Clinical Pharmacist specialized care in Management of Congestive Heart Failure - A Brief Review

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ABSTRACT

It is a critical clinical condition in which more abnormalities in cardiac structure and its functions may impact the ineffectiveness of the heart to supply required oxygen to meet the cellular metabolic demands of the body. The heart is covered with protective layers and express the various functions in the body. Clinically cardiac disease prevalence rises with individual age. Cardiac dysfunction happens because of changes in blood volume, and neurohumoral transmission status. These desirable mechanisms to maintain adequate cardiac output and arterial blood pressure. The neurohumoral responses act as compensatory mechanisms and provoke heart failure by increasing ventricular after load and increasing preload, which further elevates the cardiac failure. Health care system with a clinical pharmacist is well allocated to impact the disease management through identification of risk factors, stage of severity, educating the patients and health care practitioners and implementing the awareness programs, modification of life style interventions with in health care system beneficial to the community may reduce the progression of disease severity.

Key words: Health care system, Cardiac failure, Clinical pharmacist, Life style interventions.

INTRODUCTION

Congestive heart failure is a clinical syndrome caused by abnormal functional defects in myocardium resulting in impairment of ventricular filling. Hypertension, diabetes mellitus, and hyperlipidemia are the major causes of heart failure. The heart is the inability to supply oxygen and nutrients to meet the required body needs[1]. The chambers of the heart contract to hold more blood to pump through the body.During the heart failure condition, heart pumping is weaker. The pressure rises the blood moves slowly from the body to heart. The chambers of the heart may respond to pump the blood to all parts of the body[2].

INTRODUCTION TO CLINICAL PHARMACY

It is defined as the area of the pharmacy concerned with science and practice of rational use of drugs. Clinical pharmacists interact directly with physicians, health professionals and patients to ensure that the medications prescribed for patients contribute to the best possible health outcomes. Clinical pharmacists practice in health care settings where they have frequent and interactions with physicians and other health professionals, contributing to better care[3].

The clinical pharmacist is educated and trained in direct patient care wards, including medical centers, clinics and a variety of other health care settings. These privileges are granted on the basis of the clinical pharmacist's demonstrated knowledge of medication therapy and clinical experience[4].
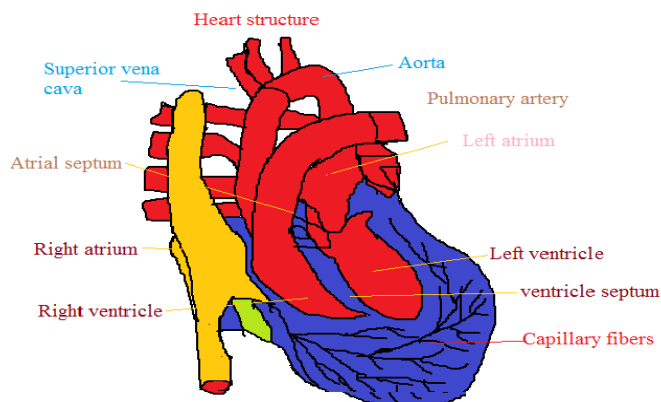

Fig 1: Structure of Heart

Physiology of heart: The heart is located in the chest between the lungs behind the sternum and above the diaphragm[5]. It is surrounded by cardiac protective membranes. Its weight is about 250-300 g. It consists of superior and inferior vena cava the

pulmonary artery and vein as well as the aorta.

Anatomy of the Heart: The heart walls are composed of cardiac muscles is called myocardium. It consists of four compartments such as the right and left atria and ventricles[6]. The anterior aspect is the right ventricle and posterior aspect shows the left atrium. The left ventricular walls are much thicker than the right ventricular wall.

The heart has four valves, the right atrium and ventricle tricuspid valve are present and the left atrium and ventricle mitral valve are located. The pulmonary valve lies between the right ventricle and the pulmonary artery[7].

The blood comes back from the systemic circulation to the right atrium and from there moves to tricuspid valve and right ventricle. Oxygenated blood returns from the lungs to the left atrium, and from there move mitral valve to the left ventricle. Finally, blood is pumped to the systemic circulation[8].

The heart has four chambers. The upper two chambers are the atria and the lower two are the ventricles. The chambers are separated by a wall of tissue called the septum. Blood is pumped through the chambers with the help of four heart valves. The valves open and closed to manage the blood flow in single direction[9].

Heart blood flow Patterns :
The normal blood flow is a cyclic process includes Heart moves to Lungs-moves to Heart-finally reaches the Body[10].

Right side of the Heart
The right side of the heart receives deoxygenated blood from the body tissues into the right atrium. This deoxygenated blood passes through the tricuspid valve into the right ventricle.

Left side of the Heart
The left-hand side of the heart receives oxygenated blood from the lungs into the left atrium. This oxygenated blood then passes through the bicuspid valve into the left ventricle[11].

Risk Factors

The main risk factors for congestive heart failure are :

High blood pressure	Coronary heart disease
Diabetes	Valve defects[13]
Heart attack	Viral or bacterial infection
Obesity	Alcohol, Drugs, Tobacco
Decreased kidney function	COPD
High cholesterol[12]	Asthma[13]

Pathophysiology
The decrease in heart rate causes reduced cardiac out put which causes the myocardial injury. Improper regulation of baro receptor stimulations causes the irregular heart pulses[15]. The reduced left the ventricular function and activation of renin angiotensin aldosterone system causes more vasoconstriction and altered hemodynamic activity which causes the improper regulation of left ventricular function[14].

The activation of renin angiotensin aldosterone system the angiotensin 1 is converted to angiotensin II causes the severe vasoconstriction[16]. The aldosterone secretion causes the salt and water retention increase the plasma volume and increase the preload after load and cardiac work load consequences cause the heart failure.

TESTS AND DIAGNOSIS

Blood tests: Sample of blood is collected from the patient to check any infections, inflammations, look of indicators for other diseases that affect the heart[17].

Chest X-ray: The presence of heart failure, the heart may appear enlarged and more 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 and displayed on a paper[18].

Echocardiogram: An echocardiogram uses sound waves to produce a video image of the heart. This test can help the physicians to verify the size and shape, pumping effectiveness of heart[19].

Cardiac computerized tomography (CT) scan and magnetic resonance imaging (MRI): This test can be used to investigate the physiological process, 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 guided through the aorta into coronary arteries[20].

Myocardial biopsy: In this test inserting a small, flexible biopsy cord into a vein in the neck or and small pieces of the heart muscle is taken[21].

Doppler Imaging: This test uses sound waves to measure the speed and direction of blood flow and valvular 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 Magnetic Resonance Imaging (MRI): An MRI shows the structure and beating capability, contractions of heart and signs of damage.

Positron Emission Tomography: It is used to see the blood is flow to the heart[22].

Thyroid Function Tests: This test is performed to determine the causes of heart failure due to thyroid dysfunction.

SYMPTOMS

Weakness	Swelling of feet
feeling tired	Changes in the frequency of urination
coughing	Severe shortness of breath.
Weight gain	Profuse sweating, Chest pain[23]

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 but are lower in calories over nutrient-poor foods.
- Eating a diet containing low in salt, fat, saturated fat, trans fat and cholesterol.
- Monitoring the salt intake.
- Reducing the cholesterol levels in the body**.**
- Weight reduction practices.
- Regular physical activity[24]

Avoiding the alcohol habit :
- Drinking too much alcohol can raise blood pressure, increase cardiomyopathy, stroke, cancer, and other diseases. It can contribute to high triglycerides and produce irregular heartbeats. Excessive alcohol consumption contributes to obesity, alcoholism, suicide and accidents.
- Avoiding the smoking habit[25].
- Getting adequate relaxed sleep.
- Maintaining the low sodium diet.
- Exercising regularly.
- Strict Medication adherence.
- Stress management[26].

Fig 2: Congestive heart failure prevention and management

TREATMENT FOR CONGESTIVE HEART FAILURE

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

Angiotensin Converting Enzyme (ACE) Inhibitors
Commonly prescribed include:
- Captopril, Enalapril, Fosinopril, Lisinopril, Perindopril, Quinapril, Ramipril
- Benazepril: Usual dose: 20-40 mg in a single or 2 divided doses.

- Captopril: Congestive heart failure / Hypertension: 6.25-12.5 mg three times a day.
- Enalapril: Congestive heart failure / 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
Commonly prescribed include : Valsartan, Losartan, Candesartan,Valsartan, Telmisartan, Irbesartan27.

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
Commonly prescribed include: Bisoprolol, Metoprolol, propranolol, metaprolol, atenolol, acebutalol, esmolol, timolol.

Acebutolol 200 mg	Carvedilol 25 mg	Nadolol 80 mg
Atenolol 50 mg	Labetalol 200 mg	Pindolol 7.5 mg
Bisoprolol 5 mg	Metoprolol 100 mg	Propranolol 80 mg

Side effects: Rashes, Tachycardia, Weakness, Nausea, Vomiting, Abdominal discomfort.

Aldosterone Antagonists
Commonly prescribed drugs include : Spironolactone, Eplerenone.

Diuretics
Commonly prescribed include:

Furosemide (Lasix)	Chlorothiazide	Indapamide
Bumetanide	Amiloride	Metolazone
Torsemide	Hydro chlorothiazide	Triamterene

Furosemide dosing information: Dose : 20 mg - 80 mg.

Adverse effects: Sudden weakness, Electrolyte imbalance, kidney problems, Severe skin reactions[28].

Spironolactone dosing information
Usual Adult Dose for Edema:
- 25 to 200 mg/day orally in 1 or 2 divided doses.
- **Usual Adult Dose for Hypertension:**
- 25 to 200 mg/day orally in 1 or 2 divided doses.
- **Usual Adult Dose for Hypokalemia:**
- 25 to 200 mg/day orally in 1 or 2 divided doses.
- **Usual Adult Dose for Primary Hyperaldosteronism Diagnosis:**
- 100 to 400 mg/day orally in 1 or 2 divided doses.
- **Usual Adult Dose for Hirsutism:**
- 50 to 200 mg/day orally in 1 or 2 divided doses.
- **Usual Adult Dose for Congestive Heart Failure:**
- 25 mg/day orally.

Adverse effects: lower back or side pain, lump in the breast or under the arm, muscle pain or cramps, muscle spasms or twitching.

Vasodilators :
Isosorbide dinitrate: 20 mg three times a day.
Hydralazine: 37.5 mg three times a day.

Side Effects of vasodilators may include:
Chest pain, Heart palpitations, Rapid heart beat, Fluid retention, Nausea, vomiting, Dizziness and Headache.

Other medications that might be prescribed includes :
These drugs include: Digoxin: Dosage Forms & Strengths. oral solution : 0.05mg/mL, injectable solution : 0.1mg/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.

Heart Failure; 0.125-0.25 mg PO/IV q Day.

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

SURGERY AND MEDICAL DEVICES FOR CONGESTIVE HEART FAILURE TREATMENT

In few cases, the patient is recommended for surgery to treat the underlying problem that led to heart failure. It includes:
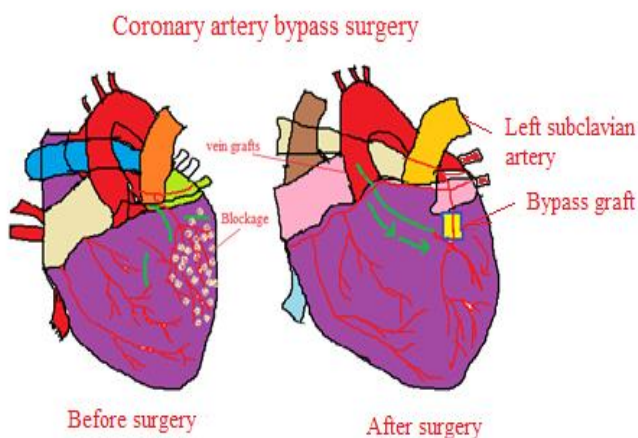
Coronary bypass surgery :

Fig 3: Before and After changes in 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 muscle29.
• 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.
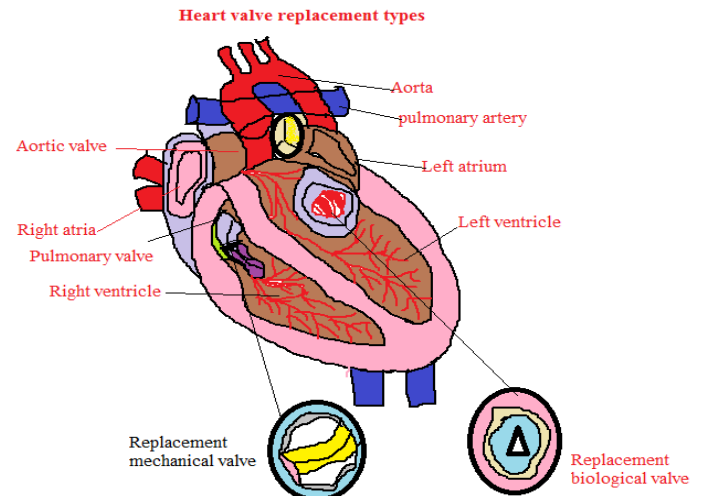

Fig 4: Heart valve replacement

Two kinds of valves can be used for replacement:
* **Mechanical valves** are usually made from plastic, carbon, or metal. Mechanical valves are strong, and they last a long time.
* **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: An ICD is a device similar to a pacemaker. It's implanted under the skin present in the chest with wires in veins and into the heart. The ICD monitors the heart rhythm.
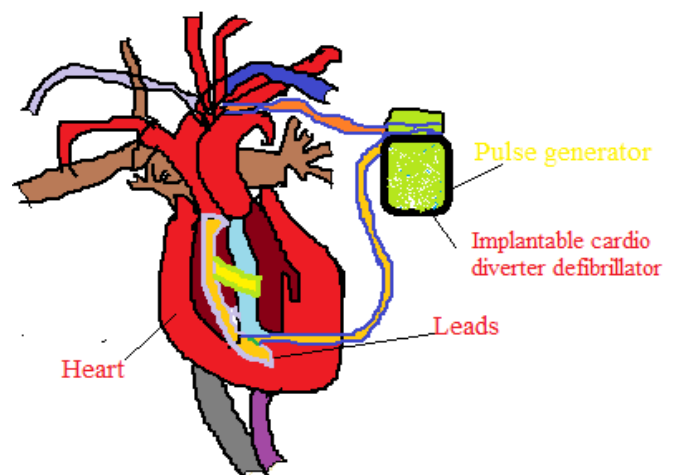

Fig 5 : Implantable cardioverter-defibrillators

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 heart failure[30].

Device therapy: Inserting a biventricular pacemaker known as cardiac resynchronization therapy, may restore synchrony to the ventricles.

Implantable cardiac defibrillators (ICDs): 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 life style interventions may impact reducing the cardiac health problems in patients with heart failure. The effective implementing treatment at early stages of the disease condition may improve the better health status in individual patients with heart failure[30]. 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 life style intervention practices may 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.

Heart failure is a complex clinical syndrome the diagnosis depends on various symptoms and laboratory investigations. The First-line pharmacotherapy consists of angiotensin converting enzyme inhibitors and β-blockers. The recent treatment depends on implantable cardioverter defibrillators and cardiac resynchronization therapies are 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 heart failure.

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