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Research Article

In-Hospital Mortality of Acute Coronary Syndromes Undergoing Coronary Angiography: A Multicenter Study in Dakar, Senegal

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Abstract

Acute Coronary Syndrome (ACS) significantly contributes to cardiovascular mortality worldwide, with an increasing prevalence in Africa due to rising cardiovascular risk factors. Despite advances in reperfusion therapies like percutaneous coronary intervention (PCI), many African countries, including Senegal, face substantial barriers to optimal care. This study aimed to assess in-hospital mortality among ACS patients undergoing coronary angiography in Dakar, Senegal, and to describe clinical features associated with mortality. We conducted a retrospective, multicenter, cross-sectional study involving patients hospitalized with ACS who underwent coronary angiography between January 2020 and June 2023 in three tertiary cardiology centers in Dakar. Demographic data, clinical presentation, cardiovascular risk factors, angiographic findings, and therapeutic interventions were collected. Statistical analysis included descriptive statistics and bivariate comparisons, with significance defined at $p<0.05$. Out of 2573 ACS patients undergoing coronary angiography, 30 died, resulting in an in-hospital mortality rate of 1.16%. The mean age was 61.2 ± 10.8 years, predominantly male (76.7%). Hypertension (53.3%) and sedentary lifestyle (83.3%) were common risk factors. Most patients presented with atypical chest pain (76.7%) and delayed hospital admission beyond 12 hours (43.3%). STEMI accounted for 70% of cases, with the left anterior descending artery frequently involved (80%). PCI using drug-eluting stents was performed in 56.7% of deceased patients. Cardiogenic shock was the leading complication (46.7%). In-hospital mortality following coronary angiography for ACS in urban Senegal is relatively low but delayed presentations and atypical symptoms remain significant barriers. Enhanced public awareness, reduced delays to intervention, and overcoming socioeconomic obstacles are essential to improve outcomes.

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Keywords

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1. Introduction

Acute Coronary Syndrome (ACS) represents the major manifestation and contributing factor to mortality in coronary artery disease (CAD). ACS is a growing health concern across Africa, with recent estimates reporting a prevalence ranging from 0.21% to 22% [1]. There is a steady increase in CAD prevalence in Africa as a result of an increase in cardiovascular risk factors such as hypertension, obesity, diabetes, dyslipidemia, and cigarette smoking. [2] Africa also faces challenges in diagnosis and management of CAD.

Although ACS-related mortality has gradually declined over the last decades in developed countries, the trend is completely different for developing countries. [3] Minimizing time delays in diagnosis and reperfusion (preferably by percutaneous coronary intervention, PCI) for patients with ST-elevation myocardial infarction (STEMI) is recommended to reduce mortality. [4-9] Despite these recommendations, up to 42% of patients with AMI in Africa do not receive any form of reperfusion. [10, 11] In many African countries, such as Senegal, there is a lack of coordination and integration among different levels of healthcare services, resulting in suboptimal care and a poor prognosis. In addition, there are few comprehensive epidemiological data on acute coronary syndromes in Senegal.

Given the recent development of Cath labs and percutaneous coronary intervention in Senegal, we aim to assess the in-hospital mortality rate in acute coronary syndrome (ACS) and describe the characteristics of deceased patients undergoing coronary angiography.

2. Methods

A retrospective cross-sectional study was conducted from January 1, 2020, to June 30, 2023, across three cardiology departments: General Idrissa Pouye Hospital (HOGIP), Dakar Principal Hospital (HPD), and the National University Hospital Center of FANN (CHNUF). The study included all deceased patients hospitalized for Acute Coronary Syndrome (ACS) and who underwent coronary angiography during this period. Patients with incomplete medical records and missing essential demographic, clinical, or angiographic data were excluded.

The data collected included:

1. *Socio-demographic status:* Age (recorded in years), sex, residence area (urban, suburban, or rural), professional status, educational level (primary, secondary, tertiary education, or none), and socioeconomic status (classified as low, medium, or high based on occupation, monthly income, and health coverage).
2. *Clinical parameters:* Chest pain characteristics (typical angina, atypical chest pain, or non-specific discomfort), time between symptom onset and hospital admission categorized as follow: ≤12 hours or >12 hours, Killip classification at admission (ranging from class I to IV), vital parameters, including heart rate (beats per minute) and blood pressure (mmHg), at admission.
3. *Risk Factor and Medical History Variables:* Self-reported tobacco use, hypertension, diabetes mellitus (fasting blood glucose ≥ 126 mg/dL or ongoing treatment), dyslipidemia, obesity (BMI ≥30 kg/m²), sedentary lifestyle, and family history of premature cardiovascular disease, prior ACS events, stroke, transient ischemic attack, and history of chronic kidney disease
4. *Electrocardiographic findings:* Documentation included the presence or absence of persistent ST-segment elevation (≥2 mm in men and ≥1.5 mm in women in at least two contiguous leads), the occurrence of pathological Q waves, ST depression, T-wave inversion, rhythm disturbances (atrial fibrillation, ventricular tachycardia, fibrillation), and conduction abnormalities.
5. *Biological Variables:* Included troponin levels (elevated or normal with quantification in ng/mL), creatine phosphokinase-MB (CPK-MB, IU/L), serum creatinine (mg/dL), lipid profile (LDL-C, HDL-C, triglycerides levels), inflammatory markers (CRP levels), renal function (glomerular filtration rate estimated by MDRD formula), and hemoglobin level
6. *Echocardiographic parameters* included left ventricular ejection fraction (LVEF) assessed by Simpson's biplane method, regional wall motion abnormalities (hypokinesia, akinesia, dyskinesia), valvular pathology, and the presence of pericardial effusion.
7. *Coronary angiography data* included arterial access (radial or femoral approach), identification of affected coronary arteries (left anterior descending artery, circumflex artery, right coronary artery), number and severity of lesions (classified as significant stenosis ≥50%), type of coronary lesions (single-vessel, two-vessel, or multi-vessel disease), and presence of thrombus or calcifications. Details regarding percutaneous coronary intervention (PCI) were specified, including types of stents used (drug-eluting, bare-metal stents), procedural

success, and occurrence of peri-procedural complications.

8. *Medications:* Documented medical therapy included thrombolytics, dual antiplatelet therapy (aspirin, clopidogrel, ticagrelor), anticoagulants (unfractionated heparin, low molecular weight heparin), anti-ischemic medications (beta-blockers, nitrates, calcium channel blockers, inhibitors of the renin-angiotensin-aldosterone system), statins, analgesics (morphine), proton pump inhibitors, and oxygen therapy.

Statistical analysis was performed using SPSS software. Quantitative data were presented as means with standard deviations (mean ± SD), while qualitative variables were presented as frequencies and percentages. For analytical analysis, comparisons between groups used the Student's t-test or Mann-Whitney U test for continuous variables depending on data distribution. Qualitative variables were analyzed with the Chi-square test or Fisher's exact test as appropriate. Statistical significance was set at a p-value <0.05.

3. Results

The study included 30 patients hospitalized for Acute Coronary Syndrome (ACS) who underwent coronary angiography and died across three cardiology departments. During this period, 2573 patients admitted for ACS underwent coronary angiography, resulting in an in-hospital mortality rate of 1.16% following coronary angiography. The mean age of the participants was 61.2 ± 10.8 years, and the majority were males (76.7%). A sedentary lifestyle (83.3%) and hypertension (53.3%) were the most prevalent cardiovascular risk factors. Most patients presented with atypical chest pain (76.7%) and were admitted more than 12 hours after symptom onset in 43.3% of cases. ST-elevation myocardial infarction (STEMI) was diagnosed in 70% of cases. Table 1 summarizes the characteristics of the patients.

Table 1. *Characteristics of the Studied Population (N=30).*

Characteristic	Percentage (%) or Mean ± SD
Sociodemographic Variables	
Age (years)	61.4 ± 12.3
Male Gender	76.7%
Sedentary Lifestyle	83.3%
Cardiovascular Risk Factors	
Hypertension	53.3%
Diabetes mellitus	46.7%
Dyslipidemia	20%
Active smoking	23.3%
Obesity	3.3%
Clinical Presentation	
Typical chest pain	23.3%
Atypical chest pain	76.7%
Killip classification ≥ II	46.7%
Admission delay (>12 hours)	43.3%
Coronary Angiography Findings	
Radial approach	76.7%
Femoral approach	23.3%
Left Anterior Descending artery lesions	80%
Right coronary artery lesions	53.3%
Multivessel coronary disease	60%
Interventional Procedures	
Angioplasty performed	56.7%
Drug-eluting stent used	100%
Thrombolysis attempted	30%
Medications	
Aspirin	86.7%
Clopidogrel	86.7%
Statins	86.7%
Beta-blockers	66.7%
ACE inhibitors/ARBs	63.3%
Low molecular weight heparin	83.3%
Outcomes	
In-hospital mortality	1.16%
Length of hospital stay (days)	6.2 ± 4.7 days

The left anterior descending artery was the culprit artery in 80% of cases. Angioplasty was performed in 56.7% of patients with drug-eluting stents in all patients (100%). Cardiogenic shock was the most frequent complication (46.7%), as shown in Figure 1.

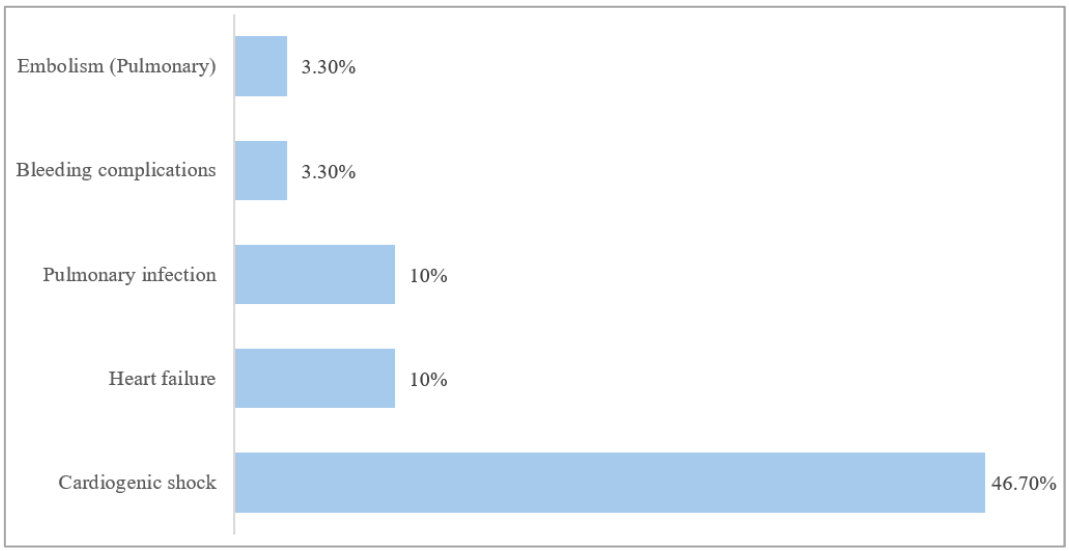

Figure 1. *Distribution of complications among deceased patients.*

Patients who had percutaneous intervention (PCI) were younger (59.2 ± 10.1 versus 63.8 ± 14.2, p-value 0.331), mostly admitted less than 12 hours after symptoms onset (76.9% versus 23.1%, p-value 0.072), and all had anterior localization of their STEMI, p-value 0.010 (Table 2).

Table 2. *Comparison of patients according to their revascularization status.*

Variables	Angioplasty (n=17)	No Angioplasty (n=13)	p-value
Age (years) Mean ± SD	59.2 ± 10.1	63.8 ± 14.2	0.331
Male gender n (%)	13 (76.5%)	10 (76.9%)	0.978
Cardiovascular risk factors			
Hypertension n (%)	7 (50.0%)	7 (50.0%)	0.491
Diabetes mellitus n (%)	10 (71.4%)	4 (28.6%)	0.127
Smoking n (%)	4 (57.1%)	3 (42.9%)	0.660
Chest pain type			
Typical n (%)	4 (57.1%)	3 (42.9%)	0.631
Atypical n (%)	13 (59.1%)	9 (40.9%)	0.631
Admission delay			
≤12 hours n (%)	10 (76.9%)	3 (23.1%)	0.072
>12 hours n (%)	6 (42.9%)	8 (57.1%)	0.072
ACS Type			
STEMI n (%)	13 (61.9%)	8 (38.1%)	0.204
NSTEMI n (%)	4 (30.8%)	5 (69.2%)	0.310
ECG territory			
Inferior STEMI n (%)	2 (22.2%)	7 (77.8%)	0.018
Anterior STEMI n (%)	7 (100%)	0 (0%)	0.010
ECG territory			
Left anterior descending artery n (%)	15 (62.5%)	9 (37.5%)	0.204

Variables	Angioplasty (n=17)	No Angioplasty (n=13)	p-value
Right coronary artery n (%)	7 (43.8%)	9 (56.2%)	0.127
Triple-vessel disease n (%)	7 (43.8%)	9 (56.2%)	0.127
Complications during hospitalization			
Cardiogenic shock n (%)	7 (50.0%)	7 (50.0%)	0.491
Heart failure n (%)	1 (33.3%)	2 (66.7%)	0.402
Laboratory parameters			
Hemoglobin ≤10 g/dL n (%)	4 (57.1%)	3 (42.9%)	0.546
Glomerular filtration rate <60 ml/min n (%)	6 (60.0%)	4 (40.0%)	0.402

SD= standard deviation; NSTEMI= Non-ST-segment Elevation Myocardial Infarction; STEMI= ST-segment Elevation Myocardial Infarction.

4. Discussion

4.1. Key Findings

The present study revealed a relatively low in-hospital mortality rate (1.16 %) among patients hospitalized for acute coronary syndromes (ACS) undergoing coronarography. This is lower than reports from other parts of Africa, ranging from 6.1% - 25.4%. [12-15] and tend to be quite similar to those observed in Western Europe (1.8% - 3.9%) [16] and North America (1.8% - 5.5%). These lower rates may be attributed to timely access to advanced therapies, such as percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG), as well as the use of evidence-based medications. In a recent systematic review, Adem et al. revealed an all-cause in-hospital mortality rate associated with ACS in Africa to be as high as 22%. [17] Additionally, the death rate was slightly lower in patients treated in cardiac centers (14%) than in patients treated in referral hospitals (24%). [17] Several studies have identified predictors of mortality in ACS patients in Sub-Saharan Africa, such as advanced age, high Killip class (≥2) at admission, impaired renal function, sustained ventricular tachycardia and heart failure, and left ventricular dysfunction. These factors highlight the need for early intervention and improved access to guideline-directed therapies in SSA. [13, 18-20]

Financial constraints and out-of-the-pocket payments remain significant barriers to timely access to coronary angiography and PCI in our region. In the current study, angioplasty was successfully performed in only 56.7% of deceased patients, all of whom received drug-eluting stents. Similarly, data from the Registry for Acute Coronary Events in Nigeria (RACE-Nigeria) showed that coronary angiography was performed in only 42.4% of cases, with an overall reperfusion rate (including thrombolysis, PCI, and CABG) of 42.8%. [21] Reperfusion was notably higher among upper-class patients compared to those from middle- or lower-socioeconomic groups (65.9% versus 45.6%, P < 0.0001). [21] These findings underscore the persistent disparity in access to PCI, primarily driven by high procedural costs and socioeconomic inequalities in our country.

The high rate of atypical chest pain (76.7%) in our study may have contributed to late admission (43.3%) of cases and poor prognosis. Comparing patients presenting with typical and atypical chest pain and dyspnea, El Menyar et al. found that patients with atypical chest pain were less likely to receive thrombolytic therapy and had a delayed door-to-needle time (99 vs 55 min; p < 0.001) and worse in-hospital outcomes (higher rates of heart failure, cardiogenic shock, stroke, and mortality). [22] In fact, atypical chest pain was associated with a 2-fold risk of in-hospital mortality (95% CI 1.29—2.75) after adjustment for confounders. [22] Thus, increasing awareness and improving recognition of atypical ACS presentations among both healthcare providers and patients is crucial to reduce diagnostic delays and enhance clinical outcomes.

4.2. Study Limitations

This study has several limitations that should be acknowledged. Firstly, due to its retrospective and observational design, there may be missing or incomplete clinical data, which could lead to information bias and limit the accuracy of the recorded variables. To mitigate the impact of missing data, we carefully reviewed patient records and excluded only those cases with critically incomplete essential data. Nonetheless, the potential influence of selection bias cannot be entirely ruled out. The small sample size also reduces statistical power and the ability to generalize findings broadly across the population. Moreover, since this study was conducted exclusively in urban tertiary centers, it did not capture data from rural regions, which may limit the generalizability of our findings to populations with limited access to specialized cardiac care. Additionally, detailed information on patient adherence to prescribed treatments, socioeconomic status, and precise data on the timing between symptom onset and intervention were not consistently available, which limited a thorough assess-

ment of factors influencing patient outcomes.

4.3. Implications

Despite these limitations, the findings of this study provide critical insights relevant to clinical practice and healthcare policy in our region. The relatively low in-hospital mortality rate observed highlights the potential benefits associated with timely access to advanced coronary interventions and guideline-directed therapies. However, significant financial and socioeconomic barriers persist, preventing equitable access to these essential interventions. To improve patient outcomes, addressing the financial constraints related to coronary angiography and PCI should be prioritized by healthcare policymakers. Additionally, our findings emphasize the importance of improving public and healthcare provider awareness about atypical presentations of acute coronary syndromes, potentially facilitating earlier diagnosis and intervention.

This study was conducted exclusively in urban tertiary centers, and thus did not include patients from rural settings, who often have limited access to specialized cardiac services. Consequently, our results may not be fully representative of the broader patient population in Senegal or other Sub-Saharan African countries. Future research should prioritize prospective, multicenter studies with larger sample sizes that deliberately include patients from both urban and rural environments. Such studies would offer more comprehensive data, enhance generalizability, and reduce potential biases associated with selective patient recruitment. A prospective design would also allow systematic tracking of clinical outcomes and adherence to therapeutic guidelines, providing stronger evidence to guide clinical practices and healthcare policy decisions.

5. Conclusion

Our study highlights a relatively low in-hospital mortality rate among patients undergoing coronary angiography for acute coronary syndromes, comparable to rates observed in high-income regions, suggesting the potential impact of timely coronary interventions and evidence-based therapies. However, significant socioeconomic and financial barriers persist, limiting equitable access to optimal care and negatively impacting clinical outcomes. The high prevalence of atypical chest pain leading to delayed diagnosis underscores the urgent need for increased awareness and better recognition of atypical presentations among both healthcare providers and the community. Addressing these challenges through targeted policy interventions, improved healthcare infrastructure, and public education initiatives is critical to further reduce mortality and improve patient outcomes in our region.

Abbreviations

ACE	Angiotensin Conversion Enzyme
ACS	Acute Coronary Syndrome
AMI	Acute Myocardial Infarction
ARBs	Angiotensin Receptor Blockers
BMI	Body Mass Index
CABG	Coronary Artery Bypass Grafting
CAD	Coronary Artery Disease
CK-MB	Creatin Kinase-MB
CRP	C-reactive Protein
ECG	Electrocardiogramm
HDL-C	High Density Lipoprotein-C
IU	International Unit
IV	Intravenous
LDL-C	Low Density Lipoprotein-C
LVEF	Left Ventricular Ejection Fraction
MDRD	Modification of Diet in Renal Disease
NSTEMI	Non-ST Elevation Myocardial Infarction
PCI	Percutaneous Coronary Intervention
RACE-Nigeria	Registry for Acute Coronary Events in Nigeria
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
SSA	Sub-Saharan Africa
STEMI	ST-elevation Myocardial Infarction

Authors Contributions

Ngone D. Gaye: Visualization, Writing - original draft
Aliou A. Ngaide: Conceptualization, Supervision, Validation, Writing - review & editing
Pierre-Adley Ngoulla: Data curation, Investigation
Joseph Mingou: Writing - review & editing
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Maboury Diaw: Writing - review & editing
Abdoul Kane: Writing - review & editing

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Conflicts of Interest

The authors declare no conflicts of interest.

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