Scientific Research Publishing

World Journal of Cardiovascular Diseases, 2024, 14, 129-139
https://www.scirp.org/journal/wjcd
ISSN Online: 2164-5337
ISSN Print: 2164-5329

Echocardiographic Aspects of Type 2 Diabetics Patients Hospitalized in the Medicine and Endocrinology Department of the Mali Hospital

Konaté Massama[1*], Mamadou Touré[2*], Mariam Sako[3*], Samba Sidibé[3*], Souleymane Mariko[4], Djeneba Sylla Sow[1*], Elhaj Mahamane Maiga[1], Coumba Adiaratou Thiam[5*], Youssouf Camara[5*], Hamidou Oumar Ba[2*], Asmao Keita Maiga[6*], Djenebou Traoré[7*], Zoumana Traoré[1], Souleymane Coulibaly[3*], Bah Traoré[1], Modibo Mariko[1], Nouhoum Ouologuem[1], Amadou Koné[1], Ichaka Menta[2*]

[1]Faculty of Medicine and Dentistry Bamako USTTB, Department of Medicine Hospital of Mali, Bamako, Mali
[2]Department of Cardiology CHU Gabriel TOURE, Bamako, Mali
[3]Department of Cardiology CHU Point G, Bamako, Mali
[4]Department of Medicine Hospital of Timbuktu, Bamako, Mali
[5]Department of Cardiology Hospital of Kati, Bamako, Mali
[6]Department of Cardiology CHU Mother and Child Bamako, Bamako, Mali
[7]Department of Internal Medicine CHU Point G, Bamako, Mali
Email: *massamakonate@gmail.com

How to cite this paper: Massama, K., Touré, M., Sako, M., Sidibé, S., Mariko, S., Sow, D.S., Maiga, E.M., Thiam, C.A., Camara, Y., Ba, H.O., Maiga, A.K., Traoré, D., Traoré, Z., Coulibaly, S., Traoré, B., Mariko, M., Ouologuem, N., Koné, A. and Menta, I. (2024) Echocardiographic Aspects of Type 2 Diabetics Patients Hospitalized in the Medicine and Endocrinology Department of the Mali Hospital. *World Journal of Cardiovascular Diseases*, **14**, 129-139.
https://doi.org/10.4236/wjcd.2024.143011

Received: February 7, 2024
Accepted: March 24, 2024
Published: March 27, 2024

Abstract

Introduction: Cardiovascular disease is the leading cause of death in diabetics. The objective of our study was to investigate the echocardiographic aspects of type 2 diabetics. **Patients and Method:** Descriptive and cross-sectional study of 12 months from June 2020 to June 2021. We included hospitalized type 2 diabetics who underwent transthoracic cardiac ultrasound in the Department of Medicine and Endocrinology at the Mali Hospital. **Results:** We collected 128 type 2 diabetics. The predominance was male with a sex ratio of 1.2. The mean age of patients was 60.06 ± 11.54 years with extremes of 28 and 84 years. Echocardiographic abnormalities were dominated by abnormal relaxation of left ventricle in 62.5%, increased of left ventricle mass in 54.7% and left atrium dilation in 28.1%. Patients with type 2 diabetes mellitus and hypertension had more left atrium dilation with a p of 0.02. Disorders of global kinetics and systolic dysfunction were more prevalent in smoking patients with statistically significant associations, respectively, p = 0.02; p = 0.03. Dyslipidemia had a statistically significant association with segmental kinetic disorders with a p of 0.008. Duration of diabetes greater than 5 years was associated with left atrium dilation and p-value was 0.04. **Conclusion:** Diabetes is responsible for cardiovascular manifestations that can be identified with transthoracic echo-

cardiography. Its performance in diabetic patients makes it possible to refine the patient's management.

Keywords

Diabetes, Echocardiography, Mali Hospital

1. Introduction

Diabetes and its complications are major causes of early mortality in most countries. Cardiovascular disease is a leading cause of death among people with diabetes [1]. Diabetes is a potent independent cardiovascular risk factor [2].

Diabetes is responsible for degenerative complications such as micro and macro angiopathies. Among these macroangiopathic complications, cardiovascular complications occupy a preponderant place. High blood pressure, coronary artery disease and heart failure affect the prognosis of patients with type 2 diabetes. The leading cause of death in diabetics is related to heart disease [3].

This high mortality attributable to heart disease is often insidious and sometimes asymptomatic, such as coronary artery disease and heart failure [3]. It is crucial for clinicians to recognize and manage cardiovascular disease in diabetic patients. Early detection of cardiovascular disease in diabetic patients may slow disease progression and prevent future cardiovascular events [4].

In patients with cardiovascular disease, echocardiography provides important information about disease severity, the decision-making process regarding treatment strategy, prognosis, and response to treatment [5]. Echocardiography is one of the best and most effective imaging modalities for evaluating patients with cardiac symptoms such as dyspnea or chest pain [4]. It plays a central role in identifying or ruling out cardiogenic dyspnea and other causes [4]. Echocardiography is a non-invasive complementary examination and a valuable tool in the diagnosis of cardiac involvement in diabetics.

What is the benefit of TTE in T2DM patients? Does diabetes affect some TTE parameters?

Diabetes can cause heart failure and mechanisms of this impairment are multiple.

Major causes of heart failure in diabetes are ischemic heart disease, hypertension, direct or indirect effects of hyperglycaemia, and obesity and related factors on the myocardium [6].

What are abnormalities we can assess by TTE in type 2 diabetes mellitus African patients? Is there difference according sex, cardiovascular risk factors, duration of diabetes and glycated hemoglobin (HBA1c) level?

In Mali, few studies have focused on the echocardiographic characteristics of type 2 diabetics. This motivated this study with the objective of studying the echocardiographic aspects in a population of type 2 diabetics.

2. Patients and Method

This study was carried out in the medical department of the Mali hospital of Bamako, Mali. This was a 12-month descriptive and longitudinal study from June 2020 to June 2021. All patients with type 2 diabetes hospitalized in the medicine department who underwent transthoracic echocardiography during the study period and consented to participate in the study were included, regardless of the reason for hospitalization.

Criteria of non-inclusion were patients with type 1 diabetes, patients who didn't had transthoracic echocardiography, patients who didn't want to participate to the study and type 2 diabetes mellitus patients who weren't hospitalized.

2.1. Data Collection

The information was collected on an individual file. Consenting patients were interviewed and underwent a complete physical examination, including a cardiovascular examination, and resting electrocardiographic recording using an EDANNINS 12-lead machine. Fasting blood glucose, HbA1c and lipid measurements were performed. A transthoracic echocardiography performed using a LANDWIND MIRROR 2 ultrasound device commissioned in 2019 and whose report was validated by a cardiologist in the department. This ultrasound device didn't have strain and doppler tissue imaging. Data collected during the interview were sociodemographic (age, sex), reasons for hospitalization, diabetes duration, cardiovascular risk factors associated with diabetes. Data from physical examination, biology (HbA1c), ECG, and transthoracic echocardiography were also collected.

2.2. Data Analysis

Continuous variables were expressed as mean standard deviation. Dichotomous variables were expressed as counts and percentages. Data entry and analysis were done with the software Microsoft Word 2016 and IBM SPSS 22 French version for Windows. The Chi^2 test was used to compare our significant results for a probability $p \leq 0.05$.

2.3. Study Parameters

Parameters of study were: socio-demographic data (age and sex), cardiovascular risk factors, echocardiographic abnormalities, reasons for hospitalization, duration of diabetes and level of HbA1c.

Cardiovascular risk factors studied were active or passive smoking tobacco, hypertension, diabetes, dyslipidemia, obesity or overweight and sedentary lifestyle. Echocardiographic abnormalities were identified upon following parameters with TM, 2D and pulsed doppler TTE.

Thickness of interventricular septum more than 11 mm, thickness of posterior wall more than 11 mm, end-diastolic diameter of the left ventricle was considered dilated if it was greater than 56 mm. The left atrium was considered di-

lated if the surface area was greater than or equal to 20 cm^2. Left ventricular systolic ejection fraction (LVSEF) was considered low if it was less than or equal to 40% by Teicholz or by Simpson. LVSEF was considered mid-range when it was more than 40 and under 50%. It was considered normal when LVSEF was more than or equal to 50%. Segmental and global kinetic abnormalities were assessed by 2D TTE. Left ventricular mass was evaluated upon criteria of American society of echocardiography with medical software on android phone. Mitral profile was evaluated by pulsed doppler. E wave and A wave were evaluated. Ratio E/A < 1 was considered abnormal relaxation of left ventricle.

2.4. Ethical Aspects

Written, free consent was obtained from patients regarding the use of their data for study purposes, and confidentiality was respected.

3. Results

During the study period, we collected 160 patients with type 2 diabetes out of 509 patients hospitalized in the medical department. Of these diabetic patients, 128 met our inclusion criteria, that is a hospital frequency of 25.14%. The mean age of patients was 60.06 ± 11.54 years with extremes of 28 and 84 years. The 55 - 64 years range accounted for 32.8% of cases (Table 1). The predominance was male with a sex ratio of 1.2. The mean BMI was 25.08 ± 5.91 kg/m^2 with extremes of 13.79 and 47.26 kg/m^2. In our study, 23.5% of our patients were overweight or obese. Foot wounds accounted for 55.5% (n = 71) of the reasons for hospitalization.

Dyspnoea was the most common functional sign with 10.9% (n = 14), followed by heaviness of hemibody with 10.2% (n = 13) and chest pain with 1.6% (n = 2).

A sedentary lifestyle was the main risk factor with 69.5% follow by dyslipidemia with 54.7%. Mean duration of diabetes course was 10.77 ± 6.9 years, among our patients, 73.4% had a duration of evolution greater than 5 years with extremes ranging from less than one year to 30 years. The mean glycated hemoglobin was 9.03% ± 2.52% with extremes of 4 and 15.60%. The glycated hemoglobin level was greater than 7% in 82% of our patients.

Diabetic neuropathy accounted for 53.1% of microangiopathic complications in our patients. Aspects suggestive of ECG and/or echocardiography of ischemic heart disease accounted for 20.3% of macroangiopathic complications in our patients.

Echocardiographic abnormalities were dominated by abnormal relaxation of left ventricle in 62.5%, increased LVM in 54.7% and left atrium dilation in 28.1% (Table 2). Patients with a type 2 DM-HTA combination had significant left atrium dilation with a p of 0.02 (Table 3). The association between T2DM and smoking had statistical links between the two sides of the population. Dyslipidemia was statistically significantly associated with segmental kinetic

Table 1. Epidemiological and clinical characteristics.

Characteristics	Men		Women		Total	
	No	%	No	%	No	%
Age range						
<55 years	16	23.2	25	42.4	41	32
55 - 64 years	26	37.7	16	27.1	42	32.8
65 - 74 years	17	24.6	13	22	30	23.4
≥75 years	10	14.5	5	8.5	15	11.7
Reason for hospitalisation						
Foot wounds	38	55.1	33	55.9	71	55.5
Hyperglycaemia	13	18.8	8	13.6	21	16.4
Dyspnoea	8	11.6	6	10.2	14	10.9
Heaviness hemibody	7	10.1	6	4.7	13	10.2
Hand wounds	2	2.9	2	3.1	4	3.1
Hypoglycaemia	1	1.4	2	3.4	3	2.3
Chest pain	0	0	2	3.4	2	1.6
Cardiovascular risk factors						
Hypertension	35	50.7	30	50.8	65	50.8
Dyslipidémia	36	52.2	34	57.6	70	54.7
Smoking	17	24.6	0	0	17	13.3
Obesity	15	21.7	24	40.7	39	30.5
Sedentary lifestyle	39	56.5	50	84.7	89	69.5
History of cardiovascular disease	10	14.5	6	10.2	16	12.5
Duration of diabetes						
≤5 years	16	23.2	18	30.5	34	26.6
>5 years	53	76.8	41	69.5	94	73.4

disorders with p = 0.008. There was no statistically significant relationship between echocardiography data and patient gender. Duration of evolution greater than 5 years was statistically significantly related to left atrium dilation with a p of 0.04 (Table 3).

LV dilation, LVEF < 40% and segmental kinetic disorder were statistically associated with an HBA1c < 7% (Table 3).

4. Discussion

The frequency of cardiovascular risk factors including diabetes increases with age. Advanced age is also a cardiovascular risk factor. In our series, the mean age of patients was 60.06 ± 11.53 years with extremes of 28 and 84 years. This data is comparable to that of Yaméogo [7] who reported a mean age of 58.81 ± 11.82

Table 2. Echocardiographic parameters.

Parameters		Men	Women	Number	Percentage
Dilated LVDD		14	4	18	14.1%
Dilated LVSD		18	12	30	23.4%
LVEF ≥ 50%		54	50	104	81.3%
LVEF 40% - 49%		0	2	2	1.5%
LVEF ≤ 40%		15	7	22	17.2%
Thickened IVS		21	19	40	31.3%
Thickened PW		9	7	16	14.8%
Dilated left atrium		23	13	36	28.1%
Increased LVM		32	38	70	54.7%
Kinetic disorder	Segment	5	3	8	6.3%
	Global	11	8	19	14.8%
Mitral profile	E/A = 1	12	7	19	14.8%
	<1	42	38	80	62.5%
	>1	15	14	29	22.7%

years in his study of diabetics. In our series, the predominance was male with a sex ratio of 1.2. This result is different from those of Tougouma [8] and Yaméogo [7] who found a female predominance with a sex ratio of 0.50 and 0.4 respectively.

In our study, the mean duration of diabetes was 10.77 ± 6.915 years, more than half of our patients had a duration of evolution greater than 10 years or 50.8%. This result is different from that of one of our previous studies [9].

In our study, diabetes was unbalanced with glycated hemoglobin greater than 7% in 73.4%, the mean HbA1c was 9.03% ± 2.52% and 39.8% had an HbA1c level > 9%. The proportion of unbalanced diabetes was lower than that of Tougouma [8] and Konate [9] which had 89.3% and 92.1% respectively.

In our series, 50.8% of our patients had high blood pressure as a risk factor for diabetes and 12.5% for cardiovascular disease. This result is lower than that found by Tougouma [8] with 67.09% of cases of hypertension associated with diabetes. The risk factor most associated with diabetes during our study was a sedentary lifestyle in 69.5% of cases; followed by dyslipidemia in 54.7% of cases and hypertension in 50.8% of cases. Contrary to the data of Tougouma [8] who found hypertension in 67.09% and obesity in 67.7%. Konate in another previous study concerning the T2DM-HTA combination, hypertension was present in 61%, dyslipidemia was present in 57.8%, followed by sedentary lifestyle in 57.7% [10].

Foot wound was the most common reason for hospitalization in our study with 55.5%; this was higher than the results of Konate [9] who found 44.2% foot wounds as a reason for hospitalization.

Table 3. Analytical studies.

Parameters		Smoking		*p*
		Yes n = 17	No n = 111	
Dilated LVDD		4	14	0.2
LVEF < 40%		6	16	0.03
Dilated left atrium		4	32	0.6
Increased LVM		7	63	0.2
Kinetic disorder	Segment	1	7	0.9
	Global	6	13	0.02

Parameters		Dyslipidémia		*p*
		Yes n = 70	No n = 58	
Dilated LVDD		9	9	0.6
LVEF < 40%		13	9	0.6
Dilated left atrium		20	16	0.9
Increased LVM		39	31	0.7
Kinetic disorder	Segment	8	0	0.008
	Global	9	10	0.4
Parameters		Hypertension		*p*
		Yes n = 65	No n = 63	
Dilated LVDD		12	6	0.1
LVEF < 40%		14	8	0.1
Dilated left atrium		24	13	0.02
Increased LVM		40	30	0.1
Kinetic disorder	Segment	4	4	0.6
	Global	12	7	0.2
Parameters		Duration of diabetes		*p*
		<5 years n = 34	>5 years n = 94	
Dilated LVDD		3	15	0.3
LVEF < 40%		4	18	0.3
Dilated left atrium		5	31	0.04
Increased LVM		20	50	0.5
Kinetic disorder	Segment	2	6	0.9
	Global	4	15	0.5
		Glycated hemoglobin		*p*
		<7% n = 23	>7% n = 105	
Dilated LVDD		7	11	0.01
LVEF < 40%		8	14	0.01

Continued

Dilated left atrium		10	26	0.07
Increased LVM		16	54	0.1
Kinetic disorder	Segment	2	6	0.5
	Global	11	8	0.03

Diabetic neuropathy was present in 53.1%. This result was lower than that of Konate [9] in whom neuropathy was present in 67.9%.

Diabetic nephropathy was present in 8.6% of our patients. This result is close to that of Merzouk [11] who found 8.5% of cases of diabetic nephropathy.

During our study, diabetic retinopathy was reported in 18% of our patients. This result differs from that of Konate [9] who had found 25%. This difference could be explained by the fact that many of our patients were not able to perform the fundus.

Aspects suggestive of ischemic heart disease were present in 20.3% of our patients. This result was consistent with that of Merzouk [11] who had a proportion of 19.5% coronary artery disease. This rate is lower than the 38% ischemic heart disease observed by Tougouma [8] in his series. In our study, the proportion of patients with ischemic stroke was 12.5% versus 10.18% observed by Konate [12].

PAD was found in 7.8% (n = 10) of our patients. This result was comparable to that of Merzouk [11] who found 6.8% of cases of PAD; but lower than that of Konate [12] who had found in 17.81%. This difference can be attributed to risk factors independent of PAD and degree of glycemic control; in the study of Konate [12] 51.64% of their patients had an HbA1c level greater than 7%.

The most reported echocardiographic abnormality in our series was abnormal relaxation of left ventricle with 62.5%. Muddu found in his study diastolic dysfunction for 55% of cases [13]. Muddu used E/A ratio to assess diastolic function. Yameogo found 13.9% of patients with E/A ratio < 1 but he found 62% of diastolic dysfunction with doppler tissue imaging. We didn't have this software in our echocardiography device.

Left ventricular hypertrophy defined by increase of LVM was observed in 54.7% (n = 70) of our patients. This proportion is close to that of Yaméogo [7] who found 62.02% in his study. Tougouma [8] had found a lower frequency of LVH than ours with a rate of 20%. This predominance of LVH in our patients could be explained by the association of diabetes and hypertension which existed in 50.8%. An increase in left ventricular mass was observed in only 34.2% in a prospective study conducted in France involving 40 diabetic patients [14]. In a Danish study, LVH was objectified in 21%, n = 213 [15]. Left atrium was dilated in 28.1% in our series, higher than the 14.2% found by Tougouma [8]. Yaméogo [7] had found a higher proportion of left atrium dilation with 72.2%. Jorgensen [15] in Denmark found dilation of the left atrium in 19.6%. The dilation of the atrium is most often related to the existence of high blood pressure. In our series,

LV dilation was observed in 14%. This proportion was close to the 21.5% of Yaméogo [7]. These results were higher than that of Tougouma [8] which was 1.2%. This dilation of the left ventricle can be secondary to several mechanisms including ischemic heart disease, high blood pressure or diabetic cardiomyopathy. LVSEF was impaired in 16.4% of our patients; close to the 12.5% of Jorgensen [15] in Denmark. Tougouma [8] found a lower proportion with 3.9%. Merzouk in Morocco [11] had reported LVSEF alteration in 44.6% of patients.

Segmental kinetic disorders were present in 6.3% of our patients, lower than the frequency found by Tougouma [8] which was 9.03%. This hypokinesia was global in 14.8% of our patients. Kinetic disorders were observed in diabetics in Uganda in 4% according to Muddu [13]. Yameogo [7] in a study carried out in Dakar had found abnormalities of segmental kinetics on stress echocardiography of diabetic patients in 67.1%. This can be explained by the major role of stress imaging in the detection of abnormalities in myocardial kinetics. In patients with a type 2 DM-HTA combination, left atrium was more dilated with a statistically significant difference $p = 0.02$. Muddu [13] in Uganda had found that hypertension was significantly associated with echocardiographic abnormalities in diabetic patients in bivariate analysis. The association of T2DM and smoking was statistically significant associated with global kinetic disorders and LV systolic dysfunction, $p = 0.02$ and $p = 0.03$. Dyslipidemia was statistically significantly associated with segmental kinetic disorders with $p = 0.008$. Dyslipidemia is a risk factor for atherosclerosis. It promotes the onset of ischemic heart disease. There was no statistically significant relationship between echocardiography data and patient gender. Duration of evolution greater than 5 years was associated with left atrium dilation with a p of 0.04. Jorgensen found that diabetes duration more than 5 years was associated with echocardiography abnormalities but with low sensitivity in his study [15].

LV dilation, LVEF < 40% and segmental kinetic disorder were statistically significantly associated with HBA1c < 7% with $p = 0.01$; $p = 0.01$; $p = 0.03$. This can be explained by the fact that HBA1c is only a reflection of blood sugar levels over the past three months. Echocardiographic abnormalities can occur at any level of HBA1c. Jorgensen didn't found a relation between TTE abnormalities and HBA1c in his study [15].

Study limitations. Several limitations are inherent in this observational study in a single center with inpatients. Hence, the findings should not be extrapolated to all patients with type 2 diabetes. Absence of dobutamine echocardiography and coronary angiography does not exclude the possibility of coronary artery disease. Finally ultrasound device we used didn't have strain and doppler tissue imaging software.

5. Conclusion

Cardiovascular pathologies exist in diabetics and are responsible for significant morbidity and mortality. Echocardiographic abnormalities are common in the

type 2 diabetic population. Disorders of segmental kinetics were more common in diabetes associated with dyslipidemia or smoking. The length of diabetes did not affect the echocardiographic aspects for our patients. Transthoracic echocardiography is a non-invasive examination that provides important information in the management of patients with type 2 diabetes.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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