A Prospective National Survey of Management and Clinical Outcome of Acute Myocardial Infarction in Israel, 2000

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Key words: acute myocardial infarction, MI registry, national registry, outcome after AMI, MI in the community

Abstract

Background: Little information is available on the clinical practice and implementation of guidelines for treating acute myocardial infarction patients in Israel.

Objective: To assess patient characteristics, hospital course, management, and 30 day clinical outcome of all AMI patients hospitalized in Israel during a 2 month period in 2000.

Method: We conducted a prospective 2 month survey of consecutive AMI patients admitted to 82 of 96 internal medicine departments and all 26 cardiac departments operating in Israel in 2000. Data were collected uniformly by means of a hospital and 30 day follow-up form.

Results: During the survey 1,683 consecutive patients with a discharge diagnosis of AMI were included. Their mean age was 66 years; 73% were male. The electrocardiographic pattern on admission revealed ST elevation, non-ST elevation and an undetermined ECG in 63%, 34% and 4% of patients respectively. Aspirin and heparin were given to 95% of patients. Beta-blockers and angiotensin-converting enzyme inhibitors were given to 76% and 65% of patients respectively. Among hospital survivors, 45% received lipid-lowering drugs. Thrombolytic therapy was administered in 28% of patients, coronary angiography was used in 45%, and 7% of patients underwent primary percutaneous coronary intervention. The 7 and 30 day mortality rates were 7% and 11% respectively.

Conclusions: This nationwide survey shows that one-third of the AMI patients in Israel are elderly ($\geq$ 75 years). The survey suggests that clinical guidelines for the management of patients with AMI are partially implemented in the community. Data from large surveys representing the "real world" practice are of utmost importance for the evaluation of clinical guidelines, research and educational purposes.

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Acute coronary syndromes, including unstable angina and acute myocardial infarction, remain a major health problem both in western and newly developing countries. Among ACS patients, those developing AMI have the highest case-fatality rates, although management of AMI has improved considerably in the last decade [1–4]. Early reperfusion therapy with thrombolytic agents or primary percutaneous coronary intervention is mandatory for the management of ST elevation or new left bundle branch block in order to achieve rapid and sustained recanalization of the infarct-related artery. The treatment strategy for patients presenting with non-ST elevation MI requires early risk stratification based on the clinical picture, the ECG pattern on admission, and the assessment of myocardial damage markers.

Clinical guidelines have been developed on the basis of clinical trials [5,6] to provide timely and appropriate decisions for each individual patient admitted with the presumed diagnosis of ACS. However, there is very little prospective state-of-the-art information regarding the practice patterns and the clinical outcome of unselected patients with AMI at the national level [7–10]. We therefore conducted a prospective survey of all AMI patients admitted to all internal medicine and cardiac departments in Israel during a 2 month period in 2000 in order to assess patient characteristics, hospital course, management and 30 day clinical outcome, as well as the adherence to current practice guidelines.

Materials and Methods

Under the auspices of the Israel Heart and Internal Medicine Societies and the Israel Medical Association, all 122 internal medicine and cardiac departments operating in the 26 medical centers throughout the country were invited to participate in a 2 month survey (February–March 2000). All 26 cardiac departments and 82 of the 96 internal medicine departments operating in the country participated prospectively. The survey was designed as a prospective observational case series of all consecutive AMI patients treated in Israel's medical centers. All patients with a definite diagnosis of AMI (Q and non-Q wave myocardial infarction) as reported in the discharge medical summary were included in the survey, and a special form including pre-hospital, in-hospital and 30 day follow-up findings was filled in for each patient. Patient demographics, characteristics, hospital course findings, management and clinical outcome were collected prospectively. AMI was diagnosed by the medical staff of each

* The two last authors contributed equally to this publication
AMI = acute myocardial infarction
ACS = acute coronary syndromes

department according to the usual clinical, ECG and enzymatic criteria. It should be noted that this survey was conducted prior to the publication of new diagnostic criteria recently proposed by a panel of experts [11]. Data checks for completeness and consistency were based on the discharge medical reports attached to each patient form and on computerized data queries. Data entry, editing and analysis were performed at the coordinating center of the Israel Society for the Prevention of Heart Attacks.

Statistical analysis

The SAS software was used for statistical analysis [12]. The chi-square test and Student's *t*-test or analysis of variance were used to determine the significance of differences between proportions and means for comparing characteristics, treatment patterns and mortality between patients with ST elevation compared to those without, men versus women, and patients with Q versus non-Q wave MI. For analysis of mortality among men and women, age adjustment was performed using the method of direct adjustment with the following age groups: <65 years, 65–74 years and 75+ years. The total population was used as the standard. Age-adjusted and multivariate adjusted odds ratios with confidence intervals were calculated using a logistic regression model.

Results

Baseline characteristics and admission findings [Table 1]

During the survey (February to March 2000), 1,683 patients with AMI were hospitalized in 108 of the 122 active cardiac and internal medicine departments (88%) operating in the 26 medical centers in Israel. The mean age of the patients was 66 years, with the mean age of men (73%) being 63 years vs. 73 years for women. Forty-one percent of patients reached the hospital independently. Most of the patients (75%) reached the hospital in Killip class 1. The large majority of patients (75%) had typical chest pain on admission. The ECG pattern on admission showed ST elevation in 63% of the patients. For 1,088 patients (65%) the first ward of hospitalization was the cardiac department, while 560 patients (33%) were first referred to an internal medical ward. Of the latter group of patients, 218 (39%) were transferred to a cardiac department within 48 hours of admission due to complications or need for invasive interventions. The median time (25–75%) from symptom onset to hospital arrival was 150 minutes (76–420 minutes).

Table 1. Baseline characteristics and admission parameters

	No.	%
Men	1,232	73
Age (mean: min-max) yrs	66 (26–102)	
⩽ 64	772	46
65–74	377	22
⩾ 75	534	32
History of		
Myocardial infarction	459	28
Angina pectoris	562	34
Congestive heart failure	176	11
Diabetes	532	32
Hypertension	790	48
Stroke/transient ischemic attack	158	10
Hyperlipidemia	772	47
Percutaneous coronary intervention	205	12
Coronary artery bypass graft	87	5
Past smokers	297	18
Current smokers	581	35
Transport to hospital		
Mobile Intensive Care Unit	480	30
Regular ambulance	414	26
Private car	651	41
Other	37	2
Presenting symptoms		
Typical chest pain	1,265	75
Atypical chest pain	123	7
Heart failure	101	6
Arrhythmia/syncope	35	2
Other	155	9
ECG findings		
ST elevation	1,048	63
Non-ST elevation	566	34
Undetermined changes	60	4
Hospitalization ward		
Coronary Care Unit/Cardiology	1,088	65
Internal Medicine	560	33
Admission parameters		
Killip class 1	1,256	75
2–3	366	22
4	52	3
Heart rate (beats/min)	83 ± 21	
Systolic blood pressure (mmHg)	142 ± 30	
Diastolic blood pressure (mmHg)	81 ± 17	
Admission time from onset of symptoms to hospital arrival (median 25–75%) (minutes)	150	(76–420)

Hospital course and treatment [Table 2]

Pulmonary edema and cardiogenic shock complicated the hospital course in 15 and 7% of patients respectively. Paroxysmal atrial fibrillation, sustained ventricular tachycardia and 3° atrioventricular block occurred in 9, 3 and 4% respectively. Stroke or transient ischemic attack and severe mitral regurgitation were present in 2 and 4% of patients respectively. The 7 and 30 day crude mortality rates were 7 and 11% respectively.

During the first 48 hours of hospitalization, aspirin and any type of heparin were administered to 95% of patients. One-third of the patients received aspirin during transport to hospital, prior to the ward admission. Nitrates, beta-blockers, ACE-I and Ca-blockers were used in 76, 65, 54 and 10% respectively. The overall rate of thrombolytic therapy was 28%. Coronary angiography, primary percutaneous coronary angioplasty, delayed PCI and coronary artery bypass graft during the index hospitalization was performed in 45%, 7%, 28% and 5% of patients respectively.

ACE = angiotensin-converting enzyme
PCI = percutaneous coronary intervention

Table 2. In-hospital complications and management

	No.	%
Pulmonary edema	253	15
Cardiogenic shock	110	7
Cardiac rupture	16	1
Tamponade	12	0.7
Asystole	84	5
Paroxysmal atrial fibrillation	152	9
Non-sustained ventricular tachycardia	88	5
Sustained ventricular tachycardia	48	3
Primary ventricular fibrillation	68	4
Secondary ventricular fibrillation	26	2
3° atrioventricular block	62	4
Significant mitral regurgitation	64	4
TIA/stroke	28	2
Re-ischemia	189	12
Re-infarction	56	3
Mortality*		
7 day	112	7
30 day	181	11
Management		
Aspirin	1,585	95
Heparin regular	1,150	70
Low molecular weight heparin	466	29
IIb/IIIa antagonists	285	18
Beta-blockers	1,070	65
ACE inhibitors	882	54
Ca-blockers	167	10
Nitrates	1,252	76
Diuretics	559	34
Digitalis	62	4
Lipid-lowering drugs	480	30
Thrombolysis	477	28
Coronary angiography	736	45
Primary PCI	122	7
Non-primary PCI	454	28
Coronary artery bypass grafting	74	4

* n=85 with missing value

ECG on admission: ST vs. non-ST elevation MI

Table 3 compares the baseline characteristics, management and outcome of AMI patients admitted with ST elevation, non-ST elevation and undetermined ECG pattern on admission. Patients with ST elevation were younger and included more men, smokers and those experiencing a first MI. They also presented more frequently with typical chest pain and in Killip class I. Thrombolytic therapy was given to 45% of patients with ST elevation and an additional 11% underwent primary PCI. Thus, 56% of patients with ST elevation received early reperfusion therapy. The reasons for which ST elevation AMI patients did not receive reperfusion therapy were: lack of ECG changes (36%), late arrival (24%), contraindication to thrombolytic therapy (16%), spontaneous reperfusion in the interim (5%), and miscellaneous (18%). Most of the patients with ST elevation (82%) ended with Q wave MI, while the majority of patients with non ST elevation (76%) and undetermined ECG findings (62%) had non-Q wave infarction.

Clinical outcome

Crude and age-adjusted 7 and 30 day mortality rates according to gender and age groups are presented in Table 4. Women and elderly patients had higher death dates. After adjustment for age, gender, past MI, diabetes, hypertension, Killip 2, revascularization, beta-blocker and ACE-inhibitor treatment, the 7 and 30 day mortality was significantly higher among AMI patients presenting with ST elevation as compared to their counterparts with non-ST elevation: odds ratio (95% confidence interval): 2.84 (1.73–4.79) and 2.17 (1.43–3.25) respectively.

30 day follow-up

Among hospital survivors, 94, 74 and 63% were treated with aspirin, beta-blockers and ACE inhibitors respectively. Lipid-lowering drugs (90% statins), nitrates and Ca-blockers were given to 49, 48 and 11% of hospital survivors respectively. The overall rate of rehospitalization was 24%, of which 12% were urgent cardiac rehospitalizations, mainly due to recurrent MI, unstable angina and congestive heart failure. Scheduled rehospitalization (8%) included coronary angiography, PCI or coronary artery bypass graft. Four percent of patients were rehospitalized for non-cardiac problems. The rate of urgent rehospitalizations was equal among ST elevation and non-ST elevation MI patients, as well as among those discharged with Q wave and non-Q wave MI.

Discussion

The importance of this study lies in the fact that uniform data were collected prospectively in more than 88% of all operating medical departments in the country for the purpose of assessing the characteristics, management and outcome of consecutive patients with AMI. This survey provides the first national data on hospital management of AMI in real-life practice from a mixture of primary, secondary and tertiary medical centers operating in one country. Furthermore, being conducted in early 2000, this survey reports on the latest medication and procedures used for the management of AMI in light of the recommended guidelines.

There are three major differences between this nationwide survey and clinical trial databases. Firstly, almost one-third of the AMI cohort was over 75 years of age. This sector of the population is generally excluded from controlled clinical trials, and data on their management and outcome are scarce. The increasing number of elderly patients may have substantial implications in terms of management, since this group of patients did not benefit sufficiently from thrombolytic therapy [13]. Furthermore, since most of them had a non-ST elevation pattern on the admission ECG, new therapies for patients admitted with a non-ST elevation electrocardiogram should also be evaluated in the elderly. Of note, although elderly patients represent only one-third of the total study cohort, they contribute to more than 50% of the mortality after AMI. Secondly, one-third of the patients had non-ST elevation MI. Clinical trials focus on ACS with or without ST elevation, precluding the possibility of comparing back-to-back these two different population groups in the same study. Thirdly, the 30 day mortality was relatively high in comparison with clinical trials. The 30 day mortality of AMI patients in the GUSTO-V study was 5.7–5.9%, while

Table 3. Characteristics, management and outcome by ECG pattern on admission

	Myocardial infarction						
	ST elevation (n=1,048)		Non-ST elevation (n=566)		Undetermined (n= 60)		*P* for trend
	No.	%	No.	%	No.	%	
Men	787	(75)	403	(71)	36	(60)	0.01
Age (mean) yrs	64±13.7		68±13.6		76±11.3		<0.001
Previous MI	226	(22)	198	(35)	32	(54)	<0.001
Past AP	278	(27)	254	(45)	30	(51)	<0.001
Previous revascularization	127	(12)	109	(19)	12	(20)	<0.003
History of							
Diabetes	323	(31)	176	(31)	31	(52)	0.002
Hypertension	439	(43)	312	(56)	37	(62)	<0.001
Stroke	89	(9)	65	(12)	4	(7)	NS
Hyperlipidemia	442	(43)	298	(53)	29	(50)	0.001
Current smoking	415	(41)	156	(28)	10	(17)	<0.001
Admission symptoms							
Typical chest pain	861	(82)	369	(65)	31	(53)	<0.001
Heart failure	31	(3)	58	(10)	12	(20)	<0.001
Admission Killip							<0.001
I	835	(80)	339	(71)	20	(34)	
II–III	180	(17)	153	(27)	31	(53)	
IV	32	(3)	12	(2)	8	(14)	
Complications							
Pulmonary edema	117	(11)	111	(20)	23	(39)	<0.001
Paroxysmal atrial fibrillation	93	(9)	51	(9)	6	(10)	NS
3° atrioventricular block	53	(5)	4	(1)	5	(9)	<0.001
Treatment							
Aspirin	1,007	(97)	523	(93)	54	(90)	<0.001
Heparin (R)	845	(83)	282	(51)	21	(36)	<0.001
Heparin (LWM)	205	(20)	237	(43)	24	(40)	<0.001
IIb IIIa antagonists	235	(23)	49	(9)	1	(2)	<0.001
Beta-blockers	668	(66)	371	(67)	30	(51)	0.04
ACE inhibitors	575	(56)	270	(49)	37	(64)	0.005
Ca-antagonists	64	(6)	95	(17)	8	(14)	<0.001
Nitrates	744	(72)	459	(82)	47	(70)	<0.001
Lipid-lowering drugs	282	(28)	182	(33)	16	(27)	NS
Thrombolysis	470	(45)	7	(1)	–	–	<0.001
Primary PCI	108	(11)	12	(2)	2	(3)	<0.001
Coronary angiography	495	(48)	231	(41)	10	(17)	<0.001
Revascularization	349	(33)	164	(29)	6	(10)	<0.001
Type of MI							<0.001
Q wave	857	(82)	134	(24)	23	(38)	
Non-Q wave	191	(18)	432	(76)	37	(62)	
Peak creatine kinase (IU)	1,517		704		1,057		<0.001
Mortality							
7 day	78	(8)	23	(4)	11	(19)	<0.001
30 day	118	(12)	52	(9)	13	(22)	0.01

in the present survey as well as in other AMI registries the 30 day mortality after AMI is higher than 10%.

In this survey, the proportion of women to men was 1:3; a 10 year age difference was noted between them (73 and 63 years, respectively). Crude mortality rates were higher in women than in men, mostly due to their older age and heavier co-morbidity.

Patients presenting with ST elevation myocardial infarction are candidates for early reperfusion therapy. In the present survey, the percent of patients with ST elevation treated with early reperfusion therapy was relatively low (56%), but these data are in line with other registries [7–10]. Contraindications to thrombolysis, late arrival and the fact that primary PCI was not available around the clock in the majority of hospitals with catheterization laboratory facilities were the main reasons for the relatively low rate of reperfusion therapy. Patients with non-ST elevation MI had lower peak creatine kinase levels, most probably reflecting smaller infarctions, which could explain the lower mortality rates among these patients when compared to those admitted with ST elevation

Table 4. Mortality*

Age adjusted (95% CI)	7 day	30 day
Men (n=1,232)	56 (5.6) (4.2–7.0)	100 (9.8) (8.0–11.6)
Women (n=451)	56 (10.1) (7.4–12.7)	81 (15.2) (11.8–18.5)
Age groups (yrs)		
<50 (n=215)	4 (2.0)	5 (2.5)
50–64 (n=557)	12 (2.2)	25 (4.7)
65–74 (n=377)	21 (5.8)	38 (10.5)
⩾75 (n=534)	75 (15.1)	113 (22.7)
Total 1,683	112 (7.0)	181 (11.3)

* Data on mortality are missing for 85 patients

MI [Table 3]. However, the similar re-infarction and urgent rehospitalization rates indicate that despite lower early mortality, patients with non-ST elevation MI are at equal risk for recurrent cardiac events compared to those presenting with ST elevation MI. Of interest, a substantial proportion of patients (18%) presenting with ST elevation ended with a non-Q MI, reflecting a relatively high rate of "spontaneous" or treatment-induced early reperfusion.

This survey suggests that guidelines for management of AMI were only partially implemented in the community. This finding is in line with other recent surveys [14–17]. For example, only 56% of patients presenting with ST elevation were given early reperfusion therapy. On the other hand, almost 50% of discharged patients received statins, although there are no explicit guidelines for using lipid-lowering drugs during hospitalization, particularly in patients with normal total cholesterol levels. In contrast, aspirin, heparin and, to some extent beta-blockers and ACE inhibitors were used in most of the patients in this study. The data from registries better represent the "real world" scenario than those collected in clinical trials. It seems necessary therefore that data from large populations or national registries should also be taken into consideration when clinical guidelines are designed for the management of AMI [18]. In addition, data from large registries are very helpful for assessing guideline implementation in the community, and when performed periodically they also provide useful time trend evaluation of the quality of medical care and outcome of patients after AMI in relation to diagnostic and therapeutic measures.

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Good writers are those who keep the language efficient. That is to say, keep it accurate, keep it clear

Ezra Pound (1885-1972), American poet and critic

APPENDIX

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