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Original Article

Do elderly females have a higher risk of acute myocardial infarction? A retrospective analysis of 329 cases at an emergency department

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ABSTRACT

Objective: Acute myocardial infarction (AMI) is a medical emergency; a missed or delayed diagnosis of this disease may contribute to a poor outcome and even death. Several studies have found elderly patients with AMI have atypical presentations for diagnosis, therefore we undertook this study to determine the risks among the elderly population, especially in female patients.
Materials and Methods: In this one-year retrospective study, we reviewed the cases of AMI patients who had visited the emergency department at Mackay Memorial Hospital, Taiwan, and who had either been discharged or had died following a diagnosis of AMI (ICD code 410). We compared the differences between the clinical presentations of these two groups as well as the risk factors, medical management, and outcomes.
Results: In our study, only 329 patients (164 elderly; 165 adults) met the defined criteria. The most common symptom of AMI was chest pain, and this was more common in adult patients than in elderly patients (81.8% vs. 60.4%, $p < 0.001$). In comparison with patients in the adult group, the patients in the elderly group had a significantly higher proportion of females (46.3% vs. 12.7%), non-ST-elevation myocardial infarction (NSTEMI) (71.3% vs. 46.7%), presenting with no chest pain (39.6% vs. 18.2%), shortness of breath (17.7% vs. 8.8%), nausea/vomiting/dizziness (7.9% vs. 2.4%), abdominal pain (4.3% vs. 0.6%), diabetes mellitus (45.1% vs. 26.1%), cerebrovascular disease (22.6% vs. 6.1%), longer hospital stays (18.2 ± 31.0 days vs. 9.8 ± 8.2 days), and increased in-hospital mortality rates (15.9% vs. 6.7%).
Conclusion: Compared with the adult AMI group, the elderly AMI group had a higher proportion of females, electrocardiography with NSTEMI and no chest-pain complaints, and a larger proportion of elderly patients with diabetes, ischemic heart disease, heart attacks at home and cardiac shock, which had longer hospital stays, and higher mortality rates.

Introduction

Acute myocardial infarction (AMI) is an emergency medical condition often seen in emergency departments (EDs); a missed or delayed diagnosis of this disease may contribute to a poor outcome and even death. Chest pain is the classic symptom that AMI patients experience. However, previous reports have shown that atypical presentations, with no chest pain, are more common in the elderly, in female patients, and among people with diabetes [1–6].

Aging is an inevitable problem. Due to the advancements in public health and medical science, human life expectancy has increased and the proportion of elderly people in Taiwan has grown rapidly [7]. As 7% or more of the population in Taiwan is aged 65

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years or older, the country has been “aging” since 1993. Indeed, the proportion of elderly people is expected to increase to 15% of the total population by 2019, making Taiwan an “aged country” [7]. According to previous reports from studies conducted in Western countries, elderly people who have AMI tend to present with more atypical symptoms, such as shortness of breath, and they tend to be associated with significantly higher mortality rates in comparison with younger people [1,4,8–10]. However, based on the developments in geriatric medicine that have taken place in recent years it is important to ask whether or not these clinical presentations and outcomes are the same in elderly patients with AMI in Eastern countries.

To address that concern, we undertook this study in order to review the differences between elderly adults with AMI and younger adults with AMI, in terms of the clinical presentations, risk factors, medical management, and outcomes at Mackay Memorial Hospital, a medical center in northern Taiwan. We hope this study will help identify the specific issues for elderly patients with AMI and result in the formulation of strategies that can be used to make an early diagnosis and improve outcomes.

Materials and methods

This study, approved by the Mackay Memorial Hospital Institutional Review Board (10MMHIS010), involves a retrospective review of 329 AMI patients (164 elderly patients, aged 65 years and older; 165 adult patients, aged 18–64 years) who visited the hospital's ED from January 1, 2008 to December 31, 2008. All patients were treated at Mackay Memorial Hospital, a 2060-bed medical center in northern Taiwan. All the emergency physicians, staff members, and nurses were fully qualified, having taken the Advanced Cardiac Life Support 2005 guideline training course [11]. According to the proposed analysis for the data, we excluded patients younger than 18 years, and we divided the enrolled patients into two groups: an elderly group (≥65 years) and an adult group (18–64 years). The exclusion criteria included patients who were younger than 18 years old, who were pregnant, who had been admitted through the outpatient department, whose onset of AMI occurred during hospitalization, and who had been transferred from an outside hospital.

AMI included both ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI). According to the American Heart Association guidelines [11], STEMI is defined as ST-segment elevation >1 mm (0.1 mV) in two or more contiguous precordial leads, two or more adjacent limb leads, or a presumed new left bundle branch block, in combination with subsequent elevation of cardiac markers (Troponin I/CK-MB). NSTEMI is defined as ischemic ST-segment depression <0.5 mm (0.05 mV) or dynamic T-wave inversion with pain or discomfort, in combination with elevation of cardiac markers (Troponin I/CK-MB). Acute heart failure is defined in terms of the clinical symptoms of shortness of breath, pulmonary rales from auscultation, pulmonary congestion on the chest X-ray, or cardiac shock in the ED. Cardiac shock was defined as systolic blood pressure <90 mmHg.

Typical symptoms presented as chest pain, chest tightness, and any chest discomfort. Atypical symptoms included shortness of breath, nausea/vomiting/dizziness, syncope/confusion/coma, fatigue/cold sweating, and abdominal pain.

Patients' information was collected from the emergency medical service data, the patients' medical charts, and reports after hospital admission. The main variables included age, gender, vital signs, STEMI or NSTEMI, presenting symptoms, risk factors, chest X-ray findings, interval between the time the patient had initial symptoms and the time the patient visited the ED, interval between the time the patient visited the ED and the time of diagnosis, heart-attack locations, medical treatment, cardiac intervention, complications, survival to discharge from hospital, survival around 1 year after discharge, and length of stay in the hospital. All records were reviewed and rechecked by two physicians.

Statistical analysis was conducted using SPSS software for Windows (version 12.0, SPSS Inc., Chicago, IL.). Chi-square tests and Fisher's exact tests were performed for the categorical variables; independent-samples *t*-tests were used for the continuous variables. A p value < 0.05 was determined to be statistically significant.

Results

Although the study reviewed 540 cases that had resulted in discharge or death after a diagnosis of AMI (ICD code 410), only 329 patients met the criteria defined. There were 165 elderly (≥65 years) and 164 adult patients (18–64 years) (Table 1).

There was a larger proportion of females among the elderly patients with AMI than among the adult patients (46.3% vs. 12.7%, $p < 0.001$). Moreover, the elderly patients were more likely to have NSTEMI (71.3% vs. 46.7%, $p < 0.001$), while the adult patients were

Table 1
Comparison of demographics, presentations, treatment, and outcomes between the elderly and adult AMI patients at the emergency department.

	Elderly patients (n = 164)	Adult patients (n = 165)	p
Age (y)	77.5 ± 7.8	50.8 ± 8.4	<0.001***
Female	76 (46.3)	21 (12.7)	<0.001***
Male	88 (53.7)	144 (87.3)	<0.001***
NSTEMI	117 (71.3)	77 (46.7)	<0.001***
STEMI	47 (28.7)	88 (53.3)	<0.001***
Presentations			
Chest pain	99 (60.4)	135 (81.8)	<0.001***
Short of breath	29 (17.7)	14 (8.8)	0.013*
Nausea/vomiting/dizziness	13 (7.9)	4 (2.4)	0.027*
Syncope/confusion/coma	9 (5.5)	6 (3.6)	0.42
Fatigue/cold sweating	7 (4.3)	5 (3.0)	0.55
Abdominal pain	7 (4.3)	1 (0.6)	0.037*
Risk factors			
Diabetes Mellitus	74 (45.1)	43 (26.1)	<0.001***
Hypertension	108 (65.9)	85 (51.5)	0.008***
Smoking	47 (28.7)	114 (69.1)	<0.001***
Ischemic heart disease	75 (45.7)	42 (25.5)	<0.001***
Hyperlipidemia	54 (32.9)	85 (51.4)	0.001**
Cerebrovascular disease	37 (22.6)	10 (6.1)	<0.001***
Previous AMI	26 (15.9)	14 (8.5)	0.041*
New onset AMI	138 (84.1)	151 (91.5)	0.041*
Interval from			
Onset to ED visit (h)	12.49 ± 19.95	8.79 ± 17.81	0.080
Arrival to diagnosis (h)	7.59 ± 25.54	3.11 ± 3.54	0.027*
Place of onset			
AMI at home	66 (40.2)	44 (26.7)	0.009**
Medication			
Aspirin	112 (68.3)	141 (85.5)	<0.001***
Plavix	102 (62.2)	132 (80.0)	<0.001***
Heparinization	73 (44.5)	96 (58.2)	0.013*
PCI	105 (64.0)	149 (90.3)	<0.001***
Primary PCI in STEMI	32 (68.1)	54 (61.4)	0.439
Thrombolytic in STEMI	1 (2.1)	12 (13.6)	0.034*
PCI in NSTEMI	58 (49.6)	61 (79.2)	<0.001***
Complications			
Acute heart failure	94 (57.3)	46 (27.9)	<0.001***
Shock	29 (17.7)	12 (7.3)	0.004**
Outcomes			
Hospital stay (d)	18.2 ± 31.0	9.8 ± 8.2	0.001**
In-hospital Mortality	26 (15.9)	11 (6.7)	0.008**
1-y mortality	39 (23.8)	14 (8.5)	<0.001***

Data were presented as n (%) or mean ± SD; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
AMI = acute myocardial infarction; ED = emergency department; NSTEMI = non-ST-elevation myocardial infarction; PCI = percutaneous coronary intervention; STEMI = ST-elevation myocardial infarction.

more likely to have STEMI (55.3% vs. 28.7%, $p < 0.001$). Chest pain was the most common symptom of AMI in both groups, but the presentation rate for chest pain among the elderly patients was significantly lower than among the adult patients (60.4% vs. 81.8%, $p < 0.001$). In addition, atypical presentation of symptoms, including shortness of breath (17.7% vs. 8.8%, $p = 0.013$), nausea/vomiting/dizziness (7.9% vs. 2.4%, $p = 0.027$), and abdominal pain (4.3% vs. 0.6%, $p = 0.037$), were more likely in the elderly patients than in the adults.

More elderly patients had diabetes mellitus (45.1% vs. 26.1%, $p < 0.001$), hypertension (65.9% vs. 51.5%, $p = 0.008$), ischemic heart disease (45.7% vs. 25.5%, $p < 0.001$), cerebrovascular disease (22.6% vs. 6.1%, $p < 0.001$), previous AMI (15.9% vs. 8.5%, $p = 0.041$), and attacks that had occurred at home (40.2% vs. 2.67%, $p = 0.009$). However, a larger percentage of the patients in the adult group were smokers (69.1% vs. 28.7%, $p < 0.001$) and had hyperlipidemia (51.4% vs. 32.9%, $p = 0.001$) and new onset of AMI.

The elderly patients had a significantly longer wait time between the onset of their symptoms and their final AMI diagnosis in the ED than the adult patients (7.59 ± 25.54 hours vs. 3.11 ± 3.54 hours, $p = 0.027$). However, although the elderly had longer intervals between the onset of their symptoms and their visits to the ED than the adults, this was not statistically significant (12.49 ± 19.95 hours vs. 8.79 ± 17.81 hours, $p = 0.08$).

The elderly patients were also less likely than the adults to receive antiplatelet medication, such as aspirin (68.3% vs. 85.5%, $p < 0.001$) or Plavix (66.2% vs. 80.0%, $p < 0.001$), during their ED stay. In addition, comparisons of the two groups showed that the elderly patients were less likely than the adult patients to use heparin or low-molecular-weight heparin (44.5% vs. 58.2%, $p = 0.013$).

Patients in the elderly group were less likely to undergo percutaneous cardiac intervention (PCI) (64.0% vs. 90.3%, $p < 0.001$) than the patients in the adult group. Although the 135 STEMI patients were given the same primary PCI, regardless of their age (68.1% vs. 61.4%, $p = 0.439$), the elderly patients received thrombolytic medication significantly less often than the adult patients (2.1% vs 13.6%, $p = 0.034$). Of the 194 NSTEMI patients, the elderly were less likely to receive PCI (49.6% vs. 79.2%, $p < 0.001$) during hospitalization than the adults.

In terms of complications and outcomes, patients in the elderly group had more complications from acute heart failure (57.3% vs. 27.9%, $p < 0.001$) and cardiac shock (17.7% vs. 7.3%, $p = 0.004$), significantly longer hospital stays (18.2 ± 31.0 days vs. 9.8 ± 8.2 days, $p = 0.001$), higher in-hospital mortality rates (15.9% vs. 6.7%, $p = 0.008$), and higher 1-year mortality rates (23.8% vs. 8.5%, $p < 0.001$) than the patients in the adult group.

Higher mortality odds ratios are found in elderly, female, NSTEMI, and clinical presentations of non-chest pain, short of breath and abdominal pain in an emergency department. Older people present a 2.6 times greater mortality rate than younger people, and females have a 2.38 times greater mortality rate than males. Additionally, electrocardiography results showed that the NSTEMI was 4.09 times higher mortality rate than STEMI. In patients with clinical symptoms of non-chest pain compared with those with chest pain, the mortality rate was 5.75 times greater. Patients with shortness of breath had 3.44 times the mortality rate than those without it. It is worth mentioning that patients that complained of abdominal pain had a higher possibility of mortality rate (up to 5.06 times greater risk) than patients without abdominal pain (Figure 1).

Discussion

Our study found that a larger proportion of AMI patients in the elderly group were female as compared with the adult group. This finding was similar to previous study populations [1,2,12]. The main reason for this could be the loss of estrogen in elderly women, which has cardio-protective effects [13,14]. However, the benefits of hormone replacement therapy in elderly women are controversial [15]. In addition, more elderly patients had NSTEMI, while the adult patients were more likely to have STEMI. This result is also similar to the findings presented in previous studies [1,2,10].

As demonstrated in previous reports, chest pain is the most common presentation of AMI patients [1,2,8,16], with the elderly having lower rates of chest pain than adults. In our study, non-chest pain presentations were more likely among the elderly patients than the adult group, with shortness of breath being the most common presentation [2,17,18], followed by other symptoms, including nausea/vomiting/dizziness, fatigue/cold sweating, syncope/confusion/coma, and abdominal pain. The elderly have a somewhat reduced pain perception and they are more likely to have diabetes-associated autonomic nerve dysfunction [10,19,20].

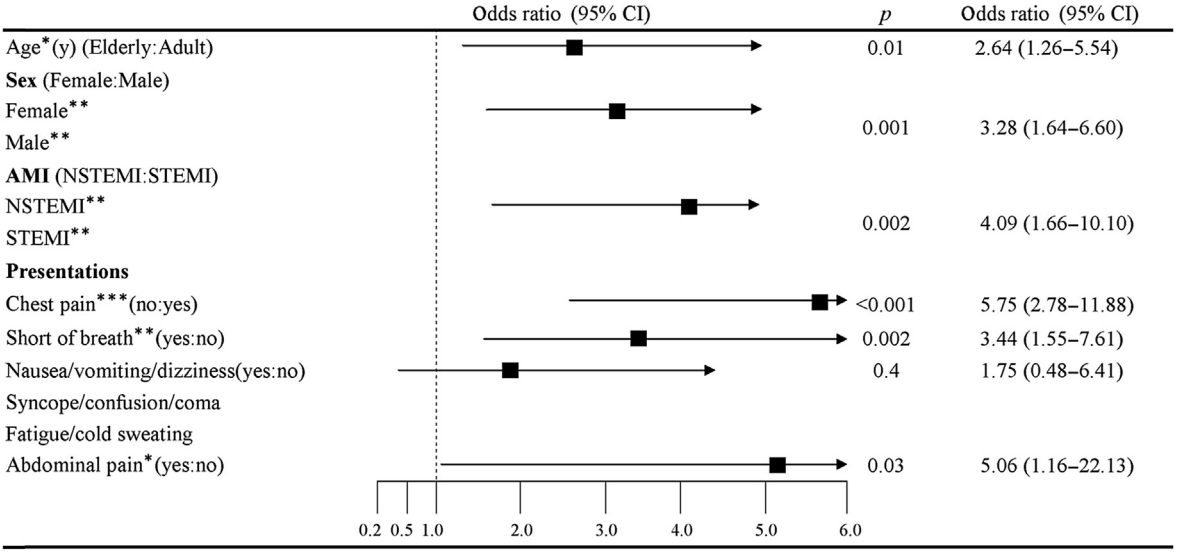

Figure 1. Odds ratios for mortality in different presentations of AMI patients. CI = confidence interval; EKG = electrocardiography; NSTEMI = non-ST-elevation myocardial infarction; STEMI = ST-elevation myocardial infarction.

Clearly, knowing the common presentations of elderly AMI patients would increase our awareness and improve their outcomes, through early intervention.

Our study also found that elderly AMI patients were more likely to have comorbidities, such as diabetes mellitus [2,16,19], hypertension [2,16,21,22], ischemic heart disease [16,22], and cerebrovascular disease [22], whereas the patients in the adult group had more hyperlipidemia [2,16], and more of them were smokers [2,16]. Knowing the distribution of risk factors may help in developing preventive strategies for these two different age groups. For the elderly, we should focus as much on better control of diabetes and hypertension as on secondary prevention of ischemic heart disease and cerebrovascular disease. The first priority for adults (18–64 years) should be to quit smoking and to bring hyperlipidemia under control. Although in our study the elderly patients were more likely to have a history of previous AMI [1,2], over 80% of the patients in both groups suffered from new onset of AMI. Therefore, based on our study's results, health education awareness about AMI is important for the general population.

Our study noted that elderly patients delayed going to the ED because their non-apparent symptoms/signs presented as atypical complaints and cognitive impairment, and they faced social constraints [20,22]. In addition, for the elderly, the AMI onset was more likely to occur at home and the diagnosis was delayed in the ED. Thus, an emergency doctor should always keep AMI in mind when examining elderly patients.

Although previous reports have shown the benefits of antiplatelet therapy and heparin therapy [11,20,23], our study found that the elderly were less likely to be taking those types of medications than the adult patients. Concerns about the risks of peptic ulcer, major bleeding, and comorbidity among the elderly may deter emergency physicians from properly providing these therapies [20,24].

Although both coronary angiography and PCI are the standard procedures for AMI [25], our study indicated that the elderly were less likely than the adults to undergo either procedure. In the subgroup of STEMI patients, we found that although the elderly were given the same primary PCI as the adults, they received thrombolytic medications significantly less frequently than the adults. For those AMI patients, either primary PCI or thrombolytic medication was the standard treatment, as necessary [23,26]. However, primary PCI was preferred for the elderly patients [27], while thrombolytic therapy had more contraindications for them [2,20]. In the subgroup of NSTEMI patients, we found that the frequency at which patients underwent coronary angiography and PCI during hospitalization was significantly lower for the elderly patients than the adult patients. While this invasive therapy is recommended for NSTEMI patients [25,28], and it is beneficial for elderly patients, it has more bleeding complications than conservative treatment [29]. The reason why coronary angiography is used less frequently in elderly patients with NSTEMI requires further investigation.

Similar to previous studies [2,10,20,22,30], our study found that elderly patients were more likely than adult patients to have complications of acute heart failure and cardiac shock in the ED. Numerous studies have found higher in-hospital mortality rates and longer hospital stays among elderly patients in comparison with adults [2,3,10,11,20]; and those results support our findings as well. The development of acute heart failure among AMI patients is known to be associated with higher hospital mortality, even in younger patients [30,31]. This finding in our study is likely the result of elderly patients having more complications, such as acute heart failure and cardiac shock [2,12,30,31], and greater comorbidities, especially hypertension and diabetes mellitus [20]. Early cardiac intervention and effective management of heart failure and cardiac shock may improve survival rates among the elderly [20,27,32].

This study has the following limitations: it is a retrospective study with a relatively small sample size, conducted in a single medical center in the capital of Taiwan. A prospective, regional or national study should be undertaken to represent the general population.

Conclusion

In comparison with the patients in the adult group in this study, patients in the elderly group tended to have NSTEMI, a higher proportion of females, less chest pain presentation, a higher incidence of diabetes, ischemic heart disease and cerebrovascular disease, more attacks that occurred at home, longer hospital stays, and higher mortality rates. Thus, clinicians need to pay more attention to early detection of AMI in the elderly and to providing aggressive management in order to improve their outcomes.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

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