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Research article

Management of congestive heart failure: a gender gap may still exist. Observations from a contemporary cohort

Jason M Burstein*[1], Raymond Yan[2], Iris Weller[3] and Beth L Abramson[4]

Address: [1]University of Toronto, Ontario, Canada, [2]McMaster University, Ontario, Canada, [3]Public Health Sciences, University of Toronto, Ontario, Canada and [4]St. Michael's Hospital, Toronto, Ontario, Canada

Email: Jason M Burstein* - jburstein@sympatico.ca; Raymond Yan - ray.yan@utoronto.ca; Iris Weller - Iris.Weller@uhn.on.ca; Beth L Abramson - abramsonb@smh.toronto.on.ca

* Corresponding author

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Abstract

Background: Unlike other cardiovascular diseases the incidence and prevalence of congestive heart failure (CHF) continues to increase. While gender differences in coronary artery disease have been well described, to date, there has been a relative paucity of similar data in patients with CHF. We conducted a pilot study to evaluate the profile and management of patients with CHF at a tertiary care centre to determine if a gender difference exists.

Methods: A chart review was performed at a tertiary care centre on consecutive patients admitted with a primary diagnosis of CHF between June 1997 and 1998. Co-morbidity, diagnostic investigations, and management of CHF were recorded. Comparisons between male and female patients were conducted.

Results: One hundred and forty five patients were reviewed. There were 80 male (M) and 65 female (F) patients of similar age [71.6 vs. 71.3 (M vs. F), p = NS]. Male patients were more likely to have had a previous myocardial infarction (66% vs. 35%, $p < 0.01$) and revascularization (41% vs. 20%, $p < 0.05$), and had worse left ventricular ejection fraction (LVEF) than women, [median LVEF 3 vs. 2 (M vs. F), $p < 0.01$]. Male patients were more likely to have a non-invasive assessment of left ventricular (LV) function [85% vs. 69%, (M vs. F), $p < 0.05$]. A logistic regression analysis suggests that amongst those without coronary disease, males were more likely to receive non-invasive testing. There were no differences in the use of prescribed medications, in this cohort.

Conclusions: This pilot study demonstrated that there seem to be important gender differences in the profile and management of patients with CHF. Importantly women were less likely to have an evaluation of LV function. As assessment of LV function has significant implications on patient management, this data justifies the need for larger studies to assess gender differences in CHF profile and treatment.

Background

Congestive heart failure (CHF), a common medical condition associated with high mortality and morbidity, has an enormous impact on public health. [1–6] In Canada, as in the United States, CHF is the leading cause of hospitalisation in the elderly. In the province of Ontario alone, there are approximately 13,000 admissions annually for CHF. One-year case fatality for patients with CHF in Ontario (1994–1997) was over 30 % for both men and for women. [7] In stark contrast to other cardiovascular

diseases, the incidence and prevalence of CHF continue to increase, for reasons including an aging population and better treatment of coronary disease and hypertension. Patients with heart failure create broad reaching management issues for both primary care physicians and specialists.

Gender differences may exist between patients with heart failure. [8–13] Although the overall prevalence is similar, women make up a greater percentage of patients in those over 75 years of age.[3,4] The syndrome results from cardiac dysfunction which is either systolic (reduced ejection fraction and ventricular dilatation) or diastolic (impaired myocardial relaxation leading to elevated end-diastolic pressures with normal cardiac chamber size). Women may have more hypertension, diabetes, and diastolic dysfunction then men, and less coronary disease. [14,15] Previous epidemiological studies such as Framingham and the National Health and Nutrition Examination Survey report better survival in women with CHF.[2,5] These studies did not assess left ventricular (LV) function, and therefore, probably captured more women with diastolic dysfunction, which bodes a better prognosis. More recent studies enrolling only patients with systolic dysfunction, have reported that women, in fact, have higher mortality rates.[16]

The management and prognosis in heart failure patients will vary depending on the etiology, and it is critical to assess LV function and look for precipitating factors, as recommended by Canadian guidelines. [17] It is extremely important to assess for possible gender differences in the profile, presentation and management of patients with heart failure to ensure optimal medical care for both men and women, given the possible differences in pathophysiology and presentation of disease. Although there is a large body of literature on "gender discrepancies" in the management of coronary disease (CAD) [18]-[29] there is a relative paucity of data on the evaluation of heart failure patients and gender. One recent study found that women with CHF are less likely to undergo assessment of LV function.[30] There is also evidence that women receive less Angiotensin Converting Enzyme (ACE) inhibitors in the treatment of CHF.[11,29,30]

Given the growing epidemic of CHF, it is important to evaluate if gender differences exist in the etiology and management of CHF. We conducted a pilot study to determine if gender differences exist in the etiology, diagnostic work-up, or management of patients admitted to tertiary care teaching hospital with a diagnosis of CHF.

Methods

The study took place at St. Michael's hospital, a tertiary care teaching centre in Toronto, Canada. Consecutive patients with a primary discharge diagnosis of CHF (ICD codes #428.0) between June 1997 and June 1998 were identified. Patients were enrolled during their first hospital admission during the study period. Subsequent admissions, if any, were not analyzed. An unbiased observer (R.Y.) reviewed the charts and recorded predetermined variables, if present, in the following categories: grade/etiology, diagnostic investigations, and management of CHF. (see below)

Grade/Etiology

The presence of hypertension, diabetes mellitus, previous myocardial infarctions, and revascularization [coronary artery bypass grafting (CABG) or percutaneous transluminal coronary angioplasty (PTCA); past and present] was noted. Coronary disease (CAD) was defined as a history of myocardial infarction, CABG, PTCA, or chart documentation of "CAD" as assessed by the attending physician. The ejection fraction (if documented in the patient chart) was recorded. Previous admissions for CHF were noted. If there was a result of an angiogram, echocardiogram, or nuclear test, the left ventricular ejection fraction (LVEF) was graded 1 to 4 based on the test result. [LVEF > 60% = grade 1, LVEF 40–59% = grade 2, LVEF 20–39% = grade 3, and LVEF 0–19% = grade 4.] Other risk factors for CHF such as valvular heart disease, body mass index, left ventricular hypertrophy, and alcohol abuse were not recorded, as they were not uniformly noted on charts.

Diagnostic investigations

The use of echocardiogram, multiple gated cardiac blood pool imaging (MUGA), and/or cardiac catheterization, either during the current admission, or comments from previous studies, was recorded. With respect to non-invasive assessment of left ventricular function, the analysis included current studies or previous studies as noted in the chart.

Management

The triage of patients [medical floor vs. cardiology ward vs. coronary care unit (CCU)/intensive care unit (ICU)] and the use of cardiac monitors were recorded. In our institution patients are uniformly monitored in the CCU and ICU, however, on the cardiology floor monitored beds are at the discretion of the treating physician. The use of ACE inhibitors, β-blockers, diuretics, and digoxin, were recorded based on discharge medications and inpatient medication records.

Statistical analysis

Differences between males and females were assessed using χ^2 tests (Fischer's Exact Test in the case of expected cell counts less than 5) for categorical variables and Wilcoxon Rank Sum tests for ordinal variables. Logistic regression analysis was used to assess the association between gender

Table 1: Gender differences in profile and management

	Male N = 80	Female N = 65
Etiology		
Previous Myocardial Infarction	66%	35% ††
Hypertension	58%	55%
Diabetes Mellitus	41%	33%
Median LVEF	3	2 ††
History of CABG or PTCA	41%	20% †††
Coronary Artery Disease	70%	37% †
Diagnostic Investigations		
Echo/MUGA	85%	69% †††
Echo/MUGA (patients with CAD)	84%	83%
Echo/MUGA (patients with no CAD)	88%	61%†††
Cardiac Catheterization	25%	22%
Triage		
Cardiology Ward	48%	37%
CCU/ICU	39%	32%
†Monitored Bed	59%	40% †††

†p < 0.001, †p < 0.01, ††† p < 0.005

and non-invasive assessment of left ventricular function. Covariates assessed were age, presence of diabetes mellitus, hypertension, and coronary artery disease. In order to assess the fit of the model, deviances from fitting the model with and without the covariate were compared. The differences in the deviances were assumed to follow a chi-square distribution. All analyses were done using the SPSS and SAS® statistical packages.

Results

One hundred and fifty three patients fulfilled entry criteria. Of these, 145/153 (95%) charts were available for review. There were 80 male (M) patients, and 65 female (F) patients in this group. The average age did not differ between men and women [71.6 ± 11.1 (SD) years vs. 71.3 ± 13.8 (SD) years (M vs. F), p = NS]. The range of ages for women and men respectively was 34 to 89 and 41 to 93. Men had worse left ventricular function than women, [median LVEF 3 vs. 2 (M vs. F), p < 0.01]. There was no difference in the rates of previous admission to hospital for CHF [49% M vs. 57% F)].

Gender differences in the profile and management of patients appear in Table 1. Male patients were more likely than females to have had a previous myocardial infarction (66% vs. 35%, p < 0.01). Male patients were more likely to have had bypass surgery or angioplasty during this admission or previously [41% vs. 20% (M vs. F), p < 0.05]. Correspondingly, males had a higher rate of CAD than females [70% vs. 37% (M vs. F), p < 0.001]. However, there were no gender differences seen in rates of hypertension [58% M vs. 55%] or diabetes [40% M vs. 31% F] in this population.

In this cohort, male patients were more likely than women to have a non-invasive (echo or nuclear) assessment of LV function during their hospital stay [85% and 69% respectively, p < 0.05]. The odds ratio (OR) and 95% Confidence Interval (CI) for males was 2.53 (1.12,5.65). Because more men than women had diagnosed coronary artery disease, and because more patients with coronary artery disease had a non-invasive assessment of their left ventricular function OR (95% CI) 2.13 (0.96,4.76)], we did an additional logistic regression analysis to assess whether coronary artery disease (CAD) confounds the relation between sex and non-invasive assessment of left ventricular function. The addition of CAD resulted in a model with a poorer fit than the model with sex alone. Nevertheless there is some indication of a small confounding influence, since the odds ratios for both CAD and SEX were altered towards the null value, OR (95%CI) 1.68 (0.72–3.91), 2.14 (0.91–5.01), respectively. However, it also suggests that sex is a stronger influence on referral practice. Because more men than women had CAD, it is not clear in this analysis whether it was the patients' sex or the presence of CAD that influenced the physicians' decisions. To further explore this we stratified by CAD status to assess the relation between SEX and non-invasive testing. Among those with CAD, sex was not related to non-invasive testing, OR (95%CI) 1.05 (0.29–3.79), whereas among those with no CAD, males were more likely to receive non-invasive testing, OR (95% CI) 4.48 (1.15–17.50), suggesting that both CAD and sex are independent factors in referral practice.

Table 2: Drug treatment in CHF patients

Medication Class	**Male** n = 80	**Female** n = 65
ACE inhibitors	56(70%)	41/(63%)
Digoxin	38 (48%)	25 (38%)
B-Blockers	32 (40%)	18 (28%)
Diuretics	63 (79%)	49 (75%)

P = NS for all comparisons

Table 3: Drug treatment in CHF patients with Grade 3 or 4 LV Function

Medication Class	**Male** n = 46	**Female** n = 20
ACE inhibitors	36 (78%)	15 (75%)
Digoxin	15 (33%)	10 (50%)
B-Blockers	14 (33%)	9 (45%)

P = NS for all comparisons

Age, and a diagnosis of hypertension or diabetes did not confound the relation between sex and non-invasive testing.

Similar numbers of male and female patients had a cardiac catheterization during this admission [25% vs. 22% respectively)].

With respect to triage, in this cohort of patients, there were no significant differences in the rates of admission to a cardiology floor (48% M, 37% F) or to a CCU/ICU (39% M, 32% F). Male patients were more likely to receive a monitored bed (CCU/ICU or cardiology ward) (59% M, 40% F, $p < 0.05$). In terms of prescribed medications there were no statistical differences in the use of ACE inhibitors, beta-blockers, diuretics, or digoxin (see table 2). Furthermore in the subgroup of patients with grade 3 to 4 LV function there were no differences in the use of ACE inhibitors, beta-blockers, or digoxin (see table 3).

Discussion

The most important finding in this study is that, among heart failure patients with no known history of coronary artery disease, women were less likely to be referred for non-invasive assessment of left ventricular function. We also found that the heart failure patients with coronary artery disease were more likely to be referred for non-invasive testing.

Eighty-five percent of men as compared to 69% of women had non-invasive assessments of LV function (via echo or nuclear imaging). Although the men and women in this group differed in rates of coronary disease (previous myocardial infarction and revascularization), this does not fully explain the lack of assessment of female patients. In those without coronary disease, a logistic regression analysis found men more likely to undergo non-invasive testing than women. The absence of CAD should not negate the necessity of LV assessment since the causes of CHF are multifactorial. Therefore, the finding that men in our cohort had more CAD does not justify their more frequent assessment of LV function as compared to women. Importantly women were under-evaluated, regardless of a gender comparison, with only 69% having a non-invasive assessment of LV function with an admission diagnosis of CHF. This lack of evaluation should be highlighted since assessment of LV function is probably the most important diagnostic and prognostic step in evaluation of this common patient population.

Little is known on gender differences in the etiology of CHF. In our cohort of patients with CHF, of those patients tested, women had preserved LV function as compared to their male counterparts. This is consistent with other reports that have noted that women are more likely to have had CHF despite having less severe LV dysfunction. Mendes et al. [12] evaluated over one thousand, five hundred patients who had undergone coronary angiography and found that women with more symptoms of CHF were found to have better LV function. Female patients had smaller end-diastolic volumes, despite similar LV end-diastolic pressures, implicating diastolic dysfunction as the etiology of the heart failure. These retrospective data, along with the data from this current study, raises the

need for ongoing evaluation of gender differences in the etiology of heart failure.

Accounting for differences in systolic and diastolic dysfunction may be explained partly in differing underlying causes of heart failure. This study, consistent with other larger studies, demonstrated that men with CHF are more likely to have had a prior myocardial infarction. Although not seen in this study, possibly due to lack of statistical power, others have noted gender differences in the rates of hypertension and diabetes in heart failure patients, both potential causes of diastolic dysfunction.[12] In both the Framingham study and the Studies of Left Ventricular Dysfunction (SOLVD) trial women were more likely to have hypertension and diabetes than their male counterparts.[2,5,16,31] The possibility exists that there may be myocardial properties and/or hormonal environments unique to women contributing to heart failure. In a study by Carroll et al examining LVH caused by aortic stenosis, women had smaller, thicker-walled ventricles despite similar outflow obstruction, suggesting that female ventricles may respond differently to a pressure-overload state.[9] Reis et al, has recently shown that women in heart failure trials on estrogen, have a greater survival rate than those not on hormone replacement.[32] While intriguing and hypothesis generating, many of these studies have been retrospective, and underscore the need for further evaluation of women with heart failure, from bench to bedside.

Limited data exists on the triage and management of patients with CHF. In this particular group, there were no gender differences noted in the triage of patients. Although men were more likely to be assigned a monitored bed, they also had a higher incidence of known coronary disease. Men in this cohort were also more likely to have undergone revascularization procedures; this possibly is also explained by the higher incidence of known coronary disease. Although not statistically significant, there was a trend for women to be admitted to a general medical floor as opposed to a cardiology floor or CCU. This cannot be explained by age difference, because in contrast to other heart failure populations, the group admitted was of similar age. Although the literature suggests a gender bias in the evaluation and treatment of coronary disease [33–38], there is a paucity of data on the differences between diagnostic procedures in men and women with CHF. This data is compelling evidence however for a more formal evaluation of gender differences in the diagnostic work-up of heart failure.

The last area studied in this cohort was the use of prescription medications. Previous reports have noted underutilization of ACE inhibitors in both sexes, with some reports noting a sex disparity.[30,39] Our data showed no statistical difference between prescription use of ACE inhibitors in men and women. Although there were no differences seen in medication use, the sample size was not large, and there may have been differences, which were not apparent due to lack of statistical power. Although this is consistent with other data from Ontario[7], it is in contrast to other preliminary data from eastern Canada[40] that show gender discrepancies in the treatment of heart failure, and therefore, raises the possibility of a regional variation in prescribing practices.

As in any chart review, there are inherent limitations to our study. The use of hospital charts may be limited by recall bias, as tests performed outside of a hospital admission, may not have been recorded on the chart. However, it is reasonable that efforts are made to obtain this information and convey it on the chart during an admission to a teaching hospital. A recent assessment of LV function would influence the need for obtaining an echocardiogram on a current admission. However in this pilot study, men and women were equally as likely to have been hospitalized previously for CHF, and the chart was reviewed for such an assessment during the previous admission. It is also possible that the use of ICD codes underestimated the number of CHF admissions, as the institution in which this study was conducted has several thousand admissions yearly in the cardiac program. Despite these limitations, this survey offers a "snap shot" of current practices in such an institution. Lastly, although this study may have been underpowered to detect certain differences such as the use of ACE inhibitors, it raises important questions that must be addressed in clinical practice in the future.

Conclusion

In summary, there have been few studies to date that have analysed gender differences in assessment and management of heart failure. In this cohort of patients, women had less frequent non-invasive evaluations of left ventricular function than their male counterparts. Significantly, LV function is the most important prognostic marker for patient outcome. Furthermore, a difference in non-invasive evaluation has significant implications in patient care, as the management of diastolic and systolic dysfunction varies. This pilot study was underpowered to show gender differences in treatment such as the use of ACE inhibitors. A recent study by Roger et al.[41] examining sex differences in unstable angina patients demonstrated that female patients with unstable angina had less cardiac diagnostic procedures but, perhaps paradoxically, had better long term outcomes when adjusting for baseline characteristics. Our study also demonstrates a diagnostic discrepancy in the work-up of patients with CHF. Although concerning, it remains to be seen if this gender difference translates into differences in patient outcomes.

This important pilot data justifies the need for larger studies to assess gender discrepancies in heart failure. It also highlights the clinical problem of optimal evaluation and management of women with this common condition.

Competing Interests

None declared.

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