Comparison of clinical presentations and outcomes between adult and elderly acute myocardial infarction patients in emergency department

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Background: Acute myocardial infarction (AMI) is one of a leading cause of death. The clinical presentations and outcomes between adults and elderly were still not well established.

Methods: We conducted a prospective study to evaluate the clinical manifestations of AMI at emergency department in Taiwan. Patients with unstable angina were excluded. The primary endpoint was all-cause mortality. The inpatient days, discharge activities, complications were collected for comparisons.

Results: Overall 210 consecutive cases with acute coronary syndrome were recruited in ER, 202 patients with AMI were enrolled for further analysis (66.3% STEMI and 33.7% NSTEMI). Among all AMI patients, 57 patients (28.2%) aged more than 65 years old. The overall inpatient days and total complications were not significantly different between adult and elderly patients. However, K-M survival analysis displayed that patients over the age of 75 years old was with poor event free survival rate of mortality (Log-rank test, P=0.03), especially for those patients with STEMI (Log-rank test, P=0.01). Cox regression exhibited that chest X-ray finding of cardiomegaly [adjusted hazard ratio (HR), 95% confidence interval (CI): 13.5, 1.27–144, P=0.03] and peak CK-MB levels (adjusted HR, 95% CI: 1.003, 1.001–1.004, P<0.001) were independent risk factors in predicting future mortality for all AMI patients.

Conclusions: The clinical presentations and outcomes may vary among adult AMI patients and older AMI patients. The chest X-ray finding of cardiomegaly and higher peak CK-MB levels may predict future mortality in AMI patients. The elderly patients over 75 years were with higher mortality after onset of AMI.

Keywords: Acute coronary syndrome (ACS); acute myocardial infarction (AMI); chest pain; emergency department

Received: 22 January 2019; Accepted: 31 July 2019; Published: 03 September 2019.

doi: 10.21037/ht.2019.08.01

View this article at: http://dx.doi.org/10.21037/ht.2019.08.01

Introduction

Acute coronary syndrome (ACS) is an acute and critical cardiac disease including acute myocardial infarction (AMI) and unstable angina (UA). AMI is one of a leading cause of death (1). The reason of AMI is that the rupture of atherosclerotic plaque, which originally causes coronary artery atherosclerosis (2). UA results from incomplete clot of the blood vessels; whereas AMI occurs when the blood vessels are completely blocked (3,4). The heart muscle needs oxygen- and nutrients-rich blood to function, and three major arteries supply to the heart, including: left anterior descending (LAD) artery, left circumflex (LCX) artery, and right coronary artery (RCA). When the heart suffers from an ischemic event, the typical symptoms of AMI include chest pain/tightness, discomfort in left shoulder, arm, or medial forearm, dyspnea, and diaphoresis (5). The diagnosis of AMI is mainly based on the symptoms, electrocardiogram (ECG), and myocardial enzymes [i.e., creatine kinase (CK) and creatine kinase-MB (CK-MB)] (3). But early accurate diagnosis of some patients may be difficult because they are presented with atypical symptoms (e.g., no chest tightness/chest pain), normal electrocardiography (ECG), and increased myocardial enzymes 3–4 hours after the onset (3).

When a suspected ACS patient goes to the emergency room (ER), the physician needs enough time to continue keep close watch over the patients for diagnosis and assessment. Only 15–50% ACS patients was judged to have a confirmed AMI (6). The care and treatment of ACS from admission to discharge is very important and worthy of attention. Due to the changes in the diet and lifestyle, the onset age of ACS gradually decreases. Early prediction of AMI from clinical history, ECG, and biomarkers is important for further treatment and outcome improvement.

Most developed world countries have accepted the chronological age of 65 years as a definition of 'elderly' or older person. The elderly AMI patients over the age of 65 years old represented half of AMI hospitalizations and 80% AMI deaths (7). Prior studies have emphasized the need for cardiac care in all patients with ST-segment elevation myocardial infarction (STEMI), particularly in elderly patients. Elderly patients are at highest risk of cardiovascular events and deaths. Recent efforts have increased physicians' awareness of age impacts on in-hospital care of AMI patients and clinical outcomes. However, the clinical presentations and outcomes for AMI patients between adults and elderly in different countries were still not well established (7-10). In addition, patients with non-ST-segment elevation myocardial infarction (NSTEMI) were often excluded from the analysis (11,12). The specific aim of this prospective study was to compare the differences in clinical manifestations and prognosis of AMI between elderly and adult patients in Taiwan.

Methods

Study design

We conducted a prospective study to evaluate the clinical manifestations of AMI at emergency department and to compare the differences between the elderly and adult patients. Data was collected from the medical records of ACS-STEMI patients in the emergency room (ER), Department of Cardiology, and coronary care unit (CCU) of Taipei and Tamsui branch of Mackey Medical Hospital from Sep. 1, 2012 to Sep. 30, 2013.

The major information were collected in the registration form, including: gender, date of birth, major complaints (clinical symptoms), vital signs, medical history and causal relationships (diabetes, hypertension, coronary artery disease, etc.), chest X-ray finding, diagnosis of STEMI or NSTEMI in ER, inpatient days, discharge activities, complications, and lab data.

Study participants

AMI was defined as (I) clinical symptoms and history: chest pain, chest tightness, and other atypical symptoms; (II) ECG performance: STEMI (ST elevation >1 mm in two contiguous leads or new LBBB) or NSTEMI; (III) abnormal level of myocardial enzymes, i.e., Troponin I, CK, and CK-MB. The definition of elderly and adult patients were age ≥65 and 20–64 years old, respectively.

The exclusion criteria were: (I) patients who were unwilling to be enrolled; (II) UA patients or non-AMI patients; (III) patients with age less than 20 years; (IV) positive human immunodeficiency virus (HIV) reaction; (V) pregnant women; (VI) out-of-hospital cardiac arrest (OHCA); and (VII) receiving hemodialysis or GFR <30 min/mL. Project principal investigator (PI) or research assistant or medical staff in the ER explained the study after admission to eligible patients or their families. The patient was enrolled and online registration was carried out after the completion of informed consent in the ER. The enrollment complied with the Human Subject Research Act of the Institutional Review Board (12MMHIS077).

Statistical analysis

Descriptive variables were expressed as means, medians with ranges, or frequencies, Chi-square or Fisher exact test were used to determine the association between nominal variables, Student's *t*-test was applied for continuous data. The Cox proportional-hazards regression was used to compare the hazard ratios (HRs) for the outcomes. A risk factor with a P value equal or less than 0.05 in the univariate analysis was put in the multivariate analysis for adjusted effect. The Kaplan-Meier (K-M) survival analysis displayed the event free survival rate of mortality. The generalized additive model (GAM) with smooth effect provided a flexible method for identifying non-linear associations between a continuous exposure and an outcome. The receiver operating characteristic (ROC) curve was used to evaluate a biomarker's ability for classifying outcome status. The Youden Index was applied to find an optimal cut-off-value. Statistical analysis was conducted using SPSS version 20.0 software (SPSS Inc., Chicago, IL, USA) and SAS software (version 9.4, SAS Institute, Cary, NC). A P value of less than 0.05 was the criterion of statistical significance.

Results

A total of 210 consecutive ACS cases were recruited at ER, 8 patients with UA were excluded, and 202 patients with AMI were enrolled for further analysis (66.3% STEMI and 33.7% NSTEMI). Among all AMI patients, 57 patients (28.2%) aged more than 65 years old. We compared the baseline characteristics between adult patients (<65 years, mean age: 77.7±8.3, 86.2% males) and elderly patients (20–64 years, mean age: 52.1 (<65, 54.3% males) in *Table 1*. The elderly patients had significantly higher percentage of female, prior history of congestive heart failure (CHF) and stroke, chest X-ray findings of pulmonary congestion and cardiomegaly, electrocardiography (ECG) finding of atrial fibrillation (AF). The location of AMI occurrence at home were common in the elderly than in the adult patients (91.2% *vs*. 55.2%, respectively, P<0.001), and patients suffered from AMI usually during their normal activities or work (*Table 1*).

Whereas percentage of male, history of hyperlipidemia, ECG finding of sinus rhythm (SR), interventional cardiac catheterization, abnormal cardiac catheterization findings

Table 1 Clinical characteristics between elderly and adult of all AMI patients (n=202)

Variables	Adult (n=145)	Elderly (n=57)	P value
Underlying			
Age (years)	52.1±7.5	77.7±8.3	<0.001
Male, n (%)	125 (86.2)	31 (54.4)	<0.001
Vital signs and clinical manifestations			
Systolic blood pressure (mmHg)	136.3±30.66	133.1±334.5	0.52
Diastolic blood pressure (mmHg)	80.6±20.1	66.5±17.0	<0.001
Heart beats (per minute)	85.1±2.2	85.3±20.4	0.95
Body mass index	25.8±3.91	24.6±3.14	0.047
Glasgow Coma Score (GCS)	14.8±1.29	14.7±1.34	0.50
Heart injury index	2.58±1.02	2.04±1.20	0.001
Shock	10 (6.9)	7 (12.3)	0.17
Chest pain	121 (83.4)	34 (59.6)	0.001
Epigastric pain	25 (17.2)	8 (14.0)	0.68
Diaphoresis	60 (41.4)	10 (17.5)	<0.01
Dyspnea	36 (24.8)	23 (40.4)	0.03
Syncope	6 (4.1)	2 (3.5)	>0.99

Table 1 (*continued*)

Table 1 (*continued*)

Variables	Adult (n=145)	Elderly (n=57)	P value
Diagnosis in ER, n (%)			0.03
ST elevation myocardial infarction (STEMI)	103 (71.0)	31 (54.4)	
Non-ST elevation myocardial infarction (NSTEMI)	42 (29.0)	26 (45.6)	
Location at occurrence, n (%)			<0.001
Home	80 (55.2)	52 (91.2)	
State at occurrence, n (%)			0.001
Exercise	7 (4.9)	2 (3.5)	
Normal activity or work	104 (72.2)	29 (50.9)	
Rest or sleep	33 (22.9)	26 (45.6)	
Medical history, n (%)			
Diabetes mellitus	53 (36.6)	24 (42.1)	0.52
Hypertension	77 (53.1)	38 (66.7)	0.08
Congestive heart failure	13 (9.0)	15 (26.3)	0.001
Hyperlipidemia	68 (46.9)	14 (24.6)	<0.01
History of stroke	4 (2.8)	6 (10.5)	0.03
Chronic kidney disease	5 (3.4)	6 (10.5)	0.08
Smoking	49 (33.8)	12 (21.1)	0.09
Alcoholic drinking	12 (8.3)	1 (1.8)	0.12
Prior AMI history	23 (15.9)	8 (14.0)	0.83
Chest X-ray, n (%)			
Pulmonary congestion	40 (27.6)	29 (50.9)	<0.01
Cardiomegaly	51 (35.2)	38 (66.7)	<0.001
ECG findings at ER, n (%)			<0.01
Sinus rhythm	138 (95.2)	47 (82.5)	
Atrial fibrillation	4 (2.8)	9 (15.8)	
Ventricular tachycardia	1 (0.7)	0 (0)	
AV block	2 (1.4)	1 (1.8)	
Treatment, n (%)			
Thrombolytic agents	2 (1.4)	1 (1.8)	0.63
Coronary artery bypass graft	18 (12.4)	6 (10.5)	0.81
Cardiac catheterization	128 (88.3)	41 (71.9)	0.01
Cardiac catheterization finding, n (%)			
Left anterior descending (LAD) artery	105 (72.4)	31 (54.5)	0.01
Left circumflex (LCX) artery	78 (53.8)	31 (54.4)	0.94
Right coronary artery (RCA)	93 (64.1)	34 (59.6)	0.55

Table 1 (*continued*)

Table 1 (*continued*)

Variables	Adult (n=145)	Elderly (n=57)	P value
Left coronary artery (RCA)	2 (1.4)	2 (3.5)	0.32
ER medication, n (%)			
Nitroglycerin (NTG)	97 (66.9)	32 (56.1)	0.15
Morphine	54 (37.2)	12 (21.1)	0.03
Heparin	63 (43.4)	16 (28.1)	0.04
Plavix	118 (81.4)	49 (86.0)	0.44
Aspirin	113 (77.9)	48 (84.2)	0.32
Beta blocker	4 (2.8)	1 (1.8)	>0.99
ACE inhibitor	5 (3.4)	1 (1.8)	>0.99
Statin	58 (40.0)	22 (38.6)	0.88
O_2	93 (64.1)	44 (77.2)	0.07
Laboratory data, n (%)			
Hemoglobin (g/dL)	14.5±1.69	12.5±1.98	<0.001
White blood cell (WBC) count	11462±8781	12133±18215	0.72
Glucose	183±94.1	183.3±66.6	0.98
Blood urine nitrogen	14.9±5.93	22.1±10.4	<0.001
Creatinine	1.1±0.81	1.3±0.61	0.11
K	3.75±0.58	3.85±0.58	0.32
Na	138±3.13	138±4.11	0.74
Troponin I	3.44±11.6	6.97±33.6	0.29
Peak CK-MB (ng/mL)	147±224	98±121	0.13
Peak CK (IU/L)	2,040±2,767	1,241±1,523	0.04

CK-MB, creatine kinase-myocardial bound.

at left anterior descending (LAD) artery and right coronary artery (RCA), medication uses of morphine and heparin at ER were more common in adult patients (*Table 1*). Besides, adult patients were with higher diastolic blood pressure (DBP), body mass index (BMI), heart injury index, and laboratory data of hemoglobin and peak CK, and lower blood urine nitrogen (BUN) level (*Table 1*).

Table 2 compared the major outcomes between adult and elderly patients. The overall inpatient days and total complications were comparable between adult and elderly patients. There were a total of 4.1% adult patients and 10.5% elderly patients died after onset of AMI (P=0.09). *Table 3* compared the gender difference in adult group and elderly group. The descriptive analyses exhibited that there was no gender difference in each adult group and elderly group.

The K-M survival analysis displayed that patients over the age of 75 years old was associated with poor event free survival rate of mortality in all AMI patients (Log-rank test, P=0.03; *Figure 1*), especially for those patients with STEMI (Log-rank test, P=0.01; *Figure 1C*). On the contrary, the event free survival rate of NSTEMI in the very old patients with the age over 75 years was not significant higher than younger groups (Log-rank test, P=0.49, *Figure 1B*). The ROC analysis showed that a cut-off-point of >77 years for all AMI patients, but a cut-off-point of >68 years for STEMI patients (*Figures 2A,B,C*). The GAM with smooth effect exhibited that the risk of mortality increased since

Table 2 Clinical outcomes between elderly and adult of all AMI patients (n=202)

Variables	Adult (n=145)	Elderly (n=57)	P value
Inpatient days			
Coronary care unit (CCU) stay (days)	3.3±4.0	4.2±4.7	0.16
Ward stay (days)	3.2±6.0	3.8±5.5	0.46
Total inpatient stay (days)	6.4±9.7	8.1±7.1	0.423
Outcome, n (%)			
Mortality	6 (4.1)	6 (10.5)	0.09
Complications, n (%)			
Total complications	43 (29.7)	19 (33.3)	0.62
Cardiac failure	1 (0.7)	0 (0)	>0.99
Cardiogenic shock	29 (20.0)	15 (26.3)	0.35
Recurrent myocardial infarction	2 (1.4)	0 (0)	0.51
Stroke	2 (1.4)	1 (1.8)	0.63
Ventricular tachycardia or fibrillation	16 (11.0)	4 (7.0)	0.45

Table 3 Clinical outcomes between elderly and adult of all AMI patients by sex groups

Variables	Adult			Elderly		
	Male (n=125)	Female (n=20)	P value	Male (n=31)	Female (n=26)	P value
Inpatient days						
Coronary care unit (CCU) stay (days)	3.22±3.30	3.75±7.20	0.59	4.65±5.61	3.73±3.29	0.47
Ward stay (days)	2.90±4.91	4.80±10.7	0.19	2.94±3.43	4.92±7.19	0.18
Total inpatient stay (days)	6.10±6.76	8.55±17.9	0.26	7.58±6.49	8.65±7.89	0.58
Outcome						
Mortality	4 (3.2)	2 (10.0)	0.19	2 (6.5)	4 (15.4)	0.40
Complications						
Total complications	41 (32.8)	2 (10.0)	0.06	11 (35.5)	8 (30.8)	0.78
Cardiac failure	1 (0.8)	0 (0)	>0.99	0 (0)	0 (0)	>0.99
Cardiogenic shock	27 (21.6)	2 (10.0)	0.37	8 (25.8)	7 (26.9)	>0.99
Recurrent myocardial infarction	2 (1.6)	0 (0)	>0.99	0 (0)	0 (0)	>0.99
Stroke	2 (1.6)	0 (0)	>0.99	0 (0)	1 (3.8)	0.46
Ventricular tachycardia or fibrillation	15 (12.0)	1 (5.0)	0.70	3 (9.7)	1 (3.8)	0.62

60 years, but reached the highest risk around 65–75 years (*Figure 2D,E*).

Cox regression exhibited that the chest X-ray finding of cardiomegaly [adjusted hazard ratio (HR), 95% confidence interval (CI): 13.5, 1.27–144, P=0.03; *Table 4*] and peak CK-MB levels (adjusted HR, 95% CI: 1.003, 1.001–1.004, P<0.001) were independent risk factors in predicting future mortality for all AMI patients. A crude effect of univariate analysis also revealed that patients over the age of 75 years were associated with higher risk of death for all patients

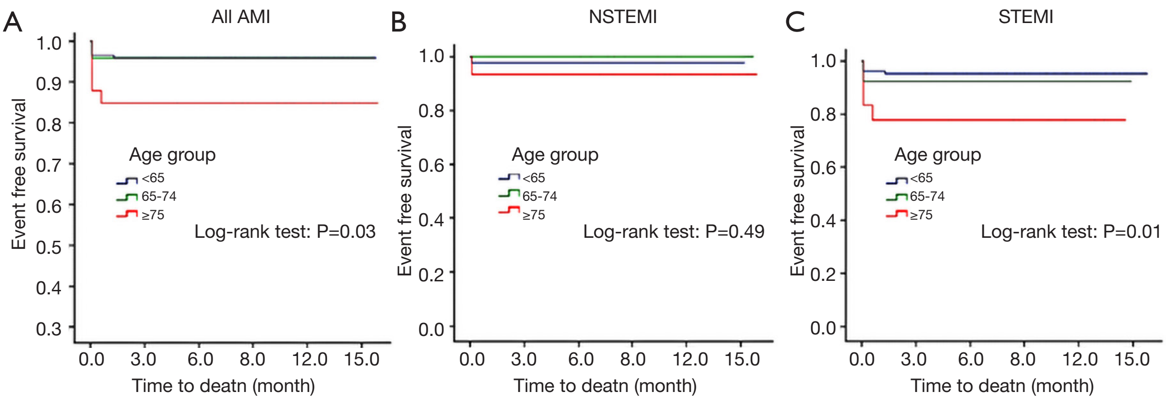

Figure 1 KM survival analysis displayed the event free survival of all-cause mortality among various age groups (<65, 65–74, ⩾ 75 years) and acute myocardial infarction (AMI) types.

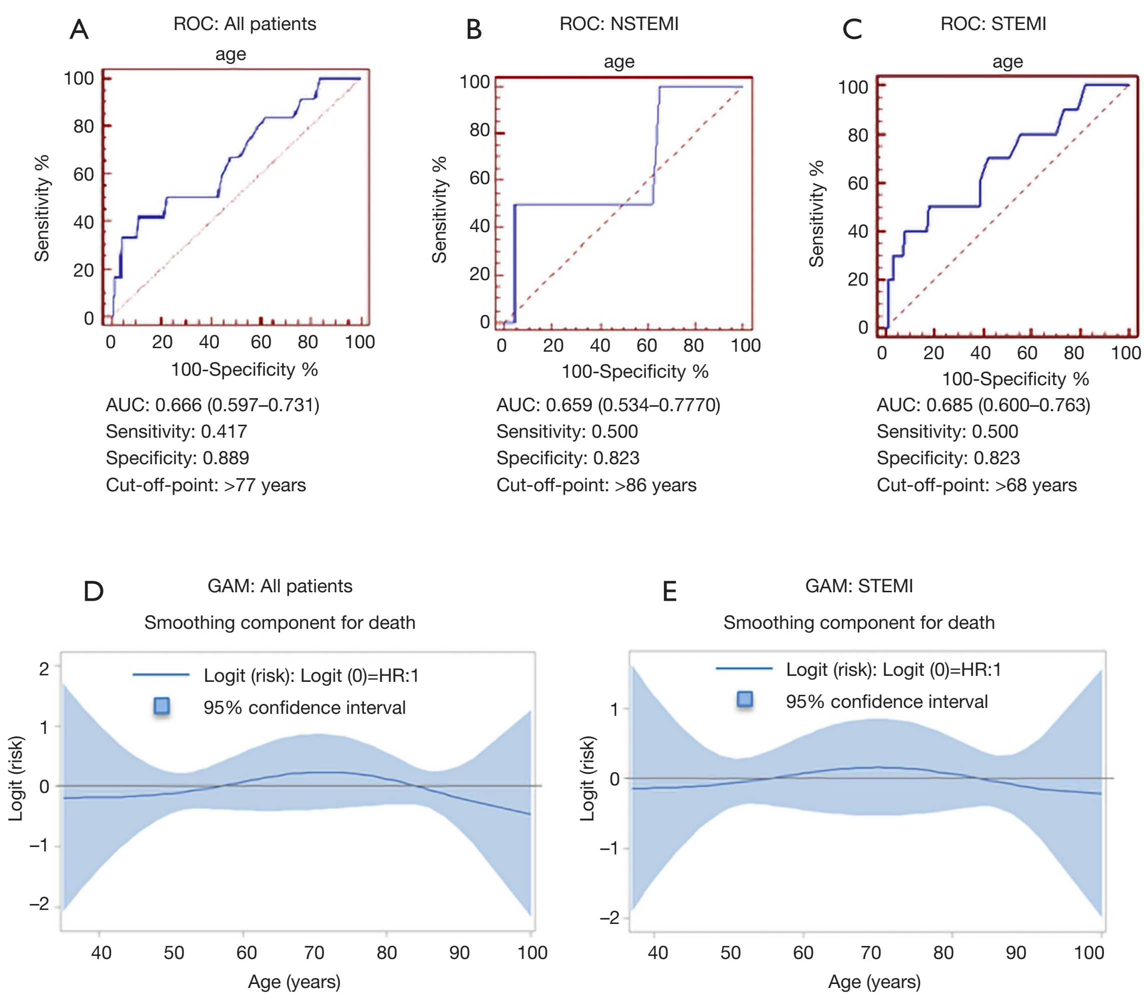

Figure 2 The ROC analyses showed that a cut-off-point of for (A) all AMI patients, (B) NSTEMI patients, (C) STEMI patients. The GAM with smooth effect exhibited that the risk of mortality for (D) all AMI patient NSTEMI patients and (E) STEMI patients. GAM, generalized additive model; AMI, acute myocardial infarction; STEMI, ST-segment elevation myocardial infarction; NSTEMI, non-ST-segment elevation myocardial infarction.

Table 4 Hazard ratios for mortality in different presentations of all AMI patients (n=202)

Variables	Univariate analysis		Multivariate analysis	
	HR (95% CI)	P value	HR (95% CI)	P value
Age (years, linear)	1.04 (1.01–1.08)	0.02	1.00 (0.96–1.05)	0.99
<65 years	1 (reference)	NA		
65–74 years	1.01 (0.12–8.38)	0.99		
≥75 years	3.73 (1.14–12.2)	0.03		
Male	0.29 (0.09–0.91)	0.03	0.308 (0.07–1.31)	0.11
Body mass index	1.04 (0.90–1.20)	0.60		
Glasgow Coma Score (GCS)	0.95 (0.67–1.34)	0.76		
Heart injury index	0.81 (0.49–1.34)	0.41		
Diagnosis				
Non-ST elevation myocardial infarction (NSTEMI, ref) vs. STEMI	2.55 (0.56–11.7)	0.23		
Diabetes mellitus	1.16 (0.37–3.67)	0.80		
Hypertension	1.06 (0.34–3.34)	0.92		
Congestive heart failure	4.54 (1.44–14.3)	0.01	2.81 (0.77–10.3)	0.12
Hyperlipidemia	1.04 (0.33–3.29)	0.94		
History of stroke	1.75 (0.23–13.5)	0.59		
Chronic kidney disease	1.59 (0.21–12.3)	0.66		
Smoking	1.75 (0.23–13.5)	0.59		
Pulmonary congestion	1.38 (0.44–4.35)	0.58		
Cardiomegaly	6.46 (1.42–29.5)	0.02	13.2 (1.21–143)	0.03
Coronary artery bypass graft	0.04 (0–83.3)	0.41		
Cardiac catheterization	0.39 (0.12–1.28)	0.12		
Acute myocardial infarction at left anterior descending (LAD) artery	0.48 (0.16–1.56)	0.20		
Medication				
Nitroglycerin (NTG)	0.28 (0.08–0.93)	0.04	0.37 (0.10–1.36)	0.14
Heparin	2.19 (0.70–6.90)	2.19		
Plavix	2.33 (0.30–18.1)	0.42		
Aspirin	2.83 (0.37–21.9)	0.32		
Statin	2.15 (0.68–6.79)	0.19		
Hemoglobin (g/dL)	0.93 (0.71–1.22)	0.60		
Blood urine nitrogen	1.04 (0.98–1.09)	0.20		
Creatinine	0.92 (0.35–2.46)	0.87		
Peak CK-MB (ng/mL)	1.002 (1.001–1.002)	<0.001	1.003 (1.001–1.004)	<0.001

A factor with a P value≤0.1 in the univariate analysis was put in the multivariate analysis. CK-MB, creatine kinase-myocardial bound.

Table 5 Hazard ratios for mortality in different presentations of AMI patients with age less than 65 years old (n=57)

Variables	Univariate analysis		Multivariate analysis	
	HR (95% CI)	P value	HR (95% CI)	P value
Male	0.32 (0.06–1.74)	0.19		
Body mass index	1.22 (1.05–1.42)	0.01	1.16 (0.99–1.36)	0.07
Glasgow Coma Score (GCS)	1.42 (0.08–26.7)	0.82		
Heart injury index	0.98 (0.43–2.02)	0.85		
Diagnosis				
Non-ST elevation myocardial infarction (NSTEMI, ref) vs. STEMI	2.04 (0.24–17.5)	0.51		
Diabetes mellitus	0.87 (0.16–4.74)	0.87		
Hypertension	0.88 (0.18–4.36)	0.88		
Congestive heart failure	5.20 (0.95–28.4)	0.06	6.01 (0.88–41.2)	0.07
Hyperlipidemia	2.27 (0.42–12.4)	0.34		
History of stroke	0.05 (0–128,133,319)	0.78		
Chronic kidney disease	0.05 (0–13,363,516)	0.76		
Smoking	0.05 (0–128,133,319)	0.78		
Pulmonary congestion	1.32 (0.24–7.19)	0.75		
Cardiomegaly	3.73 (0.68–20.4)	0.13		
Coronary artery bypass graft	0.04 (0–1588)	0.55		
Cardiac catheterization	0.66 (0.08–5.66)	0.71		
Acute myocardial infarction at left anterior descending (LAD) artery	0.76 (0.14–4.14)	0.75		
Medication				
Nitroglycerin (NTG)	0.99 (0.18–5.42)	0.99		
Heparin	1.30 (0.26–6.44)	0.75		
Plavix	1.15 (0.14–9.87)	0.90		
Aspirin	1.43 (0.17–12.2)	0.75		
Statin	1.51 (0.30–7.47)	0.62		
Hemoglobin (g/dL)	1.21 (0.72–2.04)	0.48		
Blood urine nitrogen	1.02 (0.90–1.16)	0.73		
Creatinine	0.64 (0.05–8.65)	0.74		
Peak CK-MB (ng/mL)	1.002 (1.001–1.003)	<0.001	1.002 (1.001–1.003)	<0.001

A factor with a P value≤0.1 in the univariate analysis was put in the multivariate analysis. CK-MB, creatine kinase-myocardial bound.

(crude HR: 3.73, 95% CI: 1.14–12.2, P=0.03; *Table 4*). However, the effect was not statistically significant after multivariate adjustment. After dividing all 202 AMI patients into 145 adult and 57 elderly patients, only peak CK-MB levels (adjusted HR, 95% CI: 1.002, 1.001–1.003, P<0.001; *Table 5*) was independent risk of future mortality in adult patients. In addition, lower BMI was related with higher mortality risk in older patients (adjusted HR, 95% CI: 0.80, 0.65–0.99, P=0.04; *Table 6*).

Discussion

In this study, we found several main findings: (I)

Table 6 Hazard ratios for mortality in different presentations of AMI patients with age more than 65 years old (n=145)

Variables	Univariate analysis		Multivariate analysis	
	HR (95% CI)	P value	HR (95% CI)	P value
Male	0.42 (0.08–2.27)	0.31		
Body mass index	0.78 (0.61–0.98)	0.03	0.80 (0.65–0.99)	0.04
Glasgow Coma Score (GCS)	0.88 (0.58–1.32)	0.58		
Heart injury index	0.86 (0.44–1.69)	0.67		
Diagnosis				
Non-ST elevation myocardial infarction (NSTEMI, ref) vs. STEMI	4.27 (0.50–36.5)	0.19		
Diabetes mellitus	1.39 (0.28–6.90)	0.69		
Hypertension	1.01 (0.19–5.51)	0.99		
Congestive heart failure	2.83 (0.57–14.0)	0.20		
Hyperlipidemia	0.61 (0.07–5.23)	0.65		
History of stroke	1.67 (0.20–14.3)	0.64		
Chronic kidney disease	1.73 (0.02–14.8)	0.62		
Smoking	1.67 (0.20–14.3)	0.64		
Pulmonary congestion	0.96 (0.19–4.75)	0.96		
Cardiomegaly	39.0 (0.03–45,898)	0.31		
Coronary artery bypass graft	0.04 (0–3573)	0.58		
Cardiac catheterization	0.39 (0.08–1.92)	0.24		
Acute myocardial infarction at left anterior descending (LAD) artery	0.42 (0.08–2.27)	0.31		
Medication				
Nitroglycerin (NTG)	0.01 (0–8.86)	0.19		
Heparin	5.26 (0.96–28.8)	0.06	4.79 (0.86–26.5)	0.07
Plavix	25.4 (0–539,010)	0.52		
Aspirin	26.3 (0–335,957)	0.50		
Statin	3.23 (0.59–17.6)	0.18		
Hemoglobin (g/dL)	0.95 (0.64–1.40)	0.78		
Blood urine nitrogen	1.02 (0.95–1.09)	0.67		
Creatinine	0.90 (0.19–4.30)	0.90		
Peak CK-MB (ng/mL)	1.002 (0.996–1.008)	0.55		

A factor with a P value≤0.1 in the univariate analysis was put in the multivariate analysis. CK-MB, creatine kinase-myocardial bound.

cardiomegaly and higher CK-MB led to higher incidence of all-cause death; (II) older patients with age ≥75% significantly increased future risks of death; (III) among older patients, higher BMI within normal index may play as a protector of mortality.

The data also revealed that about 45% of elderly patients suffered from an AMI onset at rest and did not precipitate in activities, which was an important finding. It suggested that more attention should be paid to the elderly at home regardless of at rest or having activities. The rate of chest pain was higher in the adult (83.4%), and followed by diaphoresis, these were indeed common clinically. The proportion of chest pain in the elderly was about 60%, followed by dyspnea, which could lead to delayed diagnosis. In this study, the chest X-ray finding of cardiomegaly and higher CK-MB levels indicated higher mortality risk in AMI patients. The onset of AMI in the elderly was common at home (91.2%), it took time to contact the family or ambulance for hospital admission. The examinations of EKG, chest X-ray, and other necessary biomarker tests may be delayed due to the atypical symptoms such as epigastric pain and syncope.

Most developed world countries have accepted the age of 65 years as a definition of 'elderly' or older person. At the moment, there is no United Nations (UN) standard numerical criterion, but the UN agreed a cut-off-point ≥60 years to refer to the older population. However, the UN has not adopted a standard criterion. The ages of 60 and 65 years are often used, despite its arbitrary nature. In our study, we found that the very old age of ≥75 years may play a role in all-cause mortality rate. The GAM with smooth effect exhibited that the risk of mortality increased since 60 years, but reached the highest risk around 65–75 years However, the effect of age was diluted after multivariate adjustment.

In our study, higher CK-MB level was an independent risk factor in predicting death risk after AMI onset. Prior studies exhibited that any increase in CK-MB levels after percutaneous coronary intervention (PCI) was associated with a small, but statistically and clinically significant increase in the subsequent risk of death (13,14), which was similar with our present study. On the other hand, in our study, elderly patients had lower BMI than adult patients, the multivariate analysis in subgroup analysis of elderly patients revealed that BMI was negatively associated with mortality risk in elderly AMI patients. Prior studies reported that both a low BMI and a high percentage of body fat were independently associated with an increased risk of all-cause mortality in middle-aged and older adults. The mortality often shown a J-shaped relation with BMI, with a small upturn in those with a low BMI (commonly below 20 or 22 kg/m^2), as well as a greater increase in those with a BMI above 30 kg/m^2 (15). With a BMI of 18.5 to 24.9 kg/m^2 as normal reference, persons who were underweight, overweight, and obese were at increased risk of death over 30 years (16). Age-related sarcopenia describes the loss of muscle strength and often accompanies an increase in adiposity in the elderly. Hamer M concluded that sarcopenic obesity did not confer any greater risk than sarcopenia alone. However, weight loss combined with sarcopenia presented the greatest risk of mortality (17). Our study result was comparable with prior studies in term of the association between BMI and mortality.

The study has some limitations: first, it is a prospectively observational study with a relatively small sample size, short duration, conducted in a single medical center in northern Taiwan. A regional or national study should be undertaken to represent the general population. Second, only patients who agreed to join this study were recruited, so selection bias should be concerned carefully. In general, emergency physicians and research assistant tend to recruit relatively stable and reasonable AMI patients in emergency department to avoid medical dispute, even though we do not provide any intervention in this study, maybe nonparticipants suffered more severe conditions than participants.

Conclusions

The clinical presentations and outcomes may vary among adult AMI patients and older AMI patients. The chest X-ray finding of cardiomegaly and higher peak CK-MB levels may predict future mortality in AMI patients. The elderly patients over 75 years were with higher mortality after onset of AMI. The results of this study are valuable, the physicians in the ER should be alert to the patient's medical histories and atypical symptoms, and carry out early EKG, chest X-ray, and biomarker tests to facilitate definite diagnosis of AMI, therefore improve the prognosis of AMI patients.

Acknowledgments

We appreciate the staff of the emergency department for striving to treat the AMI patients, and for accumulating the essential data during their busy schedules.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: This study was approved by Institutional Review Board for the Protection of Human Subjects of the MacKay Memorial Hospital (12MMHIS077). All persons gave their informed consent prior to their inclusion in this study. The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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doi: 10.21037/ht.2019.08.01
Cite this article as: Su PH, Chen PY, Lee SY, How CK, Chien DK, Chang WH. Comparison of clinical presentations and outcomes between adult and elderly acute myocardial infarction patients in emergency department. Health Technol 2019;3:7.

