International Journal of Cardiology xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Sex-specific risk of emergency department revisits and early readmission following myocardial infarction☆

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ARTICLE INFO

Article history:
Received 9 January 2017
Received in revised form 10 April 2017
Accepted 17 May 2017
Available online xxxx

Keywords:
Myocardial infarction
Readmissions
Sex-differences

ABSTRACT

Background: Readmissions within 30 days after hospitalization have been introduced as a measure of quality of care. There is a paucity of data regarding sex-specific risk of early readmissions after myocardial infarction (MI).
Objectives: To investigate the association between sex and revisits to the emergency department (ED), and readmissions after MI.
Methods: All patients with chest pain, diagnosed with MI at the Karolinska University Hospital during 2011 and 2012 were included. National Health care registers were used for information about patient characteristics, outcomes, and medication. We calculated risk ratios (RR) with 95% confidence intervals (CI) in women versus men, for revisits to the ED, readmission to hospital within 30, and 180 days, and to undergo coronary angiography, or revascularization, and to receive guideline-directed cardiovascular medication.
Results: In total there were 667 patients with MI during the study period, of whom 197 (30%) were women. Women were older (mean age 73 vs. 65 years), and had more comorbidities than men. The 30-day risk of revisits to the ED was 1.56 times greater in women than men (adjusted RR 1.56 (1.09–2.25)). Throughout the first year; women were more likely to be readmitted than men, with the most striking difference found within 30 days (22% vs. 13%) of discharge (adjusted RR 1.54 (95% CI, 1.00–2.36)). There were no differences between men and women in new cardiovascular medication, coronary angiographies or revascularizations.
Conclusions: Women have an increased risk of revisits to the ED, and readmissions to hospital during the first year after a MI.

1. Introduction

According to the WHO coronary heart disease, including myocardial infarction (MI), is one of the leading causes of death and disability globally [1,2]. In the United States, approximately 1,000,000 people are hospitalized with MI each year [3]. Readmissions after MI are common and impose a great financial burden to the health care system [4]. In the United States, 30-day readmission rates for MI are high and as many as ~20% of patients admitted for MI are readmitted within 30 days [3].

Recently, the levels of readmissions within 30 days have been suggested as an indicator of hospital quality of care [5]. In the United States higher than expected rates of early readmissions are considered to reflect poor in-hospital management and render financial penalties imposed by the federal government [6,7]. Furthermore, early readmissions for MI are considered highly preventable through measures such as disease management and cardiac rehabilitation programs [8].

No specific patient factors have been identified that can consistently predict early readmissions following MI [7]. However, some characteristics have been suggested, such as chronic kidney disease, heart failure, female sex and inhospital cardiogenic shock [9]. In a recent study it was reported that only 10% of MI patients that were readmitted within 30 days had a reinfarction and that nearly 50% were admitted for non-cardiovascular reasons [7].

☆ All authors take full responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

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http://dx.doi.org/10.1016/j.ijcard.2017.05.076
0167-5273/

Compared to men with MI, it has been observed that women with MI are at increased risk of delayed MI diagnosis, increased risk for reinfarction and death as well as an increased risk of not getting guideline-directed cardiovascular pharmacotherapy [10]. It has been suggested that this may be related to more unspecific symptoms in women compared to men with MI [11]. There is a paucity of data regarding potential differences between men and women for the risk of revisits to the ED, and readmissions to hospital after MI. Therefore, in order to investigate possible differences between men and women for the risk of revisits to the ED, and readmissions to hospital after MI, we conducted an observational cohort study in 667 patients with MI.

2. Methods

2.1. Study population

All patients who sought medical attention with a principal complaint of chest pain during 2011 and 2012 at the Karolinska University Hospital, Stockholm, Sweden were identified from the hospital's administrative database, and laboratory data were retrieved from the department of Information and Technology. The hospital has two sites that are 23 km apart, and there are approximately 75,000 yearly visits to the adult emergency department (ED) at each site. Patient and laboratory data were sent to the National Board of Health and Welfare who linked information from both the Swedish National Patient Register, which holds information about all hospital stays in Sweden, including discharge diagnoses, length of stay, and department where the patient stayed, and the Swedish Cause-of-Death register where information about causes of deaths are registered with a complete coverage of the country [12]. The Swedish National Patient Register also includes information about surgery and interventions such as coronary angiography, percutaneous coronary intervention (PCI), and coronary artery bypass grafting (CABG). Information about current medications was collected from the Swedish Prescribed Drug Register where all filled prescriptions in the country are registered [13]. The construction of the dataset has been described in detail elsewhere [14]. Moreover, in patients with MI, all admission ECGs were assessed by two investigators, one attending cardiologist, and one resident in internal medicine. Finally, from this dataset we identified all patients who were diagnosed with MI in conjunction with their visit to the ED, for the first time during 2011 and 2012, which formed our study population.

The study complied with the guidelines of the Declaration of Helsinki and was approved by the regional ethics review board in Stockholm.

2.2. Definitions

Myocardial infarction was defined as a primary discharge diagnosis of I21 in the international classification of disease (ICD) version 10. The discharge diagnoses registered in the National Patient Register are decided by the attending physician who cares for and discharges the patient. The MI diagnosis required either signs and symptoms suggestive of myocardial ischemia, or signs of ischemia on the ECG, and a typical rise and fall pattern in high-sensitivity cardiac troponin T levels, which was the cardiac biomarker used during the whole study period [15]. Estimated glomerular filtration rate (eGFR) was calculated using the Chronic Kidney Disease Epidemiology Collaboration formula. Chronic kidney disease (CKD) was defined as eGFR <60 ml/min/1.73 m^2. Ongoing medication at baseline was defined as at least two filled prescriptions in the Prescribed Drug Register during the year preceding the visit to the ED. Diabetes was defined as ongoing medication with any oral hypoglycemic agent or insulin. Other comorbidities were defined as any hospital stay before the visit to the ED with a discharge diagnosis in the Patient Register of MI, stroke, chronic obstructive pulmonary disease (COPD), heart failure, or cardiac revascularization. New cardiovascular medication started during the hospital stay for MI was defined as at least one filled prescription of a drug which was not present at baseline within the first 90 days following discharge.

2.3. Statistical methods

Baseline characteristics were described as frequencies and percentages for categorical variables and means and standard deviations for continuous variables. Incidence rates were calculated for revisits to the ED, readmissions to hospital, and for mortality at 30, 180, 365 days in all patients, as well as in men, and women seperately. Information about readmissions, and revisits was available until December 31, 2013, and information about vital status was available until March 31, 2013. Poission regression was used to calculate risk ratios (RR) with 95% confidence intervals (CI) for a) revisits to the ED, and b) readmissions to hospital within 90, 180, and 365 days; and c) coronary angiographies, and d) revascularizations, during the index hospital stay; and to have e) platelet inhibitors, f) betablockers, g) angiotensin-converting-ezyme inhibitors (ACEi)/angiotensinogen receptor blockers (ARBs), or h) statins started during hospital stay in women using men as the reference group. Cox regression was used to calculate hazard ratios with 95% CIs for a) death, and b) the combined outcome of MI, heart failure, stroke or death during the first year of follow-up in women using men as the reference group. The association between sex and the outcomes was evaluated with and without adjustment for the following covariates: age, eGFR, diabetes, MI, COPD, stroke, heart failure, prior revascularization, or treatment with any of the following medications prior to the index hospital stay: platelet inhibitors, beta-blockers, ACE inhibitors/ARBs, or statins.

The poisson regression models were conducted using R version 3.0.2 (R Foundation for Statistical Computing, Vienna, Austria). Data management was performed using the World Programming System, version 3.0 (World Programming, Hampshire, UK).

3. Results

3.1. Patient characteristics

In total 667 patients with MI, of whom 30% were women, were included in the study, (Table 1). Non-ST-elevation MI (NSTEMI) was more prevalent among women compared to men (83% vs. 72%). Furthermore, women were on average older than men (mean age 73 years vs. 65 years), and were more likely to be diagnosed with CKD, diabetes, and heart failure at baseline, but less likely to have COPD.

3.2. Revisits to the emergency department and readmissions

Women were more likely to revisit the ED during the first year after discharge (Table 2); and this difference was most striking in the first 30 days after discharge when 31% women compared with 19% men revisited the ED. After adjustement for potential confounders, the risk to revisit the ED within 30 days of discharge in women was 1.56 times greater than that of men (RR 1.56 (95% CI, 1.09–2.25)) (Table 3).

A similar proportion of revisits to the ED among men (68%) and women (71%) resulted in readmissions in the first 30 days after discharge. Throughout the first year after discharge women were more likely to be readmitted. This difference was most striking in the first 30 days after discharge with 22% vs. 13% readmissions among women and men, respectively. After adjustment for confounders, women had 1.54 times greater risk of being readmitted within 30 days than men (RR 1.54 (95% CI, 1.00–2.36)) (Table 3). Moreover,

Table 1
Baseline characteristics of 470 men, and 197 women with myocardial infarction at the Karolinska University Hospital, during 2011 and 2012.

	MI		
	All patients	Men	Women
All patients, n (%)	667 (100)	470 (70)	197 (30)
NSTEMI, n (%)	504 (75)	340 (72)	164 (83)
STEMI, n (%)	163 (25)	130 (28)	33 (17)
Age (years), mean (SD)	68 (14)	65 (13)	73 (14)
Age ≥ 80 years, n (%)	157 (24)	77 (16)	80 (41)
Age 70–79 years, n (%)	146 (22)	103 (22)	43 (22)
Age 60–69 years, n (%)	169 (25)	130 (28)	39 (20)
Age < 60 years, n (%)	195 (29)	160 (34)	35 (18)
GFR < 60 ml/min/1.73 m^2, (%)	167 (25)	102 (22)	65 (33)
Diabetes, n (%)	115 (17)	74 (16)	41 (21)
Prior stroke, n (%)	59 (8.8)	42 (8.9)	17 (8.6)
Prior MI, n (%)	127 (19)	93 (20)	34 (17)
Heart failure, n (%)	51 (7.6)	30 (6.4)	21 (11)
COPD, n (%)	24 (3.6)	87 (19)	25 (13)
Prior revascularization, n (%)	112 (17)	87 (19)	25 (13)
Length of stay			
0–3 days, n (%)	285 (43)	203 (43)	82 (42)
3–7 days, n (%)	322 (48)	227 (48)	95 (48)
>7 days, n (%)	60 (9.0)	40 (8.5)	20 (10)
Procedures during hospitalization			
Revascularization, n (%)	364 (55)	291 (62)	73 (37)
Coronary angiography, n (%)	454 (68)	346 (74)	108 (55)
Aspirin, n (%)	210 (31)	141 (30)	69 (35)
ACE/ARB-blocker, n (%)	249 (37)	164 (35)	85 (43)
Betablocker, n (%)	240 (36)	150 (32)	90 (46)
Statins, n (%)	182 (27)	128 (27)	54 (27)

Abbreviations: NSTEMI, non ST-elevation myocardial infarction; STEMI, ST-elevation myocardial infarction; SD, standard deviation; GFR, glomerular filtration rate; COPD, chronic obstructive pulmonary disease; ACE/ARB, angiotensin-converting-enzyme/angiotensinogen-receptor-blocker. GFR was estimated by the Chronic Kidney Disease EPIdemiology (CKD-EPI) collaboration equation.

Please cite this article as: M. Lundbäck, et al., Sex-specific risk of emergency department revisits and early readmission following myocardial infarction, Int J Cardiol (2017), http://dx.doi.org/10.1016/j.ijcard.2017.05.076