Differences in Management of Suspected Myocardial Infarction in Men and Women

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Background. Men and women with ischemic heart disease receive different medical treatment. Men receive more aggressive intervention and at an earlier stage of disease. However, differences in treatment between sexes have thus far been demonstrated only for invasive treatment, which may be less effective for women than for men.

Methods. In a small community hospital, all patients admitted to the family practice service for suspected acute myocardial infarction from July 1988 to June 1989 were evaluated retrospectively to determine the reasons for placement in the cardiac care unit (CCU) vs regular nursing bed units with telemetry. The variables considered were patient age, patient sex, physician sex, and the likelihood of ischemia based on the Acute Ischemic Heart Disease Predictive Instrument (HDPI).

Results. Ninety-three patients were entered in the study. The patient's age, sex, and likelihood of ischemia as measured by HDPI score were significantly related to probability of placement in the CCU. Women were less likely than men to be placed in the CCU, controlling for age and likelihood of ischemia (OR = 0.362, 95% CI = 0.135 to 0.977).

Conclusions. Women appear to receive not only less intensive invasive treatment for ischemic heart disease than men, as previous studies have shown, but also less aggressive noninvasive treatment. This may represent unnecessary treatment of men rather than undertreatment of women. The findings of this study suggest, however, that physicians view women presenting with suspected acute myocardial infarction with less urgency than men presenting with similar symptoms.

Key words. Angina pectoris; sex factors; coronary disease; physician's practice patterns. (*J Fam Pract 1993; 36:389-393*)

Coronary heart disease is the leading cause of morbidity and mortality among both women and men in the United States. Over 244,000 women die each year from coronary heart disease, a toll that exceeds deaths from all neoplastic diseases.[1] In addition, the incidence of coronary heart disease has risen among women and declined among men since 1950.[2] However, recent research has revealed that men and women with ischemic heart disease receive different treatment. Men are offered more aggressive intervention at an earlier stage of disease[3–5] than women whose symptoms are equally or more severe and disabling. For example, women with abnormal cardiovascular nuclear medicine exercise studies are significantly less likely to be referred for catheterization and coronary artery bypass than men.[4] This rate difference might be considered appropriate, as operative mortality for coronary artery bypass surgery has been found by most authors to be higher,[6–11] and efficacy of the procedure lower,[12,13] among women than among men. Not all studies have reported such a difference in surgical mortality rates between men and women,[14] however, and it may be that the differences in mortality and efficacy some have observed are the result of later referral of women.[15] It has also been shown that once patients have suffered myocardial infarction (MI), women are as likely to be offered angiography as men.[16] In contrast, women are

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more likely to suffer a second MI within 4 years of their first and are more likely to die within the first year after an MI than men.[1]

As the literature cited above suggests, research on sex bias in treatment of ischemic heart disease to date has focused on differences in use of invasive treatment, especially surgery, or on patients with proven coronary artery stenosis. Studies implying sex bias from data on invasive treatment are limited by the possibility that physicians may be accurate in their belief that women with ischemic heart disease are less likely to reap benefits and more likely to suffer complications from such treatment. Such data do not clearly establish that physicians are less likely to recognize, or regard as important, symptoms of ischemia in women than in men. Studies of patients with known disease (eg, postinfarction patients) do not reveal physicians' potential diagnostic biases, as diagnoses have already been made for such patients. A study in which the records of patients admitted for suspected MI are examined to determine the ratio of men to women, however, may avoid both of the above limitations, as expected benefit from an invasive procedure is not an issue at the time of admission and diagnoses are still unknown.

If physicians regard symptoms of suspected MI disease in men as more ominous than in women, a difference in how men and women are treated when admitted to the hospital for observation for suspected MI should be observed. The following study was conducted in a setting where physicians could choose to observe patients admitted for suspected MI either in the cardiac care unit (CCU) or in a regular medical-surgical nursing bed unit with electrocardiographic (ECG) telemetry. The hypothesis tested was that men would be more likely to be observed in the CCU than women when the probability of acute coronary ischemia was controlled.

Methods

Setting

The study took place on the family practice service at a 100-bed community hospital in southern Michigan. The hospital has a full-time emergency department, an 8-bed CCU, and availability of ECG telemetry in the regular nursing units. The hospital refers patients requiring angioplasty or bypass surgery to either a university medical center or a large (>500 bed) community hospital, both located in a town 20 miles away. The hospital is located in a town of 4000 people and serves a surrounding community of about 20,000. The population is 98% white, and 68% of local residents are blue-collar workers.

Decisions about whether to admit patients to the hospital are made by the emergency department attending physician, but once admitted, the placement decision (CCU vs regular nursing bed unit with ECG telemetry) is made by the senior resident on the family practice service, in consultation with the attending family physician. The family practice service comprises one resident (second or third year) and one attending physician, plus one or more interns and fourth-year medical students. There are 12 residents who rotate through the service, and 11 attending physicians. Each resident was on service for at least 4 weeks during this study, and each attending physician for at least 2 weeks. Physicians were aware that the care of patients with suspected MI was being studied, but were not aware of the study hypothesis.

Patients

All patients admitted to the family practice service to rule out MI from July 1988 through June 1989 were included in the study. Patients admitted primarily for other problems who also had possible ischemic disease evaluated were excluded. Patients transferred to other hospitals from the emergency department (before evaluation by the family practice service) for acute interventions such as bypass grafting or angioplasty were also excluded.

Instrument

The Acute Ischemic Heart Disease Predictive Instrument (HDPI) is a seven-factor regression formula developed to improve CCU utilization practices.[17] Its developers validated it extensively, and we have demonstrated its applicability to the primary care setting as well.[18] The HDPI is used in the hospital emergency department as part of the evaluation of a patient presenting with suspected acute ischemic heart disease, and calculates the probability that the patient actually has acute ischemia. (A modified form of the HDPI better suited to retrospective chart review, the Time Insensitive Predictive Instrument [TIPI],[19] has recently been introduced but was not available at the time this study was performed. The study data could not be entered into the TIPI formula without reabstracting the entire data set, and the authors of the TIPI noted that the HDPI and TIPI results correspond very closely.)

The seven factors comprising the HDPI are listed in Table 1. These factors are entered in a logistic formula and the result is the calculated probability that the patient has acute ischemic heart disease.[17] The calculation was programmed into a relational database management system.

Table 1. Seven Factors that Comprise the Acute Ischemic Heart Disease Predictive Instrument

1. Does the patient complain of chest or left arm pain or pressure?
2. Is chest or left arm pain or pressure the patient's chief complaint?
3. Does the patient have a history of prior MI?
4. Does the patient have a history of use of nitroglycerin for relief of angina?
5. Is there ST segment barring or straightening in at least two leads on the initial electrocardiogram?
6. Is there ST segment elevation or depression of ≥1 mm in at least two leads on the initial electrocardiogram?
7. Is there T wave hyperacuity (>50% of maximal QRS amplitude) or inversion in at least two leads (excluding aVR) on the initial electrocardiogram?

Data Collection

A graduate student trained in medical record abstraction and application of the HDPI reviewed the medical records of all patients admitted to the study. Variables abstracted included age, sex, the seven HDPI factors, identity of the admitting physician, diagnoses, complications, peak creatine kinase level, and MB fraction. Myocardial infarction was designated positive if creatine kinase serum levels exceeded laboratory-defined normal values and the CK-MB fraction exceeded 5%, if levels of lactate dehydrogenase (LDH) isoenzyme 1 exceeded 2, or if the clinical service diagnosed subendocardial MI by serial ECG changes. Complications were designated positive for patients who sustained refractory angina or reinfarction; second-degree non-Wenckebach or third-degree heart block; ventricular fibrillation or sustained tachycardia requiring cardioversion or antiarrhythmic therapy (other than prophylactic); bradycardia or supraventricular tachycardia with hypotension; acute congestive failure or cardiogenic shock; or death. Patient presentation data, including admission ECG, were abstracted before the in-hospital course and outcome data were known to the abstracter.

Analysis

Effects of the study variables of age, patient sex, physician sex, and likelihood of ischemia (HDPI score, unknown to the physician at the time of admission) on the dependent variable (placement, CCU vs regular bed) were evaluated by logistic regression.[20] The model was based on a discriminant function of the form $\beta_0 + \Sigma\beta_i x_i$, where the x_i takes values of 1 or 2 for dichotomous variables, 0–1 continuously for HDPI score, and the scalar quantity of years for age. This logistic regression was repeated with the inclusion of one nonlinear term for a postulated interaction between sex and HDPI score.

Table 2. Summary of the Characteristics of 93 Patients Admitted to the Hospital for Suspected MI

	Male (N = 43)	Female (N = 50)
No. of patients assigned to:		
CCU	29	22
Floor	14	28
No. of patients with MI	8	8
No. of patients without MI	35	42
Age, (years ± SD)	64.1 ± 14.9	71.0 ± 14.9
HDPI score (±SD)	0.369 ± 0.241	0.365 ± 0.243

CCU denotes cardiac care unit; MI, myocardial infarction; HDPI, Acute Ischemic Heart Disease Predictive Instrument.

Logistic regression was also performed for the study variables with a dependent variable of MI, to verify that the HDPI yielded the expected predictive accuracy, and to confirm the findings of the univariate analyses controlling for each of the other variables. (Although strictly speaking the HDPI predicts ischemia rather than infarction, the two are obviously closely related. While the HDPI as a decision support tool is not suited for predicting infarction in individual cases, over a statistical sample it should demonstrate a strong association with occurrence of infarction.) Simple univariate comparisons were performed using likelihood-ratio chi-squared or *t* tests as appropriate. All analyses were performed using the SYSTAT package.[21]

Results

Ninety-three patients were entered in the study, encompassing all eligible admissions during the study period. Their distribution across the study variables is detailed in Table 2. Three patients (two men and one woman) were transferred from the emergency department to the referral centers noted above, without evaluation by the family practice service, and were not included in the 93 patients studied.

Women in the study were slightly older than men (71.0 vs 64.1 years, $t = 2.20$, $P < .05$). Women and men did not differ in probability of ischemia as measured by the HDPI (0.365 vs 0.369, respectively). Occurrence of complications was also independent of sex (2 for men and 5 for women, $\chi^2 = 0.926$, $P > .30$).

Women and men were equally likely to sustain MI ($\chi^2 = 0.11$, $P > .7$). Patients who sustained MI were not

significantly older (mean age 68.2 vs 65.7 years, $t = 0.61$, $P > .50$) but, as expected, did have significantly higher HDPI scores (mean score 0.54 vs 0.33, $t = 3.40$, $P = .001$) than those who did not. Examination of the relationship between MI and age, sex, and HDPI score in the logistic model confirmed these results; age and sex were unrelated to occurrence of MI (factor weights of 0.02 and 0.01, respectively, $P > .5$ for both), and HDPI score was strongly positively related to MI (factor weight 4.27, $P < .001$).

Six of the seven complications were observed in patients who sustained MI; the one patient without MI who sustained a complication was a man aged 90 years who became bradycardic and required a pacemaker. All patients who sustained complications had been placed in the CCU at admission. Fourteen of the 16 patients who sustained MI had been placed in the CCU at admission. The other two were cared for in telemetry-equipped nursing bed units without incident.

Logistic regression demonstrated that patient age, patient sex, and likelihood of ischemia as measured by HDPI score (unknown to the physicians at the time), but not physician sex, were significantly related to probability of placement in the CCU. In particular, the odds ratio for placement of women (compared with men) in the CCU controlling for age and likelihood of ischemia was 0.362 (95% CI = 0.135 to 0.977). Higher HDPI scores were associated with increased likelihood of placement in the CCU in the logistic model (factor weight 4.81, $P < .001$). Similarly, greater age was associated with greater likelihood of CCU placement (factor weight 0.034, $P < .05$).

There was a significant interaction between HDPI score and sex (factor weight -8.24, $P < .01$). Repeating the logistic regression for men and women separately revealed that the interaction resulted from the relationship between likelihood of ischemia and CCU placement being much stronger for men (factor weight 11.34, $P < .001$) than for women (factor weight 2.97, $P < .01$).

Discussion

In this study women admitted for suspected MI were much less likely to be observed in an intensive care setting than men, though they did not differ from men in likelihood of ischemia, occurrence of infarction, or occurrence of complications. Women admitted to rule out MI were older on the average than men, a finding consistent with data showing that women develop ischemic heart disease at an older age than men.[22] The logistic models for CCU placement and MI occurrence in this study controlled for age, demonstrating that the age discrepancy did not explain the greater use of the CCU for men than for women. In fact, one might expect women to have been more often placed in the CCU, as they were older and might have been seen as requiring closer observation.

The differential use of the CCU for men and women in this study, unconfounded by expectations of differential benefits from surgical intervention as in previous studies, suggests that physicians view women presenting with possible MI with less urgency or concern than men presenting similarly. The weaker relationship for women than for men between probability of ischemia and CCU placement is also consistent with this interpretation. Men are traditionally regarded as at higher risk than women for ischemic heart disease.[1] The lifetime risk of developing symptomatic ischemic heart disease, however, is a different concept from the evaluation of a patient presenting with symptoms. "If men are more likely to have MIs, then men with chest pain are more likely to have heart disease than women with chest pain" is not a valid inference, although it would appear to be one that physicians in this study group made, whether consciously or not. In addition, the risk difference between the sexes is heavily dependent on age, appearing in women largely in the pre- and perimenopausal years. Elderly women are at risk comparable to men of the same age, but physicians trained to regard men as at higher risk may maintain that predilection even outside the appropriate age range. Similarly, the age and sex exclusions for clinical trials in the treatment of acute myocardial infarction limit physicians' information on which to base treatment of the older and female patients.[23]

The appropriateness of observing patients with low probabilities of ischemia in CCU settings has been called into question,[24] and the differential treatment seen in this study may represent unnecessary treatment of men rather than undertreatment of women. Determining the appropriate level of treatment would require an outcome study, which would in turn require very large numbers of patients to derive stable outcome estimates in this low-risk population. This study can only demonstrate that men and women are treated differently; it cannot determine which pattern of treatment is best. It is worth noting that one study has demonstrated more appropriate use of coronary artery bypass surgery after angiography among women than among men. Bickell et al[25] showed that among patients with coronary artery lesions for which surgery offers little or no survival benefit, men were more likely than women to be referred for surgery, whereas there was no sex difference in referrals among patients with lesions for which surgery offers significant survival benefit.

This study has several important limitations that

affect its generalizability. It was done in a single rural site, and residents rather than experienced clinicians were the decision makers. A small number of patients were studied and therefore a limited number of clinical factors could be built into the model. The limitations of the abstracted data set precluded detailed comparisons of treatment patients received, or of their other medical problems (although in this population patients with multiple illnesses were uncommon). Outcomes were good with few exceptions across this low-risk population, effectively precluding analysis of the effects of differential treatment on outcome.

Although limited in scope, this study does suggest that the sex differences observed for invasive treatment result from diagnostic bias rather than from objective differences in expected outcome of treatment, and that those differences are observed even when diagnostic decisions are made by physicians early in their careers. Further research with larger and more diverse patient populations, encompassing more clinical variables and with decisions made by experienced clinicians, will be necessary to clarify how these diagnostic decisions are made, how their accuracy might be improved, and how they affect patient outcomes.

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