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### REVIEW

- 396 Sleep, health behaviors, and behavioral interventions: Reducing the risk of cardiovascular disease in adults  
*Kaar JL, Luberto CM, Campbell KA, Huffman JC*

### MINIREVIEWS

- 407 Heart failure after myocardial infarction in the era of primary percutaneous coronary intervention: Mechanisms, incidence and identification of patients at risk  
*Cahill TJ, Kharbanda RK*
- 416 Transcervical access, reversal of flow and mesh-covered stents: New options in the armamentarium of carotid artery stenting  
*Paraskevas KI, Veith FJ*
- 422 Empirical anticoagulation for patients in sinus rhythm at high risk of ischaemic stroke: A review of current literature  
*Battipaglia I, O'Neill J, Hogarth AJ, Tayebjee MH*
- 429 Antitachycardia pacing programming in implantable cardioverter defibrillator: A systematic review  
*De Maria E, Giacomelli D, Borghi A, Modonesi L, Cappelli S*

### ORIGINAL ARTICLE

#### Retrospective Cohort Study

- 437 Clinical characteristics and outcomes of octogenarians presenting with ST elevation myocardial infarction in the Australian population  
*Sim WL, Mutha V, Ul-Haq MA, Sasongko V, Van-Gaal W*

#### Retrospective Study

- 442 Jailing polymer jacketed guide-wires during bifurcation coronary interventions is associated with procedural myocardial infarction  
*Chatterjee A, White JS, Hashim T, Leesar MA*

#### Observational Study

- 448 Markers of inflammation and cardiovascular disease in recently diagnosed celiac disease patients  
*Tetzlaff WF, Meroño T, Menafra M, Martin M, Botta E, Matoso MD, Sorroche P, De Paula JA, Boero LE, Brites F*

**Prospective Study**

- 457 Combined assessment of myocardial damage and electrical disturbance in chronic heart failure  
*Kadowaki S, Watanabe T, Otaki Y, Narumi T, Honda Y, Takahashi H, Arimoto T, Shishido T, Miyamoto T, Kubota I*

**CASE REPORT**

- 466 Cough induced syncope: A hint to cardiac tamponade diagnosis  
*Ramirez R, Lasam G*

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## Retrospective Cohort Study

# Clinical characteristics and outcomes of octogenarians presenting with ST elevation myocardial infarction in the Australian population

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## Abstract

### AIM

To investigate the characteristics and outcomes of octogenarians who presented with ST-elevation myocardial infarction (STEMI) compared to non-octogenarians and to investigate the outcomes of octogenarians that received primary percutaneous coronary intervention (PCI) compared to those managed conservatively.

### METHODS

We performed a single center retrospective case controlled study. All octogenarians who presented with STEMI to a tertiary referring hospital between 2007 and 2012 were included. The subsequent non-octogenarian patient who presented with a STEMI following the octogenarian patient was assigned to the control group in a 1:1 manner. The outcomes measured were peri-procedural cardiac arrest, death on table, cerebrovascular accidents (CVA), in-hospital and 30-d mortality.

### RESULTS

A total of 146 patients were analyzed. The octogenarian group had a higher percentage of females, higher overall comorbidities, higher Charlson Comorbidity Index score, worse renal function and were more likely to require residential care and home help. The octogenarian group were also less likely to have PCI attempted and had a longer symptom onset to PCI

time. Mortality rate was high amongst octogenarians who presented with STEMI. However, those managed conservatively had a higher in-hospital and 30-d mortality rate

### CONCLUSION

Octogenarians who presented with STEMI that were managed conservatively had a higher mortality rate compared to those who had primary PCI. Therefore, we propose that revascularization may be beneficial to patients in this age group.

**Key words:** Coronary disease; Acute coronary syndrome; Myocardial infarction; Percutaneous coronary intervention; Aged 80 and over

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**Core tip:** The octogenarian group represents a complex population with multiple comorbidities. Percutaneous coronary intervention in this group is challenging and is associated with a high rate of failure and complications. This study shows that the mortality rate amongst octogenarians presenting with ST elevation myocardial infarction is high. However, there may be a mortality benefit in those treated with percutaneous coronary intervention, compared to those managed conservatively.

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## INTRODUCTION

Advanced age is associated with increased risk of acute coronary syndrome (ACS) and cardiovascular comorbidities<sup>[1]</sup>. The octogenarian population (age  $\geq$  80 years) is a fast growing segment of the population worldwide, and represent a high risk group for procedural complications during percutaneous coronary intervention (PCI) particularly in the settings of ST-segment elevation myocardial infarction (STEMI)<sup>[2]</sup>. These patients are underrepresented in randomized clinical trials evaluating primary PCI for STEMI and a high mortality has been reported<sup>[3,4]</sup>. These patients are typically treated less aggressively than are younger patients, due partly to the increased risk of adverse events and PCI related complications, and partly to a lack of standard management guidelines. Evidence based management of octogenarian patients with STEMI thus remains suboptimal despite the high mortality<sup>[2]</sup>. The overseas observational trials have suggested that despite the recommendations being

that age should not influence the decision of reperfusion strategy in STEMI patients, older age remains one of the strong predictors of not receiving it. There is paucity of Australia data on outcomes of octogenarian who present with STEMI. In this context, the aim of our study was to assess the clinical characteristics and outcomes of octogenarians presenting with STEMI, as compared with non-octogenarian patients (age < 80 years), as well as the outcomes of octogenarians who received primary PCI, compared to those that were managed conservatively.

## MATERIALS AND METHODS

This study is a single center retrospective case controlled study including all octogenarians who presented with STEMI between 2007 and 2012 in a tertiary Australian hospital. The subsequent non-octogenarian patient who presented with STEMI following an octogenarian STEMI was assigned to the control group in 1:1 manner. Detailed data on baseline and procedural characteristics and patient comorbidities were obtained through electronic medical records, and compared between octogenarian and non-octogenarian STEMI patients. The charlson comorbidity index (CCI) was calculated based on the patient's comorbidities. CCI predicts long-term survival according to a patient's medical condition<sup>[5]</sup>. STEMI was defined as persistent angina for 20 min in conjunction with either: (1) an ST-segment elevation at the J point of 0.25 mV in men aged < 40 years or 0.2 mV in men aged > 40 years or 0.15 mV in women in the precordial leads V2 to V3, and 0.1 mV in all other leads; or (2) the presence of a new left bundle branch block<sup>[6]</sup>. PCI success was defined as TIMI 2 or 3 flow post intervention. Left ventricular ejection fraction (EF) was derived either from the echocardiogram performed following the presentation or coronary angiogram during the index admission. Outcomes compared between the two groups included peri-procedural cardiac arrest, death on table, cerebrovascular accident (CVA), in-hospital and 30-d mortality. CVA was defined a clinical evidence of neurological deficit leading to a documented diagnosis of transient ischaemic attack or stroke. Subgroups of octogenarian STEMI patients who received PCI vs who did not (conservatively managed) were also compared for baseline and clinical characteristics. In-hospital and 30-d mortality was compared between all subgroups and independent predictors calculated.

All data were analyzed using IBM SPSS v22 and presented as percentages or mean value  $\pm$  standard deviation (SD). Independent *t* test was used to compare continuous while  $\chi^2$  and Fisher's exact tests were performed for categorical data. Logistic regression and multivariate analysis were performed to identify independent predictors. A two tailed *P* value of < 0.05 was considered statistically significant. The statistical methods of this study were reviewed by our biostatistics expert Dr. Asrar Ul-Haq, MBBS.

**Table 1** Baseline characteristics, procedural data, and outcomes of octogenarians as compared to non-octogenarians (controls)

	Octogenarians (n = 73)	Controls (n = 73)	P
Age	85.2 ± 4.1	67.1 ± 5.3	< 0.005
Females	56	29	< 0.005
Residential care	23	2.7	< 0.005
LLC	11	0	< 0.005
HLC	12	2.7	< 0.005
Home help	25	0	< 0.005
Medical comorbidities			
Diabetes	38	19	< 0.05
eGFR	48.7 ± 19.9	68.1 ± 20.3	< 0.005
PVD	30	12	< 0.05
Prior IHD	36	20	0.06
EF	53.6 ± 14.1	50.8 ± 13.1	0.4
Charlsons	3.2 ± 2.3	1.7 ± 2.2	< 0.005
Presentation and procedural characteristics			
Location of MI			
Anterior	51	49	0.8
Inferior	42	47	0.5
Lateral	4.1	4.1	1.0
PCI attempt	47	84	< 0.005
PCI success (TIMI 2-3)	91	99	0.1
Symptoms onset to PCI < 6 h	16	45	< 0.005
Outcomes			
Peri-procedural cardiac arrest	5	3	0.1
Death on table	1.8	0.9	0.2
Stroke	1.4	0	0.3
Inhospital mortality	28	7	< 0.005
30-d mortality	45	12	< 0.005

Data are means ± SD or n (%). LLC: Low level care; HLC: High level care; PVD: Peripheral vascular disease; EF: Ejection fraction; PCI: Percutaneous coronary intervention; MI: Myocardial infarction.

## RESULTS

### Octogenarians vs non-octogenarians

A total of 146 patients were analysed (octogenarians = 73; non-octogenarians = 73). The mean age was 85.2 ± 4.1 years in the octogenarian group and 67.1 ± 5.3 years in the control group (Table 1). The octogenarian group had a higher percentage of females (56% vs 29%, *P* < 0.005), higher overall comorbidities, a higher CCI score (3.2 ± 2.3 vs 1.7 ± 2.2, *P* < 0.001), were more likely to require residential care (23% vs 2.7%, *P* < 0.001) as well as home help (25% vs 0%, *P* < 0.001), and had worse renal function (eGFR 48.7 ± 19.9 vs 68.1 ± 20.3 mL/min per 1.73 m<sup>2</sup>, *P* < 0.001).

Octogenarians were less likely to have PCI attempted compared to the non-octogenarians (47% vs 84%, *P* < 0.001). The rate of symptom onset-to-PCI of < 6 h was significantly lower in octogenarians (16% vs 45%, *P* < 0.001). The rate of PCI success was high in both groups (91% vs 99%, *P* = 0.1). Reasons PCI was not attempted in non-octogenarians include: No culprit found (3), embolic event (1), recent CVA (1), known or new triple vessel disease/complex anatomy (2), other comorbidities (5); and in octogenarians: No culprit found (9), embolic event (2), recent CVA (4), known or

**Table 2** Baseline characteristics and outcomes of octogenarians who received percutaneous coronary intervention compared to conservatively managed octogenarians (no-percutaneous coronary intervention)

	PCI (n = 34)	No-PCI (n = 39)	P
Age	84 ± 3.4	86 ± 4.3	< 0.05
Females	44	67	0.06
Residential care	3	41	< 0.005
LLC	3	18	< 0.005
HLC	0	23	< 0.005
Home help	18	35	0.2
Medical comorbidities			
Diabetes	32	44	0.3
eGFR	54 ± 23	44 ± 16	< 0.05
PVD	21	38	0.1
Prior IHD	35	36	1
EF	54 ± 13	53 ± 16	0.2
Charlsons	2.52 ± 2	3.8 ± 2	< 0.05
Presentation			
Location of MI			
Anterior	41	59	0.2
Inferior	50	36	0.2
Lateral	6	3	0.6
Outcomes			
Inhospital mortality	18	37	0.1
30-d mortality	29	59	< 0.05

Data are means ± SD or n (%). LLC: Low level care; HLC: High level care; PVD: Peripheral vascular disease; EF: Ejection fraction; PCI: Percutaneous coronary intervention; MI: Myocardial infarction.

new triple vessel disease/complex anatomy (13), other comorbidities (11). Octogenarians had a significantly higher overall in-hospital mortality (28% vs 7%, *P* < 0.005) and 30-d mortality (45% vs 12%, *P* < 0.001).

The independent predictors of 30-d mortality in octogenarians included age (OR 1.20/year of advancing age, *P* < 0.01), place of residence (OR = 4.4, *P* < 0.01 for nursing home), conservative management (No intervention - OR 2.77, *P* < 0.05), and declining renal function (OR = 0.9, *P* < 0.05).

### PCI vs conservatively managed octogenarians

The 39 (53%) octogenarians who did not receive PCI were older (86 ± 4.3 years vs 84 ± 3.4 years, *P* < 0.05) and were more likely to be in residential care (41% vs 3%, *P* < 0.001), had higher CCI score (3.8 ± 2 vs 2.52 ± 2, *P* < 0.05) and worse renal function (eGFR 44 ± 16 mL/min vs 54 ± 23 mL/min per 1.73 m<sup>2</sup>). Type of myocardial infarction was not different as compared to octogenarians who received PCI (Table 2).

Mortality rate was high among octogenarians who presented with STEMI. However, those who were managed conservatively had a higher in-hospital and 30-d mortality (37% vs 18%, *P* = 0.1; and 59% vs 29%, *P* < 0.05 respectively).

Independent predictors of intervention in octogenarians included younger age (OR = 0.86, *P* < 0.05), place of residence (OR = 0.1, *P* < 0.05 for nursing home), lower CCI (OR = 0.7, *P* < 0.05), and renal

function (OR = 1.03,  $P < 0.05$ ).

## DISCUSSION

### **High mortality**

Our study demonstrated that mortality rate amongst octogenarians presenting with STEMI is high in Australian population despite the offered treatment, although much worse when treated conservatively. This appears to be associated with higher overall comorbidities, higher CCI score, worse renal function, and need for residential care or home help (which maybe the indirect measure of overall comorbidities and physical state). These findings are consistent with overseas studies looking at similar age groups<sup>[7-9]</sup>. Some factors reported to affect the mortality in these studies include heart failure, multiple co-morbidities, cachexia, cognitive state, history of intra-cranial bleeding and pre-hospital physical activity status<sup>[10,11]</sup>. Furthermore, it has been shown that the elderly are less likely to receive evidence based medical treatment such as aspirin, clopidogrel, beta-blockers, statins or glycoprotein IIb/IIIa inhibitors<sup>[7,8]</sup>. This may be due to concerns with regards to potential side effects in this age group. Previous studies have also shown that the elderly is associated with a higher rate of PCI failure. However, this is not reflected in our study, likely because the candidates for treatment were carefully selected.

### **Underuse of invasive treatment**

Our study suggested that despite having a higher mortality rate, octogenarians are less likely to have PCI attempted as compared to non-octogenarians. Frailty, co-morbidities and time delays have been shown to contribute to the underuse of invasive therapies. In our study, the proportion of those who received PCI in less than 6 h was significantly lower in the octogenarian group. This might reflect difficulty in decision-making with regards to reperfusion strategy. Atypical clinical presentation is also more common in the elderly and could contribute to time delay as well as the higher prevalence of cardiac failure. In addition, female gender was more prevalent in the octogenarian group. Previous studies have shown that female gender is associated with lower use of invasive therapies, especially in the elderly<sup>[12]</sup>.

### **Invasive treatment appears beneficial**

Another major finding of our study is that despite a relatively poor prognosis, octogenarians who received primary PCI had a significantly lower 30-d mortality. This however maybe related to the selection bias, a limitation of observational study design. Patients managed conservatively in our study were older, more likely to be in residential care, had a higher CCI score and worse renal function, and this represents a group with higher risk profile. The most common reasons PCI was not performed in the elderly were triple vessel disease/complex anatomy, other co-

existing comorbidities and the absence of a clear culprit lesion. There was no significant difference in in-hospital mortality between those managed who received intervention and those managed conservatively. Other factors affecting 30-d mortality included age, place of residence and declining renal function, highlighting the complexity of this patient population.

### **Limitations**

Our study is not randomized, and therefore limited by selection bias. However, it is an "all comers" registry which reflects "real world" data on management and outcomes of elderly patients who presents with STEMI. A randomised trial in this particular group is not viable. Propensity score matching would be the next best option and requires larger studies. Furthermore, we did not evaluate long term mortality and re-infarction rates, which may provide incremental information and a better picture of the utility of invasive management in this group.

In conclusion, this study is the first Australian report on the outcomes of octogenarians who present with ST-elevation myocardial infarction. This group represents a complex population with multiple medical comorbidities and PCI is challenging, associated with high failure and complication rates. Consequently, mortality is high in this group. However, the detrimental prognosis of conservatively managed octogenarians and relative mortality benefit associated with PCI suggests that revascularization therapy may benefit this age group.

## COMMENTS

### **Background**

The elderly have an increased risk of acute coronary syndrome. However, there are more likely to be managed conservatively compared to the younger cohort. This is due to concerns regarding procedural complications and success. The elderly is also under-represented in major clinical trials evaluating primary percutaneous coronary intervention (PCI). Recognizing this there have been recent overseas studies evaluating the elderly and primary PCI.

### **Research frontiers**

This study is the first to evaluate the characteristics and outcome of octogenarians who presents with ST-elevation myocardial infarction (STEMI) in an Australian setting. The authors also evaluated the outcomes of octogenarians who received primary PCI compared to those that were managed conservatively.

### **Innovations and breakthroughs**

This paper showed that despite poor prognosis among octogenarians who presents with STEMI, primary PCI may offer some benefit, with significantly lower 30 d mortality in the group that received it.

### **Applications**

Primary PCI should be considered in octogenarians who presents with STEMI. The patient's co-morbidities, quality of life and life expectancy should be taken into account when making this decision.

### **Terminology**

Primary PCI consists of urgent balloon angioplasty (with or without stenting), without the previous administration of fibrinolytic therapy or platelet glycoprotein IIb/IIIa inhibitors, to open the infarct-related artery during an acute myocardial infarction with ST-segment elevation.

**Peer-review**

This is an interesting and well-written article dealing with care on octogenaries after acute myocardial infarction. The authors have found worse clinical characteristics in octogenaries in comparison with non octogenaries, as well as lower referral for interventional procedures.

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