International Journal of Cardiology 195 (2015) 259–264

Contents lists available at ScienceDirect

International Journal of Cardiology

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

Long-term survival of elderly patients undergoing percutaneous coronary intervention for myocardial infarction complicated by cardiogenic shock

Han S. Lim [a,d], Nick Andrianopoulos [b], Hariharan Sugumar [a], Dion Stub [c], Angela L. Brennan [b], Chris C.S. Lim [d], Peter Barlis [d,e], William Van Gaal [d,e], Christopher M. Reid [b], Kerrie Charter [a], Martin Sebastian [f], Gishel New [h], Andrew E. Ajani [b,e,g], Omar Farouque [a,e], Stephen J. Duffy [b,c], David J. Clark [a,e,*], on behalf of the Melbourne Interventional Group

[a] *Department of Cardiology, Austin Hospital, Melbourne, Australia*
[b] *Monash Centre for Cardiovascular Research & Education in Therapeutics (CCRE), Monash University, Melbourne, Australia & School of Public Health, Curtin University, Perth, Australia*
[c] *Department of Cardiology, Alfred Hospital, Melbourne, Australia*
[d] *Department of Cardiology, Northern Hospital, Melbourne, Australia*
[e] *University of Melbourne, Melbourne, Australia*
[f] *Department of Cardiology, Geelong Hospital, Melbourne, Australia*
[g] *Department of Cardiology, Royal Melbourne Hospital, Melbourne, Australia*
[h] *Department of Cardiology, Box Hill Hospital, Melbourne, Australia*

ARTICLE INFO

Article history:
Received 12 January 2015
Received in revised form 20 May 2015
Accepted 20 May 2015
Available online 22 May 2015

Keywords:
Cardiogenic shock
Elderly
Early revascularization
Mortality

ABSTRACT

Background: The long-term benefit of early percutaneous coronary intervention (PCI) for cardiogenic shock (CS) in elderly patients remains unclear. We sought to assess the long-term survival of elderly patients (age ≥75 years) with myocardial infarction (MI) complicated by CS undergoing PCI.
Methods: We analyzed baseline characteristics, early outcomes, and long-term survival in 421 consecutive patients presenting with MI and CS who underwent PCI from the Melbourne Interventional Group registry from 2004 to 2011. Mean follow-up of patients who survived to hospital discharge was 3.0 ± 1.8 years.
Results: Of the 421 consecutive patients, 122 patients were elderly (≥75 years) and 299 patients were younger (<75 years). The elderly cohort had significantly more females, peripheral and cerebrovascular disease, renal impairment, heart failure (HF) and prior MI (all $p < 0.05$). Procedural success was lower in the elderly (83% vs. 92%, $p < 0.01$). Long-term mortality was significantly higher in the elderly ($p < 0.01$), driven by high in-hospital mortality (48% vs. 36%, $p < 0.05$). However, in a landmark analysis of hospital survivors in the elderly group, long-term mortality rates stabilized, approximating younger patients with CS ($p = 0.22$). Unsuccessful procedure, renal impairment, HF and diabetes mellitus were independent predictors of long-term mortality. However, age ≥75 was not a significant predictor (HR 1.2; 95% CI 0.9–1.7; $p = 0.2$).
Conclusions: Elderly patients with MI and CS have lower procedural success and higher in-hospital mortality compared to younger patients. However, comparable long-term survival can be achieved, especially in patients who survive to hospital discharge with the selective use of early revascularization.

1. Introduction

The elderly population constitute an increasing proportion of patients presenting with acute MI [1,2], and advanced age is a strong predictor of adverse outcomes [3,4]. A high proportion of elderly patients present with cardiogenic shock (CS) [5]. In 1999, the benefit of early revascularization in the randomized SHOCK (SHould we emergently revascularize Occluded Coronaries for cardiogenic shocK?) was limited to patients <75 years of age, and as a result, physicians were reluctant to treat this high risk group [6]. We and others have subsequently found a benefit from percutaneous coronary intervention (PCI) in elderly patients presenting with acute MI complicated by CS, with outcomes better than previously expected with the use of contemporary interventional strategies [5,7,8]. Nevertheless, long-term data remain scarce in the elderly cohort.

The aim of this study was to evaluate the clinical characteristics, procedural and lesion details, and long-term clinical outcomes of elderly patients (≥75 years old) compared with patients <75 years old undergoing PCI for acute MI complicated by CS in a large, contemporary

* Corresponding author.
E-mail address: clarkdavidj@hotmail.com (D.J. Clark).

http://dx.doi.org/10.1016/j.ijcard.2015.05.130

multicenter PCI registry with linkage to the Australian National Death Index (NDI).

2. Methods

2.1. Study population

There were 8070 patients with acute MI in the Melbourne Interventional Group (MIG) registry who underwent PCI from April 2004 to October 2011 including both ST-elevation MI (STEMI) and non-STEMI (NSTEMI). Of these patients, 421 (5.3%) presented with CS and were categorized into 2 groups; an elderly group (age ≥75 years, n = 122), and a younger group (age <75 years, n = 299).

2.2. Data collection and registry design

The MIG registry is a collaborative PCI registry comprising 7 Australian public referral hospitals; it is designed to record prospective data of all PCI procedures. The MIG registry has been previously described in detail [9–11]. Baseline demographics, clinical, angiographic, and procedural characteristics of consecutive patients undergoing PCI are prospectively recorded on case report forms using standardized definitions for all fields [10,11]. The study protocol has been approved by the ethics committee in each participating hospital, and "opt-out" informed consent was obtained in all patients [9].

In-hospital outcomes and complications were recorded at the time of discharge. Cardiac research nurses conducted 30-day and 12-month follow-up by telephone, using a standardized questionnaire [9,11]. All adverse events were confirmed by reviewing the patients' medical records at the relevant hospitals.

The registry is coordinated by the Centre for Cardiovascular Research & Education in Therapeutics, a research body within the Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia. An independent audit is conducted annually at all enrolling sites by an investigator not affiliated with that institution, in which 15 verifiable fields from 5% of all patients enrolled from each site are randomly selected and audited. Data accuracy was 97%, which is comparable to other large registries [12].

We have previously reported the methodology of determining long-term mortality by linkage with the Australian National Death Index (NDI) [13]. Briefly, the Australian NDI is a database housed at the Australian Institute of Health and Welfare, which contains records of all deaths occurring in Australia since 1980. Data are obtained from the registries of births, deaths, and marriages in each state and territory. The following variables for each deceased patient were identified to facilitate patient matching with the MIG registry: name, date of birth (or estimated year of birth), age-at-death, gender, date-of-death, state/territory of registration, and registration number. Successful matching of patients through this linkage process was achieved in 99.42% of patients in the MIG registry. Of the 421 patients that were successfully matched in this study, there was one case where there was disagreement in the survival status between the MIG registry and NDI, and in this case, the result from the NDI was used.

2.3. Definitions and outcomes

Acute MI was defined as STEMI or NSTEMI. We defined STEMI as the presence of at least 0.1-mV ST-segment elevation or new pathological Q waves in ≥2 contiguous electrocardiogram leads or new left bundle branch block with elevation of cardiac enzyme levels above the reference range. NSTEMI was defined by the presence of ST-segment depression or T-wave abnormalities or ischemic symptoms with elevation of cardiac enzyme levels above the reference range.

Cardiogenic shock was defined as a systolic blood pressure of <90 mm Hg for at least 30 min or the need for supportive measures to maintain a systolic blood pressure ≥90 mm Hg associated with end-organ hypoperfusion (cool extremities or a urine output of <30 mL/h, and a heart rate of ≥60 beats/min). Hemodynamic criteria were a cardiac index of no more than 2.2 L/min/m^2 of body surface area and a pulmonary capillary wedge pressure of at least 15 mm Hg.

In-hospital outcomes included all-cause mortality; periprocedural MI, defined as new MI during or after the catheterization laboratory visit with at least 1 instance of elevation of creatine kinase/creatine kinase myocardial band more than 3 times the upper limit of normal and/or evolutionary ST-segment elevation, development of new Q waves in 2 or more contiguous electrocardiography leads, or new left bundle branch block pattern on the electrocardiogram; bleeding, defined as requiring a transfusion and/or prolonged hospital stay and/or causing a drop in hemoglobin >3.0 g/dL; heart failure; renal failure, defined as an increase of creatinine to >0.20 mmol/L and 2 times the baseline creatinine level or a new requirement for dialysis; stroke; emergency PCI; and unplanned coronary artery bypass graft surgery. Procedural success was defined as <50% residual stenosis after angioplasty and <20% after stenting in the treated lesions.

The 30-day and 1-year outcomes included all-cause mortality, cardiac and non-cardiac deaths, MI, target-lesion revascularization, and target-vessel revascularization (TVR), defined as repeat revascularization within 5 mm of the treated segment and repeat revascularization of the treated vessel, respectively. Major adverse cardiac events (MACE) were a composite of death, MI, and TVR. Long-term mortality refers to all cause mortality.

2.4. Statistical analysis

Continuous variables were expressed as mean ± standard deviation or median (interquartile range) as appropriate, and categorical data expressed as percentages, except where indicated. Continuous variables were compared using Student *t* tests or Kruskal–Wallis equality of population rank test as appropriate. Categorical variables were compared using Fisher's exact or Pearson's chi-square tests as appropriate. All calculated p values were 2-sided and p values <0.05 were considered statistically significant. Cumulative incidence of mortality and MACE was estimated according to the Kaplan–Meier method and the log-rank test was used to evaluate differences between groups. Cox proportional hazards modeling was used to identify univariate and multivariate predictors of long-term mortality. Univariate variables with a p value <0.10 were then included in multivariate models. Variables used were age ≥75 years, gender, diabetes mellitus, hypertension, dyslipidemia, renal function (estimated glomerular filtration rate [eGFR] ≥60 mL/min/1.73 m^2 or 30–59 mL/min/1.73 m^2 or <30 mL/min/1.73 m^2), family history of coronary artery disease, previous MI or heart failure (HF), smoking status, presentation with STEMI or HF, time from symptom onset to PCI, treated lesion location (left main, left anterior descending, circumflex, right coronary artery), bypass graft lesions, American College of Cardiology and American Heart Association type B2 and C lesions, ostial lesions, bifurcation lesions, use of glycoprotein IIb/IIIa inhibitors, intra-aortic balloon pump use, drug-eluting stent use, stent length ≥20 mm, and stent diameter ≤2.5 mm. All statistical analyses were performed using Stata v12.1 for Windows (College Station, TX, USA).

3. Results

3.1. Baseline characteristics

The mean age of the elderly group was 80.8 ± 4.3 years and the mean age of the younger group was 61.0 ± 9.3 years. The majority of patients in both groups presented with a STEMI, 87.7% in the elderly group and 86.6% in the younger group. Elderly patients were more likely to be female and have hypertension, impaired renal function, previous MI, peripheral vascular and cerebrovascular disease, as shown in Table 1. The younger group had more current smokers and a family history of coronary artery disease.