

Epidemiological Aspect of ST-Segment Elevation Myocardial Infarction (STEMI) in Saint-Louis of Senegal

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How to cite this paper: Diop, K.R., Mingou, J.S., Beye, S.M., Niasse, A., Diouf, Y., Ndiaye, P.G., Diop, C.M.B., Samb, C.A.B., Aw, F., Sarr, S.A., Bodian, M., Ndiaye, M.B., Kane, A., Diao, M. and Kane, A. (2022) Epidemiological Aspect of ST-Segment Elevation Myocardial Infarction (STEMI) in Saint-Louis of Senegal. *World Journal of Cardiovascular Diseases*, 12, 544-555.

<https://doi.org/10.4236/wjcd.2022.1212055>

Received: August 4, 2022

Accepted: December 25, 2022

Published: December 28, 2022

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Abstract

Background: Cardiovascular Disease (CVD) has become the largest and most common cause of Non-Communicable Diseases (NCD) related deaths worldwide, accounting for more than 50%. In Senegal, a few studies done on the topic showed a low prevalence of acute coronary syndrome in hospital settings. In the city of Saint-Louis in Northern Senegal, there is little epidemiological data on Acute Coronary Syndrome (ACS) and no study specifically concerned with ST-segment Elevation Myocardial Infarction (STEMI) has been carried out to date. With this in mind, we conducted a study that focused on the analysis of STEMI patients hospitalized in the Cardiology Department of the Regional Hospital of Saint-Louis. The aim of our study was to collect and analyze the epidemiological aspect of STEMI. **Results:** There were 39 cases of STEMI, (*i.e.* 82.29% of ACS), giving a hospital prevalence of 8.21%. There was a slight male predominance with a male to female ratio of 1.05. The average age of our patients was 62.93 years ranging from 38 to 90 years. The average time between the onset of pain and arrival at the hospital was 50 hours, ranging from 1 hour to 720 hours. Patients received within the first 12 hours made up 66% ($n = 26$) of our population, among them, 80.76% ($n = 21$) (*i.e.* 53.84% of STEMI) were able to benefit from thrombolysis. All thrombolysis was performed with Streptokinase. The mean time to thrombolysis was 6 hours ranging from 1 hour and 45 minutes to 11 hours. Arterial hypertension was the most frequent cardiovascular risk factor in our population with a 43.6% prevalence, followed by diabetes (33.33%), then active smoking (23%). Chest pain

was the most frequent symptom, reported in 34 patients (87.17%). The lesions on the Electrocardiogram (EKG) were located in the anterior territory in 64% of the cases (n = 25), in the inferior territory in 28% of the cases (n = 11), in the circumferential territory in 5% of the cases (n = 2), and lateral territory in 5% of the cases (n = 2). Twenty-five patients had a transthoracic echocardiogram, the left ventricular ejection fraction was preserved in 36% of the patients, 40% had moderate ventricular dysfunction and 24% had severe dysfunction. Segmental kinetic disorders of the left ventricle were noted in 18 patients (72%), akinesia in 7 patients (28%) and dyskinesia in 4 patients (16%). The average length of hospitalization was 8.43 days. Seven deaths (17.9%) were recorded during the study. Coronary angiography was performed in six patients (15.38%), and was abnormal in five cases. **Conclusion:** ST-segment Elevation Myocardial Infarctions remain a major public health issue in Senegal due to their increasing prevalence and poor prognosis due to delayed diagnosis and management.

Keywords

Myocardial Infarction, STEMI, Saint-Louis, Senegal

1. Introduction

The global pattern and burden of disease have changed considerably over the last two decades, from mainly communicable, maternal and perinatal causes to Non-Communicable Diseases (NCD) [1]. Cardiovascular Disease (CVD) has become the largest and most common cause of NCD deaths worldwide, accounting for more than 50% [1]. The World Health Organization (WHO) estimates that 17.6 million people died from CVD worldwide in 2012, accounting for about 31.43% of global mortality, with Ischemic Heart Disease (IHD) responsible for about 7.4 million deaths, or 13.2% of the total. The global burden of CVD falls mainly on low- and middle-income countries, which account for over 80% of CVD deaths [1]. Trends in sub-Saharan Africa are steadily increasing, driven by lifestyle changes, increased prevalence of cardiovascular risk factors, improved access to care and an aging population [2] [3] [4]. These ischemic heart diseases are divided into Chronic Coronary Syndrome (CCS) and Acute Coronary Syndrome (ACS), depending on their progression. The current classification of ACS depends on Electrocardiogram (ECG) findings at admission. There are ACS without persistent ST elevation (NSTEMI: non-ST Elevation Myocardial Infarction) and ACS with persistent ST elevation (STEMI: ST Elevation Myocardial Infarction) representing the most dangerous form of the pathology and therefore requiring urgent reperfusion treatment [5]. STEMI is caused by complete coronary artery occlusion and accounts for approximately 30% of ACS [5]. STEMI is the acute presentation of Ischemic Heart Disease and the leading cause of morbidity and mortality worldwide and that is of utmost concern to emergency phy-

sicians, as it is one of the few time-sensitive medical emergencies where it is clearly shown that early treatment can improve outcomes [6]. Immediate reperfusion therapy of the Infarct-Related Artery (IRA) is the mainstay of treatment, either via Primary Percutaneous Coronary Intervention (PPCI) or thrombolytic therapy when PPCI is not feasible [7]. The direct positive relationship between the early primary PCI and survival rates of ST-segment Elevation Myocardial Infarction (STEMI) patients and has been well documented [8].

In Senegal, the few currently available studies found a low hospital prevalence of acute coronary syndromes (4.05%) [9]. In Saint-Louis of Senegal, there is little epidemiological data on ACS and no study focused on STEMI has been carried out to date. With this in mind, we conducted a study that focused on the analysis of ACS with persistent ST-segment elevation patients hospitalized in the Cardiology Department of the Regional Hospital of Saint-Louis from 1 January 2018 to 31 December 2019.

The aim of this study was to collect and analyze the epidemiological, clinical, paraclinical, therapeutic and evolutionary data of ACS with persistent ST-segment elevation in Saint Louis, Senegal.

2. Methods

The study was carried out in the cardiology department of the Saint-Louis Regional Hospital in Saint-Louis of Senegal located 250 miles from Dakar, the capital of the country. It was a retrospective, cross-sectional, observational, descriptive and analytical study conducted over a period of 24 months (from 1 January 2018 to 31 December 2019).

All patients, regardless of sex, age and nationality, received in the cardiology department during this timeframe for an acute coronary syndrome with persistent ST-segment Elevation Myocardial Infarction (STEMI) basis on anginal pain at rest with electrocardiographic changes suggestive of persistent ST-segment elevation were included.

Patients with stable angina and those with an anginal pain at rest without electrocardiographic changes suggestive of persistent ST-segment elevation were excluded from the study.

We studied data on sex, age, history of diabetes, hypertension, smoking, alcoholism, sedentarism (<30 min intensity physical activity on most days of the week), obesity, family history of coronary heart disease at a young age (before 55 years in men and 65 years in women), use of estrogen-progestin contraceptives, stable angina, and stress.

We studied the presence of chest pain, dyspnea, and gastrointestinal symptoms, the time between the onset of symptoms and hospitalization, the treatment administered (thrombolysis delay and molecule used), results of physical examination.

On the electrocardiograms, subepicardial lesions and their localizations along with rhythm and conduction abnormalities were recorded. On the transthoracic echocardiography, the focus was put on left ventricle wall motion, left ventricu-

lar ejection fraction using the Simpson biplanar method, and complications such as intracavitary thrombus, pericarditis...

Results of coronarography were also evaluated. Treatment modalities were evaluated, evolution during hospitalization and hospitalization's length.

The data was entered using EXCEL software version 2010. Data analysis was performed with SPSS version 23. The descriptive study was carried out with the calculation of frequencies and prevalences for the qualitative variables and the calculation of means for the quantitative variables.

3. Results

Over the course of the study, 475 patients were hospitalized in the cardiology department of the Saint-Louis regional hospital. There were 39 cases of STEMI (*i.e.* 82.29% of all hospitalized ACS patients), giving a hospital prevalence of 8.21%.

There was a slight male predominance with twenty men (51.28%) and nineteen women (48.7%). The male to female ratio was 1.05.

The average age of our patients was 62.93 (± 13.14) years between the ages of 38 and 90 years old. Patients aged over 60 were the most represented age group.

The average time between the onset of pain and arrival at the hospital was 50 hours, ranging from 1 hour to 720 hours.

Patients received within the first 12 hours represented 66% ($n = 26$) of the cases.

Among patients received within the time limit, 80.76% ($n = 21$) (*i.e.* 53.84% of STEMIs) were able to benefit from thrombolysis with a success rate of 52.38% ($n = 11$). All thrombolysis was performed with Streptokinase. The mean time to thrombolysis was 6 hours, with times ranging from 1.45 to 11 hours.

Hypertension was the most frequent cardiovascular risk factor with a prevalence of 43.6%, followed by diabetes (33.33%), then active smoking (23%).

In 7.7% ($n = 3$) of patients, no risk factor or cardiovascular Disease (CVD) history was found.

Chest pain was the most frequent symptom, reported in 34 patients (87.17%).

Dyspnea was present in five patients (12.8%) and epigastric pain in two (02) patients (5.12%).

The physical examination was normal in 23 patients (58.97%). In addition, left heart failure was noted in 8 patients (20.5%), cardiovascular collapse in four patients (11%), diabetic ketoacidosis and unilateral pulmonary condensation syndrome each in 5.12% ($n = 2$) of patients.

There were 66.68% ($n = 26$) of patients in Killip I, 15.38% in Killip II, 5.12% in Killip III and 12.82% in Killip IV.

Table 1 bellow summarizes the socio-demographic and clinical characteristics of the patients.

The lesions on the Electrocardiogram (EKG) were located in 64% of the cases ($n = 25$) in the anterior territory, in 28% of the cases ($n = 11$) in the inferior territory, in 5% of the cases ($n = 2$) in the circumferential territory, and lateral territory each one.

Table 1. Summary of socio-demographic and clinical characteristics of the patients (n = 39).

Characteristics	Number	Percentage (%)
Men	20	51
Women	19	49
Age \geq 60 years old	25	64
Age < 60 years old	14	36
Admission \leq 12 hours	26	66
Admission > 12 hours after	13	34
Hypertension	17	43
Diabetes	13	33
Active Smoking	9	23
Past history of CVD	1	3
Chest Pain	34	87
Dyspnea	5	13
Epigastric pain	2	5
Normal physical examination	23	56
Killip 1	26	66
Killip 2	6	15
Killip 3	2	5
Killip 4	5	13

Table 2 below shows the distribution of patients according to the territory affected on ECG.

Four patients (10.25%) had AV Block 1, and two (5%) had high degree AV Block and one (2.5%) had complete Left Bundle Branch Block.

Twenty-five patients had a transthoracic echocardiography, the left ventricular ejection fraction was preserved in 36% of the patients (n = 9). Ten patients (40%) had moderate ventricular dysfunction and severe dysfunction was found in seven patients (24%). Left ventricle abnormal wall motion such as hypokinesia was noted in 18 patients (72%), akinesia in 7 patients (28%) and dyskinesia in 4 patients (16%). Mitral insufficiency was found in 5 patients (20%) of which 4% (n = 1) were due to ischemia. One case of each, pericardial effusion, apical aneurysm and intracavitary thrombus was found.

Table 3 below shows the results of the Transthoracic Echocardiography (TTE).

The most frequent complication was left heart failure in 20.5%, followed by cardiovascular collapse in 12.82%. Conduction disorders such as atrioventricular block were noted in 10.25%, ischemic vascular stroke in 2.56% and recovered cardiorespiratory arrest in 2.56%.

Table 2. Distribution of STEMI patients by ECG territory (n = 39).

STEMI territories	Number	Percentage (%)
Anterior	25	64
Extended anterior	9	23
Anterior septal	6	15
Antero septo-apical	10	26
Inferior	11	28
Lateral	2	5
Circumferential	2	5
Total	39	100

Table 3. Distribution of patients according to transthoracic echocardiograph findings (n = 25).

Transthoracic echocardiography results	Number	Percentage (%)
Left Ventricular Ejection Fraction (LVEF)		
LVEF \geq 50%	9	36
50% > LVEF \geq 40%	10	40
LVEF < 35%	6	24
Kinetics		
Normal	2	8
Hypokinesia	18	72
Akinesia	7	28
Dyskinesia	4	16
Mitral Insufficiency	5	20
Complications		
Pericardial effusion	1	4
Apical aneurysm	1	4
Intracavitary thrombus	1	4

Table 4 below shows the distribution of complications in the studied population.

The mean length of hospitalization was 8.43 days, ranging from 2 to 16 days.

The evolution was marked by death in 7 patients (17.9%).

Thirty-two patients (82.05%) were discharged with treatment consisting of Double Antiplatelet Therapy (with Aspirin (100 mg) and Clopidogrel 75 mg) and Statin in all 32 (100%) cases, ACE inhibitors in 87.5% (n = 28) of cases and Beta-blockers in 65.6% (n = 21). All hospitalized patients had received Low Molecular Weight Heparin.

Table 4. Distribution of patients according to patient complications (n = 39).

Complications	Effectifs	Percentage (%)
Left heart failure	8	20.50
Cardiovascular collapse	5	12.82
Atrioventricular block	4	10.25
Ischaemic vascular stroke	1	2.56
Recovered cardiorespiratory arrest	1	2.56

Coronary angiography was performed in six patients (15.38%), and was abnormal in five cases. In four cases, we showed monotruncal damage, including two anterior ventricular descending artery lesions, one of the Circumflex and another of the right coronary. In one case, there was tritruncal involvement.

4. Discussion

The retrospective and monocentric nature of the study was our main limitation, which led to a small number of patients and a number of difficulties: incomplete record keeping and absence of certain data from the history, physical examination and paraclinical examinations.

We found a hospital prevalence of STEMI of 8.21%, representing 82.29% of ACS. The study conducted by Mboup *et al.* over a period of 12 months in Dakar found a prevalence of 3.63% of STEMI, *i.e.* 89.8% of ACS [9]. Another study conducted by N'Guetta *et al.* over a period of four years in Abidjan found a prevalence of 9.6% of STEMIs, *i.e.* 71.5% of ACS [10]. The CORONAFRIC I study found, during a prospective survey carried out 30 years ago in 13 African countries, 1.38% of STEMI representing 50.5% of ACS [11]. The CORONAFRIC II study carried out 6 years ago on a population three times larger than the first, found a prevalence of 24% of ischemic heart disease with 18.2% of ACS, including 52.2% of STEMI [12]. These results sufficiently demonstrate the disparity of STEMI data in our regions, which can be explained by the difference in study methods. Nevertheless, we can clearly see that the prevalence of STEMI is increasing, due to poor lifestyle habits, lifestyle's westernization, also to a lack of cardiovascular risk factors optimal management due to the lack of preventive medicine and to an improvement in diagnostic tools.

The male predominance found in our study reflects the reality of coronary heart disease in Africa and Europe. It could be explained by estrogens protective effect in women, which disappears after menopause.

The mean age of our patients was 62.93 years and the group aged more than or equal to 60 years was most important.

This does not reflect the data reported in African series where ACS occurs earlier with a mean age of onset not exceeding 60 years [9] [10] [13]. However, a recent study carried out in Tanzania found similar data with a mean age of 61.2 years [14].

As the elderly population of Saint-Louis represents only 6% according to data from the National Agency for Statistics and Demography [15], this high prevalence of STEMI in elderly population could be explained by the multitude of cardiovascular risk factors and comorbidities in this age group.

The mean time from onset of pain to hospital arrival was 50 hours and ranging from 1 to 720 hours. This delay may be due to a lack of awareness or resources, but also to a particular psycho-social environment. Indeed, in West Africa, some patients prefer to first consult a traditional healer, go directly to the pharmacy, or use self-medication, while others simply tend to neglect the pain for a long time before consulting. It should also be noted that many patients go through a secondary health center or private clinic before being referred to the hospital, which increases the admission delay. Nevertheless, patients received within the first 12 hours were more important, representing 66% (n = 26) of our population. This shows that awareness efforts are not in vain although still insufficient.

Hypertension was the most frequent cardiovascular risk factor with a 43.6% prevalence, followed by diabetes (33.33%) and active smoking (23%), then obesity 10.25%. This data is similar to a previous prevalence survey on cardiovascular risk factors in the general population carried out in Saint-Louis in 2010, where prevalences of 46% for hypertension, 23% for obesity, 10.4% for diabetes and 5.8% for smoking were found [16]; except that in our study diabetes and active smoking were more common than obesity. This could be explained by the fact that these cardiovascular risk factors are likely underestimated in the general population.

The subepicardial lesions on the electrocardiogram were located in 64% of cases in the anterior territory, in 28% of cases in the inferior territory and 5% of cases in the circumferential territory. These data are similar to those found in a study conducted in Dakar, with anterior involvement in 61%, inferior in 33.9% and circumferential in 3.4% [9]. A Tunisian study found a predominance of the anterior territory in 53% [17]. The predominance of lesions located in the anterior territory should be associated, in this series, with a predominance of subjects with a high level Killip stage (III - IV) because it is described in the literature that heart failure and its aggravation are frequent, especially in patients with lesions located in anterior territory [18].

The Left Ventricular Ejection Fraction (LVEF) was preserved in 36% of patients, and reduced in 64% of cases, 40% of which were moderate and 24% severe.

On Transthoracic echocardiography, left ventricle hypokinesia was found in 72%, akinesia in 28% and dyskinesia in 16%. Left ventricular systolic function, which is determined mainly by the final infarct size, has a major influence on the prognosis after acute myocardial infarction [19].

The mean time between the onset of pain and arrival at the hospital was 50 hours, ranging from 1 hour to 720 hours. This data reflects the reality in sub-Saharan Afri-

ca. Indeed, reaching a first medical contact and achieving efficient hospital transport generate delays that are severely prolonged in sub-Saharan Africa, reaching up to 6 to 10 days [10] [20]. In Africa, transport of patients to hospital uses available rural and urban public transport and private cars, and pre-hospital facilities are rarely used [9] [20]. This is due to a lack of awareness among African populations about cardiovascular diseases and the need to use pre-hospital facilities in case of chest pain.

However, due to the growth of cardiology in certain large African cities, the delay in receiving treatment has decreased significantly in recent years. A recent study found a mean delay between the onset of symptoms and the first medical contact of 12.7 hours in these countries [21]. In our study 66% of patients were seen within the first 12 hours.

Among patients received within the time limit, 80.76% received thrombolysis, 52.38% of which were successful. All thrombolysis was performed with Streptokinase.

The mean time of thrombolysis was 6 hours, with extremes of 1.45 to 11 hours. In the CORONAFRIC II study, 34% of STEMI were received thrombolytic treatment, the mean time to thrombolysis was 8.76 hours and the use of Streptokinase was estimated at 93.6% [12]. The high cost and low availability of other thrombolytic agents mean that Streptokinase remains the most widely used molecule in Senegal.

Coronary angiography was performed in six patients, *i.e.* 15.38%. Due to the extreme scarcity of interventional cardiology facilities in sub-Saharan Africa, the rates of coronary angiography are very low, considerably lower than in middle or high-income countries [22]. In Saint-Louis there is no interventional cardiology equipment therefore patients have to be transferred to the capital, Dakar, for coronary angiography; a journey which can take over 3 hours by road (250 km distance). If primary angioplasty cannot be performed in time (2 hours) after a diagnosis of ST-segment Elevation Myocardial Infarction, fibrinolytic therapy is recommended within 12 hours of symptom onset in patients without contraindication (Recommendation IA) [23]. This explains why none of the patients were able to benefit from primary angioplasty. In addition to this geographical barrier, there is an economic one; the cost of coronary angiography is 500,000 FCFA (763 Euros) on average, while the guaranteed minimum wage is 48,000 FCFA per month (73 Euros per month) [22].

The mean hospital stay length was 8.43 days. The medical treatment consisted of 100% of cases of dual antiplatelet therapy, high-dose statin and anticoagulation with low molecular weight heparin. Angiotensin Converting Enzyme inhibitors and beta-blockers were used in respectively 87.5% and 65.6% of patients. The mortality rate in this study was 17.5%, one study carried out in Kenya found 21% and N'Guetta *et al.* found 11.3% in Abidjan [10] [13]. This high mortality is due to the delay in STEMI diagnosis and management and the lack of technical facilities encountered in Africa [21].

5. Conclusion

ST-segment Elevation Myocardial Infarction is a major public health issue in Africa and elsewhere. Its prevalence is rising in Senegal; unfortunately, there is often a delay in diagnosis and management due to insufficient awareness, a lack of technical skills and financial constraints.

Conflicts of Interest

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

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