Do women with acute myocardial infarction receive the same treatment as men?

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Abstract

Objective—To determine whether women with acute myocardial infarction in the Nottingham health district receive the same therapeutic interventions as their male counterparts.

Design—Retrospective study.

Setting—University and City Hospitals, Nottingham.

Patients—All patients admitted with a suspected myocardial infarction during 1989 and 1990.

Main outcome measures—Route and timing of admission to hospital, ward of admission, treatment, interventions in hospital, and mortality.

Results—Women with myocardial infarction took longer to arrive in hospital than men. They were less likely to be admitted to the coronary care unit and were therefore also less likely to receive thrombolytic treatment. They seemed to have more severe infarcts, with higher Killip classes, and had a slightly higher mortality during admission. They were less likely than men to receive secondary prophylaxis by being discharged taking β blockers or aspirin.

Conclusions—Survival chances both in hospital and after discharge in women with acute myocardial infarction are reduced because they do not have the same opportunity for therapeutic intervention as men.

Introduction

Myocardial infarction is common and, despite a quarter of all acute events occurring in women,¹ most studies focus on events in men. Cardiovascular disease remains the commonest cause of death in England and Wales. In 1991 ischaemic heart disease accounted for 82 000 male deaths and 68 500 female deaths. In the same year 13 800 women died of carcinoma of the breast.² Over the past 25 years the mortality from coronary artery disease in men in England and Wales has been falling but that in women has remained constant.³

Women are less likely than men to have a myocardial infarction as the initial presentation of ischaemic heart disease.⁴ Those who do have a myocardial infarction are usually older⁵ and more likely to have pre-existing risk factors such as hypertension.⁶ Superficially women seem to have a worse course after a myocardial infarction with a higher risk of reinfarction⁶ and unstable angina.⁷ This increased risk of complications and in hospital mortality may simply be age related.^{6,8} However, there is also evidence that long term mortality may be greater in women.⁹

There is good evidence that certain interventions after myocardial infarction are of benefit.¹⁰⁻¹² We therefore decided it would be timely to evaluate the in hospital course of women with acute myocardial infarction in our hospitals and assess whether they are

afforded the same therapeutic opportunities as men. We obtained information from the Nottingham Heart Attack Register,^{13,14} which has recorded all patients brought to the Nottingham hospitals, alive or dead, with suspected myocardial infarction during selected periods since 1973.

Patients and methods

Methods of data collection and storage for the Nottingham heart attack register have been described.¹⁴ Briefly, all patients admitted to the Nottingham hospitals with symptoms suggestive of acute myocardial infarction were identified prospectively and an extensive record of management and outcome made. For this study data were retrieved for 1989 and 1990, when thrombolytic treatment was standard for acute myocardial infarction. We compared management and outcome between men and women and investigated whether both sexes were afforded equal opportunity to receive the most effective treatment.

Data were collected on the following nine variables.

Age was looked at to ensure that any sex differences found were not simply due to a difference in age between the two patient groups.

Route to hospital was divided into those patients who called the general practitioner, who then arranged admission, and those patients who called for an ambulance direct without contacting the general practitioner.

Time to arrival in hospital after onset of symptoms was recorded as within six hours, between six and 12 hours, between 12 and 24 hours, or later than 24 hours.

Definite myocardial infarction—An initial working diagnosis of acute myocardial infarction was based on the presenting history and initial electrocardiogram. The diagnosis was made by the admitting senior house officer and was the basis for the immediate planned management of that patient. An initial working diagnosis of acute myocardial infarction has been shown to be a reliable predictor of a discharge diagnosis of the condition.¹⁵ The sensitivity, specificity, and positive predictive value of an initial working diagnosis for each sex is shown in table I. The initial working diagnosis of each patient, rather than the final diagnosis, was used in the analysis when it was considered more relevant.

Ward of admission—Patients were admitted to either the coronary care unit or a general medical ward. We

TABLE I—Sensitivity and specificity of initial working diagnosis of acute myocardial infarction

	Men	Women
Sensitivity	56%	54%
Specificity	94%	94%
Positive predictive value	74%	70%

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concentrated our analysis on the patient's initial working diagnosis, rather than the final diagnosis, as the patient was usually assigned to either a ward or a coronary care unit within 24 hours. The initial diagnosis therefore influenced patient disposal.

Treatment with thrombolytic agents—By mid-1988 thrombolytic treatment was recommended for myocardial infarction, and we compared the number of men and women who received thrombolysis.

Severity of myocardial infarction on admission was judged by the Killip score.¹⁶

In hospital interventions and mortality—Interventions included temporary pacing, central haemodynamic monitoring, inotropic support, or intravenous nitrates. Attempted resuscitation and death in hospital were also recorded.

Treatment on discharge—Data were available concerning the number of patients discharged taking aspirin and β blockers.

Statistical analysis

Categorical data were compared by either the χ^2 test or log linear modelling, as appropriate. Logistic regression was used to identify the important variables affecting admission to the coronary care unit, death in hospital, and receipt of thrombolytic treatment. Mantel-Haenszel analysis allowed us to calculate odds ratios for men compared with women. These were adjusted for age and any other variables found to be important.

Results

A total of 7850 patients were admitted with suspected myocardial infarction; 2988 (38%) were women. Of 1767 patients (23%) who proved to have a discharge diagnosis of definite infarction, 580 (33%) were women.

Age—Table II shows the age, sex, and diagnosis of the patients admitted. Men were significantly younger than women ($P < 0.001$).

Route to hospital—A total of 2706 (56%) of the men admitted and 1798 (60%) of the women called their doctor, who then arranged admission. Women were significantly more likely to call their doctors ($P = 0.003$).

Time to arrival in hospital—Men were significantly more likely to arrive in hospital sooner after the onset of symptoms than women. It has been reported that contacting the general practitioner first delays the time to admission.¹⁴ Table III shows the proportion of men and women arriving within each time interval from symptom onset. Patients admitted within 12 hours

TABLE II—Numbers (percentages) of admissions for suspected acute myocardial infarction

Age (years)	Men	Women
< 35	123 (2.5)	24 (0.8)
35-44	414 (8.5)	107 (3.6)
45-54	773 (15.9)	315 (10.5)
55-64	1361 (28.0)	616 (20.6)
65-74	1353 (27.8)	878 (29.4)
≥ 75	838 (17.2)	1048 (35.1)
Total	4862 (100.0)	2988 (100.0)

χ^2 test: $P < 0.001$.

TABLE III—Time from onset of symptoms to arrival in hospital

Time (hours)	No (%) of men	No (%) of women
< 6	2528 (52.0)	1404 (47.0)
6-12	535 (11.0)	329 (11.0)
12-24	340 (7.0)	209 (7.0)
> 24	1459 (30.0)	1046 (35.0)
Total	4862 (100.0)	2988 (100.0)

χ^2 test: $P < 0.001$.

FIG 1—Probability of admission to coronary care unit with initial working diagnosis of confident myocardial infarction

FIG 2—Probability of patients of either sex receiving thrombolytic treatment after admission to coronary care unit with diagnosis of myocardial infarction

were considered eligible for thrombolysis. Hence only these patients were considered in the analysis of thrombolytic treatment. Patients admitted at any stage may require other interventions or may die, and therefore all patients were included in these analyses.

Definite myocardial infarction—Altogether 1339 patients were admitted with an initial working diagnosis of acute myocardial infarction. Of these, 447 (33%) were women.

Ward of admission—A total of 2723 (56%) of the men and 1225 (41%) of the women were admitted to coronary care. Several variables affected a patient's chance of admission to coronary care. Firstly, a patient with an initial working diagnosis of myocardial infarction had a much greater chance of admission than one with a differential diagnosis. Secondly, an older patient had less chance of admission than a younger patient, regardless of the initial working diagnosis. Thirdly, sex influenced management. The odds ratio for a man's admission to the coronary care unit adjusted for age and diagnosis was 1.40 (95% confidence interval 1.26 to 1.56). Elderly women, regardless of diagnosis, had less chance of admission than their male counterparts. Figure 1 shows the probability of admission to coronary care for men and women with a diagnosis of "confident myocardial infarction." Women fared worse than men in each age group, especially the 75 and over age group. Repeating the analysis with final rather than initial diagnosis did not affect the results, nor did including the Killip class as another possible factor.

Treatment with thrombolytic agents—A total of 689 (58%) of the 1187 men with a final diagnosis of myocardial infarction received thrombolytic treatment, as did 241 (42%) of the 580 women ($P < 0.001$). Women were admitted later, were older, and were not being admitted to coronary care at the same rate as men

and so were denied thrombolysis. Inside coronary care, however, we found no sex bias regarding thrombolytic treatment. The odds ratio for men adjusted for age and diagnosis was 1.28 (95% confidence interval 0.98 to 1.67). An age bias persisted, however (fig 2).

Severity of myocardial infarction was measured by Killip class on admission. Table IV shows the Killip scores for men and women with a definite myocardial infarction. When the different age structures were taken into account women were more likely to have Killip scores of 2 and 3 ($P=0.003$) and thus likely to have a more severe infarct.

In hospital interventions and mortality—There were no significant differences in the numbers of men and women who required in hospital resuscitation, temporary pacing, central haemodynamic monitoring, or inotropic support. Men were more likely to receive intravenous nitrates ($P=0.001$). We looked at the odds of dying during admission. When the different age and diagnostic structures and the bias of ward admission between men and women were taken into consideration women showed a small increased risk of dying. The male to female odds ratio was 0.83 (95% confidence interval 0.71 to 0.97). This effect is illustrated in figure 3, showing the probability of dying for those patients in the coronary care unit with a diagnosis of definite myocardial infarction.

Treatment on discharge—A total of 997 (84%) men with a final diagnosis of definite myocardial infarction were discharged alive, as were 424 (73%) women. Of these patients, 422 men and 122 women were discharged taking β blockers; 795 men and 318 women were discharged taking aspirin. Men were significantly more likely to be discharged taking either drug ($P<0.01$). These results were adjusted for age.

Discussion

We have shown that men account for more of the admissions to our hospitals with suspected myocardial infarction and that the women admitted are on the whole older than the men. If the only discriminating factor in the treatment was age, then we should expect that both men and women of increasing years would be treated similarly. In our hospitals we do not have a

TABLE IV—Killip scores on admission

Killip score	No (%) of men	No (%) of women
0	590 (49.7)	210 (36.2)
1	510 (43.0)	302 (52.1)
2	70 (5.9)	54 (9.3)
3	17 (1.4)	14 (2.4)
Total	1187 (100.0)	580 (100.0)

χ^2 test: $P=0.003$.

FIG 3—Probability of dying in coronary care unit after admission with initial working diagnosis of acute myocardial infarction

Clinical implications

- Women with acute myocardial infarction do not receive the same treatment as men
- Elderly patients (especially women) who might benefit from thrombolysis should not be denied admission to the coronary care unit
- Reasons for differences in treatment on discharge should be looked at

formal policy of selective admission to coronary care. We have shown that though younger men and women who are admitted with an initial working diagnosis of acute myocardial infarction have an equally good chance of being admitted to coronary care, for more elderly patients the picture is somewhat different. For both men and women the odds of admission to coronary care decrease as they get older, but an older woman has a 15% less chance than an older man of admission to the unit. Under our current protocol thrombolytic treatment is given only in the coronary care unit. All patients admitted to the ward are therefore denied thrombolysis. Because women are more likely to be admitted to the ward they are automatically discriminated against by not being allowed appropriate treatment.

Women are more likely to be in a higher Killip class on admission to hospital, which might influence ward placement. We have shown, however, that there is no relation between Killip class and probability of admission to the coronary care unit, and the differences seem to be based on sex alone.

Possibly another reason that women are more likely to be admitted to the ward is that they take longer to arrive in hospital than men and therefore are more likely to be outside the time limit for thrombolysis. There may be several reasons why they take longer to arrive in hospital. Firstly, women are more likely to call their general practitioner than dial the 999 emergency service, which delays admission.¹³ It may also be that women delay longer than men in seeking help after the onset of their symptoms, though in Nottingham at least in 1992 this was not the case (C Gray, personal communication). When women are admitted to coronary care they are as likely as men to receive thrombolysis.

Independent of age, women are more likely to be in a prognostically worse category on admission, which is borne out by their slightly higher mortality during admission. The probability of dying in the coronary care unit is greater for elderly patients but is also slightly greater in elderly women than in men of a similar age. Failure to detect any differences in the numbers of patients requiring temporary pacing, central haemodynamic monitoring, or inotropic support may simply reflect small numbers of patients requiring intervention. We have also shown that women are less likely than men to be discharged taking prophylactic aspirin or β blockers^{17,18} and are thus exposed to a higher risk of reinfarction and death.

Patients with the highest mortality (elderly women) are the very people who are not being admitted to coronary care and who are being denied thrombolytic treatment. We could begin to overcome this problem by initiating thrombolytic treatment in the accident and emergency department or by a peripartetic thrombolytic service on the medical wards. Though the dilemma of whether to admit a 70 year old woman to the last bed in the coronary care unit or to keep it for a younger patient who may arrive in the accident and emergency department will always remain emotive, it is less easy to understand why a 70 year old man is more

likely to be afforded admission to the coronary care unit than a woman of the same age.

There is already enough evidence to suggest that women with chronic angina are less likely to receive surgical treatment,¹⁹ and we now have evidence that they are less likely to receive the best available treatment after acute myocardial infarction. Overall, women with ischaemic heart disease seem to be receiving a less than fair deal.

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Acute myocardial infarction in women: survival analysis in first six months

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Abstract

Objective—To examine the influence that being female has on the outcome of acute myocardial infarction.

Design—Observational follow up study.

Setting—London district general hospital.

Patients—216 women and 607 men with acute myocardial infarction admitted to a coronary care unit from 1 January 1988 to 31 December 1992.

Main outcome measures—All cause mortality and recurrent ischaemic events in the first six months.

Results—Event free survival (95% confidence interval) at six months was 63.3% (56.3% to 69.4%) in women and 76.1% (72.4% to 79.4%) in men, $P < 0.001$. The difference was confined to the first 30 days but thereafter the hazard plots for women and men converged, with reduction of the hazard ratio from 2.36 (1.70 to 3.27) to 0.81 (0.44 to 1.48). Women were older, but their excess risk persisted after adjustment for age, other baseline variables, and indices of severity of infarction (hazard ratio 1.53 (1.09 to 2.15), $P = 0.015$). Women tended to be treated with thrombolysis less commonly than men but the difference was small. Substantially fewer women than men, however, were discharged taking β blockers (23.3% v 41.4%, $P < 0.001$), and although additional adjustment for discharge treatment did not further reduce the point estimate of the hazard ratio (1.84 (0.89-3.83)), the 95% confidence interval was wide and statistical significance was lost.

Conclusions—Women with acute myocardial infarction have a worse prognosis than men but the excess risk is confined to the first 30 days and is only

partly explained by age and other baseline variables. The tendency for women to receive less vigorous treatment than men must be remedied before gender can be considered to be an independent determinant of risk.

Introduction

It is well established that women with myocardial infarction have a worse prognosis than men, but disagreement persists about whether this reflects differences in age, risk profiles, or treatment given.¹⁻⁷ Women with myocardial infarction are typically older than men, and some investigators have found the difference in age sufficient to account for all their excess risk.^{4,6} Also, hypertension and diabetes may be more common in women, and this factor too may contribute to the prognostic imbalance between the sexes.^{1,2,4,5} More recently, evidence has shown that women with coronary heart disease tend to be treated less intensively than men.⁸⁻¹² If this applies to use of thrombolysis and drugs such as aspirin and β blockers, it may not only help explain women's less favourable outcome but also provide a relatively simple remedy for correcting it.

Although women with myocardial infarction have a worse prognosis than men, it is not known for how long after the acute phase the excess risk persists. Certainly, the survival curves for women and men presented by previous investigators are in most cases approximately parallel after initially diverging,^{1,5} which implies that the excess risk in women is a temporary phenomenon that eventually disappears. It is important, however, that the time it takes to disappear is defined if specific

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