Original Research

Epidemiological Characteristics, Management and Early Outcome of Acute Myocardial Infarction in Greece: The HELlenic Infarction Observation Study

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Introduction: Taking into consideration the need for an updated survey on acute myocardial infarction (AMI) in Greece, we conducted the HELIOS study (HELlenic Infarction Observation Study), aiming to recruit a cohort of AMI patients that would be representative of the total AMI population.

Methods: The HELIOS study is a countrywide registry of AMI, conducted during 2005-2006 by the Prevention Working Group of the Hellenic Cardiological Society. We enrolled 1840 AMI pts from 31 hospitals (mean age 68 ± 13 years, 75% men, 1096 ST-elevation myocardial infarction [STEMI] patients), with a proportional representation of all types of hospitals and of all geographical areas. The study recruited 10% of the total number of AMI cases that occur per year on a countrywide basis, taking into consideration the seasonal variations of the population in each geographical area.

Results: Despite demographic changes, there is still a male predominance among AMI patients and an increasing prevalence of cardiometabolic risk factors, (obesity, diabetes, hypertension) compared to previous AMI studies in the Greek population. Almost 60% of STEMI patients received reperfusion therapy, but the median value of the pain-to-door time was 180 minutes. The rates of administration of evidence-based medications during hospitalisation or upon discharge and the short-term mortality rates were in accordance with those observed in other international AMI registries.

Conclusions: The HELIOS study provided valuable insights into the epidemiology, clinical characteristics, management and outcome of patients with AMI in the Greek population. Although there are notable advances compared to previous reports, there is still considerable room for improvement and we should particularly focus on minimising the time delay between arrival at the emergency department and performance of reperfusion, by either pharmacological or catheter-based approaches.

Acute myocardial infarction (AMI) is a clinical presentation of coronary artery disease (CAD) defined by standardised criteria which enable its objective recording. Representing a dramatic and challenging clinical situation,

AMI has been studied extensively during the last decades. From the therapeutic point of view, availability of appropriate therapeutic interventions and short-term prognosis after AMI have been used as an index of quality of cardiovascular health services in the industrialised world. Furthermore, coronary risk factor profiles of AMI patients are of unique epidemiological importance, providing information about the population attributable risk of the major cardiovascular risk factors, while the incidence of AMI has been used to assess trends in cardiovascular morbidity and mortality.

Data derived from randomised clinical trials are considered to provide the highest level of evidence in formulating the guidelines of clinical practice. However, clinical trials should not be considered as the optimal tool for evaluating the clinical characteristics and management of the average myocardial infarction patient in the everyday medical world, largely because of their limited external validity and highly controlled clinical setting. On the contrary, prospective, properly designed registries enrolling consecutive, unselected patients represent the target population more accurately and may serve a pragmatic purpose by assessing disparities in the baseline characteristics, management and prognosis.[1]

At least three previous large-scale, multi-centre studies of the Greek population focusing solely on AMI have been conducted in various parts of the country.[2-5] One of them, the Panhellenic Acute Infarction Study, was conducted on a countrywide basis.[2] However, this study was conducted 13 years ago and thus it lags behind the fast track evolution in the contemporary management of myocardial infarction. Furthermore, it cannot account for the well established changes in the profile of myocardial infarction patients that have been associated with the recent increase in the prevalence of obesity, hypertension and diabetes in the Greek population.

Taking into consideration the above reasons supporting the need for an AMI survey in Greece, we conducted the HELIOS study (HELlenic Infarction Observation Study), aiming to recruit a cohort of AMI patients that would accurately represent the current situation of the entire country.

Methods

Study population

The HELIOS study was a prospective, observational registry designed to enrol consecutive patients with a discharge diagnosis of myocardial infarction over a period of one year. Enrolment of patients took place during the years 2005 and 2006. Thirty-one centres participated in the study and their selection was made mainly on the basis of their geographical distribution, aiming to encompass the full spectrum of hospitals admitting patients with AMI in each geographical area. The names of the study investigators and of the participating centres are given in the Appendix. For the purposes of the study, the country was divided in five major regions: Attica, Thessaloniki, Northern Greece, Central Greece and Southern Greece. In order to avoid the overrepresentation of older individuals in some of the country regions due to demographic reasons, we used the population over 25 years of age as the target population for AMI. The distribution of the country population older than 25 years in year 2001 (totalling 7,717,162 individuals) was as follows: Attica 2,776,580 individuals (36%), Thessaloniki 745,453 (10%), Southern Greece 1,438,272 (19%), Central Greece 1,489,700 (19%), and Northern Greece 1,267,157 (16%). The population data were derived from the database of the National Statistical Service (data available at http://www.statistics.gr).

In order to recruit a representative sample of patients hospitalised for AMI, and owing to the lack of reliable data on the incidence of AMI in each geographical region of the country, we made the assumption that AMI cases are proportionally related to the number of total admissions. This assumption was supported by the fact that the vast majority of AMI patients in our country are hospitalised in the cardiology departments of the regional hospitals. The total number of patients hospitalised in cardiology departments throughout the country, based on data from the national statistical service, was calculated to be 135,009 for the year 2001. We originally aimed to screen 10% of the total admissions in the country (13,501 admissions) and recruit the corresponding AMI cases, which would then serve as the study population. However, after exclusion of three centres during the quality control, we finally screened 12,513 admissions (93% of the originally targeted admissions), out of which we enrolled the 1840 AMI cases which made up our study population.

The extreme seasonal variation in the incidence of myocardial infarction due to changes of the population distribution within the country, especially during the summer holidays, has been a methodological challenge in previous studies. Aiming to counterbal-

ance the effects of this potential enrolment bias, we performed a pre-study investigation in an attempt to identify the fluctuation in overall admissions in all study centres, based on data from the local admission offices. The initially proposed predetermined number of admissions for each study centre was distributed accordingly over the four seasons. For each season, every admission to the participating centres was recorded in the study logbook by the study investigators until the predetermined number of admissions had been reached. Each enrolment period in each participating centre was terminated once this number was reached.

In order to minimise recruitment bias, we also avoided disproportionate enrolment of patients from hospitals with coronary reperfusion capabilities. To achieve that, in each geographical region we distributed the number of admissions in the study centres in proportion to the overall availability of hospital beds in centres with or without coronary reperfusion capabilities. Thus, for every geographical region, the proportion of admissions in the study centres, and of the corresponding AMI cases, was analogous to the proportion of hospital beds with coronary reperfusion capabilities in the whole region.

The distribution of the participating centres, the final total admissions, and the corresponding AMI cases in relation to the population over 25 years of age in the five geographical regions of the study, are shown in Figures 1 and 2, respectively.

The protocol of this registry affected neither the diagnostic procedures, nor the therapeutic interventions applied to the studied patients. The study was performed in accordance with the Declaration of Helsinki and was approved by the participating hospitals and by the board of the Hellenic Cardiological Society.

Figure 1. Geographical distribution of the participating centres. Small red circles indicate availability of cardiac catheterisation laboratories.

Diagnosis of myocardial infarction

The diagnosis of myocardial infarction was based on the published recommendations of the AHA Statistics Committee, World Heart Federation Council on Epidemiology and Prevention, and the European Society of Cardiology's Working Group on Epidemiology and Prevention.[6] Thus, it was based on the reported cardiac symptoms and signs, the ECG findings and the values of the cardiac markers cardiac troponin I or T, creatine kinase (CK), or its MB isoenzyme (CK-MB).

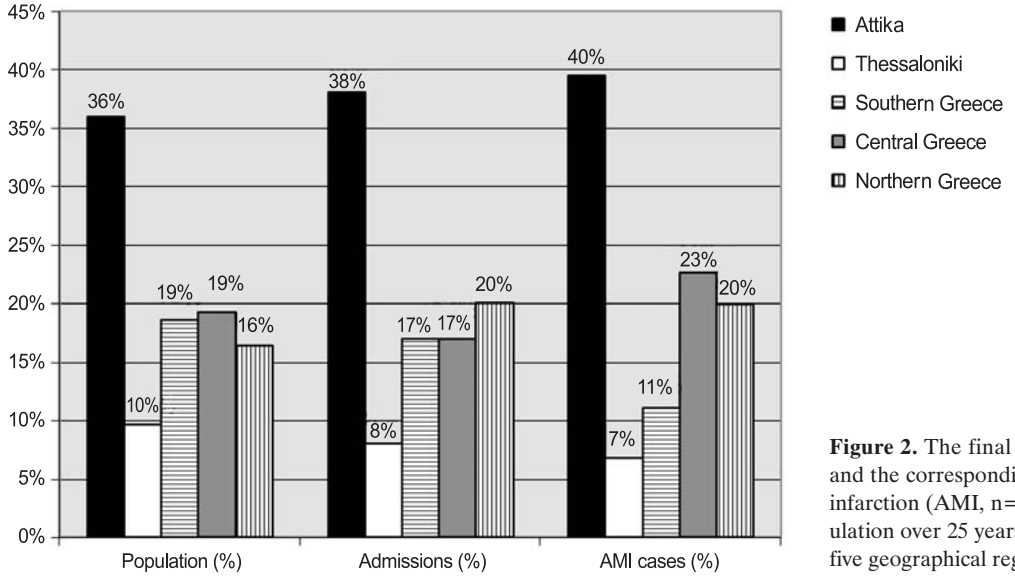

Figure 2. The final total admissions (n=12513) and the corresponding cases of acute myocardial infarction (AMI, n=1840) in relation to the population over 25 years of age (n=7,717,162) in the five geographical regions of the study.

Data collection

A medical history was obtained from every patient, including demographic data (sex, age, nationality, phone number, and address) and anthropomorphic variables (weight, height). Body mass index was calculated as weight in kilograms divided by height in metres squared. In addition, patients were questioned about the exact date and time of symptom onset, call of emergency ambulance services (optional) and presentation at the emergency department of the index hospital as well as the means of transportation used in case that the ambulance service was not preferred. All patients were asked to give information about their past medical history, smoking status, hypercholesterolaemia (total cholesterol higher than 200 mg/dL or use of hypolipidaemic agents), hypertension (usual blood pressure levels higher than 140/90 mmHg or use of antihypertensive medication), diabetes mellitus (fasting plasma glucose higher than 125 mg/dL or use of antidiabetic agents), family history of premature CAD (CAD in male first-degree relative <55 years of age or in female first-degree relative <65 years of age), previous history of CAD (prior documented myocardial infarction or known coronary artery stenosis >50%), prior myocardial infarction, previous percutaneous coronary intervention (PCI), and previous coronary artery bypass graft surgery. Patients were classified by their smoking status as current smokers if they smoked even one cigarette daily or had stopped smoking in the previous 12 months, ex-smokers if they had stopped smoking more than 12 months, and never smokers.

The case record form also included information regarding patients' medications before the index hospitalisation; their clinical symptoms and signs at presentation (levels of systolic and diastolic blood pressure, heart rate, Killip class); data on their first medical contact ECG (leads with ST elevation or depression, presence of left bundle branch block, non-specific ST/T segment changes); types of medication administered in the emergency department and during hospitalisation; reperfusion treatment, date and time of fibrinolysis administration, type of fibrinolytic agent used, date and time of primary PCI, use of stent, type of PCI (facilitated, rescue or urgent); in-hospital complications and adverse events (angina recurrence, reinfarction, heart failure, atrial fibrillation, ventricular fibrillation, cardiogenic shock, haemorrhagic stroke, ischaemic stroke, stroke of undetermined origin, major bleeding, death). Congestive heart failure was defined as Killip class >1, while cardiogenic shock was defined as oliguria and peripheral hypoperfusion with systolic blood pressure <80 mmHg. Major bleeding was defined as cerebrovascular bleeding, or requiring transfusion, or associated with a haemoglobin drop >3 g/dl, or requiring surgical management, or causing death.

Follow up of the studied patients was performed by the attending physicians with phone contacts at 30 days and 6 months post-discharge in order to ascertain vital status, current medical treatment, and potential occurrence of reinfarction or revascularisation. All definitions were clearly included in the case record forms in order to avoid heterogeneity.

Statistical analysis

Data are expressed as mean ± standard deviation for continuous variables and as percentages for categorical ones. Time delays are expressed as median with quartile ranges. Pearson's chi-square test for categorical variables and Student's t-test for continuous variables were employed to compare baseline characteristics of the groups of interest. All tests were considered to be significant at a 0.05 level of statistical significance. Statistical analyses were performed using the SPSS statistical software (version 11.5, SPSS, Chicago, IL, USA).

Results

Of the 12,513 admissions that were screened by the study investigators and entered in the logbook during the 1-year recruitment period, a total of 1840 patients (464 women, 25% of the population) with the definite diagnosis of AMI were recorded and represent the study population.

Baseline characteristics

The mean age was 68 ± 13 years (range 27 to 99 years). The main baseline characteristics of the study population categorised by gender and by age are presented in Tables 1 and 2, respectively.

Electrocardiographic pattern

The diagnosis was ST-elevation myocardial infarction (STEMI) in 59.5% of the study patients, with 49.6% having ST elevation in the inferior leads, 42.9% in V_1-V_4, 30.1% in V_5-V_6 and 16.1% in I, aVL. The baseline

Table 1. Baseline demographic and clinical characteristics of the patient population, categorised by sex.

	All patients (n=1840)	Males (n=1376)	Females (n=464)	p value
Age (years)	68 ± 13	65 ± 13	74 ± 11	
Current or ex-smokers	71%	84%	32%	< 0.001
Hypercholesterolaemia	50%	49%	53%	0.163
Diabetes mellitus	31%	29%	38%	< 0.001
Hypertension	59%	53%	76%	< 0.001
History of known CAD	26%	26%	25%	0.54
Prior MI	18%	20%	14%	0.007
Family history of CAD	22%	22%	21%	0.65
BMI (kg/m^2)	27.4 ± 4.2	27.3 ± 3.9	27.7 ± 4.8	0.116
Overweight	73%	74%	72%	0.472
Obese	22%	20%	27%	0.003

BMI – Body mass index; CAD – coronary artery disease; MI – myocardial infarction; Obese – BMI ≥30 kg/m^2; Overweight – BMI ≥25 kg/m^2.

Table 2. Baseline demographic and clinical characteristics of the studied patients categorised by age.

Age categories (years)	<40 (n=29)	40-49 (n=167)	50-59 (n=348)	60-69 (n=384)	70-79 (n=537)	80-89 (n=314)	>89 (n=61)
Male gender	89.7%	94.6%	88.8%	79.7%	68.5%	58.9%	42.6%
Current or ex-smokers	90%	93%	87%	78%	63%	54%	32%
Hypercholesterolaemia	41%	53%	59%	54%	51%	38%	20%
Diabetes	10%	15%	21%	33%	38%	38%	34%
Hypertension	21%	30%	42%	57%	71%	74%	74%
Family history	35%	33%	30%	22%	18%	13%	5%
Previous MI	3%	4%	15%	17%	24%	24%	15%
Obesity (BMI ≥30 kg/m^2)	24.1%	22.5%	26.3%	21.1%	22.4%	17.4%	7.3%
BMI (kg/m^2)	27.6 ± 4	28.1 ± 4	28.2 ± 5	27.5 ± 4	27.3 ± 4	26.7 ± 4	25.2 ± 3

Abbreviations as in Table 1.

demographic and clinical characteristics of the patient population categorised by type of myocardial infarction (STEMI vs. non-STEMI) are presented in Table 3.

Incidence

The proportion of AMI cases among the 12,513 admissions to cardiac departments that had been screened by the HELIOS investigators was 14.7%. Given that every effort, as described in the methods section earlier, was made to recruit a truly representative cohort of admissions and AMI cases, we infer that this ratio of cases/admissions is valid for the totality of AMI cases on a countrywide basis. In this context, the total number of AMI cases for a whole year can be calculated by multiplying the total number of admissions in the country by the above ratio. However, the National Statistical Service has released detailed data on admissions to hospitals only up to the year 2000. Thus, our estimation is limited by the fact that the HELIOS study admissions occurred 5 years later. Taking into consideration this limitation we calculated that the total number of AMI cases is 19,853 per year, corresponding to an incidence of 18.43 cases per 10,000 of the general population. Apparently, this number should be considered preliminary and will be revised in the near future, when more recent data on admissions are to be released by the National Statistical Service. However, an internal analysis of our databases in places where the incidence of AMI can be reliably calculated was in close accord with our countrywide results. For example, the incidence of AMI in Chios island, which has a population of 53,000, was 19 cases per 10,000.

Table 3. Baseline demographic and clinical characteristics categorised by type of myocardial infarction based on electrocardiographic pattern.

	NSTEMI (n=744)	STEMI (n=1096)	p value
Age (years)	69 ± 13	66 ± 14	<0.001
Female gender	28%	23%	0.021
Current or ex-smokers	68%	73%	0.025
Hypercholesterolaemia	54%	47%	0.009
Diabetes mellitus	35%	29%	0.011
Hypertension	67%	53%	<0.001
History of known CAD	35%	19%	<0.001
Prior MI	24%	14%	<0.001
Family history of CAD	23%	21%	0.370
BMI (kg/m^2)	27.5 ± 4.3	27.4 ± 4.1	0.861
Overweight	72%	74%	0.212
Obese	22%	21%	0.661
Cath-lab hospital	35.4%	34.7%	0.757

Cath-lab hospital – hospitals with coronary reperfusion capabilities; NSTEMI – non-ST elevation myocardial infarction; STEMI – ST-segment elevation myocardial infarction. Other abbreviations as in Table 1.

Means and delays of arrival to the hospital

In this analysis we included those patients who could reliably define delays from pain onset to admission to be less than 24 hours, given that available electrocardiographic and biochemical data were in accord with this information (88% of the total population). For those patients the median value of the pain-to-door time was 180 minutes, while the 25th and 75th percentiles were 75 and 510 minutes, respectively. Interestingly, the transfer of patients to hospital was by ambulance in only 17% of cases.

Therapeutic management

A total of 59.1% of STEMI patients underwent reperfusion therapy. Fibrinolysis was administered to 50.2%, while 8.9% of the STEMI patients underwent primary PCI. Tenecteplase was used in 48.2%, reteplase in 47.0%, alteplase in 4.2% and streptokinase in 0.5% of cases. Of all STEMI patients who were admitted to hospitals with facilities for invasive procedures 84% were admitted within 12 hours, thus being theoretical candidates for primary PCI. Yet only 26% of those patients were treated with PCI, while 47% received lytics and 27% had no reperfusion therapy. Of all STEMI patients who were admitted to non-invasive hospitals, 58% were admitted within 3 hours and would be candidates for immediate lysis or transfer. However, only 1% of those patients were transferred for primary PCI, while 69% were treated with lytics and 30% received no reperfusion therapy. Another 28% were admitted within from 3 to 12 hours, and would be theoretical candidates for transfer. However, most remained in the admitting hospital for lytic therapy (45%) or received no reperfusion (55%). Among patients with non-STEMI 6.1% underwent coronary angiography and PCI, based on clinical criteria.

The rates of administration of certain types of medications during hospitalisation or upon discharge in relation to gender are presented in Table 4.

Clinical outcomes

The in-hospital mortality was 7.7%. After the completion of the 6-month follow-up period, the 30-day and the 6-month mortality were 10.5% and 14.4% respectively. The unadjusted mortality rates during hospital

Table 4. Administration of medications in hospital and upon discharge in relation to sex.

	All patients (n=1840)	Men (n=1376)	Women (n=464)	p value (men vs. women)
During hospitalisation				
Aspirin	91%	92%	88%	0.01
Clopidogrel	67%	69%	60%	<0.001
Heparin	45%	47%	40%	0.01
LMWH	76%	75%	77%	0.65
Beta-blockers	77%	78%	73%	0.03
ACEi	69%	68%	72%	0.21
ARB	7%	6%	9%	0.03
Statins	75%	77%	66%	<0.001
Nitrates	87%	87.5%	87%	0.86
Diuretics	33%	28%	50%	<0.001
IIb/IIIa inhibitors	19%	20.5%	14%	0.003
Insulin	20%	18%	27%	<0.001
Antidiabetics	13%	13%	13%	0.88
CCB	14%	13%	16%	0.13
Inotropes	10%	8%	13%	0.002
Digoxin	6%	5%	11%	<0.001
Upon discharge				
Aspirin	88%	89%	84%	0.004
Clopidogrel	67%	70%	57%	<0.001
Coumarins	5%	5%	7%	0.07
Beta-blockers	79%	80%	74%	0.006
ACEi/ARB	75%	74%	77%	0.203
Statins	82%	84%	74%	<0.001

ACEi – angiotensin converting enzyme inhibitors; ARB – angiotensin receptor blockers; CCB – calcium channel blockers LMWH – low molecular weight heparins.

stay and during periods of follow-up in relation to selected clinical prognostic predictors are presented in Figure 3.

Discussion

The HELIOS study was designed to enrol a representative sample of patients with AMI on a countrywide basis, aiming to avoid recruitment bias and systemic distortion of patients' baseline characteristics and outcome associated with under-representation of demanding patient subgroups. In addition, we tried to avoid the confounding effect of overrepresentation of tertiary and university hospitals, a phenomenon that often distorts the populations of randomised clinical trials.[7,8] The standardised criteria for the definition of myocardial infarction avoided misclassification of patients with unstable angina, while the strict, time-consuming quality control of raw data minimised random errors.

Baseline characteristics

The present study sheds light on the clinical profile of the average myocardial infarction patient and reveals a worsening burden of cardiovascular risk factors among AMI patients in Greece (Tables 1 and 2). Despite a potential difference in definitions in the 1990s, 45% of MI patients were hypertensives (Panhellenic Acute Infarction Study and GEMIG study), while in the HELIOS study the rate has increased to 59% despite the minor differences in the average age of the patients enrolled.[2,9] The percentage of diabetics has increased considerably, from 25% in the Panhellenic Acute Infarction Study to 31% in our registry, which was also validated in the GREECS study.[5] In our registry, 50% of patients had hypercholesterolaemia, while 13 years ago the respective rate was 35%. The increased prevalence of diabetes, hypercholesterolaemia and hypertension is associated with an increased percentage of overweight and obese patients in our population, since 73% of our patients were overweight, and 22% of them obese (Table 1). Thus, the current epidemic of obesity, which is attributed to changes in our nutritional habits and lifestyle, has not spared the population of myocardial infarction patients. These findings represent an alarming call for action and stress the need for effective feedback from healthcare policymakers as well as from the cardiological community.

Incidence and mortality of myocardial infarction

In the past, a few studies conducted in our country attempted to define the incidence of acute coronary syndromes in Greece as well as the baseline characteristics, management and outcome of patients with myocardial infarction. In the early 1990s, a multi-centre study enrolling consecutive patients with myocardial infarction admitted to the seven hospitals of Crete evaluated that the incidence of myocardial infarction was 8/10,000 inhabitants, while there were no available data on the mortality and prognosis of the patients.[10] The Panhellenic Acute Infarction Study was conducted 13 years ago, and included 7433 patients with myocardial infarction from almost all

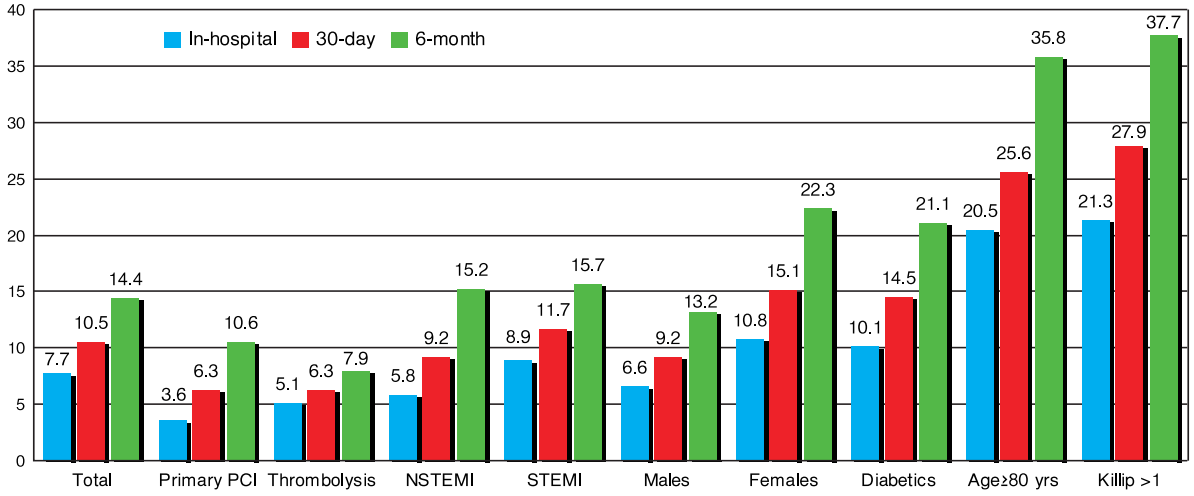

Figure 3. Unadjusted in-hospital, 30-day and 6-month mortality rates in relation to selected clinical prognostic predictors. PCI – percutaneous coronary intervention; NSTEMI – non-ST elevation myocardial infarction; STEMI – ST-segment elevation myocardial infarction.

Greek hospitals. However, during the same year, the total number of AMI cases on a countrywide basis was estimated to be about 15,000 and the incidence of AMI about 15/10,000. The authors of this study acknowledged that they did not recruit the totality of AMI cases in their registry.[2] The in-hospital mortality rate in the Panhellenic Acute Infarction Study was 10.4%, with a considerable difference between the two sexes (8.5% for men and 17.1% for women). The GEMIG study included 1749 consecutive patients hospitalised with the diagnosis of AMI, from seven hospitals located in large urban regions, and evaluated their baseline characteristics and prognosis. The reported in-hospital mortality was 7.1%.[9] In the early 2000s a registry conducted in north western Greece determined that the non-adjusted incidence of unstable angina and acute myocardial infarction was 22 per 10,000 inhabitants.[11] The GREECS study evaluated the epidemiology, management and outcome of patients with acute coronary syndromes in a sample of six Greek urban and rural regions. The overall incidence rate was calculated only for the rural part of the study population, and was 22.6/10,000, including cases of unstable angina, while the in-hospital mortality of patients with STEMI was 7.4%.[5]

In our registry, the incidence of myocardial infarction was estimated to be 18.43 cases per 10,000 inhabitants. However, the incidence reported in this manuscript should be considered rather indicative than definite. The main limitation of our methodology to estimate the incidence of AMI is the fact that hospitalisation data from the National Statistical Service are available only until the year 2000. Thus, for the calculation of the currently presented incidence rates we used data from the HELIOS study derived in 2005 in combination with data from the National Statistical Service for the total number of hospitalisations in cardiology departments which were collected in 2000. Consequently, the final incidence rates will be available in a few years time depending on the availability of the relative data concerning the total number of hospitalisations. However, the effect on our findings is expected to be small, given that only modest changes in population and in the number of hospitalisations in cardiology departments were noted during the years prior to 2000.

The in-hospital mortality was 7.7% for the total patient population, 8.9% for STEMI and 5.8% for non-STEMI patients. In the GRACE registry the in-hospital mortality was 7% for STEMI and 5% for non-STEMI patients,[12] and in the Euro Heart survey of acute coronary syndromes (ACS) the respective rates were 7% and 2.4%.[13] Thus, our mortality rates are similar to those derived from other large scale international registries.

Therapeutic management of myocardial infarction patients

In the past decade considerable progress has been noted in the management of patients with myocardial infarction. The cornerstone of treatment in STEMI patients still remains the timely implementation of reperfusion, by either fibrinolysis or PCI, while in non-STEMI patients an invasive strategy has been proven beneficial. Furthermore, several adjunctive therapies, such as low-molecular weight heparins,[14] clopidogrel,[15,16] statins in high doses,[17] factor Xa inhibitors,[18] glycoprotein IIb/IIIa inhibitors, have earned their evidence-based credentials, thus enriching the existing therapeutic armamentarium. It should be kept in mind that the adherence to published guidelines combined with effective incorporation of the recent therapeutic advances into routine clinical practice represents a prerequisite for improving the outcome of real-world myocardial infarction patients. The implementation rates of available treatments can be monitored by registries which are properly designed to enhance their generalisability by avoiding enrolment bias.

In this context, the HELIOS registry recorded representative trends in the therapeutic management of myocardial infarction patients in Greece. It is worth noting that 59.1% of patients with STEMI received reperfusion treatment, while 8.9% were subjected to primary PCI. These percentages are comparable to those reported in the GRACE registry (62% and 13%, respectively), while in the EuroHeart survey 55.8% of patients with ST elevation ACS received some form of reperfusion with an increased use of primary PCI (20.7%), which was associated with a confounding over-representation of centres with revascularisation facilities. Thus, in our country fibrinolysis is the main reperfusion therapy. This is only partially related to the limited access of patients to hospitals with catheterisation facilities, because even in centres with catheterisation laboratories only a small proportion of STEMI patients underwent primary PCI. Furthermore, the short-term prognosis up to 6 months seems to be strongly associated with reperfusion therapy, but is similar among those who underwent lytic therapy or primary PCI in both uni-

variate (Figure 3) and multivariate analysis (data not shown in this manuscript). These nationwide data should be evaluated by healthcare authorities in order to properly redirect the existing health resources. Increasing the number and optimising the geographical distribution of tertiary care centres remains an attractive choice, although recent registries have failed to demonstrate an improved outcome of patients admitted to hospitals with catheterisation facilities, thus further affirming that real life differs from the highly controlled setting of randomised clinical trials.[19,20] An effort to have more patients arriving within 3 hours from pain onset would also allow for more successful reperfusion, especially in non-invasive hospitals. Prehospital delays have not changed much in the last decade.[21]

The use of aspirin, beta-blockers and angiotensin converting enzyme (ACE) inhibitors at discharge is considered as an indicator of quality performance at the hospital level and has long been used for the evaluation of the standard of care provided.[22] In our registry, aspirin was used in 88% of patients at discharge, while beta-blockers and ACE inhibitors or angiotensin receptor blockers were administered to 79% and 75%, respectively. The respective rate of use of the abovementioned medications in the overall GRACE population at discharge was 88.7% for aspirin, 74.2% for beta blockers, and 69.8% for ACE inhibitors. In the GEMIG study, 90% of patients received aspirin upon discharge, 63% of them were prescribed beta-blockers, and 58% of them ACE inhibitors. Thus, the quality measures for the use of evidence-based medicine that have been shown to improve patients' prognosis demonstrate a highly satisfactory average hospital performance, which is indicative of considerable improvement in the care of patients and stricter adherence to the existing guidelines. Concerning the use of statins, which has been shown to favourably affect the outcome of myocardial infarction patients especially when administered in high doses, 82% of our patients received statins upon discharge, compared to 17% in the GEMIG study and about 50% in the EuroHeart survey of ACS. Thus, considerable progress has been noted in the prescription rate of statins, which is expected to enhance long-term use and adherence and consequently to exert a beneficial effect on patients' prognosis.

The usual limitations about population selection that are inherent to most registries certainly apply to HELIOS as well. However, in contrast to previous registries in our country we took care to recruit a truly representative cohort of AMI patients, with a balanced representation of invasive and non-invasive hospitals, of urban and rural areas, with additional attention to seasonal variations of the population.

In conclusion, this multi-centre registry has provided insights into the epidemiology, clinical characteristics, management, and outcome of patients with AMI. The available information can be used to achieve the ultimate goal of improving the standards of health care provided. Apart from developing and implementing a multilateral preventive strategy that would lessen the burden of cardiovascular risk factors, we should focus on minimising the time elapsed until the provision of reperfusion therapy, improving the adherence to evidence-based guidelines and enhancing the incorporation of life-saving medications in routine clinical practice. We did notice that there is still considerable room for improvement and we should particularly focus on minimising the time delays between arrival at the emergency department and performance of reperfusion, by either a pharmacological or a catheter-based approach. Taking into consideration the available data from the HELIOS study, the geographical characteristics of our country and the current socioeconomic reality, early administration of thrombolysis and the development of an effective network for rescue PCI seems to be the most effective and feasible therapeutic strategy for AMI in our country. Finally, the development of an ongoing registry for AMI, co-ordinated by the Hellenic Society of Cardiology, could verify and possibly expand the findings of the HELIOS study.

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Appendix: HELIOS study investigators and participating centres

Principal investigators: G. Andrikopoulos, A. Pipilis, J. Goudevenos, J. Lekakis.

President of the Hellenic Cardiac Society during the enrolment period: H. Boudoulas.

Athens and Piraeus *(Asklipieion Hospital, 1st Cardiac Department, Evangelismos Hospital, 1st University Cardiac Department, Hippokration Hospital, 2nd Cardiac Department, Euroclinic Hospital, Pammakaristos Hospital, Hygeia Hospital, Sotiria Hospital, 7th IKA Hospital, 1st Cardiac Department, Sismanogleio Hospital, Agios Panteleimon Hospital, and Tzaneion Hospital):* C. Antonakoudis, S. Dragomanovits, S. Tzeis, P. Kalogeropoulos, P. Arvanitis, A. Synetos, A. Theoharis, K. Ntoulas, A. Kitsiou, M. Zairis, A. Theodosis, D. Richter, G. Goumas, L. Stefanatos, E. Papasteriadis, V. Kostopoulos.

Thessaloniki *(AHEPA Hospital, IKA Panagia Hospital):* C. Kyrpizidis, C. Karvounis, N. Martiadou, F. Lazaridou.

Patra*:* N. Koutsogiannis. ***Ioannina****:* K. Kalantzi. ***Heraklion****:* G. Kochiadakis, I. Karalis. ***Alexandroupoli****:* E. Xatzinikolaou, D. Floros. ***Komotini****:* A. Gotsis, S. Ntourtsiou. ***Edessa****:* K. Oikonomou. ***Korinthos****:* V. Pyrgakis, P. Stougiannos. ***Kalamata****:* S. Zombolos, G. Tzifa, S. Kosmopoulou. ***Chalkida****:* J. Mantas, K. Toli. ***Chios****:* A. Kartalis. ***Kos****:* M. Makris, N. Stamena. ***Mesolongi****:* P. Zavitsanakis. ***Kozani****:* S. Lambropoulos. ***Karditsa****:* I. Kogias, S. Sideris. ***Volos****:* T. Tsaknakis, L. Papakosmas, E. Alexandridis, P. Kamvogiannis, A. Koutroumbas. ***Zakynthos****:* A. Kassimatis. ***Grevena****:* C. Liolios. ***Arta****:* G. Triantafyllidis, L. Sioros, D. Stalikas.

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