ACUTE MYOCARDIAL INFARCTION IN ISFAHAN, IRAN: HOSPITALIZATION AND 28TH DAY CASE-FATALITY RATE

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Abstract

BACKGROUND: This study aimed to investigate 28-day case fatality rate due to acute myocardial infarction (MI) in Isfahan using a standardized surveillance system.

METHODS: A prospective longitudinal study was performed on hospitalized myocardial infarction patients in Isfahan, Iran from 2000 to 2004. All hospitalizations due to myocardial infarction (MI) events were recorded via a system adopted from "World Health Organization Monitoring Trends and Determinants in Cardiovascular Disease" (MONICA) project, with ignoring MONICA age limitation. Patients were followed and their families enquired about their patients survival status at 28th day with phone calls and if not available at home visits.

RESULTS: Age-adjusted hospital admission rate showed an increase during the study period, rising from 131.67 to 209.27 per 100000, but slowed toward the end of the study. Patients' mean age was 62.35±12.64, with one third of events documented among female patients. Young patients (< 45 years old) comprised 8.6% of hospitalizations which remained nearly constant through the study. The corresponding figure was about 28% for patients aged less than 55 years. The 28-day case fatality rate was 23.1% for women and 13.2% for men. For individuals aged 35-64 years, the fatality rate was 13.0% for women and 7.7% for men.

CONCLUSION: This study showed an increase in myocardial infarction hospital admission rate in Isfahan but the rate of increase is decreasing. A multi-centric community-based myocardial infarction incidence study is needed to elucidate myocardial infarction epidemiology in Iran.

Introduction

Globally, Coronary Heart Disease (CHD) is the leading cause of death. WHO projected in 2005 that CHD accounts for 7.6 million deaths world wide, equivalent to 13.2 % of all deaths. Over 80% of these deaths have occurred in people living in low and middle-income countries.[1] In Iran, CVD mortality rate constituted 26.6% of deaths in 1987, increasing to 47.3% in 1995. Age-adjusted CVD mortality has increased since 1990.[2]

In Isfahan, a city in the center of Iran, a community intervention trial has started since 2000. This trial, The Isfahan Healthy Heart Program, is a six-year comprehensive integrated community-based program for cardiovascular diseases prevention and control via reducing its risk factors and improvement of relevant healthy behaviors.[3] Hence, a surveillance system was needed to monitor vascular diseases, especially CHD, during and following this community intervention program.

Based on WHO Monitoring Trends and Determinants in Cardiovascular Disease (MONICA) project, CHD surveillance system was designed and has been adopted since 2000.[4] Because of financial limitations, only hospitalized CHD patients were included in the surveillance system.

This article presents acute myocardial infarction (MI) hospital admission and 28-day case-fatality rates registered in the Surveillance system from 2000 to 2004 in Isfahan.

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Materials and Methods

Population: Isfahan is a city in the center of Iran, an Eastern Mediterranean country. Its population was about 1'777'185 inhabitants in 2000, less than 10% of them live in rural areas. It has a young population, with about 50% of population younger than 25 years.[5] Previous studies showed a relatively high rate of cardiovascular risk factors in this industrial city, that is the second large city of Iran.[6]

Hospitals: At the time the study was performed, about 13 hospitals were admitting and managing CHD patients in Isfahan. More than 75 percent of MI patients were managed in four public hospitals and the rest of patients in remaining nine private hospitals. Except for military hospitals without access to their patients' records, other hospitals records got evaluated.

Event Definition: In this registry, all possible CHD events were registered with ignoring MONICA age limitation. The MONICA MI diagnostic criteria were applied.[7] Diagnostic criteria are based on collection of standardized information including past history of MI or ischemic heart disease, symptoms at onset, maximum levels of serum enzymes, and relevant electrocardiograms (coded according to the Minnesota codes).[4] The WHO MONICA Project is concerned with events, not persons. Events are classified as first or recurrent.[7] In this study, both first and recurrent events are included. Events were categorized as: code 1: Definite MI, code 2: possible MI or coronary death, code 3: ischemic cardiac arrest, code 4: no MI or coronary death and code 9: fatal cases with insufficient data. In this study, MONICA definition 2 was used for MI events (nonfatal definite events and fatal definite or possible events). A period of 28 days was used to define the case-fatality rate and to distinguish between events. Worsening of symptoms or rehospitalization within these 28 days was not considered as a new event.[4]

Case finding: A cold pursuit method[4] was used in this study; hospital discharge lists were used for case finding. Records of patients hospitalized in cardiology wards, coronary care units or in other wards but under complete or partial supervision of cardiologists, were evaluated for possible signs and symptoms of CHD events. This evaluation was done by three experienced registered nurses trained in this regard before the study. They summarized proper records in special checklists containing information in: age, sex, event date and hospitalization date, symptoms, history of previous MI, enzymes, admission electrocardiogram, whether the event was iatrogenic, survival status in discharge and after 28 -day follow-up, and whether thrombolytics were used during hospitalization. The filled records were checked by an expert nurse with special training for the MONICA registration system. Moreover, 10 percent of the checklists were randomly chosen and refilled by the expert nurse from the original hospital records and compared with ones registered nurses had filled to see if any mistakes occurred.

As the center of Isfahan province, MI patients who live in other cities of the state are admitted to these hospitals as well as city dwellers. In order to calculate Isfahan MI hospital admission rate, only records from Isfahan city inhabitants were included in the study.

Patients follow-up: All discharged MI patients, were followed by telephone calls, and if not available, were reached by their address. The patients or their close family members were asked about patients' health status. If a patient had died during the first 28 days after the event, death scenario was asked and the event was coded as fatal after other non-cardiac etiologies were ruled out.

Statistical methods: The term "MI hospital admission rate" refers to both first and recurrent events (all MI events). "Case fatality rate" is defined as the proportion of events that are fatal within 28 days of onset.[4]

MI hospital admission rates were adjusted for age by direct standardization with the age structure of World Health Organization (WHO) world population standard.[8] Confidence Interval 95% (CI95%) for this adjusted rate was calculated using Poisson distribution.[9] CI95% for case fatality rate was calculated using Fisher's (exact) method.[10]

In order to compare proportions and means, chi square and t tests were used, respectively. SPSS$_{15}$ software (SPSS Inc., Chicago, IL) was used for data analysis. The significance value was set to P < 0.05.

Results

Overall, 10165 cases (including sudden cardiac death caused by definite or possible myocardial ischemia were registered from 2000 to 2004.

Crude AMI hospital admission rates were 79.72, 101.99, 119.82, 142.70 and 143.79 per 100000 Isfahan inhabitants in 2000, 2001, 2002, 2003 and 2004, respectively. Age-adjusted hospital admission rates were 131.67 (CI95%: 124.54, 138.80), 163.90 (CI95%: 156.10, 171.70), 180.78 (CI95%: 172.88, 188.68), 206.33 (CI95%: 198.04, 214.62) and 209.27 (CI95%: 201.00, 217.54) per 100000 Isfahan inhabitants in 2000, 2001, 2002, 2003 and 2004, respectively (Figure 1). The corresponding figures for the rate of increase in MI

hospitalization were 32.23, 16.88, 25.55 and 2.94 per 100000 inhabitants, respectively.

Patients' demographic data are summarized in tables 1 and 2. About one third of hospitalized AMI patients were female, more than 50% of them were older than 55 and younger than 75 years, and more than 90% of them were from urban areas.

Follow-up was performed in about 90% of cases (Table 2). The 28-day case fatality rate of Isfahan AMI hospitalized patients is about 16%. The case fatality rate was 23.1% for women and 13.2% in men (P < 0.001). When this analysis was restricted to patients who were 35-64 years old, case fatality rates were 13.0% in women, and 7.7% in men (P < 0.001). More than 50% of 28-day deaths occurred during the first 48 hours after the events.

About 9% of hospitalized AMI patients were younger than 45 years old (Table 2). This figure was nearly constant during the study period, 9.1, 8.3, 8.7, 8.3 and 8.8 percent in 2000, 2001, 2002, 2003 and 2004, respectively (P = 0.92). The youngest patient was 17 years old. Male to female ratio was higher in the young age group compared with older patients (P < 0.001). Furthermore, the case fatality rate was 5.83 in younger patients compared with 17.36 in older ones (P < 0.001).

**Table 1.** Age and sex distribution of Isfahan hospitalized myocardial infarction patients: 2000-2004.

	2000	2001	2002	2003	2004	Total
Female, (%)						
0 – 24	0	2(0.4)	0	1(0.1)	1(0.1)	4(0.1)
25 – 34	0	0	2(0.3)	3(0.4)	2(0.2)	7(0.2)
35 – 44	16(3.8)	20(3.7)	25(3.7)	26(3.2)	28(3.3)	115(3.5)
45 – 54	49(11.5)	60(11.2)	86(12.8)	86(10.6)	96(11.2)	377(11.4)
55 – 64	119(28.0)	152(28.3)	122(18.2)	178(21.9)	212(24.7)	783(23.7)
65 – 74	158(37.2)	168(31.3)	256(38.2)	285(35.1)	272(31.7)	1139(34.5)
75 – 84	75(17.6)	112(20.9)	153(22.8)	196(24.1)	215(25.1)	751(22.7)
≥ 85	8(1.9)	23(4.3)	26(3.9)	38(4.7)	31(3.6)	126(3.8)
Total	425(100)	537(100)	670(100)	813(100)	857(100)	3302(100)
Male, (%)						
0 – 24	1(0.1)	8(0.7)	4(0.3)	4(0.2)	3(0.2)	20(0.3)
25 – 34	14(1.5)	18(1.5)	19(1.4)	14(0.9)	30(1.8)	95(1.4)
35 – 44	91(10.0)	97(8.1)	131(9.3)	157(9.5)	161(9.5)	637(9.3)
45 – 54	206(22.6)	288(24.0)	313(22.3)	390(23.7)	416(24.4)	1613(23.5)
55 – 64	229(25.1)	330(27.5)	373(26.6)	411(25.0)	423(24.8)	1766(25.7)
65 – 74	251(27.5)	281(23.4)	361(25.7)	413(25.1)	404(23.7)	1710(24.9)
75 – 84	111(12.2)	160(13.3)	192(13.7)	234(14.2)	244(14.3)	941(13.7)
≥ 85	9(1.0)	18(1.5)	10(0.7)	22(1.3)	22(1.3)	81(1.2)
Total	912(100)	1200(100)	1403(100)	1645(100)	1703(100)	6863(100)
All, (%)						
0 – 24	1(0.1)	10(0.6)	4(0.2)	5(0.2)	4(0.2)	24(0.2)
25 – 34	14(1.0)	18(1.0)	21(1.0)	17(0.7)	32(1.3)	102(1.0)
35 – 44	107(8.0)	117(6.7)	156(7.5)	183(7.4)	189(7.4)	752(7.4)
45 – 54	255(19.1)	348(20.0)	399(19.2)	476(19.4)	512(20.0)	1990(19.6)
55 – 64	348(26.0)	482(27.7)	495(23.9)	589(24.0)	635(24.8)	2549(25.1)
65 – 74	409(30.6)	449(25.8)	617(29.8)	698(28.4)	676(26.4)	2849(28.0)
75 – 84	186(13.9)	272(15.7)	345(16.6)	430(17.5)	459(17.9)	1692(16.6)
≥ 85	17(1.3)	41(2.4)	36(1.7)	60(2.4)	53(2.1)	207(2.0)
Total	1337(100)	1737(100)	2073(100)	2458(100)	2560(100)	10165(100)

Table 2. Patients demographic and 28th day case-fatality rates data in Isfahan hospitalized myocardial infarction patients: 2000-2004.

	Patients' age (year)		Total N(%)
	< 45 N(%)	≥ 45 N(%)	
Total	878(8.6)	9287(91.4)	10165(100)
Sex(Female)	126(14.4%)	3176(34.2)	3302(32.5)
Settlement(Rural)	42(4.8)	427(4.6)	469(4.6)
Age, mean ± SD	39.01 ± 4.996	64.56 ± 10.779	62.35 ± 12.64
Survival status			
Missed	140(15.9)	1044(11.2)	1184(11.6)
Dead	43(4.9)	1431(15.4)	1474(14.5)
Alive	695(79.2)	6812(73.3)	7507(73.9)
Case Fatality (%)	5.83	17.360	16.412
CI95%	4.32–7.66	17.35–17.37	16.41–16.42
Day of death after Hospitalization			
Day 0	21(52.5)	352(26.0)	373(26.7)
Days 1-2	3(7.5)	368(27.1)	371(26.6)
Days 3-7	7(17.5)	296(21.8)	303(21.7)
Days 8-14	4(10.0)	180(13.3)	184(13.2)
Days 15-28	5(12.5)	160(11.8)	165(11.8)

SD: Standard Deviation
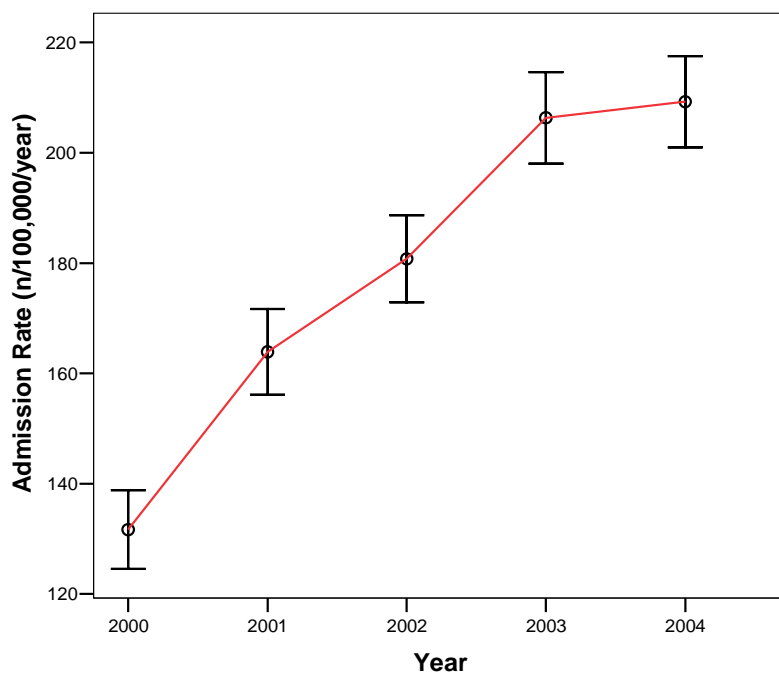
Figure 1. Directly age-adjusted acute myocardial infarction-hospital admission rate in Isfahan: 2000-2004.

Discussion

In this study, similar principles were adopted in data collection and interpretation in successive years. Therefore, a trend analysis is possible, although the study can not be accounted as an MI incidence study. The findings showed that MI hospital admission rate is increasing in Isfahan after adjusting for age. However, the rate of increase was decreasing in successive years. This improvement in MI hospitalization could be related to many reasons, including economic problems, improved knowledge of the population, so they refer to hospital or are diagnosed before getting their

heart attack which may be related to the impact of the intervention activities of "The Isfahan Healthy Heart Program" which targets the general population as well as high risk groups, those with at least one risk factor.[3] Evaluation of this intervention community trial one year after its onset, has shown improvement in healthy lifestyle of Isfahan inhabitants.[11] To differentiate these situations, a community-based MI incidence study is necessary.

Sex distribution of MI events in this study was 24.1% among females aged 35-64 years old, consistent with some other studies; In Poland-MONICA study, this figure was 23.4% among hospitalized MI events and in US it was 25.6%.[12]

About 8.6% of Isfahan hospitalized MI events occurred in young patients aged less than 45 years. This figure is comparable to reported frequencies of hospitalized MI events in Spain (9%)[13] and in Michigan, US (10.4%).[14] Frequency of young events has remained constant in Isfahan. Although in some series it has been reported to be increasing (such as in Iceland) but other series have documented a decreasing trend.[15] In Isfahan, young patients hospitalized for MI are more men than women. This figure has been reported in other series as well.[13]

The 28th day case fatality rate in Isfahan hospitalized MI events was 7.7% for men, 13.0% for women and 8.9% totally among patients 35-64 years old. This rate did not include out-of-hospital fatal MI events; consequently, this percentage could not be compared with 28th day case fatality rates reported in community-based MI mortality studies. Average 28th day case fatality rate for hospitalized MI events were 22% for men and 27% for women in MONICA study.[16] Although it seems that Isfahan events had a better prognosis but this might be related to the study period as MONICA project's figures are related to 1985-90 statistics. It has been shown that in-hospital MI mortality has been decreased from 17.8% in 1975-78 to 11.7% in 1993-95.[17] However, in one neighboring country, population based MI case fatality rates in 1995-97 has been much lower than MONICA project's rates in 1991-1993.[18]

The greatest pitfall of this study is lack of Complete, Community-Based Case Ascertainment, which includes through protocols for finding community fatal and non-fatal MI cases who are not admitted in the hospitals, and is necessary to study MI incidence. Most important is the lack of data about out-of-hospital fatal cases. Inclusion of this group of patients would affect not only MI case fatality rates but also it would increase MI events rates. In Japan, 25.4% of total MI cases were out-of-hospital fatal cases.[19] In MONICA study, 42% to 75% (median 64%) of women's MI deaths within the

28-day follow-up occurred before reaching hospitals. This was somehow lower than for men, for whom the range was 58% to 80% (median, 70%).[20] In our study there were other groups of patients not included in the study, such as MI cases that were managed at homes or in health centers. This figure might be negligible because MI event is considered an emergency in Iran health care system and all hospitals should admit such patients regardless of their insurance status. In Danish MONICA population this figure was measured to be less than 1% of total MI cases in a year.[18] Due to incomplete registration of MI cases in the population, estimating MI incidence or attack rates among study population was not possible. However, it might be the first report of MI events in Iran and one of the few reports from Middle East countries whose registration procedure is based on an international well known registration system.

In conclusion, this study showed that rate of increase in MI hospital admission rate might be declining in Isfahan and its case fatality rate might be lower than other countries. These findings necessitate conduction of more comprehensive population based MI surveillance studies in populations in which coronary vascular diseases (CVD) comprise major health problems or their prevalence is increasing.

To improve population health and implement effective strategies for coronary artery diseases patients, surveillance systems that continually monitor and follow coronary events and fatality rates are necessary. Such systems may be used as indicators of effectiveness of community-based interventions by showing the final outcome of intervention programs at population level.

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