Evaluation of Atherogenic Risk in Diabetic Patients Attending the National Hospital Center Dalal Jamm

Abstract

Introduction: Diabetes mellitus, defined by chronic hyperglycemia (fasting blood glucose ≥ 1.26 g/L or ≥ 2 g/L at any time), is frequently associated with atherogenic dyslipidemia, which exacerbates cardiovascular risk.

Methods: This was a retrospective, descriptive, and analytical study conducted among diabetic patients followed at CHNDJ. Patients were recruited from the biochemistry department of the medical analysis laboratory between August 2019 and February 2020. The main objective was to assess atherogenic risk in these patients.

Results: Mean age 57.4 ± 13.8 years; 74.9% women; dyslipidemia prevalence 67.1%. Mean AIP and AI values were elevated in the study population (Table I), and their variation according to dyslipidemia showed that these indices exceeded recommended thresholds in both dyslipidemic and non-dyslipidemic patients. Atherogenicity indices were elevated (mean AIP 0.24; Castelli I 3.9), more perturbed in patients ≥ 60 years ($p < 0.05$ for AIP, CRI-I, CRI-II) and in cases of glycemic imbalance ($p < 0.05$ for CRI-I, CRI-II, AIP, AI).

Conclusion: This study demonstrates that exploration of the lipid profile and atherogenicity indices is essential in diabetic patients to better prevent and manage cardiovascular disease risk.

Introduction

Diabetes mellitus is a metabolic disorder characterized by chronic hyperglycemia and defined by a fasting blood glucose ≥ 1.26 g/L (7 mmol/L) on two occasions or a blood glucose ≥ 2 g/L (11.1 mmol/L) at any time of the day, with disturbances in carbohydrate, lipid, and protein metabolism related to deficient insulin secretion and/or action [1]. Dyslipidemia is common in diabetic patients, affecting nearly 50% of them, and significantly increases the risk of cardiovascular diseases in these already high-risk individuals [2]. In some Western countries, refined cardiovascular risk assessment in diabetic patients incorporates lipid ratios and atherogenicity indices rather than isolated lipid parameters alone. This offers several advantages by combining atherogenic information (LDL-C, TG, non-HDL-C) and protective factors (HDL-C) for better risk prediction than individual values. It is in this context that we conducted a study on atherogenicity indices in our diabetic patients at the biochemistry department of the medical analysis laboratory of CHNDJ between August 2019 and March 2020, to explore their relevance in our Senegalese context, marked by the rapid rise of diabetes [3].

Materials and Methods

This study was conducted in the biochemistry department of the National Hospital Center Dalal Jamm in Senegal. It was a retrospective descriptive study with an analytical aim from August 1, 2019, to March 1, 2020.

Retrospective data collection was based on the laboratory register from August 2019 to March 2020. The study population consisted of diabetic patients hospitalized or attending outpatient consultations at the National Hospital Center Dalal Jamm during this period. Inclusion criteria were all diabetic patients with a prescribed lipid profile and available results in the laboratory register. Diabetic patients not meeting the following criteria were excluded: incomplete lipid profile and non-compliance with pre-analytical conditions.

Epidemiological parameters included age, sex, and diagnostic orientations. Biological parameters included the lipid profile (total cholesterol, triglycerides, HDL-cholesterol, and LDL-cholesterol) and glycated hemoglobin (HbA1c), measured using adapted enzymatic methods on the ARCHITECT ci4100 analyzer (Abbott Diagnostics). For LDL-C, when TG < 3.5 g/L, it was calculated using the Friedewald formula; however, direct measurement was performed when TG > 3.5 g/L. The selected indices were:

- Castelli I: TC / HDL-C
- Castelli II: LDL-C / HDL-C
- AIP: $\log_{10}$ (TG / HDL-C) — robust marker of small dense LDL
- AI: non-HDL-C / HDL-C, atherogenic coefficient

All observations were entered and coded in Windows Excel 2016, then analyzed using SPSS software. Graphs were generated from Excel 2016. Results were presented in tables and graphs.

Results

The mean age of the study population was 57.4 ± 13.8 years, with a minimum of 26 years and a maximum of 86 years. Patients aged ≥ 60 years represented 48.5% of the study population (Figure 1). Out of a total of 231 patients included in this series, there were 173 women and 58 men, i.e., 74.9% and 25.1%, respectively, with a sex ratio of 0.3 (M/F) (Figure 2). Glycemic imbalance was observed in 24.7% of patients (Figure 3). The mean age of patients was 56.75 ± 13.4 years in women and 59.5 ± 14.9 years in men, and patients aged > 60 years were more observed in women than in men (Figure 4). Dyslipidemia was observed in 155 patients, i.e., 67.1% of the study population.

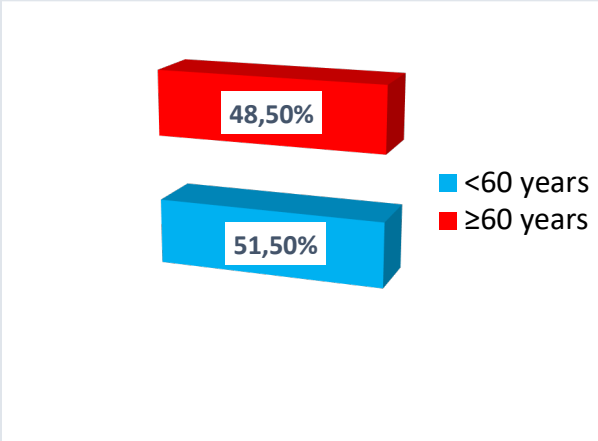

Figure1: Age distribution of patents

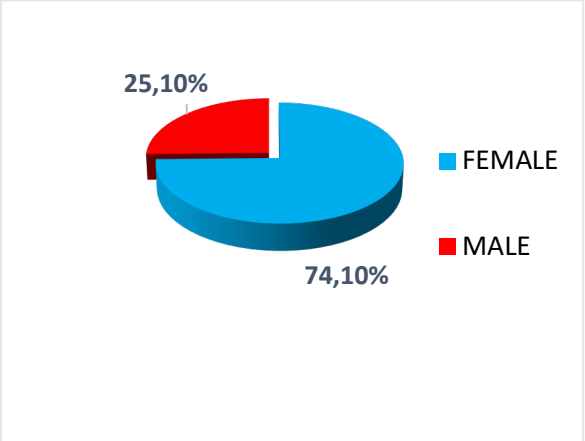

Figure2: Sex distribution of patients

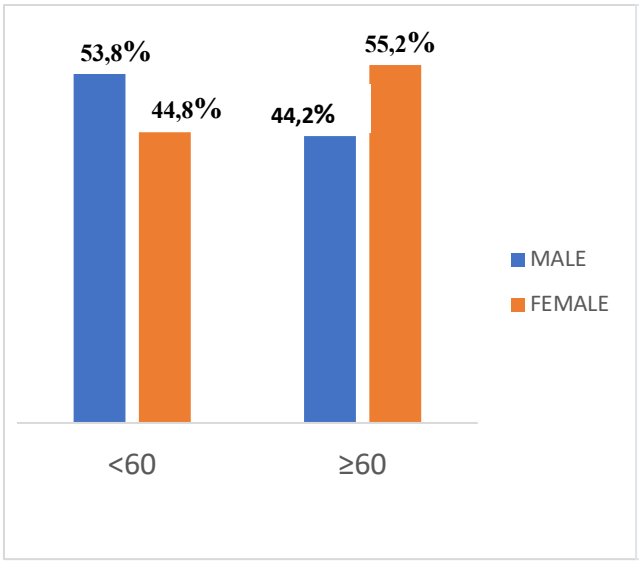

Figure 3: Distribution of patients by sex and age

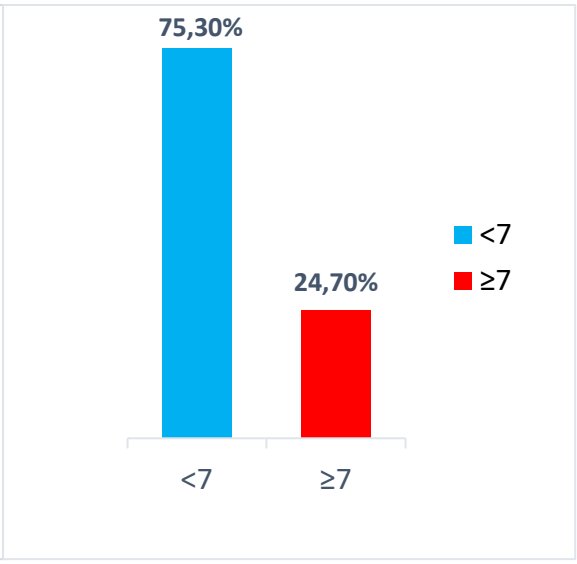

Figure 4: Distribution of patients according to glycemic control

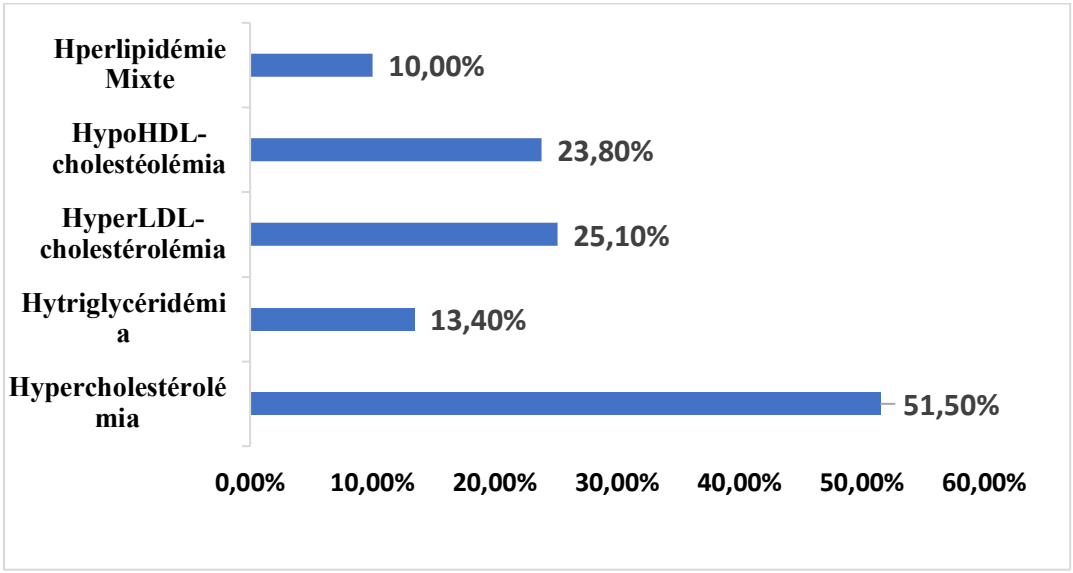

Figure 5 : Distribution of patient by type by dyslipidémia

Mean AIP and AI values were elevated in the study population (Table I), and their variation according to dyslipidemia showed that these indices exceeded recommended thresholds in both dyslipidemic and non-dyslipidemic patients (Table II).

Table I: Mean Values of Atherogenicity Indices

Variables	Min	Max	Mean	SD
CRI	1.14	19	3.9	1.5
CRII	0.62	13.19	2.5	1.2
AIP	-0.15	1.37	0.24	0.16
AI	0.74	18	2.9	1.57

Table II: Profile of Atherogenicity Indices According to Dyslipidemia

Variables	Dyslipidemia		P-value
	Yes	No	
CRI	4.4	3.07	0.001***
CRII	2.9	1.8	0.001***
AIP	0.3	0.2	0.001***
AI	3.4	2.07	0.001***

Perturbations of CRI, CRII, and AIP were more frequent in patients aged 60 years or older than in those under 60 years, with respective frequencies (56.9% vs 43.1%, p=0.036), (22.8% vs 12.1%; p=0.047), (75% vs 61.3%; p=0.026) (Table III). No statistically significant association was found between sex and index perturbation (Table IV). Elevation of atherogenicity indices (CRI, CRII, AIP, and AI) was observed more in patients with glycemic imbalance than in those without, with respective frequencies (35.1% vs 21.1%; p=0.036); (22.8% vs 12.1%; p=0.047); (28.1% vs 24.1%; p=0.036); (21.1% vs 20.4%; p=0.04) (Table V).

Table III: Variation of Atherogenic Indices with Age Group

Variables	Age group		P-value
	<60	≥60	
CRI			
Elevated	43.1%	56.9%	P=0.036*
Normal	54%	46%	
CRII			
Elevated	12.1%	22.8%	P=0.047*
Normal	87.9%	77.2%	
AIP			
Elevated	61.3%	75%	P=0.026*
Normal	38.7%	25%	
AI			
Elevated	78.2%	77.7%	P=0.9
Normal	21.8%	22.3%	

Table IV: Variation of Atherogenic Index Disturbances According to Sex

VARIABLES	SEX		P-VALUE
	Female	Male	
CRI			
ELEVATED	80.7%	19.3%	P=0.24
NORMAL	73%	27%	
CRII			
ELEVATED	76.5%	23.5%	P=0.8
NORMAL	74.6%	25.4%	
AIP			
ELEVATED	75.8%	24.8%	P=0.96
NORMAL	73%	27%	
AI			
ELEVATED	77.8%	22.2%	P=0.057
NORMAL	64.7%	35.3%	

Table V: Variation of Atherogenic Index Disturbances According to Glycemic Control

Variables	Glycemic Control		P-value
	Yes	No	
CRI			
Elevated	21.7%	35.1%	P=0.036
Normal	78.1%	64.9%	
CRII			
Elevated	12.1%	22.8%	P=0.047
Normal	97.9%	77.2%	
AIP			
Elevated	24.3%	28.1%	P=0.03
Normal	75.7%	71.9%	
AI			
Elevated	20.4%	21.1%	P=0.04
Normal	79.6%	78.9%	

Discussion

Diabetes is a major cardiovascular risk factor, partly due to dyslipidemia. This dyslipidemia is characterized by qualitative and quantitative modifications that strongly contribute to atherogenesis. These modifications have been the subject of several recent studies aimed at better assessing the thrombo-atherogenic risk in this population. Thus, we attempted to evaluate the lipid profile and atherogenicity indices of diabetic patients attending CHNDJ. This was a retrospective, descriptive, and analytical study conducted in the biochemistry department of the medical analysis laboratory at CHNDJ between August 2019 and March 2020. To conduct this study, we worked on 231 diabetic patients.

The mean age of the study population was 57.4 ± 13.8 years, with a minimum of 26 years and a maximum of 86 years. Patients aged ≥ 60 years represented 48.5% of the study population. Our results are consistent with those of the series conducted in Morocco by AMELOUK SARA [3] with a mean age of 56.58 ± 8.15 years and extremes ranging from 35 to 81 years, and those conducted in Mali by Oumar Sangho et al [5] with a mean age of 54.9 ± 12 years, extremes from 31 to 85 years, and a predominance of people over 50 years also noted in these studies. This predominance in older individuals could be explained by reduced physical activity and poor diet. The distribution of patients by sex showed a strong female

predominance: 74.9% women and 25.1% men, i.e., a sex ratio of (58/173 = 0.3) (M/F). These results are similar to those observed in Algeria by Salah Zaou et al [6] and in Benin by F. Djrolo et al [7], which showed a strong female predominance with respectively (64% women and 36% men) and (62.1% women and 37.9% men). The high percentage of diabetic women could be explained by the relative sedentariness of women compared to men and the greater attendance of health facilities by women. In our series, apart from diabetes considered a cardiovascular risk factor, 134 (58%) patients presented at least one other cardiovascular risk factor, i.e., 48.5% had an age > 60 years and 19% had hypertension. These results corroborate those of AMELOUK SARA, who found that 51% of patients presented at least one cardiovascular risk factor [4].

The prevalence of dyslipidemia in our study population was 67.1%. This prevalence is consistent with that of a study conducted in Algeria by N. Benabadji [8], who found 60% dyslipidemia. For atherogenicity indices, perturbations of CRI and CRII were more frequent in patients aged 60 years or older than in those under 60 years, with respective frequencies (56.9% vs 43.1%, p=0.036), (22.8% vs 12.1%; p=0.047). These results are comparable to those conducted in Mali by Coulibaly et al [9], who found 18% cases of elevated CRII. Moreover, CRI is the most commonly used ratio to express the respective influences of cholesterol fractions with adverse or beneficial cardiovascular effects. Numerous studies have shown its superiority as a cardiovascular risk index compared to LDL-C [10], [11]. This perturbation of CRI and CRII indices could be explained by the fact that cardiovascular risks increase with age. Indeed, during aging, biochemical modifications appear affecting several cardiovascular risk factors, among which dyslipidemia represents the most important cardiovascular risk factor.

Elevation of atherogenicity indices CRI and CRII was observed more in patients with glycemic imbalance than in those without, with respective frequencies (35.1% vs 21.1%; p=0.036); (22.8% vs 12.1%; p=0.047). These results could be explained by the fact that glycemic imbalance can lead to diabetic complications and may cause a high risk of cardiovascular disease.

The increase in AIP and AI indices was observed in approximately equal proportions in patients with or without glycemic imbalance (28.1% vs 24.1%; p=0.036); (21.1% vs 20.4%; p=0.04). These results are consistent with those of László Márk, who found strong AIP perturbation in diabetic patients with or without glycemic imbalance [12]. In our study, the means of this ratio largely exceed the recommended thresholds in diabetic subjects with or without dyslipidemia. This ratio is more associated with insulin resistance [13], and its elevation in diabetic patients with and without dyslipidemia demonstrates the interest of its determination even if lipid parameters are normal in diabetic patients. Furthermore, the study by Nwagha et al [14] showed that in situations where other atherogenic risk parameters such as TG and HDL-C appear normal, AIP can be the diagnostic alternative.

The atherogenic index (AI), calculated as {(Non-HDL-C) / HDL-C}, is a measure of LDL-C, VLDL-C, IDL-C lipoprotein fractions relative to good cholesterol or HDL-C. In our study, the means of this ratio largely exceed the recommended threshold in dyslipidemic patients as well

as in non-dyslipidemic patients, and perturbation of this ratio was more observed in patients with glycemic imbalance than in those without. This elevation of non-HDL cholesterol observed in non-dyslipidemic diabetics was found in a study conducted by Nachi et al in Algeria, who found elevated non-HDL-C levels even when LDL-C was normal in 5.2% of cases [15]. This discordance between elevated AI and normal LDL could be explained by the fact that non-HDL reflects the atherogenic potential of the entire spectrum of lipoprotein fractions. In situations of hypertriglyceridemia (diabetes, metabolic syndrome, obesity, etc.), non-HDL-cholesterol is a better predictor of risk than LDL-cholesterol alone, as it includes all ApoB-containing atherogenic lipoproteins (VLDL, IDL, chylomicron remnants, Lp(a), etc.) [12].

Conclusion

In conclusion, we can say that diabetes leads to a major increase in cardiovascular risk. It is also associated with significant lipid disorders. Thus, evaluation of the lipid profile and atherogenicity indices would be important for diabetic patients, with a view to prevention and effective management of cardiovascular diseases.

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