Clinical investigation of acute myocardial infarction according to age subsets

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Abstract. A growing number of 'Young' patients less than 40 years of age are being hospitalized with a diagnosis of acute myocardial infarction (AMI) due to increased prevalence of risk factors for atherosclerosis. The aim of this study was to compare clinical characteristics and performances of AMI between young and elderly patients. We conducted a retrospective study to compare AMI in young patients and elder patients. Based on the medical record databases in our hospital, we enrolled 114 'young' AMI patients (age ≤42 years) and 179 'elder' AMI patients (≥60 years), and then collected and analyzed their demographic information, clinical performances, and coronary angiography results. In the young AMI group, the proportion of male patients was higher than that in the elder AMI group (94.7 vs. 64.2%, P<0.05). Compared with the elder AMI patients, young patients had higher rates of smoking history and positive family medical history, but lower rates of hypertension and diabetes. Elder patients with AMI were more likely to develop various clinical performances, and multiple-branch lesions; however, young AMI patients had relatively fewer symptoms, and the tissue lesions were more limited. The clinical profiles of AMI in young patients were different from that in elder AMI patients. Specific interventions should be carried out to prevent and control the prevalence of AMI in the young population.

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Introduction

Acute myocardial infarction (AMI) is one of the most severe cardiac emergencies in internal medicine. Because of its properties of acute onset, quick progression, and high morbidity and mortality (1,2), AMI has been a research focus for a long time. However, many recent studies have reported that the incidence of AMI has started to decrease, and this reduction is mainly concentrated in the age population greater than 60 years (3-6). Considering that elderly individuals are the main population with a high AMI incidence (7), this reduced incidence as mentioned above was a delightful change. Yet, the incidence of AMI among the young population has gradually shown a rising trend (6,8,9). The young population who suffers AMI can show many clinical symptoms, such as ischemic chest pain, and the clinical course is extremely short. Some patients even experience sudden cardiac death. Although epidemiological research has determined that various behaviors and symptoms, including smoking, hypertension, diabetes, and family history of coronary heart disease (CHD), may be potential risk factors for AMI occurrence (10-12), it is still unclear how these factors differ between the young and old population. Therefore, investigating the epidemiology and clinical characteristics of AMI occurrence in the young population is a new future research focus. Through our study, the behavioral and clinical characteristics of AMI in the young population will be explored and determined, which will provide significant clues for explaining the increasing trend of AMI in the young population and helping to design specific strategies to prevent and treat young AMI patients.

Patients and methods

Study design. This retrospective, single-center, observational study was conducted during a 24-month period from January 2014 to December 2015 at Weifang People's Hospital. Consecutive patients who were diagnosed with AMI were

included in the present study, and the criteria for enrollment in this study were based on AMI diagnostic criteria from WHO (https://doi.org/10.1016/S0140-6736(08)61237-4): At least covering two of the following three features, including ischemic thoracodynia, ECG dynamic change, and serum biomarkers of myocardial necrosis. All enrolled patients were divided in two groups, including a young group (n=114) and an elder group (n=179). In addition, 60 young volunteers received health checkup and the same healthy subjects during January 2014 to December 2015 at Weifang People's Hospital were enrolled as the healthy control group (age range 18-72 years, with an average age of 42.1±6.3 years). Detailed information is listed in Table I.

Data collection. In the present study, three types of information were collected. Firstly, data of AMI-related risk factors were collected, which included blood pressure, blood fat, blood glucose, smoking history, drinking history, body mass index (BMI), family history of coronary heart disease (CHD), history of hypertension and diabetes. Among these, blood fat included total cholesterol (TC), triglyceride (TG), high-density lipoprotein (HDL) and low density lipoprotein (LDL) levels. BMI was calculated using weight (kg) and height (m) as ($BMI=kg/m^2$), and BMI >25 was defined as overweight. TC >5.75 mmol/l and TG >1.7 mmol/l were defined as being increased. Smoking history was defined as the smoking of 1 or more cigarettes per day and lasting for over 1 year; smoke 20 or more cigarettes per day and lasting for 10 years was defined as smoking heavily. Drinking was defined as drinking wine (>50 g per day); drinking wine (>150 g per day) and lasting for 10 years was defined as excessive drinking. Then, we investigated whether patients had angina or not before AMI. We determined whether thoracodynia was typical or not, and whether this was combined with complications, including arrhythmia, cardiac insufficiency, formation of ventricular aneurysm, perforation of ventricular septum, cardiac shock, and death. Finally, the results of radiography were also collected. The criteria for judgment was by means of diameter measurement: Stenosis ≥50% was defined as a significant lesion. Lesions involved in 1 branch, 2 branches, or 3 branches of left main/anterior descending coronary artery, left circumflex, and right coronary artery was defined as 1-branch-lesion, 2-branch-lesion, and 3-branch-lesion, respectively.

Statistical analysis. In the present study, we used SAS 9.2 (SAS Institute, Inc.) to deal with data cleaning and analysis. Mean ± SD (standard deviation) was used to reflect the distribution of measurement data, and t-test was used to compare data from two groups. χ^2 test was used to test the differences of categorical data from two groups. P<0.05 was defined as indicative of statistical significance, and all tests were two sided.

Results

Demographic characteristic. In the present study, we finally enrolled 293 AMI patients, including 114 young AMI patients (age ≤42 years) assigned to the young group and 179 elder AMI patients (age ≥60 years) assigned to the elder group. We also enrolled 60 young volunteers who received a health checkup as the healthy control group, and detail information is listed in the Table I. Among the young group, 108 (94.7%) patients were male and 6 (5.3%) patients were female. The range of age was from 32 to 44 years and the mean age was 36.6±4.0 years. Among the elder group, 115 (64.2%) patients were male and 64 (35.8%) patients were female; the maximum age was 81 years and the minimum was 60 years, with an average age of 69.4±6.2 years.

Analysis of AMI-related factors between the young and elder group. As documented in Table I, the compositions of male and female in these two groups showed a significant difference. In the young AMI group, the males had a higher rate (94.7%) than that in the elder group (64.2%). The percentages of males and females in the elder group were much closer. The young AMI group had a higher percentage of smoking history compared to the elder group (84.2 vs. 58.7%; P<0.05) and positive family medical history (52.6 vs. 16.2%); however, the elder AMI group seemed to be more likely to have hypertension compared with the young group (67.6 vs. 26.3%; P<0.01) and diabetes (37.4 vs. 7.0%; P<0.01). For hyperlipemia and obesity, there were no obvious differences between the two groups (hyperlipemia: 45.6 vs. 54.2%, P>0.05; obesity: 26.3 vs. 32.4%, P>0.05). Lipid metabolism in AMI patients is a key point that requires more attention. In the present study, the blood fat levels including TC and TG were significantly higher in young group compared to the elder group (TC: 8.19±2.17 vs. 5.98±1.13, P<0.05; TG: 4.71±1.17 vs. 2.18±0.69, P<0.05). However, we did not observed the significant difference in the serum HDL and LDL levels between these two groups which may due to a relative small sample size.

Clinical performance comparisons between the young and elder group. As documented in Table II, for clinical performances, we found that young AMI patients had a higher rate of typical thoracodynia which occurred most suddenly when compared with the elder group (93.0 vs. 68.2%; P<0.01). However, in the elder patients, they were more likely to have different types of clinical performances than the young patients, including premonitory symptom (84.4 vs. 33.3% yes), arrhythmia (78.2 vs. 52.6% yes), heart failure (41.9 vs. 21.1% yes), and cardiac shock (37.4 vs. 3.5%, yes).

Outcomes from coronary angiography (CAG). As documented in Table III, the different age groups had different major lesion sites and statuses. The lesion per capita in the young AMI group was 1.8, which was lower than 2.8 in the elder AMI group. The lesions in the young patients mostly focused on anterior descending coronary artery, and 62.4% of lesions were one-branch lesion. Comparatively, the elder patients had more severe conditions. The distributions of lesion sites were almost equally on left main/anterior descending coronary artery, left circumflex, and right coronary artery. Three-branch lesion was the most frequent lesion, followed by two-branch lesion and one-branch lesion, which was a little different from that in the young AMI group.

Odds ratios between the young and elder group. As shown in Fig. 1, compared with the elderly group, the young males had a history of smoking and had a positive family medical history of heart disease, and had higher risk of acute myocardial

Table I. Baseline characteristics associated with AMI between the young and elder group.

Factors	Control group n	Young group n (%)	Elder group n (%)	P-value[a]
Total	60	114	179	
Sex				<0.01
Male	31	108 (94.7)	115 (64.2)	
Female	30	6 (5.3)	64 (35.8)	
History of smoking				<0.05
Yes	14	96 (84.2)	105 (58.7)	
No	46	18 (15.8)	74 (41.3)	
Hypertension				<0.01
Yes	6	30 (26.3)	121 (67.6)	
No	54	84 (73.7)	58 (32.4)	
Hyperlipemia				>0.05
Yes	3	52 (45.6)	97 (54.2)	
No	57	62 (54.4)	82 (45.8)	
Obesity				>0.05
Yes	12	30 (26.3)	58 (32.4)	
No	48	84 (73.7)	121 (67.6)	
Diabetes				<0.01
Yes	2	8 (7.0)	67 (37.4)	
No	58	106 (93.0)	112 (62.6)	
Positive family medical history				<0.01
Yes	5	60 (52.6)	29 (16.2)	
No	55	54 (47.4)	150 (83.8)	
Blood fat level (mmol/l)				
TC	3.19±0.39	8.19±2.17	5.98±1.13	<0.05
TG	0.97±0.26	4.71±1.17	2.18±0.69	<0.05
HDL	1.93±0.38	1.66±0.42	1.39±0.21	>0.05
LDL	2.34±0.71	3.77±0.85	3.14±0.74	>0.05

Young group, age <42 years; elder group, age ≥60 years. AMI, acute myocardial infarction; TC, total cholesterol; TG, triglyceride; HDL, high-density lipoprotein; LDL, low density lipoprotein. [a]P-values comparing the young and elder group.

infarction. However, the absence of diabetes was found to be a protective factor. Details are shown in Fig. 1.

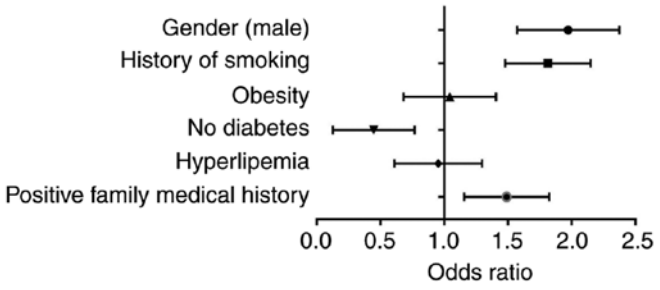

Figure 1. Adjusted odds ratios and 95% confidence intervals between the young and elder AMI group. AMI, acute myocardial infarction.

Discussion

In this study, we analyzed clinical data collected from Weifang People's Hospital to evaluate the acute myocardial infarction (AMI) characteristics in young patients, which could provide some clues for AMI diagnosis and therapy in different age subsets in the future.

In the young AMI group (age ≤42 years), the AMI incidence in males was obviously higher than that of females, which was consistent with a previous study (13). Estrogen is an important hormone protecting women from AMI (14), which involves the regulation of lipometabolism, inhibition of platelet activation, and suppression of intima proliferation caused by lesions. After menopause, the estrogen level decreases. Along with this, the protection from AMI also become weak, even disappearing, which increases the female AMI incidence (15). Smoking, hypertension, hyperlipemia, diabetes, and family history of cardiac heart disease (CHD) are potential risk factors for the occurrence of CHD (16). The present study found that 84.2% of young patients had a history of smoking, which was higher than that of the elder group (age ≥60 years). A previous study revealed that CO_2 and nicotine in smoke cause hypoxia in tissues and the myocardium, which then induced coronary

Table II. Comparisons of clinical performances between the young and elder group.

Factors	Young group n (%)	Elder group n (%)	P-value[a]
Total	114	179	
Premonitory symptom			<0.01
Yes	38 (33.3)	151 (84.4)	
No	76 (66.7)	28 (15.6)	
Typical thoracodynia			<0.01
Yes	106 (93.0)	122 (68.2)	
No	8 (7.0)	57 (31.8)	
Arrhythmia			<0.01
Yes	60 (52.6)	140 (78.2)	
No	54 (47.4)	39 (21.8)	
Heart failure			<0.05
Yes	24 (21.1)	75 (41.9)	
No	90 (78.9)	104 (58.1)	
Cardiac shock			<0.01
Yes	4 (3.5)	67 (37.4)	
No	110 (96.5)	112 (62.6)	

Young group, age <42 years; elder group, age ≥60 years. AMI, acute myocardial infarction. [a]P-values comparing the young and elder group.

Table III. Comparisons of the outcomes of coronary angiography (CAG) between the young and elder group.

Factors	Young group n (%)	Elder group n (%)	P-value[a]
Total	114	179	
Total lesions on coronary artery	194	465	
Lesions per capita	1.8	2.6	<0.01
Lesions on anterior descending coronary artery			<0.01
Yes	101 (52.1)	153 (32.9)	
No	93 (47.9)	312 (67.1)	
Lesions on right coronary artery			>0.05
Yes	42 (21.6)	112 (24.1)	
No	152 (78.4)	353 (75.9)	
Lesions on left circumflex			>0.05
Yes	40 (20.6)	103 (22.2)	
No	154 (79.4)	362 (77.8)	
Lesions on left main coronary artery			<0.01
Yes	11 (5.7)	97 (20.9)	
No	183 (94.3)	368 (79.1)	
Coronary angiography lesion (individual)			
No lesions	6 (5.3)	2 (1.1)	<0.01
One-branch lesion	71 (62.4)	44 (24.6)	<0.01
Two-branch lesion	23 (20.1)	56 (31.3)	<0.01
Three-branch lesion	14 (12.2)	77 (43.0)	<0.01

Young group, age <42 years; elder group, age ≥60 years. AMI, acute myocardial infarction. [a]P-values comparing the young and elder group.

spasm and an increase in blood viscosity (17). A history of long-term smoking decreases coronary dilation function, and increases platelet aggregation (18). Meanwhile, high-density lipoprotein is decreased and low-density lipoprotein is

increased. This change damages serum antioxidative function (19). Based on the above clinical situations, coronary atherosclerotic plaque forms, and is aggravated, which in turn promotes the occurrence and progression of CHD. Thus, abstinence from smoking is one of the most critical interventions for CHD prevention, especially for young people

The rate of hypertension and diabetes in the elder group were higher than that in the young group, which suggests that the elderly AMI patients were consistently accompanied by certain chronic diseases (20). At the same time, the elderly people had a higher frequency of complications, including arrhythmia, heart failure, and cardiac shock, which were the significant reasons for the poor prognosis in AMI elder patients. Noticeably, the rate of hypertension and various complications in young patients were not low. In the present study, the incidence of hypertension and hyperlipemia in the young AMI patients were 26.3 and 45.6%, which were significantly higher than these percentages in the young health control group, and should be focused on. The rate of hyperlipemia did not show much difference between the young and elder groups, but almost half of the patients had hyperlipemia in the two groups. Some studies have shown that high levels of serum total cholesterol (TC) and low density lipoprotein (LDL) are independent risk factors for coronary disease (21-23). Therefore, controlling blood fat is an important intervention for reducing AMI incidence in all populations.

Through the coronary angiography (CAG) results, we found that the most frequent coronary lesion in young AMI patients was the one-branch lesion (62.4%), and the secondary injury was limited. Comparatively, elder AMI patients had more multiple-branch lesions and calcified lesions, which has serious influences on cardiac function. Additionally, healthy coronary artery with only none or mild atherosclerosis, normal coronary angiography and negative treadmill test was found in a certain proportion of young AMI patients, which are consistent with previous reports (24,25). This may be related to the clinical characteristics of the young AMI patients, who exhibited a short course of disease and fewer complications of hypertension and diabetes.

After comparing the risk factors and clinical performances between young AMI patients and elder AMI patients comprehensively, we found that smoking, hyperlipemia, and positive family medical history were the most critical factors for young AMI patients, which may play important roles in increasing AMI incidence. Interventions for controlling these risk factors will be important in the future for young patients, including abstinence from smoking, alcohol consuming limitation, proper exercise and a rational diet.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

JW and LL designed the study and drafted the manuscript. NM, XZ and YQ were responsible for the collection and analysis of the experimental data. GF, GL and TZ analyzed AMI-related factors and compared clinical performance. All authors read and approved the manuscript and agree to be accountable for all aspects of the research in ensuring that the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics approval and consent to participate

The study was approved by the Ethics Committee of W.F. Maternal and Child Health Hospital, Weifang, Shandong, P.R. China. Patients who participated in this research, signed the informed consent and had complete clinical data. Signed written informed consents were obtained from the patients and/or guardians.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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