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Original article

Gender Differences in Presentation, Coronary Intervention, and Outcomes of 28,985 Acute Coronary Syndrome Patients in Victoria, Australia

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A B S T R A C T

Background: Differences in demographics, presenting characteristics, and treatment of heart disease in women may contribute to adverse outcomes. The purpose of this paper was to describe gender differences in the epidemiology, treatment, and outcomes of all admissions for acute coronary syndrome (ACS) in Victoria that occurred between June 2007 and July 2009.

Methods: We undertook a retrospective cohort study of all patients admitted to Victorian hospitals with a first time diagnosis of ACS. Use of angiograms, percutaneous coronary intervention (PCI), coronary artery bypass graft (CABG), and adverse outcomes (death and/or unplanned readmission) were compared by gender and hierarchical logistic regression models were used to account for confounding variables.

Results: Of a total of 28,985 ACS patients, 10,455 (36%) were women. Compared with men, women were older (aged ≥75 years: 54% vs 31%; $p < .001$), more likely to present with multiple comorbidities (>1 comorbidity: 53% vs 46%; $p < .001$), and more likely to be diagnosed with non–ST-segment elevation ACS (86% vs 80%; $p < .001$). Women were less likely to receive coronary interventions (angiogram: adjusted odds ratio [aOR], 0.71; 95% CI, 0.66–0.75; PCI: aOR, 0.73; 95% CI, 0.66–0.80; CABG: aOR, 0.58; 95% CI, 0.53–0.64). Adverse outcomes were similar in women and men after accounting for confounding variables.

Conclusions: Our results show that women in Victoria were less likely to receive coronary interventions after an admission for ACS. Clinicians should be wary of inherent gender bias in decisions to refer patients for angiography.

Myocardial infarction and unstable angina, collectively described as acute coronary syndrome (ACS), are the major clinical forms of coronary heart disease (CHD), which is the largest single cause of death in Australia and around the world (Australian Institute of Health and Welfare, 2012; Sharma & Gulati, 2013). In 2009, CHD accounted for 15% of all female deaths in Australia, compared with 4% from breast cancer (Australian Institute of Health and Welfare, 2012). ACS occurs when an atherosclerotic plaque ruptures or erodes causing thrombosis and distal embolization resulting in a reduction in coronary blood flow (Hamm et al., 2011). The diagnosis of ACS is based on presenting symptoms such as changes detected by electrocardiogram and, depending on the site and severity of the ischemia, may involve the presence of cardiac biomarkers indicating myocardial necrosis (National Heart Foundation of Australia & Cardiac Society of Australian and New Zealand, 2006). Strategies for the treatment of ACS require the determination of presence or absence of persistent ST-segment elevation on electrocardiogram and classification into ST-segment elevation myocardial infarction (STEMI) or non–ST-segment elevation ACS (NSTEACS; National Heart Foundation of Australia & Cardiac

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Society of Australian and New Zealand, 2006). Contemporary data indicate that there are close to 100,000 hospitalizations for ACS in Australia per year, with just over one-third (35%) being women (Australian Institute of Health and Welfare, 2011, 2012). Although ACS is less common in women than in men, the relative risk of in-hospital death after an ACS admission is higher for women than for men (Australian Institute of Health and Welfare, 2011). Yet, despite these statistics, the impact of CHD on women is often overlooked (deGoma, Karlsberg, Judelson, & Budoff, 2010).

Historically, CHD has been considered a man's disease and it has been shown that this stereotypical belief can influence the diagnostic and clinical decision making process (Bonte et al., 2008; Wenger, 2012). Over the last few years, it has been recognized that underestimation of CHD risk among women may have resulted in more conservative treatment and contributed to poorer outcomes (Poon et al., 2012; Shehab et al., 2013). Consequently, the issue of gender disparities in the diagnosis, treatment, and outcomes of ACS has started to be examined more closely (Wenger, 2012) with a view to understanding how differences in the demographics, presenting characteristics, pathophysiology, and treatment of heart disease in women may have contributed to adverse outcomes (Sharma & Gulati, 2013; Worrall-Carter, Ski, Scruth, Campbell, & Page, 2011). A number of differences in terms of the presentation and treatment of ACS in women have been well-described, whereas others are the subject of ongoing research. For example, women tend to experience ACS at an older age than men and are more likely to have hypertension, diabetes, and/or hypercholesterolemia but less likely to have a history of smoking (Claassen, Sybrandy, Appelman, & Asselbergs, 2012; Worrall-Carter et al., 2011). Women also tend to have lower rates of obstructive coronary artery disease (CAD), but a greater prevalence of microvascular dysfunction that, if not detected and well-managed with appropriate pharmacotherapy, results in adverse outcomes in terms of symptoms, hospitalizations, and mortality (Gulati, Shaw, & Bairey Merz, 2012). Nevertheless, a substantial number of women with ACS present with "male-pattern" CAD, for which cardiac catheterization and reperfusion with percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG) are highly effective strategies in both men and women (Anderson et al., 2013). In response to calls to better track the impact of ACS on women (Australian Institute of Health and Welfare, 2011), the aim of this study was to examine gender differences in the epidemiology, treatment, and outcomes of patients admitted to hospitals in Victoria, Australia, with a primary diagnosis of ACS.

Material and Methods

This retrospective cohort study analyzed a database maintained by the Victorian State government. The Victorian Admitted Episodes Data Set comprises demographic, clinical, and administrative details for every admitted episode of care occurring in Victorian hospitals, rehabilitation centers, extended care facilities, and day procedure centers (Department of Health, 2014). Clinical information is coded in the format of International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian modification (ICD-10-AM; Roberts, Innes, & Walker, 1998). Data for all patients admitted to hospital with a first time primary diagnosis of ACS between June 2007 and July 2009 were extracted, including any subsequent ACS admissions during the same 2-year period. ICD codes I210 through I213 were classified as STEMI; I214 as non-STEMI (NSTEMI); and I200 as unstable angina. I214 and I200 were grouped together as NSTEACS. With reference to national guidelines for the stratification of risk in NSTEACS (National Heart Foundation of Australia & Cardiac Society of Australian and New Zealand, 2006), the following comorbidities were classified as high-risk: congestive heart failure, cardiac arrhythmias, renal failure, and diabetes (uncomplicated and complicated). Consequently, high-risk NSTEACS were defined as all NSTEMI plus any unstable angina with high-risk comorbidities.

Variables were created for coronary interventions and outcomes that occurred for the patient during any admission across the 2-year period (e.g., angiogram any admission). Coronary interventions analyzed were angiogram, PCI, and CABG. Outcomes were in-hospital death (defined using the variable 'sepMode' coded as death for that patient during the 2-year study period) and unplanned second ACS admission (no intention to readmit recorded on first admission, but patient had a second ACS admission). Socioeconomic status (SES) was based on the Australian Bureau of Statistics Socio-Economic Indexes for Areas Index of Relative Socio-Economic Advantage and Disadvantage (ABS, 2011). For analysis purposes the deciles were regrouped into low SES (1–2), middle SES (3–8), or high SES (9–10).

Data were analyzed using SPSS V21 with comparisons between demographic or diagnostic subgroups (e.g., aged 15–59 vs aged $\geq$60; STEMI vs NSTEACS) calculated using χ^2 tests, odds ratios (OR), and 95% CI. Multivariate logistic regressions were performed to assess predictors for using coronary interventions and for adverse outcomes in females versus males. Dependent variables associated with the independent variable (e.g., angiogram any admission) with at least 80% significance (i.e., $p < .2$) were included in the multivariate model and these varied for different interventions and outcomes.

The research has been approved by the Human Research Ethics Committee at St Vincent's Hospital Melbourne, Australia.

Results

Data for 28,985 patients admitted to hospital for the first time with a primary diagnosis of ACS during the specified period were included, of whom 10,455 (36%) were female, 178 (1%) were Indigenous Australians, and 7,855 (27%) preferred to speak a language other than English. In total, there were 3,8126 ACS admissions during the 2-year period; close to one in four patients (23%) were admitted to hospital with ACS on more than one occasion. Approximately one-half (46%) of those second admissions were unplanned. Further analyses were conducted either at the patient level or first admission diagnosis level (i.e., $n = 28{,}985$).

Women were more likely than men to be aged 75 or older across all ACS types. Women were also more likely to present with multiple comorbidities (>1 comorbidity: STEMI, 53% vs 40% [$p < .001$]; NSTEACS, 53% vs 48% [$p < .001$]) and had greater prevalence of all commonly occurring (i.e., $\geq$7% of patients) comorbid conditions. They were less likely than men to have a history of smoking (Table 1). Women were more likely than men to be diagnosed with NSTEACS (86% vs 80%; $p < .001$); within NSTEACS, there was no gender difference in the proportion classified as high risk.

On univariate analysis, women were less likely than men to undergo invasive coronary intervention (angiogram, PCI, CABG) across all types of ACS (Table 2). Other variables significantly associated with use of coronary interventions in univariate