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Original article

STEMI, primary percutaneous coronary intervention and recovering of life expectancy: insights from the SurviSTEMI study

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A B S T R A C T

Introduction and objectives: In the last few decades, there has been a continuous process of improvement in medical treatment and secondary prevention measures after ST-segment elevation myocardial infarction (STEMI). Patients older than 65 years are at increased risk of death due to this event. Our aim was to determine whether patients aged less than 65 years and 65 years and older experiencing a STEMI can recover a life expectancy similar to that of the general population of the same age, sex, and geographical region.

Methods: We included all patients experiencing a STEMI at our institution during a 6-year period in an observational-study (SurviSTEMI: survival in STEMI). We calculated their observed survival, expected survival, and excess mortality. We repeated all analyses for survivors of the acute event stratifying by 65 years.

Results: For patients aged < 65 years who survived the STEMI, observed survival at 3 and 5 years of follow-up was 97.68% (95%CI, 96.05%-98.64%) and 94.14% (95%CI, 90.89%-96.25%), respectively. Expected survival at 3 and 5 years was 98.12% and 96.61%. For patients ≥ 65 years who survived the STEMI, observed survival at 3 and 5 years was 85.52% (95%CI, 82.23%-88.24%) and 75.43% (95%CI, 70.26%-79.83%), respectively. Expected survival at 3 and 5 years was 86.48% and 76.56%, respectively.

Conclusions: For survivors of the acute event, life expectancy is fairly similar to that of the general population of the same age, sex, and geographical region.

IAMCEST, angioplastia primaria y recuperación de la esperanza de vida: ideas procedentes del estudio SurviSTEMI

Palabras clave:
Infarto agudo de miocardio
Esperanza de vida
Supervivencia a largo plazo

R E S U M E N

Introducción y objetivos: El tratamiento médico y las medidas de prevención secundaria en el infarto agudo de miocardio con elevación del segmento ST (IAMCEST) han experimentado una mejora progresiva en las últimas décadas. A pesar de ello, los pacientes > 65 años presentan un mayor riesgo de muerte tras un evento coronario. Nuestro objetivo fue evaluar si los pacientes < y ≥ 65 años pueden recuperar una esperanza de vida similar a la de la población general de la misma edad, sexo y área geográfica.

Métodos: Todos los pacientes que sufrieron un IAMCEST en los últimos 6 años en nuestro centro fueron incluidos en un estudio observacional (SurviSTEMI: survival in STEMI). Se calculo la supervivencia observada, la supervivencia esperada y el exceso de mortalidad. Se repitieron todos los análisis estratificando por grupo etario < y ≥ 65 años.

Resultados: Para los pacientes < 65 años, la supervivencia observada a los 3 y 5 años fue del 97,68% (IC95%, 96,05-98,64%) y 94,14% (IC95%, 90,89-96,25%), respectivamente. La supervivencia observada a los 3 y 5 años fue del 98,12% y 96,61%. Para los pacientes ≥ 65 años, la supervivencia esperada a los 3 y 5 años fue del 85,52% (IC95%, 82,23-88,24%) y 75,43% (IC95%, 70,26-79,83%), respectivamente. La supervivencia esperada a los 3 y 5 años fue del 86,48 y 76,56%.

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Conclusiones: Los supervivientes del IAMCEST presentan una esperanza de vida similar a la de la población general de la misma edad, sexo y área geográfica.

Abbreviations

PCI: percutaneous coronary intervention
STEMI: ST-segment elevation myocardial infarctions

INTRODUCTION

Acute coronary syndrome represents one of the most relevant cardiovascular disorders worldwide and its prevalence is growing in elderly individuals. Coronary ischemic heart disease affects older adults disproportionately; in fact, it is estimated that more than 60% of ST-segment elevation myocardial infarctions (STEMIs) occur in patients aged 65 years or older.[1] In addition, age is one of the most important factors related to short- and long-term survival. More than 80% of all deaths associated with myocardial infarction occur in patients older than 65 years.[2] However, older patients are often underrepresented in clinical trials and long-term outcomes after STEMI have not been thoroughly studied.[3] Delays in the diagnosis of STEMI have been well documented in older adults and delay appropriate therapy. Several characteristics such as atypical onset, left bundle branch block and concomitant acute heart failure are much more common in patients aged 65 years or older. This particular profile could explain the higher in-hospital mortality rate in this group of patients.[3,4]

In the current era, short- and long-term mortality following STEMI has been improved with the widely standardized use of emergent reperfusion therapies, especially primary percutaneous coronary intervention (PCI), contemporary antithrombotic regimens, and intensive secondary prevention measures.[3–5] Nevertheless, mortality caused by STEMI remains relevant, with 1 year mortality being up to 10%.[6,7] Furthermore, the 30-day mortality rate is crucial within the first year of follow-up, consistently showing the highest death rates during this period.[8]

Despite the clear influence of age on long-term survival after STEMI,[9] prospective longitudinal studies rarely follow patients beyond the first year after the event.[3] It is unknown whether patients experiencing a STEMI could have a life expectancy similar to that of the general population of the same age, sex, and geographical region. Studying life expectancy is complex since it depends on social, economic, and geographical factors that could explain variations even among developed countries.[10]

The main objective of the SurviSTEMI (Survival in STEMI) study was to analyze whether patients with STEMI treated with primary PCI have a life expectancy similar to that of the general population for the same age, sex, and geographical area focusing on differences between 2 age groups (< 65 and ≥ 65 years).

METHODS

Selection of the STEMI sample and matching with the general population

All patients experiencing a STEMI and treated with primary PCI at our institution from March 2014 to March 2020 were included in the SurviSTEMI study. More than 250 patients with STEMI are usually treated at our institution by a team of interventional cardiologists with more than 10 years of experience.

The reference population was constructed using the mortality tables provided by the National Institute of Statistics (INE).[11] These tables can be consulted for different age ranges, sex and regions and are available on the official INE website. To compare survival in patients with STEMI with that in the general population, we used the INE data to match all patients in our sample with people of the same age, sex, and geographical area. More information about this process can be consulted in the section about the statistical process.

Data collection

For this retrospective study, baseline characteristics, in-hospital data and treatments at hospital discharge were collected from a prospectively collected database. One of the researchers collected the data on the follow-up. All hospitals and clinics in our region are connected by intranet, so all medical records of each patient can be easily consulted from our institution. As a general rule, patients were treated at discharge following optimal medical treatment according to European Society of Cardiology Guidelines.[3]

Causes of death were defined according to the Academic Research Consortium consensus guidelines.[12]

This investigation was approved by the local Ethics Committee the Hospital Universitario Central de Asturias with the reference number 2020.184.

Primary endpoints

a) To compare survival of patients aged less than 65 years who experienced a STEMI with that of the general population of the same age, sex, and geographical region.
b) To compare survival of patients aged 65 years or older experiencing a STEMI with that of the general population of the same age, sex, and geographical region.

Secondary endpoints

To compare survival of patients older than 80 years experiencing a STEMI with that of the general population of the same age, sex, and geographical region.

Statistical process

Quantitative and categorical variables are expressed as mean ± standard deviation and No. (%).

To compare survival of patients experiencing a STEMI with that of the general population of the same sex, age and region, we calculated the following estimates: *a)* observed survival, *b)* expected survival and *c)* excess mortality due to the disease.[13–16]

a) Observed survival is the survival of our sample estimated with the usual actuarial method. This estimate is presented with its 95%CI.

Table 1
Baseline characteristics and intervention characteristics

Variable	Age < 65 y (n = 899)	Age ≥ 65 y (n = 823)	*P*
Baseline characteristics			
Age, y	54.21 ± 7.01	75.27 ± 7.43	.0001
Sex			
Male	766 (85.21)	549 (6.71)	.0001
Female	133 (4.79)	274 (33.29)	
Hypertension	313 (34.82)	487 (59.17)	.0001
Diabetes	150 (16.69)	235 (28.55)	.0001
Dyslipidemia	361 (40.16)	346 (42.04)	.4269
Smoking			
Nonsmoker	175 (19.47)	495 (60.15)	
Exsmoker	31 (3.45)	16 (1.94)	
Smoker	693 (77.09)	312 (37.91)	
CKD	19 (2.11)	84 (10.21)	.0001
Previous MI	106 (11.79)	124 (15.07)	.0449
Previous PCI	94 (10.46)	93 (11.30)	.5739
Previous CABG	6 (0.67)	14 (1.70)	.0455
Intervention characteristics			
Access			.0001
Femoral	235 (26.14)	298 (36.21)	
Radial	662 (73.64)	521 (63.30)	
Humeral	2 (0.22)	4 (0.49)	
Culprit artery			.0724
Left main	25 (2.75)	35 (4.25)	
LAD	348 (38.71)	350 (42.53)	
LCX	133 (14.79)	96 (11.96)	
RCA	384 (42.71)	333 (40.46)	
Intermediate	8 (0.89)	5 (0.61)	
Graft	1 (0.11)	4 (0.49)	
Multivessel disease	346 (38.49)	386 (46.9)	.0004
Stents implanted, No.	1.31 ± 0.75	1.32 ± 0.85	.8240
IABP	62 (6.90)	59 (7.17)	.8252
LVAD	13 (1.45)	6 (0.73)	.1548
Failed PCI	21 (2.34)	37 (4.50)	.0131
Killip Kimball class			
I	738 (84.15)	541 (69.99)	
II	39 (4.45)	103 (13.32)	
III	13 (1.37)	31 (4.01)	
IV	88 (10.03)	98 (12.68)	
Vascular complications	6 (0.67)	15 (1.82)	.0291
Arrhythmia	66 (7.34)	51 (6.20)	.3458
Endotracheal intubation	40 (4.45)	30 (3.65)	.3986
Hs-TnT, pg	5029 ± 8969	5637 ± 7753	.1578
LVEF at discharge	53.09 ± 10.21	50.30 ± 11.13	.0001
LVEF < 30%	35 (3.89)	64 (7.68)	.005
Moderate or severe valve disease	28 (3.28)	99 (13.1)	.0001
CI-AKI	105 (11.68)	172 (20.90)	.0001
Death during the intervention	9 (1)	12 (1.46)	.3881

CABG, coronary artery bypass grafting; CI-AKI, contrast-induced acute kidney injury; CKD, chronic kidney disease; Hs-TnT, high-sensitivity troponin T; IABP, intra-aortic balloon pump; LAD, Left anterior descendant artery; LCX, left circumflex artery; LVAD, left ventricular assist device; LVEF, left ventricular ejection fraction; MI, myocardial infarction; PCI, percutaneous coronary intervention; RCA, Right coronary artery.
The data are expressed as No. (%) or mean ± standard deviation.

b) Expected survival is the survival of the general population for the same age, sex, and geographical region. In other words, the expected survival is the survival that this sample would have had if they had not had the STEMI. This measure uses mortality tables of the National Institute of Statistics representing the people in our geographical region with the same age and sex. It is calculated with the Ederer II method, which is the method of choice.[13] This allows matching of a sample of individuals with aggregated data of the general population. Since data come from all the people of the region, the expected survival has no

Table 2
Causes of death

Deaths < 30 d (n = 146)			
Variable	Age < 65 y (n = 51)	Age ≥ 65 y (n = 95)	*P*
Acute MI and complications	51 (100)	95 (100)	.0685
MI	27 (52.94)	37 (38.5)	
Sudden death	0 (0)	3 (3.16)	
Heart failure	11 (21.57)	34 (35.79)	
Stroke	3 (5.88)	5 (5.56)	
Procedural complication	4 (7.84)	10 (10.53)	
Mechanical complication	3 (5.88)	4 (4.21)	
Arrhythmic storm	3 (5.88)	2 (2.11)	
Deaths after discharge or > 30 d (n = 131)			
Variable	Age < 65 y (n = 9)	Age ≥ 65 y (n = 37)	
Cardiovascular cause			.5578
Acute MI and complications	2 (22.22)	18 (48.65)	
Sudden cardiac death	3 (33.33)	1 (2.70)	
Heart failure	2 (22.22)	11 (29.73)	
Stroke	2 (22.22)	4 (10.81)	
CV procedure	0 (0)	1 (2.70)	
Other CV cause	0 (0)	2 (5.41)	
	Age < 65 y (n = 15)	Age ≥ 65 y (n = 70)	.0003
Noncardiovascular cause			
Malignancy	13 (86.67)	23 (32.86)	
Pulmonary causes	0 (0)	4 (5.71)	
Infection	1 (6.67)	11 (15.71)	
Accident or trauma	0 (0)	3 (4.29)	
Other non-CV organ failure	1 (6.67)	3 (4.29)	
Other non-CV cause	0 (0)	12 (17.14)	
Unknown	0 (0)	14 (20)	

CV, cardiovascular; MI, myocardial infarction.
The data are expressed as No. (%).

sampling error and thus no confidence interval is estimated. If the expected survival is not included in the 95%CI of the observed survival, there is a statistically significant difference.

c) Excess mortality is the mortality that the patients of the sample show due only to the event or its consequences. In other words, it is the mortality that they would have in the theoretical assumption that they could only die from this event or its consequences. Therefore, an excess mortality of 5% indicates that 5% of the patients have died from STEMI. An excess mortality of 0% indicates that no patients have died due to the event and therefore that all deaths were from other causes. This estimation is 1 – relative survival.[13,14,17,18] The relative survival is the survival in the theoretical assumption that the patients could only die from the disease. Unlike competing risk analysis, which needs to know the causes of death, the relative survival approach does not need to know the causes of death. Causes of death are unknown or unreliable in many observational studies, probably including our own. It uses the expected survival of a group of the general population matched by age, sex, and year and provides a measure of the excess mortality experienced by patients experiencing a STEMI, regardless of whether this mortality is directly or indirectly (complications of the primary PCI such as thrombosis, restenosis, etc) attributable to the STEMI.[19] The system compares the incidence of death during a given year in the sample with that of the general population, taking into account that it may change from one year to another. The excess mortality is followed by its 95% confidence interval (95%CI). A statistically significant excess mortality is considered to exist when the 95%CI does not include the value 0%.

Table 3
Medication at discharge

	Total (n = 1576)	< 65 (n = 848)	≥ 65 (n = 728)	*P*
Medication				
ASA	1559 (98.92)	839 (98.94)	720 (98.90)	.9426
ADP	1554 (98.6)	840 (99.06)	714 (98.08)	.0984
Clopidogrel	980 (63.06)	409 (48.69)	571 (79.97)	
Ticagrelor	538 (34.62)	409 (48.69)	129 (18.07)	
Prasugrel	36 (2.32)	22 (2.62)	14 (1.96)	
BB	1449 (91.94)	798 (94.10)	651 (89.42)	.6621
ACE/ARB	1071 (67.96)	576 (67.92)	495 (69.32)	.9763
Statins	1519 (96.44)	840 (99.06)	679 (93.26)	.0001
OAC	120 (7.61)	33 (3.89)	87 (11.95)	.0001
AVK	65 (54.16)	17 (51.52)	48 (55.17)	
DOAC	55 (45.83)	16 (48.48)	39 (44.83)	
MRA	89 (5.65)	40 (4.72)	49 (6.73)	.0842

ACE, angiotensin converting enzyme inhibitors; ADP, adenosine diphosphate receptor antagonists; ARB, angiotensin II receptor blockers; ASA, acetylsalicylic acid; AVK, anti-Vitamin K; BB, beta-blockers; DOAC, direct oral anticoagulants; MRA, mineralocorticoid receptor antagonists; OAC, oral anticoagulants.
The data are expressed as No. (%).

All analyses were performed with STATA v.15.1 (STATA Corp, United States). The "strs" command[19] was used to calculate the observed survival, expected survival, and excess mortality.

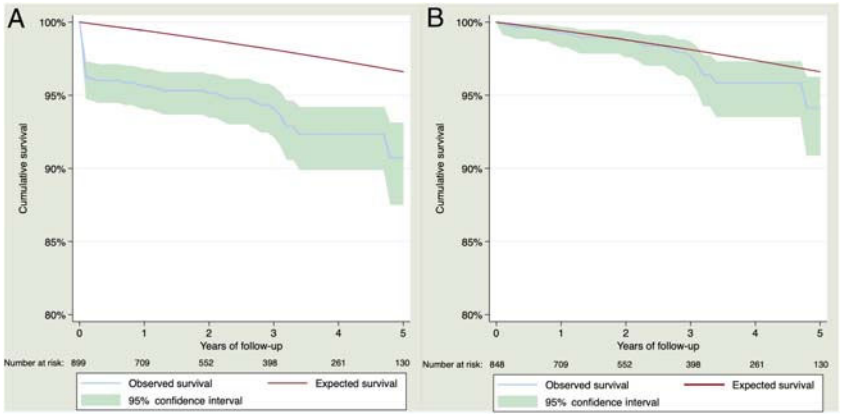

Figure 1. Observed and expected survival after STEMI in patients younger than 65 years. A: all patients. B: patients surviving 30 days after the STEMI. STEMI, ST-segment elevation myocardial infarction.

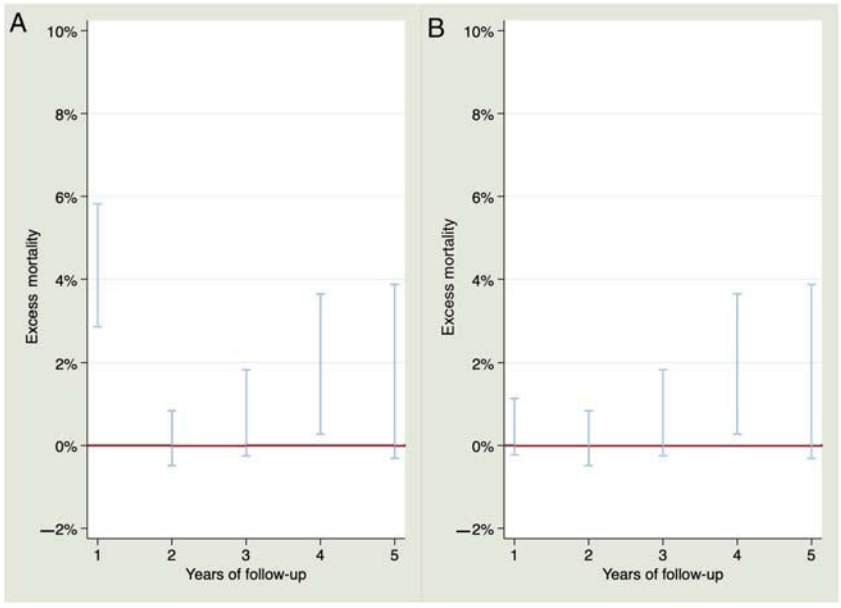

Figure 2. Excess mortality or mortality due to the event in patients younger than 65 years after the STEMI. A: all patients. B: patients surviving 30 days after the STEMI. STEMI, ST-segment elevation myocardial infarction.

RESULTS

Baseline and characteristics of the procedure

During the study period, we included 1722 patients, 1315 (76.36%) patients were male and the mean age was 64.76 ± 13.24 years. Patients in the group aged less than 65 years had a lower prevalence of comorbidities, with lower rates of hypertension, diabetes, dyslipidemia, chronic kidney disease, and previous coronary artery disease. Conversely, patients in the group aged 65 years and older had a lower prevalence of smoking. Details of the baseline characteristics can be seen in table 1.

The radial approach was the preferred vascular access in 1183 patients (68.7%). The most frequent vessel affected was the right coronary artery in 717 patients (41.64%) followed by the left anterior descending artery in 698 (40.53%) patients. Most patients presented in Killip Kimball class I, with 1279 (77.52%) patients.

There were 161 (9.35%) intraprocedural complications, 21 (1.22%) patients had vascular complications, 117 (6.79%) had arrhythmic complications, 70 (4.07%) required mechanical ventilation, and 21 (1.22%) died during the procedure. There were 146 (8.48%) deaths during admission or the first 30 days; among them, 35 patients (23.97%) had left ventricular ejection fraction < 30%.

Detailed procedural and discharge data can be seen in table 1.

Causes of death can be consulted in table 2. Medical treatments at discharge are detailed in table 3.

Observed survival, expected survival, and excess mortality in patients < 65 years

There were 899 (52.21%) patients younger than 65 years. The mean age was 54.21 ± 7.01 years and 133 (14.79%) were women. Mean follow-up of the censored observations was 34.89 ± 20.84 months. Minimum and maximum follow-up was 1.38 and 72.15 months. There were 75 (9.11%) deaths. Causes of death can be consulted in table 2.

Observed survival at 1, 2, 3, 4 and 5 years of follow-up was 95.62% (95%CI, 94.03%-96.79%), 95.16% (95%CI, 93.48%-96.42%), 94.12% (95%CI, 92.16%-95.61%), 92.33% (95%CI, 89.91%-94.20%) and 90.71% (95%CI, 87.51%-93.12%) while expected survival was

Table 4
Observed and expected survival during the follow-up of patients younger than 65 years. Excess mortality by annual intervals are also calculated

Year of follow-up	Cumulative survival of patients with STEMI (observed survival)	Cumulative survival in the reference group (expected survival)	Annual excess mortality*
All patients			
First year	95.62 (94.03-96.79)	99.43	4.12 (2.87-5.82)
Second year	95.16 (93.48-96.42)	98.79	–0.16 (–0.48-0.84)
Third year	94.12 (92.16-95.61)	98.12	0.36 (–0.25-1.82)
Fourth year	92.33 (89.91-94.20)	97.39	1.37 (0.27-3.64)
Fifth year	90.71 (87.51-93.12)	96.61	0.72 (–0.31-3.88)
Patients surviving 30 d			
First year	99.23 (98.29-99.65)	99.43	0.19 (–0.23-1.14)
Second year	98.76 (97.61-99.36)	98.79	–0.16 (–0.48-0.84)
Third year	97.68 (96.05-98.64)	98.12	0.36 (–0.25-1.82)
Fourth year	95.82 (93.55-97.31)	97.39	1.37 (0.27-3.65)
Fifth year	94.14 (90.89-96.25)	96.61	0.73 (–0.31-3.88)

STEMI, ST-segment elevation myocardial infarction.
The data are expressed as percentage (95%CI).
* Relative survival calculated by interval. This is not a cumulative estimation.

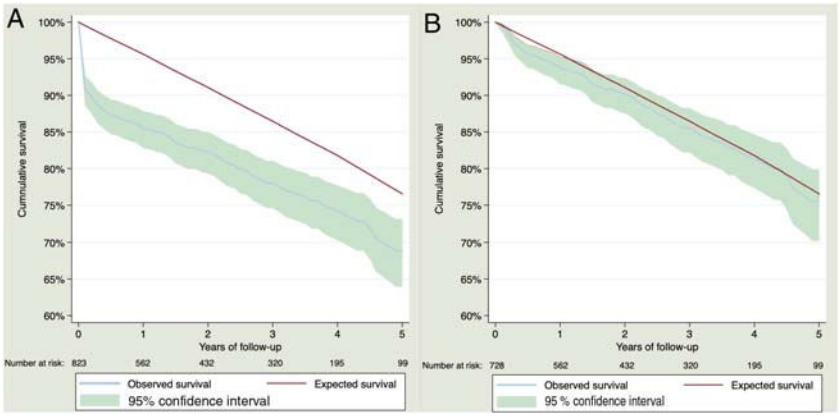

Figure 3. Observed and expected survival after STEMI in patients 65 years or older after the STEMI. A: all patients. B: patients surviving 30 days after the STEMI. STEMI, ST-segment elevation myocardial infarction.

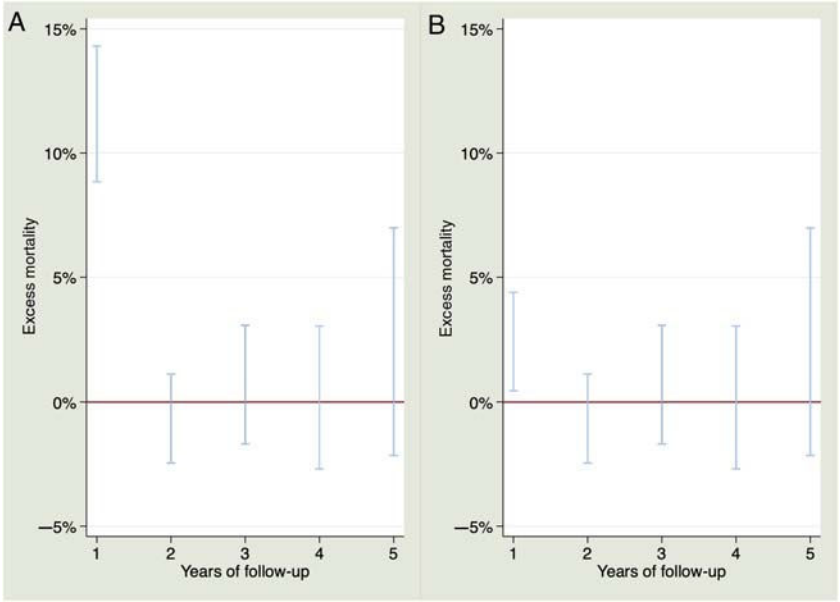

Figure 4. Excess mortality or mortality due to the event in patients 65 years or older after the STEMI. A: all patients. B: patients surviving 30 days after the STEMI. STEMI, ST-segment elevation myocardial infarction.

Table 5
Observed and expected survival for patients 65 years or older. Excess mortality by annual intervals are also calculated

Year of follow-up	Cumulative survival of patients with STEMI (observed survival)	Cumulative survival in the reference group (expected survival)	Annual excess mortality
All patients			
First year	85.49 (82.80-87.78)	95.64	11.36 (8.85-14.30)
Second year	82.32 (79.35-84.90)	91.08	–1.05 (–2.46-1.12)
Third year	78.03 (74.62-81.04)	86.47	0.21 (–1.69-3.09)
Fourth year	74.20 (70.31-77.66)	81.79	–0.54 (–2.69-3.06)
Fifth year	68.82 (63.96-73.16)	76.55	1.20 (–2.16-6.98)
Patients surviving 30 d			
First year	93.69 (91.59-95.29)	95.64	2.15 (0.45-4.39)
Second year	90.22 (87.61-92.31)	91.09	–1.05 (–2.46-1.12)
Third year	85.52 (82.23-88.24)	86.48	0.21 (–1.69-3.06)
Fourth year	81.32 (77.3884.65)	81.80	–0.54 (–2.69-3.06)
Fifth year	75.43 (70.26-79.83)	76.56	1.20 (–2.17-6.98)

STEMI, ST-segment elevation myocardial infarctions. The data are expressed as percentage (95%CI).

99.43%, 98.79%, 98.12%, 97.39% and 96.61%. Observed and expected survival curves can be consulted in figure 1A. There was statistically significant excess mortality during the first year of 4.12% (95%CI, 2.87%-5.82%). For the second year, there was no excess mortality –0.16% (95%CI, –0.48-0.84%). For the third, fourth and fifth years of follow-up, the excess mortality was 0.36% (95%CI, –0.25%-1.82%), 1.37% (95%CI, 0.27%-3.64%) and 0.72% (95%CI, –0.31%-3.88%), respectively. A visual representation of the excess mortality can be consulted in figure 2A.

For patients who survived 30 days after STEMI, observed survival at 1, 2, 3, 4 and 5 years of follow-up was 99.23% (95%CI, 98.29%-99.65%), 98.76% (95%CI, 97.61%-99.36%), 97.68% (95%CI, 96.05%-98.64%), 95.82% (95%CI, 93.55%-97.31%), and 94.14% (95%CI, 90.89%-96.25%), respectively. Expected survival for 1, 2, 3, 4 and 5 years was 99.43%, 98.79%, 98.12%, 97.39%, and 96.61%, respectively. Observed and expected survival curves can be consulted in figure 1B. The excess mortality during the first year disappeared 0.19% (95%CI, –0.23%-1.14%). For the second, third, fourth and fifth year of follow-up, there was no excess of mortality, –0.16% (95%CI, –0.48%-0.84%), 0.36% (95%CI, –0.25%-1.82%), 1.37% (95%CI, 0.27%-3.65%) and 0.73% (95%CI, –0.31%-3.88%), respectively. A visual representation of the excess mortality can be consulted in figure 2B.

Table 4 shows observed survival, expected survival and annual excess mortality for patients younger than 65 years after STEMI.

Observed survival, expected survival, and excess mortality in patients ≥ 65 years

There were 823 (47.79%) patients older than 65 years. The mean age was 75.27 ± 7.43 years and 274 (33.29%) were women. Mean follow-up of censored observations was 34.27 ± 21.06 months. Minimum and maximum follow-up was 1.58 and 72.28 months. There were 202 (24.54%) deaths. Causes of death can be consulted in table 2.

Observed survival at 1, 2, 3, 4 and 5 years of follow-up was 85.49% (95%CI, 82.80%-87.78%), 82.32% (95%CI, 79.35%-84.90%), 78.03% (95%CI, 74.62%-81.04%), 74.20% (95%CI, 70.31%-77.66%), and 68.82% (95%CI, 63.96%-73.16%), while expected survival was 95.64%, 91.08%, 86.47%, 81.79%, and 76.55%%. Observed and expected survival curves can be consulted in figure 3A. There was an excess mortality of 11.36% (95%CI, 8.85%-14.30%). There was no excess mortality for the rest of the years. For the second, third, fourth and fifth years of follow-up, the excess mortality was –1.05% (95%CI, –2.46%-1.12%), 0.21% (95%CI, –1.69%-3.09%), –0.54% (95%CI, –2.69%-3.06%) and 1.20% (95%CI, –2.16%-6.98%), respectively. A visual representation of the excess of mortality can be consulted in the figure 4A.

For patients who survived 30 days after the STEMI, observed survival at 1, 2, 3, 4 and 5 years of follow-up was 93.69% (95%CI, 91.59%-95.29%), 90.22% (95%CI, 87.61%-92.31%), 85.52% (95%CI, 82.23%-88.24%), 81.32% (95%CI, 77.38%-84.65%) and 75.43% (95%CI, 70.26%-79.83%), respectively. Expected survival for 1, 2, 3, 4 and 5 years was 95.64%, 91.09%, 86.48%, 81.80%, and 76.56%, respectively. Observed and expected survival curves can be consulted in figure 4A. The excess mortality during the first year was low but did not disappear, being 2.15% (95%CI, 0.45%-4.39%). For the second, third, fourth and fifth year of follow-up, there was no excess mortality, –1.05% (95%CI, –2.46%-1.12%), 0.21% (95%CI, –1.69%-3.06%), –0.54% (95%CI, –2.69%-3.06%) and 1.20% (95%CI, –2.17%-6.98%), respectively. A visual representation of the excess mortality can be consulted in figure 4B.

Table 5 shows observed survival, expected survival and annual excess mortality for patients ≥ 65 years after STEMI.

Observed survival, expected survival and excess mortality for patients 80 years and older

There were 303 (17.60%) patients older than 80 years. The mean age was 84.75 ± 3.67 years. Observed survival at 1, 2, 3, 4 and 5 years was 78.30 (95%CI, 73.03%-82.66%), 72.79% (95%CI, 66.97%-77.76%), 67.10% (95%CI, 60.68%-72.71%), 60.53% (95%CI, 53.37%-66.94%), and 53.82% (95%CI, 45.59%-61.35%), respectively. Expected survival was 91.58%, 83.01%, 75.04%, 67.41%, and 59.35%).

Excess mortality during the first year was 15.65% (95%CI, 10.70%-21.61%) but disappeared for the rest of the years. For the second, third, fourth and fifth year of follow-up, the excess mortality was –2.67% (95%CI, –5.95%-2.86%), –2.39% (95%CI, –6.18%-4.31%), –0.46% (95%CI, –5.49%-8.54%), and –0.52% (95%CI, –7.47%-13.38%).

DISCUSSION

The main finding of SurviSTEMI study was that patients aged 65 years and older had a significant risk of death during the first 30 days after STEMI. Nevertheless, patients surviving the first year enjoyed a life expectancy similar to that of the general population of the same age, sex, and geographical region. Young patients (younger than 65 years) had a lower risk during the first 30 days.

However, these patients maintained a small risk of death during the years following the STEMI.

Many studies have analyzed the effect of age on the long-term survival of patients experiencing a STEMI. The roles of emergent revascularization and intense secondary prevention therapies in improving survival have also been extensively investigated.[3,19–22] Our study provides additional and original information on this setting, as to date, it has been unknown whether long-term mortality of these patients remains elevated compared with that of the general population after the initial critical period.

We took advantage of a large cohort of STEMI patients treated in an experienced center, which is the referral center of the region. To directly compare their life expectancy with that of the general population, we used data provided by the Spanish National Statistics Institute, matching by the same age, sex, and geographical region.[11] Our series shows a real-life cohort of STEMI patients treated with primary PCI at a high-volume center by experienced operators and with high rate of guideline-directed secondary prevention treatments.[3,21,22]

Patients younger than 65 years

For patients younger than 65 years who experienced a STEMI and underwent primary PCI, there was excess mortality, mainly during the first year. During this year, almost 5% of the patients died due to the event or its consequences, mainly within the first 30 days after the event. These data are in consonance with those reported in randomized clinical trials and large national contemporary registries.[23,24] In young patients, 30-day mortality is the most influential factor in long-term outcomes. After the first year, our study showed a trend toward excess mortality but it was much lower. The excess mortality for these years was less than 1.5%. Interestingly, despite the excess mortality in young patients during the first month after the STEMI, if these patients survived this initial period, the excess mortality in the first year disappeared and the observed and expected survival curves were similar. Therefore, the life expectancy of patients surviving the first 30 days was similar to that of the general population of the same age, sex, and geographical region. Only a few reports have compared long-term survival of young patients after a myocardial infarction with that of the general population. Whereas our study assessed STEMI patients, previous studies included not only STEMI but also non-STEMI patients. This is very relevant when analyzing long-term outcomes because of the different prognosis of the 2 entities.[25–27]

Because of the long-life expectancy of young patients, direct comparison with the general population is highly relevant. The impact of a potentially fatal event such as a STEMI in a young patient has severe consequences in terms of potential years of life lost. The potential recovery of life expectancy in young patients surviving the first year, emphasizes the relevance of new treatments for secondary prevention.

Patients older than 65 years

Despite undergoing primary PCI, patients older than 65 years with a STEMI had high mortality (more than 10%) due to the event during the first year. However, there was no excess mortality during the remaining years. This excess of mortality during the first year did not disappear but it was highly reduced for patients who survived the first 30 days after the STEMI. Observed and expected survival became similar after the second year of follow-up.

Little is known regarding the long-term outcomes in elderly people after a STEMI because the underrepresentation of this group of patients in randomized clinical trials and the lack of data regarding long-term observational studies.[3] High mortality rates during the first year after myocardial infarction was reported by Kochar et al., in a series of STEMI and non-STEMI patients with an indirect comparison with general population without matching. This study showed a significant excess of mortality in these patients when comparing with the general population with an impaired survival of up to 10 years in 65-69 year-old patients. In a very similar way to our data, when the sample was divided, STEMI patients showed a mortality rate of 30% at 5 years of follow-up.[9]

Patients older than 80 years

Outcomes of very elderly patients (older than 80 years) were fairly similar to those of patients older than 65 years. With an excess mortality of more than 15%, the event had a strong impact during the first year. However, after the first year, the risk of death was similar to that of the general population of the same age and sex. De la Torre et al.[28] reported a 30-day and 2-year mortality of 12.2% and 24.2%, respectively, in patients older than 75 years with STEMI treated with primary PCI. Mortality in very elderly patients (octogenarians and nonagenarians) after a STEMI was reported by Antonsen. et al., [29] with rates of about 18% during the first month, 27% in the first year, and 41% during the following 5 years. However, our study is the first to perform a direct comparison with the general population.

Limitations

This is a retrospective analysis with the limitations inherent to an observational single-center study, limited to a single geographical area. Because we recruited patients until March 2020, the minimum value of follow-up is low, translating into high dispersion.

CONCLUSIONS

Currently, patients with STEMI still have a reduced life expectancy. The life expectancy of these patients depends mainly on their chances of survival during the first 30 days. Observed and expected survival of patients surviving this period are fairly similar to those of participants of the same age, sex, and geographical area.

Despite recent advances in primary PCI, patients younger than 65 years have an excess mortality of almost 5% during the first year. For the following years, mortality due to the event is much lower but does not completely disappear. In patients older than 65 years, excess mortality is more than double that of younger patients during the first year, around 10%. However, in the following years, the risk of death is similar to that of the general population.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

WHAT IS KNOWN ABOUT THE TOPIC?

- Treatment and secondary prevention measures after STEMI are continuously being improved.
- Patients older than 65 years are an identified group with a high risk of short- and long-term mortality after experiencing this event.

WHAT DOES THIS STUDY ADD?

- Elderly patients have a significant risk of death during the first 30 days after the event. Currently, patients surviving the first year enjoy a life expectancy similar to that of the general population of the same age, sex, and geographical region.
- Young patients have a lower risk during the first 30 days. However, these patients maintain a small risk of death during the years following the STEMI.

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