Original Research Article

Features of congestive heart failure in Moroccan elderly patients

ABSTRACT

Introduction: Congestive heart failure (CHF) is associated with aging-related diseases. CHF in elderly is a quite frequent and severe condition in Africa, responsible for a high mortality and hospitalization rate. Yet few African data available take into account the specific profile of CHF in this population. This study aims to characterize the epidemiological, clinical, etiologic and therapeutic features of CHF in the elderly in the region of Casablanca Morocco.

Methods: It's a transversal retrospective study conducted over 13 years, [May 2006- June 2019] including all CHF patients beyond the age of 14 years, followed-up in the therapeutic unit of HF of our department. We studied clinical, electrical, echocardiographic, etiological and therapeutic aspects of CHF among elderly patients (>= 65 years) compared with younger patients.

Results: Among 3412 patients, elderly patients accounted for 1701 (49.8%) with male predominance (62.5 %). 26,7% were smokers, 44.9% hypertensive, 31,6% diabetic, and 9,8% had dyslipidemia. In elderly vs youngsters: Ischemic-heart-disease was the most common etiology 59,9%vs57,4%, followed by non-ischemic-dilated-cardiomyopathy 9,4%vs1,2% and valvular heart disease 2.9%vs4,5%, *P*<0,001. Dyspnea stage III-IV was found in 25.5%vs7.2%, *P* <0,001. Elderly patients presented more clinical signs of HF, more atrial fibrillation, more cerebral stroke and were more likely to present chronic kidney disease. Mean LVEF was 36,18+10,34% vs 36+-9,88%, *P*:0,649. Critical elevation Doppler-filling-pressures was found in 22,5%vs18,3%, *P*:0,003. Therapeutically, ACE has been used in 78,50%, AT-II-receptor-antagonists in 7,47%, Beta-blockers in 80,32%, Furosémide in 46,64%, Spirinolactone in 58.2% and Ivabradine in 3,82%. The re- hospitalization rate in elderly patients was 53,5% vs 43,2%, *P* <0,001.

Conclusion: CHF is a major public health problem in Morocco and AFRICA in general. It's a major cause of death and re-hospitalization among elderly patients. Preventive and public health strategies need to be defined according to the local characteristics in order to implant an optimal and appropriate therapeutic treatments.

KEYWORDS

Elderly; Heart failure with reduced ejection fraction; NYHA functional class; Hospitalization for heart failure; Mortality.

1. INTRODUCTION

Congestive heart failure (CHF) is a clinical syndrome associated with systolic or diastolic ventricular dysfunction resulting from various cardiovascular diseases. Although morbidity and mortality from cardiovascular disease have decreased in recent decades, the prevalence of heart failure (HF) is increasing in developed and developing countries because of the rising burden of cardiovascular risk factors (1) (2).

Congestive heart failure (CHF) is associated with aging-related diseases and thus affects predominantly older patients. Approximately 80% of patients hospitalized with HF are older than 65 years (3). CHF in elderly is a quite frequent and severe condition worldwide, responsible for a high mortality and hospitalization rate as well as high cost. Yet few African data available take into account the specific profile of CHF in this population.

Among HF phenotypes, heart failure with reduced ejection fraction (HFrEF) patients have the worst outcomes and are challenging to manage. The difficulty of management is even greater in older patients, who often have co-existing multi-morbid illness, polypharmacy, cognitive impairment, and frailty, which may contribute to poor prognosis (4). In addition, studies report that elderly patients with HF are rarely included in randomized controlled trials. Therefore, data about them are limited. Despite the important progress in HF management during recent years, little is known about the outcomes in elderly patients with HF (5).

More insights into particularities of congestive heart failure with reduced ejection fraction in elderly patients may aid to our knowledge about this complex disease and may eventually lead to better management in this age group of patients in order to improve outcomes.

This study aims to characterize the epidemiological, clinical, etiologic and therapeutic features of CHF with reduced ejection fraction in the elderly in specialized cardiac facility in Casablanca, Morocco.

2. MATERIALS AND METHODS

2.1. STUDY POPULATION

We have conducted a transversal retrospective study between May 2006 and June 2020 including all patients with HFrEF, followed-up in the therapeutic unit of HF of the cardiology department of IBN Rochd University hospital in Casablanca, Morocco.

HFrEF is defined as a left ventricular ejection fraction (LVEF) ≤40% according to 2021 Europen Society of Cardiology guidelines.

We excluded patients with insufficient echocardiography or examination data.

When the initial cause of hospitalization was acute HF, the echocardiography assessment at discharge was retained.

This database was crossed with hospitalization records, clinical, echocardiographic and data were collected in order to study HF features in elderly patients with HFrEF compared to younger patients.

2.2. FOLLOW UP

Follow-up was censored on 1st June 2020, and consisted of a retrieval of last consultation data and verification of hospitalization and mortality registers. For all patients, we recorded data on the occurrence of death and hospitalization for HF.

2.3. ECHOCARDIOGRAPHIC ASSESSMENT

Transthoracic echocardiograms were recorded on various generations of Vivid systems. Measurements were made according to guidelines (6) (7). LV ejection fraction (LVEF) was measured according to Simpson's method.

Diastolic function analysis was based on mitral-pulsed Doppler inflow and tissue-Doppler imaging at the lateral mitral annulus. Left atrial area was measured from the apical four-chamber view.

2.4. STATISTICAL ANALYSIS

Data were collected on Excel and analyzed using SPSS 2.0 software. All continuous variables are described as means ± standard deviations; all categorical variables are described with frequencies.

Patients were divided into two groups according to their age, group 1 included elderly patient (≥65years old) and group 2 included younger patients (<65ans). Comparisons of the occurrence of HF hospitalization or death according to the age group were realized with Student's t test for continuous variables and the Chi2 test for discrete variables. Differences were considered statistically significant when $P < 0.05$.

3. RESULTS

Among 3412 patients, 1710 (49.8%) were elderly patients (Group 1) and 1702 (50.2%) were young (Group 2). 62.6% of patients in group 1 were male versus 64.9% of patients in group 2 (*P* =0.169).

Regarding cardiovascular risk factors: hypertension was represented in 44.9% versus 32.8% (*P* <0.001), diabetes mellitus in 31.6% vs 29.2% (*P* =0.127), dyslipidemia in 9.7% vs 10.1% (*P* <0.514), tobacco use 26.7.6% vs 37.2% (*P* <0.001).

Regarding etiologies of HFrEF: ischemic heart disease (IHD) was represented in 59.9% versus 57.4%, dilated cardiomyopathy (DCM) in 9.4% versus 11.2%, valvar hear disease (VHD) in 2.9% versus 4.5%, chemotherapy induced cardiomyopathy in 1.1% versus 2.5%, tachycardiomyopathy in 0.4% versus 0.2% (*P* =0.001). Demographics, cardiovascular disease risk factors, comorbidities and etiologies of HF are represented in Table 1.

Table 1: Demographics, cardiovascular disease risk factors, comorbidities and etiologies of heart failure.

	Group 1 (n=1710)	**Group 2 (n=1702)**	***P* value**
Male Gender	62.5 %	64.9%	0.169
Age (Mean±SD) [min;max] **Male** **Female**	54,65±8.69 [15;64] 54.85±8.493 [14;64] 54.28±9.05 [15;64]	75.11±6.7 [65;104] 75.22±6.82 [65;104] 74.92±6.49 [65;103]	<0.001
History of hypertension	44.9%	32.8%	<0.001
History of diabetes mellitus	31.6%	29.2%	0.123
Dyslipidemia	9.7%	10.1%	0.514
Smoking	26.7%	37.2%	<0.001

Etiologies of HF:			
IHD	59.2%	57.4%	<0.001
DCM	9.4%	11.2%	
VHD	2.9%	4.5%	
Chemotherapy induced cardiomyopathy	1.1%	2.5%	
Tachycardiomyopathy	0.4%	0.2%	

(HF: Heart Failure, IHD: Ischemic Heart Disease, DCM: Dilated Cardiomyopathy, VHD: Valvar Heart Disease).

Regarding comorbidities and clinical status: Cerebral stroke occurred in 12.8% in Group 1versus 7.4% in Group 2 (*P* <0.001). Chronic kidney disease was observed in 14.4% versus 11.3% (*P* =0.008). Patients were classified according to NYHA class I in 15.2% in group 1 vs 25.6% in group 2, class II in 59.3% vs 57.2%, class III in 23.4% vs 15.4%, class IV in 2.1% vs 1.8% (*P* <0.001). we have observed left HF signs in 10.5% vs 7.8% (*P* =0.009) and right HF signs in 7.4% vs 5.6% (*P* =0.055). Therefore, elderly patients were more symptomatic. There was no statistical difference between the two groups concerning heart rate (HR). Group 1 patients presented a higher systolic and diastolic blood pressure, mean systolic blood pressure was 132.07±24.17 versus 128.12±21.02 mmHg (*P* <0.001) and diastolic blood pressure was 73.96±13.19 versus 71.18±11.40 (*P* =0.013). Results also showed more atrial fibrillation in elderly patients compared to Group 2 (13.3% vs 9.6%, *P* <0.001). Clinical and electrical data are reported in Table 2.

Table 2: Clinical and electrical data.

	Group 1 (n=1710)	**Group 2 (n=1702)**	***P* value**
NYHA			
Class I	15.2%	25.6%	<0.001
Class II	59.3%	57.2%	
Class III	23.4%	15.4%	
Class IV	2.1%	1.8%	

Signs of left HF	10.5%	7.8%	0.009
Signs of right HF	7.4%	5.6%	0.055
Mean HR	76.61±15.96 bpm	78.45±14.82 bpm	0.067
Mean SBP	132.07±24.17mmHg	128.12±21.02mmHg	<0.001
Mean DBP	73.96±13.19 mmHg	71.18±11.40mmHg	0.013
Persistent atrial fibrillation	13.3%	9.6%	<0.001

(NYHA: New York Heart association classification of Dyspnea; HR: Heart Rate ; SBP: Systolic blood pressure ; DBP: Diastolic blood pressure).

Echocardiographic data have shown that left ventricular (LV) function was similar in both groups, mean LVEF was 36.18±10.34% vs 36±9.88% (*P* =0.649). Elderly patients were more likely to have high LV filling pressure in 22.5% vs 18.3% (*P* =0.003). Transthoracic echocardiography data are reported in Table 3.

Table 3: Transthoracic echocardiography data.

	Group 1 (n=1710)	**Group 2 (n=1702)**	***P* value**
Mean LVEF	36.18±10.34%	36±9.88%	0.649
Elevated LVFP	22.5%	18.3%	0.003

(LVEF: Left Ventricle Ejection Fraction, LVFP: Left Ventricle Filling Pressures).

Regarding pharmacotherapy prescription: Betablockers were prescribed in 85.9% vs 88% (*P* <0.001), Ivabradine was prescribed in 3.8% vs 7% (*P* <0.001), loop diuretics were prescribed in 46.6% vs 43.6% (*P* <0.001), Spirinolactone was prescribed in 58.1% vs 55.2% (*P* <0.001), ACE-I were prescribed in 83.3% vs 76.9% (*P* <0.001), ARB were prescribed in 16.7% vs 19.4% (*P* <0.001). Pharmacotherapy prescription data are represented in Table 4.

Table 4: Heart failure medical therapy.

	Group 1 (n=1710)	**Group 2 (n=1702)**	***P* value**
Beta-blockers	85.9%	88%	<0.001

Ivabradine	3.8%	7%	<0.001
Loop diuretics	46.6%	43.6%	<0.001
Spironolactone	58.1%	55.2%	<0.001
ACE-I	83.2%	76.9%	<0.001
ARB	16.7%	19.4%	<0.001

(ACE-I: Angiotensin Converting Enzyme Inhibitors, ARB: angiotensin II receptor blockers).

Regarding HF hospitalization: The hospitalization rate for HF was 53.5% for Group 1 vs 43.2% for group 2 (*P* <0.001). Hospitalization rates are reported in Table 5.

Table 5: HF hospitalization rates.

	Group 1 (n=1710)	**Group 2 (n=1702)**	***P* value**
HF Hospitalization	53.5%	43.2%	<0.001

(HF: heart failure)

4. DISCUSSION

4.1. PATHOPHYSIOLOGY

The incidence of heart failure doubles in the general population for each decade after the age of 40 years(8). Aging causes a deconditioning of the skeletal muscles and a decrease in capillary density and coronary reserve responsible for a progressive loss of myocytes and hypertrophy of the remaining myocytes, as well as progressive decrease in maximal cardiac output, maximal heart rate and maximal VO2 (9),(10). It is also responsible for increasing systemic vascular resistance along with blood pressure.(9) We observe significant changes in LV structure with aging, the LV stiffness is increased as a result of increased interstitial fibrosis, LV compliance is decreased, LV wall thickness is increased, early LV diastolic filling is decreased with a greater contribution to LV filling resulting from left atrial systole, and LV relaxation is impaired (9),(11).

The incidence of diastolic dysfunction increases with aging as well an as increase of the incidence of chronic atrial fibrillation (AF) (12),(13). In our study the prevalence of AF in elderly patients was 13.3% versus 9.6% in younger patients (*P* <0.001). The development of AF may cause a reduction in cardiac

output and the development of pulmonary and systemic venous congestion because of the loss of left atrial contribution to LV late diastolic filling and a shortened diastolic filling time caused by a rapid ventricular rate. AF can be responsible for thromboembolic complications, in our study, the occurrence of ischemic stroke concerned 12.8% of group 1 and 7.4% of group 2 (*P* <0.001). AF can lead in the long term to the development of tachcardiomyopathy.
Neurohormonal systems (including sympathetic nervous system and the renin-angiotensin-aldosterone system) are activated in HF and adversely affects outcome by leading to apoptosis, endothelial dysfunction, reduced vasodilator capacity, abnormal redistribution of blood and resulting in LV remodeling and systolic dysfunction.

With aging, the body doesn't handle the medicine in the same way. It metabolizes medicines differently, therefore taking too many medications can be a problem for older patients with heart failure (14).The elderly patients also show an increase in the occurrence of chronic kidney disease resulting from nephron loss secondary to aging as well as the chronic effects of arterial hypertension and diabetes mellitus. In our study chronic kidney disease concerned 14.4% of elderly patients and 11.3% of younger patients (*P* =0.008). This makes the elderly population fragile and candidate for close monitoring when introducing HF therapies. Medication doses must be adjusted according to renal filtration capacity, monitoring of medication effect on renal function must be rigorous and some medications may be contraindicated in advanced renal failure.

4.2. HEART FAILURE FEATURES IN ELDERLY PATIENTS

Congestive heart failure (CHF) is associated with aging-related diseases, Elderly patients are more likely to present hypertension and coronary artery disease (CAD) which are the principles causes of HF in this age group of patients. In our study elderly patients had a higher prevalence of hypertension 44.9% than younger patients 32.8% (*P* =0.001). Hypertension, leads to arterial stiffness responsible for the acceleration of atherosclerosis, the destabilization of atherosclerotic plaques and leads to an increase in systemic vascular resistance and therefore in the afterload of the left ventricle and and leads to diastolic and systolic heart failure(15). Elderly patients in our study were no different from younger patients concerning the prevalence of diabetes mellitus and dyslipidemia as shown in table 1. Elderly patients in our study had a worse clinical HF status as shown in Table 2 compared to younger patients. 23.4% of elderly patients were NYHA III and 2.1% were NYHA IV. Left signs of HF were present in 10.5% vs 7.8% (*P* =0.009) and Right HF signs in 7.4% vs 5.6% (*P* =0.055). LV filling pressure (LVFP) were elevated in 22.5% vs 18.3% (*P* =0.003) and the mean LVEF was 36.18±10.34 versus 36±9.88 (*P* =0.649). Elderly patients tend to have more advanced CHF than do younger patients because they tend to be more sedentary and thus do not note symptoms or do not receive a diagnosis of CHF until their cardiac limitation is advanced. Manifestation can be atypical, especially in frail or demented patients who may have lethargy, fatigue, or confusion. Concomitant illnesses tend to precipitate exacerbations of CHF due to excess load placed on the heart because of hypertension, renal disease with fluid retention, and high-output states due to anemia, thyroid disease, or infection(16).

Ischemic heart disease (IHD) represented the major cause of HF in elderly patients followed by dilated cardiomyopathy (DCM) and valvular heart disease (VHD) as shown in Table 1. According to literature, in comparison with younger patients, fewer elderly patients with CHF will have idiopathic dilated cardiomyopathy, and more will have hypertensive heart disease, coronary artery disease, and degenerative aortic stenosis. In some elderly patients with hypertension, the clinical picture resembles that seen in hypertrophic cardiomyopathy leading to more of diastolic dysfunction(16). However, the incidence of CAD increases with age and IHD is a frequent etiology of HF in elderly patient.

Hospitalization rates due to HF in elderly patients have increased in recent years, which is associated with the population aging process. This trend will be most likely continue. Despite significant improvements in HF treatment, readmission rates are still high (5). In the present study, we found that elderly HFrEF patients had a worse clinical status and presented a higher rate of hospitalizations for decompensated HF compared to younger patients (53.5% vs 43.2% *P* <0.001).

4.3. TREATMENT OF HEART FAILURE

4.3.1. GENERAL MEASURES

Patients with HF should decrease their sodium intake and fluid intake. Ethyl alcohol intake should be avoided and medications that precipitate or exacerbate HF such as NSAIDs and antiarrhythmic drugs other than blockers, digoxin, and amiodarone should be stopped. Elderly patients may be noncompliant because they do not understand, cannot tolerate, or cannot afford the multidrug regimen often needed for the treatment of CHF (16). Regular physical activity such as walking should be encouraged in patients with HF to improve functional status and to decrease symptoms. (9) Patients with HF who are dyspneic at rest at a low work level may benefit from a formal cardiac rehabilitation program (17).

4.3.2. HEART FAILURE MEDICAL THERAPY

Medical therapy management can be challenging in older HF patients because of polypharmacy, partially as a consequence of guideline-based care, and partially because of multimorbidity. This creates a tension among the benefits of guideline-directed medical therapy, adherence to therapy, and the risk for adverse events related to polypharmacy and caused by drug–drug interactions (warfarin and aspirin), drug–disease interactions (nonsteroidal anti-inflammatory drugs in HF), or drug–person interactions (digoxin use in older adults) (18).

Diuretics treats volume overload. Loop diuretics such as furosemide are the main diuretic used in elderly. Thiazide diuretics such as hydrochlorothiazide may be used alone or in association with furosemide to treat volume overload. However, a thiazide diuretic is ineffective if the glomerular filtration rate is less than 30 mL/min. In case of severe volume overload, patients should be treated in hospitalization with intravenous diuretics. HF patients treated with diuretics need close monitoring of their serum electrolytes and screening for hypokalemia and hyponatremia. Diuretics should be used at the minimum effective dose and should be gradually reduced and stopped if possible when fluid

retention is no longer present (19),(9). In our results 46.6% of elderly patients received Diuretics versus 43.6% of younger patients, this may be related to the worse HF clinical status in elderly as they were more symptomatic.

ACE inhibitors reduce systemic vascular resistance, arterial pressure, LV and right ventricular end-diastolic pressures, cardiac work, and myocardial oxygen consumption and increase cardiac output. They should be initiated in elderly patients with HF in low doses and gradually increased to the maximum tolerated dose. Renal function and blood pressure should be monitored closely, as increase in the serum creatinine level and hypotension are side effects of ACE inhibitors, that should not necessarily cause discontinuation of this drug, but should cause the physician to consider reducing the dose of diuretics the dose of ACE inhibitor. In our study 83.2% of group 1 patients received an ACE inhibitor versus 76.9% (*P* <0.001), the higher use of ACE inhibitors in elderly patients can be explained by the higher incidence of hypertension in this age group of patients. Angiotensin II receptor blockers (ARB) must be considered in patients with HF who cannot be treated with an ACE inhibitor because of cough or angioneurotic edema(19). In our finding 16.7% of elderly patients received ARB versus 19.4% (*P* <0.001). In the PARADIGM-HF trial, the use of an angiotensin receptor-neprilysin inhibitor (ARNI), the sacubitril/valsartan, was shown to be superior to enalapril in reducing hospitalizations for worsening HF, CV mortality, and all-cause mortality in patients with ambulatory HFrEF with LVEF <_40% (changed to <_35% during the study) as well as improving symptoms, thus 2021 ESC guidelines of management of HF recommend using an ARNI straight away for the inhibition of renin-angiotensin system or as a replacement of ACE inhibitors (19).

Beta-blockers have been shown to reduce mortality and morbidity in patients with HFrEF in general and elederly patients in specifically(20), in addition to treatment with an ACE-I and diuretic.(20) They also improve symptom. Blockers should be initiated in a low dose and should be doubled at 2-week or 3-week intervals. During titration, the patient should be monitored for HF symptoms, fluid retention, hypotension, and bradycardia(19). Ivabradine can be used in HFrEF<35% patients in sinus rhythm when the heart rate is still >70 pbm despite the use of maximal tolerated dose of beta-blockers or in case of contraindication of beta-blockers(19). Calcium channel blockers such as nifedipine, diltiazem, and verapamil exacerbate HF in patients with HFrEF (19). In our finding 58.9% of elderly patients received a Beta-bocker vs 88% (*P* <0.001) and 3.8% received Ivabradine versus 7 % (*P* <0.001), this result can be explained by the importance of HF signs and the frequent elevation of LV filling pressure in the elderly, which makes it difficult to introduce beta-blockers in these patients.

The 2021 European society of cardiology (ESC) guidelines to the management of acute and chronic HF, recommend using Mineralocorticoid receptor antagonists (MRAs) (spironolactone or eplerenone), in addition to an ACE-I and a beta-blocker, in all patients with HFrEF to reduce mortality and the risk of HF hospitalization (21), (22) and improve symptoms.(21) Caution should be exercised when MRAs are used in patients with impaired renal function and in those with serum potassium concentrations >5.0 mmol/L(19). 58.1% of elderly patients received an MRA versus 55.2% in younger patients (*P*<0.001). Dapagliflozin or empagliflozin are recommended, in addition to optimal medical therapy

(OMT) with an ACE-I/ARNI, a beta-blocker and an MRA, for patients with HFrEF regardless of diabetes status. The diuretic/natriuretic properties of SGLT2 inhibitors may offer additional benefits in reducing congestion and may allow a reduction in loop diuretic requirement.(23)

Digoxin may be considered in patients with HFrEF in SR to reduce the risk of hospitalization,(24) although its effect on those routinely treated with beta-blockers has not been tested. In the DIG trial, the overall effect on mortality with digoxin was neutral(19). Digoxin has a narrow therapeutic window and so levels should be checked aiming for a serum digoxin concentration <1.2 ng/mL(25). Elderly patients are at increased risk for developing digitalis toxicity because of age-related reduction in renal function and drugs interactions (26).

Oral anticoagulation by direct oral anticoagulants (DOA) should be administered in HF patients with prior systemic or pulmonary embolism, atrial fibrillation, or cardiac thrombi detected by two-dimensional echocardiography. Warfarin should be warfarin should be reserved for patients with mechanical prosthetic valves and significant mitral stenosis.

4.3.3. CARDIAC IMPLANTABLE DEVICES

Intraventricular conduction delay in patients with HFrEF may worsen LV systolic dysfunction through asynchronous ventricular contraction.(27) Cardiac resynchronization therapy has been shown to cause significant clinical improvement in patients with NYHA II-III, despite OMT who present an intraventricular conduction delay (28). Implantable cardioverter-defibrillators (ICDs) reduce mortality in survivors of cardiac arrest and in patients who have experienced sustained symptomatic ventricular arrhythmia. ICD also reduced the rate of sudden arrhythmic death in patients with HFrEF and ischemic cardiomyopathy (29). In the DANISH trial, rates of sudden death were low in patients with non-ischemic cardiomyopathy (NICM) (30). The decision of an automatic implantable cardioverter-defibrillator should take into account the stage of heart failure, comorbidities and life expectancy in elderly patients (31),(32). Patients with severe refractory symptoms, who are not candidates for a ventricular assist device (VAD) or cardiac transplantation have limited life expectancy and are likely to die from pump failure, thus those patients should not benefice from an ICD (33),(34).

5. CONCLUSION

CHF is a major public health problem in Morocco and AFRICA in general. Our study shows particularities of HF features in Moroccan elderly patients. Elderly patients accounted approximately for half of our population of study, they had a more severe clinical status and a higher risk of hospitalization for heart failure. Therefore, more focus should be given to this age group of patients, since they have more comorbidities, are more frail and HF treatment can be difficult to optimize because of concern about potential side effects. Preventive and public health strategies need to be defined according to the local characteristics in order to implant an optimal and appropriate therapeutic treatments.

6. BIBLIOGRAPHY

1. Lüscher TF. Heart failure: the cardiovascular epidemic of the 21st century. Eur Heart J. 14 févr 2015;36(7):395-7.

2. Cotter G, Cotter-Davison B, Ogah OS. The burden of heart failure in Africa. Eur J Heart Fail. août 2013;15(8):829-31.

3. Hunt SA, Baker DW, Chin MH, Cinquegrani MP, Feldman AM, Francis GS, et al. ACC/AHA guidelines for the evaluation and management of chronic heart failure in the adult: executive summary. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to revise the 1995 Guidelines for the Evaluation and Management of Heart Failure). J Am Coll Cardiol. déc 2001;38(7):2101-13.

4. Butrous H, Hummel SL. Heart Failure in Older Adults. Can J Cardiol. sept 2016;32(9):1140-7.

5. Verulava T, Jorbenadze R, Lordkipanidze A, Gongadze A, Tsverava M, Donjashvili M. Readmission after hospitalization for heart failure in elderly patients in Chapidze Emergency Cardiology Center, Georgia. J Health Res [Internet]. 1 janv 2021 [cité 13 mars 2022];ahead-of-print(ahead-of-print). Disponible sur: https://doi.org/10.1108/JHR-07-2020-0294

6. Lang RM, Bierig M, Devereux RB, Flachskampf FA, Foster E, Pellikka PA, et al. Recommendations for chamber quantification: a report from the American Society of Echocardiography's Guidelines and Standards Committee and the Chamber Quantification Writing Group, developed in conjunction with the European Association of Echocardiography, a branch of the European Society of Cardiology. J Am Soc Echocardiogr Off Publ Am Soc Echocardiogr. déc 2005;18(12):1440-63.

7. Rudski LG, Lai WW, Afilalo J, Hua L, Handschumacher MD, Chandrasekaran K, et al. Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography. J Am Soc Echocardiogr Off Publ Am Soc Echocardiogr. juill 2010;23(7):685-713; quiz 786-8.

8. Klapholz M. Heart failure in the elderly. Heart Dis Hagerstown Md. août 2003;5(4):241-3.

9. Aronow WS. Epidemiology, pathophysiology, prognosis, and treatment of systolic and diastolic heart failure in elderly patients. Heart Dis Hagerstown Md. août 2003;5(4):279-94.

10. Olivetti G, Melissari M, Capasso JM, Anversa P. Cardiomyopathy of the aging human heart. Myocyte loss and reactive cellular hypertrophy. Circ Res. juin 1991;68(6):1560-8.

11. Aronow WS. Left ventricular diastolic heart failure with normal left ventricular systolic function in older persons. J Lab Clin Med. mai 2001;137(5):316-23.

12. Aronow WS, Ahn C, Gutstein H. Prevalence of atrial fibrillation and association of atrial fibrillation with prior and new thromboembolic stroke in older patients. J Am Geriatr Soc. mai 1996;44(5):521-3.

13. Wolf PA, Abbott RD, Kannel WB. Atrial fibrillation as an independent risk factor for stroke: the Framingham Study. Stroke. août 1991;22(8):983-8.

14. Sean Pinney. What's new in caring for older adults with heart failure? [Internet]. [cité 13 mars 2022]. Disponible sur: https://www.uchicagomedicine.org/forefront/heart-and-vascular-articles/older-adults-with-heart-failure

15. Aronow WS, Ahn C, Kronzon I. Comparison of incidences of congestive heart failure in older African-Americans, Hispanics, and whites. Am J Cardiol. 1 sept 1999;84(5):611-2, A9.

16. Senni M, Redfield MM. Congestive Heart Failure in Elderly Patients. Mayo Clin Proc. 1 mai 1997;72(5):453-60.

17. Aronow WS. Exercise therapy for older persons with cardiovascular disease. Am J Geriatr Cardiol. oct 2001;10(5):245-9; quiz 250-2.

18. Gorodeski EZ, Goyal P, Hummel SL, Krishnaswami A, Goodlin SJ, Hart LL, et al. Domain Management Approach to Heart Failure in the Geriatric Patient. J Am Coll Cardiol. mai 2018;71(17):1921-36.

19. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M, et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J. 21 sept 2021;42(36):3599-726.

20. Effect of metoprolol CR/XL in chronic heart failure: Metoprolol CR/XL Randomised Intervention Trial in Congestive Heart Failure (MERIT-HF). Lancet Lond Engl. 12 juin 1999;353(9169):2001-7.

21. Pitt B, Zannad F, Remme WJ, Cody R, Castaigne A, Perez A, et al. The effect of spironolactone on morbidity and mortality in patients with severe heart failure. Randomized Aldactone Evaluation Study Investigators. N Engl J Med. 2 sept 1999;341(10):709-17.

22. Zannad F, McMurray JJV, Krum H, van Veldhuisen DJ, Swedberg K, Shi H, et al. Eplerenone in patients with systolic heart failure and mild symptoms. N Engl J Med. 6 janv 2011;364(1):11-21.

23. Jackson AM, Dewan P, Anand IS, Bělohlávek J, Bengtsson O, de Boer RA, et al. Dapagliflozin and Diuretic Use in Patients With Heart Failure and Reduced Ejection Fraction in DAPA-HF. Circulation. 15 sept 2020;142(11):1040-54.

24. Digitalis Investigation Group (DIG) - Full Text View - ClinicalTrials.gov [Internet]. [cité 26 févr 2022]. Disponible sur: https://clinicaltrials.gov/ct2/show/NCT00000476

25. Rathore SS, Curtis JP, Wang Y, Bristow MR, Krumholz HM. Association of serum digoxin concentration and outcomes in patients with heart failure. JAMA. 19 févr 2003;289(7):871-8.

26. Aronow WS. Digoxin or angiotensin converting enzyme inhibitors for congestive heart failure in geriatric patients. Which is the preferred treatment? Drugs Aging. mars 1991;1(2):98-103.

27. Cazeau S, Leclercq C, Lavergne T, Walker S, Varma C, Linde C, et al. Effects of multisite biventricular pacing in patients with heart failure and intraventricular conduction delay. N Engl J Med. 22 mars 2001;344(12):873-80.

28. Linde C, Leclercq C, Rex S, Garrigue S, Lavergne T, Cazeau S, et al. Long-term benefits of biventricular pacing in congestive heart failure: results from the MUltisite STimulation in cardiomyopathy (MUSTIC) study. J Am Coll Cardiol. 3 juill 2002;40(1):111-8.

29. Theuns DAMJ, Smith T, Hunink MGM, Bardy GH, Jordaens L. Effectiveness of prophylactic implantation of cardioverter-defibrillators without cardiac resynchronization therapy in patients with ischaemic or non-ischaemic heart disease: a systematic review and meta-analysis. Europace. nov 2010;12(11):1564-70.

30. Køber L, Thune JJ, Nielsen JC, Haarbo J, Videbæk L, Korup E, et al. Defibrillator Implantation in Patients with Nonischemic Systolic Heart Failure. N Engl J Med. 29 sept 2016;375(13):1221-30.

31. Connolly SJ, Hallstrom AP, Cappato R, Schron EB, Kuck KH, Zipes DP, et al. Meta-analysis of the implantable cardioverter defibrillator secondary prevention trials. AVID, CASH and CIDS studies. Antiarrhythmics vs Implantable Defibrillator study. Cardiac Arrest Study Hamburg . Canadian Implantable Defibrillator Study. Eur Heart J. déc 2000;21(24):2071-8.

32. Connolly SJ, Gent M, Roberts RS, Dorian P, Roy D, Sheldon RS, et al. Canadian implantable defibrillator study (CIDS) : a randomized trial of the implantable cardioverter defibrillator against amiodarone. Circulation. 21 mars 2000;101(11):1297-302.

33. Hess PL, Al-Khatib SM, Han JY, Edwards R, Bardy GH, Bigger JT, et al. Survival benefit of the primary prevention implantable cardioverter-defibrillator among older patients: does age matter? An analysis of pooled data from 5 clinical trials. Circ Cardiovasc Qual Outcomes. mars 2015;8(2):179-86.

34. Sanders GD, Hlatky MA, Owens DK. Cost-effectiveness of implantable cardioverter-defibrillators. N Engl J Med. 6 oct 2005;353(14):1471-80.