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Management of myocardial infarction in the elderly. Insights from Spanish Minimum Basic Data Set

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Abstract

Background: We aimed to assess the impact of implementation of reperfusion networks, the type of hospital and specialty of the treating physician on the management and outcomes of ST segment elevation myocardial infarction in patients aged ⩾75 years.

Methods: We analysed data from the Minimum Basic Data Set of the Spanish public health system, assessing hospital discharges between 2004 and 2013. Discharges were distributed in three groups depending on the clinical management: percutaneous coronary intervention, thrombolysis or no reperfusion. Primary outcome measure was all cause in-hospital mortality. For risk adjustment, patient comorbidities were identified for each index hospitalization.

Results: We identified 299,929 discharges, of whom 107,890 (36%) were in-patients aged ⩾75 years. Older patients had higher prevalence of comorbidities, were less often treated in high complexity hospitals and were less frequently managed by cardiologists (p<0.001). Both percutaneous coronary intervention and fibrinolysis were less often performed in elderly patients (p<0.001). A progressive increase in the rate of percutaneous coronary intervention was observed in the elderly across the study period (from 17% in 2004 to 45% in 2013, p<0.001), with a progressive reduction of crude mortality (from 23% in 2004 to 19% in 2013, p<0.001). Adjusted analysis showed an association between being treated in high complexity hospitals, being treated by cardiologists and lower in-hospital mortality (p <0.001).

Conclusions: Elderly patients with ST segment elevation myocardial infarction are less often managed in high complexity hospitals and less often treated by cardiologists. Both factors are associated with higher in-hospital mortality.

Keywords

Myocardial infarction, elderly, mortality, percutaneous coronary intervention

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Introduction

Cardiovascular diseases are the leading cause of morbidity and mortality in elderly patients.[1] These patients are poorly represented in clinical trials,[2,3] so the evidence regarding their management is scarce. Frailty and comorbidities are associated with higher incidence of complications, mortality and overconsumption of healthcare resources.[4]

A few previous studies[5–9] assessed the benefit of reperfusion therapy in elderly patients with ST segment elevation myocardial infarction (STEMI). Elderly patients are often managed conservatively in routine clinical practice.[10] In contrast, some data suggest that very elderly patients may benefit from primary percutaneous coronary intervention (PCI).[11] An invasive strategy also has been found superior to a conservative one in elderly patients with non-ST segment elevation acute coronary syndromes.[12]

Little attention has been paid to the impact of geographic factors, healthcare policies and the type of treating hospitals on management and prognosis of elderly STEMI patients. The Resources and Quality in Cardiology (RECALCAR) project is a Spanish initiative[13] launched to evaluate the association of structure and management variables with outcomes in patients with heart disease.

The aim of this study was to assess the impact of the implementation of reperfusion networks and the type of treating hospitals on hospital mortality in patients with STEMI aged 75 years or older.

Methods

More information can be found in the Supplementary Material online.

Study setting, data source and population

We evaluated the data from the minimum basic data set (MBDS) of the Spanish National Health System, which includes admissions from acute general hospitals from 2004 to 2013. We selected discharges with STEMI being the 'principal diagnosis' (codes 410.*1, except: 410.71), defined by ICD-9-CM (International Classification Disease Ninth Review, Clinical Modification).[14] For 'crude'(non-risk-adjusted) and risk-adjusted statistics we analysed hospital discharges of patients ⩾35 years with primary discharge diagnosis of STEMI. Hospital discharges with a length of stay < 2 days were excluded only if the patient was transferred to another centre (*n*= 4374) in order to avoid duplication of episodes.[15–17] Hospitals with fewer than 25 STEMI discharges were also excluded.

Hospitals and services characteristics

Hospitals were classified into five groups: group 1, no structured cardiac unit: <1500 'cardiac disease' discharges a year, no specific coding for cardiac unit discharges or <500 cases coded for cardiology each year; group 2, structured cardiac unit without cathlab facility: ⩾ 1500 cardiac disease cases a year and that encodes ⩾ 500 discharges to cardiology, or that even encoding ⩾ 1500 cases does not perform, ⩾ 200 PCI a year; group 3, structured cardiac unit with cathlab facility, but without cardiac surgery department: ⩾ 1500 discharges of cardiac diseases per year, encoding ⩾ 500 cases to cardiology, performing ⩾ 200 PCI and <50 coronary artery bypass grafting procedures (CABG); group 4, structured cardiac unit with cathlab and cardiac surgery department: ⩾ 1500 discharges of cardiac disease per year, encoding ⩾ 500 cases to cardiology, performing ⩾ 200 PCI and ⩾ 50 CABG a year; and group 5, hospitals with cathlab facility and/or cardiac surgery, performing ⩾ 200 PCI and/or ⩾ 50 CABG a year, but without a structured cardiac unit (encoding < 500 cases to cardiology).

The services responsible for the treatment were considered to be either cardiology or any other service, excluding the intensive care unit when we compared outcomes between services.

Reperfusion strategies

We used ICD-9-CM codes to identify whether the patients received thrombolysis (V45.88, 99.10) or PCI (PCI; 00.66, 36.01, 36.02, 36.05, 36.06, and 36.07). Those patients without any of these codes were considered to have received medical therapy alone (no reperfusion). For patients with ⩾ 1 procedure code, we considered the least invasive therapy as the intended treatment. Patients who had thrombolysis and PCI were assigned to the thrombolysis group.

Regional healthcare network systems for STEMI. We considered the presence of regional healthcare network systems for STEMI, when the percentage of population coverage was higher than 50% in each Autonomous Community. The year of the development of organized systems of care for STEMI patients in each region[17] was double-checked using data from the National Cardiac Catheterization and Interventional Cardiology Annual Registry.[18] In 2003 only three of 16 regions had developed organized network systems of care for STEMI reperfusion by PCI covering 5% of the population of the aggregate of region. In 2012, 10 of 16 Autonomous Communities had complete or partial network systems of PCI reperfusion for STEMI patients, with 61% of population coverage. The implementation of the organized networks was progressive in the majority of regions.

In-hospital mortality risk adjustment. The primary outcome measure was all cause in-hospital mortality, defined as death during the hospitalization documented in the database. Risk-adjusted mortality rates were calculated using multilevel logistic regression models to account for the

Table 1. Patients with ST segment elevation myocardial infarction aged ⩾75 years in the Spanish national health system 2004–2013.

Year	Age groups						
	35–74	75–79	80–84	85–89	>89	Total	⩾ 74 / Total
2004	21,069	4,994	3,889	2,137	1,059	33,148	36.4%
2005	20,248	4,682	3,885	2,030	1,102	31,947	36.6%
2006	19,886	4,390	3,765	2,104	1,019	31,164	36.2%
2007	19,445	4,287	3,617	2,155	1,052	30,556	36.4%
2008	18,550	4,182	3,622	2,118	1,018	29,490	37.1%
2009	18,471	3,946	3,456	2,240	930	29,043	36.4%
2010	18,715	3,761	3,320	2,196	1,052	29,044	35.6%
2011	18,326	3,561	3,234	2,201	1,043	28,365	35.4%
2012	18,400	3,450	3,272	2,165	1,059	28,346	35.1%
2013	18,929	3,346	3,305	2,138	1,108	28,826	34.3%
Total	192,039	40,599	35,365	21,484	10,442	299,929	36.0%

clustering of observations within hospitals and differences in the number of admissions across hospitals.[13,19] We included variables identified as predictive predictors for mortality in acute myocardial infarction in a previous study (age, sex, shock, diabetes mellitus with complications, congestive heart failure, malignant tumour, cerebrovascular disease, pulmonary oedema, acute renal failure, chronic renal failure and arrhythmia)[13] and the Charlson Index.[20] For risk adjustment, patient comorbidities were identified from data for each hospitalization. Collineality among selected risk factors was low. This modelling strategy accounts for within-hospital correlation of the observed deaths and reflects the assumption that after adjusting for patient risk and sampling variability, the remaining variation is due to hospital quality of care. We calculated risk-standardized in-hospital mortality rate (RSMR) as the ratio of the predicted mortality (which considers, on an individual basis, the hospital in which the patient is being treated) to the expected mortality (which considers a standard functionality according to the average of all hospitals), multiplied by the crude mortality rate. Thus, if the RSMR of a hospital is higher than the crude mortality rate, the probability of a patient dying in that hospital is greater than the average of the hospitals considered.

Statistical analysis. Categorical variables were expressed by number and percentage. Quantitative variables were expressed as mean and standard deviation. Comparisons of categorical variables were performed with the Chi-square test and comparisons of quantitative variables were performed with the ANOVA test, correcting with the Bonferroni test for the level of significance. The discriminative ability of the models was assessed by the area under the receiver operating characteristics (ROC) curve. A logistic regression model, taking into account comorbidities, was developed to explore differences regarding STEMI management between age subgroups. For this analysis, the dependent variable was the group of patients aged ⩾75 years. Statistical significance was defined as a p value <0.05. Analyses were performed using STATA 13.0.

Results

We identified 299,929 discharges of STEMI, of whom 107,890 (36%) occurred in patients aged 75 years or older. The percentage of elderly patients remained around 35% across all study period (Table 1). Older patients were more often females, with higher prevalence of complicated diabetes, previous heart failure, stroke, renal failure and arrhythmia and higher values of Charlson index (Table 2). Significant differences were also observed regarding clinical management (Table 3). Older patients were less often managed in high complexity hospitals, and less often managed by cardiologists as compared with younger patients. Indeed, both rates decreased progressively as age increased (Table 2). Both PCI and fibrinolysis were less often performed as age increased (Table 2).

During 2004–2013, 30,062 patients (27.9%) ⩾75 years underwent PCI, 10,042 patients received thrombolysis (9.3%) and 67,786 were not treated with reperfusion therapy (62.8%). Of 10,042 patients undergoing thrombolysis, 2789 underwent thrombolysis + PCI. Table 4 describes the baseline characteristics, co-morbidities and in-hospital mortality in each group. Non-reperfused patients were older, with more comorbidities and more complications during the hospitalization. A progressive increase in the rate of PCI was observed in STEMI patients ⩾75 years across the study period (from 17% in 2004 to 45% in 2013, $p<0.001$; Figure 1), paralleling a decrease of the thrombolysis rate from 12% (2004) to 5% (2014). For the analysed period, the crude mortality rate for STEMI patients ⩾75 years was 9.7% in the PCI cohort, 20.8% in the thrombolysis group and 26.7% in the non-reperfused group ($p<0.001$). Crude mortality rate decreased in elderly patients from a 23% in 2004 to 19% in 2013 ($p<0.001$) (Figure 2).

Table 2. Baseline characteristics, management and outcomes according to age subgroups.

		Age										p
		35–74		75–79		80–84		85–89		>89		
		(A)		(B)		(C)		(D)		(E)		
Age, years (Mean, SD)		59.2 ± 9.9		77.0 ± 1.4		81.9 ± 1.4		86.7 ± 1.4		92.5 ± 2.6		
		N	%	N	%	N	%	N	%	N	%	
Men (%)		156,816 B C D E	81.7	25,324 C D E	62.4	18,977 D E	53.7	9,352 E	43.5	3,476	33.3	<0.001*
Treatment	**PCI**	96,111 B C D E	50.0	15,374 C D E	37.9	10,299 D E	29.1	3,674 E	17.1	715	6.8	<0.001*
	Thrombolysis	32,377 B C D E	16.9	5,071 C D E	12.5	3,406 D E	9.6	1,268 E	5.9	297	2.8	
	No reperfusion	63,551	33.1	20,154 A	49.6	21,66 A B	61.2	16,542 A B C	77.0	9,43 A B C D	90.3	
Shock (785.5)		9,089	4.7	3,63 A	8.9	3,415 A B	9.7	2,072 A B	9.6	918 A	8.8	<0.001*
DM complications (250.1–250.9)		6,429	3.3	2,263 A D E	5.6	1,883 A D E	5.3	993 A	4.6	433 A	4.1	<0.001*
Congestive heart failure (428.x)		24,092	12.5	9,396 A	23.1	10,183 A B	28.8	7,461 A B C	34.7	4,222 A B C D	40.4	<0.001*
Cerebrovascular disease (430.0–438.x)		4,943	2.6	2,443 A	6.0	2,396 A B	6.8	1,482 A B	6.9	668 A	6.4	<0.001*
Metastatic cancer, acute leukemia and other severe cancers (140.0–208.9)		3,041	1.6	1,331 A	3.3	1,28 A	3.6	796 A	3.7	326 A	3.1	<0.001*
Acute pulmonary edema (518.4, 514.x)		810	.4	426 A	1.0	462 A B	1.3	366 A B C	1.7	227 A B C D	2.2	<0.001*
Acute renal failure (584.x, 586.x, 788.5)		6,278	3.3	3,497 A	8.6	3,697 A B	10.5	2,695 A B C	12.5	1,536 A B C D	14.7	<0.001*
Chronic renal failure (585.x, 403.x, 404.x, 996.7, 394.2, 399.4, v451)		9,992	5.2	4,348 A	10.7	4,736 A B	13.4	3,303 A B C	15.4	1,783 A B C D	17.1	<0.001*
Arrhythmia (427.0–427.9)		30,452	15.9	10,115 A	24.9	9,809 A B	27.7	6,487 A B C	30.2	3,128 A B C	30.0	<0.001*
Charlson Index	**1**	84,431 B C D E	44.0	9,706 C D E	23.9	7,086 D E	20.0	3,781	17.6	1,86	17.8	<0.001*
	2	26,871 C D E	14.0	5,469 C D E	13.5	3,833 D E	10.8	1,894 E	8.8	787	7.5	
	⩾3	80,737	42.0	25,424 A	62.6	24,446 A B	69.1	15,809 A B C	73.6	7,795 A B C	74.7	
Mortality		10,523	5.5	6,168 A	15.2	7,39 A B	20.9	5,854 A B C	27.2	3,684 A B C D	35.3	<0.001*
Cardiology Unit		123,461 B C D E	64.3	22,479 C D E	55.4	18,484 D E	52.3	9,796 E	45.6	3,633	34.8	<0.001*
Regional healthcare network systems for STEMI		15,34 B	45.1	2,905	43.0	2.678	43.6	1,888 B	45.9	917 B	46.6	0.001*
Hospital & Cardiac Unit Typology	**1**	16,875	13.9	4,472 A	18.0	4,594 A B	20.6	3,597 A B C	25.1	1,979 A B C D	29.1	<0.001*
	2	9,125	7.5	2,209 A	8.9	2,273 A B	10.2	1,549 A B	10.8	836 A B C D	12.3	
	3	37,597 B C D E	31.0	7,341 E	29.5	6,405	28.7	4,042	28.2	1,864	27.4	
	4	55,541 B C D E	45.8	10,436 C D E	42.0	8,788 D E	39.3	4,954 E	34.6	2,036	29.9	
	5	2,034 C D	1.7	386	1.6	282	1.3	180	1.3	88	1.3	

*Capital letters show statistical significant differences between age groups.

Table 3. Logistic regression model. Clinical management according to age subgroups (patients ⩾75 vs <75 years).

	OR	S.E.	p	95% C.I. O.R.	
				Lower	Upper
Treatment			0.000		
Thrombolysis vs PCI	0.881	0.039	0.001	0.816	0.950
No reperfusion vs PCI	2.892	0.024	0.000	2.760	3.030
Cardiology vs other	0.807	0.026	0.000	0.767	0.849
Hospital & Cardiac Unit Typology			0.000		
2 vs 1	1.038	0.049	0.448	0.943	1.142
3 vs 1	0.894	0.034	0.001	0.837	0.955
4 vs 1	0.875	0.033	0.000	0.820	0.934
Regional healthcare network systems for STEMI	0.923	0.021	0.000	0.886	0.962

After adjusting for potential confounders, both being admitted to high complexity hospitals and being treated by cardiologists were associated with lower mortality in elderly patients. This model showed a very good discriminative ability to predict mortality in elderly patients (area under the ROC curve of 0.877; 95% confidence interval 0.875–0.879). RSMR was significantly lower for all age groups when PCI was performed, the discharge unit was cardiology, the discharge hospital had a unit with cathlab facility and a regional STEMI network was present (Table 5). RSMR decreased in elderly patients from 12.5% (SD 2.9) in 2004 to a 10.1% (SD 2.2) in 2013 ($p<0.001$) (Figure 2).

Discussion

The main findings from our study are: a) the rate of PCI in elderly patients with STEMI in Spain progressively increased across the study period, while in-hospital mortality progressively declined; b) elderly patients were less often managed by cardiologists and less often treated in high complexity hospitals, and c) both being managed in high complexity hospitals and treated by cardiologists were associated with a better prognosis.

Current guidelines[21] recommend the implementation of STEMI reperfusion networks. The number of STEMI networks substantially increased over the past 10 years in Spain.[22] The important increase of PCI rate across the study period observed in our series might be at least in part due to this fact. Similar findings have also been described in other countries across Europe.[23]

Several registries have consistently shown a lower rate of reperfusion in elderly patients.[10,24–28] This is an important issue, since the number of elderly patients will likely increase during the upcoming years. In addition, these patients are at higher risk for complications, longer hospital stay and mortality.[4] As in most registries, selection bias is noticeable in this series. We observed a progressive reduction in the percentage of patients receiving thrombolysis or PCI as age of patients increased. Reasons for a lower utilization of reperfusion in STEMI in elderly patients have not been fully elucidated. Atypical symptoms,[29] misdiagnosis, perception of short life expectancy by the treating physician and patient's preferences might partially explain this phenomenon. Adherence to guidelines' recommendations is also lower in patients at older ages.[30] Importantly, conservative strategy in these complex patients is not fully supported by clinical evidence, since elderly patients are often excluded from clinical trials. Some elderly patients with ACS are conservatively managed because of perception of short life expectancy, but others (especially in non-PCI capable hospitals) might be conservatively managed only because PCI is not immediately available. In our opinion, most patients who are conservatively managed might obtain some benefit from an invasive strategy. In fact, good outcomes have been described in octogenarian STEMI patients undergoing primary PCI,[31] and improved prognosis from primary PCI in very elderly patients has previously been suggested.[11]

As in previous data,[32] we also observed a trend towards increasing rate of reperfusion therapy in elderly patients, which was associated with a progressive reduction in mortality.

Several authors have described significant differences in clinical management of patients according to the complexity of treating hospitals. Patients admitted to PCI capable centres undergo more commonly an invasive strategy, are managed with higher levels of adherence to recommendations[33–35] and have lower mortality. We also found lower mortality and a higher rate of PCI in patients admitted to high complexity hospitals and treated by cardiologists,[13] thus suggesting a potential benefit of centralizing the care of patients in PCI capable hospitals. The proportion of patients treated in high-complexity centres and the proportion of patients managed by cardiologists progressively decreased as age of patients increased. Patients managed conservatively were

Table 4. Distribution of variables according to clinical management in patients aged ⩾ 75 years.

		Treatment Groups						p
		PCI		Thrombolysis		No reperfusion		
		(A)		(B)		(C)		
		N	%	N	%	N	%	
Episodes		30,062	27.9	10,042	9.3	67,786	62.8	
Age (Mean, SD)		80.1 ± 4.1 C		80.2 ± 4.2 C		83.2 ± 5.4 AB		<0.001
Men		18,376 BC	61.1	6,003 C	59.8	32,750	48.3	<0.001
Shock (785.5)		2,439	8.1	1,226 AC	12.2	6,370 A	9.4	<0.001
DM complications (250.1–250.9)		1,036	3.4	363	3.6	4,173 AB	6.2	<0.001
Congestive heart failure (428.x)		6,419	21.4	2,189	21.8	22,654 AB	33.4	<0.001
Cerebrovascular disease (430.0–438.x)		1,231	4.1	555 A	5.5	5,203 AB	7.7	<0.001
Metastatic cancer, acute leukemia and other severe cancers (140.0–208.9)		822 B	2.7	204	2.0	2,707 AB	4.0	<0.001
Acute pulmonary edema (518.4, 514.x)		225	.7	72	.7	1,184 AB	1.7	<0.001
Acute renal failure (584.x, 586.x, 788.5)		2,828 B	9.4	771	7.7	7826 AB	11.5	<0.001
Chronic renal failure (585.x, 403.x, 404.x, 996.7, 394.2, 399.4, v451)		3,742 B	12.4	718	7.1	9710 AB	14.3	<0.001
Arrhythmia (427.0–427.9)		7,780	25.9	2748 A	27.4	19011 A	28.0	<0.001
Charlson Index	**1**	7,863 C	26.2	2582 C	25.7	11988	17.7	<0.001
	2	3,715 C	12.4	1216 C	12.1	7052	10.4	<0.001
	⩾3	18,484	61.5	6244	62.2	48746 AB	71.9	<0.001
Mortality		2,901	9.7	2092 A	20.8	18103 AB	26.7	<0.001
Cardiology Unit		22,658 BC	75.4	4956 C	49.4	26778	39.5	<0.001
Regional healthcare network systems for STEMI		3,272 BC	49.2	249	19.9	4867 B	43.9	<0.001
Hospital & Cardiac Unit Typology	**1**	1,222	5.6	1518 A	26.7	11902 AB	29.1	<0.001
	2	480	2.2	954 AC	16.8	5433 A	13.3	<0.001
	3	6,943 C	31.9	1948 AC	34.2	10761	26.3	<0.001
	4	12,768 BC	58.7	1208	21.2	12238 B	29.9	<0.001
	5	321 B	1.5	61	1.1	554	1.4	<0.001

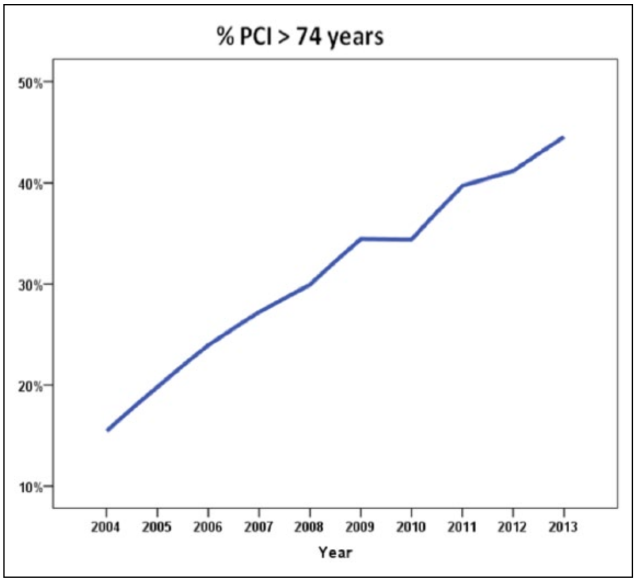

Figure 1. Rate of percutaneous coronary intervention (PCI) in patients aged ⩾75 years across the study period.

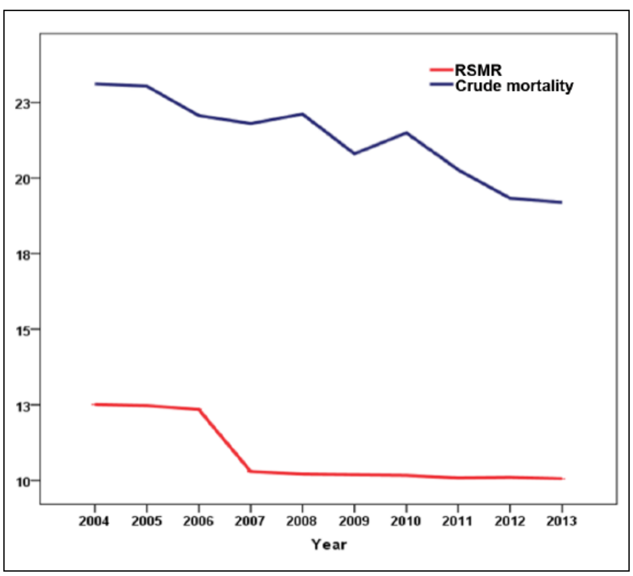

Figure 2. Trends for crude mortality and risk-standardized in-hospital mortality rate (RSMR) in patients ⩾75 years across the study period.

older and had more comorbidities. However, after adjusting for potential confounders the association between high complexity hospitals, management by cardiologists and lower mortality remained significant.

Our study has some limitations. This is an observational study, so we cannot exclude the effect of unmeasured confounding factors, as a bias selection of healthier patients for invasive management or the impact of 'do no resuscitation' (DNR) orders.[36] However, due to the advances in health care most patients currently reach 75 years in a good clinical condition, without frailty or disability. In our experience, a very low proportion of these patients have DNR at admission, so we believe that the confounding role of this variable should not be important in this series.

We did not capture data on important variables such as frailty and disability.[37–43] However, comorbidity was assessed by the Charlson index, which is an objective and reliable tool that has shown a strong association with mortality. In addition, a significant overlap between comorbidity, disability and frailty has also been described.[44] In our opinion, including comorbidity in the analysis can contribute to significantly reduce the confounding effect of frailty on the association between the type of treating hospitals and mortality.

Information about characteristics of transfers between hospitals was not available. In addition, it is a retrospective study based on administrative data, and it has the limitations inherent to mortality risk-adjustment. However, using administrative registries to assess results for health care services has been validated by comparing it with data from hospital records, and has also been successfully applied to research regarding outcomes of health services.[45,46] Data from the MBDS of Spanish health service are subject to quality auditing and provide reliable information.[13] Administrative databases do not give us much information on core metrics like door-to-balloon time or medication utilization. Secondary diagnoses employed as risk adjustment variables may correspond to conditions that are present on admission or to complications that, occasionally, may reflect inadequate treatment.[19] In contrast with the model developed by the Centers for Medicare & Medicaid Services, the mortality analysed in the present study does not refer to a standardized period of time, but to the duration of the episode.

Despite these limitations, data from this series show significant differences regarding characteristics and management of elderly patients with STEMI. This is one of the largest published series of non-selected elderly patients from routine clinical practice. A strong association was found between the type of treating hospitals and mortality, regardless of comorbidity. In our opinion, our data do not support a routine conservative management in elderly STEMI patients treated at non-PCI capable centres, since this approach was independently associated with a worse prognosis. In the absence of more solid scientific evidence regarding the optimal approach and the role of a comprehensive geriatric assessment in elderly STEMI patients,[38] these patients should be referred to complex PCI capable centres, in order to optimize their management and outcomes.

Conclusions

During the study period the rate of reperfusion therapy in elderly patients with STEMI increased and the mortality

Table 5. Ratio of Standardized Mortality Rate according to age groups, management performed, clinical unit, type of hospital and STEMI Regional Network.

		RSMR (%)				p
		75–79	80–84	85–89	>89	
		B	C	D	E	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Treatment	**PCI**	10.1 (2.8) CDE	9.9 (2.5) BD	9.7 (2.3) BC	9.7 (2.1) B	<.0001*
	Thrombolysis	11.4 (2.6)	11.3 (2.5)	11.2 (2.3)	11.3 (2.1)	
	No reperfusion	11.4 (2.9) CDE	11.3 (2.7) BDE	11.1 (2.4) BC	11.0 (2.2) BC	
Cardiology Unit		10.4 (2.9)	10.4 (2.8)	10.4 (2.5)	10.7 (2.5) BCD	<.0001*
Other clinical unit		11.6 (2.7) CDE	11.4 (2.5) BDE	11.2 (2.3) BCE	11.1 (2.1) BCD	
Hospital & Cardiac Unit Typology	**1**	11.0 (2.2) CDE	11.1 (2.2) BE	11.2 (2.0) BE	11.3 (1.9) BCD	<.0001*
	2	11.3 (2.5)	11.4 (2.3)	11.3 (2.1)	11.3 (1.8)	
	3	10.1 (2.3)	10.1 (2.3)	10.1 (2.1)	10.2 (1.9)	
	4	9.4 (2.0) CDE	9.5 (2.0) B	9.5 (1.8) B	9.6 (1.6) B	
	5	10.6 (1.9)	10.6 (1.8)	10.7 (1.7)	10.8 (1.5)	
Regional healthcare network systems for STEMI	**Yes**	8.6 (2.1) CDE	8.9 (2.1) BDE	9.3 (2.1) BCE	10.8 (1.9) BCD	0.001*
	No	10.5 (1.6) CDE	10.6 (1.6) BDE	10.8 (1.6) BC	9.6 (1.5) BC	

*Capital letters show statistical significant differences between age groups.

decreased. Despite this, elderly patients underwent reperfusion less commonly than younger patients, were less commonly managed at PCI capable centres, and were less often treated by cardiologists. This approach was associated with higher mortality.

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Conflict of interest

The authors declare that there is no conflict of interest.

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