

Analysis of clinical characteristics and risk factors of young acute myocardial infarction

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Abstract. OBJECTIVE: The aim of the study is to investigate the clinical characteristics and risk factors for the development of young acute myocardial infarction (AMI). METHODS: A number of 196 AMI patients (31 young patients and 165 older patients) were enrolled in the study. The clinical characteristics in young AMI patients were explored by comparing their baseline characteristics, imaging features and serological results. The risk factors were tested by logistics regression analysis. RESULTS: The younger AMI patients were more likely to have hyperlipidaemia (67.74% vs. 36.97%, $P=0.002$), a family history of coronary heart disease and hyperlipidaemia (29.03% vs. 12.12%, $P=0.025$) (51.61% vs. 18.79%, $P<0.001$), (54.84% vs. 35.15%, $P=0.045$) (61.29% vs. 34.55%, $P=0.008$). The proportion of alcohol and tobacco use were higher in younger AMI group. More severe anterior descending lesions involvement (77.42% vs. 46.06%, $P=0.002$) and a higher Gensini scores (62.23 ± 16.80) vs. (53.00 ± 18.58), $P=0.011$) were found in CTA imagines of younger AMI patients. The triglyceride levels were also significantly higher in younger AMI patients (2.55 ± 1.59) vs. (1.67 ± 0.79), $P=0.005$). A family history of hyperlipidaemia, Gensini score, IL-6 and triglycerides were risk factors for young AMI patients. CONCLUSION: Poor lifestyle management and family history were risk factors for the AMI development in young patients.

Keywords: Acute Myocardium Infarction, age, clinical characteristics, risk factor

1. Introduction

Myocardial infarction is defined in pathology as myocardial cell death due to prolonged ischemia, which can occur in some animals as early as 20 minutes after the ischemia.¹ Acute Myocardium Infarction (AMI) has a moderately high in-hospital mortality rate of 11.9%.² Although hospitalisation rates for AMI or coronary artery disease have declined to 4-5% in the US since 1987, there are still around 550,000 and 200,000 first episodes of AMI and recurrent AMI each year respectively.³

With continuous advances in diagnostic and therapeutic techniques in cardiovascular medicine, mortality from cardiovascular disease is declining year on year.⁴ According to a study from Norway, the prevalence of AMI in middle-aged and older adults over 45 years old decreased by 12-30% between 2001 and 2009, but there was no significant decrease in the incidence of AMI in younger patients aged 25-44 years.⁵ In a study on hospitalisation rates for younger AMI, it was found that hospitalisation rates for younger AMI increased from 27% in 1995-1999 to 32% in 2010-2014.⁶ The rejuvenation of younger AMI patients is associated not only with a lack of patient awareness of associated cardiovascular disease, but also with the failure of relevant guidelines issued by the Heart Association to predict high-risk young people.⁴ The disease characteristics and epidemiological features of younger patients are significantly different compared to older AMI patients. For example, older AMI patients have significant atherosclerosis, but 20% of younger AMI patients do not develop atherosclerosis.⁷ And a higher proportion of younger AMI patients present with atypical clinical manifestations.⁴ Younger AMI patients are more likely to have single vessel involvement than older AMI patients.⁸ There are clinical differences in the treatment and prognosis of younger AMI compared to older AMI.⁹ In a retrospective study, it was found that younger AMI patients used diuretics, calcium antagonists and antidiabetics less frequently in the first year than older AMI patients.¹⁰ Younger AMI patients in China have different risk factors and clinical diagnoses compared to younger AMI patients in western societies.¹¹

There are limited international data and articles on risk factors for young AMI,¹² in which there are conflicting data on the clinical profile and prognostic predictors of young AMI in China.¹¹ Therefore, it is important to explore the risk factors for young AMI for the diagnosis and treatment of young AMI patients.

2. Methods

2.1. Study Population:

31 young AMI patients (age <45 years old) who presented at our hospital from 2013-2018 were retrospectively included in this study, while 165 older patients (age ≥45 years old) were matched and included in the control group. Imaging features and serology were refined within 48h of patient admission and findings were included in the baseline data.

2.2. Inclusion Criteria:

(1) meet the diagnostic criteria for AMI; (2) have a sound admission examination; (3) undergo standard PCI according to the guidelines.

2.3. Exclusion Criteria:

(1) other cardiovascular diseases; (2) malignancy, autoimmune disease, coagulation disorders; (3) inadequate admission tests; (4) untimely follow-up and missed visits.

2.4. Statistical Methods:

Data were analysed using SPSS 26.0 software, with measurement data expressed as ($\bar{x} \pm s$) and count data expressed as frequencies (percentages). The t-test was used for measurement data conforming to a normal distribution, and the u-test was used for measurement data not obeying a normal distribution; the χ^2 test was used for count data. Baseline data, imaging data, and serological data were included, and one-way and multi-way analyses were done by applying logistic models. The predictive power of the model was assessed using the Receiver Operating Characteristic Curve (ROC) and Area Under Curve (AUC). $P < 0.05$ was considered a statistical difference between the two data sets.

3. Results

3.1. Baseline Profile Characteristics of Young AMI Patients

A total of 31 young AMI patients with a mean age of 39.45 ± 3.42 and 24 (77.42%) males were included in this study. Compared to older AMI patients, younger AMI patients were less likely to have hypertension (22.58% vs. 63.03%, $P < 0.001$), more likely to have hyperlipidaemia (67.74% vs. 36.97%, $P = 0.002$), a family history of coronary artery disease and hyperlipidaemia (29.03% vs. 12.12%, $P = 0.025$) (51.61% vs. 18.79%, $P < 0.001$), and a higher proportion of a history of alcohol and tobacco use (54.84% vs. 35.15%, $P = 0.045$) (61.29% vs. 34.55%, $P = 0.008$). (See Table 1.) Younger AMI patients had less than 5% prevalence of diabetes, COPD, and chronic kidney disease, and had better underlying health status.

Table 1. Baseline Information of Young AMI Patients and the Control Group

Factors	Young AMI (n=31)	Control Group(n=165)	χ^2/t	P value
Age (years)	39.45±3.42	64.39±7.58	29.26	<0.001
Male [cases (%)]	24 (77.42%)	97 (58.79%)	3.84	0.069
BMI (kg/m ²)	24.94±3.80	25.19±3.19	0.40	0.689
Diabetes Mellitus [cases (%)]	2 (6.45%)	31 (18.79%)	2.84	0.118
Hypertension [cases (%)]	7 (22.58%)	104 (63.03%)	17.39	<0.001
COPD [cases (%)]	0 (0.00%)	6 (3.64%)	1.16	0.592
Chronic Kidney Disease [cases (%)]	1 (3.23%)	5 (3.03%)	<0.01	1.000
Hyperlipidaemia [cases (%)]	21 (67.74%)	61 (36.97%)	10.16	0.002
Family History of Coronary Heart Disease	9 (29.03%)	20 (12.12%)	5.92	0.025
Alcohol Consumption [cases (%)]	17 (54.84%)	58 (35.15%)	4.28	0.045
Smoking History [cases (%)]	19 (61.29%)	57 (34.55%)	7.86	0.008
Family History of Hyperlipidaemia [cases (%)]	16 (51.61%)	31 (18.79%)	15.43	<0.001
Family History of Sudden Death [cases (%)]	2 (6.45%)	14 (8.48%)	0.14	1.000

3.2. Characteristics of Imaging Data in Young AMI Patients

Compared to older AMI patients, younger AMI patients had more advanced anterior descending lesion involvement (77.42% vs. 46.06%, $P=0.002$), higher Gensini scores (62.23±16.80) vs.(53.00±18.58), $P=0.011$) and higher left ventricular ejection fractions (Left Ventricular Ejection Fractions, LVEF) ((60.84±7.60) vs.(56.11±9.47), $P=0.009$). (See Table 2.) Younger AMI patients had more severe left coronary artery involvement, particularly in the anterior descending artery, and less severe right coronary artery involvement. Younger AMI patients had higher ejection fractions and good functional status.

Table 2. Imaging Characteristics of Young AMI Patients and the Control Group

Factors	Young AMI (n=31)	Control Group(n=165)	χ^2/t	P value
Left Main Stem [cases (%)]	1 (3.23%)	9 (5.45%)	0.27	1.000
Anterior Descending Artery [cases (%)]	24 (77.42%)	76 (46.06%)	10.27	0.002
L-branch [cases (%)]	5 (16.13%)	34 (20.61%)	0.33	0.806
Right Coronary Artery [cases (%)]	7 (22.58%)	68 (41.21%)	3.84	0.069
Gensini Rating	62.23±16.80	53.00±18.58	-2.57	0.011
Ejection Fraction [cases (%)]	60.84±7.60	56.11±9.47	-3.05	0.009

3.3. Serological Characteristics of Young AMI Patients

Younger AMI patients had higher triglyceride levels ((2.55±1.59) vs. (1.67±0.79), $P=0.005$) but lower creatinine levels ((82.09±10.71) vs. (93.43±20.44), $P<0.001$) compared to older AMI patients. (See Table 3)

Table 3. Serological characteristics of young AMI patients and the control group

Factors	Young AMI (n=31)	Control Group(n=165)	χ^2/t	P value
Procedure				
IL-1B Elevated [cases (%)]	2 (6.45%)	7 (4.24%)	0.29	0.636
IL-2R Elevated [cases (%)]	3 (9.68%)	11 (6.67%)	0.36	0.468
Elevated IL-6 [cases (%)]	5 (16.13%)	11 (6.67%)	3.12	0.142
Elevated IL-8 [cases(%)]	9 (29.03%)	71 (43.03%)	2.12	0.167
Triglycerides (mmol/L)	2.55±1.59	1.67±0.79	-3.03	0.005
Creatinine ()	82.09±10.71	93.43±20.44	4.54	<0.001
Albumin ()	41.54±8.45	41.43±3.34	-0.07	0.945

3.4. Risk Factor Analysis

Baseline data, imaging data and serological data were included in this study and the results were analysed using univariate logistic regression. The results showed that hyperlipidaemia, family history of coronary heart disease, alcohol consumption, smoking history, family history of hyperlipidaemia, Gensini score, IL-6, triglycerides and ejection fraction were independent risk factors for AMI in different age groups. The above factors were included in a multifactorial regression model and found that family history of hyperlipidaemia (OR: 4.611 (2.060-10.318), Gensini score (OR: 1.067 (1.034-1.101), $P<0.001$), IL-6 (OR: 7.665 (2.135- 27.522), $P=0.002$), and triglycerides (OR: 2.371 (1.504-3.738), $P=<0.001$) as multiple risk factors. (See Table 4) The predictive ability of the model was tested using ROC and AUC and the result of AUC=0.846 indicated that the model was a good predictor. (See Figure 1)

Table 4. Single Logistic Regression of Risk Factors in Young AMI Patients

	Single factor logistic regression		Multi-factor logistic regression	
	OR (95% CI)	P value	OR (95% CI)	P value
Hyperlipidaemia	3.580 (1.582-8.102)	0.002		
Family History of				
Coronary Heart	2.966 (1.199-7.335)	0.019		
Disease				
Alcohol				
Consumption	2.240 (1.031-4.868)	0.042		
Smoking History	3.000 (1.361-6.615)	0.006		
Family History of	4.611 (2.060-10.318)	<0.001	6.492 (2.293-18.382)	<0.001
Hyperlipidaemia				
Gensini Rating	1.028 (1.006-1.051)	0.013	1.067 (1.034-1.101)	<0.001
IL-6	3.028 (1.179-7.816)	0.071	7.665 (2.135-27.522)	0.002
Triglycerides	2.126 (1.434-3.151)	<0.001	2.371 (1.504-3.738)	<0.001
Ejection Fraction	1.076 (1.016-1.139)	0.013		

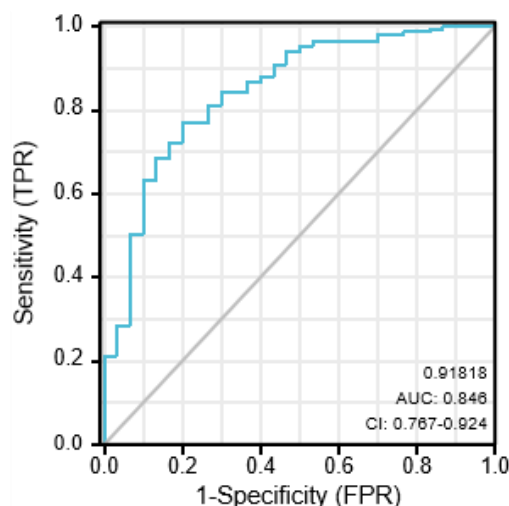


Figure 1. ROC Graph

4. Discussion

Through statistical analysis, this study identified hyperlipidaemia, family history of coronary heart disease, alcohol consumption, history of smoking, family history of hyperlipidaemia, Gensini score, IL-6, triglycerides and ejection fraction as single-factor risk factors in young patients with AMI, with family history of hyperlipidaemia, Gensini score, IL-6 and triglycerides as multi-risk factor variables in young patients with AMI. Previous studies have shown that older AMI patients are often women, but they are much less likely to have a family history of coronary heart disease, do not show a significant increase in body triglycerides, and smoke less.¹³ Therefore, the risk factors for AMI in older adults do not apply to younger AMI.

In this study, a higher proportion of young patients had a family history of hyperlipidaemia. A family history of hyperlipidaemia and coronary heart disease were independent risk factors for the development of AMI in young adults, a finding similar to previous studies. In one clinical study, the risk of AMI was significantly increased in a younger population with a combination of familial hyperlipidaemia.¹⁴ This study also found that a family history of coronary heart disease was three times more common in the younger AMI group than that in older AMI patients, which is consistent with the findings of previous studies where the incidence was two to four times higher.^{15,16} In a previous study of risk factors for AMI in young women, a family history of AMI was found to be positively associated with the risk of early AMI in women.¹⁷

According to the results of this study, the prevalence of diabetes and hypertension among young patients was low, at only 6.45% and 22.58% respectively, in line with the results of previous studies. In contrast to a study on young people at high risk of AMI, most of the traditional cardiovascular risk factors were found to be uncommon in young patients.¹⁸

A history of smoking is a risk factor in the young AMI population. In a study exploring risk factors in young AMI patients, poor lifestyle such as smoking and staying up late were found to be independent risk factors for acute myocardial infarction.¹⁹ In a study on the relationship between smoking cessation and survival in young AMI patients, it was found that young patients with a history of smoking were more likely to develop ST-segment elevation myocardial infarction and that mortality in AMI patients was reduced by 70% after 1 year of smoking cessation.²⁰

The Gensini score can be used to assess coronary atherosclerosis and is suitable for the screening of AMI patients.²¹ It has been used several times for the prediction of AMI.²²⁻²⁴

In this study, the analysis showed that IL-6, triglycerides and ejection fraction were independent risk factors, with IL-6 and triglycerides being multiple risk factors. In a study on the clinical role of IL-6, correlators found that elevated IL-6 levels were a risk factor for young women with mild AMI.²⁵ In a study on the relationship between IL-6 and endothelial dysfunction in young AMI patients, the

authors found that IL6 was an important circulating marker of endothelial dysfunction and also a major marker of AMI.²⁶ In a study on the association between triglycerides/HDL and acute coronary syndrome, a number of scholars found that increased triglycerides/HDL were associated with the development of AMI in young adults.^{27,28}

Given the risk factors of young AMI patients, we recommend enhanced screening of patients with a family history of hyperlipidaemia, regular or enhanced follow-up, reasonable management of those at risk with a family history of hyperlipidaemia, and complementary early rehabilitation care interventions to modify risk factors in young patients with the disease. For patients with unhealthy lifestyles, we advise them to manage their lives by reducing the frequency of smoking and alcohol consumption and increasing their intake of vegetables and fruit. For patients with abnormal serological indicators, we advise patients to eat a light diet, reduce the intake of fried foods and animal offal, and increase physical activity when used. As this study is a single-centre study with a relatively small number of patients, the conclusions drawn are somewhat limited. Therefore, we hope to collaborate with more research centres with a view to making more accurate clinical judgements for young AMI.

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