International Journal of Cardiology xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

International Journal of Cardiology

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

Magnitude and impact of multiple chronic conditions with advancing age in older adults hospitalized with acute myocardial infarction☆

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ARTICLE INFO

Article history:
Received 1 March 2018
Received in revised form 17 July 2018
Accepted 20 August 2018
Available online xxxx

Keywords:
Multiple chronic conditions
Myocardial infarction

ABSTRACT

Background: To examine age-specific differences in the frequency and impact of cardiac and non-cardiac conditions among patients aged 65 years and older hospitalized with acute myocardial infarction (AMI).
Methods: Study population consisted of 3863 adults hospitalized with AMI at 11 medical centers in central Massachusetts on a biennial basis between 2001 and 2011. The presence of 11 chronic conditions (five cardiac and six non-cardiac) was based on the review of hospital medical records.
Results: Participants' median age was 79 years, 49% were men, and had an average of three chronic conditions (average of cardiac conditions: 2.6 and average of non-cardiac conditions: 1.0). Approximately one in every two patients presented with two or more cardiac related conditions whereas one in every three patients presented with two or more non-cardiac related conditions. The most prevalent chronic conditions in our study population were hypertension, diabetes, heart failure, chronic kidney disease, and peripheral vascular disease. Patients across all age groups with a greater number of previously diagnosed cardiac or non-cardiac conditions were at higher risk for developing important clinical complications or dying during hospitalization as compared to those with 0–1 condition.
Conclusions: The prevalence of multimorbidity among older adults hospitalized with AMI is high and associated with worse outcomes that should be considered in the management of this vulnerable population.

1. Introduction

The prevalence of multiple coexistent chronic conditions (MCCs) in patients with cardiovascular disease has become increasingly common, especially as the U.S. and other industrialized populations age. Patients hospitalized with an acute myocardial infarction (AMI) and MCCs experience higher levels of healthcare use and suffer poorer health related outcomes than those without MCCs [1–8]. The clinical management of persons hospitalized with an AMI and MCCs is particularly challenging, due in part to their high risk for adverse events, as well as the need for complex and tailored therapeutic regimens [9].

Despite the high prevalence of MCCs in patients hospitalized for AMI, especially among older individuals, there are relatively limited contemporary data describing the magnitude of MCCs in older adults of different ages hospitalized with AMI, and possible age-specific differences in the effects of cardiac and non-cardiac related conditions on the risk of developing important clinical complications and dying during hospitalization for AMI [10–12].

The purpose of this large observational study was to describe the magnitude of cardiac and non-cardiac related multimorbidity, among older adults in three age strata (65–74, 75–84 and 85 years and older) hospitalized at all 11 central Massachusetts medical centers with AMI, and to examine the association between burden of cardiac and non-cardiac conditions with the risk of developing various adverse outcomes during admission to the hospital for AMI. Data from the population-based Worcester Heart Attack Study were used for purposes of this investigation [13–16].

2. Materials and methods

The Worcester Heart Attack Study is an ongoing population-based investigation that is examining long-term trends in the clinical epidemiology of AMI among residents of the Worcester, Massachusetts (MA), metropolitan area hospitalized at all medical centers in central MA on an approximate biennial basis [13–17].

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

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https://doi.org/10.1016/j.ijcard.2018.08.062

Computerized printouts of residents of central MA discharged from all 11 greater Worcester hospitals with possible AMI [International Classification of Disease (ICD) 9 codes 410–414, and 786.5] on a biennial basis between 2001 and 2011 were identified. Cases of possible AMI were independently validated using predefined criteria for AMI, including diagnoses of ST segment elevation myocardial infarction (STEMI) and non-ST segment elevation myocardial infarction (NSTEMI) [18,19]. This study was approved by the Institutional Review Board at the University of Massachusetts Medical School.

Trained nurses and physicians abstracted information on patient's demographic and clinical characteristics and hospital treatment practices and outcomes through the review of hospital medical records. These characteristics included patient's age, sex, race/ethnicity, hospital length of stay, and 11 previously diagnosed chronic conditions. These 11 chronic conditions were further classified into two groups: five Cardiac related conditions: atrial fibrillation, heart failure, hypertension, peripheral vascular disease, and stroke; and six Non-cardiac related conditions: anemia, asthma/chronic pulmonary disease, chronic kidney disease, dementia/Alzheimer, depression, and diabetes. Information on the development of important in-hospital complications including atrial fibrillation [20], cardiogenic shock [21], heart failure [22], stroke [23], and dying was collected through the review of hospital medical records. Data on the receipt of three coronary diagnostic and interventional procedures [cardiac catheterization, percutaneous coronary intervention (PCI), and coronary artery bypass graft surgery (CABG)] during hospitalization, and evidence-based pharmacotherapies during hospitalization, namely angiotensin converting inhibitors (ACE-I)/angiotensin receptor blockers (ARBs), aspirin, beta-blockers, and lipid lowering agents were also obtained.

2.1. Data analysis

We stratified our study population into three age groups for purposes of contrast and analysis, namely those 65–74 years old, 75–84 years old, and persons 85 years and older. We compared differences in the baseline demographic and clinical characteristics, hospital management practices, and in-hospital outcomes within each of these three age strata using chi square tests for categorical variables and the ANOVA test for continuous variables. We estimated the overall prevalence of the five cardiac and six non-cardiac related conditions and, based on the previous literature [24], included in this study any morbidity with a prevalence ≥5% in this patient population.

For purposes of more systematically examining the association between the number of cardiac and non-cardiac conditions previously diagnosed with the risk of dying or developing any of the examined important clinical complications (heart failure, stroke, cardiogenic shock, or atrial fibrillation) during hospitalization for AMI (as a single composite endpoint) among patients in the three age strata, we used logistic regression modeling and we adjusted for several potentially confounding demographic and clinical factors of prognostic importance in these models. These factors were chosen based on findings from prior studies and on their clinical importance. The variables we controlled for included sex, type of AMI (STEMI vs NSTEMI), AMI order (initial vs. prior), receipt of the examined cardiac interventions (cardiac catheterization, percutaneous coronary intervention, and coronary artery bypass graft surgery) and receipt of evidence- based cardiac medications during the index hospitalization (angiotensin converting enzyme inhibitors/angiotensin receptor blockers, aspirin, beta blockers, and lipid lowering medications). We created interaction terms between age and the number of chronic conditions previously diagnosed to examine whether the association between MCCs and the risk of developing our composite study endpoint differed according to age. We used likelihood ratio tests to compare models with and without our interaction terms.

3. Results

A total of 3863 residents of central MA 65 years and older were hospitalized with an independently validated AMI at all 11 greater Worcester medical centers during the six study years between 2001 and 2011. The median age of this patient population was 79 years and 48.9% were men. The average number of previously diagnosed chronic conditions in this population was 3.1 while the median was 3.0. The average number of cardiac conditions was 2.6 while the average number of non-cardiac conditions was 1.0.

3.1. Baseline characteristics according to patient's age at hospital presentation

Patients aged 75–84 years old were more likely to have been diagnosed with a NSTEMI and to have had a previously diagnosed AMI as compared with those 65–74 years old (Table 1). Patients 85 years and older were more likely to be women, Caucasian, to have been diagnosed with an NSTEMI, and to have presented with a previous AMI as compared with those aged 65–74 years old (Table 1).

Frequency of chronic conditions according to patient's age at hospital presentation.

Table 1
Patient demographic and clinical characteristics according to age among patients hospitalized with acute myocardial infarction.

Characteristic	65–74 years (n = 1186) (%)	75–84 years (n = 1540) (%)	≥85 years (n = 1137) (%)
Age (mean, years)	69.8	79.7	88.5**
Male	59.5	49.9	36.4**
White	86.9	93.1	95.5**
Non ST-segment myocardial infarction	68.7	75.1	78.7**
Initial myocardial infarction	61.9	59.9	59.2
Do not resuscitate order	12.9	29.4	61.4**
Medical history			
Anemia	8.9	13.8	19.1**
Atrial fibrillation	11.8	20.5	26.8**
Chronic kidney disease	21.3	23.6	29.7**
Chronic lung disease/asthma	26.0	24.9	20.6*
Dementia/Alzheimer	0.7	4.7	9.2**
Depression	14.5	16.7	17.8
Diabetes mellitus	45.5	39.7	27.1**
Heart failure	23.2	30.5	38.4**
Hypertension	79.5	80.5	81.5
Peripheral vascular disease	22.9	22.5	20.4
Stroke	11.5	16.9	14.7**
Cumulative number of morbidities			
Cardiac related			
2 or more	41.9	52.5	56.3**
Non-cardiac related			
2 or more	29.9	34.0	36.6*
In-hospital clinical complications			
Atrial fibrillation	19.6	28.3	31.2**
Cardiogenic shock	6.7	6.2	4.9
Heart failure	47.1	53.1	63.1**
Stroke	2.3	2.0	2.5
Death	8.3	12.9	14.9**
No complications	43.1	34.6	25.8**
Any 1 complication	41.1	44.3	49.6**
Any 2 or more complications	15.9	21.2	24.6**

* Significant at $p < 0.05$.
** Significant at $p < 0.001$.

Patients 75–84 years old and those 85 years and older were more likely to have been previously diagnosed with almost every one of the 11 chronic conditions examined in this study, with the exception of chronic pulmonary disease/asthma and diabetes, as compared with patients 65–74 years old (Table 1). The most prevalent chronic conditions in patients 65–74 years old were hypertension, diabetes, chronic pulmonary disease/asthma, heart failure, and peripheral vascular disease whereas the most prevalent chronic conditions among patients 75–84 years old were hypertension, heart failure, diabetes, chronic lung disease/asthma, and chronic kidney disease; similar disease patterns were found in patients 85 years and older. Almost one of every two patients across all age groups presented with two or more cardiac related conditions, whereas almost one in every three patients presented with two or more non-cardiac related conditions (Table 1).

3.2. In-hospital complications according to patient's age

Patients aged 75–84 years and those 85 years and older were more likely to have developed atrial fibrillation and heart failure during their index hospitalization for AMI as compared with those in the youngest age group. Approximately one in every six patients 65–74 years old, one in every five among those 75–84 years, and one in every four patients 85 years and older developed two or more serious in-hospital complications (Table 1).

3.3. Differences in hospital management practices according to patient's age and comorbidity burden

The proportion of patients aged 85 years and older who received all four evidence- based medications during their acute hospitalization was

Please cite this article as: M. Tisminetzky, et al., Magnitude and impact of multiple chronic conditions with advancing age in older adults hospitalized with acute myocardial infarcti..., Int J Cardiol (2018), https://doi.org/10.1016/j.ijcard.2018.08.062