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CLINICAL RESEARCH

Coronary artery disease in black African patients with diabetes: Insights from an Ivorian cardiac catheterization centre

Lésions coronaires chez le diabétique noir africain : données d'un centre de cardiologie interventionnelle en Côte d'Ivoire

Roland N'Guetta[a,*], Hermann Yao[a], Arnaud Ekou[a], Benjamin Séri[b], Marie-Paule N'Cho-Mottoh[a], Esaïe Soya[a], Christophe Konin[a], Jean-Baptiste Anzouan-Kacou[a], Rémi Seka[a]

[a] *Abidjan Heart Institute, 01 BP V206 Abidjan, Côte d'Ivoire*
[b] *PAC-CI, ANRS Research Site, University Teaching Hospital of Treichville, 18 BP 1954 Abidjan, Côte d'Ivoire*

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KEYWORDS
Diabetes;
Coronary artery disease;
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Summary
Background. — Coronary angiography data are scarce for black patients with diabetes.
Aim. — To assess coronary angiography findings in patients with diabetes at the Abidjan Heart Institute.
Methods. — This observational cross-sectional survey was conducted between 1 April 2010 and 31 December 2014. All patients admitted for known or suspected coronary artery disease who underwent coronary angiography were included in the *Registre Prospectif des Actes de Cardiologie Interventionnelle de l'Institut de Cardiologie d'Abidjan*. We analysed and compared coronary angiographical findings in patients with and without diabetes.
Results. — Eighty patients with diabetes were compared with 353 patients without diabetes. Patients with diabetes were significantly older (58.7 ± 8.9 vs 52.1 ± 11.5 years; $P < 0.001$).

Abbreviations: ACC/AHA, American College of Cardiology/American Heart Association; ACS, acute coronary syndrome; BMI, body mass index; CABG, coronary artery bypass graft; CAD, coronary artery disease; CI, confidence interval; HR, hazard ratio; PCI, percutaneous coronary intervention.

* Corresponding author at: Department of Interventional Cardiology, Abidjan Heart Institute, Boulevard de Marseille, 01 BP V206 Abidjan, Côte d'Ivoire.
E-mail address: rolandnguetta@hotmail.com (R. N'Guetta).

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Hypertension and hypertriglyceridaemia were significantly associated with diabetes ($P < 0.001$ and $P = 0.04$, respectively). A higher proportion of patients with diabetes had an abnormal coronary angiogram (85.0% vs 67.7%; $P = 0.002$). Coronary artery disease in patients with diabetes was predominantly characterized by multivessel disease ($P < 0.001$). Cardiovascular risk factors associated with diabetes influenced the severity of coronary lesions. A SYNTAX score ≥ 33 was found in a higher proportion of patients with diabetes (12.5% vs 7.1%). In the multivariable logistic regression, after adjustment, age > 60 years (hazard ratio 2.53, 95% confidence interval 1.59—4.04; $P < 0.001$) and diabetes (hazard ratio 2.12, 95% confidence interval 1.26—3.57; $P = 0.004$) were associated with multivessel coronary artery disease.

Conclusions. — In our study, diabetes emerged as a risk factor for multivessel coronary artery disease. Future studies should help to define the long-term prognosis of these patients, and to assess the benefits of myocardial revascularization procedures.

MOTS CLÉS
Diabète ;
Lésions coronaires ;
Afrique subsaharienne

Résumé

Contexte. — Peu de données existent sur l'état des coronaires du sujet diabétique noir africain.

Objectif. — Analyser les particularités des lésions coronaires chez le diabétique à Abidjan.

Méthodes. — Étude observationnelle transversale du 01 avril 2010 au 31 décembre 2014 réalisée à l'Institut de Cardiologie d'Abidjan. Tous les patients admis pour maladie coronaire avérée ou suspectée et chez qui une coronarographie a été réalisée pendant la période d'étude ont été inclus dans le Registre Prospectif des Actes de Cardiologie Interventionnelle de l'Institut de Cardiologie d'Abidjan. Nous avons analysé et comparé les aspects coronarographiques chez les diabétiques et les non diabétiques.

Résultats. — Quatre-vingt diabétiques ont été comparés à 353 non-diabétiques. Les patients diabétiques étaient significativement plus âgés que les non-diabétiques ($58,7 \pm 8,9$ ans et $52,1 \pm 11,5$ ans; $p < 0,001$). L'hypertension artérielle et l'hypertriglycéridémie étaient significativement associés au diabète ($p < 0,001$ et $p = 0,04$, respectivement). La coronarographie était plus fréquemment anormale chez les diabétiques ($p = 0,002$). Les lésions coronaires chez les patients diabétiques étaient plus souvent pluritronculaires ($p < 0,001$). Les facteurs de risque cardiovasculaire associés au diabète influençaient la sévérité des lésions coronaires. Un score SYNTAX ≥ 33 était plus souvent retrouvé chez les diabétiques (12,5 %) que chez les non-diabétiques (7,1 %). Après l'analyse multivariables par régression logistique, l'âge > 60 ans (2,53, 1,59—4,04 ; $p < 0,001$) et le diabète (2,12, 1,26—3,57; $p = 0,004$) étaient les facteurs de risque de maladie coronaire pluritronculaire, après ajustement.

Conclusions. — Les diabétiques dans notre contexte, présentent plus fréquemment des lésions coronaires pluritronculaires. De futures études devront permettre de préciser le pronostic à long terme de ces patients et d'évaluer les méthodes de revascularisation myocardique.

Background

The prevalence of diabetes mellitus has risen in recent years in developing countries, driven by changes in lifestyle and diet [1]. Diabetes is a major cardiovascular risk factor for coronary artery disease (CAD); the risk of occurrence of CAD is 2—5 times higher in patients with diabetes than in those without diabetes, after adjustment for sex and age [2]. About 75% of all deaths in people with diabetes are related to CAD [3].

In Western countries, CAD in patients with diabetes appears to be more extensive, more diffuse and more distal than in the non-diabetic population [4—7]. CAD is all the more severe if there are many cardiovascular risk factors associated with the diabetes [8].

In sub-Saharan Africa, the burden of CAD has increased steadily in recent years [9—11]. Few coronary angiography data are available for black African patients with diabetes [12—14]. The objective of this study was to describe the coronary artery lesions observed in patients with diabetes in Ivory Coast, in order to assess their severity and opportunities for management.

Methods

Study design and patient criteria

Our study was carried out in the Department of Hemodynamic and Interventional Cardiology of the Abidjan Heart Institute, which is the national referral centre for the treatment of cardiovascular diseases in Ivory Coast.

We conducted a cross-sectional study from 1 April 2010 to 31 December 2014. All patients admitted to the Abidjan Heart Institute for known or suspected CAD who underwent coronary angiography during the study period were included; these patients were divided into two subgroups according to whether or not they had diabetes. Patients admitted for coronary angiography with a contraindication (renal failure, uninterrupted metformin therapy for $\geq$ 48 hours) or who refused the test were not included. A signed consent form was obtained from each study participant.

Diabetes mellitus was defined as one of the following [15,16]: fasting hyperglycaemia $\geq$ 1.26 g/L, twice; hyperglycaemia $\geq$ 2 g/L, at any time of day; glycated haemoglobin $\geq$ 6.5%; or treatment of previously diagnosed diabetes mellitus. Hypertension was defined as systolic blood pressure $\geq$ 140 mmHg and/or diastolic blood pressure $\geq$ 90 mmHg or treatment of previously diagnosed hypertension. Dyslipidaemia was defined as a total cholesterol concentration > 2.40 g/L and/or a low-density lipoprotein cholesterol concentration > 1.60 g/L and a high-density lipoprotein cholesterol concentration < 0.40 g/L in men or < 0.50 g/L in women. Hypertriglyceridaemia was defined as a triglyceride concentration > 1.5 g/L. Physical inactivity was defined as the absence of regular daily activity lasting for 30 minutes. Coronary heredity was defined as the occurrence of a myocardial infarction or sudden death: before the age of 55 years in the patient's father or in a first-degree male relative; and before the age of 65 years in the patient's mother or in a first-degree female relative. Body mass index (BMI) was used to define a patient as obese (BMI $\geq$ 30 kg/m^2), overweight (BMI $\geq$ 25 and < 30 kg/m^2) or normal weight (BMI < 25 kg/m^2).

Data collection

Data collection was performed using a standardized survey form for each patient; epidemiological data (age, sex, race, place of residence, health insurance), clinical data (cardiovascular risk factors, clinical presentation) and echocardiographic data were recorded consecutively for each patient.

Identification of CAD severity was based upon coronary angiography findings. CAD was described according to: its location [left main coronary artery or epicardial vessels (left anterior descending artery, left circumflex artery or right coronary artery)]; the number of lesions with $\geq$ 70% narrowing; and its severity, in terms of the number of obstructive vessels, with at least one lesion with $\geq$ 70% narrowing (i.e. no significant vessel disease, one-vessel CAD, two-vessel CAD or three-vessel CAD), according to the American College of Cardiology/American Heart Association (ACC/AHA) classification [17], and according to the SYNTAX score [18]. Multivessel CAD was defined as two-vessel CAD or three-vessel CAD.

Statistical analysis

Continuous variables are presented as means $\pm$ standard deviations. Categorical data are presented as numbers and proportions. Statistical comparisons between groups used analysis of variance or the Mann—Whitney test for continuous variables, and the χ^2 test or Fisher's exact test for categorical variables. We used RStudio statistical software, version 1.1.383 (RStudio Inc., Boston, MA, USA).

Univariate and multivariable backward stepwise logistic regressions were used to assess predictors of multivessel disease, with a value of $P < 0.25$ for inclusion in the multivariable model. The candidate variables included were cardiovascular risk factors: age, sex, BMI, hypertension, diabetes, dyslipidaemia, hypertriglyceridaemia, physical inactivity, coronary heredity and smoking status. Wald's test (or Fisher's test) was used to test the significance of individual regression coefficients. We defined statistical significance using a two-sided P-value < 0.05.

Results

Four hundred and thirty-three coronary angiograms were performed between April 2010 and December 2014. The prevalence of diabetes was 18.5% (80/433). The mean age was 53.3 $\pm$ 11.3 years (range, 26—82 years). Among patients with diabetes, a male predominance was noted (70 men, 10 women; sex ratio = 7). Black subjects were predominant in our series, in those with diabetes (70/80, 87.5%) as well as in those without diabetes (319/353, 90.4%). Most of the patients did not have health insurance (341 patients, 78.8%). The distribution of patients according to cardiovascular risk factors and history is summarized in Table 1. Patients with diabetes were older than those without diabetes (58.7 $\pm$ 8.9 vs 52.1 $\pm$ 11.5 years; $P < 0.001$). Hypertension and hypertriglyceridaemia were more frequently reported in patients with diabetes. Acute coronary syndrome (ACS) was the main indication for coronary angiography (Table 2) in over half of cases in patients with and without diabetes. Coronary angiography was more frequently abnormal in patients with diabetes (85.0% vs 67.7%; $P = 0.002$). CAD in patients with diabetes was predominantly characterized by multivessel disease ($P < 0.001$) (Table 3).

The number of lesions with $\geq$ 70% narrowing was highest on the left anterior descending artery in 39.2% of cases (187/477). The left circumflex artery was involved more frequently in patients with diabetes, with no significant difference ($P = 0.08$) (Table 4). According to the severity of CAD, assessed by the ACC/AHA classification, type B2 lesions were more common in patients with diabetes, with no significant difference (24.8%; $P = 0.83$). Patients without diabetes presented mostly type B1 lesions (39.3%; $P = 0.92$).

The presence of at least two cardiovascular risk factors associated with diabetes significantly influenced the occurrence of type B1 lesions ($P = 0.006$). Severe lesions (types B2 and C) were more frequent in patients with at least two risk factors, with no significant difference. Type A lesions were reported significantly more frequently in the subgroup of patients with diabetes and a single cardiovascular risk factor ($P < 0.001$) (Table 5).

Table 1 Baseline risk factors and history.

	All patients ($n=433$)	With diabetes ($n=80$)	Without diabetes ($n=353$)	*P*
Age (years)	53 ± 11.3	58.7 ± 8.9	52.1 ± 11.5	< 0.001
Male sex	374 (86.4)	70 (87.5)	304 (86.1)	0.74
Hypertension	236 (54.5)	60 (75.0)	176 (49.9)	< 0.001
Smoking status				0.04
Non-smoker	325 (75.1)	62 (77.5)	263 (74.5)	
Ex-smoker	55 (12.7)	14 (17.5)	41 (11.6)	
Active smoker	53 (12.2)	4(5.0)	49 (13.9)	
Dyslipidaemia	108 (24.9)	26 (32.5)	82 (23.2)	0.08
Hypertriglyceridaemia	16 (3.7)	6 (7.5)	10 (2.8)	0.04
BMI				0.89
Normal	106 (33.6)	22 (32.8)	84 (33.9)	
Overweight	136 (43.2)	28 (41.8)	108 (43.6)	
Obese	73 (23.2)	17 (23.4)	56 (22.5)	
Physical inactivity	119 (27.5)	26 (32.5)	93 (26.3)	0.26
Coronary heredity	22 (5.1)	4 (5.0)	18 (5.1)	0.99
History of ACS	52 (12.0)	13 (16.2)	39 (11.0)	0.19
Previous PCI	26 (6.0)	8 (10.0)	18 (5.1)	0.09

Data are expressed as mean ± standard deviation or number (%). ACS: acute coronary syndrome; BMI: body mass index; PCI: percutaneous coronary intervention.

Table 2 Indications for coronary angiography.

	All patients ($n=433$)	With diabetes ($n=80$)	Without diabetes ($n=353$)
STEMI	208 (48.0)	44 (55.0)	164 (46.5)
NSTE-ACS	82 (18.9)	13 (16.2)	69 (19.6)
Stable CAD	49 (11.3)	10 (12.5)	39 (11.0)
Atypical pain	42 (9.7)	7 (8.8)	35 (9.9)
Dilated cardiomyopathy	37 (8.6)	4 (5.0)	33 (9.3)
Preoperative assessment	15 (3.5)	2(2.5)	13 (3.7)

Data are expressed as number (%). CAD: coronary artery disease; NSTE-ACS: non-ST-segment elevation acute coronary syndrome; STEMI: ST-segment elevation myocardial infarction.

Table 3 Distribution of patients according to the number of obstructive coronary arteries.

	All patients ($n=433$)	With diabetes ($n=80$)	Without diabetes ($n=353$)	*P*
No significant vessel disease	217 (50.1)	30 (37.5)	187 (53.0)	0.01
One-vessel disease	91 (21.0)	15 (18.8)	76 (21.5)	0.58
Two-vessel disease	84 (19.4)	24 (30.0)	60 (17.0)	0.007
Three-vessel disease	41 (9.5)	11 (13.7)	30 (8.5)	0.14
Multivessel disease	125 (28.9)	35 (43.8)	90(25.5)	0.01

Data are expressed as number (%).

The majority of patients had a SYNTAX score ≤ 22, predicting a good prognosis for percutaneous coronary intervention (PCI). A SYNTAX score ≥ 33 was found more often in patients with diabetes (12.5% vs 7.1%), with no significant difference. PCI was performed in 28.8% of patients with diabetes (23/80) and 29.2% of patients without diabetes (103/353), with a favourable in-hospital outcome. A coronary artery bypass graft (CABG) was performed in three patients in our series.

In the univariate analysis, there was a statistical association between CAD and age, hypertension and diabetes (Table 6): age > 60 years (hazard ratio [HR] 2.49, 95% confidence interval [CI] 1.59—3.91; $P < 0.001$), hypertension (HR 1.73, 95%CI 1.13—2.66; $P = 0.01$) and diabetes (HR 2.27,

Table 4 Location of lesions.

	All patients ($n = 477$ lesions)	With diabetes ($n = 121$ lesions)	Without diabetes ($n = 356$ lesions)	*P*
Left main coronary artery	10 (2.1)	1 (0.8)	9 (2.5)	0.46
Left anterior descending artery	187 (39.2)	47 (38.8)	140 (39.3)	0.88
Left circumflex artery	122 (25.6)	38 (31.4)	84 (23.6)	0.08
Right coronary artery	158 (33.1)	35 (28.9)	123 (34.6)	0.25

Data are expressed as number (%).

Table 5 American College of Cardiology/American Heart Association classification of coronary lesions in patients with diabetes according to the number of associated cardiovascular risk factors.

Classification	All patients with diabetes ($n = 121$ lesions)	One CV risk factor ($n = 15$ lesions)	At least two CV risk factors ($n = 106$ lesions)	*P*
Type A	26 (21.5)	9 (60.0)	17 (16.0)	< 0.001
Type B1	47 (38.8)	1 (6.7)	46 (43.4)	0.006
Type B2	30 (24.8)	3 (20.0)	27 (25.5)	0.76
Type C	18 (14.9)	2 (13.3)	16 (15)	0.99

Data are expressed as number (%). CV: cardiovascular.

95%CI 1.38—3.76; $P = 0.002$) were risk factors for CAD. In the multivariable backward stepwise logistic regression, age > 60 years (HR 2.53, 95%CI 1.59—4.04; $P < 0.001$) and diabetes (HR 2.12, 95%CI 1.26—3.57; $P = 0.004$) were associated with multivessel CAD after adjustment for other cardiovascular risk factors (Table 7).

Discussion

Data on CAD in patients with diabetes in sub-Saharan Africa are limited [12—14]; this is because of the extreme scarcity of catheterization laboratories and the lack of interventional cardiologists in the region [19]. Furthermore, there is still no universal healthcare system in our country, and in the majority of countries in sub-Saharan Africa. These shortcomings may explain why so few of our patients underwent coronary angiography and PCI.

The low prevalence of diabetes in our study population (18.5%) reflects its relatively low prevalence in patients with ACS in our country (28.5%) [9]. The same trend is reported in other sub-Saharan African series of patients with ACS [11]. These observations contrast with data from Northern African, where diabetes accounts for about 40% of cases [20].

This study, describing angiographical analyses of CAD in black African patients, showed abnormal coronary angiograms mostly in patients with diabetes. Chronic hyperglycaemia has been recognized in the literature as an independent risk factor for CAD, and is considered equivalent to CAD [21,22]. Our study emphasized diabetes as a risk factor for multivessel CAD. Diabetes increased the risk of multivessel CAD twofold, after adjustment for age, sex and other cardiovascular risk factors. In Western countries, it has been widely reported that CAD in patients with diabetes is often a multivessel disease [5,7]. In the BARI 2D registry [23], 30.7% of patients had three-vessel disease. The FREEDOM study [24] found a higher proportion of patients with three-vessel disease (83.3%). In a Chinese series [6], three-vessel disease was significantly more frequent in patients with diabetes (35.2% vs 24%; $P = 0.009$). Angiographic data in this report revealed three-vessel disease predominantly in patients with diabetes (13.7% vs 8.5%; $P = 0.14$), although with no significant difference, which may be a reflection of the small size of our study population. It is also well known that diabetes is an independent risk factor in complex lesions, particularly in bifurcations and coronary ostia, as demonstrated by Baris et al. [4].

Data from our catheterization laboratory showed a non-significant link between cardiovascular risk factors associated with diabetes and the number of vessels with CAD. The correlation between the number of vessels involved and the number of cardiovascular risk factors has been assessed by Scognamiglio et al. [8] in a series of 1899 patients with diabetes. Among patients with at least two cardiovascular risk factors associated with diabetes, three-vessel disease was reported significantly more frequently (33.3% vs 7.6%; $P < 0.001$).

Cardiovascular risk factors associated with diabetes may affect the severity of CAD. Our study suggests that associated risk factors can affect the severity of coronary artery lesions assessed by the ACC/AHA classification in patients with diabetes. Among patients with diabetes in our study, distributed according to the number of associated risk factors, type B1 lesions were commonly observed in patients with at least two risk factors ($P = 0.004$). Severe type B2 and type C lesions were often reported in patients with at least two risk factors, without statistical association. In addition to validated scores, the diffuse and extensive nature of lesions determine their severity. In agreement

Table 6 Predictors of multivessel coronary disease (univariate analysis).

	< 2-vessel disease ($n = 308$)	≥ 2-vessel disease ($n = 125$)	HR	95% CI	*P*
Age (years)					< 0.001
≤ 60	243 (78.9)	75 (60.0)	1	–	
> 60	65 (21.1)	50 (40.0)	2.49	1.59–3.91	
Sex					0.53
Female	44 (14.3)	15 (12.0)	1	–	
Male	264 (85.7)	110 (88.0)	1.22	0.65–2.29	
BMI (kg/m²)					0.16
< 25	166 (53.9)	58 (46.4)	1	–	
≥ 25	142 (46.1)	67 (53.6)	1.35	0.89–2.05	
Hypertension					0.01
No	152 (49.4)	45 (36.0)	1		
Yes	156 (50.6)	80 (64.0)	1.73	1.13–2.66	
Diabetes					0.002
No	263 (85.4)	90 (72.0)	1	–	
Yes	45 (14.6)	35 (28.0)	2.27	1.38–3.76	
Dyslipidaemia					0.49
No	234 (76.0)	91 (72.8)	1	–	–
Yes	74 (24.0)	34 (27.2)	1.18	0.74–1.90	
Hypertriglyceridaemia					0.73
No	296 (96.1)	121 (96.8)	1	–	
Yes	12 (3.9)	4 (3.2)	0.82	0.26–2.58	
Physical inactivity					0.13
No	217 (70.5)	97 (77.6)	1	–	
Yes	91 (29.5)	28 (22.4)	0.69	0.42–1.12	
Coronary heredity					0.21
No	295 (95.8)	116 (92.8)	1	–	
Yes	13 (4.2)	9 (7.2)	1.76	0.73–4.23	
Smoking status					0.42
Non-smoker	226 (73.4)	99 (79.2)	1	–	
Ex-smoker	41 (13.3)	14 (11.2)	1.17	0.48–2.82	
Active smoker	41 (13.3)	12 (9.6)	1.5	0.75–2.97	

Data are expressed as number (%). BMI: body mass index; CI: confidence interval; HR: hazard ratio.

with data published previously [5], our study shows diffuse CAD in patients with diabetes. The poor prognosis of ischaemic heart disease in patients with diabetes may be partly explained by the number of obstructive coronary arteries and by the extent of the CAD [25].

Considering the absolute number of lesions, there was a higher percentage on the left anterior descending artery, although without significant association. The left circumflex artery was involved particularly frequently in patients with diabetes. In the FREEDOM study [24], almost all patients had right coronary artery CAD (98.9%); the left circumflex artery and the left anterior descending artery were involved in 92.6 and 91.7% of patients, respectively. The right coronary artery was most commonly involved in those without diabetes. In China [6], a preferential location of lesions on the right coronary artery was reported in patients with diabetes (66.4% vs 52.6%; $P = 0.002$). Regarding the left anterior descending artery and the right coronary artery, lesions appeared to predominate on the middle and distal segments. The distal tropism of coronary lesions in patients with diabetes is well known in the literature [5].

In our practice, the indications for coronary exploration were mainly ACS, in patients with and without diabetes. In the USA [26], the diagnosis was ACS in 43.5% of patients and stable angina in 17.6% of patients. In France [27], stable angina or silent ischaemia was the main presentation in 23% of patients and ACS in 22% of patients. Our activity is incipient, and patients in this study were largely those admitted for ACS. These findings support the need for additional healthcare facilities capable of providing appropriate acute care in sub-Saharan Africa. In recent decades, cardiology departments in sub-Saharan Africa have experienced a sharp rise in ACS [19]. However, catheterization laboratories and interventional cardiologists are very scarce in our countries, so management of ACS remains challenging [19]. In addition, and despite the guidelines, many patients suspected of having CAD cannot benefit from the non-invasive tests to detect the myocardial ischaemia that would justify coronary angiography [28,29]. These disparities are explained by the economic environment, the lack of health insurance in sub-Saharan Africa and also by the inertia of practitioners.

In sub-Saharan Africa [12], as well as in developed countries [30,31], recent studies in patients with CAD showed

Table 7 Predictors of multivessel coronary artery disease (multivariable analysis).

	Initial model			Final model		
	HR	95% CI	*P*	HR	95% CI	*P*
Age (years)			< 0.001			< 0.001
≤ 60	1	–		1	–	
> 60	2.32	1.42–3.80		2.53	1.59–4.04	
Hypertension			0.10			
No	1	–				
Yes	1.49	0.93–2.40				
Diabetes			0.01			0.004
No	1	–		1	–	
Yes	1.96	1.15–3.35		2.12	1.26–3.57	
BMI			0.13			
< 25 kg/m^2	1	–				
≥ 25 kg/m^2	1.41	0.90–2.20				
Physical inactivity			0.02			0.03
No	1	–		1	–	
Yes	0.52	0.30–0.89		0.56	0.34–0.94	
Coronary heredity			0.24			
No	1	–				
Yes	1.76	0.69–4.53				

BMI: body mass index; CI: confidence interval; HR: hazard ratio.

that those with diabetes were older than those without diabetes. The mean age of our patients with diabetes was about a decade lower than that in several studies conducted in the Western countries [21,22]; it is correlated with the age gradient between wealthy countries and sub-Saharan Africa concerning CAD [9,32]. This difference could be the result of the expansive age-sex pyramid in sub-Saharan Africa, resulting in a younger population experiencing epidemiological transition, with changes in diet and lifestyles, thus leading to an increase in diabetes and metabolic diseases.

Hypertension was commonly associated with diabetes in our study, with a non-significant trend for association with hypercholesterolaemia and hypertriglyceridaemia. The prevalence of hypertension in patients with diabetes is estimated to be between 49% and 60% [33,34]. Previous studies in Western countries [24] found hypertension and hyperlipidaemia in 84.8% and 83.7% of included patients, respectively. Baris et al. [4] found that rates of hypertension and hyperlipidaemia were significantly higher in patients with diabetes than in those without diabetes. In a meta-analysis [35] comparing coronary atherosclerotic progression in patients with and without diabetes, those with diabetes were significantly more hypertensive ($P < 0.001$) and more dyslipidaemic ($P = 0.004$). Hypertension (usually systolic) has long been recognized as a cardiovascular risk factor commonly associated with diabetes [36].

This study revealed only one myocardial revascularization procedure by CABG in patients with diabetes, performed on the left main coronary artery. Five patients had PCI with implantation of a drug-eluting stent. Among patients with diabetes with one-vessel or two-vessel disease, or with CAD affecting the left main coronary artery, the choice of revascularization strategy remains controversial between PCI with drug-eluting stent implantation and CABG [28]. In the presence of multivessel lesions, CABG is the revascularization technique of choice [37,38]. The superiority of CABG as a myocardial revascularization technique has already been confirmed [24]. Among 1900 patients with multivessel disease and diabetes, a reduced risk of major cardiac events (particularly heart attack and death) at 5 years was reported in those who underwent CABG.

Study limitations

Compared with Western series, our study included relatively small numbers, so some statistical analyses were unpowered. Those participating were consecutive patients presenting to the Abidjan Heart Institute for coronary angiography exploration. This sample may not be representative of the entire population of patients with diabetes mellitus in Ivory Coast with suspected or known CAD during the same period. Non-invasive tests for myocardial ischaemia were not performed according to international guidelines in asymptomatic patients with diabetes with high cardiovascular risk or target organ damage [39–41]. Glycated haemoglobin was not available for all patients with diabetes included in this registry, which prevented us from obtaining information on glycaemic control and its correlation with the severity of CAD. The duration of diabetes was not reported in our study. Nevertheless, this study reported data on coronary angiography in patients with diabetes in sub-Saharan Africa.

Conclusions

In this study carried out at the Abidjan Heart Institute catheterization centre, diabetes appeared as a risk factor

for multivessel CAD. Risk factors associated with diabetes influenced the severity of CAD. The screening of patients with diabetes with non-invasive tests is an important step in the early identification of patients who should undergo coronary angiography. Implementation of catheterization laboratories and fellowship in interventional cardiology should be encouraged.

It would be interesting to conduct multicentre studies with larger samples of patients to confirm the role of diabetes in multivessel CAD in black Africans, to reveal the long-term prognosis of these patients and to assess the benefits of myocardial revascularization methods.

Disclosure of interest

The authors declare that they have no conflicts of interest.

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