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A Pilot Study about the First Cases of Coronary Angioplasty in Democratic Republic of Congo/Kinshasa: Patient Profile

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Abstract

Background: The objective of this pilot study was to describe clinical profile, electric, echocardiographic and angiographic caracteristics with procedural outcome of congolease patients undergoing coronarography in the first and only one cardiac catheterization center opened in Kinshasa. **Methods:** An analytical cross-sectional study was carried out over a period from October 2019 (date of establishment of the first coronary angiography unit in DR Congo) to March 2021. We proceeded to a serial sampling of the consecutive cases of all the patients who have an angiographic exploration of coronary arteries. Clinical, ECG and cardiac ultrasound data were collected in all patients. The indications for the coronary angiography examination were set by differents cardiologists on the basis of repolarization troubles in the electrocardiogram, cinetic troubles in echocardiography, positive stress test and chest pain in patients with cardiovascular risq factors. **Results:** The serie (47 patients) was predominantly male with a sex ratio M/W of 2.6. The average age was 59.8 ± 10.5 years. Arterial hypertension (HBP) was the main risk factor (89.4%); followed by diabetes mellitus (14.9%). Chest pain was the main functional sign with an atypical character in 44.7%. The ECG showed ST segment depression (17%) and T wave inversion (17%), the anterior region being the most affected. Hypokinesia was the most common echocardiographic abnormality (34%), followed by akinesia (10.6%). The anteroseptal and apical territories were affected in 12.8%. Dilated myocardiopathy (DMC)

was significantly predominant in the male sex (29.4% vs 7.7%; p = 0.011). With radial puncture as the main approach, coronary angiography was pathological in 44% revealing mono-truncal lesions. The left coronary network was the most affected: the middle inter ventricular artery (12.8%), the proximal interventricular artery (10.6%) and the proximal circonflex artery (10.6%). In multivariate logistic regression analysis, age (for age > 50 years for men and >60 years for women), arterial hypertension and dilated cardiomyopathy emerged as independent determinants of pathological coronary angiography. Transluminal angioplasty was performed in 27.7% of patients. The bypass indication was retained in 4.3% of cases and medical treatment in 68%. **Conclusion:** Coronary angiography was used to diagnose lesions responsible for ischemic heart disease and to treat 27.7% of patients locally. The young age of patients and limited financial resources encourage the strengthening of preventive measures against cardio vascular risq factors.

Keywords

Heart Disease, Coronary Angioplasty, Patient Profile, Pilot Study, Democratic Republic of Congo

1. Introduction

Fifty years ago, the majority of deaths worldwide were caused by infectious diseases. Over time the trend has reversed with the emergence of chronic non-communicable diseases, mainly cardiovascular diseases (CVD), cancers, chronic respiratory diseases reflecting the notion of epidemiological transition already evoked around 1971 by A. Omran [1].

Cardiovascular diseases are currently the leading cause of morbidity and mortality according to the World Health Organization (WHO). Their morbidity and mortality has increased further with the ageing of the population, urbanization and the adoption of new eating behaviours.

Because of the epidemiological transition, cardiovascular diseases, including ischemic heart disease, are becoming very frequent in sub-Saharan Africa. Thrombolysis and coronary angiography remain a great challenge in this environment.

In these regions, mortality from cardiovascular disease accounts for more than 20 percent of overall mortality, and the prevalence rate of coronary heart disease and stroke tends to match that of infectious and nutritional diseases [2] [3].

Cardiovascular risk factors such as high blood pressure (arterial hypertension), diabetes mellitus, high cholesterol, obesity and smoking are strongly associated with the occurrence of atherosclerosis.

Ischemic heart disease is a condition in which there is insufficient oxygen supply to the heart muscle. It is the leading cause of morbidity and mortality in

industrialized countries and its frequency is increasing in developing countries. According to the WHO, ischemic heart disease and stroke account for 15 million deaths/year worldwide [4].

In Sub-Saharan Africa this pathology is clearly on the rise, with a prevalence of 13.5% and a hospital mortality rate of 10% in Côte d'Ivoire and 5.7% in South Africa [5]. In Senegal, acute coronary syndrome (ACS) has a hospital prevalence and mortality of 4% and 15.25%.

Socioeconomic status has measurable and important effects on cardiovascular health. In addition, biological, behavioral and psychosocial risk factors are more common among disadvantaged people, which accentuates the link between socioeconomic status and cardiovascular disease.

In high-income countries, there are four indicators of socioeconomic status that are systematically associated with cardiovascular disease: income level, education level, employment status and environmental factors. A low level of income, a low level of education, and a precarious employment situation are often associated with increased morbidity and mortality due to cardiovascular diseases.

Cardiovascular diseases also have serious socio-economic impacts in terms of cost, health care, absenteeism and national productivity on individuals, families and communities [6].

The Democratic Republic of Congo is a country in central africa, that has exceptional natural resources, including mineral deposits (cobalt, copper, gold, diamond, etc…), great hydroelectric potential, vast arable land, tremendous biodiversity and the second largest large tropical forest in the world. However, it is one of the poorest countries in the world with a large part of the population living below the poverty line and facing very marked inequalities [7] [8].

Furthermore, the increase in the incidence of CVD has not gone hand in hand with a corresponding adjustment of health structures and human resources. The under-equipment of many hospital structures and the absence of established health insurance at the national level mean that health care systems are inadequate to meet the needs. The resources available to hospitals structures are insufficient to care for people with chronic conditions such as CVD. These people must pay the costs of medical care out of their own pocket.

Few people benefit from medical agreements between their employers and hospital structures. Nevertheless, there is some progress made by the government in improving the health situation of the population but much remains to be done.

For several decades the role of coronary artery occlusion in the occurrence of myocardial infarction and myocardial necrosis has been clearly established. The benefit of early reperfusion of the culprit artery has been widely demonstrated by several randomized studies and registries [9]. All this work has led to the development of recommendations for management by learned societies: European Society of Cardiology (ESC) and American Heart Association (AHA) [9] [10] [11].

To apply those recommendations is essential in any health institution to ensure optimal management of patients with ischemic heart disease according to the various existing diagnostic and therapeutic strategies among which coronary angiography occupies a significant place [12] [13] [14]. A coronary angiogram is a procedure that uses X-ray imaging to see heart's blood vessels. The test is generally done to see if there's a restriction in blood flow going to the heart.

Coronary angiograms are part of a general group of procedures known as heart (cardiac) catheterizations. Cardiac catheterization procedures can both diagnose and treat heart and blood vessel disease. A coronary angiogram, which can help diagnose heart conditions, is the most common type of cardiac catheterization procedure.

Coronarography is the gold standard for diagnosing coronary artery disease [15] [16]. Coronary artery disease is caused by narrowing or blockage of the coronary arteries due usually to the formation of atherosclerotic plaques in the walls of these arteries, thus restricting blood flow to cardiac muscle. Coronary artery disease is the main cause for angina, myocardial infarction (or heart attack), and heart failure. Coronary artery disease must be present in varying degrees. There are others coronary arteries abdormality like spasm, spontaneous dissections whitch can be diagnosed by coronary angiography too [17] [18] [19].

The equipment is mainly composed by a mobilizable coronagraphy table, an arch which contains an X-ray tube on one side and a sensor on the other side, abble of performing movements around the patient for image acquisition according to different incidences using the buttons on the examination table. The patient lies on an examination table in a dedicated room respecting rigorous aseptic conditions and X ray protections measures.

After placement of the sterile fields, local anesthesia is given around the arterial puncture point (generally this is the radial artery in the wrist, or the femoral artery in the inguinal folds).

The interventionnel cardiologist use catheter throught the artery to mount guides and angiolasty equipement.

During a coronary angiogram, iodinated contrast medium is injected into the blood vessels of the heart. The X-ray machine rapidly takes series of images (angiograms), offering a look at blood vessels. Anticoagulants, vasodilators and antiplatelet agents are used during the procedure.

In the same time, it is possible to unclog an occluded artery or enlarge the lumen of a narrowed artery using different equipment such as active balloons, stents, rotablators, chockwave…

In case of non-significant coronary damage, it is recommended to give medical treatment only without resorting to stents.

Sometimes the lesions can be complex and not accessible to angioplasty according to the syntax score, the patient may be eligible for bypass surgery after a multidisciplinary discussion between cardiologists and cardiac surgeons. At the end of the procedure, a pressure dressing is applied to the puncture site and pa-

tient monitoring is required.

The low availability of cardiac catheterization rooms in sub-Saharan Africa to which must be added the expensive blow of these sophisticated methods (between $1000 and $8000 in DRC), the low standard of living of the populations and the lack of health insurance not only makes the management of patients with cardiovascular diseases sub-optimal, but is also a major gap for research in the field of interventional cardiology [20] [21].

The Democratic Republic of Congo, populated by 120,000,000 inhabitants, still had no coronary angiography units until November 2019, despite the existence of risk factors within its population as evidenced by several local studies. It therefore seemed wise and appropriate to undertake this study, the first to describe the angiographic profile of Congolese patients suspected of ischemic heart disease.

By carryng this study, we provide new data and contribute to filling as well as possible the large gap that exists in the research focused on ischemic heart disease in general, and coronary angiography in particular in The Democratic Republic of Congo.

2. Methods

2.1. Study Design, Setting and Period

This study was an analytical cross-sectional carried out over a period from October 2019 (date of establishment of the first coronary angiography unit in DRC) to March 2021.

2.2. Sampling

We proceeded to a serial sampling of the consecutive cases of patients who underwent Percutaneous Coronary Intervention (PCl) at cardiac catheterization lab of kinshasa between Octobrer 2019 and March 2021. All patient's coronary artery disease was suspected on the basis of clinical history, clinical presentation, 18 lead electrocardiogram (ECG) findings, non-invasive tests like treadmill test and echocardiography.

2.3. Samples Collections and Analysis

Sample was collected by medical folders of patients in the cardiology unit of Hj Hospitals.The data were collected in a survey sheet.

Socio demographic parameters such a gender, age old and profession were collected.

Cardio vascular risc factors like arterial hypertension (HTA), Diabetes mellitus, hypercholesterolemia, smoking obesity was sought.

Clinical presentattion can be a chest pain typical or not, dyspnea, palpitations.

Related to ECG finding, ST segment elevation or subshift, necrosis Q wave, recent left branch block, T-wave anomalies like an inversion was looking for.

The results of the cardiac ultrasound performed using a VIVID S70 brand de-

vice commissioned in April 2017 was collected. Left ventricule ejection fraction (LVEF) was considered abnormal if less than 50%, left ventricule filling pressures: normal and high according to ultrasound criteria validated by the ESC. The existence of valvular heart disease, disorders of segmental or global kinetics was described: normal kinetics, hypokinesia, akinesia and dyskinesia. The right ventricular function considered preserved if the TAPSE is greater than 17 mm and the velocity of the tricuspid lateral S wave in tissue Doppler greater than 9.5 cm/sec. Existence of dilated cardiomyopathy and mechanical complications was researched.

Coronary angiography was performed by several operators according to their vacations, with a General Electrics digital radiological system using the usual retrograde catheterization technique with catheters from 5 to 6 French. Coronary angiography was performed in all patients, with the primary objective of assessing the existence and extent of coronary lesions and secondary objective to make angioplasty if possible. Normal coronary angiography was defined by angiographically healthy coronary angiography (absence of any parietal irregularities); pathological coronary angiography in case of parietal irregularity and/or reduction of the vascular lumen. Lesions were considered significant when they halved the diameter of the left coronary trunk and other coronary arteries by more than 70%. A lesion is said to be diffuse when significant in at least two arteries and involving at least two segments of each coronary.

2.4. Statistical Analysis

The data were collected on a survey sheet, encoded in an Excel table and processed with SPSS-24 software. Results were presented as appropriate frequencies and proportions (in percentages) or means ± standard deviation. Pearson's chi-carré or Fisher's exact test as appropriate was performed to compare proportions. Student's t-test was performed to compare the means with normally distributed data. Logistic regression testing was applied to identify factors associated with coronary lesions. The calculated Odd ratio estimated the association degree between coronary lesions and independent variables. The difference was statistically significant for a threshold of $p \leq 0.05$.

2.5. Ethics Approval

The data has been collected anonymously and confidentially with respect for the privacy and personality of patients. We ensured that the three fundamental principles of ethics were respected in the course of the study: the principles of respect for the person, that of beneficence and justice.

3. Results

We includeed a total of 47 patients who had a coronary heart exploration with a sex ratio men/women of 2.6. The average age was 59.8 ± 10.5 years. Arterial hypertension (HTA) was the main risk factor (89.4%); followed by diabetes mel-

litus (14.9%). All patients had at least one cardiovascular risk factor. There were 14 patients with 3 CVRF (29.8%). Chest pain was the main functional sign with an atypical character in 44.7%. The ECG showed ST segment depression (17%) and T wave inversion (17%), the anterior region being the most affected. Hypokinesia is the most common echocardiographic abnormality (34%), followed by akinesia (10.6%). The anteroseptal and apical territories are affected in 12.8%. Dilated myocardiopathy (DMC) was significantly predominant in the male sex (29.4% vs 7.7%; p = 0.011). With radial puncture as the main approach, coronary angiography was pathological in 44% revealing mono-truncal lesions. The left coronary network was the most affected: the middle LVMA (12.8%), the proximal LVMA (10.6%) and the proximal CXL (10.6%). In multivariate logistic regression analysis, age (for age > 50 years in men and >60 years in women), hypertension and DMC emerged as independent determinants of pathological coronary angiography. Transluminal angioplasty was performed in 27.7% of cases. The bypass indication was retained in 4.3% of cases and medical treatment in 68%.

Table 1 shows that the majority of patients (57.4%) were under 60 years of age

High blood pressure (89.4%) and advanced age (70.2%) were the most represented risk factors followed by obesity (36.2%). Diabetes mellitus was present in 7 patients (14.9% of the study population). Only two patients were smokers (4.3%).

All patients had at least one cardiovascular risk factor. There were 14 patients with 3 CVRF (29.8%).

Pain was the main functional sign. It was atypical in 44.7% of cases especially in men (50%) with a difference that was not statistically significant between the two sexes (p = 0.196).

Dyspnea was present in 23.4% of cases with a predominance at NYHA stage II. Palpitations were rare observed in 7.7% of cases. Note that 14.9% of patients were asymptomatic.

Most patients had a regular sinus rhythm (97.8%), only one patient was in atrial fibrillation which accounted for 2.9% of cases.

Table 1. Socio-demographic characteristics.

Variable	Number of Staff (n = 47)	Percentage
Old		
<60 year	27	57.4
60 - 69 year	10	21.3
≥70 year	10	21.3
Sex		
Female	13	27.7
Male	34	72.3
Total	47	100.0

The average age was 59.8 ± 10.5 years; extremes: 38 and 83 years.

The upper ST segment shift was present in 2.1% of cases in a woman, it interested the anterior territory.

The under-lag of the ST segment was found in 17% of cases and the previous territory was the most affected.

T-wave inversion was observed in 8 patients (17%) with a predominance for the upper lateral territory (6.7%). LBBB was the most common conductive disorder (in 14 patients, or 29.8%), one patient had BAV2 mobitz 2 (2.1%). Four patients had ESV, that represent 8.5%.The ECG was normal in 14.9% of case.

Figure 1 shows that 2.1% of patients had benefited from coronary angiography for STEMI, 36.2% for Non-STEMI and 61.7% for other indications.

The mean biplane simpson ejection fraction was 49.3% ± 16.6%.

Fourteen patients had high filling pressures, accounting for 29.8%.

The most found kinetic abnormality was hypokinesia (34%), followed by akinesia in 10.6% of cases, 24 patients (51.1%) had no wall kinetics abnomality.

The two most affected territories were anteroseptal and apical in 12.8% of cases.

DCM was found in 23.4% of cases and predominated in men with a statistically significant difference (p = 0.011).

Five patients had mitral regurgitation (10.6%), Pulmonary hypertension was found in 5 patients (10.6%) and left ventricular hypertrophy in 19.1% of cases.

Only one patient had intra-LV thrombus (2.1%) and three patients experienced impaired right ventricular function (6.4%).

In 44.7% of cases, coronary angiography was pathological with a predominance of monotruncal lesions (31.9%). The left network was most affected with middle IVA in 12.8% of cases, followed by proximal IVA and proximal LCX in 10.6% of cases each.

The middle RCA accounted for 10.6% of breaches.

The common core was reached in 2.1% of cases in the same way as the proximal RCA, the first marginal and posterior interventricular artery.

In a multivariate logistic regression analysis, age (for age > 50 years for men and >60 years for women, ORa: 3.02; IC 95%: 1.68 - 5.13; p = 0.011), hypertension (ORa: 3.87; IC 95%: 1.54 - 7.28; p = 0.014), and the existence of a DCM (ORa: 3.28; IC 95%: 1.95 - 9.37; p = 0.017) emerged as independent determinants of pathological coronary angiography.

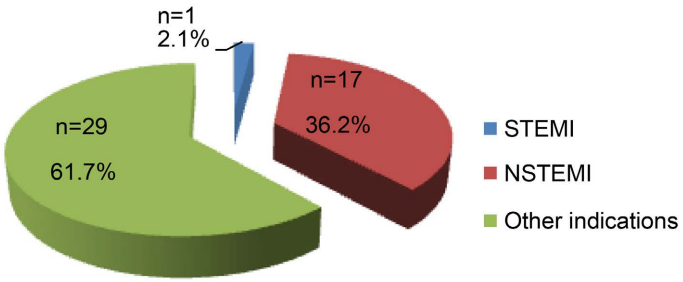

Figure 1. Distribution of patients by coronary angiography indication.

4. Discussion

The present study was done to describe for the first time the profile of patients who had coronary arteries exploration by angiography in The Democratic Republic of Congo.

General caracteristics of participants

The majority of patients in our study were male (72.3%). The average age was 59.8 ± 10.5 years and the age group under 60 (57.4%) was the most represented (**Table 1**). This result is comparable not only to that observed by Beyes in Mali and Coulibaly in Nigeria who reported male predominance, but also to data from Western literature [22].

Indeed, several studies have shown that women and men are far from being on an equal footing when it comes to cardiovascular disease in general and ischemic heart disease in particular. The male sex is already considered a cardiovascular risk factor, and if one looks closely at the list of risk factors reported in the literature, one realizes relatively quickly that it can be strongly influenced by gender stereotypes, which would explain this rather instinctive association of these diseases with men [23] [24] [25] [26] [27].

In an African context, men are more confronted with stressful situations, not only in the family sphere where they are the guarantors of social life by providing for the daily needs of the family, but also in the professional sphere where they occupy positions of greater responsibility than women, despite the growing importance of women's emancipation movements and fashionable policies advocating gender parity [28] [29]. The interheart study analysed the influence of psychosocial factors on the risk of ischemic heart disease particularly well in a specific twin publication [30] [31]. The prevalence of the 4 stress indices (professional, domestic and financial stress, recent distressing events) is very significantly increased among infarction cases compared to that observed among control subjects. It should be noted, however, that this stress aspect has not been specifically investigated in this work. Add to this a biological observation: estrogens, natural hormones called "feminine" (because much more present in women than in men), would play an important role in the prevention of cardiovascular diseases [32].

According to cardiovascular risk factors, hypertension and age (more than 50 years for male and 60 years for female) were the most represented in our study with respectively 89.4% and 70.2% of cases, followed by obesity in 36.2% (**Table 2**). Beyes found hypertension as a risk factor in 62.5% of cases. The deleterious action of hypertension is clearly objectified by the Framingham survey, There is a linear relationship between the elevation of blood pressure and the development of atherosclerosis, in addition to its role as an extrinsic factor of vulnerability of this plaque [32] [33].

Diabetes mellitus was present in 14.9% of cases in our study population. It is a risk factor frequently described in the literature [34]. According to Bertrand it is present in 14% of cases. Other African authors report varying prevalence rates ranging from 8.8% for Touré in Mali, 9% for Cenac in Niamey to 16% for Bou-

ramoué in Congo Brazzaville.

The low percentage of smokers in our study could (4.3%) can be explained by the small size of our sample but seems to reflect more the rather marginal proportion of smokers in the general Congolese population (Bayauli *et al.* 2014).

It should be noted that the more risk factors are present, the greater the risk of ischemic heart disease [35] [36] [37]. All patients in the present study had at least one cardiovascular risk factor. In 29.8% of cases, patients had 3 CVRF. Kimbally found an average of 2.4 factors per individual.

Clinical and electrical presentation:

Pain was the main functional sign found in our study. It was atypical in 44.7% of cases mostly in men with a difference that was not statistically significant between the two sexes (**Table 3**). The literature reports instead a higher frequency of atypical chest pain in women, diabetics and the elderly [38] [39]. The clear male predominance over a small sample size in our study could justify this divergence of findings.

Table 2. Distribution of patients by cardiovascular risk factors individually and cumulatively.

CVRF	Number of staff (n = 47)	Percentage
Old ≥ 60 F/≥50 M	33	70.2
Hypertension	42	89.4
DM	7	14.9
Hypercholestérolémia	5	10.6
Tabagism	2	4.3
Obesity	17	36.2
Cumulative CVRF		
1	7	14.9
2	9	19.1
3	14	29.8
4	12	25.5
5	5	10.6

CVRF: cardio vascular risq factor DM: diabetes mellitus F: female M: male.

Table 3. Main clinical characteristics of patients.

Variables	Female n = 13 (%)	Male n = 34 (%)	All n = 47 (%)	p
No symptom	3 (23.1)	4 (11.8)	7 (14.9)	0.291
Chest pain				
- Typical	5 (38.5)	4 (11.8)	9 (19.1)	0.051
- Atypical	4 (30.8)	17 (50.0)	21 (44.7)	0.196
Dyspnea	3 (23.1)	8 (23.5)	11 (23.4)	0.647
- NYHA I	0 (0.0)	1 (12.5)	1 (9.1)	
- NYHA II	3 (100.0)	7 (87.5)	10 (90.9)	
Palpitations	1 (7.7)	1 (2.9)	2 (4.3)	0.481

NYHA: New York heart association.

Pain was even more atypical and there was not a large proportion of patients presenting a coronary syndrome with ST-segment elevation in this study population, most of them had T wave inversion and the under-lag of the ST segment (Table 4).

Table 4. Electrocardiographic data of patients.

Variable	Female n = 13 (%)	Male n = 34 (%)	All n = 47 (%)	p
Regular rhythm	13 (100.0)	33 (97.0)	46 (97.8)	0.369
Sinus rhythm	13 (100.0)	33 (97.0)	46 (97.8)	0.369
Heart rate				
Normal	12 (92.3)	31 (91.2)	43 (92.5)	0.366
Tachycardia	0 (0.0)	3 (8.8)	3 (6.4)	
Bradycardia	1 (7.7)	0 (0.0)	1 (2.1)	
SUS-ST	1 (7.7)	0 (0.0)	1 (2.1)	
Territories				
Antérior	1 (7.7)	0 (0.0)	1 (2.1)	
SOUS-ST	2 (15.4)	6 (17.6)	8 (17.0)	0.614
Territories				
Antérior	1 (7.7)	2 (5.9)	3 (6.4)	0.732
Antéro septal	0 (0.0)	1 (2.9)	1 (2.1)	
Septal	0 (0.0)	1 (2.9)	1 (2.1)	
Hight Latéral	0 (0.0)	2 (5.9)	2 (4.3)	
Inférior	1 (7.7)	0 (0.0)	1 (2.1)	
Inverted T-wave	3 (23.1)	5 (14.7)	8 (17.0)	0.386
Territories				
Antéro septal	0 (0.0)	1 (2.9)	1 (2.1)	0.355
Septal	0 (0.0)	1 (2.9)	1 (2.1)	
Hight Latéral	1 (7.7)	2 (5.9)	3 (6.4)	
Low side	2 (15.4)	0 (0.0)	2 (4.3)	
Inférior	1 (0.0)	1 (2.9)	1 (2.1)	
Q wave of necrosis	0 (0.0)	1 (2.9)	1 (2.1)	-
Territories	100.0)	97.1)	9 (7.9)	
Antéro septal	0 (0.0)	1 (2.9)	1 (2.1)	
Conduction disorder	5 (38.5)	12 (35.3)	17 (36.2)	0.549
AVB 2 Mobitz 2	0 (0.0)	1 (2.9)	1 (2.1)	0.898
LBB	5 (38.5)	9 (26.5)	14 (29.8)	
RBB	0 (0.0)	2 (5.9)	2 (4.3)	
Rhythm disorder	0 (0.0)	5 (14.7)	5 (10.6)	0.181
AF	0 (0.0)	1 (2.9)	1 (2.1)	
ESV	0 (0.0)	4 (11.8)	4 (8.5)	
NORMAL ECG	2 (15.4)	5 (14.7)	7 (14.9)	0.636

AVB: atrio ventricular block LBB: left bundle block RBB: right bundle block AF: Atrial fibrillation.

Echocardiography

The most found kinetic abnormality was hypokinesia (34%), followed by akinesia in 10.6% of cases, 24 patients (51.1%) had no wall kinetics abnormality (Table 5).

Coronary aspect

The radial ponction was the most commonly used route in our study in line with ESC recommendations [38], it offers certain advantages such as limiting the risk of hematoma and prolonged immobilization imposed by the femoral approach. The left network was most affected with middle IVA in 12.8% of cases, followed by proximal IVA and proximal LCX in 10.6% of cases each (Table 6).

Table 5. Distribution of patients by cardiac ultrasound.

Variable	All n = 47	Female n = 13	Male n = 34	p
LVEF %	49.3 ± 16.6	45.2 ± 13.1	50.9 ± 17.6	0.298
<40%	15 (31.9)	4 (30.8)	11 (32.4)	0.280
40% - 49%	8 (17.0)	4 (30.8)	4 (11.8)	
≥50%	24 (51.1)	5 (38.5)	19 (55.9)	
Filling pressure				
Normal	33 (70.2)	10 (76.9)	23 (67.6)	0.404
Hight	14 (29.8)	3 (23.1)	11 (32.4)	
Wall kinetics				
Normal	24 (51.1)	5 (38.5)	19 (55.9)	0.691
Akinésia	5 (10.6)	2 (15.4)	3 (8.8)	
Hypokinésia	16 (34.0)	5 (38.5)	11 (32.4)	
Dyskinésia	2 (4.3)	1 (7.7)	1 (2.9)	
Territories				
Antéro septal	6 (12.8)	2 (15.4)	4 (11.8)	0.780
Apical	6 (12.8)	2 (15.4)	4 (11.8)	
Antérior	3 (6.4)	2 (15.4)	1 (2.9)	
inférior	3 (6.4)	1 (7.7)	2 (5.9)	
Hight Latéral	2 (4.3)	0 (0.0)	2 (5.9)	
Global	2 (4.3)	1 (7.7)	1 (2.9)	
Septal	1 (2.1)	0 (0.0)	1 (2.9)	
MR	5 (10.6)	2 (15.4)	3 (8.8)	0.426
HPP	5 (10.6)	1 (7.7)	4 (11.8)	0.574
RV dysfunction	3 (6.4)	0 (0.0)	3 (8.8)	-
THROMBUS	1 (2.1)	1 (7.7)	0 (0.0)	-
LVH	9 (19.1)	2 (15.4)	7 (20.6)	0.792
DCM	**11 (23.4)**	**1 (7.7)**	**10 (29.4)**	**0.011**

The values are the mean ± absolute and relative standard deviation or frequencies in parentheses. LVEF: left ventricular ejection fraction; MR: mitral regurgitation; HPP: hight pulmonary pressure; RV: right ventricule; LVH: left ventricular hypertrophy; DCM: dilated cardiomyopathy.

Table 6. Coronary angiography results.

Variable	All	Female	Male	p
	n = 47 (%)	n = 13 (%)	n = 34 (%)	
Coronary angiogram				0.324
abnormal	21 (44.7)	7 (53.8)	14 (41.2)	
Normal	26 (55.3)	6 (46.2)	20 (58.8)	
NATURE				0.505
Atheroma	20 (42.6)	6 (46.2)	14 (41.2)	
Number				0.510
SVD	15 (31.9)	4 (30.8)	11 (32.4)	
DVD	4 (8.5)	1 (7.7)	3 (8.8)	
TVD	1 (2.1)	1 (7.7)	0 (0.0)	
Arteries				
Middle IVA	6 (12.8)	1 (7.7)	5 (14.7)	0.753
Proximal IVA	5 (10.6)	3 (23.1)	2 (5.9)	0.121
proximal LCX	5 (10.6)	1 (7.7)	4 (11.8)	0.574
Middle RCA	5 (10.6)	0 (0.0)	5 (14.7)	0.181
First Diagonal	3 (6.4)	2 (15.4)	1 (2.9)	0.181
Distal LCX	2 (4.3)	1 (7.7)	1 (2.9)	0.481
LMCA	1 (2.1)	0 (0.0)	1 (2.9)	-
Proximal LMCA	1 (2.1)	1 (7.7)	0 (0.0)	0.277
First marginal	1 (2.1)	0 (0.0)	1 (2.9)	0.723
PIV	1 (2.1)	1 (7.7)	0 (0.0)	-

SVD: single vessel disease; DVD: double vessel disease; TVD: triple vessel disease; LMCA: left main coronary artery; IVA: anterior inter ventricular artery; LCX: left circurnflex artery; RCA: rigfit coronary artery; PIV: posterior inter ventricular artery.

In a multivariate logistic regression analysis, age (for age > 50 years for men and >60 years for women, ORa: 3.02; IC 95%: 1.68 - 5.13; p = 0.011), hypertension (ORa: 3.87; IC 95%: 1.54 - 7.28; p = 0.014), and the existence of a DCM (ORa: 3.28; IC 95%: 1.95 - 9.37; p = 0.017) emerged as independent determinants of pathological coronary angiography (Table 7).

Strenght and limitation

The present study is the very first to describe clinical, electrical, echocardiogragraphic and coronarographic profile of people who had a coronaries percutaneous angiography in the first and only one cardiac catheterisation laboratory of The Democratic Republic of Congo.

It provides new data and contribute to filling as well as possible the large gap that exists in research focused on ischemic heart disease in general, and coronary angiography in particular in The Democratic Republic of Congo.

Table 7. Factors associated with pathological coronary angiography.

		Univariate analysis	Multivariate analysis	
Factor	p	OR (CI 95%)	p	ORa (CI 95%)
Age ≥ 60 F/≥50 H				
No		1		1
Yes	**0.015**	4.40 (1.03 - 8.74)	**0.011**	3.02 (1.68 - 5.13)
Hypertension				
No		1		1
Yes	**0.017**	3.99 (1.66 - 5.47)	**0.014**	3.87 (1.54 - 7.28)
Obésity				
No		1		1
Yes	**0.033**	0.24 (0.06 - 0.89)	0.276	0.48 (0.48 - 170)
CVRF				
No		1		1
Yes	**0.015**	3.56 (1.46 - 5.36)	0.770	1.36 (0.17 - 3.78)
DMC				
No		1		1
Yes	**0.019**	2.67 (1.61 - 11.70)	**0.017**	3.28 (1.95 - 9.37)

OR: odds ratio; CI: confidence interval; CVFR: cardio vascular risk factor; DCM: dilated cardiomyopathy.

It also highlights the flagrant mismatch between the availability of cardiac catherization rooms reported to the general population (only one operating room, located in the capital Kinshasa, for a vast country of 2,345,000 km^2 which has 26 provinces).

There is not yet a green number and a national emergency medical assistance service that can go to the patient's bedside in case of chest pain whereas there are strong recommmendations according to the timing in the management of acute phase of myocardial infarction.

Novertheless, because of the lack of health insurance, the low income of the population and the expensive cost of coronary angiography, the small size of the poorly representative sample does not give enough power to the statistical analyses used. Thus some of our findings may not be accurately reflective of the spectrum of ischemic cardiopathy in the population at large.

Surely there are many patients in general population who have cardiovascular risqk factors, who could not undergo coronary angiography or PCI for a variety of reasons. Hence further short term and long term follow up data needs to be collected in this patient cohort to provide further insight into their clinical outcomes.

5. Conclusion

Coronary angiography was used to diagnose lesions responsible for ischemic

heart disease and to treat 27.7% of patients locally. The young age of patients and limited financial resources encourage the strengthening of preventive measures.

Availability of Data and Materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Authors Contribution

DIG participate in survey conception, wrote the protocole, collected, processed data, reviewed the manuscript and drafted the manuscript, assisted to perform some coronarographies.

EVK reviewed the manuscript;

YL reviewed the protocole and the manuscript;

GN reviewed the manuscript;

TM reviewed the manuscript;

DM reviewed the manuscript;

NB reviewed the manuscript;

ZK reviewed the manuscript;

FQ performed coronarographies;

AN conducted data analysis;

JRRM reviewed the manuscript;

JRM reviewed the protocole and the manuscript.

Conflicts of Interest

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

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