Nutritional Deficiency & Impact on Health

Chapter 3

Nutrition in Heart Failure

Tsaloglidou Areti[1]; Koukourikos Konstantinos[2]; Tsiligiri Maria[3]; Iliadis Christos[4]; Kourkouta Lambrini [5]*

[1]Assistant Professor of Nursing Department, Alexander Technological Educational Institute of Thessaloniki, Greece

[2]Clinical Professor of Nursing Department, Alexander Technological Educational Institute of Thessaloniki, Greece

[3]Professor of Physiotherapy Department, Alexander Technological Educational Institute of Thessaloniki, Greece

[4]RN, Private Diagnostic Health Center of Thessaloniki, Greece

[5]Professor of Nursing Department, Alexander Technological Educational Institute of Thessaloniki, Greece

*[*]**Correspondence to: Kourkouta Lambrini,** Professor of Nursing Department, Alexander Technological Educational Institute of Thessaloniki, Greece.*

Email: laku1964@yahoo.gr

1. Introduction

The syndrome of chronic heart failure (CHF) in developed countries has taken the form of an epidemic. Patients with heart failure worldwide amount 23 million. The prevalence of the syndrome in the US, from 1% at the age of 50, exceeds 10% at 80 years. This is due to the increase in life expectancy as well as to the therapeutic developments of coronary artery disease. These developments have drastically reduced the mortality rate of CHF, but at the same time they have increased its incidence [1]. Despite the therapeutic efforts and developments in recent years, CHF continues to have a poor prognosis [2,3]. Survival during the first year after diagnosis has been estimated at 80-90% in a moderate and 50 to 60% in severe form, rates worse than many types of cancer [2,3]. The five-year survival is <50%. CHF is associated with very high rates of morbidity as it is the most common cause of hospitalization in the developed countries, for patients> 65 years old [4,5].

Heart failure is a common and public health problem, since the number of patients suffering from the disease is increasing worldwide. The 1-3% of the adult population suffers from the syndrome, while the percentage reaches the 10% in the elderly population [6]. It is a complex clinical syndrome, which has a bad prognosis and is manifested by various symptoms in all body systems. It represents a major and growing public health problem worldwide for both

its high prevalence, and the severity of its clinical manifestations [7].

Nutrition is accepted as an integral and essential part of the treatment of heart failure and seeks to improve patient's condition, aiming at replenishing energy reserves, increasing skeletal muscle tissue and improving exercise capacity. Nutrient deficiency is common in patients with heart failure due to prolonged use of diuretics, low dietary intake and increased nutrient loss [8].

Chronic heart failure is often accompanied by severe eating disorders, which in combination with chronic inflammation, neuro-hormonal stimulation, and reduced physical activity contribute to the vicious circle of heart failure leading progressively in cardiac cachexia. The occurrence of cardiac cachexia with intense weight loss, as its main manifestation, leads to a particularly poor quality of life, as well as to a dramatic increase in patient mortality [9].

The purpose of this study is to investigate the role of nutrition in the prevention and treatment of heart failure.

2. Heart Failure

Heart Failure (HF) is the inability of cardiac muscle to provide cells with sufficient blood supply for the metabolic needs of the body. Heart Failure is, clinically, a syndrome manifested by congestive symptoms or low cardiac output in combination with typical clinical and laboratory findings [10].

In heart failure, there is a malfunction of the ventricles, mainly of the left ventricle. Heart failure of the right ventricle, shows weakness of the right ventricle in the exudation of blood to the lungs as the result of the left ventricle's inability to eject the blood. This leads to high levels of pulmonary vein pressure and consequently to an increase to the mean pulmonary artery pressure and to an increase to the right ventricular afterload and, ultimately in deficiency [11].

In the early stages of cardiac failure, there is no symptom, since neurohormonal compensatory mechanisms manage to maintain tissue perfusion sufficient for some time. However, left ventricular function progressively decreases and symptoms begin to appear [12]. This is the result of Cardiac Remodeling and especially of the left ventricle, which is increased , becomes more spherical and overloads due to increased blood volume (preload) and increased peripheral resistance (afterload). The mechanical performance of the ventricle decreases, the wall stress increases and mitral insufficiency occurs due to dilatation of the mitral ring [11,12].

According to the New York Heart Association (NYHA), Heart Failure can be classified into four categories, depending on symptomatology of patients during physical activity [13]:

✓Class I - Physical exercise without limitation: patients do not show symptoms (palpitation, dyspnea, undue fatigue) during ordinary physical exercise.

✓Class II - Physical exercise with slight limitation: patients show mild symptoms during ordinary exercise.

✓Class III- Physical exercise with marked limitation: patients show symptoms even during exercise less intensive compared to daily activities.

✓Class IV: patients show symptoms at rest, severe limitations. They cannot take care of themselves [14].

2.1. Clinical picture - Symptoms of heart failure

Depending on the side of the heart affected, heart failure symptoms observed, are traditionally divided into “left” and “right” sided.

There are two types of left-sided heart failure: systolic and diastolic. Systolic is a pumping problem where the left side of the heart does not pump blood sufficiently to the body organs. Diastolic failure occurs when the heart is unable to rest between heart beats [15]. Their symptoms are similar and are the following [6, 16]:

- Dyspnea due to the increased work of breathing caused by decreased lung compliance due to pulmonary congestion
- Pleural effusion (fluid collected in the lung)
- Edema, mainly in the lower limbs and the rest of the body at an advanced stage
- Reduced capacity for activity and exercise
- Cough
- Tachycardia
- Tachypnea
- Sweating
- Weakness
- Fatigue
- Anemia
- Confusion
- Memory disorders due to decreased cerebral perfusion.

The symptoms of right sided heart failure are due to decreased cardiac output, and are as follows [7,16]:

- Dilatation of the cervix vein due to increased blood volume and venous pressure
- Pleural effusion (fluid collected in the lung)

- Shortness of breath
- Cough
- Fatigue
- Edema of the lower extremities, especially in the ankle area
- Congestive hepatomegaly: sensitivity to the right hypochondrium and feeling of fullness in the abdomen
- Ascites (collection of fluid in the abdomen)
- Nausea and anorexia

Moreover, there are some clinical set criteria for the diagnosis of heart failure, which are divided into major and minor. These criteria are presented in the following table [17].

Diagnostic Criteria for Heart Failure

Major Criteria	Minor criteria
Paroxysmal nocturnal dyspnoea or orthopnea	Peripheral edema, nocturnal cough
Jugular vein distention	Dyspnea on effort/ Dyspnea on exertion
Moist rales	Enlarged liver
Megalocardia	Tachycardia> 120 / min
Third heart sound	Reduced Vital Capacity
Hepatojugular reflux	Pleural effusion
Increased venous pressure> 16cmH2O	

Source: Mc Kee et al., 1971

2.2. Classification of Heart Failure (HF)

Heart Failure is divided into left sided, right sided, biventricular, acute, chronic and end-stage.

In the left heart failure, the left ventricle is unable to push the blood into the aorta. When the left ventricle is weak, there is a diminishment in cardiac output with its associated feelings of fatigue and dizziness, along with symptoms of fluid congestion [18]. The blood backs up (be congested) into the two chambers of the left heart (left atrium and left ventricle) and even "backwards" to the lungs. As a result, it increases the dimensions of the left heart, and on the other hand there is fluid exudation in the perivascular space of the pulmonary capillaries, while in more severe conditions excess of fluid also accumulates mainly within the lung alveoli [16]. Often this accumulation of fluid is combined with shortness of breath on exertion, the incapacity to breathe while lying flat, and the patient's tendency to awaken during sleep with shortness of breath [18].

Left- sided heart failure may result from any cause that causes an excessive load on the left ventricle or its blood perfusion disorders. It is observed in hypertension, valve diseases, stenosis - deficiency, coronary artery disease, etc [19].

In the right heart failure there is decreased right ventricular function, which is unable to push blood to the lungs in order for it to be oxygenated. Therefore, the blood transferred back through the lungs ultimately damaging the heart's right side. When the right side loses pumping power, blood backs up in the body's veins and the pressure in the veins is increased. This usually causes swelling of the cervix, liver and spleen, lower limbs and rarely fluid collection in the abdomen (ascites) or even throughout the body [7]. Causes leading to the creation of right heart failure are left ventricular failure, mitral valve stenosis, congenital heart disease, chronic obstructive pulmonary disease and multiple pulmonary embolisms [12].

In biventricular heart failure, both sides of the heart are affected. Left and right heart failure coexist, have a mixed clinical picture and show manifestations of failure of both ventricles [19].

Acute heart failure (CRS) has a rapid onset of symptoms and signs due to structural or functional cardiac dysfunction with or without pre-existing heart disease. Cardiac dysfunction may be associated with systolic or diastolic dysfunction with heart rhythm disturbances and failure of compensatory mechanisms [20].

In chronic heart failure (CHD), patients experience progressive worsening of symptoms and left ventricular myocardium is more and more dysfunctional [21].

In end-stage heart failure, the major haemodynamic disorder is the large increase of the left ventricular diastolic pressure (mean pulmonary capillary wedge pressure 30mmHg), which causes functional mitral valve failure, pulmonary hypertension, functional tricuspid deficiency and increased pressure in hepatic and visceral veins [20].

2.3. Diseases leading to heart failure

The most common disease responsible for the development of heart failure are:

Hypertension: heart exposure to high arterial pressures over a long period may lead to an increase in its size and ultimately to a decrease in its functionality [26].

Coronary artery disease: Coronary artery disease is likely to lead to the onset of myocardial infarction, which causes necrosis and permanent damage to a part of the cardiac muscle. In cases where the damage concerns a larger part of the heart, it is possible to lead to heart failure [27].

Heart valve malfunction: Disorders of the valve functionality may lead to increased pressure within the cavities and heart failure [22].

Cardiomyopathies: These are congenital or acquired diseases in which the heart muscle is affected. They usually lead to an increase in the size of the heart cavities, a reduction in its

contractile capacity, and ultimately to heart failure [23].

Diabetes mellitus: Diabetes mellitus in some cases causes myocardial damage and increases the probability of developing heart failure, especially in patients in whom other risk factors, such as smoking or hypertension coexist [28].

2.4. Heart Failure Diagnosis

Based on the guidelines of the European Heart Association, Cardiology for the diagnosis of heart failure (systolic or diastolic), the following conditions must be met: a) the presence of heart failure symptoms at rest or fatigue; b) the existence of objective findings of cardiac dysfunction at rest and c) improvement of patient's clinical picture after administered treatment in cases where there is doubt about the accuracy of diagnosis [23].

The most commonly used objective criterion for left ventricular systolic dysfunction is the reduction of the ejection fraction (lower than 59%) [24].

Heart failure diagnosis starts with a careful patient's medical history, continues with the performance of physical examination to determine the presence of clinical symptoms, and the evaluation is completed with exams and laboratory tests.

By taking the patient's medical history, the doctor collects information about the symptoms and underlying diseases that may be responsible for the onset of the disease. By the physical examination, the doctor listens carefully to the heart and lungs, examines the abdomen and checks about the flow of blood to the upper and lower extremities. Based on the findings of the history and clinical examination, he/she will then request the appropriate diagnostic tests to assess the functional capacity of the heart and the causes of heart failure [22].

The most common tests requested by the patient are the following [23]:

Chest X-ray: Shows the size and shape of the heart, as well as the large vessels within the thorax. It also helps to detect the accumulation of fluid in and around the lungs [22].

ECG: Electrocardiogram can help diagnose underlying diseases, such as coronary heart disease and various arrhythmias (disturbances of the normal heart rhythm, which often coexist with heart failure). It also provides information about the size of the heart [24].

Cardiac Triplex Ultrasound Imaging: Cardiac triplex provides information about the size of cardiac chambers, the functionality of heart valves and the mobility of the different parts of the heart. It also helps to estimate the ejection fraction, which describes the contractile capacity of the heart, as well as the pressures present within the heart and large vessels [20].

Stress Test: A stress test shows how patient's heart works during physical activity. The patient

walks onto a moving belt and at the same time his blood pressure, electrocardiogram and heart rate, are recorded [11].

Myocardial Scintigraphy: It is a non-invasive diagnostic technique, by which blood supply to the heart is investigated. The severity of coronary heart disease, the efficacy of treatment, the existence of viable or "live" myocardium in patients with heart failure, as well as the future outcome of patients who have had a heart attack or coronary heart disease can be assessed. Most often it is performed in conjunction with the stress test [6].

Coronary angiography: Coronary artery imaging is a procedure that uses X-ray imaging to see the heart's blood vessels. It is part of the cardiac catheterization. In angiography, the morphology and anatomy of the coronary arteries are observed and any constrictions are recorded [7].

Ventriculography is performed by injection of contrast media into the left ventricle in order to assess its capacity of extruding. The right ventricular catheterization provides information about the pressures in the right cavities of the heart and the vessels of the lung [22].

Electrolytic control

Electrolyte disorders occur frequently in heart failure due either to the disease itself or to the administered medication. The most common of them are hyponatremia, hypokalaemia and hypomagnesaemia. Hyperkalaemia is also common [26].

2.5. Heart Failure Treatment

One of the most important steps in the treatment of heart failure is the early diagnosis and treatment of the underlying diseases, responsible for the onset of the disease, such as hypertension, diabetes mellitus, coronary heart disease, valvular diseases etc.

The medication treatment administered to patients with heart failure includes one or more drugs aimed at reducing the overall risk, improving quality of life and prolonging survival. These drugs are the following [23]:

➢ **Antagonists of the renin-angiotensin-aldosterone system:** they inhibit the action of certain hormones and improve the functionality of the heart. Their most common side effect is dry cough [24].

➢ **B - Blockers:** They reduce heart rate and blood pressure, lowering heart load. The most common side effects are hypotension and bradycardia [22].

➢ **Diuretics:** They help the removal of fluid excess and salt retained due to impaired cardiac function. The most common side effect is hypokalaemia, and that's why regular biochemical

control (by taking blood) is necessary [6].

➢ **Nitrates:** These are drugs that cause dilatation of the arteries and veins (vasodilatation), reducing heart load. They are often prescribed in transdermal form (sticker). The most common side effect is headache [7].

➢ **Digoxin:** It is mainly used in patients with heart failure, when arrhythmia (atrial fibrillation) coexists, to control heart rate. Regular monitoring of drug levels in the blood is required. The most frequent side effects are bradycardia and gastrointestinal disorders [11].

➢ **Anticoagulants:** There is an increased risk of thrombus formation in patients with heart failure due to slow blood flow, cavity enlargement and coexisting arrhythmias. Because of the risk of bleeding from warfarin, regular blood tests are required for the assessment of INR [23].

➢ In cases of advanced stage of heart failure, it is often observed that the right and left ventricle of the heart contract asynchronously with each other, resulting in a decrease of its overall capacity of extruding. It is often an indication for the implantation of a special pacemaker that succeeds in re-synchronizing the two ventricles so that they contract contemporaneously. These pacemakers are called biventricular pacemakers and the therapy they provide is called re-synchronization [22].

Surgical treatment of heart failure

In many cardiac patients, medication is not sufficient for treatment, and as a result there is a need for further treatment. Recent interventions in cardiac failure, such as the implantation of a biventricular pacemaker to achieve resynchronization of the heart and the implantation of defibrillators for the treatment of dangerous arrhythmias, contribute to the improvement of quality of life, reduction of hospitalization rates and prevention of sudden death. Surgical treatment is used as a necessary complement to pharmaceutical treatment in selected patient groups [8].

Coronary artery bypass surgery (CABG) is the most common surgical procedure for patients with heart failure, applicable for the treatment of coronary artery disease [6].

Some patients with end-stage heart failure are candidates for heart transplantation. However, the limited number of available grafts often prolongs dramatically the waiting of these patients in the transplant list [24].

Left ventricular assistants (LVADs), moreover, are usually placed as an intermediate, treatment in patients who are to undergo a heart transplant [16, 22].

Treatment with stem cells

The administration of autologous stem cells is a promising therapeutic method, which needs caution, as many trials are still required until safe clinical conclusions are drawn. The "stuff" is injected into the myocardium in order for the stem cells to become myocardial cells and to improve heart's functionality. Stem cell administration can be used as adjunctive therapy along with other methods [6,22].

2.6. Cachexia and heart failure

Heart failure, and especially chronic heart failure, is characterized by severe nutrition disorders, which in combination with chronic inflammation, neurohormonal stimulation, and reduced physical activity contribute to the vicious circle of heart failure leading to sarcopenia and progressively to cardiac cachexia [9]. The loss of body fat and lean body mass that accompanies weight loss is called cardiac cachexia [29].

Eating disorders (anorexia, malabsorption), as the only underlying cause of cachexia, cannot explain all the metabolic changes occurring in cardiac cachexia [30]. Moreover, it has been shown that without the contribution of other therapeutic interventions, dietary intervention can be supportive, but it cannot reverse the course of weight loss in cachexia patients, as it happens in other cases of starvation or neurogenic anorexia [31].

Nowadays, the role of the gastrointestinal system in the genesis of cachexia is being extensively studied. Under normal conditions, visceral circulation receives 25% of the cardiac output, making the intestine one of the organs with the richest blood supply at rest. Pathological changes in bowel vessels, happened earlier than the changes in heart rate or blood pressure, may result in intestinal ischemia, even in poorly discrete reductions in cardiac output [32,33].

The gastrointestinal tract of patients with chronic heart failure is characterized by structural abnormalities such as high collagen content, large distance between capillary wall and enterocytes, or intestinal wall thickening consistent with mucosal edema [34]. The consequence of this is inadequate nourishment of enterocytes and malabsorption development [31]. Finally, there are a number of functional changes such as increased Para cellular permeability and decreased absorption capacity of proteins and lipids [35]. The incidence of anemia in CHF patients is a common phenomenon, particularly in a possible loss of blood from the gastrointestinal tract, which is burdened by the anticoagulation treatment, received by many patients with chronic heart failure [36].

Treatment in heart cachexia

In the literature, it seems that at least 19 different pharmaceutical agents regulating muscle loss, have been studied. These interventions include the use of anti-inflammatory agents

and appetite stimulants. [37] More effective in preventing weight loss and the occurrence of cardiac cachexia are angiotensin converting enzyme (ACE) inhibitors and beta-blockers (metoprolol, bisproolol, carvedilol). Their positive effect on weight gain appears to be based on a reduction in catecholamine-induced lipolysis, an increase in fat body mass, a decrease in energy expenditure of rest or insulin sensitivity [38,39]. Testosterone also acts auxiliary in improving cardiac function, muscle strength and glucose metabolism [40].

3. Nutrition and Heart Failure

There is evidence that diet may play a role in preventing heart failure and even improving the prognosis of the disease in patients who have already experienced symptoms. However, there is little data available to develop adequate and specific recommendations similar to those available for other cardiovascular diseases, such as hypercholesterolemia or hypertension [41,42].

Patients with heart failure, therefore, have particular dietary needs caused by the disease itself and its complications as described below:

➢ **Symptoms of the disease:** premature saturation, feeling of fullness, anorexia, decreased hunger and gastrointestinal disorders, such as nausea, constipation and abdominal pain. In addition, patients have increased energy requirements due to increased breathing work, dyspnoea and body temperature increase [43].

➢ **Pharmaceutical treatment:** side effects of drugs (digoxin, diuretics, beta blockers, ACE antagonists), such as anorexia, thirst, stomach cramps, nausea, vomiting, constipation, dry mouth, diarrhea, glossitis, stomatitis, gastritis, dyspepsia, unpleasant taste, may further complicate the situation , if they occur [44].

➢ **Dietary habits:** Heart patients consume only two meals a day, resulting in reduced energy intake [45].

➢ **Modified macronutrient absorption:** the presence of gastrointestinal edema, hepatomegaly and ascites reduce the feeling of hunger and lead to hypo motility of the gastrointestinal tract with anorexia and constipation [44].

➢ **Oxidative stress:** the increased oxidative stress observed in heart failure is partly due to the decreased absorption of micronutrients but also to the increased metabolic needs of the body [46].

➢ **Hormonal changes:** Changes in hormones (insulin, cortisol) play a role in enhancing protein catabolism [44].

➢ **Tasteless diets:** Elderly patients are mostly affected by dietary choices due to sodium and

fluid restriction and changes in taste and odor [47].

➢ **Oral hygiene:** poor oral hygiene affects nutritional choices, so inadequate dietary intake affects oral health [44].

➢ **Repeated hospital admissions:** patients don't follow their usual dietary intake, leading to a deterioration in their dietary status [48].

➢ **Psychosocial factors:** Patients with heart failure usually experience depression, anxiety and social isolation, which cause reduction of the desire for food consumption [49].

Therefore, for better support of adequate dietary intake of patients with heart failure, attention should be paid to dietary habits and the effects of diet-related illness or therapy, as well as to the use of information by the patient himself [40].

Dietary intervention in patients with heart failure aims at [50]:

Maintaining good nutritional status

Reducing myocardial stress

Reducing and avoiding fluid retention

Reducing the severity of cardiac cachexia syndrome

To meet the energy needs of patients with heart failure, the following should be taken into account:

Energy Requirements: The poor-nourished patients, who are clinically stable may consume at least 31.8 kcal / kg, while the normally-nourished, clinically stable patients can consume at least 28.1 kcal / kg [49].

Macronutrients: According to the American Heart Association and the US Department of Agriculture, the following quantities are considered beneficial to heart health:

• **Protein:** the poor-nourished patients who are clinically stable may consume at least 1.37 g / kg of protein, while normally-nourished, clinically stable patients can consume at least 1.12 g / kg of protein [49].

• **Saturated fatty acids:** reducing consumption of saturated lipids leads to a reduced risk of developing cardiovascular events [51]. The recommendation for heart disease is <10% of total calories and for hyperlipidemia <7% of total calories [49].

• **Trans fatty acids:** have particularly harmful effects on the health of the cardiovascular system [52]. The recommendation for heart disease is <2% of total calories [53].

• **Omega 3 fatty acids:** influence the atherogenic process by affecting mechanisms other than lipid metabolism (and have antiarrhythmic and anti-inflammatory activity) [53,54]. The recommendation for cardiac patients is 1,3 gr [49].

*It is also noted that the replacement of saturated fatty acids by polyunsaturated has beneficial effects on cardiovascular health [55].

• **Vegetable fibers:** They are beneficial to patients with heart failure mainly due to their effects on the intestine and the reduction of constipation. They have also anti-inflammatory action [56]. In addition, fibers derived from cereals and fruits has been shown to protect against the occurrence of cardiovascular disease [57]. The recommendation for patients with heart failure is 14gr / 1000 kcal (adjustment of the amount according to the patient's needs.) [49].

Micronutrients:

• Vitamin A: The recommendation for patients with heart failure is for men 900μg and for women 700mg of retinol equivalents [58].

• Vitamin B12: The recommendation for patients with heart failure is 2.4μg [48].

• Vitamin C: The recommendation for patients with heart failure is for men 90 mg and for women 75 mg [59].

• Vitamin D: The recommendation for patients with heart failure is 15mg [49].

• Vitamin E: The recommendation for patients with heart failure is 15 mg [49,59].

• Vitamin K: The recommendation for patients with heart failure is for men 120μg and for women 90mg [49].

• Thiamine: The recommendation for patients with heart failure is for men 1.2 mg and for women 1.1 mg [49].

• Folate (folic acid): The recommendation for patients with heart failure is 400mg [49].

• Iron: The recommendation for patients with heart failure is for male and postmenopausal women 8mg and for premenopausal women 18mg [49].

• Magnesium: Lack of magnesium is common in patients with heart failure and can lead to hypokalaemia and cardiac arrhythmias. The recommendation for patients with heart failure is for men 420mg and for women 320mg [49,59].

• Zinc: The recommendation for patients with heart failure is for men 11mg and for women 8mg [49, 59].

• Copper: The recommendation for patients with heart failure is 900mg [49,59].

• Potassium: The recommendation for patients with heart failure is 4700mg [49].

• Calcium: Calcium deficiency is associated with life-threatening cardiac arrhythmias. Taking diuretics increase calcium loss through urine. The recommendation for patients with heart failure is 1200mg [49].

• Selenium: The recommendation for patients with heart failure is 55mg [49, 59].

✓ **Sodium:** High sodium intake is a risk factor for heart failure in obese individuals. The guidelines for the sodium intake in heart failure range 2-2,4gr per day (sodium restriction) and 3-4gr per day (moderate limitation) [8]. In a worsening of the disease, the recommendation is 0,8-1,6gr salt per day [44].

✓ **Meat:** Scientific data are not sufficient to establish the relationship between the consumption of meat or red meat in particular with the health of the cardiovascular system [60].

✓ **Fish:** Fish consumption has beneficial effects on the health of the cardiovascular system and especially in relation to mortality from cardiovascular disease. Consumption of more than 5 servings a week has a greater reduction in cardiovascular mortality [61].

✓ **Dairy products and milk:** Consumption of milk and dairy products is associated with a reduced incidence of cardiovascular disease. Based on a meta-analysis of prospective studies, milk consumption is associated with a lower risk of cardiovascular disease [62].

✓ **Eggs:** Eating one egg a day does not seem to burden your cardiovascular health. More specifically, in relation to the highest intake (≥1 egg per day), lower egg consumption (<1 egg per week or never) was associated with a 4% lower risk of developing cardiovascular disease [63].

✓ **Whole grain cereals:** The high consumption of whole grain cereals compared to the low is associated with a reduced incidence of developing cardiovascular disease. In particular, high daily consumption (3-5 servings/ day) of whole grains cereals has been associated with a 21% reduced incidence of developing cardiovascular disease [57].

✓ **Vegetables and fruits:** Higher consumption of vegetables and fruits compared to lower consumption is associated with reduced risk of developing cardiovascular disease [64].

✓ **Legumes:** Legume consumption does not seem to be related to the risk of heart disease and, in particular, bean consumption has been found to have a protective role in both mortality from cardiovascular disease and overall mortality [65,66].

✓ **Nuts:** Nuts have beneficial effects on cardiovascular health [67].

✓ **Olive Oil:** Olive oil has beneficial effects on cardiovascular health [66].

✓ **Alcoholic beverages:** Low to moderate alcohol consumption has a beneficial effect on the prevention of cardiovascular disease. On the other hand, high alcohol intake and its episodic over-consumption (bingesrinking) have been associated with an increased risk of developing cardiovascular disease [68].

✓ **Liquids:** Based on the European Society of Cardiology, guidelines for fluid intake should be given to patients with advanced heart failure, in the presence or not of hyponatremia [29]. In patients with moderate to severe heart failure, it is recommended to ingest 1.5 l fluids per day. Liquid status should be assessed by urine specific gravity, and the values of the serum electrolytes and physical examination for the presence of edema [8].

3.1. Diet in heart cachexia

The goals of nutritional intervention are to achieve and maintain the patient's body weight (without edema) within the ideal range or slightly lower, further avoiding tissue loss, and succeeding long-term recovery of lost energy reserves [9].

Specialized nutritional recommendations for macronutrients and micronutrients do not exist. Patients should be adequately covered with calories according to their daily energy needs, with individualized protein increase. Special care is required in the administration of essential vitamins and electrolytes, especially when diuretics are used or when renal dysfunction or intestinal malabsorption is present [69]. Prolonged fasting periods should be avoided and patients should be encouraged to consume small, frequent meals. Keeping a balanced diet rich in anti-inflammatory ingredients, taking liquid dietary supplements and exercise can improve and possibly prevent progressive tissue loss and catabolism [43].

4. Conclusions

Heart failure is a serious disease, which is associated with increased morbidity and mortality. Cardiac patients receive medications that can cause several side effects and may affect patients eating habits. Typically, patients experience premature feeling of satiety and decreased feeling of hunger, while nausea, constipation, abdominal pain and shortness of breath are present. Due to these symptoms, further food intake becomes more difficult.

Keeping a diet is a complex and demanding process that requires patients to understand the content of foods, to obtain and prepare the food properly, and to follow these limitations daily and for the rest of their lives.

Furthermore, poor taste, the lack of availability of low-sodium foods, food consumption difficulties in restaurants or social activities, great preparation time and increased cost, are some of the reasons that make it more difficult for patients to follow a proper diet.

However, the health care team in collaboration with the patient's family should facilitate patient with heart failure to obtain proper eating habits aiming at being able to cope with the existing situation, gaining the benefits from the treatment (pharmaceutical and non- pharmaceutical), reducing mortality and consequently having a better quality of life.

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