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# Acute Coronary Syndrome in the Elderly: Assessment of Risk Factors, Management Strategies and Complications

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## Abstract

Background: ACS is a leading cause of mortality worldwide, but it is unknown whether the advanced age of patients constitutes a prognostic factor. Objective: The present study compared the burden of risk factors and the prognosis of ACS in older and younger patients in order to improve their management. Methods. A retrospective analysis of a series of ACS patients admitted from January to December 2022 to intensive care unit of the cardiology department at the South Francilian Hospital Center. Results: The files of 551 patients including 60 elderly subjects (10.9%) were analyzed. Average age was 81.7 ± 6.1 years for the elderly, 54.5 ± 11.9 years for the younger patients. Men predominated in both age categories ($p = 0.014$) and were older than women (59.2 ± 14.3 vs 53.1 ± 13.2 years; $p = 0.014$). Obesity ($p = 0.007$), smoking ($p = 0.002$) and dyslipidemia ($p = 0.022$) were the cardiovascular risk factors found more in elderly patients, hypertension ($p < 0.001$) and diabetes ($p < 0.001$) in the youngest. NSTEMI (66.3%) predominated in both the elderly (55.0%) and the younger (60.8%) subjects. Treatment consisted of immediate angioplasty in 66.1%, including 61.7% elderly subjects and 66.6% younger subjects ($p = 0.224$). Death was significantly associated with the severity of coronary lesions ($p < 0.001$) and chronic renal failure ($p = 0.006$), with no significant influence of age. Conclusion: The proportion of elderly subjects with ACS is not negligible. Comorbidities increase the prognosis, without age per se being associated with death.

**Keywords**

ACS, Elderly, Angioplasty, Prognosis, Death

## 1. Introduction

The prevalence of cardiovascular disease (CVD) has almost doubled over the last three decades worldwide with an increase in attributable mortality from 12.1 million to 18.6 million [1] [2], mainly due to acute coronary syndrome (ACS) its important manifestation [3]. However, a better insight into etiopathogenesis of ACS and current management techniques have significantly improved the prognosis [3] [4].

ACS patients are increasingly older and even very old and studies in which more than 50% of patients are 70 years and over are no longer uncommon [5]. Older age is characterized by polypathology and accumulation of cardiovascular risk factors that may affect the prognosis of ACS despite appropriate management [5]. Indeed, inspite of available evidence, advanced age can often inappropriately influence treatment decisions. The treatment for ACS is coronary revascularization. In the elderly patients, management often requires a multidisciplinary team (heart team) discussion to decide on the most suitable strategy [6].

The burden of atherosclerotic plaque increases in the elderly patients whose coronary anatomy changes in the presence of several age-related or not comorbidities. These patients are fragile with several comorbidities for which polymedication is often administered rending their management a complex challenge as, unfortunately, elderly patients have been marginalized from most therapeutic trials [7].

Therefore, the present study was undertaken to evaluate features associated with the ACS prognosis in the elderly as compared to younger patients to contribute to improvement of their care. We aimed to assess whether advanced age poorly affects the prognosis of ACS patients.

## 2. Material and Methods

### 2.1. Setting and Design

We retrospectively analyzed the files of ACS patients admitted from January to December 2022 in the intensive care unit, department of Cardiology at the Sud Francilien Hospital Center, Essonnes, France.

The study population consisted of patients of both sexes and all ages whose files contained the parameters of interest. Patients with known history of ischemic heart disease who had undergone a prior revascularization procedure (stenting or bypass graft) and those with medical records missing the parameters of interest were not included in the analysis.

From the patients' medical records we extracted information on anthropometric

and sociodemographic characteristics (age, sex, weight, height, BMI); the history of CVRF such as arterial hypertension (HT), diabetes mellitus, smoking, overweight/obesity, dyslipidemia, chronic kidney disease (CKD), coronary heredity and measurements of blood pressure, heart rate and high sensitivity troponin level on admission; the results of echocardiography: left ventricular ejection fraction (LVEF) and coronary angiography (absence of lesion, mono, bi or tri-truncular lesions and atheroma); the treatment decision and procedure (coronary angioplasty, medical treatment, bypass decision) and the listed complications such as cardiogenic shock, heart failure, ischemic stroke, rhythm disorder, conduction disorder, pericardial effusion and cardio-respiratory arrest (CRA) and death at discharge.

### 2.2. Operational Definitions

The elderly are defined as patients aged 75 years or more. Other patients are referred to as younger patients. Overweight/obesity is defined as body mass index (BMI) ≥ 25 kg/m$^2$.

Left ventricular dysfunction was a left ventricular ejection fraction (LVEF) <50% and significant lesions were tri-troncular lesions on angiography.

### 2.3. Statistical Analysis

For data management and statistical analysis, we used Microsoft Excel and Epi info software version 7.2.2.5. We expressed quantitative variables as means standard deviations, and categorical as frequencies and percentages (%). Tables and figures have been used to present the results. To compare proportions and means of the elderly and the youngest patients we used Pearson's Chi-square (or Fischer's exact test as appropriate) and student's t-test, respectively. Multiple logistic regression analysis was applied to identify factors independently associated with death. The threshold for statistical significance was p value of 0.05 or less.

### 2.4. Ethical Considerations

The data was collected and processed anonymously, respecting the privacy and personality of the patients. Confidentiality and ethical rules were respected in accordance with the Helsinki protocol. We ensured that the three fundamental principles of ethics were respected throughout the study: respect for the individual, beneficence and justice.

## 3. Results

As shown in Figure 1, the records of 696 patients admitted for ACS were collected during the study period; 145 were excluded from the analysis: 140 for prior revascularization procedure (stent or bypass) and 5 with missing information. The files of 551 patients, 60 elderly (10.9%) and 491 younger patients (89.1%) were analyzed.

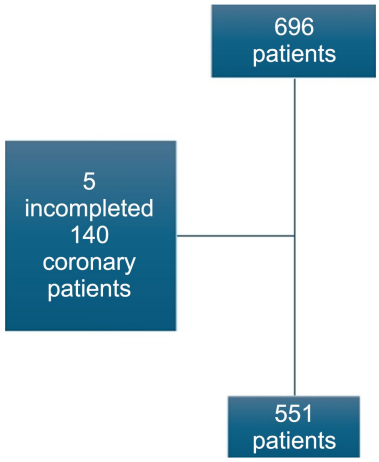
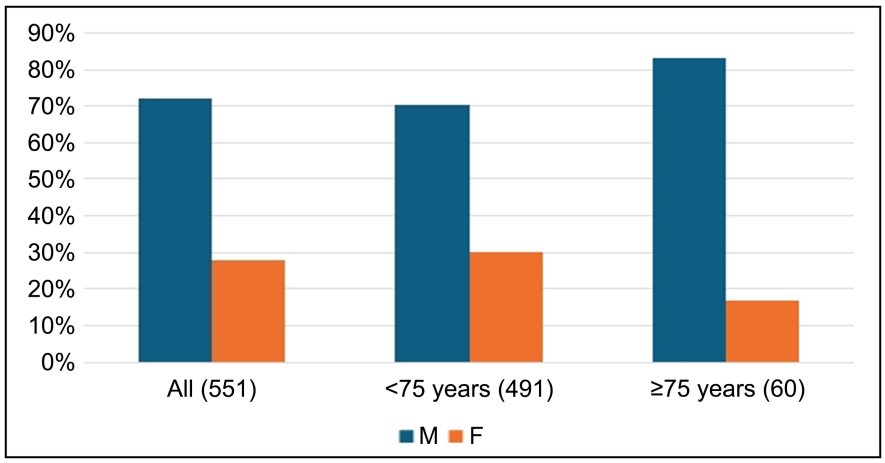



**Figure 1.** Patient flow chart.

The series comprised of 394 men (72.0%) and 157 women (28.5%), a sex ratio of 2.5. The male predominance was obvious among elderly (83.3% vs 16.7%) and among the younger patients (70.1% vs 29.9%). Figure 2 shows the gender distribution of the study population by age group. There was a predominance of males ($p = 0.014$) in both older.




$p = 0.014$.

**Figure 2.** Breakdown of patients by sex and age group.

### 3.1. General Characteristics of the Population

Table 1 compares general characteristics and cardiovascular risk factors of the two age categories of ACS patients. The patients age averaged 57.5 ± 14.2 years for the whole study population, range 25 and 101 years with men being older than women (59.2 ± 14.3 vs 53.1 ± 13.2 years; $p = 0.014$). It averaged 81.7 ± 6.1 years for the elderly and 54.5 ± 11.9 years for the younger patients.

Overweight/obesity ($p = 0.007$), smoking ($p = 0.002$) and dyslipidemia (0.022) were CVRF predominant among the elderly, hypertension ($p < 0.001$) and diabetes mellitus ($p < 0.001$) among the younger patients.

**Table 1.** General characteristics and background.

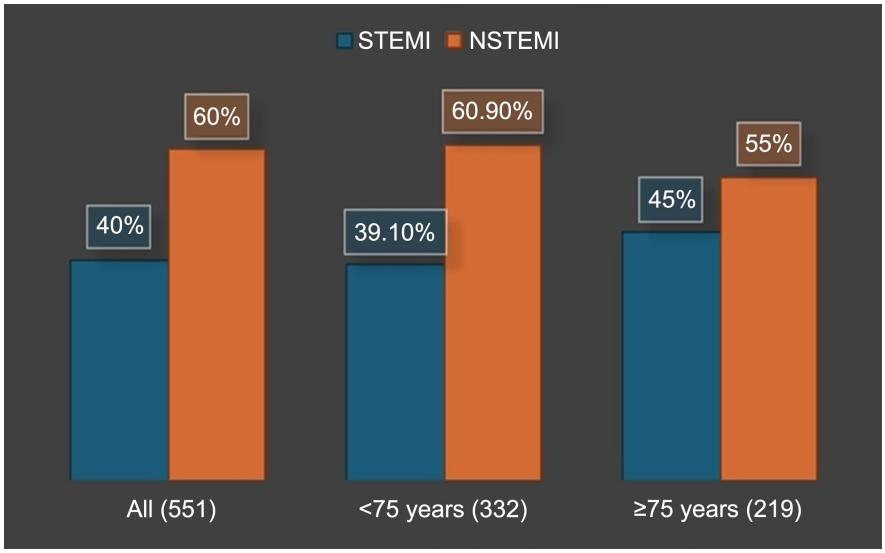
| Parameters | All | <75 years | ≥75 years | p |
|---|---|---|---|---|
| n (%) | 551 | 491 (89.1) | 60 (10.9) | |
| Sex | | | | 0.014 |
| M | 394 (71.5) | 344 (70.1) | 50 (83.3) | |
| F | 157 (28.5) | 147 (29.9) | 10 (16.7) | |
| Overweight/obesity | 369 (66.9) | 220 (44.8) | 37 (61.8) | 0.007 |
| HT | 278 (50.5) | 262 (53.4) | 16 (26.7) | <0.001 |
| Tobacco consumption | 249 (45.2) | 211 (42.9) | 38 (63.3) | 0.002 |
| DM | 130 (23.6) | 126 (25.7) | 4 (6.7) | <0.001 |
| Dyslipidemia | 151 (27.4) | 141 (28.7) | 10 (73.1) | 0.022 |
| CKD | 33 (5.9) | 30 (6.11) | 3 (5.00) | 0.323 |
| Heredity coronary | 65 (11.8) | 54 (11.0) | 11 (18.3) | 0.057 |

M: male, F: female, HT: hypertension, DM: diabetes mellitus, CKD: chronic renal failure.

Blood pressure, heart rate and troponin levels on admission averaged 120 ± 13 mmHg, 77 ± 12 per minute and 1279 ± 2722 pg/ml respectively.

### 3.2. Initial Diagnosis

Most patients (Figure 3), n = 332 (66.3%) including 299 (60.9%) younger patients and 33 (55.0%) older patients (p = 0.191), were admitted for a non-ST + acute coronary syndrome (NSTEMI).




p = 0.191.

**Figure 3.** Patient diagnosis on admission.

### 3.3. Results of Coronary Angiography

Table 2 indicates that monotruncular damage was the most common lesion (n = 177; 32%), followed by bitruncular damage (n = 135; 25%). Lesser elderly subjects had significant lesions compared to the young (p = 0.012).

Table 2. Proportion of coronary lesions.

| | All (551) | <75 years (491) | ≥75 years (60) |
|---|---|---|---|
| | n (%) | n (%) | n (%) |
| Atheromas | 119 (22) | 98 (20) | 20 (33) |
| Monotroncular | 177 (32) | 151 (32) | 21 (35) |
| Bitroncular | 135 (25) | 123 (25) | 12 (20) |
| Tritroncular | 119 (22) | 113 (23) | 7 (12) |

The commonest culprit lesion was the stenosis of the IVA in 32.3% of cases, with no difference between the younger (32.8%) and the older patients (30%) (Table 3).

Table 3. Nature of culprit injuries.

| Culprit lesion | All (551) | <75 years (491) | ≥75 years (60) |
|---|---|---|---|
| | n (%) | n (%) | n (%) |
| No lesion | 187 (34.0) | 164 (33.1) | 23 (38.3) |
| Anterior interventricular | 179 (32.5) | 161 (32.8) | 18 (30.0) |
| Right coronary | 106 (19.0) | 97 (19.8) | 9 (15.0) |
| Circonflex | 33 (6.0) | 29 (5.9) | 4 (6.8) |
| Bissector | 11 (2.0) | 10 (2.0) | 1 (1.8) |
| Marginal | 15 (2.7) | 11 (2.2) | 3 (5.0) |
| Diagonal | 9 (1.6) | 7 (1.4) | 2 (3.3) |
| Common core | 6 (1.1) | 6 (1.1) | 0 (0.0) |
| Retro ventricular | 2 (0.4) | 2 (0.4) | 0 (0.0) |
| Posterior interventricular | 1 (0.2) | 1 (0.2) | 0 (0.0) |

The management (Figure 4) consisted of immediate angioplasty in 364 patients (66.1%). Surgery (coronary artery bypass grafting) was indicated in 13 patients (16.2%) and 174 patients (17.8%) received medical treatment only.

Figure 5 shows that management in the 2 groups consisted of ad hoc coronary angioplasty in 364 cases (66.1%), with no significant difference (p = 0.662) between younger subjects (66.6%) and older subjects (61.7%).

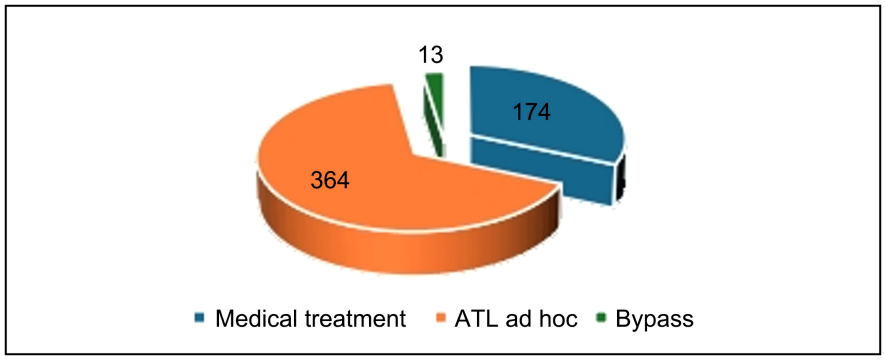



**Figure 4.** Therapeutic management procedures.

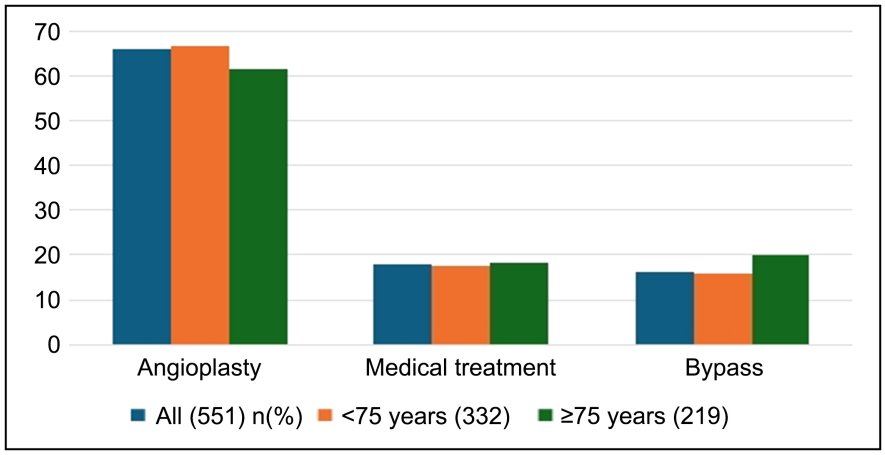



**Figure 5.** Management in the two groups.

## 4. Complications

Table 4 summarizes the various complications and deaths. Left ventricular dysfunction (18.3%) was the predominant complication in the younger patients (p = 0.013), followed by ventricular rhythm disorders (1.3%).

**Table 4.** Complications.

| Complications | All (551) | <75 years (491) | ≥75 years (60) | p |
|---|---|---|---|---|
| | n (%) | n (%) | n (%) | |
| Cardiogenic shock | 2 (0.36) | 2 (0.4) | 0 (0.0) | 0.397 |
| Death | 4 (0.7) | 4 (0.8) | 0 (0.0) | 0.315 |
| DCD | 2 (0.4) | 2 (0.4) | 0 (0.0) | 0.397 |
| VDRD | 7 (1.3) | 6 (1.2) | 1 (0.1) | 0.364 |
| Others | 10 (2.0) | 10 (2.0) | 0 (0.0) | 0.156 |
| LV dysfunction: | 101 (18.3) | 96 (19.6) | 5 (8.3) | 0.013 |

VDRD: ventricular rythm disorder; DCD: conduction disorder; LV dysfunction: left ventricular dysfunction.

## 5. Analysis of Factors Associated with Death

At discharge, 4 deaths (0.7%) were recorded, all among younger patients (0.8%). Death was significantly associated (Table 5) with the severity of coronary lesions ($p < 0.001$) and chronic renal failure ($p = 0.006$). Age category was not significantly associated with death.

Table 5. Factors associated with death.

| Parameters | p | IC 95% | Z score |
|---|---|---|---|
| HT | 0.348 | 1.08 - 0.31 | 0.9393 |
| CKD | 0.006 | 122.2 - 2.81 | 2.7683 |
| Overweight | 0.402 | 0.04 - 3.67 | −0.8381 |
| DM | 0.946 | 0.79 - 0.11 | 0.6790 |
| Dyslipidemia | 0.328 | 0.98 - 0.37 | 0.9783 |
| Tobacco consumption | 0.846 | 0.19 - 0.17 | 0.1937 |
| Age group | 0.435 | −0.81 - 0.06 | −0.7801 |
| Significant lesions | <0.001 | 11663 - 0.21 | 2.5924 |

HT: hypertension, CKD: chronic renal failure, DM: diabetes mellitus.

## 6. Discussion

To improve the management of ACS in the elderly, the present study was meant to compare epidemiological and clinical profile and post-treatment outcome at discharge in the elderly and younger patients. The study population comprised more men than women ($p = 0.014$), with a mean age of 57.5 ± 14.2 years (range 25 to 101 years) and consisted of 10.9% of elderly subjects. The salient results indicate that in comparison to the younger patients, in whom hypertension ($p < 0.001$) and diabetes mellitus ($p < 0.001$) were predominant CVRF, overweight/obesity ($p = 0.007$), smoking ($p = 0.002$) and dyslipidemia (0.022) were mostly encountered in the elderly. Most patients (66.3%) were admitted for NSTEMI with monotruncular damage and stenosis of the anterior interventricular artery as prominent injuries. Coronary angioplasty was immediately performed in 66.1% of cases, with no significant difference ($p = 0.224$) between the two age groups. The odds for in-hospital mortality were higher in the presence of significant coronary lesions ($p < 0.001$) and chronic renal disease ($p = 0.006$); not with age-group.

The predominance of male gender in the present study agrees with observation in other reports on ACS [8] [9] and might be accounted for at least partly by the preponderance of CVRF among men. Females are known to benefit from protective effects of estrogens before the menopause, with regards to low LDL cholesterol, reduced insulin resistance, regulation of platelet aggregation and low blood pressure all of which are factors favoring ischemic heart disease. However, as that

protective effect diminishes or even disappears with aging, the very reason for the persisting male predominance in the elderly is unclear.

Our patients' average age is similar to 59.8 ± 10.5 years reported by Gondele *et al.* in a Congolese ACS patients' series [10]. It is, however, relatively younger than in other previous works. Indeed, for the FAST-MI 2015 study [11] and the survey on factors associated with complications of ST + ACS by MAVUNGU JM *et al.* [12], the patients' age averaged 63 ± 14 years and 61.7 ± 13.4 years, respectively. On the other hand, our observation of men older than women in the present work contrasts with most literature which, quite invariably, reports female ACS patients to be older than men, in keeping with the aforementioned protective effect of estrogens. Their average age is generally around 65 years. Studies in which patients age was much older, such as that of Gale CP *et al.* with more than 50% of ACS patients over 70 years have been reported [13].

The ACS consisted of NSTEMI in most admitted patients (67%) in the present study as well among elderly as in younger subjects. The proportion of elderly patients (11% only) was lesser than in some previous studies. Alexander KP *et al.* reported the patients aged 75 years and over account for approximately 25% of STEMI and 40% of NSTEMI [14]. Our younger ACS patients had more hypertension and diabetes whilst the older subjects were more overweight, smokers and dyslipidemic. This preponderance of hypertension among younger patients is consistent with the French FAST-MI registry where the elderly tended to be less hypertensive (27.6% vs. 30%) while the younger patients comprised more smokers (66.8% vs. 70.6%) [14] [15]. Hypertension is the most common CVRF. Its prevalence increases with age, reaching 65% after the age of 65, compared with less than 10% in subjects aged between 18 and 34. This may explain why, in most studies, hypertension is more common in older subjects than in younger ones. Likewise, in a Tunisian retrospective register of STEMI + patients, hypertension was more common in older patients, who were less obese and less likely to smoke [16].

Coronary angiography revealed monotruncular and bitruncular injuries in 32% and 22 % of cases, respectively. Other studies have also reported the predominance of monotruncular lesions [11] [16] [17]. The stenosis of IVA in 32.3% was the commonest culprit of ACS cases. Such a predominance of the anterior topography of MI could be explained by the fact that this is generally the most dominant coronary trunk. Ad hoc coronary angioplasty was the immediate management procedure undergone by the patients with a slight predominance of the younger subjects and medical treatment tended to be prescribed in similar proportions to both age groups.

Left ventricular dysfunction (18.3%) and arrhythmia (1.3%) were the most observed complications in agreement with many studies in which ventricular rhythm disorders do predominate [18] [19]. In fact, MAVUNGU *et al.* reported arrhythmia in 22.85% of cases and hemodynamic disorders (left ventricular failure) in 13%. Belle L *et al.* [9] and Lubenga Y *et al.* also had similar observations. Within rythmic disorders associated with ACS, ventricular rhythm disturbances

are the predominant features [17] [20]. MAVUNGU *et al.*, found the risk of hemodynamic problems to be 5, 3 and 4 folds higher respectively in elderly patients, hypertensives and cigarette smokers. Such a finding confirms the profile of patients with severe LV dysfunction as established by Hochman *et al.* [21]. Left ventricular dysfunction complicating MI is more easily grafted onto a heart with already impaired systolic and/or diastolic function, thus justifying a higher prevalence of hemodynamic complications among elderly patients.

Our patients below 75 years had more significant lesions and were, therefore, likely to be stented. They developed more complications. There were fewer complications and no death among the elderly. As treatment of ACS in the elderly is generally medical and far from optimal, one could rightly fear a greater risk of complications. Elderly subjects are less likely to undergo coronary angiography and coronary angioplasty [22], and such agist attitudes are unfortunately observed from diagnosis to therapeutic decision. This cautious attitude is generally justified by their frailty and numerous comorbidities. Moreover, the experts' recommendations are not unanimous, and management is, therefore, a matter of careful evaluation by the angioplastic surgeon alone. Factors associated with death were coronary artery disease and chronic renal disease, not age category. However, some studies have shown a higher mortality rate among elderly subjects [23] Mozaffarian D *et al.* found a 3-fold higher mortality rate in elderly ACS patients, with their in-hospital mortality increasing by 75% for each additional decade of age [24]. In STEMI patients, TIMI risk index provides an estimated risk of mortality outside the hospital or on arrival at the hospital. This index is defined as (heart rate × $[age/10]^2$)/PAS. This simple three-item score is strongly correlated with prognosis and highlights the key role of age in determining outcome after ACS [25]. There is also the GRACE (Global Registry of Acute Coronary Events) score, which correlates with in-hospital mortality, 6-month mortality and recurrent myocardial infarction or mortality at 6 and 12 months [26] [27]. Age is one of eight items used to calculate this score, highlighting the strong correlation between age and major adverse cardiovascular events during ACS.

The monocentric retrospective nature of the present study constitutes a major limitation with possible selection bias. The number of elderly subjects was small, with only a few complications recorded; this may not reflect the adverse profile of ACS in this age category. The patients were not followed in the long-term, so various complications such as hemorrhages could not be observed. We only reported troponin levels on admission and found no association with mortality rate. Finally, we were unable to analyse the potential effect of comorbidities, assessment of frailty, dysfunction of various organs and medication use as well as the evolution overtime of high sensibility troponin on the prognosis of elderly patients with ACS.

## 7. Conclusion

The proportion of elderly patients with ACS is not negligible. Cardiovascular risk

factors and comorbidities do worsen ACS prognosis regardless of age but promote wait-and-see and ageist attitudes regarding the care to elderly patients that are worth avoiding.

## Conflicts of Interest

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

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