strong, and they last a long time.
 2. Biological valves are made from animal tissue and taken from the human tissue of a donated heart known as allograft or homograft. Biological valves break down faster in children and young adults, these valves are used often in elderly patients.

Implantable cardioverter-defibrillators (ICD)

An ICD is a device similar to a pacemaker. It is implanted under the skin present in the chest with wires in veins and into the heart. The ICD monitors the heart rhythm.

Cardiac resynchronization therapy (crt) or biventricular pacing

A biventricular pacemaker sends timed electrical impulses to both of the heart's lower chambers (the left and right ventricles) so that they pump in a more efficient, coordinated manner.

Heart pumps

These mechanical devices, such as ventricular assist devices, are implanted into the chest and attached to a weakened heart to pump blood to the rest of the body.

Heart transplant

Heart transplants can dramatically improve the survival and quality of life of some people with severe HF.^[41]

Device therapy

Inserting a biventricular pacemaker known as CRT, may restore synchrony to the ventricles.

ICD

It prevents the sudden cardiac death by delivering an electric shock to the heart to stop the ventricular arrhythmia and restore the heart to a normal rhythm.

CONCLUSION

The clinical pharmacist having a significant role in lifestyle interventions may impact reducing the cardiac health problems in patients with HF. The effective implementing treatment at early stages of the disease condition may improve the better health status in individual patients with HF.^[41] These approaches are beneficial to the patients to minimize the hospital admissions in future. The prevention of disease depends on identification of causative factors, early screening of high-risk patients, diagnosis and lifestyle intervention practices may be beneficial. The management of disease depends on reaching the various pharmacological classes of medications and surgical treatment available to manage the cardiac diseases and effective medication adherence practices may reduce the disease burden. HF is a complex clinical syndrome the diagnosis depends on various symptoms and laboratory investigations. The first-line pharmacotherapy consists of ACE inhibitors and β -blockers. The recent treatment depends on ICD and CRT is strongly recommended. Community level awareness programs will efforts at risk factor identification and its prevention. The adoption of healthy lifestyle habits in individual patients essential to promote better outcomes and deflate the HF.^[42]

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