A COMPREHENSIVE REVIEW OF CONGESTIVE HEART FAILURE

*[1]Khole Nikhil Santosh, [2]Bansode Sakshi Vijay, [3]Thombre Mamata Bhausaheb, [4]Fand Varun Sanjay and [5]Asst. Prof. Suraj Gholap Sir

Mrs. Saraswati Wani College of Pharmacy, Ganegaon.

*Corresponding Author: Khole Nikhil Santosh

Mrs. Saraswati Wani College of Pharmacy, Ganegaon.

ABSTRACT

Objective/Purpose: Congestive Heart failure (CHF) is a common clinical disorder that leads to pulmonary vascular congestion and reduced cardiac output. The main objective of this review is to study the risk factors/ causes, pathophysiology, symptoms, diagnosis, their types or stages, pathogenesis, and treatment of Congestive Heart Failure (CHF). This review provides information about the development of CHF, condition, causes, its treatment and how to improve the patient care and safety. It emphasizes the role of healthcare providers or pharmacists in counselling the patients who are suffering from any type of heart related disorder. **Content:** Congestive Heart Failure is a chronic condition in which the heart does not pump enough blood which is required for normal functioning of the body. Congestive Heart Failure in India appears in high range and estimates of occurrence range from 1.3 million to 4.6 million. In the 16LMIC'S, a heart failure cohort study of 5800 participants had been conducted, which revealed that one year death rate for acute heart failure was highest for participants from Africa (347) and India (23%). In America, persons over 20 years of age have a heart failure. Approximately 6-7 million Americans of an age over 20 years have suffered from heart failure. It is also expected that it may rise to 8.5 million by 2030. Approximately 1 in 4 persons suffers from Heart Failure in their lifetime. Generally, congestive heart failure is a long-term clinical disorder in which the heart can't pump enough blood which is essential for normal functioning of the body. Appropriate medication and treatment should be selected or by considering the type and stage of Congestive Heart Failure.
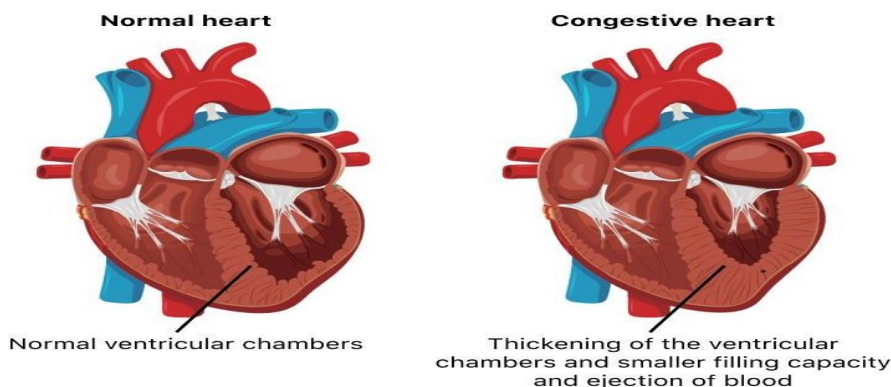
KEYWORDS: Congestive Heart Failure (CHF), Heart Failure (HF), Diastolic dysfunction, Systolic dysfunction, Respiratory Failure (RF).

INTRODUCTION

Congestive Heart failure is a complex clinical syndrome that can occur due to any functional or structural cardiac disorder that reduces an ability of ventricle to fill or expel the blood. It is characterized by ineffective myocardial performance, leading to threatened blood supply to the body. CHF results from any disorder that reduces the process of filling or ejection of blood to the systemic circulation.

Normal vs. Congestive Heart

Normal heart — Normal ventricular chambers

Congestive heart — Thickening of the ventricular chambers and smaller filling capacity and ejection of blood

The common cause of congestive heart failure (CHF) is coronary artery disease.

Coronary Artery Disease (CAD) involves generation of plug or atheroma in arteries thatsupply blood to the heart. It results in a decrease in supply of oxygen and also decreasesblood pressure.

Other causes include arrhythmia, Cardiomyopathy, high blood pressure, lung disease, Obesity, endocarditis. Since Congestive Heart Failure has a no conclusive diagnostic test. CHFis diagnosed clinically on the basis of history and physical examination. Diagnosis is also supported by aricillory tests such as electrocardiogram, echocardiography. With almost 80% of cases of CHF, it occurs in patients which are over the age of 65.

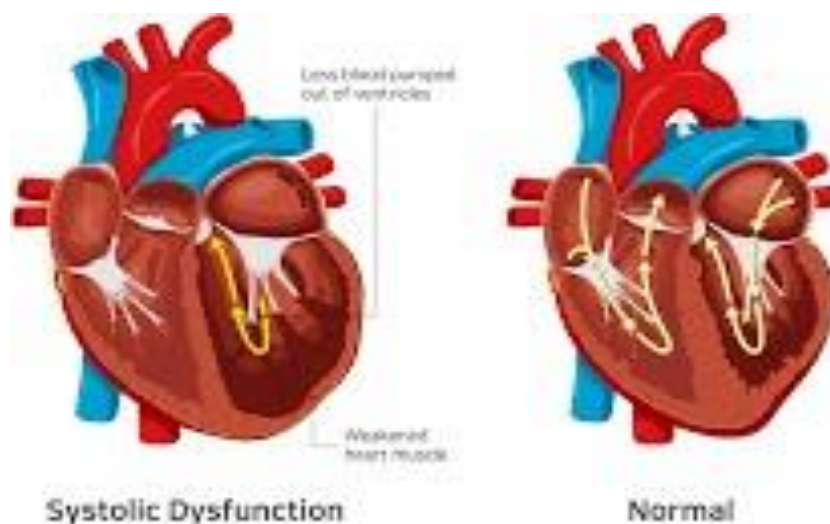The etiology of heart failure is variable and extensive.

Ischemic heart disease. Is a main cause of death and also causes CHF reduces functional capacity and significantly affects the quality of life. There are two mechanisms of heart failure i.e. systolic dysfunction and diastolic dysfunction.

1) Systolic dysfunction
It is a condition in which at a high enough pressure, the heart's left ventricle is unable to pump the blood out into the aorta. It is caused due to reduced flow through the left ventricle's outflow tract.

- **Symptoms**
1) Confusion
2) Weight gain
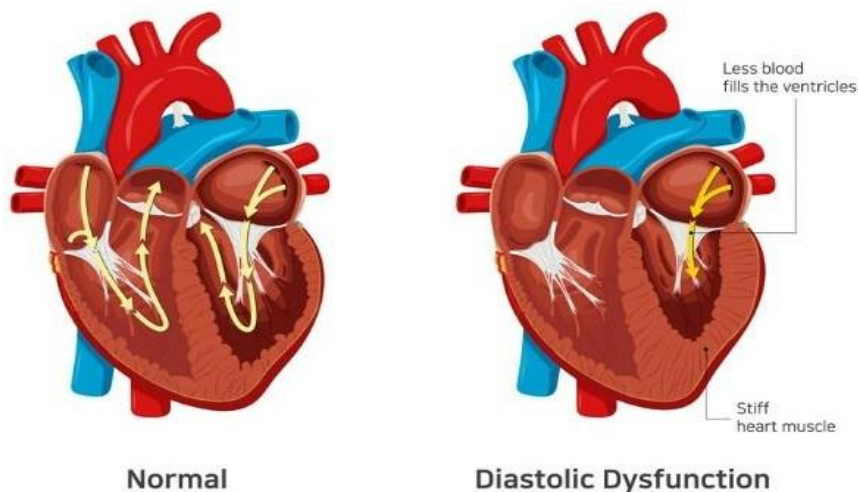3) Fatigue

Systolic Dysfunction   Normal

2) Diastolic Dysfunction
It is a Condition in which the heart muscle becomes stiff and can't relax properly. It is caused due to aging, high B.P,
diabetes, CAD, obesity.

- **Symptoms**
1) Shortness of breath.
2) Fatigue
3) Swelling in the legs, ankles,feet.
4) Nausea

Normal   Diastolic Dysfunction

Diastolic dysfunction is morefrequent in women.

This article reviews an etiology, pathophysiology, pathogenesis, diagnosis and treatment of CHF. By using New York Heart Association (NYHA) functional classification, symptoms of CHF can be classified as follows.

1) Class I: - In this there are no symptoms, patients can perform ordinary activities without anylimit.

2) Class II: - In this, there are mild symptoms Includes occasional swelling, somewhat limited in ability to exercise.

3) Class III: - It includes noticeable limitations in ability to exercise at rest. Comfortable onlyat rest.

4) Class IV: - In this symptoms mostly occur at rest. In this, patient is unable to do any physical activity without discomfort.

ETIOLOGY
There are several etiologies of CHF. An identification of causative factors of CHF is essential for prevention and treatment of CHF.

1) Ischemic heart disease
Ischemic heart disease is the main cause of CHF. It is a condition in which, due to a lack of or decrease in blood supply. The heart muscles get damaged. It is caused due to coronary artery disease.

2) Hypertension
Hypertension may also cause CHF. When the heart works harder to pump blood, then it can lead to congestive heart failure. Hypertension induces structural and functional changes in myocardium, this includes hypertrophy of the left ventricle.

3) Cardiomyopathy
Cardiomyopathy is a disorder that affects the heart muscle. It makes it stiffen, enlarge or thicken. Cardiomyopathy makes it difficult to pump blood effectively. That's why it can lead to heart failure. There are 3 types of cardiomyopathies.
1) Dilated cardiomyopathy.
2) Hypertrophic cardiomyopathy.
3) Restrictive cardiomyopathy.

EPIDEMIOLOGY
CHF is a cardiac disorder which may be caused due to a variety of cardiac disorders. Five million Americans should suffer from CHF. Approximately 550,000 new cases of CHF shouldregister every year and nearly about 2, 50,000 die every year. 2.5% of the total population has this disease. Within five years, 50% of patients die. It is expected that associated morbidity and mortality will increase in the future.

RISK FACTORS
1) Hypotension
2) Bradycardia
3) Heart attack
4) Fluid retention.
5) Age Family history
6) Smoking tobacco
7) Coronary Artery Disease
8) High B.P
9) Obesity
10) Infections such as HIV or COVID-19
11) Diabetes

PATHOPHYSIOLOGY
Heart Failure occurs when there are some changes to the structure of the heart muscle and when it doesn't pump enough blood, which is essential for the body. When this condition happens, blood can back up and then the fluid may build up in the legs, lungs or arms that indicates congestive heart failure. To maintain normal cardiac output, various compensatory mechanisms play a role under compensatory enlargement in the form of cardiac hypertrophy, cardiac dilatation.

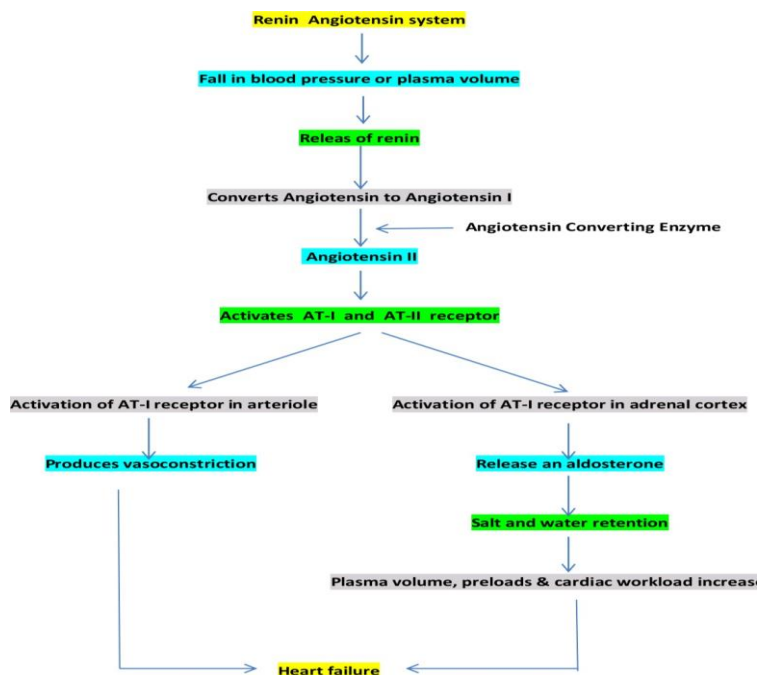### Compensatory Mechanisms in CHF
1) Neurohormonal reflex
This mechanism increases the work of the heart and also helps to decline the cardiac function.

a] Activation of norepinephrine atrial natriuretic peptide
b] Activation of the renin-angiotensin aldosterone system.

2) Myocardial hypertrophy
Myocardial hypertrophy is a condition in which heart muscles become thickened. It isalso called hypertrophied. It is the most important compensatory mechanism. In this condition muscles get thickened and then it becomes harder for the heart to pump blood. There is an increase in myocardial mass, which further helps to maintain cardiac performance in pressurized phase or volume overload. However, after a specific time, it can also lead to heart failure, ischemic changes and alteration in ventricular geometry.

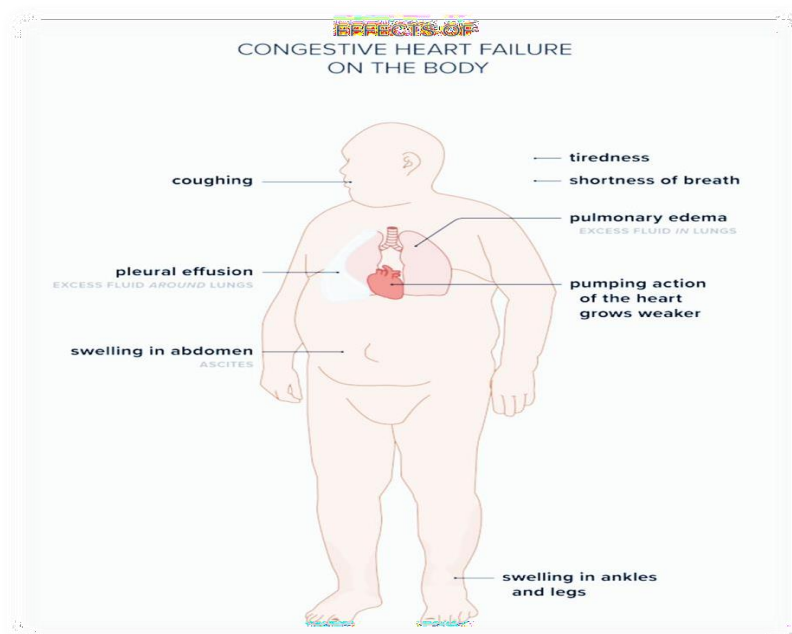● **Congestive Heart Failure due to the renin angiotensin system**

The Renin angiotensin system includes: cascades of events. When blood pressure or plasma volume decreases or falls, then these events are activated by release of renin. Then renin being protease and converts circulating angiotensinogen to a physiologically inactive angiotensin I. This angiotensin I is converted into Angiotensin II by an angiotensin converting enzyme. Angiotensin II causes an activation of two receptors, i.e. AT-1 and AT-2 receptor. AT-2 is present in arterioles and adrenal cortex.

When. AT-I receptor is activated in adrenal cortex, then it leads to the release of aldosterone. When the AT-1 receptor is activated in arteriole, then it can lead to vasoconstriction. Due to the release of aldosterone, there is retention of salt and water which leads to an Edema. It also causes an increase in plasma volume, preload and cardiac workload.Then it may cause heart failure.

Sign and symptoms of CHF
1) Shortness of breath.
2) Wheezing
3) Inability to exercise
4) Nausea
5) Lack of appetite.
6) A Difficulty in concentrating
7) Swelling in ankles, feet, legs.
8) Weakness
9) Weight gain
10) Coughing

DIAGNOSIS AND TESTS
Diagnosis of CHF is very important to understand or to identify the causative factor or a condition. It helps in choosing an appropriate medical treatment. Primarily, Healthcare providers ask you about your medical history and symptoms. Health care providers also ask about;
1) Use of tobacco products
2) Amount of alcohol consumption.
3) Medication taken
4) Family history

They also perform a physical exam.
There are various tests which are used for diagnosis of congestive heart failure.

These are as follows.
1] Blood test: - It is a laboratory test, which includes a full blood count to diagnose anemia. Italso includes renal and liver function test to remove renal on liver failure as a cause of peripheral edema. A high sensitivity Troponin-T test also helps to diagnose a heart attack.

It also includes;
a) Brain Natriuretic Peptide test (BNP Test)
BNP is a protein which is produced by the heart and blood vessels. During heart failure, BNP level increases, then this test is used to measure the level of BNP.
b) Pro-BNP (N-terminal pro- B-type natriuretic peptide test):-
It is a natriuretic peptide which increases during heart failure. This test measures the levelof Pro-BNP.

c) Electrolyte test
It is used to measure the level of potassium and sodium.

2) Cardiac catheterization
It is also used to diagnose Congestive Heart Failure. It is also called coronary angiogram. In this test, a thin tube known as catheter, which is inserted into a blood vessel in your groin, arm or upper thigh and then. It is threaded through to the heart.

3) Chest X-ray
It is not a primary method for diagnosis of CHF. But also used to identify the complications of CHF.

4) Echocardiogram
It is used to diagnose CHF. It is a common non-invasive test that measures the heart's pumping function, and also evaluates its structure and function.

5) Heart MRI
It is a non-invasive imaging technique that accesses the function and structure of the heart. It measures ventricular. Systolic function, access myocardial anatomy.

6) Electrocardiogram
It is also used to diagnose CHF. It is a basic tool for screening the heart failure particularly for people with a family history of heart disease. ECG alone cannot give a significant diagnosis of OHF. Combination of rather tests. Other tests used in combination art.
• Echocardiogram
• CT scan.
• MRI
• PET
• Biopsy

Management of Congestive Heart Failure
There is no specific treatment that cures the congestive heart failure. The main objective of the treatment is to relieve the symptoms and to prevent the progression of CHF. Treatment depends on the stage and type of heart failure, condition, symptoms and an individual patient. There are two methods to manage the Congestive Heart Failure.

These are;
1) Non-pharmacological treatment.
2) Pharmacological treatment.

Both treatments help to prevent the symptoms but do not cure the disease.
1) Non-pharmacological treatment
Non-pharmacological treatment includes,

a) Lifestyle Modification
There are various factors which are related to our daily lifestyle that may cause heart failure. The factors such as improper diet, irregular exercise, obesity, smoking, alcohol consumption and fluid intake. There are some changes which are essential for preventing congestive heart Salt failure. Doctors may advise you to avoid salt and caffeine. Patient should have a limited fluid intake.

b) Exercise
Exercise is the most important factor for reducing the progression of congestive heart failure. Exercise mostly focuses on weight loss. Exercise can improve the blood flow. Exercise may keep your heart healthy and also promotes micro vascular dilution. The non-pharmacological management of CHF has often focused on weight loss through exercise and dietary modification.

2) Pharmacological treatment
Pharmacological management is used to manage or to prevent the symptoms which are associated with CHF. The agents used in the treatment of CHF only prevent the progression but do not cure it. There are a variety of drugs which are used in the prevention of CHF. Theseare as follows;

1) Diuretics
Diuretics are effective for controlling fluid retention and to reduce symptoms of congestion by reducing preload, but it does not prevent disease progression. Diuretics are the drugs that increase urine formation and thereby produce rapid symptomatic relief in patients of heart failure. Loop diuretics are more preferable drugs for

severe cases of congestive heart failure, because as compared to the thiazide diuretics, loop diuretics produce more natriuretic effect. On continuous use of loop diuretics may lead to dehydration, hypokalemia, and alkalosis.

Prolonged use of diuretics may also activate the Renin Angiotensin System which further accelerates the disease process. So that only in advanced cases of heart failure, theprolonged diuretic therapy is recommended.
Ex: Furosemide, Hydrochlorothiazide.

2) Vasodilators
These are those drugs that dilate the blood vessels thereby decreasing blood pressure and also provide relief in congestion associated with congestive heart failure When vasodilators can be given intravenously they are used for acute heart failure and advanced cases. When used orally, these drugs are used for long term therapy.

a) ACE inhibitors: Ex: Captopril, Enalapril, Ramipril
Mechanism of action - These drugs inhibit angiotensin converting enzymes so they are used in congestive heart failure. ACE catalyzes the conversion of angiotensin I to pharmacologically active angiotensin II. The latter compound may increase the secretion of aldosterone. Antidiuretic hormone also produces vasoconstriction. Then ACE inhibitors inhibit the action of ACE and produce a vasodilation effect

b) Angiotensin Receptor antagonist
Ex: - Losartan, Valsartan.
These drugs show an in antagonist effect on AT-1 receptor in smooth muscle and provide relief in patient of congestive heart failure. Due to blockage of AT 1 receptor in vascular smooth muscle, these drugs produce vasodilation effect. When AT-1 receptors are blocked in the adrenal cortex, then these decrease aldosterone secretion.

c) Other vasodilators
This class includes nitrates, hydralazine and nitroprusside.

i) Nitrates
Organic nitrates like isosorbide dinitrate and glycerol nitrate are primary vasodilators. They decrease preload by relaxing the venous smooth muscles more than arterial smooth muscles.

ii) Hydralazine
It is an arteriolar dilator that dilates arteriolar smooth muscles more than venous smooth muscles. These drugs decrease aortic impedance and cardiac afterload. Hydralazine is used as an alternative to ACE inhibitors in renal insufficiency.

iii) Nitropruside
It is a mixed vasodilator that relaxes arteriolar. They are also a vasodilator. It also decreases preload and
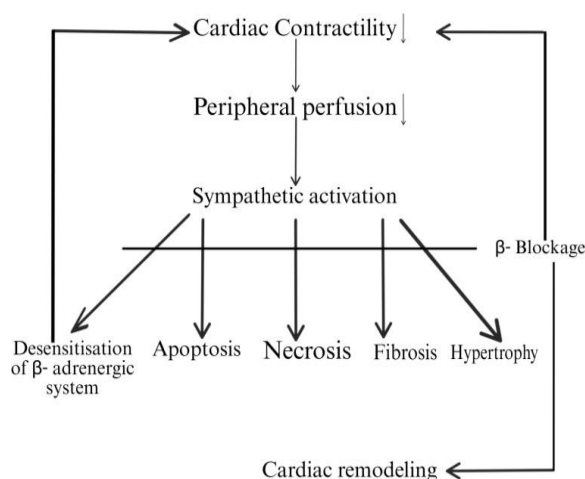
afterload. Nitropruside is indicated for short term treatment of acute heart failure.

3) B-blockers
Ex: - Metoprolol and Carvedilol.

B-blockers have recently emerged as a new class of drugs for heart failure patients. B- blockers prevent stimulation of the sympathetic nervous system by inhibiting the action of a catecholamine at B- adrenergic receptors by this they improve left ventricular function.

B-blockers include Metoprolol and Carvedilol. B-blockers have the ability to decrease excessive stimulation of the sympathetic nervous system. That leads to counteracting acute adverse effects like tachycardia and increased myocardial oxygen demand. B-blockers also decrease adverse effects of the renin angiotensin system on the heart.

4) Aldosterone receptor antagonist
It includes drug spironolactone. These drugs inhibit the action of aldosterone by inhibiting the binding of aldosterone to the receptor. Aldosterone may cause an increase in plasma volume and cardiac preload. It reduces blood level of potassium and magnesium, by this they promote the chances of ventricular arrhythmias that may lead to sudden death in patient with CHF. All this action exerted by aldosterone can be inhibited by spironolactone.

5) Cardiac Inotropic Agents
a) Cardiac glycosides
E.g. Digoxin, Digitoxin.

Cardiac glycosides are called Cardio tonic agents. They increase the mechanical efficiency of heart as a pump without increase in oxygen consumption.

• Mechanism of action:- Digitalis shows positive inotropic effect. Digoxin reversibly binds to a site on the extracellular aspect of the alpha subunit of the Na+/K+ ATPase pump in the heart's cell membrane This results in inhibition of pump activity and cause increase in the

level of Na+ in the myositis, then it stimulates an exchange of Na+ and ca²+ Due to this, Ca² + enters into the cell and Na+ is given out. Thus increase in intracellular ca²+ resulting in an increase systolic force of contraction. This may modify an autonomic outflow.

b) Phosphodiesterase III inhibitors

It includes Amrinone and Milrinone. These drugs inhibit the enzyme phosphodiesterase which catalyzes the degradation of cAMP to inactivate the product 5- AMP. It increases concentration of cAMP in the heart, blood vessels and smooth muscles in bronchi. These drugs produce a positive inotropic effect and cause relaxation of vascularsmooth muscles.

CONCLUSION

Congestive heart failure is a clinical condition in which an efficiency of the heart to fill and to pump the bleed is decreased due to structural or functional diseases. CHF is crowned due to Various factors such as ischemic heart disease Chronic Obstructive Pulmonary Disease, hypertensive heart disease and Rheumatic heart disease. Early diagnosis is necessary for mitigation, adequate treatment preventing progression of CHF and severe complications. For an adequate treatment, it is necessary to obtain the clinical history and to perform laboratory tests. Treatment depends on the stage and type of CHF. Lifestyle modification can improve quality of life.

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