European Heart Journal (1982) **3**, 130–135

Incidence and prognosis of acute myocardial infarction among men below age 40 in Göteborg, Sweden

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KEY WORDS: Myocardial infarction, young males, incidence, survival, non-fatal reinfarctions.

All cases of acute myocardial infarction occurring in the community of Göteborg in certain age groups have been registered in an Infarction Register for more than a decade. All survivors have systematically been followed-up at a special Postmyocardial Infarction Clinic. Sixty-one cases of myocardial infarction below the age of 40 were registered through the years 1968–78. Fifteen men died either outside hospital or in hospital in the acute stage. The annual incidence of a first myocardial infarction was low — 6·1 and 29·4 per 100 000 males in the age groups 30–34 years and 35–39 years respectively. However, the incidence among Finnish immigrants was significantly higher than among other groups, the figures being similar to those reported from Helsinki. Compared with older patients, the survivors below the age of 40 seemed to have larger and more complicated infarcts.

During an 11-year follow-up the mortality was significantly lower among patients below the age of 40 than in older age groups. The incidence of non-fatal reinfarctions and the prevalence of angina pectoris did not differ between the groups. The non-fatal reinfarctions could not be predicted from primary or secondary risk factors.

Acute myocardial infarction and sudden cardiac death are the predominating causes of death in the industrialized world. The incidence of ischemic heart disease is sex and age dependent.

Studies of vital statistics show an increase in the mortality from ischemic heart disease among men in some countries during the 1960s[1]. A similar study of the mortality in Sweden during 1951–68 did not show a change in mortality during these years[2]. During the years 1968–75 several countries have shown a decreasing mortality — for example U.S.A. and Finland — while countries like Denmark and Sweden have shown an increase[3].

The object of the present study was to determine the incidence and prognosis regarding mortality and non-fatal reinfarction among men with a first myocardial infarction below the age 40 within a geographically and demographically well-defined area through the years 1968–78.

Patients and methods

Göteborg, the second largest city in Sweden, has a population of approximately 450 000 with 9% being foreign citizens. Among men in the age group 30–39 years, 21% were born abroad. The biggest and second biggest immigrant groups were from Finland and Yugoslavia, respectively[4,5].

From 1 January 1968 onwards, all cases of acute myocardial infarction occurring in the population of Göteborg in certain age groups have been registered in a special Infarction Register. This register comprises more than 90% of all diagnosed cases of myocardial infarction in the city. All survivors have been systematically cared for after the acute phase of the infarction at a special Postmyocaridal Infarction Clinic. During follow-up, deaths and reinfarctions were registered in the Infarction Register[6,7].

REGISTRATION OF NON-FATAL INFARCTIONS

During the period studied, 1968–78, there was only one hospital, Sahlgrenska Hospital, in Göteborg for emergency cases. The patient and the diagnosis lists at the emergency department of Sahlgrenska Hospital were examined daily by special register personnel. Persons known or

Received for publication 4 March 1981; and in revised form 16 July 1981.

0195–668X/82/020130 + $02.00/0

suspected to have had acute myocardial infarction were recorded and followed-up at the department to which they were admitted until the diagnosis was verified or eliminated. All medical wards were visited by register personnel at least twice a week and patient lists were examined jointly with ward staff. All suspected cases of acute myocardial infarction were recorded. The final decision on whether an acute myocardial infarction had occurred or not was taken by the physician directly responsible for registration, or personally assessed in each individual case. Registration in accordance with the criteria stated below was done independently of the diagnosis of the physician treating the patient.

Acute myocardial infarction was considered to have occurred when at least two of the following criteria (a, b and c) were fulfilled:

(a) Central chest pain of more than 15 min duration and with onset within the last 48 h, or pulmonary oedema without previously known valvular disorder or shock without suspicion of acute hypovolemia or intoxication.

(b) Transient rise of S-GOT or S-ASAT to values above the normal limits applied by the laboratory with a maximum approximately 24 h after the calculated infarction onset, combined with a less pronounced increase or lack of increase of S-GPT or S-ALAT or two values of lactate-dehydrogenase above the normal limits with a maximum about 60 h after the calculated infarction onset, or one raised S-ASAT value in combination with one raised lactate-dehydrogenase value.

(c) ECG series with occurrence of pathological Q waves and/or occurrence or disappearance of localized ST elevations in combination with the development of T inversion in at least two of the 11 routine standard leads (I, II, III, aVR, aVL, aVF, V_1, V_2, V_4, V_5, V_7).

REGISTRATION OF FATAL CASES

The death certificates of all deceased persons registered in Göteborg were collected continuously. In addition to personal data they included information on place of death and the basis of diagnosis. Deaths occurring outside hospital were subjected to routine police enquiry by special police personnel. These enquiries concerned the circumstances of death, such as where death occurred, as well as the interval between onset of any symptoms and death. Witnesses were questioned concerning symptoms. All persons who died outside hospital in Sweden and for whom the cause of death was not known by a doctor, were autopsied by a forensic pathologist. Patients who were in hospital at the time of death were submitted to autopsy.

For myocardial infarction to be recorded as the cause of death in the autopsied patients, morphological evidence of fresh infarction was required. For non-autopsied patients the clinical criteria were the same as for the diagnosis of myocardial infarction at entry to the study. The diagnosis required two of the three criteria to be fulfilled. The deaths during follow-up in which no extracardiac or cardiac cause of death could be found were ascribed to acute arrhythmias. They have been included among coronary deaths.

The present study comprised men with a first acute myocardial infarction occurring during the years 1968–78 and the groups below were studied:

(1) Men with first infarction below the age of 40. This group consists of all men with myocardial infarction, fatal or non-fatal below the age of 40 years. Those men who were discharged alive from hospital are henceforth called the *younger patients.*

(2) In order to compare the prognosis of younger patients, another patient group was defined: men in the age group 40–59 years with a first acute myocardial infarction during the years 1968–78 and discharged alive from hospital, henceforth called the *older patients* (n=1214).

VARIABLES

All younger patients born and raised abroad were regarded as being of foreign origin. The information about the origin of those who died outside or before admission to hospital were collected from the police records or from the necropsy protocols.

The classification of smokers, ex-smokers and non-smokers, the determination of serum cholesterol and blood pressure and the registration of the ECG were made in the same way for all patients[6]. Angina pectoris was defined as chest pain on exertion according to Rose and Blackburn[8]. In order to ensure uniform collection of data, special forms were used.

The localization of the myocardial infarct was determined by the ECG changes in the following leads: anterior I, V_1 – V_5, lateral II, aVL, V_7 and inferior II, III and aVF.

Determination of enzymes (S-ASAT and S-ALAT) was made routinely each morning during the first three days at hospital. The sampling was not related to the onset of symptoms.

Statistical methods

Proportions were compared with χ^2-test or Fisher's exact test. Distributions were compared with the t-test or tests for trend in contingency tables[9]. Differences were considered statistically significant when $P < 0{\cdot}05$ and almost significant when $0{\cdot}05 < P < 0{\cdot}10$. Life tables and survival curves with standard error were calculated according to conventional methods.

Results

INCIDENCE

Sixty-one cases of myocardial infarction below the age of 40 were registered during the 11-year period 1968–78. Eleven men (18%) died outside hospital and four (7%) during the hospital stay. The average age was 35·6 years and the age distribution can be seen in Fig. 1. The annual incidence of a first myocardial infarction per 100 000 males was 1·7 in the age group 25–29 years, 6·1 at 30–34 years and 29·4 at 35–39 years (Table 1). There was a significantly lower incidence among men of Swedish origin than among men of Finnish origin ($P<0{\cdot}01$) while no differences were noticed between men of Swedish and foreign non-Finnish origin. Among men of foreign origin the Finns tended to have a higher incidence than the other immigrants (P = 0·10). The annual number of infarct cases was too low to indicate any time trends.

CLINICAL SIGNS

Forty-six younger patients were discharged alive from hospital. Three of these had a juvenile diabetes mellitus. Thirty-seven fulfilled all three diagnostic criteria for infarction. Of the remaining nine patients who fulfilled two criteria, seven had had chest pain. The two patients without chest pain were both juvenile diabetics.

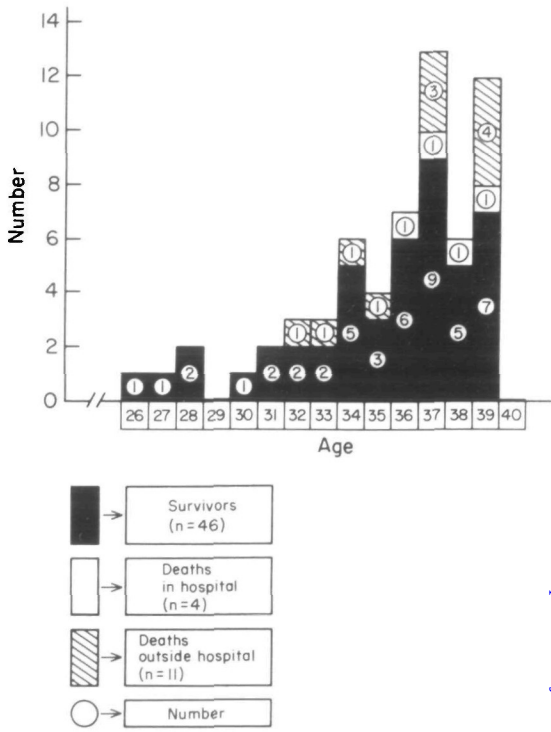

Figure 1 Age distribution among men with myocardial infarction below the age of 40 in Göteborg 1968–78. Mean = 35·6 years; median = 37·1 years.

The younger patients had a higher maximal mean S-ASAT value than the older patients (4·1 ukat/l and 2·9 ukat/l, respectively; $P < 0{\cdot}05$) during the acute phase.

There were more primary ventricular fibrillations among younger patients compared to the older patients (13% and 2%, respectively;

Table 1 Incidence of myocardial infarction among men below the age of 40 in Göteborg 1968–78

Age (years)	Population: Place of birth			Cases of myocardial infarction: Country of origin			Annual incidence per 100 000: Country of origin			Annual incidence per 100 000
	Sweden	Finland	Abroad except Finland	Sweden	Finland	Abroad except Finland	Sweden	Finland	Abroad except Finland	Total
30–34	14083	1158	2525	10	3	2	6·5	23·6	7·2	6·1
35–39	9758	876	2372	26	7	9	24·2	72·6	34·5	29·4
30–39	23841	2034	4897	36	10	11	13·7	44·7	20·4	16·8

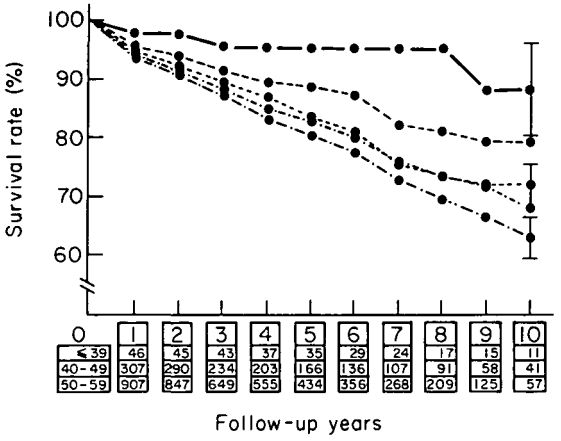

Figure 2 Accumulated survival among younger and older myocardial infarction patients who survived hospital stay. Numbers in boxes along the abscissa denote numbers of patients in each age group studied during each interval. ●—● = ⩽ 39 years of age; ●– –● = coronary deaths 40–49 years of age; ● - - - - ● = total deaths 40–49 years of age; ● · – · – · ● = coronary deaths 50–59 years of age; ●— · —● = total deaths 50–59 years of age.

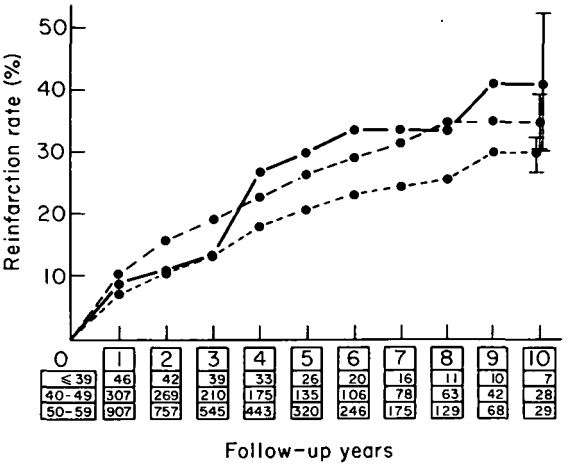

Figure 3 Accumulation of non-fatal reinfarctions among younger and older patients. Numbers in boxes along the abscissa denote numbers of patients in each age group studied during each interval. ●—● = ⩽ 39 years of age; ●– – –● = 40–49 years of age; ●– –● = 50–59 years of age.

$P < 0{\cdot}01$). None of the younger patients and less than 1% of the older patients had secondary ventricular fibrillation (>24 h after admission).

ECG changes were found in 43 of the 46 younger patients of whom 31 (67%) had a pathological Q wave. Twenty-five (54%) of the patients had an anterior infarction of whom 18 had a pathological Q wave, while 18 (39%) of the patients had inferior infarction of whom 13 had a pathological Q wave.

FOLLOW-UP

The mortality during the follow-up was lower among the younger patients. The difference was significant compared with the two age groups 40–49 years ($P < 0{\cdot}05$) and 50–59 years ($P < 0{\cdot}05$; Fig. 2).

During the follow-up, 14 younger patients suffered from a non-fatal reinfarction (Fig. 3). There were no differences between the three age-groups. Eleven of the younger patients with a non-fatal reinfarction had initially an anterior infarction. There were no differences between patients with and without non-fatal reinfarction with respect to the variables serum cholesterol, blood pressure, smoking habits or angina pectoris after infarction, enzyme maximum during the acute stage or dyspnea at the initial phase of infarction. The reinfarctions were localized to the anterior as often as the inferior wall. At the check-up three months after infarction, 22 patients (48%) of the 46 surviving younger patients had angina pectoris. After one year the figure had decreased only slightly to 44%. Among the older patients 43% had angina pectoris after three months and after one year. Fourteen (35%) of the 40 younger patients who were smokers before infarction stopped smoking in connection with the acute hospital stay. The older patients stopped to a greater extent (56%; $P < 0{\cdot}01$).

Discussion

The validity and reliability of the registration and follow-up procedures has been reported previously[6,7].

The annual incidence of myocardial infarction among men below the age of 40 during the period studied was in concordance with the results seen in the multicentre study 1970–71 organized by WHO, where Göteborg was one of the participating centres[10]. Out of 21 centres only two — Bucharest and Erfurt — had as low an incidence as Göteborg in the studied age group while all the other had considerably higher incidences. In Perth, Australia, the incidence in age group 30–34 years and 35–39 years, has been shown to be 5 and 2·5 times higher than in Göteborg, respectively[11]. The observed

higher incidence among Finnish men is in accordance with the incidence figures from Helsinki[10].

The mortality before and during acute hospital stay was somewhat lower in this study than among older patients in the same area[6]. A similar age relation has been shown in other studies[11,12]. The hospital mortality is in agreement with other studies[13,14].

Higher maximal S-ASAT level among younger patients was observed in another Swedish study[12]. The proportion of patients with a pathological Q wave was inversively related to age in a previous study[15]. The large proportion of Q waves and the high enzyme levels may suggest that the young patients had suffered a morphologically larger and more complicated infarct. This may be supported by the higher frequency of primary ventricular fibrillation. However, cellular enzyme content and kinetics of liberated enzymes may be related to age.

Several studies show a relatively better long-term survival among young patients than older ones[16–19]. However, despite the low absolute mortality there was a marked relative excess mortality compared with the healthy population[13,20–22]. There was no difference between the ages regarding frequency of non-fatal reinfarction and symptomatic angina pectoris. Several factors have been shown to influence the long-term course after discharge from hospital. Treatment with beta-blockers[23,24] was used to the same extent among younger and older patients in the present study. Another important factor, is tobacco smoking[25,26]. Younger patients tended to stop smoking to a lesser degree after the infarction but the number of deaths and non-fatal reinfarctions among the young patients were too few to show a difference between those who continued to smoke and those who stopped. Total serum cholesterol only carries minor importance as a secondary risk factor during limited periods of follow-up. Thus, it stands out clearly that younger patients have severe coronary disease. The use of beta-blockade, smoking habits and other secondary risk factors may all be important in explaining the varying outcomes but the relative importance of each factor, however, cannot be elucidated and requires further studies.

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