

Epidemiological Profile of Macroangiopathy in Type 2 Diabetic Patients at the National Reference University Hospital: Predictive Factors

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Abstract

The objective of this study was to determine the risk factors related to diabetic macroangiopathy. This was a cross-sectional study with a descriptive and analytical aim over a period of six (06) months from January 1, 2022 to June 30, 2023 including 100 patients with type 2 diabetes with or without complications received in consultation and/or hospitalized in the cardiology and diabetology department of the National Reference University Hospital Center. The patients benefited from a meticulous questioning, a complete somatic examination and a biological assessment including in particular the dosage of dyslipidemia. The 100 subjects included in this study were categorized into group 1 with complications (n = 48) and group 2 without complications (n = 52). The prevalence of macroangiopathy was 48%. The mean age of the patients was 62.21 years for group 1 versus 61.94 years for group 2. The male sex was predominant in both groups with the overall sex ratio of 1.85 or 2.4 for group 1 versus 1.5 for group 2. The mean waist circumference was 100.13 ±



11.5 for group 1 versus 90.12 ± 8.7 for group 2. The mean fasting blood glucose was 2.9 ± 0.6 in group 1 versus 2.2 ± 0.32 for group 2. High blood pressure and smoking were predominant in group 1. The mean glycated hemoglobin was 9.6 ± 1.7 for group 1 versus 7.4 ± 0.6 for group 2. Most patients in group 1 were not undergoing medical monitoring of their diabetes and were on insulin, unlike subjects in group 2 who were on oral antidiabetics and were adhering to medical monitoring. Prevention of macroangiopathy in type 2 diabetic patients involves early screening of blood sugar, glycated hemoglobin and all cardiovascular risk factors.

Keywords

Type 2 Diabetes, Macroangiopathy, Cardiovascular Risk Factors,
N'Djamena

1. Introduction

Diabetes is a chronic disease that constitutes a major public health problem because of its sharply increasing prevalence and the severity of its complications and its impact on the quality of life of those affected [1]. In 2019, according to the IDF, the number of deaths worldwide due to diabetes was estimated at 4.2 million among adults aged 20 - 79, or one death every eight seconds linked to diabetes. Its global prevalence was estimated in 2021 by the International Diabetes Federation (IDF) at 537 million adults (20 - 79 years) and according to forecasts based on epidemiological data, this figure will reach 700 million (10.9%) in 2045. Africa will experience the largest increase in diabetes in the world, rising from 24 million in 2021 to 47 million (4.4%) in 2045 [2]. In France, this prevalence was 5.3% in 2021 [3]. A study conducted by Dionadji *et al.* (2015) in Chad, showed a hospital prevalence of 4% of diabetes with a predominance of type 2 diabetes (89.6%). The main complications were: high blood pressure (31.9%), stroke (30%) and diabetic wounds (21%) [4]. Another study was conducted by Bessimbaye *et al.* (2023) on 104 patients with diabetic feet, 95% of whom were type 2 diabetics with an average duration of evolution of 8 years. Coronary heart disease is the leading cause of cardiovascular death in diabetics [5]. Diabetes is an independent risk factor for stroke, with a relative risk of 1.5 to 3. Globally, the prevalence of stroke in diabetics was approximately 10% in 2017. Compared to non-diabetics, diabetics have a four times higher risk of having lower limb arteritis. Peripheral arterial disease (PAD) affects more than 200 million patients worldwide, including 40 million in Europe [6].

In Chad, despite the galloping epidemiology of type 2 diabetes and its serious cardiovascular complications, no study has focused on screening for predictive factors of macroangiopathies in diabetics, hence the interest of our study, the aim of which is to contribute to the prevention and improvement of the management

of macroangiopathies in these patients.

2. Materials and Methods

2.1. Study Framework

The study was conducted in the diabetology and cardiology departments of the National Reference University Hospital Center (CHU-RN) of N'Djamena.

2.2. Type and Period of Study

This was a cross-sectional and analytical study that lasted 6 months from January to June 2023.

2.3. Study Population

The study population consisted of type 2 diabetic patients.

2.4. Eligibility Criteria

2.4.1. Inclusion Criteria

The following were included in this study:

- Type 2 diabetic patients hospitalized in the Diabetology and/or Cardiology department of the National Reference University Hospital of N'Djamena and having the presence of at least one macroangiopathy (coronary insufficiency and/or stroke, and/or obliterating arteriopathy of the lower limbs) confirmed by paraclinical examinations (brain scan, arterial Doppler ultrasound, stress echocardiography);
- Informed consent signed by the parents is obtained;
- Type 2 diabetic patients hospitalized with no proven macroangiopathy.

2.4.2. Non-Inclusion Criteria

- The non-inclusion criteria were pregnant or breastfeeding women, type 2 diabetics under 65 years of age and pregnant or breastfeeding women with anamnestic or clinical signs suggestive of cerebral cardiovascular diseases but who had not benefited from diagnostic tests to confirm or rule out the presence of macroangiopathy;
- The absence or refusal of parents to participate in the study.

2.5. Study Population, Sampling

The sampling was random, consecutive and non-exhaustive. The above criteria allowed us to select 100 type 2 diabetic patients divided into two groups:

- Group 1: 48 patients with at least one macroangiopathy (coronary insufficiency and/or stroke and/or peripheral arterial disease (PAD));
- Group 2: 52 patients with no proven macroangiopathy during questioning.

2.6. Data Collection

Data collection was carried out on a pre-established technical sheet containing specific items (sociodemographic, clinical, paraclinical and therapeutic infor-

mation) for patients hospitalized or seen for type 2 diabetes.

2.7. Technical Materials

The following materials were used to collect the data: a glucometer, a blood pressure monitor, a scale, a height gauge and a tape measure.

2.8. Biological Material

The biological material consisted of whole blood and serum.

2.9. Written and Signed Informed Consent

Madam/Sir

We would like to take your blood, this is a procedure usually done to look for biological parameters (sugar, total cholesterol, HDL/LDL, glycated hemoglobin, etc.) in the blood. We want to conduct specific research on macroangiopathy in type 2 diabetic patients. Diabetes is a disease present in all age groups depending on the type of diabetes and is responsible for several complications that are often difficult to resolve.

The sample will not pose any risk to your health, and it will be used to assess the blood sugar level and the average glycated hemoglobin and other biological parameters mentioned above. Under no circumstances will other tests be carried out without your consent. The results obtained, which will be available to you, will undoubtedly allow us to better understand glycemic balance in order to better control the factors influencing it.

You will be informed of any change in the purpose of the research on the samples and you will be able to object to it.

Madam/Sir, your participation is essential for the realization of this study which will allow us to contribute to the improvement of your care.

Signature of the patient

2.10. Data Analysis

Our data were entered into Microsoft Word 2017 and Excel 2013 software and analyzed using SPSS.21 statistical software. Qualitative variables were expressed as percentages and quantitative variables as mean $\pm$ standard deviation. Chi-square and T-Student statistical tests were used to determine the degree of statistical significance between variables.

3. Results

3.1. Sociodemographic Characteristics of the Population Studied

A follow-up of 100 patients with type 2 diabetes was carried out at the diabetology department of the National Reference University Hospital (CHU-RN) of N'Djamena.

Of the 100 patients followed, 48 had macroangiopathy with complications and 52 patients were without complications (**Figure 1**).

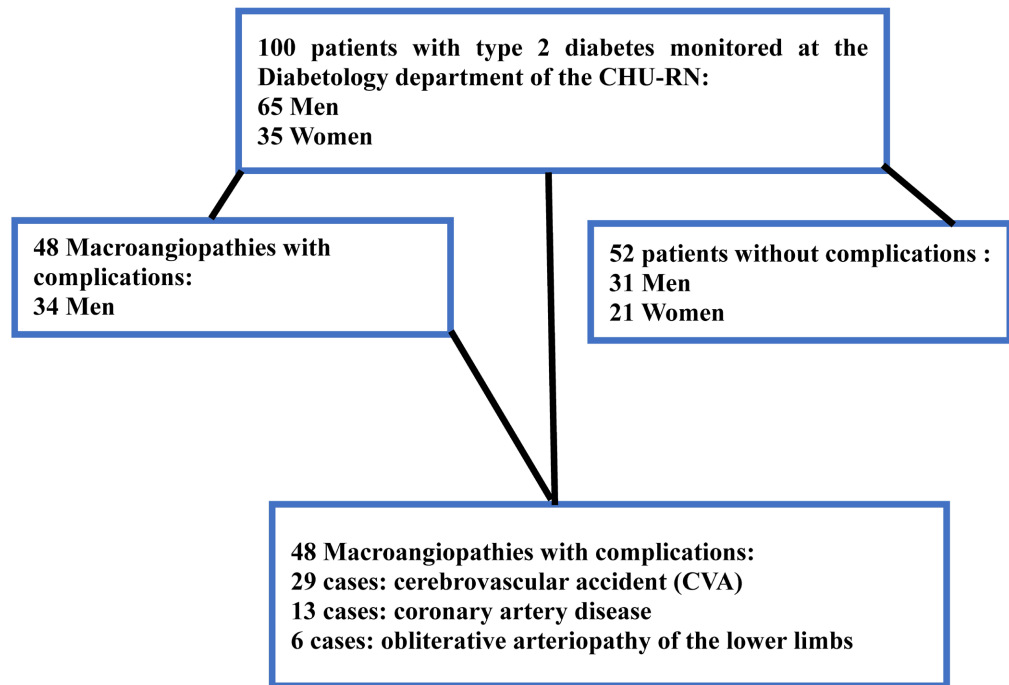


Figure 1. Sociodemographic characteristics of the study population.

3.2. Distribution of Patients According to the Presence of Macroangiopathy with Complications

Of a total of 100 patients with type 2 diabetes, 48 in the first group with macroangiopathy, 29 (60%) of whom had stroke, 13 (27%) had coronary artery disease and 6 (13%) had peripheral arterial disease (**Figure 2**).

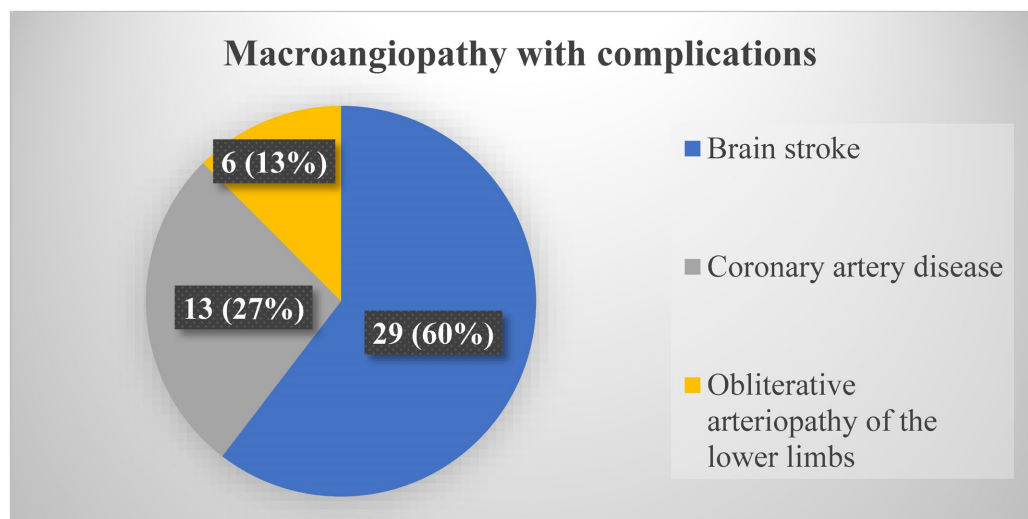


Figure 2. Distribution of patients according to the presence of macroangiopathy with complications.

3.3. Clinico-Biological Characteristics of the Population Studied According to the Presence of Macroangiopathy

According to the age group, the most represented patients were 61 to 65 years old

34 (70.8%) of the cases. The average age was 62.21 years.

Speaking of gender, our sample consisted of 70.8% men and 29.2% women. The sex ratio (M/F) was 2.42.

Concerning smoking 52.1% were smokers.

Speaking of duration of diabetes 83.3% of the patients had a duration of diabetes greater than 10 years.

Speaking of high blood pressure 77.1% of the patients were hypertensive.

Regarding blood glucose, 56.3% had a fasting blood glucose between 2 and 2.99. The mean fasting blood glucose was 2.9 ± 0.6 .

In our sample, 98% had an HbA1C between 7 and 12. The mean glycated hemoglobin was 9.6 ± 1.7 .

Regarding dyslipidemia, 31.3% had an increased LDL-cholesterol. The mean LDL-cholesterol was 1.2 (**Table 1**).

Table 1. Clinico-biological characteristics of the population studied according to the presence of macroangiopathy.

Parameter	With complications	
	Effective	Percentage
Age (year)	34	70.8 (62.21 years)
Sex (H/F)	34	70.8 (H/F: 2.42)
Smoking	25	52.10
Duration of diabetes (10 years)	40	83.30
HTA	37	77.10
Average fasting blood sugar	27	56.3 (M: 2.9 ± 0.6 g/L)
Average HbA1c	47	98 (M: $9.6 \pm 1.7\%$)
Average LDL	15	31.3 (M: 1.2g/L)

3.4. Clinico-Biological Characteristics of the Population Studied According to the Presence or Absence of Macroangiopathy

Our study showed that the occurrence of macroangiopathy in type 2 diabetic patients was linked to the presence of high blood pressure, high glycated hemoglobin levels, high fasting blood sugar, hyperlipidemia (LDL), high waist circumference, smoking, duration of diabetes greater than 10 years, all correlated with the lack of diabetes monitoring. Then, the information in **Table 2** showed that the accumulation of risk factors that characterize the diabetic patient was always associated with cardiovascular accidents. The responsibility of chronic hyperglycemia in diabetic macroangiopathy remains an aggravating factor. Therefore, the more the number of cardiovascular risk factors increased in type 2 diabetics, the greater the risk of macroangiopathy. In addition, poor glycemic control and glycated hemoglobin were predictive of cardiovascular disease (**Table 2**).

Table 2. Clinico-biological characteristics of the study population according to the presence or absence of macroangiopathy.

Parameter	With complications (n = 48)	Without complications (n = 52)	P-value
Age (year)	62.21 ± 4.41	61.94 ± 3.3	0.10
Sex-ratio (H/F)	2.4	1.5	0.00
Smoking (%)	52.1	36.5	-
Families' ATCD (%)	4	5	Ns
Diabetes duration > 10 years (%)	40	83.30	-
BMI (Kg/m ²)	27.07 ± 5.9	42.03 ± 3.6	0.00
Average TT	100.13 ± 11.5	90.12 ± 8.7	0.00
Blood pressure (%)	77.8	23.1	0.00
Average fasting blood sugar	2.9 ± 0.6	2,2 ± 0.32	0.00
Average HbA1c (%)	9.6 ± 1.7	7.4 ± 0.6	0.00
Average LDL	1.2	0.9	0.00
Previous follow-up (%)	27.1	78.8	0.00

n = effective; % = percentage; Families' ATCD = Families' histories; BMI = body mass index (Kg/m²); Average TT = Average Waist measurement; LDL = low density lipoproteins.

Characteristics of type 2 diabetic arterial foot diseases

Table 3 shows the obliterative arteriopathy images of the lower limbs (a: edema and b: edema with open wound).

Table 3. Photos of obliterative arteriopathies of the lower limbs.

4. Discussion

Data on predictive factors of macroangiopathy in type 2 diabetic patients help to understand the occurrence of current type 2 diabetes complications and/or predict future trends of the disease. Hospital data in type 2 diabetes will help regions, countries and stakeholders to design type 2 diabetes prevention and control strat-

egies at national, regional and international levels.

Out of 100 consultations made to the Diabetology and Cardiology departments of the CHU-RN of N'Djamena from January to June 2023, *i.e.* 6 months; 48 patients in the first group had 6 (12.5%) of the sample, a complication such as obliterating arterial disease of the lower limbs (AOMI), 29 (60.4%) of stroke and 13 (27.1%) of coronary artery disease and 52 in the second group without macroangiopathy. On the other hand, the macroangiopathy reported by Sebai *et al.* [7] is dominated by coronary artery disease in 25 patients, by a history of stroke in 8 patients and by arteritis of the lower limbs in 11 patients. This result is in the range of other authors [8]-[10]. According to literature data, macroangiopathy reveals endothelial dysfunction, chronic inflammation and a prothrombogenic state [11]. This frequency in our study could be explained by the lack of follow-up; the socioeconomic level; which does not allow for adequate support.

The overall mean fasting blood glucose was 2.54 with extremes of 1.58 to 4.01 g/L. This result is comparable to that of Camara in Mali in 2022 who found an average of 2.59 [12]. The cardiovascular impact of fasting blood glucose was described by a Finnish study [13], involving 1059 diabetic patients, which analyzed the impact of blood glucose and other traditional risk factors on the risk of developing coronary heart disease. The risk of coronary heart disease was twice as high in patients with fasting hyperglycemia (>13.4 mmol/L or >2.41 g/L), independently of other risk factors. [13]. Our study is part of a prevention approach, by focusing on cardiovascular risk factors in type 2 diabetics, before any cardiovascular event occurs.

The overall mean age in our study was 62.7 years with extremes of 55 to 65 years. This result is consistent with that of Camara in 2022 in Bamako who found 62.5 years. On the other hand, our result is higher than that of Mbaye in Senegal in 2011 [14], of Bertal in Morocco in 2009 [15], of Konaté in Bamako in 2019 [16] who found respectively 43.4 ± 17.8 years; 58.7 years; 59 years. The prevalence of cardiovascular diseases increases with age [17].

The male sex was the most represented in 65% of cases with an overall sex ratio (M/F) of 1.85. This result is similar to that of Dembélé in Bamako in 2023 [18] who found 65.64% with the overall sex ratio of 1.7; Derrazi *et al.* In Morocco in 2020 [19] made the observation with a clear male predominance at 79.50%. According to some authors, the relative risk of death from coronary heart disease is significantly higher in women than in men [20].

Concerning HBP; 77.1% of patients were hypertensive in the first group with complications. This is consistent with the literature data and This result is similar to that found by Chaâbane *et al.* in Tunisia in 2013, and Dina *et al.* in Morocco in 2016 [21], who found the percentages of HBP respectively 71% and 69.6%. The association of HBP with diabetes is a formidable association. The coexistence of diabetes and HBP increases the risk of cardiovascular disease and mortality. The currently accepted pathophysiological mechanisms are: hyperinsulinism related to an increase in renal sodium reabsorption [22]. The literature data had reported

a linear and continuous association between systolic blood pressure and the risk of cardiovascular events in diabetics [23].

From the smoking point of view; 52.1% of patients in the first group with complications were tobacco users. This result corroborates those of Hakimi [24] in 2015 in Morocco Amoussou-Guenou in 2018 in Benin, who obtained respectively 57.7%, 53% [25]. This result is in the range that other African authors have reported varying from 25 to 65% [26]-[30]. The Motreff study specifies that a consumption of 20 cigarettes per day exposes to a risk of coronary artery disease multiplied by 3, a risk of infarction or sudden death multiplied by 5 and a risk of PAD multiplied by 7. This relative risk is all the higher as the patient is young. Tobacco smoke has a direct toxic effect on the arterial endothelium, LDL oxidation and nitric oxide (NO) production, particularly promoting coronary spasm. Tobacco is also a thrombogenic factor promoting the release of thromboxane A2 by platelets and increasing the fibrinogen level [31].

Glycated hemoglobin level was significantly associated with the presence of atherosclerosis with an overall mean of $9.6 \pm 1.7\%$ in group 1 with complications. Our result corroborates that of Selvin *et al.* who found a mean of $9.3 \pm 1.3\%$ and who showed that any 1% increase in HbA1c level in type 2 diabetics increased the risk of cardiovascular disease by 1.18 [32]. The UKPDS study, which included 3642 patients, is the first to have analyzed the impact of HbA1c level on micro and macrovascular complications (angina, infarction, death). In this study, a 1% decrease in glycated hemoglobin was associated with a 14% reduction in the number of IDM, 12% in stroke, 16% in heart failure, 43% in deaths related to peripheral macroangiopathy, and 37% in amputations [33].

In our study, the duration of diabetes development greater than 10 years without prior follow-up appeared to be a factor in the occurrence of macroangiopathy with 83.3% in the first group with complications. This result is the same as that of the German study of 2018 analyzing the impact of the duration of diabetes compared to other existing traditional risk factors on carotid intima-media thickness and on the variation in the diameter of the arterial lumen of the brachial artery, showed that the duration of diabetes greater than ten (10) years was a factor promoting the increase in intima-media thickness [34]. Other studies conducted in young diabetics have confirmed the correlation between the duration of diabetes development and the occurrence of macroangiopathic complications [35].

In the first group, 31.3% of patients had a high LDL cholesterol level, with an average LDL cholesterol of 1.2 g/L. This result is comparable to that of Damoune in Morocco in 2014 which reported 34% with an increase in bad cholesterol (LDL) averaging 1.35 g/L [36]. This result is lower than those in the literature, which reported 50%, 50.8%, 79.8% respectively) [37]-[39]. Lipid metabolism disturbances are closely linked to the occurrence of cardiovascular accidents. A high LDL cholesterol level as well as a lowered HDL cholesterol level are accompanied by an increase in morbidity and mortality. This confirms the conclusion of the UKPDS which showed that the effect of diabetes on plasma lipids contributes to excess

cardiovascular risk [40]. The occurrence of macroangiopathy demonstrates the role of bad LDL cholesterol in the occurrence of cardiovascular complications.

5. Conclusion

Cardiovascular disease is considered the leading cause of death in type 2 diabetics. It is the consequence of several factors. This study has made it possible to determine the different factors namely male gender, blood pressure, high LDL-cholesterol with glycemic imbalance (increased Hb1Ac) and lack of follow-up. Therefore, it is important to expand our study population in order to prevent cardiovascular diseases by screening for risk factors specific to diabetes.

Conflicts of Interest

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

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