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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

The influence of diabetes on in-hospital and long-term mortality in patients with myocardial infarction complicated by cardiogenic shock: results from the PL-ACS registry

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Abstract

Backgroud: Cardiogenic shock (CS) affects the prognosis in patients with myocardial infarction (MI). An additional factor affecting the prognosis is diabetes mellitus (DM).

Aim: To evaluate the impact of DM on in-hospital and long-term mortality in patients with MI complicated by CS, who were included in the Polish Registry of Acute Coronary Syndromes (PL-ACS). We also sought to demonstrate a relationship between treatment method and mortality in this group.

Methods: 71,290 consecutive patients with non-ST elevation MI (NSTEMI; 33,392) and ST elevation MI (STEMI; 37,898) were included in the PL-ACS register. CS was diagnosed on admission in 4,144 patients. This group included 1,159 patients with DM.

Results: The patients with DM were older, more frequently female and more frequently presented with hypertension, hypercholesterolaemia, obesity, suffered from multivessel coronary disease significantly more frequently (76.4% vs. 64.6%; $p = 0.00003$) and had lower coronary angioplasty efficacy (TIMI 3 flow) (67% vs. 75.8%; $p = 0.001$) compared to patients without DM. The mortality rate comparisons for patients with DM vs. those without DM, respectively, were as follows: in-hospital mortality, 61.4% vs. 55.9%; $p = 0.001$ (revascularisation treatment: 45.7% vs. 39.5%; $p = 0.03$, conservative treatment: 69.3% vs. 64.6%; $p = 0.02$) and 3-year mortality 78.6% vs. 70.7%; $p < 0.0001$ (revascularisation treatment: 64.7% vs. 55.0%; $p = 0.001$, conservative treatment: 85.5% vs. 79.2%; $p = 0.0001$). In the multivariate analysis, DM was, with borderline statistical significance, an independent predictor of higher in-hospital mortality (OR = 1.16; 95% CI 1.00–1.35; $p = 0.054$] and 3-year mortality (HR = 1.11; 95% CI 1.02–1.20; $p = 0.01$). Interestingly, after excluding patients who died in the hospital, DM was still associated with significantly higher 3-year mortality (50.1% vs. 40.0%; $p < 0.0001$). Multivariate analysis revealed that DM was still an independent risk factor for higher 3-year mortality (HR = 1.21; 95% CI 1.04–1.41; $p = 0.02$).

Conclusions: Diabetes is associated with higher in-hospital and long-term mortality in patients with MI complicated by CS. Revascularisation treatment, compared to conservative treatment, reduces mortality in this group of patients.

Key words: myocardial infarction, cardiogenic shock, diabetes mellitus

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INTRODUCTION

Cardiogenic shock (CS) affects the prognosis in patients with myocardial infarction (MI). The in-hospital mortality of patients with MI complicated by CS is significantly higher compared to patients without CS [1]. An analogous association has been observed in long-term follow-up: CS is an independent predictor of death [2, 3]. Despite the implementation of revascularisation treatment, mortality in this group remains high [4]. An additional factor affecting the prognosis of patients with MI is diabetes mellitus (DM). The Global Registry of Acute Coronary Events (GRACE) showed a significantly higher in-hospital mortality rate in patients with MI and DM compared to patients without DM. A multivariate analysis revealed that DM is an independent risk factor for in-hospital death in both ST-elevation myocardial infarction (STEMI) and non-ST elevation myocardial infarction (NSTEMI) patients [5]. DM also leads to a worse prognosis based on long-term follow-up. The Global Use of Strategies To Open occluded coronary arteries in acute coronary syndromes (GUSTO-IIb) clinical trial showed statistically higher 30-day and 6-month mortality in patients with STEMI and DM compared to those without [6]. Similar conclusions were drawn from the Donahoe et al. [7] analysis of 11 studies: DM increased the 30-day and 1-year risk of death. Furthermore, it was observed that DM predisposes patients to CS, as do the following: older age, anterior wall MI, low left ventricular ejection fraction (LVEF), extensive infarction, advanced coronary artery atherosclerotic changes, congestive heart failure and prior MI [8]. In the second Euro Heart Survey on Acute Coronary Syndrome (EHS-ACS-II), there was a two-fold higher incidence of CS in patients with DM. In multivariate analysis, DM was an independent factor that increased the risk of CS [9]. It appears that the presence of DM with MI complicated by CS may further worsen the prognosis. However, the reports on this subject are scarce and ambiguous and are based on analyses of relatively small and selected groups of patients [10–13]. In the SHOCK (SHould we emergently revascularise Occluded Coronaries for cardiogenic shocK) Trial Registry, 1,163 patients with CS were analysed, of whom the DM group comprised 379 patients [10]. Similarly, Farkouh et al. [13] showed the influence of DM on long-term mortality in 288 patients with CS. In the TRACE (TRAndolapril Cardiac Evaluation) registry, the CS and DM group comprised only 76 patients [13]. Tedesco et al. [12] analysed 73 patients with MI complicated by CS. There were 16 patients with DM.

Therefore, the aim of this study was to evaluate the impact of DM on in-hospital and long-term mortality in patients with MI complicated by CS, who were included in the Polish Registry of Acute Coronary Syndromes (PL-ACS). We also sought to demonstrate a relationship between treatment method and mortality in this group.

METHODS

The PL-ACS registry design has been previously described [14]. In brief, the PL-ACS registry is a nationwide, multi-centre, prospective, observational study of consecutively hospitalised patients with acute coronary syndrome (ACS). This registry was a joint initiative of the Silesian Centre for Heart Diseases in Zabrze and the Polish Ministry of Health. Logistical support was provided by the National Health Fund, which is a nationwide, public health insurance institution in Poland, whose policy is required for all Polish citizens. The pilot phase of the registry commenced in October 2003 in the Silesia region; from June 2005 onward, all Polish regions collected data for the PL-ACS registry. This analysis includes patients who were enrolled in the registry between October 2003 and August 2006. A total of 417 centres, including 59 (14%) centres with PCI facilities, participated in the registry.

A detailed protocol, consisting of inclusion and exclusion criteria, methods and logistics, and definitions of all fields in the registry data set, was prepared before the registry was started. In May 2004, the definitions were adapted for compatibility with the Cardiology Audit and Registration Data Standards [15]. According to the protocol, all admitted patients with suspected ACS were screened for entry into the registry, but the patients were not enrolled until ACS was confirmed. The initial diagnosis was made by the attending physician and was based on the clinical presentation, initial electrocardiographic patterns, and markers of myocardial necrosis acquired at least 6 h from the time of symptom onset. The patients were then classified as having unstable angina, NSTEMI, or STEMI (see definitions below). If the patient was hospitalised during the same ACS episode at more than one hospital (transferred patient), all hospitals were required to complete the case report form. These hospitalisations were linked during data management and were analysed as one ACS. Data was collected by attending physicians and entered directly into the electronic case report form. In some cases, a printed case report form was used before data was transferred to the electronic form. Internal data checks were implemented by the software.

All-cause mortality data, including the exact dates of death, was obtained from the National Health Fund and analysed at the data management and analysis centre of the Silesian Centre for Heart Diseases.

Definitions

The definitions of the initial diagnoses were as follows:

— STEMI: 1) the presence of ST-segment elevation consistent with MI ≥ 2 mm in adjacent chest leads and/or ST-segment elevation of ≥ 1 mm in 2 or more standard leads or new left bundle branch block (LBBB); and 2) positive cardiac necrosis markers.

— NSTEMI: 1) the absence of ST-segment elevation consistent with MI ≥ 2 mm in adjacent chest leads and ST-segment elevation ≥ 1 mm in 2 or more standard leads and new LBBB; and 2) positive cardiac necrosis markers.
— CS was defined as hypotension (a systolic blood pressure of < 90 mm Hg for at least 30 min or the need for inotropes or vasopressors or intra-aortic balloon pump counterpulsation [IABP] to maintain a systolic blood pressure of > 90 mm Hg) and end-organ hypoperfusion (cool extremities or a urine output of < 30 mL/h, and a heart rate of ≥ 60 bpm).

In-hospital and long-term complications were defined as follows:

1) Death — death from all causes (cardiac and non-cardiac).
2) Re-infarction — ischaemic event that satisfied the European Society of Cardiology/American College of Cardiology criteria for infarction and was clearly clinically distinct from the index event at the time of admission [16].
3) Stroke (haemorrhagic or ischaemic) — an acute neurologic deficit that lasted more than 24 h and affected the ability to perform daily activities or resulted in death.
4) Major bleeding — overt clinical bleeding that i) was associated with a decrease of greater than 5 g/dL (0.5 g/L) in haemoglobin or greater than 15% (absolute) in hematocrit, or ii) caused haemodynamic compromise, or iii) required blood transfusion.

The invasive strategy was defined as the performance of coronary angiography during the index hospitalisation. Decisions related to treatment modalities (i.e. use of stents, IABP, glycoprotein IIb/IIIa inhibitors, and methods of angioplasty) were made at the discretion of the attending physicians.

Diabetes mellitus diagnosis and treatment

The group of patients with DM was identified based on patient history (documented DM treated with insulin, oral hypoglycaemic drugs or diet) or elevated glycaemic values during hospitalisation (at least 2-fold elevations in fasting glycaemic levels ≥ 7 mmol/L after the acute phase of MI phase or blood glucose ≥ 11.1 mmol/L, as determined from a 2-h glucose tolerance test performed at the end of the hospitalisation period). All diabetic and non-diabetic patients with hyperglycaemia in the acute phase of the MI were treated with short-acting insulin administered as an infusion or as subcutaneous injections. Following acute MI and at discharge, if daily demand for insulin was lower than 30 U, the treatment used before the MI was reinstated. If DM was diagnosed in the hospital following the acute phase of the MI and the daily demand for insulin was lower than 30 U, then oral hypoglycaemic agents or diet was used; otherwise, intensive insulin therapy was continued.

Statistical analysis

Continuous variables are presented as means ± standard deviation or medians and interquartile ranges, as appropriate. Categorical variables are presented as percentages. Continuous variables were compared using the t-test or the Mann-Whitney U-test where appropriate, while categorical variables were compared using the χ^2 test. Multiple logistic regression (for in-hospital mortality) and Cox proportional hazards regression (for long-term mortality) were used to evaluate the influence of DM on survival after adjustment for age, sex, smoking status, hypertension, hypercholesterolaemia, previous MI and invasive strategy. Crude 3-year mortality curves were calculated using the Kaplan-Meier method and were compared using the log-rank test. A p-value of less than 0.05 was considered to be statistically significant. All reported p-values are 2-sided. Analyses were performed with Statistica ver. 7.1 (Stat Soft Inc.).

RESULTS

From October 2003 to August 2006, 71,290 consecutive patients with NSTEMI (33,392) and STEMI (37,898) were included into the PL-ACS register. CS was diagnosed on admission in 4,144 (5.8%) patients. This group included 1,159 patients with DM (28%) and 2,985 patients without DM.

Clinical and angiographic characteristics

The patients with DM were older, more frequently female and more frequently presented with hypertension, hypercholesterolaemia, obesity, and history of coronary artery bypass grafting (CABG) and MI compared to patients without DM. Furthermore, higher systolic and diastolic blood pressures on admission were observed in this group. DM patients were less frequently admitted to the hospital within 2 h of symptom onset, and were more frequently admitted 6–12 h after symptom onset. The baseline demographic and clinical characteristics of the analysed groups of patients are presented in Table 1. Invasive diagnostics (coronarography) were performed in 34.4% of the CS patients, with a similar percentage of patients with and without DM. The coronarography did not show any significant differences between the groups in terms of the angiographic location of the infarctions and the baseline flow in the infarct-related artery (IRA). However, compared to patients without DM, patients with DM suffered from multivessel coronary disease significantly more frequently and had lower coronary angioplasty efficacy (TIMI 3 flow). The angiographic data is presented in Table 2.

Treatment

Percutaneous coronary intervention (PCI) was implemented in 31.6% of the CS patients, and there were no significant differences related to the presence or absence of DM. In patients with DM, however, balloon angioplasty was performed

Table 1. Baseline demographic and clinical characteristics of the analysed patient groups

Parameter	DM (n = 1,159)	Non-DM (n = 2,985)	P
Mean age [years]	70.6 ± 10.3	68.0 ± 12.6	0.00001
Female [%]	52.6	36.0	0.00001
Hypertension [%]	65.6	47.1	0.00001
Hypercholesterolaemia [%]	40.3	29.0	0.00001
Current smoker [%]	18.8	31.4	0.00001
Obesity [%]	34.7	13.4	0.00001
Previous myocardial infarction [%]	28.2	22.5	0.0012
Previous CABG [%]	6.0	4.1	0.007
Previous PCI [%]	1.7	2.2	0.33
Time to presentation [%] (n = 3,661):			
0–2 h	27.3	33.2	0.0006
2–4 h	20.5	20.7	0.93
4–6 h	10.6	10.7	0.93
6–12 h	12.5	10.1	0.03
> 12 h	24.6	21.7	0.51
Unknown	4.5	3.6	–
STEMI [%]	71.3	72.4	0.56
Heart rate (n = 2,567)	90.4 ± 33.2	90.3 ± 37.2	0.94
Systolic BP [mm Hg] (n = 2,567)	77.4 ± 42.0	73.4 ± 45.0	0.04
Diastolic BP [mm Hg] (n = 2,569)	44.0 ± 29.6	40.9 ± 30.2	0.01
Initial ECG [%] (n = 2,568):			
Sinus rhythm	70.0	70.2	0.16
Atrial fibrillation	14.8	12.8	
Pacemaker	2.3	1.7	
Other/non-specified	12.8	15.4	

DM — diabetes mellitus; CABG — coronary artery bypass grafting; PCI — percutaneous coronary intervention; STEMI — ST-segment elevation myocardial infarction: BP — blood pressure; ECG — electrocardiogram

Table 2. Angiographic characteristics of the analysed patient groups

Parameter	DM (n = 1,159)	Non-DM (n = 2,985)	P
Coronary angiography [%]	33.2	34.9	0.31
Angiographic location of the infarction [%] (n = 1,305):			
Right coronary artery	36.1	37.3	0.94
Circumflex artery	12.1	12.9	
Left anterior descending artery	38.9	36.2	
Left main artery	6.9	7.6	
Bypass	0.3	0.5	
Unknown	5.7	5.5	
Initial TIMI 0–1 flow in the IRA [%] (n = 1,268)	86.0	84.8	0.92
Multivessel coronary disease [%] (n = 1,409)	76.4	64.6	0.00003
Final TIMI 3 flow in the IRA [%] (n = 1,287)	67.0	75.8	0.001

DM — diabetes mellitus; IRA — infarct-related artery; TIMI — thrombolysis in myocardial infarction

more frequently, while stent implantation was performed less frequently compared to patients without DM. Moreover, ACE-inhibitors, nitrates and diuretics were administered more frequently in this group during hospitalisation and at discharge. Insulinotherapy was employed in 54.3% and 36.7% of the patients with DM during the hospitalisation and at discharge, respectively. The treatment-related data is presented in Table 3.

Table 3. Treatment details employed in the patent groups

Parameter	DM (n = 1,159)	Non-DM (n = 2,985)	P
PCI [%]	30.4	32.2	0.27
Balloon angioplasty [%]*	17.1	12.1	0.03
PCI with BMS [%]*	81.7	86.7	0.04
PCI with DES [%]*	1.2	1.2	0.99
IABP [%]	7.5	6.2	0.13
Fibrinolytic treatment [%]	9.6	10.6	0.32
Medications during hospitalisation:			
Aspirin [%]	71.3	70.1	0.45
Ticlopidin [%]	18.3	18.6	0.82
Clopidogrel [%]	24.3	28.2	0.01
UFH [%]	34.5	35.5	0.53
LMWH [%]	43.6	40.8	0.11
Beta-blocker [%]	39.1	38.7	0.82
Calcium inhibitor [%]	3.4	2.5	0.13
Statin [%]	43.1	40.1	0.8
ACE-inhibitor [%]	37.3	32.3	0.002
Nitrate [%]	36.1	30.1	0.002
Diuretic [%]	48.3	35.8	0.0001
GP IIb/IIIa inhibitor [%]	11.7	12.2	0.63
Oral antidiabetic [%]	8.7	0.5	0.0001
Insulin [%]	54.3	8.6	0.0001
Medications at discharge:			
Aspirin [%]	78.3	75.9	0.3
Ticlopidin [%]	24.2	29.9	0.02
Clopidogrel [%]	22.2	23.3	0.62
LMWH [%]	13.4	12.4	0.59
Beta-blocker [%]	64.0	62.6	0.6
Calcium inhibitor [%]	4.0	2.7	0.17
Statin [%]	68.2	64.7	0.18
ACE-inhibitor [%]	62.6	53.5	0.0008
Nitrate [%]	37.1	30.7	0.01
Diuretic [%]	50.3	32.9	0.00001
Oral antidiabetic [%]	17.0	–	–
Insulin [%]	36.7	–	–

*For patients treated with PCI; DM — diabetes mellitus; PCI — percutaneous coronary intervention; BMS — bare metal stent; DES — drug-eluting stent; IABP — intra-aortic balloon pump counterpulsation; LMWH — low molecular weight heparin; UFH — unfractionated heparin; ACE — angiotensin-converting enzyme

In-hospital observation

Patients with DM had significantly lower LVEF compared to patients without DM. Furthermore, compared to patients without DM, patients with DM experienced sudden cardiac arrest during hospitalisation more frequently and experienced re-infarction less frequently. However, the percentage of re-PCI of the IRA was comparable in both groups. The data concerning in-hospital observation is presented in Table 4.

Mortality

In-hospital mortality in the CS patients was 57.4%. Patients with DM displayed a significantly higher rate of in-hospital mortality than patients without DM. Analogous results were obtained in the subgroup treated with revascularisation and conservatively. Multivariate analysis showed, with borderline statistical significance, that DM was an independent risk factor for higher in-hospital mortality. The results of the multivariate analysis are presented in Table 5. The 3-year mortality in the CS patients was 72.9%. Similarly, a higher mortality rate was observed in patients with DM based on long-term follow-up. In the multivariate analysis, DM was an independent predictor of 3-year mortality. The results of the analysis are presented in Table 6. After excluding from the analysis patients who died in the hospital, DM was still as-

Table 4. Characteristics of the in-hospital and long-term observation

Parameters	DM (n = 1,159)	Non-DM (n = 2,985)	P
Maximum troponin level [IU/L] (n = 1,689)#	5.5 (1.4–23.1)	4.2 (1.3–22.3)	0.13
Maximum creatine kinase-MB level [IU/L] (n = 2,129)#	98.5 (42.4–232.2)	107 (43–257)	0.04
Left ventricular ejection fraction [%] (n = 1,464)#	35 (25–44)	39 (28–48)	0.0003
Major bleeding during in-hospital observation [%]	1.6	2.2	0.24
Re-infarction during in-hospital observation [%]	5.2	6.9	0.04
Re-PCI during in-hospital observation [%]	1.4	0.9	0.21
Cardiac arrest during in-hospital observation [%]	45.4	38.6	0.0003
Stroke during in-hospital observation [%]	1.7	1.4	0.4
Mean hospitalisation time [days] (n = 4,025)#	2 (1-11)	2 (1-9)	0.2
In-hospital mortality [%]:	61.4	55.9	0.001
Invasive treatment	45.7	39.5	0.03
Non-invasive treatment	69.3*	64.6*	0.02
Three-year mortality [%]:	78.6	70.7	< 0.0001
Invasive treatment	64.7*	55.0*	0.001
Non-invasive treatment	85.5	79.2	0.0001
Mortality for patients who survived hospitalisation	50.1	40.0	< 0.0001

#Medians and interquartile ranges; *p < 0.00001 invasive treatment vs. non-invasive treatment; DM — diabetes mellitus; PCI — percutaneous coronary intervention

Table 5. Independent predictors of in-hospital mortality for patients with myocardial infarction complicated by cardiogenic shock. Multivariate analysis

Parameter	Odds ratio	95% confidence interval	P
Diabetes	1.16	1.00–1.35	0.054
Female	1.14	0.99–1.32	0.07
Age (per 1 year)	1.03	1.02–1.04	0.00001
Previous myocardial infarction	1.24	1.06–1.45	0.008
Hypercholesterolaemia	1.45	1.26–1.68	0.00001
Hypertension	0.89	0.77–1.02	0.09
Invasive treatment	0.44	0.39–0.51	0.00001
Current smoker	0.79	0.67–0.92	0.003

Table 6. Independent predictors of 3-year mortality for patients with myocardial infarction complicated by cardiogenic shock. Multivariate analysis

Parameter	Hazard ratio	95% confidence interval	P
Female	1.03	0.95–1.11	0.95
Diabetes	1.11	1.02–1.20	0.01
Age (per 1 year)	1.02	1.02–1.02	0.00001
Hypercholesterolaemia	0.78	0.72–0.85	0.00001
Previous myocardial infarction	1.10	1.02–1.20	0.02
Hypertension	0.94	0.87–1.01	0.11
Current smoker	0.89	0.81–0.97	0.01
Invasive treatment	0.62	0.57–0.68	0.00001

sociated with significantly higher 3-year mortality. The multivariate analysis in this subgroup of patients revealed that DM was still an independent risk factor for higher 3-year mortality. The results of the multivariate analysis are pre-

Table 7. Independent predictors of 3-year mortality for patients with myocardial infarction complicated by cardiogenic shock, who survived hospitalisation. Multivariate analysis

Parameter	Hazard ratio	95% confidence interval	P
Diabetes	1.21	1.04–1.41	0.02
Previous myocardial infarction	1.18	1.00–1.38	0.045
Female	0.97	0.84–1.13	0.73
Age (per 1 year)	1.03	1.02–1.04	0.00001
Hypercholesterolaemia	0.74	0.64–0.87	0.0002
Hypertension	0.95	0.82–1.15	0.45
Current smoker	0.97	0.82–1.15	0.74
Invasive treatment	0.58	0.50–0.67	0.00001

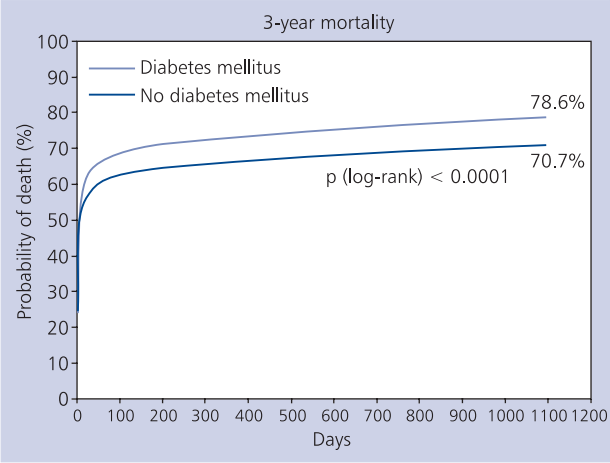

Figure 1. Kaplan Meier curves for 3-year mortality

sented in Table 7, whereas the data on the in-hospital and long-term mortality is shown in Table 4. The Kaplan-Meier curve is presented in Figure 1.

DISCUSSION

The current study analysed the clinical characteristics, treatment as well as in-hospital and long-term mortality in patients with MI complicated by CS who were included in the PL-ACS registry based on the presence of DM. DM incidence was 28% and was comparable to the percentages observed in the SHOCK trial [13].

Clinical characteristics

The results of this study show that patients with MI complicated by CS and DM have less favourable clinical outcomes. These patients are approximately 2.5 years older, are more frequently female, have more risk factors for coronary disease (with the exception of cigarette smoking) and more frequently have a history of MI and CABG. The lower incidence of smoking probably occurred because DM patients are a better-educated group and implement secondary prophylaxis. These results are not consistent with the reports of other authors, which may be due to the smaller number of patients in those analyses [10–13]. Other analyses that were not limited to CS only revealed correlations that are similar to those presented in this study [7, 9]. Although the time from symptom onset to admission was not statistically different between the groups, DM patients were less frequently admitted to the hospital within 2 h and were more frequently admitted after 6–12 h. A similar relationship was observed in a group of STEMI patients in the GRACE registry [5]. In our study, the majority of patients (72.1%) presented with STEMI. This was because CS is more common in STEMI patients compared to NSTEMI patients (8.2% vs. 3.6%, respectively) [14].

Angiographic characteristics

In our study, we observed a significantly higher incidence of multivessel coronary disease in patients with DM. Similarly, more advanced coronary disease in this group was observed in the SHOCK trial. The percentage of 3-vessel disease was 73.6% and 61.5% for patients with and without DM, respectively [13]. In the CS patients, the frequency of obtaining final TIMI flow 3 in the IRA was 73.3% and was statistically lower in patients with DM compared to those without DM. This effect dependence cannot be unequivocally compared to the results of other studies due to the absence of analysed data [10–13]. Different results were obtained for analyses that were not limited to CS only. The TAMI study (Thrombolysis and Angioplasty in Myocardial Infarction) (1, 2, 3, 5), which compared fibrinolytic treatment strategies, showed that the percentage of final TIMI flow 3 in the IRA did not differ between the groups with and without DM [17]. The absence of a correlation between DM and obtaining TIMI flow 3 was also observed in patients treated with PCI. In the PAMI study (Primary Angioplasty in Myocardial Infarction), TIMI flow 3 following PCI was observed in 92% and 93% of patients with and without DM, respectively [18]. Significantly, the percentage of final TIMI flow 3 in the CS patients in our study is comparable to findings of other reports. White

et al. [19] showed that the frequency of effective revascularisation (TIMI 2–3) was 77.2%. A similar percentage of TIMI 3 after PCI (71.7%) in a group of patients with STEMI complicated by CS was reported by Giri et al. [20].

Revascularisation treatment

The American College of Cardiology offers precise guidelines for the treatment of STEMI complicated by CS. According to ACC/AHA, revascularisation treatment candidates with CS should undergo coronarography. Early revascularisation treatment (PCI or CABG) is recommended in patients with ST elevation or LBBB in whom CS developed within 36 h of infarction and who are appropriate candidates for this type of treatment. The procedure may be carried out within 18 h of CS occurrence. However, there are no additional guidelines for revascularisation treatment strategies in DM patients [21, 22]. According to the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS), in patients presenting with STEMI and DM, primary PCI is preferred over fibrinolysis if it can be performed within the recommended time limits [23]. The guidelines for the treatment of NSTEMI complicated by CS are less precise. The ESC and the ACC/AHA recommend invasive diagnostics with subsequent revascularisation treatment in patients with symptoms of haemodynamic instability [24, 25]. Additionally, the ESC recommends strategies of early (up to 24 h) invasive treatment and implantation of drug eluting stent in patients with NST-ACS and DM [26]. For patients with multivessel coronary disease and DM, the ACC/AHA suggests CABG involving the internal thoracic artery, which offers greater benefits than PCI. However, PCI may be performed in patients with single-vessel coronary disease and DM [25]. Invasive diagnostics were performed in 34.4% of the CS patients, whereas revascularisation treatment was performed in only 31.6% of the CS patients; these values include similar percentages of patients with and without DM. The frequency of invasive diagnostics and revascularisation treatment in our study was lower compared to the reports of other authors [10]. In the SHOCK Trial Registry, DM patients underwent revascularisation significantly less frequently than patients without DM (40% vs. 49%), whereas the percentages of PCI and CABG were comparable in the 2 groups [10].

Mortality

The most important aspect of our study is the observation of higher in-hospital and long-term mortality in patients with MI complicated by CS and DM compared to patients without DM. Furthermore, the results of this study show that 3-year mortality in patients with MI complicated by CS who survived the in-hospital follow-up remains high and DM dependent. Reports on the impact of DM on mortality in patients with CS are ambiguous. The SHOCK Trial Registry revealed statistically higher in-hospital mortality in patients with DM (67% vs. 58%). However, in multivariate analysis, DM was not an independent predictor of death [10]. In the SHOCK trial subanalysis, a comparable percentage of 30-day and 1-year death was observed, regardless of the presence of DM. Similar results were reported by the TRACE registry: 30-day mortality was 63% and 62%, while 5-year mortality was 91% and 86% for patients with and without DM, respectively. In multivariate analysis, DM was not associated with higher mortality [13]. This finding is not consistent with the results of the Tedesco et al. [12] analysis. Despite the absence of an association between DM presence and in-hospital mortality, the authors showed a significantly higher mortality rate at the 5-year follow-up in DM patients. Furthermore, they identified DM as an independent predictor of death [12]. In our study, the mortality of patients with CS was also analysed in terms of treatment modality. The in-hospital and long-term mortality rates were significantly higher in DM patients in both the conservative and revascularisation treatment groups. Furthermore, it was observed that compared to conservative treatment, revascularisation treatment significantly decreased mortality in patients with and without DM. In multivariate analysis, this form of treatment reduced in-hospital and long-term mortality in CS patients. The relationship between treatment modality and mortality in patients with CS has also been analysed by other authors. Carnendran et al. [27] estimated that in-hospital mortality in patients treated with PCI or CABG was 41%, whereas it was 79.0% in patients who were treated conservatively. In the SHOCK trial, 30-day mortality was comparable regardless of treatment modality. However, in patients who were < 75 years old, there was a significantly lower mortality rate associated with revascularisation treatment. At the 6-month follow-up, mortality in the entire analysed group was 50.3% and 63.1% for PCI or CABG and conservative treatment, respectively. In multivariate analysis, PCI or CABG was independently associated with lower 6-month mortality [28]. A similar association was observed at the 1-year follow-up [29]. In the PL-ACS registry, in CS patients aged ≥ 75 years, invasive treatment was associated with lower in-hospital (55.4% vs. 69.9%) and 6-month (65.8% vs. 80.5%) mortality compared to non-invasive treatment [30]. However, the above-cited analyses do not consider the correlations between treatment, mortality and the presence of DM. Shindler et al. [10] showed the benefits of revascularisation compared to conservative treatment based on in-hospital follow-up of patients with CS and DM.

Strengths and limitations of the study

The great strength of this study is the large group of patients with CS and DM. These are results of a nationwide, multicentre registry, which reflects the treatment and outcome of patients in daily practice. The fact that it was retrospective analysis is a limitation of the study. We did not measure glucose level and HbA1c during hospital stay, and we did not analyse the influence of these parameters on mortality.

CONCLUSIONS

1. Diabetes is associated with higher in-hospital and long--term mortality in patients with MI complicated by CS.
2. Revascularisation treatment, compared to conservative treatment, reduces mortality in this group of patients.

Conflict of interest: *none declared*

References

1. Lekston A, Slonka G, Gasior M et al. Comparison of early and long-term results of percutaneous coronary interventions in patients with ST elevation myocardial infarction, complicated or not by cardiogenic shock. Coron Artery Dis, 2010; 21: 13–19.
2. Lindholm MG, Køber L, Boesgaard S et al. Cardiogenic shock complicating acute myocardial infarction; prognostic impact of early and late shock development. Eur Heart J, 2003; 24: 258–265.
3. Singh M, White J, Hasdai D et al. Long-term outcome and its predictors among patients with ST-segment elevation myocardial infarction complicated by shock: insights from the GUSTO-I trial. J Am Coll Cardiol, 2007; 50: 1752–1758.
4. Hochman JS, Sleeper LA, Webb JG et al.; SHOCK Investigators. Early revascularization and long-term survival in cardiogenic shock complicating acute myocardial infarction. JAMA, 2006; 295: 2511–2515.
5. Franklin K, Goldberg RJ, Spencer F et al.; GRACE Investigators. Implications of diabetes in patients with acute coronary syndromes. The Global Registry of Acute Coronary Events. Arch Intern Med, 2004; 164: 1457–1463.
6. McGuire DK, Emanuelsson H, Granger CB et al. Influence of diabetes mellitus on clinical outcomes across the spectrum of acute coronary syndromes. Findings from the GUSTO-IIb study. GUSTO IIb Investigators. Eur Heart J, 2000; 21: 1750–1758.
7. Donahoe SM, Stewart GC, McCabe CH et al. Diabetes and mortality following acute coronary syndromes. JAMA, 2007; 298: 765–775.
8. Hasdai D, Califf RM, Thompson TD et al. Predictors of cardiogenic shock after thrombolytic therapy for acute myocardial infarction. J Am Coll Cardiol, 2000; 35: 136–143.
9. Hasin T, Hochadel M, Gitt AK et al. Comparison of treatment and outcome of acute coronary syndrome in patients with versus patients without diabetes mellitus. Am J Cardiol, 2009; 103: 772–778.
10. Shindler DM, Palmeri ST, Antonelli TA et al. Diabetes mellitus in cardiogenic shock complicating acute myocardial infarction: a report from the SHOCK Trial Registry. SHould we emergently revascularize Occluded Coronaries for cardiogenic shocK? J Am Coll Cardiol, 2000; 36: 1097–1103.
11. Lindholm MG, Boesgaard S, Torp-Pedersen C et al. Diabetes mellitus and cardiogenic shock in acute myocardial infarction. Eur J Heart Fail, 2005; 7: 834–839.
12. Tedesco JV, Wright RS, Williams BA et al. Effect of diabetes on the mortality risk of cardiogenic shock in a community-based population. Mayo Clin Proc, 2003; 78: 561–566.
13. Farkouh ME, Ramanathan K, Aymong ED et al. An early revascularization strategy is associated with a survival benefit for diabetic patients in cardiogenic shock after acute myocardial infarction. Clin Cardiol, 2006; 29: 204–210.
14. Polonski L, Gasior M, Gierlotka M et al. Polish Registry of Acute Coronary Syndromes (PL-ACS). Characteristics, treatments and outcomes of patients with acute coronary syndromes in Poland. Kardiol Pol, 2007; 65: 861–872.
15. Flynn MR, Barrett C, Cosío FG et al. The Cardiology Audit and Registration Data Standards (CARDS), European data standards for clinical cardiology practice. Eur Heart J, 2005; 26: 308–313.
16. Myocardial infarction redefined — a consensus document of The Joint European Society of Cardiology/American College of Cardiology Committee for the redefinition of myocardial infarction. Eur Heart J, 2000; 21: 1502–1513.
17. Granger CB, Califf RM, Young S et al. Outcome of patients with diabetes mellitus and acute myocardial infarction treated with thrombolytic agents. The Thrombolysis and Angioplasty in Myocardial Infarction (TAMI) Study Group. J Am Coll Cardiol, 1993; 21: 920–925.
18. Harjai KJ, Stone GW, Boura J et al. Comparison of outcomes of diabetic and nondiabetic patients undergoing primary angioplasty for acute myocardial infarction. Am J Cardiol, 2003; 91: 1041–1045.
19. White HD, Assmann SF, Sanborn TA et al. Comparison of percutaneous coronary intervention and coronary artery bypass grafting after acute myocardial infarction complicated by cardiogenic shock: results from the Should We Emergently Revascularize Occluded Coronaries for Cardiogenic Shock (SHOCK) trial. Circulation, 2005; 112: 1992–2001.
20. Giri S, Mitchel J, Azar RR et al. Results of primary percutaneous transluminal coronary angioplasty plus abciximab with or without stenting for acute myocardial infarction complicated by cardiogenic shock. Am J Cardiol, 2002; 89: 126–131.
21. Antman EM, Anbe DT, Armstrong PW et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction. A report of the American College of Cardiology/ /American Heart Association Task Force on Practice Guidelines (Committee to Revise the 1999 Guidelines for the Management of patients with acute myocardial infarction). J Am Coll Cardiol, 2004;44: E1–E211.
22. Antman EM, Hand M, Armstrong PW et al. 2007 Focused Update of the ACC/AHA 2004 Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines: developed in collaboration With the Canadian Cardiovascular Society endorsed by the American Academy of Family Physicians: 2007 Writing Group to Review New Evidence and Update the ACC/AHA 2004 Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction, Writing on Behalf of the 2004 Writing Committee. Circulation, 2008; 117: 296–329.
23. Wijns W, Kolh P, Danchin N et al. Guidelines on myocardial revascularization: The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). Eur Heart J, 2010; 31: 2501–2555.
24. Bassand JP, Hamm CW, Ardissino D et al. Guidelines for the diagnosis and treatment of non-ST-segment elevation acute coronary syndromes. The Task Force for the Diagnosis and Treatment of Non-ST-Segment Elevation Acute Coronary Syndromes of the European Society of Cardiology. Eur Heart J, 2007; 28: 1598–1660.
25. Anderson JL, Adams CD, Antman EM et al. ACC/AHA 2007 guidelines for the management of patients with unstable angina/non ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines for the Management of Patients With Unstable Angina/Non ST-Elevation Myocardial Infarction): developed in collaboration with the American College of Emergency Physicians, the Society for Cardiovascular Angiography and Interventions, and the Society of Thoracic Surgeons: endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation and the Society for Academic Emergency Medicine. Circulation, 2007; 116: 148–304.
26. Hamm CW, Bassand JP, Agewall S et al. ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: the Task Force for the management of acute coronary syndromes (ACS) in patients presenting without persistent ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J, 2011; 32: 2999–3054.
27. Carnendran L, Abboud R, Sleeper LA et al. Trends in cardiogenic shock: report from the SHOCK Study. The SHould we emergently revascularize Occluded Coronaries for cardiogenic shocK? Eur Heart J, 2001; 22: 472–478.
28. Hochman JS, Sleeper LA, Webb JG et al. Early revascularization in acute myocardial infarction complicated by cardiogenic shock. SHOCK Investigators. Should We Emergently Revascularize Occluded Coronaries for Cardiogenic Shock. N Engl J Med, 1999; 341: 625–34.
29. Hochman JS, Sleeper LA, White HD et al. One-year survival following early revascularization for cardiogenic shock. JAMA, 2001; 285: 190–192.
30. Gasior M, Slonka G, Wilczek K et al. Comparison of invasive and non-invasive treatment strategies in older patients with acute myocardial infarction complicated by cardiogenic shock (from the Polish Registry of Acute Coronary Syndromes: PL-ACS). Am J Cardiol, 2011; 107: 30–36.

Wpływ cukrzycy na śmiertelność wewnątrzszpitalną i odległą chorych z zawałem serca powikłanym wstrząsem kardiogennym: wyniki rejestru PL-ACS

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Streszczenie

Wstęp: Wstrząs kardiogenny (CS) determinuje śmiertelność chorych z zawałem serca (MI), a dodatkowym czynnikiem pogarszającym rokowanie jest cukrzyca (DM).

Cel: Celem pracy była ocena wpływu DM na śmiertelność wewnątrzszpitalną i odległą chorych z MI powikłanym CS włączonych do Ogólnopolskiego Rejestru Ostrych Zespołów Wieńcowych (PL-ACS) i wykazanie zależności między sposobem leczenia a śmiertelnością w tej grupie.

Metody: Do rejestru PL-ACS włączono 71 290 kolejnych chorych z MI bez uniesienia odcinka ST (NSTEMI; 33 392) i z MI z uniesieniem odcinka ST (STEMI; 37 898). Wstrząs kardiogenny przy przyjęciu stwierdzono u 4144 (5,8%) chorych. W grupie tej było 1159 pacjentów z DM (28%).

Wyniki: Chorzy z DM byli starsi, częściej płci żeńskiej, częściej występowały u nich: nadciśnienie tętnicze, hipercholesterolemia, otyłość, przebyte pomostowanie aortalno-wieńcowe i MI, wielonaczyniowa choroba wieńcowa (76,4% *vs*. 64,6%; p = 0,00003) oraz stwierdzono u nich niższą skuteczność angioplastyki wieńcowej (67% *vs*. 75,8%; p = 0.001) w porównaniu z pacjentami bez DM. W grupie z DM oszacowano istotnie wyższą śmiertelność wewnątrzszpitalną w porównaniu z chorymi bez DM (61,4% *vs*. 55,9%; p = 0,001). Analogiczne wyniki uzyskano w podgrupie leczonej rewaskularyzacyjnie (45,7% *vs*. 39,5%; p = 0,03) oraz zachowawczo (69,3% *vs*. 64,6%; p = 0,02). W analizie wieloczynnikowej stwierdzono, na granicy istotności statystycznej, iż DM była czynnikiem determinującym wyższą śmiertelność wewnątrzszpitalną (OR = 1,16; 95% CI 1,00–1,35; p = 0,054). Podobnie wyższą śmiertelność u chorych z DM wykazano w obserwacji odległej. Śmiertelność 3-letnia w grupie z i bez DM wynosiła odpowiednio: 78,6% *vs*. 70,7%; p < 0,0001 (leczenie rewaskularyzacyjne: 64,7% *vs*. 55,0%; p = 0,001, leczenie zachowawcze: 85,5% *vs*. 79,2%; p = 0,0001). W analizie wieloczynnikowej DM była niezależnym predyktorem śmiertelności 3-letniej (HR = 1,11; 95% CI 1,02–1,20; p = 0,01). Po wykluczeniu z analizy chorych, którzy zmarli w szpitalu, DM nadal wiązała się z istotnie wyższą śmiertelnością 3-letnią (50,1% *vs*. 40,0%; p < 0,0001). Ponadto w analizie wieloczynnikowej w tej podgrupie chorych wykazano, że DM była również niezależnym czynnikiem wyższej śmiertelności (HR = 1,21; 95% CI 1,04–1,41; p = 0,02).

Wnioski: Cukrzyca determinuje wyższą śmiertelność wewnątrzszpitalną i odległą u chorych z MI powikłanym CS. Leczenie rewaskularyzacyjne, w porównaniu z terapią zachowawczą, ogranicza śmiertelność w tej grupie pacjentów.

Słowa kluczowe: zawał serca, wstrząs kardiogenny, cukrzyca

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