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The association between pre-infarction angina and care-seeking behaviors and its effects on early reperfusion rates for acute myocardial infarction

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Abstract

Objective: To examine the association between pre-infarction angina (PA) and care-seeking behaviors and its effects on early reperfusion rates for patients with ST-elevation myocardial infarction (STEMI).
Methods: Between November 1, 2005 and December 31, 2006, a prospective, cross-sectional, and multicenter survey was conducted in 19 hospitals in Beijing and included consecutive patients with STEMI admitted within 12 h of onset of symptoms. Data were collected by structured interviews and medical records review.
Results: PA within 48 h prior to the onset of the infarction occurred in 50.4% of the 498 patients. Prior to seeking care, patients in the PA group more frequently thought the symptoms would go away (61.8% vs. 38.5%, $p<0.001$) and attempted some form of self-treatment (61.0% vs. 45.3%, $p=0.001$) than the patients without PA (non-PA group). Median pre-hospital delay in the PA group was longer (118 vs. 103 min, $p=0.045$) than in the non-PA group. The prevalence of ambulance use in the PA group was significantly lower than in the non-PA group (31.5% vs. 43.3%, $p=0.007$). Multivariate analysis showed that the presence of PA was an independent predictor of pre-hospital delay >2 h (OR 1.863, 95% CI: 1.112–2.765, $p=0.013$) and non-ambulance use (OR 1.724, 95% CI: 1.185–2.670, $p=0.003$). In addition, patients in the PA group had a lower early reperfusion rate (74.7% vs. 83.3%, $p=0.027$), mainly because of a lower incidence of primary percutaneous coronary intervention (58.6% vs. 67.9%, $p=0.042$).
Conclusions: Presence of PA was associated with longer pre-hospital delay, significantly decreased use of ambulance, and lower early reperfusion rates among patients with STEMI.

Keywords: Pre-infarction angina; Myocardial infarction; Care-seeking behaviors; Delay; Ambulance use; Reperfusion

1. Introduction

Extent of delay in seeking medical care in patients with acute myocardial infarction (AMI) is receiving increasing attention, given the time-dependent benefits associated with early administration of reperfusion therapy [1–5]. In the United States, median pre-hospital delay ranges from 1.5 to 6.0 h [6,7]. Many patients with AMI did not seek medical care for approximately 2 h after symptom onset, and this pattern appears unchanged over the last decade [8–10]. The time that patients take to decide to seek care accounts for most of the delay [11,12]. Quick calling for emergency medical service (EMS) for symptoms of AMI can dramatically shorten overall pre-hospital delay. The EMS may dispatch ambulance crews who are trained to detect and treat life-threatening complications at the accident scene and during transport. Several studies have shown that ambulance

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use may lead to greater and/or faster administration of early reperfusion therapy [13,14]. Regrettably, previous studies [15–17] indicated that almost half of AMI patients arrived at the hospital by other means than an ambulance.

Factors associated with the care-seeking behaviors (pre-hospital delay and ambulance use) among AMI patients have been extensively explored. Demographics, situational and clinical factors, symptoms characteristics, and cognitive factors were found to be related to them [6–11,18–22]. However, the association between pre-infarction angina (PA) and care-seeking behaviors among AMI patients had not been investigated in previous reports.

In the current era of reperfusion therapy, several studies have shown that patients with AMI preceded by angina have smaller infarcts and better outcomes than patients without PA [23–25]. However, if the patients with PA have lengthy decision-making processes and unproductive coping strategies such as self-treatment, as well as underuse of ambulance, the beneficial effects of PA may be partly offsetted. Therefore, this study aims to examine the association between PA occurring within 48 h before onset of the infarction and care-seeking behaviors and its effects on early reperfusion rates for acute myocardial infarction.

2. Materials and methods

2.1. Patients and setting

This prospective, cross-sectional, and multicenter survey was conducted between November 1, 2005 and December 31, 2006. The patients comprised consecutive ST-segment elevation myocardial infarction (STEMI) patients who were admitted to 19 hospitals in Beijing. Ninety percent of these hospitals were located in urban areas. Twenty-six percent had fewer than 500 beds; and 74% had 500 or more beds. Ten hospitals were academic medical centers, and the rest were community hospitals. All these hospitals were capable of performing thrombolysis and/or primary percutaneous coronary intervention (PCI) 24 h a day. Patients meeting the following criteria were included in the study: (1) ST-segment elevation >0.1 mV in ≥ 2 contiguous precordial leads or adjacent limb leads or new left bundle branch block; (2) elevated serum cardiac biomarkers; (3) admission within 12 h of AMI symptom onset. We excluded those who were transferred from other hospitals. The remainders were categorized into the following 2 groups according to presence of PA: the PA group and the non-PA group. In a prospective temporal analysis of PA and its effect on outcome, angina that occurred within 24 h was more protective than PA occurring later than 24 h [26]. In an experimental study, the optimal interval between ischemic preconditioning stimulus and the prolonged episode occurred between 24 h and 72 h [27]. Therefore, in this study, we arbitrarily defined PA as the presence of cardiac symptoms within 48 h preceding the AMI.

2.2. Definitions

Cardiac symptoms included chest discomfort, abdomen, back, shoulder, arm, neck and jaw pain, diaphoresis, dyspnea, and nausea or vomiting. PA was defined as the presence of cardiac symptoms occurring within 48 h prior to onset of the infarction and persisting for less than 30 min. The onset of AMI was defined as the initiation of cardiac symptoms persisting for at least 30 min[5, 6]. Decision delay or patient delay was defined as the time interval between the onset of AMI symptoms and the action taken by the patient for medical assistance. Pre-hospital delay was defined as the time interval between the onset of AMI symptoms and arrival at the hospital.

2.3. Data collection

Data were collected by trained doctors through structured interviews and reviewing of medical records. The following information were included in our study: (1) demographics: age, gender, education level (college or <college), marital status, monthly income ($\geq$2000 or <2000 Chinese yuan [being equivalent to approximately 264 $]), health insurance coverage, and living arrangements (living alone or with others); (2) situational factors: time and place of AMI symptom onset, presence of bystander, self-treatment approaches, and consulting a doctor before seeking care; (3) symptoms: PA within 48 h prior to the onset of the infarction, severity of symptoms (bearable or unbearable), location and duration of pain or discomfort, other associated symptoms, such as nausea, vomiting, perspiration, dyspnea, etc.; (4) attribution of symptoms (cardiac or non-cardiac origin); (5) actions taken prior to seeking care: wait and see, self-treatment approaches, and consulting a doctor; (6) care-seeking behaviors: decision delay, pre-hospital delay, and mode of transport to the hospital (ambulance or self-transport); (7) cardiovascular risk factors and medical histories; and (8) early reperfusion approaches. All patients and/or family members were interviewed within 7 days of admission, and interviews were conducted as soon as possible after the patients became pain free and hemodynamically stable in order to obtain accurate information.

2.4. Ethical considerations

The study protocol was approved by human research ethics committees at the People's Hospital of Peking University and complied with the Declaration of Helsinki. The study was explained to each patient and their family members and a written informed consent was obtained.

2.5. Statistical analysis

Categorical data were expressed as numbers and percentages; continuous data, as mean±SD; and time intervals, as medians and interquartile ranges because of non-normal distribution. Chi-square tests were used to analyze categorical data, unpaired student's *T*-test were used to analyze the continuous variables, and Mann–Whitney *U* test was used to analyze the medians. Two multivariable logistic regressions were performed to identify the predictors of pre-hospital delay >2 h and non-ambulance use. Odds ratios (OR) and 95% confidence intervals (CI) were calculated. All significant tests were 2-sided, and $P<0.05$ was considered statistically significant. Experimental and clinical studies have shown that most of the irreversible damage to the myocardium occurs during the first 2 h after coronary occlusion. Milavetz et al. demonstrated that successful reperfusion therapy within 2 h was associated with the greatest degree of myocardial salvage [28]. So we chose 2 h as the time cut point to distinguish between early and late responders to their AMI symptoms.

3. Results

3.1. Sample characteristics

During the study period, a total of 516 patients met the eligibility requirement for the study, of which 4 died before they could be approached, 6 provided incomplete interviews, 8 refused to participate, and were dropped. For the remaining 498 patients, 78.9% were male and mean age was 61.3±12.3 years. PA within 48 h prior to the onset of the infarction occurred in 50.4% of the patients.

The baseline characteristics of patients with and without PA were presented in Table 1. Patients with PA had more prevalence of history of CAD (30.5% vs. 20.7%, $p=0.002$). However, age, sex, cardiovascular risk factors, other medical histories, and attribution of symptoms were similar between the 2 groups. Prior to seeking care, patients with PA more frequently thought the symptoms would go away and attempted some form of self-treatment (61.7% vs. 38.6%, $p<0.001$; 53.9% vs. 45.9%, $p=0.024$, respectively) than those without PA. Regarding to consulting a doctor, there was no difference between the 2 groups (2.0% vs. 3.6%, $p=0.172$).

Table 1
Comparison of the baseline characteristics for patients with and without PA.

Variables	Total (n=498)	PA (n=251)	Non-PA (n=247)	p Value
Demographics				
Age, mean±SD, y	61.3±12.3	61.4±12.4	61.3±12.3	0.854
Male, %	78.9	78.1	79.8	0.662
Cardiovascular risk factors, %				
Any	92.8	92.0	93.5	0.605
Hypertension	53.8	55.4	52.2	0.529
Diabetes	20.5	20.3	20.6	1.000
Dyslipidemia	23.3	20.7	25.9	0.203
Current smoker	54.6	55.0	54.3	0.928
BMI ≥ 25 kg/m^2	46.4	43.4	49.4	0.208
Family history of CAD	8.6	10.8	6.5	0.110
Medical history, %				
CAD	28.1	35.1	21.1	0.001
MI	11.2	13.1	9.3	0.202
Heart failure	1.6	2.0	1.2	0.724
Stroke	10.8	9.6	12.1	0.389
Cognitive factor, %				
Attribution of symptoms to cardiac origin	65.3	67.7	62.8	0.259
Actions taken prior to seeking care, %				
Thought the symptoms would go away, wait and see	50.2	61.8	38.5	<0.001
Self-treatment	53.2	61.0	45.3	0.001
Consulting a doctor	3.0	2.0	4.0	0.200

PA, pre-infarction angina; BMI, body mass index; CAD, coronary artery disease; MI, myocardial infarction.

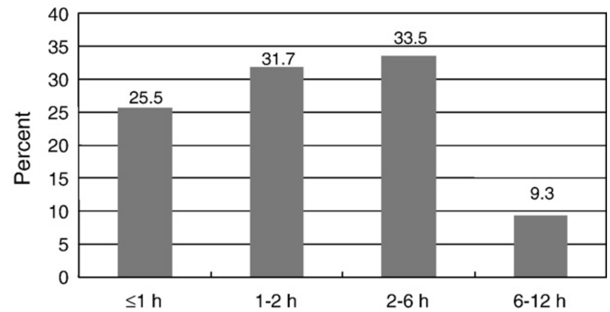

Fig. 1. Distribution of pre-hospital delay times.

3.2. PA and care-seeking behaviors

The distribution of pre-hospital delay times was shown in Fig. 1. One hundred and twenty-seven (25.5%) patients presented to hospital within 1 h of the onset of AMI symptoms; 285 (31.7%) presented within 1–2 h; 167 (33.5%) presented within 2–6 h; and 46 (9.3%) presented within 6–12 h. In total, the median (25%, 75%) decision delay was 60 (20, 180) min and the median (25%, 75%) pre-hospital delay was 110 (60, 200) min. Although median decision delay in the PA group was only 10 min longer than

Table 2
Comparison of the care-seeking behaviors for patients with and without PA.

Variables	Total (n=498)	PA (n=251)	Non-PA (n=247)	p Value
Decision delay, medians (25%, 75%), min	60 (20, 180)	64 (24, 203)	54 (20, 140)	0.032
Pre-hospital delay, medians (25%, 75%), min	110 (60, 200)	118 (20, 228)	103 (63, 187)	0.045
Pre-hospital delay ≤2 h, % (n)	57.2 (285)	50.3 (126)	64.4 (159)	0.002
Ambulance use, % (n)	37.3 (186)	31.5 (79)	43.3 (107)	0.007

PA, pre-infarction angina.

Table 3
Comparisons of the baseline characteristics for patients with different care-seeking behaviors.

Variables	Total	Ambulance use			Pre-hospital delay		
	(n=498)	Yes (n=186)	No (n=312)	p Value	>2 h (n=213)	≤2 h (n=285)	p Value
Age, mean±SD, y	61.3±12.3	63.0±12.0	60.1±13.0	<0.001	62.9±12.2	60.1±12.2	0.011
Male sex, %	78.9	78.5	79.2	0.910	75.6	81.4	0.121
College, %	16.3	21.5	13.1	0.017	9.9	21.1	0.001
Income≥2000 Chinese yuan/m, %	26.1	29.6	24.0	0.206	18.3	31.9	0.001
Health insurance, %	76.1	81.2	73.1	0.050	70.9	80.0	0.020
History of CAD	28.1	34.9	24.0	0.010	29.6	27.0	0.547
PA, %	50.4	43.5	54.5	0.021	57.3	45.3	0.009
Unbearable symptoms, %	73.8	80.1	70.2	0.015	65.3	80.4	<0.001
Perspiration, %	71.9	72.0	71.8	1.00	66.2	76.1	0.016
Dyspnea, %	14.7	19.4	11.9	0.026	10.8	17.5	0.040
A sense of impending doom, %	6.8	7.5	6.4	0.714	3.3	9.5	0.007
Attribution of symptoms to cardiac origin, %	65.4	64.0	54.8	0.049	42.3	70.2	<0.001
Using ambulance, %	37.3	100.0	0	-	23.9	47.4	<0.001

CAD, coronary artery disease; PA, pre-infarction angina within 48 h before onset of the infarction.

in the non-PA group (p=0.032), the difference of 75th percentile for decision delay was large (63 min). Importantly, patients with PA had longer total pre-hospital delays than the patients without PA (median, 118 vs. 103 min, p=0.045), and the proportion of patients with pre-hospital delay ≤2 h was significantly lower in the PA group than in the non-PA group (64.4% vs. 50.3%, p=0.002).

Only 186 (37.3%) patients arrived at the hospital by ambulance; the remaining 312 (67.0%) relied on other means of transport. The prevalence of ambulance use was significantly lower in the PA group than in the non-PA group (31.5% vs. 43.3%, p=0.016) (Table 2).

Table 4
Multivariate logistic regression predicting pre-hospital delay >2 h.

Predictors of pre-hospital delay >2 h	Odds ratio	95%CI	p value
Age	1.026	1.008–1.043	0.004
Presence of PA	1.863	1.112–2.765	0.013
Bearable symptoms	1.499	1.020–3.278	0.039
Attribution of symptoms to non-cardiac origin	1.709	1.190–2.451	0.031
Without using ambulance	3.012	1.931–4.695	<0.001

MI, myocardial infarction; PA, pre-infarction angina; CI, confidence interval.

Table 5
Multivariate logistic regression predicting non-ambulance use.

Predictors of non-ambulance use	OR	95%CI	p value
Age	0.980	0.962–0.990	0.003
Education level (college vs. <college)	0.625	0.265–0.919	0.021
History of CAD	0.604	0.329–0.990	0.048
History of stroke	0.493	0.271–0.901	0.020
Presence of PA	1.724	1.185–2.670	0.003
Bearable symptoms	1.661	1.091–2.519	0.019
Attribution of symptoms to non-cardiac origin	1.490	1.021–2.589	0.041

CAD, coronary artery disease; PA, pre-infarction angina; CI, confidence interval.

3.3. Factors associated with pre-hospital delay≥2 h and non-ambulance use

We examined a variety of demographics, situational factors, medical histories, clinical characteristics and cognitive factors associated with care-seeking behaviors (pre-hospital delay and ambulance use) in these patients. The positive data were presented in Table 3.

As illustrated in Table 4 and 5, after multivariable analysis, increased age, presence of PA, bearable symptoms, attribution of symptoms to non-cardiac origin, and without using ambulance remained as independent predictors of pre-hospital delay >2 h; Decreased age, lower education level, without history of CAD and stroke, bearable symptoms, attribution of symptoms to non-cardiac origin, and presence of PA remained as independent predictors of non-ambulance use.

3.4. PA and early reperfusion rates

In total, 399 (80.1%) patients received early reperfusion therapies, more precisely, 78 (15.7%) received thrombolysis, and 321 (64.4%) underwent primary PCI (not including those with facilitated or rescue PCI [4.0%]). Patients in the PA group had a lower early reperfusion rate (74.7% vs. 83.3%, p=0.027), mainly because of a lower incidence of primary PCI (58.6% vs. 67.9%, p=0.042). However, the proportion of patients who received thrombolysis was similar between the 2 groups (16.1% vs. 15.4%, p=0.899) (Table 6).

Table 6
Comparison of early reperfusion therapies for patients with and without PA.

Descriptions	Total (n=498)	PA (n=186)	Non-PA (n=312)	p Value
Any reperfusion, n (%)	399 (80.1)	74.7 (139)	83.3 (260)	0.027
Thrombolysis, n (%)	78 (15.7)	16.1 (30)	15.4 (48)	0.899
Primary PCI, n (%)	321 (64.4)	58.6 (109)	67.9 (212)	0.042

PA, pre-infarction angina; PCI, percutaneous coronary intervention.

4. Discussion

4.1. Major results

Our study showed that presence of PA was associated with more counterproductive coping strategies (e.g. wait and see, attempting self-treatment), longer pre-hospital delay, and significantly decreased use of ambulance in patients with STEMI. In addition, patients with PA had a lower early reperfusion rates, mainly because of a lower incidence of primary PCI.

4.2. PA, care-seeking behaviors and early reperfusion therapy

A lot of experimental data suggested that PA may favorably influence the course of AMI [23,29]. Recent clinical studies show that PA results faster and more coronary recanalization and smaller infarcts in patients receiving reperfusion therapy [30,31]. Thus the occurrence of PA may provide more benefits for AMI patients in the era of reperfusion therapy. However, Psychari et al. [32] found that PA does not alter infarct size and in hospital outcome after STEMI. Our results suggest that the protective effect of PA may be partly offsetted by lower early reperfusion rate because of longer pre-hospital delay and underuse of ambulance among STEMI patients.

Zahn et al. reported that pre-hospital delay in the patients with PA (occurring within the last 4 weeks before the infarction) was 1 h longer than in the patients without PA [33]. McKinley et al. [34] reported that intermittent symptoms were related to increased patient delay in response to the AMI symptoms. In our study, the median pre-hospital delay in the PA group was 15 min longer than in the non-PA group, and PA was an independent predictor of pre-hospital delay >2 h. No reports have previously described the association between PA and ambulance use by AMI patients. Our research indicated that the presence of PA significantly decreased the likelihood that patients would call for an ambulance. Taken together, these findings suggest that PA can negatively affect the care-seeking behaviors of AMI patients, and further influence early reperfusion therapies.

The identification of factors contributing to care-seeking behaviors in patients with AMI is essential to develop appropriate patient-directed educational interventions. Previous studies show that Leventhal's self-regulation model of illness provides a useful theoretic framework to explain decision-making process or care-seeking behavior of patients experiencing AMI symptoms [22,35–37]. Therefore, we would try to discuss our findings in light of the self-regulation model of illness.

4.3. Self-regulation model of illness

The self-regulation model of illness [38] was developed originally to explain symptom representation and care-seeking behaviors of individuals experiencing a health crisis. It includes three stages: (1) the illness representation, which is a mental schema by which symptoms are interpreted. The major attributes of illness representation are identify of the problem, cause or causes of the identified problem, duration of symptoms or expected timeline, consequences of condition, and expectations regarding control and cure. These schema provide meaning to the illness experience and drives goal setting. The care-seeking behavior is, in turn, influenced by how the goal is expected to be achieved, (2) the action plan, or coping stage, considerable time may be consumed in this stage. The action plan may include a decision to wait and see what happens or a decision to seek immediate help by calling for an ambulance or driving to the hospital, and (3) the appraisal stage, in which a person assesses the success of one's coping actions based on specific criteria. According to Leventhal et al., people obtain information from several sources that can influence their illness representation, i.e. the first stage of the model. These sources include culture, social communication and the individual's past illness experience. Once an individual has constructed a mental representation of the health threat, the model suggests that the individual will engage in one or more coping strategies. Some of these coping strategies may be less deliberative. This process is fundamental to whether or not patients seek care for their symptoms, and if they do, how long they might delay, as well as whether they would call for an ambulance or not.

There is growing evidence from many illnesses including AMI showing that patients' interpretation of symptoms can influence their care-seeking behaviors. Recognition of symptoms and accurate labeling are important. Johnson J.A. and Horne R et al. [39–41], who have used components of the self-regulation model of illness, consistently found that patients sought care sooner if they attributed their symptoms to the heart (cause) or if their symptoms matched their expectations of having an AMI (labeling). In accordance with their results, we found that incorrect attribution of symptoms was an independent predictor of longer pre-hospital delay or non-ambulance use. However, Mussi et al. [42] reported opposite results in 43 women with AMI. A potential explanation may be that their sample is too small to draw definitive conclusions. Additionally, according to Cameron et al. [43], consequences, duration, and control or cure attributes also play an important role in the decision to seek care in some illness. However, these components have been rarely explored in the context of AMI.

Clinical feature of PA is characterized by short anginal attacks preceding AMI. Therefore, patients experiencing PA usually believed that the symptom would vanish or the pain would resolve by itself similar to prior short attacks. When symptom of AMI onsets, patients with PA usually thought the symptom would be an short anginal attack (cause), would go away soon (duration), would not be a life-threatening condition (consequence), and the pain would be self-limited or could be controlled or cured through self-treatment (cure) similar to prior short attacks. As expected, in our study, patients with PA more frequently thought the symptoms would go away, took a "wait-and-see" posture, or attempted some form of self-treatments prior to seeking care, all these resulted longer delay. Meanwhile, failure to realize the life-threatening condition might result underuse of ambulance.

Our data further reinforce the importance of symptom interpretation in relation to care-seeking behaviors. Thus to reduce patient decision delay and increase use of ambulance for AMI, it is critical to increase patients' accuracy in interpreting the situation. Our results suggest that future interventions are needed to provide people with not only typical and atypical symptoms of AMI but also earlywarnings or prodromal symptoms such as PA, as well as the appropriate and quick response when experiencing AMI symptoms preceded by angina. Moreover, some AMI events may be prevented if the patients with PA could seek care soon after the onset of the angina.

4.4. Implications for future intervention and research

The application of Leventhal's self-regulation model to study care-seeking behaviors of AMI patients suggests a new avenue for future research and interventions. First, healthcare providers should more systematically address the episodic and semantic beliefs that may affect the representation of the health threat in prevention strategies. Second, future research should focus on the procession of behaviors (illness representation, coping strategies, and appraisal) that evolve in light of changing beliefs rather than focusing on one or two particular aspects of this process.

4.5. Study limitations

There are several limitations of this study that require mentioning. Firstly, a cross-sectional observational design may pose concerns related to residual confounding. Secondly, information collected during the interview relied on the recall of events by the patients. However, in order to minimize the recall bias, the interview was conducted within a week upon admission. Thirdly, we did not collect the data of several characteristics of PA, such as its duration, frequency, and severity. We also did not differentiate between stable and unstable angina pectoris. All these may also influence the patients' care-seeking behaviors. In addition, it is sometimes difficult to determine the exact time of the onset of AMI in patients who have frequent or prolonged PA. In our study, the onset of AMI was defined as the initiation of cardiac symptoms lasting for >30 min according to previous reports. Finally, our sample only represented hospitalized STEMI patients who were admitted in 19 participating hospitals within 12 h of onset of symptoms. It did not include those who were pronounced dead at the site of accident or en route and those who were admitted to other hospitals. Thus, caution should be exercised in generalizing our results to entire AMI population.

5. Conclusion

Presence of PA was associated with more counterproductive coping strategies, longer pre-hospital delay and significantly decreased use of ambulance. In addition, patients with PA had a lower early reperfusion rates, mainly because of a lower incidence of primary PCI. Taken together, these findings suggest that PA negatively influenced the care-seeking behaviors of patients with AMI and the protective effects of PA may be offsetted by the lower early reperfusion rate. Our results suggest that future interventions are needed to provide people with not only typical and atypical symptoms of AMI but also earlywarnings or prodromal symptoms such as PA, as well as the appropriate response when experiencing AMI symptoms preceded by angina.

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