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Changes in management of elderly patients with myocardial infarction

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Aims Despite being at higher risk for mortality, elderly patients (≥75 years) admitted for acute myocardial infarction (MI) often receive fewer effective therapies, because of contraindications or higher risk of drug-induced adverse events. The aim of this study was to assess the changes in the use of effective treatments between 2001 and 2006 in elderly patients, and the relation with 1-month mortality.

Methods and results Prospective, multicentre registry, considering two periods: 6 months between October 2000 and March 2001 (cohort 1) and 12 months between October 2005 and October 2006 (cohort 2). Demographic and clinical characteristics at admission, in-hospital treatment (reperfusion or early invasive therapy, oral antiplatelets, anticoagulants, angiotensin-converting enzyme (ACE)-inhibitors, beta-blockers, and statins), and 1-month survival were compared between the two cohorts, after adjustment on a propensity score (for being admitted in 2001). Eight hundred and sixty-eight elderly patients were included, 280 in cohort 1 and 588 in cohort 2. When compared with cohort 1, patients from cohort 2 presented with comparable characteristics, except for the Global Registry of Acute Coronary Events risk score and we observed a significant increase in the use of aspirin, clopidogrel, reperfusion therapy, ACE-inhibitors, and statins in cohort 2. One-month mortality was significantly lower in cohort 2 (13.6% in cohort 1 vs. 7.1% in cohort 2, $P = 0.001$), mainly driven by a decrease in the mortality among patients with ST-segment elevation MI (23.3% in cohort 1 vs. 9.2% in cohort 2, $P < 0.001$). Adjustment on the propensity score did not alter these results. By multivariable analysis, the three-fold higher mortality in patients from cohort 1 was offset when the rate of use of treatments was considered in the model, suggesting that the treatment intensity was related to lower mortality.

Conclusion Between 2001 and 2006, a significant increase in the use of guidelines-recommended treatments (GRTs) was observed, associated with lower 30-day mortality, in elderly patients. These data confirm that high-risk patients, such as the elderly, benefit from an increase in the use of GRTs.

Keywords Elderly • Quality of care • Acute myocardial infarction • Guidelines

Introduction

In western countries, elderly patients (defined as patients with a chronological age ≥75 years) represent between 22 and 37% of all admissions for acute myocardial infarction (MI), and the mortality rate in this population is more than twice that of non-elderly patients.[1] Indeed, older age is an independent predictor of short-term mortality. Risk scoring systems developed from large registries have shown that with increasing age, the risk of death during hospitalization, or within 1 or 6 months, increases gradually.[2]

Among the potential explanations for this higher mortality, the so-called 'high-risk paradox' illustrates the observation that elderly patients are not only at higher risk,[2] but are also those

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who least often receive effective treatments. Similar observations have been reported in other clinical situations. In a report covering 30 chronic diseases, Asch *et al.*[3] observed that the quality of care was lower in elderly than in non-elderly patients and similar findings have also been reported in acute or chronic cardiac care.[4]

The under-use of guidelines-recommended treatments (GRTs) reported in elderly patients may be explained by the presence of contraindications, the higher risk of drug interactions, and the higher risk of drug-induced adverse effects.[5] It is widely acknowledged that the optimal management of elderly patients with acute coronary syndrome (ACS) must take into account the risk/benefit ratio, and current guidelines recognize elderly patients as a 'special population', justifying tailored treatments.[6,7]

Longitudinal surveys have shown a significant increase in the rate of use of GRT over the last few years. Rates of use of reperfusion therapy, glycoprotein IIb/IIIa receptor blockers (GP2b/3a), aspirin, beta-blockers, and angiotensin-converting enzyme (ACE)-inhibitors and statins are significantly higher than a few years ago[8–11] and these changes are associated with a favourable impact on short- and long-term clinical outcome.[12,13] However, it remains unclear whether there has been a corresponding increase in the rate of use of GRT in the elderly and whether this has a positive impact on clinical outcome. The aim of this study was therefore to assess, through the results of a prospective registry, the degree of change in GRT between 2001 and 2006, in elderly patients admitted for acute MI, and its impact on 30-day mortality.

Methods

Population and risk profile

The 'Registre Franc Comtois des Syndromes Coronariens Aigus' is a prospective registry recording all admissions of patients suffering from MI, in a pre-defined geographic area: all patients with a definite diagnosis of acute ST-elevation MI (STEMI) or non-STEMI (NSTEMI), in any of the 10 cardiology centres in the region of Franche-Comté in Eastern France were eligible for inclusion in the registry. A dedicated team of data managers was available to verify the exhaustiveness of the recruitment by comparing in each centre the list of included patients with the list of patients with a final diagnosis of MI from the hospital's administrative records and to assist with completion and verification of the data. Recorded variables correspond to the CARDS data set as available on the website of the European Society of Cardiology (www.escardio.org). Patients who gave written informed consent were contacted at 1 month through telephone contact or a scheduled consultation to assess 1-month survival (all causes of death were considered). The registry is supported by a research association (Association Franc Comtoise d'Aide à la Recherche en Cardiologie) and by unrestricted grants from Sanofi-Aventis and Servier Companies.

Data collection

Patients admitted for acute MI during the period from October 2001 to March 2001 (6 months, cohort 1) or between October 2005 and October 2006 (12 months, cohort 2) were eligible. The choice of the periods of inclusion was dictated by data availability and to ensure sufficient statistical power, but not prospectively or retrospectively decided. Before the study commenced, standardized definitions were established and all the participating centres were informed through meetings and written notification. The same definition of MI (with or without ST-segment elevation) was used in both cohorts.

The Global Registry of Acute Coronary Events (GRACE) risk score[2] was calculated for all patients. Computerized checks were performed to verify the coherence of the data, queries were generated in case of inconsistencies, and a sample of medical records was reviewed in each centre.

Acute treatment indicators

Acute management was assessed by the rate of use of several indicators, based on the current guidelines.[6,7,14,15]

- For all patients: (i) aspirin, (ii) clopidogrel, (iii) anticoagulation (with distinction between unfractionated heparin and low molecular weight heparin), (iv) ACE-inhibitors [or angiotensin 2 receptor blockers (ARB)], (v) beta-blockers, and (vi) statins.
- For STEMI patients admitted within the first 12 h after onset of symptoms: reperfusion therapy (thrombolytics or primary angioplasty).
- For NSTEMI patients: early (within 72 h after admission) coronary angiography with GP2b/3a receptor blockers.

Statistical analysis

Categorical variables are presented as number of cases and percentage, continuous variables as mean $\pm$ standard deviation and scores as median (inter-quartiles).

The clinical history, risk factors, haemodynamic conditions, renal function, and GRACE risk score were compared between the two cohorts.

A propensity score was calculated using a logistic regression, with inclusion in cohort 1 as dependent variable and forcing all clinical characteristics on admission as independent variables (type of infarction, age, gender, history of prior MI, prior percutaneous or surgical revascularization, stroke, peripheral artery disease, the classical cardiovascular risk factors, centre, delay of admission in the cardiology unit, and all components of the GRACE risk score on admission except age). Using this model, subjects were classified into five strata according to quintiles of the estimated propensity score distribution. To assess the differences, between the two periods, in the characteristics of the population, in the use of treatment indicators and in the 30-day mortality, we calculated the odds ratio (OR) adjusted on the strata of propensity score.

To assess the impact of the treatment changes on mortality, we compared (i) the mortality rate between the two periods, adjusted on the strata of propensity score and (ii) the results of the logistic regression model, and particularly the cohort effect, when treatment indicators were considered or not. To ensure the absence of bias resulting from logistic regression model building, all selected candidate variables were forced in the model: age, gender, type of infarction, systolic blood pressure, heart rate, Killip class >2 on admission, renal function, strata of propensity score, and treatment indicators.

All tests were two-sided, and a P-value <0.05 was considered significant. Analyses were performed using SAS software, version 9 (SAS Institute Inc.).

Results

Baseline characteristics and propensity score

During the two phases of inclusion, 2491 patients were admitted for acute MI and Elderly patients represented 38% of the patients

admitted; 39% (297/761) in the cohort 1 and 38% (659/1730) in cohort 2. Among these patients, 88 (9.5%) refused to participate or had incomplete follow-up (*Figure 1*). The type of infarction and the clinical characteristics between the two cohorts showed no significant difference, except for the serum creatinine level, heart rate at admission, GRACE risk score, and the delay of admission in NSTEMI patients (*Table 1*). The median of the GRACE risk score was higher in patients admitted in 2006 than in those admitted in 2001 [168 (147; 182) vs. 172 (150; 192), $P = 0.01$].

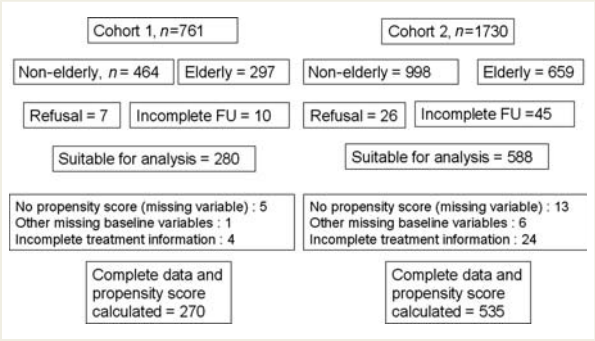

Figure 1 Flow chart of the study population.

The propensity score was calculated with cohort 1 as dependent variable. The median value of the propensity score was 0.32 (0.26; 0.46) with a range from 0.13 to 0.74. In cohort 1, the median value for propensity was 0.38 (0.29; 0.52) and in cohort 2, 0.29 (0.21; 0.40). *Figure 2* shows the proportion of patients from cohorts 1 and 2 in each strata of the propensity score. After adjustment on the strata of propensity score, there was no longer any difference between the two cohorts in clinical variables, particularly in the GRACE risk score. Adjusted and non-adjusted OR are presented in *Tables 1* and *2*.

Rate of use of treatment indicators

We observed major changes in the rate of use of treatment indicators between 2001 and 2006: the use of aspirin, clopidogrel, reperfusion therapy, ACE-inhibitors (or ARB), and statins was significantly higher in 2006 when compared with 2001. Among patients receiving anticoagulants, the use of unfractionated heparin decreased, with a corresponding increase in the use of enoxaparin. In patients with STEMI, a higher proportion of patients

Table 1 Baseline characteristics of elderly patients admitted in the two cohorts

	Cohort 1 ($n = 280$)	Corhort 2 ($n = 588$)	*P*-value[b]	OR[c] (95% CI)	Adjusted OR[d]
STEMI	103 (37)	218 (37)	0.88	1.03 (0.7; 1.3)	1.2 (0.8; 1.5)
Male gender	141 (50)	300 (51)	0.85	1.01 (0.9; 1.1)	1.1 (0.8; 1.4)
Age[a]	81 (78; 87)	83 (78; 85)	0.13	1.01 (0.99; 1.04)	0.85 (0.6; 1.2)
History of previous MI	61 (22)	112 (19)	0.34	0.95 (0.7; 1.3)	0.8 (0.5; 1.2)
History of stroke	24 (9)	53 (9)	0.83	1.06 (0.6; 1.7)	1.0 (0.6; 1.7)
History of peripheral artery disease	48 (17)	86 (15)	0.40	0.85 (0.6; 1.2)	0. 8 (0.5; 1.2)
History of chirurgical revascularization	13 (5)	38 (6.5)	0.28	1.2 (0.7; 2.0)	1.3 (0.75; 2.5)
History of percutaneous revascularization	27 (10)	57 (10)	0.98	1.04 (0.8; 1.4)	1.0 (0.6; 1.6
diabetes	72 (26)	175 (30)	0.83	1.2 (0.9; 1.6)	1.0 (0.7; 1.4)
High blood pressure	182 (65)	402 (68)	0.33	1.2 (0.8; 1.6)	1.3 (0.9; 1.8)
Hypercholesterolaemia	98 (35)	237 (40)	0.13	1.25 (0.9; 1.7)	1.2 (0.9; 1.7)
Current smoker	80 (29)	134 (23)	0.06	0.7 (0.5; 1.1)	0.8 (0.6; 1.1)
Serum creatinine level[a]	112 (89; 142)	106 (86; 134)	0.02	0.99 (0.98; 1.00)	1.0 (0.99; 1.01)
Onset to admission time					
STEMI patients	4 (2; 19)	4 (2; 20)	0.24		
NSTEMI patients	11 (3; 24)	9 (3; 22)	0.02		
Renal dysfunction					
GFR $<$ 30 mL/min/1.72 m^2	123 (44)	229 (39)	0.05[b]	0.85 (0.7; 1.3)	0.95 (0.7; 1.3)
30 $>$ GFR $>$ 60	146 (52)	306 (52)			
GFR $>$ 60 mL/min/1.72 m^2	11 (4)	53 (9)	0.20	0.99 (0.98; 1.02)	1.0 (0.99; 1.01)
Heart rate at admission	81 (20)	83 (20)			
Systolic blood pressure	145 (21)	140 (21)	0.01	0.98 (0.97; 0.99)	1.0 (0.99; 1.01)
Killip class $>$1	67 (24)	137 (23)	0.83	0.95 (0.7; 1.3)	0.8 (0.6; 1.2)
GRACE risk score[a]	168 (147; 182)	172 (150; 192)	0.001	1.08 (1.03; 1.12)	1.01 (0.95; 1.07)

Non-adjusted and adjusted comparison on a propensity score being admitted during the first period (2001).
[a]Median (inter-quartiles).
[b]χ^2 test for comparison between cohorts 2001 and 2006.
[c]Non-adjusted *P*-value.
[d]OR adjusted on the propensity score.

were submitted to reperfusion in 2006. This was driven by an increase in primary angioplasty, despite a reduction in thrombolysis. The use of GP2b/3a receptor inhibitors an early invasive strategy doubled from cohort 1 to 2. Adjustment on the propensity score did not change these results except for the increase in the use of beta-blockers that became significant (*Table 2* and *Figure 3*).

One-month mortality

At 1 month, 38/280 (13.6%) patients died in cohort 1 and 42/588 (7.1%) in cohort 2. This difference was significant ($P = 0.001$) and was mostly driven by the difference in mortality in STEMI patients (23.3% in cohort 1 vs. 9.2% in cohort 2, $P < 0.001$), whereas there was only a non-significant trend towards reduction in mortality in NSTEMI patients. *Figure 4* presents the Kaplan–Meier survival curves in STEMI and NSTEMI patients in both cohorts.

Multivariable analysis performed without including the acute treatments showed that the patients admitted during the first period had a three-fold higher mortality than those admitted during the second period, even after adjustment on the strata of propensity score (*Table 3*). When the rate of use of treatments was introduced in the model, the effect of the period was no longer significant. In the final model, among predictors of mortality, the rate of use of clopidogrel, beta-blockers, and ACE-inhibitors (or ARB) were significant. Conversely, the effect of reperfusion in STEMI or early invasive strategy was not statistically significant.

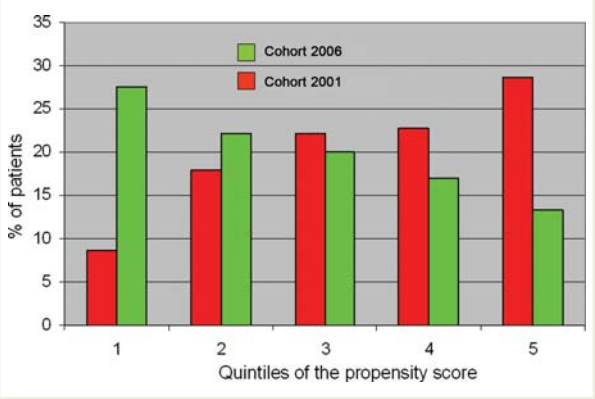

Figure 2 Proportion of patients from each cohort by deciles of the propensity score.

Discussion

This prospective observational study compared treatments and the 30-day mortality in 868 elderly patients admitted for acute MI between two periods, 5 years distant from each other. We observed only few differences in the patients characteristics between the two cohorts, but the rate of use of GRT increased from cohort 1 to 2. The adjustment on a propensity score, being admitted in 2001, did not change the results. At the same time, we observed a significant reduction in mortality in the 2006 cohort when compared with 2001.This effect was particularly important in STEMI patients, where a 50% reduction in mortality was observed. Multivariable analysis showed that the effect of

Table 2 Rate of the use of guideline-recommended treatments and 30-day mortality in the two cohorts

	Cohort 1 ($n = 280$)	Cohort 2 ($n = 588$)	*P*-value[c]	OR (95% CI)	Adjusted OR (95% CI)[d]
Aspirin	253 (90)	564 (96)	0.001	5.0 (2.9; 8.5)	4.9 (2.7; 8.9)
Clopidogrel	44 (16)	523 (89)	0.001	48 (32; 72)	55 (35; 89)
Reperfusion[a]	28/103 (12)	128/218 (59)	0.001	3.8 (2.3; 6.4)	1.8 (1.0; 3.4)
Thrombolytics[a]	21/103 (20)	35/218 (16)	0.25	0.8 (0.4; 1.4)	0.8 (0.4; 1.6)
Primary angioplasty[a]	7 (7)	94/218 (43)	0.008	8.9 (4.1; 19)	6.9 (3.1; 15)
GP2b/3a inhibitors[b]	31/177 (17)	111/370 (30)	0.001	1.8 (1.2; 2.9)	4.2 (2.7; 6.7)
Early angiography with GP2b/3a inhibitors[b]	24/177 (14)	92/370 (25)	0.001	2.1 (1.3; 3.5)	4.3 (1.5; 12.9)
UFH	135 (48)	210 (36)	0.001	0.65 (0.5; 0.9)	0.6 (0.2; 0.8)
LMWH	138 (49)	352 (60)	0.001	1.5 (1.1; 2.0)	1.6 (1.2; 2.2)
ACEI (or ARB)	141 (50)	453 (77)	0.001	3.1 (2.3; 4.1)	2.6 (1.6; 3.9)
Beta-blockers	137 (49)	323 (55)	0.06	1.3 (0.99; 1.7)	1.4 (1.1; 2.0)
Statins	38 (14)	323 (55)	0.001	4.2 (2.9; 6.3)	5.4 (3.6; 7.0)
30-day mortality (all)	38/280 (13.6)	42/588 (7.1)	0.001	0.55 (0.34; 0.86)	0.41 (0.25; 0.69)
STEMI	24/103 (23.3)	20/218 (9.2)	0.001	0.37 (0.2; 0.71)	0.27 (0.13; 0.56)
NSTEMI	14/177 (7.9)	22/370 (5.9)	0.46	0.83 (0.41; 1.63)	0.68 (0.33; 1.4)

Non-adjusted and adjusted comparisons on a propensity score being admitted during the first period (2001). GP2b/3a, glycoprotein IIb/IIIa; UFH, unfractionated heparin; LMWH, low molecular weight heparin; ACE-I, angiotensin-converting enzyme-inhibitor; ARB, angiotensin receptor blocker.
[a]Only patients with ST-elevation myocardial infarction.
[b]Only patients with non ST-elevation myocardial infarction.
[c]Non-adjusted *P*-value.
[d]OR adjusted on the propensity score.

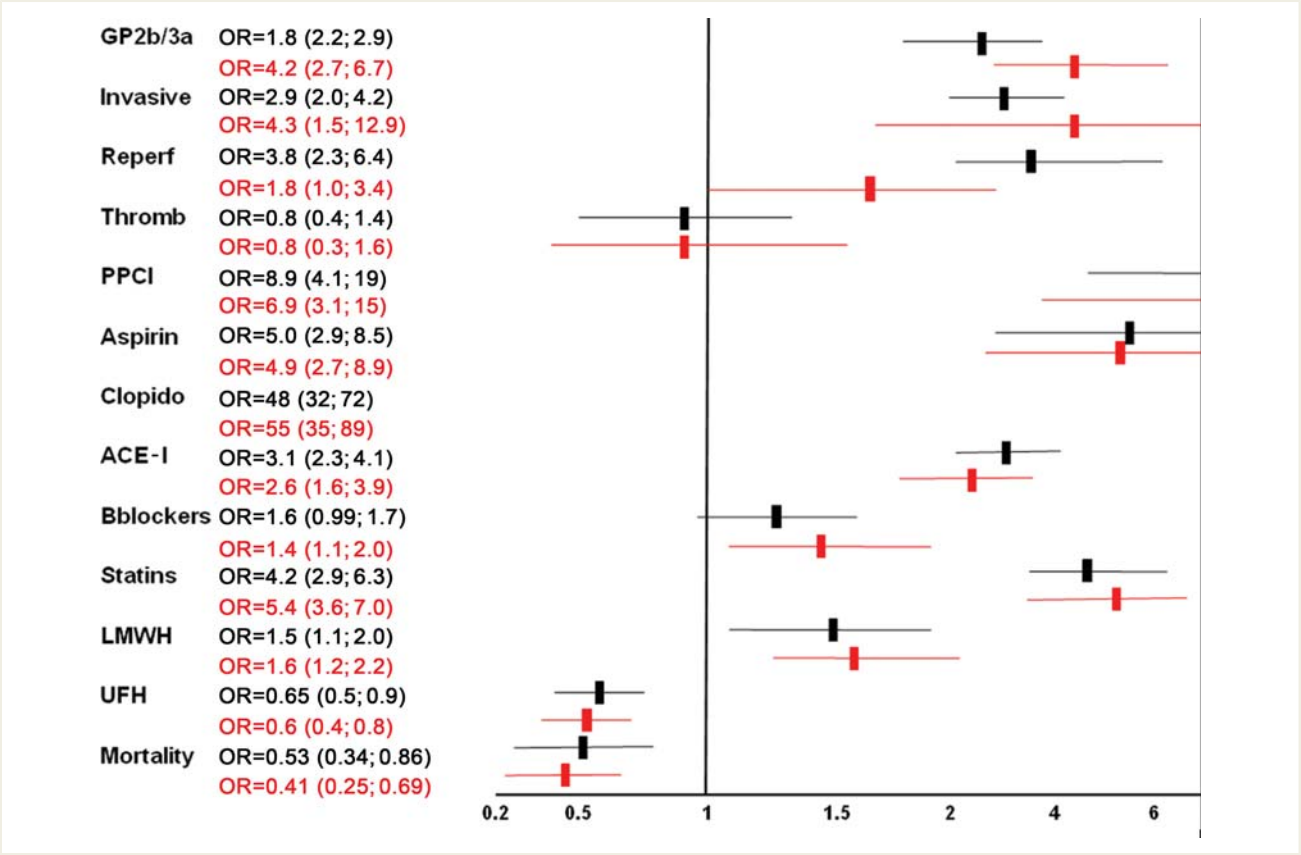

Figure 3 Odds ratios for the use of guideline-recommended treatments and for 30-day mortality in patients admitted in 2006 vs. 2001, adjusted on the strata of propensity score (for being admitted in 2001). In black non-adjusted odds ratio. In red, odds ratio adjusted on the propensity score. GP2b3a inhibitors, glycoprotein IIb/IIIa inhibitors; early invasive; coronary angiography within 72 h after admission (non-ST-elevation myocardial infarction patients); TLyse, thrombolytic therapy (ST-elevation myocardial infarction patients); PCI, percutaneous coronary intervention (ST-elevation myocardial infarction patients); ACE-I, angiotensin-converting enzyme-inhibitors; Bblock, beta-blockers; LMWH, low molecular weight heparin; UFH, unfractionated heparin.

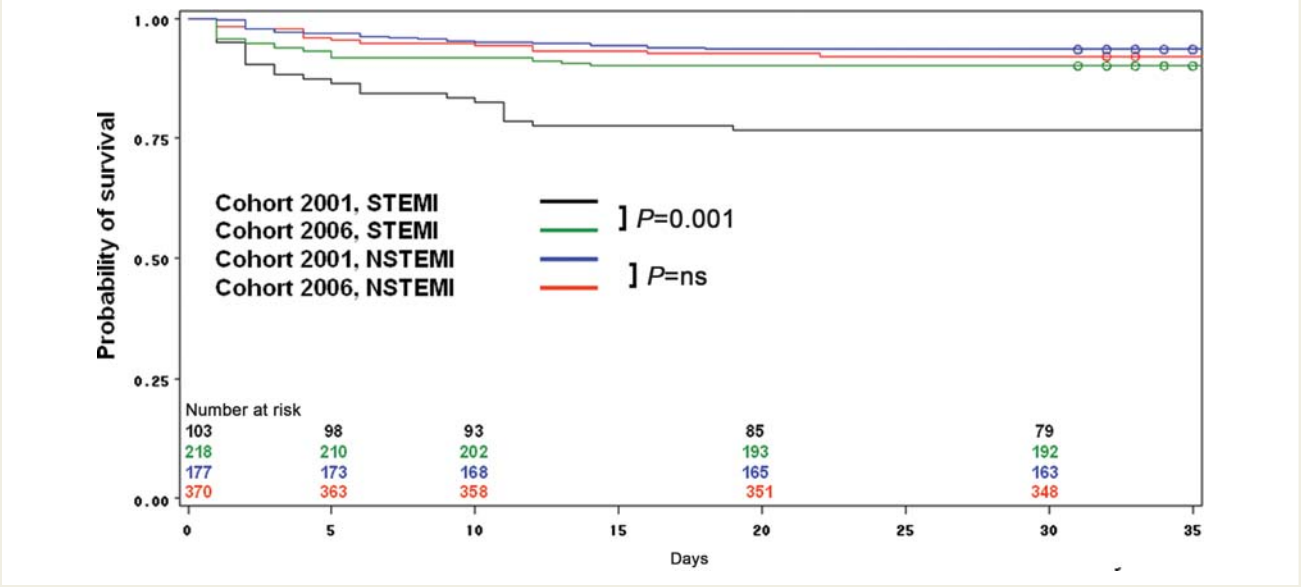

Figure 4 The Kaplan–Meier 30-day mortality curves of patients according to the type of infarction (with or without ST-segment elevation) and cohort (2001 vs. 2006).

Table 3 Predictors of 30-day mortality in elderly patients

Variables	Model without acute management		Model with acute management	
	Odds ratio	Wald 95%CI	Odds ratio	Wald 95% CI
Cohort (2001 vs. 2006)	3.0	1.7; 5.4	2.5	0.8; 6.1
Propensity score				
1 vs. 5	1.1	0.4; 5.5	1.7	0.5; 6.3
2 vs. 5	2.7	1.1; 6.2	4.5	1.3; 15.0
3 vs. 5	1.5	0.6; 3.7	2.0	0.6; 7.1
4 vs. 5	1.5	0.6; 3.9	1.7	0.5; 6.3
Age (per year)	1.06	1.01; 1.11	1.03	0.95; 1.10
Serum creatinine (per mmol/L)	1.005	1.003; 1.008	1.004	1.00; 1.01
NSTEMI vs. STEMI	2.1	1.25; 3.7	1.5	0.6; 3.9
Admission systolic blood pressure (per mmHg)	0.98	0.97; 0.99	0.98	0.97; 1.02
Admission heart rate (per b.p.m.)	1.01	1.001; 1.02	1.001	0.99: 1.02
Killip class (>2)	2.4	1.4; 2.5	3.0	1.4; 6.7
Aspirin use			1.4	0.4; 12.5
Beta-blocker use			0.3	0.15; 0.7
ACE-I use			0.4	0.2; 0.8
Statins use			0.9	0.4; 8.6
Unfractionated heparin			0.6	0.1; 1.6
LMWH			0.8	0.3; 2.3
Reperfusion or early invasive strategy			1.3	0.5; 3.04
Measures of fit				
AIC	423		250	
c-statistic	0.80		0.878	
P-value (Hosmer–Lemeshow)	0.57		0.85	

Comparison of results of logistic regression between models with vs. without acute management [aspirin, clopidogrel, invasive procedures (reperfusion in STEMI patients or early invasive strategy with glycoprotein IIb/IIIa inhibitors in NSTEMI patients), ACE-I (or ARB), beta-blockers, and statins]. STEMI, ST-segment elevation myocardial infarction; AIC, Akaike Information Criterion.

the period was offset when the rate of use of treatments were introduced.

Increase in treatment intensity in elderly

Registries have shown that elderly patients usually receive fewer effective treatments, despite being at higher risk.[3] The increase in the use of GRT over time, as shown in our study, is consistent with previous reports from large registries. Over a 5-year time interval, significant changes have been observed in the management of patients with ACS, not only in hospitals involved in an implementation programme,[16,17] but also in centres participating in large registries[11,18] or even in a broad set of hospitals as reported by the Joint Commission of Accreditation of Healthcare Organization.[19] In parallel, better clinical outcomes have been reported, such as decreases in mortality or incidence of heart failure.[18]

The considerable increase in the use of some indicators can be explained by the results of large randomized studies or changes in guidelines occurring in the meantime, such as for clopidogrel,[20,21] statins,[22] or ACE-inhibitors.[23] However, the increase in the use of aspirin, reperfusion, or early invasive therapy cannot be explained by changes in knowledge or guidelines, but may also be the result of implementation programmes or public campaigns highlighting early admission in case of suspicion of ACS. The higher rate of reperfusion by angioplasty in STEMI patients observed in our population is likely due to physician decisions and not because patients were admitted earlier; indeed, the elapsed time between onset of symptoms and admission did not change between 2001 and 2006.

Moreover, we cannot exclude that the mere fact of participating in the registry, may in itself have increased compliance with guidelines. In the Euro Heart Survey on ACS, a greater improvement with respect to the use of recommended medical therapy, intervention, and outcome had been observed in centres participating in multiple registries when compared with those participating in only one registry.[11]

Adverse effect of intensive treatment in the elderly

The comparison of 30-day mortality between the two cohorts indicates that, in our population, the increase in the use of GRT in elderly did not result in worse outcomes. In older patients, an increase in quality of care has been associated with better long-term survival in various medical conditions,[24] but in the setting of

ACS in particular, increased age is associated with an increased risk of drug-related adverse events, such as bleeding, caused by excess dosing of anti-thrombolytic drugs[7] and inappropriate prescription may be responsible for substantial mortality, morbidity, and economic burden.[25] Nonetheless, invasive procedures still improve in-hospital and 1-year survival.[1] In our study, the higher reperfusion rate was observed through wider use of primary angioplasty and less frequent use of thrombolytic therapy. This could be explained by the publication of results from large registries showing, in elderly, better outcomes after primary angioplasty than after thrombolysis.[26]

Reduction of mortality by intensive treatment in the elderly

In our study, the increase in the use of GRT in the population of elderly patients between 2001 and 2006 was contemporary with a significant decrease in mortality rate. Whether this better outcome was solely due to the changes in the use of GRT is difficult to ascertain. Decreases in mortality over time attributed to quality of care in MI patients have previously been reported,[9] but studies based on a historical comparison of two cohorts suffer from potential bias, since it is highly likely that the populations differed. Since only registry studies can supply useful information in this context, a solid methodology is mandatory. Despite having included all consecutive patients without exclusion from the same centres, using the same definitions, and with the data collected by the same research team, we nonetheless observed a difference in the level of risk particularly in patients with STEMI. To deal with this issue, we adjusted on a propensity score for inclusion in the first cohort. The propensity score was established from an extensive propensity score model to ensure that all variables related to treatment are included (both real and chance predictors). The propensity score was considered as satisfactory, with a range from 0.13 to 0.74 and a *c*-statistic value of 0.67. We adjusted on the propensity score by strata and not as a continuous variable since it was not likely that the propensity score would predict mortality linearly. This approach for the use of propensity scores, taken as a categorical variable in the prediction model, has previously been shown to be efficient.[27] After adjustment, there was no longer difference in patient characteristics, but the differences in the use of treatments and in mortality remained significant. In addition to this result, we observed that, in a multivariate model, a three-fold mortality was associated with admission in 2001 when compared with 2006, but this 'cohort' effect was no longer significant when the use of treatment was entered in the model.

Strengths and limitations

The design of the registry to include all patients admitted in all centres in a geographically delimited area, and the relatively short inclusion periods were chosen to reduce the risk of methodological bias. Adjustment on a propensity score has limited effect to reduce bias; other statistical methods for registry studies, such as the instrumental variable method, may possibly allow for a better control of potential bias, but we were not able to define an adequate 'instrumental variable', related to the period of inclusion but not directly related to the outcomes. We can assume that there was no economic confounding factor since, in the French medical insurance system, neither the patients nor the physicians are directly concerned with the cost of care. Nevertheless, despite the great attention paid, this study has several inherent limitations associated with cohort studies. We restricted the study to the comparison between two cohorts (2001 vs. 2006) because the data recorded in 2001–04 were incomplete, due to the organization of the registry. The geographic and time-specific design may limit the extrapolation of the results to other medical centres and patients. In this study, only 30-day mortality was assessed and not occurrence of cardiac failure, stroke, or non-fatal recurrence of ACS.

In conclusion, this registry study, focusing on an elderly population, confirmed that these patients represent a high risk and an under-treated population. Nevertheless, over a period of 5 years, a significant increase in the use of GRT was observed, and these changes in management were associated with a lower 30-day mortality. These data confirm that high-risk patients, such as the elderly patients benefit from an increase in the use of GRT.

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Conflict of interest: none declared.

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