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Risk Factors for Early Complications of Acute Coronary Syndromes Seen in the Cardiology Department of Befelatanana

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Introduction

Acute coronary syndrome (ACS) refers to the set of clinical manifestations secondary to a sudden reduction of blood supply to the myocardium in relation to a complete or incomplete occlusion of the coronary artery [1].

This pathology remains a major public health problem because of its frequency and its impact on the morbidity and mortality of patients. According to the World Health Organization (WHO), it is responsible for nearly seven million deaths per year, i.e. 12.8% of global mortality [2]. In Europe, there has been a general trend towards a decrease in ischemic heart disease mortality over the last three decades [3]. Yet, in- hospital mortality ranges from 4% to 12% [4]. The prevalence of this disease is gradually increasing in sub-Saharan Africa due to the change in lifestyle in urban areas [5]. It was 13.5% in Côte d'Ivoire in 2016 and 5.1% in Kenya in 2012 [6, 7]. In Madagascar, we do not have national data, we have the impression that this condition has become increasingly common.

It is a diagnostic and therapeutic emergency because it is life-threatening in the short, medium and long term due to the numerous complications that may arise during its evolution [1]. These complications are becoming less and less frequent in developed countries [3]. The lack of technical facilities and the high cost of ACS management favor the occurrence of complications in sub-Saharan Africa, as is the case in Madagascar. Thus, we propose this study to identify the risk factors of early complications during ACS, in order to act upstream.

Patients and Methods

This is a retrospective case-control study covering a 6-month period from November 01, 2018 to April 31, 2019. Patients are divided into two groups Group I (Cases) represented by patients who had ACS with at least one of the following complications: hemodynamic complications, rhythmic disorders and conduction, mechanical complications, thromboembolic complications, and sudden death, and group II (Controls) consisted of patients with uncomplicated ACS. We included in the study all patient records diagnosed as ACS with or without ST-segment elevation and incomplete records were excluded.

The clinical elements studied were: gender, age, cardiovascular risk factors and the presence of comorbidity (renal, pulmonary, infectious, neurological, hematological). The early complications sought were: hemodynamic complications (left heart failure, right heart failure, and cardiogenic shock), rhythm disorders (atrial fibrillation, ventricular fibrillation, and ventricular tachycardia), conduction disorders (atrioventricular block, left bundle branch block, right bundle branch block), mechanical complications (heart wall rupture, acute ischemic mitral insufficiency, ventricular septal defect), thromboembolic complications (intracardiac thrombus, systemic embolus), pericardial effusion, residual angina, secondary extension of the infarction, and sudden death. The paraclinical variables studied were: ACS topography on resting ECG, ACS type, left ventricular ejection fraction (LVEF), and filling pressures on transthoracic Doppler ultrasound. Data were entered into Word™ and Excel™ 2010 software. The Statistical processing waś performed using Epi-Info™7® software. A distribution univariate statistics of the variables (frequency table, mean) waś established and then we proceeded to a bivariate analysis by performing crossovers between the different variables to search for existing associations. The KHI-two test has waś used for comparison of proportions, considered statistically significant if the p value was less than 0.05. Logistic regression test waś performed for obtaining the Odds Ratio (OR).

Results

Epidemiological and Clinical Aspects

During the study period, 373 patients were initially enrolled in the study. We identified 73 cases of ACS, giving a hospital prevalence of 19.57%.

Four cases were excluded because the records were incomplete, finally 69 cases were retained including 38 cases and 31 controls. More than half (55.07%) of our study population had presented at least one complication during hospitalization. We found a male predominance in both groups. The sex ratio was 1.7 in the complicated ACS group and 1.2 in the uncomplicated ACS group. The mean age of our population was 55.92 years in the "Case" group, the rate was 55.79 and in the "Control" group the rate was 55.79, with an extreme age range of 17 and 90 years. The age range 51 to 70 years was the most exposed in both patient groups (Figure 1).

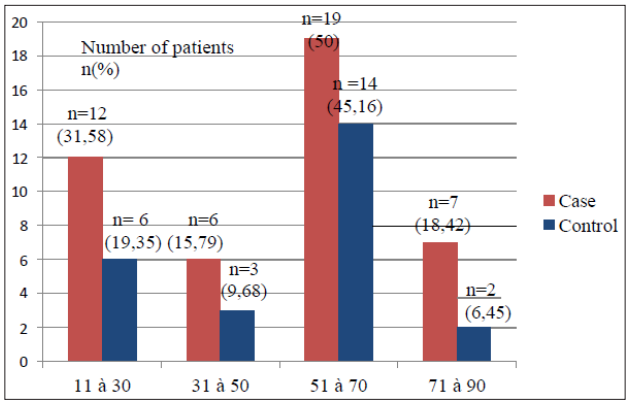


Figure 1: Age distribution

Among the nonmodifiable CV FDRs, cardiovascular heredity was the first in the "Case" group, it was the only nonmodifiable factor significantly associated with the occurrence of complications with an Odds ratio of 7.96 (Table I).

Modifiable risk factors were all predominant in the "Cases" with the most frequent hypertension, although the association was not significant. (Table II). Diabetes, obesity, and dyslipidemia were significantly associated with the occurrence of complications during ACS with an odds ratio of 4.2, 2.6, and 2.1 respectively (Table III). The majority (97.37%) of patients in the "Case" group had at least 3 CV FDRs that were significantly associated with the occurrence of complications during ACS (p=0.004, OR=3). Comorbidity was present in 73.68% of patients in the "Cas" group and a significant association (p=0.004, OR=5) with the occurrence of ACS complications was found.

Table I: Non-modifiable risk factors associated with the occurrence of complications

	Case n (%)	Witness n (%)	p	GOLD	IC
Male gender					
Yes	24 (63,16)	17 (54,84)	NS	2,8	0,26-1,86
No	14 (36,84)	14 (45,16)			
Men > 55 years old					
Yes	17 (44,74)	8 (25,81)	NS	1,8	0,83 -6,50
No	21 (55,26)	23 (74,19)			
Menopause or ≥ 65 years old					
Yes	4 (10,53)	13 (41,94)	NS	2,9	0,29-1,67
No	13 (34,21)	18 (58,06)			
HCV					
Yes	34 (89,47)	16 (51,61)	0,002	7,9	2,27-27,89
No	4 (10,53)	15 (48,39)			

NS : Not significant
CVH: Cardiovascular Heredity OR : Odds ratio
CI: Confidence interval

Table II: Modifiable cardiovascular risk factors associated with the occurrence of complications in ACS

Risk factors	Case n (%)	Witness n (%)	GOL D	p	IC
Smoking					
Yes	19 (50)	11 (35,48)	1,2	NS	0,45-2,21
No	19 (50)	20 (64,52)			
HTA					
Yes	29 (76,32)	19 (61,29)	1,5	NS	0,12-1,66
No	9 (23,68)	12 (38,91)			
Dyslipidemia					
Yes	20 (52,63)	10 (32,26)	2,1	0,048	1,35-6,17
No	18 (47,37)	21 (67, 74)			
Diabetes					
Yes	19 (50)	5 (16,13)	4,2	0,001	0,48-8,54
No	19 (50)	26 (83,87)			
Obesity					
Yes	11 (28,95)	1 (3,23)	2,6	0,002	2,11-5,81
No	27 (71,05)	30 (96,77)			

NS: Not significant
HTA : Hypertension OR :
Odds ratio
CI : Confidence interval

Table III: Modifiable cardiovascular risk factors associated with the occurrence of complications in ACS

Risk factors	Case n (%)	Witness n (%)	GOL D	p	IC
Smoking					
Yes	19 (50)	11 (35,48)	1,2	NS	0,45-2,21
No	19 (50)	20 (64,52)			
HTA					
Yes	29 (76,32)	19 (61,29)	1,5	NS	0,12-1,66
No					
Dyslipidemia					
Yes	20 (52,63)	10 (32,26)	2,1	0,048	1,35-6,17
No	18 (47,37)	21 (67,74)			
Diabetes					
Yes	19 (50)	5 (16,13)	4,2	0,001	0,48-8,54
No	19 (50)	26 (83,87)			
Obesity					
Yes	11 (28,95)	1 (3,23)	2,6	0,002	2,11-5,81
No	27 (71,05)	30 (96,77)			

Paraclinical Data

On ECG, the anterior territory predominated (52.63%) in the "Cas" group, although there was no statistically significant association between the occurrence of complications during ACS and the territory affected. ST-ACS was the most frequent form (86.84%) in the "Cas" group (Figure 2) and its association with the occurrence of complications was significant (p=0.007, OR=2). Renal failure was present in 44.74% of patients in the Case group and was significantly associated with the occurrence of ACS complications (p= 0.0001 OR= 11.73).

On ultrasound, reduced LVEF was significantly related to the occurrence of complications (Table IV). A significant association was found between high left ventricular filling pressures and the occurrence of complications during ACS (Table V).

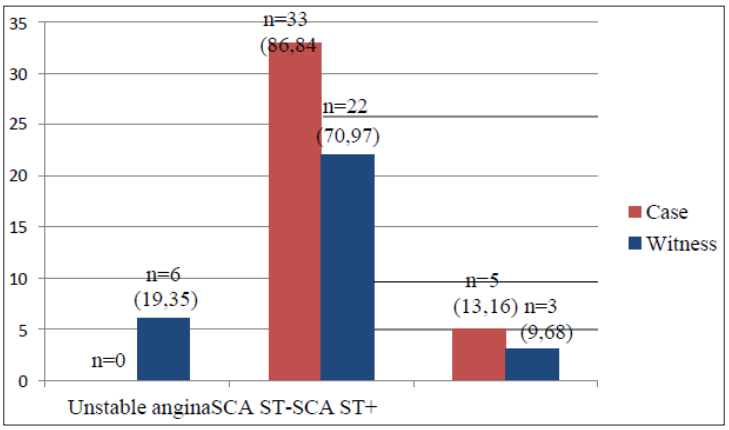


Figure 2: Distribution by type of ACS

Table IV: Distribution by left ventricular systolic ejection fraction

FEVG	Cases n (%)	Control n (%)	GOLD	p	IC
Preserved	12 (31,58)	21 (67,74)			
Intermediate	16 (42,11)	10 (32,26)			
Reduced	10 (26,32)	0 (0,0)			

LVEF: Left ventricular ejection fraction OR : Odds ratio
CI : Confidence interval

Table V: Distribution of left ventricular filling pressures

Filling pressures	Cases n (%)	Control n (%)	GOLD	p	IC
High	20 (52,63)	0 (0)	2,9	10-7	0,77-7,15
Normal	18 (47,37)	31 (100)			

OR: Odds ratio
CI: Confidence interval

Discussion

Epidemiological and Clinical Aspects

We identified 73 cases of ACS in our study with a hospital prevalence of 19.57%. This figure was much higher than in other African studies: 13.5% in Côte d'Ivoire, 4.2% in Burkina Faso and 3.5% in Mali [6,8,9]. This difference could be explained by the inadequacy of prevention activities in Madagascar, particularly with respect to early detection and correct management of cardiovascular risk factors. The high prevalence of complications in our study (55.07%) as in other African studies reported by Seydou D in Mali (48.3%) and Sonou A in Benin in 2018 (47.1%) would be related to the delay in management and the failing technical platform [10,11]. However, in Greece, the PHAETHON study reported a lower complication rate (38%) which could be explained by the existence of a technical platform allowing early management of ACS [12]. We found a great disparity in the predominant gender in the "Case" group. In fact, in our study and that of Seydou D in Mali in 2018, the male gender predominated in the "Cas" group [11]. On the other hand, Teixéira R in 2011, in Portugal, reported the predominance of the female gender in the "Cas" group because their populations were older [13]. Indeed, before the age of 60 years, men were at greater risk than women for cardiovascular events. However, after the age of 75 years, women became more vulnerable to an adverse outcome of ACS [14]. The age range 51 to 70 years was the most affected in both patient groups. This is consistent with the literature [10, 11]. Nevertheless, the patients in the Case group were younger in our study than in Sonou A (Table VI) [11]. This could be explained by the inadequate control of CV risk factors in Madagascar, leading to the earlier occurrence of ACS and its complications.

Table VI: Comparison of average age and age range

Authors	Cases (%)		Control (%)	
	Average of age (year)	Tranche of age	Average of age (year)	Tranche of age (year)
Our study	55,92	51-70 (50 %)	55,79	51-70 (45,16 %)
Seydou D [10] (Mali)		50-69	-	50 - 69
2018	-	(64,29 %)		
Sonou A [11] (Benin)			56,51	-
2018	61,78			

The predominant CV DRF had a large variability in the "Cases" group. (Table VII). In our study, HCV was the first and the association was significant. This could be explained by the young age of our population. In fact, it was shown in the Afiji registry that 40% of patients with MI before 45 years of age had coronary heredity [15, 16]. In fact, in HCV: a genetic predisposition was found, in fact in the imbalance of the hemostatic system by increasing the level of fibrinogen activator inhibitor and in the disturbance of the inflammatory process. These two mechanisms contribute to the modification of the architecture of the atheroma with a tightened and rigid microfilamentary character making the fibrin more resistant t o t h e action of fibrinolysis initiated in the acute phase of the myocardial infarction [17]. On the other hand, Sonou A, in Benin, in 2018, reported the predominance of HTA [11]. Our study was consistent with the literature on two risk factors: diabetes and obesity (Table IX). Indeed, during diabetes, coronary lesions are often diffuse, complex, and pluritronular and the subsequent cardiac autonomic neuropathy also participates in the diastolic and systolic dysfunction of the LV [18,19]. In relation to obesity, it leads to cardiac adaptation that induces left ventricular diastolic and systolic dysfunction and may aggravate coronary artery disease (Figure 3) [20]. Finally, dyslipidemia was significantly related to ACS complications in our study. Indeed, cardiovascular mortality up to 6 years was proportional to total cholesterol level according to the literature [21]. Intensive lipid-lowering statin therapy resulted in better protection against major cardiovascular events or death compared to standard therapy [22]. It should be noted that lipid levels are paradoxically low in the acute phase of ACS, which should not prevent high-dose statin therapy, which has been shown to reduce morbidity and mortality in the acute phase of ACS [23]. In our study, the presence of more than 3 CV FDRs was significantly associated with the occurrence of complications during ACS (p=0.004, OR= 3). This is in line with the study conducted by Seydou in Mali in 2018 [10]. Indeed, it was reported that the accumulation of CV DRFs was associated with complex and multitruncular coronary damage, leading to left ventricular systolic dysfunction during ACS [24]. The other cardiovascular risk factors defined by the ESC 2018 could not be studied because of the retrospective nature of our study limiting Data available from the patient record. These are sedentary lifestylé, abdominal obesity, resting heart rate more than 80 cpm, psychosocial and socioeconomic factors, uricemia, microalbuminuria, and the notion of advanced retinopathy [25]. This constitutes one of the limitations of our study. In our study.

The presence of comorbidities was significantly associated with the occurrence of complications during ACS. This is consistent with the literature [11, 26]. Indeed, the number of comorbidities has been shown to be related to the risk of complications during ACS [27]. The role of these comorbidities on the outcome of the ACS patient is multiple. These include: interference with diagnosis, worsening of symptoms, and influence on treatment (inability to receive treatment, toxic treatment, drug interactions,...)[27].

Table VII: Comparison of associations between cardiovascular risk factors and the occurrence of complications

Authors	Our study	Sonou A [11] (Benin) 2018	Teixeira R [13] (Portugal) 2011
Male gender	NS	-	-
Men > 55 years old	NS	-	-
Menopause or > 60 years old	NS	NS	NS
HCV	0,002	NS	NS
Smoking	NS	NS	NS
HTA	NS	NS	0,007
Dyslipidemia	0.048	NS	NS
Diabetes	0,001	0,004	-
Obesity	0,002	0,057	-

NS : Not significant HTA: Hypertension
CVH: Cardiovascular Heredity

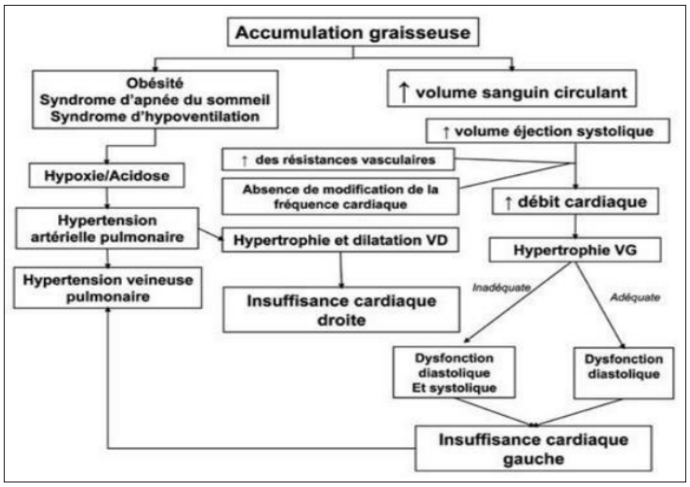


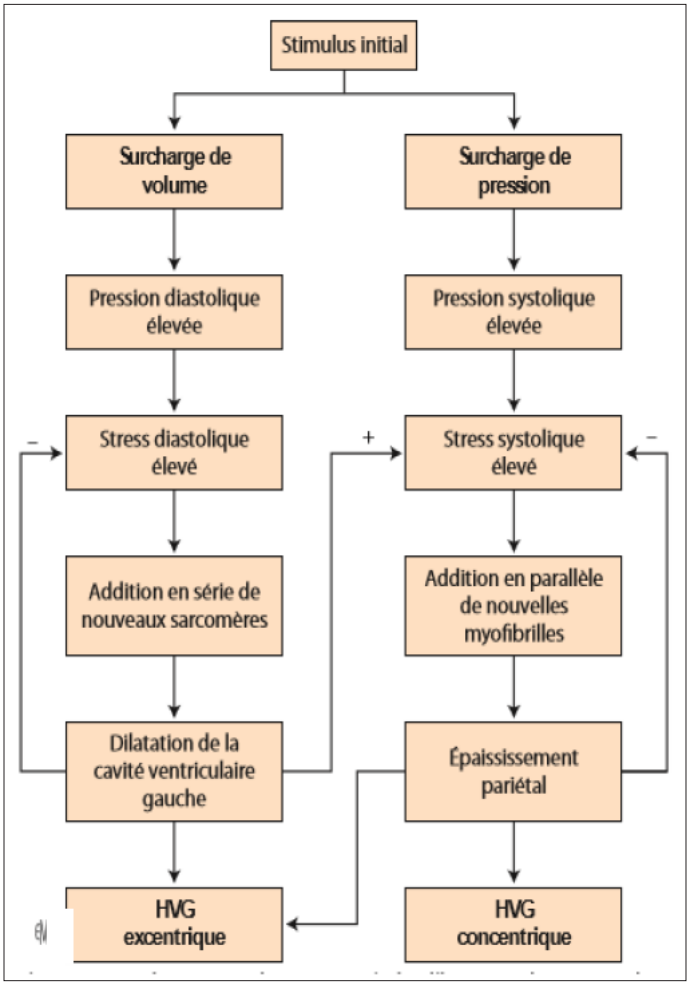
Figure 3: Pathophysiology of cardiac involvement in obesity

Source: Cottin Y, Zeller M. Obesity and cardiovascular risk: risk factors, the paradox and impact of weight loss. Archives Medical Cardiology- Practice 2013;19(217): 27-31 [20]

Paraclinical Data

On ECG, several authors reported that the anterior territory was the most frequent during complicated ACS [10,11] although we did not find a significant association. In our study, ST- ACS predominated in the "Cases" with a significant association (p=0.007, OR= 2). This could be explained by the lower number of ST+ ACS in our population (n=5 (13.16%)). But, in fact, in the literature, ST+ ACS was more complication-providing, as in the GRACE Global Registry of Acute Coronary Events) where in-hospital mortality of ST+ ACS was 8.4% vs. 2.9% for ST- ACS and in the PHAETHON study where ST+ ACS had significantly higher incidence of complications than ST- ACS (16% vs. 7%, p<0.001) [12,27].

In our study, the presence of renal failure was significantly associated with the occurrence of complications (OR=11.73, p=0.0001). This is consistent with the Hanna EB study in the United States and the Sonou A study in Benin [12, 28]. Renal dysfunction being an important determinant in risk stratification during ACS [29]. Indeed, a decrease in coronary reserves by alteration of microcirculations and coronary calcifications have been reported during chronic renal failure [30, 31]. Moreover, chronic renal failure, related to the overload of pressure and volume, will result in LVH [32]. Figure 4 shows the relationship between renal failure and left ventricular hypertrophy.



LVH: Left ventricular hypertrophy GFR:

Glomerular filtration rate

Figure 4: Relationship between renal failure and left ventricular hypertrophy

Source: London GM. Left ventricular alterations and end-stage renal disease. Nephrol Dial Transplant 2002; 17(1): 29-36 [32].

At ultrasound, in our study, reduced LVEF was significantly related to the occurrence of complications (p < 10-7 , OR=3.1). This is superposable with the study of Sonou A in Mali and Maurin O in Djibouti [12, 33]. In fact, left ventricular systolic dysfunction was a poor prognostic factor as highlighted by Cambou et al in the USIK study [34]. Indeed, the alteration of the LVEF leads to a neuro-hormonal activation which generates deleterious changes of the myocardium, which will maintain a vicious circle (Figure 5) and contribute to the aggravation of the ACS [35]. In our study, high left ventricular filling pressures (LVFP) were significantly associated with the occurrence of complications during ACS (OR=2.9 p= 10-7). This agrees with a Portuguese study in 2011 [13]. Indeed, the increase in LVP was implicated in the increase in left atrial pressures and distension that will induce diastolic heart failure [36]. The cardiac consequences of LVRP elevation are shown in Figure 6.

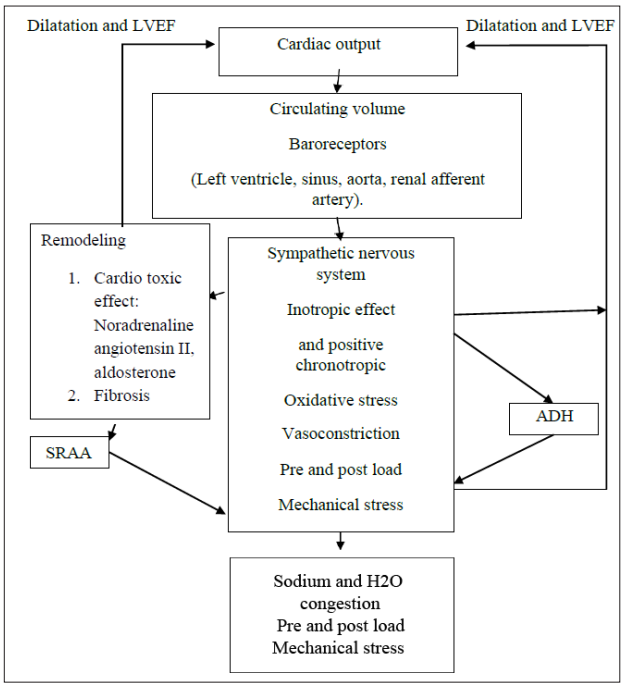


Figure 5: Pathophysiology of heart failure with impaired LVEF LVEF

: left ventricular ejectionPrferaacntidonpost load
ADH : antidiuretic hormone
RAAS : renin-angiotensin-aldosterone system.

Source: Packer M. The neurohormonal hypothesis: A theory to explain the mechanism of disease progression in heart failure. J Am Coll Cardiol 1992; 20: 248-54 [35]

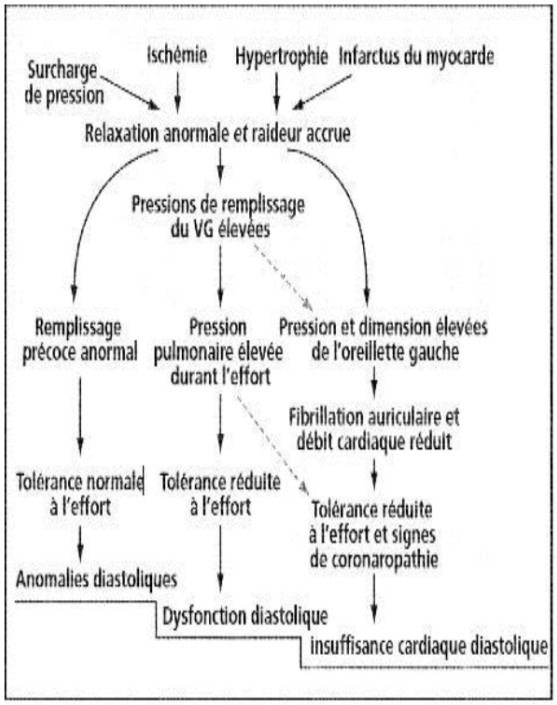


Figure 6: Consequences of elevated GWP

Source: Chinnaiyan KM, Alexander D, Maddens M, McCullough PA. Curriculum in cardiology: Integrated diagnosis and management of diastolic heart failure. Am Heart J 2007; 153: 189-200 [36].

Conclusion

Few data are available in the literature regarding risk factors for complications during ACS. Nevertheless, this study has provided some insights into the characteristics of patients at risk for complications.

Complications were significantly associated with comorbidity, presence of renal failure, elevated LVEP, reduced LVEF, and diagnosis of ST-ACS.

The incriminating risk factors were diabetes, cardiovascular heredity, dyslipidemia, and obesity.
The knowledge of all these predictive elements of complications allows us to foresee the severe evolution of ACS in order to intensify the treatment from the outset and to bring the monitoring closer.

As a result of this study, we recommend:

1. Educate the general population about cardiovascular risk factors and their prevention.
2. Screen and treat all modifiable cardiovascular risk factors early.
3. Equip the CHU Befelatanana with a coronary angiography room to benefit from a primary angioplasty in order to prevent early and late complications.
4. To train cardiology, emergency and intensive care personnel on the preventive and curative management of ACS.
5. Conduct a large-scale study to confirm this hypothesis and increase the representativeness of the Malagasy population.

Conflicts of Interest

The authors have no conflicts of interest.

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