




Comparative Analysis of Minoca Phenotypes in Central Africa: Distinguishing Stemi and Nstemi Presentations

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Abstract

Background: Data on Myocardial Infarction with Non-Obstructive Coronary Arteries (MINOCA) in sub-Saharan Africa is limited and not existing in Central Africa. We sought to characterize the clinical and angiographic profiles of MINOCA patients in Yaoundé, Cameroon, comparing them to those with obstructive myocardial infarction (MI). **Methods:** We conducted a cross-sectional study of patients admitted to the cardiac catheterization laboratory in Yaoundé. MINOCA was defined according to ESC criteria. Comparisons were made between MINOCA and obstructive MI groups. **Results:** Out of 69 patients with MI, 11 (15.9%) met the criteria for MINOCA. Patients with MINOCA were significantly younger than those with obstructive MI ($47.55 \pm 13, 67$ years vs. 58.76 ± 10.49 years; $p = 0.003$), with 27.3% aged ≤ 40 years. Hypertension was less frequently observed in the MINOCA group (36.4% vs. 75.9%; $p = 0.027$), as was a history of ischemic heart disease (9.1% vs. 44.8%; $p = 0.041$). Notably, STEMI was the most frequent clinical presentation in MINOCA patients (72.7%), mirroring the proportion seen in obstructive MI (74.1%). MINOCA patients also had more preserved cardiac function, with a lower prevalence of impaired LVEF $< 50\%$ (18.2% vs. 53.4%; $p = 0.032$). **Conclusion:** In this first comparative analysis in Cameroon, MINOCA represents nearly 1 in 6 MI cases and appeared to affect younger patients in our series. The high prevalence of STEMI-MINOCA (72.7%) highlights that ST-elevation in the absence of obstructive disease is a common and critical phenotype in this population.

Keywords

MINOCA, Myocardial Infarction, Coronary Angiography, Sub-Saharan

1. Introduction

Myocardial infarction (MI) is classically associated with significant obstruction of the coronary arteries. However, a noteworthy subgroup of patients presenting with a clinical, electrocardiographic, and biochemical profile consistent with MI does not exhibit obstructive coronary lesions upon coronary angiography. This entity, termed Myocardial Infarction with Non-Obstructive Coronary Arteries (MINOCA), is now recognized as a distinct clinical diagnosis rather than a mere diagnosis of exclusion [1] [2].

According to contemporary registries, MINOCA accounts for approximately 5% to 15% of all myocardial infarctions, preferentially affecting younger patients, often with fewer traditional cardiovascular risk factors, and sometimes showing a female predominance [3] [4]. The underlying pathophysiological mechanisms are heterogeneous, including non-obstructive plaque rupture or erosion, coronary artery spasm, microvascular dysfunction, spontaneous coronary artery dissection, and coronary embolism [5]. This diversity explains the diagnostic and therapeutic challenges encountered in managing these patients.

Long considered an entity with a favorable prognosis, MINOCA is now associated with significant morbidity and mortality, comparable to that observed in certain forms of obstructive MI, highlighting the importance of appropriate recognition and management [6] [7]. Despite the growing abundance of data from high-income countries, data from Sub-Saharan Africa remain extremely limited, particularly in contexts where access to advanced investigations—such as intracoronary imaging or cardiac MRI—is restricted.

In this context, the objective of this study was to describe the prevalence and clinical, biological, and angiographic characteristics of patients presenting with MINOCA in Yaoundé, and to compare them with those of patients presenting with obstructive myocardial infarction (STEMI or NSTEMI), in order to identify potential specificities within the African context.

2. Materials and Methods

2.1. Study Setting and Design

This was a retrospective analysis of prospectively collected data from the DéRICA registry (Yaoundé Registry of Interventional Cardiology Achievements).

The registry prospectively includes all consecutive patients admitted to the cardiac catheterization laboratory of the Yaoundé General Hospital.

For the present study, we retrospectively analyzed patients enrolled between November 8, 2022, and November 8, 2025, and applied predefined inclusion and exclusion criteria to identify patients with myocardial infarction.

2.2. Data Source

Data were collected from the interventional cardiology registry of Yaoundé, known as DéRICA (Yaoundé Registry of Interventional Cardiology Achievements). This registry prospectively includes all patients admitted to the cardiac catheterization unit of the Cardiovascular Explorations Department at the Yaoundé General Hospital.

The collected information included sociodemographic, clinical, biological, electrocardiographic, echocardiographic, angiographic, and therapeutic data.

2.3. Equipment and Procedures

The catheterization laboratory was equipped with a SIEMENS® Artis One angiograph. Coronary angiographies were performed according to standard practices, via radial or femoral access, with visual analysis supplemented by quantitative coronary angiography (QCA) when necessary.

2.4. Study Population and Flow of Participants

During the study period, a total of 115 patients were admitted to the cardiac catheterization laboratory. Among them, 69 patients met the diagnostic criteria for myocardial infarction (STEMI or NSTEMI) and were included in the present analysis.

A total of 46 patients were excluded for the following reasons:

- Non-Myocardial infarction diagnoses, including chronic coronary syndrome (n = 26), unstable angina (n = 14), aortic aneurysm (n = 1), and in-stent thrombosis without criteria for acute myocardial infarction (n = 2);
- Incomplete clinical or angiographic data (n = 3).

Patients were excluded if they had an alternative diagnosis explaining troponin elevation or incomplete clinical or angiographic data.

Among the included myocardial infarction cases, 11 patients fulfilled the criteria for MINOCA, while 58 had obstructive myocardial infarction.

This corresponds to a MINOCA prevalence of 15.9% among 11 myocardial infarctions.

Sampling was exhaustive, consecutive, and non-probabilistic.

2.5. Inclusion Criteria

Patients included in the study were:

- Aged 18 years or older;
- Admitted for acute coronary syndrome (STEMI or NSTEMI) according to international guideline criteria;
- Having undergone diagnostic coronary angiography during hospitalization.

2.6. Group Definitions

- MINOCA Group: The diagnosis of MINOCA was based on the following criteria:

1. Fulfillment of the Fourth Universal Definition of Myocardial Infarction (elevation/dynamics of troponins associated with compatible clinical, ECG, or imaging signs);
2. Absence of obstructive coronary lesions, defined as stenosis < 50% in all coronary arteries on angiography;
3. Absence of an obvious alternative cause explaining the clinical presentation at the time of initial diagnosis.

In routine clinical practice, alternative causes of troponin elevation were excluded based on a combination of clinical assessment, laboratory investigations, and imaging when available.

Myocarditis and Takotsubo syndrome were suspected based on clinical presentation, electrocardiographic findings, and echocardiographic patterns. Cardiac magnetic resonance imaging was performed when accessible.

Pulmonary embolism was excluded based on clinical probability assessment and, when indicated, CT pulmonary angiography.

Sepsis was ruled out based on clinical signs of infection and biological markers.

Renal failure was assessed using serum creatinine and estimated glomerular filtration rate.

Only patients without an identifiable alternative diagnosis at the time of initial evaluation were classified as MINOCA.

However, the absence of systematic advanced imaging may have led to potential misclassification of some MINOCA cases.

- Obstructive Infarction Group: The comparator group consisted of patients with obstructive myocardial infarction (STEMI or NSTEMI) with at least one significant coronary lesion $\geq 50\%$, assessed by QCA, whether or not they underwent percutaneous coronary intervention (PCI).

2.7. Non-Inclusion/Exclusion Criteria

Excluded were:

- Patients with an obvious non-ischemic cause for troponin elevation (myocarditis, pulmonary embolism, severe sepsis, end-stage renal failure) when clearly identified;
- Patients with incomplete clinical or angiographic data.

2.8. Variables Studied

The variables analyzed included:

- Sociodemographic data: age, sex, insurance coverage;
- Cardiovascular risk factors: hypertension, diabetes, dyslipidemia, smoking;
- Cardiovascular history and comorbidities;
- Clinical and ECG data at admission;
- Biological parameters, specifically troponins;
- Echocardiographic data, including left ventricular ejection fraction (LVEF);
- Angiographic data (type of lesions, coronary dominance, access site);

- Treatments prior to admission and during hospitalization.

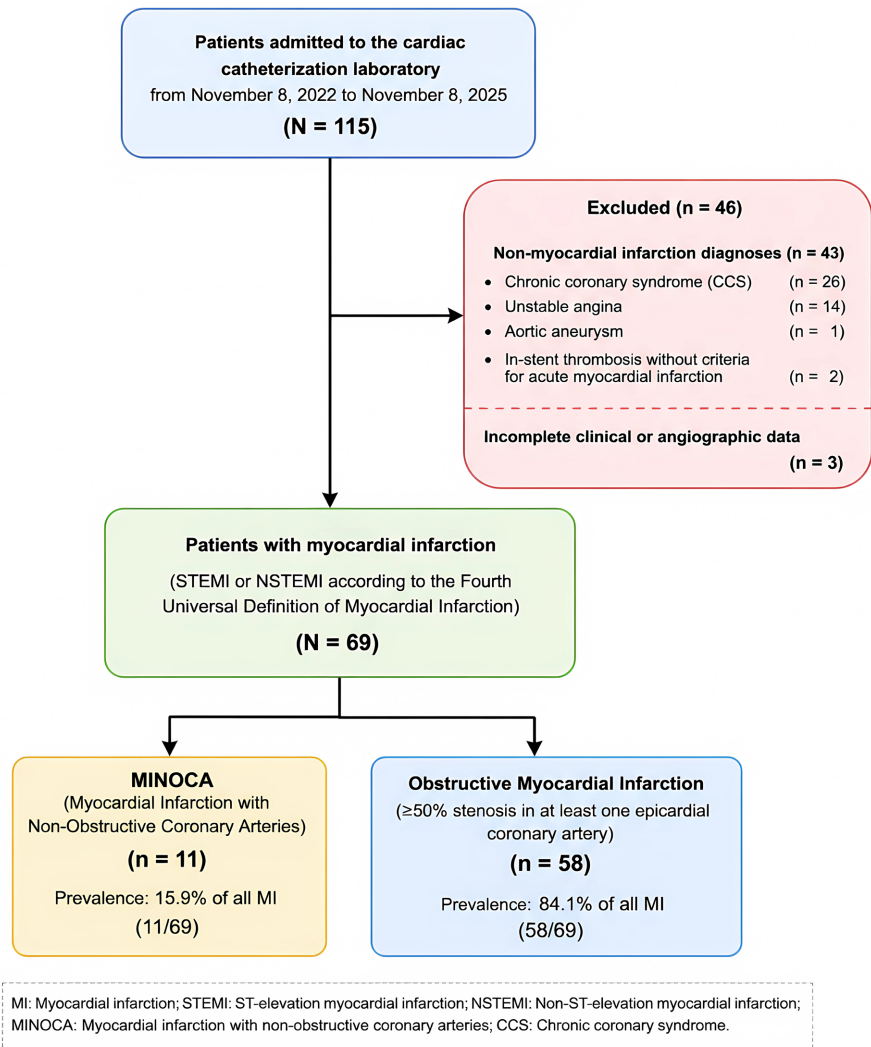


Figure 1. Flowchart of patient selection.

2.9. Definitions of Key Variables

Optimal Medical Therapy (OMT) was defined as the use of at least three of the following drug classes: antiplatelet agents, statins, beta-blockers, and angiotensin-converting enzyme inhibitors or angiotensin receptor blockers.

Prior coronary history was defined as a documented history of myocardial infarction, percutaneous coronary intervention, or coronary artery bypass grafting.

Ischemic heart disease was defined as a prior diagnosis of coronary artery disease based on clinical, electrocardiographic, or imaging findings.

Impaired left ventricular ejection fraction (LVEF) was defined as LVEF < 50% on transthoracic echocardiography.

Troponin levels were measured using high-sensitivity troponin I and myocardial infarction was defined as a value above the 99th percentile upper reference limit with a rise and/or fall pattern.

2.10. Statistical Analysis

Data were analyzed using SPSS® version 26.0 software. Quantitative variables were expressed as mean \pm standard deviation or median [IQR] depending on their distribution. Qualitative variables were presented as counts and percentages.

Comparisons between the MINOCA and obstructive infarction groups were performed using:

- Student's t-test or Mann-Whitney test for quantitative variables;
- Chi-square test or Fisher's exact test for qualitative variables.

Results were expressed as odds ratios (OR) with 95% confidence intervals. A p-value < 0.05 was considered statistically significant.

Given the small sample size of the MINOCA group, all analyses were considered exploratory and no multivariable adjustment was performed.

2.11. Ethical Considerations

All patients provided free and informed written consent prior to the procedures. The study received approval from the Ethics and Pharmacovigilance Committee of the Yaoundé General Hospital. Data were collected and analyzed in strict compliance with patient confidentiality and anonymity, in accordance with the principles of the Declaration of Helsinki.

3. Results

During the study period, 115 patients were admitted to the catheterization laboratory. After applying inclusion and exclusion criteria, 69 patients with myocardial infarction were retained for analysis, including 11 cases of MINOCA and 58 cases of obstructive myocardial infarction (**Figure 1**).

The mean age of the study population was 56.97 ± 11.69 years, ranging from 27 to 82 years.

Sociodemographic Characteristics (**Table 1**)

Table 1. Sociodemographic characteristics of patients with MINOCA compared to obstructive myocardial infarction.

Variables	MINOCA (n = 11)	Obstructive MI (n = 58)	P-value	OR (95% CI)
Mean age \pm SD	47.55 \pm 13.67	58.76 \pm 10.49	0.003	Mean diff: -11.21 (-18.45; -3.98)
Age groups (years)				
≤ 40	3 (27.3)	3 (5.2)	0.047	6.87 (1.18 - 40.11)
[41 - 50]	4 (36.4)	7 (12.1)	0.066	4.16 (0.97 - 17.94)
[51 - 60]	2 (18.2)	24 (41.4)	0.188	0.32 (0.06 - 1.59)
[61 - 70]	1 (9.1)	18 (31)	0.268	0.22 (0.03 - 1.87)
> 70	1 (9.1)	6 (10.3)	1.00	0.87 (0.09 - 8.00)
Insurance coverage				
Yes	1 (9.1)	14 (24.1)	0.434	0.31 (0.04 - 2.68)
No	10 (90.1)	44 (75.9)		3.18 (0.37 - 27.09)

Patients with MINOCA were significantly younger than those with obstructive myocardial infarction (mean difference: -11.2 years; 95% CI [-18.4 to -4.0]; $p = 0.003$).

The age group ≤ 40 years was more frequent in the MINOCA group (27.3% vs. 5.2%; $p = 0.047$).

No significant difference was observed between the two groups regarding sex, with a male predominance in both populations (72.7% vs. 79.3%, $p = 0.694$).

The majority of patients lacked insurance coverage, with no significant difference between groups (90.9% vs. 75.9%, $p = 0.434$).

Medical History, Comorbidities, and Prior Treatments (Table 2)

Hypertension was less frequently observed in MINOCA patients compared to those with obstructive infarction (36.4% vs. 75.9%; $p = 0.027$). No statistically significant differences were found regarding diabetes, dyslipidemia, smoking, or heart failure.

Table 2. Medical history, comorbidities, cardiovascular risk factors, and prior treatments in MINOCA patients compared to obstructive myocardial infarction patients.

Variables	MINOCA (n = 11)	Obstructive MI (n = 58)	P-value	OR (95% CI)
Medical History				
Prior coronary history	0 (0.0)	1 (1.7)	1.000	-
Hypertension	4 (36.4)	44 (75.9)	0.027	0.18 (0.05 - 0.71)
Diabetes mellitus	2 (18.2)	16 (27.6)	0.715	0.58 (0.11 - 2.99)
Dyslipidemia	3 (27.3)	31 (53.4)	0.111	0.33 (0.08 - 1.36)
Smoking	1 (9.1)	7 (12.1)	1.000	0.73 (0.08 - 6.59)
Heart failure	1 (9.1)	14 (24.1)	0.434	0.31 (0.04 - 2.68)
Heart Disease Phenotypes				
Hypertensive heart disease	4 (36.4)	29 (50.0)	0.406	0.57 (0.15 - 2.16)
Ischemic heart disease	1 (9.1)	26 (44.8)	0.041*	0.12 (0.02 - 1.03)
Mixed heart disease	1 (9.1)	10 (17.2)	0.679	0.48 (0.06 - 4.18)
Comorbidities				
HIV infection	0 (0.0)	4 (6.9)	1.000	-
Elevated Lp (a) (≥ 50 mg/dl)	3 (27.3)	30 (51.7)	0.137	0.35 (0.08 - 1.45)
Impaired LVEF ($< 50\%$)	2 (18.2)	31 (53.4)	0.032	0.19 (0.04 - 0.98)
Medication Prior to Admission				
DAPT	10 (90.9)	55 (94.8)	0.509	0.55 (0.05 - 5.79)
OMT	4 (36.4)	43 (72.4)	0.034	0.22 (0.06 - 0.85)
Comorbidities				

DAPT: Dual Antiplatelet Therapy; OMT: Optimal Medical Therapy; Lp (a): Lipoprotein (a); LVEF: Left Ventricular Ejection Fraction; OR: Odds Ratio; CI: Confidence Interval. *result from Fischer Exact test.

Ischemic heart disease was less frequent in the MINOCA patients (9.1% vs. 44.8%), but no significance could be concluded due to the confidence interval including 1 (0.12 (0.02 - 1.03)), despite a borderline P value ($p = 0.041$, Fischer Exact test). The prevalence of impaired left ventricular ejection fraction (<50%) was significantly lower in the MINOCA group (18.2% vs. 53.4%; $p = 0.032$).

Regarding treatment prior to admission, optimal medical therapy was less frequently observed in MINOCA patients (36.4% vs. 72.4%; $p = 0.034$), while the use of dual antiplatelet therapy was comparable between the two groups.

Clinical, Angiographic, and Procedural Data (Table 3)

The majority of MINOCA patients presented with STEMI (72.7%), a proportion comparable to that observed in patients with obstructive infarction (74.1%), with no significant difference ($p = 1.00$). No significant differences were observed between the two groups regarding management delays, coronary dominance, or the coronary angiography access site (radial vs. femoral).

Table 3. Clinical, angiographic, and procedural characteristics of MINOCA patients compared to obstructive myocardial infarction patients.

Variables	MINOCA (n = 11)	Obstructive MI (n = 58)	P-value	OR (95% CI)
Time to Coronary Angiography				
< 24 hours	1 (9.1)	6 (10.3)	1.000	0.87 (0.09 - 8.00)
[1 - 30] days	8 (72.7)	42 (72.4)	1.000	1.02 (0.24 - 4.32)
[1 - 3] months	1 (9.1)	3 (5.2)	0.509	1.83 (0.17 - 19.44)
> 3 months	1 (9.1)	7 (12.1)	1.000	0.73 (0.08 - 6.59)
Clinical Presentation				
STEMI	8 (72.7)	43 (74.1)	1.000	0.93 (0.22 - 3.97)
NSTEMI	3 (27.3)	15 (25.9)	1.000	1.08 (0.25 - 4.59)
Coronary Dominance				
Right	8 (72.7)	36 (62.1)	0.734	1.63 (0.39 - 6.80)
Left	0 (0.0)	10 (17.2)	0.345	-
Balanced	2 (18.2)	12 (20.7)	1.000	0.85 (0.16 - 4.47)
Vascular Access Site				
Femoral	5 (45.5)	23 (39.7)	0.748	1.27 (0.35 - 4.65)
Radial	6 (54.5)	35 (60.3)	0.748	0.78 (0.22 - 2.89)

STEMI: ST-Segment Elevation Myocardial Infarction; NSTEMI: Non-ST-Segment Elevation Myocardial Infarction; OR: Odds Ratio; CI: Confidence Interval.

4. Discussion

In this single-center study of 115 patients admitted to the coronary angiography

unit in Yaoundé, 58 patients (84,1%) presented with obstructive myocardial infarction and 11 patients (15.9% of MIs) met the definition of MINOCA. This prevalence is close to that reported in major contemporary series, where MINOCA accounts for approximately 5% to 15% of myocardial infarctions diagnosed by angiography [7] [8].

4.1. Demographic Characteristics and Risk Factor Profile

Patients with MINOCA were significantly younger than those with obstructive infarction, a recurring finding in the literature. Several international registries describe a tendency for MINOCA patients to be younger and to have a lower burden of classical cardiovascular risk factors [9]. In our series, hypertension and a history of ischemic heart disease were significantly less frequent in the MINOCA group. This observation is consistent with trends reported in previous studies, although our findings should be interpreted cautiously given the small sample size. [8].

Regarding sex, although some studies report a female predominance in MINOCA cohorts [10], our series showed no significant difference between genders, which may be related to the small size of the MINOCA subgroup.

4.2. Clinical Presentation and Functional Parameters

In our series, the clinical presentation (STEMI vs. NSTEMI) was similar between the two groups. Although STEMI was the predominant presentation among MINOCA patients, the small sample size did not allow for a meaningful subgroup analysis between STEMI-MINOCA and NSTEMI-MINOCA. However, MINOCA patients significantly more often had a preserved left ventricular ejection fraction (LVEF) compared to those with obstructive infarction, a result also found in other international cohorts [10].

4.3. Treatment and Management

MINOCA patients were less likely to have received optimal medical treatment before admission. This observation is noted in other studies, where secondary medical management is often less intensive in MINOCA patients than in those with coronary angioplasty or established obstructive coronary artery disease, despite emerging recommendations encouraging tailored medical therapy [7] [11].

4.4. Prognostic Implications

Historically, MINOCA was perceived as an entity with a more favorable prognosis than infarction with coronary obstruction, but recent studies challenge this notion. After adjusting for comorbidities, some registries show that patients with MINOCA still experience noteworthy rates of major adverse cardiovascular events at 12 months, although often lower than those in patients with obstructive disease [12]. Furthermore, recent data even suggest a comparable or worse prognosis in certain subpopulations, highlighting the heterogeneity of underlying mechanisms and the need for accurate etiological diagnosis [13].

4.5. Underlying Pathophysiology

The diversity of etiological mechanisms likely explains the clinical and prognostic differences observed. Described mechanisms include coronary microvascular dysfunction, coronary spasm, non-significant plaque rupture or erosion, spontaneous coronary artery dissection, and coronary embolism [14]. This heterogeneity underscores the need for deeper investigation, including the use of advanced techniques such as intracoronary imaging or cardiac MRI, to identify underlying causes in MINOCA patients [11].

4.6. Study Strengths and Limitations

The strengths of this study lie in the systematic description of the clinical and demographic characteristics of MINOCA patients in an African center, a context underrepresented in current literature. However, this study has several limitations, notably its retrospective analytical design despite prospectively collected data and the lack of advanced imaging techniques to clarify underlying mechanisms, which remains a common limitation in many published series. The absence of systematic cardiac MRI or intracoronary imaging may have resulted in misclassification of some cases labeled as MINOCA. The small number of MINOCA cases ($n = 11$) limits the statistical power of the study, and the observed associations should be interpreted as exploratory and hypothesis-generating rather than confirmatory.

5. Conclusions

In this first comparative analysis in Cameroon, our findings reveal that MINOCA in Yaoundé, Cameroon, represents nearly 1 in 6 MI cases and appears to affect younger patients in our series. It is characterized by a distinct clinical signature: it predominantly affects a younger, non-hypertensive population and frequently presents as STEMI. The fact that 72.7% of MINOCA cases presented with ST-elevation—a rate nearly identical to obstructive MI—suggests that in our resource-limited setting, ECG presentation alone cannot reliably predict the presence of obstructive disease.

Furthermore, the significantly lower prevalence of “Optimal Medical Therapy” (OMT) prior to admission in the MINOCA group (36.4%) compared to obstructive MI (72.4%) may suggest a difference in early cardiovascular management, although this finding requires confirmation in larger studies. These results advocate for a high index of suspicion for MINOCA in young patients and emphasize the urgent need for cardiac MRI availability in the region to further elucidate the diverse etiologies of this phenotype. However, given the limited sample size, these findings should be interpreted with caution and warrant confirmation in larger prospective studies.

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AI Disclosure

Gemini AI was used for sound translation and reference verification.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. All authors have participated in the research and/or article preparation and have approved the final manuscript for submission.

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