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Cardiac rupture risk estimation in patients with acute myocardial infarction treated with percutaneous coronary intervention

Ewa Markowicz-Pawlus[1], Jerzy Nożyński[1], Agnieszka Sędkowska[1], Piotr Jarski[1], Michał Hawranek[2], Witold Streb[1], Teresa Zielińska[1], Lech Poloński[2] and Zbigniew Kalarus[1]

[1]1st Department of Cardiology, Silesian Centre for Heart Diseases, Zabrze, Poland
[2]3th Department of Cardiology, Silesian Centre for Heart Diseases, Zabrze, Poland

Abstract

Background: *Cardiac rupture (CR) is a common cause of death following acute myocardial infarction (AMI). Despite improvements in AMI treatment, the frequency of CR remains considerable and in most cases leads to death. The aim of the study was to define the independent prognostic CR risk factors of AMI in patients treated with percutaneous coronary intervention (PCI).*

Methods: *A total of 4,200 AMI patients treated by PCI were studied retrospectively. Two hundred and seventy patients who had died of AMI were examined. In all cases CR was confirmed in post-mortem examination.*

Results: *Cardiac rupture occurred in 49 patients (18.1%). In the CR group, 24.4% patients received thrombolysis and 22.6% in the non-CR group (p = NS). The following characteristics were associated with a higher rate of CR in univariable analysis: age (70.3 ± 3.2* vs. *65.2 ± ± 9.9; p < 0.001), female (75.0%* vs. *60.2%; p < 0.001), prior cardiac event and absence of myocardial infarction history (61.2%* vs. *40.2%; p < 0.05 and 14.2%* vs. *33.4%; p < 0.05), presence of QS complex in first ECG (75.5%* vs. *52.0%, p < 0.05) and multiple coronary heart disease (75.5%* vs. *61.5%, p < 0.05), and long time from onset of symptoms to thrombolysis and to PCI (8.1 ± 2.8* vs. *4.7 ± 2.3 hours, p < 0.001 and 9.0 ± 5.5* vs. *4.5 ± 3.2 hours, p < 0.001). In the multivariable analysis, independent predictors of CR were: age (OR: 1.1; 95% CI: 1.02–1.19; p = 0.01); female gender (OR: 0.2; 95% CI: 0.07–0.52; p = 0.001); time from onset of symptoms to PCI (OR: 1.15; 95% CI: 1.07–1.47; p = 0.003).*

Conclusions: *Old age, female gender and long time from onset of symptoms to AMI treatment (independent of previous fibrinolysis) are independent factors of CR in PCI patients.* (Cardiol J 2007; 14: 538–543)

Key words: cardiac rupture, acute myocardial infarction, risk factors

Address for correspondence:
Dr. Ewa Markowicz-Pawlus
1st Department of Cardiology
Silesian Centre for Heart Diseases
Szpitalna 2, 41–800 Zabrze, Poland
Tel: +48 32 373 36 82, fax: +48 32 271 76 92
e-mail: markowicz@epf.pl

Introduction

Nowadays we can observe a systematic increase in the total number of percutaneous transluminal intervention (PCI) patients, also as a method of acute myocardial infarction (AMI) treatment. This has improved the results of AMI treatment as defined by in-hospital and long-term mortality [1–3].

Despite all of these methods, there are AMI complications which are difficult to predict and treat. One of these complications is cardiac rupture (CR). The majority of CR complicated cases lead to death, most of them being recognised in postmortem examinations. The risk factors of CR before PCI in AMI treatment are known — female gender, old age, prior coronary heart disease (CHD), absence of AMI in the past, arterial hypertension (HA) and one-vessel coronary artery disease (CAD) [4–12].

There is also analysis which estimates the risk of CR in patients undergoing PCI in AMI compared to those treated with thrombolysis. According to Moreno [13], old age, female gender and anterior location have been postulated; however, the advantage of PCI has been confirmed as a protective factor against CR.

In contrast to other investigations, all AMI patients in our study had been treated with PCI. In some cases, fibrinolysis had been used previously. The objective of this study was to isolate CR risk factors in patients with AMI treated with PCI.

Methods

A total of 4,200 consecutive AMI patients treated by PCI at our institute within 12 hours of the onset of symptoms were studied retrospectively. We analysed 270 patients who died from AMI. PCI had been performed on all patients. CR was found in 49 patients, which was confirmed in post-mortem examinations and in most cases also by echo-examination. The status of the CAD history was known from the patients' previous histories. Patients were considered to have diabetes if they had been diagnosed or if they were being treated with either insulin or oral drugs. Patients were considered to have hypertension if they had been diagnosed or if they were receiving antihypertensive drugs.

All the analysed patients received aspirin 325––500 mg and heparin 500–1000 IU, administered intravenously. Sixty-two (22.9%) of the CR patients were treated with thrombolytic agents before PCI. Glycoprotein Ilb/IIIa inhibitors were administered in 72 (26.6%) patients. Coronary stents were used in the case of essential coronary artery stenosis or its dissection.

Despite the identification of infarct related artery, angiography of other coronary arteries was also performed to assess the presence of any multivessel CHD.

We provided a comparative analysis between CR and non-CR patients by considering demographic data, concomitant diseases, the course and methods of AMI treatment and patients' coronary history. We selected independent CR risk factors from all the available factors. Moreover, from the CR group we selected patients who had been treated with thrombolysis before PCI in order to determine independent CR risk factors in such a group and to check if they differed from other CR patients.

Statistical analysis

The means of normally distributed variables were compared by using the student t-test. For comparison of the distribution of risk factors between groups, χ^2 analysis was used. Independent CR risk factors were calculated using uni- and multivariable logistic regression models. Descriptive statistics are expressed as mean ± SD.

Results

Baseline characteristics in both groups are presented in Table 1. CR patients were older, presented more frequently female gender, QS complex in the first ECG and the presence of multivessel CHD, had neither a history of AMI nor cardiac events and had had a longer time from the onset of symptoms to both thrombolysis and PCI. CR was present in 18.1% of patients who died from AMI. Thirty-six patients (73.4%) presented acute CR (Table 1).

In the multivariable analysis, three parameters were found as independent predictors of CR: age, [odds ratio (OR): 1.1; 95% confidence interval (CI): 1.02–1.19; p = 0.01], female gender (OR: 0.2; 95% CI: 0.07–0.52; p = 0.001), and time from onset of symptoms to PCI (OR: 1.15; 95% CI: 1.07–1.47; p = 0.003). Results of multivariable analysis are presented in Table 2.

Based on the above results, we are able to estimate the probability of CR in AMI patients with more than one CR independent factor. As an example, we present the probability of CR risk in a patient using the two CR risk factors: age and time of AMI pain (Fig. 1).

For a 70-year-old patient regardless of gender, who presents 12 hours of AMI pain, the probability of CR is 0.20. Moreover, we attempted to estimate

Table 1. Comparison of clinical features of cardiac rupture (CR) and non-cardiac rupture (non-CR) patients.

	CR	Non-CR	p
Age	70.3 ± 3.2	65.2 ± 9.9	< 0.001**
Female	37 (75.0%)	88 (60.2%)	< 0.001*
Male	12 (25%)	133 (39.8%)	
Arterial hypertension	20 (40.8%)	121 (54.7%)	NS*
Diabetes mellitus	15(30.6%)	71 (32.1%)	NS*
Prior cardiac event	30 (61.2%)	89 (40.2%)	< 0.05*
Myocardial infarction in the past	7 (14.2%)	74 (33.4%)	< 0.05*
QS complex	37 (75.5%)	115 (52.0%)	< 0.05
Multiple coronary artery disease	38 (77.5%)	136 (61.5%)	< 0.05
Time from onset of symptoms to PCI [h]	9.0 ± 5.5	4.5 ± 3.2	< 0.001
Anterior wall acute myocardial infarction	30 (61.2%)	129 (58.3%)	NS*
ST depressions	27 (55.1%)	110 (49.7%)	NS*
Time from onset of symptoms to fibrinolysis [h]	8.1 ± 2.8	4.7 ± 2.3	< 0.001**
Successful PCI	29 (59.1%)	118 (53.3%)	NS*
Fibrinolysis	12 (24.4%)	50 (22.6%)	NS*
IIb/IIIa blocker	10 (20.4%)	62 (28.0%)	NS*

*χ analysis, **student t-test; PCI — percutaneous coronary intervention

Table 2. Results of multivariable analysis.

	Age	Sex	Time to PCI	QS complex	MI in the past	Prior CAD	Multiple CAD
P	0.01	0.001	0.003	0.17	0.84	0.07	0.13
Odds ratio	1.1	0.2	1.25	1.82	0.89	2.39	2.05
–95% confidence interval	1.02	0.07	1.07	0.76	0.27	0.92	0.8
+95% confidence interval	1.19	0.52	1.47	4.36	2.86	6.22	5.25

PCI — percutaneous coronary intervention; MI — myocardial infarction; CAD — coronary artery disease

the probability of CR only in women recording two independent CR risk factors: age and time of AMI pain (Fig. 2).

For a 70-year-old woman who presents 12 hours of AMI pain, the probability of CR is 0.30. In multivariable analysis, for CR patients who received thrombolysis before PCI, the only independent risk factor was the long time from the onset of symptoms to PCI (OR: 1.7; 95% CI: 1.2–2.4; $p < 0.001$).

Discussion

Despite improvements in AMI treatment, the incidence of CR remains significant. The frequency of CR in this study was 18.1%, which is comparable with data from studies of patients treated conservatively or with fibrinolysis [7, 13–24].

The recognition of CR risk factors in AMI patients treated with PCI may have important clinical implications. It would allow us to select patients with an increased risk of CR who require special supervision. We could also question whether invasive methods of AMI treatment are suitable for all patients and whether or not we can do anything more to avoid CR.

Multivariable analysis showed that old age was an independent CR risk factor, as did most other investigators [7, 13, 23–28]. The presumed mechanism of increased risk of CR in elderly patients is organic lesions of the myocardium. This makes the myocardium less resistant to mechanical factors, such as sudden ischemia.

In our study, all the cases of CR examined were confirmed in post-mortem examinations. In the SHOCK Trial Registry, for example, only 9 out of

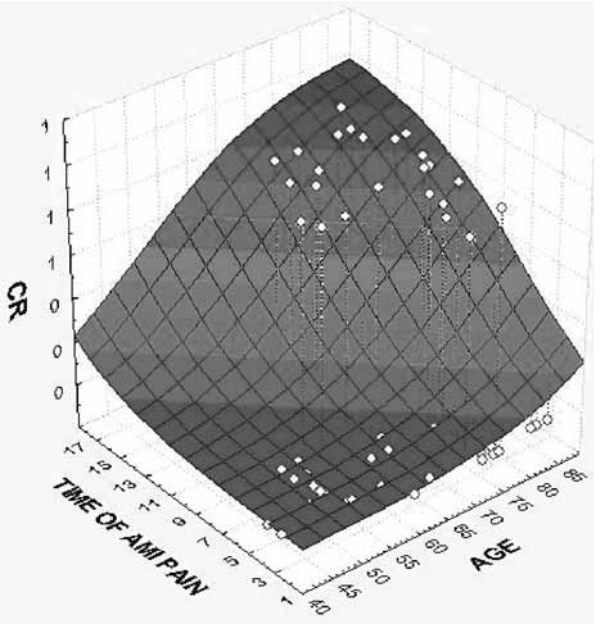

Figure 1. The probability of cardiac rupture (CR) in acute myocardial infarction (AMI) patient considering age and time of AMI pain.

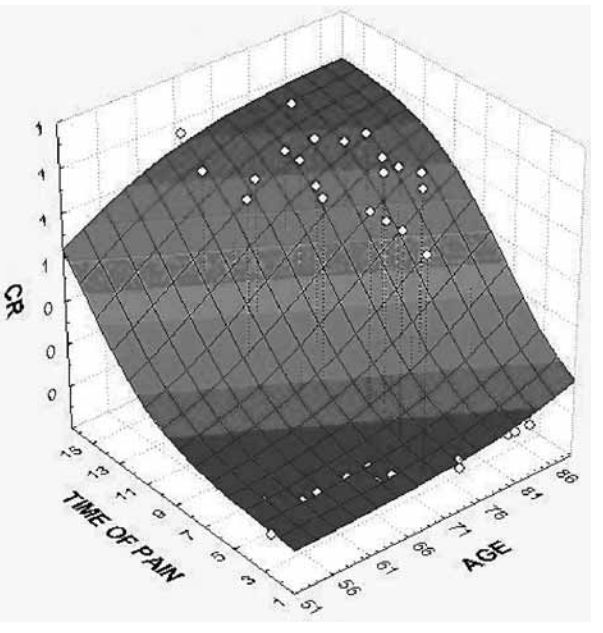

Figure 2. Probability of cardiac rupture (CR) in acute myocardial infarction (AMI) women considering age and time of AMI pain.

the 28 cases classified as CR presented cardiac tamponade in the absence of a left ventricle rupture [17]. In our data we found that CR occurred significantly more often in females, which in fact was also pointed out by other investigators [7, 13, 19, 22, 28]. This can be explained by the observation that females have AMI more often as a first symptom of CAD. Our analysis of patient coronary histories showed that the presence of previous MI was significantly the most frequent prior cardiac event in CR patients. However, the patients in the non-CR group had had MI more often in the past. These relationships were also observed by other investigators [7, 17, 28], something which has been associated with the preconditioning effect. The comparative analysis showed that the time from the onset of AMI symptoms to both fibrinolysis and PCI were significantly longer in CR. Moreover, in the multivariable analysis, a long time to PCI was an independent CR risk factor. Based on these results we conclude that independently of the mechanism leading to the revascularization, a long time to revascularisation tended to CR. Moreno et al. [27] also postulated the role of early revascularisation as a CR protective factor — according to them, treatment over 2 hours was associated with a higher rate of CR.

In our data, considering the time to AMI treatment, we found that time over 6 hours significantly increases CR risk. Based on this, we concluded that reducing the incidence of CR might be obtained by early reperfusion. Considering the presence of the QS complex in ECG, which may be an expression of prolonged AMI, we observed its presence significantly more often in CR patients. This fact was also observed in the SHOCK Trial and is related to prolonged AMI [29]. Using angiographic data of coronary arteries we found that in the CR group, multivessel CAD was present significantly more often. Our findings are not confirmed by other investigators' results which supposed the hypothesis of collateral circulation in one-vessel CAD. This was explained as an outcome of a myocardial protection mechanism against sudden ischemia. According to some other investigators, the absence of collateral circulation cannot be the only or main mechanism of CR [7]. In the age of thrombolysis in AMI treatment, the role of fibrinolytic drugs in CR was postulated as playing a role in collagen destruction. Becker et al, based on large registry experience including over 350,000 patients, suggested that thrombolytic therapy does not evoke but only accelerates CR [4, 5]. Now, in the age of PCI, this is not confirmed by investigators. In addition, we did not observe the advantages of fibrinolysis frequency in CR patients. Moreover, there were no differences in abciximab treatment between both groups. In the comparative analysis considering concomitant diseases, there were no significant differences in

the presence of arterial hypertension and diabetes mellitus between both groups. The determination of risk factors plays an important role in the treatment of AMI patients: it allows the isolation of a group with increased CR risk (old age, female gender) and emphasizes the need for special supervision. The provided analysis also confirmed the role of shortening the time to AMI treatment for CR prevention.

Conclusions

Cardiac rupture is a common, fatal AMI complication. Old age, female gender and a long time from the onset of symptoms to AMI treatment are independent factors of CR in PCI patients. Increased length of time from the onset of symptoms to PCI is a risk factor of CR independent of previous fibrinolysis.

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